Title

Communities of Pottery Production and Consumption on the Taraco Peninsula, Bolivia, 200 BC-300 AD

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Publication Date

2009

Peer reviewed|Thesis/dissertation

Communities of Pottery Production and Consumption on the Taraco Peninsula, Bolivia, 200 BC-300 AD

by

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B.A. (University of British Columbia) 2000

A dissertation submitted in partial satisfaction of the requirements for the degree of

Doctor of Philosophy

in

Anthropology

in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA, BERKELEY

Committee in charge:

Professor Christine A. Hastorf, Chair
Professor Rosemary A. Joyce
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Professor Jean Lave

Fall 2009

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Abstract

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Doctor of Philosophy in Anthropology

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Professor Christine A. Hastorf, Chair

This dissertation examines Late Formative Period (200 BC-300 AD) communities of potting practice at the three settlements of Kala Uyuni, Kumi Kipa and Sonaji on the Taraco Peninsula, of the Lake Titicaca Basin, Bolivia. Ceramics play a central role in defining the social boundaries of prehistoric communities in the region. However our current narratives are stymied for the Late Formative Period, which precedes the appearance of the urban center of Tiwanaku (AD 400- 950). This is partly due to a reliance on ceramic design style. This study develops a practice-oriented approach to define Taraco Peninsula technological styles, refine the local ceramic chronology and evaluate the relationship between Late Formative communities and pottery. A "communities of practice" approach (Lave and Wenger 1991), which stresses the social entanglements between learning and identity, drives the analysis of the subtle changes in production sequences and their related consumption practices.

Pottery production and consumption at Kala Uyuni, Kumi Kipa and Sonaji were analyzed through attribute analysis, petrography, x-ray fluorescence and x-ray diffraction. Shifts in learned bodily practice, such as surface finishing techniques, and a suite of new technological choices, including paste preparation, define both the transition to the Late Formative Period and internal sub-phases. These technological choices were likely linked to a larger symbolic landscape and embedded in a greater productive taskscape. The spatial context of production tools suggests that pottery was manufacture in all three settlements. A survey of the local hills found that potters likely used local clays, while petrography showed that tempers were added and may have been collected further afield. The similarity in operational sequences and paste recipes indicates that Taraco potters were a single learning community and part of their identities were likely constituted through their skillful potting practice. Consumption patterns changed slightly through the Middle and Late Formative, with an increased use of deep bowl forms. Large-scale political feasting, essential to the urban experience at Tiwanaku, was not a central social practice. Rather particular forms had multi-purpose functions, framing special events. This research contributes to social archaeologies of community, research on craft production and archaeological theories of practice.

Christine A. Hastorf (Chair)

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ACKNOWLEDGMENTS

This dissertation would not have been possible without the support of a number of people. First and foremost, I would like to thank my advisor Christine Hastorf. Many graduate students do not have the luxury of an advisor with an open door policy. I do not envy them. Through my many visits to her office, Christine has helped fine tune my writing and in turn my thinking. Working in the Titicaca Basin with Christine has also been extremely rewarding. She runs a tight project, and there is no doubt that the quality of the data presented in this dissertation is due to her extraordinary skills as a project director.

Rosemary Joyce has also been essential to many of the ideas of this dissertation. Rosemary has consistently helped me to position my work within a larger theoretical landscape. I will always remember those moments of literally running back to my computer to write after being pushed to think in new ways about my data. Rosemary, like Christine, is also an inspiration for my own future teaching career. If I can someday create such excitement in a young (if sometimes unfocused!) graduate student, then I know that I have "made it".

Steve Shackley has also been particularly important to helping me think through some of the methodological issues of this dissertation. Many of my issues with XRF were clarified through conversations with Steve. I should point out that Steve also caught a few geoarchaeological errors in this dissertation, embarrassing mistakes for the son of two geologists. Of course, if several slipped through the editing process, Steve should remain blameless!

Jean Lave, my outside committee member, was a late addition to my dissertation committee, yet in my mind remains one of the most important. I find her theoretical ideas to be incredibly stimulating, and having her name on the cover means a lot. Because of her seminal work, this dissertation takes communities of practice and learning as core theoretical foundations. Thanks to Jean's work I now find myself thinking about the material culture of the Titicaca Basin in a new way. I hope that I have done justice to her concepts and that this dissertation will encourage other archaeologists to delve into her writings in more detail.

My time at Berkeley drives home the importance of learning communities. I would like to first thank my 2002 cohort, a group of incredibly inspiring academics, but also a whole lot of fun. This includes Jon Daehnke, Sara Gonzales, Shanti Morell-Hart, Doris Maldonado, Sven Ouzman, Lee Panich and Burcu Tung. In addition to this group, I also benefitted from discussions over beer with David Cohen, Rob Cuthrell, Esteban Gomez, Kat Howlett Hayes, Scott Hutson, Kari Jones, Jeanne Lopiparo, John Matsunaga, Mark McCoy, Darren Modzelewski, Colleen Morgan, Paolo Pellegati, Matt Russell, Matt Sayre, Tsim Schneider and Liz Soluri.

Our 2008-2009 dissertation-writing group, led by Meg Conkey, was essential in my last push with this thesis. Meg put her busy schedule on hold to help us through the stressful writing process, and I am certainly indebted to her for the time she put in reading my dissertation. Meg was not officially on my committee, but time after time she has gone out of her way to help me during my time at Berkeley. Moreover, Meg has effectively taught me the importance of conducting ethical archaeology and engaging with wider publics.

I would like to thank the institutions and agencies that have provided financial support integral to my research. This support includes that of the Canadian Social Science and Humanities Research Council (SSHRC), who provided several years of funding at Berkeley. My research on the Taraco Peninsula was funded by the National Science Foundation grant #0631282. Various fellowships from Berkeley have also been essential to my research including two Tinker Travel Grants from the Center for Latin American Studies (CLAS), Lowie Olsen support from the Department of Anthropology and a Stahl Grant from Berkeley's Archaeological Research Facility.

I have been working in Bolivia for almost ten years (!), and in this time I have found myself with a number of new families. First I would like to thank the communities from which this dissertation evolved. The communities of San José, Santa Rosa and Coa Collu were particularly receptive to TAP's research and my 2006 and 2007 seasons of ceramic analysis. Victor and Petrona Arquipa Mamani were like a second family to me, looking out for me when I inevitably got myself into trouble. Our excavations, from 2003-2005, were supported by too many local community members to name, but I thank them all for making us feel at home in such a beautiful and archaeologically intriguing landscape.

The 2006 clay and sediment survey could not have happened without the participation of students from the Universidad Mayor de San Andrés in La Paz, Bolivia, including Edgar Centellas, Mabel Michelly, Henry Poma Loza, Juan Carlos Chavez, Mario Viviani Burgos, Roger Angel Cossio Carrillo, Marcial Medina Huanca and Sandra Paye. Franz Choque lent his expert eye to the process, leading a survey team and helping to spot appropriate clays for ceramic manufacture. Further work on the clays and the larger ceramic database at UC Berkeley occurred with the help of Jay Stampfl, Hannah Sistrunk and Thomas Murphy. Tim Teague of the Department of Earth and Planetary Sciences at UC Berkeley prepared thin-sections and kindly offered assistance in the x-ray diffraction. Michael Glascock, at the Archaeometry Center at the University of Missouri Research Reactor, conducted instrumental neutron activation analysis. This data, while only briefly mentioned in the dissertation, is extremely important and will be part of future analysis.

The Taraco Archaeology Project, directed by Drs Christine Hastorf and Matt Bandy, has framed my time in Bolivia. Matt is one of the best field archaeologists I have ever worked with, and I hope I have the opportunity to work in the Basin with him in the near future. This dissertation relies a great deal on the TAP ceramicist, Dr. Lee Steadman, who trained me in ceramic analysis in 2003 and 2004. I confess to many nervous moments with Lee as she checked my ceramic attribute categorizations. I hope that I have fairly presented and utilized Lee's system; her work is foundational for much of this dissertation. Maria Bruno has also contributed both her time and interpretations to this work. Maria finished before me, as is evidenced in this dissertation by the many images she, and TAP team member Eduardo Machicado, kindly shared with me. Bill Whitehead gave substantial help to all parts of the early stages of this project (and to the entire TAP enterprise) but especially the database component. Also integral to the TAP project has been the contributions of Luis Callisaya, Jose Capriles, Soledad Fernández, Melissa Goodman, Kate Moore, Ruth Fontana, and Jose Luis Paz. I also wish to thank Ron Davis and Diane Bellomy whose home has served as TAP's headquarters in La Paz and who have provided moral support to scholars for many years.

Outside of TAP I need to thank the wider fictive kin of Titicaca Basin archaeology. John Jansusek helped to develop some of the ideas explored in this dissertation. John is an innovative thinker, prolific scholar, a generous colleague, and a whole lot of fun. I look forward to working with him in the future. Arik Ohnstad gathering local clays in and around Khonkho Wankane to be included in my XRD analysis. I would also like to thank Robin Beck, Laurence Cuelenaere, Elizabeth Klarich, Alisson Kohn, Claudia Rivera, Alexei Vranich, and Ryan Williams.

My mother has been financially and psychologically supportive throughout my graduate education in Canada, the US and Bolivia. I certainly appreciated the phone calls, over the last few stressful months, reminding me to breathe. I owe you a tour of the Titicaca Basin! I also need to thank my brother, Geoff, who was sailing through the Caribbean through the final stages of this dissertation, for reminding me of the important things in life. My sister, Jenny, is evidence for how long I have been in grad school, somehow growing up from a high school girl to a married, successful teacher in the course of a dissertation. And to my dad - the irony that I am drawing on geological approaches is not lost on me, and I know it wouldn't be lost on you. I hope you would be proud.

Finally, thanks to Katy Killackey, who was on her own difficult journey through the course of this dissertation, yet remained supportive throughout. Katy produced the beautiful drawings in this dissertation, but also was often the other side of the words in this dissertation. Thanks for listening to my (ceaseless) dissertation rants through the dinners and dog walks of the stressful last weeks.

Chapter 1
Dissertation Goals and Overview

1.1 Introduction

This dissertation explores the life history of early Andean ceramics, from production and distribution to use and discard, with an emphasis on daily practice. I contribute to archaeological research on the concept of community by examining the socio-political and economic organization of pottery production and consumption during the Late Formative Period (200 BC-AD 200) on the Taraco Peninsula, of the Lake Titicaca Basin of highland Bolivia. I apply a "community of practice" (Lave and Wenger 1991) model to investigate local level diversity in pottery production to complement larger scale regional work on this important period prior to state formation. This "communities of practice" approach permits investigations of Late Formative social boundaries and the varying social fields of participation within pottery production, distribution and consumption activities.

It is a dissertation in three parts. The first part consists of an overview of the role of ceramics in narratives of increasing sociopolitical complexity. I suggest that a focus on daily practice may productively shift our gaze to the nature of prehistoric communities from a perspective of shared practice and knowledge. I argue that a "communities of production" approach is a useful tool for de-centering some our assumptions towards prehistoric technological traditions. With this first part of the dissertation I contribute to a growing corpus of archaeological literature employing theories of practice, situated cognition and learning in the examination of craft production. The second part of the dissertation, which builds on the ideas presented in the first, is a technological analysis of ceramic production in the southern Lake Titicaca Basin, and more specifically at the sites of Kala Uyuni, Sonaji and Kumi Kipa in the Southern Lake Titicaca Basin. This part contributes to research on community organization prior to state emergence, scholarship on technology and technological style and archaeometric methodologies. The final part of the dissertation returns to fine-grained contextual and spatial analysis of at the three excavated sites to track both the use and deposition of the potsherds at the end of their use-life. The perspective on pottery use, or "communities of consumption" harnesses both technological and design styles to examine the social embedded nature of pottery use, and the possibility of "commensal politics" on the Taraco Peninsula.

1.2 Goals of the dissertation

> "Throughout human history, most people have not been the scheming political elites, profoundly religious megalith users, or the other categories of actors who populate the pages of archaeological theory. If we do not theorize about ordinary people, if we assume that they are the mere bricks in the fabric of society, we leave the great bulk of our subject uninvestigated. Similarly, ordinary material culture - the undecorated potsherd, the casual flake - forms the vast bulk of archaeological collections. If we theorize about "hot technologies" [metalwork, exotic goods, cult gear, or monuments] rather than about everything else the archaeological record affords us, we are throwing away most of our data." (Robb 2007: 2)

How we conceive of community in prehistoric societies is often directly related to the interpretive frameworks of craft production. Andean scholars correctly recognize the complexity of interpreting material culture (Aldenderfer 1993; Reycraft 2005), but often still revert to considering cultures in pot form or decoration (the "pots as people model"). Furthermore our understanding of the boundedness of community is entangled with notions of settlements and increasing socio political complexity. This issue is particularly relevant for the Late Formative Period, prior to the spread of the Tiwanaku state. Much of the research of the Titicaca Basin has been based on survey projects, whereby the particular location of pottery fragments has a dramatic effect on interpretations of larger socio-political process. This thesis attempts to disentangle these issues at three Late Formative settlements on the Taraco Peninsula, Bolivia, while engaging with the complexities of the relationship between people and things. By considering technology vis-à-vis social agency, and by reframing community as practice, I stress the "doing" of the Late Formative.

Since pottery assemblages are the major evidence for the conventional meta-narrative, a practice framework for the Late Formative may have important implications for our pre-Columbian stories of the Titicaca Basin. The Taraco Peninsula, with its dense occupation prior to the organization of the Tiwanaku polity, history of detailed excavations and ceramic analysis, is an ideal place to explore these issues. My data demonstrate how an emphasis on daily practice fundamentally changes not only how we view the role of technology in settings of increasing socio-political complexity, but the meta-narrative itself. This thesis is not explicitly concerned with the rise of the Tiwanaku state. Rather it is about understanding the people of 200 BC-200 AD on their own terms, not simply as a stage for political-religious elites emerging prior to Tiwanaku hegemony in the region. The general aim of the dissertation, then, is to critically examine the nature of technology in pre-state societies and to explore the dynamic nature of "community" from the perspective of the life history of the humble potsherd. Furthermore, I hope to offer some "narrative space" to those working on similar issues of daily practice, where the relationship with the material world is a complex and recursive one.

In this dissertation I ask two broad questions for production during the Late Formative Period, one regarding the regional traditions of potting practices, another regarding the materialization of particular communities of potters on the Taraco Peninsula. While this dissertation only touches on the first question due to comparable data sets, the second requires a series of analytical models for exploring both communities of production and communities of consumption. Can we define materializations of particular "communities of practice" during the Late Formative? Here I examine the case of the three sites of Kala Uyuni, Kumi Kipa and Sonaji in order to investigate any variation in the way learning is occurring. I am asking several particular questions to distinguish communities of practice. First, were specific raw materials (clay and tempers) being mined on the Taraco Peninsula? If so, do they correspond with particular communities of practitioners? It may be that particular clay types were necessary for the construction of particular vessels. However if clays are localized material, knowledge may be also localized. Were technologies being shared across groups of potters? Were particular settlements in the Taraco region producing a higher range of variability than others?

My second series of research questions are focused on consumption activities. I focus in particular on whether there were specific contexts of ceramic use and food consumption that may have represented ritualized or specific moments of sociopolitical feasts. Is there intra-site, or inter-site ceramic variability between Kala Uyuni, Kumi Kipa and Sonaji? Were non-local ceramic styles being brought in, and used in specialized contexts? Were specialized vessel forms used for the preparation of particular cuisines? To answer these questions I draw upon careful contextual analysis from the excavations and link my ceramic data with larger artifact patterns of the Taraco Archaeological Project.

1.3 Overview of the dissertation

This dissertation takes a different approach to the narrative of the archaeological remains, starting with the big conventional archaeological picture, then moving back in time and finer grain in space, all the while following the story constructed from a particular ceramic assemblages. **Chapter 2** presents the meta-narrative for the pre-history of the Titicaca Basin, with particular attention to the role of ceramics. A narrative analysis highlights the predictable assumptions we have about the past, whether it concern the story (temporal sequence), plot (causation), agency (medium of the story) or the point of view (Hodder 1999; Joyce 2002; Pluciennik 1999, among others). The focus on the evolution of institutions, and in particular political institutions, has been a central focus in anthropological archaeology in general, and specifically to the meta-narrative in the Titicaca Basin. On the one hand it is difficult to argue the importance of this question. The social, political and economic orientation of Tiwanaku, and its related sites, remains unclear. Questions concerning the "evolution of the state" and the "emergence of inequality" drive many projects, including that of the Taraco Archaeological Project. In the effort to track these processes researchers have begun to focus their attention on the Formative Period with a more nuanced perspective to the environmental and historical processes leading up to the "big bang" of Tiwanaku.

On the other hand, even with this shift to an earlier chapter of Titicaca Basin prehistory, the plot, and agency continue to be quite similar throughout the region. The central story of emerging elites and evolving political institutions has had an enormous effect both on how material culture is interpreted, and how, tautologically, this material culture supports particular iterations of social action. For example, pottery collected in surface surveys in the Titicaca Basin is sometimes (although rarely) considered from a perspective considering the role of the artifact in the past (style, function, etc). More frequently, pottery is interpreted as de-facto evidence for iterations of community boundaries, and proof for regional religious and political traditions. Notions of community and social boundaries become much more nuanced and fluid when we replace static notions of community with one focusing on an "interaction" perspective (see chapters in Yaeger and Canuto 2000). My discussion of community, style and tradition draws upon Andean ethnography and ethnohistory in order to bolster my argument for more nuanced and perspective on technology and community in the past.

In **chapter 3**, I present an argument for using learning models as a conceptual bridge, or a "middle range theory", for investigations into particular formulations of community in prehistoric settings. After a brief overview of the style literature, which is the foundation for much research into social boundaries in archaeology, I examine the foundation of this literature, which I argue is concerned with learning. It is difficult to track actual cases of individual learning in the past (but see Crown 1999; Crown 2007; Van Keuren 2006), however throughout human (and pre-human) history we can safely assume that the process of learning was perpetually occurring (Stout 2002). I argue that learning must be considered within any given social practice, as it is essential in the process of subject making. It is also the local of both the status quo and the seed for change. Within archaeological work on craft production there has been a fluctuating interest in learning, with a recent flourish of research in both learning and technology, as well as considerations of the archaeology of childhood.

I find the work on situated cognition and “communities of practice” not only thought provoking, but also constructive in considerations of prehistoric technological practice (on both the local and regional scale) embedded with larger sociopolitical dynamics. Situated cognition is a powerful tool for social scientists concerned with subject making as it stresses that personhood occurs not through simply learning, but is embodied through practice. A focus on communities of practice is of particular use due to its focus on groups, rather than individuals. As such this approach deftly negotiates through some of the critiques of agency theory, and is especially appropriate for research on pottery production, where ethnographic research has found that multiple individuals can play an essential role in every step of pottery manufacture (Crown 2007). Social boundaries as the interfaces between particular “communities of practice” become more nuanced and complex, yet can be defined within the patterning of a given artifact assemblage. This artifact patterning represents a range of discursive and non-discursive decisions materialized in both design and technological style. The materialization process of pottery production is both an embodied (fleeting) and inscribed (long-lasting) practice and thus speaks to both technological style and design style. Furthermore “communities of practice” can be operationalized through well-explored methods focusing on technological choice and operational sequences.

In the second part of this chapter I make the point that these technological choices are not made in isolation, rather they are embedded both in consumption and greater social practice. I begin this section by arguing that we must consider the wider social arena of consumption. I explore the idea of embededdness, and how archaeologists can approach artifacts from a perspective that acknowledges broader significance in foodways and daily practice. I draw on the work of Bill Sillar and Tim Ingold to argue that archaeologists must attempt to properly re-embed their specialist data.

In **chapter 4**, I turn to my particular case study. I begin by introducing the prehistory of the Taraco Peninsula in detail with an overview of recent archaeological projects before turning to the Taraco Archaeological Project (TAP). The Taraco Archaeological Project, directed by Dr. Christine Hastorf and Dr. Mathew Bandy has been conducting both survey-based and excavation work in the Southern Titicaca Basin since 1992. TAP, an international collaborative project including Bolivian, Canadian and American scholars, has drawn on a variety of specialists and has some of the most detailed information on the Formative Period in the Lake Titicaca Basin. As such this data set is appropriate to address the patterns of daily practice from 200 BC to 200 AD.

After presenting the particular excavation methodology and strategy, I present a fairly detailed overview of the recent (2003-2005) TAP excavations on the Taraco Peninsula. I discuss the relevant Late Formative contexts from the sites of Kala Uyuni, Sonaji and Kumi Kipa, and include a brief summary of taphonomy from the perspective of the ceramics. Taphonomy is rarely discussed from a ceramic perspective (but see Nielsen 1991; Schiffer and Skibo 1989; Skibo 1987a; Skibo and Schiffer 1987; Skibo 1987b), which is unfortunate as there is much to be gained from such considerations. This is especially true in surface survey work, where surface collections play immense roles in re-constructing community boundaries. Surface to sub-surface relationships are, however, only part of the story. The re-consideration of archeological interpretation “at the trowel’s edge” is an essential process in complex depositional environments.

In **Chapter 5**, I look to examine whether there was a "constellation of potting practices" during the Late Formative. In order to *begin* to answer this rather large and daunting question, I must construct a basic understanding of how pottery was produced during the Late Formative, not just on the Taraco Peninsula, but in the wider Southern Titicaca Basin. I need to examine the variability across the Titicaca Basin in pottery production sequences. In order to address this issue I confront the usual, yet testy issues of space-time systematics. How are people defining the Late Formative? What are the best C14 dates available? Only then can I begin to examine the technological choices were being made. The proper way to answer such questions is through a detailed study of a local assemblage and to compare the ceramic attributes across different sites in the region. At the current time, however, there have been more survey projects than ceramic seriations based on stratigraphic excavations. This means that there are few data sets that can be compared across the region.

This chapter, then, serves a short summary of the history of Late Formative ceramic analyses. While I do briefly examine the earlier Middle Formative and the Late Formative II, the focus here in on the Late Formative I period (see Steadman 1999, 2006 for important on-going work on the Middle Formative). I present a brief overview of the history of ceramic analysis in the region. What becomes clear in this chapter is the need for more detailed stratigraphic excavations, but also of detailed ceramic analysis if scholars of Titicaca prehistory wish to decode the role of material culture in sociopolitical practice of the Late Formative Period. As will be seen the detailed system of attribute analysis developed by Lee Steadman (originally for the northern Titicaca Basin, see Steadman 1995) is ideal for tracking issues of technological style. After this brief review, I introduce the "Paste Question" (concerned with the subtle changes in ceramic paste recipes and the possible reasons for these shifts) that frames much of the later data chapters. Finally, I summarize our current understanding of radiocarbon dates in the Southern Lake Titicaca Basin.

In **Chapter 6** I present the methods applied for the particulars of this dissertation. I used ceramic attribute analysis along with a suite of characterization tools, explored in chapter 8, to investigate the life history of the sherd. The Taraco Archaeological Project and this project both rely upon Lee Steadman's attribute system (1995, 1999, 2004). This system was created for the construction of a fine-grained micro-seriation and is well tuned to issues of technological style. This approach, when correlated with contextualized ^{14}C date sequence is essential in defining the seriation for the period. Using this system, Dr. Lee Steadman recently succeeded in isolating and identifying the technological changes from Late Formative I to Late Formative II in the Taraco Peninsula. Steadman's system is a three-tiered approach to pottery analysis with each stage varying in type and number of attributes tracked depending on the level of detail required for particular research questions. As 200, 799 body sherds and 23, 948 diagnostic samples (rim, base, decorated etc.) were recovered from these three multi-component sites, an expedient and thorough system of analysis proved essential. This system is particularly well suited to the research questions and models being investigated here.

In **chapter 7** I explore the manufacture of Late Formative pottery. What is the typical series of technological choices on the Taraco Peninsula from 200 BC-200 AD? What defines local in terms of communities of potting production? Is there any evidence for small-scale specialization? Are there indeed potters during the Late Formative, or just people making pottery? What signs for innovation (new technological choices and design styles) and tradition (embodied, repeated and "hexus" based practice) are there during this period? Such a fine-grained analysis to get at the technological choices of potters in the Late Formative relies on accessing not only the explicit signaling role of ceramics (such as design style) but also that of non-discursive embodied practices (technological style). In this chapter I focus on the attribute analysis I conducted on the Taraco materials between 2005 and 2008.

In **chapter 8**, I turn to the raw materials exploited by the potters of the Late Formative. In order to track the local raw material variability I conducted a clay and sediment survey of the Taraco Peninsula, tracking the available resources. A re-firing (oxidation) study was conducted to examine the firing temperature of the ceramic materials, as well as to track the firing behavior of the collected clays. In order to further track technological style I employed compositional analyses, including x-ray fluorescence, x-ray diffraction and neutron activation on a limited number of clay and pottery samples. As many of these techniques have not been used in the Titicaca Basin before, I include a short discussion of their utility for pottery. Finally a small petrographic study was conducted on the various paste types associated with Late Formative pottery.

In **Chapter 9,** the final data chapter, I present data on the distribution, use and discard of the Taraco Late Formative pottery. In this chapter I am concerned with the "communities of consumption" of the Southern Titicaca Basin. As Arjun Appadurai (1986: 13-15) noted in his often-cited work on the social life of things, objects have different trajectories. He noted that some objects are viewed as exchangeable depending on cultural conceptions (which also change through time), and that spatial contexts affect the degree which objects will change. Distribution analysis is quite difficult to conduct at this point as chapter 5 demonstrates. Until detailed levels of analysis are conducted throughout the region, we can only skip through any given production sequence to levels of details that have been collected for our fragmented assemblages. Compositional analysis, however, does begin to access the movement of raw materials and finished goods throughout the basin to compliment work done on design style in the basin.

I investigate the intended use of vessels by first reconstructing the morphological variability for Late Formative vessel forms, and second combining this analysis, in effect re-embedding the ceramic data, with the work of palaeoethnobotanical, faunal and isotope specialists on the Taraco Archaeological Project. These data are then tracked across the various Late Formative contexts (middens, floors & surfaces, burials and fills) of Kumi Kipa, Sonaji and Kala Uyuni. These data speak to variability in consumption patterns, variations in cuisine, and the role of commensality during the Late Formative. As recent scholars have stressed (Van Keuren 2004), the relationship of pottery and feasting is not a simple one: the presence of large serving vessels does not necessarily indicate feasting, and small vessels can be easily used in moments of commensality. Nevertheless, a subtle analysis drawing upon multiple lines of evidence may be indicative of the social dimensions of particular meal-times.

I use the last chapter, **Chapter 10,** to discuss the implications of this dissertation. I begin with a discussion of how my data, and that of the larger Taraco Archaeological Project, contributes to our understanding of daily life during the Late Formative Period. I consider my data within the three overlapping types of meaning that archaeologists read into their data (Hodder and Hudson 2003: 236). I first begin by considering the pottery as a resource, as fired clayed vessels used for particular aims. Second, I consider pots as the structured content of the Late Formative Period, as meaningfully constituted items on the Taraco Peninsula. This contextualizes the life-history of the potsherd into the larger regional world. Finally, I examine the operational meaning, which explicitly accesses the situated intentions and the shifts in embodied practice. Of course I do not offer the final word on these topics, as Formative Period research is only now really developing. I do suggest, however, that the data offered in this dissertation does dramatically shift some of our interpretations into the past, and specifically regarding those people who made their cooking pots, storage jars and serving bowls from 200 BC to 200 AD. Furthermore, I suggest how these levels of meaning can offer many avenues of future investigations into the Late Formative.

Chapter 2
Pots, Politics and People: Narratives in the Lake Titicaca Basin

The Lake Titicaca Basin is a high plateau approximately 80,000 square kilometers in area and 4,000 meters above sea level in the Central Andes of South America. Flanked by several mountain chains, it is an internal drainage basin centered on Lake Titicaca, but continuing south on the Desaguadero River. Twenty kilometers from the edge of Lake Titicaca is the Middle Horizon (AD 400- 950) site of Tiwanaku. This large urban center, located at a high cold altitude has intrigued tourist and scholars alike with its remains of large cut stones, carved monoliths, beautiful pottery and a diversity of long-distance trade items (Figure 2.1).

My first experience in the Bolivian altiplano, in the summer of 2000, however, was not at the monumental site of Tiwanaku. Rather it was at the site of Chiripa, one the most well studied sites of the Formative Period, pre-dating Tiwanaku by more than 2000 years (Figure 2). Chiripa is found in one of the most densely populated regions of the prehistoric Titicaca Basin, 25 kilometers down the road from Tiwanaku, on the Taraco Peninsula. I was there to help a graduate student excavate one of these Middle Formative sites, and to begin a Master's project on the ceramics from Chiripa. At that moment my interest was only marginally linked to the larger questions surrounding Tiwanaku: monumental architecture and the making of place (Blom and Janusek 2004; Protzen and Nair 2000), ethnicity and material culture (Aldenderfer 1993; Goldstein 2005; Janusek 2004a) or the political, economic and ideological nature of the Tiwanaku state (Albarracin-Jordan 1996; Janusek 2004a; Janusek 2004b; Kolata 1986b; Kolata 1993).

My interest lay then, as it does now, with the rather unimpressive earthenware pottery of the earlier Formative Period (Figure 2.2).

Figure 2.1: Lake Titicaca Basin and relevant sites mentioned in this dissertation. (Adapted from Stanish 2003 (Map 1.3) and Janusek 2004 (Figure 1.1)

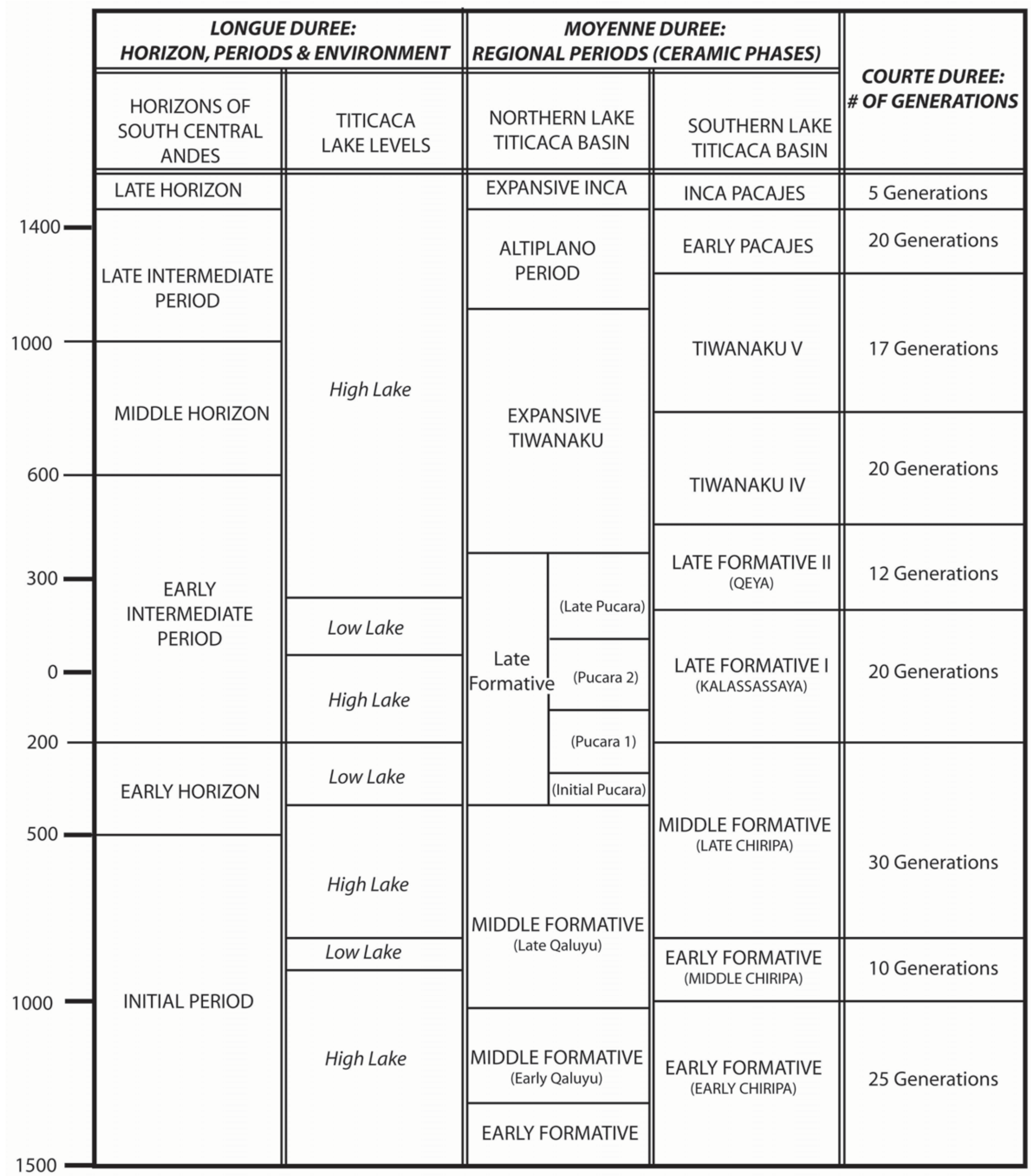

Figure 2.2: Chronology for the Lake Titicaca Basin with various scales of analysis, including regional horizons, Lake level variation (based on wet and dry periods), Southern and Northern Basin archaeological periods and their associated human-scale generations.

If my first experience in Chiripa was daunting (my barely comprehensible Spanish, the cold and wind of the altiplano, my sloppy coca chewing etiquette), my first encounter with the potsherds of the Middle Formative evoked an even more visceral reaction. As the eroded sherds tumbled from the tyvek bag, I could not fail to notice how similar they all looked (Figure 2.3). How was I to discuss activity areas and ritual practice, the goal of my Master's thesis (Roddick 2002), based on this assemblage? Most published sources on this period define the various phases of the Formative Period based on decorative (slipped, painted or incised) motifs from small judgmental surface collections and grave lots. In contrast, most excavated contexts consist of highly fragmented body sherds. Dr. Lee Steadman, who has been analyzing Titicaca pottery for over 15 years, helped to point out the subtle differences in the sherds, those materialized signatures of technical choices of 2000 years ago.

Figure 2.3: Typical bag of Formative Period sherds.

Upon returning from the field and re-reading the extensive recent scholarship of the region, I discovered a surprisingly close relationship between the humble potsherd and the larger narratives of identity, the construction of community and the very nature of the Tiwanaku state. One aspect of this dissertation is to critically examine these Titicaca Basin narratives, and further probe the complexity of linkages between materiality (the human relations with the world), and mutuality (or the human inter-relations) during the Late Formative Period (Gosden 1994). In my review of this literature, which I present below, I found that the complex entanglement of this material – from production through its use and discard – with the lives of people centuries ago is often presented unproblematically. This is due, in part, to a lack of research, with few of the dissertation or Bolivian *licienciaturas* projects (the core of Titicaca Basin research) focused on the ceramics themselves (Mohr 1966; Steadman 1995). This has resulted in some real problems with the ceramic seriation of the region. Any archaeologist would concede that seriation, no matter ones theoretical orientation, is almost always necessary in prehistoric archaeology.

On the one hand this gap in research is not surprising: I have been told several times by colleagues at archaeological conferences that studying ceramics is both uninteresting, ("boring and slow") and of little use academically ("You won't get a job as a ceramicist"). The result has been many more survey projects conducted than those concentrating on finding good stratified deposits to seriate. On the other hand, it IS surprising, as the humble Formative Period potsherd plays a central, if sometimes under-theorized, role in our stories of Titicaca Basin prehistory. Pottery, that hardy artifact that preserves even in the dynamic environment of the northern Bolivian altiplano, is essential to the very surveys that form the foundations of Titicaca narratives. As will be seen below, these earthenware sherds are essential actors in the re-construction of Formative Period trade routes, of chiefly power, of community fusion and the spread of an integrating religious ideology.

In this chapter I explore archaeological narratives of the Titicaca Basin, and how pottery is being used as a tool in telling these stories. It is an introduction to both the rich recent history of the Formative Period in the Titicaca Basin as well as a presentation of my own theoretical positioning. I propose here that combining a narrative approach of daily practice with micro-scale methods may be of use in exploring some of these themes. This permits me in the next chapter to integrate middle-range research with some theoretical work on daily practice and artifact variability, and in chapter 6 to explore appropriate methodologies.

2.1 Narratives or models: Reflectivity in presenting the past

I am using narratives in discussing the role of pottery in Titicaca Basin prehistory rather than the language of archaeological models. The language of narratives, meta-narratives and stories is employed neither as a pejorative dismissal of the scientific method, nor is it a slight at the scholarship of the past 100 years. Rather it is an attempt to be more reflective in presenting my work (and biases) within the research agenda of Anglo-American archaeology in the larger Titicaca Basin. The narrative theorist Hayden White (White 1985; White 1992) defines the narrative as the structure that takes the chronicle, a series of events, and gives them a beginning and end, thus creating a formal coherence for the past. History, therefore, is about events placed in a meaningful sequence, a process that has been called emplotment (White 1985). The organization of particular events in this process is what gives history it's meaning (Ballard 2003; Joyce 2002). As history and archaeology are implicitly political, such narratives are used both in the construction of the past across many realms of discourse, both in the present, and the past, both scholarly and public.

In our probing of the past, a narrative-like approach may be seen as similar to "model-testing". Narratives are certainly similar to models (in their predictive value and redirecting research), yet "they are also a particular type of model (for not all models are narrative in structure), with a peculiar logic and structure which is necessarily sequential, or evocative of sequence, and convincing by virtue of being familiar to the audience" (Ballard 2003: 144). Ian Hodder (1999) has argued that how we tell our stories affects the very process of excavation. While both hypotheses and narratives are propositions, narratives are essential to archaeologists as they are situated in larger arguments. Moreover they have beginnings, middles and ends.

Ballard notes that narratives "influence both the actions of agents in past worlds and our reconstructions of those past actions." (Ballard 2003: 144). The actions of these agents are firmly placed within a larger structure of meaning, or a meta-narrative. Meta-narratives are the intellectual frameworks, either explicit or implicit, within which intellectual framework within which are composed". As such, these tend to be the "grand visions of history" and "provide one sort of coherence or emplotment"(Pluciennik 1999: 656). Therefore, more than a particular theoretical orientation, a meta-narrative is how we tell our archaeological stories, what Rosemary Joyce (2002), drawing on Bahktin, discusses as a chronotype. Meta-narratives consist of the larger structure, such as Marxist theories of social evolution and archaeological accounts of complexity, or the shift from egalitarian to non-egalitarian societies (Ballard 2003: 136). A critical evaluation of archaeological narratives may help foster reflexivity in our archaeological practice, as well as encourage us to investigate questions of "causality and sufficiency in explanation" (Ballard 2003). Furthermore we may recognize those moments where diversity in evidence is homogenized for the greater narrative.

Andean archaeologists are aware of this issue, especially in terms of the infamous Lo Andino, the canon of assumed and often timeless/ahistorical Andean traits (Roddick and Van Gesingham 2003). Nevertheless, I would argue that our intellectual primacy on emerging complexity often results in particular types of interpretations. In presenting the following Titicaca narratives I hope to both examine our assumptions surrounding the construction of prehistoric identities of our archaeological subjects and subsequently position this dissertation within these narratives. This means paying close attention to the Titicaca metanarrative, and how scholars are fitting ceramics into theories of materiality and mutuality. Such a narrative exegesis highlights the context of research and reveals the interpretive entanglement between Late Formative pottery, people, place and politics. Let me begin, then, with the basics: What do we know about the Titicaca Basin? And how do ceramics play into these particular stories?

2.2 A Bird's Eye View

What follows is a broad overview of the data relating to this meta-narrative of social-evolution, or the chronicle of the Titicaca Basin. This meta-narrative is truly a "bird's eye view"; it is primarily concerned with large-scale processes and rarely includes a phenomenological, or lived perspective (but see Isbell and Vranich 2004). Furthermore, these works rely to a large degree on surface survey data, specifically site hierarchies and population trends formulated from surface ceramics. My focus here is on the meta-narrative as ontological orientation; comprehensive reviews of the entire sequence (Archaic – Colonial Period) (Hastorf 2005; Janusek 2004b; Stanish 2003) and the rich history of research in the Titicaca Basin (Kolata and Ponce Sanginés 2003; Stanish 2003) are available elsewhere.

2.21 The Archaic Period (Pre 1500 BC)

The Titicaca Basin is thought to have been first populated by semi nomadic groups during the Early Archaic period, by approximately 10,000 cal BP after the retreat of the Pleistocene glaciers (Aldenderfer 1989; Aldenderfer 1998). Researchers speculate that groups entered the Titicaca Basin from the Western Chilean or Peruvian coast (Aldenderfer 1998: 138). These hunter-gatherer populations lived in large temporary settlements focusing on wild camelids, quinoa (Klink 2005). The majority of Archaic period settlements were focused on the more interior parts of the Lake Titicaca Basin, rather than the lakeshore (Klink and Aldenderfer 1996; Klink 2005:23). By the Late Archaic period settlements reduce in size, and are closer to the shores of Lake Titicaca, with populations "water tethering", or moving their settlements to permanent water sources (Klink 2005: 24). Populations of the Archaic were likely engaged in camelid pastoralism (Aldenderfer 1998: 268), but agricultural domestication was also occurring during this period. For example, Bruno (Bruno 2008) suggests that quinoa (Chenopodium quinoa), potatoes (Solanum tubersosum, Solanum stenotomum) and perhaps oca (Oxalis tuberosa) were domesticated although there is not direct archaeological evidence at the current time.

2.22 The Early Formative Period (1500 BC - 800 BC)

The transition from the terminal Archaic to the Early Formative in the Titicaca Basin is defined by a much wetter climate an increase in lake levels. This period also sees an introduction of new technologies such as pottery, shifts in domestic and ritual structures and a reliance on domestic plants (Browman 1984). The first fired clay objects appear at the site of Quelcatani. Here Stanish found sherds called Pasiri, dating to 1660 B.C. that are ”poorly fired, unslipped, with heavy inclusions of fiber and coarse sand” (Stanish 2003: 102). Two main ceramic traditions develop during this period and continue through the Middle Formative. Both Chiripa, which develops between 1500 and 1000 B.C (Whitehead 1999) in the southern basin, and Qaluyu technology, by around 1300 BC in the northern Basin (Browman 1980) are named after their type sites. Thick walls, fiber temper and geometric designs characterize Chiripa ceramics, while Qaluyu sherds are sand-tempered and slipped with geometric and curvilinear motifs with shallow incisions (Browman 1980; Rowe 1956: 144; Steadman 1995: 491-493). The difference between the northern sand tempered and the southern fiber tempered tradition has been suggested to be an outcome of technological differentiation of the Archaic Period (Cipolla 2005: 62).

While the adoption of ceramics during this period does not necessitate sedentism, the Early Formative period is associated with the settling down in village centers, the construction of some of the earliest “ceremonial” architecture and the domestication of plants (Bruno and Whitehead 2003; Whitehead 2006) and animals (Moore, et al. 1999). Sites tend to be under 1 ha in size (Janusek 2004b: 135) and in some cases early formative people settled on archaic sites (Bauer and Stanish 2001: 139-140). An exception is the Taraco Peninsula. Here small villages were settled and never grew to a large size (Bandy 2004; 2001), but increase in density of settlements and underwent processes of village fission throughout this Period. Stanish (2003: 109) suggests that balsa boats were likely used to facilitate trade routes and for the exploitation of these resources. Archaeobotanical work has found the domestication of Chenopodium quinoa, with the earliest dates at Chiripa dating to 1500 BC (Bruno and Whitehead 2003: 350). Erickson (1993; 2006) draws on the presence of Early Formative ceramic scatters near agricultural terraces and sunken gardens to argue that landscape modification was occurring during this period (See Bruno 2008, and others for the detailed arguments surrounding this idea). Nevertheless, populations in many regions were still fairly mobile (Herhahn 2004).

Material culture was certainly widely exchanged during this period. For instance, lithic analysis from sites such as Ch'uxuqullu and Titinhuayani on the Island of the Sun indicated that obsidian was arriving from the Colca Valley, 350 kilometers from the Titicaca Basin (Stanish 2003; Tripcevich 2007: 106-107). Cylindrical sodalite (lapis lazuli) beads, likely originating from Cochabamba, have been found in mortuary goods (Browman 1981: 414). Excavations on the Taraco Peninsula have also recovered seashell and small amounts of gold, silver and copper (Bandy 2005: 95).

2.23 Middle Formative Period (800 BC - 200 BC)

The Middle Formative is defined by a shift in ceramics, in settlement systems, subsistence and public architectural complexes. Scholars have defined several regional centers during this period, including Chiripa (Hastorf 1999; Hastorf 2003), Pucara (Lynch 1981) and Qaluyu (Stanish 2003: 112-113). These centers are all defined, at least in part, by their ceramic assemblages. In the South Basin Chiripa, named after the type site on the Taraco Peninsula, is defined by the spread of a fiber-tempered pottery with red-brown slipped decoration and flat-bottomed bowls (Janusek 2004: 127). The ceramics associated with Chiripa have been found throughout the Titicaca Basin (both north and south), as far east as the eastern Cordillera (Stanish 2003: 129), as far south as the northern Chilean coast, and as far north as Cusco (Moseley 1992: 146-148). Qaluyu pottery, also widespread, is most densely found in the Ayaviri area to the east (Stanish 2003: 129). Lumbreras (1974: 57) and Mohr Chávez (1988: 24) both note a similarity between these ceramics and the decorated ceramics of the Cuzco region, and Silverman (1996: 112) sees similarities to the Acari region near Nazca. Steadman has suggested that most ceramics were locally made (Stanish, et al. 1997; Stanish, et al. 1994; Steadman 1995). Her work at Sillomoco found a unique style of pottery that draws upon both traditions (Stanish et al. 1997).

The Middle Formative Periods sites in both the North and South Basin are located along streams and the lakeshore, many including sunken court architecture (Stanish 2003: 123). The varying density of surface ceramics have been used to suggest two-tier settlement patterns (Stanish 2003), with two-levels of decision making within the regional political economy. Some scholars have used this to infer the presence of simple chiefdoms and early ranking (Anderson 1994; Wright and Johnson 1975). Others suggest that rather than representing integrated political entities, the courts are evidence for ritual and religious practice. They interpret the appearance of these sunken courts, a specialized ceramic assemblage (painted serving wares and tubular ceramic "trumpets"), and carved stone stelae with particular iconography as evidence for an integrating regional religious movement, a "Yayamama Religious Tradition" (Chávez 1988; Chávez and Mohr Chávez 1975).

Of the survey conducted so far, it appears that the Taraco Peninsula is the most densely occupied area during the Middle Formative Period in the South Basin. During the Late Chiripa phase, there was a two-tier settlement hierarchy with 10 sites in the 3-8 ha size. Some have argued that it served as a ritual center (Beck 2002, Hastorf 1999), but there appear to be other sites on the Taraco Peninsula, yet to be excavated, that may be as extensive as Chiripa. Throughout the Basin there is a surge in the number and size of sites, with many sites similar in type to Chiripa. For instance, in the Katari Valley a two-tier settlement pattern was defined, with one larger site, Qeyakuntu, with significant platforms. In the Tiwanaku Valley researchers found sites approximately 3 ha in size, and two sites similar in size to Chiripa.

Settlements during this period continue to move towards the lake, with agrarian and pastoral subsistence along with fishing, hunting and foraging. Paleoethnobotanical data suggest that chenopodium and tubers were being cultivated. Stanish (2003: 134) argues that agricultural intensification, in the form of raised fields and slope terrace farming, generated surpluses for the developing political economies of the Titicaca Basin (but see Bruno 2008).

In addition to the movement of decorated ceramics, sodalite beads, obsidian, shell and gold and silver, the Middle Formative sees extensive movement of olivine basalt hoes throughout the basin (Bandy 2005: 95-97). Bandy believes that the hoes, which have been used as evidence for intensification, are simply a small, preserved part of a much larger trade network that gathered strength during the later phases of the Middle Formative Period. Janusek (2004: 136) suggests an increase in communication for this period, with "humans, goods, and ideas travel[ing] vigorously across the Titicaca Basin".

2.24 The Late Formative Period (200 BC-AD 500)

The Late Formative, the focus of this dissertation, is defined as "the period between the rise of the Pukara polity in the northern Titicaca Basin and the beginning of the Tiwanaku period in the South" (Bandy 2001 162). Scholars have recently subdivided this period into the Late Formative 1 (200 BC-AD 300) and 2 (AD 300-500) for the South Basin (Janusek 2003), or Upper Formative (500 BC-AD 400) in the North Basin (Stanish 2003). This division is based, at least in part, on Kalasasaya and Qeya decorative styles of ceramics that have been found in stratified deposits (Figure 2.4). While these sherds have been found throughout the southern Basin, chronological control is hampered by the fact that Kalasasaya continues through the Late Formative Period. Furthermore, few Qeya sherds have been found outside of Tiwanaku proper and even fewer complete vessels (Bandy 2001:164; Janusek 2002, 2003, 2004a, 2004b). The differential distribution of decorated wares has been interpreted as a sign for "regional socioeconomic differences and, perhaps, political hierarchy" (Janusek 2004: 148). In the South Basin it is only recently that a proper chronology has been constructed from non-decorated ceramics (Bandy 2001; Janusek 2003; Lemuz 2001; Roddick and Steadman 2005; see chapter 5).

a. b.

c. d.

Figure 2.4: Late Formative diagnostics. a) Kalasasaya incised, b) Kalasasaya red rimmed, c) Qeya incised, d) Qeya polychrome

Scholars suggest that the onset of the Late Formative period is also defined by the appearance of “ethnic polities” (Hastorf 2005: 67) and “multi-community polities” (Bandy 2001, 2004; Stanish 2003). Interpretation of settlement data suggests that populations aggregated to several central sites that gained political prominence in the region. Bandy (2001), Lemuz (2001) and Janusek and Kolata (2004) all note that during this period, many sites decrease in size as other larger sites emerge. Three-tier settlement clusters have been found in the Southern Basin, political units defined, like the earlier two-tiered system in the Middle Formative, from the presence of surface ceramics. The construction and use of public architecture continues in this period, with sunken courts central at many sites (Janusek, et al. 2003). The best-excavated examples for domestic life have been found at the site of Lukurmata where several houses with packed clay floors and indoor hearths were excavated (Bermann 1994: 59-96).

Typically three sites are viewed as "dominant" over the other settlements: Tiwanaku, Khonko Wankane and Pukara, each with a particular sculptural tradition thought to epitomize the ongoing *Yayamama Religious Tradition*. Tiwanaku emerged as a major settlement, approximately 20 ha in size, and at the point where the Tiwanaku sunken temple was constructed. The site of Khonkho Wankane in the Machaca region of the upper Desaguadero Basin included a trapezoidal sunken court linked by a corridor to a large plaza. Neighborhoods of circular structures stretched across the mounded site, and large sandstone monoliths still litter the surface. The 200 ha North Basin site of Pukara arose out of the Qaluyu settlements and is divided into a residential sector and a central monumental section that includes 32 meter high terraces, a central sunken court with surrounding structures, and two artificial mounds marking the boundaries of the ceremonial site core (Klarich 2007: 57-59; Wheeler and Mujica 1981). Archaeologists have just begun to scratch the surface of both Pukara and Khonko Wankane, and we still know very little about the Late Formative occupation at Tiwanaku.

By the end of the Formative Period, around AD 475, all settlements appear to be stylistically associated with Tiwanaku. By these "post-formative" Tiwanaku IV/V phases Tiwanaku is thought to portray a classic site-size hierarchy for first-generation states: a four-tiered site size hierarchy in its core territory (Albarracin-Jordan 1996; McAndrews, et al. 1997) and a six tiered hierarchy in the "provincial territory" (Stanish 2001: 56; Stanish et al 1997). Artisans at Tiwanaku produced elaborate crafts (Janusek 1999), potters produced ceramics at designated workshops (Rivera 2003) and stonemasons constructed large architectural complexes and carved iconographic entities including representations of elites (Couture 2002; Protzen and Nair 1997; 2002). Surplus food goods were produced from raised field agriculture and trade items arrived from the western valleys (Kolata 1986a; Moore, et al. 2006). Ceramics have also been used to argue for a concentric gradation of social status within the emerging city, with higher status groups found in the center of the site (ibid, see below). In these higher status neighborhoods fancy serving vessels (*escudillas*, ceremonial basins and modeled figurines) have been found in much higher percentages.

2.3 Narratives of the Lake Titicaca Basin

It is clear that there has been an extraordinary amount of archaeological work conducted in the Lake Titicaca Basin over the past 50 years. In what follows I wish to argue that more recently, in the past 20 years or so, scholars of the region have been developing several particular prehistoric narratives. All these archaeological narratives tend to focus on the themes of complex societies, including plant and animal domestication, monumental architecture, craft specialization, increasing social hierarchy, and “other markers of advancement” (Kojan 2008: 72). The chronological sequence, settlement patterns, architectural canons, and the domestication of flora and fauna are presented as a narrative of steady growth over the *longue durée* of approximately 2000 years. That is to say it is, for the most part, this bird’s eye perspective is a socio-evolutionary meta-narrative. Tiwanaku data are fitted into three particular narratives of this larger meta-narrative, each stressing different social factors: One approach stresses religious integration, another emergent chiefs and “multi-community polities” and the final one identity and ethnicity. These are certainly not mutually exclusive perspectives; the scholars proposing these perspectives do not do ignore other factors, and in some cases scholars draw upon aspects of all these narratives in their explorations. I present them as separate thematic areas of interest within these regional perspectives in order to situate the import of several common themes that run across all these stories, which I return to momentarily. Finally, these are not the only narratives of Titicaca Basin evolution. For instance, I am not including a specific model involving the importance of inter-regional trade (Browman 1980)(Browman 1980; Dillehay and Nunez 1988).

2.31 Narrative 1: Religious Integration

In the sequence above the Middle Formative is defined, in part, by the appearance of carved monoliths. This art style, initially called P'ajano (Portugal Ortiz 1981; Browman 1972), continues through the Late Formative Period. These monoliths coincide with painted, finely made ceramics and higher densities of sunken court architecture. Karen and Sergio Chávez bundled these elements into a comprehensive package of ceremonialism named the "Yayamama Religious Tradition" (Burger, et al. 2000; Chávez 1988). Sergio Chávez (1992: 28) has defined the Yayamama religious tradition as "a religious movement that unified a number of diverse groups". This focus on a regional tradition results in a rather broad focus of social process; while the religious tradition is usually restricted to the Middle and Late Formative period, others suggest its inception at the beginning of settled life in the Basin, and continuity through to Middle Horizon, spanning over 2500 years (Burger, et al. 2000). Furthermore, it affects the interpretations of lived lives at Formative Period sites. Chávez and Chávez (1997) call major Middle Formative sites "temple dominions". This view of social boundaries is quite fluid, and general, stressing the similarities in site layout, settlement patterns and pottery traditions.

Yayamama researchers stress integration, particularly at the regional scale, and to do so they employ the larger Peruvian chronology “resulting in a representation of altiplano prehistory as much more integrated into regional processes.” (Isbell 2004: 213). This integration is sometimes viewed as religious, with semiautonomous sociopolitical groups throughout the Formative Period landscape (Albarracin-Jordan 1996; Albarracín-Jordan and Mathews 1990). Mathew Bandy argues the Yayamama Religious Tradition represents a shared ceremonial experience that served to integrate the communities of the Taraco Peninsula and the greater Titicaca Basin. Bandy (2001, 2004) suggests that the ritual of religious services affected residential decisions. While in the short term individuals may have affected population pulls, “special efficacy could also come to be attached to totemic figures, idols, monoliths, or ancestral mummies” (Bandy 2001: 80). Furthermore, Bandy argues that the ceremonial practices of the Yayamama Religious Tradition served to ameliorate the effects of scalar stress in communities and as a result Middle Formative villages expanded to much larger sizes.

Stanish (2003) also believes that the Yayamama religious tradition served as an integrative tool, but was also the basis for a certain group to gain power and prestige. He believes the religious tradition was, in fact, an elite ideology and served as a catalyst for the shift in the political structure of Lake Titicaca basin society. Specifically he sees the religious practices as a resource that allowed the emergence of social and political ranking during the Middle Formative Period (Stanish 2003: 132). Stanish envisions this as a pan-regional ideology that fueled elite competition at a handful of sites where stone stelae were located in a symbolic show of participation in the system. He characterizes these regional centers as the seats of competing simple chiefdoms.

2.32 Narrative 2: Chiefs, Feasts & Multi-Community Polities

Chiefdoms play a central role in socio-evolutionary interpretations of state development (see for example Anderson 1994; Early 1997; Johnson and Earle 1987 and critiques in Pauketat 2007 and Yoffee 1993) and the Titicaca Basin is no different. This focus has manifested itself in several studies on the emergence of new polities, the appearance of leaders, and the movement of prestige goods (Klarich 2007; Plourde and Stanish 2001). Ceramics have played a particularly important role in these studies. For instance Lee Steadman's (1994; 1995) ceramic analysis in the North Basin found sites with styles similar to both Chiripa and Qaluyu styles, yet somewhat distinct. This style variability is thought to represent autonomous political entities. James Mathews (1995: 93) found Chiripa phase sherds on the surface of Middle Formative sites in the Tiwanaku Valley and suggests they are remnants of a Chiripa chiefdom. Juan Albarracin-Jordan suggests that the appearance of fancy, decorated ceramics after a phase dominated by domestic wares are examples of emerging chiefs with higher status. Albarracin-Jordan (1992) believes that if this site "was an appendage of a broader social sphere, it can be argued that leadership was recognized within the larger social group, and that authority figures within each segment also possessed a different status" (Albarracin-Jordan 1992: 141).

These emerging leaders are actually rarely defined or fleshed out in the literature, and their presence is often not archaeologically defined. Much like similar social evolutionary narratives elsewhere, this narrative can result in an over-emphasis of the role of emerging elites, with these actors "implicitly or explicitly at the fore of social action"

(Costin 2007: 144). Aimee Plourde (2006: 399-400) cogently explains the evidence for this emergence: a continued growth of site size ranking, increased intensification of subsistence production and a rise in maximum cost of prestige goods. She also observes a slight rise in exotic goods in burials and an increase in elaboration in decorated ceramics. Nevertheless, she admits that primary evidence for elite emergence would include "excavation data from households of varying degrees of status (as determined by household size, diet differences, skeletal data showing genetic relationships and states of health, etc.) against which the distribution of prestige goods could be compared" (Plourde 2006: 400). Unfortunately this type of data is usually not available; as such the presence, quantity and elaboration of decorated ceramics is used as a proxy measure.

Charles Stanish offers the most developed chiefdom narrative. He argues (2003: 2, 109) that ranked society appears as far back as the Early Formative, as evidenced in the appearance of public architecture and decorated ceramics. By the Middle Formative, Stanish sees competing peer polities (Figure 2.5), with elites and specialists based out of regional centers: "The origin of these complex chiefly societies, I believe, is best understood as the result of elite groups efforts to attract commoner laborers and *attached specialists* to their centers. Evidence from throughout the Titicaca Basin indicates an elite capable of mobilizing labor for agricultural intensification, architectural embellishment, *commodity production*, and the organization of individuals for conflict and trade during this period" (Stanish 2003:4, my italics). Unfortunately we have no evidence for either attached specialists or primary evidence for production at this time (see chapter 7). Stanish (2003:128) sees the distribution of fine-ware ceramics as evidence for emerging elite lineages that held control over the domestic labor of their communities. He argues that by the Late Formative Period elite pottery are essential players in political practice, particularly for commensal politics. Stanish interprets the spread of similar styles of pottery, which in some cases does extend as far as the Peruvian Coast (Silverman 1996 cited in Stanish 2003:135), as evidence that chiefs developed long-distance trade networks in the Titicaca Basin. However, no detailed attribute analysis or geochemical work has been conducted to verify whether products or ideas were moving across the landscape.

Mathew Bandy's research takes a somewhat different tact, tracking demographic processes of Taraco Peninsula prehistory tracks using surface potsherds (see Chapters 3 and 5 for discussion of this method). Bandy sees populations shifting through time, as groups of people change their choice in residence) due to differing redistribution options of leaders. As Bandy puts it, "a chief or leader is a point resource on the landscape. S/he is a location from which goods emanate, and proximity to this location could prove advantageous to other persons" (Bandy 2001:79). Thus, chiefs predicate where people settle, as such determining population growth rates throughout the Formative Period on the Taraco Peninsula. According to Bandy these chiefs initiated local status competition, and the trade of exotic goods were central points of rivalry. A shift in trade routes caused a number of changes throughout the Basin including changes in ceramic

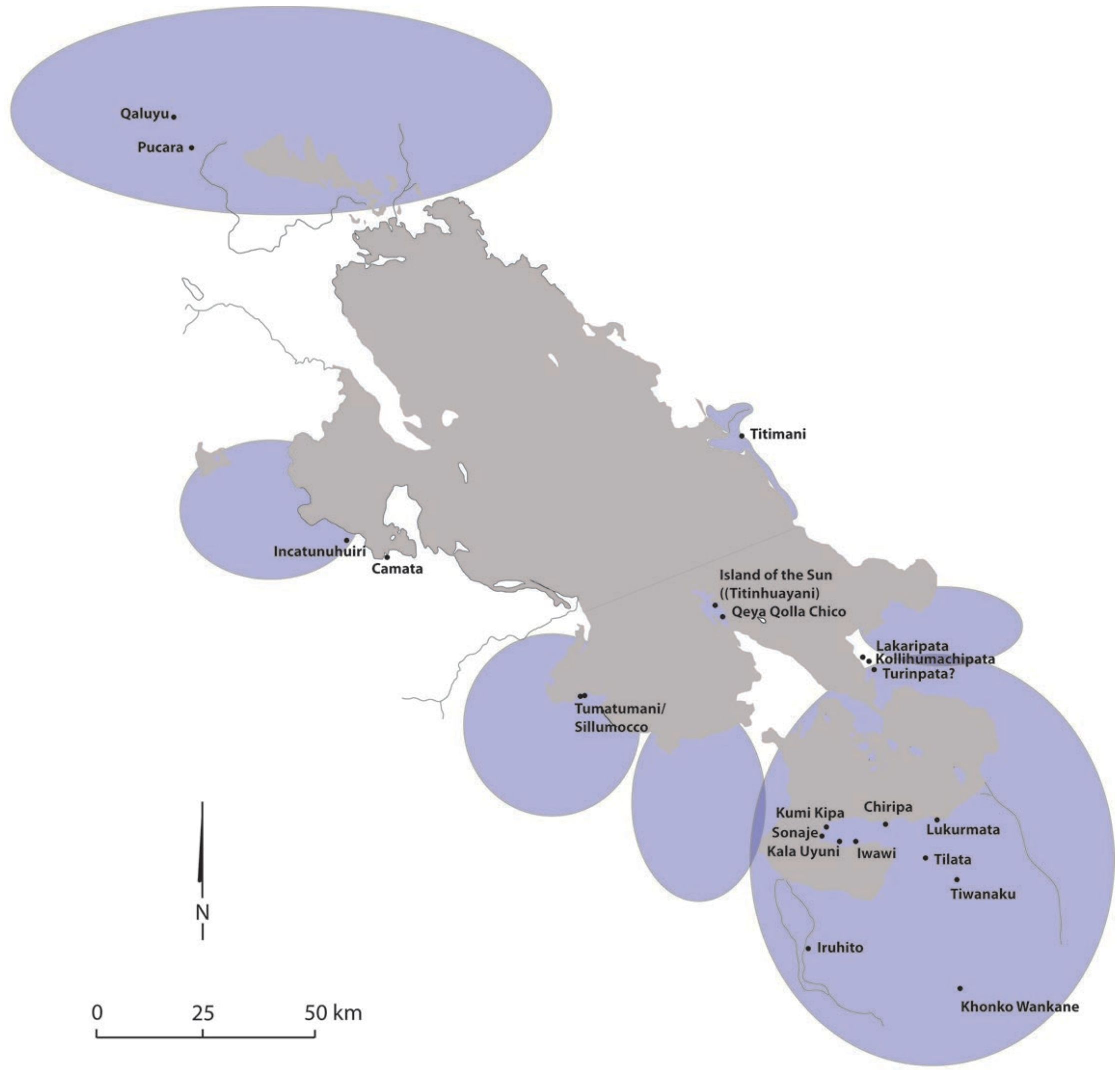

Figure 2.5: Stanish's chiefdoms of the Titicaca Basin (adapted from Stanish 2003, map 1.3).

production decisions. Like Stanish, Bandy sees ceramics as evidence for ritual and competitive status feasting as well as political integration:

> "In particular, the presence of a complex of decorated serving ceramics, which are moreover associated almost exclusively with public architectural contexts, suggests the serving of food and drink in a public context; in a word, feasting... We may imagine that a system of competitive generosity developed which allowed competition to take place in a way which actually increased the solidarity of the community as a whole." (Bandy 2001: 286)

2.33 Narrative 3: Social Identities

The idea of investigating ethnicity in the past is highly contested in archaeology. Ethnicity is a form of conscious identity, it is a self-perceived entity that holds in common a set of traditions not shared by others and can include religious beliefs, language, and a sense of historical continuity. Social anthropologists have recognized the difficulty of tracking ethnic groups defined by a set of cultural traits. Ethnic homogeneity can be maintained over a broad area despite a diversity of behavioral styles and forms of social organization (Barth 1969). Since ethnic groups are situational and unstable through time (Barth 1969; Cohen 1978; Wolf 1984: 393-396), they "are often fleeting targets in the coarsely resolved archaeological record" (Clark 2004: 44). This is even more so in moments of great upheaval prior to development of regional polities. Nevertheless, ethnicity, much like gender, has forced archaeologists to consider difference located outside of status (Brumfiel 1992; Bowser 2000; Goodby 1998; Reina and Hill 1978:238-243) and probing for social identities is a productive avenue in many prehistoric settings societies, including pre-state societies.

When Alan Kolata (1986) suggested that the Tiwanaku heartland consisted of several ethnic-like groups he was one of the first scholars to explore social identities for the Titicaca Basin site. However his student, John Janusek, has done perhaps the most work on social identities in the region, stressing social variability other than status at Tiwanaku. Janusek tracked variation in burial goods, skeletal remains and residential architecture, but he found stylistic variation in the Tiwanakau IV ceramic assemblages to be the best evidence for social identity. "Within any compound, serving assemblages maintained remarkable spatial and historical continuity, while between them, assemblages varied significantly" (Janusek 2002: 46). He found variability between neighborhoods with a slightly higher percentage of nonlocal vessels and subtle iconographic variations (ibid). The pottery production area of Chi'iji Jawira had an even higher percentage of nonlocal vessels and higher maize densities (Janusek 2002: 47).

Further afield, at the site of Lukurmata, Janusek notes that there is significant variability in ceramic assemblages both between residential sectors, and compared to Tiwanaku itself. A paste unique to the Katari valley indicated to that not only were there local centers of production, but cranial modification pattern appear to confirm these identity boundaries (Blom 1999, 2002). As such Janusek argued that the Katari Valley formed a "coherent, wealthy, and powerful ethnic-like group" (Jansusek 2002: 54). Janusek argues that identities may have been formulated within particular communities with control over resources and productive systems: "That is, they formed factions that, although participating in and benefitting from state institutions, also expressed local identity and at times resistance through body modification and stylistic innovation in valued goods. These factions potentially had tremendous political power and cultural influence." (Janusek 2002: 55)

The notion of *ayllus* has played a predominant role in explaining the rise of Tiwanaku (Albarracin-Jordan 1996, 2003; Isbell 1997; Janusek 2004: 71-73, 284-285; Ponce 1981, 2001). This term is a long-debated one in Andeanist literature because for Andean people the "ayllu is a complex concept with a wide range of senses, as inclusive as the English word group" (Rasnake 1988: 51; Weismantel 2006). Rasnake (1988: 49-51) notes Andeanists using the terms as primary kin group, larger social groups holding land together, and more complex relational perspectives of people, houses and place brought together.

Titicaca Basin archaeologists employ the concept to argue for Tiwanaku as a segmentary state – a federation of ayllus – rather than a centralized state. Of course there are obvious problems with using the ayllu concept to argue for a segmentary organization in the deep past, foremost being that, "the segmentary model is based on ethnographic description of political organization in modern Aymara communities. If one is willing to assume that cultural principles have remained unchanged for more than 1500 years, [the] argument is appealing." (Isbell 2004: 218). Nevertheless many Andean archaeologists have argued for its presence in prehistoric settings, and in the Titicaca Basin scholars have applied it as an analogy to ethnicity (Goldstein 2005; Janusek 2004).

Like the chiefdom/multi-community polity model above, feasting also plays a central role in approaches to ethnicity. Feasts were the key moments for the negotiation of not only status, but also identity (Janusek 2002: 54). Thus ceramics were utilized at Tiwanaku both to create and reproduce local social boundaries through production and signaling of ceramic styles, as well as use in conspicuous consumption. While all three perspectives – religious integration, emerging chiefs and social identities – are struggling with some similar themes, it appears that social boundaries in particular reoccur throughout.

2.4 Social boundaries and communities in Titicaca narratives

As Janusek (2004: 122) has recently pointed out, communities and their relationships are central to our interest in understanding the trajectory of cultural development in the Titicaca region. He suggests that a community perspective provides "comparative insights into the role of ritual and ceremonial centers, the organization of craft production and productive enterprises, the character of political organization, and the agency of local groups and communities in the process of state development, expansion, and collapse" (Janusek 2004: 122). In order to define prehistoric communities archaeologists must draw on a particular theory of social boundaries. Put another way, communities require boundaries, real or imagined, flexible or strict.

In the discussion above one model advocates a broad boundary based on the religious belief and practice of a Yayamama Religious Tradition from the Middle Formative Period onwards. Another defines relatively strict boundaries developing in the Late Formative Period based on the agency of a few highly competitive elites who formed the foundation of multi-community polities. The last focuses on the relationship between politics, identity and ethnicity. Each of these narratives interprets the material culture of the region slightly differently. Those stressing a religious tradition note the similarity in material culture rather than the subtle, but sometimes not so subtle diversity in material patterning. The chiefdom narrative concentrates on so-called prestige items to formulate political boundaries seeking variation in goods with greater degrees of elaboration. The social identity and ethnicity perspective stresses the internal social boundaries of the state society, but often misses the processes and boundaries prior to state development.

The very nature of the concept of social boundary is perhaps as slippery as their archaeological application. Like ethnicity, "social boundaries are abstract and ideological constructs, recognized differently and for different reasons by people on the basis of their perceived identity, interest and social contexts" (Goodby 1998: 161). Social boundaries can occur at a number of scales from the household, to the village to the larger region, and can be based on kinship, fictive kin, economic models, ritual system, political power or gender. Recent research includes work on gender differentiation in the US Southwest (Hegmon et al. 2000), ethnic variability in colonial situations (Lightfoot et al. 1998), and political (Hastorf 1990) and moiety divisions (Hosler 1996) in the Andes. Social boundaries also may vary through time and across space.

Archaeologists have acknowledged the possible axes of variation in particular for pottery. Pottery has received extensive study due to its ubiquity in prehistoric contexts and continued production in many parts of the world. Through this research scholars have found that pottery can vary for a large number of reasons, with ethnicity and politics sometimes entangled in an incredibly complex way (Bowser 2000; see chapter 3), and in other cases playing no role at all. There is no doubt that the search for ethnic boundaries in prehistoric non-state societies can be, as Miriam Stark puts it, unproductive and tautological. However, "efforts to understand patterns of cultural variation, and to identity and explore social boundaries in the material record, are not" (Stark 1999: 26). This acknowledgement that materials can vary for a variety of reasons has the potential to crack open a fairly evolutionary metanarrative to encourage a number of different types of stories, and with different types of community formation in the past. Before exploring these possibilities, however, we should examine the particular relationship between social boundaries and ceramics in the Titicaca Basin Formative.

2.5 The role of ceramics

Settlement data, stone monoliths, obsidian geochemistry, and plant paleoethnobotany all have cameos in each of the narratives above. Ceramics, however, play a more central role. Like most archaeological regions, our understanding of Titicaca Basin social reproduction is predicated on the notion of culture change at the boundary of ceramic technological shifts. Stylistic types are reified as "fossilized time". This perspective can lead us "further away from the inherent diversity in our data, as its inherent complexity is homogenized and reduced to a convincing narrative supported by chronometric dating" (McGlade 1999). If social boundaries, and thus political interaction, economic exchange and religious ideology, are all being conceptualized from the standpoint of ceramics, it is essential to probe the details of these ceramic traditions.

In chapter 5 I discuss the important work on ceramic chronology that has occurred since the 1950s in the North and South Basin. As will be seen the production, distribution and use of ceramics in the region, in particular during the Formative Period, is still not well understood. In fact, many of the surveys conducted throughout the late 1980s and early 1990s were done without a good handle on the Late Formative Period. As William Isbell rather directly states, "analyses based on survey can be no better than the ceramic chronology…[and] there are serious problems with altiplano ceramic chronologies" (Isbell 2004: 230). Furthermore Isbell is particularly critical of the ceramic-based site size ranking used to define hierarchical organization. "When settlement patterns [serve as] proxies for political economies…their interpretations involve many assumptions and models. So inferences are based as much on models as empirical data" (Isbell 2004: 231).

Let me demonstrate this briefly with an example from the Late Formative Period. The subdivision of the Late Formative into two phases has long been problematic as the Kalasasaya and Qeya decorated pottery that serves as diagnostic for the sub phases are differentially distributed. In his survey of the Tiwanaku valley, James Mathews (1992:

106) found few Qeya ceramics on the surface of his sites and noted more continuity than abrupt changes in the utilitarian ceramics. On this evidence, he argues that the Kalasasaya and Qeya design styles are variants of the same cultural stage. Specifically, Mathews sees three stages of political evolution – Chiripa, Formative Tiwanaku and Tiwanaku. Furthermore he suggests that the rare presence of decorated Qeya-style vessels at the end of this period represents "the first appearance of unequivocally elite ceramics" (1992:108). Nevertheless, those scholars specifically investigating the Formative Period have not found evidence for the elaborate workshops of attached specialists, and most scholars believe that pottery was produced locally on a small-scale (Lemuz 2001; Stanish et al. 1997; Stanish and Steadman 1994; Steadman 1995). Approaches such as Mathews' places great responsibility on the humble potsherd, linking the emergence of sociopolitical inequality with the mere appearance of decorated vessels, a fairly common argument (as discussed above).

Design style may be an appropriate marker of temporal shifts and social boundaries and even indicator of political process for periods of quick stylistic change and contexts of controlled craft production. However work thus far, including Mathews' example above, suggests that the Formative Period was not such a moment. Rather throughout the Formative Period ceramic production was a long lasting tradition, and consisted of fairly conservative changes. So is it unreasonable to seek prehistoric social boundaries – whether conceived as broad religious traditions, political groupings or other social identities?

I believe, like Stark (1999), that social boundaries no matter ones narrative trope are essential in archaeology. I argue that the humble potsherd of the Formative Period is up the task of tracking social boundaries. Technology, of which our earthenware is a prehistoric variety, can tell us much about social boundaries (Stark ed. 2000). Technologies are related through varying webs of interaction through which the social, symbolic and material are enmeshed. Social identities can be defined or maintained through these interactions (Jones 2002: 93). Thus the question for ceramics should be how technologies are produced and reproduced, and how social identities and social boundaries are created.

Such a question does not involve completely moving away from prior questions. We can still ask whether pottery production was controlled or manipulated by those "seeking" social status. We can investigate whether feasting, a community wide social act central to all three narratives above, was indeed the basis of defining religious, political or ethnic groups. And we can probe our data for variability in practices within and outside of a given religious tradition. But we can take questions further, and explore the dynamic nature of the social engagement with technology, including quotidian pottery often left out of such discussions. We can ask how "economic and ethnic behaviors were learned, taught, expressed materially, and thus made part of everyday life" (Dobres 1999: 16). By examining the variability in intersubjective dynamics we can unpack material variability, variability that is so essential to the narratives of the Titicaca basin. But to ask such questions requires a micro-scale approach, both on methodological and theoretical grounds (Dobres and Hoffman 1994: 213).

2.6 Another narrative thread: The Micro-Scale and Daily Practice

> All analysis does violence to life as it is lived, chopping it into bits because it is impossible to understand the whole simultaneously. A relational view allows us to isolate different contexts of action and causes of change, whilst always keeping mind the importance of interconnectedness."
> (Gosden 1999:121)

Many researchers have stressed that sociopolitical change occurs at different scales and paces (Crumley 1979, Marquardt 1992). Different temporalities can include differential rhythms of change for social, political and economic processes. The pace of this change is likely to be highly variable with moments of stability and other episodes of great change (Robb 2007: 295). It is these varying rates of change that are the basis of structural histories of societies (McGlade 1999). In fact, an awareness to the rhythms that exists in different parts of life are essential as they become embodied in things, a point cogently made by Tim Ingold (2000, see chapter 3).

Therefore different analyses are required for exploring long term prehistoric processes: a macro-scale approach with regional processes big swaths of time, and local or micro-scale approaches examining aspects of lived lives. Andrew Jones warns "if we undertake our analyses within a narrative framework that only attends to the macroscale, our interpretations will tend to be restricted to this scale of analysis. If our analyses attend to the microscale, then our analysis may also be able to inform us about processes that occur at greater scales." (Jones 2002: 72). While clearly the relationship between scales of analysis and method and theory is not simply a case of "scaling up" (Dobres 1999; Joyce and Lopiparo 2005), taking a more micro-scale perspective has an enormous impact in how we see patterning in the archaeological record. Jones concludes that the microscale "represents the most appropriate scale with which to initiate our analyses." (Jones 2002: 72). Additionally such a micro-scale approach is particularly appropriate for archaeologists concerned with the role of material culture since macro-scale approaches often result in a "passive view of the artifact" (Roe 1995: 28).

Although an important initial step, taking the narrative stance of the micro-scale is not enough. The micro-scale perspective clearly needs theoretical support, which is found in theories of practice. Although practice theory has had an immense surge of interest in the past 20 years, it is perhaps worth a brief review. Practice theory developed in the 1970s, at a point when anthropology had progressed from a concern with socialization (culture reproducing culture) to a view focused on the role of ritual in maintaining the social order (Ortner 1984). Theories of practice were a result of both Marxist theorizing of praxis and the cultural Marxist work of "beginning "from everyday social life where social structure and subjectivity occur and are patently historically specific and spatially located." (Holland and Leander 2004: 130). Practice theories focused on the partially determined and partially determining character of human agency and the impact of practice on structure and vice versa. These approaches questioned the subject/object dualism, attempted to bridge the materialist and idealist theories, micro- and macro-socialists and the role of individual in society (Bourdieu 1977; Giddens 1979). Others questioned the relationship between structure and history (Comaroff 1985; Sahlins 1987) and between cognition and culture, specifically challenging Durkheim's separation of the individual from collective aspects of cognition (Lave 1988: see Chapter 3).

Practice theories focused in particular on the significance of routine, day-to-day activity, and its importance to the constitution and reproduction of society. Scholars working with practice theories have noted that it shifts us away from a bird's eye perspective, towards viewing a dynamic lived landscape. From this perspective of practice, or what has been called an *archaeology of inhabitation,* material culture is no longer simply the residue of processes, but instead is the "necessary conditions of a world inhabited, interpreted, and acted upon" (Barrett 1999: 257; As quoted in Gillespie 2008). Furthermore, in a practice-based social archaeology, human actors are the agents of change, not reified systems or institutions (Brumfiel 1992: 559). As such, defining particular genealogies of practice require a tacking back and forth between different scales of analysis (Joyce and Lopiparo 2005; Pauketat and Alt 2005). Archaeologists have productively used such approaches for a range of concerns of the past, but have been particularly successful in research on craft production (see chapters 3 and 4). A practice approach has allowed scholars to "model the dynamic social processes involved in ongoing, day-to-day technological endeavors, and to consider the differential participation of the actors and groups involved" (Dobres and Hoffman 1994: 21). To stress again, this is not necessarily at odds with previous themes; rather in richens them and in some cases opens them up for investigation in ways that macro-scale approaches cannot. For instance, if feasting is being argued for as a role for increasing complexity, what does daily life look like outside such feasts? (See similar arguments in Hodder and Cessford 2004; Van Keuren 2004)

In this dissertation I "look up" (Vitelli 1999) from the Late Formative Period of 200 BC-300 AD of the Taraco Peninsula. I do not avoid what comes before (the Middle Formative) or after (the Tiwanaku polity), or the treat the Taraco Peninsula or the Basin as an island (Isbell 2004). As van der Leeuw has argued, ceramicists (but also archaeologists) must, "travel back in time and look forward with those whom they study' (van der Leeuw 1991: 13), and understand the particular "historical trajectory that has led to each situation' (ibid 21). It means to look up through time from the Late Formative without assuming a steady growth of political hierarchy through time. Put simply, I wish to treat the Late Formative Period as a time where we don't know the "endgame".

The approach taken in this study picks upon this idea of multiple entanglement of people's identity, practice, and pottery. It is a 'biography of things' approach (Gosden and Marshall 1999) whereby ceramics have histories, histories in which their relationships, importance and roles change. These entanglements begin with the production of the pottery, but continue in processes of exchange, consumption (of the ceramics and associated food goods), to pot reuse, and eventual deposition. This position clearly encompasses a number of different perspectives linking material culture to social process. As such it depends on a number of re-definitions of terms used in a bird's eye perspective (such as style, community and tradition) that take on unique meanings when talking about the daily practice of production (Roddick and Hastorf in press).

2.7 Community as Doing, Community as Practice

An important beginning step of taking a daily practice approach to social boundaries is to recognize communities from another perspective than that of static settlements on the landscape. I suggest we try to move towards community as intersecting modes of social practice (Yaeger and Canuto 2000), to seek out the multiple scales and types of community. In contrast to approaches that focus in on a particular causal agent (the environment, elites or trade), such an approach focuses in on the relations between all people, material things and environments (Robb 2007: 327). Robb, in his search for the roots of change for the Mediterranean Neolithic, considers the mutual constitution of political relationships between communities, with particular attention to the knowledge of interacting parties. "It is the network of interactants which sets the conditions of action, and since how each interactant decides to act is based in part upon these conditions, a network spanning communities can change individual decisions within each community" (Robb 2007: 328). In a sense Robb is arguing for a focus on "action in the world" rather than a model of culture as some internalized force.

Such an "action in the world" perspective evokes many questions appropriate for thinking about social boundaries in the material record. Many aspects of daily social practice can help to differentiate/ create social boundaries (Stark 1998, 1999:42), including domestic architecture (Aldenderfer 1993), wild animal procurement (Lemonnier 1986) or agricultural practice (Rosaldo 1988:163-164). There is a rich literature in Andean ethnography tracking material practice and the construction of social relations and ideological positions. For instance, Joanne Rappaport (1985) explores how people defined community boundaries through the actions involved in walking or travelling across the landscape. Bill Sillar effectively summarizes a range of other practices that define community:

> "Canal cleaning is understood both to structure a community's internal social relations and its ritual position in the landscape (Isbell 1974; Urton 1981). The roofing of a house both expresses kinship relations and creates a new social, economic, and ritual unit in society (Carter and Mamani 1989; D.Y. Arnold 1992). The techniques used in weaving, and the cloth produced, serve both to register ideological concepts and to reproduce gender relations (Cereceda 1987; Silverman-Proust 1988; Crickmay 1993)" (Sillar 2000:3).

Some Andean archaeologists already draw on such a perspective. For instance, Clark Erickson (1993) has argued that raised-fields were maintained even as state-level societies rose and fell, and that the maintenance of raised fields maintained the community itself. John Janusek has explored such a views of community in Andean ethnography and archaeology, without falling victim to essentialist arguments. To return briefly to his use of the ayllu, that ethnicity-like term employed in ethnography and archaeology alike. Janusek uses the term as analogous to a practice-based community. The ayllu "was partly imagined and partly the concrete product of kin-based relations productive activities, access to common lands, ritual practices, claims to common ancestry, and political activity. It defined multiple embedded figured worlds and contexts of social identification and was, to varying degrees, an economic, ritual and political group." (Janusek 2004a: 28). In short, ayllu was a way of stressing the varying "doing" of community.

2.8 Summary: A New Perspective on ceramic patterns?

Two recent studies, one popular and one academic, have taken a narrative stance of "looking up" through the past. For instance, Charles C. Mann's (2006) recent work, 1491 takes this consequential year to examine the pre-history of the Americas, to present the complexity of the "New World" upon the arrival of the first Europeans. In contrast, John Robb's recent scholarly work on the Italian Neolithic takes a particular day (September 1st 5000 BC) as his starting point. Like Mann, he wishes to question common narrative, and to "tease apart a normality of the past, strand by strand" (Robb 2007: 22). But unlike Mann, his position has implications for the methodology of archaeological work. Robb argues that the majority of archaeological records are under-interpreted and that "we have subjected our archaeological material to only a very limited range of questions which highlight our fixations rather than where the material leads us." In other words, our narratives have affected our data.

I began this chapter by presenting the common meta-narrative for increasing sociopolitical complexity in the Titicaca Basin. I presented the metanarrative of complexity, and discussed some of the implicit ideas surrounding pottery within some of the explicit narratives being employed and/or tested. Employing a critical stance on these narratives "has the potential to awaken us to a kind of enquiry and writing which, 'instead of pacifying our will to know, stimulates us ever more to research, ever more discourse, ever more writing' (White 1989: 25).

I suggest that our understanding of the Titicaca meta-narrative and the relationship of pottery to people could productively be re-examined through a lens of daily practice. We are currently in a rather strange place in the Titicaca Basin, where there have been extensive survey projects with the focus on the long term, but few local synchronic analyses. This has implications both to the types of stories we tell, but also, more pragmatically, how scholars attribute significance to patterning in ceramic data. How would we view community if we examined crafting traditions not from the perspective of emerging elites strategies (who clearly are present by the Middle Horizon, but are certainly not omnipresent during most of the Middle Formative), but from the day-to-day embodied experiences of the potters and consumers themselves? In the next chapter I suggest that style, a category often deployed to explore the relationships between people, identity and things, is a useful starting point to develop a more nuanced, practice-based approach to prehistoric communities.

Chapter 3
Styles, Learning and Consumption

In the previous chapter I discussed the central role ceramics play in the prehistoric narratives of the Titicaca Basin. I underscored how potsherds are essential to our definitions of community and to interpretations of prehistoric social boundaries. While social boundaries can speak to a variety of different analytical levels – from the regional scale down to the village, residential group and individual – Titicaca basin archaeologists have been primarily concerned with political and ethnic boundaries. As the last chapter demonstrated, I am wary of such interpretations. In this chapter I confront this wariness, ultimately suggesting that the construction of personhood and community *can* be tracked in pottery sherds. In order to do so we need to take a life-history approach to ceramic materials, focusing in on the production, distribution and use of pottery, and it's entanglement in the messy realities of daily practice. This approach continues to build on my interaction view of community, but also introduces some new practice-based concepts including ideas that address daily comportments (hexis and habitus), and bodily practices over several generations (genealogies of practice) and across regions (constellations of practice). In order to arrive at these ideas I first examine some important debates on material culture, identity and social boundaries, beginning with an overview of the literature on style in archaeology.

While this is well-tread territory, "style is involved in all archaeological analysis" (Conkey and Hastorf 1990: 1), and even more so in social boundaries research (Stark 1998). Some 50 years ago style was seen as fossilized indicator of cultural identity, whereas 30 years ago style revealed adaptive cultural systems (Conkey and Hastorf

1990:8). By the mid 1980s and early 90s scholars recognized that "material culture is nowhere near as simple as it once seemed to be" (Arnold 1991: 345). I begin my overview with a discussion of design style, or "active style", those components archaeologists assume producers deploy for communicative purposes. I then move to examine the notion of technological style and "micro-style", the potentially non-discursive aspect of pottery production. I suggest that technological style is particularly appropriate for analyzing the subtle technological variability throughout the Late Formative Period, and micro-styles may be the manifestation of subtleties in ceramic production across the Titicaca Basin.

It is important that we uncover the processes behind both design and technological style. My strategy follows in the footsteps of previous scholars (Crown 1999; 2002; 2007; Dietler and Herbich 1998; Friedrich 1970; Hill 1970; Longacre 1970) and examines issues of learning. As Gregory Bateson (1972) reminds us, "all species of behavioral scientists are concerned with 'learning' in one sense or another of that word". Bateson's words resonate throughout the debates on style, and learning is a useful conceptual bridge for my larger narrative of prehistoric daily practice. The scholarship on learning and embedded practice, from the disciplines of anthropology, psychology and education is particularly rich for considerations of craft production. This research, which examines the relationship between cognition, inter-subjectivity, artifacts and identities, suggests that learning is central to the cycles of social reproduction. I have found that Jean Lave and Elliot Wenger's work on "communities of practice" offers particularly useful conceptual tools to consider the manifestations of design, technological and micro-style.

This approach is also an appropriate jumping-off point for exploring variability in consumption. Changes in technological style can be due to non-discursive slippage or changes in learning patterns, but other shifts may be due to changing consumer values and needs. I suggest that pottery, as a socially flexible medium, may be differentially stressed at particular moments over the *longue duree*. At some points pottery may indeed be central to the construction of (elite) personhood and have a central role in Titicaca Basin sociopolitical development, as the bird's eye narrative suggests. This concern with value and consumption clearly does not *necessitate* a "learning model". However a communities of practice approach, broadly construed, is about shifting participation, and learning constitutes changes in knowledge and practice. This makes considerations of learning appropriate across a range of social acts, including political and ritualized practices such as the hypothesized feasting events of the Late Formative. Consumption practices are clearly changing through time on the Titicaca Basin, and it is likely that there are different participants using pottery in a wide variety of ways through time. Rather than assuming a decorated pot represents a particular strategy by a group of elite and competitive actors, I "look up" through the Late Formative. I end the chapter with a discussion of "embededdness" and the "taskscape", two concepts useful for investigations of pottery production and consumption within wider social practice.

3.1 A short overview of style

3.11 Active style: Design, social interaction and information exchange

I have divided my consideration of style into three components: active style, technological style and micro-style. These notions of style are the product of particular developments and debates in Anglo-American archaeology in the past 40 years, but all three are broadly concerned with defining social boundaries. The investigations into the nature of style can be traced back to the 'ceramic sociologists' interest in the relationship between ceramic design and social structure (Arnold 1984; Deetz 1965; Hill 1970; Longacre 1970). The common position was that similarity in artifact design is correlated with the degree and duration of social interaction between groups; if two groups interact socially, their pottery design styles become increasingly similar over time.

For example, Margaret Hardin (1970) argued that design structure reflects the intensity of potters' interaction patterns. Design elements and their configuration may diffuse through a community quickly with very little social interaction. However, structural analysis revealed patterns varying along the axis of social interaction due to family or community affiliation. Many of the assumption of the ceramic sociologists were revealed through equally productive critical responses (Allen and Richardson 1971; Stanislawski 1969, 1973) and catalyzed further detailed examination of style through the 1970s and 80s. Debates raged over the communicative aspect of material culture. Do objects communicate? Are there rules or laws in the communicative process? Does material culture communicate actively or passively? Or more importantly, to whom is the style signaling, and what is being signaled (Sterner 1989)?

Martin Wobst (1977) used such questions to explore the role of material culture in information exchange. He argued that artifact 'messaging' was used not only to display social group membership, but also to demonstrate a willingness to conform to the norms and ideology associated with a given group (Wobst 1977: 327-8). Wobst believed that style 'affixed' messages to artifacts through style giving it a higher "cost of emission" than other modes of communication. For Wobst, the deployment of style requires a commitment and a general interest in the longevity of the social signal. Furthermore, style is directed at people a certain distance away from the producer, otherwise it would not be worth the effort. Wobst (1977: 322-330) thus argued that style was effective in communicating social boundaries. Some scholars have questioned Wobst's active style, in particular the dichotomy between "style" and "function". A focus on the cost of style only works if it is viewed as an additive process (like decoration on pottery) requiring more energy than required for the basic form (Dietler and Herbich 1989: 156-157). Nevertheless, many (including Titicaca Basin archaeologists) have taken designs, morphological features, and other visible attributes as constituting "consciously emblemic messages of ethnicity, and from the archaeologist's point of view, convenient means for approaching social boundaries" (Gosselain 1998: 81).

Polly Wiessner's (1983) take on Wobst's communicative style model is a much more dynamic approach to social identity and intragroup and intergroup relations. Wiessner, like Wobst, stressed the active nature of style. Her *emblemic style* has a specific social referent and expresses information about social group identities and boundaries (her example is a football team emblem). Wiessner applies her *assertive style* when referring to individual expressions of individuality (such as clothing style) and skills (Wiessner 1990: 108). Wiessner's study of San projectile point styles finds that both emblemic and assertive styles contain information about the existence of groups and boundaries, rates of interaction, the nature of social relationships and the balance between expressions of personal and social identity through time (Wiessner 1985: 164).

A particularly important insight is that variation is particularly pronounced at intersecting social boundaries (see also Hodder 1979).

The focus of these scholars on the active components of style, particularly on design style, led many ethnographers to present cases where design style did not communicate, at least in the implied discursive sense (Herbich 1987). In response James Sackett (1977; 1990) offered both active and passive types of style. Sackett's *iconological style* is purposeful social signaling, functioning symbolically to identify human groups (Sackett 1982: 80). His *isochrestic variation* is a passive form of style, whereby producers choose between equally viable options. These choices are constrained by the technological traditions where producers are enculturated (Sackett 1990: 33). In this model function and style are complementary and both result in stylistic variation (1982: 68). Sackett's idea of isochrestic variation, in particular, has been viewed as complimentary to ideas of technological style (Dobres 2000; Pfaffenberger 1992). However, much of the work on technological style has developed out of the work on the anthropology of technology, the French school of *techniques et culture*, and, more recently, practice approaches to agency and technology.

3.12 Technological style: What about Choice?

The concern with technological choice, central to Sackett's work on isochrestic variation, was perhaps best articulated by the French school of *technique et culture*. French anthropologists and archaeologists, most notably perhaps Andre Leroi-Gourhan (1993), drew upon ideas developed by Marcel Mauss (1935). Mauss' contribution to our understanding style cannot be overstated, in particular his view on techniques, "ways of using the body", and his argument for the study of "total man". He argued that social scientists should observe technical activities in their totality, as a process, and their relationship to other cultural processes. While the approaches that developed in France varied somewhat (Creswell 1976; Lemonnier 1986; 1992; Schlanger 1991), they all build upon Mauss' work, and stress the idea of choice of "different ways of doing the same thing" (Lemonnier 1983: 17). These perspectives are clearly appropriate for considering technological practice. The relationship between raw materials, tools for manipulation, gestures and movements are organized in an operational sequence (see chapter 6), and a sphere of knowledge. Lemonnier argues that these techniques are social productions, and there is an "objectification (in the sense of 'put into object') of what are socially elaborated thoughts" (Lemonnier 1990) (Lemonnier 1990: 27). In stark contrast to cultural ecological approaches (Arnold 1985), in this approach there are no external constraints strong enough to dictate a particular technological system (Gosselain 1992a: 560). These scholars also reinforce the importance of the body in considerations of technology and style, an issue I will return to shortly.

While French anthropologists and sociologists were stressing the social totality of technological practice, American anthropologist Heather Lechtman was making a similar argument. For Lechtman technological style includes the traits, including form, function and decoration that are embedded in a particular technological system. Lechtman argued that it is the "synthesizing action of the style, the rendering of the performance, that constitutes the cultural message" and "the relationships among the formal elements of the technology establish its style, which in turn becomes the basis of a message on a larger scale" (Lechtman 1977). Lechtman noted that practical knowledge of technical processes were not divorced from the larger social context and belief systems.

She demonstrated that Andean metallurgy could only be understood within the larger symbolic system. Key technologies associated with cloth and metal production shared stylistic modes since they were expressions of cultural ideals, incorporating ideological concerns of the larger society (Lechtman 1993: 273). In this way, Lechtman catalyzed archaeological considerations of the ideational perspective on technology and the social role of technology (Hegmon 1998: 267-268).

While the French culture and technique school and Lechtman's technological style differ in many regards (see Dobres and Hoffman 1994 for a comparison) neither see artifacts as a passive reflection of social life. Rather they see artifacts as "an active constitutive feature of human life" (Conkey 1991: 71) and take a more performative view of social relations. This results in several important reorientations that shift our focus from statics to dynamics (van der Leeuw 1994: 135). To summarize:

1. Objects are active in creating identities, rather than reflecting them or simply affirming them.
2. Choices here are not constrained; instead cultural context, natural environment and overt social signaling frame particular technological choices (Chilton 1998: 133-134). (see discussion below on embeddedness and the taskscape).
3. Technological style is concerned with the activities themselves – 'ways of doing' – as much as the artifacts themselves. Technological style is the result of the repetitive gestures activities associated with everyday life.

For tracking the variability in pre-historic craft production, technological style can be particularly useful for considering non-discursive components of style (those so-called passive styles). Dietler and Herbich (1989), for instance, suggest that potters make their stylistic discriminations not simply on design style, but “on the basis of a sort of intuitive multivariate analysis”. They suggest that subtleties such as the color of the fired clay, shape of rim or the particularities of morphology may, in fact, be more important that the decorative motifs applied (Dietler and Herbich 1989: 157). This idea has been supported by a multitude of ethnographic and ethnoarchaeological studies. As Stark has recently noted, this technological approach may be more productive in finding social boundaries than those relying on design style: “Adopting a technological approach to understanding material culture provides a more holistic perspective than do conventional stylistic frameworks used in archaeology. These goods, precisely because of their vernacular qualities, may be more indicative of some types of prehistoric social boundaries than goods that people consciously manipulate for conveying social information, the content of which the archaeologist can only approximate” (Stark 1999: 27).

3.13 Habitus and Micro-Style

Technological style still does not resolve the important and problematic dichotomies of active versus passive style, of communication versus signification and intentional versus unintentional practice (Dietler and Herbich 1998; Joyce 2004; Knappett 2005; Pauketat 2000a). By the late 1990s the debates on style in pottery production began to converge with the theoretical/ methodological issues of practice (Hegmon 1998; Stark 1998, 1999). A number of scholars have applied this practice approach to pottery in a wide variety of ways to explore issues of structure and agency, the dialectic that serves the basis of much of practice theory. Some argue that the details of the production of an individual pot is the playing out of this core dialectical relationship, with the act of pottery production an act of agency within a particular design style, or structure (Hegmon and Kulow 2005).

This approach has been particularly useful in thinking about larger ceramic assemblages and ceramic styles through the idea of the *habitus*. Bourdieu's idea of the habitus stresses unspoken shared understandings rather than explicit rules, those durable dispositions of practice. It is from the habitus that techniques involved in craft production develop (Dietler and Herbich 1998: 246). When components of the habitus are brought to the discursive sphere, through heterodoxy, they can be questioned, manipulated and subjected to multiple interpretations. Ethnography suggests that pottery production can be located in either unquestioned states or open to active dialogue and innovation (see below), and one would expect for craft production, along with other types of embodied and materialized practices to move along such a discursive/non-discursive continuum. The materialized traces of such movement are the basis for the archaeological phases of the Formative Period in the Titicaca Basin (Roddick and Hastorf in press).

Dietler and Herbich (1998) suggest that technological style can benefit from practice theory. Rather than viewing style as a simple correlate of self-expression, they see it as the nexus of joint activity, of shared understanding. Dietler and Herbich examined potter communities and noted that the interaction among potters had an important role in determining the material patterning. Such communities did not live in bounded groups, but made similar choices, resulting Dietler and Herbich call *micro-styles*. Micro-styles are the result of distinct differences in the manipulation of materials, tools and gestures derived from particular groups of potters, which developed within learning patterns personal interaction among potter communities (Dietler and Herbich 1989: 150). Research demonstrates that micro-styles, and particularly those that indicate social identities, are more often linked to technological choices, rather than design style (Childs 1991; Chilton 1998; Dietler and Herbich 1989; Gosselain 1992a; Lechtman 1977; Pfaffenberger 1992; Sterner 1989). While ultimately not resolving the essential relationship between social identity, intentionality and style, practice theory can offer an important crack in the door. I will return to the advantages of this joining of technological style with the notion of the habitus to explore social boundaries below.

3.14 The basis of style: Futility or archaeological necessity?

While there have been few publications explicitly dealing with style in the past decade or so, the underlying issues and debates have not been resolved. Clearly there are some deep philosophical problems with style, and its association with the Cartesian mind/body dichotomy (Boast 1998). I argue that we should not throw away all the valuable work conducted on this topic. In many cases research into design style and the maintenance of social boundaries may be productive. Design style signifies group identity indexically in many parts of the world (Bunzel 1972; DeBoer 1984), and Janusek (2002,2004) and Goldstein (2005) are both persuasive in their position on the significance of design style during Tiwanaku periods. However, it is not so clear that this indexical value of designs plays a similar role for the earlier Formative periods, where design elements are not so elaborate or regionally patterned. Are we simply projecting the social role of decorated ceramics back in time by prioritizing design style? Is design style used to signal during the Late Formative period? I will return to this question in later chapters, and briefly to design style in regards to situated cognitive approaches below.

The design style literature, whether historically framed within culture historical, processual or postprocessual moments, tends to see decoration as text to be read. This perspective, as Dietler and Herbich (1998: 243-244) have pointed out, is problematic. As a theoretical foundation the work on technological style (from the anthropology of technology, the French school and practice theories) is clearly more robust than the earlier work on the active components style. An approach that foregrounds an embedded social approach to craft production, embracing ideas of materiality, is productive both in cases where producers are overtly signaling and when they are not. In order to truly investigate the significance of style to identity we need to delve a little deeper into the complexities of daily life. To do so, we need to examine learning, the major commonality that runs across all previous work on style. A consideration of learning is essential to disentangle the relationship between material culture variability, social boundaries and larger sociopolitical context. Design styles are only passed on from mother to daughter by learning and technological styles and their symbolic significance is a process of learning. And micro-styles can only be investigated through a consideration of learning communities. Learning is an essential theoretical foundation for those concerned with daily practice and craft production.

3.2 Learning

Ethnographers and a small number of archaeologists have actively engaged with issues of learning, identity and materiality. One needs to look no further than the titles of some recent Andean ethnographies to spot this close relationship: Bill Sillar's (2000)

"Shaping culture: Making pots and constructing households" or Elayne Zorn's (2004) "Weaving a future: Tourism, cloth and culture on an Andean island". Ethnographers and archaeologists have examining learning and craft production in a variety of cultural contexts, exploring both the individual level of learning all the way to the relevance to wider cultural practice. Scholars have paid particularly close attention to both apprenticeship models and situations involving more informal, observational learning. In fact, most of us do our learning by doing without teachers, or more eloquently, "we grow into knowledge rather than having it handed down to us" (Ingold and Lucas 2007: 288). Ethnographies of ceramic production offer many examples of such learning processes.

In his rich ethnography of African potters, Krause (1985) notes the embedded nature of craft learning. Here a number of practices and values, including gender relations, are learned by way of observation and participation. He writes of a young boy and girl watching a woman named Mutshekwa forming a pot. Eventually they pitch in to help:

> After several interruptions she stood up and paused for about 3 minutes to exhort the boy to "stay away from women's work" and to encourage the girl to experiment with some of the clay. I took this opportunity to ask her how long she had been making pots and who taught her. She did not know exactly how long she had been making pots. In her own words, "I've made pots too long to remember when I learned." She was, however, emphatic about how she learned. "We don't teach. When women make pots some (children and others) come to watch, then go and try." …The little girl was learning the same way she did. As I could clearly see, no one was teaching her." (Krause 1985: 95)

In some cases archaeologists have attempted to find evidence of such processes in the past, opening their interpretation to explore the actual learners in prehistory (Ingold and Lucas 2007; Kamp 2001; 2005; Lopiparo 2006; Minar 1999; Sofaer Derevenski 1994;

Sofaer Derevenski 2000). For example Kathryn Kamp (1999; 2001), working in the Sinagua area of Northern Arizona, found fingerprints on objects to indicate that children were making pots. Kamp draws on van der Leeuw's (1994) cognitive concepts essential for the manufacture of ceramics (discussed further below) to argues that children will make pottery at different ages depending on cognitive development. She develops this idea to explore the necessary skill levels to create particular vessels and finishes (Kamp 2001: figure 1). She finds that Sinagua children were learning by observation, but also by manufacturing 'play things' of clay, namely figurines and small vessels.

John Robb's (2007: 176-177) analysis of ceramic attributes on an Early-Middle Neolithic bowl fragment was also able to track a particular learning process. Robb notes that the thickness of the vessel along with the lumpy surface and "imprecise" and "ungrammatical" designs all suggest that the bowl was created by an apprentice. This learner was likely working alongside an expert, as the paste is identical, the design required similar stamp tools, and most importantly, the vessel was fired. "All of these give the impression of someone working alongside experienced potters who gave him or her a lump of clay, passed tools around, and included the bowl in their firing" (Robb 2007: 176-177).

These studies are extremely thought provoking for considerations of learning, daily practice and craft production, yet perhaps not directly applicable to our problem of social boundaries. For an ideal and extremely interesting case of social boundaries and learning we can turn to Steven Shackley's (2000; 2003) study of cultural identity and lithic technology. Shackley studied the learning patterns and social identity (ethnicity) of Ishi, 'the last Yahi Indian', through analysis of stylistic attributes of projectile points Ishi produced both prior to and after his arrival at the University of California. While Ishi spoke Yahi, he physically appeared to be Wintu/Nomlaki. Shackley found that Ishi's projectile points were identical (statistically and observationally) to Wintu/Nomlaki style. While Ishi never explained who taught him his skills, Ishi described how men would assemble "in a circle in a warm sunny place" to make projectile points. "Producing arrows in a group may have served to standardize point and arrow styles such that a Yahi point style was readily distinguishable from a Wintu/Nomlaki style" (Shackley 2003:189). Shackley thus finds a complex case of an individual learning during a time when social boundaries were undergoing great upheaval: "a Wintu/Nomlaki-Yahi boy [who] learned to produce projectile points as a Wintu/Nomlaki but lived the life of a Yahi in the Lassen foothills until no more Yahi remained" (Shackley 2001: 193).

The examples above all present an exciting engagement with the topics of learning and apprenticeship (Coy 1989). Nevertheless, in most archaeological settings there remains a tendency to see learning - or what is often called either acculturation or socialization - in a passive way and in contrast to "formal socialization" (Smith 2005). These normative approaches assume that learning is the same as socialization, or the acquisition of a stock of knowledge about proper ways to think, feel and act. Specifically with socialization models "learning entails the transmission of culture, a mental code or script that exists prior to and independent of human activities, a recipe for action analogous to a book of grammar or a dictionary" (Palsson 1994: 903). This normative approach, or the "culture of acquisition" (Lave 1990), stresses the separation of learning from doing and the presence of cultural rules. A different approach would see cultural rules of how to pot "like a map of unfamiliar territory, which can be discarded once you have learned to attend to the features of the landscape, and can place yourself in relation to them. The map can be a help in the beginning to know the country, but the aim is to learn the country, not the map" (Ingold 2000: 415). Learning, in fact, is about throwing away the map, in cases where strong rules of potting exist, or in more non-discursive situations, never having the map in the first place.

There are a variety of theoretically informed approaches that may be appropriate to avoid the normative underpinning learning, and yet still engage with some of the important work of the style scholarship. The literature on situated learning (or situated cognition) is a particularly important bridge from styles sedimented in material culture, to the larger social contexts in which they were (re) produced. Situated learning scholars argue that learning is embedded in all social practice. If this is true, a consideration of style, and by correlation learning, may aid in both defining social boundaries and revealing larger social processes. I now turn to the recent literature on learning with the purpose of developing a more holistic framework to consider pottery styles, social boundaries and greater Late Formative society.

3.3 Cognition in practice: Models of situated learning

> "The archaeologist who is searching for the ancient mind behind the prehistoric tool is committing the same 'category mistake' as the foreign visitor at Cambridge who having seen the colleges, libraries and departments asks to be shown the University. There is no mind apart form the world…just as there is no University apart from the colleges and departments." (Malafouris 2004: 59-60)

In both cognitive science and many early sociological and anthropological approaches to learning the role of artifacts, other participants and the general social context of cognition are often ignored (Hutchins 1995). There is a scholarship, broadly defined as "situated learning" or "situated cognition", that is working to re-position learning and cognition in the social world. Situated cognition is a movement that initially developed in cognitive psychology but draws on a number of theoretical traditions. These cognitive approaches against mind body division, at times called embodied, extended, enacted, distributed or mediated (Malafouris 2004: 57) includes the work of Toren 1999, and particularly Ingold's (2000) work on enskilment (within his dwelling perspective). This broad literature on situated cognition, while varying, would certainly benefit many archaeologists, as noted recently (Renfrew et al. 2008). The ideas developed under this rubric offer fresh perspectives to archaeologists concerned with learning networks and material culture. While I draw here on one particular strand of this intellectual tradition (Engestrom 1999), it is worth briefly noting its foundations, which are primarily based in activity theory.

Activity theory was a response to the purely mental perspectives on cognition that developed in the early 20th century, and attempts to transcend the dualism between subject and object, nature and society. Based on the early work of Marx, activity theory evolved in the 1920s and 30s in the work of Russian scholars Lev Vygotsky, Alexander Luria and Alexei Leont'ev. Vygotsky founded the school of cultural-historical psychology as a reaction against psychoanalysis and behaviorism, and suggested the concept of artifact-mediated and object-oriented action (Vygotsky and Cole 1978: 40). Vygotsky saw the interaction between social sources (e.g. others, artifacts and symbols) as the basis for cognition. Leont'ev's work shifted focus away from the individual to the collective activity system. More recent work has acknowledged cultural diversity (Cole 1990) and has drawn on Bruno Latour's actor-network theory (Engeström and Escalante 1996) and

Bakhtin's (2006) work on dialogism.

Both situated cognition and activity theorists express dissatisfaction with how cultural contexts are treated as "containers" of behavior, untouched in themselves by human action or as contained within interpersonal interaction. As Jean Lave puts it, and reflecting a similar longstanding issue in anthropological archaeology, "one has system without individual experience, the other experience without system" (Lave 1988: 150). In general, activity theory is one approach to examine how practices shape both thinking and future practice. Or put another way, activities structure cognition (Rogoff and Lave 1984).

Activity theory and practice theory are linked by several themes. Both emphasize the dialectical character of the fundamental relations constituting human experience. And both shift the boundaries of cognition and the environment such that cognition "is stretched across mind, body, activity and setting" (Lave 1993). The work of Lave in particular has stressed that cognition does not occur in the head, but rather is the result of the ongoing relationship between persons and the world.

3.4 Communities of Practice

In a highly influential 1991 monograph "Situated Learning: Legitimate Peripheral Participation", Jean Lave and Elliot Wenger synthesized their thoughts on cognition in practice. Lave and Wenger's idea of learning negotiates structuralist and interactive modes of analysis. Structuralist approaches see all social practice as evidence of underlying systems (or structures) with learning as the acquisition of a structure. An interactive viewpoint would completely reject this position. Lave and Wenger's work suggests a more adaptive structure that is an outcome of action, and may be “reconfigured” in the context of action (Lave and Wenger 1991:17-18). They suggest that learning is firmly embedded within the larger social world and that learning is not only situated in practice rather it is an ”integral part of generative social practice in the lived in world” (Lave and Wenger 1991:35).

Their model is a process-based approach with learning occurring within “legitimate peripheral participation”. They explore the entanglement of activities, identities and artifacts, the relationship between newcomers and old-timers, and, in particular, between communities of knowledge and practice (Lave and Wenger 1991: 29). Peripheral participation specifically focuses on the process by which newcomers slowly become integrated into a particular community of practice (Lave and Wenger 1991: 29). A community of practice is defined as a web of relations among persons, activity and world, over time and in relationship with other tangential and overlapping communities of practice. Their use of communities of practice does not necessitate co-presence, a well-defined group, or socially visible boundaries (Lave and Wenger 1991: 98). This is important in the context of how community is envisioned in archaeology (see chapter 1). Here the term “is a set of relations among persons, activity and world, over time and in relation with other tangential and overlapping communities of practice” (Lave and Wenger: 98).

A community of practice, then, is not simply restricted to clear cases of training or apprenticeship; rather it is found in a variety of everyday activities and situations where a skill can develop sufficiently for a certain kind of performance. It is a framework where skills are learned through both an *education of attention* and active participation. An education of attention, following Gibson (Gibson 1979: 254) and Ingold (2000:354), is when "each generation contributes to the next not by handing on a corpus of representations, or information in the strict sense, but rather by introducing novices into contexts which afford selected opportunities for perception and action, and by providing the scaffolding that enables them to make use of these affordances" (Ingold 2000: 354). In our own experience, the scaffolding within a particular community of practice can be found in bands rehearsing for weddings, recovering alcoholics going to weekly meetings, scientists in laboratories corresponding with colleagues, and computer users in an office working on obscure systems (examples from Wenger 1998: 6-7). In short, any interactions initially involving limited, but highly asymmetric forms of co-participation (Lave and Wenger 1991: 18). Lave and Wenger are suggesting that it is possible to delineate the community by analyzing the reproduction cycles involved in their relations.

The activities, tasks and functions that occur within a community of practice, such as those involved in pottery production, do not occur in isolation. They are parts of broader systems of relations, loaded with meaning:

> "The person is defined by as well as defines these relations. To ignore this aspect of learning is to overlook the fact that learning involves the construction of identities…We conceive of identities as long-term, living relations between person and their place and participation in communities of practice. Thus identity, knowing, and social membership entail one another"
> (Lave and Wenger 2005:152-153).

We have thus arrived at one of the great strengths of this approach for research into prehistoric communities and material culture: a linkage from activity and tasks, to relations, and the construction of identity. Somewhat like Bourdieu's (1977: 35) practical kin, identities within particular communities of practice “are something people make, and with which they do something”.

Bourdieu’s practice theory and Lave and Wenger’s model are often commended for strong theories of cultural reproduction, but critiqued for their weak explanations for cultural transformation and power dynamics (Kristiansen and Rowlands 1998: 15-22; Linehan and McCarthy 2000). Both frameworks are indeed less focused on power than more deterministic approaches to agency (Joyce and Lopiparo 2005), but neither is blind to power relations. Recently Linhnean and McCarthy (2000) have explored power and communities of practice by considering discursive positioning: “…Becoming in community invokes both manipulated and manipulating self, and a space shaped by conflicts and tensions between them which creates moments of identificatory possibilities. These are moments in which a person engages with the activity or practice but tends to withdraw from identification, is becoming “part of” but at the same time recognizes a sense of being “different from”” (Linhnean and McCarthy 2000: 440).

Lave (1993: 15) responds to these critiques by pointing out the contractions, tensions and power relationships that must be negotiated within particular communities of practice. Lave and Wenger (1991: 35) stress that there is neither central participation, nor homogeneity across any given community of practice. A given community of practice will be heterogeneous as some people will have different knowledge and different goals, and relations of power will develop and be reinforced within a given community of practice. (Lave 1992: 14-16). It is a heterarchical notion of power dynamics, in that these relations will develop within, but also independently, of a range of different power relations. While participation is a way to belong, it does involve a certain degree of foot dragging, and other “weapons of the weak” (Scott 1985). Anyone who has spent any time on an archaeological project can relate to such a perspective - there are times when you are simply not in the mood to wash artifacts, draw the minutiae of a plan map or back-fill.

Thus far I have stressed the “doing” of community of practice, and less the “thingness” of communities of practice. Clearly we need to emphasize this aspect in order to develop a practical approach to prehistoric community, learning and social boundaries through artifact patterning. Lave and Wenger do not ignore materiality. For them the cycles of social reproduction are productive; that is to say they leave traces of artifacts, including physical, linguistic, and symbolic, but also social structures, which constitute and reconstitute particular practices over many generations (Lave and Wenger 2005: 155). Wenger (1998: 57-62) refers to reification as the process by which members of a particular community of practice give form to their experience by creating object, the solidification of community into “thingness”.

3.41 Peripheral participation, identity and cognition: Some examples

It may be of use to examine some examples of communities of practice, before looking to see how, exactly, these ideas can be further explored in prehistoric craft production. While my concern in this dissertation is with communities of craft production, and the varying associated communities of consumption, it is important to note that there were likely many arenas in which communities of practice could (and did) emerge. We can effectively use these ideas to explore a range of practices if we accept that all knowledge is situated. Below I will make such an argument for the consumptive, and possibly politicized moments in pottery's use life. It is therefore worth examining learning and communities of practice within ethnographic cases of political practice.

Take, for example, Astvaldsson's (2002) work on ritual power and learning. His study in the Highland Andean community of Titiri explores the distinction between ideal structures of knowledge and real practices. Astvaldsson finds that the basic knowledge about communal practices, such as socio-political and ritual practices are preserved and spread through active participation rather than abstract notions (Astvaldsson 2002:112-114). In fact, learning political and ritual actions is learned on the periphery, and embedded in both the social contexts of the village and other communities of practice. Children begin to learn skills while accompanying and helping their parents and other relatives with daily tasks such as herding and domestic work. "Later, agricultural tasks alongside socio-political and many other skills were learned in a similar way, through active participation and experience." (Astvaldsson 2002: 113) Astvaldsson clarifies his argument through a thick description of the social and ritual practices called the *chhiphina* sequence. This sequence of steps defines the shift from adolescence to adulthood, but also highlights peripheral participation in a community of politico-ritual practice:

> "The term *chhiphina* describes a prolonged trial and transitory period for newly 'wedded' couples. During this time they as individuals and their relationship as a social unit had to undergo the scrutiny of their families and community, and they had to prove themselves as responsible community members. They built their own house, broke in their fields, harvested their first crops and most probably had their first children, and so on. They also served their families, authorities and community by helping out with the tasks of everyday life and participating in the all-important fiestas. In the process, they learned to show commitment to the interests of their community and respect for the deities who influenced and protected its welfare, and from whom the men received their right to govern when they were initiated into office at the end of the *chhiphina*

> sequence." (Astvaldsson 2002: 121)

While such Andean ethnographic examples are particularly evocative with their 'exotic' settings and the particularities of a given practice, we are all actively engaged with multiple communities of practice. Archaeologists are especially attune to these issues since we are concerned with the source of variation in the past, but also because our own social identity is the result of learning through peripheral participation and rites of passage into particular communities of practice. By looking at our own involvement in multiple practice-based communities we can see the multiplicity of identity and cognitive aspects surrounding shifting participation. For example, my identity is a product of my peripheral (and increasing) participation in a wide range and number of communities, including field and laboratory archaeology, the online *flickr* photography community, and my earlier participation in competitive sports and skateboarding.

The process of entering a community of practice as a peripheral participant is painfully reminiscent of my efforts to become a ceramicist on the Taraco Archaeology Project (Steadman 1994, 1999; See also chapter 5). As mentioned in chapter 1, I began my involvement with my master's thesis without personal interaction with Lee Steadman. I could not make heads or tails of Steadman's paste analysis system: there was no education of attention, and instructions on a page did not seem to sink in. I then conducted two summers in the laboratory working alongside Steadman, learning her system of ceramic analysis. This process of enskilment (Ingold 2000: 416), is a classic case of peripheral participation:

> "Enskilment in fieldwork inevitably involves psychosomatic processes, if not veritable 'gut reactions'. Fieldworkers usually begin their 'trip' on the margin of the community, nauseated by their novice status. As they become increasingly involved in and knowledgeable about the activities

> of others, they move towards the centre and begin to feel 'at home', in both their bodies and the company of others." (Palsson 1994: 902)

Although Steadman had trained various students in portions of her system (primarily cataloguing and drawing sherds), she certainly had never had to train anyone in the entire system. While participating in her system I worked from the periphery: I observed, participated and questioned various aspects of her system, bringing her repeated and non-discursive process to the surface. Often I didn't see what Steadman saw through the 10x hand lens. Nevertheless, as I went through a process of legitimate peripheral participation, I took on little pieces and bit-by-bit the logic of her system became clear to me. The active peripheral participation have certainly morphed my identity, but not only because I call myself a ceramicist (rather reluctantly!) This process has had a cognitive effect on how I see and interpret ceramics, potentially tuning me in to both potter's cognitive elements (see below) but also the minute detail of a number of *potentially meaningless* attributes (see Chapters 6 and 7).

Activities within particular communities have a long lasting cognitive effect on how we see the world. Archaeology has had a pronounced affect on how I look at road cuts, how I feel and interpret textures of materials and have brought modern garbage disposal out of the non-discursive sphere (Malafouris 2004: 58). These cognitive effects, which are central to my identity, are not completely reliant on continual active participation; they are intimately attached to my experience of the world through artifactual engagement. For example, I still experience the urban landscape as a skateboarder even though I have not participated in this subculture in several years. I see skateboarding opportunities while walking with colleagues in new cities at conferences, almost as if the skateboard was under my feet. Due to my situated learning from my early teenage years through my late twenties, I see and experience the world differently that non-skateboarders. (See Borden (2001) for how skateboarders differential experience urban environments and Grasseni (2007) for an interesting corollary on communities of breeders ways of "good looking"). And even though I am not actively participating myself, the community of practice – including the identity, ways of moving, dressing and seeing the world – is being replicated at local skateparks, through a range of both inter-subjective and artifactual interactions in online forums, print magazines and fashion trends.

Ceramic ethnographers, of course, have tracked many cases of such peripheral participation and education of attention. Much like Kraus' ethnography, Dorothy Hosler (1996) also observed the children of the Andean settlement of Las Animas learning pottery by observation. Here the children and adolescents practice in secret, and only invite themselves into the workshop of a nearby relative when they are feel they are competent to enter a particular community of practice (Hosler 1996:73). The variability in Las Animas learning communities, here divided on moiety lines within one village, created visible micro-styles in terms of productive attributes.

But these micro-styles are only the materialized remains. There are likely differential cognitive effects between communities of potters as well. van der Leeuw's work on cognitive development, particularly in terms of topology/shape, partonomy and sequence, is a more detailed conceptual approach to the development of potter cognitive development. Topology refers to how potters conceptualize shapes – whether shapes are seen as horizontal or vertical, whether vessel forming is about the transformations of a sphere or a cylinder, and how the outside and inside of vessels are conceived. Partonomy refers to how a potter divided the conceptual space of the vessel. And sequence is the order in which potters organize the necessary steps of production (van der Leuww 1993: 257-258).

In summary, the ability of communities to reproduce themselves, whether in the political spheres of Andean communities, the ceramic laboratory, youth sport subcultures, or potters workshops, relies on the maintenance of certain modes of co-participation. These communities of practice are essential in forming identities and values, but also have cognitive affects on how we each experience the world. While archaeologists cannot *directly* access such experiential moments, we can track how experiential clusters changed through time. Such a co-participation framework is well suited for a narrative focus of daily practice and social boundaries. Pottery production is a tacit and embodied knowledge (Hendon 2007) that is, like any form of social practice, learned in a community of practice. From this perspective, technological style, and the resulting micro-styles of particular communities of potting practice, are more than simply indicative of social boundaries. I suggest that the situated learning literature can: 1. Help with time/space systematics and fleshing out ideas of ceramic traditions 2. Navigate issues of prehistoric agency, identity and scales of analysis, and 3. Stress the embodied nature of social practice and craft production.

3.42 Seriation, traditions and constellations of practice

Lave and Wenger's model speaks to issues of time-space systematics. Rather than assuming that traditions are widely shared and change at a slow pace, an approach on learning examines the processes behind these subtle shifts (see chapter 5). The idea of legitimate peripheral participation "derives from the richness of its interconnections: in historical terms, through time and across cultures" (Lave and Wenger 1991: 39). The notion is diachronic and cross-cultural. Communities of practice are shared histories of learning (Wenger 1998: 86) and include the dynamic notion of the habitus and Pauketat and Alt's (2005) archaeological version of "genealogies of practice". These genealogies, or histories of practice, can be compared in great empirical detail (Pauketat and Alt 2005: 230). An archaeological seriation from the perspective of a community of practice would begin with the acknowledgement that a single attribute may vary for a number of reasons - from ecological constraints on the materials and method, to the greater social and political pressures and possibilities.

From such a perspective, the ability of a community to reproduce itself - in this case maintain a ceramic tradition - relies on the maintenance of certain modes of co-participation. Thus tradition needs as much explanation as change, since learning is no longer viewed as simple transfer or assimilation (Lightfoot 2001; Pauketat 2001). But what is the scale of a community of practice? It may not directly relate to typical archaeological units of villages, cultures or ethnic groups (Stark 2006: 25-26) since particular practices may be shared across such boundaries. While face-to-face interactions lie at the center of most informal modes of learning, the scale of relationships can vary across geographic distances (Frankel 2003: 44). But ceramic seriations are based on change, as much as continuity. Dietler and Herbich (1989: 161) note that changes in design styles happen within the greater production sequence, but must be accepted by a community of potters. They have found that innovations with Luo communities of potting practice are accepted due to the innovator's personality or due to those practitioners at the periphery (Dietler and Herbich 1989: 161).

In some cases communities of practice may not be the appropriate scale of analysis. Wenger (1998: 127-33, 168-169, 246-7, 256-60) discusses moments where individual communities of practice are joined through larger "constellations of practice". Such constellations of practice may be the result of sharing historical roots, facing similar conditions, having members in common, sharing artifacts, having geographic relations of proximity or interaction, having overlapping styles or discourses and competing for the same resources (Wenger 1998: 127). Constellations of practice may not consist of a discursive element, and it may neither be overtly acknowledged nor conceptually identified/named. There may or may not be an overarching control, people attempting to keep a given constellation together. And finally, the connections that tie a given community of practice together may be intentional, or due to "emerging circumstances" and unintended consequences (Joyce 2004; Pauketat 2000b; Wenger 1998: 128).

Alexandre Livingston-Smith (2000), who has conducted extensive research on the potters of Cameroon, has noted the creation of such constellations of practice through the effect of ruptures in social interaction networks. When population dense areas are bounded (due to natural, political or economic factors), they can create what he calls a regional identity, but could safely be called constellations of practice: "These ruptures – acting as boundaries – appear to be sufficient to confine, or limit, the diffusion of technical knowledge. The identity of the people living in these bounded zones transcends the most classical facets of ethnicity – such as the classical ethno-linguistic or 'tribal' affiliation – to create larger groupings – a regional identity – which, although rarely considered by anthropologists, may well be related to what archaeologists call cultures or techno-complexes (e.g., Shennan 1989)" (Livingston-Smith 2000: 38).

3.43 Agency and Identities

Trends in particular "ways of doing" often do not equate with ethnic identity or even overtly acknowledged cultural fields (Jones 1997: 122-123). Rather they may more accurately correspond to the ever-changing nature of different learning communities. Ceramic analysts have made a similar argument that communities of potters are the proper level of analysis for ceramic analysis rather than the individual (Arnold 1984: 134). For example, Da Cruz's (Da Cruz 2003: 563) recent dissertation on potters in Ghana found that learning networks crossed ethnic boundaries. By the same token, this approach also confronts some of the critiques of individual agency in the past (Fowler 2000). Patricia Crown argues for a community level of analysis in pottery production as there are often "multiple hands" participating in the creation of finished ceramic vessels and it is collaboration (co-participation) that is an essential component of pottery production. In short, "collaboration may be a fairly common aspect of the learning/teaching process in ceramic production… Consideration of the role of multiple hands in producing vessels alters our viewpoint by changing the focus of attempts to identify individual artisans with individual vessels towards situating the individual within a community of producers" (Crown 2007: 678).

What is often glossed as learning involves a complex relationship between artifacts and the creation of the human subject (Barrett 1994: 155), and it in this process that identities are constituted through practice (Lave and Wenger 1996: 147). Anthropologists have come to accept that identity is a relatively fluid property, and individuals and groups maintain multiple social identities at different scales (Barth 1969; Dobres and Hoffman 1994; Moerman 1965; Thomas 1996). Furthermore material culture, in particular pottery, is polysemic: it is encoded with multiple levels of meaning (Miller 1985). Artisans may, in some cases, consciously and discursively forge certain cultural and political affiliations in a communicative manner (emblemic style), but their subconscious practices may support or contradict them, displaying yet another level of identity. Furthermore, it is not always the case that non-potter consumers in a society would be able to identify such pots (Bowser 2000). It is on such grounds that I argue to momentarily separate communities of potting practice from communities of consumption practices (see below).

In their study of West African potters, Gosselain and Livingston-Smith (2005) observed the steps involved in clay selection and processing, noting that these steps were essential to a process of identity formation. While investigating the social significance of paste variation, they found that much of the knowledge for the collection of clays and raw materials occurs in an early stage in the learning process. Individuals learn how to select and prepare raw materials "in a participation framework that involves specific social relationships and is part of the wider process of becoming a community member" (Gosselain and Livingston Smith 2005: 42). This means that particular traditions can neither be separated from interpersonal interaction, nor from the construction of the self.

This interaction among potters has a central role on determining a particular material patterning, but it is important to remember that we are 'made' through a range of practices. Potters have a range of other relationships outside of this particular practice. For instance Cleland and Shimada (1998: 122), find that the Andean Morrope potters are specialist potters since they are skilled in pottery making. But potting is not a full time practice, and they are "potters-cum-agriculturalists or potters-cum-fishermen who have the ability and means to be largely self-sufficient." The archaeological implications are difficult to track within the constraints of typological approaches, where it is assumed that part-time specialists only worked at the household–level of production (Cleland and Shimada 1998: 122).

Those manufacturing ceramics may not identify as potters, since this particular identity may not be the most important in term of overall status (Herbich 1987). Furthermore, as Kostalena Michelaki (2006) has recently pointed out, to make a pot is not the same thing as to be a potter, since a potter requires a community of learners. In fact, as I argue in later chapters, it may be that during the Formative Period that the very idea of potter (the discursive positioning) is emerging just as much as the ever-active and scheming elites discussed in chapter 1. This approach, then, is less an approach on the free floating individual or the potter as proxy for institution, and more about persons in practice, within a particular historical and geographical place. Specific crafting communities are the basis for learning, where practitioners share manufacturing techniques guided by both local tradition and reflect a shared habitus (Gosselain 1998; Stark 1999).

3.44 Hexis and embodied memory

Although we cannot easily directly access the cognitive effects of shifts in prehistoric potting practice (but see Malafouris 2004) we can access those long-term repeated bodily practices, or Late Formative *hexis*. Bourdieu's (1977) hexis refers to the ways people move and position ones body in a lived world and is an essential foundation to habitus, those internalized structures that generate practice, perceptions and actions.

Put simply, hexis is the inculcation of bodily practices. A concern with hexis in prehistoric pottery production is a focus on the learning of motor-habits and muscle memories including posture, gestural movements and handedness. All of these aspects are particularly resistant to change, therefore any automatic, motor skill dependent attributes of a given artifact will be more conservative than any other attribute (Minar 1999; Minar 2001). Potters in particular work in regular ways, to ensure success or to establish a rhythm and momentum within a repeated sequence (Hagstrum 1985: 69). Tool use is also an important part of hexis, as similar tools will be used within a given community of practice related to particular bodily practices. While subtle variability in tools can vary slightly from potter to potter (Gosselain 1992b: 574) and in some cases reliable tools are curated or inherited (Hardin 1977: 118), they are also integrated into the production sequence.

The stability in particular practices makes pottery bodily memory particularly rich for exploring incorporating and inscribing practices (Connerton 1989) from a diachronic perspective over several generations (Roddick and Hastorf in press). Hexis is therefore important in tracking the iterations of micro-styles, since these bodily practices are learned in particular communities of practice. For instance, Scott Van Keuren's (1999) work on brush stroke sequencing in prehistoric Arizona found that while design styles can be copied, the details of manufacture cannot be reproduced exactly outside a given community of practice. Similarly, Sassaman and Rudolphi (2001) constructed kinship and matrilocal residence patterns based on data reflecting the handedness of potters.

Dean Arnold's (1993; 1985) important work in both the Andes and Mexico has also examined the muscle memory aspects of pottery production. Arnold finds that different groups of potters, physically separated by distance, topography, and languages tend to use different fabrication technologies and thus use different motor habits (see also Reina and Hill 1978: 230). Arnold points out two important temporal aspects of muscle memory for archaeological work. First, he notes that such culturally patterned muscular habits are the most difficult part of learning to pot (Arnold 1998: 357). Changes in muscle memory takes a long time, and is most affective in infancy, thus motor habit patterns for pottery may take at least a generation to change.

Second, Arnold notes the effects of moving craft production outside of the household to workshops, where crafting is not learned as effectively. In such cases fabrication techniques would change, in some cases with the creation of molds or the segmentation of tasks. Such a shift would create more visible production context (Arnold 1998: 358). Such appears to be the case for Tiwanaku production, where evidence for molding accompanying new forms has recently been found (Janusek 1999: 114-115; Rivera 2003). Molding requires less skill than virtually any other type of forming technology, and unlike the coiling techniques assumed for the Late Formative (Chapter 7), does not require long periods of learning specific motor habit patterns (see Arnold 1985: 203-208, 1998: 359).

It should be stressed that pottery production here is not simply about the education of attention, or cruder still, the mindless reproduction of particular communities of practice. We must consider moments of intentionality in pottery production, those series of reflective moments of monitoring within a context of tacit practice (Giddens 1979; Lave and Wenger 2005: 153). Hardin (1970) notes potters in some groups actively monitor the steps of innovation, whereas others decode, accept or reject, particular stylistic innovation. Such would be the case in significant shifts in particularly important technological choices in prehistoric contexts. Finally, the hexis of pottery production is not the only bodily practice to be considered when examining prehistoric pottery. Since pottery production is dialectically linked to pottery consumption, and since technological style of pottery is by definition embedded in greater cultural fields, larger social practices must be considered. Below I will return to consider one other small realm of prehistoric practice, that of communities of potting consumption. However, it is important (especially for a ceramicist) to realize that communities of practice revolving around pottery production and use is possibly not nearly as important as practices centered in other non-preserved object worlds.

3.45 Summary: Back to (design) style

Let me summarize the perspective on style I have presented thus far. I began this chapter by arguing that style is essential for archaeologists to access prehistoric social boundaries. I suggested that technological style is advantageous as it engages with 'passive' components of material culture, and it does not segregate productive practices from larger cultural structures; rather these structures both constrain and enable particular choices. I suggest that micro-styles, as a result of learning patterns, are a particularly productive way to track the subtle signatures of particular groups of practitioners. I then examined some work on situated cognition and learning to strengthen our theoretical foundation for learning vis-à-vis style and social boundaries. This literature forces us to reconsider the importance of the material world and the constitution of society.

I want to return to design style now for a moment from a position of situated cognition. A particularly rich case study demonstrates that such 'active' components of style can still be particularly significant, especially when placed in the larger sequence of technological choice. While design style may neither signal directly to a consumer like other forms of communication, nor the way the ceramic sociologists of the 1960s and 70s suspected, design style still sends important messages to the *archaeologist* when placed into a model of situated cognition and daily practice. For example, Ortman's (2000) exciting work on Mesa Verde metaphors finds significant linkages between pottery decoration, baskets and textiles. In particular he finds twenty-five features of pottery decoration that originate in the woven materials. This ceramic design leads Ortman to argue that other aspects of life were also linked metaphorically and linguistically to textiles and pottery, affecting views of architecture and the cosmos. Modern pueblos groups refer to an earth-bowl below and sky-basket above, and kiva architecture is especially significant of this relationship, with its clay walls (pottery bowl) and timber roof (coiled basket).

Implicit in Ortman's argument is the idea that the concepts that form the basis for these ceramic designs exist in a mental template and language *before* being applied materially (Gosden 2006: 435). In contrast, Chris Gosden takes an embodied cognitive perspective to suggest that these forms and decorations could have given rise to mental representations (Gosden 2006: 436). Ceramic design, in this case a pattern derived from skilful practice in another domain, is embedded in larger meaningful practice. Although the decorative design style is not communicating social boundaries, a situated cognition approach would see the significance of decorative style to greater social practice. In fact, design style can be significant of emerging relationships (rather than reflecting pre-existing ones) within larger constellations of practice such as different potting communities within a region or between different communities of practice, such as producers and consumers. Again, it is important to remember that potters may belong to other communities of practice, and are not simply structured agents passively replicating the signature of their political or social affiliation. The implications of such an argument for studies over the *longue-durée* can be further explored by considering consumption

3.5 From communities of production to communities of consumption

In my above discussion of communities of practice I stress those aspects of style resulting from pottery production. Change in technological style is viewed as a change in a group's taken-for-granteds, as pottery production and use is integral to social reproduction itself (Cummins 1988; Hardin and Mills 2000; Jones 2004). My approach has prioritized the technological style generated by potters in their choices made in a particular operational sequence, which is one aspect of practice available to archaeological investigations. But pottery "exhibits a plasticity and flexibility that does not end with the sheer number of categories created from the clay itself but is subject to complex manipulation thereafter" (Miller 1985: 140). We must explore the social arenas in which pottery would have played an essential role. To do so, we must examine consumption, and in particular explore why a consumer would want a particular product. Put simply, without demand there would have been no production (Sillar 2000: 11).

From a "social life of things" perspective consumption would appear to be the last stage of the reproductive process, the final step in a ceramic production sequence. However consumption is the origin of a particular structure of demand. Consumption is analytically prior to production, but they are enmeshed in a complex recursive relationship (Dietler 2003: 277; Friedman 1994: 16). Consumption is the moment where things enter new operational sequences. Pottery production may have been located in a realm of practices of agricultural field work, gathering of fuel for cooking fires, etc, at the consumption stage vessels may enter a whole new social field and sequence of productive practices (Sillar 2000).

On the one hand the historical relationship between contexts of use and production are "entangled" (Thomas 1991). For example, variations in Guatemalan water jars are due, at least in part, to the methods consumers employ to carry jars. The learned cultural values about how women, as consumers, ought to conduct themselves in public affect the technological choices in production (Reina and Hill 1978: 238-243). On the other hand, the use of ceramic vessels represents a different social field than the practices involved in production. Dietler and Herbich have argued in a series of important articles that we must make an interpretive distinction between the social context of production and consumption (Dietler and Herbich 1994, 1998: 255-256):

> "This distinction is crucial for a social understanding of ceramics. Otherwise, one risks committing the logical fallacy of "affirming the consequent" through a tautological conflation of a possible eventual role of style (i.e. the signaling of social or ethnic identity) with a constitutive function (hence a necessary factor in its creation)…We would maintain that an exploration of the importance of this contextual distinction exposes the impossibility of proposing a theory which purports to explain the creation of ceramic or other material culture style solely on the basis of observations made in the context of consumption … Equally clear, however, is the fact that one cannot obtain a full understanding of the social significance of ceramics only by studying the context of production... What is essential for the development of a body of theory which may lead to a realistic understanding of ceramics as a social phenomenon is ethnoarchaeological research that explores the complex relationship between the social contexts of production and consumption." (Dietler and Herbich 1994: 461)

Many ethnographic cases, including Dietler and Herbich's study of the Lao of Western Kenya, provide evidence that producers and consumer do not perceive or categorize pottery the same way. As such, the life history of the pottery itself has a different role to play in the identities of the consumers than the pottery may signal of the producer. A group of pots interpreted specifically by a community of producers, may be conceived and categorized much more broadly by consumers (Bowser 2000; Longacre 1991: 102-103). Producing a style must be distinguished from consuming that style (DeBoer 1990: 87), thus communities of consumption must also be examined. Since we use material culture to create cultural order (Douglas and Isherwood 1979), consumption also can also be viewed as varying modes of participation. Communities of consumption, like communities of production, are social spheres of learnt behaviors. I argue that we can utilize the ideas of situated cognition and peripheral participation presented in the previous section on production to explore communities of consumption.

Consumption of particular objects can also serve to bring together communities of practice. For instance, the Inka ceramic *urpu* stored corn beer, while the beer was presented in the wooden drinking cup, the *kero*. Cummins (2002: 37) notes the relationship of these vessels on the level of production and use, and that "their relationship was built into their design: it was present, as it were, at the level of their manufacture." The relationship of these two objects, so important to the Incaic political economy, formulated a social relation between communities of potters and woodworkers. By studying the vessels from the point of production, Cummins recognizes that "the meaningfulness of the kero beyond utilitarian use is already present at the vessel's inception. The kero is embedded in the ritual and the mythic discourse of drinking as a significant participant" (Cummins 2002: 37). The need for corn beer, and thus the specialized vessels for this alcohol, brought together two groups of craft producers with otherwise divergent identities. This example is particularly relevant to this dissertation, as the kero is also found during Tiwanaku periods in the Titicaca Basin, and likely was used in commensal politics.

3.6 Feasting and Frames

Chapter 2 demonstrated the central importance of feasting, or commensal politics, to macro scale narratives of the Titicaca Basin. In fact, interest in feasting has produced important research into studies of ceramics, foodways and studies of consumption (Bray 2003; Clark and Blake 1994; Dietler and Hayden 2001; Joyce and Henderson 2007; Potter 2000). A consideration communities of practice may help in repositioning the processes of daily life, since feasts are a public contexts where people learn to behave in a particular way, by learning or solidifying ones status and rank through eating and drinking. This process of learning, like other types of practice, is embodied:

> "Like other critical practices that help forge new social relations, one learns these lessons with the body, underscored in sensual ways. The exaggeratedly physical qualities of feasting, of eating to surfeit, and drinking to – and sometimes past – inebriation, coincide with the importance of the body's feeling one's social position to know it better…establishing a new social order, or modifying social relations, is not for minds alone, not merely something to be mentally re-formulated, but rather something that must be undertaken in the flesh, experienced in the person, and practiced under various social circumstances." (Gero 2003: 287)

This process, of course, is evidenced in consumption patterns (faunal and botanical), and in *ideal archaeological scenarios* with the creation of specialized feasting ceramic forms in design and shape like the Inka and Tiwanaku *queru*. In chapter 2 we saw that during the Late Formative period, where no querus have yet been found, it is decorated vessels that play an immensely important role in the Formative Period ‘commensal package’ and as a signature of elite feasting activity. However, if style is not a simple text to be read by consumers then we require further type of evidence both for social status and for feasting (Dietler 2003: 276). In fact, it may well be that the fancy ceramics are less a status marker, or an essential category for a ritual feasting, and more of a framing device (Miller 1985).

Framing simply means that pottery can provide cues, in public scenarios, to establish the ritual significance of what is taking place (Goffman 1974; Miller 1985: 181). In some cases pottery is a clear symbol itself, as we saw above with the case of the Inca *queru*. In other cases framing can determine which attributes of ceramics are significant in particular situations (i.e. the size of the vessel or the painting on the vessel). In Miller’s study, pots as physical forms were seldom remarked upon, while what they contained was deemed more important. In this case pottery itself was an essential physical frame as well (Miller 1985: 182). As Sillar (2001: 12) notes, “it is largely the valuation of how objects are used, by whom, when, and for what (the difference between champagne at a wedding, and beer in a pub) that defines the cultural value of the object. It is not just that the goods are consumed that is important; it is the way that society structures a wide diversity of forms of consumption. Who is permitted to consume particular goods, in what ways are the goods ‘consumed’, and with whom should they share the act of consumption?”

Framing is a productive way to reconsider our understanding of what pottery “means” in particular vis-à-vis the oft-assumed status symbol. Miller suggests that pottery becomes significant due to its functionality and triviality. As “mundane material culture” it is rarely the center of attention, and it this which permits individual to strategically control the frames themselves. Indeed, Miller argues that it is the three properties of function, concreteness and apparent triviality that make pottery ideal for studying the constitution of society. As Miller puts it:

> "The very functionality of pottery – its place as container, transporter, framer of other substances make it suited to the role of 'framing'. Different forms of social action and interpretation demand different kinds of responses and interaction. Some are concerned with more practical effects, some with ritual action, some with status, and some with the exercise of power. Pottery does not often signify directly but more commonly acts as an "appropriate" setting, for the exchange relationships…for the ritual action of a wedding and for the display purposes of a major feast, as well as for the practical (but also the "appropriate") transformation of foods in cooking." (Miller 1985: 204)

So, according to Miller, the "signaling" of pottery may have less to with the production stage, as how the ceramics are deployed after the fact. Ceramic framing and re-contextualization has been noted in a variety of cultural settings. For instance, Cruz (2003: 247, 265, 284) and Stahl (Stahl 2008: 168) both note in Banda society of Ghana, mundane pottery is used at shrine sites, but is recontextualized through ritualization. Stahl notes that everyday pottery used during the Makala phase (1773-1925) was often recontextualized, specifically ritualized, when framed with animal bone (snake, bird, fish and mammal) and beads (Stahl 2008: 182). Since production and consumption are closely intertwined, tracking framing necessitates a close contextual analysis in the archaeological setting (Dietler 2003: 274). However, as Stahl (2008:182) points out, this recontextualizing can taken place in a range of context types, making it necessary to consider how the particular framing of ceramic is done in terms of larger social practice. One fruitful way to consider the bigger picture, including the interconnections between various materialities, is to investigate the embeddedness of particular practices.

3.7 The right choice: Embedded practice and the greater taskscape

The concept of embeddedness has been a recurrent theme throughout this chapter. One productive way of conceptualizing the entanglement of craft production to larger social practice is well articulated by Bill Sillar (Sillar 2000a, 2000b, 2006a, 2006b; Sillar and Tite 2000). He argues that we must remember that social relations lie at the heart of production. The idea of embeddedness is a way of expressing the fact that "every technique is part of a wider context of artifacts, environments, ideologies, economic systems and social structures' (Sillar 2001: 291). Like Lechtman's technological style, it forces us to think about how particular techniques develop within a complex web of relations, and that rational functionalism to artifact style is potentially misguided. Sillar (in press) argues that the embedded nature of particular technologies can be considered in two related ways. First, it can reinforce an examination between different technologies, where the product of one activity becomes the raw material or tool for another. Second, like technological style, an embedded analysis allows for particular technologies to maintain or transform social and economic relationships and for cultural understandings to inform technological acts.

Some have been critical of such a term, suggesting it implies disembeddedness (Cumberpatch 2001), an idea unfortunately present in some uses of the term (Johnson 1996). Sillar is clearly not making such an argument, rather he argues that archaeologists have tended to artificially separate pottery production and use from greater social practice, due to the "hegemony of the specialist". In many archaeological settings, ceramic specialists do not consider their evidence through the filter of the larger, meaningfully produced archaeological record. Sillar's use of embeddedness serves as a corrective to functional approaches, and catalyzes the consideration of a range of entanglements, including larger labor organization, the effects of ideology, and seasonality.

Embedded perspectives help us to consider the temporality of the landscape, or what Ingold (2000:194-200) calls the "taskscape". Tasks are any practical activity carried out in an environment as part of day-to-day life. As we learned above, tasks take place with a community of practice, but are also part of a larger grouping of tasks, embedded in greater sociality. "It is the ensemble of tasks, in their mutual interlocking, that I refer by the concept of *taskscape*" (Ingold 2000: 195). This taskscape, I argue, is central for us to properly re-embed our archaeological evidence of communities of practice into the greater prehistoric social world. We cannot divorce the steps of pottery production and pottery use from the temporal, spatial and material practices on the landscape such as pastoralism, agriculture, house construction, etc. It is from within the greater taskscape that the habitus, the durable dispositions of craft production, develop. The concept of the taskscape helps us to consider the different interrelated rhythms of tasks, and how they are entwined in particular situations. Shared taskscapes can take the technological choices of particular communities of practice and put them into a more broad local knowledge (Robb 2007-107).

3.8 Summary: Late Formative Communities of Practice

My aim in this chapter has been to stress the relationship of style to prehistoric social boundaries in the past, as well as to suggest that a focus on learning provides an extremely important theoretical bridge between process and archaeological data. While I certainly agree that "the relationship between style and social boundaries is problematic and embedded in the dynamics of particular historical and social contexts" (Goodby 1998: 162), I believe that seeking out such relationships is extremely important. A focus on learning builds a link between the rich ethnoarchaeological research on pottery production, distribution and consumption of the past 50 years, along with the more nuanced perspectives of social archaeologies of daily practice. The notion of communities of practice are good to think through, and will permit an re-examination the macro-scale processes discussed in Chapter 2, and is a "good conceptual bridge" to discuss social boundaries, webs of interaction and knowledge during the Late Formative Period. A model of legitimate peripheral participation is attractive for many reasons, but perhaps the most important aspect is that the outcomes are not predictable. How potting practitioners (or ritual participants, or political agents) interact and learn is not a simple predictive process. Thus evolutionary trajectories from this perspective will not aid us in seeing how this particular mode of practice pans out.

I argued several important points in this chapter, including:

1. Learning is always occurring no matter the context, yet the context determines the nature of this process.

2. Learning is a cognitive process that involves embodied practices, and thus is not simply "in the head"

3. Communities of practice can be investigated at the local scale, or regionally as "constellations of practice"

4. Learning is materialized, and necessarily includes artifacts, which aid in the reproduction of communities of practice.

5. Archaeological studies of craft production, in particular, are well suited for exploring communities of practice, by employing approaches to style and technical style.
6. Archaeologists, while creating seriations and mapping out traditions, are in fact tracking particular iterations of communities of practice.

I believe the Late Formative period of the Titicaca Basin encompasses "multiple overlapping communities" (Thomas 1996: 178-179), and pottery producing and consuming communities are two that can be explored with archaeological sherd data. Production communities can be explored through considerations of technological choice and their link to the operational sequence (see Chapter 6). I have stressed both here and in Chapter 2 that seeking out the social boundaries of production communities must begin at the local level, rather than assuming ethnic groups or political divisions (see Arnold 1989: 182 for a similar point). Pottery production (and the design and technological styles recoverable for archaeologists) may not speak to larger political processes, while pottery distribution and consumption/use (as tracked on a intra- and inter- site scale) may be significant. Therefore we must consider communities of pottery production along with communities of pottery consumption.

Chapter 4
The Taraco Archaeological Project, 2003-2005

In this chapter I delve into the history of research on the Taraco Peninsula, focusing in particular on the work of the international and multi-disciplinary Taraco Archaeological Project (TAP). I begin with a short overview of the methodology employed by TAP. The fine-grained analysis utilized by the project, which includes paleoethnobotany and micromorphology, is well suited for a micro-scale analysis of daily life in the Titicaca Basin. TAP's methodology depends upon detailed interaction between the excavator and the analysts, an important component of an embedded approach to prehistoric craft production. After a brief overview of the methodology, I turn to TAP's 2003-2005 excavations to present my own sampling universe.

The ceramics studied in later chapters were chosen based on feedback between ceramic phasing and the interpretation of stratigraphic profiles, as illustrated in the elaborate Harris Matrices of Kala Uyuni, Sonaji and Kumi Kipa (see Appendix 1). Although this chapter focuses on excavators' interpretations of these contexts, I do include some basic ceramic data. I present average sherd weights for the studied assemblage as a relative taphonomic index. While this data is certainly approximate, and may result from a range of post-depositional processes, I hope this data will contribute to greater TAP research on post-depositional processes at these three sites. I also include the relative sherd densities to contribute to excavator's interpretations of particular contexts. I end this chapter by summarizing both the taphononomic and density data, presenting the most dense and least eroded (or trampled) contexts. The details of how Titicaca Basin archaeologists define the Late Formative will be presented in the next chapter, and the specifics of the TAP phasing process will be discussed in Chapter 6.

4.1 History of the Taraco Archaeological Project (TAP)

The Taraco Archaeological Project (TAP) instigated research on the Taraco Peninsula in the early 1990s[1]. TAP focused its work primarily on the site of Chiripa. Chiripa, with its rich history of research (as discussed in chapter 1), plays a central role in our understanding of the Formative Period in the South Central Andes. Excavations at Chiripa were fairly continuous from the 1930s through the 1970s, with particular focus on the history of the mound (or Monticulo) (Bennett 1936; Browman 1978; Chávez 1988; Kidder 1956; Mohr 1966; Ponce Sanginâes 1970; Wallace 1957). Christine Hastorf, and the Taraco Archaeological Project, continued this research program, but included excavations in the off-mound components of the site, investigating both public and domestic spaces (Hastorf 1999).

Five seasons of excavations recovered a complex site history both on the *Monticulo*, or mound, and at several off mound occupations (Hastorf 1999; 2003). The excavations recovered evidence of domestic activities, including thick midden deposits, but no intact domestic architecture was uncovered in the TAP seasons at Chiripa. This trend continued in the more recent 2003-2005 excavations on the Taraco Peninsula. The detailed excavations and the intensive laboratory analysis have helped to create a better understanding of the deep history and occupation of Chiripa (Bandy 2006; Hastorf 2003; Roddick 2002; Steadman 2002; Steadman and Hastorf 2001). Lee Steadman's ceramic

[1] Systematic overviews of Taraco Peninsula climate ecological zones, ancient lake levels and flora and faunal diversity can be found in Bandy (2001), Bruno (2008), Peterson (2006) and Whitehead (2007). Information concerning the geology of the Taraco Peninsula is found in Chapter 8.

analysis (1999), along with a series of C14 dates (Whitehead 1999), have redefined the phasing of the Early and Middle Formative. Maria Bruno's Master's thesis (2001) and doctoral dissertation (2008), and Bill Whitehead's (see also Bruno and Whitehead 2003) doctoral dissertation on the botanical remains have created a solid foundation for understanding plant domestication and shifting cultivation practices. Kate Moore's (1999) work on faunal remains has begun to elucidate some interesting patterns for the process of camelid domestication, and has shown the importance of fish in the diet of Formative Period villagers (see Chapter 9). The analysis and interpretations from this work is ongoing, but we already have a better sense of Formative Period social worlds, including ritual practice, and a better sense of Formative Period foodways.

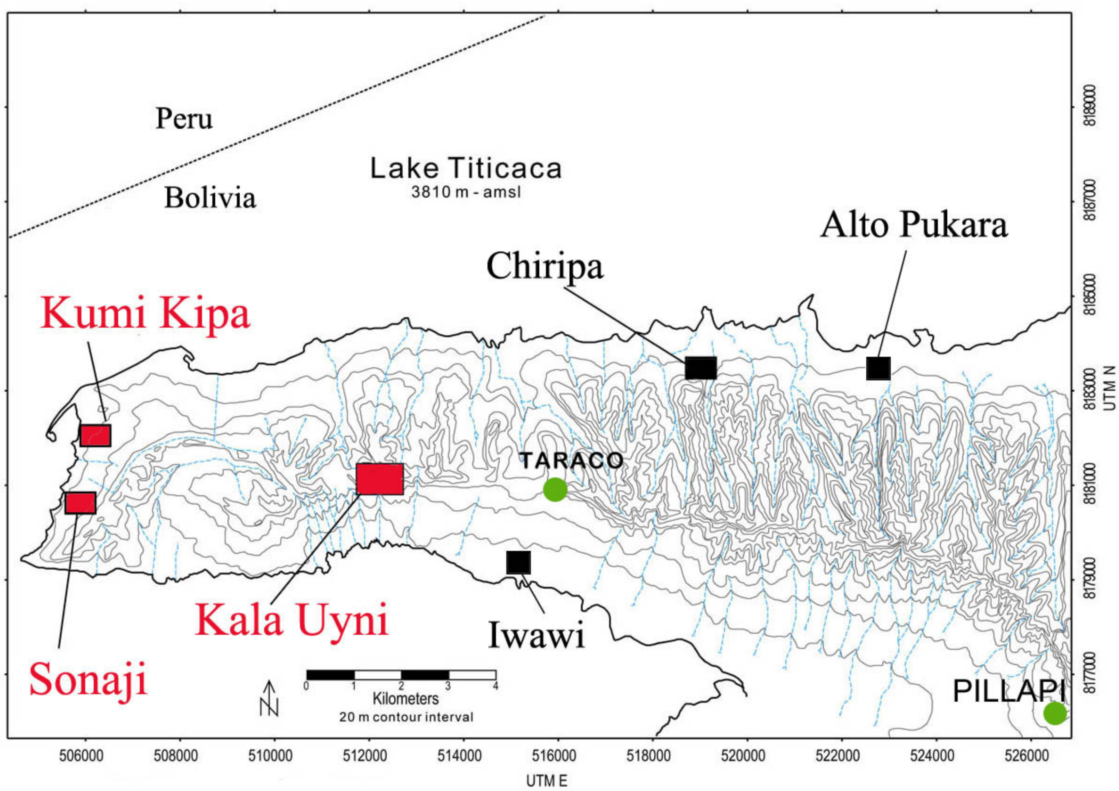

Figure 4.1: The Taraco Peninsula, with sites excavated by the Taraco Archaeological Project (2003-2005) in red, other important sites in black, and the modern towns of Taraco and Pillapi. (Adapted from map: 5844IV H731 Edition 2-IGM)

Robin Beck's (2004) work at the site of Alto Pukara, approximately 5 kilometers east of Chiripa (Figure 4.1), was conducted under the auspices of the Taraco Archaeological Project. In his 2000 and 2001 seasons, Beck excavated two cobblestone and mud mortar structures on a mound in the community of Kala Kala. These structures, with dimensions of 5.2 x 4.2 meters and 5.4 x 4.8 meters, date to the Middle Formative Period (800 B.C.-400 B.C.). In his dissertation, Beck compares these structures with other "platform-chamber complexes", including those at Chiripa and Pukara. He tracks the history of ceremonial architecture in the Titicaca Basin, arguing for a house society model. Beck believes that these Formative Period complexes were the seeds for later socio-political developments at Tiwanaku. Essential to Beck's work was Matt Bandy's doctoral research.

Bandy (2001), who participated in all phases of TAP research at Chiripa (and co-directed the more recent work), took the first truly regional approach to the Peninsula. Before Bandy's survey project we had little idea of the high density of sites on the Peninsula during the Middle and Late Formative period. Other Titicaca scholars had conducted survey in the lower Tiwanaku Valley and the Pampa Koani, but it was Bandy who linked these areas with a full coverage systematic survey to the entire Taraco Peninsula (a total of 85.22 km^2). He found that "the entire Taraco Peninsula is one large, low-density ceramic scatter" (Bandy 2001:40), but some areas are denser than others. For example, Bandy found that at Sonaji (discussed in greater detail below) surface ceramics varied in intensity across the site (Figure 4.2). TAP excavators employed this variability in their judgmental sampling strategy in the 2003-2005 excavation seasons. Bandy, who defined a site by a minimum density of 0.1 sherds per square meter over >100 m2, found a total of 476 prehistoric sites on the Peninsula (Bandy 2001: 42-44).

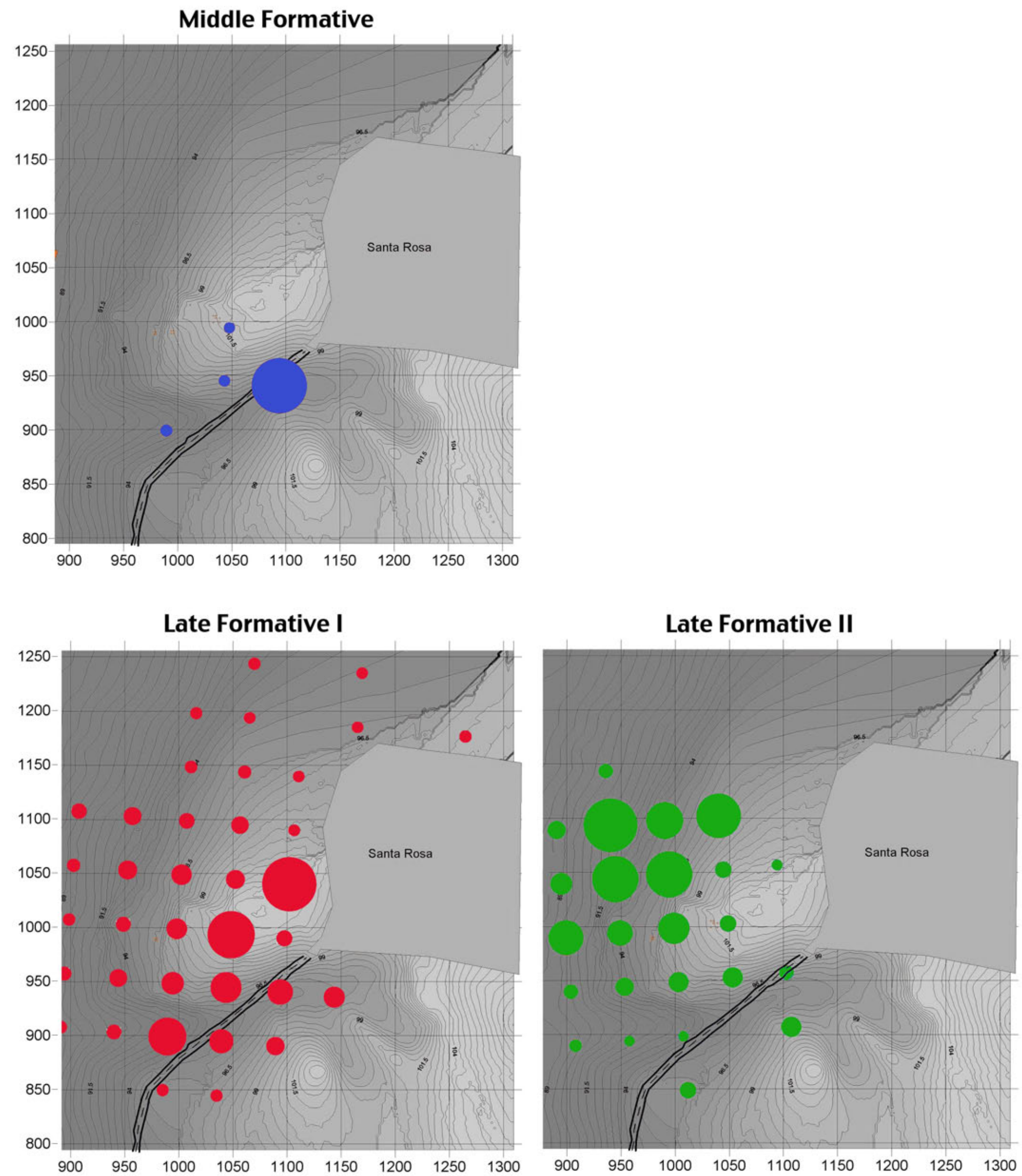

Figure 4.2: Surface sherd densities through the Middle and Late Formative, as determined by Mathew Bandy's ceramic index system at the site of Sonaji on the Taraco Peninsula. The 2004-2005 excavations of this site occurred on the terraces extending westwards from the town of Santa Rosa.

Using an innovative sequence of archaeological models, equations and programs in the Perl programming language, Bandy linked ceramic surface scatters to household population densities and eventually to track demographic processes. Bandy believes there were important moments of village fissioning throughout the Formative Period. He suggests these events were catalyzed by the influence of emergent leaders to affect the residential choices made by villagers of the Taraco Peninsula. Bandy argues that the process of re-settlement occurred in tandem with shifts in the lake levels of Lake Winaymarka, the smaller section of Lake Titicaca (Bandy 2004; 2006; 2005). The decrease in lake levels may have created new trade routes, while the retuning level would destroy them. Bandy therefore argues that the social, political and economic fortunes of those living on the Taraco Peninsula were intimately connected to the shifts in rainfall.

I will return to the specifics of his system of Bandy's ceramic analysis in the next chapter. Later in this chapter I will present Bandy's interpretations of scatters at Kala Uyuni, Sonaji and Kumi Kipa in greater detail. For now I simply wish to note that his analysis of the surface ceramics scatters are essential not to just his model of political and economic development on the Taraco Peninsula, but also to the collection of the data presented in this dissertation.

4.2 2003-2005 Research Questions

In 2003, the Taraco Archaeological Project instigated a new phase of research focusing on the Late Formative Period. The team planned to build on Bandy's doctoral work, concentrating specifically on the Middle-Late Formative transition. The research questions and theoretical orientation of the larger TAP project are slightly different than mine. However these questions influenced the sampling procedure, and are therefore worth presenting briefly here. The plan was to take a nuanced, multifaceted approach to evaluate the major models used to explain political development in the southern Titicaca Basin, specifically considering 1) subsistence intensification, 2) exchange and 3) public ceremonialism.

Subsistence production, and specifically the questions of economic intensification and surplus production, would be examined by investigating shifting farming (through macrobotanical analysis and analysis of agricultural tools), herding (through demography of the herd and dental wear analysis) and fishing practices (through density and ubiquity of fish bones and the frequency of net gauges). TAP planned to examine exchange by measuring the intensity of participation in regional and interregional exchange networks over time. Such involvement would be investigated through the analysis of faunal assemblages for cargo animals used for long-distance caravans, and the inter- and intra-site variation in exotic items, which include lithic materials (basalt for hoes and obsidian), exotic hardwoods, and plant drugs. Finally, TAP would study ceremonialism through the detailed mapping and excavations of public architecture at three sites with Middle Formative (Kala Uyuni and Yanapata) and Late Formative (Kala Uyuni and Sonaji) occupations.

TAP planned on tracking these shifts at sites that had both Middle and Late Formative components, specifically with domestic and ceremonial contexts that began in the Middle Formative – as such Yanapata, Kala Uyuni, Sonaji and Kumi Kipa were to be excavated over three field seasons. After our first season of excavation (at Kala Uyuni), the team decided to focus on the Late Formative Period, and the Middle Formative site of Yanapata was not excavated.

4.3 TAP excavation methodology

The TAP methodology has progressively developed since the first seasons at Chiripa, and those interested in the history of this methodology are directed to recent TAP reports and publications. The Harris Matrix and a *FileMaker* project database drive the nested system. The methodological foundation is the locus, which constitutes the smallest unit of activity evident during excavation. The locus refers to a unique deposit, from which a locus number refers to the excavated matrix. The 2003 excavations began with loci number 5000 to distinguish from the previous work at Chiripa. Thus, 5000s represent the 2003 excavations at Kala Uyuni, 6000s at Sonaji and Kumi Kipa in 2004, and 7000s at Kala Uyuni and Sonaji in 2005.

When several loci are found to be representative of the same cultural or geological process, they are grouped as an event. The event is representative of the natural property of the matrix, resulting from natural and cultural site formation processes. Excavators distinguish particular events by TAP's convention of naming their Area (sector of the site) then by a unique event number, for example KU-234. An event can be a feature (an architectural component, a burial, etc) or be part of an architectural subdivision (ASD). Events (and loci) include removal and depositional practices. Therefore a pit would include an event number for both the "pit cut" and "pit fill", even though the "pit cut" event would not include any excavated soil. In an ideal scenario, we would have only one stratigraphic event per loci. However in some cases excavators noted the subtleties of the deposits in drawing unit profiles; in such scenarios there may be multiple events per locus.

Excavation units were chosen judgmentally, often based on the results from Bandy's surface survey. In some cases systematic auguring was conducted (Paz Soria and Fernandez 2007). Excavations began, for the most part, with 2 x 2 m units, with the exception of the 2005 excavations at Sonaji, where the previous years excavations permitted a larger horizontal unit to be opened. Since all sites excavated had previously been surface collected by Bandy (2001), no intensive site-wide surface collection was completed during these field seasons.

The implementation of TAP's recording system began when each team was assigned blocks of loci numbers. Excavation notes were kept on formal locus forms that were digitized and uploaded to the project database. Excavators noted on these forms how each locus was defined, how the sediment and texture changed, the volume of soil excavated, the number of bags of artifact collected, and the relational status of the locus to its neighboring loci. This system permits for events to be defined on site and for Harris Matrices to be constructed at the end of the season. A new locus was defined at the moment a new cultural or depositional event was defined based on sediment change or changes in artifact distribution. Excavators were advised to begin a new locus at the sign of a change in natural or cultural deposits or at the point of reaching a 10 cm arbitrary level. At the beginning of each locus, bulk point provenienced flots of 10 liters and three small sediment samples were collected. Each sample was given a unique slash number.

At the end of each day of excavation artifacts were washed and cataloged. Excavators' interpretations of excavations were immediately shared with the laboratory team including the ceramicists. Using an extensive series of cultural context codes, the excavators categorized the nature of the deposits both during excavation (field cultural context) and at the end of an excavation season (final cultural context) (Table 4.1). Such a system of cultural context codes permits the ceramicists, and other specialists, to create priority lists of contexts and to begin to interpret data in the field. As a participant in both TAP excavations and laboratory work, I cannot stress enough the advantage of having ceramic analysis occur concurrently with excavations. Such a strategy permits excavators to receive almost immediate feedback on contexts, in some cases while they are still excavating them. The analyst can actively engage with the excavations themselves, taking note of taphonomy, spatial information and the realities of the complex stratigraphy. In this sense, it is an interpretative archaeology at the "trowel's edge" (Hodder 1997). At the end of the field season we produced Harris Matrices by feeding the stratigraphic information from the project database into Arched™ (1.4.1). I then re-constructed the Harris Matrix within the Adobe Illustrator™ program in order to reposition the spatial data and to add contextual information (Appendix 1).

High Level Cultural CC Code and Definition		Specific CC Code Example and Definition	
0-100	Surfaces and Sub-Surface Modern Disturbances	097	Animal burrow
100-200	Walls	170	Retaining wallfall
200-300	Middens	252	High density midden with ash - secondary
300-400	Surfaces	344	Clay floor inside structure
400-500	Features	418	Pit with cuy bones
500-600	Burials	590	Unlined burial in pit
600-700	Fills	631	Mound construction fill
700-800	Lenses	740	Organic stain
900-	No Evidence for depositional History	999	Mixed locus or information lost or incorrect: Check notes

Table 4.1: Cultural context codes utilized by TAP. The left column presents general level numbers used by analysts to prioritize analysis. On the right are some specific examples.

The ceramicists (Lee Steadman and myself) use these Harris Matrices to phase contexts. The matrices were also essential for me to decide which contexts were appropriate for further ceramic analysis. In the discussion of the excavations below I include a summary of those contexts determined to be "Unmixed Late Formative" by way of the ceramic analysis (see Chapter 6 for how this was determined). In some cases this includes events that may, as a whole, be viewed as partly mixed, but have solid Late Formative contexts. As such some of my sample includes both red (unmixed Late Formative I) and half red (1/2 Late Formative I or II, 1/2 generally mixed or with a particular other phase) events in the Harris Matrices of Appendix 1. These contexts form the bulk of my Late Formative sample, although in some cases I draw more widely from the greater TAP ceramic database for particular examples.

4.4 TAP Excavations

I now turn to the three seasons of TAP excavations on the peninsula. I include summaries of the ceramic data by context to briefly present the studied Late Formative ceramic assemblage and as another interpretive perspective of specific contexts from the cataloguing stage of the ceramic analysis. I include the raw quantity and weight of sherds from analyzed loci to give an idea of the quantity of material examined for each context. Small fragments are excluded from this calculation, as they were not used in later detailed analysis. Some loci were found in multiple events, due to mixing or post-excavation defining of distinct events. These loci were excluded from average sherd weight and density calculations.

I present the average sherd weight as a suggestive index of the state of erosion of the context. Do contexts interpreted to be erosional events by excavators have lower sherd weights? Are sherds excavated on floor surfaces more trampled, and thus smaller in size? This approach, of course, is an approximation. Many factors will influence sherd weight, including non-plastic inclusions in the paste, and vessel thickness. I am also including a column in these tables showing the variability in vessel densities (ceramic weight: volume of soil excavated). In some cases sherd density is not available (n/a) either because the soil was all floated (while ceramics were collected through point-proveniencing) or because excavated volumes were not recorded. Through the ceramic density index I hope to investigate several questions: Is there intra- or inter-site midden variability in ceramic densities? Are contexts interpreted as use-surfaces lower in their sherd weight ratio, since inhabitants kept them clean of large broken sherds? I will summarize some of these preliminary findings at the end of this chapter.

4.41 Defining Late Formative Kala Uyuni

Mathew Bandy identified Kala Uyuni (T232 in his site designation system), in the community of Coacollu, based on a dense sherd scatter and a number of worked stones on the surface of the site. The ceramics indicated multiple occupations beginning in the Early Formative and continuing through the Middle and Late Formative. Bandy noted that the top of Achachi Coacollu, a hill overlooking the agricultural fields of Coacollu and Lake Wiñaymarka, had Late Chiripa phase ceramics along with terraces and large *in situ* limestone blocks. Bandy correctly hypothesized the presence of a Middle Formative sunken court. In fact, excavations in 2003 revealed two sunken courts contemporaneous with Chiripa. The largest component of the site (at 14.75 ha), however, pertains to the Late Formative Period (Bandy and Hastorf 2004: 10).

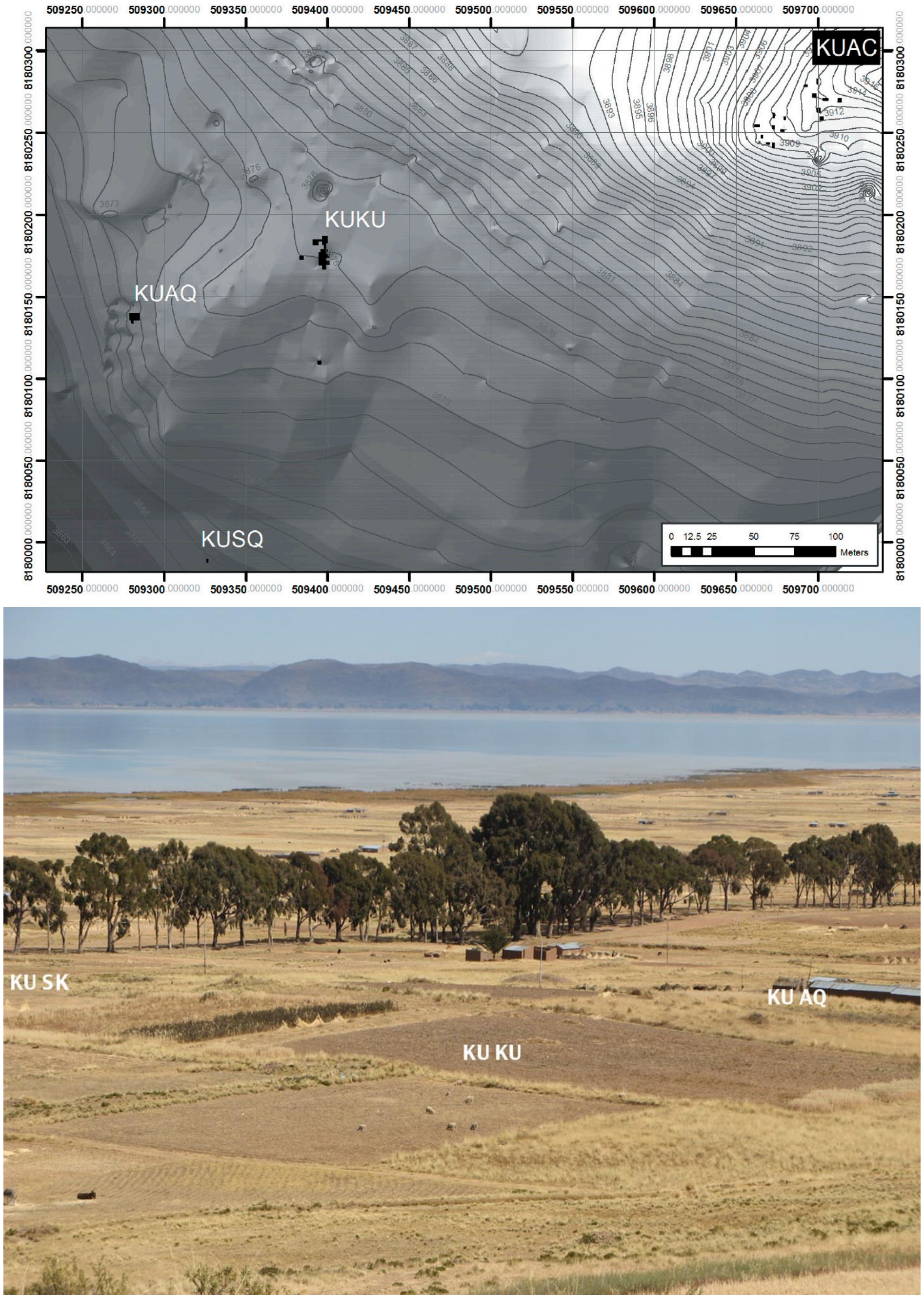

Figure 4.3: Plan map of Kala Uyuni and photograph of the site from the hilltop Middle Formative site of Kala Uyuni Achachi Coacollu (KU AC). Labeled are Middle Formative Kala Uyuni Ayrampu Qontu (KU AQ) and Late Formative Kala Uyuni Kala Uyuni (KU KU) and Kala Uyuni Siwinka Qontu (KU SK).

Bandy argues that Kala Uyuni was first occupied by the fissioning of villages at the later part of the Early Formative (Bandy 2001:123-128). The site was occupied throughout the Middle Formative, and likely was an important point on the landscape, as visible today from the surface architecture on Achachi Coa Collu, and the sherd scatters in the lower part of the site. However it was at approximately 250 BC, at the beginning of the Late Formative, that Bandy believes that Kala Uyuni became "the center of a multi-community polity encompassing all of the Taraco Peninsula settlements (Bandy 2001: 176). Bandy suggests that during the Late Formative I period Kala Uyuni was approximately the same size as both Tiwanaku and Lukurmata, and that the villagers of Kala Uyuni 'competed' with inhabitants of Tiwanaku and Lukurmata. Utilizing his population index system, Bandy hypothesized that Kala Uyuni grew rapidly in the earlier part of the Late Formative I, and Sonaji grew more in the later part of the Late Formative I and Late Formative II phases (Figure 4.2). As will be seen below, excavations conducted thus far, along with the ceramic phasing and C14 dates (discussed in the next chapter) do not completely support this hypothesis.

TAP's 2003 excavations focused on the upper Middle Formative Achachi Coacollu, or the KU AC area (Cohen and Roddick 2007), the lower Middle Formative Ayrampu Qontu domestic area, or the KU AQ area (Bruno 2007) and the core Late Formative area, the KU KU area (Bruno and Leighton 2007; Paz Soria and Fernandez Murillo 2007). The excavations in the KU AC area revealed two Middle Formative sunken enclosures, constructed with limestone pillars and river cobbles, and a dense midden deposit associated with the sunken architecture. In the lower KU AQ area, excavations uncovered a domestic midden deposit, likely contemporaneous with the upper area. Lee Steadman's 2003 analysis determined that both KU AC and KU AQ have very few unmixed Late Formative contexts (Steadman 2007: 86).

In 2005 the team returned to focus on the rich and well-preserved Late Formative occupations in the KU KU area (Fernandez and Alvarez 2006, Roddick et al 2006). In addition, units were placed in a southern sector of the site, in an area called Kala Uyuni Siwinka Qontu, or KU SK (Hastorf 2006b). As my focus is on the Late Formative Period, I limit my discussion to KU KU and KU SK (Figure 4.3), but detailed discussion of the Middle Formative occupations can be found in several recent reports, theses and publications (Bruno 2008; Capriles Flores 2006; Cohen and Roddick 2007; Ulloa Vidaurre and Killackey 2005).

4.42 – Kala Uyuni ASD-2

In the 2003 season Jose Luis Paz and Soledad Fernandez, after excavating through approximately one meter of erosional and fill episodes, discovered the first Late Formative structure at the site of Kala Uyuni, Architectural Subdivision 2 (ASD-2) (Figure 4.4; Fernandez Murillo and Fontela Alvarez 2006; Paz Soria and Fernandez Murillo 2007; Paz Soria and Fernandez Murillo 2004). This U-shaped structure extends east west, with the entrance opening to the west. The northern wall measures 3 meters long, the eastern wall 2.8 meters and the south wall 3.5 meters (Paz Soria and Fernandez 2007: 26). The foundations of the structure (KU-B13), measuring between 80 centimeters and 1 meter thick, are constructed from river cobbles filled with smaller stones, gravels and clay bricks/adobes with a yellow clay mortaring material. This stonewall was placed in a foundation cut (KU-B18), above a cultural fill (KU-B100), which in turn was placed over sterile (KU-B95).

Figure 4.4: Photograph of KU KU ASD-2 from the north, with the large pit (KU-B15), that contained fine incised Late Formative ceramics, in the lower left corner.

Inside the structure Paz and Fernandez uncovered a thick yellow clay floor (KU-B12) about 3 cm thick. This surface was mostly clean, but did have some ceramics laying on the surface. A radiocarbon date from this context returned a 1-sigma date of AD 20-220 (AA70201). Above this floor was a sequence of occupation surfaces (KU-B10, KU-B11) a fill (KU-B23) and clay lenses (KU-B24, KU-B22). The KU-B22 clay lens returned a 1-sigma date of AD 130-340 (AA59719). Above the floor and the walls, the excavators found lenses of clay and of sandy clay loam (KU-B10, KU-B11), either from the erosion of adobes or perhaps a later floor. Paz and Fernandez also encountered an intrusive pit (KU-B15) with a series of pit fills (KU-B16, KU-B17, KU-B57, KU-B78). While this pit was intrusive, it was still Late Formative in date, as the cut predated the later wall fall or roof elements of the structure (KU-B9), and the pit fills included a Late Formative zonally incised ceramics (as discussed in the next chapter and Chapter 7).

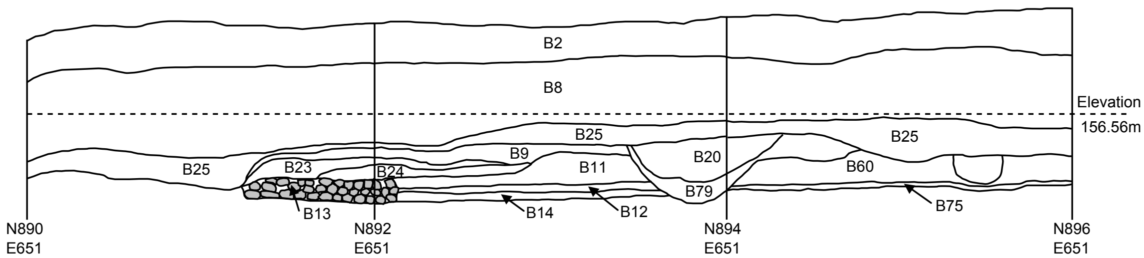

Figure 4.5: KU KU west wall profile.

Event	Context	Loci Analyzed	# (weight) sherds *Volume Excavated*	Average sherd weight	Density (Excavated Weight/Volume excavated)
B22	Fill	5164	9 (35.6)	3.9	3.6
B9	Wall Fall	7530, 7533, 7534, 7531	415 (2759.2)	6.6	1.9
B24	Fill	5168	12 (81.8)	6.8	8.2
B23	Fill	5167	100 (517.9)	5.2	2.5
B16	Pit Fill	5150, 5156	178 (1115.7)	6.3	2.0
B17	Pit Fill	5157, 5356	267 (1457.8)	5.5	5.6
B57	Pit Fill	5357	435 (2812.9)	6.5	14.1
B78	Pit Fill	5372	893 (6775.7)	7.6	11.7
B10	Surface	5039, 5042, 5151, 5152, 5354, 5163, 7536	1169 (7425.4)	6.3	2.7
B11	Surface	5040, 5170	50 (799.9)	16.0	1.8
B12	Surface	5045, 5154, 5358	260 (1482.0)	5.7	1.8
B14	Surface	5044	112 (1246.4)	11.1	4.1
B75	Surface	5369	239 (1423.3)	6.0	3.6
B77	Surface	5371	748 (4416)	5.9	44.2

Table 4.2: Analyzed Late Formative contexts from KU ASD-2.

Excavations outside, slightly to the east of ASD-2, uncovered a series of surfaces and hearths. One external surface (KU-B14) likely preceded the construction of ASD-2 yet still phased to the Late Formative I. Like the other use surfaces, this event included artifacts laying flat on the compact surface with dispersed flecks of carbon. Paz and Fernandez also encountered three “hearths” (KU-B61, KU-B76 and B276), associated with two possible occupation zones, or informal external surfaces (KU-B75, KU-B77). Bruno (2008: 404) has found a high density of carbonized plant materials and wood that support the interpretation of KU-B276 as a hearth, but the other two features do not appear to be cooking pits. KU-B76 has a low density of carbonized remains and the complete absence of wood, while some carbonized plant materials but no wood are found in the KU-B61 samples. Bruno suggests that KU-B61 possibly was used for ceramic production or the burning of garbage (discussed further in chapter 7). In general, Bruno (2008: 406) notes that the features outside of ASD-2 have a much higher density of botanical materials suggesting that cooking and cleaning took place outside of the building.

Associated with the abandonment of this building is a silt and clay-lined pit (KU-B20). While stratigraphically above ASD-2, this pit still dates to the Late Formative, and is filled with LFI ceramics. Above this structure is a series of mostly mixed (Late Formative and Tiwanaku IV/V) contexts, likely derived from erosional deposits originating upslope. However one fill episode (KU-B25) included unmixed Late Formative ceramics, and as such several loci from this event are included in my sample.

4.43 – Kala Uyuni ASD-4

In the 2005 field season, Fernandez Murillo and Fontela Alvarez (2006) encountered another large structure. ASD-4 is similar in construction to ASD-2, but is in a much more degraded state. While the southern wall was clearly visible, only a portion of the northern wall was recovered. Like the structure discovered in 2003 it has a river cobble foundations filled with gravels and clay with an opening to the west (KU-B201). The southern wall of this structure measures two meters long and the foundation is approximately 50 centimeters thick.

Due to the destroyed nature of this building, fewer intact deposits were uncovered; many were mixed with later Tiwanaku IV/V intrusive contexts. Inside this structure was a thin deposit of silty clay loam with some yellow clay, likely an eroded surface (KU-B206). Bruno found significantly more evidence for burning activity within this structure when compared to ASD-2, but the samples are "interspersed high-density and low-density" across the surface (Bruno 2008: 415). Ceramic phasing revealed some mixing suggesting cautious interpretation of this event. Such contexts appear ideal for analysis, but the low density of ceramics made it impossible to phase many apparently ideal events, or determine the nature of activities (represented in gray on the Harris Matrices of Appendix 1). Many of the loci associated with KU-B206 had less than 25 body sherds, a sample size far too small to determine phase, taphonomy or activity. The exterior of the surface (KU-B207) was defined as a compact deposit of clay made up of with silt lenses (Fernandez Murillo and Fontela Alvarez 2006: 20).

Beneath ASD-4 was a pre-construction level (KU-B213) dense with cultural remains that may represent an occupation surface or an accumulated midden. Cut into this deposit the excavators found a pit full of ash, and a dense deposit of carbonized plant materials (KU-B221). These botanical remains included a spiny bush (*Tetraglochin cristatum)* that may have been used for firewood (Bruno 2008: 413).

Figure 4.6: Heavily eroded ASD-4 structure. The scale is placed in the interior of the structure by the entrance (photo taken from the west)

Event	Context	Loci (Unit N/E) Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
B221	Pit Fill	7665, 7674	137 (1339.7)	9.8	3.1
B201	Stone Wall	7547	52 (362.4)	7.0	3.3
B213	Surface	7666	142 (1164.8)	8.2	5.8
B200	Midden	7544	82 (477.7)	5.8	9.9

Table 4.3: Analyzed Late Formative contexts from KU-ASD-4.

Outside of this building were a series of deposits associated with the structure. The ceramics associated with the external use surface (KU-B207) were not included in my sample due to excessive mixing in individual loci. The external use surface of ASD-2 (B-77) was also likely shared with this structure. A midden (KU-B200) that appears to be associated with the structure included some mixed later Tiwanaku IV ceramics, but many loci from this trash deposit are clearly all Late Formative in nature. One date for this building, from a hearth (KU-B202), returned a 1-sigma date of AD679-878, well into the early part of the Tiwanaku IV period, further demonstrating the disturbed nature of this structure. ASD-4, however, is an important finding for developing an understanding of Late Formative spatial organization at Kala Uyuni.

4.44 – Kala Uyuni ASD-5

In the 2005 field season Marcia Peterson, Mary Leighton and I investigated the area to the north of ASD-4. After systematic auguring revealed deep Late Formative I deposits approximately 3.5 meters to the north of ASD-4 (Roddick et al. 2006), we laid out a series of 2 X 2 meter units. Excavations uncovered an oval structure a mere 40-45 centimeters below surface, encouraging us to excavate horizontally (Figure 4.7). This strategy gave us a better sense for the nature of this particular structure and it's external use spaces. While the north and eastern foundations (KU-B268) of the structure were well preserved, we found few cobbles in the western section. Instead we found a "ghost wall", in the form of clay rich mortaring material (KU-B26) that was likely laid in between the cobbles that were likely taken for other purposes.

This structure, much like ASD-2 and ASD-4 had an entrance to the west, but is different in size and construction technique. This building is circular in shape with the foundation of cobbles (usually three cobbles in width) laid on a clay base, resulting in much thinner walls (25-30 centimeters wide) than ASDs 2 and 4. Adobes bricks were likely used as suprastructure of this building (see below). Bruno (2008: 420) has suggested that ASD-5 included a "semi-circular annex", an interesting idea that is hard to confirm with the poor state of the western wall. I interpret this missing eastern wall section as the entrance to the structure (Roddick et al. 2006).

We defined an interior use surface for the structure (KU-B249) and an exterior midden (KU-B261) possibly associated with the use of the building. The interior surface was compact and fairly uneven, likely formed through the use of the building (Roddick et al. 2006: 28-29). The surface was rich in clay, carbon, fish bones and ceramics lying flat on the surface. Remains of large cooking vessels were also recovered from the surface of the structure. A large burned adobe brick was found on top of some of the large carbonized ceramics (Figure 4.7). Bruno (2008: 425-26) found the densest area of botanical samples in this northern part of the structure, with *Chenopodium quinoa* especially high near the smashed carbonized sherds.

Figure 4.7: ASD-5 with view towards the west (see 5.405) and remnants of a smashed vessel associated with carbonized quinoa grains on the internal surface (locus 7508, event KU-B249) along the burned eastern wall of the structure.

A neonate (KU-B250) burial was found near to the entrance of the structure with an associated ashy pit (KU-B254) filled with carbon, fish bone and ceramics capped with clay. We found some midden-like deposits outside of the structure, much denser in the materials to the north of the structure. These deposits may have been a dumping area associated with the building, although "dump" may be too strong a word, as deposits were not all that dense. Fragmentary remains of another individual (KU-B25) were found in this northern midden area. These human remains have not yet been examined by a bioarchaeologist. Interestingly, this northern external area, which clearly had higher densities of archaeological materials than the southern area, had much lower plant densities (Bruno 2008: 426).

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
B249	Surface	7590, 7508, 7579, 7588, 7507, 7578, 7593	751 (7737.95)	10.3	12.7
B262	Fill	7506	118 (627.5)	5.3	4.3
B261	Surface	7518, 7580, 7519, 7517, 7522, 7713	769 (4955.5)	6.4	4.7

Table 4.4: Analyzed Late Formative contexts from Kala Uyuni ASD-5

We interpreted ASD-5 as a domestic structure or food preparation area associated with the lower structures (Roddick et al. 2006: 37-38). In her thesis, Bruno (2008: 426) notes a high density of quinoa suggesting food consumption in this area, and agrees that this is likely a domestic structure. This is significant: since the inception of TAP we have been interested in finding such discrete spaces (Dean and Kojan 2001; Hastorf 1999; Paz Soria 2005; Roddick 2002). As such this structure represents an extremely important finding for Late Formative archaeology on the Taraco Peninsula. The relationship between the three structures, however, is currently unclear. Bruno points out that the three radiocarbon dates do not appear to support similar phases for ASD 5 and ASDs 2 and 4. While all three of these contexts appeared to be *ceramically* Late Formative I in date, they all returned dates usually associated with Late Formative II. There are several possibilities for this discrepancy, which I will explore in detail in the next chapter.

4.45 –Kala Uyuni outside of ASD 5

During the 2005 season Mary Leighton and Marcia Peterson excavated a 1x4 meter area directly to the west of ASD-5. The goal was to further identify any possible use surfaces associated with ASD-5, and perhaps other domestic architecture. Leighton and Peterson quickly came across a clay surface (KU-B237) that extended throughout most of their excavation units (Roddick et al. 2006: 32-33). This yellow clay had very few artifacts and was disturbed by Tiwanaku and Late Formative period middens, pits and burials. The material from this surface often included mixed bags of Late Formative and Tiwanaku IV/V materials. However, a series of events were deemed to be sufficiently unmixed (and possibly related to ASD 5) to generate a sufficient Late Formative sample size. These contexts include several pits, a mottle clay surface and a clay cap. As I will discuss in later chapters, these surfaces are potentially important spaces when considering ceramic production.

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
B239	Clay Cap	7702	28 (161.4)	5.8	5.4
B273	Pit Fill	7712	194 (1473.2)	7.6	7.6
B271/B269	Pit Fill	7711	122 (750.8)	6.2	13.6
B270	Surface	7710	369 (1942.6)	5.3	7.3

Table 4.5: Analyzed Contexts Outside of ASD 5

4.46 – Kala Uyuni west of ASDs 2,4 & 5

In the 2003 season Maria Bruno and Mary Leighton opened a 2x2 meter unit (N894/E639, see the isolated unit to the left in Figure 4.9) with the hopes of finding a better stratigraphic deposits for phasing purposes (Bruno and Leighton 2007: 35). After excavating approximately 156 centimeters, and uncovering two burials and many mixed Tiwanaku deposits, Bruno and Leighton encountered the Tiwanaku IV/V to Late Formative transition. The first unmixed Late Formative deposit was a medium-density midden (KU-B33). Under this they found a yellow clay surface (KU-B34), which ceramically is one of the few Late Formative II phase contexts excavated by TAP at Kala Uyuni.

Bruno and Leighton (2007: 37) then excavated a sequence of pits and a medium-density midden (KU-B39). This midden returned a 1-sigma date of AD 70-240 (AA59721). Below this midden was another compact clay deposit with bright yellow and orange staining and a high density of artifacts. Bruno and Leighton (2007: 37) interpret as an occupation zone (KU-B67). At approximately the same level of the occupation zone, but in the corner of the unit, they encountered two burials of adults in flexed position (Bruno and Leighton 2007: 38-39). The first (KU-B72) burial had no grave goods. The second (KU-B73) individual was oriented east west and lined with a large grinding stone. Placed at the foot was a small red-rimmed Kalasasaya bowl (Bruno and Leighton 2007: 39, Figures 5.4 and 5.5, see also Figure 9.9b), suggesting this was a Late Formative burial.

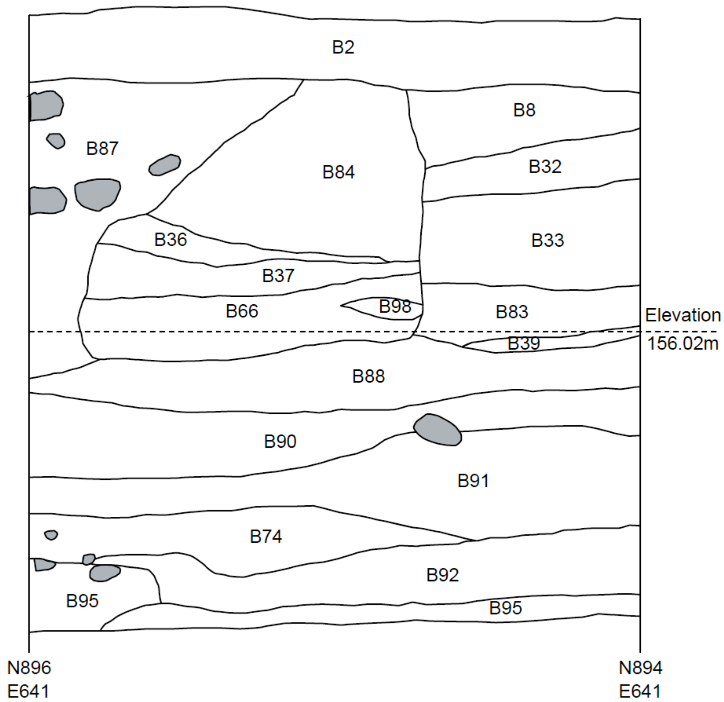

Figure 4.8: East profile of KU KU N894/E639

Event	Context	Loci Analyzed	# (weight) analyzed sherds/Volume Excavated	Average Sherd Weight	Density
B39	Midden	5274, 5304	148 (1091.1)	7.4	na
B88	Midden	5305	9 (62.5)	6.9	2.0
B67	Occupation Zone	5308	328 (2713.6)	8.3	5.7
B70/B89	Midden	5310, 5312	103 (883.8)	8.6	8.8
B73	Burial	5316	91 (840.4)	9.2	11.3
B91	Midden	5317, 5318	3129 (17871.1)	5.7	12.2
B74	Midden	5320	977 (6808.1)	7.0	na
B92	Midden	5321, 5323	1627 (9240.2)	5.7	10.1
B34	Surface	5272	116 (852.2)	7.3	1.5

Table 4.6: Analyzed Late Formative Contexts from the west of ASD 2,4 and 5. ** Note that B34 was phased to the Late Formative II.

In other parts of the unit Bruno and Leighton encountered a complex series of Late Formative deposits, few of which were superimposed in a clear fashion. They uncovered a medium-density midden (KU-B89), an ash deposit (KU-B70) and several high-density middens (KU-B88, KU-B91 and KU-B92). The final deposit they encountered above sterile was a lens of ash and fish bones (KU-B97), which returned a 1-sigma date of 22-212 cal. AD (AA59713). This ash rich midden also included the densest deposit botanical samples that Bruno (2008: 447) encountered.

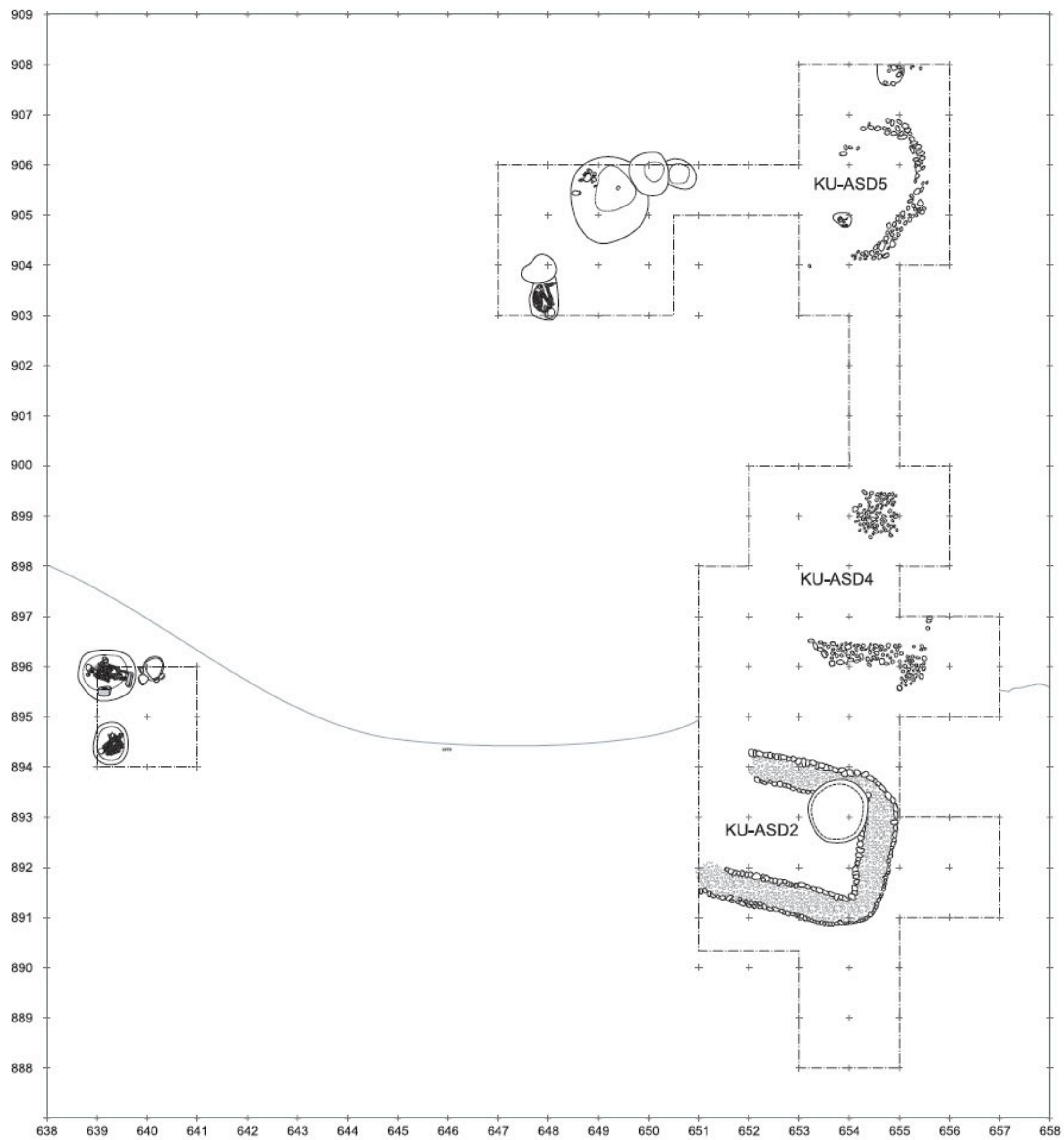

Figure 4.9: KU KU area plan map showing locations of ASD-2, ASD-4, ASD-5, use area outside of ASD-5, and area west of ASD-2, ASD-4 and ASD-5.

It is not entirely clear what this area represented, however the evidence from ASD-2, ASD-4 and ASD-5 offers one possibility. All the structures associated with the KUKU open to the west. Moreover, the dates from this area overlap with dates from the interior of ASD-2 (discussed in Bruno 2008: 448). If structures 2 and 4 are, in fact, part of series of structures surrounding this central area this could be the center of a court or patio similar to that found at Chiripa and Pukara (Beck 2004; Hastorf 1999; Mohr Chávez 1988). As a total of five burials (albeit of different phases) were found in this sector, Bruno (2008: 442) suggests this area may have been a mortuary area of the site. This, of course, is not necessarily counter to the court idea, and excavations in the 2009 season will hopefully clarify these issues.

4.47 –Kala Uyuni Siwinka Qontu (KU SK)

In the 2005 season, Christine Hastorf placed a 1x2 meter unit in the most southern section of the site, Siwinka Qontu (KU SK). This area was chosen as Bandy had encountered a high density of Middle Formative ceramics on the surface (see Figure 4.2 and 4.3), and auguring recovered both Middle and Late Formative sherds. Like in the KU KU area, the plan was to seek out the Middle to Late Formative transition. In this small excavation, totaling 9 distinct events, Hastorf found a series of middens (KU-D7, KU-D8 and KU-D9), with substantial densities of ceramics, lithics and faunal materials.

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
D7	Midden	7608	427 (2797)	6.6	6.2
D9	Midden	7611	362 (2663.3)	7.4	7.2

Table 4.7: Analyzed Late Formative contexts from the Siwinka Qontu area of Kala Uyuni

Two radiocarbon dates were run from these middens. One midden (KU-D9) returned a 1-sigma date of 370-110 BC (Beta217120). Another midden (KU-D8) was dated to 1-sigma 40 BC- AD130 (Beta217119). These dates reflect our interest in the transition from the end of the Middle Formative to the early phase of the Late Formative I period, but unfortunately Hastorf did not encounter any pure Middle Formative materials. Each midden event had a mix of Middle Formative (Late Chiripa Phase) materials with Late Formative ceramics (D7 with 14 % late Middle Formative, D9 with 23% late Middle Formative). While excavations and later laboratory work have not revealed the nature of the possible activities in this area, Bruno (2008: 393) does note that that this area was useful for tracking the shifting plant taxa between the Middle and Late Formative Period. As we will see in Chapter 8, this area is also suggestive of some changes in production sequence through time.

4.48 Defining Late Formative Sonaji

Bandy's 2000 survey of the Peninsula found the site of Sonaji (T-271), located under the modern town of Santa Rosa (Bandy 2001:101). While the entire site is approximately 13.75 ha in size, the Middle Chiripa (Early Formative component) is approximately 5.0 ha, making Sonaji, along with Chiripa (T-1) and Janko Kala (T-394), one of the largest Middle Formative sites Bandy found for the Middle Chiripa phase of the Early Formative. Bandy ascertained that there was "no doubt" that Sonaji was a major Middle Chiripa site" (Bandy 2001: 102; see Figure 4.2). Nevertheless, excavations conducted at the site thus far have found no evidence of a substantial Middle Chiripa assemblage.[2]

Bandy believes that the site was abandoned during the Middle Formative through the complex sequence of village fissioning seen across the Peninsula. He suggests that Sonaji was reoccupied during the Late Formative I period, at which point the population extended across approximately 6.75 ha (Bandy 2001: 177), and the inhabitants were also associated with Kumi Kipa (T-272, discussed below) and Kollin Pata (T-322). Bandy refers to the three settlements as the Santa Rosa group. By the Late Formative 2, there was only a slight depopulation of the site (compared to other sites of the Peninsula) and it is likely that Sonaji, Kumi Kipa and Kollin Pata formed a single extended community. While both Kumi Kipa and Kollin Pata were primarily residential, Bandy extrapolated a large platform (approximately 50m x 50m) at Sonaji suggesting a more public function. Furthermore, the high number of decorated sherds on the surface suggested to Bandy that "Sonaji itself seems to have been relatively specialized…It may very well have been the residential locus of a local elite, as well as the location of the principal public architectural complex on the Taraco Peninsula" (Bandy 2001: 182).

In fact, Sonaji plays an essential role in Bandy's narrative of village fissioning and aggregation. Bandy believes that the village attracted populations from nearby Kala Uyuni midway through the Late Formative Period: "At some later point within the LF1, Kala Uyuni was almost completely abandoned, and the bulk of its population was relocated to the Santa Rosa group. This population relocation accounted in part for the

[2] We did encounter several mixed Middle Formative deposits underneath the substantial Late Formative contexts (Appendix 1). However, we have yet to uncover any extensive occupations, or any intact Middle Formative contexts.

very rapid growth of the Santa Rosa group" (Bandy 2001: 192). He posits that the Santa Rosa group had a combined population much larger than Kala Uyuni and likely larger than Tiwanaku at approximately 100 AD. Bandy notes that the ceramic phasing does not permit a division within this Tiwanaku 1 period, a time that according to his model would have seen important changes in the local dynamics of the region.

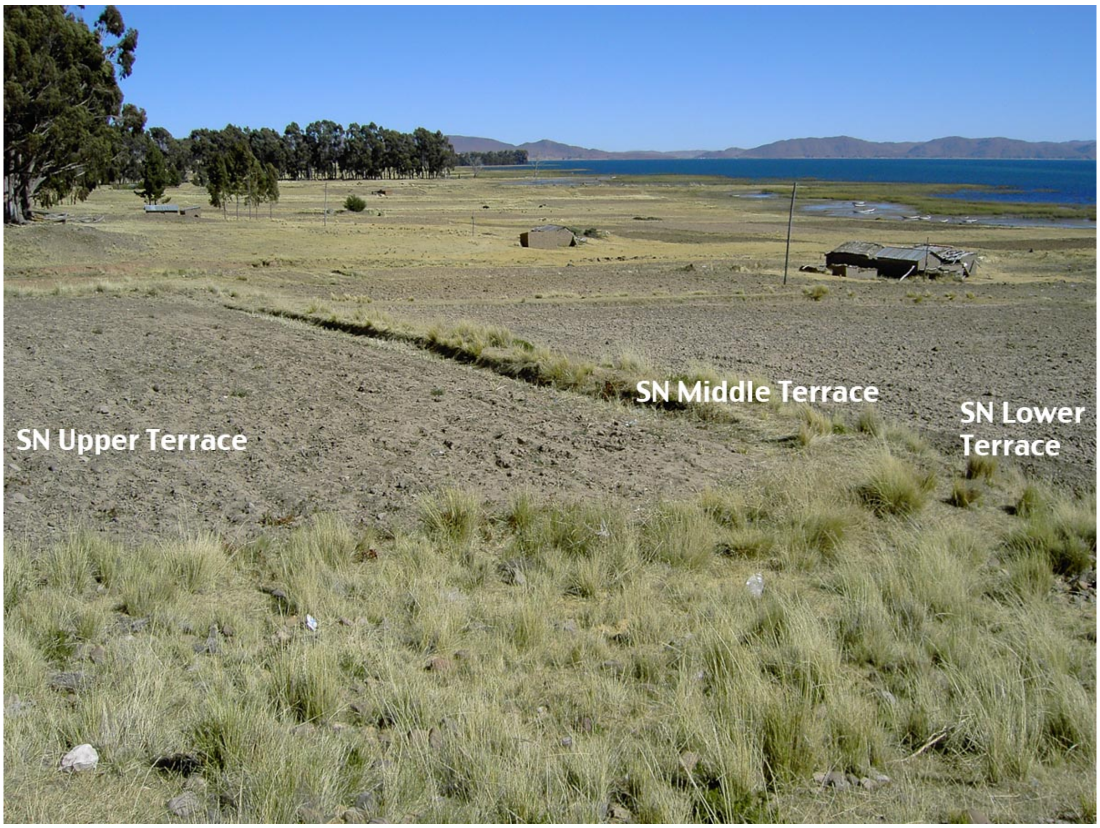

Figure 4.10: Late Formative site of Sonaji, with relative location of upper, middle and lower terraces. Note that the middle terrace is defined in the slump between the upper and lower terrace (see topography in Figure 4.2).

Unfortunately for TAP, with our primary interest in the Formative Period, the site was also occupied during the Tiwanaku IV/V periods. There were few clear occupations that were not destroyed by later Tiwanaku activity and pits. The natural stratigraphic sequence was extremely complex, and often was quite mixed. Nevertheless, the samples from this site offer an important lens into production and consumption in another local site on the Peninsula, and they compliment the Kumi Kipa assemblage discussed below. Excavations took place on three terraces of the hypothesized platform, which descend to the lacustrine plain below. Unlike the work at Kala Uyuni, little interpretation of the site has been conducted apart from that of the reports presented to the Bolivian government.

4.49 Sonaji's Lower Terrace

Excavations in 2004 began on the lower terrace with one 2x2 meter unit (N988 E978) excavated by Delfor Ulloa Vidaurre (Ulloa Vidaurre and Killackey 2005: 19-20). The stratigraphic sequence here was fairly clear (see Figure 3.9 in Ulloa Vidaurre and Killackey 2005: 20), with little complexity in the sequence of pit fills and midden deposits. These deposits were interpreted by Ulloa Vidaurre as a series of leveling events associated with the upper terraces. Table 4.8 shows the phased Late Formative assemblage from the lower terrace.

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A10	Midden	6011	443 (939.6)	4.4	7.7
A18	Midden	6057, 6058	266 (937.7)	3.5	3.7
A19	Midden	6054	99 (582.6)	5.9	9.6
A20	Midden	6055	418 (1306.9)	3.1	4.7
A21	Midden	6059	108 (401.8)	3.7	6.4
A22	Midden	6061	188 (498.5)	2.6	2.0
A7	Midden	6006, 6012, 6015, 6050	1324 (4585.3)	3.5	3.2
A12	Pit Fill	6019, 6024	181 (758.7)	4.2	5.9

Table 4.8: Analyzed Late Formative contexts from Sonaji's lower terrace

4.410 Sonaji's Middle Terrace

Kathryn Killackey placed the sole unit on the middle terrace (Ulloa Vidaurre and Killackey 2005: 11-19). Some of the earliest deposits in this area were fill and erosional deposits from upslope, but most phased ceramically to the Late Formative period. Killackey found two hearths (SN-A67, SN-A68) – full of ash, charcoal, bone and ceramics – and other ash rich deposits (SN-A72 and SN-A73) capped by a clay surface (SN-A70). This surface suggests that there were activities associated with this area during the use of the stepped platform. Above this clay was a medium density midden (SN-A66), with a very poorly preserved red clay floor above the midden (SN-A53). Capping a surface and a midden deposit was a level of green silty clay (SN-A61).

On top of this green level was a 30 cm-deep midden, dense in Late Formative ceramics, ground stone, lithics, bone and charcoal (SN-A60). Next Killackey found another greenish gray layer (SN-A59), approximately 2 cm thick. A 120 cm wide and 75 cm deep bell shaped pit was cut into this layer. This pit was stratified (SN-A57, SN-A56, SN-A55, SN-A54) with a complete unworn stone hoe found mixed in with clay, charcoal and faunal bone in deposit SN-A56 (see Ulloa Vidaurre and Killackey 2005: Figure 3.6). The majority of these deposits had Late Formative I phase ceramics, although several were mixed with Middle Formative ceramics (Table 4.9 and Appendix 1).

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A52	Fill	6047, 6078, 6080	202 (1067.6)	5.3	3.5
A60	Midden				
A66	Midden	6098	114 (689.3)	6.0	3.6
A54	Pit Fill	6083	84 (466.5)	5.6	4.7
A54/A60	Pit Fill/Midden	6084, 6085	653 (3862.5)	5.9	3.9
A54/A55	Pit Fill	6089, 6087, 6088	342 (4352.7)	12.7	7.1
A59	Surface	6082	29 (130.4)	4.5	2.2
A63	Surface	6096	29 (103.9)	3.6	2.6
A74	Surface	6128	6 (30)	5.0	7.5
A75	Surface	6136	364 (1882.7)	5.2	5.0

Table 4.9: Analyzed Late Formative I contexts from middle terrace at Sonaji

Figure 4.11: Adobe wall of Sonaji ASD-1.

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A48	Fill	6045	64 (220.4)	3.4	3.8
A50	Fill	6075	20 (77.3)	3.9	3.1
A46	Midden	6039, 6040	48 (228.6)	4.8	3.0
A49	Surface	6048	131 (806.4)	6.2	3.4
A47	Wall	6043, 6076	135 (948.1)	7.0	6.8
A51	Wall	6079	28 (216)	7.7	2.7

Table 4.10: Analyzed Late Formative II Contexts from ASD-1 from the middle terrace at Sonaji

Directly on top of a final fill episode (SN-A52), Killackey encountered ASD-1, the only structure TAP has excavated that has been clearly phased to the Late Formative II period (Table 4.1). ASD 1 consists of 1 to 2 courses of pink and yellow clay bricks running north-south, with three bricks seen in the south profile (Figure 3.7; see also Ulloa Vidaurre and Killackey 2005: 17). A yellow clay floor (SN-A49) extended westward from the wall, but was very disturbed by later pits. While this wall and floor suggests that

Sonaji was occupied during the Late Formative II period, as suggested by Bandy (2001:180-182), it is quite destroyed and the relationship of this structure to the rest of this site remains unclear. Above this wall and rubble Killackey noted a low-density midden (SN-A46), a sequence of intrusive Tiwanaku contexts and several erosional deposits.

4.411 Sonaji's Upper Terrace

Delfor Ulloa Vidaurre and Christine Hastorf first excavated the upper terrace at Sonaji in 2004 (N1001 E1035) (Ulloa Vidaurre and Killackey 2005: 20-26). More extensive excavations (a 6x6 meter unit) were opened in the 2005 season (Bruno, et al. 2006). At the end of the 2004 season the excavators had uncovered three walls at approximately 2 meters below datum (ASD-2) and directly above a thin Middle Formative assemblage, which in turn sat on sterile. It was these in situ walls that pushed another season at Sonaji in 2005 (Bruno et al. 2006). This area is stratigraphically extremely complicated. Even from the small units encountered in the first season it was clear that Tiwanaku phase pits would be an issue: in the 2005 excavations a total of 35 pits were excavated (see Bruno et al. 2006: Figure 4.1). Due to these continual pits, many of the deposits were excavated as small loci, often with too few cultural materials to accurately phase or determine the taphonomy of particular contexts. I will not delve into the details of these difficult excavations here, but rather will focus on those that form my sampling universe of the Late Formative assemblage, paying particular close attention to the larger excavations of the 2005 excavations.

Intact Late Formative deposits at Sonaji begin, in earnest, at approximately 98 centimeters below datum, with a bright yellow/orange clay deposit (SN-A206, SN-A207 and SN-A266 depending on the area of the site) that covered almost the entirety of the excavated 6 by 6 meter area. Many pits disturbed this area, some of which appear to have been Late Formative in date (for example SN-A305, Figure 4.12). A radiocarbon date from one of these clay surfaces (SN-A207) returned a 1-sigma date of AD253-530 (Beta217118). Excavators found little evidence of architecture in the 6 by 6 meter. While excavators initially interpreted the hard matrix associated with all these pits as the result of burning activities, analysis of the soils by micromorphologist Melissa Goodman and of the bone by Kate Moore suggests rather a magnesium deposit. Nevertheless, burned material was indeed found in many of these pits (Moore et al. 2007).

Figure 4.12: The event A206, with locus 7046 on the right, and locus 7086 on the right. Note the later Tiwanaku pits excavated into the clay surface.

The true complexity of this area was found beneath this clay surface, where a series of midden and fill deposits dense with high carbon and ash were found across the excavated area[3]. In the western part of the unit, below the orange clay (SN-A207), they uncovered a likely occupation zone and surface (SN-A299/SN-A300). The excavators

[3] There was much discussion between the excavators here as to what constituted fill and what was midden deposit. Such debates are not inconsequential; if these deposits are fill we cannot interpret the use of space for much of this upper terrace, while midden deposits suggest a very complicated use-history of this part of Sonaji.

defined this event based on artifacts laying flat on the surface of a yellow clay deposit, but again there were no clear associated architectural foundations. Below these surfaces were more typical midden deposits (SN-A324, SN-A325), with a dark soil rich in ash and carbon, although differentially deposited throughout the excavation area. Another dense midden deposit (SN-A278) was found across the entire area. Below this was another use surface (SN-A285) and a midden (SN-A270) associated with two burials: Burial 2 (SN-A233), of a likely sub-adult with two grinding stones, and Burial 3 (SN-A334, SN-A335, SN-A336), of a child with no grave goods, although fragments of a necklace were found in the associated floatation samples.

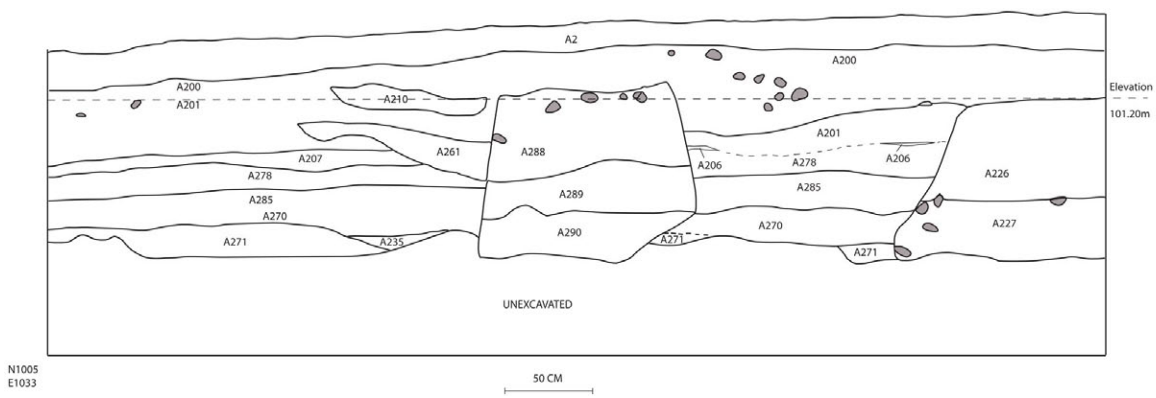

Figure 4.13: North profile of Sonaji's upper terrace

In the eastern part of the excavation unit, below the clay surface SN-A206/SN-A297), the excavators uncovered several middens (SN-A324, SN-A325), a rocky fill (SN-A337) and the large midden dump (SN-A278), also found in the western sections of the unit. Another sequence of middens (SN-A268, SN-A271) and pits (SN-A272/SN-A273, SN-A275/SN-A276) were encountered beneath this. Cutting into the SN-A271 midden was another burial, Burial 4, of a sub adult positioned in a seated flexed position. Associated with this burial were several grave goods including pieces of gold, a small ceramic vessel, some lithic tools and some large ceramic fragments (Bruno, et al, 2006: 56).

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A267/A298	Fill	7068	122 (527.9)	4.3	2.5
A272	Fill	7154	21 (74.2)	3.5	2.5
A298	Fill				
A268	Midden	7117	159 (835.5)	5.2	3.0
A270	Midden	7132, 7136, 7138, 7140, 7141, 7146	1349 (6993.4)	5.2	4.0
A271	Midden	7139, 7143, 7152, 7229, 7174, 7176, 7198, 7202	1391 (5255.1)	3.8	4.1
A278	Midden	7086	317 (1058.8)	3.3	6.6
A324	Midden				
A325	Midden	7126, 7147	195 (752.3)	3.9	5.6
A278/A324	Midden	7104, 7119	157 (801.2)	5.1	4.7
A278/A286	Midden/Lens	7123	200 (1139.7)	5.7	5.3
A278, A298	Midden/Surface	7116	119 (454.2)	3.8	3.4
A257	Pit Fill	7102	73 (363.4)	5.0	4.0
A275	Pit Fill	7214	88 (430.5)	4.9	10.0
A306	Pit Fill	7038	166 (1518.3)	9.1	9.7
A313	Pit Fill (clay)	7079	99 (347.9)	3.5	3.1
A317	Pit Fill (ash)	7091	124 (456.6)	3.7	1.6
A330	Pit Fill (ash)	7211, 7157	130 (503.1)	3.9	na
A281/A319	Pit Fill (clay)	7184	57 (245.5)	4.3	3.5
A23	Sterile	6138	15 (71.4)	4.8	0.1
A206	Surface	7062, 7046, 7058	461 (1658.8)	3.6	4.2
A207	Surface	7064, 7057, 7074, 7095	976 (4117.2)	4.2	2.7
A285	Surface	7085, 7092, 7094, 7111, 7131, 7129	1943 (7331.1)	3.8	4.0
A299/A300	Surface	7105	88 (274.5)	3.1	5.7
A339	Surface	7155	64 (242.3)	3.8	10.4
A281/A320	Wall Fall	7182, 7188	175 (753.8)	4.3	2.4
A282/A322	Wall Fall	7194	133 (128.5)	1.0	1.0

Table 4.11: Analyzed Late Formative Contexts from the Upper Terrace at Sonaji.

Beneath the complex stratigraphy of the upper levels, the excavators exposed more of ASD-2 in the form of some wall fall (SN-A320, SN-A328) and large sections of orange clay. The irregularity of this clay along with the thickness suggested to the excavators that this orange clay was most likely a decomposed collapsed adobe wall. The low level of cobble rubble suggested to the excavators that the structure was likely constructed using *tapia* (rammed earth) architecture. Although it was almost impossible to define internal and external use space for this structure, a use surface, potentially a floor (SN-A329) with much bioturbation and very few cultural materials was found in the western part of the excavation unit. This surface, however, is found below the structure's foundation (and included some Middle Formative materials), and as such may relate to activities prior to the construction of this building. Furthermore, it was quite disturbed by a later intrusive pit. In other areas there were clearer examples of surfaces (SN-A344) including possibly the earliest occupation zone of the site in the form of clay surface with discreet carbonized areas suggesting in situ burning (SN-A343).

Figure 4.14: SN ASD-2.

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A249	Burning	7217	23 (83.3)	3.6	2.1
A274	Clay	7504, 7233	59 (280.7)	4.8	3.1
A322	Fill	7194	133 (128.5)	1.0	1.0
A96	Fill	6121, 6122, 6123, 6124, 6150, 6152, 6153	300 (1720.9)	5.7	3.2
A99	Hearth	6155	10 (30.9)	3.1	4.6
A277	Midden	7222, 7237	174 (850.3)	4.9	3.7
A277/A321	Midden	7234	28 (115.7)	4.1	1.6
A247/277	Midden/Pit Fill	7207	326 (2231.9)	6.8	5.7
A247	Pit Fill	7219	80 (309.6)	3.9	4.8
A100	Surface	6156	111 (479)	4.3	6.0
A101	Surface	6157	20 (86.1)	4.3	Na
A251	Surface	7228	43 (374.1)	8.7	3.2
A329	Surface	7223	97 (452.4)	4.7	Na
A98	Surface	6154	115 (749.7)	6.5	20.6
A321	Wall	7212	17 (53.4)	3.1	1.4
A320	Wall Fall	7182, 7188	175 (753.8)	4.3	2.4
A328	Wall Fall	7220, 7210	32 (103.2)	3.2	1.2
A95	Wall Fall	6120	20 (88.4)	4.4	1.0

Table 4.12: Analyzed Late Formative Contexts from ASD2 of upper terrace at Sonaji

The excavators end their discussion of this structure by making two important points. First, and in contrast to Bandy's interpretations based on surface survey, this site was not a large Middle Formative site (although there were a few Middle Formative sherds found deep in the unit). Second, this sequence of deposits were likely built up over a long period of time, rather than from two quick fill episodes as initially proposed by Ulloa Vidaurre after the 2004 field season.

4.412 Defining Late Formative Kumi Kipa

The archaeological site of Kumi Kipa (T-272), like Sonaji, is part of Bandy's Late Formative Santa Rosa group (Figure 4.1). The site is located in the community of Santa

Rosa, and lies 150 meters from the modern shore Lake Titicaca on a north-south ridge running from the lakeshore. Bandy (2001: 102) believes that Kumi Kipa was an 11-hectare site during the Late Formative, with two low artificial mounds. The southern one measures 20 square meters, while the northern feature is smaller and ovoid. Bandy found primarily Late Formative and Tiwanaku period sherds on the surface, although he also found a small Middle Chiripa site (in his sector A) that he associated with Sonaji. Bandy interpreted the low quantity of decorated sherds on the surface as evidence that Kumi Kipa was where the majority of the Santa Rosa group lived. This is surprising, as excavations found a high density of decorated ceramics (discussed in Chapter 7 and 9). TAP treated the two mounds as two components of a single dispersed site. Bandy (2001: 182) suggests that Kumi Kipa is one of the few Taraco Peninsula sites that grew during the Late Formative 2 phase. TAP excavations and the analysis discussed below do not support this interpretation. In fact no LF2 occupations have yet been phased from these excavations.

The 2004 excavations focused on two sectors of the site – the upper mound and a lower area – to expose architecture and midden deposits. Although the upper Monticulo area dates primarily to the Tiwanaku Period, some Late Formative contexts were uncovered. After systematically auguring the lower area, excavators placed 4 isolated 2x2 meter units along with 14 square meters of excavation of a Late Formative structure (Fernandez Murillo et al 2004). The unusually shallow deposits initially suggested that the area was deflated (perhaps due to its exposed location), however recent geoarchaeological work suggests otherwise (Petersen 2007).

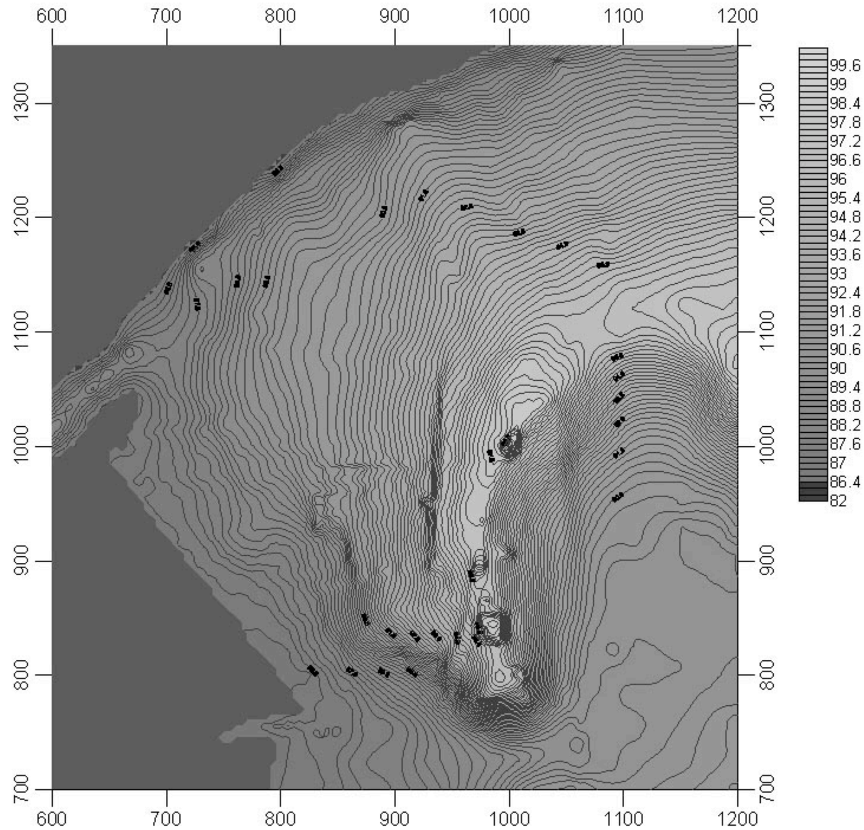

Figure 4.15: Kumi Kipa topographic map

4.413 Kumi Kipa Monticulo

Emily Stovel and Ani Raath placed a unit (N868 E983) in the center of the larger low mound on the Kumi Kipa Monticulo. They immediately encountered a hole suggesting the area may have served as a burial mound. They found one major Tiwanaku tomb (KK-A67, KK-A39, KK-A66), with disarticulated remains, a grinding stone, turquoise, a complete Tiwanaku vessel and some laminate gold fragments (Fernandez Murillo et al. 2004: 30-32, Figures 4.3-4.5). They also found another Tiwanaku tomb in the corner of the unit (KK-A66). Below this was a Late Formative surface (KK-A72), which was little more than compacted clay with artifacts laying flat on the surface, and what the excavators call an occupation zone (KK-A80). No Late Formative architecture was found associated with these surfaces. A Late Formative pit (KK-A70) (Fernandez Murillo et al. 2004: 34, Figure 4.7) was encountered with llama remains placed inside a Kalasasaya vessel. Both the tomb and the Late Formative contexts were somewhat disturbed by a later, modern pit cut (KK-A24).

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A70	Pit fill (camelid bones)	6607, 6608	95 (256.1)	2.7	3.9
A80	Occupation Zone	6611	296 (728.7)	2.5	2.7

Table 4.13: Analyzed Late Formative contexts from Kumi Kipa Monticulo area

4.414 Isolated Kumi Kipa Units

In the lower area, Soledad Fernandez placed three isolated 2x2 meter units (N921 E905, N911 E968, N06 E936) based the results of systematic auguring. No architecture was found in these units, but various Late Formative pits, middens and occupation deposits were encountered (Fernandez Murillo, 2005: 31-35). These contexts, although not clearly linked to clear activity areas, serve to augment the sample size of the Kumi Kipa LF1 ceramic assemblage.

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A9	Occupation Zone	6532	98 (585.8)	6.0	1.0
A11	Occupation Zone	6534	407 (2230.9)	5.5	2.3
A15	Occupation Zone	6538	801 (3889.7)	4.9	3.8
A17	Occupation Zone	6540, 6555, 6558	552 (3340.1)	6.0	1.9
A28	Surface	6551	257 (2148.1)	8.4	5.0

Table 4.14: Analyzed Late Formative contexts from three units excavated at Kumi Kipa

4.415 Kumi Kipa ASD-1

The 2004 excavation at Kumi Kipa revealed the foundation of a Late Formative structure, KK ASD-1. This structure was encountered during an initial auguring project from which a series of 2 x 2 meter excavation units were placed (Fernandez Murillo 2005: 35-36). In total 9 units and 14 square meters were excavated in order to define the structure of ASD-1 (Figures 4.16 and 4.17). The original unit (N921 E905) recovered part of a foundation as well as a clay surface extending to the north. To the west, the foundation extends approximately 5 meters, with a small corner pointing northwards. Further units to the west were excavated to discover the entrance, however no more stone foundations were found (Fernandez Murillo et al 2004: 37-38). A north-south trench also recovered little intact architecture or any other significant features. Little of the building was found as the surfaces were ephemeral, much of the foundation was destroyed, the nature of the surrounding sediments made defining eroded adobe walls and surfaces extremely difficult, and much like Sonaji, those later inhabitants from Tiwanaku IV/V periods had placed pits throughout the area. In sum, ASD-1 is limited to a single wall with a floor to the north and possibly an external surface to the south.

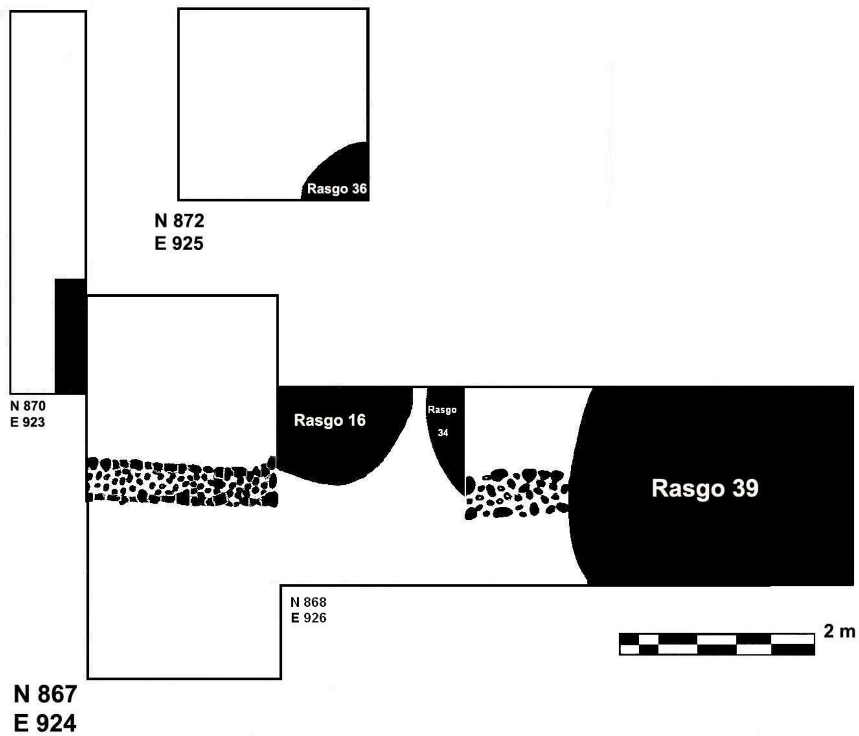

Figure 4.16: Plan map of ASD-1 at Kumi Kipa. The excavators believe that the area to the North (upper part of the image) is the interior surface of the structure).

ASD 1 was constructed on a thick layer of dark brown clay (KK-A64). The wall foundations of this structure were constructed with two rows of flat river cobbles (in some cases reused grinding stones), filled with smaller gravel and mortared with clay (Fernandez Murillo 2005: 44). The cobble wall varies from 33 and 35 centimeters in width and is more or less east/west in orientation. The recovered wall measures approximately 3 meters long.

A floor was identified on the north side of the structure, suggesting that the excavators discovered the interior of the structure. The floor of the structure (KK-A50 and KK-A55) was made of thick, compact yellow clay (Fernandez Murillo 2005: 37). The floor was fairly clean with few materials, but an occupation deposit was found on top of the floor (KK-A127). To the north of the foundation, and associated with the floor, the excavators recovered small, circular features with ash, which they refer to as hearths. Maria Bruno's botanical analysis of the contexts found low densities of materials (primarily Fabaceae and Poaceae seeds) with very little wood. However she also recovered relatively high numbers of Nicotiana sp. seeds within otherwise sparse samples (Bruno personal communication). This suggests that these hearths are unusual deposits, as such botanical samples are rarely found elsewhere in Late Formative contexts. A sample from one such burning context (KK-B56) returned a 1-sigma radiocarbon date of AD 60-250 (AA64918).

Figure 4.17: Photograph of ASD 1 at Kumi Kipa

Event	Context	Loci Analyzed	# (weight) analyzed sherds	Average Sherd Weight	Density
A4	Occupation Zone	6505	3306 (11284.1)	3.4	9.1
A5?	Midden	6722	167 (1130.4)	6.8	6.4
A85	Surface	6661	27 (171.2)	6.3	5.9
A159/A160	Midden	6702	214 (1409.1)	6.6	14.8
A43	Surface	6572, 6573	257 (1400.3)	5.4	na
A41	Midden	6568, 6571	582 (1964.5)	3.4	4.6
A154	Occupation Zone	6642	83 (407.4)	4.9	7.1
A98	Clay Lens	6628	10 (69.2)	6.9	3.5
A50	Occupation Zone	6588, 6674	305 (1589.8)	5.2	2.8
A55	Surface	6688, 6671, 6589,	140 (1073.8)	7.7	na
A127	Floor	6740, 6648, 6629	159 (1228.3)	7.7	5.6
A46	Fill	6575	201 (770.4)	3.8	9.4
A64	Fill	6595	235 (1381.4)	5.9	4.3
A47/A48	Fill	6577	515 (1080.4)	2.1	8.1

Table 4.15: Analyzed Late Formative contexts from Kumi Kipa ASD-1 area

To the south of the foundation, the area "outside" of the structure (KK-A98, KK-A4), excavators found more diffuse deposits (Fernandez Murillo et al 2004: 37, 46). This use surface was constructed from various lenses of clay, with a thickness of approximately 3 centimeters. A sample from this surface (KK-B43) returned a 1-sigma date of AD 30-220 (AA64919). Bruno (personal communication) found that these features south of the wall have relatively low densities of charred Poaceae, Fabaceae, Mavlaceae, and Chenopodium quinoa seeds. Above the interior and exterior surfaces of ASD1 was a level of clay and larger gravels with various sand lenses (KK-A41), thought to be associated with the use of the structure.

In sum, the Late Formative occupation at Kumi Kipa consists of a series of occupation surfaces and a fairly destroyed enclosure. While excavators had hypothesized that the fluvial processes destroyed ASD-1, Marcia Peterson's (2007) geoarchaeological work suggests that the structure was likely destroyed by human activity. The radiocarbon dates, which both fall between the 1st and the 3rd century AD, fit the end of the Late Formative I period, thus are contemporaneous with KU-ASD2. The ceramics from these contexts were also primarily Late Formative I in phasing, with the exception of one midden context (KK-A15) and other generally mixed contexts.

4.5 Summary: Excavations and Beyond

The 2003-2005 excavations of the Taraco Archaeological Project uncovered a wide range of Late Formative contexts with equally diverse ceramic densities with a variety of states of fragmentation. As Table 4.16 shows, the 2003-2005 seasons excavated a total of 42,376 liters of matrix associated with the Late Formative period. If those contexts not yet phased are accounted, close to 50,000 liters of soil were excavated associated with this period. It is important to note that my sample size varies considerably for particular sites and particular areas. For instance, fewer materials were sampled from Kumi Kipa during my analysis (8,480 liters) and the small excavations at Kala Uyuni Siwinka Qontu (KU SK) moved less earth (820 liters) when compared to those from Kala Uyuni Kala Uyuni or Sonaji.

The ceramics studied in this thesis were recovered in a wide range of conditions, which must be factored in for my later analysis. Tables 4.17 and 4.18 show those contexts that are the most and least fragmented in terms of the index employed here (section 4.4). Not surprisingly, those contexts from Kala Uyuni, particularly the deep contexts well protected under later Tiwanaku erosional deposits, tend to be the best preserved.

AREA	CONTEXT	VOLUME EXCAVATED (L)
KU KU	ASD 2	8090
	ASD 4	790
	ASD 5	1820
	OUTSIDE ASD 5	540
	West of ASDs 2,4,5	3625 *
	TOTAL	**14865**
KU SK	KU SK	820
	TOTAL	**820**
SN SN	LOWER TERRACE	2490
	MIDDLE TERRACE	2679
	MIDDLE TERRACE LF2	625
	UPPER TERRACE	10080*
	UPPER TERRACE ASD 2	2337 *
	TOTAL	**18211**
KK KK	MONTICULO	335
	ISOLATED UNITS	4770
	ASD 1	3375 *
	TOTAL	**8480**
TOTAL		**42376**

Table 4.16 The volume of soil excavated associated with Late Formative phase assemblages from the 2003-2005 TAP excavations in the KU KU, KU SK, KU SN and KK KK areas.

At Kala Uyuni, we excavated three relatively intact structures (ASD-2, ASD-4 and ASD-5) with their associated work areas (hearths, exterior surface and midden deposits). We encountered a wide variety of midden and pits, in some cases with specialized deposits within their fills (KU-B15). While Kala Uyuni did not reveal the clear chronological transition from the Middle to Late Formative that we were hoping for, the SK area included several mixed deposits that are suggestive of the sequence of subtle changes that most likely occurred over that transition.

While neither the contexts from Sonaji nor Kumi Kipa were as well preserved as those from Kala Uyuni, they both offer some important contexts for analysis. For instance, Tables 4.19 and 4.20 show the highest and lowest ceramic densities (by volume excavated). Like the above pattern for the fragmentation of ceramics, Kala Uyuni has a few more of the top dense contexts.

SITE	Event	Context	# (weight) analyzed sherds	Average Sherd Weight
KU ASD 2	B11	Surface	50 (799.9)	16
SN Middle Terrace	A54/A55	Pit Fill	342 (4352.7)	12.7
KU ASD 2	B14	Surface	112 (1246.4)	11.1
KU ASD 5	B249	Surface	751 (7737.95)	10.3
KU ASD 4	B221	Pit Fill	137 (1339.7)	9.8
KU west of ASDs	B73	Burial	91 (840.4)	9.2
SN upper terrace	A306	Pit Fill	166 (1518.3)	9.1
SN ASD 2	A251	Surface	43 (374.1)	8.7
KU west of ASDs	B70/B89	Midden	103 (883.8)	8.6
KK	A28	Surface	257 (2148.1)	8.4

Table 4.17: Top ten best-preserved contexts, from average sherd weight (in grams)

SITE	Event	Context	# (weight) analyzed sherds	Average Sherd Weight
SN ASD 2	A99	Hearth	10 (30.9)	3.1
SN ASD 2	A321	Wall	17 (53.4)	3.1
SN Upper terrace	A299/A300	Surface	88 (274.5)	3.1
SN Lower terrace	A20	Midden	418 (1306.9)	3.1
KK	A70	Pit fill (camelid bones)	95 (256.1)	2.7
SN Lower terrace	A22	Midden	188 (498.5)	2.6
KK	A80	Occupation Zone	296 (728.7)	2.5
KK	A47/A48	Fill	515 (1080.4)	2.1
SN ASD 2	A322	Fill	133 (128.5)	1
SN Upper terrace	A282/A322	Wall Fall	133 (128.5)	1

Table 4.18: Bottom ten least-preserved contexts, from average sherd weight (in grams).

Nevertheless, Sonaji and Kumi Kipa offer a good variety of dense contexts as well. The density at Sonaji may be related to the occupation history of this area; it would appear that this mound gradually accumulated through a complex history of use. At the base of excavations of the mound a unique Late Formative architectural space was uncovered.

SITE	Event	Context	# (weight) analyzed sherds	Density
ASD 2	B77	Surface	748 (4416)	44.2
SN ASD 2	A98	Surface	115 (749.7)	20.6
KK	A159/A160	Midden	214 (1409.1)	14.8
ASD 2	B57	Pit Fill	435 (2812.9)	14.1
OUTSIDE OF ASD5	B271/B269	Pit Fill	122 (750.8)	13.6
ASD 5	B249	Surface	751 (7737.95)	12.7
KU WEST	B91	Midden	3129 (17871.1)	12.2
ASD 2	B78	Pit Fill	893 (6775.7)	11.7
KU WEST	B73	Burial	91 (840.4)	11.3
SN UPPER T	A339	Surface	64 (242.3)	10.4
KU WEST	B92	Midden	1627 (9240.2)	10.1

Table 4.19: 10 most ceramically dense contexts.

SITE	Event	Context	# (weight) analyzed sherds	Density
ASD 2	B9	Wall Fall	415 (2759.2)	1.9
KK	A17	Occupation Zone	552 (3340.1)	1.9
ASD 2	B11	Surface	50 (799.9)	1.8
ASD 2	B12	Surface	260 (1482.0)	1.8
SN ASD 2	A277/A321	Midden	28 (115.7)	1.6
SN UPPER T	A317	Pit Fill (ash)	124 (456.6)	1.6
KU WEST	B34	Surface	116 (852.2)	1.5
SN ASD 2	A321	Wall	17 (53.4)	1.4
SN ASD 2	A328	Wall Fall	32 (103.2)	1.2
KK	A9	Occupation Zone	98 (585.8)	1
SN ASD 2	A95	Wall Fall	20 (88.4)	1
SN ASD 2	A322	Fill	133 (128.5)	1
SN UPPER T	A282/A322	Wall Fall	133 (128.5)	1
SN UPPER T	A23	Sterile	15 (71.4)	0.1

Table 4.20: 10 least dense contexts.

While the effects of pitting limits our interpretations, ceramic analysis may aid in constructing a better understanding this area. As Table 4.20 demonstrates, this was a somewhat cleaner space, with some of the lowest densities from the entire ceramic assemblage.

Similarly, at Kumi Kipa we found the foundation of a poorly preserved structure, although in this case surprisingly close to the surface. The project wide assumption that this site was 'taphonomically compromised' affected my sampling procedure, and as such I analyzed far fewer ceramics from this site (Table 4.21). This is unfortunate, as Peterson's observations, discussed above, suggest that the site may still offer some interested spatial aspects. Given the shallow nature of the site at Kumi Kipa, and the high number of small loci excavated at Sonaji, neither site would permit a discussion of discrete uses of space as Bruno (2008) did in her study of plant use at Kala Uyuni. Nevertheless, I include them in here as they allow for variability in production to be explored in greater detail. Furthermore, the analysis of the ceramics may, in fact, be useful apart from simply defining chronological phases. We shall see in later chapters that the analysis of materials from Sonaji and Kumi Kipa may aid in re-evaluating excavators conclusions of the events discussed above.

As Table 4.21 shows, my sample consists of 71,007 sherds, and includes body sherds, decorated sherds, rim sherds, handles, bases, a small number of complete vessels, and several other non-vessel types. In the next chapters I will begin to explore how these artifacts may be signatures of particular communities of practice.

Chapter 5:
Defining the Late Formative Period

In a recent summary of archaeological research in the Central Andes, William Isbell and Helaine Silverman acknowledge the advantages of local chronologies, what they call "independent evolutionary approaches", but are wary of artificially creating distinct culture areas with autonomous histories. "At present, it may be impossible to accurately evaluate interaction between *altiplano* cultures and other Central Andean societies, at least in part because separate chronologies are being employed" (Isbell and Silverman 2006: 504). They argue that better chronologies are needed in order to evaluate whether groups in the Central Andes interacted as a single tradition or evolved independently. Isbell and Silverman ask us to be explicit about the goals of utilizing separate chronologies, and to explain what constitutes a separate evolutionary trajectory.

As should be evident by now, I am not interested in following evolutionary trajectories. The evolutionary approach is seeking cultural and temporal boundaries in defining the emergence of state-like entities, a macro-level problem. This is rather different than the approach taken here, where crafting traditions are embedded in history and practice. From this perspective technological choice, bodily memory, and political practice cannot simply be bundled into a ceramic sequence. I do agree with Isbell and Silverman's main point that a better seriation is needed in the Central Andes. I agree that we require further detailed ceramic analyses, careful stratigraphic excavations and more C14 dates. But I argue that a detailed analysis wedded with a daily practice perspective has real interpretive consequences.

A good example of such consequences can be seen in Susan Gillespie's (2008) reanalysis of the stratigraphy and socio-political interpretations at an important Olmec site. Gillespie does not take an evolutionary perspective; rather she espouses a life-history approach to understand the chronology and historical processes of Complex A at La Venta (900-500 BC). La Venta is often presented as a single-period site based on stratigraphic interpretations. She notes that a practice approach generates attention to variation, "to the actions and perspectives of different categories of people, and to the internal origins of social change (Brumfiel 2000)" (Gillespie 2008: 134). Gillespie examines the complex and recursive relationship between continuity, when practices become unquestioned, and those moments of change, when doxic traditions come to the discursive surface (Barrett 2001: 154, in Gillespie 2008). Using this approach, she makes a convincing case for a chiefly house appropriating Complex A for the elaboration of its political authority.

This chapter does not offer such a radical synthesis. We do not have the rich history of research for the Late Formative yet, nor do we have a site of the scale of La Venta (although see Janusek et al 2003). Nevertheless, I believe that a practice stance can change how we approach seriation. It forces us to return to the nuts and bolts of chronology in order to ask some specific questions concerning the social and political significances of both continuity and change (Lightfoot 2001; Pauketat 2001; Roddick and Hastorf in press). In this chapter I confront the usual, yet testy issues of space: time systematics through a careful summary of current ceramic chronologies and radiocarbon dates, while considering how a shift in focus to technological style, the result of particular choices in craft production, can lay the foundation for a more socially dynamic approach to ceramic traditions.

I begin with a brief history of Middle and Late Formative seriation in the region, first by briefly summarizing the chronology building of the 1930's through the 1960's. All prehistoric narratives of the Titicaca Basin have developed out of this important early work. However this early ceramic seriation, predominately relying on design styles on vessels from museum collections and mortuary contexts at Tiwanaku, is not as useful in wider regional contexts, where there are fewer decorated sherds. The past 25 years has seen a few scholars take a more detailed-oriented approach to the ceramics, noting a wider range of attributes. This research, some of which is complimentary to that of TAP, lays important groundwork for a more detailed analysis of technological style. This part of the chapter is an important foundation for Chapter 7 where I consider broader trends in Southern Titicaca Basin pottery production. I then examine the sequence of available C14 dates for the Middle to Late Formative period. This allows me to discuss the particular phasing issues at Kala Uyuni, Kumi Kipa and Sonaji. I will discuss my sampling procedure and TAP's ceramic methodology in the next chapter.

5.1 A short history of Formative Period ceramic chronologies

5.11 Culture historical foundations: A focus on design style

The majority of work that has been done on the Formative Period of the Lake Titicaca Basin builds on culture historical publications of the early and middle part of the last century. Wendell Bennett (1936) conducted some of the earliest research on the Formative Period at the site of Chiripa. From this work, particularly his systematic excavations at the Akapana structure at Tiwanaku, Bennett assembled the first seriation of the Southern Titicaca Basin. He defined what are now known to be Chiripa (Early and Middle Formative) ceramics. Bennett found that Early and Middle Formative assemblages were manufactured with a white quartz and fiber paste, decorated with a cream on red slip step-patterned motif, and often included distinctive flat bottomed bowls (Bennett 1936: 441; figure 6.1). He also investigated later periods, defining three stylistic groups, representing the Early, Classic and Decadent Tiahuanaco chronological periods. Tiahuanaco, or what Ponce Sanginés (1972) called "Tiahuanaco Urbano" is generally known today as Tiwanaku IV, while Decadent Tiahuanaco, or "Expansivo", is considered to be Tiwanaku V (see Figure 2.2 for the current cultural chronology). Early Tiwanaku is usually called Late Formative today.

Bennett's (1948:91) five test excavation units at Chiripa found Early Tiwanaku ceramics stratigraphically above levels with Chiripa sherds. He defined the Early Tiahuanaco assemblage based on three categories: bowls with horizontal handles, small clay buttons and two decorated wares (Bennett 1934: 450-451). One decorated group consisted of red banding, while another were highly burnished polychromes often with simple zoomorphic designs. Both of these decorated groups are acknowledged today to be diagnostic of the Late Formative. However, Bennett's excavations consisted of arbitrary 50 cm strata, therefore he missed important temporal dimensions within his Early Tiahuanaco assemblage. Furthermore, Bennett only analyzed decorated ceramics, resulting in 55 % of his sample remaining unanalyzed (Bennett 1934: 449; as discussed in Burkholder 1997: 65-66; Janusek 2003: 33).

In 1957 Dwight Wallace presented his doctoral dissertation at UC Berkeley, the first detailed seriation of Titicaca Basin ceramics. Wallace examined almost 900 ceramics from museum collections and compared them with excavated assemblages from Tiwanaku, Mocachi, Khonko Wankane, Chiripa and Pariti (see Figure 2.1). He named Bennett's second design style of Early Tiahuanaco, the highly burnished polychrome ware, 'Qeya' after the site of Qeya Qollu Chico (the Island of the Sun) that had a high density of this particular style (Bandelier 1910: 173). "The Qeya style is marked by a light buff or brown micaceous paste which is relatively soft, a lack of slip and careful smoothing and polishing, thick glossy design pigments, use of relatively broad and deep incision, and certain shapes" (Wallace 1957: 19). Particularly useful is Bennett's detailed analysis of vessel morphology for each of his chronological phases (Figure 5.1).

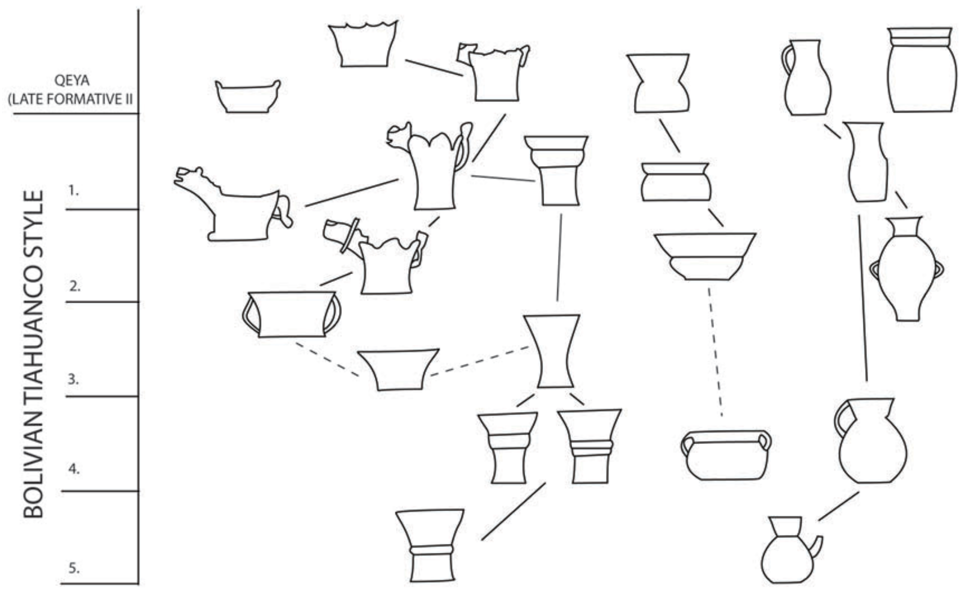

Figure 5.1: Dwight Wallace's ceramic seriation, from Late Formative II (Qeya at the top of the image) through Tiwanaku V (at the bottom of the image). (Adopted from Wallace: 122a, Figure 9.)

While Wallace's work is crucial, the seriation of the Titicaca Basin emerged in the modern era with the work of Ponce Sanginés. Ponce Sanginés defined a three-stage evolutionary sequence with five political and economic sub-periods, and was the first to connect ceramic chronologies with radiocarbon dates. Ponce hypothesized that the Late Formative lasted from 1580 BC to AD 375, a range well beyond the tighter chronology available today (see below). Ponce Sanginés believed that Bennett's red-banded vessels were linked to a first phase of the Late Formative, which he called Tiwanaku I (Ponce

Sanginés 1971, 1993). As he found a large quantity of these sherds in his excavations at the Kalasasaya structure at Tiwanaku, they are often referred to as Kalasasaya style (Figure 5.2). He initially suggested that Chiripa and Tiwanaku I styles coexisted for a long period of time based on one uncontextualized C14 date, which has been since refuted (: 66; Mathews 1992: 114-115).

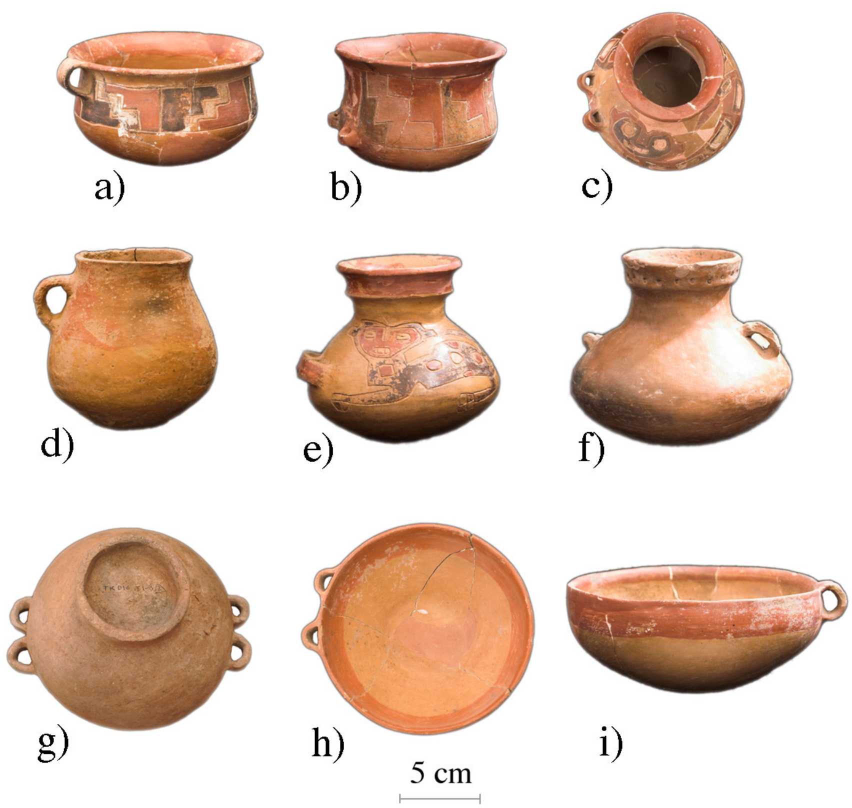

Figure 5.2: Some of the decorated and undecorated ceramics excavated by Ponce Sanginés currently housed in the Tiwanaku museum. Design styles include Kalasasaya zonally incised (a, b, c, and e) and Kalasasaya red rimmed bowls (h and i). For details on forms local to the Taraco Peninsula see Chapters 7 and 9.

Ponce Sanginés defined the Tiwanaku II assemblage by a coarse undecorated ware with mica inclusions (Ponce 1981). This problematic phase relies upon the differentiation of two strata from different types of contexts – his Tiwanaku I strata included grave lots, his Tiwanaku II was from an occupation midden – and the undecorated ceramics from his

Tiwanaku I were not described (Ponce Sanginés 1993: 53, table 1; as discussed in Janusek 2003: 37-38). Most scholars have since discarded this phase, as it could not be defined outside of Tiwanaku proper and may not effectively represent temporal phases (but see Janusek's argument below). His Tiwanaku III was later connected with the decorated Qeya ware through later survey and synthetic work (Janusek 2003: 39).

The earlier Early and Middle Formative periods were not defined until further detailed analysis at the site of Chiripa. While these periods are not central to this thesis, an understanding of the Middle Formative will be important in looking at the production shifts in Chapter 7. Furthermore scholars studying these assemblages were the first to apply fine-grained methodologies to Titicaca materials. Karen Mohr Chávez' (Mohr 1966; Mohr Chávez 1977) research deserves particular attention. She was the first ceramicist in the Titicaca Basin who focused on a range of attributes, not simply those of surface design and vessel shape. Chavez' Masters thesis demonstrated a considerable eye for detail and applied both attributional and compositional analysis (as discussed in Chapter 7) to the Middle Formative material. She worked from materials originally excavated by Kidder in order to examine how the Chiripa phases shifted through time. There has been other important ceramic research at Chiripa (for example Browman 1978a, b; 1980, 1981), but Chavez' work remains essential for her consideration of a wide number of attributes, laying the foundation for future work on technological style.

5.12 Modern approaches to seriation: Towards technological style?

Throughout the 1980s and early 1990s many survey archaeologists in both the North and South Titicaca Basin attempted to both apply and refine the ceramic sequence. In the South Basin James Mathews and Albarracin-Jordan conducted extensive survey throughout the lower Tiwanaku Basin, and Mathews excavated the 8 ha Late Formative site of Tilata. Mathews found that the chronology was "…rife with gaps, inconsistencies, and unsubstantiated sweeping claims; even such basic information as the dates and material correlates of this period are still only hazily understood." (Mathews 1990: 64). Mathews' point resonates today, and his research marks a shift towards a focus on a more comprehensive view towards the ceramic sequence.

That Mathews defines this renewed attention to more detailed phasing is somewhat ironic, considering he argued for more general phases. Although Mathews noted some important shifts, such as an increase in micaceous tempers in Later Late Formative cooking vessels, he was generally skeptical of smaller phase divisions. Mathews' solution was to return to Bennett's "Early Tiahuanaco" designation, believed to be an acceptable solution since they all represented the same evolutionary stage (Mathews 1992: 230). In chapter 1 I discussed Mathews' approach to demonstrate how evolutionary perspectives can result in a rather superficial understanding of the significance of ceramic data. Janusek (2003: 4) makes a more pragmatic observation concerning Mathews' ceramics interpretations. In his excavations Mathews found most Kalasasaya sherds from 140-145 cm below surface, while all Qeya sherds were found from 97.5-124.5 below the surface. Janusek points out that in most cases Kalasasaya diagnostics were found below Qeya diagnostic wares, and suggests that Mathews mistakes "continuity for contemporaneity". I will return to this issue below.

After his initial survey work with Mathews, Albarracin-Jordan returned with William Isbell to excavate Iwawi (Mathews 1992; Ponce Sanginés 1981), an important Tiwanaku Period site with a small Late Formative Period occupation. As Iwawi is so close to the site of Kala Uyuni (less than 3 kilometers), it is worth briefly discussing the work of Iwawi ceramicist Jo Ellen Burkholder. Burkholder's dissertation research explored the theoretical orientation of Titicaca Basin chronological techniques, and worked towards a ceramic chronology for the site of Iwawi (Isbell and Burkholder 2002: 18-19). Although initially a site-based analysis, Burkholder (1997) returned to this project, adding further ceramics to her sample, including complete vessels from the Tiwanaku Museum, and the findings of Seddon (2001), Alconini Mujica (1998), Janusek (1995; Janusek 1994) and Albarracin-Jordan (1999). As we shall see in Chapter 7, her work was quite detailed, looking not just at design, but also at a number of attributes resulting from technological choice.

While there are as of yet no published C14 dates for the Formative occupations to correlate Burkholder's ceramic phasing, I must stress that her use of the "Popular Tiwanaku Chronology" is much different than the one used here (Figure 2.2). She constructed a unique Iwawi chronology, based on the specific stratigraphy of their excavations. Burkholder had no C14 dates to anchor her ceramic chronology, resulting in long temporal phases. For instance, her Late Formative I equivalent, the Cocha phase (1000 BC- AD 100), includes the entirety of the Early and Middle Formative, while her Orqo phase (AD 100-600) relates to Late Formative II. Burkholder defined three typological wares (based on form, paste, etc) that are found through this period– Huchani (300 BC- AD 1100), Qeya (AD 100-600) and Ojepuku (100-800 AD). Huchani refers to a ware that Albarracin-Jordan considered a utilitarian variant on the Qeya style (Burkholder 1997: 173-176, 2001: 226). Ojepuku is thought to be a Qeya domestic ware, due to the presence of mica, but these vessels are harder and darker in color than Qeya vessels

(Burkholder 1997: 176-178, 2001:230). Burkholder (1997: 209) argues that the Ojepuku ceramics are non-local. She believes the mica was not available on the Taraco Peninsula, but this remains a guess since no raw material survey had been conducted.

Burkholder found no fiber in Iwawi Formative Period material (Burkholder 1997: 207). This is strange considering the high percentage of fiber- tempered materials in both Middle and Late Formative ceramics at TAP sites just three km from Iwawi as well as from throughout the Tiwanaku valley (Janusek 2003, and Chapter 7). If the Late Formative potters at Iwawi truly did not use fiber-based tempers, this suggests a unique community of practice, and bears further investigation in the future. The development of a unique local chronology is in accord with my general argument of distinct rhythms in technological choice, but unfortunately much of Burkholder's system is incompatible with the work I conducted making such a conclusion premature. Her scheme is based on extremely long time spans. Were there truly no technological shifts over 1400 years of domestic production in the Huchani style? In particular it is virtually impossible to subdivide the Formative, let alone the Late Formative in this system.

The most detailed modern work on the chronology of the Tiwanaku heartland was conducted within the framework of the large Wila Jawira Project, under the direction of Alan Kolata (1996; 2003). This project included extensive survey of the Tiwanaku and Katari valleys and excavations at various sectors of the sites of Tiwanaku and Lukurmata. Marc Bermann's (1994; 1990; 1996) work at Lukurmata is one of the more systematic investigations of the Late Formative. Bermann defined the Late Formative period by way of radiocarbon dates and the presence of both ceramics of a local tradition, and non-local ceramics that he assumed were imported from Tiwanaku.

Bermann defined a local and a non-local ceramic tradition dating to the Late Formative I period. The local tradition includes both Lorokea Fiber vessels and non-fiber tempered vessels. A non-local class of ceramics includes thin red ware bowls, more finely made than other domestic wares with a different temper and paste. Bermann believed these were primarily used for serving or eating (Bermann 1990: 77). By the end of the Late Formative I what Bermann calls "Tiwanaku-style" pottery replaces his thin redware bowls. The Local Tradition plainwares are partly supplanted by Queruni Orange ceramics. Bermann's "Local Tradition" of fiber and non-fiber pastes continues through the Late Formative II occupations at Lukurmata. During this time he also sees the appearance of Tiwanaku III/Qeya forms including tripod bowls, and "antler cups", forms not found on the Taraco Peninsula. A new utilitarian ware – slipped vessels with a light-brown color – arrives during this period, which Bermann calls Cutini cream ware, (Bermann 1990: 162). This Cutini cream ware is associated with two new forms (a large dish and a large jar).

Like Burkholder, Bermann defines local and non-local based on ubiquity or the presence of particular tempers. He suggests that any vessel lacking in fiber temper was imported from Tiwanaku rather than made locally (Bermann 1990: 93). Despite taking a non-centric approach, critical of core-periphery models, Bermann assumes the Late Formative I Queruni Orange ceramics were produced at Tiwanaku. He does not consider that other sites in the region may have had craft producers. Bermann uses his Lorokea Fiber group to "aggregate all fiber-tempered sherds recovered" (Bandy 2001: 170), and does not discuss the variability in the other class of wares. Furthermore his description of the Thin Redware bowls and the Queruni Orange is rather ambiguous. Nevertheless, Bermann's work is one of the few examples we currently have of careful excavation of domestic contexts. And while his level of details on particular wares (not to mention attributes of paste and surface finish) is somewhat lacking, his detailed drawings of the forms permits some comparison (see chapter 7).

The most important contribution to ceramic analysis by the Wila Jawira project is John Janusek's (2003) overview of the ceramics of the Tiwanaku and Katari valleys. Janusek presents a systematic overview of the history of ceramic research, and provides the best regional synthesis of the ceramics from the Late Formative through the Late Intermediate Period. Furthermore, he anchors the associated dates to a sequence of radiocarbon dates while creating one of the most usable chronologies for the South Basin. While Janusek does not consider himself a ceramicist, he is concerned with both the methodological approach and theoretical interpretation of ceramics, working to "distinguish clearly between style and time…[and] the significance of contemporaneous stylistic variation…I examine and describe them with an eye to their significance in Tiwanaku culture and social relations and explore the significance of change in ceramic assemblages and styles through the course of state formation, consolidation, and disintegration" (Janusek 2003: 35).

Janusek presents an overview of the research up to this date, with a critical eye to style and change. Particularly useful is his re-defining of the periods, which I employ here (Figure 2.2), his detailed discussion of the Tiwanaku II period and the idea of functional categories developing through time (see Chapter 9). Janusek believes that the Late Formative terms "Tiwanaku I" and "Tiwanaku III" should be kept for Tiwanaku, but correctly points out that this may not be appropriate for other sites in the region. He suggests that 'Late Formative' be employed for the entire period, but 'Late Formative I' to refer to Tiwanaku I (with Kalasasaya diagnostics) and 'Late Formative II' for the Tiwanaku III phase (and Qeya diagnostics). This particular chronology has gained favor in the archaeology of the Southern Titicaca Basin (see Stanish 2003 for a slightly different North Basin chronology). Janusek's work offers much to the ceramic scholar, but it is not particularly quantitative. In order to properly track the subtleties of crafting traditions through time, and communities of practice across space, a more detailed methodology is necessary.

Lee Steadman's work in both the North and South Basin offers such a methodology, and lays out considerable groundwork for a more theoretical engagement with the social relevance of shifting technological choice. I will expand on this methodology in Chapter 6, and the results of this approach in Chapter 7. Here I simply discuss how other scholars have adapted, and modified Steadman's system for the study of the Late Formative. For instance, Carlos Lemuz (2003) relied upon her attribute analysis in his detailed survey and excavation of sites in the Santiago de Huata area, relating his own phasing categorization with that of Chiripa phasing. Like Burkholder, he did not see a utility in creating a pan-Titicaca basin chronology for the entire sequence, instead seeing some unique technological styles developing based on local social relationships and raw materials. Lemuz calls the early-mid Formative Kalake (1500 B.C. -1000 B.C.), but keeps Steadman's Middle Chiripa (1000-800 B.C.) and Late Chiripa (800 – 100 B.C) phases for the later periods. He defines two Late Formative phases (Lemuz 2001:164-174) that he defined as unique traditions. His "Pana Temprano" (100 B.C.- 200 A.D.) and "Pana Tardio"(A.D 200-400) were both defined on the basis of excavations (with a total of three units) at the sites of Lakaripata, Kollihumachipata and Turninpata (SH-74) (Lemuz 2001: 169, 171). I have not had the opportunity to examine these particular assemblages, but as we will see in Chapter 7, there appear to be some similarity to Taraco ceramic assemblages.

Bandy (2001) employed Steadman's system in his survey of the Taraco Peninsula. As I mentioned in the previous chapter, this work laid the foundation for our sampling methodology, and thus is important to discuss in more detail. Bandy found that while distinguishing Tiwanaku IV and V periods is virtually impossible without intact decorated vessels, Late Formative phasing with decorated wares is even more problematic, "as the relative abundance of decorated wares in the later Tiwanaku periods contrasts with their extreme scarcity in the Late Formative" (Bandy 2001: 45-46). Nevertheless, while Bandy combines all Tiwanaku IV/V material into a Tiwanaku phase, he attempts to divide the Late Formative into two stages based on Janusek (2001) and Lemuz' (2001) research.

Bandy splits Late Formative I and II based on both design style and technological style (in particular paste). Bandy considered three groups of ceramics to be diagnostic of the LF1 phase: 1. Kalasasaya style zonally incised ceramics 2. Kalasasaya hemispherical bowls with red-painted rims and 3. A distinctive fiber-tempered paste (with mica), termed Paste Group 6 (Bandy 2001: 165-171). Bandy notes that his Paste Group 6 is similar to Carlos Lemuz' Paste 18, the paste associated with his Early Pana phase. In Chapter 7, I will discuss this paste group 6 in terms of TAP's paste 17 and 18. He defines Late Formative II by the presence of Qeya polychrome ceramics, Qeya incised ceramics, and a thin reduced micaceous ware he calls Paste Group 13. (Bandy 2001: 171- 174). As we shall see in Chapter 7, TAP defines this as paste group 29. This particular paste, so important with the rarity of decorated Qeya sherds at Late Formative 2 sites, was also somewhat rare on the surface of sites leading him to concede that this particular phase is "the most tenuously identifiable" (Bandy 2001: 174).

This system, however, is reliant on unmixed assemblages, and most sites are multi-component sites; a problem considering most ceramic traditions extend across archaeological phases. Bandy created a system of paste index profiles in order to phase mixed assemblages. These paste groups were built on Steadman's paste work for the Early and Middle Formative at the site of Chiripa. I will not describe his highly original system here as it is explained in full in his dissertation (Bandy 2001: 47-57), and the result of these surface surveys was demonstrated in the last chapter. However, I would like to offer three words of caution.

First, the firm phase divisions should be questioned as the Late Formative varies in extremely subtle ways, which I believe is virtually impossible to gage from mixed surface finds. Bandy's phasing of Formative Period surface deposits largely relies upon a singular attribute (paste) to phase occupations that likely varied (both within and between sites) across the Taraco Peninsula. Taphonomy is also a problem here; Bandy does consider an "artifact splash zone" but does not specifically factor in how much erosion can redeposit material, and takes for granted that material is deposited in a regular fashion through time.

Second, it is important to note that Steadman's phasing was meant for the site of Chiripa, not the entire region. The technological choices involved in pottery production likely varied subtly (or not so subtly) from site to site. My general observations of other Late Formative occupations in the Southern Titicaca basin suggests that there is indeed local variation in paste recipes and surface finishes as would be expected in localized communities of practice[1]. It may have been slightly premature for such a model, as more recent quantitative work by TAP on the excavated materials from several Taraco Peninsula sites has found the Late Formative not so easily defined.

Third, and finally, some of the pastes that were defined as being Early Formative – namely Bandy's paste group 3 – included micaceous pastes (pastes 17 and 18 in the TAP system employed here) are also found in the Late Formative I. His diagnostic of the Late Formative II phase, his paste group 13, is found in extremely small quantities and is also found in Late Formative I. Thus the original index profiles, which were based on small numbers to begin with, have since been revised based on a larger ceramic assemblage.

PHASE/PROJECT	**Burkholder (1997, 2001) @ Iwawi**	**Bermann (1990, 199x, 200x) @ Lukurmata**	**Bandy (2001) @ Taraco Peninsula Survey**	**Lemuz (2001) @ Santiago de Huata**
Late Middle Formative	Huchani, (C14 dates n/a)	n/a	Late Chiripa (800 B.C.-100 B.C)	Late Chiripa (800 B.C. – 100 B.C.)
Late Formative I	Huchani, Qeya, Ojepuku (C14 dates n/a)	Lorokea fiber, Qeruni Orange, Thin Red Ware	Late Formative I (insert date) Kalasasaya red rim, Kalasasaya incised, Paste Group 6	Pana Temprano (100 B.C.- 200 A.D.)
Late Formative II	Huchani, Qeya, Ojepuku (C14 dates n/a)	Qeya/Tiwanaku III, Cutini Cream	Qeya Incised, Qeya polychrome, "Paste Group 13"	Pana Tardio (A.D 200-400)

Table 5.1: Communities of practice, crafting traditions, or just diverse methodologies? Phases, dates and ceramic types (or attribute clusters) for some recent important Middle-Late Formative projects in the South Basin of the Lake Titicaca Basin.

Bandy (2001: 56) was quite aware of the relative crudeness of his system: "Clearly all of the population indices, measures, and associated interpretative methods laid out in this chapter are fraught with empirical and theoretical difficulty. The derivation of the

[1] I have had the opportunity to preliminarily examine several ceramic assemblages from the sites of Khonkho Wankane and Iruhuito thanks to John Janusek and Adolpho Perez, respectively.

population estimates or indices from surface data is a difficult and contentious undertaking…nothing about it is straightforward." (Bandy 2001: 86). As we saw in the last chapter Bandy's work is the first to truly define the breadth of Taraco Peninsula prehistory, and was the basis of our 2003-2005 field seasons. Bandy's work defined a multitude of sites in the region, and effectively demonstrated the truly dense prehistoric settlement in the region. It is this work that permits a critical reappraisal of the notion of community, and specifically for us to investigate the multiple communities of practice active throughout the Late Formative (Table 5.1).

5.2 Design style versus technological style: The paste question

The last section clearly demonstrates an important shift in the ceramic phasing of Formative period contexts in the Lake Titicaca Basin. Scholars are aware that design style is not sufficient for defining manageable archaeological phases. Although earlier culture historians relied upon design style, more recent qualitative work has included other attributes in their analysis. Indeed subtle local shifts in ceramic manufacturing sequences are identifiable throughout the Titicaca Basin, and at this point there is no regional master ceramic sequence. I believe it is unlikely that we will define such a regional chronology with a more fine-grained analysis.

Design style is particularly problematic for the Late Formative Period. The most common decoration for Late Formative 1, the Kalasasaya red banding, appears to offer little variability. Although there are some cases of iconographical representation on Late Formative II Qeya vessels, they are limited in their distribution. There are also many examples of Qeya and Kalasasaya design styles overlapping. Finally, it appears that local sites were differentially involved in the manufacture and distribution of decorated ceramics. These factors mean we cannot rely solely on design style to define Late Formative social boundaries between particular communities; technological style may be more appropriate.

Those scholars employing a more detailed technological style have made some intriguing findings. For instance, if Burkholder's observations of the Iwawi materials hold, with their significant lack of fiber temper, there appears to be a definable micro-style on the Taraco Peninsula. These differentially tempered ceramics are likely associated with Late Formative II potters, but their description makes them distinct from the few Late Formative II assemblages from Kala Uyuni, Sonaji and Kumi Kipa (see below and Chapter 7) and settlements in the Tiwanaku and Katari Valleys (Janusek personal communication). Bermann finds paste changing and varying surface finishes through his Late Formative sequence, suggesting either changing preferences, or the local implementation of more regional design styles. However with both Bermann and Burkholder's ceramic analysis there remains a larger question of how the "local" is being defined. Pastes appear to be one of the more essential changes from the Middle Formative, and these recipes help to distinguish the two Late Formative phases.

It is this shift that defines the "paste question" that I will explore in later chapters. In Chapter 7 I will investigate whether pastes are also varying through time at Kala Uyuni, Kumi Kipa and Sonaji, from the Middle Formative through the Late Formative II. In later chapters I investigate several specific possibilities. In Chapter 8 I will begin with a more typical ceramic ecology perspective, see if pastes may be varying due to available raw materials. Potters may be sharing access to the same raw materials, and thus certain inclusions that are changing through time could be simply the result of changing local clay deposits.

In Chapter 8 I will also consider wider production logics. For example, research on contemporary African potters stress the traditional nature of their paste recipes, and has found that "individuals do change processing recipes through time, for reasons related to their own social trajectory or fluctuations in customers' demand." (Gosselain and Livingston Smith 2005: 39). Pastes and tempers may also vary due to a shared logic or knowledge of how a particular pot should be made. From this perspective, certain materials are chosen due to their perceived essence (Lechtman 1979, 1984), and it may be that certain clays were chosen, or pastes added, specifically in the Titicaca Basin due to the aesthetic value, as is the case for added mica in some regions (Lunt 1988: 493; Arnold 1993: 113; Sillar 1996).

In Chapter 9, in my discussion of communities of consumption, I will return to consider the functional requirements of pottery and consumers preferences. Particular recipes may be due to functional requirements of a particular type of pot. These reasons are not mutually exclusive, and initial reasons for a shift in paste may have been quite different from the significance of the crafting convention several generations later. Throughout my discussion of this "paste question", I stress caution in using this attribute to phase sites. Although pastes certainly may be significant changes through time, it is rather questionable to immediately apply these to a regional scale. As Janusek (1994: 93) and Lemuz (2001: 169) all point out, we must be wary of using pastes like a type:

> "La presencia del Pana Temprano no es possible reconocer a partir de un solo tipo de pasta, o de alguna característica aislada, sino más bien, como producto de un combinación de atributos entre los cuales se reconoce la presencia distintiva de algunos tipos de pasta, elementos decorativos, formas y tipos de acabado."

> *"Early Pana can not be identified by one paste or by an isolated attribute, rather it is a product of a number of attributes including particular pastes, decorative elements, forms and types of surface finishes."*
> (Lemuz 2001:169, my translation)

Pastes are not types, and they can be the result of local geology, particular choices, or wider taskscapes – rhythms of practical activities and their embeddedness in wider social practice (see Chapter 3). In order to track these rhythms, we need more local analysis and radiocarbon dates.

5.3 Radiocarbon dates of the late Middle Formative and Late Formative Periods

5.31 Overview of phases and C14 dates

In his synthesis of available dates for the Southern Titicaca basin Janusek (2003) notes that few dates were available for the Late Formative period at time of publication (Janusek 2003: 46). His dates consist of recalibrated dates (using Oxcal 3.5 and Stuiver and Pearson's 1993 calibration curve) from Ponce's (1981) excavation of the Kalasasaya structure at Tiwanaku and more recent work in the Katari valley (including the sites of Lukurmata and Kirawi). Since this publication there have been many more Late Formative excavations in the Southern Basin (including on the Copacabana Peninsula, and the Tiwanaku and Desaguadero valleys). Unfortunately much of this work remains unpublished, and thus dates cannot be integrated here.

Janusek's analysis of the available dates notes that all dates for the Late Formative I reveal a combined 1-sigma range spanning 1300 years, from 840 BC to AD 440, but a tighter central range spans from 200 BC to AD 250. (Important to note here is that the offering pit from which Ponce recovered 24 of the 35 decorated Kalasasaya vessels dated later than this 1-sigma range, dating between AD 85-423). There is a bit of variability here. For instance, a date from the first Late Formative occupation at Lukurmata yielded a date of 20 +- 80 BC, while another date at Kirawi, which appeared ceramically similar to the second occupation at Lukurmata, revealed a date of AD 240 +- 60 (B-91780). Janusek argues for a Late Formative 1b (representing Ponce's Tiwanaku II), with a 1-sigma range from 1-620 AD, but with a tighter overlap of 1-sigma ranges between A.D. 140 and 400. Since we have yet to define ceramic phases associated with his Tiwanaku 1b, I conflate this subphase into Late Formative I. These dates slightly overlap with later Late Formative II dates, for which Janusek has less confidence. He suggests however that a start date of A.D. 300 through to A.D. 500. Clearly there is substantial overlap with his Late Formative 1b, and likely with earlier Late Formative 1a as well. Janusek points out that so-called "rural" sites, such as Kirawi, also appear to be somewhat later in these ceramic phases.

5.32 The phasing dilemma: C14 dates & separating LF1 and LF2

TAP also ran an extensive number of dates from its excavations. Maria Bruno has recently assembled these dates in her dissertation (Table 5.2). The radiocarbon dates are not completely clear in separating Late Formative I and II. Janusek explicitly notes that the ceramic phasing and radiocarbon dates vary from site to site. So where does that leave us in defining the Late Formative phases on the Taraco Peninsula? The TAP excavations recovered many examples of the Kalasasaya or red on buff variety, yet few of the Qeya style (Figure 5.3 is one of the few decorative examples, see Figure 9.21 for a complete Late Formative II vessel). However, we have seen design style does not accurately differentiate these two periods, especially as many sites simply do not have high densities of decorated wares. It may simply be that we have a low quantity of clearly Qeya vessels. Our solution, as I will describe in Chapter 7, is to rely on other attributes, in particular paste.

Lab Number	TAPLocus #	Site	Area	Event	Context	Material	Ceramic Phase	C14 Age BP	Error +/-	YearsCalIntCal04 95.4%	YearsCal ShCal04 95.5%
AA64923	5431/1	KU	AC	KU-A159	Ash Deposit Above Upper Floor (AC)ASD-3	seeds	LC	2176	38	375-113BC	355-41BC
AA59714	5342/1	KU	AC	KU-A143	Fill Over Upper Floor (AC)ASD-3	wood	LC	2253	31	395-207BC	378-175BC
AA59717	5183/1	KU	AC	KU-A33	Ash Above Upper Floor (AC)ASD-1	seeds	LC	2438	62	763-402BC	762-365BC
AA59711	5344/1	KU	AC	KU-A144	Fill between Floors (AC)ASD-3	wood	LC	2560	35	806-547BC	793-417BC
AA59720	5288/1	KU	AC	KU-A11	Fill between Floors (AC)ASD-1	seeds	LC	2751	51	1008-809BC	976-789BC
AA59718	5233/1	KU	AC	KU-A108	Midden (above sterile)	seeds	MC+5%EC	2829	43	1126-852BC	1042-816BC
AA64924	5289/2	KU	AC	KU-A12	Lower Floor (AC)ASD-1	seeds	LC	2848	50	1208-896BC	1112-822BC
AA59712	5347/1	KU	AC	KU-A147	Pit Fill (into sterile below ASD-3)	seeds	EC	2848	32	1117-922BC	1042-837BC
AA74668	5139/1	KU	AC	KU-A119	Lower Floor (AC)ASD-3	wood	LC+MC	2858	35	1130-917BC	1056-835BC
AA59716	5070/1	KU	AQ	KU-C4/C5	Midden	seeds	LC	2490	32	779-418BC	753-404BC
AA59715	5065/1	KU	AQ	KU-C18	Midden (above sterile)	seeds	LC+20%MC	2536	32	798-544BC	770-416BC
AA74669	5093/1	KU	AQ	KU-C18	High Density Midden	wood	EC+5%MC	2751	35	979-819BC	919-798BC
AA64918	6590/1	KK	KK	KK-A56	Poss. Hearth	seeds	LFII	1851	42	AD65-254	AD88-378
AA64919	6572/1	KK	KK	KK-A43	Exterior Surface (KK)ASD-1	seeds	LFI	1894	37	AD27-224	AD75-315
AA70202	7546/1	KU	KU	KU-B202	In situ burned area (KU)ASD-4	seeds	NA	1244	38	AD679-878	AD708-968
AA70205	7590/1	KU	KU	KU-B249	Occupation zone inside (KU)ASD-5	wood	LFI	1605	38	AD356-550	AD421-598
AA74667	5272/1	KU	KU	KU-B34	Prepared clay floor	seeds	LFII	1690	34	AD256-422	AD266-538
AA70203	7521/1	KU	KU	KU-B254	Pit Fill (KU)ASD-5	wood	NA	1694	40	AD247-424	AD261-540
AA70204	7580/1	KU	KU	KU-B261	Occupation zone outside (KU)ASD-5	seeds	LF I+2%LC	1755	41	AD139-390	AD235-430
AA59719	5164/1	KU	KU	KU-B22	Clay Lens Inside/Poss. Surface (KU)ASD-2	wood	LFI	1785	34	AD132-337	AD230-410
AA59721	5274/1	KU	KU	KU-B39	Midden	seeds	LF I+13%LC	1868	35	AD70-234	AD86-330
AA70201	5358/2	KU	KU	KU-B12	Floor Inside (KU)ASD-2	wood	LFI	1898	40	AD24-224	AD69-317
AA59713	5322/1	KU	KU	KU-B97	Midden and Ash (above sterile)	seeds	NA	1908	32	AD22-212	AD75-242
Beta - 217119	7610/1	KU	SK	KU-D8	Midden	seeds	LFI+14%Ch	1960	40	43BC-AD126	AD5-226
Beta - 217120	7612/1	KU	SK	KU-D9	Midden	seeds	LFI+24%Ch	2170	40	371-106BC	BC355-2
AA64922	6090/1	SN	SN	SN-A56	Pit Fill	seeds	mixed	1578	43	AD369-577	AD427-624
Beta - 217118	7046/1	SN	SN	SN-A207	Upper Clay Surface	wood	LFI	1670	40	AD253-530	AD340-550
AA64920	6040/1	SN	SN	SN-A46	Midden	seeds	LFII	1701	44	AD239-426	AD260-538
AA64921	6125/1	SN	SN	SN-A67	Hearth	seeds	NA	1779	52	AD126-391	AD139-426
Beta - 217122	7094/1	SN	SN	SN-A285	Poss. Surface near Burial	wood	LFI	1830	40	AD80-318	AD132-381
Beta - 217121	7224/1	SN	SN	SN-A343	Poss. Occupation zone (above sterile)	seeds	NA	2180	40	379-114BC	BC356-41

Table 5.2: All TAP radiocarbon dates (AA = Arizon AMS Laboratory, Beta= Beta Analytic)

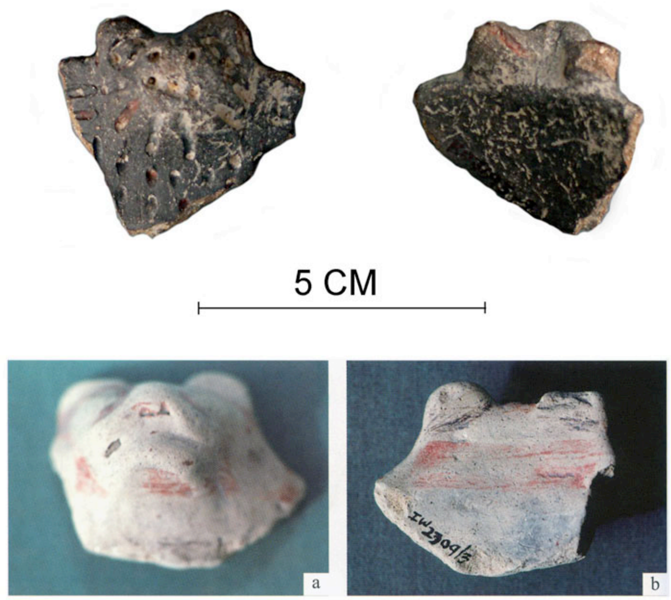

Figure 5.3: Late Formative II "Qeya" modeled feline head from Kala Uyuni with eroded post-fire paint (top) and similar feline from Iwawi (bottom) (Iwawi images, without scale, adopted from Burkholder 2001 figure 10a and b.

Through analysis of the undecorated assemblage, we defined a few (a total of 9 events in all three sites) unmixed Late Formative II contexts in the ceramic assemblage (see green coded boxes in the Harris Matrices in Appendix 1 for Late Formative II contexts). It is important to note, however, that not all contexts have been analyzed in detail, and in some cases the small number of sherds precluded defining whether the context was Late Formative I or II. Our analysis to date has not defined any clear Late Formative II contexts at Kumi Kipa and only two at Kala Uyuni (KU-B34, KU-B55). The middle terrace at Sonaji, however, included 6 events associated with ASD 1 that all were phased to Late Formative II, and have returned later C14 dates. For instance, the SN-A46 midden was clearly associated with Late Formative II ceramics, and returned a 1-sigma date of cal AD 240-430. Since we have such a small number of Late Formative II contexts (and are still attempting to define what other attributes define this transition), I focus on the Late Formative I in this dissertation.

However, Figure 5.4 suggests that we do have several carbon-14 dates that fall within Janusek's range for the Late Formative II that ceramically have been defined as Late Formative I. One date from the upper yellow clay surface of SN-A207, which had many Late Formative ceramics (including diagnostic red-rimmed Kalasasaya vessels) returned a 1-sigma date of AD 250-530 (Beta-217118). The other late dates are from contexts associated with the circular structure of ASD-5 at KU KU. A radiocarbon date from event KU-B261, the midden outside of ASD-5, returned a 1-sigma date of AD 140-390 (AA70204) appears to be in the later part of Late Formative I. Another C14 date, from event KU-B254, the pit fill associated with a burial associated with this structure gave a 1-sigma of AD 270-350 (AA70203). Event KU-B249, the internal occupation surface, appears quite late, with a 1-sigma date of AD 360-550 (AA70205). All three of these contexts appeared to be *ceramically* Late Formative I in date. There are several possibilities for this discrepancy.

The first option, suggested by the one C14 date, is that the material of the exterior midden formed prior to the pit of the burial and that the structure was used in the following Late Formative II phase. Bruno (2008: 429) favors this interpretation, noting that ASD-5 is 90 centimeters higher than ASD-2 and 4. However this is an issue that, as discussed in the previous chapter, was highly debated in the excavations. Fernandez and Fontenla (2006: 21-22) opened a unit to investigate the stratigraphic relationship between these two areas. Some members of TAP noted what appeared to be terrace wall between these areas, making the area around ASD-2 and -4 sunken. Unfortunately the profiles from these excavations do not resolve this issue. There are plans for further excavate this area which may substantially clarify this issue.

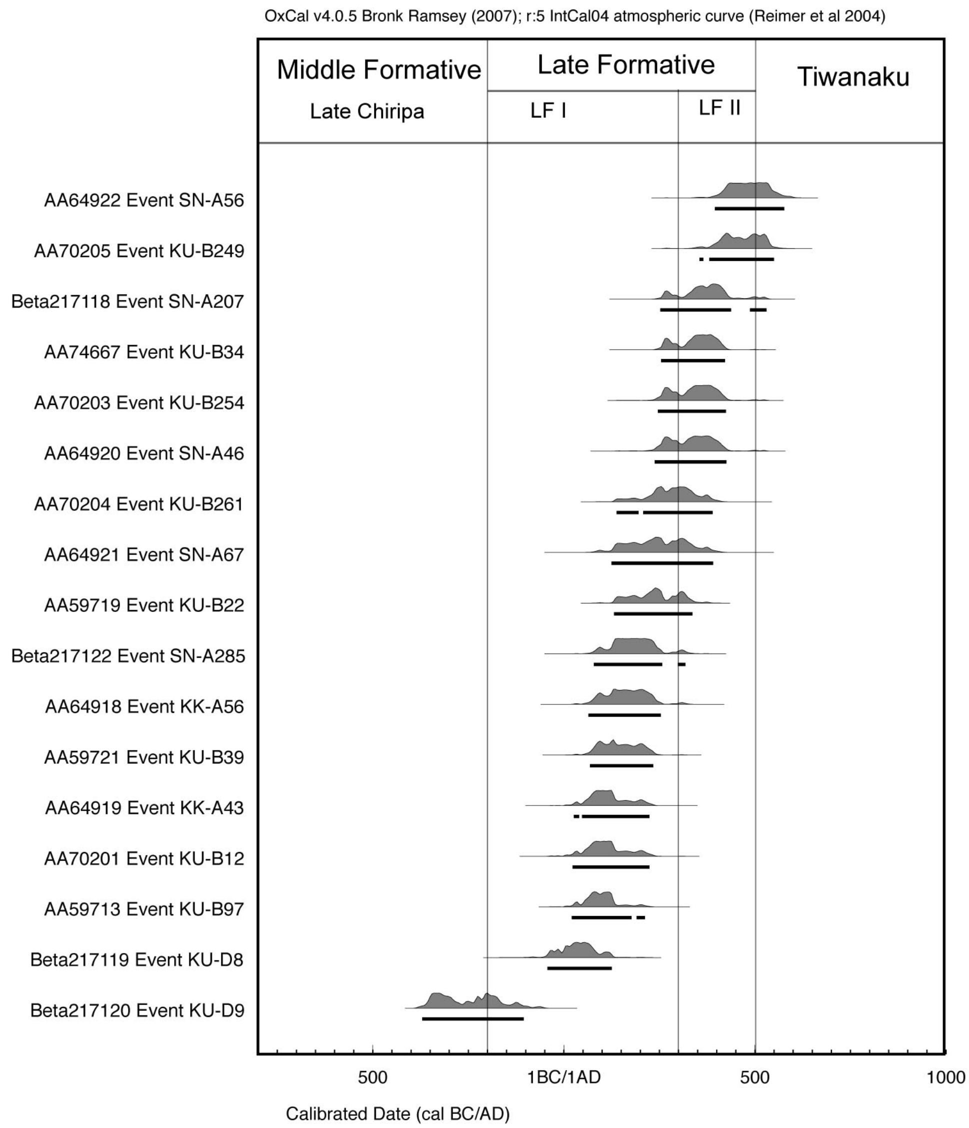

Figure 5.4: Radiocarbon dates, run by the University of Arizona (AA) and Beta Analytic (Beta) labs, from TAP excavations. (See Bruno 2008 for all TAP dates including earlier Middle Formative and later Tiwanaku period). (Image adapted from Bruno 2008).

Another option is that there is a problem with the samples; in particular there is the possibility that the samples were from erosional Tiwanaku contexts. We noted high bioturbation in our excavations of this shallow structure (Roddick et al. 2006: 27). The sample for the internal surface was taken from a locus (7590) that may be associated with the burning/destruction of the building. Nevertheless, even if this one date is a result of bioturbation, the other later dates need to be explained vis-à-vis the clear Late Formative I ceramic patterns.

A final possibility is that the TAP phasing for LF1 does not follow Janusek's (admittedly tentative) regional ceramic phase: C14 date relationships. As we have seen, Janusek's definition of these phases was based on a limited number of carbon dates, and the majority of them were re-calibrations of Ponce's original excavations. In addition to the C14 dates, another option is that those technological choices found in non-decorated ceramics, those attributes often used to define these phases, changed at different paces throughout the basin. The stratigraphic relationship between "continuity and contemporaneity", which caused problem for Mathews at Tilata, may be a problem for defining local distinctions in ceramic manufacture during the Late Formative archaeological phases.

We may need to take a more nuanced position – rare in the construction of seriation - for the Late Formative I / II dates. Janusek (2003: 52) has suggested we "investigate the significance of a "staggered" temporal introduction of innovative technological and material styles" for the Late Formative II/Tiwanaku IV period. This may be necessary for the earlier periods as well. This staggered temporal introduction, in fact, would make more sense in terms of the learning occurring over multiple generations. From this perspective the contexts associated with the interior of ASD-5 may not be a mixed context, but rather point to a longer Late Formative I ceramic tradition, or genealogy of practice, at Kala Uyuni. This is similar to a series of later dates associated with Late Formative materials at the site of Kirawi in the Katari valley. One context associated with Late Formative I ceramics returned a 1-sigma date of A.D. 420

(Beta-91777), and another, associated with Late Formative II ceramics, a 1-sigma date of A.D. 596 (Beta-91776), both well later than his own defined phases (Janusek 2003: 142,144).

Clearly a strict usage of archaeological phases would have a similar impact as those political and social boundaries critiqued in chapter 2. Such reification would homogenize the varied rhythms that defined the taskscapes of prehistoric Titicaca Basin inhabitants. A communities of practice perspective accounts for different rhythms of change both across similar material practices and across technological traditions. Future work should not reify the rather young Titicaca ceramic sequence. Rather we should look for social relational accounts for variability in technological choice in ceramic manufacture.

5.4 Summary: Local or regional chronologies

I started this chapter by suggesting that a regional approach to seriation is not only premature, but also inappropriate for particular prehistoric narratives. As we are still attempting to hash out the details of particular manufacturing procedures and their relationship to stratigraphic profiles and radiocarbon dates, we cannot preemptively take a bird's eye perspective. I suggest that fine-grain analysis is still needed on this period. After summarizing the history of ceramic studies of the Late Formative, which originally relied upon design style, I applied some of the concepts from Chapter 3 to suggest that technological style may be more appropriate for examining the Late Formative. I noted that specific attention would need to be directed towards changing paste recipes through time. This diachronic shift was framed as "The Paste Question" which will serve as a central issue in later chapters. I noted that technological style is a particularly effective way to generate attention to variation. In Chapter 7 I will demonstrate in detail how these pastes change vis-à-vis design style and other realms of technological style on the Taraco Peninsula.

I then examined the current radiocarbon dates for the Late Formative in the Southern Lake Titicaca Basin. Working from Janusek's distinction between Late Formative I and Late Formative II, I observed that the majority of the excavations conducted by the Taraco Archaeological Project are well within the Late Formative I. However, the local seriation employed here, following similar examples elsewhere, suggests that technological choices may be "staggered" as well. The implications of this for regional work (including survey) are rather important: "a master sequence would provide little more than a highly abstract portrait of chronology and the development of social complexity in the region…Only by comparing entire ceramic assemblages and by considering patterns of diversity among those assemblages can we build effective and meaningful chronologies." (Janusek 2003: 87-88). This does not mean that we follow Mathews and treat the Late Formative as a single "cultural stage" in a particular evolutionary trajectory; rather it means we take local rhythms seriously as both Burkholder and Lemuz do, as evidence for different relationships between practitioners over several generations.

For the most part the TAP recovered contexts that are similar in dates, ranging from approximately 50 BC to AD 300. If we follow an approximation that each generation is of approximately 20 years, then this sequence represents the lived lives of 14 generations of practitioners. Important exceptions lie in the several clear Late Formative II contexts at Kala Uyuni and Sonaji, which I do not include in my greater sample of ceramics. More ambiguous are several contexts associated with ASD 5 at Kala

Uyuni. As pointed out by Bruno (2008), these dates may be representative of the late Late Formative I or early Late Formative II. Although the stratigraphic nature of these excavations may be problematic, I believe that these do not represent substantially different ceramics. I include these in my greater sample, but noting any substantial variability in my analysis of intra-site variability.

In the next chapter I turn to the methodology employed in my ceramic analysis, looking at the relationship between particular manufacturing processes (or operational sequences) to the attribute patterning. I will examine how TAP ceramicists have seriated these contexts, and how I propose to link these particular attributes, as residues of technological choices, to define a community of practice. I will further develop the claims made here: that a practice-based approach, particularly one stressing community of potters, is a productive approach to examining both practical issues of time-space systematics, and for asking social questions through time. In particular, I will draw on the conceptual arguments made in Chapter 3 through my specific attribute analysis, arguing that while we may not have a singular working "theory of style", there are many useful tools that developed out the style dates (summarized in chapter 3) that permit the investigation of Late Formative communities of practice. I will also examine in detail how my sampling methodology was conducted vis-à-vis the radiocarbon dates discussed in this chapter.

Chapter 6: Micro-Styles and TAP Ceramic Methodologies

I ended the last chapter by noting that while there are still considerable problems in approaching Late Formative ceramics, research embracing technological style offers many avenues to define micro-scale variability across space (communities of practice) and through time (genealogies of practice). As Chapter 3 demonstrated, I appreciate the critiques of theories of style, but am still find it to be a necessary methodological concept. I find style, in particular technological style, useful to explore those habits and the materialization of sequences of learned gestures. In this chapter I use the concept of technological style to confront the specific problems of Titicaca ceramic assemblages described in the last chapter, and to develop an appropriate methodology for studying Late Formative communities of potting practice. I argue that we can utilize rich ethnoarchaeological and archaeological case studies, and employ strong, well-tested methods to define prehistoric communities of practice.

I begin by exploring the concept of the *chaîne d'opératoire* and the method of attribute analysis, and explain how each is well suited for defining prehistoric micro-styles. Attribute analysis is not the only methodology being employed in this project; I return to examine some methods of compositional analysis in Chapter 8, in the context of defining the raw materials available to local production communities. But attributes do offer some important perspectives on technological choices. I examine the particular production attributes studied within the TAP system (including paste, vessel shape and size, rim form, surface treatment, decoration, and firing cores) and how they signify cemented technological choices of particular communities of practice. In the second half of this chapter I introduce the hierarchical system of ceramic analysis employed by the Taraco Archaeological Project, and how I used this system to subsample the ceramics excavated in the 2003-2005 seasons.

6.1 Operational Sequences – Production, consumption and back again

In section 3.5 I briefly mentioned van der Leeuw's (1993, 1994) cognitive approach to ceramic analysis and the three cognitive categories - topology, partonomy and sequence – that he believes are central to the craft learning process. The sequence component of van der Leeuw's tripartite system has received perhaps the most attention in studies of craft production, variously called the *chaîne d'opératoire*, the "operational sequence", or "the birth to death approach" to artifact analysis (Kolb 1989; Schlanger 1990, 1994). This approach is particularly well developed in studies of hand-built ceramics, as summarized in a variety of syntheses and case studies (Mahias 1993; Rice 1987; Rye 1981; Sillar 2000; Stark 1999 Table 3.1).

Operational sequences are certainly easier to define for archaeological ceramics than partonomy and topology, but a number of scholars stress that we should not assume that the operational sequence within any given context is necessarily isolated and straightforward. Subtle variation within any given sequence may indicate important social variability. For instance, in Cameroon women make coil built pots for daily use, whereas men make ritual vessels drawing on woodcarving techniques (Barley 1994: 63-64). Interpretation of any given sequence also depends on what is considered to be the "end" result. For instance, Sillar (2000:9), asks whether the bottom or end of particular operational flow chart should be "the pot, the food that will be cooked inside it, or the people who will be fed?" (Sillar 2000:9). In developing his argument for embedded production (see section 3.8), Sillar notes that the process of preparing clays in the Andes involves variants of the same techniques, along with symbolical and conceptual similarities, used to prepare *ch'unu* (freeze-dried potatoes).

Particular production sequences during the Titicaca Basin Late Formative were likely directly linked to food consumption, and pottery production and consumption were apt to be embedded in other realms of social practice. The act of consumption often consists of deploying the product from one operational sequence within the sequence producing another product: "A pick is used to excavate potting clay, the pot is used as a container in which to dye wool, the wool is used to make a sack, and the sack is used to transport fertilizer to the field" (Sillar 2000: 12). There are several ways to deal with such "embeddedness", but I use two particularly well-used approaches while formulating my methodology below. First, as Sillar suggests, we should see consumption as the removal of a product from one operational sequence and its position as a tool in another sequence. Another way is to consider the operational sequence of a particular crafting item from a perspective of its 'social life'. This is an examination of the biography, or life-history of the potsherd (Gosden and Marshall 1999; Tringham 1994; 1995) and the "interconnections between the lives of things and the lives of people" (Holtorf 2002: 53). Both the series of operational sequences and the biographic approach frame the discussion that follows. I now turn to the attribute, an essential archaeological signature of ceramic operational sequences.

6.2 Accessing technical choice and defining micro-style: attribute analysis

Anna Shepard was one of the first scholars to note the inherent strengths of attribute analysis. She recognized that the type-variety approach, so frequently utilized in archaeological research, would not aid in tracking cultural process (Rands 1991: 167; Shepard 1980). Typologies are formal schemes that are usually associated with surface finish and decoration and tend to stress similarities among ceramics rather than differences. While tracking similarities results in a quicker form of analysis, it also means that variation within assemblages is more difficult to observe (Hammond 1972; Steadman 1995: 48). Attribute analysis, by contrast, is used to track such subtle variation. In fact, with "an attribute analysis of technical choice', the goal is to look for variation and co-variation within and between objects - not to formulate a typology" (Chilton 1996: 58).

An attribute is "a logically irreducible and independent variable within a specific frame of reference" in which "the character has two or more states" (Clark 1968: 139). Attribute states are the smallest units, traits, or characteristics of artifacts that can be reliably observed. They are the result of either a single action or a micro-sequence of actions. These should be clear elements that another analyst can observe and record in the same way. Each ceramic variable can potentially vary independently. For example, different pastes may not always associate with recognizable form or surface finishes. As such, and unlike the type-variety system, attribute analysis does not give any one attribute more weight; rather it records them all equally until it is apparent which attribute varies the most.

An attribute analysis is suitable for a study of communities of ceramic production and consumption on the Taraco Peninsula. Attribute analysis is appropriate for chronological, spatial and pragmatic reasons relating to the nature of the Late Formative assemblage. While a type-variety method may be of use for homogeneous production practices with long chronological duration (as numerous attributes must change to create a new type), attribute analysis can track those elements that change more rapidly than others. It is thus ideal for looking at the subtle changes that occur within a specific ceramic tradition. Attribute analysis also encourages comparison across space (between communities of practice) since specific attributes can be compared between sites "independent of their associations with other attributes or in different associations" (Steadman 1995: 49). Finally in cases where assemblages are extremely fragmented, such as the Late Formative assemblages across the Titicaca Basin, an attribute analysis permits for various stages in production to be examined, even if the entire operational sequence cannot be examined. Or, put another way, an attribute analysis permits the ceramicist to study of a number of sedimented choices – clay access, forming vessels, manipulating rims, firing, surface finish, etc - rather than being constrained by seeking out the end-result "types" of all these choices.

Carr (1995) offers further support for the use of attribute analysis to examine the signatures of both communities of production and consumption. Carr's hierarchical model of artifact design stresses the physical and contextual visibility of artifacts. Physical visibility is the size and frequency of an attribute on an artifact, the number of alternative states associated with an attribute, and the relative order of attribute in the production sequence (Carr 1995: 173). Contextual visibility describes the environments in which an artifact or attribute is used; such as artifact ubiquity, average viewing time and distance, the number of viewers, and lighting conditions (Carr 1995, table 7.5). High visibility pottery attributes, such as decorative elements, may have been used to convey social identity and group membership; these are attributes that create 'active' styles. Such attributes may be important to communities of consumption, as they are clear to both producers and consumers. In the Titicaca Basin, these would be limited to the geometric designs and high polishes and burnishes found on some Late Formative vessels. While archaeologists typically employ such traits for both seriation and defining communities in the Titicaca Basin, they should be used carefully. As I pointed out in Chapter 3, the social boundaries for fine-ware ceramics are often rather permeable as this material can circulate widely, potentially reaching a wide diversity of communities of consumption.

More preferable for tracking micro-style are attributes with low visibility, such as those of raw materials and preparation, rim shape, wall thickness and firing technique. The patterning in such attributes is more likely to be the result of particular communities of practice (Carr 1995). While Steadman's (1995) system was not explicitly geared towards tracking communities of practice, her attribute analysis is well suited since, "technological styles, rather than ceramic subvarieties, may become evident when we view ceramics as combinations of technological attributes rather than simply as types" (Stark 1999:32). It is to this system that I now turn, focusing first on the sequence of attributes studied within the TAP ceramic analyses.

6.3 TAP ceramics analysis: Attributes Studied

The TAP system of ceramic analysis tracks attributes related to vessel production choices and potential use. Potters will make choices in various parts of the production sequence to plan for specific usage. This is especially the case with cooking vessels, which are placed on and removed from a fire repeatedly. If a vessel is used as a cooking vessel it should have high heat conductivity: heat should move through the vessel walls quickly and efficiently to heat the food within. But when vessels are heated they expand, and unless both the clay and the inclusions have similar rates of expansion, the vessel will break. In some cases differential thermal expansion will occur, when the outside of the vessel heats faster than the interior when placed on a fire, or when the exterior cools faster when taken off the fire, both of which can cause thermal shock. Such stresses can create cracks or break the vessel. Researchers have found that potter can make a sequence of choices to help alleviate such issues, including changing clays, temper recipes, wall thickness, vessel size and shape, firing temperature and surface treatment (Schiffer et al. 1994). All of these decisions help for us to define possible decisions the potter made, and help us to ascertain what various functions particular vessels may have been used for.

6.31 Paste

As I mentioned in the previous chapter, paste is one of the most important chronological markers for the Late Formative Period. All ceramics analyzed by the ceramicists of the Taraco Archaeological Project were categorized by paste. Steadman has found that pastes vary substantially through time, and are thus essential for phasing purposes. In fact, archaeologists often rely on the continuity of a paste over time. In Andean archaeology, including the Titicaca Basin, pastes are often used to define the "local", and thus political and/or ethnic boundaries. Archaeologists rarely explicitly investigate the social practices that generate such continuity (Sillar 2000: 76), but I believe this paste assumption is based on a "site catchment" type of logic. This perspective is well articulated by the ceramic ecologists (for example Arnold 1985), whose cross-cultural ethnography suggests that potters *usually* exploit raw materials within 7 kilometers (and more often 1 km). However as both the ethnographic research by

DeBoer (1984) and Sillar (2000) suggest potter's social relations are essential in thinking through locality and clay collection. Ceramic raw materials "can't be explained by the economics of the pottery production alone …the choice of a particular clay source may be heavily influenced by the particulars of local land ownership and/or political control." (Sillar 2000:69)

Sillar's (2000: 57) work with modern potters in the South central Andes found that the paste meant for one household's pottery production is never prepared by another household. The processing itself is often guided by learning patterns, as was observed in Cameroon by Livingston-Smith (2000) and Olivier Gosselain (Gosselain and Livingstone Smith 2005; Gosselain 1999). They observed potters exploiting the same resources, but employing different processing techniques since different people taught them in different places. These paste choices are often not articulated as an active choice per say; an old potter told Livingston-Smith that 'using one technique or the other is essentially a question of habit'" (Livingston Smith 2000: 24). Dietler and Herbich have found for the Luo, major clay or temper sources are usually the product of local traditions, which can be disturbed by short-term events. They found, for example, that one particularly good clay was sworn off due to the collapse of an extraction tunnel (Dietler and Herbich 1989: 151). On a larger scale ethnographers have found that clay-processing techniques can, in fact, create patterns that archaeologists might interpret as "regional techno-complexes, traditions, groups or cultures" (Livingston Smith 2000: 27).

Pastes are a performance attribute and therefore consumers may express preference for certain recipes. Potters, in turn, often acknowledge the importance of paste preparation for the ceramic end results (Arnold 1971; Deboer 1978: 116). Raw materials and paste characteristics can greatly affect vessel performance, including thermal behavior and permeability (Braun 1978, 1983; Bronitsky 1986; Matson 1981; Rye 1976; Shepard 1980). Vessels that are tempered with fiber tend to be significantly lighter (Reid 1984), an important quality for nomadic or semi-nomadic consumers. Fiber tempered vessels would also be appropriate for serving as insulation for the heat transmitted by stones used in indirect cooking (Reid 1989: 173). Research also suggests these pastes would have had positive performance characteristics, as the high density of pores permit gases to pass through the body without cracking. Voids permit the crystals to expand, allowing for the stresses to be withstood (Bronitsky 1986; Skibo 1989). Perhaps most importantly for the excessively plastic Taraco clays, fiber tempering would help reduce shrinkage (Rye 1981: 34). Specifically organic temper can act as a binder providing more strength to the wet clay and to unfired vessels (Skibo et al. 1989: 140). As we shall see in Chapter 8, the clays of the Taraco Peninsula were quite plastic; fiber would have been essential to improve strength.

While there are advantages for cooking with fiber-tempered ceramics, sand tempered vessels tend to be more durable and efficient cooking pot. Sands tempers improve the transfer of heat to the contents of a vessel (Skibo et al. 1989). Braun (1983) and Reid (1989) have suggested that it is only with the introduction of sand that direct-fire cooking would be efficient. Kilikoglou et al. (1998) found that the increasing the size and density of quartz in tempers caused the formation of cracks from differential shrinkage and expansion of clay and quartz inclusions during drying and firing. But if the volume of quartz in tempers remained at 10 to 20 % these cracks would not affect the toughness of the vessel. Mica sand tempered ceramics also offer particular advantages.

Biotite and muscovite have particular cleavage (occurring in thin sheets) that make it particularly flexible, durable and mechanically strong. For instance, muscovite is stable up to 500 degrees Celsius (Benbow 2002), and slippage between mica plates can allow for stress relief, potentially preventing crack propagation.

Although paste choice is not necessarily the most important performance attribute, this choice does constrain subsequent steps. For instance, fiber and larger, chunky sand inclusions tend to mean that vessels have thicker walls. Thicker walls, and the chunky inclusions, increase strength and permit for larger vessels to be constructed. Therefore for indirect heating, fiber tempered, with heavy thick vessels walls are often manufactured. Thinner walls, possible with finer sand tempers, mean that vessels can be manufactured in smaller sizes. Such pastes also result in reduced temperature differences between the surface and the interior of the wall of a vessel while over a fire (Rice 1987: 229). The choice of a particular paste also has an effect on permeability and heat retention; meaning potters may make decisions later on in the operational sequence. Slips and labor intensive burnishing may have been necessary for porous fiber tempered cooking and liquid storage vessels (Rye 1981: 27; Schiffer 1990: 378).

We should retain a healthy skepticism towards optimizing models to production sequences. It is not always the case that the ideal cooking pot is set towards increasing heating effectiveness (Skibo 1992: 37). For some busy, multi-tasking cooks, a pot that can be left unattended may be deemed more useful. Simmered foods and better thermal shock resistance may be enough to bias producers against what archaeologists see as the advantages of sand tempers (Sassaman 1993: 161-163). In other cases aesthetic reasons and loaded symbolic choice may trump other requirements. Finally, it is unlikely that a potter will make a different paste for each pot. For instance, in much of the Andes modern potters prepare one paste recipe for all the pot forms they make.

Within the TAP system of analysis all sherds over 1 cm^2 in size are snipped with pliers then examined with a 10x hand lens. Working off of a paste box, compiled by Steadman over the past 10+ years of analysis of Taraco Peninsula ceramics, pastes are then analyzed according to various characteristics. Pastes were first grouped as primarily fiber-tempered or mineral (sand) tempered. The clay body was then judged by texture and compactness (or porosity). Color, shape and luster of the non-plastic inclusions were described subjectively, and their size was gauged by way of the Wentworth scale. The paste groups defined for all phases by the Taraco Archaeological Project are presented in Appendix 2. Those particular to the Late Formative Period, and methods for identifying them, are discussed in Chapter 7 and 8, while Chapter 9 examines the performance characteristics in more detail.

6.32 Vessel shape, size and thickness:

Ethnographers have found that micro-styles may be well defined within a particular morphological class of vessels (DeBoer 1990; Dietler and Herbich 1989; Stark 1999:32; van der Leeuw 1993). This is because producers and consumers track variability in shape and/or size (Stark 1991; 1999:38). The shaping stage is particularly important during the learning process; it is unlikely that unintentional innovation will occur here since gestures are immediately corrected, and then are incorporated into potting practice. “At this moment, innovation or the adoption of another technique is virtually impossible because it would require an unlearning compensated by a relearning process, and it is hard to imagine any factor strong enough to provide adequate motivation for such drastic measures" (Gosselain 1992: 582). As such variation and standardization of form may be a strong indicator of social boundaries within particular potting producers.

The form of vessels can also be utilized to predict their use. There is an extensive literature on the relationship between vessel morphology, vessel performance and vessel function (Henrickson 1990, Henrickson and McDonald 1983; Rice 1987; Smith 1985). For instance, cooking pots are likely to have rounded bases to reduce the potential of breakage from thermal shock (Rye 1976), and sometimes include handles to help lifting on and off the fire. Bowls may be used for serving liquids (such as soups, stews, etc), or used to burn ritual offerings (see Chapter 9). Vessel size has been used to investigate vessel function as well as to explore shifting foodways through time. For instance, the size of vessels may indicate different food serving practices.

Attaining information on forms has been extremely difficult for Formative Period researchers, as assemblages tend to be extremely fragmented. Nevertheless, TAP recorded form details as much as possible, with the goal of achieving something analogous to Janusek's (2003) form chart for the Formative Period (reproduced in Figure 9.1). As I worked intensively with Steadman in the field, I follow her distinctions for vessels shapes, first defined in her dissertation work in the northern Titicaca Basin (Steadman 1995). In this system maximum vessel thickness is recorded for body sherds, maximum wall thickness and rim thickness for diagnostic rim forms, and bases are measured for thickness on both the wall and the actual base of the sherd. The dimensions of width and thickness are recorded for handles.

Bowls are defined as unrestricted with a mouth diameter equal or greater than the maximum vessel diameter (Steadman 1995: 56). However bowls are extremely varied for the Late Formative assemblage, with a range of forms identified. TAP ceramicists use a protractor to measure interior rim and wall angles and then define the angles according to four wall profile categories: a very flared bowl (wall angle of <35), flared bowl (35-55), slightly flared bowl (56-77) and a vertical-sided bowl (78-90). Steadman identifies bowls with convex walls and carinated bowls that have a basal angle separating a straight upper wall from the convex lower wall and base (Steadman 1995: 56).

Necked vessels include both jars and ollas, with neck height being the main difference between the two. Ollas are restricted necked vessels, called short-necked when they have less than 2 centimeters of neck, and medium when they are 2.1 to 3.9 centimeters in neck height. Neck height is measured from the rim to the point where the neck joins with the vessel body (Steadman 1995: 57). In those cases where the upper body of the rim sherd is preserved, the shoulder angle is measured. These angles permit for descriptive terms to be used to define these angles and neck height (slightly flared medium-necked olla, for instance; see Appendix 2 for all possible forms). Jars are similar to ollas, yet have neck heights higher than 4 centimeters. Short-necked jars vary from 4 to 5.9 centimeters in height, while tall-necked jars range from 4-5.9 centimeters. In some cases the junction of the neck is missing, making neck height inaccessible for measure; in such cases the vessels are simply called jars (Steadman 1995: 57).

Bases are classified by way of a list of forms and interior wall angles (Appendix 2). Angles are measured in a similar fashion as rims, with degree measurements the opposite of rim figures (flared 145-125, slightly flared 124-103). If less than 1 cm of the wall is present, the angle is not measured (Steadman 1995: 57).

Vessel size and volume is almost impossible to ascertain in the fragmented Taraco assemblages, so vessel orifice diameter was investigated using a rim diameter chart. While this technique is appropriate for bowls, where there is often a linear relationship between rim diameter and vessel volume (Mills 1999: 106), it may not be as appropriate for necked vessels. This issue will hopefully be resolved in the near future when the ratio of orifice to volume for necked vessels can be reconstructed through the study of complete vessel forms[1].

6.33 Rim form

A particular group of potters may change how they form their rim shape for a number of reasons, due to either slippage (non-discursive aspects are part of the gestural learning process) or more purposeful choices by potters. In some cases rims may actual serve as a signature of the producer or producing community (but see Solheim 1984). Rim variation would appear to have less of a functional role than other form attributes, but there are functional reasons for rim variation. For instance, Sillar finds that many potters take great care finishing the rims of their pots "because it requires different finishing techniques to facilitate the changing direction of the inclusions, as well as the stresses and strains of differential drying, all of which make the rim particularly susceptible to the propagation of cracks (Sillar 2003).

Rims were described using a master list of rim forms that stresses particular variability in attributes. Steadman has compiled a list of 59 possible rims for the entire Formative through Tiwanaku sequence, but only a handful of these are predominant

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[1] Mills notes that for the northern Southwest of the US, height is the best proxy for restricted jars. Until a comparable sample of full vessels is published for the Late Formative, such a conclusion is not possible for the Titicaca Basin.

during the Late Formative (see next chapter). While rim forms are noted on both drawn and non-drawn diagnostic forms, experience suggests that rim variability is best noted through the illustration of the ceramic profiles.

6.34 Surface Treatment: Finish, Contour, and Luster

Surface treatment can vary in production sequences for a number of reasons, including those related to learning patterns. The tools used in finishing a vessel and the direction of smoothing, wiping or burnishing a surface may be indicative of communities of practice (Van Keuren 2006). Other aspects of surface treatment may be related to potential use. For example, the use of resins and coatings on pots may reduce permeability of cooking vessels (DeBoer and Lathrap 1979; Schiffer 1990; Skibo 1992; Rice 1987:231; Rye 1981: 26), but burnishing can also decrease permeability (Steadman 1995: 147). Dietler and Herbich's (1989: 157) discussion with Luo potters found that burnishing is the most time-consuming and physically tiring process of decorative techniques.

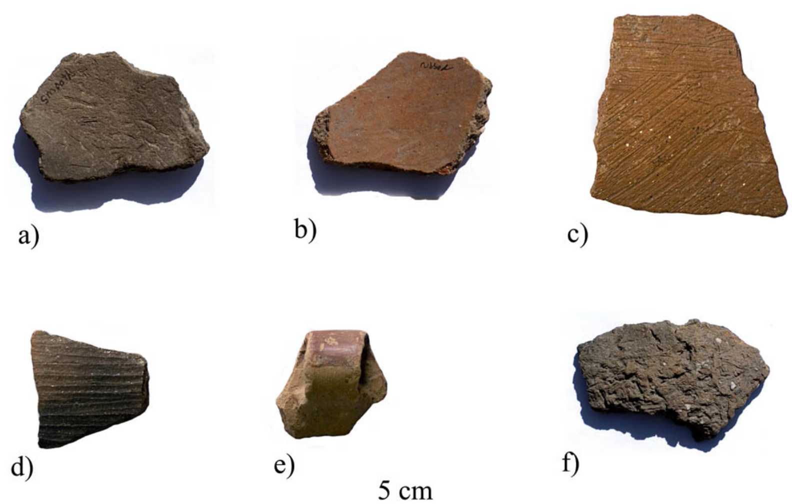


Figure 6.1: TAP surface finishes: a) smoothed, b) rubbed, c) wiped, d) incomplete burnish, e) burnished, f) stucco

TAP ceramicists record a variety of attributes concerning the surface treatment of the vessels. Surface contour, referring to the regularity of the vessel's surface, is judged (subjectively) as very even, even, slightly irregular and irregular. Luster is ranked to high, medium, low and matte. While a high luster has a glossy surface due to burnishing, a matte reflects little to no light (Steadman 1995: 60). Surface contour and luster were found to co-vary with surface finish, and future studies may not need to record luster.

Surface finishes, following Steadman (1995:61-68), are categorized according to the variation of 7 possible finishes on the interior and exterior surface (Appendix 2). Smoothed surfaces are obtained by rubbing the surface of the vessel with a soft tool (such as cloth or skin) creating a matte, and well-compacted surface (Shepard 1956: 121, 191; as discussed in Steadman 1995: 64). Wiped finishes were likely the result of wiping the still plastic surface of the vessel using a piece of cloth or the hand (Steadman 1995: 65). A characteristic wiped pattern is a series of fine ridges (see Figure 6.1). Burnished surfaces are those worked with a hard, smooth tool such as a pebble, on the firm clay surface. A complete burnish refers to the complete vessel being worked with a smooth tool, and the surfaces are often even and high in luster. Incomplete burnish refers to those cases where spaces of 1 to 5 mm remain between the burnish strokes. In some cases troughs left by the tool are visible, as are wiped surfaces beneath the burnishing. Very fine burnish is restricted to those cases where the pottery is so highly burnished that no evidence of the process (other than a high luster) remains. Finally, some vessels have a slurry of clay applied as a "stucco", likely for insulating cooking vessels (Chapter 9).

6.35 Decoration

As the previous two chapters have demonstrated, decoration, or design style, has played a central role in defining social boundaries of the Late Formative Period. Decoration is also tracked by recording a series of attributes. First, the location of the slip was noted. Was the slip was found all over the sherd, only on the neck (exterior or interior), on the rim or the base, etc. Slip color and location are also codified into the system of ceramic analysis. The type of decoration is categorized by whether the sherd is painted (in 2-5 colors), incised, modeled, or a combination. In cases where incisions are present, the width of incision lines are measured. Slip colors are recorded using a Munsell color chart (for color categories, see Appendix 2). The designs of slips and incisions are recorded using a master motif list. Finally, in cases where the phase of the ceramic could be determined, a decorated ware code is given (for example Chiripa black and cream on red incised, or Late Formative I red and unslipped incised). All decorated sherds are drawn, and in some cases, photographed.

6.36 Firing Attributes

As of yet, there has been no direct evidence for firing sites in the Titicaca Basin Formative. This is perhaps because, in most parts of the Andes prior to Spanish contact, bonfire open firings were the norm. In this type of firing it is rare that high temperatures are sustained for more than 50 minutes in such firings (Rye 1981: 102-103) thus it is rare to find evidence for over fired pots in such scenarios (Rice 1987: 106-107). As I discuss in later chapters, the pottery of this period was likely low-fired, resulting in little evidence for production sites – wasters, over fired clays, etc. I will discuss evidence for firing in the next chapter, for now I focus on the attributes that may permit us to track variability.

One option is related to the oxidation process. The color of ceramics is the product of both the clay contents itself and the oxidizing environment during firing (as discussed below). The TAP ceramics team recorded surface color by using the Munsell Soil Color chart, and a list of substituted colors for the Munsell nomenclature (Appendix 1). This analysis was complimented by a series of re-firing experiments that I explore in chapter 8. Firing patterns were also examined through sherd cores patterning (Steadman 1995). In order to burn off all organic materials in a clay body, oxygen must be present with firing temperatures of 500 to 800 degrees C. Inefficient combustion causes a lack of oxygen, thereby producing carbon monoxide (CO), which slows the burning of organic material. This blocks the development of color in the metal oxides and affects the color patterns in sherd cores.

Following Steadman's system the variation in patterning of black, red brown, brown and light brown are used to track the oxidation environment (Appendix 2). A red brown color indicates that all carbonaceous material has been burned off and the iron has been completely oxidized. Cores that are red brown with dark brown or black interior cores suggest incomplete oxidation, caused by either a short firing time, low temperature or an atmosphere with insufficient oxygen. A sharp boundary between the dark core and the red brown edges may suggest a brief period of strong oxidation - perhaps the vessel was cooled quickly after being removed from the fire (Shepard 1956: 193). Rye (1981: 118) suggests that sharp boundaries are only possible in open firing methods, as kiln firings require extended cooling times. Steadman (1995: 69) notes that quick cooling can cause brighter slip colors. Light brown paste colors were also likely incompletely oxidized.

Red brown cores and dark brown or black edges are likely caused by the deposition of carbon onto the surface of the vessel, either by fire clouding (contact with the fuel during firing), post-depositional burning (by use close to the fire) or smudging (Steadman 1995: 70). Smudging is the intentional smothering of the fire with organic matter, preventing oxygen and causing carbon from the fuel to be deposited on the surface of the vessel. The result is a black color on the surface or throughout the cross-section, or a light brown or gray if the smothering is brief in duration (Shepard 1956: 88, 106; Rice 1987: 158, 335, 345; Rye 1981; Obstler 2000; Orton, Tyers and Vince 1993: 133). Completely black cores may be caused by smudging, but also may be from incompletely oxidized highly carbonaceous clay, or perhaps from use as cooking vessels.

The amount of dark core present can also be affected by other factors: for example paste texture, and the related porosity, can affect the ease of which oxygen reaches the organic material inside. Placement of the pots in the firing process can affect the airflow and thus the core patterning. Of course tracking the atmosphere of any given environment is not as simple as simply recording the firing code list. Paste colors can be also affected by the properties of the clay, the firing temperature, and duration of the firing.

6.37 Consumption Attributes: Use, residues and pot-use lives

The attributes discussed thus far have been focused on production choices. TAP ceramicists also examine attributes that are the result of vessel use. It is possible to seek out vessel function through the identification of residues deposited or absorbed into the ceramic fabric during vessel use. In Andean ethnographic case studies, a cooking pot is often prepared or seasoned (Aymara =*arini*) in some cases poring boiling ch'unu water, or rubbing the inside and outside of the vessel with animal fat or blood (Chávez 1984: 174; Sillar 2000: 138). In other cases it is possible to extract residues, such as food, carbon, minerals, fats, etc. from the inside of the vessel (Duma 1972; Evershed et al. 1992; Hally 1983; Kobayashi 1994; Skibo 1992). These attributes can include dark discolorations and sooting resulting from use over a fire, food remains and encrustations from cooking over a fire, interior pitting due to acidic contents.

Since a good portion of the ceramic assemblage is fragmented, it is quite difficult to access the effects of food processing activities within vessels, but we can study the patterns of carbon deposits. Residues may be deposited throughout the use-life of a particular pot. Particular cooking practices may result in specific soot deposits (Hally 1983, 1986; Skibo 1992; Skibo and Blinman 1996). Indirect cooking, so often associated with fiber tempering (see below), should be evident in the abrasion from the use of hot stones. If vessels had been used for direct heat cooking we would expect residues of burned contents on interior vessel walls. If vessels were set directly in the fire there should be an oxidized exterior base with sooting on exterior walls. If the vessels were used to cook with water there should be carbon deposits on the interior body in bands. If the vessel was set above the fire, there should be sooting on the exterior bases. Finally if cooking occurred without water, such as for stews or roasts, we would expect deposits on the interior base and lower walls.

TAP ceramicists codified interior and exterior powder, encrustations, scorching and fire blackening for all body sherds and diagnostics (Appendix 2). Encrustations were scraped off using a sterilized dental pick for isotope analysis (Miller 2005). This approach, of course, is not without its problems. In some cases we may be looking at a one-time event in the life of a pot, in other cases particular residues may not preserve due to post-depositional processes. The strongest approach combines technological aspects, sooting patterns, changing foodways and cuisine and the context of recovery into account.

Vessel use life also may also indicate use of vessels within particular consumption strategies. Much research has shown the impact of vessel function on the degree of representation in archaeological assemblages has been tracked in various studies (Mills 1989; Roddick 2002 for summary). For instance vessels subjected physical stress, such as heating and impacts, will break more often. Thus transportation or cooking vessels will break more often than stationary storage vessels. Since larger vessels are often heavy and immobile, it is often the smaller "mobile" vessels that have shorter use-lives (David 1972; David and Henning 1972; DeBoer and Lathrap 1979). Vessels that are used on a regular basis are exposed to more potential sources of stress. So the cooking pot, being used daily for food preparation, may have a higher breakage (and replacement) rate than those used in special occasions (David and Henning 1972; DeBoer 1974; M. Stark 1994: 182). Furthermore, those vessels that are used for special events may be handled with a greater degree of care. Miriam Stark (1994: 182) has noted that the expectations surrounding a vessels use-life can affect how much effort will be put into the manufacturing process. It is such factors that create the archaeological distinction between fine (and assumed to be ceremonial) wares and utilitarian wares[2]. Fine wares may receive more attention in the preparation sequence, are handled more carefully, and do not break as frequently (DeBoer 1985; Longacre 1985: 335; Mills 1989: 144). Utilitarian wares are less likely to receive the same amount of ware, and thus appear in higher proportions in the

[2] These may be problematic distinctions, as pottery can move in and out of ceremonial and domestic spheres no matter their morphology and surface finish.

archaeological record.

The lives of ceramics are rarely over when they are broken. Ethnographically, large pieces of broken pots can be used to dye wool, to toast grain, collect ash from the stove. In some cases they are repaired, and in other cases they continue with different uses. Sherds may be used to infill muddy paths, as lids for storage vessels, to feed animals, or used as grog (Sillar 2000: 149). Spindle whorls have been found in many cases from re-used pots. In other cases, the potsherds themselves are employed in further production of other vessels as smoothing tools, and as such serve as one of our few indicators of production at Taraco sites (see next chapter). This variability in "non-vessels" is recorded within TAP's system; we codify all ceramic artifacts by a basic ID (Appendix 2). Codes are given to the type of ceramic entity that is present, whether it be a rim and base (10), a neck (21) or a base with lug (58). Included in this identification system are these "non-vessels", such as figurines, and modified or re-used sherds (spindle whorls, smoothing tools).

6.4 TAP ceramic analysis: Sampling

The Taraco Archaeological Project generated 1539 bags of ceramics in the 2003-2005 excavations, representing 1,454 kilograms of ceramics (see Table 4.21 for specific breakdown). With such an immense quantity of sherds an effective sampling strategy is essential; it would be virtually impossible to conduct any type of in-field analysis on all this material, let alone the slow and detailed system required to define micro-style. However, my problem of sample size was immediately ameliorated from both the contextual information provided in the field, and after a basic phasing of contexts was completed. The Late Formative ceramics analyzed here were chosen primarily by availability.

Kala Uyuni, Sonaji and Kumi Kipa are multi-component sites, in some cases with extremely complicated depositional histories. Numerous later Tiwanaku pits adversely affected the Late Formative components, causing particular stratigraphic havoc at Sonaji. The action of bioturbation can have a considerable impact on some contexts (Goodman 1998; Peterson 2007). This results in an understandable amount of mixing in some of the excavated contexts. In general the sampling decisions at all three sites was also affected by the size of the associated ceramic assemblage. Since I did not wish to mix Middle Formative, Late Formative I and Late Formative II assemblages, only those loci that had sufficient ceramics for phasing purposes were included in my sample.

Determining which contexts were appropriate for analysis was determined in two phases. Dr. Lee Steadman and I conducted the first phase in the 2003-2005 field seasons in the field ceramic laboratory. This first phase (C- and Z-level of analysis described below) determined the level of mixing, and served as a feedback, providing important contextual phasing interpretations to the excavators and other laboratory specialists. This first phase helped to construct the TAP Harris Matrices. The second phase of sampling and analysis occurred in my 2006-2007 laboratory seasons. Here I relied upon the initial phasing, along with Harris Matrices and C14 dates generated from the 2003-2005 seasons, to analyze in much greater detail the Late Formative contexts (Appendix 1). Although this analysis *mostly* confirmed phasing attained in the 2003-2005 seasons, in several cases the second round of analysis clarified the stratigraphic relations.

6.42 TAP methodology

Steadman's (1995) system of attribute analysis, created through her work in the Northern Titicaca Basin, tracks different attributes depending on the context and level of efficiency and detail required. Within the first phase of ceramic analysis the TAP ceramicist makes scalar and contextual decisions regarding a given bag of ceramics. Ideally we would like to attain as much information as possible, but in many cases the nature of the deposit constrains interpretation to very general chronological and taphonomic questions, such as "is the deposit mixed?" or "is this depositional event Middle Formative in phase?" Loci associated with upper levels of excavations often require a cursory analysis for purely chronological purposes. This level of analysis, called C-analysis, is based on those gross attributes that change noticeably from one phase to another. While none of the data used here were generated by C-analysis, this type of analysis helped me to avoid plow-zones and mixed contexts. The data used in this dissertation were generated either by 'Z-analysis' or, preferably, 'A-analysis'.

6.43 'Z-analysis'

In cases of relatively unmixed but ambiguous depositional contexts (such as "possible midden" and "possible fill") the diversity of the ceramic assemblage can be used to help to determine the nature of the deposits and the use of space. This level of analysis, called Z-analysis, allows for the variability in both communities of consumption and production to be explored. Appendix 2 shows the form used in Z-analysis. This is a much more detailed analysis for loci thought to be unmixed by the excavators (due to stratigraphic relations). In this level of analysis we summarize basic body sherd data and record in more detail information regarding diagnostic sherds (rims, handles, bases, decorated body sherds, etc). We also record the phasing of the bag if it easily determined by the analyst, and basic count and weight of body sherds, small fragments (under 1 cm^2) and diagnostics. This form includes areas to note further information depending on the phase of the context. For instance, in a Middle Formative context, TAP records the total number of paste 21 (a diagnostic Late Chiripa phase paste recipe), the number of sherds slipped red (often relating to decorated vessels) and intrusive "post-Chiripa sherds". For Late Formative assemblages, we focus on paste groups that continue from the earlier Middle Formative period, or are exclusively used during the Late Formative. These pastes include sandy micaceous (paste groups 1, 2, 17 and 18), extremely dense mica (29), other mineral-tempered (3 and 9), buff (5 and 6) and those few remaining Late Chiripa pastes (19 and 21 in particular). These pastes, and there relevance to phasing, will be discussed in the next chapter.

Specimen numbers are recorded, and diameter and thickness measurements to the millimeter are taken. Codes for shape, diameters, exterior color, exterior finish, rim shape, exterior or interior carbonization, decoration and phase are all recorded. For those diagnostics requiring more detailed information, the drawn diagnostic form is used (Appendix 2). In addition to the information recoded on the main Z form, on this diagnostic form exterior and interior finish, firing core, color, luster, contour, mica density, finish direction and carbonization are all recorded. Also noted are codes and measurement for incisions, base finish and motif. The bottom half of this form is used for a 1:1 scale drawing of the specimen, from which additional information – thickness of rim, body and base, angle of rim, neck height, etc – can be extracted and entered into the ceramic database.

6.44 'A-analysis'

In those ideal situations where excavators successfully isolate stratigraphically unmixed Formative contexts, TAP ceramicists can conduct more detailed investigation into the use of space, and the role of ceramics in a given context. In such scenarios, the most detailed level of analysis is deployed. The majority of the data used in this dissertation was generated in A-level analysis. The form for this level of analysis records a number of attributes for each and every body sherd (all non-diagnostic sherds >1 cm^2) and diagnostic (Appendix 2). Codes are recorded for paste, finish, exterior and interior color, exterior and interior carbonization, firing, maximum thickness, sherd id, ware and weight. Count is included for the initial recording of small fragments (<1cm^2) and those sherds that can be refitted. A notes column is included for those qualitative aspects of the individual sherd that are not captured in the codified system. Diagnostic sherds are recorded either on the drawn-diagnostic form (the same form used for Z-drawn diagnostics) or the non-drawn diagnostic form. The non-drawn diagnostic form records all the same data that could be extracted from the drawn form, with several exceptions; if neck height or angle could be recorded, the specimen was likely drawn (Appendix 2).

6.45 A cautionary note and solution?

To effectively track the variability in these attributes requires both a good "attribute-type collection" – with at least a paste type collection and surface finish collection – and (ideally) an apprenticeship program. Thankfully I had both. Steadman created a surface finish type collection from her work at Chiripa. She also assembled a Middle Formative paste box in her early work at Chiripa, and within the first (2003) season at Kala Uyuni. Mathew Bandy, who used Steadman's phased bag to learn the seriation sequence, notes: "it is very difficult to learn to distinguish the various paste groups as I have described them here. They really cannot be conveyed satisfactorily in writing" (Bandy 2001: 56).

My own experience has found that nothing could substitute actually working with Steadman. This observation is somewhat disquieting. It suggests that replicability is an issue with these assemblages. It is for this reason that I have developed a detailed photographic record of the attributes themselves throughout this dissertation. I have assembled all these images and all the recorded attribute and compositional data, along with the available regional information on ceramics of the Late Formative to a relational *Filemaker* database to attempt to confront this worrisome issue. Such a database will eventually be made to be open to Titicaca Basin researchers to explore communities of practice throughout the region.

6.5 Chapter Summary

In this chapter I presented the system of ceramic analysis of the Taraco Archaeological Project. This framework is an effective way to track operational sequences and the use-life of Late Formative ceramics from the Lake Titicaca Basin. Steadman's system can accurately be described as painfully slow, but this attribute analysis permits for technological choices to be tracked. Lee Steadman's system has proved incredibly useful in defining the chronological shifts of the Formative Period. I argue that this approach is more than just a seriation tool; it is also appropriate for investigating subtle synchronic social variability. The TAP system of ceramic analysis produces vast quantities of data, organized in a relational database. In the next chapter I turn to examine the Late Formative ceramic assemblage from the Taraco Peninsula.

Chapter 7
Late Formative Pottery Production on the Taraco Peninsula

The last chapter summarized the system of attribute analysis employed by the Taraco Archaeological Project. I use these tools in this chapter to explore the manufacturing steps for Late Formative ceramics and the organization of production on the Taraco Peninsula. As Gosselain and Livingston-Smith (2005:44) recommend, we need "to go further and disentangle micro- from macro-social interaction networks, we need detailed reconstruction of complete manufacturing processes". My general aim is to reconstruct as much as possible of Late Formative production, with the goal of identifying possible communities of practice. This chapter has three specific objectives: 1. Define the nature of production spaces during the Late Formative, 2. Describe the shifts in technological choice between the earlier Middle Formative period and the Late Formative period from a practice-based perspective and 3. Examine the production variability between the Taraco sites and the larger Titicaca Basin drawing on some of the studies I discussed in Chapter 5.

I begin by summarizing the primary evidence we have for ceramic production in the Titicaca Basin. In Chapter 2 I mentioned the paucity of primary evidence for Formative Period ceramic production locations in the region. Here I examine what evidence we have from the later periods, particularly at the site of Tiwanaku, before turning to examine possible production areas on the Taraco Peninsula. In particular, I argue that we must consider the embedded and distributed nature of Formative Period pottery production. I then ask two questions regarding learning communities and their genealogies of practice: How did the hexis of potting production change over time in general across the Titicaca Basin? How did Late Formative potters of the Lake Titicaca Basin produce their pottery? I include a diachronic perspective here by drawing on some of the Middle Formative period scholarship discussed in Chapter 5, in particular Lee Steadman's work at Chiripa and Kala Uyuni. The wider scholarship on Late Formative pottery is also essential here in my effort to define particular communities of practice, as defined by particular micro-styles, and larger constellations practice, as defined by shared regional technological choices.

The core of this chapter is a descriptive overview of the pastes, forms and surface finishes of the Late Formative. As I mentioned in Chapter 5, technological choices, in particular the choice of paste, are becoming increasingly important in defining archaeological temporal phases. I present our evidence for the changing pastes of the Formative Periods, foregrounding an investigation into the reason clay and temper variation in later chapters. I then look at the forming techniques, surface finish and decoration in greater detail. In an ideal scenario it would be possible to present the operational sequence of a typical Taraco Late Formative I and II pottery assemblage, and compare it to other areas of the southern Titicaca basin. This, however, is difficult because particular components of the production sequence cannot be reconstructed. There have been too few systematic excavations, and even fewer published line drawings of Late Formative forms to compare shapes intensively throughout the circum-Titicaca region. While it is premature to define regional communities of practice, I hope this chapter will serve as a foundation for future studies examining regional communities of potting practice, and possible disjunctures in a regional constellation of practice.

7.1 Searching for Formative Period pottery production

7.11 Distributed practice: Locating production

The most well defined case for pottery production for Lake Titicaca Basin prehistory can be found at the Ch'iji Jawira area of Tiwanaku, dating from AD 700 to 800. This 6 hectare neighborhood, approximately 1.2 kilometers east of Tiwanaku's central monumental district, is littered with ceramics and artifacts associated with ceramic production: misfired sherds, wasters, figurines, baked clay lumps and production tools (Rivera Casanovas 2003: 297). Here excavators found a long stone alignment that they interpreted as a boundary wall to separate a ceramic production neighborhood from the rest of the site. In addition to the materials found on the surface, excavations recovered pigments, llama dung, layers of ash, vessels filled with pigments and minerals, burned clay lumps, several small mold fragments and many production tools including reused sherds and polishing stones (Rivera Casanovas 2003: 297).

Their excavations defined four specific activity areas related to production: 1) A clay source and procurement area. Excavators interpreted a culturally sterile base level as a likely clay source. 2) Floor surfaces used for the forming of vessels along with other production activities. Trampled surfaces (*apisonados*) suggest that ceramic forming took place in these external production areas. 3) A ceramic firing area, as evidenced by a 1-meter diameter circle of contrasting heat signatures. Excavators found a circle of black burning, followed by bright orange earth, and a white scorched earth circle in the center from the highest heat concentration. 4) Refuse areas, where the remains of fuel were deposited along with wasters. These four elements, combined with the high density of surface ceramic fragments, make a convincing case that Ch'iji Jawira was a ceramic production workshop.

Archaeologists have found no such evidence for the Formative Period. There is good reason to think that production did not take place in workshops bounded off from other types of production practice in the earlier periods. For instance, Andean ethnographic work has found few settings with single functional spaces, and pottery production in particular is usually embedded in other household activities (Sillar 2000: 125).

In fact some archaeological evidence for such a type of production has begun to emerge. At the North Basin site of Pucara (discussed in Chapter 2), Elizabeth Klarich (2007), hoped to find evidence for "attached-specialization" associated with emerging elites. What she found instead was small scale production: "The presence of groundstone artifacts *in situ*, small pits of clay and tempering materials, and the production tools indicate that this area was used for the early stages of ceramic production…[However], there were no formal spatial divisions, large stashes of raw materials, drying areas, centralized firing facilities, or any of the other common indicators of large-scale ceramic production" (Klarich 2007: 249). Klarich found remnants of ceramic production in association with other productive domestic activities. In fact, there is similar evidence at Tiwanaku, outside of the Ch'iji Jawira area, suggesting that Tiwanaku pottery production was integrated with other production activities. Outdoor patios appear to have been used for a range of production activity, perhaps including ceramic production (Janusek 1999, 2003a; Couture and Sampek 2003).

I argue that Late Formative pottery production (clay acquisition, paste preparation, vessel forming, finishing and firing) was spread across the landscape as the part of a larger taskscape, embedded in broader productive practice. This taskscape framework is important as it shifts the nature of required evidence for Formative Period pottery manufacture. I will draw out my argument for embedded production and the greater taskscape in the following chapters (in particular for the accessing and preparation of pastes). For the moment I consider embedded production and the definition of pottery production spaces.

On all three Taraco sites there is tantalizing evidence that particular spaces may have been used as the locals for pottery forming and finishing. Particularly evocative are the many trampled clay surfaces outside of Late Formative buildings. Excavators called these external occupation zones, or simply clay surfaces. At Kala Uyuni we see a variety of such spaces outside of ASDs-2 and 4. ASD-2 included several surfaces including KU-B77 (external occupation surface) and KU-B21 (surface) outside of ASD 2. Many of these compacted external spaces were likely shared with ASD-4 including KU-B207 (external occupation surface) (Figure 4.9). I should note that we have not excavated much of these spaces in part due to the large quantity of overburden. Future excavation of Late Formative architecture must extend outwards to further define such activity spaces, as this is likely where a wide range of productive activity was occurring. We did excavate a much greater area outside ASD-5, and found a number of ashy deposits and trampled clay surfaces. Finally at Sonaji we found several clay surfaces, the most intriguing being SN-A206 (see Figure 4.12).

Many of these surfaces would have been relatively close to water sources, necessary for the preparation of clay pastes. For instance, at Kala Uyuni, a spring was located within a five-minute walk from the Late Formative structures. I argue that these surfaces were likely used for the primary and secondary forming processes in the manufacture of ceramics. Micromorphological soil analysis, which has been initiated by Dr. Melissa Goodman, may further substantiate this hypothesis.

Artifact distributions lend some support to this idea. While these surfaces were never littered with high densities of materials (it is likely that this material was swept into local middens), they do include signs for manufacturing activity, including bone and lithic tools. I am particularly interested in the distribution of polishing stones, grinding stones for temper preparation (see next chapter), bone awls and perforating tools that may have been used for engraving (Rivera Casanovas 2003: 309). These data will be integrated in future collaborative research. For now I focus on the ceramic tools, specifically modified ceramic sherds used to smooth out coils in the manufacturing process, and re-used ceramic sherds utilized as spindle whorls (Figures 7.1 and 7.2).

All three Taraco Peninsula sites included smoothing tools, which suggests that the inhabitants of all three sites were involved in pottery manufacture. The highest density of smoothing tools were found in the extremely dense midden deposits, in particular events KU-B91 and KU-B74, of the area to the west of ASD-2, 4 and 5. Although spindle whorls were not found in great density here, we did find both blanks and finished spindle whorls also on the Kala Uyuni use surfaces. We also recovered a miniature jar, associated with the exterior surface KU-B77, which may have been used for pigments and slips (Figure 7.1g). Sonaji pits, fills and surfaces all have completed and blank spindle whorls, with the yellow clay surface of SN-A206/207 including three polishing tools. Kumi Kipa, a site that was thought to be primarily a public architectural space, also included both smoothing tools and blank spindle whorls.

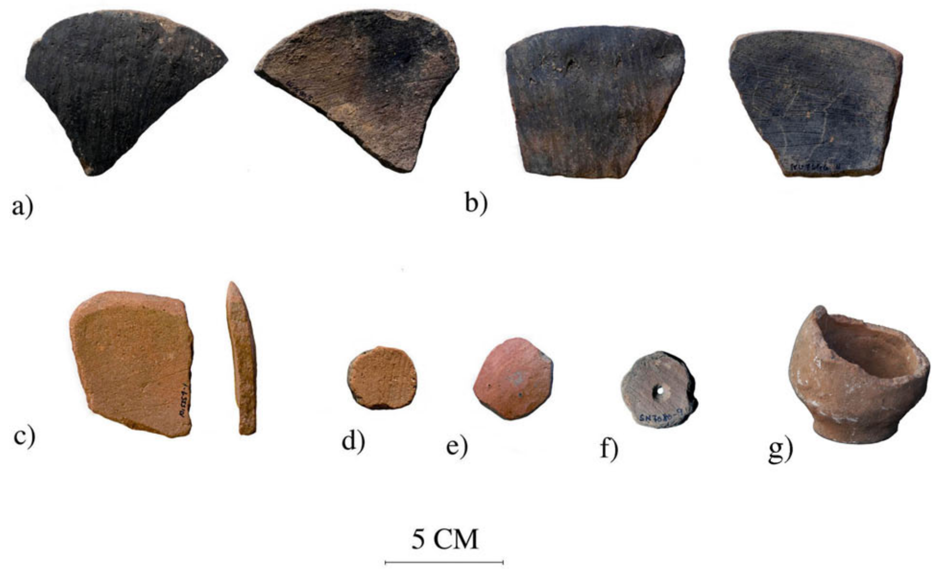
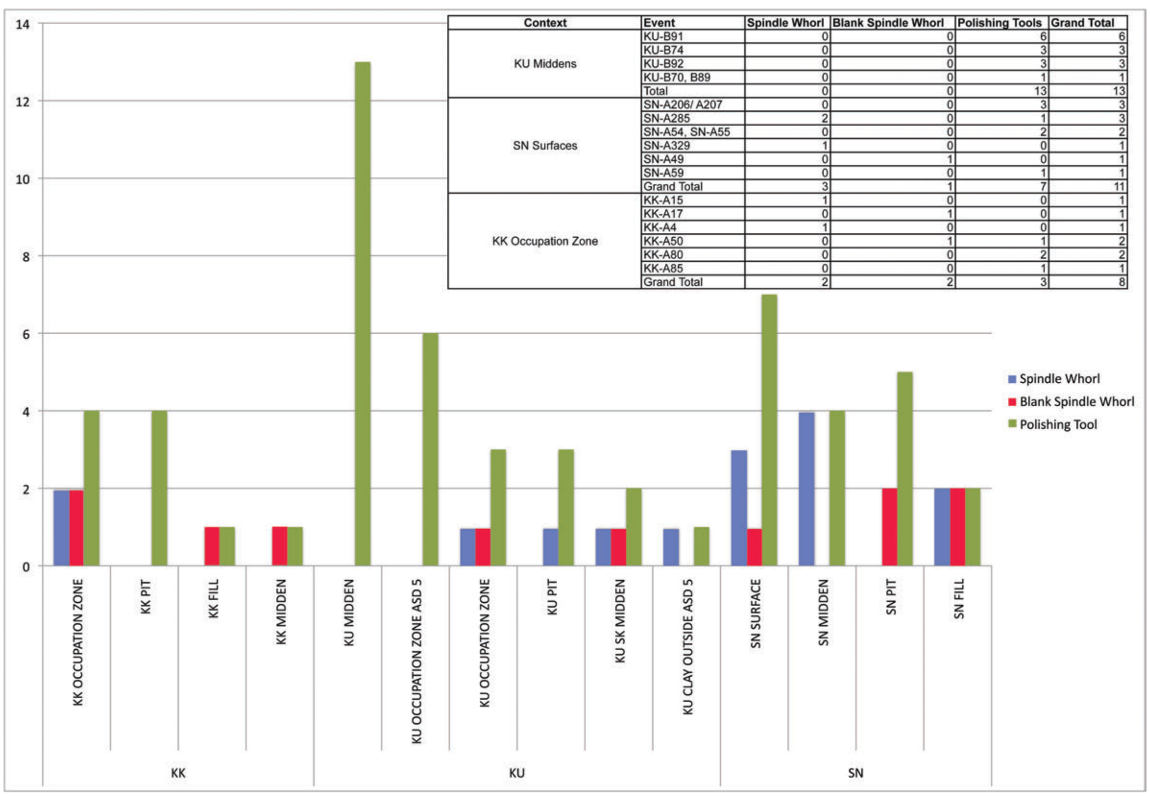


Figure 7.1: Smoothing tools (a-c), spindle whorl blanks (d, e), completed spindle whorls (f), and miniature jar, possibly for pigment and slips (g).



Context	Event	Spindle Whorl	Blank Spindle Whorl	Polishing Tools	Grand Total
KU Middens	KU-B91	0	0	6	6
	KU-B74	0	0	3	3
	KU-B92	0	0	3	3
	KU-B70, B89	0	0	1	1
	Total	0	0	13	13
SN Surfaces	SN-A206/ A207	0	0	3	3
	SN-A285	2	0	1	3
	SN-A54, SN-A55	0	0	2	2
	SN-A329	1	0	0	1
	SN-A49	0	1	0	1
	SN-A59	0	0	1	1
	Grand Total	3	1	7	11
KK Occupation Zone	KK-A15	1	0	0	1
	KK-A17	0	1	0	1
	KK-A4	1	0	0	1
	KK-A50	0	1	1	2
	KK-A80	0	0	2	2
	KK-A85	0	0	1	1
	Grand Total	2	2	3	8

Figure 7.2: Smoothing tools, spindle whorl 'blanks' and completed spindle whorls across Late Formative contexts as index of domestic production. Table inset shows the top events from those general contexts with high counts of polishing tools as possible indication of pottery manufacture.

7.12 Embedded practice: Locating firing

If pottery was being produced on these surfaces, how and where was the pottery fired? Archaeobotanists have important insights on fuel use for both cooking and ceramic production, since burning is one of the main ways that seeds are introduced into the archaeological record. Recent studies suggest that prehistoric potters and cooks relied on two forms of fuel in the Titicaca Basin. The first type of fuel is one of the locally available wood species. Wright et al. (2003: 494) found that t'ula (*Bacharis microphilla*), was used to fuel some fires and is still used today (Bruno 2008:150, table 5.7). Bruno establishes that other woody shrub species, such as *Tetraglochin cristatum,* were likely used as fuel as well. However, there is some debate as to how much wood was available during the Formative Period. A recent study by Bill Whitehead found that there was a decline in density of wood from the Early to Middle Formative period contexts at Chiripa (Whitehead 2006: 226). Bruno (2008: 468-469) found slightly more wood in Late Formative contexts than earlier Middle Formative samples at Kala Uyuni. She points out that this does not necessarily contradict Whitehead's findings. This variability may be due to wood acquisition through trade, through the management of tree species, or there simply may be differential distributions of woody species across the peninsula.

I suggest that it is more likely that ceramics were fired using the second type of fuel, camelid dung. Dung is a good fuel for both bonfires and shallow pit firings, and for oxidized and reduced firings (Parks 1993; Rye and Evans 1976). Dung also keeps its shape when burned down to ash allowing the ceramic to cool slowly (Arnold 1985; Rye and Evans 1976: 165). Researchers have found that dung firings can achieve high temperatures (see next chapter) and have a surprisingly high success rate, resulting in few wasters (Sillar 2000b: 47). A series of studies in the Andes suggest that dung was used for the manufacture of ceramics both in the past (Shimada and Shimada 1985) and the present (Hagstrum 1989: 173, 234-235; Johannessen and Hastorf 1990; Sillar 2000). On the North Coast of Peru workshops have been found with accumulations of llama dung (Elera 1998: 90; Mackey and Jauregui 2001, 2003; Pozorski 1976: 130). At Tiwanaku the highest dung concentration during the Tiwanaku V phase was in the Ch'iji Jawira pottery workshop (Wright et al. 2003: 394) signifying that at least by this time, dung was entangled with potting operational sequences.

Dung was likely integrated in a wide variety of practices, not just pottery firing. In fact, dung is a good example of how particular practices are embedded, how specific operational sequences, such as craft production, pastoralism and cultivation are entangled (Sillar 2000b: 50; for an Aymara ethnographic case involving cow dung, see Tschopik Jr. 1950). Dung plays a diverse role in Andean rural life today, as it likely did in the past. Dried camelid excrement is so essential in some regions that, "the house is sometimes perceived as a giant dung-heap…[as] a reference to the centrality of dung within the productive activities of the household" (Sillar 2000b, drawing on Arnold 1988). There is good reason to believe that camelid dung may have been used for improving soil fertility for tuber production (Winterhalder et al. 1974; as discussed in Bruno 2008). Since llamas often defecate in one location, it is likely that people were collecting the dung to spread as fertilizer as well as for fuel purposes.

As we will see in Chapter 9, camelids certainly were present during the Middle and Late Formative, and there is good evidence that it was being burned on the Taraco Peninsula. Bruno (2008: 431) finds that Pocaceae is the most abundant taxon from all surfaces, and the presence of this grass along with other wild species is often introduced into the archaeological record as burning dung. She identified dung fragments in 9 % of her samples showing that people indeed were using it as fuel. This is, however, a rather small number, and other researchers have found it in much higher densities. For instance researchers at Tiwanaku found it in 90 % of their samples (Wright et al. 2003: 388, as discussed in Bruno 2008: 265). However, as mentioned above, dung ash is often used for agricultural purposes, thus distributing the evidence for production across the landscape. If dung was integrated as both a fuel and for agriculture, there is no reason to think that potters would leave it for later archaeological recovery. The ash from pottery firings may have been swept up and deposited on local fields.

The ceramic evidence is also suggestive of dung firings. A typical wood ceramic firing often creates smudging and heterogeneous firing patterns all over individual vessels as well as between vessels. In contrast, camelid dung burns evenly and does not release free carbon. The porous structure of dung usually results in oxidized, rather than reduced vessels, although a sprinkling of damp dung can create a smudging effect (Sillar 2000b: 46). As Figure 7.3 shows, the majority of Late Formative ceramics were fired in an oxidized environment. There certainly is some variability. For instance, the decorated vessels made with the compact paste (discussed below) are always oxidized (Figure 7.3 inset), potentially suggesting separate firings, perhaps by different potters, or at least careful management of the firing process. I will return to discuss firing atmospheres and the likelihood of dung firings in the next chapter in greater detail, specifically looking at the relationship between local raw materials and re-fired ceramics.

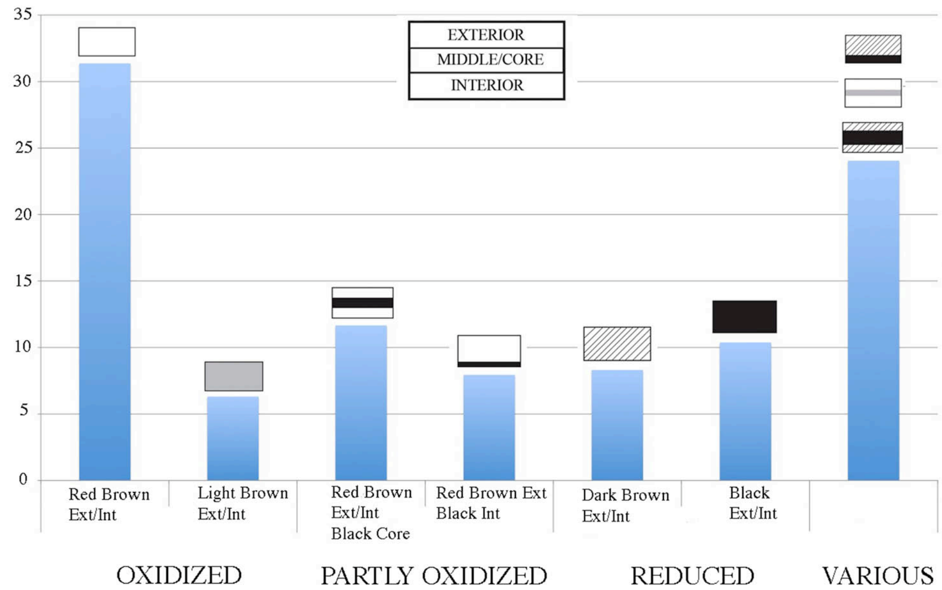


Figure 7.3: Percentage distribution of Late Formative firing cores (n=16,238). Note that the "various" category includes 26 other firing cores, with most well under 5 % of the total. The three core pattern signatures diagramed here are the top three cross sections, each representing approximately 3% (500 individual cases) of the overall assemblage.

But where did potters fire their wares? One possibility is near the surfaces where they formed the vessels. There are a number of firing features found on exterior use surfaces at Kala Uyuni, including event KU-B77 outside of ASD-2, and the KU-B265 ashy fill above the KU-B21 surface that are suggestive of such activity. Bruno (2008: 433) notes that archaeobotanical samples associated with these firing features are particularly low in food remains, but high in grass densities. She suggests that these features may be indicative of ceramic firing. While this is a possibility, I would point out that these are extremely small ashy features. Larger fires are often preferred for pottery firings to take advantage of temperature to fuel ratios, and to maintain high temperatures (Sillar 2000b: 46-47). I believe that after ceramics had dried to a leather hard state, they were transported elsewhere for completion. Ceramic firing likely took place further away from the architectural spaces and perhaps even "off-site". It would have been difficult to maintain a fire with consistent temperatures near ASDs-2, 4 and 5. Firing likely occurred on slight rises, as it often does today at high altitudes, perhaps to promote good airflow in the lower oxygen environment (Sillar personal communication). If the Taraco hills, above the attitude of arable land, were utilized as pastoral land (see Chapter 9), then the collection, drying and firing of ceramics may have occurred there too.

In summary, an embedded and distributed perspective can drastically change our perspective on locating production. If manufacture occurred across an integrated taskscape, if there are few wasters associated with dung firings, if ceramic firing took place away from settled regions and if dung ash (and perhaps misfired ceramics and wasters) was collected and re-distributed across fields after firings, well, it is no surprise that we rarely find clear evidence for production at Formative Period sites. Furthermore, if potting was distributed across varying spaces, it is also suggestive that there was more than a single individual involved in the production stages. Following Crown (2007: 678), there were likely multiple hands involved in Late Formative communities of ceramic production rather than single specialized potter solely taking the production sequence from beginning to end.

7.2 Late Formative phasing: A local perspective on the paste question

If pottery production is, in fact, distributed and embedded, then attribute analysis is even more important for defining communities of potting practice. I now turn to the attribute patterning of Late Formative production sequences on the Taraco Peninsula and several other regions of the Southern Titicaca Basin. After summarizing some basic trends of the entire assemblage (including the body sherds which represent the majority of my sample), I will turn to the specifics of the particular sequence for both necked and open vessel forms. As this system relies predominantly upon visual cues I am including a visual, photographic component to these attributes.

I begin by presenting the relevant attributes tracked by the Taraco Archaeological Project for the Formative Period and some general changes through time. We have a good sense of the technological choices for Late Middle Formative (Late Chiripa phase) from Lee Steadman's work on Chiripa assemblages (from the floor of the Llusco structure, the Quispe and Santiago areas and in all areas of the Monticulo, see Hastorf 1999) and the Middle Formative assemblages at Kala Uyuni (Achachi Coacollu and Aryampu Qontu). I draw on this research to present some of the shifts in potting practice from the late Middle Formative to Late Formative I. Here I define the technological shifts and the particulars of the combined three-site assemblage, attempting to find particular communities of practice. I also explore the similarity between the assemblage from the Taraco assemblages with those analyzed by Janusek, Bermann and Mathews in the Tiwanaku valley, Burkholder's analysis at Iwawe and Carlos Lemuz's work in the nearby Santiago de Huata area (see Chapter 5 for background of these projects). After a detailed examination of paste recipes, I offer a brief overview of surface color, finish, and decoration. I then turn to details of the technological choices and design styles linked to particular forms of the Late Formative assemblage.

Archaeologists studying the Formative Period in the Titicaca Basin have used a variety of systems to describe the paste recipes of pottery, but most are difficult to compare with TAP designations. On the one hand this is not too worrying. As I mentioned in Chapter 5, we should not treat paste recipes like types and expect them to vary in a similar fashion across the landscape. On the other hand, all pastes, whether tempered or simply used with natural inclusions, are indicative of learned choices. The significance of pastes to particular communities of practice will not be clear until systematic studies are completed. Furthermore, macro-scale paste studies (using a hand lens or microscope) are necessary to both define the local, and to investigate larger regional questions. For example, compositional analyses applied to studies of exchange (see next chapter) must begin with a good understanding of how paste groups vary. Unfortunately, much of the ceramic analysis in the Titicaca Basin is vague with little detailed description of the inclusions (mineralogy, density, roundedness, etc). In some cases a Munsell designation is included giving a sense for the oxidizing nature of the paste recipes. While color is certainly important, color alone conflates up to three technological steps (collecting clay, preparing pastes and firing clay). Exceptions are found in the work of Mohr's (1966) Middle Formative work at Chiripa, and to a certain extant, Burkholder (1997, 2001) and Lemuz's (2001) work on Late Formative assemblages. For Lemuz, in particular, paste choices are central to phasing the sites of the Santiago de Huata region. For each of the 19 paste groups for the region (Lemuz 2001: 156-174), he gives a general phase breakdown, how the paste co-varies with other attributes (such as surface finish), describes the similarity with other pastes, and then characterizes the mineral inclusions of each recipe.

7.21 Fiber and mica: Pastes 1, 2, 17, 18, 19, 21, and 29

TAP ceramicists have noted a total of 21 pastes for the Formative Period with 8 particularly important to the Late Formative Period (Appendix 2, Figures 7.4-7.9). Fiber tempered pastes characterize the earlier periods in the Southern Titicaca Basin. Mohr Chávez (1966: 33-4, 187-191), employing the aid of grass epidermis specialist Christiane

Vignal, suggests that Middle Formative sherds at Chiripa were tempered with the local wild grass Stipu Ichu (and not quinoa or totora reed), a wild grass seen throughout the Bolivian altiplano. Steadman's intensive work on the Late Chiripa phase of the Middle Formative Period defined numerous important fiber tempered recipes, with paste 21 and 19 the most frequently encountered (Figure 7.4). Paste 21 is perhaps the most diagnostic paste recipe of this period. This medium texture paste has large angular opaque white inclusions and no mica. It is distinctive due to the large grass temper and chunky quartz inclusions.

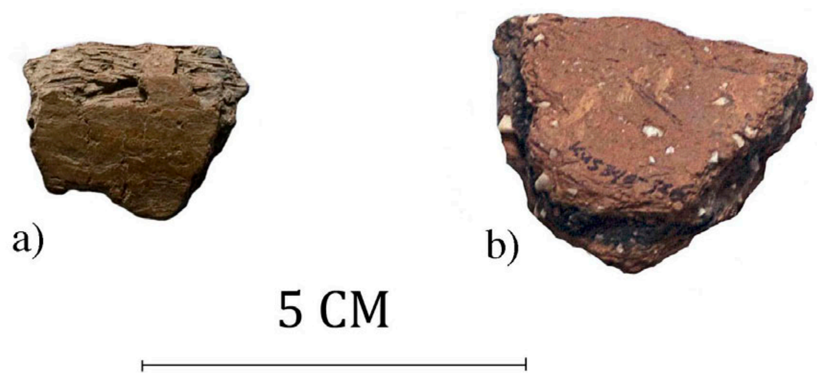


Figure 7.4: Late Middle Formative (Late Chiripa) pastes from Kala Uyuni, a) paste 19 b) paste 21.

Steadman's work at the Middle Formative contexts at Kala Uyuni found that paste 21 encompassed a higher ratio of the total assemblage than at Chiripa; as much as 78% of a particularly utilitarian assemblage (Steadman 2007:75). The Middle Formative contexts are also defined by paste 19, which is a medium textured paste, with translucent rounded and sub-rounded inclusions as well as some other small, well-sorted mineral inclusions. It is similar to paste 21 with a high density of thick grass temper. Steadman found that this paste in much greater densities (53%) in the Middle Formative special purpose sunken enclosures at Kala Uyuni Achachi Coacollu than in the domestic contexts (Steadman 2007: 76). Neither of these pastes is associated with the Late Formative period.

As Figure 7.9 demonstrates, there are several pastes that continue from the earlier Late Chiripa phase of the Middle Formative into the Late Formative phases. This lack of strict temporal divisions in the pastes has been the cause of many seriation problems in the region. For instance, earlier scholars believed that fiber-tempered sherds were diagnostics of Middle Formative phases, and today we still acknowledge that the Late Formative period is defined, in part, by the appearance of non-fiber tempered pastes. However, we now know that fiber-tempered pastes continue throughout the Late Formative period, and into Tiwanaku periods. While fiber is still often employed in Formative pastes, the size and density of the grass changes. In some Late Formative cases, especially for the later Late Formative II and Tiwanaku phases, the fiber inclusions may be incidental to the paste preparation process (i.e. simply blown in while preparing the paste), but in many cases the fiber appears to purposefully added. The shift from the Middle to Late Formative is defined by an increase in pastes with micaceous inclusions. Janusek notes that Late Formative temper combinations throughout the Titicaca Basin often included mica, mica-sand, and mica-sand-fiber (Janusek 2003a; Stanish 2003). Steadman (1999, 2007: 87) has found that Early Middle Formative Chiripa ceramics also included mica rich recipes (pastes 17 and 18), although rarely in more than 13 % of the population.

The shift in mica and fiber-tempers does appear to be significant, reflecting clear changing practices. All sherds during the Middle Formative were fiber-tempered, while the Late Formative is defined by changing ratios of micaceous and non-micaceous recipes. Of the analyzed combined Late Formative assemblage for Kala Uyuni, Sonaji and Kumi Kipa 34 % are fiber tempered and 66% are mineral tempered. One micaceous paste, in particular, has been used to define the Late Formative, what TAP ceramicists call paste 29 (Figure 7.5). This particular paste is unique with its high density of biotite (and few other visible inclusions), in some cases the mica is so dense that one cannot see the surface finish, becoming so friable it crumbles. It is only found in 1.2 % of the total TAP assemblage, and in only 28 cases could a particular form be associated with paste 29, making it inappropriate as a diagnostic for the period.

Figure 7.5: The highly micaceous paste 29.

Biotite mica is found in other pastes, including sand tempered pastes (pastes 1 and 2) and sand and fiber-tempered pastes (pastes 17 and 18) (Figure 7.6). Paste 1 is defined as a paste with angular and subangular inclusions, black, white or translucent, with a fair amount of mica. When this same combination includes fiber, TAP ceramicists designate it paste 18. Paste 2 is defined by the presence of translucent subrounded and rounded inclusions including biotite. This medium texture paste is related to the fiber-tempered paste 17. Of our micaceous Late Formative assemblage 43% are tempered only with micaceous sand and 57% with grass and sand. These groups are primarily distinguished by the texture and density of the inclusions, although paste 29 was often (~30% of cases) fired in reducing atmospheres.

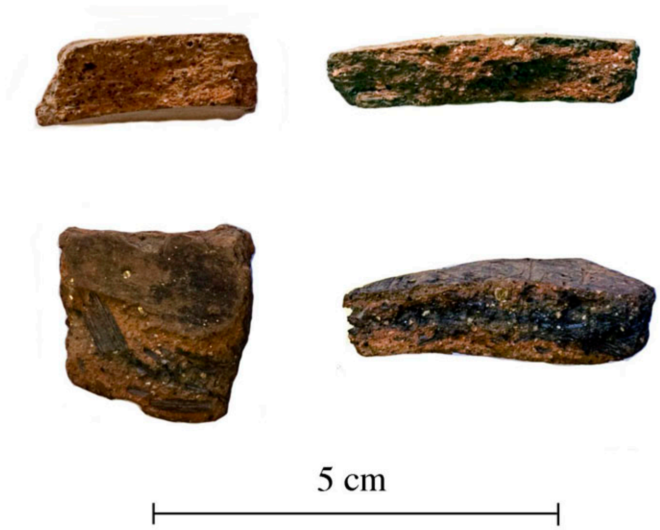


Figure 7.6: Cross sections and surfaces of fiber-tempered pastes (pastes 17 and 18) of the Middle and Late Formative periods. Note that pastes 1 and 2 appear the same, but without the fiber voids.

In many cases distinguishing these pastes groups is extremely difficult. Does one define a mica rich paste recipe as 1 or 2 if there is only one visible fiber in the cross section? Is a paste with a high density of mica, but a few other inclusions no longer paste 29? At what point does sub-rounded become sub-angular and thus move the recipe from 17 to 18? Although these can be quantified using geological typologies, this is slow and sometimes difficult. In the next chapter I return to investigate the variability of our paste groups from a mineralogical and chemical perspective, which will permit me to group these pastes for further analysis. In Chapter 8 I will discuss the possible functional value of mica and fiber. For now, it should simply be noted that for the Taraco sites, vessels with only sandy mineral component (and no fiber) are one particular defining element for the Late Formative Period.

7.22: Other mineral tempered: Pastes 3 and 9

Steadman has also noted the appearance of some important "Other Mineral Tempered" paste recipes during the Late Formative. Pastes 3 and 9, relatively compact pastes clean of micaceous inclusions, become increasingly predominant throughout the Late Formative period and into Tiwanaku IV times. Paste 9 is defined primarily by the presence of transparent inclusions (which unfortunately does not photograph well), and paste 3 by speckled white inclusions (Figure 7.7).

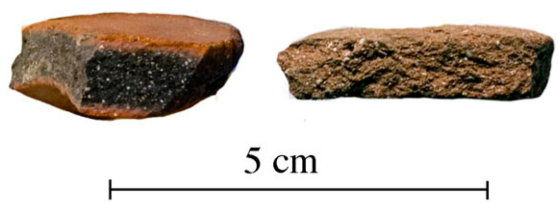


Figure 7.7: Pastes 3 cross sections. Note the characteristic white speckles.

By the end of the Late Formative II these are much more common, especially for Tiwanaku cooking vessels on the Taraco Peninsula. In fact, TAP ceramicists use the proportional relationship of pastes 9 and 3 (grouped together as Other Mineral Tempered or OMT for phasing work) to those mica rich pastes 1,2,17 and 18 to define the Late Formative phases. Under 30 % OMT defined the Late Formative I phase, 30-50 % OMT defined the Late Formative II phase, and more than 50 % OMT represents either a very mixed assemblage or more likely an erosional or an intrusive later Tiwanaku context (Figure 7.9).

7.23: "Buff": Pastes 5 and 6

Two other common Late Formative pastes are a bit easier to identify. The compact pastes 5 and 6 both fire to a beige or chestnut color, and are relatively free of large mineral inclusions. These pastes, as I mentioned above (section 7.12), are always fired in an oxidized atmosphere. Paste 5 is a fine textured paste, compact or subcompact with extremely fine white and translucent inclusions a relatively soft matrix that usually fires to a light brown color. Paste 6, is also buff in and only differs with the presence of a low density of red inclusions in the matrix (Figure 7.8). Steadman (2007: 88) believes that paste 6 is a variation of a Middle Formative recipe at Chiripa. Both of these pastes are associated with decorated bowls throughout the southern Titicaca Basin.

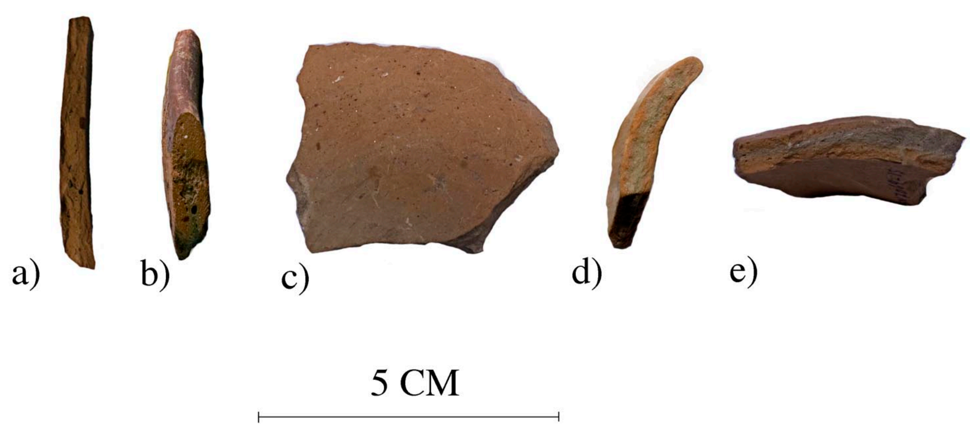


Figure 7.8: Compact and "buff" pastes 6 (a-c) and 5 (d,e) from Kala Uyuni and Sonaji. Note the small red inclusions visible on the surface of c).

For example, Janusek (2003a: 43) notes that the ceramics recovered from Ponce's excavations at Tiwanaku often consisted of "a light beige paste slipped in various shade of yellow to reddish beige, or chestnut." His excavations at the Kk'arana area at Tiwanaku found paste recipes to be most often brown, but commonly (30-40 %) was beige or light brown to pale orange (Munsell 7.5 YR 6/4-6/6). Janusek found many vessels with light-colored paste included crushed red mineral along with biotite mica. Janusek found similar trends in the Katari Basin. While the ollas from the earliest occupations (Late Formative) at Qeya Kuntu were made from mica or fiber temper, Janusek found that the bowls and small jars had "beige pastes (7.5YR 6/6; 10YR 6/4) with crushed red temper". At Kirawi, Janusek found that only 4 % of bowls had this beige paste with the red mineral, suggesting a limited distribution of this recipe (see below).

At Kala Uyuni, Kumi Kipa and Sonaji this paste was not common, and varied in percentage by contexts, up to 15 % of Late Formative I assemblages in some contexts. Unlike Janusek's observations, all vessels manufactured with paste 6 at the Taraco sites lacked micaceous inclusions, perhaps suggesting different tempering practices using a common clay source. Future work would certainly benefit from a more focused attention on the regional significance of this paste. As will be seen below, this paste was used extensively for decorated vessels, in particular bowls.

7.24: The paste question: Taraco pastes as temporal markers

In sum, pastes continue to be used as one major attribute for phasing from the Middle to Late Formative and to distinguish the Late Formative I from Late Formative II. In particular we rely upon the shifts in fiber, micaceous sand, and non-micaceous inclusions to define these phases (Figures 7.9 and 7.10). Specifically the decrease in thick fiber tempered pastes and an increase in micaceous pastes defines the beginning of the Late Formative. Unlike earlier suggestions, fiber-tempered pastes are not only diagnostic of the Middle Formative "Chiripa" producers. Fiber-tempered pastes were utilized throughout the sequence, albeit with different densities of fiber and in changing percentages of particular assemblages. Compact pastes such as 5 and 6, easily defined with a hand lens, also appear during the Late Formative.

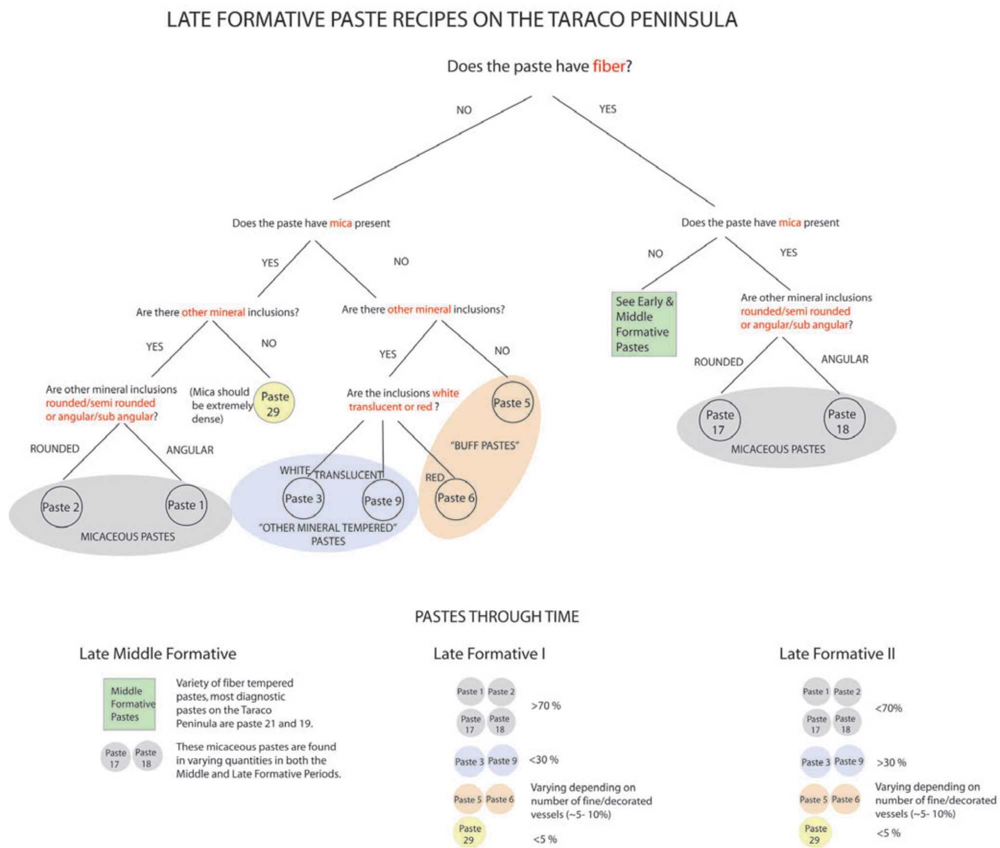


Figure 7.9: A heuristic of pastes recipes and ceramic phasing of Formative Period archaeological assemblages on the Taraco Peninsula.

The later phase, Late Formative II, is defined by a gradual increase in pastes with non- micaceous minerals, which become more predominant in Tiwanaku IV/V phases (Figure 7.10). Pastes, then, are varying through time, perhaps suggestive of different technological choices regarding both clays and perhaps tempers. It is significant that there is no noticeable inter-site variability: there is a relatively similar distribution of paste recipes and paste ratios across all three sites (with the exception being the few Late

Formative II contexts). If there is more than one Taraco community of practice, they are either making similar choices in raw materials, or are widely sharing their pottery.

Similar broad trends in pastes have been found elsewhere in the Southern Titicaca Basin. For example, Carlos Lemuz' work on the Santiago Peninsula found that *"the presence of fiber temper with mica is predominant in the Early Pana phase, much less in the Late Pana phase, and only occasionally in the Tiwanaku phases"*. ("La presencia de antiplástico vegetal asociado con mica se da fundamentalmente en la Fase Pana Temprano, mucho menos en la Fase Pana Tardío y apenas aparece en la Fase Tiwanaku"). (See Lemuz 2001: table 8.6 for the specific paste recipe ratios). Marc Bermann made similar observations for fiber and mica. Although his Lorokea Fiber continued through later Tiwanaku periods (which forced him to re-define his phases), he found that in general changes in fiber to non-fiber ratios signaled a change for the Late Formative Period (Bermann 1994: 52). In his second level of occupation at Lukurmata he found that non–decorated vessels were constructed with an orange paste with mica-based inclusions. This paste, "Queruni Orange", became the more common paste recipe over the older fiber-based recipe and now amounted to 60-70 percent of ceramic assemblages.

Finally, recent and ongoing work in the Northern Titicaca Basin suggests a similar shift in fiber to non-fiber vessels (Steadman 1994: 62; see Chapter 9). These are all suggestive of a pan-Titicaca constellation of technical practice, at least in terms of paste preparation. However, these trends should not be accepted as a defining moment for the Late Formative everywhere. It is not clear how many generations it took for these new technological choices to be adopted by specific communities of practice. Future work should examine whether these choices and preferences were implemented at a similar rate by potting communities throughout the Titicaca Basin. A staggered production may be suggestive of different social interaction, and of wider social practices and taskscapes (as discussed in Chapter 5). Defining these rates of technological change requires further stratigraphic excavations, radiocarbon dates and detailed ceramic analysis. Only then will it be possible to construct useable and related seriations, and, just as importantly, zero in on the significance of the changing technical choices.

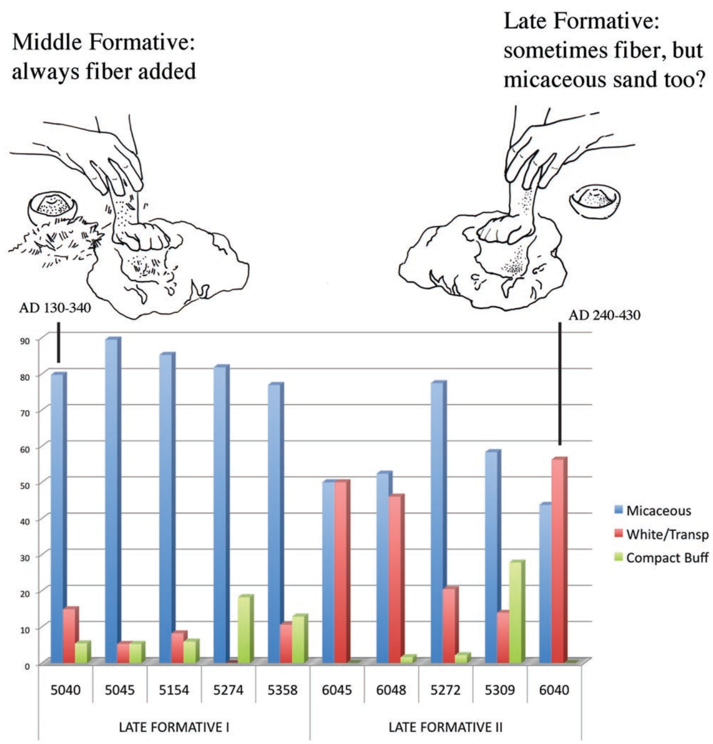


Figure 7.10: Illustration (by Katy Killackey) showing Middle and Late Formative period pastes. Bottom graph showing how TAP utilizes paste groups as representation of change through time. Micaceous includes pastes 1,2,17 and 18, White/Tranp includes both pastes 3 and 9, compact buff includes pastes 5 and 6.

Now that I have further defined the broad "paste question" for the Late Formative, how can I proceed? How can I interpret the changes in pastes within the TAP assemblage? Steadman makes a persuasive argument that the paste variation in the northern basin is not representative of different groups of practitioners, but rather reflects different technological choices by the same potters (Steadman 1994: 24, 1995:

141). This is a good testable hypothesis, and appears to be supported by the intra-site similarities observed on the Taraco peninsula. However we should not simply accept homogeneity and diversity of pastes in a particular assemblage as an index of local and non-local. The paste similarity between the three sites of Kala Uyuni, Kumi Kipa and Sonaji either suggests that potters did not temper their ceramics and were simply accessing the same self-tempering clays, they were accessing raw materials and preparing raw materials together, or they were using similar tempers with unique clays to create similar paste recipes. I will return to elaborate on these issues and the greater paste question in the next two chapters. I now turn to examine both primary and secondary forming and finishing techniques used in the production process of Late Formative vessels. This is another step in the manufacturing sequence where particular technological choices between varying communities of potting practice may result in unique micro-styles.

7.3 Late Formative choices: Forming and finishing (body sherds)

I suspect that the entirety of the Formative assemblage was produced using either a coiling technique, a pinching technique, or a combination of the two. It is sometimes possible to identify forming techniques archaeologically based surface markings, variation in wall thickness, preferred orientation of the inclusions and vessel shape (Hagstrum 1989: 161-165; Michelacki 1999: 31, 35, 36, table 3.1; Rye 1981). In most cases I could not ascertain what particular forming technique was used for the Taraco Late Formative assemblage, as many of these characteristics require complete vessels, or re-constructible vessels to follow fracture lines (but see coiling evidence in Figure 7.21a). Furthermore, Late Formative potters obliterated such evidence with their intensive surface finishing. These finishing techniques, however, are another important shift in the potting practices from the Middle to Late Formative. This particular attribute, along with paste group, is essential in phasing body sherds from the Late Formative Period.

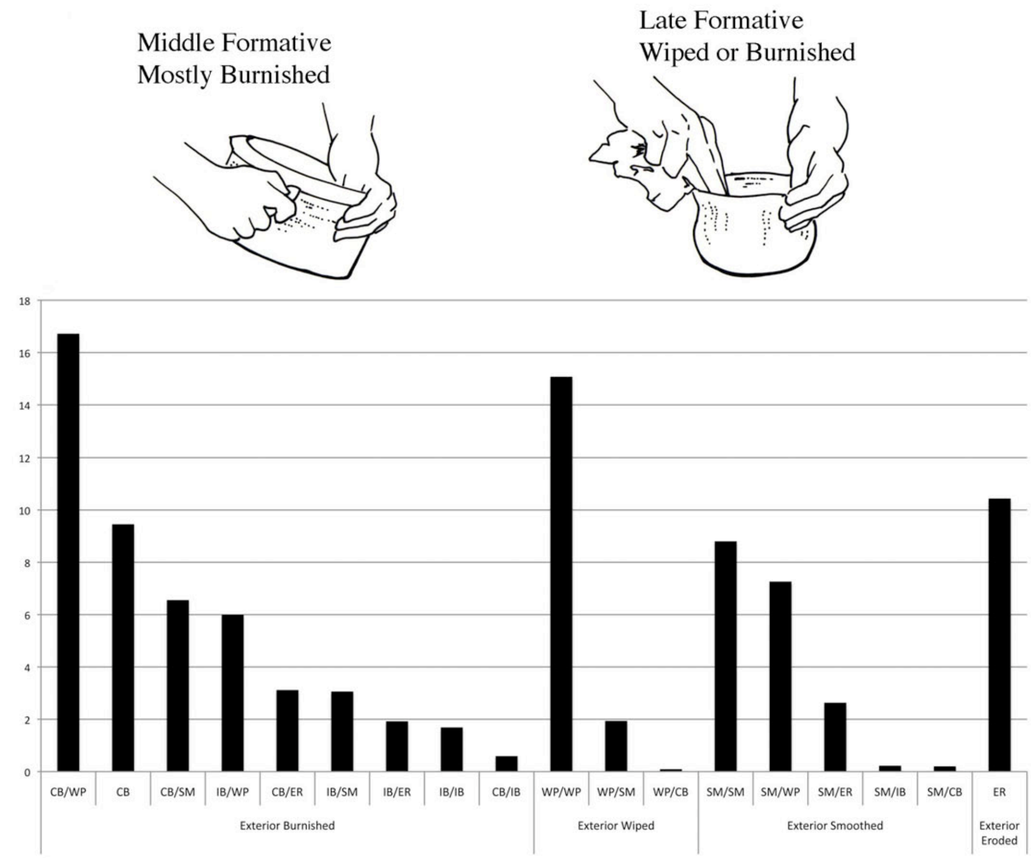


Figure 7.11: Illustration (by Kathryn Killackey) showing Middle Formative ceramics as entirely burnished, while Late Formative ceramics are wiped. The relative percentage of particular finishes across Late Formative contexts (n=18,039) demonstrate that potters frequently completely burnish the exterior and wipe the interior, or wipe both surfaces. Note: CB Complete Burnish, IB incomplete Burnish, WP wiped, SM smoothed, ER eroded.

In general there is a shift from completely burnished surfaces, both exterior and interior, to a more expedient wiping on the surface of vessels (Figure 7.11). A high percentage of ceramics in the Late Chiripa phase of the Middle Formative were highly burnished. Steadman (2007: 75) found that 42 % of ceramics at Kala Uyuni have a complete surface burnish and only 7% were either wiped or smoothed. Although slipped and decorated vessels are more likely to be burnished, the larger assemblage is less likely to have such a labor-intensive finish. In the combined Late Formative assemblage 37 % have at least one surface burnished, but only 9% have both sides burnished. If we combine the wiped and smoothed surface, a total of 38% have no burnishing at all on their surface. Perhaps more interesting, 12% of the overall assemblage has one surface with an incomplete burnish, with facets from burnishing stones clearly visible on the surface (Figure 7.11, 7.21b). The exception is found with decorated sherds where burnishing is much more exact in its detail. This change in embodied practice, or hexis, may be suggestive of discursive shifts or slippage in the learning process.

Another important change is found in the stucco and slips applied to the surface of vessels. For example, in the Middle Formative potters used extra slurry, what we term stucco, on their cooking pots. Steadman (2007) found that 18% of Late Chiripa phase cooking pots had daubed stucco on the bottoms of cooking pots. Late Formative potters no longer add such slurry to their cooking wares (see Chapter 9). Most (34%) of the Late Formative ceramics found on the Taraco Peninsula have an unslipped red brown surface. The rest of the assemblage is either brown unslipped (16 %), light brown unslipped (13 %), gray brown unslipped (9%) or black unslipped (9%). This means only a small percentage of the assemblage – only 18 % - are slipped at all. Of these most are decorated (meaning with either multiple slips, or one slip on an unslipped surface), or are slipped brown. In contrast, Steadman (2007: 75) found that potters during the Late Middle Formative slipped over half of their ceramics. As will be seen below, this lower slip percentage in the Late Formative is partly due to the fact that decorative slips were often only applied to the upper portion of ceramics during the Late Formative. Steadman (2007: 87, 88) suggests these shifts – the decrease in burnishing, increase in incomplete burnishing and the application of slips to only the decorated surface - may be the result of "less attention to detail" during the Late Formative Period. I will return to consider this idea, vis-à-vis hexis at the end of this chapter.

Like the pastes, finishing techniques appear are similar across all three sites. The body sherds from all three sites suggest a similar shift in surface finishing for the Middle to Late Formative. Although it appears that Late Formative II potters applied similar surface finishes as during Late Formative I, these are very tentative observations at this time as my later sample is quite small. Scholars working elsewhere in the Titicaca Basin use different language for describing surface finishes, but it appears that similar trends are found (Janusek 2003: 41; Lemuz 2001: 365; Steadman 1995: 303). Lemuz, who presents the most detailed analysis, tracks each paste as it varies by surface finish, and find finds that the majority of his vessels are wiped on both surfaces for the Late Formative I, and a smaller proportion are burnished on the exterior and wiped internally (Lemuz 2001:150). Rather than actually representing actual differences in manufacturing technique of different practitioners, these patterns may simply be the result of fewer decorated vessels in his assemblage.

7.4 Late Formative design style

Titicaca archaeologists have relied heavily upon decorative design style to date the Late Formative. There is a clear change from the Middle to Late Formative. While the Middle Formative is dominated by thick applications of cream slip in geometric patterns over the entirety of red slipped vessels (Bennett 1934, 1948; Mohr 1966; Steadman 1999, 2007), the Late Formative sees both simplification and elaboration (see Chapter 5). Scholars have used the presence of "Kalasasaya" and "Qeya" styles of ceramics to define Late Formative I and Late Formative II. Kalasasaya style sherds dominate the TAP decorated ceramic assemblage, although excavators did recover a few possible Qeya sherds in unmixed Late Formative II assemblages at Kala Uyuni and Sonaji.

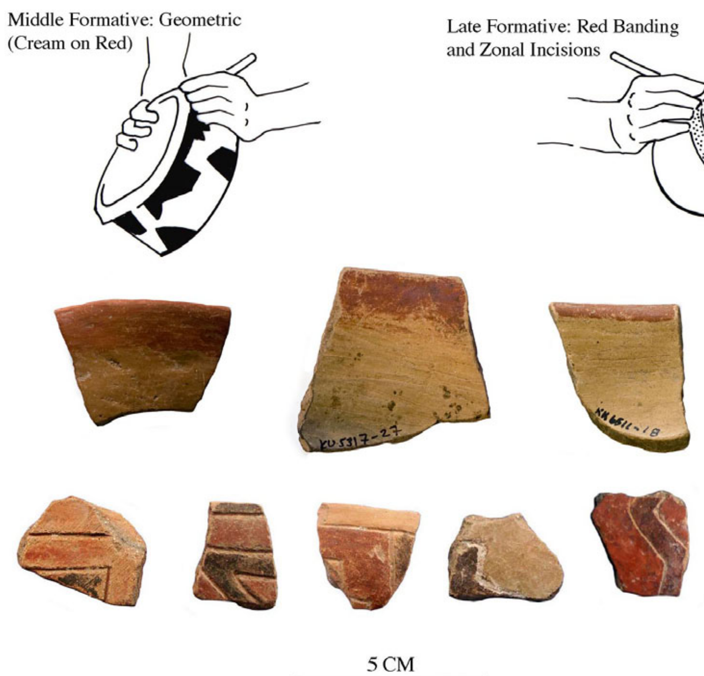


Figure 7.12: Illustration (by Kathryn Killackey) showing Middle Formative to Late Formative transition in decoration. Some examples of red banded (middle) and zonally-incised sherds (bottom) encountered in TAP excavations.

Taraco Late Formative I decoration includes paints, slips, incisions, and paint and incision, what is often called zonally incised. We find a number of sherds with appliqué fillets or ridges, incised bands, lugs and incised or stamped lugs. These decorations are primarily found on necked vessels (Figure 5.2 f, Figure 7.17 a-e,). However the great majority of the decorated sherds, which represent 9 % of the total diagnostics (Figure 7.14), are slipped vessels. This percentage represents an especially high density of decorated sherds if we consider that, unlike the earlier Middle Formative, the decoration is usually only found on the top 1/4th -1/8th of the vessel (see below). Kalasasaya red-banded vessels are quite simple, usually with a red slip applied to rim (either exterior or interior, or both) of bowls, and sometimes to the necked forms (see Figures 5.2h and i, 7.12, 7.16, 7.17g, 7.23, 7.24, 7.25 a and c).

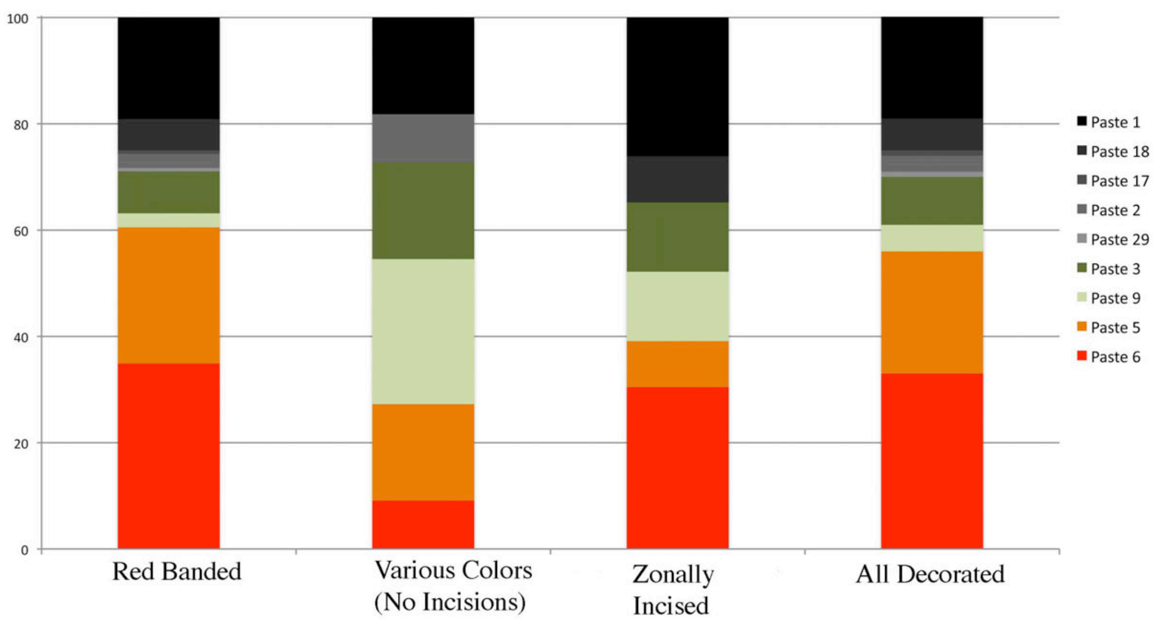


Figure 7.13: Graph of Late Formative decorated sherds by paste type. Note the predominance of the "buff" pastes 5 and 6 (red and orange) in all decorated sherds.

A more complex decorative technique, called zonally incised, uses incisions to separate different slip colors and unslipped areas of the vessel surface. In Ponce's collection of Late Formative ceramics 1/3 included decoration with red, black, yellow and white outlined by thick incisions (Ponce 1970). This style may have roots in the Middle Formative (Mohr 1966: 131; Steadman 2007: 77) but also looks remarkably like the ceramics from the Northern Titicaca Basin site of Pukara. The vessels are produced with the compact pastes (5 and 6), and are therefore we believe them to be "locally" produced, although this clearly needs to be verified. The zonally incised sherds include geometric designs (triple steps) (Figure 7.12), although a few have representational motifs (Bermann 1994: Figure 5.5C; Ponce 1971 Figures 3-26, 30, 33, 34). We have few examples of the bichrome, or polychrome zonally incised ceramics from TAP sites (see Chapter 9). We have no pieces large enough to define particular forms, although one vessel appears to be a bowl rim form. Both the red-rimmed and zonally incised sherds are primarily manufactured using one of the compact buff paste types (56% of all decorated, and 62% of the red banded vessels) (Figure 7.13).

The Kalasasaya and Qeya vessels are found across the Late Formative Titicaca Basin, but vary in density depending on the site. Lemuz (2001: 171), in Santiago de Huata, found few cases of the Kalasasaya and no decorated Qeya vessels. Neither Mathews' excavations at Tilata, nor Burkholder's Late Formative assemblage at Iwawe recovered Kalasasaya sherds. Burkolder's analysis found several good examples of Qeya vessels suggesting Iwawe was occupied during Late Formative II rather than Late Formative I. Marc Bermann's excavations at Lukurmata found no evidence for a decorative assemblage in his first level, but his second Late Formative occupation found Kalasasaya incised-and-painted wares, Kalasasaya red on chestnut bowls and Kalasasaya-style decorated jars and vasijas. Janusek's (2003a: 46) insights from the Katari Valley may be the most informative in terms of the decorative assemblage. He found that the Kalasasaya decorated ceramics were selectively distributed both within and between sites. One site, Qeya Kuntu, had a high number of decorated sherds, while another site, Kirawi, had few examples. Of the decorated sherds Janusek found at Kirawi, 90% were concentrated in one outdoor midden rather than in primary domestic contexts. This suggests either that both Mathews and Burkholder may not have sampled widely enough to capture these distributions, or more likely, that there sites simply did not have any Kalasasaya vessels. I will return to the spatial patterning at Kala Uyuni, Kumi Kipa and Sonaji in Chapter 9.

In sum, it appears that the Late Formative TAP assemblage includes a large number of diagnostic decorated sherds, primarily in the red-rimmed Kalasasaya variety. This suggests that design style may be appropriate for phasing the Late Formative. However, I would argue that we have other serious issues with our temporal resolution. The common belief, as discussed in Chapter 5, is that Kalasasaya vessels were produced during the Late Formative I, and Qeya during Late Formative II. Qeya vessels are rarely found, reinforcing the phasing of these sites as primarily being Late Formative I in date. However, Qeya is rare throughout the Titicaca Basin, and Kalasasaya vessels appear to be produced in the later phases as well. For instance, in TAP's excavations, we found several cases of the Kalasasaya red-rimmed vessels (manufactured with the micaceous paste 29) in clear Late Formative II contexts.

It is also unclear how technological styles were changing vis-à-vis design style over time; whether the same generation of Late Formative potters begin manufacturing these decorated ceramics as those changing their paste recipes. There do appear to be more Kalasasaya banded vessels at Taraco sites than have been recovered elsewhere in the Southern Titicaca Basin, with the one possible exception being Kirawi. A logic of abundance would suggest that Late Formative vessels were locally produced. However, much like the paste discussion above, this needs to be further quantified (see the next chapter). The decorated sherds represent distinct operational sequence (distinct pastes, always oxidized, slipped and decorated, and highly burnished), however future regional work (ideally comparing pastes, forming and finishing attributes and geochemistry) may elucidate whether these decorated sherds represent separate communities of practice, or simply different decisions by the same producers.

7.5 Late Formative forms

I now turn to examine the common vessel forms for the Late Formative Period. This section serves as a brief introduction to the forms. Although I briefly discuss attributes such as surface finish and paste, I return to a more detailed discussion of particular attributes, including paste, surface color, bases, charring/sooting patterns and orifice diameter, in my discussion of consumption in chapter 9. When possible, I discuss findings from elsewhere in the Southern Titicaca Basin. I include detailed drawings of the forms from the Taraco Peninsula. Figures 7.16, 7.17, 7.21, and 7.23 through 7.26 are composite line drawings of common forms.

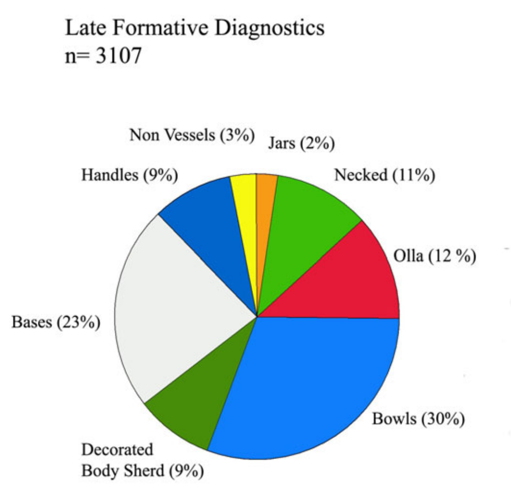


Figure 7.14: All diagnostics across all Late Formative contexts. Note: 1. "Necked" refers to vessels with insufficient neck height to distinguish between jar and olla forms. 2. "Decorated body sherd" refers to sherds with paint slip, or elaborations, not those sherds where vessel form could be distinguished.

I used illustrator to digitize the drawings and to reflect the left hand side of the image in a grey shade. These symmetrical renderings are my assumptions, one that may be somewhat problematic when it comes to handles and other specific elaborations of the vessel wall and rim. However I think the visual advantage of a descriptive image is worth this risk. When possible, photos are integrated with the drawings. In other cases drawings include the RGB version of Munsell colors.

Figure 7.14 presents the distribution of diagnostic sherds analyzed in my Late Formative assemblage. I have already discussed the decorated body sherds and the significance of this relatively high percentage. Another important value to be noted in this figure is the high percentage of bowl forms. As I will discuss below, bowl diversity is a particularly important shift at the onset of the Late Formative period, resulting in a lower percentage of necked vessels (including jars, ollas and generally "necked"). Steadman found that 77 % and 64 % of the Late Middle Formative assemblage was necked at Kala Uyuni and Chiripa respectively. In my sample, necked vessels represent approximately 35% of the Late Formative assemblage, a substantial drop from the earlier Middle Formative period. This broad breakdown should be considered cautiously, as identifying whole vessels from broken necked vessels is quite difficult; 43% of necked vessels cannot be refined to jar or olla category due to small diagnostic size and a high % of forms cannot be identified. This is even more pertinent when comparing my data with data generated from survey projects, where the quantity or percentage of unidentified sherds is usually not given. I will not discuss those handles and bases that cannot be linked to any particular form here, but in Chapter 9 I will consider both categories in regards to vessel function.

7.51 Necked vessels: Ollas and jars

Ollas play a somewhat important role in seriation of the Titicaca Basin. The short-necked olla, for example, is a characteristic form for the earlier phases of the basin (Bandy 2001; Steadman 1999). By the Middle Formative period, the medium-necked olla is the most common vessel shape at both Chiripa and Kala Uyuni (41 % and 45 % of the sample respectively) (Steadman 1999:66, Steadman 2007: 80). These vessels tended to have slightly flared or flared rim angle, (67% and 25 % of them in the case of Kala Uyuni samples) but sometime straight and flared-necks (Steadman 2007: 81). In some cases there are lugs and nubbins on a few of these vessels, but Steadman finds that strap handles are more popular (Steadman 1999: 66, figure 25c). Jars encompass 41 % of the Kala Uyuni sample (Steadman 2007). This is a particularly high number if we consider the difficulty in identifying these forms in fragmented Formative Period assemblages.

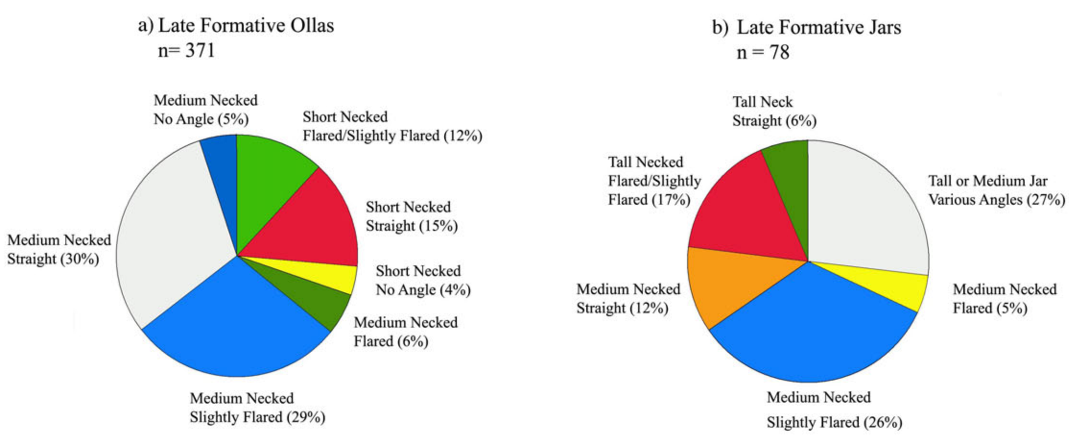


Figure 7.15: Late Formative a) Ollas and b) Jars across all contexts.

By the Late Formative ollas are still found in high percentages at Taraco sites, likely produced for similar uses (Chapter 9). Like the Middle Formative, the medium necked-ollas (averaging 2.9 centimeters in neck height) were the most frequent form (70 % of all ollas). There is a fair amount of diversity within this main group, but the most common were the medium-necked straight and medium-necked slightly flared ollas. We found examples of short-necked olla in the Late Formative assemblage, including flared, slightly flare and straight varieties. The angles in these categories are suggestive that the rest of the body of the globular vessels varied somewhat.

Figure 7.16: Late Formative Ollas and Jars. a) S-N straight olla, b) & c) M-N flared olla, d) & e) M-N slightly flared olla, f) & g) M-N straight olla, h) M-N flared jar, i) T-N slightly flared jar, j) T-N straight jar. Note that the drawing/photograph of the sherds are positioned with the interior on the left and exterior on the right.

Ollas tend to be made of one of the micaceous pastes, with pastes 1 and 18 the most frequently employed (black and top grey in Figure 7.18). There are a very small number of cases where pastes 5 or 6 are used for manufacturing these vessels (S-N straight and slightly flared). The surface finishes of these ollas are either red slipped or light brown unslipped, suggesting that these vessels were decorated in the Kalasasaya style (Figures 5.2 c and e, 7.16e, 7.17g,). We have 2 decorated short-necked straight ollas, one medium-necked flared olla and four medium-necked slightly flared ollas.

The largest number of jars were medium-necked slightly flared, or tall necked slightly flared jars. We also had some cases of medium-necked straight jars and tall-necked straight jars. However, I could only positively identify 78 jars for unmixed Late Formative assemblage due to breakage on the neck of the vessel. Those forms that could not be differentiated due to common breakage around the neck were codified as "necked vessel", a category that accounted for a large percent of identified necked vessels. In many cases forms could not be distinguished between olla and jars, perhaps indicating that their functions (cooking and storage) overlapped (Janusek 2003: 41). This point seems especially to be the case for jars and medium-necked ollas for the Late Formative contexts in that they served similar roles (Steadman 2007: 89 and Chapter 9). Much like the ollas, jars were primarily produced using the micaceous pastes, with paste 1 and 18 together accounting for 66% of the cases.

Scholars working elsewhere in the Titicaca Basin have noted similar trends for necked vessel frequencies, although in some cases ollas represent a higher percentage in their assemblages. Mathews found that 72 % of his Tilata assemblage was defined by ollas (Mathews 1992: 157-62; Janusek 2003a:44). In the Katari Valley Janusek found 90 % of the identified forms in Late Formative assemblages were ollas. Notably, his ollas were in a less fragmented state, and Janusek could distinguish entire forms.

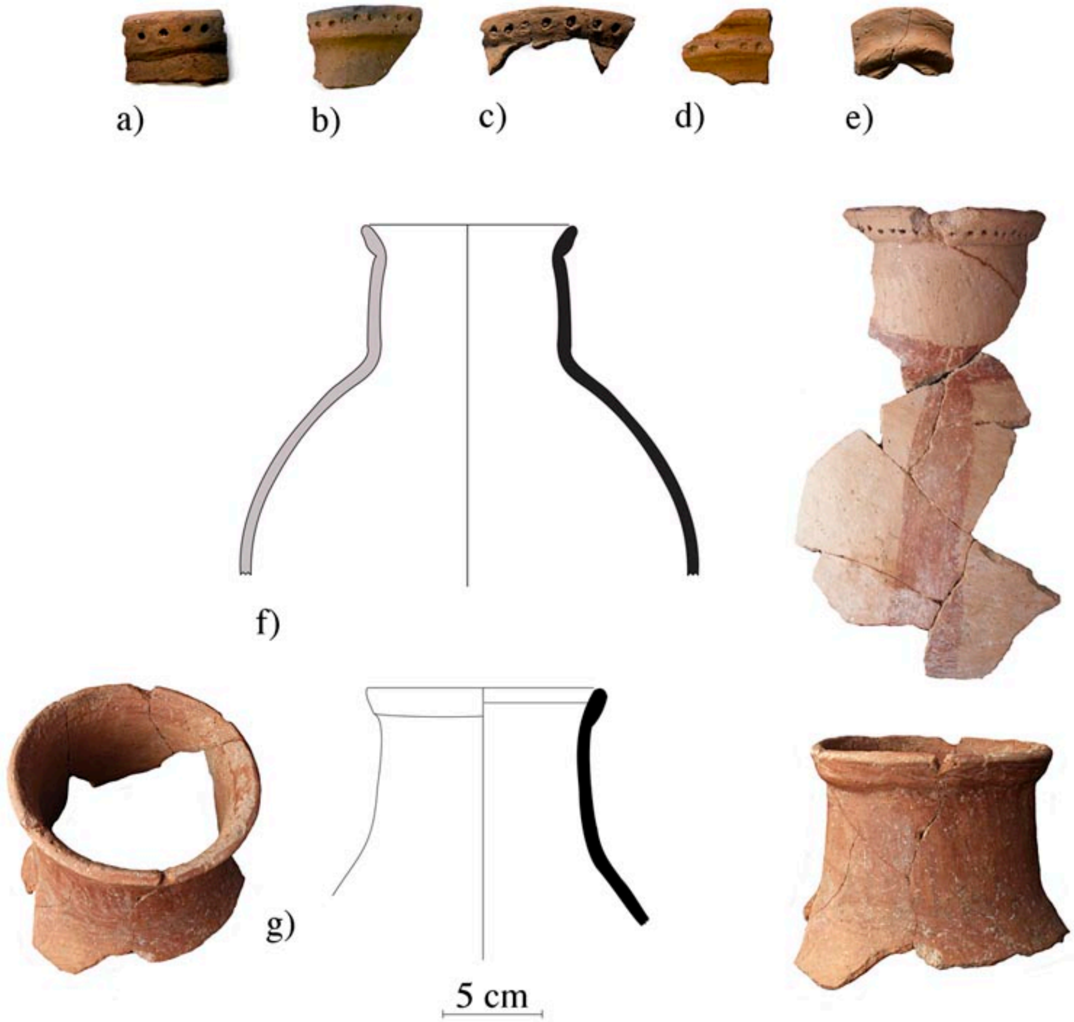


Figure 7.17: Examples of slipped, elaborated (with appliqués) and punctuated Late Formative necked vessels: a) – d) punctate decoration on likely necked vessels, e) ridge elaboration, f) straight-necked olla with punctate and red slip, e) possible jar. Note that a) is from Sonaji midden event SN-A271, while b-g are all from high-density middens west of ASDs 2,4 and 5 at Kala Uyuni.

He noted two primary varieties of olla forms, one wide globular vessel with slightly restricted mouths and a taller "pear-shaped" form with long, sloping necks and opposing handles. Most of these ollas had rounded bases, although a few had short-thickened pedestals. (Janusek 2003a: 40). Both Janusek (2003a: 41) and Mathews (1992) both found few jars in their analysis. At larger sites such as the Kk'arana neighborhood at

Tiwanaku and Kirawi in the Katari valley, Janusek encountered a higher density of them (Janusek 2003a figs. 3.9c-f and 3.10e). Janusek's large jars consisted of globular vessels with a flaring rim, restricted neck, and in most cases thick walls. Janusek's medium-sized vessels displayed the same fundamental form as the large size with slightly less flaring rims and shorter necks. I use these descriptions of ollas and jars, and Janusek's associated drawings along with the few complete ollas recovered, to cautiously project possible forms for the reconstruction in Chapter 9.

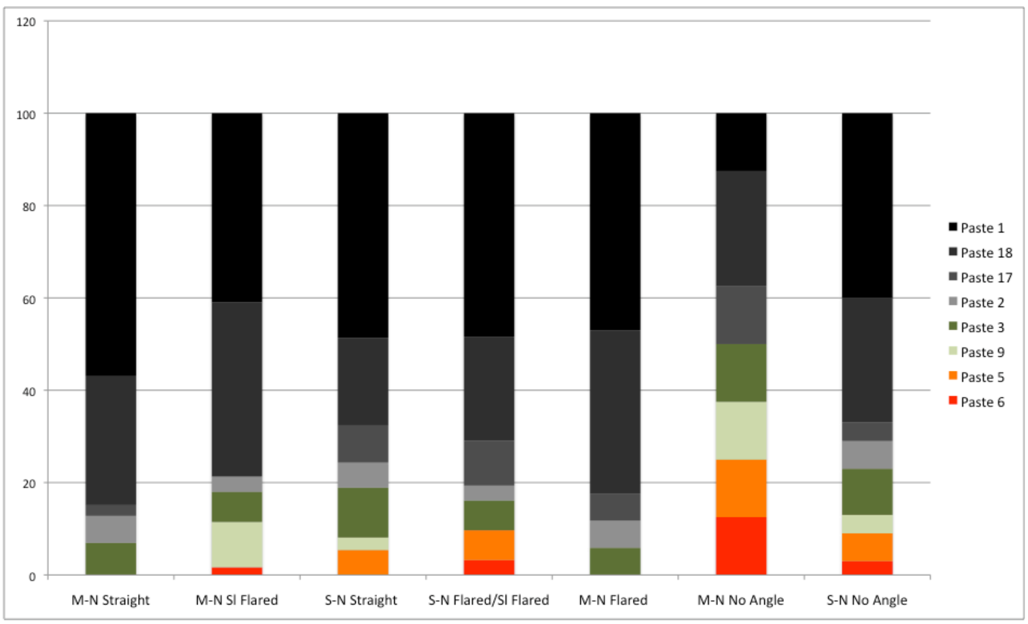


Figure 7.18: Late Formative ollas, from most common on the left to least common on the right, by paste %. Gray scale represents "micaceous pastes", greens "other-mineral tempered" and orange/red "buff pastes". Note: 1. M-N is medium necked, S-N short-necked, 2. There is a very small sample size for M-N no angle (see Figure 7.15a).

After the basic forming of the vessels, Late Formative potters would have finished with a particular rim, and it is this micro-embodied practice that we may identify different community of potters. Ollas tend to have a slightly smaller rim thickness (7.4 cm) than jars (8.6 cm). For both jars and ollas, the predominant rims found are round, slightly rounded or flattish in shape. There are a few rim shapes that are new to this period including the flat grooved rim and the rounded rim with external pico, or bump on the rim (see Figure 7.19 for examples). Potters produced rounded rims with external picos for their ollas, particularly with straight necked or slightly flared ollas (22 % of the time).

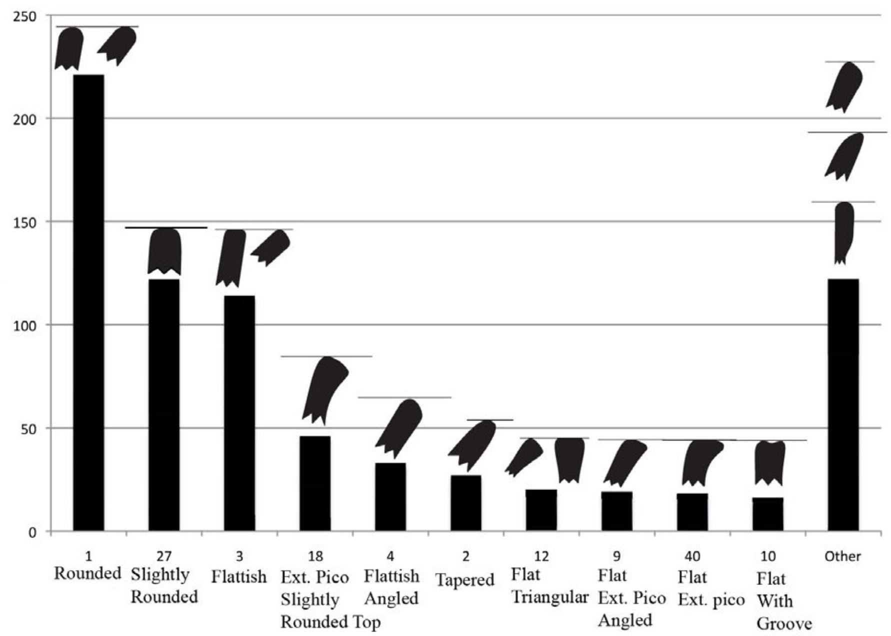


Figure 7.19: Number of rims associated with Late Formative necked vessels. Note that the other category includes 18 other rim forms, however only forms 29, 19 and 58 are over 1.5 % (between 10 and 15 cases) of the assemblage, and thus only these rims are illustrated here.

There is remarkable similarity between the rim populations at all three sites. Looking at the olla category alone, we see that all Kala Uyuni, Sonaji and Kumi Kipa each have primarily rounded rims (26.5%, 24.8%, 30.6%), slightly rounded (21.2%, 16.0%, 19.4%), flattish (15.2%, 13.9%, 18.1%) external pico with a slightly rounded top (8.0%, 6.6%, 5.6%), and so on. All the ollas are remarkably similar in thickness, with Kala Uyuni averaging 7.3 cm and both Sonaji and Kumi Kipa at 7.6 cm. Late Formative jar rims show a similar pattern. Rounded, slightly rounded and flattish rims are the most common, but have little variation in thickness or form across the three sites. There is little evidence of micro-style in necked vessels, and the rims of necked vessels do not suggest these vessels were products of different communities of practice. However, one interesting possibility would be that the less common rims (represented as “other” in Figure 7.19) are from a different group of potters. I did investigate whether these particular rims were unique in terms of paste or finish, but the small sample size renders interpretation difficult.

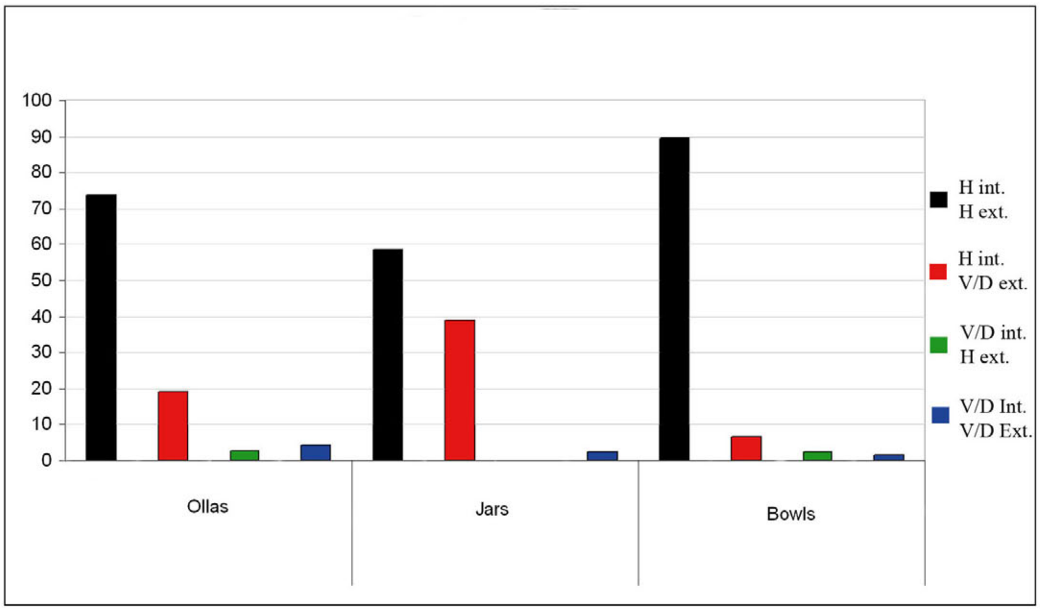


Figure 7.20: Percentage breakdown of direction of surface finish for Late Formative ollas, jars and bowls. Note: H: horizontal, V: vertical, D: diagonal.

Above I have used the shift in surface finishing to further define the shift in potting practice from the Middle to the Late Formative. This shift in hexis is even clearer when we consider the direction of surface finish on necked vessels. While during the Middle Formative phases burnishing is always applied horizontally, by the Late Formative 8 % of external and internal burnishes are applied vertically, diagonally, or horizontally. As figure 7.22b shows it is the necked vessels where the vertical (or diagonal) surface finish is applied. This makes intuitive sense in terms of bodily practice and finishing a necked vessel. However, this shift is important of a change in how potters are learning how to use their tools, a shift that likely occurred over only one or two generations around 200 BC. Steadman (1995: 304) has made a similar observation for Late Formative surface finishes in the Northern Lake Titicaca Basin. It is possible that these shifts are replicated in other Late Formative communities of potting practice, which may help define local genealogies and regional constellations of practice. However, the extant archaeological literature makes no mention of such shifts elsewhere in the southern Titicaca Basin.

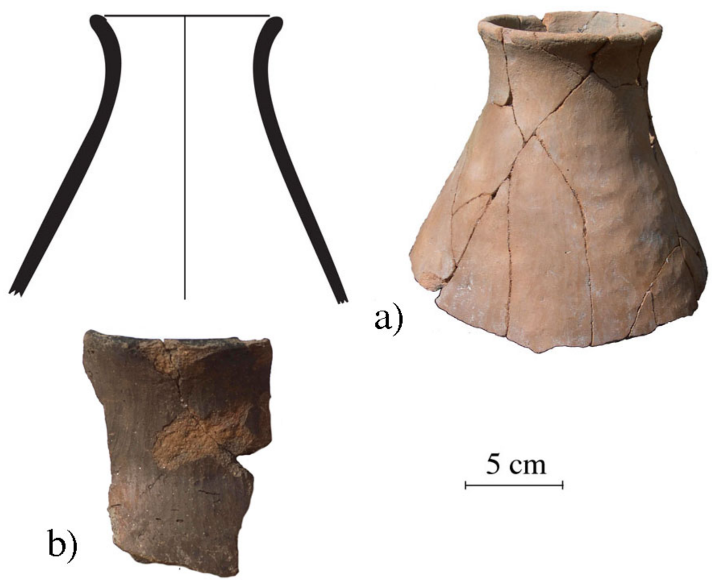


Figure 7.21: a) Olla from event (locus 6089) with visible signs of horizontal coils and vertical burnishing b) close up of a medium necked olla, showing vertical incomplete burnishing.

7.52: Open vessels: Bowls

As we saw above, there appears to be great continuity in the production of particular forms of necked vessels throughout the Formative Period. In contrast, bowl forms appear to be much more important during the Late Formative, showing much greater diversity (Figure 7.22). This diversity permits the possibility of defining particular distinctions across communities of practice. Like the necked vessel discussion above, I will limit my discussion here to focusing on the production sequence, and will return to vessel size, possible function and distribution in Chapter 9.

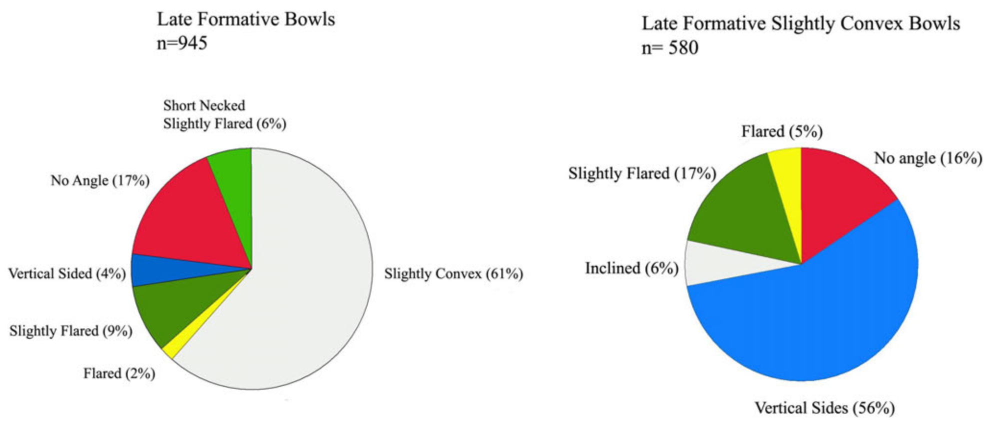


Figure 7.22: Distribution of identified Late Formative bowls, and specifically slightly convex bowls, across all sites and all contexts.

Steadman found that bowls became more common in the later phases of the Middle Formative, representing 36 % and 22 % of the late Middle Formative at Chiripa and Kala Uyuni respectively (Steadman 1999: 66, Steadman 2007: 80). The majority of the sample at both sites were slightly flared bowls, although there were a significant proportion of vertical walled bowls as well. Much like earlier scholars of the region (Bennett 1936, Mohr 1966), Steadman noted that Middle Formative potters often used characteristic thickened rims and flat bases for their bowls (Steadman 1999: 68). Significantly, Steadman found that most of the bowls (70%) from the Late Chiripa phase are made with a particular paste (Steadman 2007: 80). Bowls become more common during the Late Formative Period. Although certain forms certainly continue from the earlier periods, including bowls with flat bases and straight walls with slightly flared or flared walls (Steadman 2007: 92), it is within this group that Late Formative ceramic innovation is clearest. This innovation is connected to the choice of paste. Unlike the necked vessels, a high percentage of Late Formative bowls on the Taraco Peninsula are produced using one of the compact 'buff' pastes.

The most common form across all contexts is the new category of the slightly convex bowl, which has a fair amount of diversity in wall angle and basic form. Within this group the vertical sided slightly convex bowl is the most common (Figures 7.24 e-h). As I mentioned above, Janusek recovered more complete vessels than the TAP excavations. This is usefully, as it permits us to make a connection between a particular base, called a "ring base" by TAP ceramicists, and another type of slightly convex bowl. Janusek calls these bowls, with their ring bases and, in many cases, horizontal handles, "annular bowls (Figures 5.2g, 7.26, 9.20).

As we saw in Chapter 5, bowls with horizontal handles were central to Bennett's (1934: 450-451) definition of the Late Formative. Some slightly convex bowls have small horizontal strap handles on the rim, loops, or in rare cases rounded/oval lugs on the rim (Figures 5.2a,b,g,h, 7.25). These components are found in both decorated and non-decorated vessels, in some cases with the red slip passing along the loop or handle. A variety of similar vessels are found at Tiwanaku itself, in some cases in extreme forms, these vessels include multiple loops all in a row. The finer versions of these "looped" vessels, constructed with the compact pastes, are associated with a partially slipped, indented base (see Figure 9.9b).

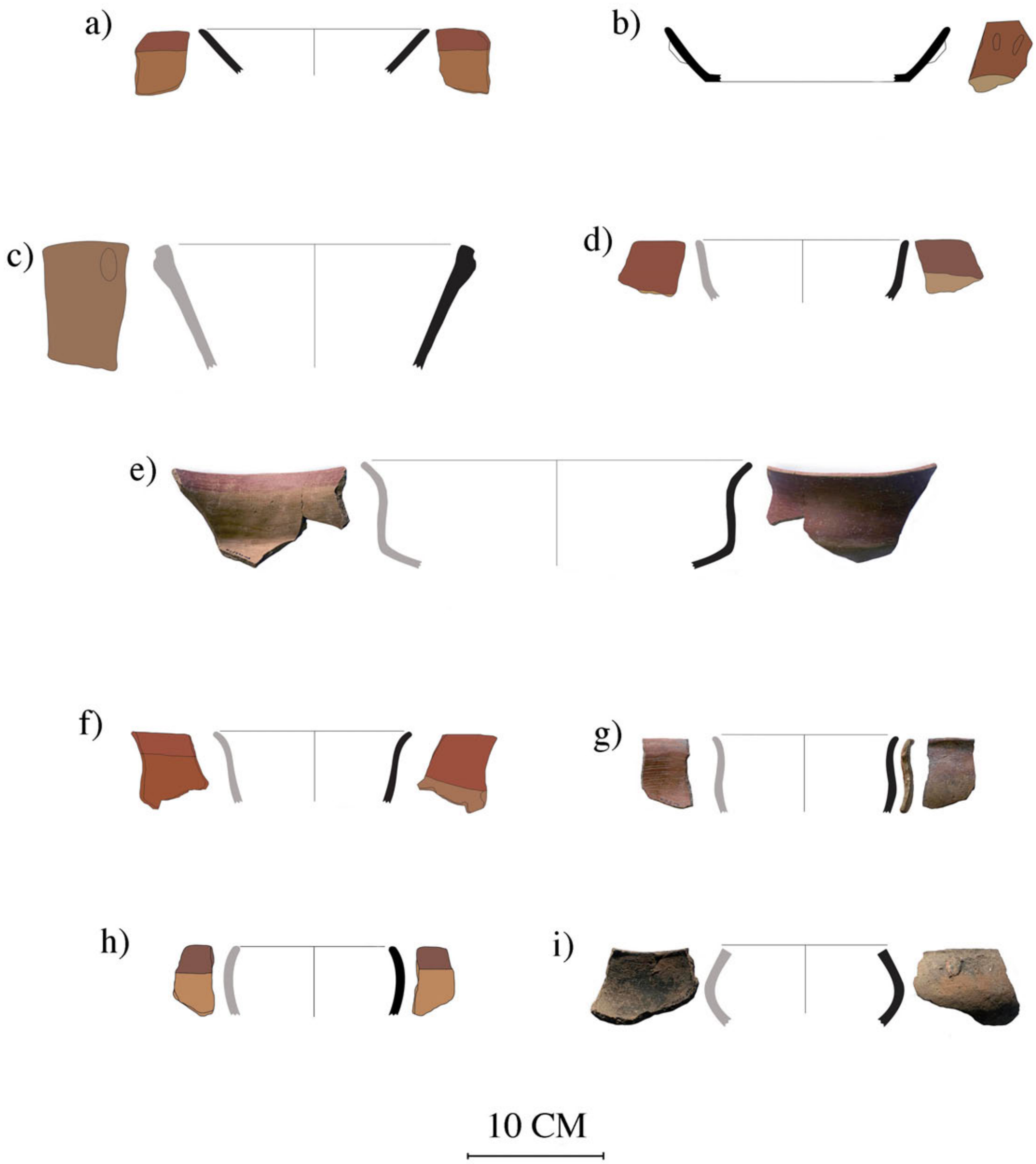


Figure 7.23: Late Formative Bowls: a) Flared, b) & c) Slightly Flared d) Vertical sided bowl e)-g) Short-Necked Slightly Flared, h) & i) Incurving. Note that the drawing/photograph of the sherds are positioned with the interior on the left and exterior on the right.

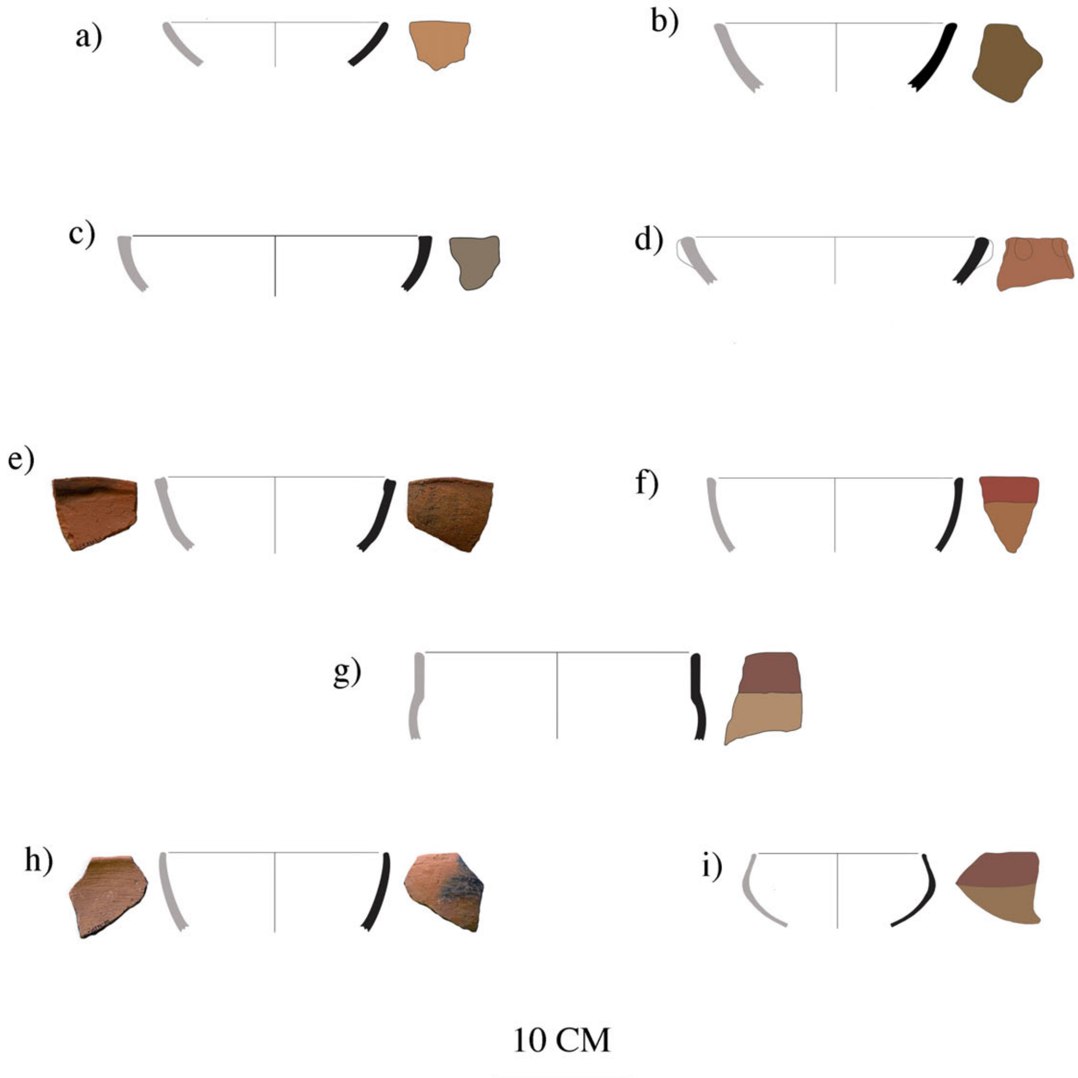


Figure 7.24: Late Formative Slightly Convex Bowls: a) Slightly Convex Flared, b)-d) Slightly Convex Slightly Flared, e)-h) Slightly Convex Vertical Sided i) Slightly Convex Inclined. Note that the drawing/photograph of the sherds are positioned with the interior on the left and exterior on the right.

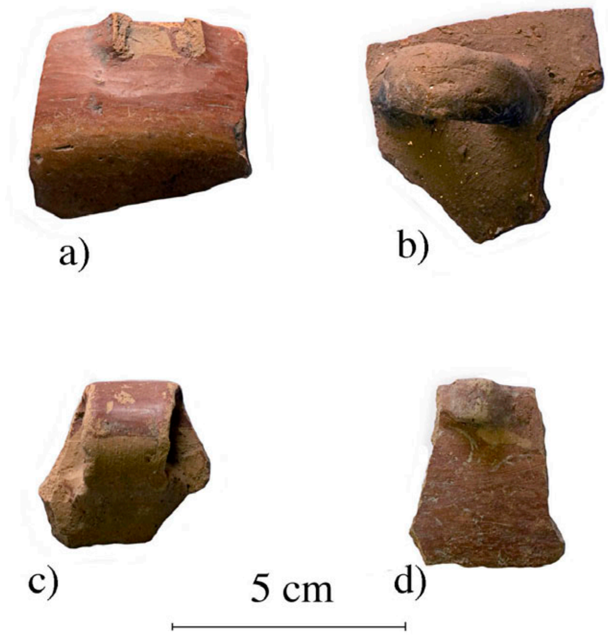


Figure 7.25: Loops and horizontal handles associated with Late Formative bowls.

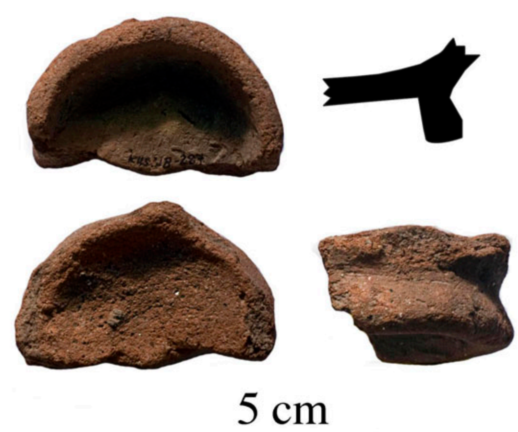


Figure 7.26: A ring base, which is likely a part of an “annular bowl”.

The drawings in Figures 7.23 and 7.24 demonstrate diversity outside of the wall angles. There is considerable variation in the bowl depth and diameter (and thus volume) of these vessels. In some cases there are shallow serving bowls such as the flared (Figure 7.23a and b) and slightly convex flared bowl (Figure 7.24a). In other cases producers made deep bowls, such as the new "short-necked slightly flared" bowl (Figure 7.23e-g), the incurving bowl (Figure 7.23i), the slightly convex vertical sided (Figure 7.24e-h) and the slightly convex inclined (Figure 7.24i). There are more than twice as many deep forms as shallow bowls during the Late Formative. I will return to the possible significance for consumption practices in Chapter 9.

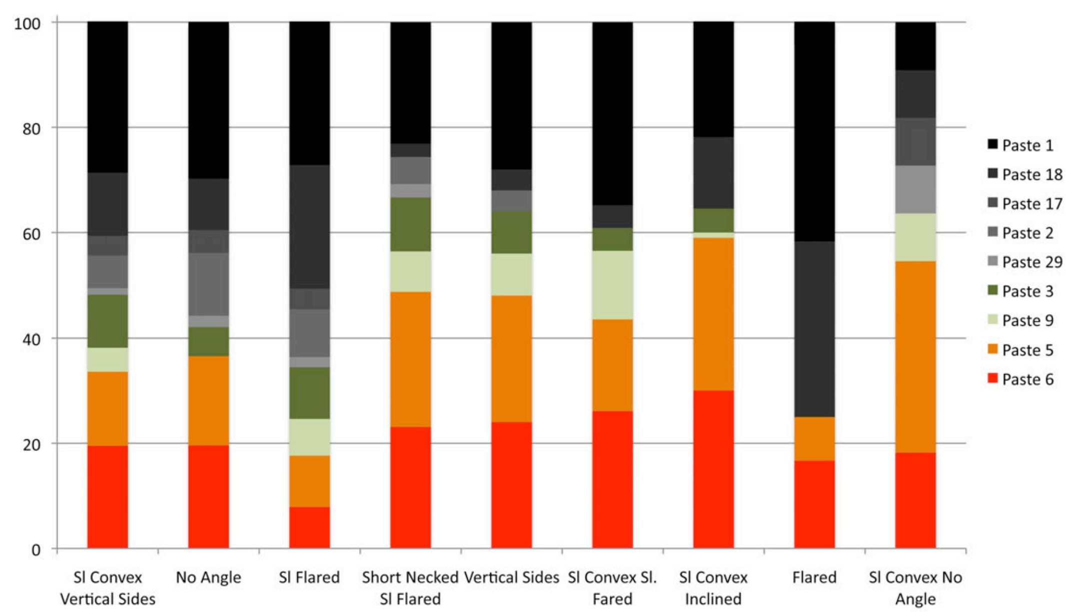


Figure 7.27: Late Formative bowls, from most common on the left to least common on the right, by paste %. Gray scale represents "micaceous pastes", greens "other-mineral tempered" and orange/red "buff pastes". Note that both "Flared" and "Sl. Convex No Angle" had a very low sample sizes.

The most common surface color of all bowls (both slipped and unslipped) is red slipped (28%). We have not yet recovered any complete/semi-complete bowls that are entirely slipped red, and it is likely that all these red slipped bowls are red-rimmed vessels. If it is the case that these are the same, and we add these red slipped examples to the third largest category of various red (including dark/light red and red-brown) on light brown or red brown unslipped surfaces, a total of 47 % of the bowls are decorated in the Kalasasaya red rimmed design style. While 47 % of the slightly convex bowls have either the slip or the banding, 67% of the short-necked flared or short-necked slightly flared appear to be decorated. As I mentioned above in the discussion of decorated body sherds, there are few additional examples of decorated bowls in the analyzed population. The only exceptions within the analyzed assemblage are one black on red slip bowl and one black and red on unslipped red brown bowl. To reiterate the point I made above, compared to other parts of the Titicaca Basin this is a notable high density of red-banded Kalasasaya vessels, suggesting that these are either locally produced or are integrated in particular consumption activities to a larger degree than other regions of the southern Lake Titicaca Basin.

Late Formative potters formed similar rims on their bowls as on their necked vessels, most frequently making a round, slightly rounded or flattish rims. A larger percentage of bowls have tapered rims, a form that continues from the earlier Middle Formative phases, although in a much thinner form. 76% of these tapered rims are found on the slightly convex bowls. Most of the patterns noted across all bowls in Figure 7.29 holds for specific bowl forms as well. One exception is the slightly convex inclined bowl, where 10.8% have a slight internal beveled rim (however 43.2% have a rounded rim).

Much like the necked vessels, these trends are similar across sites, although Kumi Kipa appears to have slightly more internally beveled rims. Of the ceramics recovered at Kala Uyuni, Sonaji and Kumi Kipa most are rounded (30.6%, 27.7 %, 37.2%), tapered (25.45%, 21.1%, 20.3%), flattish (17.2%, 15.2%, 9.3%), slightly rounded (14.6%, 9.9%, 11.1%) or with a slight internal bevel (2.0%, 2.3%, 9.3%). The other category does not appear to be linked to a particular form, with the highest number found in the slightly convex vertical sides category. However, while approximately 13 % of the bowls found at Kala Uyuni and Sonaji have various other rims, Kumi Kipa has exactly half as many, at 6.4%. This may indicate either a slightly different production routines, or rather less differentiated bowl diversity. This extremely subtle difference in bowl rims used is the only realm of differentiation found in production sequences of the three sites.

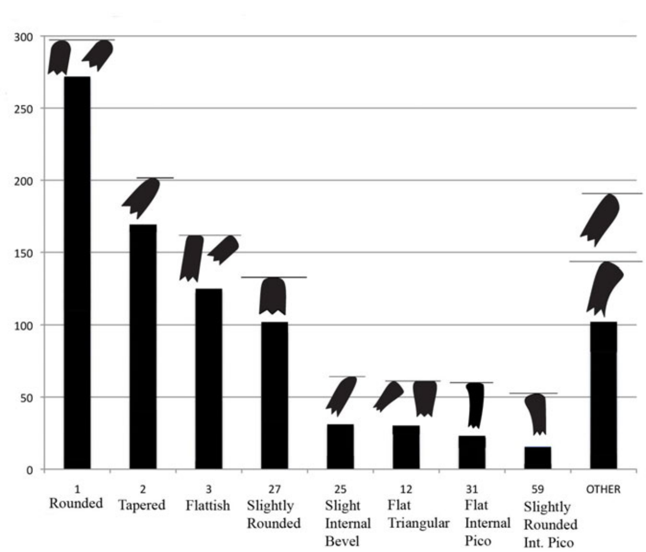


Figure 7.28: Rims for Late Formative Bowls. Note: Category “Other” includes 15 other rim forms, but only rim forms 8 and 4 (illustrated here) are over 1% (between 10 and 15 cases) of the assemblage.

As decoration appears to be associated predominantly with bowl forms, it is of no surprise that TAP sites, which we noted above have a high density of decorated vessels, also have a relatively high density of bowls compared to other regions. Only Tiwanaku, Lukurmata and Qeya Kuntu have similar densities. For instance, Mathews found only 13 % of his assemblage at Tilata consisted of bowls, many with ring (or pedestal) bases (Mathews 1992: 157-62; Janusek 2003a: 44). At Kirawi even fewer bowls were found, representing only 3 % of the assemblage. Both small bowls and deeper bowls with thickened lips were present but they were far less common than elsewhere in the Basin. Unlike Tiwanaku, Lukurmata, and Qeya Kuntu, only 15 % of the Kirawi bowls were decorated, and only 4 % had the beige paste.

Other scholars have noted a great degree of bowl diversity during the Late Formative of the southern Titicaca Basin. Various scholars have noted the presence of both shallow and deep bowls. Burkholder found that her "shape 2" included shallow and deep bowls in the Iwawe excavations (Burkholder 2001: 223). Janusek (2003a: 46) notes that a Qeya Kuntu, the earliest Late Formative level included a small percentage of shallow bowls. Excavations at the Late Formative neighborhood of Kk'arana at Tiwanaku recovered a variety of shallow bowls with beige (chestnut) or pale orange paste, in most cases with a red band painted along the rim (Janusek 2003:43). Some of these shallow bowls included horizontal handles (most burnished).

Some of this work in the basin suggests that these shifts in bowl forms may be related to changes in production choices. For instance, at Lukurmata Bermann found a diversity of bowls, including annular, straight flaring sides and thin red bowls. The thin red bowls were similar to the Kalasasaya vessels encountered on the Taraco Peninsula, but have a more porous paste (Bermann 1994: 63-65). In his second Late Formative occupation, Bermann encountered the Kalasasaya red-rimmed vessels, which replace the thin red bowls. By the third level, in what Janusek (2003a: 46) believes represents a later phase of Late Formative 1 (perhaps the elusive Tiwanaku Ia discussed in Chapter 5), the thin red bowls reappear at Lukurmata.

There certainly does appear to be a shift in bowl forms through time on the Taraco Peninsula. However it is difficult, at this point, to use vessel forms to help in defining Late Formative micro-styles due to the fragmented nature of the assemblage. Although forms are essential for defining particular communities of practice and their generated micro-styles (Dietler and Herbich 1989: 157), the number of vessels identified for all three Taraco site precludes any discussion of particular micro-styles for the Taraco Peninsula. Janusek's comments for the Katari Valley, however, suggest that bowl forms are important to track. He found that each Late Formative site maintained a distinctive assemblage of bowls. Although Lukurmata, Tiwanaku and Qeya Kuntu were part of the "Kalasasaya complex" each appear to have been producing local bowl forms as well (Janusek 2003b: 145). This suggests that a) bowls are good indicators of Late Formative communities of practice and b) that we may have a single community of practice on the Taraco Peninsula, as represented by similar distribution of bowl forms. Rim form, another important factor discussed elsewhere in ethnographic and ethnoarchaeology, as a representation of particular communities of practitioners, does not clearly differentiate distinct micro-styles for Kala Uyuni, Kumi Kipa and Sonaji. There is somewhat less diversity at Kumi Kipa, but this may be a product of a small sample size.

7.6 Discussion: Embedded, distributed and embodied production

I began this chapter with a critical overview of how distinct pottery production areas are defined in the Lake Titicaca Basin. After presenting some convincing evidence for workshop production at Tiwanaku, I suggested that most production during the earlier Formative period, and even during Tiwanaku periods, was likely distributed and embedded within wider social practice. While there is no evidence for ceramic workshops or spatially discrete pottery production areas on the Taraco Peninsula, there is evidence for pottery production as a part of other productive operational sequences. I argued that pottery was formed and finished on some of the nebulous clay surfaces uncovered in TAP's excavations. Since tools are an important part of the hexis of a particular community of practice, and potters tend to curate particularly effective tools (chapter 3), I paid particular attention to the distribution of ceramic smoothing tools. I noted that they were found in association with spindle whorl production, suggesting that a range of crafting activity occurred on these surfaces. Future work will integrate the results from ongoing micromorphology of these clay surfaces, with stone and bone tools and debitage data. I suggested that while forming and drying of vessels may have occurred on these surfaces, the firing likely did not occur on site. Future excavations, of course, may reject this hypothesis. Although we conducted a 6 x 6 meter excavation at Sonaji, most of our excavations have not large horizontal excavations. One possibility is that the firing of ceramics occurred "off-site", that llama dung, the likely fuel for pottery firings, was collected as part of a greater "taskscape".

If my interpretation of the distribution of smoothing tools is correct, and all three sites were indeed participating in ceramic manufacture, there seems to be remarkable consistency in the final products across the peninsula. The attribute analysis I presented in this chapter did not find great variability between the three sites. I did not find any major differentiation in the attributes associated with forming, firing and finishing steps of Late Formative operational sequences. In Chapter 3 I summarized Dean Arnold's (1998) argument that learning to craft is more effective in a domestic settings. This certainly appears to be the case for the Late Formative, where we see no evidence for workshops, and pottery producers integrated their craft in greater productive practice. In the next chapter I will consider how collecting raw materials may have been a moment when different potters may have been interacting, learning, and increasing participation in becoming potters. This social interaction, fostering an education of attention, may be one reason for consistency in the production attributes of Late Formative pottery.

One essential goal of this chapter was to present the ceramic assemblage that define the Late Formative Period on the Taraco Peninsula. Steadman's analysis of earlier periods suggests that Middle Formative potters used fiber-tempered pastes, often with large opaque quartz inclusions, to produce highly burnished serving vessels, including some with simple geometric patterns. These vessels tend to be thick-walled, with distinctive vessel forms, painted decoration and a stucco surface on the exterior portion of the cooking vessels (Steadman 1995, 2007). TAP ceramicists define the end of the Middle Formative, around 200 BC, based on four distinct shifts in ceramic production in the entire assemblage (Figure 7.29). These shifts continue to play out, albeit at different rhythms, through the Late Formative I and II phases.

These shifts began first with the Taraco Peninsula changing their surface finishing routine. Potters stopped the labor intensive full coverage surface burnishing so characteristic of the Middle Formative Period and began to wipe the surface of most of their vessels. These surface finishes appear to continue throughout both Late Formative phases. The second change is in the nature of the decorated ceramic assemblage. The geometric cream-on-red motifs so often found on Middle Formative bowls abruptly disappear around 100 BC, and were replaced by a simple red band on the unslipped surfaces of new bowl forms and some small-necked jars. This adoption suggests that these banded vessels were produced locally, an idea supported by the fact that Taraco sites have relatively high densities of these decorated ceramics than most (but not all) other settlements in the Titicaca Basin. Third, paste recipes changed over time. Paste recipes, in fact, are the best evidence to track changes within both Late Formative I and II phases. At the beginning of the Late Formative period we see ceramics with the large opaque quartz inclusions abruptly disappear. Throughout both Late Formative phases the ratio of mineral pastes increased as potters gradually skip fiber-tempering their pastes. By the Late Formative II phase and into the Tiwanaku periods these highly micaceous pastes become less important than other mineral pastes and potters shift to use finer and more compact pastes. Fourth, and finally, there were some changes in form. The biggest change in forms is found in the variety of bowl forms found throughout the Late Formative Period, with both decorated and undecorated finishes. I will return to potential consumptive reasons for this variability in Chapter 9.

Lee Steadman (2007) suggests that these new Late Formative production attributes would have facilitated more rapid ceramic production. Such an argument would suggest that pottery could have been produced for potentially a wider distribution. I would certainly agree that we should consider aspects from functional models (see Chapter 8 and 9). However there are other possible reasons for such a change. Rather than simply signaling a suite of mechanical and technical strategies, perhaps these shifts also represented the surfacing of new bodily practices. For example the shine of the mica might have become highly valued, in lieu of the burnishing on earlier pots (Roddick 2009; see next chapter). This shift could also be linked to new social formations, values and innovations within particular communities of practice.

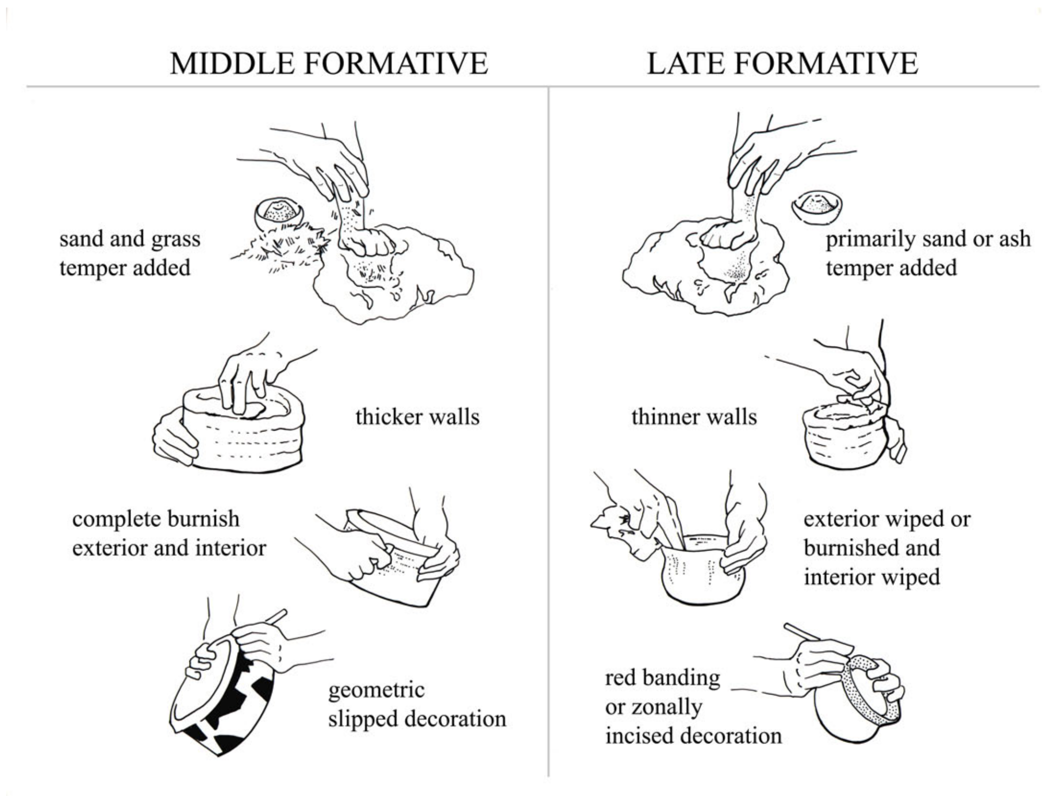


Figure 7.29: Some of the basic shifts in learned potting practice from the Middle to Late Formative. Note that coiling is a hypothesized step in this operational sequence (illustration by Kathryn Killackey).

Titicaca Basin scholars have argued that the Late Formative is a time of increasing social and political integration, perhaps through ritual practices. It may be that as new potters were integrated in families and settlements on the Taraco Peninsula (through fictive kin, marriage or migration), unquestioned habits were brought the surface and catalyzed innovations in the production sequence. Similarly, the increasing interest in micaceous pastes need not have been the result of economic practicality. As other scholars have pointed out for the Andes, the decision to use micaceous clays or schists as temper may have been as much due to its "technological essence" (sensu Lechtman 1984: 33) and the appearance of the pot - for example the shiny micaceous surface - as for the functional requirements of the vessel (Lunt 1988: 493; Sillar 2000: 62). It may well be that these micaceous pots were made by particular communities and were especially valued throughout the Titicaca Basin, as similar descriptions of pottery has been found in the Titicaca region (Ponce Sanginés 1971: 18; Lemuz 2001: 352; Janusek 2003a; Stanish 2003). I will return to both these options in the next two chapters.

Some of the changes that define the Late Formative were likely not unconscious changes over the course of several generations. Rather they likely occurred within one pottery producer's lifetime, with such discursive moments affecting significant components of the operational sequence. As will be discussed in Chapter 9, these shifts may have been linked to changes in cooking and serving interests and practices within arenas of familial and community-wide consumption. To determine whether this shift represents changes in pottery consumption (shifts in cooking practices, new demand for different aesthetics), new steps and innovations within the production sequence of a particular community of practice, or increased cross-generational slippage, Titicaca Basin archaeologists need to better identify the operational chain of pottery production through time and across space. By clearly defining shifts in attributes within a production sequence, we can then identify specific changes in practices, discovering how different choices would affect the entire sequence of bodily practices of production. I now turn to examine paste recipes with a focus on available raw materials.

Chapter 8
Raw Materials and Communities of Production

I ended the previous chapter by reiterating that potter's changing paste recipes is essential for defining Late Formative ceramic assemblages on the Taraco Peninsula. Due to the fragmented nature of these assemblages, the subtle changes in paste ratios are extremely important for constructing serrations. From the perspective of technological style paste is also essential. Preparing a paste is the first step in the operational sequence and has a considerable impact on all subsequent steps. Two important questions were briefly introduced in the last chapter concerning these paste changes: Can we distinguish why paste recipes were shifting? Can we define the "local" through particular paste recipes? In this chapter I address these questions by presenting the results of research I conducted on the raw materials and Late Formative pottery.

A focus on raw materials has been a central concern to those studying ceramic production and distribution. The early "ceramic ecologists" stressed the environmental and ecological constraints of pottery production (Arnold 1985), specifically the nature and accessibility of raw materials, climate and intended vessel function. However, ethnoarchaeologists studying both environmental and social aspects of pottery production have found that the relationship between raw materials and technological choice is quite complex. For instance, Gosselain and Livingston-Smith stress that ecological exploitation is not the major deciding factor in paste recipes in African potting communities, rather historical relationships, from "socially and culturally mediated relationships between potters" are more important (Gosselain and Livingstone Smith 2005: 97). They note situations where both producers and consumers may see the choice of a foreign paste recipe as "socially and economically interesting". The authors suggest that such a valuing of foreign pastes may be why processing techniques are more homogenous around major pottery centers as "behaviors tend to homogenize at regional scale and that, within these geographical units, variations ever occur within a limited number of possibilities" (Gosselain and Livingston-Smith 1995: 44).

A focus on raw materials is also essential from a community of practice perspective. Peripheral participation begins at the clay collection stage and this is where children are encouraged to begin their entry into potting practice. Furthermore, the collection and use of clay is an essential component of the greater taskscape, and was likely embedded in a range of geo-social practices. Late Formative Period villagers would have had "encounters" with clay while working fields or digging canals. Clay collection would also have been necessary for floor construction and the manufacture of adobe bricks. Melissa Goodman, the geoarchaeologist on the Taraco Archaeology Project, believes that the preparation of clays for surfaces and floors may have involved similar techniques as those employed for the preparation of ceramic vessels (Goodman personal communication 2009; more on this below). Finally, clay may have been an important component for particular cuisines. Geophagy, or the consumption of clay, is a common practice today on the Taraco Peninsula, specifically used in spicy sauces served with potatoes. As I will present in this chapter, there is good reason to believe that clay use was just as important during the Late Formative, and its patterned deployment points to wider social significance.

Potters may use particular pastes for many generations because of their acceptable working properties (Reina and Hill 1978), but also because of the inculcation of proper modes of testing the quality of available clays. One can imagine that these extractions were linked to a series of patterned, ritualized activities and taboos learned from a young age (Sillar 2000; Gosselain 1992). The continuing use of the same raw materials may help create techniques appropriate for both the local materials and the resulting forms (Sillar 2000: 77), potentially leading to both standardization and specialization. A shift in this first production stage will affect every subsequent step, and a change in the pastes used may result in either undesirable restraints on vessel forms or surface finishes, or alternatively may bring about innovation in these later steps.

In this chapter I delve into the details of the early stages of Late Formative operational sequences, focusing on the raw materials used for pottery production and their chemical and physical characteristics. This chapter has three parts. I begin by presenting the geology of the region. Researchers have stressed that in the absence of identifiable workshops, it is necessary to understand the distributions of clays within any given region, characterize what naturally occurs in these clays, and how sources vary across space (Arnold D. E. 2000; Neff and Bove 1999; Neff, et al. 1992; Orton, et al. 1993; Rice 1987; Stoltman, et al. 1992; Tite 2000; Vaughn and Neff 2004).

Over forty years ago Mohr (Mohr 1966) called for a detailed study of the available resources of the Taraco Peninsula in order to investigate production variability during the Middle Formative (discussed further below). Bandy (2001) has suggested that the Taraco Peninsula clays were likely exploited during the formative period. In the second part of this chapter I investigate Bandy's claims and follow up on Mohr's call, and present the results from a three-week pedestrian survey I conducted to find available raw resources of the Taraco Peninsula. While collecting clay samples, I paid particular attention to the quality of the materials and sought out mica-rich materials observed in Late Formative ceramics.

The third part of this chapter presents the methods and results of a series of subjective tests and geo-chemical analyses on a subsample of these clays to better understand their diversity. I begin with some subjective tests I employed to gauge plasticity and strength, both of which are important factors when determining the suitability of materials for making pottery. I also investigated the color of the raw clays and the oxidized fired clays, and compared the collected samples to the oxidized color of re-fired pottery sherds. This approach allows me to discuss estimates of firing temperatures and suggests linkages between raw resources and fired clays. Only then do I turn to the more detailed suite of techniques I employed.

No single technique can be completely secure in terms of providing clear results (Kingery 1996: 178), especially for a region that has received no prior work on compositional groups. Compositional and chemical analysis of pottery is an ideal way to trace the boundaries of production communities (Arnold et al. 1999; Stark, Bishop and Miksa 2000). I employed a number of approaches in order to examine the possible source variation for Taraco communities of potting practice, including x-ray diffraction, x-ray fluorescence, and petrography. I focus here on the most predominant paste groups – the mica (pastes 1,2,29) and mica/fiber (pastes 17,18) groups, leaving more detailed work on the "Other Mineral Temper" group (pastes 3 and 9, which define later Late Formative II and Tiwanaku) and the compact pastes (5 an6) for a future regional study.

8.1 Geology of the Taraco Peninsula

The Lake Titicaca Basin is located in the northern Bolivian and Peruvian *altiplano* (high planes), an intermontane basin of 200,000 km^2. The altiplano is positioned between the Cordillera Real and the Cordillera Blanca of the Andes, and ranges in altitude between 3700 and 4600 meters above sea level. It was created by a tectonic uplift during the Miocene (Clapperton 1993). Lake Titicaca itself is approximately 8560 km^2 and consists of two connected lake basins, *Lago Grande* (at 7130 km^2, 125 meter average depth) and *Lago Wiñaymarka* (at 1430 km^2, 9 meter average depth), both of which are connected by the Straights of Tiquina (Figure 8.1). The Lake Titicaca hydrological system has only one outlet in the south at Rio Desaguadero.

The ecological zones of the region consist of the lake, a marshy/damp pampa zone, a dry pampa/dry terrace and the upland/hilltops with deep *quebradas*, or river cuts, running north to south. The nature of each of these zones would have been exploited during prehistory for a range of economic purposes (Bruno 2008; Orlove 2002; Whitehead 2007). Titicaca lake levels can fluctuate dramatically, in some years up to 3.2 meters. Such variability can result in a 33 % volume change for the smaller Lake Wiñaymarka (Cross, et al. 2001). During years of heavy rainfall these lake level variations can cause Wiñaymarka and the Lago Grande to be separated (Baker, et al. 2005; Rigsby, et al. 2003). This variation certainly would have had an impact on the populations living on the Taraco Peninsula, and some scholars give these changing lake levels a central role in the social, political and economic dynamics throughout prehistory (Abbott, et al. 1997; Bandy 2001; Bandy 2005).

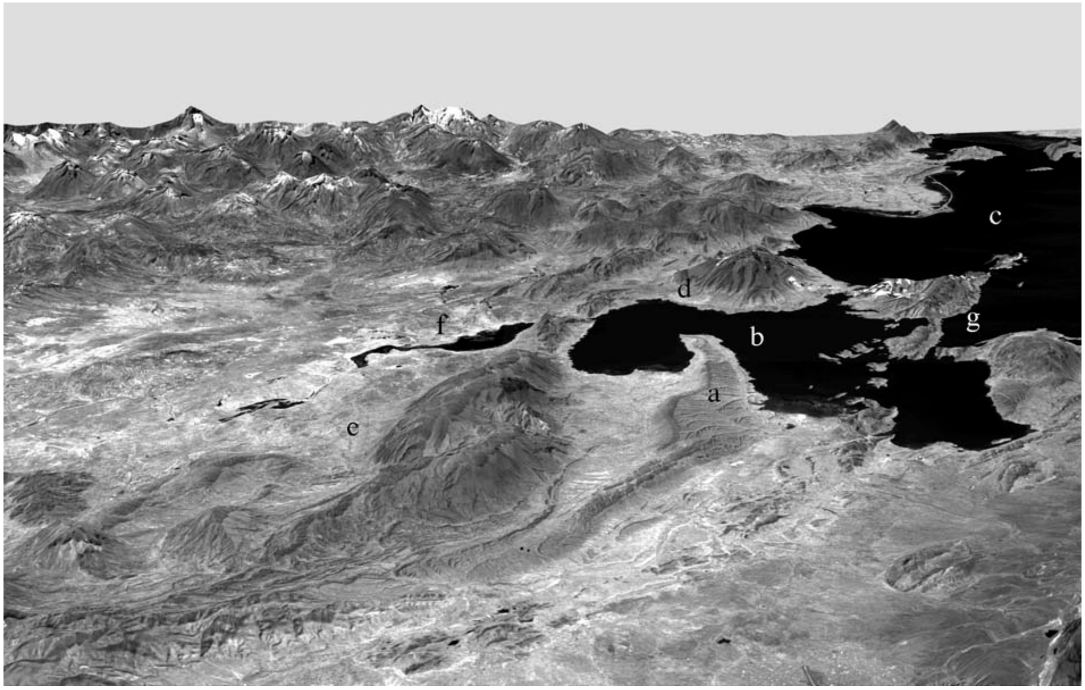


Figure 8.1: View of the Southern Lake Titicaca Basin with locations mentioned in text: a) Taraco Peninsula, b) Lake Wiñaymarka, c) Lago Grande, d) Mount Ccapia, e) Khonko Wankane, f) Desaguadero River, g) Tiquina Straights. For larger plan map image, see Figure 2.1. (Image adapted from a map provided by Arik Ohnstad).

The Taraco Peninsula juts into Lake Wiñaymarka, with a ridge running down the center creating the Taraco Hills. The shores, plains, and gentle slopes of the peninsula have gravel, sand, silt, and clay created by deep Pleistocene lakes and modern erosional processes (Qfl and Qcf in figure 8.2). Fluvio-lacustrine sediments were deposited from three paleolakes from the Pleistocene – Lake Ballivar, Lake Tauca and Lake Minchin (Qfl). The upper elevations of the Taraco Hills consist of deposits from Lake Ballivar while lakes Tauca and Minchin deposited white and reddish silts (Argollo, et al. 1996). Colluvial deposits (Qc) of boulders and gravel are found throughout the Taraco Hills. Alluvial deposits (Qa) of pebbles, gravel, sand, silt and clay have been deposited from the various rivers run from the hillsides.

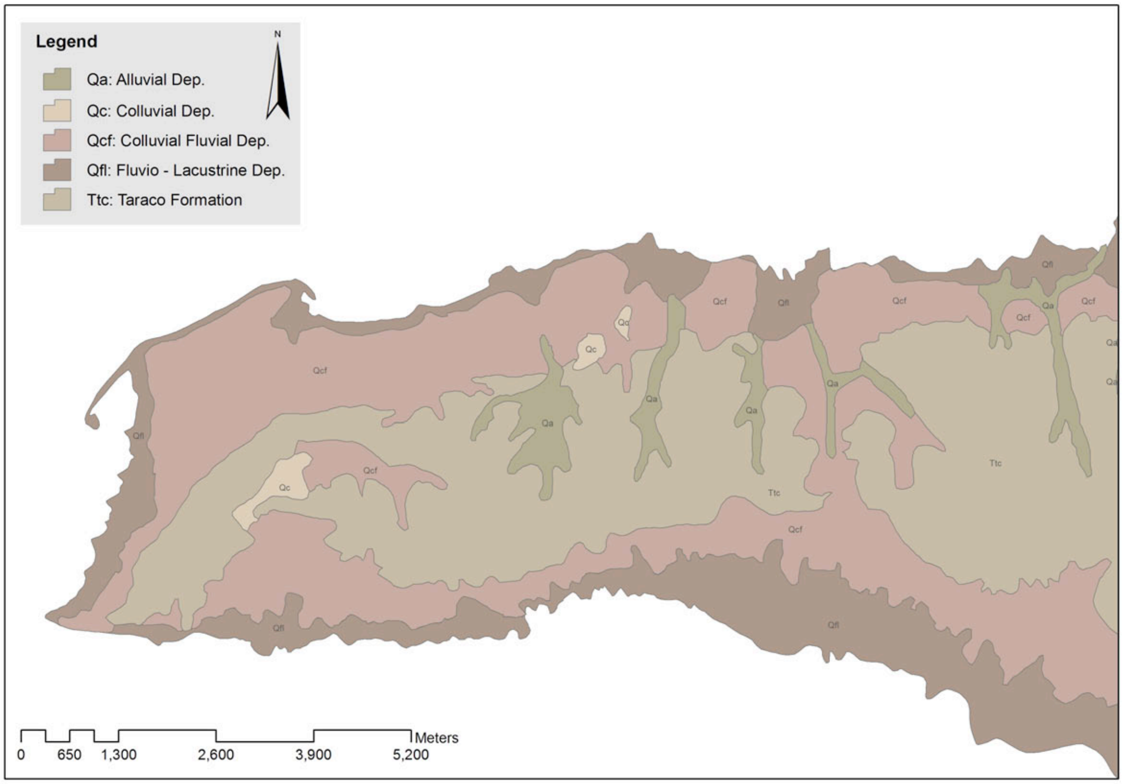


Figure 8.2: Geology of the Taraco Peninsula (image adapted from Instituto Geográfico Militar (IGM) 1994 map by Maria Bruno and Eduardo Machicado).

The Taraco range is composed of the conglomerate rocks of the Conrir, Kollu Kollu (Oligo-Miocene), and Taraco (Pliocene) formations (Argollo et al. 1996: 60). The Taraco Formation consists of approximately 200 meters of red-orange conglomerates and sandstones. The clasts are primarily Devonian mudstone, quartzite, vein quart and Permian calcareous gravels embedded in a sandy-clay matrix. The Taraco Formation deposits are finer and richer in clay to the south (Argollo et al. 1996: 69. The Kollu Kollu formation, intersecting with the higher Taraco Formation at about 3830 meters above sea level, is composed of conglomerates, red sandstones, clayish mudflows and alluvial clays.

The clasts are subangular to angular and include Paleozoic quartzites and Permian calcareous clasts. It is in general more compact, and thus less porous than the Taraco formation (Bandy 2001). Both of these formations include andesites, micas and epidotes, as well as chlorites and tourmalines.

8.2 Locating suitable clays and tempers

Scholars such as Bandy (2001) and Mohr (1966) have hypothesized that Formative Period Taraco potters used local raw materials for producing their pottery, however there has been no sampling of the raw materials of the region. Rivera Casanovas (2003: 97) characterized clays from the Chi'ji Jawira workshop (see section 7.1) as paligorskyte, illite, kaolonite and feldspars. She suggests that other Chi'ji Jawira clays and pigments (yellow, red and green) were either found locally or were imported in. Distinguishing the local raw material from the import, and characterizing locally produced ceramics from regionally exchanged ones, can be explored through a local raw material survey.

For this reason I conducted a three-week intensive survey of the region, from the community of Santa Rosa to just west of the community of Pillapi (see Figure 4.1) to identify local "source communities" (Arnold 2000). Two teams, including a local Tiwanaku potter and Bolivian archaeology students, walked a flexible transect system. We walked 100 meter North-South transects from lake edge to lake edge, but diverted off grid based on feedback from local informants (Figure 8.5). Although the Taraco Peninsula does not have problems with dense vegetation coverage as other regions might, the rocky and steep nature of the Taraco Hills restricted accessing all possible resources. I found that auguring, an appropriate technique for subsurface sampling, was not effective in the rocky soil of much of the Peninsula. Unfortunately detailed soil maps are not available for the region, and I was restricted to use more general geological maps (Figure 8.2).

Today clay is used for building material and for making figurines for nativity scenes during the Christmas season, but there are currently no practicing potters on the Taraco Peninsula. Franz Choque, from a family of potters near Tiwanaku, led one of the survey teams, and helped find clays that would be deemed suitable within his community of potters. Upon discussing our reasoning for trekking through their fields, Taraco locals informed us that very few quality clay resources, or *k'ink'u* (the Aymara word for clay) would be found near the lakeshore. They explained that all good plastic clays were to be found in the Taraco Hills. As such, we changed our strategy and only walked from road to road of the peninsula, focusing our attention on the alluvial clays of the river drainages (Figures 8.2, 8.5). These deep deposits were the best locations for finding clays. One notable exception was found outside of the modern community of Coacollu and within walking distance of the site of Kala Uyuni. This was a particularly deep deposit of white clay, clean of inclusions and particularly plastic, which likely would have been present during the Late Formative (Figure 8.3c)

One interesting observation several of us made during survey was the nature of the clay deposits. Often the clays were deposited in a banded nature, in a very similar color pattern as that found for the Kalasasaya red-banded vessels, and a stone bowl recovered from the excavations at Kala Uyuni (Figure 8.6b). This bowl was carved to take advantage of the natural banding of the stone, creating a similar (although reversed) pattern to the red-banded vessels. This skeuomorphic play with color may lend some support to local production, but also to a common manipulation of clay colors during the

Formative Period. I will return to the possible significance of these skeuomorphs at the end of this chapter.

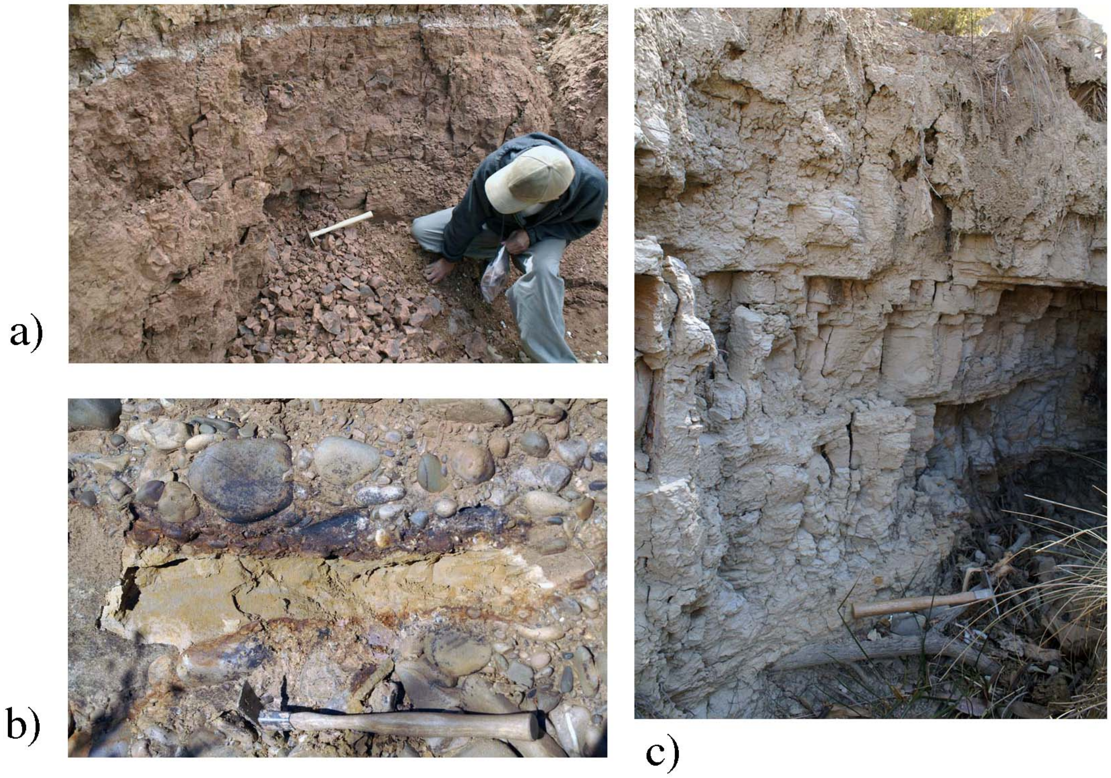


Figure 8.3: Some examples of clay sources collected: a) Red-brown clay collected outside of Chiripa, b) Light brown clay deposit c) Deep white clay deposit outside Coacollu.

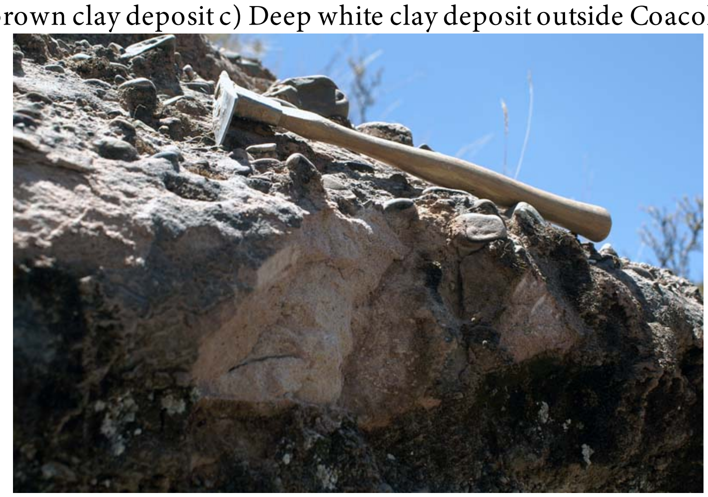


Figure 8.4: Example of a possible temper source, a micaceous rich material called "chillo" by Tiwanaku potters.

Figure 8.5: Source map of the collected soils (map from GoogleEarth).

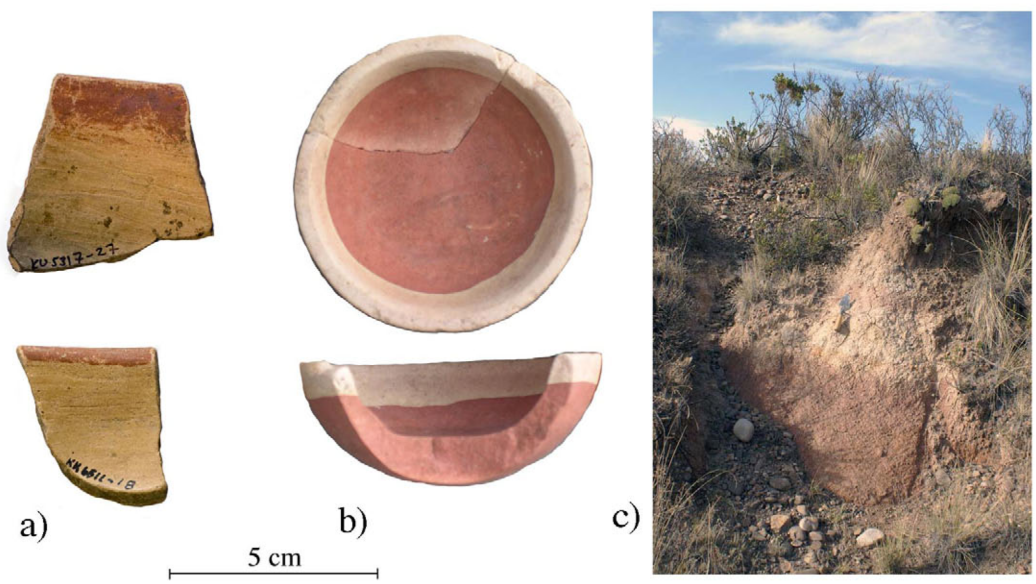


Figure 8.6: Skeuomorphs on the Taraco Peninsula. a) Kalasasaya red-rimmed bowl b) Sandstone bowl c) Taraco clay deposit

Sediments were also collected that may have been used for tempering pottery. Due to the ubiquity of micaceous inclusions in Late Formative pottery, we paid particularly close attention to any micaceous dense deposits (Figure 8.4), but we also collected beach sands and fine sediments from the Taraco Hills. Once a clay or sediment sample was found, a photo was taken of the location, and a GPS point was taken. Usually a single 300-gram sample was collected in a tyvek bag at each location. This was a sufficient quantity for the small amount required for compositional analysis and for the firing of test briquettes (see below). For larger deposits several samples were collected from different sections of the deposit.

A total of 112 clays, 14 possible temper sediments and 5 colorful mineral pigments were collected over the course of three weeks. All clay materials were allowed to air dry for several days, and then were ground down with a mortar and pestle. I exported 73 clay samples, a representative subsample of the collected materials, while all temper and pigments were exported. I included five samples from the TAP excavations. Excavations at Kala Uyuni, Kumi Kipa and Sonaji found clays being employed in a wide variety of fashions, including semi-formal floors, surfaces and for use as building material (Goodman 2005). I also attained three clay samples and two tempers from modern potters in Tiwanaku, as well as some clay from recent excavations of the foundation of the Akapana structure. Finally, some samples collected by Arik Ohnstad in and around the site of Khonkho Wankane, in the Desaguadero Valley, were included for comparative purposes.

8.21 Subjective tests

It would be impossible to perform chemical compositional analyses on the large number of collected samples. Berkeley graduate student Anna Harkey and URAP (undergraduate research apprentice program) students Jay Stampfl and Hannah Sistrunk joined me in performing a series of subjective tests on 40 of the exported clays to ascertain whether the clays were appropriate for potting. These tests also acted as a sampling procedure for more detailed analysis. Potters often utilize a series of subjective tests in order to verify important characteristics of clays needed for ceramics. Archaeologists, in turn, have often replicated such procedures for "quality control". We applied three trials recently employed in an investigation of Woodland ceramics and potting clays from North Carolina (McReynolds and Herbert 2004), which mirror many potters approaches to assessing the working range of clays (Rice 1987). This system includes a "coil test", a "loop test", and a "ball test", which allowed for plasticity, stiffness and strength to be examined. Following the Woodland study, clays were designated as "lean", "moderately lean" or "good" based on these tests (Figure 8.7).

Plasticity, or malleability, is the property of the water-clay mixture when the clay particles are surrounded by water, and it permits or constrains the retention of a given shape as it dries (Rice 1987; Shepard 1965). Plasticity was measured by the coil and ball tests (McReynolds and Herbert 2004). For the coil test, loops of moist clay were rolled out one centimeter in diameter and approximately 9 cm long (Rye and Evans 1976). The coil is then wrapped around a finger. The clay was judged to have "good" plasticity if a coil could be formed with no cracking, "moderately lean" if a coil could be formed but with a few cracks, and "lean" plasticity if a loop could not be formed from the sample without breaking in half. For the ball test, a golf ball-sized ball of clay was compressed to approximately one centimeter in thickness. Clays that are lean develop deep cracks when compressed, moderately lean clays develop slight cracks, and good clays do not develop any cracks. Strength, or what potters call thixotropy, refers to the capacity of a wet clay to maintain its shape and provide the necessary strength for a vessel to support its own weight and not slump (Hamer and Hamer 1986). We tested for thixotropy by taking a 1-centimeter coil and creating an 8-centimeter loop of clay was stood on end. If the loop remained vertical and did not sag, it was considered good, or thixotropic.

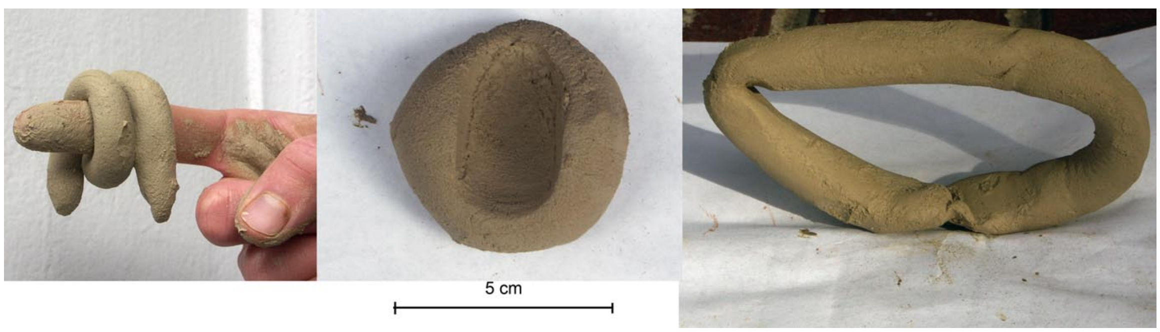


Figure 8.7: Examples of "good" coil and ball tests showing high plasticity and strength, and a sag test with poor thixotropy, or high water retention but not ideal strength.

These subjective tests found that almost all Taraco clays ranked moderately lean to good in all three tests with good to excellent strength and plasticity. The Taraco clays are well sorted and fine in texture, and are all sedimentary clays (or secondary/transported clays) rather than residual clays. When sedimentary clays are wet the fine particles can "slip" across each other as in a deck of cards, and it is this 'slippability' that gives it its workability or plasticity. These are opposed to primary/residual clays that are from the same location of the parent rock with much higher densities of coarse angular inclusions. Such clays are often called non-plastic as they do not shape easily. While primary clays may be used without tempering, as there are natural angular inclusions in the clay that have eroded from the parent material, sedimentary clays are usually finer, although they may include well sorted rounded inclusions and may require tempering.

The collected clays were appropriate for potting, but they were clean of large inclusions, and likely require tempering prior to firing (see below for more). Late Formative potters would have recognized that tempering counters the stickiness of these clays, increase porosity, decrease shrinkage, and decrease deformation during drying. The clays we collected in our survey included mica inclusions, but not in the density noted in pastes 1,2,17,18 and 29 (see Chapter 7). In the process of conducting our survey we did locate several deposits of micaceous schists. Perhaps the best example is the *chillo*, the fine micaceous sediment that modern Tiwanaku potters use to temper their clays today (Figure 8.4). We tempered several clays with the collected chillo and other tempers to note the performance and qualitative effects when fired (discussed further below).

8.22 Oxidation: The importance of color

My analysis included a basic description of all the clays in the field, including the color of the wet and dry state of the clays. Soil color is thought to vary based on the soil constituents, particularly the kind and amount of iron compounds, the oxidation state of the iron, and the organic matter properties (Rice 1987: 333). For instance, yellow, brown and red soils are created by iron oxides (Beck 2006). A lack of iron oxides creates "a grayish, greenish, or whitish color…[and] indicates either little or no weathering or the complete removal of Fe oxides following microbial reduction or chelation" (Shwertmann 1993: 54, quoted in Beck 2007: 97).

In order to account for the interpersonal variability, or "eye of the beholder" conditions, in designating Munsell colors, the same person noted color for all the clays (wet and dry) in a shaded setting. From this observational data, I created a systematic grid of color clays currently available on the Taraco Peninsula (Figure 8.8). While it is certain that there are many sub-surface clays not collected, this is likely a good representation of the colors of raw clays available in the Collu Collu and Taraco geological formations. Once I defined the color groups of unfired clays of the region, I examined the firing behavior of the collected raw clays and tempers. This would permit me to see if tempering was necessary with these raw materials, and would show the range of color of local clays as compared to the prehistoric sherds.

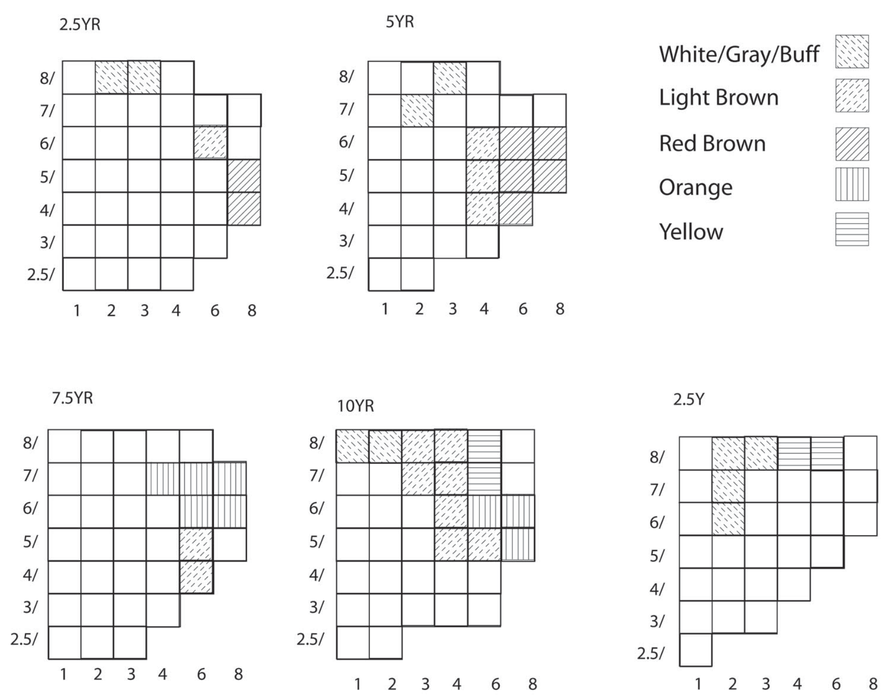


Figure 8.8: Available clay colors on the Taraco Peninsula (from Munsell color of dry samples).

Clays will fire to different colors in an oxidizing atmosphere depending on their parent materials. Raw clay color does not always correlate to the fired clay color, as the oxidation process will affect the coloring. The iron content of the clay will only have an effect after organics are oxidized and eliminated. Residual clays may fire to darker and redder brown colors, whereas alluvial sediments often fire lighter and less red buff colors (Beck 2007). Clays may have carbonaceous material such as humus or fibers depending on the depositional process. Once the organics have been eliminated the iron compounds begin to be oxidized creating a suite of colors depending on the chemical state of the iron, with ferric (fully oxidized) iron (Fe_2O_3 such as hematite) becoming red or reddish brown, while iron in the ferrous state (sulfides, carbonates and silicates) becomes gray, bluish, greenish or gray-brown (Rice 1987: 335). While the color of the fired clays can indicate composition and help match clays to ceramics, this process can also aid in noting the firing temperature and firing atmosphere of the ceramics themselves.

When raw clay is heated, a number of complex changes occur (at varying rages depending on the clay mineral and the presence of fluxes) creating irreversible changes to the clay. As heat is first applied, water contained within the crystal structure of the clay minerals is driven off. This loss of water effectively destroys the crystal lattice and the clay begins to shrink. When the clay reaches higher temperatures, sintering begins and the edges of the clay particles soften and then start to bond together. Oxidation then begins to act on the impurities of the clay body, primarily the carbon and iron compounds. The final stages, not present in low-fired Late Formative ceramics, consists of vitrification, or the formation of a glassy, liquid phase, and the crystallization of new minerals.

The important point is that this process can be "restarted" through application of heat. "After a clay has been heated to several hundred degrees Celsius or above and then cooled, the physical and chemical transformations its constituents experience will be halted or frozen at the point of maximum heating. These processes will not be resumed upon reheating – thus continuing to alter the properties of the sherd – until this temperature is exceeded" (Rice 1987:427 see also Shepard 1985: 217-222). It is possible to isolate the relative firing temperature at the moment of the most dramatic shift in color and hardness, both aspects that have been successfully applied in various other case studies (Curet 1993; Hammond 1971; Mills 1993; Zedeño 1994). These studies have also noted that firing atmosphere can be reconstructed from changes in color. For instance, clays that normally (in an oxidizing atmosphere) are reddish or buff in color may fire brown in incompletely oxidizing atmospheres (Shepard 1985: 221).

I followed a similar procedure for firing both the clay samples and re-firing the ceramics. The same team that worked on the subjective tests joined me in creating 10 briquettes from 10 clay samples, measuring 9 by 3 centimeters and 0.9 centimeters thick, representing the full color and textural variability of the sampled clays (Kaplan et al 1982; Neff et al. 1992). These briquettes were fired for 48 hours at 100° Celsius in order to rid the briquettes of any water trapped within the clay matrix. The briquettes were then notched with needle-nose pliers into ten evenly sized chips. I clipped 10 evenly sized chips of 15 ceramic sherds representing all Late Formative ceramic pastes. Surface colors, core condition and sherd thickness were all recorded for these ceramic chips prior to re-firing. These attributes were recorded individually on each chip, to account for possible variability across the larger complete sherd. Surface hardness, another typical trait to record in such investigations was not noted. The variability of inclusions on the surface and cross section of the sherds made it difficult to determine the hardness of the fired clay matrix.

I used a Lindberg furnace in possession of Dr. Michael Manga (UC Berkeley Department of Earth and Planetary Sciences) to fire the clays and the ceramics in 4 series of 100°C intervals from 500 - 800 °C. Following the working assumption that the maximum temperature of a traditional open fire would be held between 5 and 20 minutes (Rye 1981: 98; Shepard 1985: 84; Nieves Zedeño 1994), each sample was warmed up in the furnace to its intended temperature, was held for ½ hour, then was allowed to cool within the oven for ½ hour. This process was employed to avoid any rapid cooling or heating that may cause implosion. The shifts in color of the ceramics and the oxidation colors of the Taraco raw clays were then noted using a Munsell color chart. The re-fired sherds and the fired clays were then organized by temperature and color to see if any similarities could be found between clays and the re-fired sherds (Nieves Zedeño 1994: 49).

The re-firing of the ceramics suggests a fairly low firing temperature for most of the ceramics, with most varying in the range of 550 to 650 °C (Figures 8.9, 8.10). For a few samples the color shifts of both the surface and cross sections were too slight to note, and no estimated firing temperature was possible. The firing atmosphere for several of the ceramics was also clarified, in that brown sherds fired in an oxidizing environment became much redder in color. The important point here is that these firing temperatures are well within the range of dung firings (see Chapter 7), and all these ceramics appear to have been oxidized or incompletely oxidized as would be expected with dung firings.

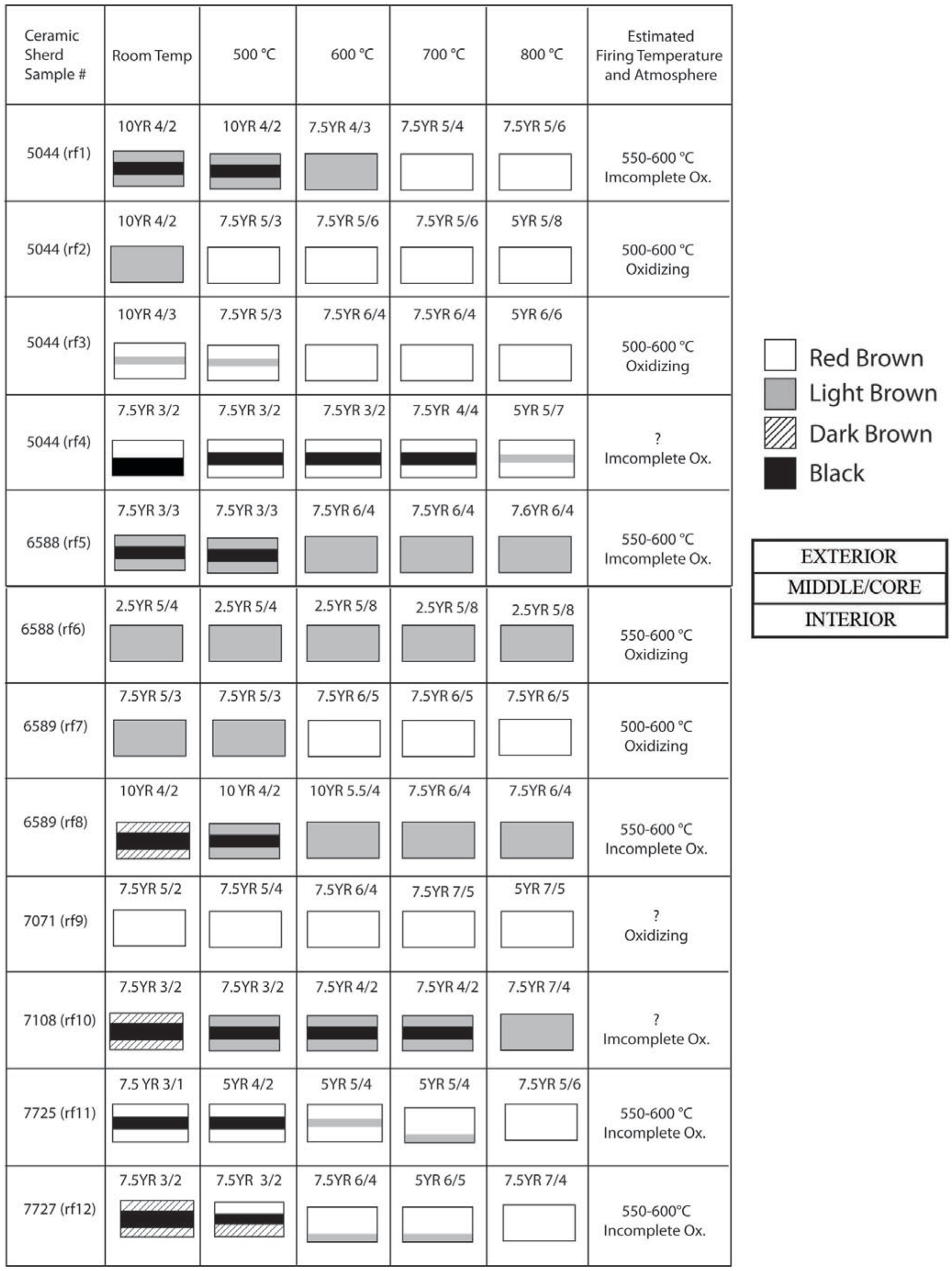


Figure 8.9: Re-fired Late Formative sherds from TAP excavations with estimated firing temperature and estimated atmosphere. Note that all colors were taken from the darkest portion of the sherd core.

Sample #	Room Temperature (Clay color group)	Post 700 C (TAP ceramic color group)
57	7.5YR 6.5/4 (light brown)	5YR 5/6 (red brown)
78	2.5Y 7/2 (grayish/white/buff)	10YR 7/4 (cream slip/ light brown unslipped)
85	5YR 4/6 (red brown)	5YR 5/6 (red brown)
103	10YR 5/8 (orange)	2.5YR 4/7 (red brown)
159b	7.5YR 6.5/8 (orange)	5YR 5.5/6 (red brown)
170	10YR 7/4 (light brown)	7.5YR 6/6 (yellow cream slip/light brown unslipped)
188a	2.5Y 8/2 (grayish/white/buff)	10YR 7/4 (cream slip)
228	2.5Y 8/6 (yellow)	7.5YR 5/7 (yellow slip)
231	2.5Y 8/2 (grayish/white/buff)	10YR 7/4 (light brown unslipped)
234	5YR 5/4 (light brown)	2.5YR 6/6 (red brown)
296	5YR 4/6 (red brown)	5YR 5/6 (red brown)
297	5YR 4/6 (red brown)	5YR 5/8 (red brown)
302a	10YR 5/6 (light brown)	5YR 5/7 (red brown)
333a	10YR 4.5/6 (light brown)	7.5YR 5/6 (light brown)
356	5YR 4/4 (light brown)	5YR 5/8 (red brown)

Table 8.1: Fifteen clays subjected to experimental oxidation analysis with their clay color group and the color assigned the TAP ceramic analysis. Preference is given to unslipped color categories, but in some cases slipped colors are a better fit, and are therefore included.

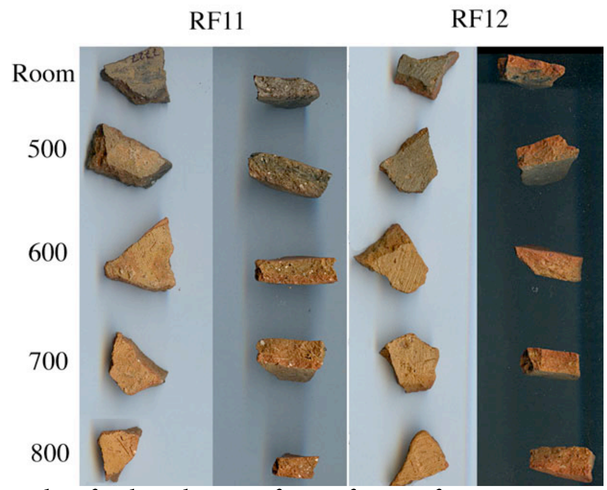


Figure 8.10: Example of color changes for re-firing of two Late Formative ceramic sherds. I estimate that RF11 was likely fired at approximately 550 °C, and RF12 at 500°C degrees.

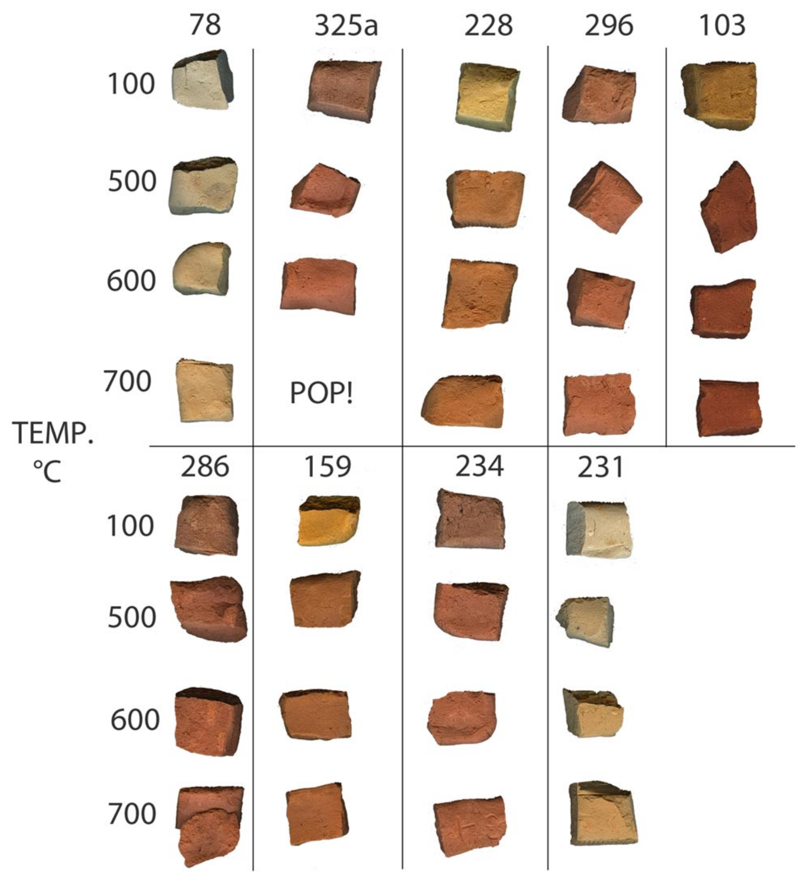


Figure 8.11: Firing test of Taraco clay materials. Note that the 325a and 286 would have needed temper, as they imploded at higher temperatures.

The collected clay samples oxidized to groups that were very similar to many of the ceramic matrix colors and slips. There was a fair amount of correspondence, particularly in the red-brown ceramic groups (Table 8.1; Figure 8.11). The colors of the fired clays are associated with a number of the ceramics, perhaps most intriguing for future study is the close correspondence between the white/buff raw materials (78 and 231 in Figure 8.10) and pastes 5 and 6. I noted the presence of red minerals, which define paste 6 from paste 5, in the re-fired clays as well. As mentioned in Chapter 7, these pastes are noted throughout the region, and this finding suggests that these clays may be the material used elsewhere in the Titicaca Basin. Other samples fired to colors not associated with Late Formative ceramics. For instance samples, clays 78,188a, 228 all fired to lighter colors, Munsell designations associated with slips employed during the earlier Middle Formative Period. Another important point concerns how the clays handled the heating process. Although I carefully controlled the warming up and cooling down process, some of the fine clays free of inclusions imploded in the firing process (Figure 8.11). Formative potters must have learned of this danger (both physically and to the ceramic themselves) during peripheral participation in becoming enskilled in pottery production.

In summary, oxidation analysis suggests that Late Formative Taraco ceramics were low-fired between 500 and 650 °C. The firing of the clays demonstrates that Taraco potters had sources of buff, brown and red-brown and orange clays to choose from. Some of these clays fired to approximately the same color as the buff wares (paste 5 and 6). This technique is clearly a productive way to see pastes, slips and (possibly the original) slip colors. In the future it would be beneficial to re-fire many more sherds to clarity original oxidation colors and to clearly examine the cross section (this would also be beneficial prior to making thin sections). While the earlier subjective analysis suggests that the clays would have been useful for potting, it is worthwhile to achieve a more empirical idea of what types of resources were likely available to Late Formative potters. In order to investigate this, more detailed methods are required.

8.3 X-ray diffraction

I now to turn to examine a suite of geochemical and mineralogical approaches I applied to further characterize the ceramic materials, beginning first with x-ray diffraction (XRD). We have seen that the local clays exhibit good plasticity and fire to similar colors. In this section I employ x-ray diffraction to define the nature of the locally available clays. In the geological sciences x-ray diffraction is recognized as a primary methodology for characterizing clays. Archaeologists have utilized XRD to analyze the temper fraction of pottery when it is too fine grained for macro inspection. Others have identified the high temperature crystalline phases in pottery to investigate firing temperature and fabrication methods (Heimann 1982; Philpotts and Wilson 1994). All these scholars note that variations in particular phases help to track shifts in potter's mixtures, use of different clay sources or the presence of imported wares.

Low-fired ceramics, such as those analyzed here, are typically complex mixtures of clays, carbonates, SiO_2, and regionally variable silicates. The detailed mineralogy of any given ceramic sample depends on the chemistry of both the starting clay recipe and the firing temperature, but also the length of time the ceramic was fired and the amount of oxygen in the firing environment. One reason that XRD is not used more frequently in archaeology is that clays undergo alteration during firing, becoming amorphous or forming new minerals, which makes a reconstruction of the original compositions off the ceramics somewhat more difficult (Eiland and Williams 2001: 876-877). With these constraints in mind, I employed XRD to 1) attempt to link local raw materials to fired ceramics and 2) empirically define the mineral composition of local resources for both defining technological choice based on performance characteristics, and 3) set the foundation for future wider studies of available potting materials.

8.31 XRD: Principles, methods and sampling

XRD relies on the scattering of x-rays by the electron charge clouds surrounding atoms in a crystal. Stacked planes of atoms within the crystal can diffract x-rays if Bragg's law is satisfied:

$$\lambda = 2d \sin \theta$$

Where λ is the x-ray wavelength, d is the interplanar spacing generating the diffraction, θ is the angle between the planes of spacing d, and the incident and also the scattered beam. Constructive interference or a "Bragg reflection" is obtained when the path of the wavelet scattered of the lower of the two planes is longer by an integer number of wavelengths. The "angle" of the diffraction is related to the interplanar spacing [d] by the Bragg law, and the intensity of the diffraction maximum is related to the strength of those diffractions in the specimen. The angles are intensities of the diffractions are recorded electronically using a detector, and a resulting plot of 2-theta (horizontal axis) vs. intensity/counts (vertical axis) for the specimen. This pattern gives a diagnostic "fingerprint" for a given crystalline phase. I assigned diffraction patterns by using software that draws on the Inorganic Crystal Structure Database, which runs a Poser Diffraction File database with diffraction patterns of more than 50,000 materials.

The phases likely to present within archaeological ceramic materials are quite limited, which simplifies search procedures. However the background noise is often quite significant in these samples.

The samples were characterized by a PANalytical X'Pert PRO powder diffractometer equipped with a conventional x-ray tube using Cu–Kα radiation (λ = 1.5406 Å). This machine is set with a fixed divergence slit in order to deal with low 2Th angles, and was set to a 0.5° slit angle. The diffractometer is equipped with a specimen-spinning device to rotate the specimen in its own plane to give a larger irradiation area and reduce particle statistics problems. The starting 2-theta angle was set at 3° and the ending 2-theta to 50°. In some cases researchers set their ending angle higher, but most pottery and clay analyses demonstrate that the diagnostic patterning occurs between 15° and 45°. I extended the run time to 100-theta (a 25 minute run time) and did not notice any other additional phases or precision in peaks.

The peak positions, intensities, widths and shapes of diffractograms all provide important information about the structure of the material. The shape of diffracted line profile depend on the axial divergence of the x-ray beam, the particle size and/or micro-strain of specimen, the monochromaticity of the source, and the degree of data smoothing employed in processing the raw data (Jenkins 1999: 57). Peak height may be due to factors intrinsic to the mineral under study (for example the development of the crystal structure), or simply be a result of the way the specimen is mounted.

The evaluation of crystalline phases was carried out using X'Pert HighScore Plus software, which includes the Powder Diffraction Standards (JCPDS) data bank. JCPDS holds the single-phase x-ray powder diffraction patterns in the form of tables of the interplanar spacing and relative intensities ($_{I}/_{I1}$) characteristic of any particular compound. The software follows the steps of data collection, smoothing, background subtraction, α_2 stripping, peak location, 2θ calibration and the calibration of d (as discussed in Jenkins 1999).

A total of 15 clays and 7 ceramics were explored using this system of analysis (Table 8.2). The ceramic analysis, however, was soon found to be inappropriate for characterizing the plastic component of the ceramics (as discussed below). The clays analyzed consisted of 9 samples from the Taraco Peninsula, including one from an excavated floor context. I also included 2 samples from Tiwanaku and 4 samples from the hills surrounding the site of Khonko Wankane. The reason for broadening the sample was in order to begin to judge the variability outside of the Taraco Peninsula proper. Put bluntly, if there is no variability between these areas, further work using XRD to characterize raw materials from the Southern Titicaca Basin would be pointless.

I followed the sample preparation steps described by Moore and Reynolds (1997) under the guidance of Tim Teague of the Department of Earth and Planetary Sciences at UC Berkeley. Powder samples were prepared by grinding down the ceramic and clay samples using an agate mortar and pestle. The particles should be finer than .062 mm to avoid mineral fractionation. The sample was then brushed into the cavity of a small (~3 cm in diameter, .5 cm deep) sample holder. The purpose of the brushing is to obtain an even distribution and to minimize preferred orientation of the particles. Once the holder was filled with powder, I used a roughened glass slide to pack the sample into the cavity. This packing must be firm enough so that it will not fall out, deform, or slide, but not so firm as to cause preferred orientation on the opposite surface (which later became the top surface). I then attached a clip to the back of the holder. The glass cover was carefully lifted with a slight twisting motion to break and surface adhesion. This was done with great care, as it was the surface exposed to the X-rays (see Moore and Reynolds 1997: 204-226 for more).

A subset of clays was investigated using a more detailed system to separate and isolate the clay fraction of the collected samples. In this case, clays were put in suspension: the powdered sample was mixed with ionized H20 and allowed to sit for 24 hours. The clays still in suspension after this time, were dripped onto a paper filter, and then transferred onto a 1 inch diameter glass slides and allowed to air dry. This entire process both separates non-clay inclusions such as quartz and feldspars, and produces oriented clay samples with much sharper diffraction peaks.

Since this preparation often results in peaks that may include several clay minerals, I treated a subset of the clay samples with ethylene glycol to shift the clay diffraction peaks. After running the samples through the XRD detector once, several clays were then saturated with an ethylene-glycol vapor bath for 24 hours and subsequently analyzed by XRD. Glycolated samples were analyzed within one hour after removal from the vapor bath. This glycol isolates swelling clays (smectites, some mixed-layer clays and vermiculite) from the other clay minerals being investigated, specifically separating the [001] planes of both montmorillonite and chlorite, each of which have characteristic d-spacing of 14 angstroms. After exposure to the glycol vapor, the measured d-spacing for the smectite’s [001] plane expands 17 angstroms, enabling it to be differentiated from that of chlorite, which remains at 14 angstroms. Unfortunately the size of the exported samples made this process impossible with the analyzed ceramics. I sampled sherds specifically that were appropriate size for XRF (see below), and discovered that larger volumes were needed for the glycolation. Future work should attempt the levigation and glycol treatment.

SAMPLE	CATEGORY (Paste or Color)	XRD ANALYSES
BS-54	Pottery Sherd (1)	Powder mount, 2-theta 3-40°
BS-53	Pottery Sherd (1)	Powder mount, 2- theta 3-40°
BS-71	Pottery Sherd (3)	Powder mount, 2 -theta 3-40°
BS-50	Pottery Sherd (3)	Powder mount, 2-theta 3-40°
7707-6	Pottery Sherd (6)	Powder mount, 2-theta 3-40°
BS-52	Pottery Sherd (9)	Powder mount, 2-theta 3-40°
BS-65	Pottery Sherd (18)	Powder mount, 2-theta 3-40°
79	Clay Taraco (Gray/White)	Powder mount, 2-theta 3-40°
81	Clay Taraco (Gray/White)	Powder mount, 2-theta 3-40°
103	Clay Taraco (Orange)	Powder mount, 2-theta 3-40°
218	Clay Taraco (Gray White)	Powder mount, 2-theta 3-40°
234	Clay Taraco (Light Brown)	Powder mount, 2-theta 3-40°
296	Clay Taraco (Red Brown)	Powder mount, 2-theta 3-40°
122	Clay Taraco (Light Brown)	Suspension/glycol saturation 2-theta 3-40 and 3-100°
333b	Raw Clay Taraco (Light Brown)	Suspension/glycol saturation
KUAC	Floor Clay from MF architecture	2-theta 3-40 and 3-100°
TIA RIVER	Tiwanaku Clay	Suspension/glycol saturation
TIA AKA	Tiwanaku Clay	2-theta 3-40 and 3-100°
KL-P8B	Khonkho Clay	Suspension/glycol saturation
KL-P4B	Khonkho Clay	2-theta 3-40 and 3-100°
KL-P7E	Khonko Clay	Suspension/glycol saturation
KL-P11	Khonko Clay	2-theta 3-40 and 3-100°

Table 8.2: XRD tests used on the clay and ceramic samples. Note that in some cases various runs were conducted.

8.32 XRD results

The results of the clays and pottery results are shown in the diffractograms of Figures 8.12 and 8.13. The first round of analyses consisted of the powder mount analysis on the pottery and clays. Since I returned to do more detailed work with the glycol-treated clays, let me begin with the pottery. In the ceramic samples, seen in Figure 8.11, I found clear evidence of quartz and mica (muscovite) with some low intensity peaks of plagioclase (albite) and hematite. Not shown in this figure are the small peaks, thought to present deflated clays, which are present in the buff pastes (5/6). It should be noted that there is considerable noise in these diffractograms, and residuals show that peaks have not been fitted well at various angles. This is a common problem in analyzing heterogeneous samples such as archaeological ceramics.

I used quartz as a built-in internal standard to compare other peaks since the crystalline structure of quartz does not accept atomic substitutions, thus is easy to remove such peaks from consideration (Moore and Reynolds 1997: 227). Quartz's strongest peak is at 26.65 2theta, so if this was present I checked the 20.85 2theta position where the second more intense peak occurs. One unidentified peak occurs at approximately 10.5 [2th] in both samples bs65 and bs79. Table 8.3 shows the top three intensity peaks for the identified minerals. When viewed in tandem with Figure 8.12, these data suggest that the quartz grains and their associated sharp diffraction peaks, and large area (subjectively speaking) are masking any other variation in the ceramic samples.

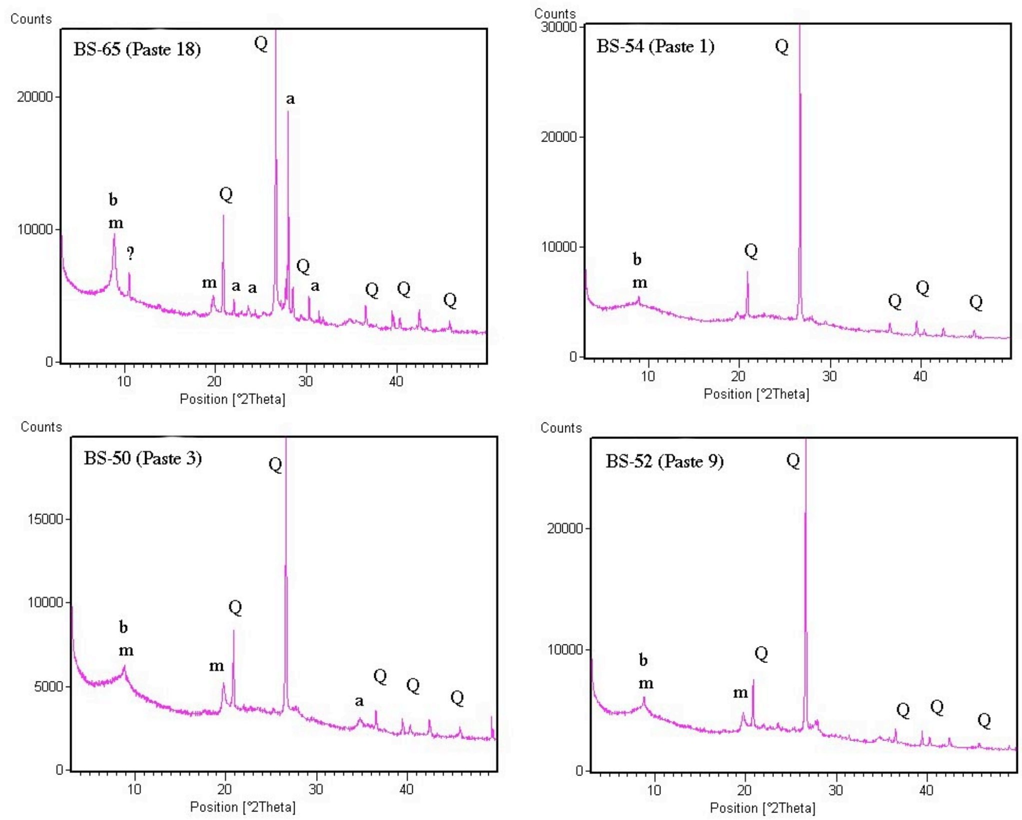


Figure 8.12: Examples of x-ray diffraction analysis, plotted in diffractograms, of four TAP samples. Note the small, undeveloped peaks, with the exception of the high intensity Quartz peaks. Q=Quartz, b=biotite, m=muscovite, a=albite.

Phase	d [Å]	2th [°]	I [%]	Glycol effect
Quartz (Low)	3.34	26.6	100.0	
	4.27	20.9	20.8	
	1.82	50.2	14.0	
Muscovite	10.11	8.7	100.0	
	4.49	19.8	89.2	
	3.37	26.4	78.0	
Biotite	9.94	8.9	100.0	
	2.62	34.2	38.9	
	3.31	26.9	29.4	
Albite	3.21	27.8	100.0	
	3.18	28.0	64.0	
	4.04	21.9	52.0	
Hematite	2.52	35.6	100.0	
	3.68	24.1	2.6	
Montmorolinite-Chlorite	14.50	6.1	100.0	expands to 17 Å
	30.50	2.9	50.0	
	9.70	9.1	20.0	
Illite	10.0	8.84	35.0	
	5.0	17.7	30.0	
	4.47	19.9	100.0	
Kaolinite	7.14	12.39	100.0	
	4.36	20.36	41.6	
	2.49	36.0	38.4	

Table 8.3: The d values, 2-theta position and relative intensities of XRD-peak patterns of some common phases of the analyzed clays and pottery. Intensity is an integer of energy ($E= {}^{6.199}/_{d_{hkl}\ \mathrm{Sin}\ \mathrm{theta}}$). Note that many of the 2th [°] positions lay near superimposed on one another. The first three peaks are listed from the X'Pert HighScore Plus software by level of intensity, however it should be noted that quartz had the highest intensity in many peaks, and hematite only has 2 peaks above 1 in intensity. Finally some 2th positions shifted during my work as a copper tube was switched out for a cobalt tube.

XRD peaks of archaeological ceramics tend to be difficult to interpret, specifically because pottery often consists of a mixture of different clay minerals plus clastics and a variety of accessories (Hughes et al. 2002; Rice 1987: 385). Heat treatments at various temperatures are commonly used to help identify clay minerals by revealing changes in crystal structure spacing, or structural breakdown. Depending on the temperature and the specific mineral composition, such treatments can collapse the structure by dehydration, or in the case of other minerals, destroy the crystal structures (see Table 8.4). Such an amorphous mass produces no identifiable peaks on the diffractogram. For instance, Mitchell and Hart (1989) have demonstrated that while kaolinite undergoes little change between 300 and 400 ° Celsius, from 400 to 500° Celsius the peaks begin to disappear and by 600° kaolinite totally loses its structure.

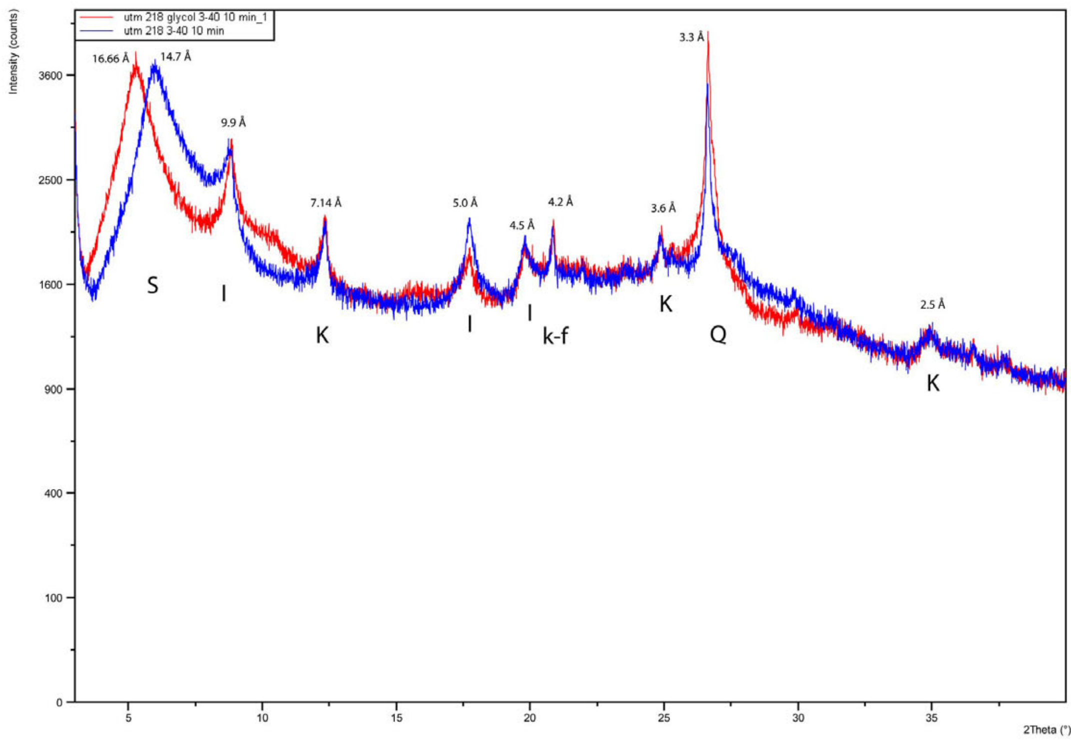
The Taraco Peninsula Formative ceramics were fired high enough to destroy the clay matrix, yet were not fired at a high enough temperature to create the new high temperature phases (Rice 1987: 385). As we saw above (section 8.22), our pottery was likely fired above these temperatures, thus destroying any remains of these clays. Note that the XRD analysis was conducted prior to the re-firing study. In the future, only those ceramics deemed to be low-fired should be subjected to XRD analysis.

Kaolinite	400°C +
Calcite	400°C +
Montmorillonite	400-500°C
Halloysite	400-500°C
Illite	350-600°C
Chlorite	500-550°C

Table 8.4 Temperature at which point select clay minerals undergo structure collapse or destruction due to dehydration (from Nutting 1943 and Ross and Hendricks 1945).

The analysis of the clay was more revealing. The untreated Taraco clays exhibited peaks around 6 2θ that range in d spacing from 14.66-14.94 Å (Figure 8.12). When treated with ethylene glycol, the 6 2θ peaks shifted to approximately 5.2 2θ with a d spacing of 16.66-16.96 Å. This is well within the range expected for the smectite group of clays (Moore and Reynolds 1997: 241-243). The presence of montmorillonite is not surprising, as it erodes from limestone, which is widely present on the Taraco Peninsula.

Another important clay peak seen in the Taraco clays is at around 12.4 2θ at approximately 7.13 Å. This is the pattern for kaolinite, which undergoes no substantial changes through the glycolation treatment. Finally, there appears to be some illite found in the samples (although since distinguishing micas from illite is difficult, this may also be muscovite). In addition to these clay peaks, there are a number of other minerals found in both the powder sampled and those that had been put in suspension, including potassium feldspars and plagioclase feldspars, and in several cases some hematite. Most notable is that all of the tested Taraco clays have almost entirely the same diffraction peaks. Since this was a qualitative, rather than quantitative analysis, the XRD data does not tell us the relative breakdown of each clay constituent (see Moore and Reynolds 1997 for more).



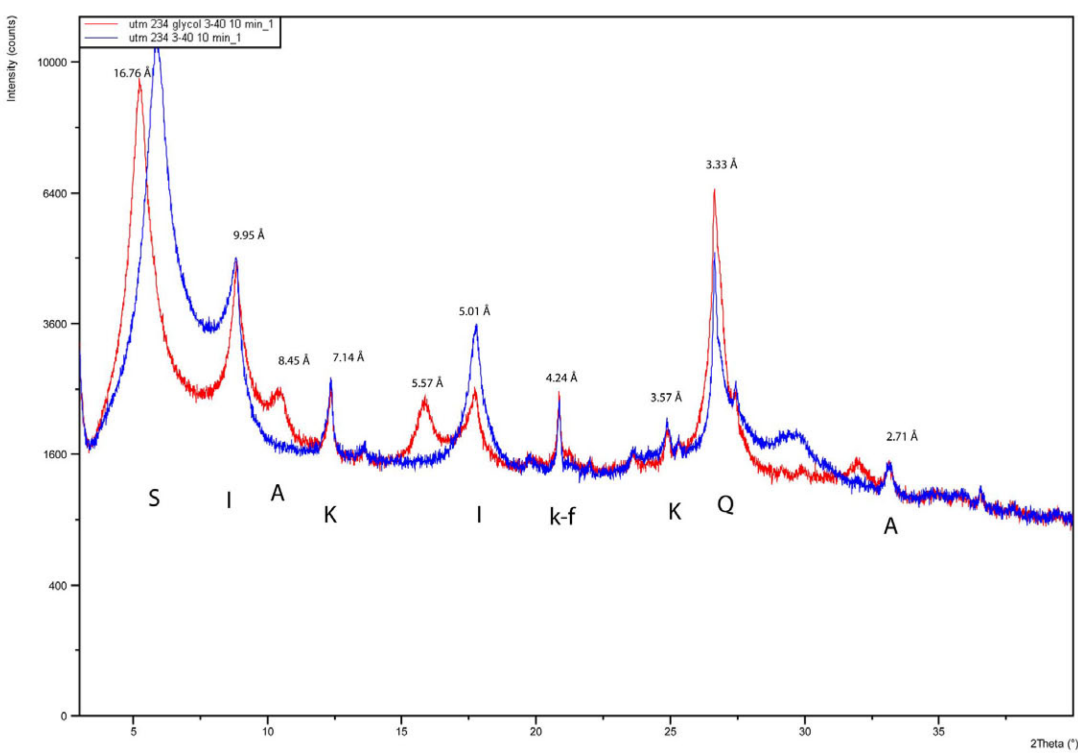


Figure 8.13: X-ray diffractograms for two Taraco clays showing clay phases smectite/montmorillonite (S), illite (I),kaolinite (K) and other phases albite (A), quartz (Q), Potassium Feldspars (k-f).

The materials used for the surfacing of floors have similar XRD peak patterns as the local clays – not surprisingly, since the local clays show little mineralogical variability. When I compared these peaks to the samples taken outside the Taraco Peninsula I found similar patterns. For instance the clays collected from around the site of Khonkho Wankane also contained the same montmorillonite, illite mix. However, most Khonkho Wankane clays are not as rich in smectites, and have much more intense illite peaks. While intensity does not correspond to quantity, the subjective tests found these clays to be much lower in plasticity. On the Taraco Peninsula it would make sense that the aplastics are purposefully added rather than being natural inclusions, but the clays collected around Khonko Wankane appear to have more inclusions and are less plastic. These clays, if used in Late Formative production sequences, offered a different foundation, perhaps encouraging a different series of technological choices. Specifically Khonkho Wankane potters may have employed a different tempering regime, if tempers were necessary at all. I have not had the opportunity to conduct detailed examination of ceramics from this region, but future comparative studies may be revealing.

In summary, it is unclear from this analysis what *specific* clays were employed in the making of Late Formative vessels. As Rice (1987: 385) suggests, XRD is best suited to the clastic inclusions of the pottery. The analysis of TAP ceramics clearly shows a bias towards the large crystalline grains in the sample, and likely represents the aplastic components of the temper. However, if local clays were being employed unaltered, potters were using a mix of montmorillonite, illite and kaolonite. Montmorillonite clays swell with the introduction of water, so Taraco potters would have created solutions to the problems associated with clay shrinkage in order to produce successful vessels.

In the future it would be beneficial to experiment with the use of local clays and locally available sand sediments. I have conducted a re-firing of clays with various proportions of sand for the oxidation analysis and for future petrographic purposes (see below), but have not yet performed XRD on these samples. Taraco potters' recipes almost certainly contained clays such as kaolinite or illite, which on thermal decomposition produce quartz plus aluminum-bearing accessory phases (Carty and Senapti 1998). There has been good documentation of the structural changes that occur in firing clay minerals (Starkey, Blackmon and Hauff 1984), which allows us to work backwards from the XRD pattern of fired sherds and fired clays and put some constraints on the original mineralogy clay matrix of the pottery.

Another future project could employ XRD to track firing temperatures by observing the mineralogical effects on clays at different temperatures. After firing their clays to 850°C, Douglass and Schaller (1993) found their kaolonite peaks were eliminated, whereas their montmorillonite and illite peaks were greatly attenuated. Through comparing these clays with their analyzed pottery, they found the peaks corresponding to the clay minerals on the x-ray patterns on the potsherds displayed a nearly identical degree of attenuation as compared to the peaks on the fired raw clay samples, suggesting that the archaeological pottery had been fired at approximately 850° Celsius (Douglass and Schaller 1993). Such a process may be of use to add further detail on the firing temperatures defined through oxidation analysis.

8.4 Geochemical approaches

Geochemical approaches, including x-ray fluorescence (XRF) and instrumental neutron activation analysis (INAA), and the mineralogical technique of optical petrography, were employed to answer three specific questions relating to the paste variability. First, do the paste groups that TAP ceramicists employ have analytical and chemical reality? Second, is it possible to distinguish paste recipes across the sites using XRF? Finally, following up on the XRD, can we track the relationship between the locally available raw materials and Late Formative ceramics? Each of the techniques I employed offers a slightly different perspective on these three questions, however when combined, these data can offer important insights.

8.41 XRF: Principles, methods and sampling

X-ray fluorescence has been a popular analytical method for compositional analysis since the 1960s, and is a fairly standard geochemical approach for ceramic materials. Although the technique is most often employed with obsidian and metals, there have been quite a number of successful applications to pottery (for example Adan-Bayewitz et al. 1999; Poole and Finch 1972). In XRF, the primary x-rays are produced by an x-ray tube or radioactive sources. An x-ray tube has an anode made from a metal that emits x-rays efficiently when bombarded with electrons. The produced x-rays displace electrons from the inner orbits of atoms, and electrons from outer levels fill these energy levels. The energy released is in the form of secondary or fluorescent x-rays with wavelengths from around 0.1 to 50 Angstroms, which is equal to the specific difference in energy between the two quantum states of the electron. With energy dispersive x-ray fluorescence, analyzer can measure the fluorescent x-rays emitted, and determine the elements present and their relative concentrations.

I primarily employed portable energy dispersive x-ray fluorescence (p-ed-xrf) in this study. These units have two advantages for geochemical studies of cultural heritage in international settings: 1. They are non-destructive and 2. They are portable. I used a Niton Xlt 793 with the software set up to analyze the energy spectrum for 20 elements (Ti, Mn, Fe, Zn, Rb, Sr, Zr, Mo, Ca, K, Pb, Cu, Ni, Se, As, Hg, Co, Cr, V, Sc). After employing several tests with the unit, we found an optimal time of 240 seconds is an ideal exposure time for pottery sherds. A series of ceramics were imported for this non-destructive analysis, along with a small subset that underwent destructive analysis (XRD, INAA and petrography). Ceramic sherds had to be at least 1x2 cm in size, since this is the size of the window of the portable unit. A total of 153 tests were conducted on the ceramics and 55 tests on the clay and sediment samples were analyzed using this technique (see raw data of all 2008 samples in Appendix 3). I sampled the micaceous sherds (1,2,17 and 18) because they make up the bulk of the Late Formative assemblage. These sherds also tend to be non-decorated, facilitating the exportation process and meaning that I did not need to account for high iron content caused by the iron oxide slips. I included a small number (n=10) of pastes 5/6, paste 3 (n=33) and 9 (n=11) and a few Middle Formative ceramics from the site of Chiripa. I also ran XRF on the sediments and clays from the Taraco Peninsula and Tiwanaku, and on mixtures of the clays with the collected sands. Finally, several of the samples from the site of Khonkho Wankane were included.

At the time that this project was initiated, little research had been published using portable units in archaeological settings (Appoloni et al. 2001; Roldan et al. 2004; Morgenstein and Redmount 2005), but in the last 5 years there has been a surge in interest. Due to their increased popularity, there are some important issues and particular problems related to the use of portable XRF machines. First, the irradiation intensity is low therefore the analytical precision can sometimes be worse than standard instruments. Second, the beams on portable XRF machines also tend to have small diameters (often only several millimeters wide) limiting spatial resolution (Pollard and Heron 2008: 39).

While these issues did not seem to be a factor in this study (see below), one more problematic issue concerns scanning a non-homogenized sample. Unlike trace element XRF analysis, in non-destructive analysis ceramics are not ground up and prepared in powdered glass beads. As such, the portable units irradiate a particular part of a sherd, and it is likely in some cases that these small parts are not representative of the entirety of the sherds. Since I had resolved to examine the Late Formative samples by INAA as well, whereby the samples are homogenized and trace elements are recorded, these limitations were not of great concern. However, to alleviate any possible issues I took several steps: I always did the analysis on the non-slipped component of the sherd, and I ran analysis on different parts of sherds, both exterior and interior surfaces. My results were compared with the results of an analysis on a subsample of my sherds with a QuantX EDXRF in Dr. Steve Shackley's XRF lab on the Berkeley campus. As Appendix 3 demonstrates, this small study demonstrated consistent results. Nevertheless, as seen below, the nature of the mineralogically heterogeneous paste recipes of the Late Formative resulted in a particular type of XRF patterns.

8.42 XRF results

Of the 20 elements recorded by the portable XRF unit, only 10 elements were found within detection limits (Ti, Mn, Fe, Zn, Rb, Sr, Zr, Ca, K, Pb) (Appendix 3). This is to be expected, as clays are hydrous aluminum silicates with substitutions in the crystalline structure of Mn and Fe ions. The high density of micaceous inclusions could easily increase K, Rb and Fe. As was made evident in the XRD discussion above, potassium feldspars are present in the local environment. Calcium is found in many of the feldspar and clay groups, and strontium often substitutes for it. In fact, since strontium goes into solution easily and is not as complex as calcium, I pay particular attention to this element (as have others conducting ceramic XRF studies) along with iron, rubidium and manganese.

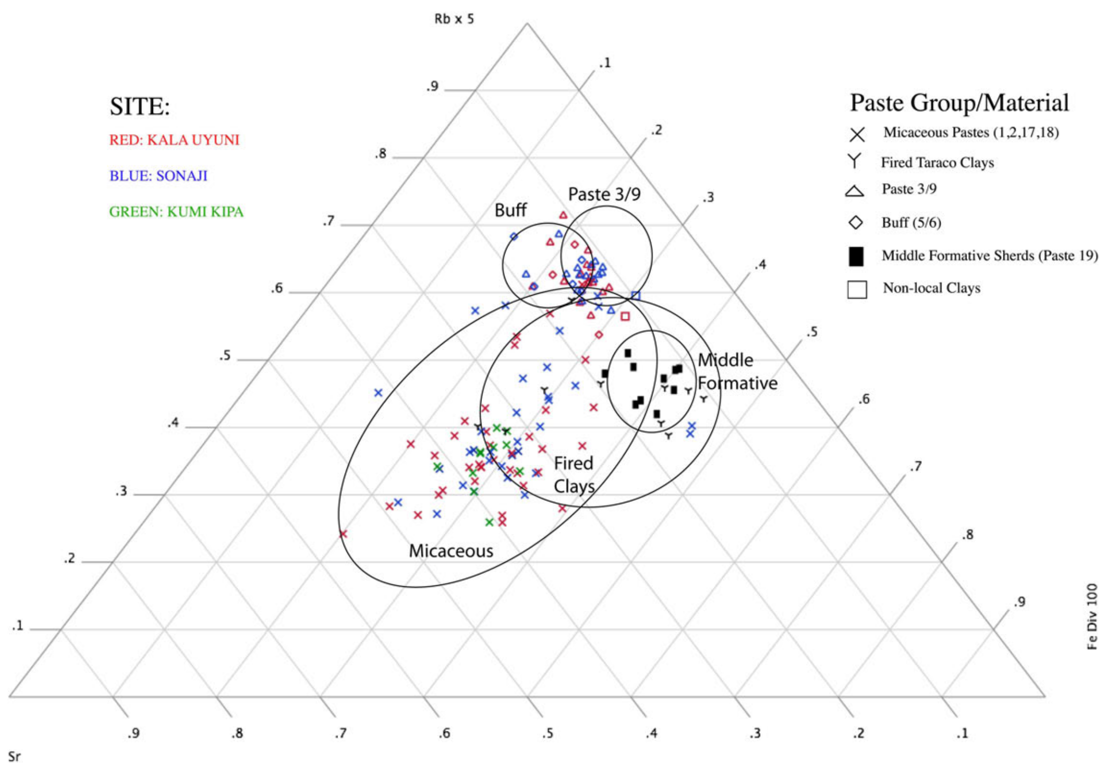


Figure 8.13: XRF ternary plot (Sr, Fe, Rb) of all ceramics and fired clays. Note that the Middle Formative ceramics are fairly distinct, as are the other paste groups, although those without inclusions do not separate out.

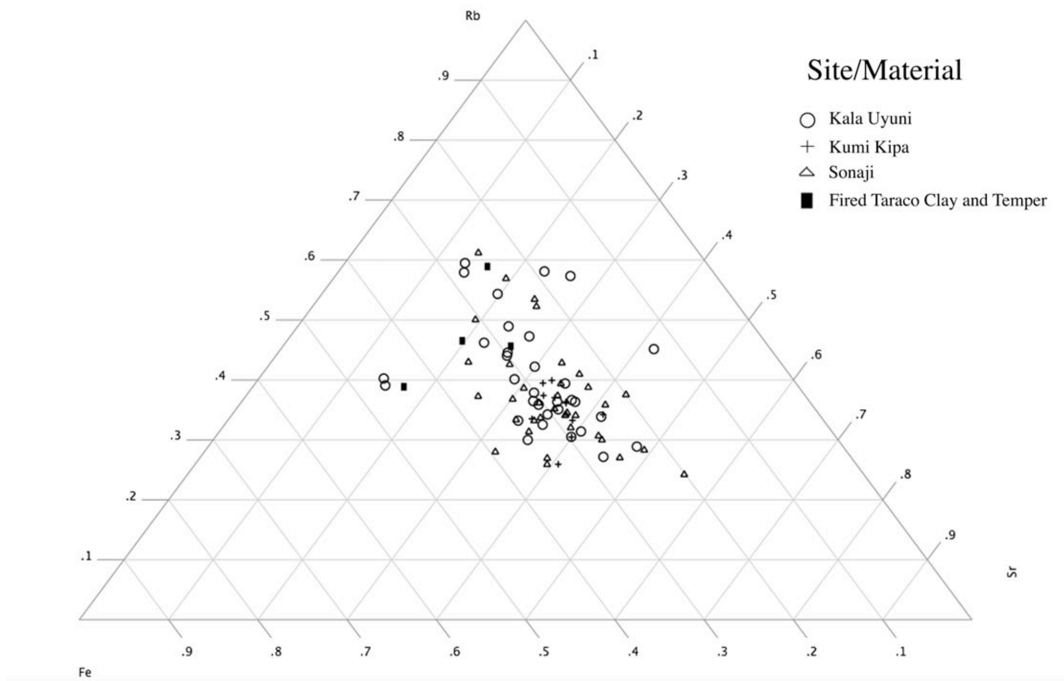


Figure 8.15: XRF ternary plot (Rb, Fe and Sr) of micaceous ceramics and fired local clays.

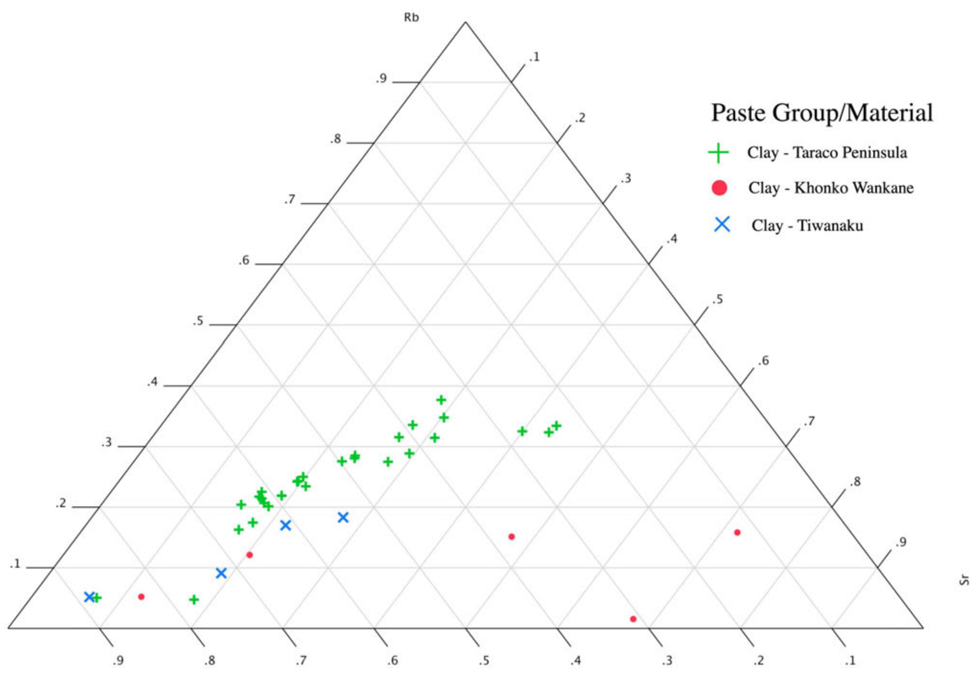


Figure 8.16: XRF ternary plot (Sr, Mn, Sr) of Taraco clays as compared to modern potters samples from Tiwanaku and from resources near the site of Khonko Wankane.

The ternary plots of the archaeological ceramics appear to plot fairly closely to the paste groups used by TAP. An initial plot of all the paste groups, including the internal variability within the micaceous group (pastes 1, 2, 17, 18) which are defined macroscopically be the roundedness of inclusions, presence of fiber temper and the density of mica vis-à-vis other inclusions. Significant chemical distinction was found neither within the large micaceous group, nor between sites. When I grouped all the micaceous materials together, and compared them to other pastes, earlier ceramics and local clays, I found that they still plotted by inclusions and not by site (Figure 8.15).

If we compare the fired mixtures of locally collected Taraco clays and sands to the micaceous ceramics, we find that they plot well within the archaeological samples. A similar series of ternary plots were produced for variability within paste groups 3 and 9 with no variability between sites found. In fact, the only variability was found between paste groups (and from the Middle to Late Formative samples), but even here no distinct spatial variability was noted. Portable XRF effectively tracked distinction between the mineral inclusions, basically confirming distinctions that were visible through the 10x hand lens. The portable XRF was somewhat more productive in clustering the local Taraco clays apart from Tiwanaku clays and even more so from Khonko clays (Figure 8.16).

The issues of tempering materials is not confined to using the portable XRF unit, as the analysis of 50 samples using Dr. Shackley's QuantX found similar patterning. This analysis suggests that while XRF is attractive to archaeologists due to its portability and non-destructive nature, it may not be appropriate for heavily tempered ceramics. A more detailed effort on just the compact/buff pastes (5 and 6), which are found throughout the southern Titicaca Basin, is planned for the future.

8.43 INAA

I also conducted a small pilot study of neutron activation on the Late Formative materials. With neutron activation analysis it is possible to produce multi-element analyses with detection limits at the parts per million (ppm) level. In INAA some of the elements in the sample are converted into artificial radioactive elements by way of irradiation with neutrons. This bombardment results in the transformation of some elements into unstable radioactive isotopes. These isotopes have characteristic half-lives with unique, measurable gamma rays that serve to identify them. There is one short irradiation through a pneumatic tube irradiation system and a long irradiation for a total three gamma counts (Glacock 992; Neff 1992). After the long irradiation, samples decay for seven days then are counted on a high-resolution germanium detector. This middle count determines seven medium half-life elements (As, La, Mu, Nd, Sm, U and Yb). After three or four more weeks of decay, a final count is conducted measuring the half-life of Ce, Co, Cr, Eu, Fe, Hf, Ni, Rb, Sb, Sc, Sr, Ta, Tb, Th, Zn, and Zr (Galccock 1992; Neff and Glascock 1997).

A total of 110 samples, including 96 ceramics (focusing on the non-decorated ceramics) and 14 clay samples, were submitted to the Missouri University Research Reactor (MURR), where they were prepared by way of standardized procedures (Glasock 1992; Hays 1994). I included samples from both the compact paste groups (5 and 6) and the micaceous sand group. The raw data is presented in Appendix 3. These samples are still being interpreted, and will be discussed in greater detail, within the context of a larger regional sample, in the near future.

Preliminary findings appear to support the XRF findings. I am exploring the homogenized samples (which were crushed to a fine powder for both short and long irradiations) based on the 33 elemental concentrations, although Ni was eliminated from the data set because too many values were missing from the analysis. Scatter plots and principle component analysis suggest that the samples are clustering based on temper density, thus are not distinguishing specific sources. Future work should focus on the compact pastes from a more regional perspective, as it appears that neutron activation, like XRF, will be define particular distinction in the less tempered samples. For both the compact pastes, and the micaceous sherds, optical mineralogy may prove to be especially useful.

8.5 Optical mineralogy

This final methodology I employed is extremely important given the issues of heterogeneity of the Taraco Peninsula paste recipes. I used petrography to characterize the mineralogy of the aplastic inclusion of the ceramic samples. Petrographic analysis uses polarized light to study samples ground to a thickness of 30 microns. Minerals can be identified by their optical properties including transparency versus opaqueness, color, pleochroism, refractive index, relief, morphology and cleavage angles. When examined under crossed polarizers properties such as transparency, birefringence, extinction angle, zoning, twinning, undulose extinction and anomalous polarization can all be used to identify minerals (See for example Kerr 1977). Archaeologists have found that the type, quantity, and angularity on mineral inclusions can help distinguish the origin of particular raw materials (Stoltman 1989; Whitbread 1991). Petrography is relatively inexpensive, and has been successfully employed in a number of studies exploring production and exchange (Day 1998; Dickinson and Shutler 1974; 1979, 1990). More recently, petrography has proven to be an important corrective to chemical approaches (Stoltman and Mainfort 2002; Stoltman et al. 2005). Nevertheless petrography remains "one of the most under-utilized analytical techniques of proven value" (Stoltman 1989: 147).

There has been very little work done on petrography in the Andes (but see Druc 1998; Hayashida 1995,1998; Ixer and Lunti 1991), and even less in the South Central Andes. Only Sergio Chávez and Karen Mohr Chávez have applied this technique to pottery of the Titicaca Basin (Chávez 1992: 84-96, Mohr 1966). Karen Chávez' early work at Chiripa applied petrographic analysis in order to answer some similar questions that plague the Late Formative: how pastes change through time, whether temper classes correlate with forms and whether there is intra-site differences in temper. Mohr Chávez had defined five temper classes through using a 10x hand lens (no visible inclusions, with grass, quartz, quart-mica and mica/sand), which changed subtly through time (see Steadman's work in Chapter 6).

Her petrographic work was guided specifically to confirm previous hand lens observations and to quantify and identify the non-plastic inclusions. Were the mineral and rock fragments in the paste really tempering materials intentionally selected and added by the potters or were they inclusions in the original clay? Could local manufacture be confirmed? How did Chiripa paste and temper compare with non-Chiripa pottery? Finally, Mohr wished to provide an objective standard for the comparison with other pottery-yielding sites (Mohr 1966: 23-24).

Although Mohr Chávez and geologist Frederic Layman conducted this work over forty years ago, no one has followed up on this research since. My goals and questions are virtually the same; although for Late Formative materials, with an important difference – I have conduced the raw materials survey that Mohr Chávez insisted was necessary. The petrography presented below is a preliminary step towards a more detailed study to be performed in the future that will integrate thin sections of re-fired local materials.

8.51 Petrography: Principles, methods and sampling

Thin sections of 18 sherds were prepared by Tim Teague of the Department of Earth and Planetary Sciences at the University California, Berkeley. Thin sections were made using a gem saw to slice narrow sections of the sherd, which was then consolidated with a polymer to secure the grains in the paste to prevent them from being destroyed. The section was then glued to a glass slip and ground to 0.03 mm thickness. The thin sections were examined using a Nikon Eclipse E600 petrographic microscope, with a Digital Sight 5M camera attachment, at the Berkeley Archaeological Research Facility. A series of texts and mineral atlases (Kerr 1977; MacKenzie and Adams 1994: Philpotts 1989) were used to help identify the minerals.

Originally I had planned to conduct a detailed point count analysis. While basic point counts have been conducted, the sample size of 18 remains much too small. At the time of writing, several more slides were being produced, which will be analyzed in the future. These data (including ternary plots of the quantitative mineralogy) will be reported at a later date. The approach here was primarily to utilize the descriptive observations to further corroborate the variability seen in the geochemistry discussed above. The qualitative technique employed here used standardized reference charts to describe sphericity (Adams et al. 1984) and the estimate compositional percentages (Terry and Chillinger 1955; Woods 1991).

8.52 Petrography results

Quartz (SiO_2) was found in abundance in all Late Formative ceramics. This is to be expected, as quartz occurs naturally in most rocks and unconsolidated sediments, and does not easily break down with erosion, but does weather (with changing sphericity) and into smaller sized particles. The nature of the quartz was essential in distinguishing paste 1 from paste 2, and paste 17 from paste 18. Both plagioclase and alkali feldspars are found in the Taraco ceramics. Plagioclase Feldspar ($CaAl_2Si_2O_8$ or $NaAlSi_3O_8$) is found in volcanic, metamorphic and detrital rocks. Plagioclase can alter to kaolin, or through metamorphic processes, to epidote (Ehlers 1987: 151), both of are native on the Taraco Peninsula (section 8.1). Alkali Feldspars ($NaKAlSi_3O_8$) are found in igneous and metamorphic rocks. The Late Formative pottery studied here has the microcline variety. Biotite ($K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$) is the most common micaceous element found in many of the paste groups, and is prevalent in igneous (granites, diorites, gabbros and perodites) and metamorphic environments (volcanic and plutonic rocks) (Elhers 1987: 177).

<u>Pastes 1, 2, 17 and 18</u>

Quartz was found in great variety in the 5 slides made from pastes 1 and 2. The pastes have quartz in the coarse (1.6-.575 mm), medium and very fine sizes (.425-0.025 mm) range. The quartz is not well sorted, and is found in sub-angular, and rounded grains. In the previous chapter I distinguished this paste based on the angularity of the inclusions, noting that paste 1 was generally angular to sub-angular and paste 2 generally sub-rounded to round. Based on the results of the qualitative analysis, it appears to be the case. There are real divisions in the nature of the quartz in these sherds (Figure 8.17 and 8.18). Future work would benefit from examining this variability in a quantitative fashion to examine whether this varies with other mineralogical distinction. Biotite is found in these samples, although varying in density. In some cases the biotite is weathered. In other samples the mica is so severely altered it appears to split, or open up (see Figure 8.20 for an example in paste 3). This is due to either the firing process, or, more likely, from metamorphic processes. Other minerals found in these pastes include feldspars, a small number of amphiboles (specifically hornblende) and rock fragments.

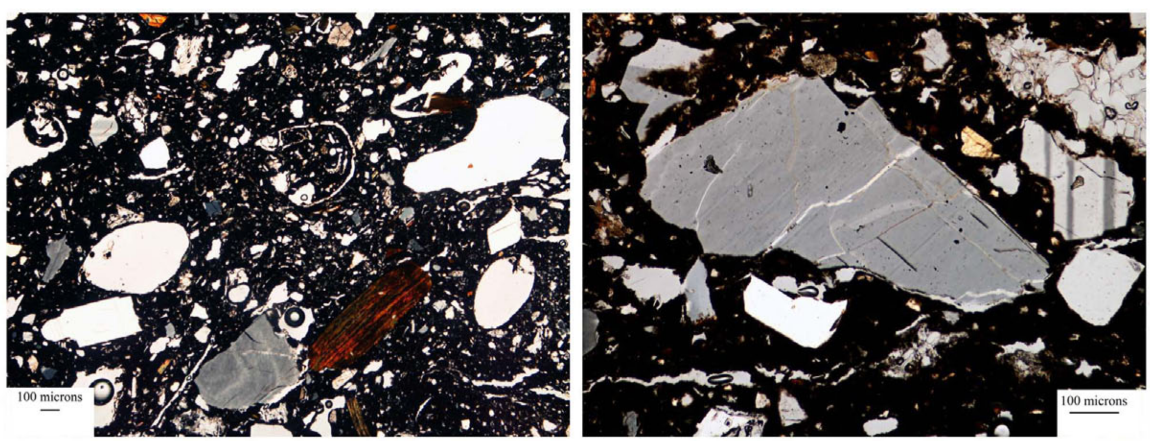


Figure 8.17: Paste 1. On the left (4x, xpl) showing large quartz and biotite inclusion, on right (10x, xpl) angular quartz fragment.

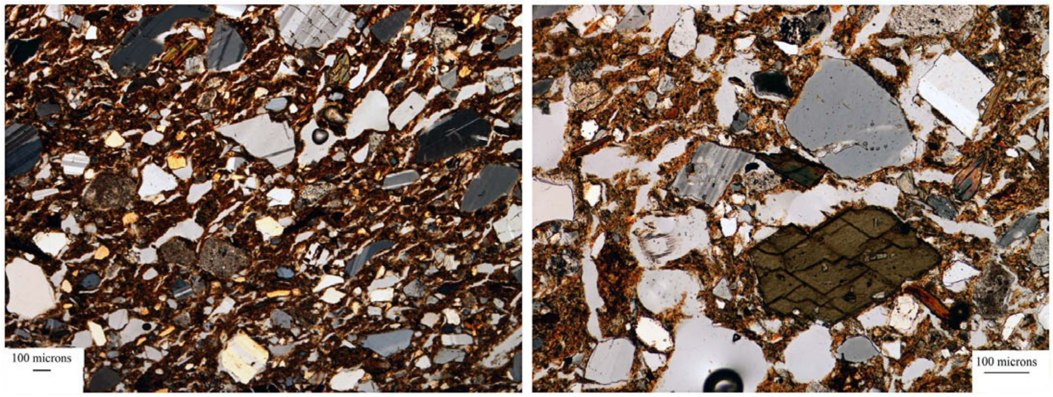


Figure 8.18: Paste 2. On the left (4x, xpl) showing typical paste 2 composition of quartz and feldspars. On the right (10x, xpl) of semi-rounded quartz fragment and hornblende.

The six slides analyzed for paste 17 and 18, much like pastes 1 and 2, were characterized macroscopically by the presence of micaceous sand and were distinguished from one another by the angularity of the inclusions. Paste 17 has semi-rounded quartz inclusions instead of the more angular inclusions found in paste 18 (Figure 8.19). Both include the fiber tracks from grass temper . The void spaces make up a significant percentage of the sherd space in some cases. These voids are probably from *Stipa ichu*, locally very common on the Taraco Peninsula (see section 7.21).

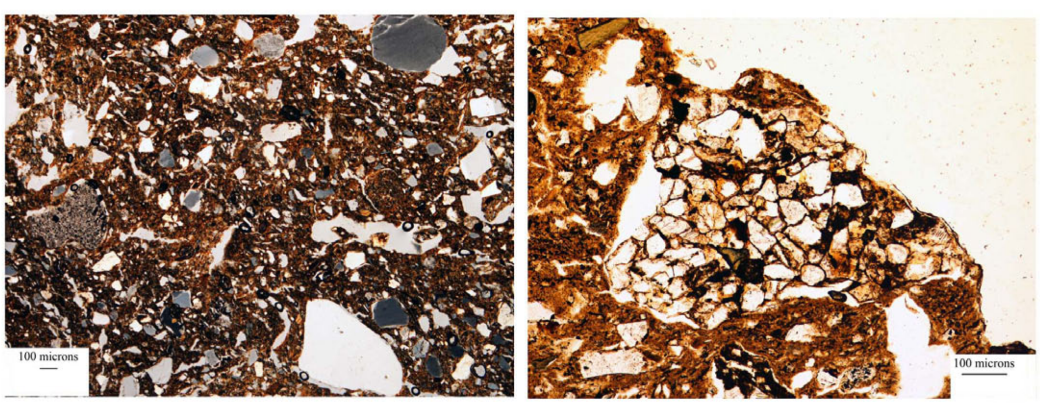


Figure 8.19: Paste 17. On the left a typical paste 17 (4x, xpl) with fiber tracks and rounded quartz fragments. On the right (10x, xpl) a crushed rock fragment.

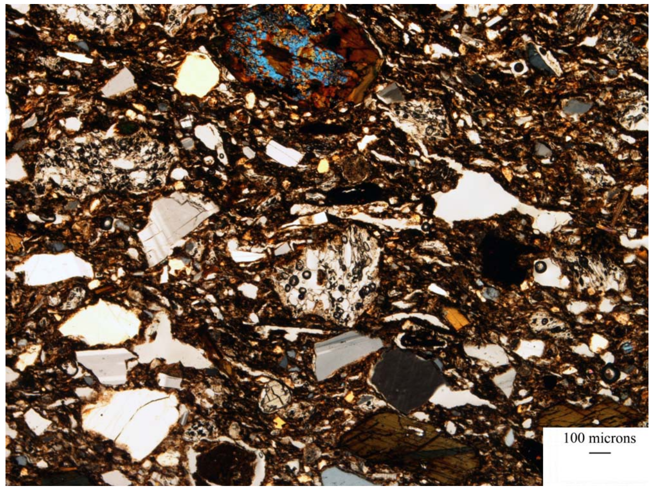


Figure 8.20: Paste 18. A view (4x, xpl) of paste 18 with angular inclusions including biotite (in lower right corner), quartz and amphibole (hornblende) in the top center.

Were the micaceous elements of Late Formative ceramics added tempers or were they natural inclusions? Layman, who conducted the petrography at Chiripa for Karen Mohr, offers some helpful perspective here. He suggests that for the Middle Formative ceramics, rock and mineral fragments larger than 25-30 microns were likely added by potters. His three justifications are worth presenting in full: "1. These larger fragments in general have an unaltered, clean appearance, in contrast to the character of the minute, non-clay mineral constituents (chiefly quartz) occurring in the matrix material; hence the larger fragments were probably not an original constituent of the clay. 2. Many of the larger fragments are angular to subangular, suggesting that they had been crushed intentionally. 3. The mineral-rock suites are diverse, in contrast with the essential homogeneity of the clay matrix material." (Layman and Mohr 1966) Following this logic, sandy inclusions were almost certainly intentionally added as temper. I noted two types of quartz in my analysis, one that is severely weathered, sub-rounded to rounded in shape, and another with distinct borders is more often sub-angular to angular, much like Layman's description.

Paste 3

Paste 3 is defined through the hand lens by its speckled white inclusions (Figure 7.7). Under the petrographic microscope this paste was revealed to be full of pumice, or volcanic ash (discussed below). In some cases the rest of the matrix was remarkably clean of other inclusions, potentially suggesting an intensive sieving process, or simply use of a naturally well-sorted material. In some cases the sherd includes a few well-sorted and very round quartz inclusions. This suggests that no sand was added to this material. The extremely weathered and small quartz suggests that the clays were sedimentary, much like those found throughout the Taraco Peninsula. In rare cases, however, there are other inclusions such as biotite fragments and more angular quartz (Figure 8.21). The small presence of such inclusions may be due to natural mixing at the source of the material, or perhaps from accidental mixing of other materials while preparing the materials for production. It is unclear at this time whether the volcanic ash was added as temper, or if the clay was collected with the ash. As there have been few other petrographic studies in the Lake Titicaca Basin, it is difficult to ascertain if volcanic ash is used in other Late Formative communities of potting practice. However, Karen Mohr Chávez' (1992) detailed ethnoarchaeological work at Raqch'i, near Cuzco, found modern potters using volcanic ash from the nearby volcano for tempering purposes.

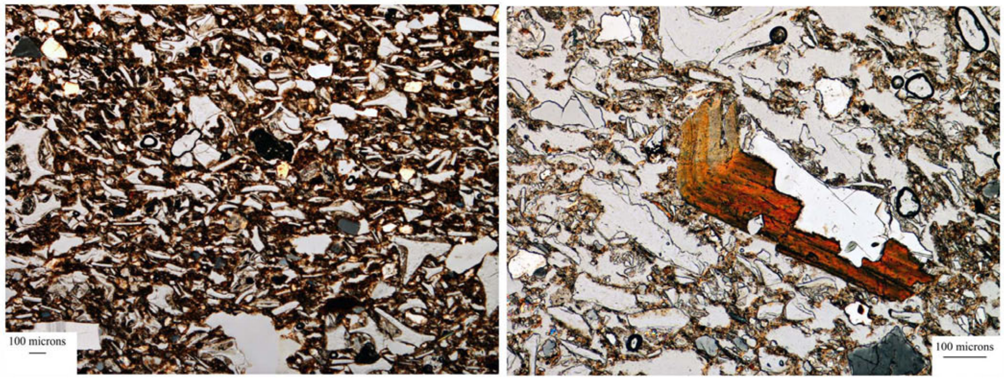


Figure 8.21: Paste 3. On the left (4x, xpl) showing the characteristic bone shape of volcanic ash, or pumice. On the right (10x xpl) showing some rare biotite embedded in the volcanic ash.

Paste 5 & 6

Paste group 5 and 6 was much finer in texture, although some inclusions were noted (Figure 8.21). Hematite (Fe2O3) is also found, albeit in low quantities as a diagnostic element of paste group 6. This red mineral is found in a wide variety of soils, and is a significant authigenic component of clay fractions (Allen and Hajek 1989). In fact, hematite was noted in some of the collected clays from the Taraco Peninsula, and an examination of re-fired raw clays suggests that these are the same materials. Thin sections of the re-fired clays are currently in preparation.

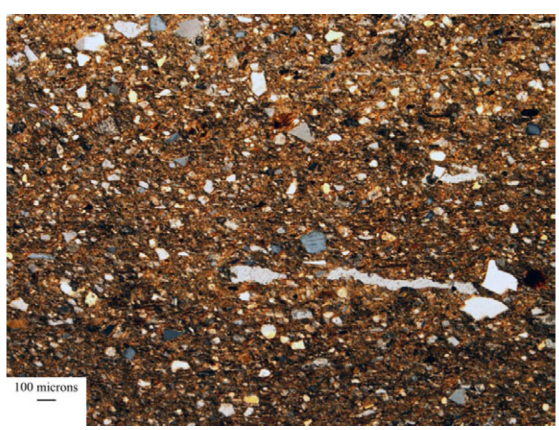


Figure 8.22: Paste 5. Note the fine and well-sorted quartz and feldspar inclusions (4x, xpl).

In summary the qualitative petrography performed on a small sample of the various diagnostic pastes of the Late Formative have demonstrated that pastes are the result of tempering activity. Following a similar logic that was applied at the Middle Formative site of Chiripa, I can conclude that inclusions are added (likely after first being crushed up) to Late Formative ceramics as tempers. The preliminary work suggests that further more detailed analysis is warranted. Lee Steadman has a collection of Middle Formative thin sections that have yet to be analyzed from the site of Chiripa. Significantly some of these include pastes that carry on through the Late Formative. It would be revealing to see how particular communities of potters choose (and prepare) their tempers through time, and whether there are any mineralogical signs of new sources being exploited. A larger sample of other pastes from nearby Late Formative sites is also necessary. If tempers are moving throughout the Titicaca Basin, as I will suggest in the next section, petrography is an ideal fashion to track these movements and, in turn, the local communities of practice.

8.6 Tempers, clays and *meaningful* technological choice

There are many other types of evidence that suggest tempers, in particular micaceous tempers, are being accessed and perhaps exchanged throughout Titicaca Basin prehistory. Ponce noted in his excavation field notes that mica was associated with several burials at the Kalasasaya structure at Tiwanaku (Janusek personal communication). More recently several excavations have encountered examples of what appear to be ceramic workshops that include micaceous sediments. Donna Yates' 2004 excavations at Tiwanaku, in the area to the west of the Akapana, found patches of mica associated with a surface rich in domestic debris, including both fine polychromes and domestic wares and smoothed sherds likely used for finishing vessels. In her excavations in the specialized ceramic production workshop area of Ch'iji Jawira (see section 8.1 for more details), Rivera Casanovas also found sheets of biotite, some measuring up to 10 centimeters in length (Rivera Casanovas 2003: 307).

Bermann's (1990: 425) excavations at Lukurmata also mentions mica being found, along with a range of stone and bone tool production debris on a patio of a Tiwanaku IV structure. Further afield, at the Wari site of Cerro Baúl, Donna Nash and Ryan Williams found a mica deposit associated with a ceramic production area that included tools, clays and other temper sources. These findings, along with the petrographic data, suggest that mica is being collected specifically for the use in ceramic manufacture. It is not clear, however, whether these materials were local, as is often assumed, or was the mica traded from further afield. There are very few other mentions of mica sources in the Titicaca Basin archaeological literature; Lemuz notes the availability of mica in the Santiago de Huata region (Lemuz 2001: 147) and Arik Ohnstad (personal communication) located some in the hills behind Khonko Wankane. I found very few ideal micaceous tempers in my survey. In fact, the best example of micaceous materials was the *chillo* currently being used by modern potters. This material is available on the north side of the Tiwanaku River, just outside of the modern town of Tiwanaku.

I found no ash deposits in my soil survey on the Taraco Peninsula. Although it is certainly possible that the ash used in manufacturing pottery is no longer available (or simply was not visible in my survey), an obvious place where these ashy tempers may have been gathered is the volcanic area to the north of the Taraco Peninsula (Figure 8.1

and Figure 8.23). Mount Ccapia also happens to be a sacred mountain, or *huaca*, in the modern Aymara sacred landscape, and Quechua speaking ritual specialists as far away as the eastern slopes of Peru recognize its importance suggesting a deeper historical ideological significance (Ryan Patrick Williams personal communication). It may well be that this peak was important during the Late Formative, as it appears that the architecture of Tiwanaku and the Taraco Peninsula are lined up with this sacred peak (Benitez 2009). Although future survey and petrography is required to confirm such a suggestion, it does have some resonance with other arguments for the connection between raw materials and symbolic practice.

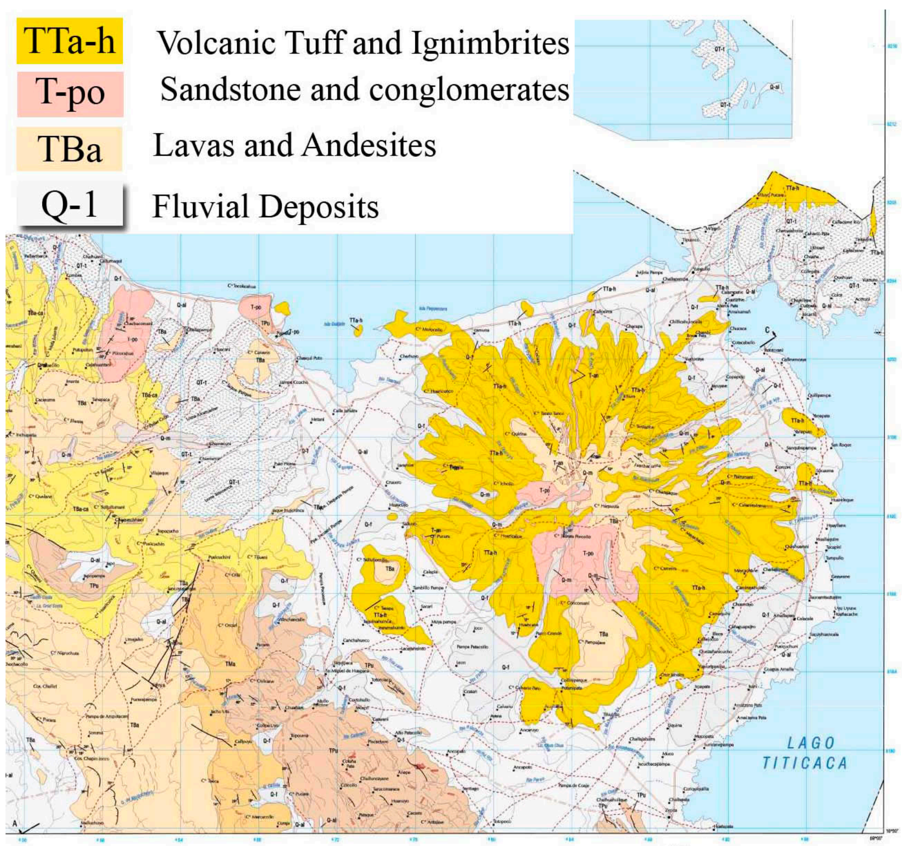


Figure 8.23: Geology of Ccapia region in Peru, just west of the Taraco Peninsula (see Figure 8.1)

Kolata (1993:198-117, 2003: 183-188) has made the argument that the Akapana pyramid, with its transported materials (earth, clay, gravel and cut stones) and complex drainage system, was a sort of simulacrum of a sacred mountain. Kolata suggests that small bluish-greens stones, brought from the Quimsachata and Chila mountains to surface the Akapana pyramid, indexed mountains, converting the Akapana into a productive mountain. "The gravel was…imbued with the spiritual essence of the mountain huacas…This green gravel condensed in one material the symbolic essence of two Tiwanaku sacred elements: mountains and water." (Kolata 1993: 109). It may well be the case that the micaceous tempers and volcanic ash were symbolically embedded in a similar fashion, thus offering particular creative options within the technological sequence. Support for this claim may be found in the simple design motifs of the Formative Period. For instance, Janusek (2003: 55) has suggested that the step-pattern motif that is found in both Middle Formative and the Late Formative zonally incised ceramics is representative of stylized mountains (Janusek 2003: 55; see Beck 2004 for more on what he calls the "primordial-mountain symbolism").

The symbolic importance of particular technological choices may also be reflected in the use of colored clays. As I discussed above, there appears to be a skeuomorph pattern of the red clay banding associated in clay deposits around the Taraco Peninsula. Colored clays appear to have been deployed in particular patterns throughout the Taraco Peninsula. In my excavation of the earlier Middle Formative contexts in the Achachi Coacollu section of the site, I found that Late Formative builders used multi-colored clays as a construction material (Cohen and Roddick 2007). At an earlier Middle Formative site of Kala Kala on the Taraco Peninsula, Robin Beck found a slab-covered burial of what may have been a mummy bundle, with the skull covered in a red mineral pigment (likely hematite) (Beck 2004: 82). He notes that this red is the same color as the flooring surface of the platform mound associated with the architecture of this small site (Beck 2004: 100). Finally, at the site of At Kirawi, Janusek excavated a Late Formative structure, the "Multicolored Building", that used blue gray clay as a foundation, bonded with thin bands of red clay mortar, and yellow clay bricks as a superstructure. Clay, like micaceous minerals and volcanic ash, clearly was more than simply a building material, but rather was a part of a wider symbolic world. A consideration of this inhabited world from the standpoint of the complex materialities of clays and tempers may help in creating a unified narrative contradicting traditional archaeological categorizations (Boivin 2004: 3).

8.7 Summary

I began this chapter with several questions concerning the pastes employed by Late Formative potters. As we saw in chapter 5, environmental variability is one possible reason for shifts in inclusions in ceramic pastes. I presented the survey I conducted to investigate this possibility and to move towards a more definite idea of what can be considered local. The survey and subjective tests clearly show that there is a predominance of good plastic potting clays on the Taraco Peninsula, and these resources were likely available during the Late Formative period. X-ray diffraction shows that these clays are a mixture of montmorillonite, illite and kaolonite. Montmorillonite often naturally occurs with kaolonite, and as Anna Shepard (1985: 377) points out, "even a small amount [of montmorillonite] – as little as 5% - will have a pronounced effect on the properties of a clay, particularly its plasticity".

X-ray fluorescence and neutron activation analysis were employed to study the micaceous ceramics. In the case of the XRF, the density of inclusions created the geo-chemical variation, and clusters were based on paste groups. This was not solely due to the instrumental precision of the portable XRF; as Appendix 3 shows, the non-portable machine offered similar results as other EDXRF machines. Neutron activation data, at this point, is preliminary, but future work will focus on the compact pastes. As Chapter 7 demonstrated, these pastes are found throughout the Southern Titicaca Basin, and defining regional variability would be of great use. Moreover, as these pastes do not have large added inclusions, the homogenization of the pastes for study would be of much greater use.

Although instrumental analyses did not confirm what represents the local, there are other indications, in addition to the primary production areas in Chapter 7, that the ceramics were produced locally. The oxidation study shows that the local clays fire to the similar colors as those of Late Formative ceramics. This, of course, is not conclusive, but is suggestive of possible local clay usage in prehistory, which will be essential for larger regional projects in the future. It is also an important step towards confirming my working hypothesis of a single Formative community of potting practice on the Taraco Peninsula. Future subjective and more quantitative analyses in other regions will help clarify the nature of local production.

I have also clarified some of the steps in the Late Formative operational sequence. The small petrographic study suggests that Late Formative potters were preparing their tempers for their micaceous pastes. Potters sometimes mix clays due to scarcity of quality clay (Chávez 1992), likely an unnecessary step on the Taraco Peninsula. Rather, if clay mixing occurred, it was due to the excessive fineness of these clays. Future detailed petrographic work should attempt to separate other steps in the production sequence. For instance, is there any evidence that the finer clay fraction of paste 6 was prepared through levigation?

So what is the significance of the tempering choices by Late Formative potters? There is reason to believe that particular materials were chosen for more than simply their availability. It may well be that these raw materials were used for more ideological reasons, embedded in greater social traditions, an idea that has been argued for technological choices for later periods. I hypothesized in this chapter that tempering material, including micaceous sands and volcanic ash, was coming from the sacred mountain of Ccapia, across Lake Wiñaymarka. If future provenience work confirms this suggestion, mica and volcanic ash may have been loaded with a variety of significances, a technological style linked to the greater ideological concerns of Late Formative society (Lechtman 1977). Similar significance can be argued for the choice of decoration of red banding. Clays are found in beds of red and light brown deposits, thus it may well be that potters were reproducing a connection to their landscape. Much like Ortman's suggestion that various parts of Mesa Verde metaphorically and linguistically to textiles and pottery, and Gosden's (2006) follow up that skilful practice gave rise to mental representations (section 3.54), the preparation of pastes and decoration of vessels were embedded in a greater taskscape; a potting habitus developed out of this taskscape, but also contributed to greater symbolic relationships.

The production of clay recipes was also likely linked to other skilful practice. I suggested in the previous chapter that the firing of ceramics was likely integrated in wider agro-pastoral activities, an idea reinforced by the firing temperatures noted above. The accessing of clay, however, was also likely embedded in other practices, like the construction of structures. For instance, Goodman has recently noted that the preparation of clay surfaces was likely linked to similar practices as those used for pottery production; an issue that should be studied in greater detail in the future. In the next chapter I turn to examine other possible connections to wider social practice, including the importance of wider consumption practices, in particular the agricultural intensification occurring in the Late Formative, vis-à-vis ceramic production choices.

Chapter 9:
'Framing' Late Formative Pottery: Communities of Consumption

In this chapter I explore the use of Late Formative ceramic vessels on the Taraco Peninsula, and their contribution to greater social and political practice. I examine use categories, focusing in particular on cooking practices, variability in serving forms by context, and the possibility of feasting during the Late Formative. Did producers manufacture and consumers use their vessels within particular use-categories, such as storage, serving and cooking, or was the ceramic assemblage more generalized? Were particular vessels manufactured (or traded in) for use at particular important socio-political events? Can the shifts in pottery manufacture be connected to wider changes in daily life?

The chapter is divided into three parts. In the first part I present recent research on vessel use during the Tiwanaku IV/V and earlier Middle Formative periods. This overview demonstrates that four variables (vessel paste, vessel form, sooting and charring patterns and context of recovery) are essential in defining vessel use. Archaeologists have used these ceramic attributes, along with other types of data, to argue for feasting, and in the case of the Titicaca Basin, political feasting or commensality. Commensality has special relevancy to Andeanists who often are willing (or sometimes not so willing!) participants in modern feasting events. As Janusek points out, "feasting remains a competitive affair in the altiplano. Community leaders and aspiring individuals spare no expense in providing troops of bands and dancers, heaping plates of food, and truckloads of *chicha* [fermented corn beer], beer, and cane-alcohol drink, or *trago*. Their generosity demonstrates *cariño*, 'affection, fairness', and justifies a limited degree of hierarchy and inequality in society" (Janusek 2003b: 267). Feasting is particularly thought provoking to archaeologists, with its rich entanglement of material culture and social practice; we can use various types of evidence (faunal, botanical, ceramic and iconographic) to access an event with all social, political and economic partialities intact (Dietler and Hayden 2001). Researchers at the site of Tiwanaku have made persuasive arguments for large scale, competitive feasting. As we saw in Chapter 2, scholars have projected this practice back to the Formative Period, with ceramics playing a particularly important role in this interpretation. Here I summarize the ceramic indicators employed to argue for feasting for both archaeological periods.

It is from this diachronic vantage point I begin the second part of the chapter. In this section I investigate Late Formative Taraco forms from a performance standpoint, integrating vessel morphology, technological choices, charring residues and the context of recovery. Taking a cue from Steadman's ideas on technological choice and changes in cuisine, I examine the relationship of paste choice to cooking practices, and the spatial variability of cooking vessels. Finally, I ask whether feasting, specifically political feasts, were important during the Formative Period, as suggested by bird's eye Titicaca narratives. Here I draw on the spatial distribution of vessel sizes and decorated serving wares across contexts at the three Taraco sites. I end the second section by considering ceramic patterning through the notion of framing, rather than feasting, as outlined in Chapter 3.

In the third part of the chapter I move my analysis "out of the specialist ghetto" (Fairbairn 2005) by re-integrating pottery with other evidence for shifting foodways. I examine the Late Formative data within context of the greater Late Formative Period changes by considering how ceramic production and use are a part of several communities of practice. I have already presented some evidence for how one community of practice is not isolated from other productive engagements, but rather is part of a wider taskscape. In the previous chapter raw materials were linked to other landscape practices including architectural construction, and to symbolic connections to the volcanic region to the east. In Chapter 7 I proposed that the forming and finishing of vessels might have occurred in patio spaces involving a range of other "domestic" activities. Firing ceramics involved both pastoral and agricultural practices, and I suggested that camelid dung was used to fertilize fields and fire ceramics. The use of Late Formative ceramics is clearly embedded within greater productive agro-pastoral and quotidian practices. I finish this chapter by integrating pottery use with current knowledge about agricultural intensification and changing foodways on the Taraco Peninsula, with the goal of completing (or rather beginning, as I have only scratched the surface) a "thick description" narrative of Late Formative pottery and prehistoric daily life (Cumberpatch 1997, drawing on Geertz 1973).

9.1 A diachronic perspective on vessel use

9.11 Tiwanaku IV/V use categories

John Janusek's work at Tiwanaku has defined several use categories for Tiwanaku ceramics. Drawing on technology, vessel form, context of recovery, as well as Titicaca Basin ethnoarchaeology, he has organized the Tiwanaku IV/V assemblage into a comprehensive use-category typology. These categories include cooking, storage, ceremonial serving, domestic serving and a broader ceremonial vessel category (Figure

9.1). Here I neither attempt to summarize the extensive variability in Tiwanaku vessels that Janusek has defined, nor do I elaborate on the important questions regarding production and consumption during the Middle Horizon. I simply outline Janusek's hypotheses concerning the uses of Tiwanaku IV/V pottery to develop a more diachronic perspective on the Formative period. This summary also allows me to describe the variables used to create his functional categories.

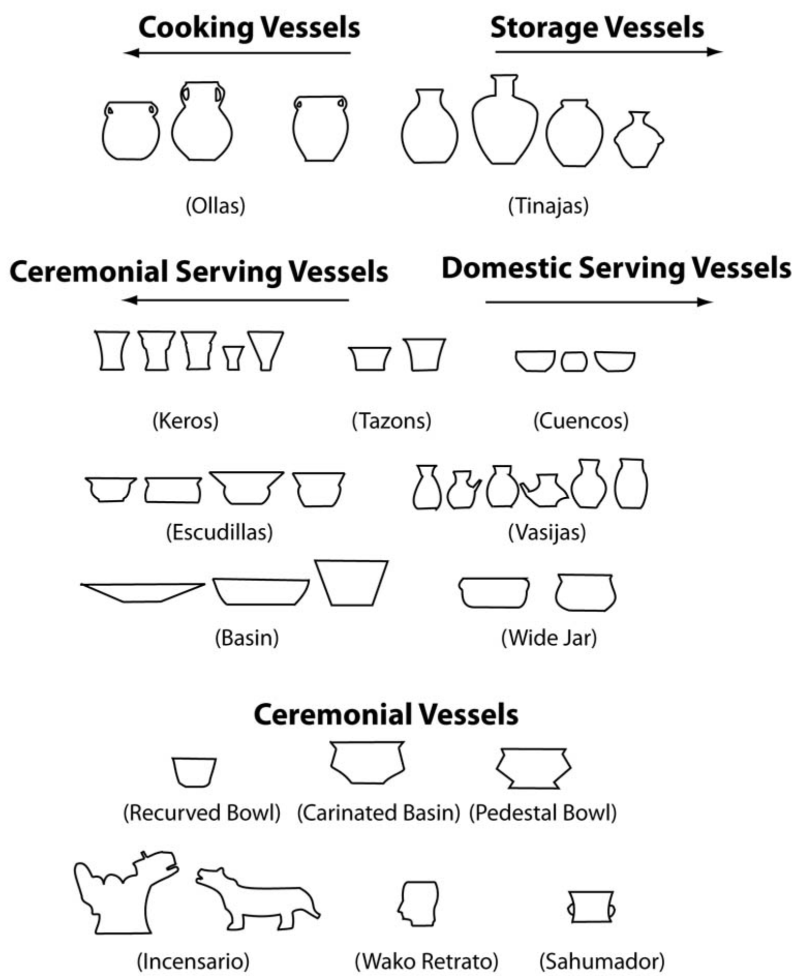


Figure 9.1: Tiwanaku use categories (adopted from Janusek 2003: 57, figure 3.27)

Janusek found that ollas were used for most cooking activities. The most common was usually squat with a wide mouth, short neck, a flat base, and often included vertical handles on the rim. Janusek notes that cooking shapes in general do not change drastically over time, and that these vessels are often "indistinguishable from Late Formative ollas" (Janusek 2003: 58). Although the Tiwanaku IV/V ollas were made with a micaceous porous paste, they were much finer than those Janusek observed for Late Formative wares and are usually burnished (Janusek personal communication). Tiwanaku archaeologists tend to interpret contexts with high percentages of ollas as indicators of cooking and domestic activity (Janusek 2003a/b). Janusek notes that the cooking vessels are not large, with olla orifices generally in the 10 to 18 centimeters diameter range. However several cases of large ollas and cooking vessels have been recovered from special contexts, in some cases almost 1 meter in diameter (Couture and Sampeck 2003, discussed below).

There were several specialized forms that appear during Tiwanaku IV/V phases, including several new bowl forms (*escudillas*), incense burners similar in form to Late Formative forms (see below), large basins and portrait vessels. Janusek notes, in particular, the appearance of specialized storage and serving vessels. Very large jars and *tinajas* were likely used for carrying and storing liquids and for fermenting maize and quinoa *chicha* (corn beer). These vessels were either red slipped or unslipped and were sometimes decorated with elaborate iconography (Janusek 2003a: 59-60). The storage vessels have heavy compact pastes, with very few inclusions, and thick walls. The most emblematic Tiwanaku vessels include the highly decorated *kero* form. Keros are fairly standardized with "clear rules of form and decoration" (Janusek 2003a: 60), and conventionally are about 16-20 centimeters high with an orifice diameter of 12-18 centimeters. The highly decorated *tazone*, also for serving and eating purposes, also appears during this period. Both are found in greater densities in specialized serving contexts.

9.12 Tiwanaku IV/V feasting

Researchers working on the Wila Jawira project (summarized in Chapter 5) have found evidence for feasting throughout the city, including the urban core. John Janusek (2002, 2003a, 2003b) argues that feasting became an essential component of the social and political fabric of both commoner and elite experiences through Tiwanaku phases. Nicole Couture (2002b: 208-209) finds high proportions of large tinajas with long cylindrical necks (see Figure 9.1) associated with the preparation, storage and consumption of *chicha* (maize beer). These vessels, along with new pear-shaped ollas for boiling and cooking large quantities of food (Janusek 2002: 81) were found in association with keros in these locations. Janusek argues that these new forms likely were produced during the later part of Late Formative II and early Tiwanaku IV phases. These containers quickly became conventions of the Tiwanaku state: "These vessels served in everyday use, but their ubiquity and elaborate execution indicate that it was largely their role in public feasts (state or local) that motivated their production and the desire to acquire them." (Janusek 2002: 82).

Feasting is also supported by the spatial distribution of these particular types of vessels. In one area, Akapana East 1, excavators recovered a much higher ratio of decorated tazones and escudillas than in other sectors of the settlement. In some cases, large tinajas were found together with specialized drinking vessels. Both Janusek (2003b) and Couture and Sampeck (2003) suggest that while specialized spaces may have been used for the preparation of chicha, the alcoholic beverage was likely consumed in the larger public spaces. In some cases this involved ritualized smashing of keros themselves (Alconini Mujica 1995). Most feasting contexts had low quantities of cooking vessels, suggesting a separation of space for preparation and serving.

The new forms of ceramics do appear to be associated with maize use, which archaeologists believe was consumed in its liquid beer form. Maize density was highest not in the high status areas, but rather in the periphery of Tiwanaku (Wright, et al. 2003). For instance high densities of maize were found in the Ch'iji Jawira pottery production area (see section 7.11 for discussion of this area). Janusek (2002b: 281) believes that populations with connections to the lower, temperate valleys may have been providing the crop to family and neighbors. He also suggests that maize was being prepared for feasts in specific preparation areas. In one residential compound, Wright et al. (2003) found high kernel to cob densities of maize (suggesting it arrived pre-shelled) and in association with large storage jars. The relationship between maize, its traditional form as a fermented beer, and the accompanying specialized vessels is an essential component to the feasting story, and I will return to it at the end of this chapter.

9.13 Middle Formative use categories

Vessel use during the Middle Formative Period, like the later Tiwanaku phases, has also been investigated by form, technological style and context of recovery. The Formative Period, however, presents new problems. The more fragmented nature of Formative Period assemblages makes it difficult to assess form variability (i.e. we need rim, neck, body and base). At this point it has not been possible to create a ceramic use-category, like Figure 9.1, for Formative periods. In fact an effort may not be useful if there is great local variability. The context of recovery during the Middle Formative rarely presents clear divisions between domestic and public spaces (Dean and Kojan 2001). However we excavated substantial Middle Formative contexts at Kala Uyuni (see Bruno 2007, 2008 and Cohen and Roddick 2007) including a domestic midden area and two sunken enclosures. Steadman's (2007: 73) work at Kala Uyuni recognizes a domestic assemblage, a utilitarian cooking and storage assemblage and a special purpose assemblage. Such a spatial definition is supported by slight variability with different proportions of bowls, jars and ollas in the three ceramic assemblages.

Steadman (2007: 74) distinguishes the domestic and utilitarian (a separate area near the sunken courts) assemblages primarily by the excavators' interpretations but also the higher percentage of sooted and charred sherds in the domestic assemblage. In the utilitarian contexts jars appear to have been used for cooking, with sooted jars found in slightly higher quantities in the domestic midden area. These cooking jars were manufactured with the coarse fiber tempered paste (paste 21, see Chapter 7) (Steadman 2007: 81). The cooking vessels usually have rounded bases and, like Mohr's (1966: 102) findings for Chiripa, tend to have small lugs for helping place the pots on the fire. A slurry of clay or "daubed stucco" was added to the exterior bottom of 18 % of the cooking pots, likely to increase thermal shock resistance (Steadman 2007: 75, after Schiffer et al. 1994; Rice 1987: 230). Cooking vessels were generally plain black or gray, brown or slipped brown. Although Steadman found no evidence for red slipped vessels being used over fire, brown and red-brown slips were quite common.

Without the sooting evidence it is quite difficult to distinguish between Middle Formative cooking and storage vessels. Steadman (1997: 74, 81) suggests unslipped red/brown vessels (often with handles) are associated with serving and storage activities.

Much of this assemblage was burnished, perhaps for functional requirements for both cooking and storage (see below). Medium-necked ollas appear to have served all three functions and span a variety of pastes, slips and sizes. In contrast to the Tiwanaku assemblage, it appears that the choices made concerning paste recipe, surface finish and orifice size may be better indicators for the use of the vessels than the form itself, if potters were even making such distinctions.

The special purpose assemblage is defined by a higher percentage of serving vessels, in particular flat-based bowls, which are always burnished and slipped. Necked vessels are also found, but tend to be red or red brown slipped, manufactured in a less coarse paste. These vessels generally are bigger (discussed further below). There are some specialized forms in this assemblage. Painted vertical sided bowls likely served as incense burners, as made evident from the sooted deposits on the interior of the vessels. In fact vertical sided bowls, which tend to be decorated and larger than other bowls (as discussed further below), seem to be more prevalent in this assemblage (Steadman 2007: 80). These vessels are more likely to be slipped, and while Steadman found red slips to be rare in the domestic/ utilitarian assemblage, it is the most common in the special purpose assemblage. Almost 8% of this assemblage is decorated in the cream-on-red decoration described in Chapter 5 and 7. Finally, more vessels are produced using the dense, translucent quartz and fiber paste (Paste 19, see Chapter 7). In fact, paste choices relating to serving and cooking practices may be quite important during the Middle Formative, as suggested by Steadman's dissertation work in the Northern Titicaca Basin.

9.14 Fiber, Sand and Cooking Practices: A Northern Titicaca Basin Example

In her dissertation on the ceramics of Camata (see Figure 2.1), Lee Steadman (1995) found that Formative potters changed their paste recipes in tandem with their cooking methods. Steadman finds that sooting/charring patterns and changes in form co-vary with the Middle Formative fiber pastes. This evidence is used suggest a shift in cooking techniques through the Formative period. In the earlier phases neckless ollas are produced using sand tempers. These pastes have chunky angular inclusions perhaps for vessel strength and thermal shock resistance, but are formed into thin walled vessels that would have better thermal conductivity (Steadman 1995: 147, drawing on Feather 1989). By the later Middle Formative (Late Qaluyu and Early Pucara in the Northern Basin chronology, Figure 2.2) thick-walled, fiber tempered, slipped ollas are the predominant cooking ware as evidenced in the sooted deposits. These fiber-tempered vessels, like those on the Taraco Peninsula (as discussed above), often include a stucco finish on their base. Steadman believes that potters applied the stucco on the fiber-tempered cooking vessels in order to manufacture cooking vessels that heat foods slowly and that can maintain a constant temperature for long periods of time (Steadman 1995: 150). Nevertheless, by the Late Formative (Pucara 1 phases), potters were once again using sand tempers, this time rarely slipping the pots and never with the stucco finish.

Steadman believes that during the earlier phases mineral tempered vessels were primarily placed over the fire, resulting in fire-blackened and sooted bases. By the later phases, fiber-tempered vessels were usually placed in the fire, resulting in more burned food remains (charring) on interior surfaces, an unsooted oxidized base from the hottest part of the fire, and sooting on the mid vessel wall (Steadman 1995: 151, drawing on

Hally 1983). A rare complete Middle Formative fiber tempered olla appears to have been used for cooking liquid foods, as the vessel had a ring of food residues on the middle of the interior wall suggesting that food was floating at the waterline and was later charred (Steadman 1995: 152; Skibo 1992 150-151). Earlier phase neckless ollas did not have such sooting patterns, and were likely used for cooking solid foods. By the Late Formative Steadman finds that some of the mineral tempered necked vessels are sometimes placed in the fire, but are generally used over the fire.

Steadman believes that these shifts in ceramic technology may be connected to shifts in diet. Stable isotope analysis of charred material from both earlier sand tempered and later fiber tempered vessels found a predominance of C3 plants (quinoa, beans or tubers) rather than C4 (maize) (Steadman 1995: 152). Steadman suggests that changes in diet may have occurred within the C3 plants; starchy seeds that were likely intensified during the Late Middle Formative and early Late Formative may have benefited from mineral tempered vessels that would have made longer, higher temperature boiling more efficient.

Steadman's study of pastes and sooting/charring over three archaeological phases suggests that the history of production and consumption were somewhat different than, yet ultimately connected to, the Taraco Peninsula sequence. Sand tempers at Camata are prevalent in earlier Formative phases, replaced by fiber temper in the later Middle and early Late Formative, only to steadily reappear throughout the Late Formative (Steadman 1995: 145). This local northern Titicaca Basin sand: fiber: sand sequence of technological choices is temporally different than the Taraco Peninsula's fiber: fiber: sand sequence. Nevertheless, Steadman believes that some of these cooking preferences, including the use of fiber tempered pastes and the olla forms are brought over from the southern Titicaca Basin. She finds further evidence for interaction in the similarity between fiber-tempered Polychrome painted/incised ceramics at Camata and the Chiripa black and cream on red painted/incised wares (Steadman 1994: 145-146).

The possible connections, and slightly differing rhythms between different regional versions of ceramic manufacturing techniques are particularly important for considering constellations of learned practices during the Middle Formative. These technological choices, linked to new ways of cooking, were likely learned from within the dynamics of constantly emerging (through marriage, alliances, trade, etc) communities of practice. If pastes are changing on a regional scale due at least in part to shifting cooking practices, particular technological traditions may index wider changes in foodways and greater social and political practices. I will return to this dynamic for the Late Formative at the end of this chapter, but now I turn to examine how such arguments have been made with Middle Formative data on the Taraco Peninsula.

9.15 Middle Formative feasting

I investigated feasting at Middle Formative contexts at Chiripa in my 2002 Master's thesis. My research goals were to define the use of space at two structures, Quispe and the Monticulo, specifically to characterize domestic and ritual spaces (a dichotomy I now seen as rather unproductive). To do so I used various case studies to define ceramic expectations for feasting (Roddick 2002: 20-21; drawing on Underhill 1990; Blitz 1993; Deal 1998; Mills 1999; Hayden 2001). I argued that public consumption activities would drive a higher expenditure of labor in making vessels, and there would be a demand for larger vessels for preparation of large quantities of food. I suggested that there should be a high number of cooking pots and a significant quantity and diversity of serving forms. Archaeologists working in the US Southwest have found that feasting is often indicated by an increase in vessel size of cooking and storage vessels (Mills 1999). Hayden, in his systematic overview of feasting contexts, suggests evidence for commensality can be found in "feasting middens", which can be identified by contexts with high quantities of articulated joints and unprocessed bone (2001: 40). In my thesis I stressed that this type of evidence is essential, as other shifts in ceramics may simply be related to changes in diet or in cooking practices.

I found that while Middle Formative Chiripa potters did produce some vessels larger than 30 centimeters, most "large" vessels were around 25 centimeters, not really that large. All ceramics were produced with local pastes and design styles, with no evidence for non-local "prestige" goods. "Convincing evidence for sizable 'corporate' feasting…has yet to be found. However, the serving of food was clearly an essential activity, and such activity may have served various socio- political purposes" (Roddick 2002: 41). I concluded that while there was evidence for public serving (and ritual practice) in both buildings, there was little to suggest large scale feasting. Rather, the activities that were occurring in and around the Monticulo and Quispe structures could be viewed as "designated serving spaces", a rather tedious term employed to avoid the implications of scale and intensity suggested by feasting.

My thesis was based on both Bandy (2001) and Steadman's (2002) suggestion that feasting was an integral part of the Yayamama Religious Tradition. Steadman was well aware of the difficulties in defining particular activities at Chiripa, as few clear *in situ* domestic structures had been found, making contextually driven interpretation of specialized activities difficult. Kala Uyuni, with its three assemblages permitted a more detailed spatial analysis. Steadman notes that large bowls and necked vessels were recovered in greater density in the sunken courts (Steadman 2007: 80-81). In this case, and in contrast to my work at Chiripa, some of these vessels are quite large with some jar orifices measuring 39 centimeters in diameter. These larger vessels are also associated with more decorated ceramics in general, and are more frequently found in special use contexts. In my excavations of one of these courts I found high densities of fish remains in specialized dumping pits on the edge of the courts. Although such specialized assemblages were present, it is still not entirely clear that such food serving activities should be interpreted as evidence for competitive feasting, at least in the way that is defined for the Tiwanaku phases in the urban core. Clearly these sunken courts were being used for public performative consumption, but there is little sign for a conventionalized competitive feasting.

9.16 Summary of diachronic perspective on vessel use

There are significant shifts in ceramic use categories over the six centuries between the later Middle Formative and the Tiwanaku IV phases. During the Tiwanaku phases, there is good deal of diversity in vessel shapes, and it appears that production choices (including paste) were constrained by the intended use of vessels. Cooking vessels do not show a great deal of diversity, although at this point no detailed study of sooting and charring patterns has been conducted. Feasting appears to be a common practice in particular contexts, as indicated in the standardized size and detailed decoration of specific serving forms. Storage forms are also sometimes decorated. These vessels can be quite large, and Tiwanaku scholars believe they were used for fermenting chicha, which was served in public events of communal consumption. These vessels are standardized in form and size, but include more diversity in decoration, suggesting multiple communities of consumption (perhaps defined by place-based affiliations such as the lowland connection of the Ch'iji Jawira potters) engaged in a common competitive feasting enterprise. It appears that inhabitants of Tiwanaku were involved in constellation of shared consumption practices revolving around specialized chicha drinking.

Middle Formative consumption is not only on a smaller scale, but it is also qualitatively different. There appears to be a more generalized approach to ceramic production vis-à-vis use categories during the Middle Formative Period, with less specificity in terms of form and function. Middle Formative forms may have had multiple uses, and were more fluid in their use lives, making specific social practices involving these vessels more difficult to identify. However, paste choice relating to vessel use certainly appears to have been important during the Lake Titicaca Middle Formative, with variability in recipes across different forms and contexts. Particularly intriguing is Steadman's suggestion from the Northern Titicaca Basin, that particular technological choices were associated with shifting cooking practices and new cuisines.

9.2 Late Formative communities of consumption

I now turn to address several questions concerning use of ceramics during the Late Formative. Are changes in vessel use taking place within the Late Formative Period? Do these shifts help explain the changes in paste ratios described in Chapter 7? Are large-scale feasting practices an essential component of daily politicking or ceremonial practice? Do new foodways play a role in changing technological choices? I begin by defining Late Formative use-categories based on four variables, including vessel form (attributes such as form, orifice diameter, presence of appendages, etc), technology (paste, surface finish, color, etc), residue (carbon and sooting patterns) and excavation context. I will then consider the evidence for feasting during the Late Formative at Kala Uyuni, Sonaji and Kumi Kipa. If feasting were occurring during the Late Formative phases I would expect to find new types of serving vessels appearing in the archaeological record. I discussed some of these forms in Chapter 7, but here I will return to discuss their importance for communities of consumption. I would also expect to find larger vessels (Blitz 1993; Deal 1998; Hayden 1991; Underhill 1990), in particular storage vessels that may have been used for storage/fermentation of important drinks. I also expect greater concentrations of cooking and serving vessels in particular contexts (Mills 1999; Spielmann 2002).

Unfortunately we do not have the clear division of space for the Late Formative that is available for both the earlier Middle Formative at Kala Uyuni or for the later periods at Tiwanaku. This is perhaps due to TAP's research design (see section 4.2), but also due to amorphous nature of Late Formative mud brick architecture (Goodman-Elgar 2008). Making contextual comparisons is even more difficult at Sonaji and Kumi Kipa, where excavators (appropriately) defined many unique depositional events, resulting in small sample sizes for many contexts. To alleviate this issue, I grouped contexts together into representative categories from all three sites when examining contextual variability (described in Chapter 5). This increased my sample size, but it also homogenized potential intra-site variability. In the future I will increase my sample size for some of these contexts, to allow for a more fine-grained study of particular spaces within Kala

Uyuni, Sonaji and Kumi Kipa. However, there does appear to be a difference between the U-shaped structures of ASD 2 and 4 and the circular structure 5. And while the series of pits and middens associated with the structures at Sonaji and Kumi Kipa offers neither clear spatial variability nor clear evidence for the function of these buildings, they offer important intra-site variability that could be clarified in future excavations.

9.21 Use categories for the Late Formative: Technology, form and function

Table 9.1 shows both interior and exterior soot deposits and charring by paste group. The most important finding here is the unusually low number of sooted sherds recovered from the unmixed Late Formative contexts. I will return to discuss the significance of this below, but I should mention that more sooted sherds were recovered in more mixed analyzed contexts. The micaceous tempered ceramics dominate both those with internal and external residues. Internal sooting and charring is likely the result of cooking or from burning incense, herbs or fat. Of those showing signs of internal sooting and charring, the highest percentage are non-fiber micaceous tempered (1 and 2), followed by fiber and mica tempered (17 and 18) ceramics. Of the micaceous sherds, a total of 218, representing 0.5 percent of all micaceous sherds, have external soot deposits, likely evidence for cooking over the fire. Paste 9 has the highest percentage for both internal and external patterning, but this sample size is quite small (38 had some sort of carbon deposit). The finer pastes (5 and 6) never have any kind of carbon deposit, and this supports our assumption that the compact pastes are exclusively serving vessels. Unlike Steadman's finding for the Middle Formative, cooking vessels do not appear to be preferentially slipped during the Late Formative, and most cooking pots tend to be black, gray, brown or red brown. Furthermore, a much greater percentage of the sooted sherds are wiped or smoothed on the exterior of the vessels, rather than burnished, suggesting less attention to detail for these later cooking vessels.

INTERIOR CARB BY PASTE GROUP							
	1 & 2	17 & 18	29	3	9	5 & 6	TOTAL
Light Powder	30	24	1	2	6	0	63
Medium Powder	9	9	0	1	1	0	20
Heavy Powder	3	0	0	0	1	0	4
Light Encrustation	23	10	0	3	10	0	46
Medium Encrustation	16	13	1	0	7	0	37
Heavy Encrustation	11	2	0	3	7	0	23
Light Encrustation with White Edges	0	0	0	0	0	0	0
Heavy Encrustation with White Edges	0	0	0	0	1	0	1
Scorched Gray	0	0	0	0	0	0	0
Scorched White	0	0	0	0	0	0	0
Fire Blackened	8	1	0	0	0	0	9
Fire Blackened with Light Powder	0	1	0	0	0	0	1
# Carb	100	60	2	9	33	0	204
No Carb	7078	5348	194	1030	1022	1036	15708
Grand Total	7178	5409	196	1039	1056	1036	15914
% Carb	**1.39**	**1.11**	**1.02**	**0.87**	**3.13**	**0.00**	**1.27**
EXTERIOR CARB BY PASTE GROUP							
	1&2	17 & 18	29	3	9	5 & 6	TOTAL
Light Powder	13	29	0	1	1	0	44
Medium Powder	0	2	0	0	0	0	2
Heavy Powder	0	1	0	0	0	0	1
Light Encrustation	6	6	0	0	2	0	14
Medium Encrustation	1	1	0	0	0	0	2
Scorched Gray	0	0	0	0	1	0	1
Fire Blackened	10	5	0	0	1	0	16
# Carb	30	44	0	1	5	0	90
No Carb	7148	5365	196	1038	1051	1036	16054
Grand Total	7178	5409	196	1039	1056	1036	16114
% Carb	**0.42**	**0.82**	**0.00**	**0.10**	**0.48**	**0.00**	**0.56**

Table 9.1: Carbonization pattern by paste groups.

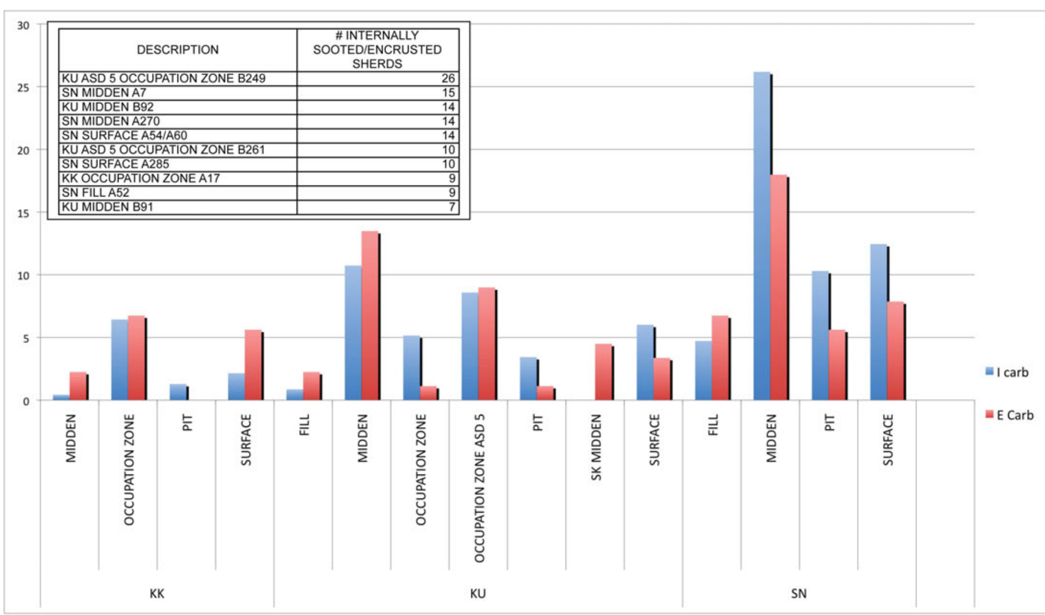


Figure 9.2: Location of internal (I carb) and external (E carb) carbonized sherds presented as percentage of total sooted/charred assemblage. Inset shows top ten event contexts with internal surface residues (see Chapter 5 for context description.

The fewest sooted sherds were recovered at Kumi Kipa (likely due to the fewer number of contexts analyzed) and the greatest were recovered in midden contexts at Kala Uyuni and Sonaji (Figure 9.1; see Chapter 7 for context descriptions and Appendix 1 for Harris Matrices). At Sonaji high densities of charred and sooted sherds were recovered from the SN-A7 midden of the lower terrace, the SN-A285 surface and its associated SN-A270 midden of the upper terrace and SN-A54/A60, a middle terrace midden with other signs of cooking activity including ground stone, lithics, bone and charcoal. At Kala Uyuni event KU-B92, which was a midden west of ASD's 2,4 and 5 also had many sooted sherds. Bruno notes (2008: 447) that this context had a high density of botanical materials, primarily with *Chenopodium quinoa*, but also unknown Amaranthaceae, Cyperaceae, Poaceae, Fabaceae and a large amount of wood.

The highest density of sooted and charred sherds from any given event, however, was found associated with the internal use surface of ASD 5. The internal surface (KU-B249) included a number of sherds, including what appears to be a good portion of a complete vessel (Figure 9.3). These vessels were sooted, and often were fire clouded, and included a few cases where cooking forms could be clearly identified. Interestingly, we also recovered several examples of Kalasasaya sherds in that same location. I will return to the significance of finding decorated serving vessels together with cooking sherds below. For now, I want to stress that this event, and the particular forms found within this structure, are the best example of a Late Formative cooking assemblage. As discussed in Chapter 5, this is a later Late Formative I context, meaning temporal comparisons should be made cautiously.

Figure 9.3: Sooted and charred sherds associated with cooking from the internal surface of ASD 5: a) medium necked flared olla, b) thickened edge base, c) medium necked slightly flared jar, d) thickly encrusted body sherd.

Event KU-B261, associated with the outside of the same structure, also yielded a high number of sooted sherds. Bruno found that the botanical data varied depending on what area outside of ASD-5 was studied. Although she found a high amount of quinoa inside ASD-5, suggesting food production took place in this area, KU-B261, outside the building, had a rather low density in plant materials. Bruno's careful analysis noted the micro-variability in plant materials, but the ceramic evidence did not pattern so clearly. Either broken cooking pots were scattered haphazardly outside the structure, or, more likely, taphonomic processes have transported these shallow deposits from their original deposited locations.

In most cases I could not identify the particular form of cooking vessels from Kala Uyuni, Kumi Kipa and Sonaji, since sooting and charring is rarely found so high on the vessel walls (but see Figures 9.3 a and c). In the few cases where form could be identified the sooting was restricted to necked vessels, with most found on either tall-necked jars or medium necked straight ollas. We did find three cases of short-necked ollas with charring as well. We had far fewer jars in the Late Formative assemblage than in the Middle Formative, either because ollas became more widely used, or (more likely) they could simply not be differentiated in the fragmented state. Forms alone are not sufficient for distinguishing use categories, and it may be more productive to examine broader potting technology, in particular choice of paste.

Although I presented the specifics of paste by form while discussing the detailed production choices in Chapter 7, I now turn to the general patterns of form to paste with regard to function. Figure 9.4 shows how pastes vary by general form in the larger analyzed assemblage. Ollas, jars and the generalized necked vessel category are all quite similar, with predominantly micaceous pastes being used in these particular forms. There does not appear to be any clear preferential use of the micaceous sand recipe versus the mica and fiber tempered vessels in terms of use categories. There is a slightly higher ratio of pure micaceous sand pastes in the olla category than other forms.

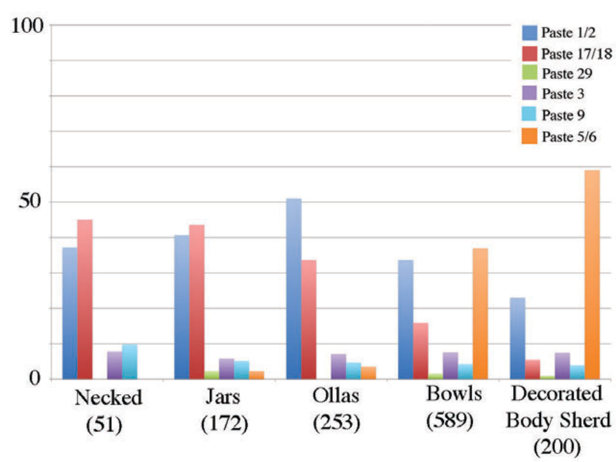


Figure 9.4: Paste percentages by general vessel shape

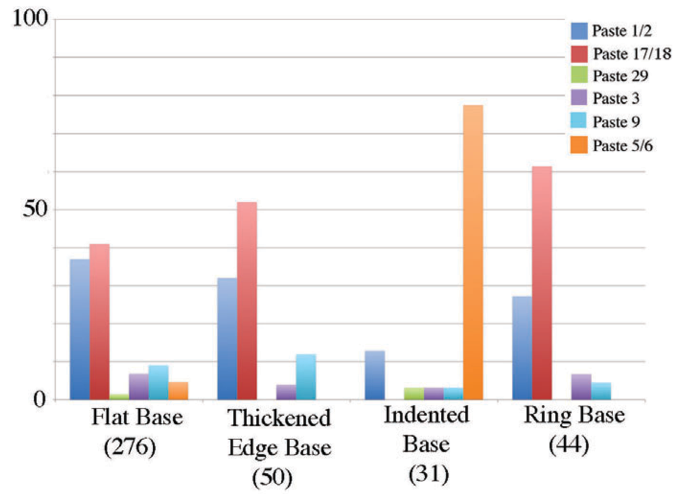


Figure 9.5: Paste percentage by base form

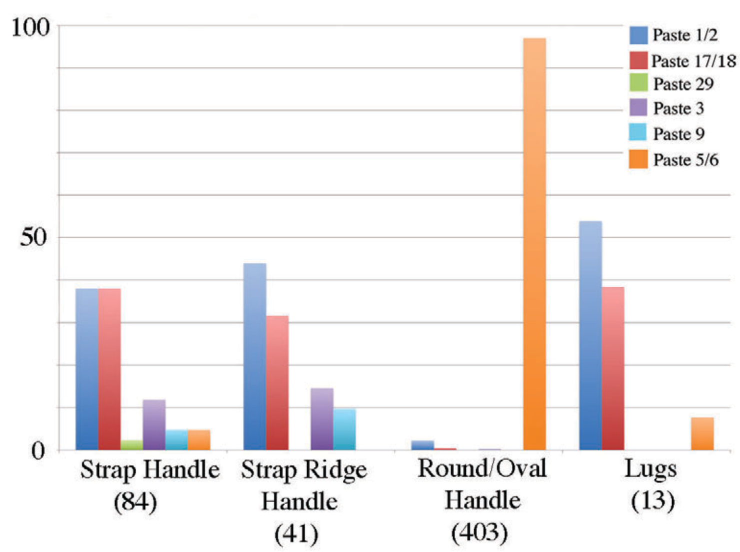


Figure 9.6: Paste percentage by appendage form

Bases and appendages may also help to identify cooking vessels. Lugs were found to be associated with fiber-tempered cooking ollas at Camata (Steadman 1995) and were often carbonized in Middle Formative Chiripa (Mohr 1966: 104). The few excavated cases examined here are tempered with fiber and sand, and are never carbonized. Following Steadman's work at Camata, I expected to find a great deal of sooting on Late

Formative bases. However, out of all bases analyzed (n=726) only 12 have sooted exteriors (all on flat bases) and 30 have interior carbonized remains (in flat bases and thickened edge bases). Unlike Steadman's findings for the Middle Formative, where rounded bases are used for cooking, most Late Formative vessels had flat bottoms (for half of these the vessel wall was not present, making identification even more difficult). The majority of bases were made with either micaceous sand or mica and fiber pastes. In all cases, the sooted bases are manufactured using micaceous pastes suggesting that these vessels are being used within the fire. The fact that the assemblage has twice as many sherds with internal sooting than external (Table 9.1) would seem to support this. The color of bases tend to be light brown or brown (29 %), red brown (28%) in most cases, lending further support that the vessels may being used directly in the fire. Unfortunately we do not have full cooking pots to further investigate this pattern on higher parts of vessel walls. In those cases where larger vessel walls are present, and in clearer cooking assemblages (Figure 9.3b), we do see evidence for fire clouding and sooting from vessel use. So while it is possible that a good portion of vessels were being directly in fires, resulting in internal sooting and external oxidation, another option is simply that we have not excavated many contexts associated with cooking for the Late Formative. Future excavation and analysis may clarify this issue.

While it was difficult to identify cooking sherds, storage vessels are equally hard to identify. Many Late Formative forms associated with cooking, such as the tall-necked jars and ollas, also have ideal storage attributes, including outflaring and vertical rims, for the use of covers to prevent spillage and keep out pests and dampness. For both storage and serving vessels we may expect handles to help in tilting. Appendages were often made in both of the micaceous tempers, with the exception of the round or oval handles. These are associated primarily with decorated bowls, and appear to only be found with the compact pastes themselves. We had many cases of handles showing signs for use in cooking settings, and others free of sooting or fire clouding (Figure 9.4).

Figure 9.7: Ridge strap handles from TAP excavations suggestive of use of necked vessels in both storage and cooking capacities.

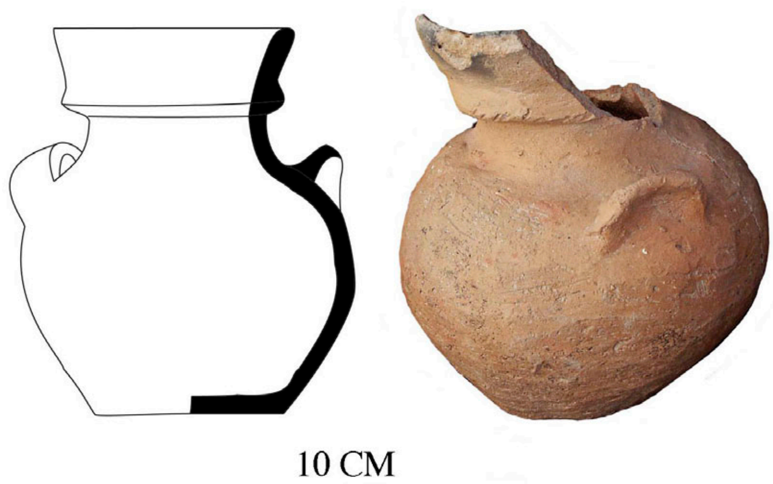


Figure 9.8 Medium Necked Slightly Flared Olla from Kala Uyuni locus 5316, showing little sign of use in fire settings. However handles are suggestive of a possible construction for use over the fire.

As we saw in Chapter 7, there is a great increase in the diversity of bowls during the Late Formative Period, with each site appearing to have their own local forms as well as wider regional styles. Bowls were the major ceramic serving vessel for the Late Formative period. The paste choice for bowls presents a more bimodal distribution, with a little over half being constructed with micaceous pastes, and the other half with the finer pastes. Indented bases, usually associated with decorated bowls (as discussed in section 7.42), and in rare cases, small finely decorated ollas are also made with the compact pastes. This suggests that consumers may have had a general serving bowl, usually made with a micaceous paste, and a more specialized assemblage manufactured using paste groups 5 and 6. In fact, it may be that these finer bowls were fired in a different fashion or by a different group of potters, as these vessels are always oxidized, whereas others are slightly more variable. We saw in Chapter 7 that dung firing creates an oxidizing atmosphere, but these firings were remarkably consistent. In a small number of cases decorated ceramics are being produced using a micaceous paste, usually preferring the non-fiber tempered pastes. In this decorated group there are both oxidized and semi-reduced firing cores.

Bowls, in some rare cases show evidence in their use lives for use outside of serving functions. Slightly convex bowls with vertical sides had some sooting (6 sherds in 6 unique contexts) along with encrustation of food on their interiors, and in some cases a light powder suggesting possible use for burning activities. These vessels often are manufactured using the micaceous pastes (Figure 9.9a). Ring bases, often associated with the annual bowls used for incense burning, also appear to have been used for burning. Nine percent of these vessels had evidence of burning on their interior surfaces, but are never sooted on the outside. These ring bases are not differentially distributed, and are found in middens and pits at all three sites. This category of vessel is a precursor to the incensarios of later Tiwanaku periods (compare pedestal bowl in Figure 9.1 with Figure 9.20). So, it appears that there are three distinct functions for bowls: burning activities, specialized serving, and a more multipurpose use (Figure 9.9)

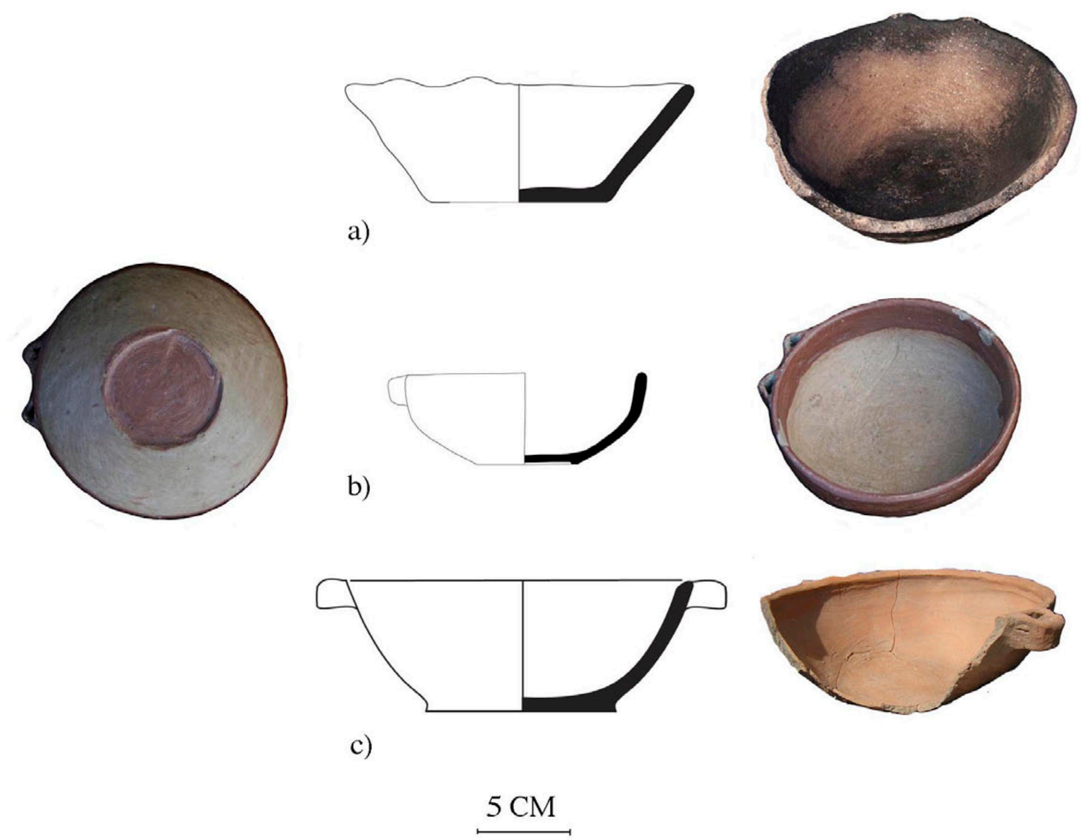


Figure 9.9: Form to function? a) Flared bowl, from event KU-B22 showing both micaceous paste and carbon deposits. b) Slightly Convex Vertical Sided bowl from event KU-B73 showing slight base indentation and double loops on rim. c) Bowl from event KK-A70 with no sooting or decoration.

In summary, the available evidence suggests that the Late Formative people made and used a relatively unspecialized ceramic assemblage. There is little to suggest that particular forms served specific functions other than a broad cooking/storage, serving and perhaps incense burner distinction. While storage vessels, in particular, were difficult to identify, we do have more concrete evidence for cooking practices. Evidence for cooking was found in similar quantities across all three Late Formative sites, although further work is needed at Kumi Kipa to define whether there was, indeed, less cooking occurring as the sherd densities suggests. The context with the best evidence for cooking activities is found in ASD-5, with several charred and sooted ollas and jars found *in situ* on the interior surface, and some cooking materials found in the outside use area. All three terraces at Sonaji show evidence for quotidian activities, but in particular on the upper terrace below the yellow clay surface and above SN-ASD 2.

9.22: Paste question: Technological choice and functional requirements

I can now summarize the evidence for the question of why paste varied through the Middle and Late Formative. In previous chapters we have seen that pastes were a product of potters adding (micaceous) sand, fiber, and perhaps ash. In the case of the compact pastes 5 and 6, potters may have simply used collected clays without adding tempers. Pastes may have resonance with the greater social practice, perhaps indexing local mountains. Above we saw that pastes are not directly associated with functional categories. Micaceous pastes appear to be used across multiple shape categories. Within the micaceous pastes there does not appear to be preferential use for either fiber and micaceous sand, or just micaceous sand. This does not preclude the idea that micaceous pastes were first adapted to a new way of cooking, or for aesthetic reasons. It is a perhaps fruitless exercise to look for the original intentions of choosing a particular paste, to assign techno-functional or symbolic reasons for these initial choices.

More productive is to see the results as "unintended consequences" of the choices through time. It may well be that as potters drew on new sources, the advantages of the micaceous pastes were seen - that thinner sand tempered vessels were more beneficial in direct heat firing - and were gradually shifted to be used in cooking contexts. Unlike the heavily fiber-tempered ceramics, which needed to be highly burnished in order to be impermeable, these sherds were less porous, and thus were wiped as opposed to burnished. As potters increasingly choose to temper their ceramics with micaceous tempers, some potters may have tried using a range of mica recipes. If mica was being traded in sheets like at Tiwanaku (Chapter 8), there may be attempts to use only the mica as a tempering agent, resulting in paste 29. This paste, of which many archaeologists have noted local versions during the Late Formative Period, may be the result of particular choices for functional, symbolic and/or experimental purposes.

The fine compact pastes (5 and 6) are primarily found in bowls, and serving vessels. The bowls (plus a few jars and ollas) made with these pastes are never used for cooking. Although no experimental work was done with these pastes, it is suspected that they would not deal with the thermal stress of repeated firing and cooling of direct, or even indirect heat, associated with cooking. These pastes are also spatially and temporally associated with several new bowl forms, most notably the short-necked slightly convex bowls (which were likely used for drinking and may have been the precursor to the kero) that appear during Late Formative II (see below). Although these vessels are lightly burnished, in many cases this appears to be decorative rather than functional, as the vessels are most highly burnished on the red slipped area on the upper part of the vessel near the rim. The compact pastes (with few large inclusions or pores) used for the decorated bowls make them appropriate for serving liquids. Future experimental work should include an investigation of the permeability of these vessels.

I also found that in some cases the decorated bowls are manufactured using micaceous pastes. My working hypothesis, as discussed in Chapter 8, is that the majority of Taraco forms were produced locally. If I am correct, it may be that potters were learning to produce Kalasasaya style serving vessels using the more robust micaceous pastes. Another possibility, to be investigated in future studies, is that the compact pastes were accessed through trade relationships. In the manufacture of red slipped vessels with micaceous pastes may suggest local technological choices for manufacturing a regional design style. This same logic holds for the other mineral tempered pastes. Pastes 3 and 9 were found in remarkably similar proportions across all types of vessels: it appears that a small number of vessels are being produced across all forms. This appears to be less a function of vessel use, or of preferences from communities of consumption, than an indicator of different potters technological choices and preferences. It may well be that particular communities of potters preferred the volcanic ash temper, or that these were being produced elsewhere.

9.23 Vessel sizes: Shifting consumptions practices?

I now turn to look at vessel sizes as indicators of potential feasting activity. I am not currently able to take into account vessel volume (an important issue considering there are both shallow and deep bowls during the Late Formative) due to the fragmented nature of the assemblage. However as I mentioned in Chapter 7, the distribution of deep and shallow forms appears to be similarly distributed across all three sites. Table 9.2 shows that vessel orifices are not all that large for the Late Formative. Although there are a small number of outliers in the larger vessel range, these values are somewhat smaller than those recorded for the Middle Formative discussed above. Average bowls sizes are approximately 15.5 centimeters in orifice diameter and ollas are slightly smaller at 15.2 centimeters. I could only attain orifice diameters on a small number (n=41) of jars, but their average diameter is 14.6 centimeters.

	Form	Min.	Q1	Median	Mean	Q3	Max.	Upper Adjacent Value	Lower Adjacent Value	Count
BOWLS	SL CONVEX FLARED	5	14	16	15.72	18	34	24	8	212
	SL CONVEX VERTICAL SIDES	5	14	16	15.92	18	34	24	8	202
	SL FLARED	7	11	14	14.61	17	40	26	7	72
	SHORT NECKED SL. FLARED	7	12.75	15	15.56	17	30	23.375	7	36
	SL CONVEX INCLINED	7	13	15	15.31	17	25	23	7	32
	VERTICAL SIDES	7	10.5	14	14.00	16	27	24.25	7	23
	FLARED	5	9.5	14	13.89	16.75	25	25	5	18
	SL CONVEX SL FLARED	9	11	14.5	15.28	18.75	26	26	9	18
	NO ANGLE	7	13	18	17.24	21	27	27	7	17
	INCURVING	12	12	15	14.20	16	16	16	12	5
DEC. BOWLS	SHORT NECKED SL FLARED DEC	7	13.5	15	16.6	18.5	30	26	7	15
	SL CONVEX VERTICAL SIDES DEC	9	15	17	16.6	19	21	21	9	19
	SL FLARED DEC	7	8.75	13	13.5	17.25	22	22	7	12
	ALL DECORATED DEC	7	13	15	15.6	18	30	25.5	7	82
OLLAS	MEDIUM NECKED SLIGHTLY FLARED	4	13.75	16	16.24	18.25	28	25	7	92
	MEDIUM NECKED STRAIGHT	8	14	16	16.11	19	24	24	8	71
	SHORT NECKED STRAIGHT	5	10	12	12.44	16.25	21	21	5	36
	SHORT NECKED SL FLARED	4	9.5	13	13.37	16	31	25.75	4	30
	MEDIUM NECKED FLARED	13	14.75	16	16.70	18.5	24	24	13	20
	SHORT NECKED FLARED	5	5.5	7.5	8.83	11	16	16	5	6
JARS	MEDIUM NECKED SLIGHTLY FLARED	12	14.5	19	19.1	22.5	30	30	12	23
	TALL/ MEDIUM NECKED	10	13	14	15.1	18	22	22	10	19
	TALL NECKED FLARED/SL FLARED	10	13.5	16	16	16.5	26	21	10	11
	MEDIUM NECKED STRAIGHT	8	10.5	13	13.8	15.5	23	23	8	6
	TALL NECKED STRAIGHT	10	11	11	11.2	12	12	12	10	5

Table 9.2: Size distribution for bowls, decorated bowls, ollas and jars from TAP excavations, showing minimum value (min), lower quartile (Q1), median, mean, upper quartile (Q3), maximum value (max) and upper and lower adjacent values. Note that the "dec. bowls" are included in the values for the greater "bowl" category.

Bowls clearly have a strong central tendency, with a few rare cases of larger bowls. In fact, most appear to be on average smaller than earlier periods. "Short-necked slightly flared" bowls have several outliers in the larger size range, whereas vertical sided bowls have somewhat smaller vessel size. Upon examination just the decorated bowl assemblage (n= 82), similar trends were found, with "slightly flared decorated" bowls a bit smaller at 13.5 centimeters in diameter, but decorated bowls as a whole were an average of 15.6 centimeters in diameter. While there is remarkable size consistency in all bowl forms, I define three vessel sizes based on their distribution: *small* from 5 centimeters to 10 centimeters, *medium* from 11 to 17 centimeters, and *large* 18 centimeters to 30 centimeters.

Vessel size for necked vessels showed slightly more variability than bowl forms (Figure 9.13, 9.14). "Medium necked slightly flared" (n= 92), "medium necked straight" (n=71) and "medium necked flared" (n=20) ollas have an average orifice diameter of 16.24, 16.11 and 16.70 centimeters respectively. These vessels rarely are much bigger than 25 centimeters in diameter, or smaller than 8 centimeters. The "short necked straight" (n=36), "short necked slightly flared" (n=30) and "short-necked flared" (n=6) vessels averaged 12.44, 13.37 and 8.83 centimeters in diameter respectively. Short-necked vessels are rarely much bigger than 20 centimeters (the one outlier, I believe, may have been a misidentification as it was analyzed by a student without being checked in the field). This is likely indicative of the morphology and not of variation in the volume capacity of the vessel. Short-necked vessels likely could not have large orifices due to manufacturing constraints (the necks would likely collapse), and it is likely that the rest of the vessel was bulbous resulting in a similar volume. If this hypothesis is correct, it may be that short-necked vessels had a different function.

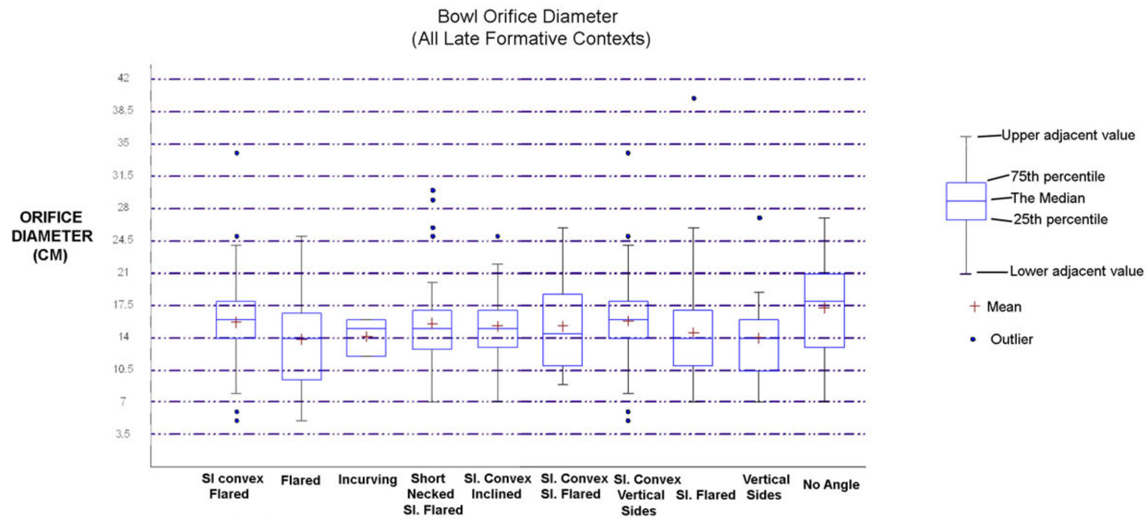


Figure 9.11 Box plot figure of bowl sizes.

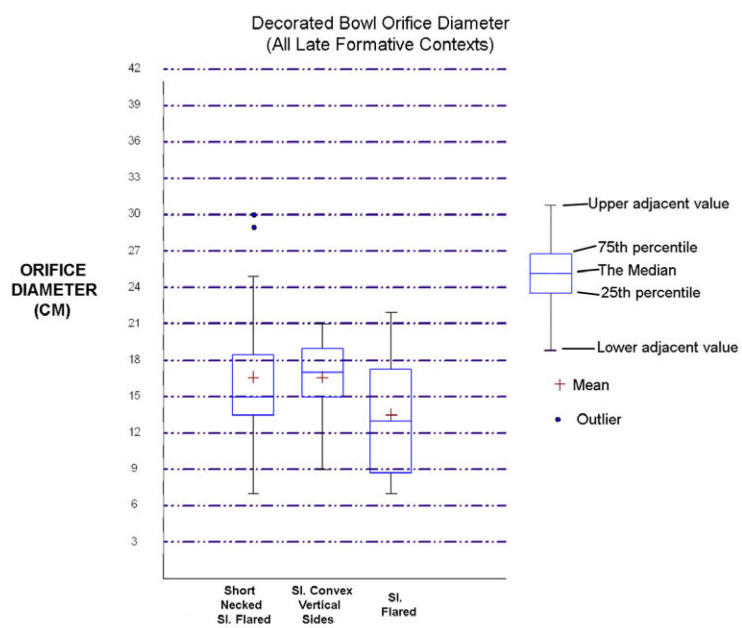


Figure 9.12: Box plot of orifice diameter of decorated bowl forms.

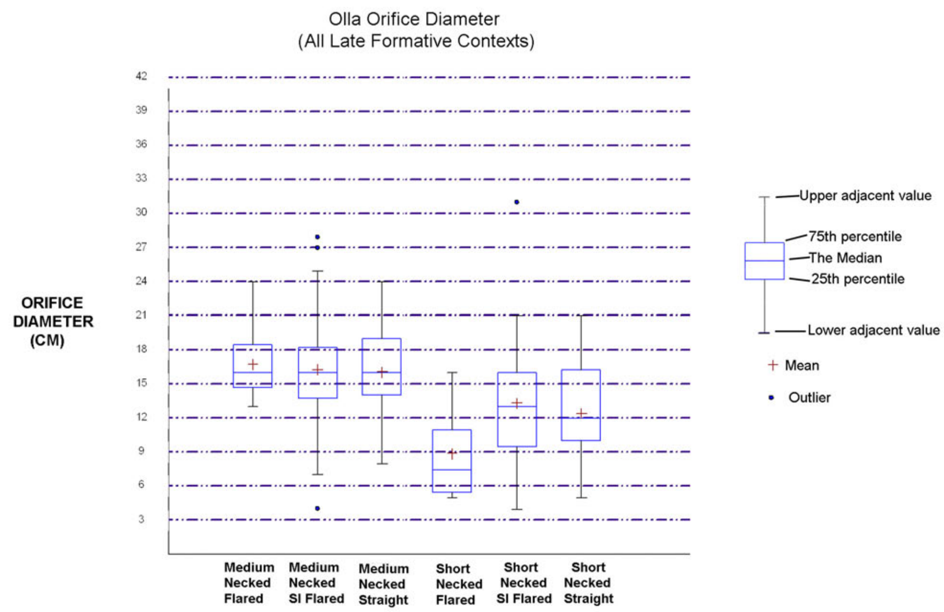


Figure 9.13: Box plot of orifice diameter of necked vessels.

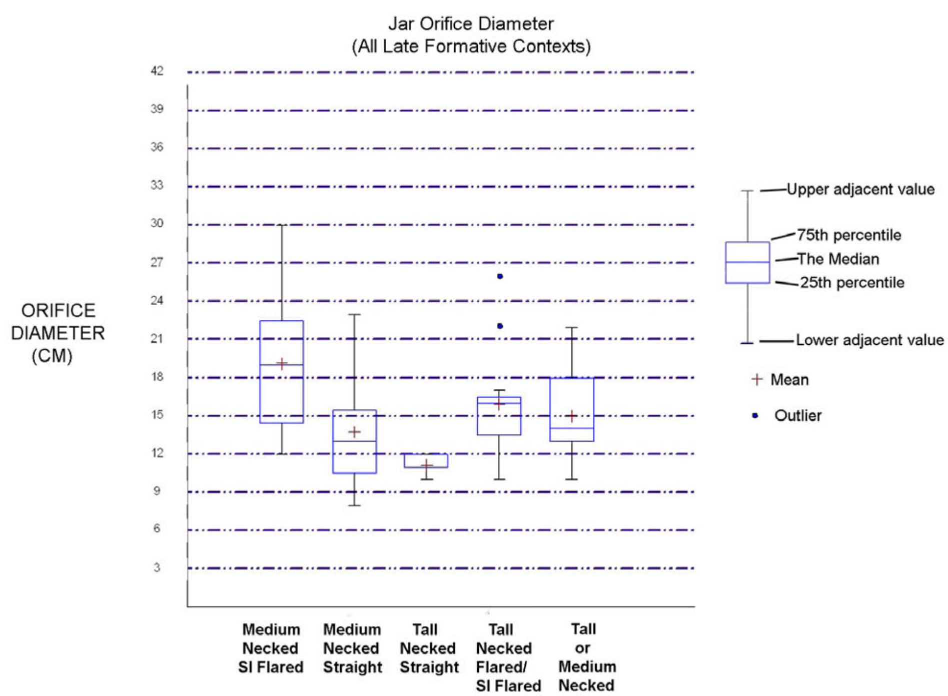


Figure 9.14: Box plot of orifice diameter of jars.

The greatest number of jars in which orifice diameter could be recorded was in the "medium necked slightly flared" category (n=23). Here we see an average orifice diameter of approximately 19 cm in diameter, modestly larger than the medium necked olla size. Tall necked vessels are represented by 11 vessels in the "tall necked slightly flared/flared" category, which have a smaller diameter of 16 cm. For both the jars and ollas I used a similar size typology as for bowls, based on a histogram of the orifice sizes. While there is some variation within the olla and jar categories, there is good reason to think that these vessels had similar function (as discussed above). Necked vessels range from *small*, from 4 to 10 centimeters, *medium* from 11 to 18 centimeters and *large* from 19 to 31 centimeters.

9.24 Feasting: Vessel size and context

Although there is not a great deal of variability in terms of vessel size during the Late Formative, to fully understand whether particular vessels were being employed for particular types of activities a more detailed contextual analysis is necessary. As we saw in the beginning of this chapter, in the Tiwanaku period, and to a certain extent during the Middle Formative, there is intra-site variability at Kala Uyuni, Chiripa and Tiwanaku. Were particular sizes of forms found in particular areas of the sites, or in specific types of deposits?

As I presented in Chapter 4, Kala Uyuni offers a great deal of contextual variability, including surfaces and occupation zones from both ASD 2 and ASD 4, pits associated with these structures, and middens outside with these structures. There is some variability in size and form distribution across this site. Occupation zones and pits at Kala Uyuni have a higher density of large bowls, although only in a few cases are vessel orifices much larger than 25 centimeters. I also examined their distributions in the occupation zones associated with ASD 5 and the SK areas separately. All areas were dominated by medium bowls and medium necked vessels, with one important exception in the SK midden, where large necked vessels, in particular straight necked ollas (20-25 centimeters, n=10) were found in greater densities. Interestingly, the lowest presence of large bowls was found in this area, suggesting different types of activities. Future excavations in this area may help clarify this significance of these midden deposits.

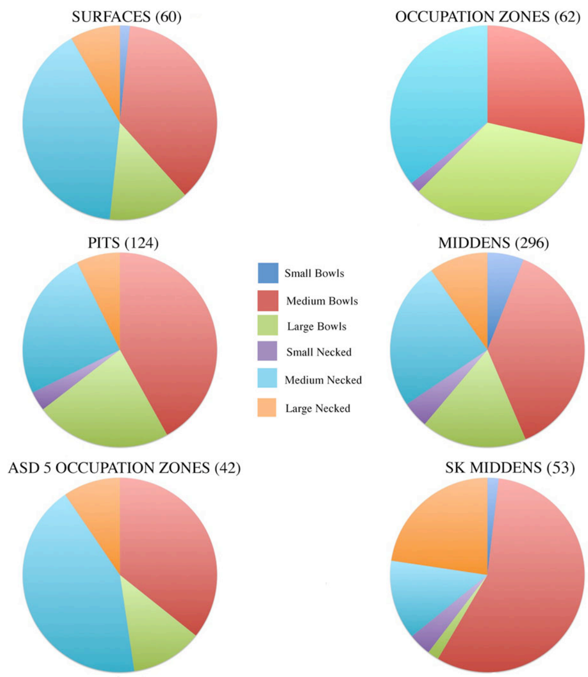


Figure 9.15: Pie charts showing vessels sizes across Kala Uyuni contexts, with the number of identifiable vessel forms (n).

Sonaji contrasts with Kala Uyuni in terms of their vessel sizes. Sonaji has a higher proportion of both small-necked vessels and small bowls. Sonaji surfaces, in particular, have many small bowls in the 7 to 10 centimeter range. Small-necked vessels are found in a similar ratio across all contexts of Sonaji, but are more significant proportion of the assemblage when compared to the other two sites.

Kumi Kipa appears to have the highest density of bowls throughout all identified contexts. Although not shown in these images, Kumi Kipa has fewer necked vessels than the other two sites. While the Kala Uyuni excavations yielded 164 ollas (14,865 liters of dirt), Sonaji has 125 ollas (out of 18,211 liters of dirt), we only recovered 72 ollas from Kumi Kipa contexts 8,480 liters of dirt). Kumi Kipa only has 12 jars rims, compared to 34 at Kala Uyuni, and 27 at Sonaji. There does not appear to be any intra-site diversity as to where these necked vessels are found at Kumi Kipa, but these site-wide patterns are suggestive that this space may have been used for different activities. However, we certainly did not excavate the volume at Kumi Kipa (although the site was much shallower) and once we take the volume of soil excavated into account, the raw counts of vessels are comparable (see also Table 4.16).

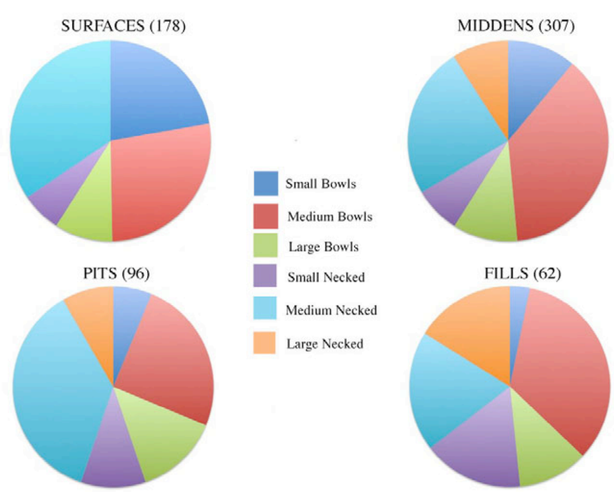


Figure 9.16: Pie chart showing vessels sizes across Sonaji contexts, with the number of identifiable vessel forms (n).

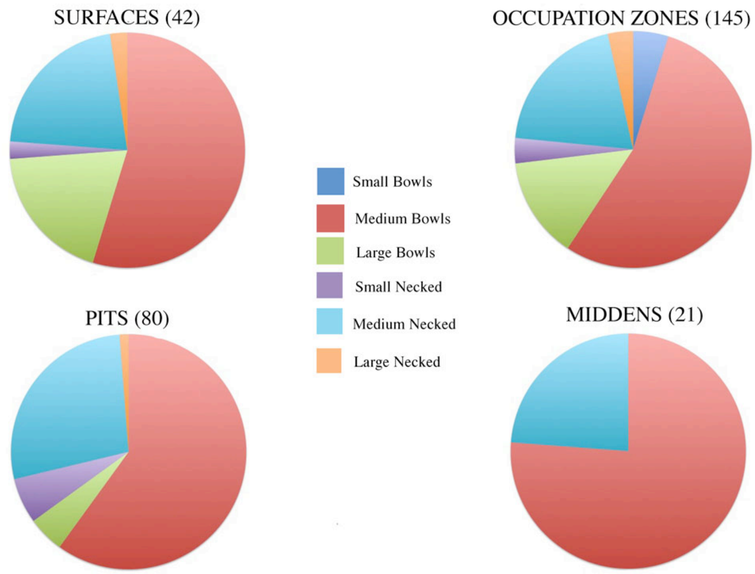


Figure 9.17: Pie chart showing vessel sizes across Kumi Kipa contexts, with the number of identifiable vessel forms (n).

In sum, like the production attributes noted in Chapter 7, there is not a great deal of variability in vessel size distribution across these three Late Formative sites. There are several context groups – notably the KU SK midden and most of the contexts at Kumi Kipa – that would benefit from a more integrated analysis, and further excavations. The KU SK midden consisted of small excavations, and we are still not clear how this part of the site fit into greater social practices across Kala Uyuni. In the case of Kumi Kipa, there has been little analysis of materials other than the ceramics with which to compare the ceramic results (but see Peterson 2007). For the moment, however, I can conclude that there neither inter-site nor intra-site variability in size of vessels.

9.25 Feasting: Specialized serving and context

As the descriptions of the Middle Formative and Tiwanaku phases in section 9.1 and the Late Formative in section 9.3 demonstrated, there is a significant shift between the Late Formative and Tiwanaku IV assemblages. Specifically potters begin to manufacture particular sets of ceramics for more specific functions. Decorated vessels also are appearing throughout the Titicaca Basin. I now turn to examine the contextual significance of these decorated vessels. Figure 9.18 shows the percentage of decorated or red slipped identified forms of particular contexts, while 9.19 show the distribution of decorated body sherds. These figures demonstrate that there is no preferential distribution of decorated sherds across either sites or contexts. However the majority of these decorated sherds consist of red slipped vessels, which as I noted in Chapter 7, are ubiquitous in all three sites.

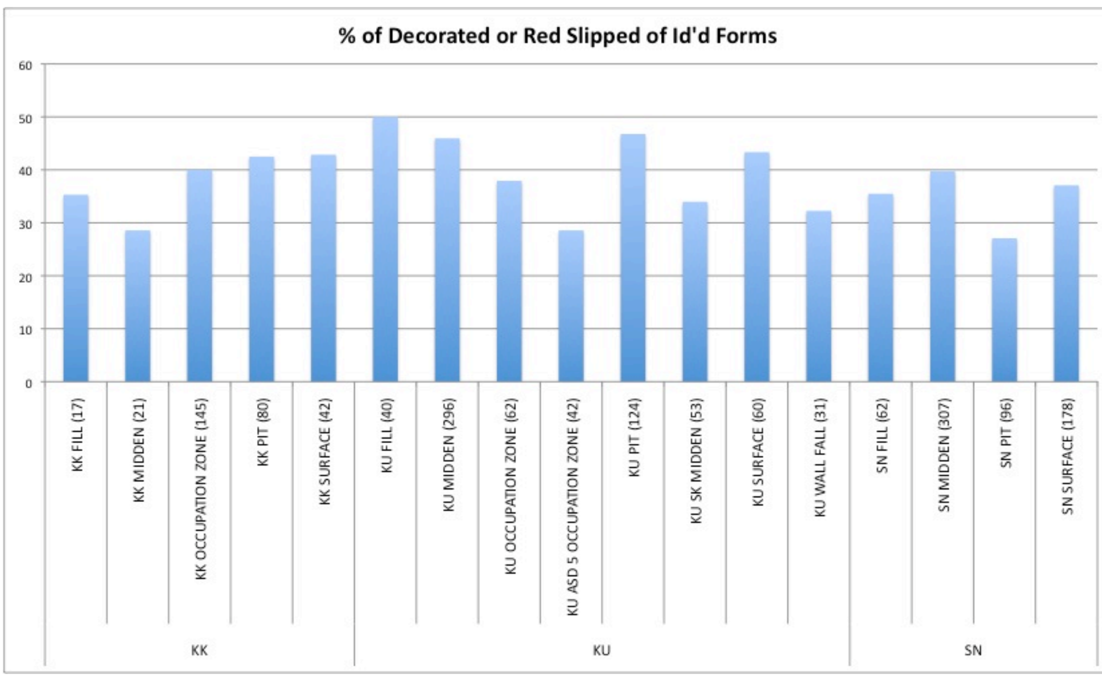


Figure 9.18: Decorated vessels as a percentage of identifiable forms.

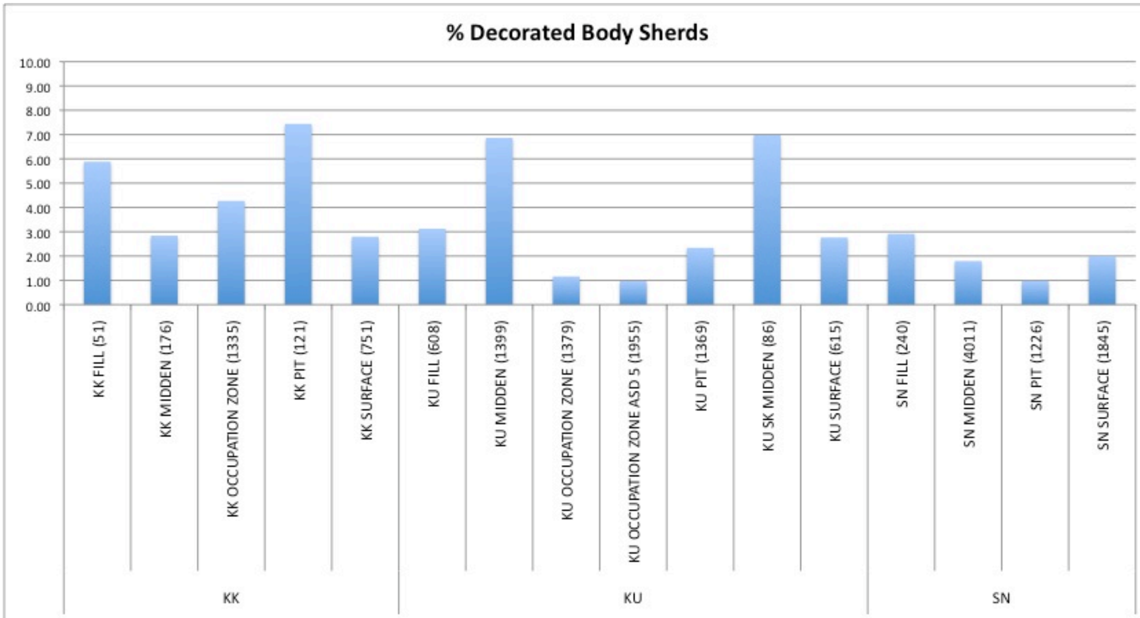


Figure 9.19 Number of red slipped or decorated body sherds by context as a percentage of all body sherds.

Basic Context	# incised sherds	Specific Events (# incised)
KU MIDDEN	14	B92 (6), B74 (4), B91 (4)
SN MIDDEN	10	A271 (4)
KK OCCUPATION ZONE	6	A4 (4), A15 (2)
SN SURFACE	5	A285 (3)
KU CLAY OUTSIDE ASD 5	3	B270 (3)
KU PIT	3	B57 (2)

Table 9.3 Number of incised sherds by context.

Kalasasaya zonally incised sherds, as described in section 7.4, are in general more preferentially distributed throughout the Titicaca Basin. Table 9.3 shows the distribution of these particular ceramics. Note that the greatest density is found in three midden deposits at Kala Uyuni. However these are not extremely large densities, and surely is not a sufficient quantity to support elite or political prestige.

In sum, the distribution of decorated ceramics does not support either inter-site or intra-site variability in specialized serving. This, of course, does not mean that there were not specialized serving occurring at these settlements. It simply means that is not structured depositional patterning of these vessels within or between sites. It may well be that the communities of consumption, much like the communities of production, are not differentiated socially during Late Formative times. There is little *ceramically* that suggests fundamental social differentiation between the communities of practice (of production or consumption) within these three settlements. Nevertheless, it is still very likely that food consumption played an essential role in framing particular consumptive events. After summarizing the greater evidence for Late Formative foodways, I will return to consider this possibility.

9.3 Foodways

As I stressed in Chapter 2, my focus on communities of practice is not only about craft production, and Taraco inhabitants were certainly involved in other communities of practices (likely involving the kin and neighbors), including (but not limited to) economic practices such as farming, fishing, pastoralism and trade. One of the major research interests of the Taraco Archaeological Project is the shifting foodways and landscape management through the Formative Period. TAP researchers have focused on how food consumption changes over time and how these shifts are connected to the larger political economy and ritual practice. Faunal and botanical experts have focused on the intra-site variability within sites, and are beginning to track variability between sites. More recently we have been working with the isotope data from ceramic sherd chars in order to examine how particular vessels may be used. These researchers have also stressed that these practices - farming, herding, and fishing - were also complimentary, entangled, and embedded (Bruno and Moore 2008; Capriles et al. 2008). While this research on foodways is ongoing, it is important to link the shifts in ceramics with these bigger changes. After a brief discussion of some of these trends, I will turn to discuss the relationship of these shifts, the appearance of maize on the Peninsula, and connection of these food trends to the Late Formative ceramic assemblage.

9.31 Landscape intensification

Understanding the changing agricultural practices prior to the Tiwanaku state is important for a study of ceramic production and consumption since they likely had an impact on agricultural yield, and thus changed specific needs for containers. As we saw in Chapter 2, raised field agriculture is one of the major components of the Tiwanaku state, used to sustain high population levels and as a monumental display of political power and organization. Some scholars have suggested that the use of raised fields was also predominant during the Middle and Late Formative period.

Maria Bruno's palaeoethnobotanical work on the Taraco Peninsula questions this simple scenario by examining carbonized materials from the Early through Late Formative Periods, primarily from the site of Kala Uyuni, but including some data from Sonaji and Kumi Kipa. Bruno traces the processes of intensification on the Taraco Peninsula, arguing that the dry land agriculture of the Formative Period is just as significant, in terms of yield, as the monumental raised field agriculture and the water management associated with the Tiwanaku state. She has found evidence for intensification practices that are especially apparent during the Late Formative Period, including moving and manipulating soil, increasing soil fertility, diversifying production and the protection of crops.

Examining evidence for soil manipulation, she finds an increase in agricultural weed species (the Asteraceae, Brassicaceae, Fabaceae, Malvaceae, and Poaceae families) through time (Bruno 2008: 461) including the appearance of new species during the Late Formative. In general the Late Formative plant assemblages of Kala Uyuni, Kumi Kipa and Sonaji have more taxa present in the population than during the Middle Formative. Bruno suggests that these changes are occurring across the Peninsula and are due to increased soil tilling, and potentially a reduction of fallow time (ibid 462-467, 470). Bandy's finding on the trends in stone tools, specifically the increase in stone hoe fragments through the Formative periods, supports the palaeoethnobotanical findings for landscape intensification.

9.32 Shifts in diet

Due to preservation issues, Bruno was only able to definitely say that several crops were diversified during the Formative period: tubers and domesticated quinoa. The latter increases slightly in ubiquity during the Late Formative Period (Bruno 2008: 477). However tubers, in particular Solanum sp. increases, suggesting an increase in a particular type of agriculture through time. "Perhaps this is evidence that tubers began to have a more important role in Late Formative period farming. A hypothetical scenario could be that Early and Middle Formative period farming focuses on quinoa, with only limited tuber agriculture. Perhaps the importance of tubers increased in the Late Formative period and there was a greater mixture of the grain and tubers." (Bruno 2008: 480). Amanda Logan did find what appears to be a tuber starch grain on a bone tool recovered from a Late Formative I context at Sonaji. Significantly it had characteristics that are common in potato starch grains that have been freeze-dried (lacking lamellae, an obscured extinction cross and appears flattened) (Logan 2006: 57). Chiachin Oduor

(2008) has recently found further support for the presence of freeze-dried potatoes, or *chuño*, in Middle Formative contexts at Chiripa. This evidence suggests that production of freeze-dried potatoes was occurring during the Late Formative. It may well be that similar bodily practices were employed during the Formative in preparing *chuño* and clay, as Sillar (2000) has suggested in his ethnoarchaeological work.

There is tantalizing evidence for the arrival of maize in the Lake Titicaca basin during Formative Periods. Logan (2006: 102) identified diagnostic maize starch grains on ground stone from Middle Formative Period contexts at Chiripa, and phytoliths in soil samples and on the teeth of an individual buried in the Middle Formative area of Kala Uyuni. Logan also found maize phytoliths in a Tiwanaku I ring-based bowl from Kumi Kipa (locus 6782; Figure 9.20) (Logan 2006: 103, 158). Melanie Miller's (2005) analysis of isotopes from Late Formative human bone found a few higher C4 values, which is a good signature for increased maize consumption. Bruno found only a small amount of maize during this period, and thus believes that maize was not a local crop at this time. She suggests that maize was not locally grown, but likely was traded into the Titicaca Basin. More specifically, she argues that its presence on grinding stones suggests it may have been prepared for a beverage such as the fermented drink chicha.

It is important to mention that Logan (2006: 159) found possible maize phytoliths in Early Formative contexts as well, suggesting that this trade was occurring for some time. These are only possible maize phytoliths; she points out that many grass species are "local wild confusers", and therefore both archaeological assemblages and local wild taxa must be examined (Chávez and Thompson 2006) (contra to Chavez and Thompson 2006, see Logan 2006: 78, 80-81). By Tiwanaku periods maize is arriving from colonies in the lowlands (Hastorf et al. 2006), and is likely being consumed as chicha in the keros discussed above. Although it is found in quite high amounts across the site of Tiwanaku (25 % presence), the locally grown Chenopodium (quinoa and canihua) and tubers were always more important, and were likely staples in Formative Period diets (Wright et al. 2003: 389-390).

Figure 9.20: Late Formative I ring based "annular bowl" recovered from Kumi Kipa event KK A108 (mixed locus 6782, thus not included in my sample) that contained maize phytoliths. Photo adapted from Logan (2006: 155, figure 10.2).

Ongoing TAP foodways research suggests that while camelid consumption increases through the Late Formative, fish consumption decreases. Kate Moore's research on the large mammals in the TAP assemblages has made the important discovery that there were three classes of camelids during the Late Formative Period. Furthermore, she has found that the average age of large and medium sized camelids drops between the Middle and Late Formative periods, suggesting that the camelids were increasingly used for meat. The age of the smaller class of camelids, in contrast, increased in average age at death. Moore believes that this shift in age of death is related to the use of these smaller animals primarily for their fiber. Moore's research suggests an increased management of camelids, and a greater reliance of camelid meat in Late Formative diets. Bruno (2008: 482) finds support for this perspective in the botanical data. The shrub Tetraglochin cristatum is found in the Late Formative botanical remains, a plant that today signals overgrazing.

A final shift in diet may be found in changes in use of the lacustrine resources. Capriles Flores finds that fish are extremely important in both the Early and Middle Formative Period (Capriles Flores 2006: 53-55; Capriles Flores et al. 2007). By the Late Formative, there appears to be a decline in the importance of fish, but an increase in the capture of waterfowl (Capriles Flores et al 2008).

In summary, we see four important shifts in foodways and greater economy in the Late Formative Period archaeological record of these three Taraco settlements. First, it appears that the landscape is being worked more intensively. Second, we see certain plants being relied upon more heavily, with tubers in particular being more important relative to quinoa grains. Third, while maize is increasingly more ubiquitous, it does not appear to be locally grown, and can perhaps be thought of as a luxury food (Hastorf 2003). Fourth, and finally, we see changing patterns in meat consumption, with decreasing fish use and an increased reliance on water birds and camelids, in particular the consumption of large and medium camelids at a younger age.

9.33 Cuisine and ceramic choice

Although these shifts through time should be used cautiously, especially as analysis continues and particular variability may stem from contextual variability, all of these data may suggest changes in cuisine over time. At this point we cannot focus on the particulars of this cuisine changes, but particular foods seem to have been differentially stressed. Many changes in cuisine, such as the increased production of potatoes, may not have had an immediate impact on production choices for serving vessels. For example, many Andean cooks today prepare potatoes by boiling them and presenting them on a textile rather than preparing a specific meal within a special ceramic vessel (Johnsson 1986).

Nevertheless, it is more than likely that the changes in craft production sequences, including basketry, wooden cups (both of which were likely present but do not preserve) and ceramics, were entangled with these subsistence changes. This may help highlight which ceramic changes are linked to broader social changes, and not simply due to learning slippage within particular production sequences (Roddick and Hastorf in press). For example cooks may have changed how they chose to cook potatoes, relying on the new micaceous paste recipes, and perhaps choosing to cook above the fire in pots rather than in the fire. Future work on sooting patterns should continue to examine the ideas suggested by Steadman for the Northern Basin.

Serving activities may have also been changing. Researchers at Tiwanaku have found that while cooking vessels appear to be similar throughout the sequence, greater diversity is seen in storage and serving wares. These changes were linked to an increased reliance on the drinking of fermented beverages, and the social context of food presentation. Both Chenopodium and maize were more available during the Late Formative, suggesting the possible specialized consumption was becoming more central to social and political practice. We see the introduction of new vessels throughout the Late Formative, particularly an increased diversity of local bowl forms, specifically with new deep forms that would have been ideal for drinking practices.

9.4 Frames and embedded communities of practice

In this chapter I have worked towards viewing the social life of Late Formative ceramics by defining how they were used on the Taraco Peninsula, paying particular attention to production choices vis-à-vis use, sooting patterns, and context of recovery. I found that the Late Formative assemblage continues to remain fairly generalized, particularly in comparison with later Tiwanaku IV/V phases. However there is evidence that a generalized choice was made for cooking categories. The few Late Formative 2 contexts that we have examined suggest an increased preference for particular types of vessels for particular uses. In the future it would be informative to see how particular carbon patterns vary with form and technological choice in the Late Formative 2; in particular, whether such contexts have a similar low percentage of external sooting, or whether this is simply a result of the contexts TAP excavated.

The contexts analyzed from Kala Uyuni, Kumi Kipa and Sonaji do not offer overwhelming evidence to suggest large-scale feasting for the Late Formative period. While there are particular fancy, red painted ceramics, likely manufactured for serving, they are not discarded in higher density in specific settings. There are particular contexts where slightly higher densities of incised sherds were recovered, however these numbers do not seem significant of particularly large moments of public consumption. Moreover there are only a few cases of large vessels, and the limited quantity of these vessels is not evocative of competitive feasting and commensal politics that define later periods.

We do need to recognize the importance of “looking up” through prehistory, an issue I brought up at the beginning of this dissertation. I must look at the Late Formative assemblage from its own particular historical setting. One way to explain the significance of vessel use during the Late Formative is to return to the issue of framing. In Chapter 3 I argued that Daniel Miller's (1985) idea of framing is a useful term to shift our interpretation of particular vessels as definitive status markers or categories for feasting, to consider them rather as social cues. Following Miller, the decorated red-rimmed vessels which are found across Taraco sites may have been important in a range of social contexts, including political and ritual events, but not limited to them. Miller's idea of framing forces us to consider what the pottery itself was framing; i.e. what the pots contained, as well as the social (not necessary spatial) contexts themselves.

Figure 9.21: Possible Late Formative II proto-keros: a)"antler" design from Lukurmata (adapted from Bermann 1990: 75, Figure 74), b) Late Formative kero from Lukurmata (adapted from Bermann 1990: 479, Figure 78), c) possible Late Formative II kero from 7698 at Kala Uyuni.

In this chapter I drew upon the work of my colleagues on the Taraco Archaeology Project, to trace the variety of approaches to track shifting Formative foodways.

However, to fully appreciate the diachronic shifts in framing, further analytical work is necessary. A pilot project is currently underway with Dr. Richard Evershed at Bristol University, to extract lipids from the fabric of Middle and Late Formative cooking vessels (ollas) and serving bowls so that we can learn even more about the specific recipes of these meals.

Work in the greater Titicaca Basin suggests that Late Formative II ceramics are quite similar, but are perhaps being used in more discrete social settings. Although there are several new, unique forms and design styles (discussed in Chapter 5, and significance in the next chapter), the functional categories remain similar. Janusek, for example, notes that bowls continue to diversify through time, and that in particular they increase in volume, produced much larger and deeper bowls with horizontal handles. Although we only have a few well-defined contexts dating to this period in the TAP assemblage, there is one ceramic finding that is suggestive of these changing types of practices. In a mixed context from outside of ASD-5, we found a drinking vessel that may represent a Late Formative II "proto-kero" (Figure 9.21c). This vessel is quite similar to those found at Lukurmata by Bermann (1994: 119, figure 9.21a and b) and similar to the Qeya undulating design style, likely influenced by Cochabamba styles and thought to be unique to Lukurmata (Janusek 2003: 53). Although it is unclear at the moment at what point that feasting becomes a politically and socially essential act, it is certainly a central component of social practice by the Tiwanaku IV and V period.

Chapter 10
Summary of the Dissertation

In this final chapter I review the theoretical approach taken in the dissertation, focusing in particular on communities of practice, wider taskscapes, and framing. I will argue that the concepts and methodologies employed here are well suited to explore Late Formative communities. Each of the earlier chapters includes a detailed review of the data and my interpretations; in this chapter I will present my findings within a more integrated narrative. It will also serve as an evaluation of the diverse methodologies employed. After this summary I will consider the applicability of the approach developed in this dissertation for a local and relatively synchronic case study, for broader regional and diachronic questions. First I will consider future work on regional approaches to community and community specialization. I will then take a more diachronic perspective to consider potting, identity, and wider social practice over the longer chronological sequence.

10.1 A new narrative?

I began this dissertation with an overview of the meta-narrative currently employed in much of Titicaca Basin prehistory, which takes a social evolutionary perspective to examine increasing sociopolitical complexity over the *longue durée*. I presented an overview of more than 50 years of research on Titicaca Basin prehistory, much of it taking a "bird's eye" perspective. This substantial research has revealed a deep and complex past in the region, a palimpsest of social, political, economic and ideological processes that likely were occurring simultaneously. Recent research has focused in particular on the Formative Period, with particular focus on the periods leading up to the Tiwanaku urban center and the spread of its material culture throughout the South Central Andes. Most of the research conducted thus far points towards a slow development of this process, followed by an explosive moment, that could be called Tiwanaku's "big bang", somewhere around 500 or 600 AD. Archaeologists are relatively unclear on what was occurring within and between communities right before Tiwanaku "emerged" due, at least in part, to problems with the ceramic chronology of this period. This Late Formative Period was the focus of this dissertation.

I briefly discussed the relationship between pottery sherds and definitions of community in the prehistoric Lake Titicaca Basin. I noted that from the "bird's eye" perspective we tend to see communities as rather bounded social entities, which vary according to the particular narrative taken. I suggested that Titicaca Basin archaeologists have defined communities in terms of religious boundaries (defined by a common religious practice), political boundaries (defined, competed over and maintained by chiefs), and ethnic boundaries (defined, possibly, by a nested sequence of identities using the *ayllu* analogy). My portrayal is perhaps unfair in that Titicaca scholars are aware that these processes are overlapping, but my characterization does show that the ubiquitous pottery sherd plays an enormously important role in defining communities.

Scholars have considered the production of ceramics as reflections of social identities and political and economic inequalities. The use of the ceramics, in the consumption of food, has often been considered in terms of competitive political feasts. Ceramic production and use are rarely investigated in great detail, as Formative Period assemblages tend to be highly fragmented and there is rarely primary evidence for ceramic production. This difficulty of finding data to investigate traditional themes of ceramic analysis in the Titicaca Basin has not helped to develop seriations in the region. But there have been few detailed ceramic studies conducted to track secondary signs of production. This dissertation represents an effort to fill this gap in research into pottery production and consumption in the Lake Titicaca Basin.

This situation – a common narrative, a particular view of community and a lack of detailed ceramic analysis – served as the backdrop for my suggestion for another approach to the Late Formative period. I certainly did not discount the important findings and hypotheses of the current narrative. In fact, I worked from the foundation of much of this empirical research. But I did suggest that we could benefit from taking a different narrative stance, for "if we need more sites, we also need more stories. We need larger plots and more complicated ones'" (Ballard 2003: 145, paraphrasing Landau 1987: 122). I used this critical narrative perspective to argue for the advantages of taking a practice-oriented perspective to examining prehistoric communities. I suggested we see community from an "action in the world" perspective, which may be investigated through an "archaeology of inhabitation". Archaeologists excavate the result of the daily repeated activities (the "genealogies of practice") at Late Formative settlements, and can analyze sequences of particularly socially informed choices by conducting micro-scale analysis on artifacts.

In Chapter 3 I turned to examine how archaeologists have struggled with the complex relationship between community and material culture. I began with an overview of the style debates of the 1970s and 1980s. I used my discussion of design style, technological style and micro-styles to summarize the essential ethnoarchaeological and archaeological research generated by the style debates. Various case studies demonstrate how design style and technological style work in tandem. I argued that Dietler and Herbich's idea of micro-style is particularly effective practice-oriented approach to studying style to define prehistoric "communities of practice".

The term "communities of practice", developed by Jean Lave and Etienne Wenger (1991), drives my narrative and refers to the web of relations among person, activity and world, over time and in relationship with other tangential and overlapping communities of practice. Lave and Wenger posit that all individuals are located in multiple, varied fields of participation defined by multiple communities. They are interested in the process of how skills are acquired in an embodied way, and how identity is completely entwined in this process. I believe that this approach offers a productive theoretical perspective, in contrast with the bird's eye narrative, and deftly navigates the issues of social boundaries; communities of practice do not necessitate co-presence, or socially visible boundaries. But the communities we define archaeologically are about doing things in the world, and are always the result of learning. This literature is an untapped resource for archaeologists who wish to avoid the normative underpinnings of both community and socialization perspectives to learning, and for those interested in the *processes* leading to technological style, which in turn is used for creating fine-grained archaeological seriations.

In the second part of Chapter 3 I demonstrated the utility of an archaeological approach to communities of practice. Far from abandoning the important work on style, the work in situated cognition may help to situate it in a very different framework. This approach moves away from seeing style as either an analytical given or a singular theory of style, towards seeing style as the result of a particular, historically situated social practice. The community of practice approach also is useful in changing our interpretation of seriation, a shift that I believe may be productive in Titicaca Basin archaeology. There is not a single driving force behind change in ceramic style, as those looking for a theory of style suggest. Subtle changes in ceramic attributes are integral results of changing social relations, learning patterns and processes of enskilment.

I then turned to look at the other side of the production story, that of consumption. The relational practice oriented position developed for Late Formative pottery production must be connected to consumption. I suggest that we consider the embededdness of ceramic production in a larger landscape of productive activities, or what Ingold calls the taskscape (Ingold 2001). Both embededdness and the taskscape are extremely powerful concepts that are most likely differentially naturalized for most archaeologists. Few would argue that productive enterprises are isolated from greater social, political or economic practice; that particular tasks are "disembedded" (although see Johnson 1996: 179-201 and critique in Cumberpatch 2001). In fact the entire idea of tracking the development of political entities through potsherds on the landscape, often employed in surface surveys in the Titicaca Basin, shows archaeological awareness to the entanglement of craft production, consumption and larger processes of social life. But this is my very point; we may have moved away from seeing pottery as people, but in some cases we have come to see pottery as a reflection of long-term political processes, and, at least to a point, lost some of the other aspects of social life prehistoric pottery may represent. As Gosden (1999: 121) reminds us, "people and things have no essential properties, [rather] these properties crystallize out of the relationships within which entities are enmeshed (Gosden 1999: 121). I argue that one way to think through the relationship of people and things in terms of community was through the taskscape. If the concept of embeddedness is somewhat of an abstraction, the idea of the taskscape is a framework which permits us to fit particular activities on to the larger landscape. I am particularly excited about some of the implications of investigating Titicaca Basin taskscapes. I will return to some of these issues below.

I do believe that archaeological focus on ceramic use is important. Working from the findings of a small study I conducted at Chiripa (Roddick 2002), I argued that ceramic use, whether in quotidian spaces, or in moments of specialized feasts, may be more inclusively explored in Miller's idea of "framing". On the one hand this perspective suggests that the presence of decorated ceramics is not enough to argue for political feasts, an idea well articulated by many scholars. On the other hand, decorated ceramics are not needed to make particular social occasions important if they are properly framed: filled with the appropriate materials, re-contextualized through ritualization, or even owned by a specific person. Framing thus encompasses both the dichotomies of the large competitive feast and the small family meal, but also includes the many food consumption events in between. It also allows for vessels that may not be conventionalized for particular uses to have more complex "social lives", moving in and out of particular use contexts.

In sum, I positioned my dissertation on Late Formative communities by taking a theoretically distinct approach to the pottery remains. Instead of seeing design and technological style as *reflecting* bounded communities, I see particular ceramics as the result of a series of technological choices, embedded in a wider taskscape, *constituting* particular social identities.

10.2 A Taraco community of potters

The particular perspective described above developed out of my involvement in the larger Taraco Archaeological Project. While my theoretical perspective differs from other members of the project, I think it's safe to say that all participants in the project see the advantage of a fine-grained and integrated approach to archaeological materials. In Chapter 4 I offered a brief overview of the recent history of research on the Taraco Peninsula, focusing in particular on Matt Bandy's (2001) doctoral work that served as the foundation of TAP's more recent research. A summary of TAP's fine-grained methodology showed how the excavators and the specialists, including the ceramic analysts, work together to explore the complex stratigraphy so characteristic of the Titicaca Basin.

I then summarized the 2003-2005 excavations of the project at Kala Uyuni, Kumi Kipa and Sonaji, while presenting the basic ceramic densities and an initial attempt to look at taphonomy from a ceramic perspective. This overview demonstrated that while Kala Uyuni clearly had the best-preserved contexts, including the foundation of three Late Formative structures, Sonaji and Kumi Kipa offered important assemblages from surfaces, pits and middens. There are certainly still issues to be resolved at all three of these sites. Small-scale excavations at Kala Uyuni are planned for the near future, and hopefully will resolve the spatial and temporal relationship of ASD-2, ASD-4 and ASD-5. Further analysis of the pottery, lithics, faunal, and botanical materials may further explain the complexity of the significance of these three settlements. At the moment, these excavations are some of the best examples of Late Formative settlements in the Southern Titicaca Basin making them ideal for a study of Late Formative communities of potting practice.

In Chapter 5 I explored our current understanding of Formative period potting traditions in the Southern Titicaca Basin. We are still in our infancy in understanding Late Formative pottery, but the future does look bright. The ceramic specialists of the region, working with Kalasasaya, Qeya and the many highly fragmented undecorated body sherds, are beginning to include technological attributes and design style. This shift in attention to the entire technological sequence is significant, and may catalyze a new focus, more common in other archaeological regions (Crown 2007; Habicht-Mauche et al. 2006; Hegmon 2005; Stark 2000), of *potters on the landscape*. As I hope I made clear in this dissertation, asking questions of the micro-steps of potters learning their craft does not preclude the construction of seriations, nor investigating wider questions of socio-political life in the region. In fact, I believe that this approach methodologically facilitates the approach, adding a thick-description to our archaeological narratives.

There is no question that we still have many issues to resolve in terms of the Late Formative. I highlighted two particular problems in the second part of Chapter 5. The first problem is the "paste question". Although ceramic ethnoarchaeologists warn of using pastes as a chronological marker, many Formative scholars note that pastes are one of the clearer changes in the Formative period sequence. Why would pastes vary through time? I explored this issue through the rest of the dissertation through both attribute analysis and geochemical approaches.

The second problem is concerned with the absolute dates. John Janusek (2003a) recently presented a compilation and interpretation of a sequence of radiocarbon dates from Tiwanaku and the Katari and Tiwanaku Valleys, and proposed a series of subphases, Late Formative I and Late Formative II. These phases generally correspond the Kalasasaya and Qeya decorated wares, but also with other trends in technological choice. These dates do not completely fit with some of the calibrated dates and ceramic phases defined by Lee Steadman and myself at Kala Uyuni. There is a good reason to revisit the dating of the region before we too strongly reify Janusek's impressive chronological ordering (see, for example, Isbell and Knoblock 2008). Variation in the calibration in C14 dates may be partly to blame, but I suggested another possibility associated with the learning process of ceramic production, or of staggered temporal changes in the sequences of technological choices by potters of the region. From the practice perspective this would be expected; if potting is embedded in other productive practices, and is temporally associated with the larger taskscape, differences are to be expected, and this staggering may be quite meaningful. This hypothesis could be tested as more fine-grained excavations are conducted, more radiocarbon dates are run and further detailed ceramic analysis is performed. If this current situation bares investigation, only then may we further zero in on the social significance of this variability.

In Chapter 6 I presented the detailed methods employed by the TAP ceramics team. Although Lee Steadman's system was primarily constructed with seriation in mind, I contend that it is also ideal for taking a relational perspective to Late Formative pottery. I used the well-used, yet essential idea of the operational sequence to explore the attributes related to pottery production and use. In looking back at my use of Steadman's detailed system, I believe that it could be streamlined. There are certain attributes that served as indicators of similar practices (luster and surface finish for instance), and significantly slow down analysis. The development of the *filemaker* database is ongoing, and I hope to soon have my data in a searchable format for comparative usage by other scholars of the region.

In Chapter 7 I turned to examine the production sequence of the ceramic sample presented in Chapter 4. There is evidence that pottery as produced in all three settlements, likely embedded in other productive practice, distributed across the large taskscape. I, like other scholars of the region, did not find the typical indicators of large-scale pottery production. Excavations did reveal ceramic production tools in association with other remains from outdoor work areas. In an ideal scenario it would be possible to present the entire operational sequence for all three Late Formative sites, and to isolate those steps with statistically relevant variation. This was impossible with the fragmented assemblage (and the low number of diagnostic rim sherds that could be assigned to specific form categories). My approach was to concentrate on the steps of the operational sequence that could be studied.

I found that Late Formative sherds were likely coil built, although in most cases the evidence for this coiling is destroyed by surface finishes. The assemblage consisted of jars, ollas, and an especially diverse bowl category, and all three categories included a decorated component, usually consisting of a red slipped band, but in a very small number of cases, incised patterns. With the exception of the decorated wares, the vessels were not as heavily burnished as earlier ceramics, and the interiors in particular were wiped. Firing cores, the re-firing of ceramics and Bruno's palaeoethnobotanical work suggests that the vessels were prepared dung fires that created an oxidizing, or semi-oxidized environment. Little variability was found in the ceramic attributes between the Late Formative assemblages from Kumi Kipa, Sonaji and Kumi Kipa.

The pottery from all three sites, however, is indicative of skilled practice. While measuring skill is clearly difficult, measures of consistency, errors and accidents can be informative (Michelaki 1999: 250-264). There is consistency across much of the Late Formative ceramics studied here, in terms of the learned bodily practices as well as the attention to detail in preparing pastes and clays. I have had the opportunity to examine the assemblages from other sites in the region, and the Taraco pottery (in particular the undecorated assemblage) appears to be more finely finished, with more consistent thicknesses and surface finishes. The control of a relatively consistent firing atmosphere, in particular for the decorated vessels, suggests that there were skilled craftspeople at work during the Late Formative. I will return to consider the implications of this below.

I highlighted some of the important changes from the earlier Middle Formative Period in these technological attributes, including vessel form, thickness, and surface finish, all of which indicate changes in bodily practice, and likely shifts in greater social practice. Some of these bodily changes were likely the result of slippage in the learning over generations of practitioners. Other attributes, the result of clear technological choices, were likely more discursive. Following the findings from scholars discussed in Chapter 5, and Steadman's local work on the chronology, the attribute of paste from the TAP sites was found to be particularly indicative of changes from the Late Middle Formative through Late Formative II.

In Chapter 8 I followed up on this question of paste, focusing on the potters in their greater taskscape. In order to investigate these issues I employed a suite of techniques, some of which have not been employed in the Titicaca Basin before. The subjective tests that I employed, which included tests of plasticity and oxidation colors through re-firing, are cheap techniques that can offer important information. If used in the future in other sites of the region the results presented here may be even more meaningful. X-ray diffraction is a more expensive technique that offered an empirical perspective on the raw materials, and may be useful in more detailed examinations of firing temperatures. X-ray fluorescence was not ideal on the heavily tempered ceramics, but may be more revealing in regional studies of the compact pastes (see below). The neutron activation data, which is still being analyzed and will soon extend to a more regional perspective (see raw data in Appendix 3), appears to show little variation. Petrography may have been the most revealing of all the compositional approaches. This time intensive technique offers a glimpse into the significance of the time sensitive tempers. I only conducted a small, qualitative study here, but hope to develop a more regional petrographic approach in the future.

These techniques were employed to answer a series of specific questions related to the paste recipes. Where were potters accessing their materials? Was there local variability? How might their local landscape constrain or enable the technological choices of particular Taraco communities of practice? The local raw materials survey, and the series of subjective and empirical tests, found an abundance of high quality potting clays. There are no potters actively working on the Peninsula today, but local Tiwanaku potters informed me that these montmorillonite, kaolonite and illite mixes are ideal today when tempered with local sands or grasses. These clays appear chemically quite similar across the Peninsula, and may explain why little variability was found in the XRF results from these sites. The geochemical findings, however, should be tempered (pun intended) by the fact that the inclusions make non-destructive XRF analysis problematic.

These tempers, however, are essential for those making pottery from the locally available clay. A re-firing test found that these clays oxidized to similar colors as the prehistoric pottery, but also confirmed the need for tempers. A small petrographic study is suggestive that prior to forming their vessels, Late Formative potters would have prepared tempers for the inclusion in their paste recipes. While the earlier Middle Formative potters preferred the use of grass and sand, by the Late Formative, sand, and in particular micaceous sand, was chosen for potting purposes. This is part of a wider constellation of practice throughout the Titicaca Basin.

I also found that volcanic ash was being deployed in some cases. One hypothesis, in need of investigation, is that such material was imported from *Cerro Ccapia*, a volcanic peak just west of the Taraco Peninsula, with symbolic and ritual significance today and likely in the deep past. Wider research on Late Formative ceramic motifs and architectural layout would suggest that during the Formative and Tiwanaku phases the local peaks had deep significance and were indexed through a range of material practices. It is clear that the technological choices of Taraco communities of potters were embedded in other types of activities, and we would benefit by considering these aspects in future research.

10.3 Late Formative consumption practices

In Chapter 9 I made a first step towards considering the use of pottery vis-à-vis broader social life on the Taraco Peninsula. I focused here on foodways and in particular specialized political moments of public consumption. This choice was appropriate in the context of the Taraco Archaeological Project, with its multifaceted and multiscalar approach to foodways. Bandy, whose survey work and interpretations framed much of TAP's excavations, has argued for the role of feasting in the political processes on the Late Formative Taraco Peninsula. However addressing the relationship of pottery, food, and wider social practice is a particularly difficult task due to small number of reconstructed forms and the extremely limited research conducted elsewhere in the region.

To deal with these limitations, I worked from a foundation of Middle Formative and later Tiwanaku IV/V vessel use. I used this information cautiously, particularly after my argument for "looking up" in Chapter 2. This overview highlighted some of the extraordinary shifts that occurred during Tiwanaku IV and V phases. The Middle Formative assemblage includes a few specially manufactured ceramics for specialized use, but for the most part is a generalized assemblage that may have been equally important in both daily use and special occasions. Vessels are not very diversified, and there is no sign for larger vessels being used. It does appear that those pots manufactured with some kinds of pastes were preferred for some occasions, but the trends are not overwhelmingly strong. Although some maize does appear during this period, it is neither widely available, nor a central part of daily practices. Ongoing work may elucidate more ritualized framing of this historically "prestige food".

I suggest in Chapter 9 that the Late Formative potters continued to manufacture their vessels for a relatively unspecialized use, albeit making different choices in production. There are some important exceptions in the appearance of some new forms, including the "annual bowls" and, in one special case likely during the Late Formative II phase, the "proto-kero", both of which may suggest important changes in particular contexts of ceramic use. The more subtle changes, as seen in both the ceramics and the wider taskscape of foodways, may also point towards important social reorientations. The major shift for the Taraco sites is seen in the diversity of bowl forms, with a particular diversity seen in deep bowls. These vessels, like the annular bowls, are not exclusive to particular depositional contexts. We do not find any evidence for large vessels being used for the preparation process. In general there was little intra-site variability in the use of ceramics.

This lack of evidence, however, does not mean they are not used in special occasions. As Hastorf and Weismantel (2007) have pointed out, the everyday meal and the large political feast lie on a continuum, and presenting foodways as a dichotomy is not always productive. Framing may be one way fit this fairly generalized assemblage onto this continuum. This means that bowls and ollas may have been used freely across both special moments of group consumption, and more quotidian use. It may be that the decorated Kalasasaya vessel was produced (or imported, see below) for a use in a broader use. The decorative elements may have had a level of iconicity (Joyce 2007) permitting quick interpretation by those using the vessels, but may not have restricted their use in other acts of serving. Another likely possibility is that feasts simply did not focus on the ceramics, that this material was not the framed to the same degree as another material item. Large communal meals may have not required a specialized ceramic assemblage, but rather may have been presented on a textile. Future work of TAP paleaoethnobotanists, zooarchaeologists and bioarchaeologists will offer a more multi-dimensional data set, hopefully to present a more embedded perspective of this range of consumption activities. The pilot study of organic residues in Late Formative pottery, currently being run by Dr. Richard Evershed of Bristol University, may be particularly informative.

10.4 Regional perspectives: Constellations of practice and taskscapes

One of the most significant findings of this dissertation was the similarity in ceramic material between the three Late Formative sites. My analysis of ceramics from the sites of Kala Uyuni, Sonaji and Kumi Kipa uncovered an assemblage indistinguishable from each other in terms of both technological and design style. Raw materials, tools for manipulation, gestures and movements appear to have been organized in a similar operational sequence for most of the pottery. Ultimately this is not too surprising, as these settlements are not too far apart from each other. However this study lays the groundwork for beginning to move outwards, from a cluster of sites, to a more regional study. Now that I have defined one Late Formative I micro-style between the three sites, likely representing one community of practice, we may extend outwards looking for disjunctures between communities of potters and their learned operational sequence.

One exception to the similarity in the assemblage is seen in the ceramic produced using pastes 5 and 6, those compact recipes often used to manufacture fancier vessels. While not varying between sites, and similar to those manufacture in the other non-micaceous and micaceous pastes, the sherds manufactured in the compact pastes appear to have been finely made, and in a more controlled firing environment. These vessels are a prime example of skilful practice during the Late Formative. But were they locally produced? To answer this question Titicaca Basin scholars will need further detailed local analyses across the larger region.

Taking a regional gaze on the Late Formative at this point reveals a relatively common potting grammar across the Southern Titicaca Basin during the Late Formative Period. Even though clay resources are bound to have varied substantially over the region, a review of the available scholarship appears to suggest significant similarity in choices being made (Chapter 5 and 7). For instance, other scholars note an increase in non-fibrous micaceous pastes through the early part of the Late Formative, and then a subsequent increase in non-micaceous pastes in the later part of the Late Formative. The published scholarship demonstrates the similarity the Kalasasaya design style throughout the southern basin, although certain sites do appear to have higher densities of this material. These researchers note that the decoration of the surface of the pot, the most technically unconstrained moment in manufacture (Robb 2007: 180), appears to be the most consistent.

A major problem in evaluating the significance of these vessels is that we must seek to define the subtle variability resulting from their operational sequence. Until detailed comparative images and databases are available, it is difficult to ascertain whether a Kalasasaya red rimmed vessel from Kala Uyuni and another Southern Basin site are being widely produced in a constellation of practice –several communities of practice sharing similar technological choices. Titicaca Basin archaeologists would certainly benefit from a more regional detailed attribute analysis for both practical purposes of seriation building, but also for asking questions of regional variability.

For instance, the idea of the taskscape sets up some particularly evocative questions regarding regional heterogeneity and homogeneity in pottery production. If pottery production is embedded in wider practice and part of a broader taskscape, it would follow that particular taskscapes would affect production choices. While potters of the Late Formative appear to have made similar choices, I wonder whether the taskscapes of potters living further from the lake, or further from clay sources, had different operational sequences. If we find little variability in pottery (or tools), this may suggest a very different organization and interaction of Late Formative potters. In addition to further fine-grained attribute analysis, a regional database on raw material availability would certainly make local perspective much more meaningful. The types of questions that could be considered from further regional geochemical studies are also quite exciting, particularly in considering the movement of both raw materials, such as mica, and finished products.

Would different seasonal tasks, different temporalities on the landscape, affect their choices? Melissa Hagstrum's (1989) detailed ethnoarchaeological work in the Peruvian Andes, in particular, speaks to this seasonal variability. In particular she notes the complimentarity between farming and potting in the Andes, where the rainy season can structure the timing of particular activities (Hagstrum 1989: 362). This is an important issue to consider in the context of shifting agricultural strategies of the Late Formative (Bruno 2008), which would have encompassed different labor requirements and activities as the very nature of the taskscapes changed. Hagstrum (1989: 84-91) also notes the development of tool kits that encompass both the farming and potting lifestyle. Changes in the types of tools employed for changing agriculture within Late Formative settlements may have affected the choice of tools employed in ceramic production sequences.

10.5 Regional perspectives: Community specialization?

In Chapter 8 I suggested that the ceramics from Kala Uyuni, Kumi Kipa and Sonaji were locally produced on the Taraco Peninsula, where similar clays had been found (in some cases with the characteristic red inclusions in the "buff" clay), and the banding representation seen in Kalasasaya vessels was found replicated in clay deposits. It may be that specialized communities produced these vessels. Community specialization refers to "autonomous individual or household-based production units, aggregated within a single community, producing for unrestricted regional consumption" (Costin 1991:8). Scholars have noted a high number of cases of community specialization in the Andes (Mischkin 1946: 434; Shimada 1987; Tschopik 1946; Sillar 2001: 126). This propensity can be attributed in part to the ecological diversity of the Andean region, but is also the result of historical interdependence between particular geographic communities of practice (see, for instance, Murra 1972). There certainly would have been such a relationship between the potters of Kala Uyuni, Sonaji and Kumi Kipa in the past.

One way to explain the emergence of specialized communities may be examined by considering the embeddedness of other specialized economic practice. For instance, communities of potters may take advantage of specialization in subsistence and food preparation, by connecting their crafts to local food goods and thus providing a market for their vessels (Arnold 1998: 359). Another possibility sees specialization as a process of nucleation through shared practice. Communities of practice often come together to share tools or labor. With pottery manufacture, potters may nucleate (Costin 1991: 14) due to labor needs and to share fuel for firings. In such a scenario potters aim towards standardization since the same paste recipes can be used and learned bodily actions can be applied in forming and decorating vessels. Such nucleated production reinforces a particular ceramic tradition but also may result in community specialization (Sillar 2001:73-81).

This process of nucleation is further reinforced by demand from consumers. Once a community of producers' micro-style becomes standardized, and recognized as an important ceramic tradition, consumers may distinguish "reputable pots" (Sillar 1997), after Chávez (1992). Such pots serve as a sort of guarantee in social interaction and economic transactions. Sillar describes a group of itinerant Andean potters visiting a new community with their wares. The traveling potters are initially given a hostile reception, but the recognition of their goods helps to establish hospitality. "Knowledge of 'reputable' pots is itself a kind of contract, and the goods themselves create a bond through the consumer's knowledge of the producer's wares." (Sillar 2000: 79). It may well be that the Kalasasaya vessels became such reputable pots during the Late Formative, especially if their use lives included "framing" of new cuisines and beverages. Again, we require further attribute analysis, raw material survey and geochemical work to further investigate this idea.

10.6 A narrative of learning, choice & stylization

More work is certainly needed to define the significance of Late Formative design and technological styles, and to distinguish the micro-styles produced by communities of potters throughout the Southern Titicaca Basin. Such a fine-grained approach, however, does not preclude consideration of the changes over the long term. In fact, as mentioned above, I believe that the approach advocated for in this dissertation has many advantages for diachronic studies. This is particularly true when thinking about the development of both technological and design style over the longer term.

In Lechtman's (1977) discussion of technological style it is the relationship among various attributes of a particular technology that creates a style, which in turn had potential messaging roles on the larger scale. This has important implications for the meaning of particular technological choices over greater time and space. From such a perspective the initial choice of a paste recipe, such as micaceous sand, or a particular painted design, such as a red band, may have been chosen for a particular purpose (such as temper for a thinner cooking pot). However this initial use does not necessarily correlate to its use over time. The micaceous use of an early cooking pot may begin to be associated as a reputable pot, or be associated with an important point on the landscape. Although we may never know the reason for this initial shift, or ultimately the meaning embedded in a particular choice, we can track how these particular learned disposition in pottery making had over generations of practitioners.

This particular process for the increased deployment of design style could be called "stylization", whereby ceramics being to carry further iconographic elements, likely used for ideological and identity politics. Although we see pottery from Middle Formative Chiripa loaded with iconography, this process of stylization on ceramics truly begins during the Late Formative, and appears to be a regional process. For instance the zonally incised ceramics of the Late Formative I appear to draw on themes from Pukara in the Northern Titicaca Basin, and perhaps also from the Paracas pottery on the Peruvian coast. Other design styles, such as those of the stepped motifs, perhaps indexing sacred mountains, may in fact be more locally oriented.

By Late Formative II, sometime after the primary occupation of Kala Uyuni, Sonaji and Kumi Kipa, ceramic iconography appears to have changed in its significance. There is anew stress on mythical creatures. Janusek has suggested that the limited distribution of these vessels may be due to limited use by ritual specialists (Janusek 2003a: 54-55). By approximately AD 500, the stylization process exploded at Tiwanaku. By this point, design style, technological choice, and consumption practices appear to be entangled with both group identity and new consumption practices (Janusek 2002). As we saw in both in Chapter 2, and Chapter 8, it is clear that this use of design style by Tiwanaku times served to both create and maintain boundaries and hierarchies.

It is often the case that Titicaca Basin archaeologists have sought out the chiefs attached to the pottery, or the emergent leaders. In fact a quick survey of recent dissertations being produced in the region finds the majority explicitly examining the emergence of leaders. This is not surprising when we consider Tiwanaku - a large urban center with large scale monumental architecture and highly sophisticated craft producers appearing out of nowhere in a difficult environment.

However we are beginning to realize that Tiwanaku did not appear out of nowhere, that the Formative Period was also a socially, politically and economically complex period. This dissertation has shown the importance of pottery in understanding that process, and has argued for the importance of thinking about the many hands that created those pots. Clearly communities of potters, as people learning to craft, and in the process maintaining and developing particular identities, should be an essential part of this narrative. Throughout this dissertation I have stressed that learning is important to stress through time and across space, and we cannot lose site of these people in tracking this stylization process.

In fact, the early stylization process may be connected to the identities of communities of potting practice. As new technologies and techniques develop through the Formative Period, the idea of skill is likely becoming more prioritized. As Pálsson (1994) and Ingold (2001), among others, have pointed out, learning a skill requires the recognition of what is a skill. When does identity and skill coalesce? When does the idea of a potter become important (Michelaki 2008)? There certainly are indications by Tiwanaku IV times that potting skill was recognized, with particular neighborhoods defined for specialist potters. In these areas there is evidence for potters using molds at Tiwanaku, which have real implications for thinking about embedded production, the changes in learning within the "domestic mode of production" (Sahlins 1972), and potter's relationship to the larger taskscape, not to mention the significance of increased production.

In this dissertation I have not examined the political, economic development of institutions. I am not arguing that there were no chiefs, or hierarchies at work in the region. Nor am I suggesting we stop focusing on how particular political entities come about. I am suggesting that we take seriously micro-scale processes and consider the practices of the potters, the cooks, and the farmer-herder-fishers, who after all, were those who lived the role of leaders. I believe that future research would benefit from taking this approach, and ideally some of these methods, to a wider region and to examine the histories of particular communities of practitioners through time.

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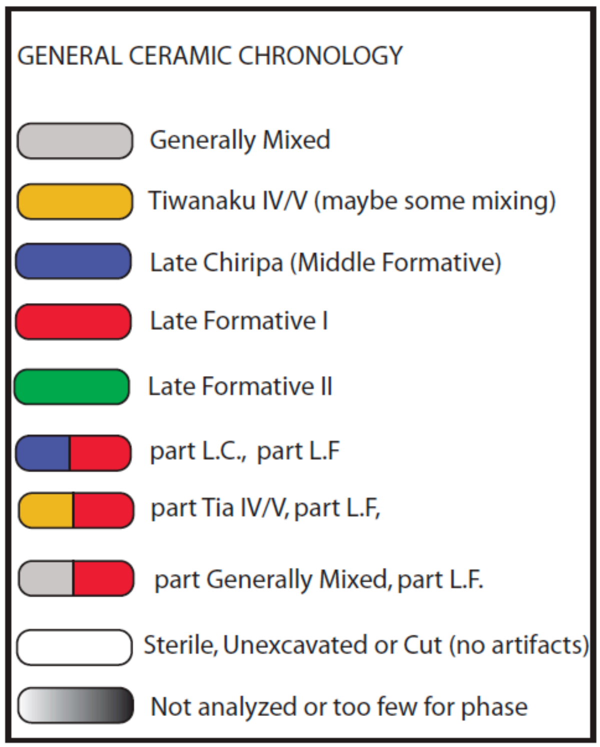
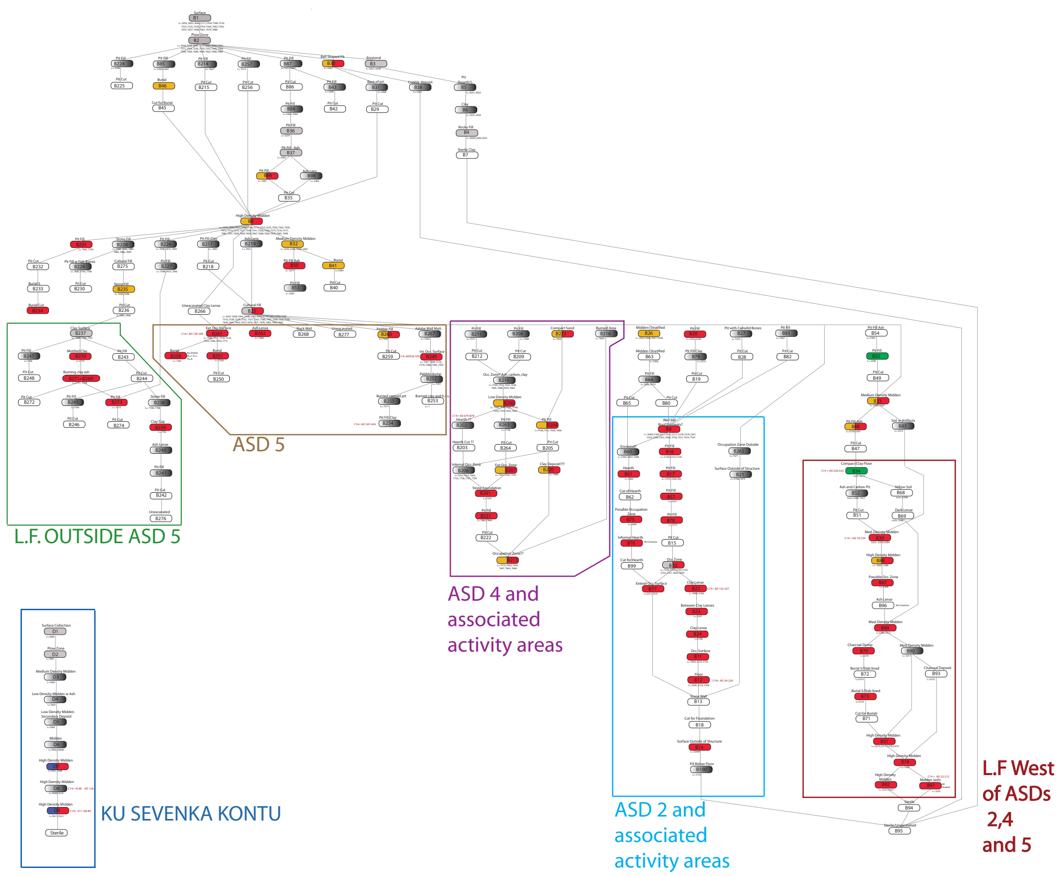
Appendix 1:
TAP Harris Matrices

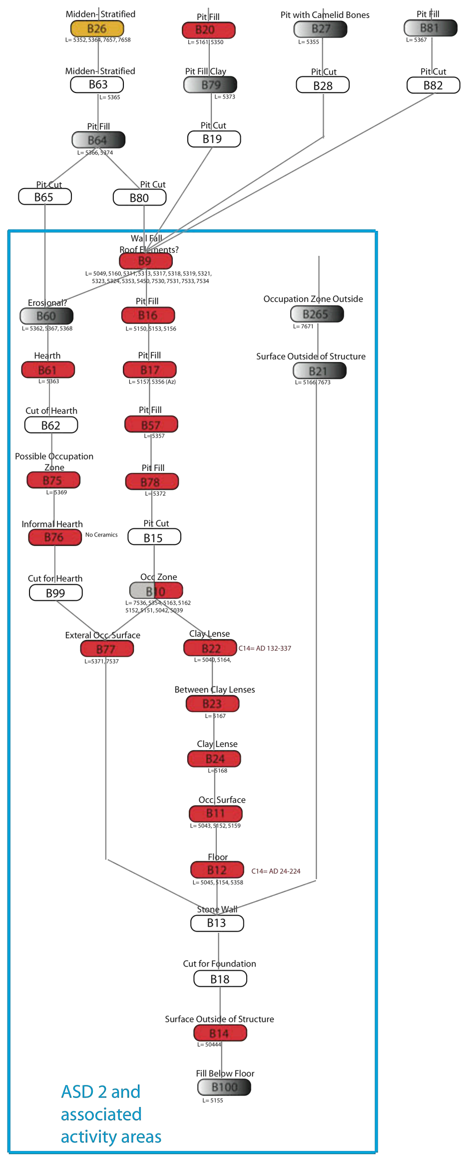


Legend for TAP Harris Matrices

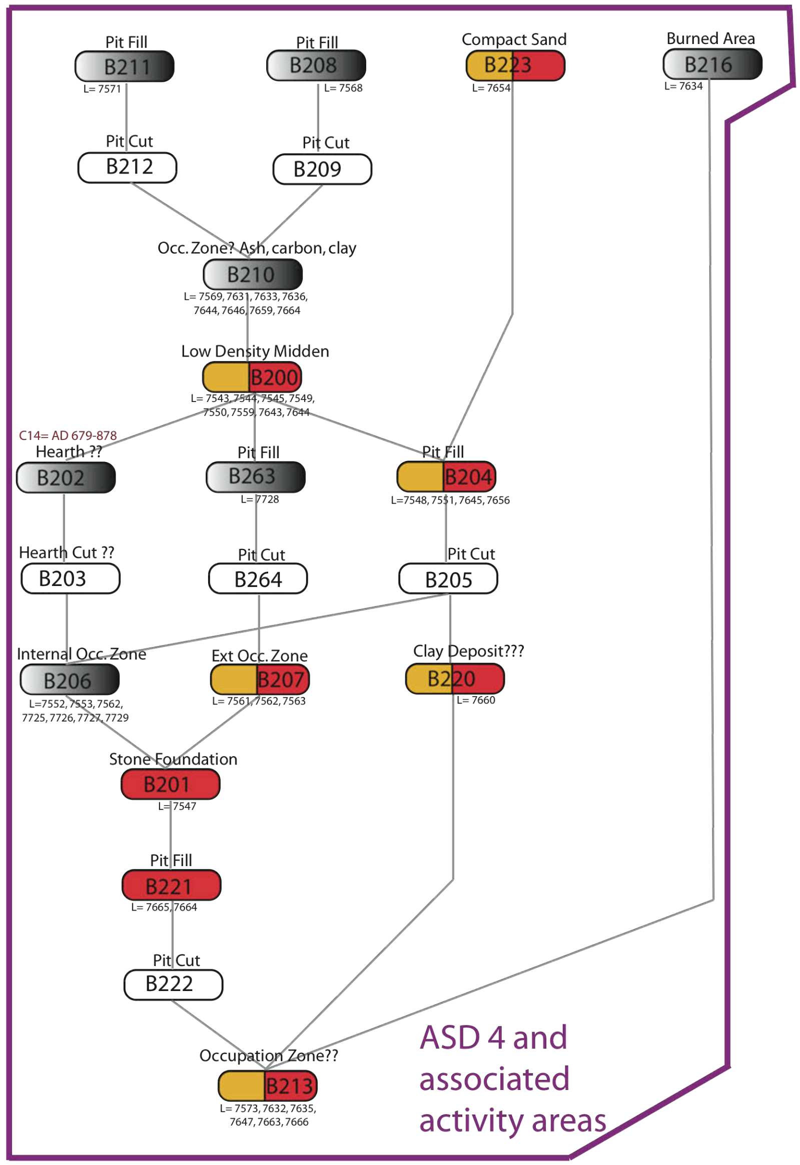
KALA UYUNI (KU AND SK) EXCAVATIONS (2003, 2005)



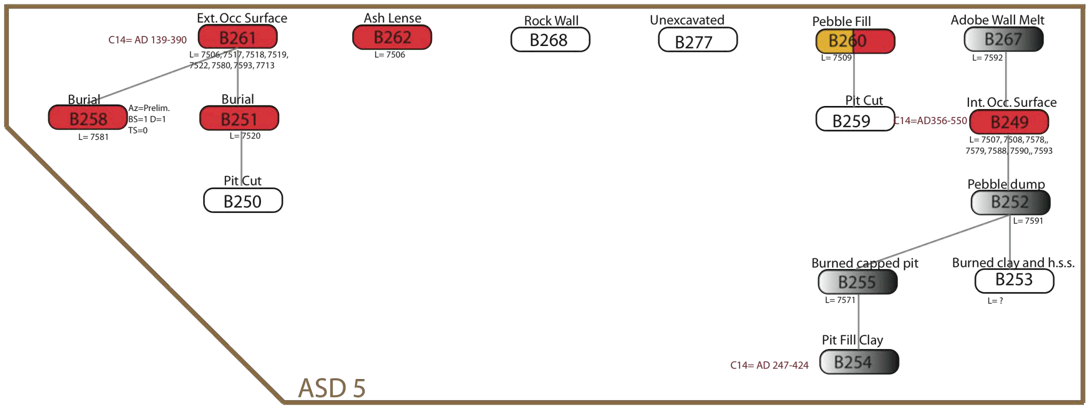
Harris Matrix for the site of Kala Uyuni



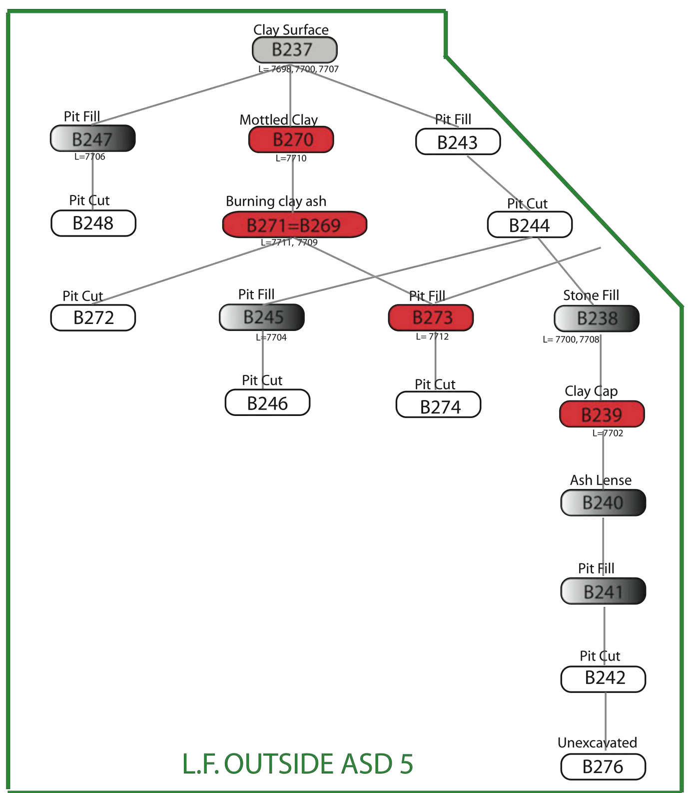
Harris Matrix for KU ASD 2



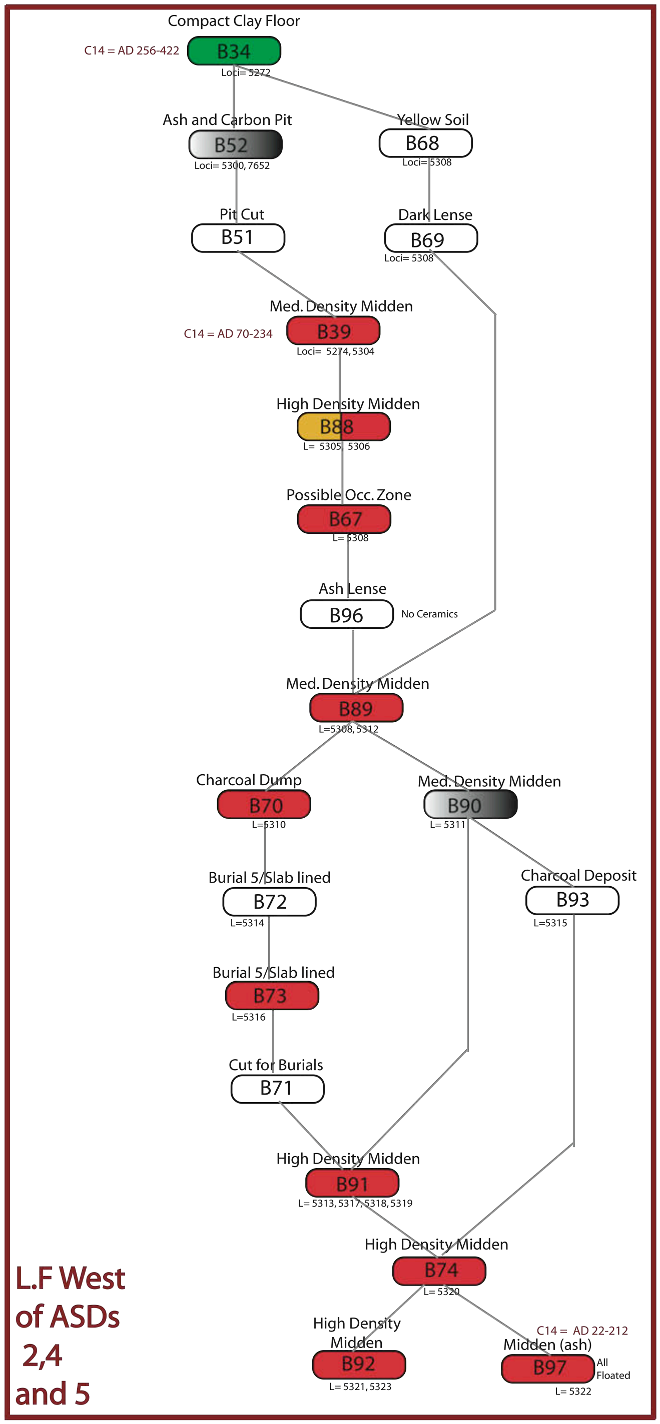
Harris Matrix for ASD 4 and associated Late Formative activity areas



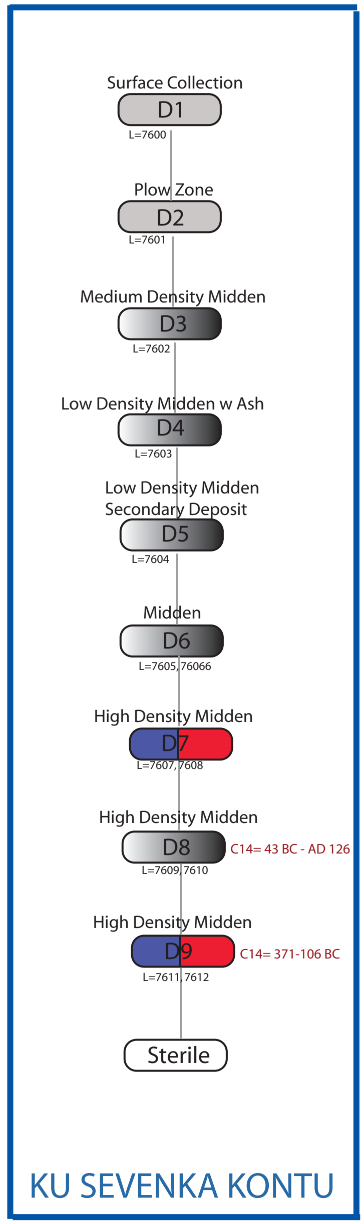
Harris Matrix for ASD 5 at Kala Uyuni



Harris Matrix for the Late Formative deposits outside (to the west) of ASD 5

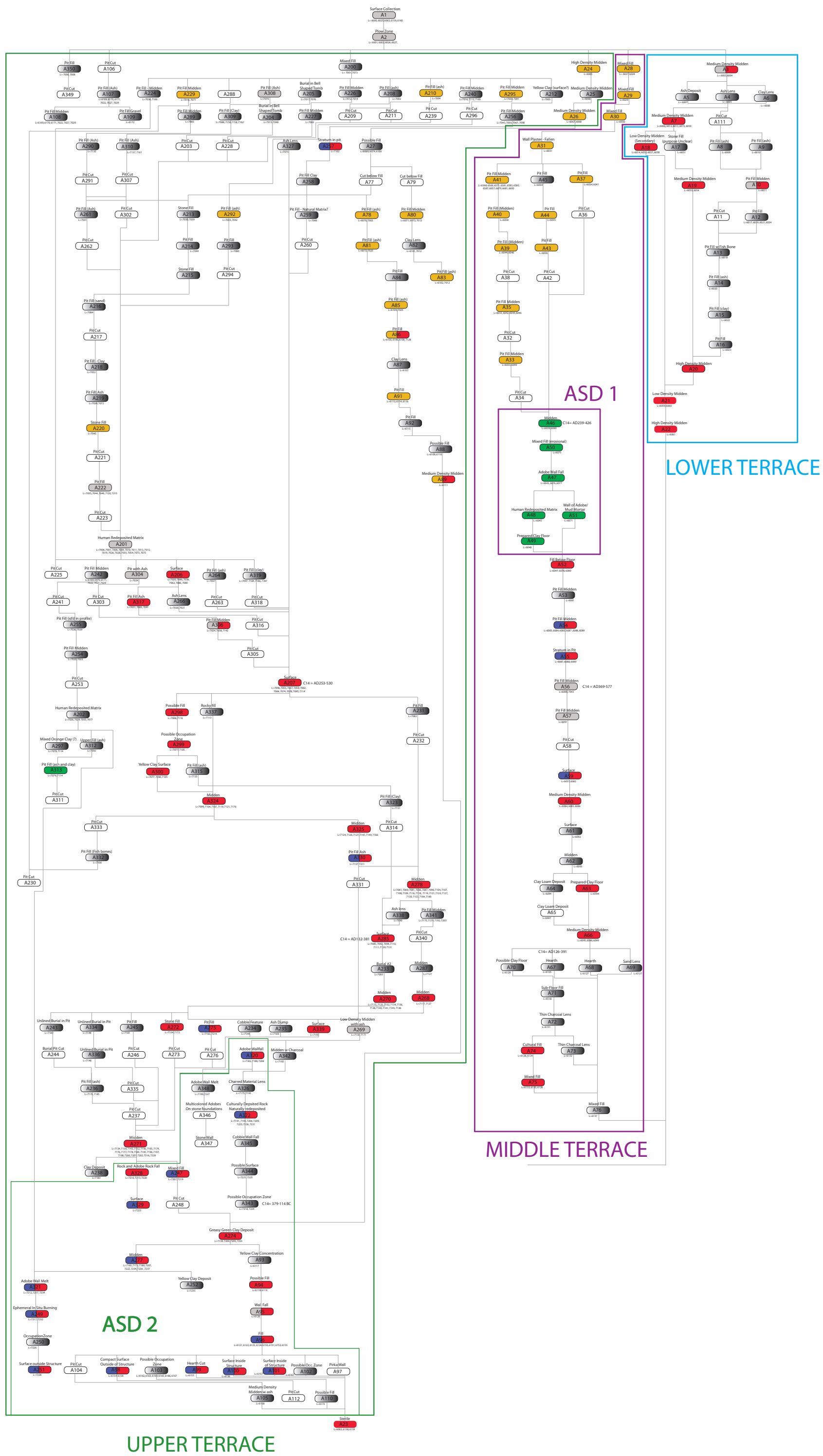


Harris Matrix for the Late Formative deposits of unit N894 E639 (west of ASDs 2, 4 and 5) at Kala Uyuni

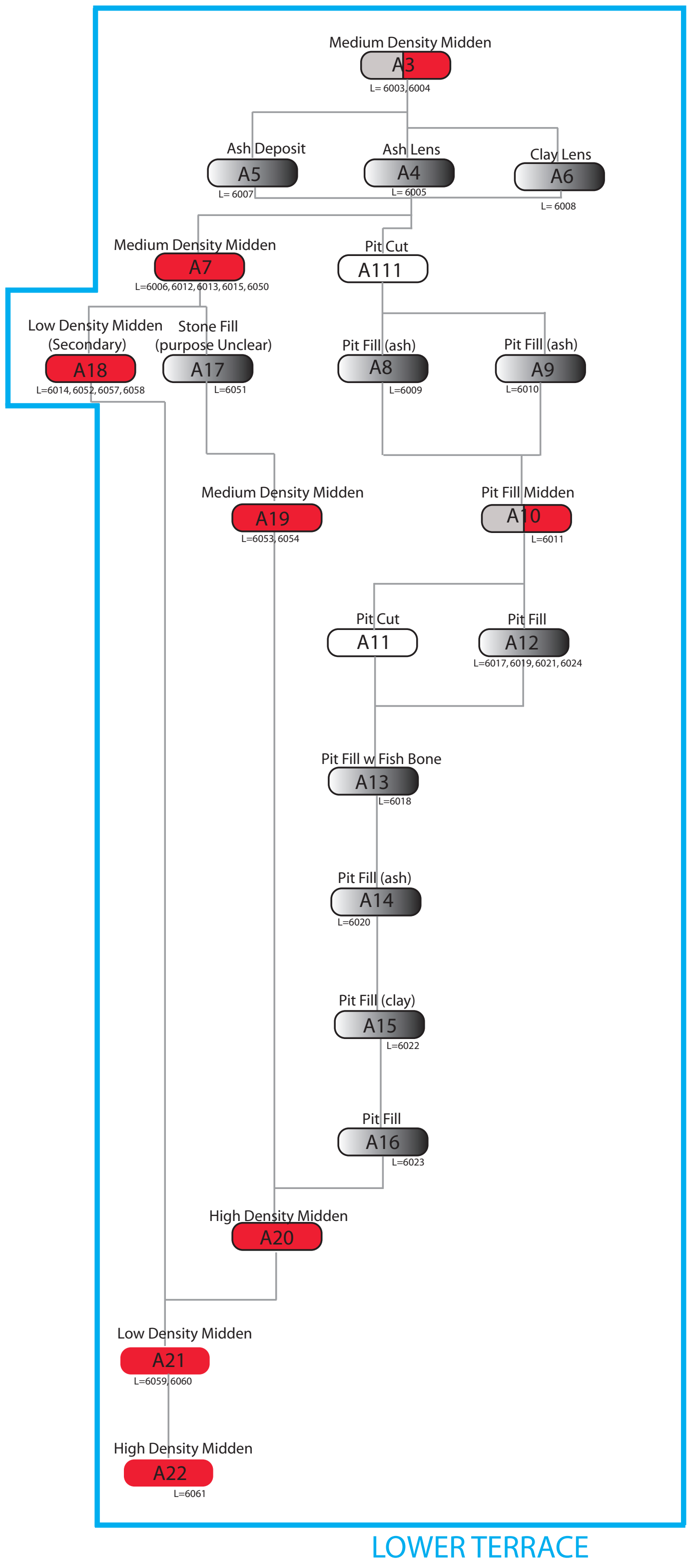


Harris Matrix for KU SK

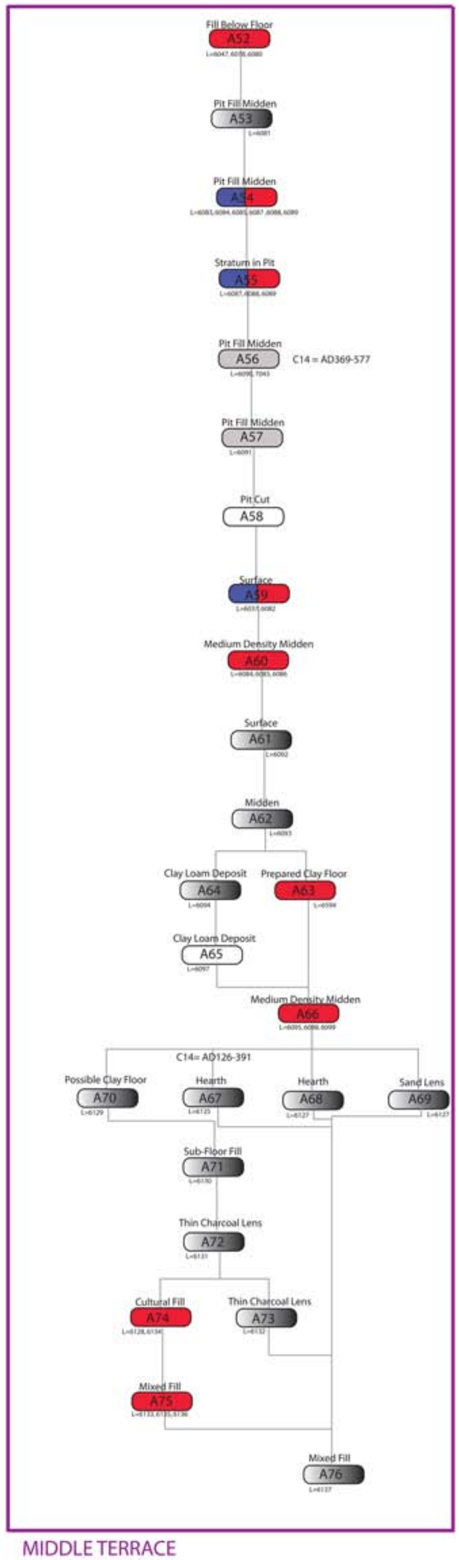
SONAJE EXCAVATIONS (2004, 2005)



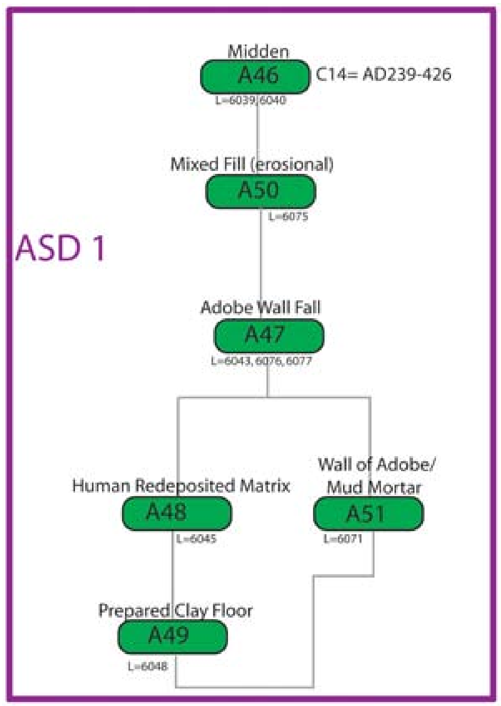
Harris Matrix for the site of Sonaji



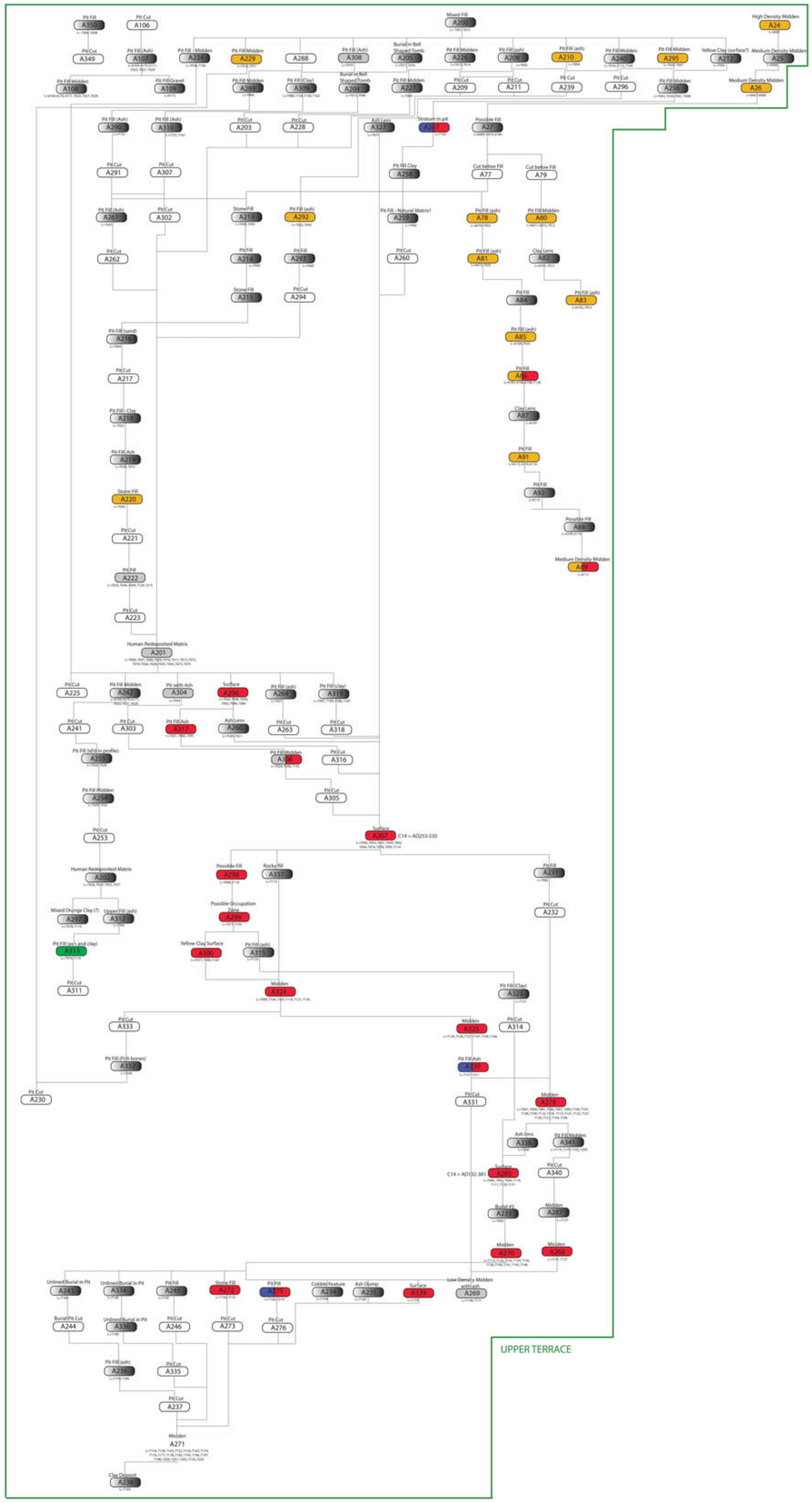
Harris Matrix for Sonaji's Late Formative lower terrace



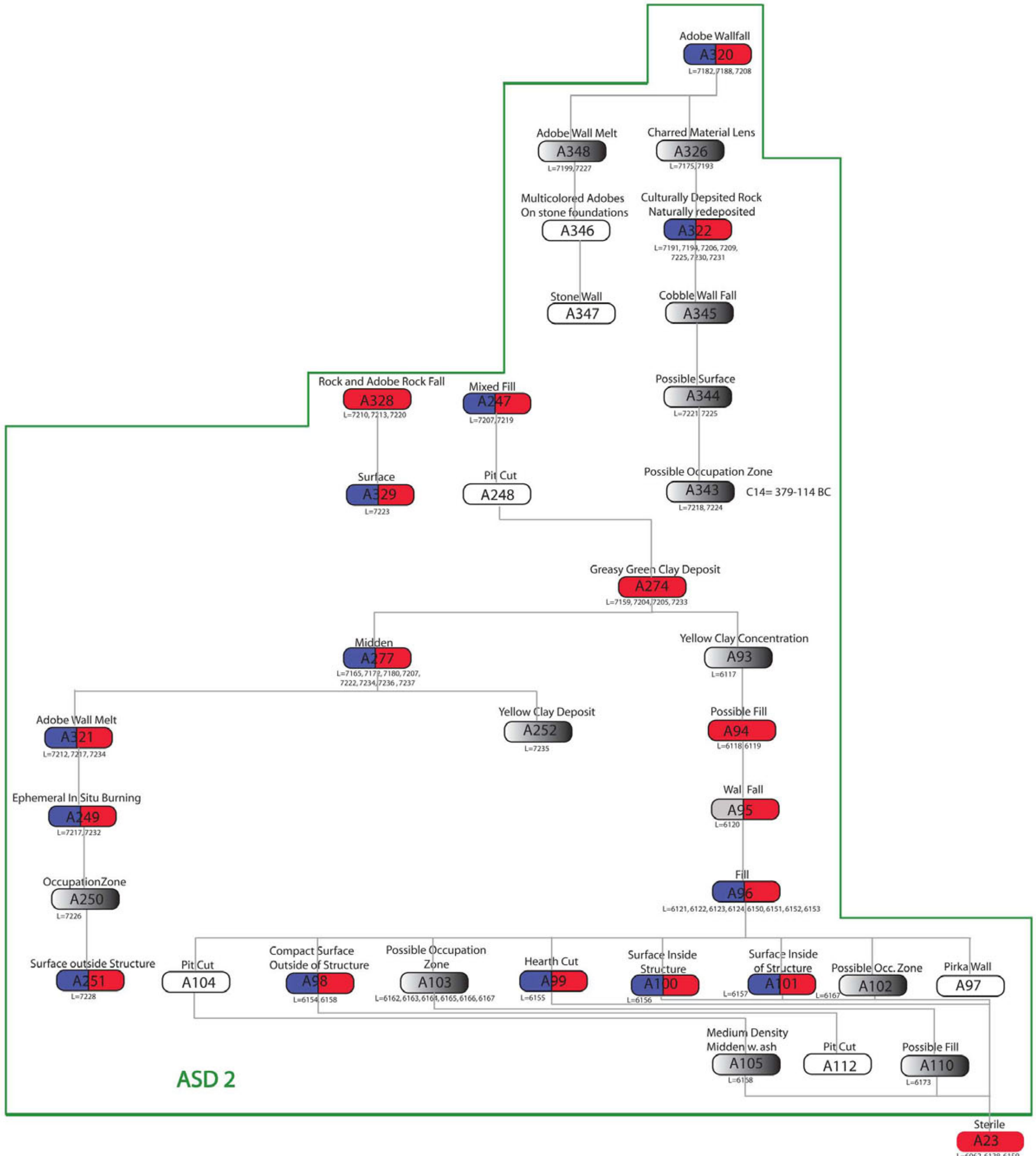
Harris matrix of Sonaji's Late Formative middle terrace



Harris Matrix of Sonaji's Late Formative II ASD-1

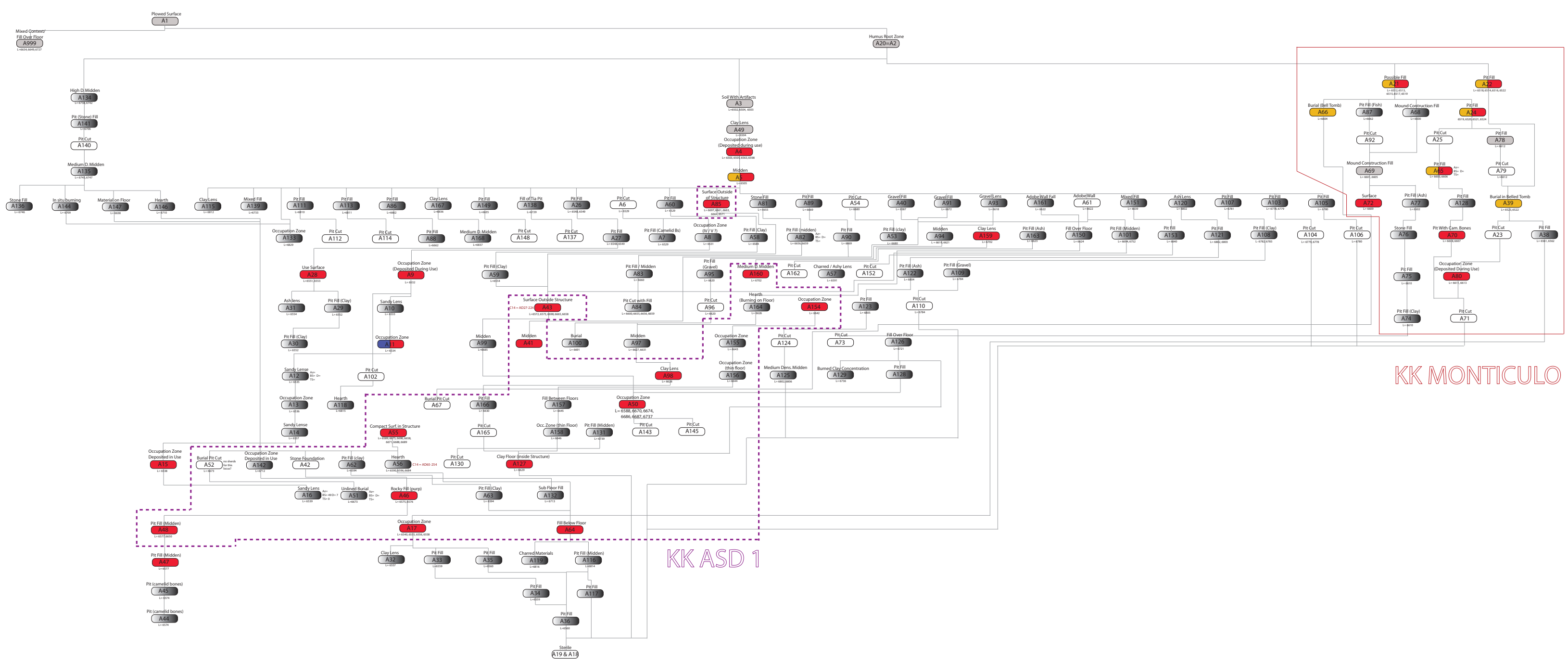


Harris Matrix of Sonaji's Late Formative upper terrace

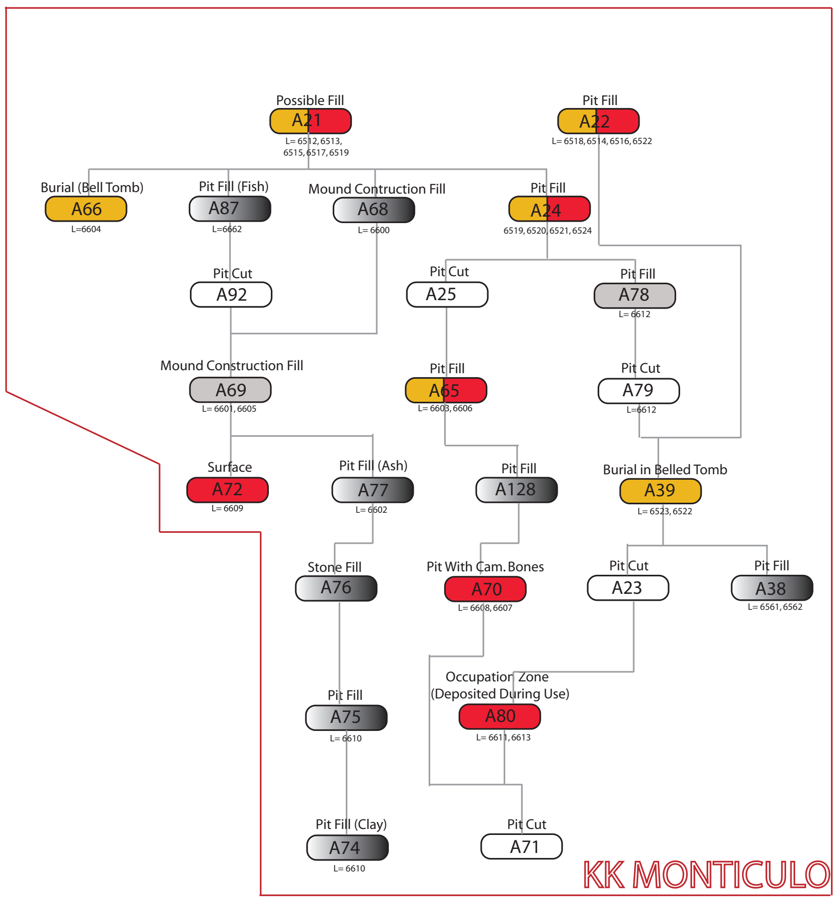


Harris Matrix of Sonaji's Upper Terrace ASD 2

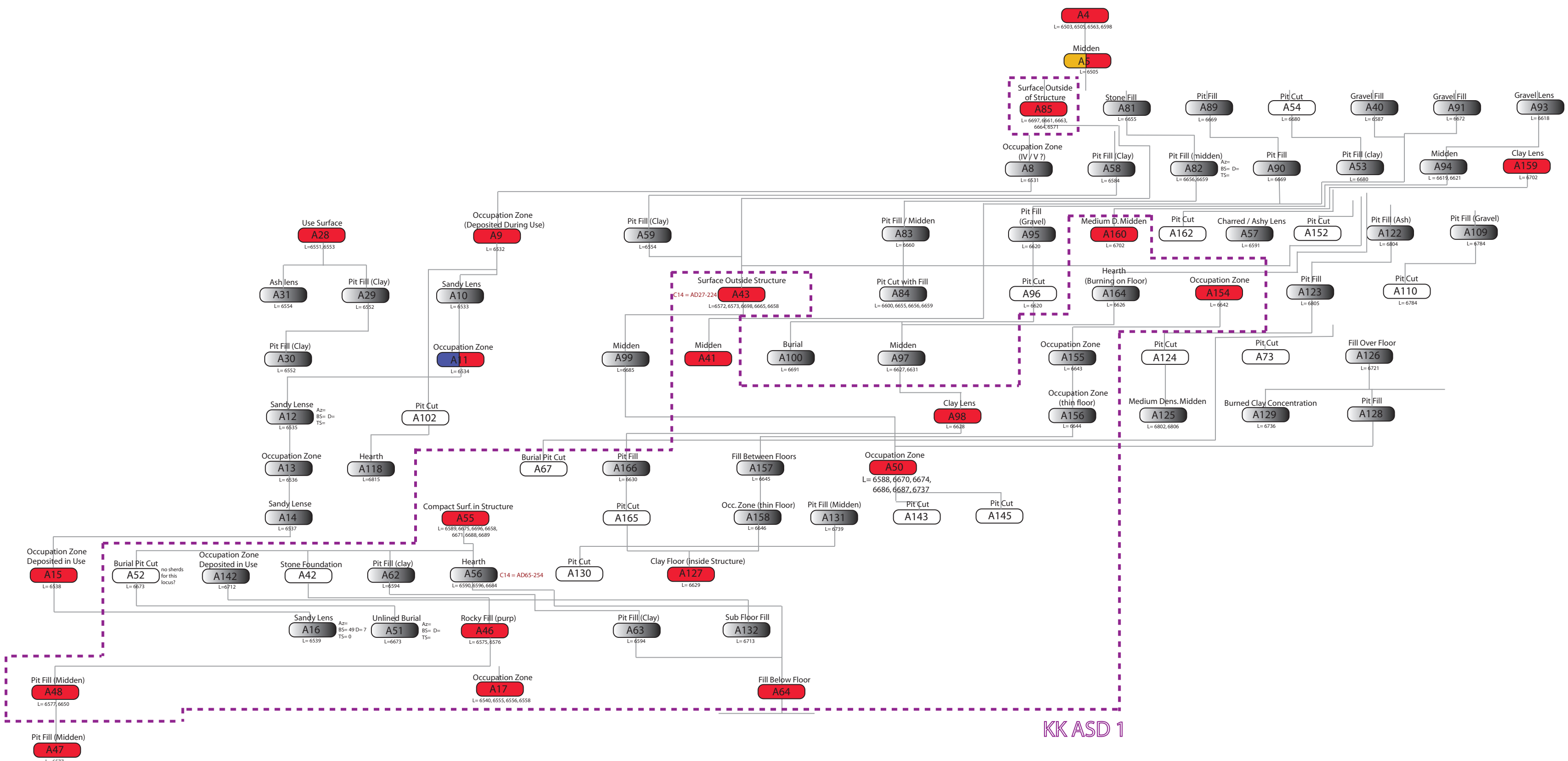
KUMI KIPA EXCAVATIONS (2004)



Harris Matrix for the site of Kumi Kipa



Harris Matrix for Kumi Kipa Monticulo



Harris Matrix for Kumi Kipa ASD- 1

Appendix 2:
Ceramic analysis forms and attributes codes

Taraco Archaeological Project
Ceramic catalog

Locus	SL	Sitio	Norte	Este	Tipo de A	# de Diags	Peso	Fecha de A	# de Crpos	Peso	Fecha de A	# de Frgs. P	Peso

TAP analysis forms: TAP Ceramic Catalog Form

Taraco Archaeological Project
Ceramic Z Analysis Form

Site ____________ Locus ____________ Phase ____________
Area ____________ Slash # ____________ Event ____________
Unit ____________ Date ____________ Notes ____________
____________ Anlzd by ____________ ____________

# of body sherds ________ weight ____________
# of small frags. ________ weight ____________
# of diagnostics ________ weight ____________

1/2/17/18 =
3/9 (Other Mineral Tempered)=
5/6=
29=
Chiripa=

Total number (*including diags*) of:
Paste 21 ________ Sooted ext or int ________ Intrusive post-Chiripa ________
Red slip ext ________ Stucco ext ________

Common shape codes:
140 Med jar, sl flared
180 Tall jar, sl flared
200 Ncked vssl, no angle
210 Nckd vssl, flared
220 Nckd vssl, sl flared
310 Short olla, sl flared
350 Medium olla, sl flrd
400 Bowl, no angle
410 Vertical bowl
420 Sl flared bowl
900 Unknown
914 Dec body, no shape
820 Horizontal lug
H Handle frag, no orient.
B Base, flat, any angl

Spec #	Shape	Diam	Ext color	Ext finish	Rim shape	Wall thick	Carb ext/int	Dec ext/int	Phase/ ware	Notes

TAP analysis forms: Z-analysis form

Page _____ of _____

Locus:
North:
East:
Analyzed by:
Date:

Paste	Finish	Exterior Color	Exterior Carb	Interior Color	Interior Carb	Fire	Max Thick	ID	Dec	Ware	Weight	Count	Notes

TAP analysis forms: A-analysis body sherd form

Taraco Archaeological Project

Site ___________
Unit ___________
____

Locus ________ Spec # ________ Date ________ Drw. ______ Anl. _______

Paste _______ Finish _______ Fire _______ Form _______ Rim _______ Wght _______
Ext: color____
luster _________ contour _________ mica _________ dir.fnsh _________ carb ________
notes ____
Int: color ____
luster _________ contour _________ mica _________ dir.fnsh _________ carb ________
notes ____
incisions ____________ base fnsh _____________ motif ________ ware/phase ________
notes ____

TAP analysis forms: Drawn diagnostic form

Taraco Archaeological Project

Site ________ Unit ________ Locus ________ Date ________ Anlyst. ________

Spec# _________ Paste _______ Fnsh _______ Fire _______ G.id _______ Form ________
Ext: color____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
Int: color ____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
diam _________ % of diam ________ thick: w ________ r/b ________ weight ____________
rim ________ base fnsh ________ dec code _______ motif ________ ware/phase _________
____

Spec# _________ Paste _______ Fnsh _______ Fire _______ G.id _______ Form ________
Ext: color____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
Int: color ____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
diam _________ % of diam ________ thick: w ________ r/b ________ weight ____________
rim ________ base fnsh ________ dec code _______ motif ________ ware/phase _________
____

Spec# _________ Paste _______ Fnsh _______ Fire _______ G.id _______ Form ________
Ext: color____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
Int: color ____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
diam _________ % of diam ________ thick: w ________ r/b ________ weight ____________
rim ________ base fnsh ________ dec code _______ motif ________ ware/phase _________
____

Spec# _________ Paste _______ Fnsh _______ Fire _______ G.id _______ Form ________
Ext: color____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
Int: color ____
luster ________ contour __________ mica __________ dir.fnsh __________ carb _________
diam _________ % of diam ________ thick: w ________ r/b ________ weight ____________
rim ________ base fnsh ________ dec code _______ motif ________ ware/phase _________
____

TAP analysis forms: Non-drawn diagnostic form

Paste Code	Temper Type	Paste Description
1	Mineral	Medium size, angular and subangular, black, white, translucent. Tends to have a lot of mica, subcompact, and medium texture. Fiber version would be p.18. Inclusions in p.17 finer than p.1
2	Mineral	Translucent subrounded and rounded, subcompact, medium size, medium texture, mica, and some blacks.
3	Mineral	Fine, very fine and medium white opaque, subcompact, and medium texture.
4	Mineral	Medium and fine translucent or gray angular inclusions, medium texture.
5	Mineral	Fine texture paste; fine inclusions, compact/subcompact white translucent and opaque, very few blacks. For fine and semi-nice wares.
6	Mineral	Buff color, fine texture, compact/subcompact. White, translucent, reds, fine size.
7	Mineral	Buff color, fine texture, compact/subcompact. Fine and medium reds.
8	Mineral	Medium texture, subcompact, medium size angular and subangular reds.
9	Mineral	Medium texture, subcompact. Dense translucent subrounded fine and medium size.
10	Mineral	Fine paste, compact, with medium size subangular white opaque and some translucent inclusions.
11	Mineral	Medium Texture, compact/subcompact. Medium size subrounded translucent, some opaque whites, red opaque inclusions.
12	Mineral	Fine paste, compact, fine and very fine white inclusions. For fine ware.
13	Mineral	Fine paste, dense. Very fine white, translucent, a few reds. For fine ware. Generally later than 12, apparently goes into Pacajes period.
29	Mineral	This One is MINERAL TEMPERED. Much much mica. Medium textured, translucent medium subangular incursions. Some black too. Very dense mica. Laminated appearance.

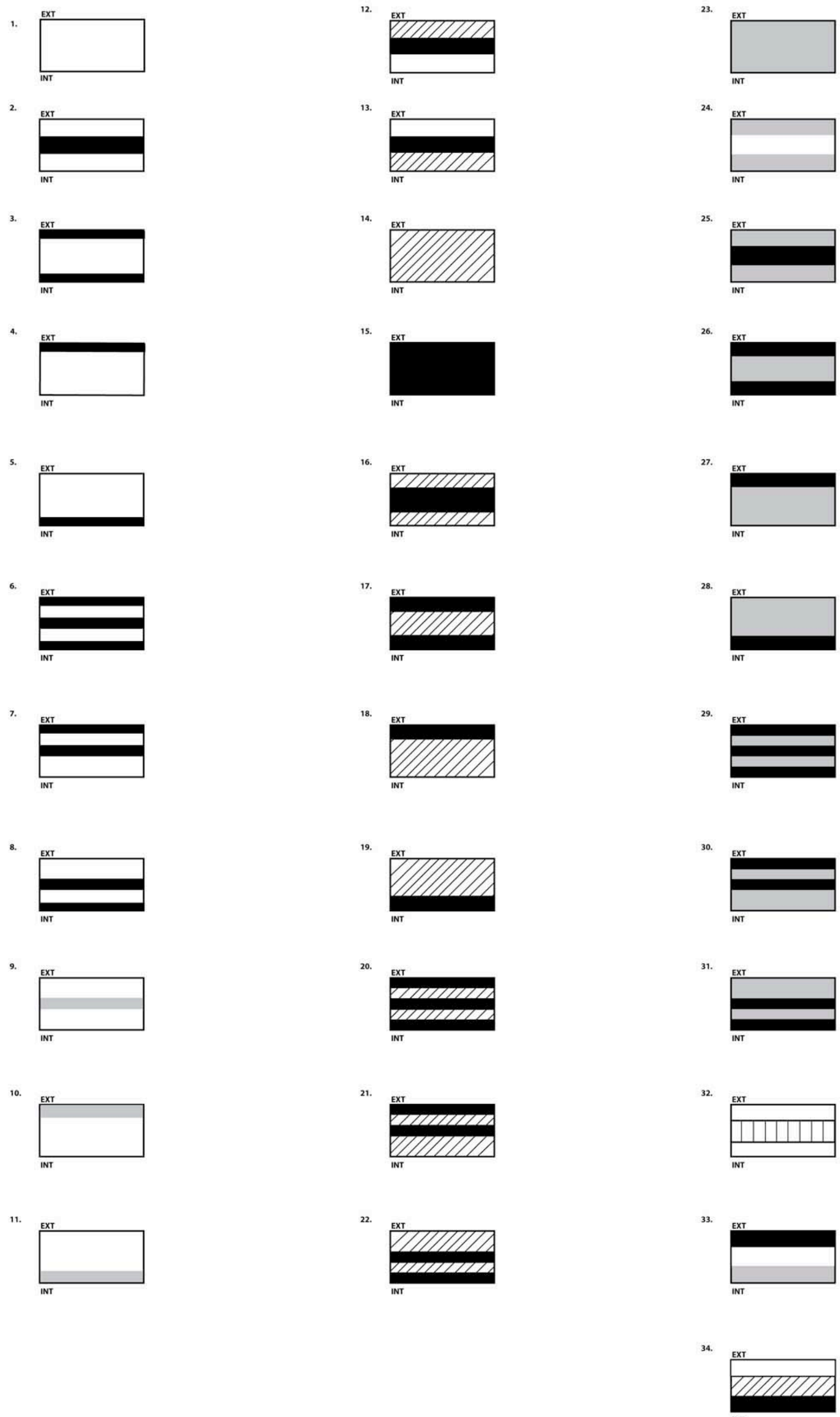
TAP paste codes: Mineral pastes analyzed by the Taraco Archaeological Project from Early Formative through Tiwanaku phases.

Paste Code	Temper Type	Paste Description
16	Fiber	Medium texture, subangular, chunky inclusions, blacks, translucent, but predominantly whites. Medium size.
17	Fiber	Medium texture, opaque whites, some translucents, characteristic blacks. Medium size, subrounded, subangular. Tends to have lots of mica.
18	Fiber	Medium texture, chunky, angular and subangular, translucents, whites and blacks in even mix. Similar to 17 but coarser. Less mica than 17
19	Fiber	Medium texture, translucents principally, some others. Medium and fine size, subrounded (like paste 9)
20	Fiber	Medium texture, white principally, some others. Medium and fine size, subrounded. Small matte whites, speckled. Paste 16 is similar but it has large chunky whites.
21	Fiber	Medium texture. Large size angular opaque white inclusions. No mica. Red slipped ones have fewer whites, medium sized inclusions.
22	Fiber	Fine textured, melted, paste. Medium size angular inclusions. Opaque and translucent whites. Large fiber voids on surface.
23	Fiber	Fine textured pastes, very few inclusions. Fine and medium sized translucent subrounded inclusions. Little else. Sometimes, but not often is tink ware. When not tink ware, has a soft look to it, fawnlike.
24	Fiber	Fine textured paste generally, some medium textured. Very fine small white opaque inclusions. Often tink ware. Compact.
25	Fiber	Medium textured. Subangular black-gray inclusions, chunky.
26	Fiber	Medium textured. Medium and sometimes large size round translucent inclusions. Often with many air holes. Sometimes mica. Often tink ware.
27	Fiber	Buff paste fine texture. Fine opaque and translucent whites, fine reds. Little fiber.
28	Fiber	Fine paste, compact. Very fine white inclusions, plus large sized chunky opaque white, dull color (unlike lustrous quality of Paste 21 inclusions). In cases where 02 firing, the core is always gray sintered. Often is tink ware.
30	Fiber	Medium textured, crumbly look. Opaque whites, blacks, grays, distinctively pinking hue opaques. Tends to have mica.

TAP paste codes: Fiber pastes analyzed by the Taraco Archaeological Project from Early Formative through Tiwanaku phases.

Code/Description					
1	body sherd	24	polishing tool	47	b. sherd with repair hole
2	too small b. sherd	25	possible polish. Tool	49	miniature vessel
3	b. sherd for scraping	26	figurine	50	b. sherd with basket imp.
4	adobe/tierra quemada	27	trumpet	51	very eroded sherd, no phase
5	tile	28	complete pot, or almost	52	appliqué fillet
6	dec. body sherd	29	foot	53	clay disk
7	rim	30	b. sherd with broken off handle	54	ceramic bead
8	base	31	bottle neck	55	neck with broken off handle
9	lug	32	nubbin	56	b. sherd with appliqué and vertical handle
10	rim and base	33	b. sherd wall near base	57	neck with lug
11	rim and horiz. Handle	34	more than 60% of vessel	58	base with lug
12	rim and vert. handle	35	modeled vessel	59	b. sherd with broken horiz. Handle
13	base and horiz. Handle	36	rim and lug	60	b. sherd with broken vertical handle
14	base and vert. handle	37	b. sherd flat part of base	61	carinated sherd
15	rim, base and horiz handle	38	hemispherical object	62	sherd from incensario
16	rim, base and vert. handle	39	mix shapes for plow zone and C analysis	63	ear plug
17	rim, base and lug	40	scallop	64	lip plug
18	horiz. Handle	41	possible carination angle	65	neck with broken off vertical handle
19	vertical handle	42	less than 60% of vessel	66	Decorated Rim Sherd
20	handle (no orientation)	43	curved body. Glob. Vessel	67	Decorated body sherd with repair hole
21	neck	44	pierced rim scallop	98	non ceramic given a cat # by mistake
22	spindle whorl	45	rim loop, no rim	99	unknown
23	blank spindle whorl	46	rim sherd with loop		

TAP ceramic I.D. codes



TAP ceramic firing codes: black=black, white=red-brown, gray=light brown, diagonal hatch= brown, vertical lines=purple

Code/Ext Surface/Interior Surface		
1	Wiped	Wiped
2	Wiped	Smoothed
3	Wiped	Rubbed
4	Wiped	Incomplete Burnish
5	Wiped	Complete Burnish
6	Grainy Wipe	Wiped
7	Smoothed	Smoothed
8	Smoothed	Wiped
9	Smoothed	Rubbed
10	Smoothed	Incomplete Burnish
11	Smoothed	Complete Burnish
12	Smoothed	Retocado
13	Incomplete Smoothed over Grainy Surface	Wiped
14	Rubbed	Rubbed
15	Rubbed	Wiped
16	Rubbed	Smoothed
17	Rubbed	Incomplete Burnish
18	Rubbed	Complete burnish
19	Incomplete Burnish	Incomplete Burnish
20	Incomplete Burnish	Wiped
21	Incomplete Burnish	Smoothed
22	Incomplete Burnish	Rubbed
23	Incomplete Burnish	Complete Burnish
24	Incomplete Burnish over grainy surface	Wiped
25	Complete Burnish	Complete Burnish

TAP surface finish codes

Code/Ext Surface/Interior Surface		
26	Complete Burnish	Wiped
27	Complete Burnish	Smoothed
28	Complete Burnish	Rubbed
29	Complete Burnish	Incomplete Burnish
30	Stucco	Wiped
31	Stucco	Smoothed/Worn
32	Stucco	Rubbed
33	Stucco	Incomplete Burnish
34	Stucco	Complete Burnish
35	Very Fine Complete Burnish	Very fine Complete Burnish
36	Very Fine Complete Burnish	Wiped
37	Very Fine Complete Burnish	Fine Wipe
38	Very Fine Complete Burnish	Smoothed
39	Smoothed	Very fine Complete Burnish
40	Very Fine Complete Burnish	Complete Burnish
41	Complete Burnish	Retocado
42	Complete Burnish	Very fine Complete Burnish
43	Fine Line Scrape	Fine Line Scrape
44	Smoothed	Fine Line Scrape
45	Striate Burnish	Striate Burnish
46	Stucco	Striate Burnish
47	Fine Line Scrape	Smoothed
48	Striate Burnish	Incomplete Burnish
49	Rubbed	Striate Burnish
50	Wiped	Striate Burnish

TAP surface finish codes continued

Code/Ext Surface/Interior Surface		
51	Grainy Wipe	Incomplete Burnish
52	Complete Burnish	Striate Burnish
53	Incomplete Burnish	Fine Line Scrape
54	Striate Burnish	Fine Line Scrape
55	Incomplete Burnish	Retocado
56	Incomplete Burnish	Striate Burnish
57	Smoothed	Striate Burnish
58	Grainy Wipe	Smoothed
59	Grainy Wipe	Complete Burnish
60	Complete Burnish	Stucco
61	Stucco	Stucco
99	Eroded	Eroded
100	Wiped	Not recorded
101	Wiped	Eroded
110	Smoothed	Not recorded
111	Smoothed	Eroded
120	Complete Burnish	Not Recorded
121	Complete Burnish	Eroded
130	Incomplete Burnish	Not Recorded
131	Incomplete Burnish	Eroded
140	Stucco	Not Recorded
141	Stucco	Eroded
150	Rubbed	Not Recorded
151	Rubbed	Eroded
160	Very Fine Complete Burnish	Not Recorded
161	Very Fine Complete Burnish	Eroded

TAP surface finish codes continued

Munsell/ Color Description					
7.5R 3/6	Red Slip	10R 4/5	Red Slip	10R 4.5/6	Light Red Slip
7.5R 3/6.5	Red Slip	10R4.5/5	Red Slip	10R 4.5/7	Light Red Slip
7.5R 3/7	Red Slip	10R 4/6	Red Slip	10R 4.5/8	Light Red Slip
7.5R 3/7.5	Red Slip	10R 4.5/4	Red Slip	10R 5/5	Light Red Slip
7.5R 3/8	Red Slip	10R 5/4	Red Slip	10R 5/6	Light Red Slip
7.5R 3.5/4	Red Slip	7.5R 3/4	Dark Red Slip	10R 5/7	Light Red Slip
7.5R 3.5/5	Red Slip	7.5R 3/5	Dark Red Slip	10R 5/8	Light Red Slip
7.5R 3.5/6	Red Slip	7.5R 3.5/2	Dark Red Slip	2.5YR 3/4	Red Brown Slip
7.5R 4/4	Red Slip	10R 3/2	Dark Red Slip	2.5YR 3/5	Red Brown Slip
7.5R 4/5	Red Slip	10R 3/3	Dark Red Slip	2.5YR 3/6	Red Brown Slip
7.5R 4/6	Red Slip	10R 3/4	Dark Red Slip	2.5YR 3.5/4	Red Brown Slip
10R 3/6	Red Slip	10R 3/5	Dark Red Slip	2.5YR 3.5/5	Red Brown Slip
10R 3/7	Red Slip	10R 3.5/2	Dark Red Slip	2.5YR 3.5/6	Red Brown Slip
10R 3/8	Red Slip	10R 3.5/3	Dark Red Slip	2.5YR 4/2	Red Brown Slip
10R 3.5/4	Red Slip	7.5R 4/7	Light Red Slip	2.5YR 4/3	Red Brown Slip
10R 3.5/5	Red Slip	7.5R 4/8	Light Red Slip	2.5YR 4/4	Red Brown Slip
10R 3.5/6	Red Slip	7.5R 4.5/6	Light Red Slip	2.5YR 4/5	Red Brown Slip
10R 3.5/7	Red Slip	7.5R 4.5/7	Light Red Slip	2.5YR 4/6	Red Brown Slip
10R 3.5/8	Red Slip	7.5R 4.5/8	Light Red Slip	2.5YR 4.5/4	Red Brown Slip
10R 4/3	Red Slip	10R 4/7	Light Red Slip	2.5YR 4.5/5	Red Brown Slip
10R 4/4	Red Slip	10R 4/8	Light Red Slip	2.5YR 4.5/6	Red Brown Slip

TAP Munsell: color categorization

Munsell/ Color Description					
2.5YR 4.5/7	Red Brown Slip	5YR 4/3	Brown Slip	10YR 3/3	Brown Slip
2.5YR 5/4	Red Brown Slip	5YR 4/4	Brown Slip	10YR 4/2.5	Brown Slip
2.5YR 5/5	Red Brown Slip	5YR 4/5	Brown Slip	10YR 4/3	Brown Slip
2.5YR 5/6	Red Brown Slip	5YR 4/6	Brown Slip	10YR 4/4	Brown Slip
2.5YR 2.5/2	Drk Red Brown Slip	5YR 4.5/3	Brown Slip	10YR 4.5/3	Brown Slip
2.5YR 3/2	Drk Red Brown Slip	5YR 4.5/4	Brown Slip	5YR 2.5/2	Drk Brown Slip
2.5YR 3/3	Drk Red Brown Slip	5YR 4.5/5	Brown Slip	5YR 2.5/3	Drk Brown Slip
2.5YR 3.5/2	Drk Red Brown Slip	5YR 4.5/6	Brown Slip	5YR 3/2	Drk Brown Slip
2.5YR 3.5/3	Drk Red Brown Slip	7.5YR 3/3	Brown Slip	5YR 3/2.5	Drk Brown Slip
5YR 3/3	Brown Slip	7.5YR 3/4	Brown Slip	5YR 3.5/2	Drk Brown Slip
5YR 3/4	Brown Slip	7.5YR 3.5/3	Brown Slip	7.5YR 2/2	Drk Brown Slip
5YR 3.5/3	Brown Slip	7.5YR 3.5/4	Brown Slip	7.5YR 2/3	Drk Brown Slip
5YR 3.5/4	Brown Slip	7.5YR 4/2	Brown Slip	7.5YR 3/2	Drk Brown Slip
5YR 3.5/5	Brown Slip	7.5YR 4/3	Brown Slip	7.5YR 3/2.5	Drk Brown Slip
5YR 3.5/6	Brown Slip	7.5YR 4/4	Brown Slip	7.5YR 3.5/2	Drk Brown Slip
5YR 4/1.5	Brown Slip	7.5YR 4.5/3	Brown Slip	10YR 3/1.5	Drk Brown Slip
5YR 4/2	Brown Slip	7.5YR 4.5/4	Brown Slip	10YR 3/2	Drk Brown Slip

TAP Munsell: color categorization continued

Munsell/ Color Description					
10YR 4/1.5	Drk Brown Slip	7.5YR 6/3	Lt Brown Slip	7.5YR 2.75/0	Black Slip
5YR 5/3	Lt Brown Slip	7.5YR 6/4	Lt Brown Slip	10YR 2/1	Black Slip
5YR 5/4	Lt Brown Slip	7.5YR 6/5	Lt Brown Slip	2.5Y 2/0	Black Slip
5YR 5/5	Lt Brown Slip	10YR 5/3	Lt Brown Slip	2.5YR 4/0	Gray Brown Slip
5YR 5/6	Lt Brown Slip	10YR 5/4	Lt Brown Slip	5YR 3/1	Gray Brown Slip
5YR 5.5/4	Lt Brown Slip	10YR 5/5	Lt Brown Slip	5YR 3.5/1	Gray Brown Slip
5YR 5.5/5	Lt Brown Slip	10YR 5.5/2	Lt Brown Slip	5YR 4/1.5	Gray Brown Slip
5YR 5.5/6	Lt Brown Slip	10YR 5.5/3	Lt Brown Slip	5YR 4.5/1	Gray Brown Slip
5YR 6/4	Lt Brown Slip	10YR 5.5/4	Lt Brown Slip	7.5YR 3/1	Gray Brown Slip
5YR 6/5	Lt Brown Slip	10YR 6/2.5	Lt Brown Slip	7.5YR 4/1	Gray Brown Slip
7.5YR 5/2	Lt Brown Slip	10YR 6/3	Lt Brown Slip	10YR 3/1	Gray Brown Slip
7.5YR 5/3	Lt Brown Slip	10YR 6/4	Lt Brown Slip	10YR 4/1	Gray Brown Slip
7.5YR 5/4	Lt Brown Slip	10YR 6/5	Lt Brown Slip	5YR 8/3	White Slip
7.5YR 5/5	Lt Brown Slip	5YR 6/3	Lt Brown Slip	7.5YR 8/2	White Slip
7.5YR 5/6	Lt Brown Slip	2.5YR 2/0	Black Slip	7.5YR 8/3	White Slip
7.5YR 5.5/2	Lt Brown Slip	2.5YR 2.5/0	Black Slip	10YR 7/2	White Slip
7.5YR 5.5/3	Lt Brown Slip	5YR 2/1	Black Slip	10YR 8/2	White Slip
7.5YR 5.5/4	Lt Brown Slip	5YR 2.75/1	Black Slip	10YR 8/3	White Slip
7.5YR 6/2.5	Lt Brown Slip	7.5YR 2.5/0	Black Slip	5YR 7/3	Cream Slip

TAP Munsell: color categorization continued

Munsell/ Color Description					
5YR 7/4	Cream Slip	10YR 7.5/4	Cream Slip	2.5YR 3/4	Red brown Unslipped
7.5YR 6/5	Cream Slip	10YR 8/4	Cream Slip	2.5YR 3/5	Red brown Unslipped
7.5YR 6.5/4	Cream Slip	7.5YR 6/7	Yellow Slip	2.5YR 3/6	Red brown Unslipped
7.5YR 6.5/5	Cream Slip	7.5YR 7/7	Yellow Slip	2.5YR 4/4	Red brown Unslipped
7.5YR 7/3	Cream Slip	10YR 6.5/6	Yellow Slip	2.5YR 4/5	Red brown Unslipped
7.5YR 7/4	Cream Slip	10YR 7/6	Yellow Slip	2.5YR 4/6	Red brown Unslipped
7.5YR 7/5	Cream Slip	7.5YR 5.5/6	Yellow Cream Slip	2.5YR 5/4	Red brown Unslipped
7.5YR 8/4	Cream Slip	7.5YR 6/6	Yellow Cream Slip	2.5YR 5/5	Red brown Unslipped
7.5YR 8/5	Cream Slip	7.5YR 7/6	Yellow Cream Slip	2.5YR 5/6	Red brown Unslipped
10YR 6.5/2	Cream Slip	5YR 6/6	Yellow Orange Slip	2.5YR 4/3	Red brown Unslipped
10YR 6.5/3	Cream Slip	5YR 6/7	Yellow Orange Slip	2.5YR 6/5	Red brown Unslipped
10YR 6.5/4	Cream Slip	5YR 6.5/6	Yellow Orange Slip	5YR 4/4	Red brown Unslipped
10YR 7/2.5	Cream Slip	5YR 7/6	Yellow Orange Slip	5YR 4/5	Red brown Unslipped
10YR 7/3	Cream Slip	2.5YR 4.5/8	Orange Slip	5YR 4/6	Red brown Unslipped
10YR 7/4	Cream Slip	2.5YR 5/7	Orange Slip	5YR 4.5/4	Red brown Unslipped
10YR 7/5	Cream Slip	2.5YR 6/7	Orange Slip	5YR 4.5/5	Red brown Unslipped
10YR 7.5/3	Cream Slip	5YR 5.5/8	Orange Slip	5YR 4.5/6	Red brown Unslipped

TAP Munsell: color categorization continued

Munsell/ Color Description					
5YR 5/3.5	Red brown Unslipped	5YR 3.5/4	Brown Unslipped	10YR 3/2	Brown Unslipped
5YR 5/4	Red brown Unslipped	5YR 4/2	Brown Unslipped	10YR 4/2	Brown Unslipped
5YR 5/5	Red brown Unslipped	5YR 4/3	Brown Unslipped	10YR 4/3	Brown Unslipped
5YR 5/6	Red brown Unslipped	5YR 4/3.5	Brown Unslipped	10YR 4/4	Brown Unslipped
5YR 6/6	Red brown Unslipped	7.5YR 3/2	Brown Unslipped	5YR 5/2	Light Brown Unslipped
5YR 5.5/6	Red brown Unslipped	7.5YR 3/3	Brown Unslipped	5YR 5/3	Light Brown Unslipped
2.5YR 4/7	Red/Orange Unslipped	7.5YR 3/4	Brown Unslipped	5YR 5.5/2	Light Brown Unslipped
2.5YR 5/7	Red/Orange Unslipped	7.5YR 3.5/2	Brown Unslipped	5YR 5.5/3	Light Brown Unslipped
2.5YR 6/6	Red/Orange Unslipped	7.5YR 3.5/3	Brown Unslipped	5YR 5.5/4	Light Brown Unslipped
10R 4.5/8	Red/Orange Unslipped	7.5YR 3.5/4	Brown Unslipped	5YR 5.5/5	Light Brown Unslipped
2.5YR 3/2	Brown Unslipped	7.5YR 4/2	Brown Unslipped	5YR 6/4	Light Brown Unslipped
5YR 3/1.5	Brown Unslipped	7.5YR 4/3	Brown Unslipped	5YR 6/5	Light Brown Unslipped
5YR 3/2	Brown Unslipped	7.5YR 4/4	Brown Unslipped	5YR 7/4	Light Brown Unslipped
5YR 3/3	Brown Unslipped	7.5YR 4.5/2	Brown Unslipped	5YR 7/5	Light Brown Unslipped
5YR 3/4	Brown Unslipped	7.5YR 4.5/3	Brown Unslipped	7.5YR 5/2	Light Brown Unslipped
5YR 3.5/2	Brown Unslipped	7.5YR 4.5/4	Brown Unslipped	7.5YR 5/3	Light Brown Unslipped
5YR 3.5/3	Brown Unslipped	10YR 3/1.5	Brown Unslipped	7.5YR 5/4	Light Brown Unslipped

TAP Munsell: color categorization continued

Munsell/ Color Description			
7.5YR 5/5	Light Brown Unslipped	7.5YR 2.5/0	Black Unslipped
7.5YR 5.5/4	Light Brown Unslipped	2.5Y 2/0	Black Unslipped
7.5YR 6/4	Light Brown Unslipped	2.5YR 3/0	Gray/Gray Brown Unslipped
7.5YR 6/5	Light Brown Unslipped	2.5YR 4/0	Gray/Gray Brown Unslipped
7.5YR 6.5/4	Light Brown Unslipped	5YR 2.75/1	Gray/Gray Brown Unslipped
7.5YR 6.5/5	Light Brown Unslipped	5YR 3/1	Gray/Gray Brown Unslipped
7.5YR 6.5/6	Light Brown Unslipped	5YR 3.5/1	Gray/Gray Brown Unslipped
10YR 5/2	Light Brown Unslipped	5YR 4/1	Gray/Gray Brown Unslipped
10YR 5.5/6	Light Brown Unslipped	5YR 4/1.5	Gray/Gray Brown Unslipped
10YR 5.5/3	Light Brown Unslipped	7.5YR 2/2	Gray/Gray Brown Unslipped
10YR 6/3	Light Brown Unslipped	7.5YR 3/0	Gray/Gray Brown Unslipped
7.5YR 6/3	Light Brown Unslipped	7.5YR 3.5/0	Gray/Gray Brown Unslipped
10YR 6/4	Light Brown Unslipped	10YR 3/1	Gray/Gray Brown Unslipped
2.5YR 2.5/0	Black Unslipped	10YR 4/1	Gray/Gray Brown Unslipped
5YR 2/1	Black Unslipped	2.5Y 3/0	Gray/Gray Brown Unslipped
5YR 2.5/1	Black Unslipped	2.5Y 4.5/0	Gray/Gray Brown Unslipped
7.5YR 2/0	Black Unslipped	2.5Y 4/0	Gray/Gray Brown Unslipped

TAP Munsell: color categorization continued

Code/Exterior Color			
1	red brown	25	yellow cream on red
2	black	26	yellow orange on red
3	gray, gray brown	27	black on cream
4	brown	28	orange on red
5	light brown	29	cream on brown
6	mottled black, brown and red brown	30	cream on red
7	mottled brown and red brown	31	cream on red brown
8	red orange	32	black on red
9	mottled black and brown	33	black on red brown
10	red slip	34	black and cream on red
11	dark red slip	35	black and cream on red brown
12	light red slip	36	cream on dark red
13	red brown slip	37	cream on light red
14	brown slip	38	black on dark red
15	dark brown slip	39	black on light red
16	light brown slip	40	black and cream on dark red
17	cream slip	41	black and cream on light red
18		42	black and red on cream
19	gray brown slip	43	dark brown and cream on red
20	dark red brown slip	44	dark brown and cream on red brown
21	yellow orange slip	45	dark brown and cream on unslipped red brown
22	orange slip	46	black and red on unslipped red brown
23	yellow orange on dark red	47	black and red on light brown
24	white on red	48	dark brown and red on light brown

TAP ceramic color codes

Code/Exterior Color			
49	red on yellow orange	76	cream on unslipped red brown
50	red on light brown	77	light brown on red
51	red on cream	78	light brown on light red
52	light red on cream	79	light brown on uslipped brown
53	dark red on cream	80	dark brown on red
54	red on brown	81	dark brown on light red
55	dark red on light brown	82	dark brown on dark red
56	red on yellow orange	83	dark brown on cream
57	red on yellow cream	84	dark brown on unslipped red brown with red rim
58	light red on light brown	85	balck on light brown
59	red on orange	86	dark brown on light brown
60	red on unslipped red brown	87	dark brown on cream with red rim
61	dark red on unslipped light brown	88	dark brown on orange
62	red on unslipped brown	89	light brown on r/b
63	red on unslipped black	90	red brown and orange on unslipped brown
64	red on unslipped mottled	91	white and black and yellow/orange on red
65	red brown on unslipped red brown	92	black and white and cream on brown
66	red brown on unslipped brown	93	black and orange on red
67	red brown on unslipped black	94	black and cream on brown
68	red brown on unslipped mottled	95	black and yellow cream on red
69	red on unslipped light brown	96	black and light brown on red
70	brown on unslipped red brown	97	black and cream on unslipped red brown
71	brown on unslipped brown	98	dark brown and light brown on red
72	brown on unslipped black	99	misc.
73	dark red on unslipped red brown	100	yellow on red
74	black on unslipped red brown	101	red brown on light brown
75	brown on unslipped gray		

TAP ceramic color codes continued

Code/Exterior Color			
102	yellow cream on red brown	116	light red on unslipped red orange
103	red on red brown	117	black on brown
104	dark brown and red on unslipped red brown	118	brown on u/s l.brown
105	red brown on unslipped light brown	119	orange on dark red
106	black on unslipped light brown	120	d. brown + red on u/s l. brown
107	red brown on brown	121	black + l.red + white on u/s light brown
108	light red on unslipped light brown	122	yellow orange on light red
109	light red on unslipped red brown	123	cream on dark brown with red rim
110	black and red on unslipped light brown	124	black and yellow cream on red brown
111	black and light red on unslipped light brown	125	red brown on cream
112	light red on orange	126	red on yellow
113	dark brown and red brown on unslipped red brown	127	dark brown and red on cream
114	light red on red brown	128	red on dark brown
115	black and light red on unslipped red brown	129	cream on brown with red brown rim

TAP ceramic color codes continued

Code/Slip Location	
1	All over sherd
2	neck only ext
3	neck only int
4	neck only both int and ext
5	on top of rim only
6	ext all over and int. neck only
7	dec on u/s background
8	top of rim and a bit on int.
9	ext all over and a few cm down int.
10	ext wall, but not as far down as base (or in band)
11	ext wall in band, int wall in band
12	underside of base
13	interior only in band
14	ext band on body (not rim), int. in band

TAP slip location codes

Code/ DecType			
1	Chiripa Cream on red	21	Chiripa black/dark brown with red rim (Qaluyu copy)
2	Chiripa black and cream on red	22	Chiripa dark brown on red (Qaluyu copy)
3	Chiripa black on red, (Could be some cream somewhere)	23	Chiripa misc. one color on unslipped
4	Chiripa black on red (Fairly certain no cream)	24	Early Chiripa/Middle Chiripa bi-level raised areas
5	Chiripa single color wide line incised	25	Chiripa black and cream on red modeled
6	Chiripa single color incised	26	Chiripa black on red modeled
7	Chiripa black and cream on red incised	27	Chiripa cream on brown with red rim
8	Chiripa red on cream	28	Chiripa modeled + incised (single color slip)
9	Chiripa modeled (Single color slip)	29	Chiripa red on cream modeled
10	Chiripa dark brown on cream	30	Chiripa miscellaneous
11	Chiriap cream on red modeled	31	Chiripa red on cream modeled + incised
12	Chiripa cream on red incised	32	EC/MC red on cream with bi-level raised areas
13	Chiripa cream on red modeled and incised	40	Tiwanaku I/III red banded bowl
14	Chiripa black/dark brown and cream with red (Qaluyu copy)	41	Tiwanaku I black and red on light brown incised
15	Chiripa applique fillet/ridge	42	Tiwanaku I black and red and unslipped red brown or light brown incised
16	Chiripa black on red incised	43	Tiwanaku I black and red on light brown
17	Chiripa cream on brown	44	Tiwanaku I black and red and unslipped
18	Chirpa cream on red and applique fillet	45	Tiwanaku I single color incised
19	Chiripa black on red modeled and incised	46	Tiwanaku I black and unslipped incised
20	Chiripa misc. two colors painted		

TAP ceramic decoration codes

Code/ DecType			
47	Tiwanaku I modeled (single color slip)	60	Tiwanaku III balck and orange on light brown
48	Tiwanaku I black and red and light brown incised	61	Tiwanaku III black on unslipped red brown
49	Tiwanaku I applique fillet, ridge, band	62	Tiwanaku III black on unslipped light brown
50	Tiwanaku I black and red incised	63	Tiwanaku III black on light brown
51	Tiwanaku I red and unslipped	64	Tiwanaku III single color incised
52	Tiwanaku I black on red brown	65	Tiwanaku III black and red on unslipped light brown
53	Tiwanaku I red banded and incised lug	66	Tiwanaku III black and cream on red
54	Tiwanaku I applique fillet, ridge, band incised	67	Tiwanaku I/III rim scalloops
55	Tiwanaku I red banded and applique fillet, ridge, band	68	Tiwanaku III black + red + white on u/s l.brown
56	Tiwanaku I red and unslipped incised	96	Modern Decorated
57	Tiwanku I black on light brown incised	97	Pacajes decorated
58	Tiwanaku I black on red	98	Tiwanaku I/III decorated (From before had other codes)
59	Tiwanaku I red banded + lug	99	Tiwanaku IV/V decorated

TAP ceramic decoration codes continued

Code/Decoration Type			
1	Painted in 2 colors	15	Painted in 1 color on unslipped background
2	Painted in 3 colors	16	Incised and 1 slip color and post-fire
3	Painted in 4 colors	17	Painted in 2 colors with unslipped areas
4	Incised on unslipped	18	painted 1 slip color with raised areas
5	incised and 1 slip color	19	modeled and 3 slip areas
6	Incised and 2 slip colors	20	incised and 2 slip colors with unslipped areas
7	Incised and 3 slip colors	21	post-fire on unslipped (no incision)
8	Incised, unslipped area and 1 slip color	22	incised applique, lug or fillet
9	Modeled unslipped	23	painted in 2 colors + post-fire
10	modeled and 1 slip colors	90	Simple band of color on rim or neck
11	Modeled and 2 slip colors	91	Slipped base, when wall is unslipped
12	Modeled and Incised and 1 slip color	92	band of color and incised lug, fillet or applique
13	Modeled and incised and 2 slip color	93	band of color plus incision

TAP decoration type codes

Code/Decoration location	
1	ext. wall
2	ext. globular body of necked vessel
3	exterior neck or neck joint of necked vessel
4	exterior wall, bowl, to just under base
5	exterior wall, bowl, to joint with base
6	interior wall, bowl, to joint with base
7	exterior wall, bowl, to just above base
8	exerior wall, bowl, to just under rim and int. coming down from rim
9	ext and int. wall
10	int wall, bowl, coming down from rim
11	top of rim
12	ext. wall, bowl, to joint with base and int. wall
13	ext wall on wide band of thick at rim
14	on handle
15	ext wall and int bottom of vessel

TAP decoration location codes

Code/General Category/Specific Form		
100	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Medium Necked Jar (No angle, but have neck height)
101	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 100, with vertical Rim to Body Handle
102	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 100, with vertical Handle just below rim
109	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Possible Medium Necked Jar (no angle, no neck height)
110	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall Necked Jar, No Angle
111	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall or Medium Jar, No Angle
112	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall or Medium Jar, sl. Flared, (Not olla, as is over 4)
113	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall or Medium Jar, flared (definitely not olla)
114	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall or Medium Jar, Straight
115	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall or Medium Jar, Straight, with lug on neck
116	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall or Medium Jar, Sl. Flared, vertical handle t below rim
119	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Possible Tall necked jar
120	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Medium Necked Very Flared Jar (<35)
130	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Medium Necked Flared Jar (35-55_
131	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 130, with vertical handle rim to body
140	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Medium Necked Slightly Flared Jar (56-77)
141	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 140, with vertical rim to body handle
142	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 140, with vertical just below rim to body handle
150	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Medium Necked straight Jar (78-94)
151	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 150, with Vertical rim to body handle
152	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 150, with Vertical handle just below rim
160	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall necked very flared jar
170	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall Necked Flared Jar
180	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall Necked Slightly Flared jar
181	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 180, with vertical rim to body handle
182	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Same as 180, with vertical handle just below rim
190	Tall (> 6 cm) Medium (4-5.9) Necked Vessels	Tall Necked straight Jar

TAP ceramic form codes: Tall and Medium Jars

Code/General Category/Specific Form		
200	Necked Vessels (Medium ollas or Jars…no height)	Necked Vessel, No Angle
201	Necked Vessels (Medium ollas or Jars…no height)	Same as 200, with verticle handle just below rim
202	Necked Vessels (Medium ollas or Jars…no height)	Same as 200, with vertical handle just above neck joint
203	Necked Vessels (Medium ollas or Jars…no height)	Same as 200, with vertical handle at rim
209	Necked Vessels (Medium ollas or Jars…no height)	Possible Necked Vessel
210	Necked Vessels (Medium ollas or Jars…no height)	Flared Necked Vessel
220	Necked Vessels (Medium ollas or Jars…no height)	Slightly Flared Necked Vessel
230	Necked Vessels (Medium ollas or Jars…no height)	Straight Necked Vessel
231	Necked Vessels (Medium ollas or Jars…no height)	Same as 230, with vertical handle at rim
240	Necked Vessels (Medium ollas or Jars…no height)	Inclined Necked Vessel
250	Necked Vessels (Medium ollas or Jars…no height)	Neckless Olla, no angle
251	Necked Vessels (Medium ollas or Jars…no height)	Extremely inclined neckless olla, 165-175
252	Necked Vessels (Medium ollas or Jars…no height)	Very inclined neckless olla, 150-164
253	Necked Vessels (Medium ollas or Jars…no height)	Inclined Neckless Olla, 135-149
254	Necked Vessels (Medium ollas or Jars…no height)	Slightly Inclined Neckless Olla, 113-134
255	Necked Vessels (Medium ollas or Jars…no height)	Inclined Neckless Olla with horizontal lug
256	Necked Vessels (Medium ollas or Jars…no height)	Slightly Inclined with horizontal lug

TAP ceramic form codes: Tall and Medium Necked Vessels
(Used when distinguishing between jar and olla is impossible)

Code/General Category/Specific Form		
300	Ollas, Short (<2) and Medium (2.1-3.9)	Short Necked flared olla
310	Ollas, Short (<2) and Medium (2.1-3.9)	Short-Necked Slightly Flared Olla
311	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 310, with rim to body vertical handle
319	Ollas, Short (<2) and Medium (2.1-3.9)	Possible Short Necked Olla
320	Ollas, Short (<2) and Medium (2.1-3.9)	Short-Necked Straight Olla
321	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 320 With Horizontal Lug
322	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 320, With Vertical Handle Below Rim
330	Ollas, Short (<2) and Medium (2.1-3.9)	Short-Necked Inclined Olla
339	Ollas, Short (<2) and Medium (2.1-3.9)	Short-Necked Olla, No angle
340	Ollas, Short (<2) and Medium (2.1-3.9)	Medium Necked Flared Olla
349	Ollas, Short (<2) and Medium (2.1-3.9)	Possible Medium Necked Olla
350	Ollas, Short (<2) and Medium (2.1-3.9)	Medium Necked slightly flared olla
351	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 350, with rim to body vertical handle
352	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 350, vertical handle on shoulder
353	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 350, with vertical handle just below rim

TAP ceramic form codes: Ollas

Code/General Category/Specific Form		
360	Ollas, Short (<2) and Medium (2.1-3.9)	Medium necked straight olla
361	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 360, with rim to body vertical handle
362	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 360, with vertical handle just below rim
363	Ollas, Short (<2) and Medium (2.1-3.9)	Same as 360, with lug
370	Ollas, Short (<2) and Medium (2.1-3.9)	Medium necked inclined olla
377	Ollas, Short (<2) and Medium (2.1-3.9)	Medium necked olla, no angle, vertical handle at rim
378	Ollas, Short (<2) and Medium (2.1-3.9)	medium necked olla, no angle, vertical handle just below rim
379	Ollas, Short (<2) and Medium (2.1-3.9)	Medium necked olla, no angle
380	Ollas, Short (<2) and Medium (2.1-3.9)	Collared olla, no angle
381	Ollas, Short (<2) and Medium (2.1-3.9)	Collared olla, very inclined body, straight neck
382	Ollas, Short (<2) and Medium (2.1-3.9)	Collared olla, very inclined body, slightly flared neck
383	Ollas, Short (<2) and Medium (2.1-3.9)	collared olla, slightly inclined body, straight neck
384	Ollas, Short (<2) and Medium (2.1-3.9)	collared olla, slightly inclined body, slightly flared neck
385	Ollas, Short (<2) and Medium (2.1-3.9)	collared olla, inclined body, straight neck
386	Ollas, Short (<2) and Medium (2.1-3.9)	collared olla, inclined body, slightly flared neck
387	Ollas, Short (<2) and Medium (2.1-3.9)	collared olla, slightly inclined body, straight neck, with lug

TAP ceramic form codes: Ollas continued

Code/General Category/Specific Form		
400	Bowl	bowl, no angle
401	Bowl	bowl, with horizontal handle on rim, titled slightly up
402	Bowl	bowl, with loop on rim
403	Bowl	bowl, no angle, horizontal handle at rim
409	Bowl	possible bowl
410	Bowl	vertical sided bowl
411	Bowl	vertical sided bowl, shallow
412	Bowl	vertical sided bowl, medium
413	Bowl	vertical sided bowl, deep
414	Bowl	vertical sided bowl, lug just under rim
419	Bowl	possible vertical sided-bowl
420	Bowl	slightly flared bowl
421	Bowl	slightly flared bowl, shallow
422	Bowl	slightly flared bowl, medium
423	Bowl	slightly flared bowl, deep
424	Bowl	slightly flared bowl with decorative nubbin
425	Bowl	slightly flared bowl with horizontal handle (Tia)
426	Bowl	slightly flared bowl with rounded base
429	Bowl	possible slightly flared bowl
430	Bowl	flared bowl
431	Bowl	flared bowl, with rim scallops
432	Bowl	flared bowl, with horizontal handle just below rim

TAP Forms: Bowls

Code/General Category/Specific Form		
439	Bowl	Possible flared bowl
440	Bowl	Slightly convex bowl, no angle
441	Bowl	Slightly convex bowl, slightly flared sides
442	Bowl	slightly convex bowl, flared sides
443	Bowl	slightly convex bowl, vertical sides
444	Bowl	slightly convex bowl, slightly flared with lug
445	Bowl	slightly convex bowl, vertical sides with lug
446	Bowl	slightly convex bowl, no angle, horizontal handle just below rim
447	Bowl	slightly convex bowl, vertical sides, horizontal handle on rim
448	Bowl	slightly convex bowl, vertical sides, horizontal handle just below rim
449	Bowl	slightly convex bowl, inclined
450	Bowl	Convex Bowl, no angle
451	Bowl	slightly convex bowl, inclined, horizontal handle on rim
452	Bowl	sl convex bowl, no angle, with lug
453	Bowl	slightly convex bowl, slightly flared sides, horizontal handle on rim
454	Bowl	slightly convex bowl, flared sides, horizontal handle on rim
455	Bowl	Convex Bowl, with short neck, similar to short necked olla (Chiripa)
456	Bowl	Slightly convex bowl, no angle, loop on rim
457	Bowl	Short Necked slightly flared bowl, red banded. Tia 1
458	Bowl	Short Necked slightly flared bowl, red banded. Tia 1, with horizontal handle below neck
459	Bowl	Short necked slightly flared bowl, red banded, with vertical handle below neck
460	Bowl	Incurving Bowl

TAP ceramic form codes: Bowls continued

Code/General Category/Specific Form		
462	Bowl	Convex bowl with short neck (455) with lug
465	Bowl	Carinated bowl, with slightly flared sides
466	Bowl	Carinated bowl, with vertical sides
467	Bowl	Carinated Bowl, no angle
468	Bowl	Carinated Bowl, slightly flared, medium depth
470	Bowl	Tazon
480	Bowl	Zahumador
490	Bowl	Zoomorphic head incensario
491	Bowl	Scalloped incensario (may or may not have zoomorphic head)
492	Bowl	Shelf rim bowl, vertical sides
493	Bowl	Shelf rim bowl, slightly flared sides
494	Bowl	Shelf rim bowl, no wall left
497	Bowl	Incensario, no scallops on the piece preserved

TAP ceramic form codes: Bowls continued

Code/General Category/Specific Form					
500	Bottles	Bottle	817	Ear Plug	Ear Plug
509	Bottles	Possible Bottle	818	Lip Plug	Lip Plug
600	Keros	Kero (rim only)	819	Loop	Rim loop no rim
601	Keros	Banded kero	820	Lug	Horizontal Lug
609	Keros	Possible kero	821	Lug	Vertical Lug
710	Miscellaneous Tiwanaku Shapes	Spouted Jar	822	Lug	Semi-Circular Lug
720	Miscellaneous Tiwanaku Shapes	Challador	823	Lug	EC type squared horizontal lug
800	Spindle Whorl	Spindle Whorl	824	Lug	wavy lug
801	Blank Spindle Whorl	Blank Spindle Whorl	825	Lug	ring lug
805	Polishing Tool	Polishing Tool	826	Nubbin	Nubbin
806	Possible Polishing Tool	Possible Polishing Tool	827	Scallop	Scallop
810	Trumpet	Trumpet	828	Pierced Rim Scallop	Pierced Rim Scallop
811	Trumpet	Trumpet with handle	829	Appliquet Fillet	Appliquet Fillet
815	Figurine	Figurine	830	Box-Shaped vessel	Box-shaped vessel
816	Hemispherical Object	Hemispherical Object			

TAP ceramic form codes: Various other forms

Code/General Category/Specific Form		
900	Unknown	Unknown
901	Unknown	Unknown, closed vessel
902	Unknown	unknown, body sherd, probable bowl
903	Unknown	unknown, small diameter, probable neck
904	Unknown	same, open vessel, slightly flared
905	Body Sherd	Body sherd, probable tia Cantaro
906	Unknown	Unknown, open vessel, flared
907	Unknown	Unknown, straight angle
908	Body Sherd	body sherd from olla or jar, globular
909	Body Sherd	body sherd from somewhere near neck
910	Unknown	Unknown, necked vessel (short or medium necked olla), no angle
911	Body Sherd	body sherd, maybe kero
912	Unknown	unknown, open vessel, no angle
913	Unknown	unknown, necked vessel (olla or jar), slightly flared
914	Body Sherd	Decorated body sherd, don't know shape
915	Body Sherd	Plain body sherd scraped for sherd char
916	Body Sherd	Body Sherd Wall Near Base
917	Body Sherd	Body Sherd Flat Part of Base
918	Body Sherd	Body Sherd with Repair Hole
919	Body Sherd	Decorated Body sherd with repair hole
920	Tierra Quemada	Tierra Quemada
921	Tile	Tile
922	Unknown	Unknown with horizontal handle
923	Unknown	Unknown with vertical handle
924	Body Sherd	Body Sherd with broken off handle

TAP ceramic form codes: Various unknown categories

Code/General Category/Specific Form					
B10	Base	Flat Base, Flared Wall (35-55)	B70	Base	Rounded Base
B19	Base	Flat Base, no wall or less than 1 cm	B79	Base	Possible Rounded Base
B20	Base	Flat Base, Slightly Flared Wall (56-80)	B80	Base	Ring Base, no height
B21	Base	Same, With nubbin on wall	B81	Base	Ring Base, < 2 cm
B30	Base	Flat Base, Straight Wall, (80-90)	B82	Base	Ring Base, 2.1-4 cm
B33	Base	Same, Probable Kero	B83	Base	Ring Base, 4.1-6 cm
B40	Base	Thickened edge base, less than 1 cm of wall	B89	Base	Possible Ring Base
B41	Base	Thickened edge base, very flared wall	B90	Base	Carinated Base
B42	Base	Thickened edge base, flared wall	B93	Base	Possible Carinated Base
B43	Base	Thickened edge base, slightly flared wall	B94	Base	Foot of Tripod or tetrapod vessel
B44	Base	Thickened edge base, straight wall	B95	Base	Basal Flange
B50	Base	Up then outcurving wall	H10	Handle	Strap Handle
B60	Base	Flat Base, Convex Wall	H20	Handle	Strap Ridge
B61	Base		H30	Handle	Squared Oval
B65	Base	Indented Base, flared convex wall	H40	Handle	Round
B66	Base	Indented Base, slightly flared convex wall	H50	Handle	Oval
B67	Base	Indented Base, No angle	H99	Handle	Broken, can't get handle shape

TAP ceramic form codes: Bases and handles

Code	Carbonization
1	light powder
2	medium powder
3	heavy powder
4	light encrustation
5	medium encrustation
6	heavy encrustation
7	light encrustation with yellow or white edges
8	medium encrustation with yellow or white edges
9	heavy encrustation with yellow or white edges
10	scorched gray
11	scorched white
12	fire blackened
13	black all over/post breakage charring

TAP carbonization codes

Appendix 3: Compositional Analysis Data

EDXRF Data[a]

SAMPLE	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
kk 6685 bs 109	KK	1	5318.74	468.14	53463.27	122.95	148.97	607.86	202.15	27097.62	27090.46	24.98
kk 6685 bs 109	KK	1	5056.91	< LOD	51544.47	249.77	151.91	627.23	224.87	27794.68	26377.73	89.3
THIN SECTION 1	KK	1	6036.09	458.03	51464.17	115.66	104.62	1102.38	300.71	25507.68	22901.91	28.91
xrf-bs-1017	KK	1	2881.18	827.91	39601.77	84.86	106.2	326.06	223.16	12161.35	21997.03	40.69
xrf-bs-1012	KK	1	4315.62	355.21	52202.54	81.16	123.66	473.24	213.12	10580.49	25366.69	23.88
ku 7727 bs 101	KU	1	5507.11	452.86	52981.54	66.7	124.14	580.06	268.37	13260.16	24819.45	29.29
ku 7725 bs 104	KU	1	5008.43	467.8	56435.21	131.17	133.2	595.55	225.5	15287.49	28270.64	29.1
ku 7707 bs 100	KU	1	4579.61	817.13	47625.77	87.18	131.04	803.79	198.92	21429	33340.98	23.86
xrfbs1024	KU	1	4449	1513.29	57152.91	93.58	117.68	768.77	276.56	45561.56	33841.03	32.21
pet6	KU	1	4489.08	589.5	52765.54	99.61	132.19	643.16	192.92	30653.94	36847.4	26.83
pet7	KU	1	4664.49	536.99	58700.22	114.37	164.89	665.39	171.54	17660.16	32711.24	23.08
pet1	KU	1	4396.62	518.47	47386.34	98.02	117.06	626.11	216.85	22145.15	24959.03	26.1
sc-KU7590sl5-6	KU	1	4611.61	598.95	49077.39	58.15	96.24	799.24	266.37	17502.77	22762.39	25.06
sc-KU6648-5	KU	1	3595.34	359.1	41411.16	53.99	103.56	860.75	222.2	36896.77	23517.27	22.62
sc-KU7508sl14-5	KU	1	3350.98	562.92	41440.26	75.71	124.15	358.15	184.02	18565.78	27669.22	26.28
xrf-bs-90	SN	1	3828.35	1221.69	42594.16	169.21	204.36	464.28	197.58	32685.95	47150.14	23.76
xrf-bs-84	SN	1	5234.42	373.9	55796.39	85.53	134.55	681.85	226.67	16740.16	32871.78	30.39
XRF-bs-85	SN	1	4477.6	447.07	53480.25	82.48	127.71	700.69	223.38	29666.85	25823.89	30.03
XRF-bs-67	SN	1	4741.38	506.52	57876.56	115.99	106.87	591.29	245.36	13187.01	27972.89	27.75
XRF-bs-87	SN	1	4508.95	602.32	51946.99	96.23	129.34	731.99	271.29	17157.81	30938.17	25.61
XRF-bs-55	SN	1	5294.79	267.71	37316.45	77.1	130.37	496.54	251.96	13692.9	20002.96	24.54

[a] The portable EDXRF data is presented here, in part per million, without the error columns. Only those elements that had readings well above the error bracket were included. In some cases, however, particular samples had high error ratings for some element. These are presented as <LOD. These particular samples were not used in the elemental plots in Chapter 8.

SAMPLE	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
XRF-bs-74	SN	1	4888.21	1007.03	52394.96	85.52	124.6	575.26	247.72	27244.5	35164.61	30.53
xrf-bs-1018	SN	1	5469.93	604.05	43173.75	88.85	108.29	940.01	256.2	18885.1	28260.39	36.75
xrf-BS_1011	SN	1	4739.17	410.61	52238.79	154.33	145.88	461.07	281.91	12859.13	42779.23	21.16
xrf-BS_1013	SN	1	6066.68	1117.96	51398.9	83.79	109.78	940.42	306.85	16029.23	27313.36	21.19
xrfbs1021	SN	1	4679.24	417.72	55011.74	86.45	117.69	608.04	286.48	14610.61	26583.36	21.24
xrfbs1015	SN	1	4629.5	534.18	39701.94	62.43	95.5	1097.98	234.09	23955.14	26562.46	29.17
7087-1	SN	1	4515.91	619.39	59294.46	98.85	131.97	540.9	197.4	14625.16	32025.56	23.95
kk 6685 bs 110	KK	2	4278.1	407.76	45987.36	93.44	121.28	611.47	234.69	22888.27	34957.02	19.82
ku 7725 bs 102	KU	2	4250.85	813.12	63635.27	101.54	123.5	605.32	270.64	18102.44	55795.97	24.04
pet8	KU	2	4968.09	1205.46	54477.31	74.08	110.59	709.41	274.4	16556.69	25301.13	23.77
sc-KU5308-56	KU	2	3895.78	347.35	44630.87	104.36	135.18	479.05	177.2	11265.36	35081.27	25.49
sc-KU7519-9	KU	2	4761.1	1454.3	57735.89	159.94	129.1	832.44	243.36	24362.19	43053.63	30.26
xrf-bs-93	SN	2	3382.19	541.12	45817.67	87.16	141.79	811.42	272.53	98603.3	47160.23	25.08
XRF-bs-91	SN	2	4287.49	447.85	45155.12	72.41	157.38	683.06	202.75	25802.33	33869.14	30.13
SN7074-6	SN	2	4075.74	415.37	39153.43	106.74	187.6	318.9	196.91	16813.85	60164.21	32.04
SN7074-17	SN	2	4308.14	385.45	55125.39	61.1	111.96	391.53	253.46	15520.16	35500.2	28.9
xrfbs1014	SN	2	5707.47	886.16	51948.37	104.3	117.75	854.94	299.74	19957.36	30098.08	28.28
xrfbs1019	SN	2	4671.08	354.82	48608.11	76.54	116.84	639.32	249.58	23867.4	24739.66	31.47
ku 7727 bs 97	KU	3	2483.44	537.55	23698.5	84.01	173.57	159.69	197.21	20249.64	51893.95	35.43
ku 7725 bs 95	KU	3	3791.75	385.52	42416.83	96.67	165.01	191.09	169.77	11939.77	26838.59	33.14
ku 7727 bs 103	KU	3	3137.94	393.35	30597.68	98.33	153.35	130.57	213.28	17173.78	25059.37	31.2
ku 7665 bs 105	KU	3	2653.46	476.96	31513.47	88.86	173.76	182.23	200.66	13163	42881.09	31.65
ku 7725 bs 94	KU	3	3831.81	462.91	35539.63	102.32	189.2	163.21	152.44	13550.71	43384.4	27.54
pet5	KU	3	3561.71	628.34	34644.08	83.93	163.29	180.92	202.02	18200.03	44712.37	37.71
pet4	KU	3	4082.34	601.22	39297.14	108.01	164.96	186.06	191.83	15859.55	28335.68	31.37

	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
sc-KU7659-16	KU	3	2994.54	849.85	34879.88	111.21	184.99	170.09	146.73	17979.39	38427.76	30.65
sc-KU7654-35	KU	3	3298.8	540.9	32666.55	93.42	182.71	216.42	183.03	21180.51	54560.06	31.83
sc-KU7659-28	KU	3	3192.49	891.83	37681.41	155	170.38	223.28	174.22	30736.39	55869.43	34.14
SC-ku7654-35	KU	3	2330.12	517.7	25051.59	130.16	169.15	253.5	179.56	83971.26	49012.08	29.21
1057	KU	3	3401.16	571.27	33038.56	82.69	168.38	176.76	192.47	25488.17	33766.71	30.58
1058	KU	3	3090.01	551.22	34365.89	98.4	180.84	198.04	183.54	9552.12	43662.35	36.1
7727-7	KU	3	2586.64	1022.11	29098.69	103	141.95	127.93	190.94	32314.94	24452.59	29.01
1059	KU	3	3799	572.19	32246.25	59.22	156.74	159.48	181.85	16817.86	25067.73	30.33
1061	KU	3	3336.82	652.57	33371.96	116.15	162.76	202.6	163.43	15440.68	31741.14	29
xrf-bs-75	SN	3	3286.32	436.57	31763.59	93.75	172.06	218.44	175.35	14585.05	32570.36	36.01
XRF-bs-63	SN	3	3831.82	446.48	33688.03	68.74	152.35	204.46	204.44	13424.14	27395.43	28.08
XRF-bs-83	SN	3	2394.45	677.85	24243.11	86.11	176.63	184.26	161.86	73504.78	40448.99	27.42
XRF-bs-66	SN	3	3599.45	594.33	38348.87	88.74	168.92	178.55	182.73	25636.74	30836.99	28.52
SN7074-2	SN	3	3212.19	930	31301.08	86.17	163.65	154.03	186.63	14350.94	26925.56	25.81
SN7074-14	SN	3	3532.48	660.17	32246.27	87.34	169.57	182.08	192.96	13601.56	31388.94	29.33
sn-7080-12	SN	3	2407.76	594.97	28726.35	78.24	174.02	272.22	164.01	12522.62	50533.34	22.1
xrf-BS1003	SN	3	2973.37	483.95	30666.92	96.52	178.45	148.4	203.77	15114.97	38901.52	31.59
7087-10	SN	3	2798.13	355	33187.36	78.33	179.14	170.62	173.99	12159.54	28023.14	32.46
1050	SN	3	3086.22	698.81	32325.46	91.44	155.17	163.14	194.84	38909.43	30549.2	31.27
1051	SN	3	3481.17	665.33	35467.52	84.8	156.33	151.2	187.89	28132.1	35974	30.98
1052	SN	3	3359.26	592.89	36185.5	82.26	173.43	210.43	180.43	27206.37	43585.95	29.83
1053	SN	3	2826.17	400.01	23899.46	92.82	192.03	145.29	175.35	9188.81	32300.41	37.08
1054	SN	3	99.61	353.58	32619.93	97.04	158.67	173.84	169.66	1187.4	< LOD	31.45
1055	SN	3	3434.56	446.61	40541.01	82.31	164.49	226.6	181.96	16746.02	29466.85	32.97
1056	SN	3	3126.64	542.52	34636	90.28	172.79	176.54	178.17	20327.5	42885.68	31.38
xrf-BS_1006	KK	5	6804.13	600.79	39028.63	76.33	131.6	500.61	309.96	12363.29	22216.7	37.39

SAMPLE	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
xrfbs-1007	SN	5	4955.9	489.49	48052.67	90.45	138.33	544.25	251.91	13699.68	24639.4	19.99
XRF-bs-92	KK	6	5543.19	504.51	59315.46	62.83	139.82	386.46	271.98	11387.78	24483.01	22.97
xrf-bs-1026	KK	6	4590.08	339.64	41261.09	108.92	184.19	162.67	219.52	9635.38	57736.14	28.22
ku 7707- 3	KU	6	5297.54	250.15	42371.61	88.72	164.32	134.45	208.62	9810.68	27633.12	26.63
sn7174-15	SN	6	5597.91	315.79	41758	99.48	151.11	164.53	260.61	8582.91	31336.15	26.22
xrfbs1025	SN	6	4870.32	488.43	37371.95	79.66	145.31	293.2	241.78	7907.22	41892.13	25.74
sc-7590-13	KU	9	3119.8	435.96	31030.49	110.24	192.53	199.49	170.26	11641.1	44626.82	32.19
sc-KU7517-28	KU	9	2700.69	506.34	27971.93	97.41	168.41	260.93	200.24	10724.62	42418.92	34.04
sc-KU5308-54	KU	9	2882.71	365.95	28805.21	82.3	163.67	155.29	196.39	10803.96	39654.66	31.09
sc-KU5156-18	KU	9	2852.38	508.77	31857.28	83.86	164.39	201.02	159.03	14011.86	27739.23	25.58
SC-ku7659-27	KU	9	1760.45	804.64	20157.19	163.87	189.26	237.07	177.95	46712.28	52465	29
SC-ku7646-23	KU	9	3212.19	448.8	35008.54	118.13	167.49	204.29	195.76	16817.56	42852.38	30.8
XRF-bs-70	SN	9	2827.96	479.11	28393.92	90.92	181.4	159.98	178.54	11988.26	41804.77	42.91
XRF-bs-49	SN	9	3617.48	512.42	44811.46	97.09	160.37	241.64	175.81	14668.46	33903.36	45.82
XRF-bs-76	SN	9	2989.77	582.12	29152.33	108.3	172.82	223.64	150.4	19689.48	34154.81	31.58
SN7074-3	SN	9	3446.46	419.83	33872.22	94.2	165.88	178.22	213.42	21969.19	51701.99	28.99
xrfbs1008	SN	9	3022.39	414.62	31376.32	80.78	166.88	181.11	175.12	17277.4	33696.73	27.57
kk 6585 bs 107	KK	17	4553.1	420.68	51955.82	76.11	132.62	590.36	227.36	27894.87	32147.51	27.2
XRF-bs-82	SN	17	6823.8	632.45	70268.51	86.94	105.06	800.07	350.03	11361.61	38057.55	33.69
SN7074-15	SN	17	4700.98	448.13	54833.94	106.5	134.71	729.71	203.49	15461.07	27338.97	33.72
SN7074-15	SN	17	3230.59	380.89	34114.99	93.72	169.04	194.85	175.22	15527.51	31925.21	26.77
xrf-BS_1009	SN	17	4447.68	570.38	54373.08	113.29	146.45	684.36	226.23	17907.21	42497.94	28.27
pet-paste6	SN	17	4977.13	283.14	42188.66	91.76	156.45	305.35	301.72	12905.21	24892	21.68
kk 6588 bs 112	KK	18	5101.74	368.14	49195.45	61.14	101.2	662.91	266.53	26159.05	24741.39	29.06
kk 6588 bs 113	KK	18	4697.97	458.89	54619.66	81.55	143.39	672.36	229.04	22869.04	46132.1	26.69
kk 6689-12	KK	18	4733.07	1108.7	46778.11	101.37	124.62	622.72	259.41	18156.43	21439.76	27.88
kk 6685 bs 108	KK	18	4305.16	583.96	52279.66	98.56	123.58	717.66	201.35	21878.21	25913.46	28.66
ku 7725 bs 99	KU	18	4896.56	740.66	56853.11	106.89	142.92	603.93	221.06	17867.03	43620.62	22.7
ku 7727 bs 96	KU	18	4172.99	593.58	51765.28	108.05	151.65	364.91	235.62	17952.81	49309.07	26.41
ku 7725 bs 106	KU	18	4713.54	710.86	56396.78	109.21	145.12	518.87	222.2	15504.79	29990.51	32.17
xrf-BS1023	KU	18	4293.73	327.19	41182.57	106.6	125.48	552.77	223.89	14477.73	25775.75	24.68
xrfbs-1022	KU	18	5301.09	334.94	37925.89	66.38	138.12	391.3	247.06	10965.3	26161.47	25.55

SAMPLE	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
sc-KU5150_p18	KU	18	3001.46	358.75	39034.82	83.52	171.7	194.25	162.73	18526.36	38996.1	30.11
sc-KU5308-55	KU	18	3893.1	442.07	45517.21	85.75	117.05	569.2	229.53	55223.28	19941.76	21.21
xrf-bs-73	SN	18	3285.42	520.08	41033.16	96.11	134.19	259.63	175.37	15308.3	29335.7	31.34
XRF-bs-57	SN	18	3978.29	690.44	73867.31	81.06	104.94	611.38	176.33	21815.96	25414.5	29.38
XRF-bs-88	SN	18	4803.85	599.06	51071.38	97.42	152.48	663.76	198.71	18805.32	35348.68	30.16
XRF-bs-69	SN	18	4926.62	525.61	56490.35	114.99	141.25	557.49	271.48	12520.4	37306.85	37.37
XRF-bs-98	SN	18	3526.33	1031.53	38626.3	98.17	126.88	615.91	190.18	108643.33	23222.43	26.15
SN7074-1	SN	18	3680	489.82	32878.06	81.59	151.57	363.88	167.21	24278.16	35155.96	29.38
SN7074-22	SN	18	4132.37	470.83	52791.07	80.18	129.88	334.09	260.1	17816.47	27071.2	23.94
SN7074-25	SN	18	4196.87	707.11	64241.58	98.34	131.46	679.91	220.33	12909.64	35539.71	24.24
xrf-bs-1001	SN	18	3576.9	566.44	49035.13	80.13	113.4	792.11	235.65	13005.89	19986.64	30.02
xrf-BS_1010	SN	18	4734.59	992.78	65398.79	82.91	103.22	746.64	248.51	19066.96	24158.69	21.18
xrf-BS_1004	SN	18	4523.93	432.38	35927.01	85.56	134.85	763.21	195.87	17743.88	37383.02	22.46
xrf-bs-1005	SN	18	5461.3	645.53	58119.4	105.86	121	1053.77	189.12	21870.66	25884.23	29.02
xrfbs1002	SN	18	3668.57	482.47	51160.63	80.79	113.25	690.26	178.21	14114.97	27002.71	22.93
xrfbs1016	SN	18	5771.42	499.2	65594.8	82.5	127.22	615.2	223.11	12839.45	27692.6	29.09
pet-3	SN	18	4301.08	454.92	47731.5	104.84	146.88	377.17	217.37	29313.31	51504.36	19.46
pet-2	SN	18	4325.41	518.85	44856.82	81.39	125.54	705	215.36	21563.32	26346.92	24.6
xrfbs1020	SN	19	3945.77	920.87	53444.69	84.67	114.04	348.94	244.92	33014.64	25630.05	25.07
kk 6585-5	KK	29	6103.01	637.12	57571.29	82.98	118.59	600.63	312.53	18462.78	23361.37	38.53
kk 6588 bs 111	KK	29	7462.16	1656.17	68802.38	145.84	106.9	838.49	328.05	23220.94	21092.65	28.05
1062	KU	1 or 2	3929.04	531.92	50849.26	83.1	148.95	437.83	195.06	13206.83	26643.27	21.62
1063	KU	1 or 2	5392.39	< LOD	41996.71	1539.78	290.35	1343.89	231.38	19794.36	23686.96	780.64
1064	KU	1 or 2	5733.2	8235.76	46746.8	1417.98	288.28	571.78	328.01	11667.86	26499.16	462.75
1065	KU	1 or 2	3494.92	8784.97	41265.17	1214.2	289.96	666.36	283.28	41441.05	38148.6	< LOD
1066	KU	17 or 18	4793.87	441.78	45078.96	94.6	124.68	640.98	230.33	17809.15	48306.81	25.47
1067	KU	17 or 18	4056.47	522.96	50935.52	82.55	181.62	438.21	189.13	16449.35	57554.59	31.43

SAMPLE	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
1068	KU	17 or 18	99.61	425.14	56116.91	78.27	114.74	628.35	237.43	1187.4	< LOD	28.43
1068	KU	17 or 18	99.61	467.32	54033.71	67.21	121.65	627.6	239.85	1187.4	< LOD	< LOD
1069	KU	17 or 18	4310.67	448.95	33756.14	90.51	141.29	256.03	184.66	14925.93	39134.43	21.95
1070	KU	17 or 18	5446.48	371.31	79362.23	58.56	134.28	253.25	251	8247.38	27290.78	32.17
1071	KU	17 or 18	4891.09	543.18	53638.04	94.83	130.76	672.78	220.36	15802.44	29693.6	28.9
1072	KU	17 or 18	5187.56	389.49	76717.99	58.58	134.9	234.36	257.2	7850.71	23804.25	16.26
1073	KU	17 or 18	3416.46	490.48	39379.96	82.68	163.34	199.31	186.66	12628.92	30069.64	38.94
1074	KU	17 or 18	4118.15	654.28	64099.77	100.26	110.6	649.66	229.24	18595.61	23485.89	23.72
kw-kl-p4b	Khonko	Clay	3751.18	766.16	45643.49	114.07	137.44	231.02	156.38	47200.13	21794.67	26.82
CL-kw-kl-p7e	Khonko	Clay	4041.47	188.65	36681.21	67.91	76.29	239.43	188.77	6975	14617.97	19.62
CL-kw-kl-p11	Khonko	Clay	3920.06	107.11	38654.08	174.22	136.64	619.6	153.31	7350.28	19054.89	29.72
CL-kw-kl-p8b	Khonko	Clay	3309.59	2104.65	49800.16	127.44	132.61	304.31	152.87	47176.34	18822.74	31.14
CL-kw-kl-p10	Khonko	Clay	1092.28	505.6	13381.89	61.6	25.16	1104.8	63.67	188034.22	7125.75	9.56
clay90	Taraco	Clay	5173.49	207.98	38626.08	80.78	143.96	146.78	246.82	6835.04	22534.18	23.28
utm79	Taraco	Clay	4644.16	117.91	24198.08	66.38	139.28	171.02	251.51	4518.73	19891.15	12.31
utm320	Taraco	Clay	2452.43	475.09	21709.17	87.2	29.17	110.45	143.76	14776.99	7456.47	25.26
utm112b-paint	Taraco	Clay	979.62	538.23	12623.85	< LOD	30.95	44.1	94.12	2414.09	10319.36	48.98
utm-159b	Taraco	Clay	4467.64	135.41	53025.16	36.97	102.95	87.97	272	3637.63	17302.13	16.64
utm-296	Taraco	Clay	3642.95	392.57	44203.85	69.19	131.69	112.34	198.65	17400.63	19186.68	19.42
utm-333b	Taraco	Clay	4252.77	174.22	61955.84	97.99	194.2	146.91	139.08	11379.85	28048.14	29.64
utm317-chillo	Taraco	Clay	2560.35	122.15	10340.44	19.89	49.08	67.73	321.5	4632.77	10268.67	6.85
utm60-sand	Taraco	Clay	812.93	71.77	7506.43	< LOD	20.64	43.56	90.9	3530.78	2652.49	< LOD
utm71sand	Taraco	Clay	1870.71	242.91	27887.99	27.06	49.02	106.79	188.86	3498.3	8654.43	16.3
utm339-sed	Taraco	Clay	732.98	< LOD	11071.3	< LOD	35.01	97.94	115.92	295367.84	5868.98	12.32
clay103	Taraco	Clay	4385.01	277.15	86979.49	44.18	90.83	83.04	315.74	4374.29	17444.04	35.14
clay103	Taraco	Clay	4385.01	277.15	86979.49	44.18	90.83	83.04	315.74	4374.29	17444.04	35.14
clay296	Taraco	Clay	5006.71	423.57	51313.15	91.74	156.84	135.81	247.5	23765.1	29202.92	29.04
clay296	Taraco	Clay	5006.71	423.57	51313.15	91.74	156.84	135.81	247.5	23765.1	29202.92	29.04
clay78	Taraco	Clay	5153.31	93.93	19264.69	51.85	122.95	163.12	286.5	4637.23	22341.1	15.43

SAMPLE	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
clay78 500	Taraco	Clay	4904.18	84.35	18611.59	48.49	120.72	156.04	295.7	4417.1	21283.46	16.99
clay286 100	Taraco	Clay	5537.09	434.32	68150.63	101.98	188.32	151.45	169.55	6738.18	34688	30.33
clay286 700	Taraco	Clay	5092.55	726.28	77485.74	136.06	230.63	172.68	155.68	12891.81	37708.3	44.79
clay159-b 100	Taraco	Clay	5146.46	117.34	55272.34	51.51	116.72	101.5	290.28	3389.43	21429.46	20.4
clay159-b 600	Taraco	Clay	5019.4	137.5	54785.27	36.12	118.35	96.82	304.54	3253.48	21816.04	24.56
clay234 100	Taraco	Clay	99.61	653.75	55494.59	77.6	159.87	167.65	192.75	1187.4	< LOD	29.12
clay234 500	Taraco	Clay	5101.49	< LOD	47945.15	1243.36	323.59	283.32	147.65	8528.62	31544.54	< LOD
clay234 700	Taraco	Clay	5351.35	652.76	63202.09	99.1	176.65	182.54	194.9	8902.64	31627.05	32.7
clay231 100	Taraco	Clay	5716.81	134.38	23791.5	55.1	112.33	110.39	419.01	6423.77	19741.8	21.01
clay231 700	Taraco	Clay	5351.09	184.55	23161.18	52.93	113.43	114.68	414.61	5878.58	18582.21	20.32
clay57 100	Taraco	Clay	4692.73	273.96	49190.07	69.32	115.24	102.4	232.48	23664.58	25029.68	25.94
clay57 500	Taraco	Clay	4357.06	284.56	47588.9	61.32	122.44	98.65	238.99	29981.32	24214.81	20.92
clay57 700	Taraco	Clay	4461.96	222.63	51324.79	76.46	123.41	101.74	234.98	25010.89	24379.7	14.67
clay170 100	Taraco	Clay	5171.39	342.06	47118.59	75.87	126.37	92.38	265	5307.48	22166.04	17.34
clay170 700	Taraco	Clay	5194.02	368.47	48840.43	82.95	129.9	99.11	278.19	5184.17	21867.59	23.67
clay43 100	Taraco	Clay	4521.71	175.11	66397.93	46.16	102.23	86.81	322.55	5061.93	18585.29	27.44
clay43 500	Taraco	Clay	4392.76	172.87	69972.42	47.76	103.08	85.65	356.38	4956.8	19277.62	27.61
clay325a 100	Taraco	Clay	4856.78	445.86	70642.03	106.55	201.81	159.53	135.23	11902.73	36230.97	37.78
clay325a 600	Taraco	Clay	4912.59	620.59	73366.86	126.74	216.22	171.63	143.73	12258.69	36780.75	50.64
clay228 100	Taraco	Clay	4844.94	< LOD	31268.65	43.12	111.75	88.51	403.55	3559.57	18161.26	23.62
clay228 500	Taraco	Clay	4952.95	< LOD	30164.17	38.47	106.37	87.52	425.09	3611.67	18577.08	19.82
clay228 700	Taraco	Clay	4908.89	< LOD	31398.29	42.71	112.46	89.94	406.69	3707.18	18616.99	20.74
clay-tia-akap-c	Tiwanaku	Clay	5051.55	352.94	52355.97	153.35	119.22	178.9	184.44	14377.74	21545.84	31.13
clay-tia-akap-3	Tiwanaku	Clay	5066.48	776.68	51374.74	96.22	98.11	202.07	177.78	28431.01	16709.4	36.76
clay-tia-akap-base	Tiwanaku	Clay	5487.1	513.95	67230.62	132.81	143.01	183.58	163.99	20952.61	26263.71	40.64
clay-tia-river	Tiwanaku	Clay	6631.95	2288.02	67846.6	161.26	133.97	163.52	185.69	18308.46	26432.13	48.6

SAMPLE	SITE/LOCATION	PASTE	Ti	Mn	Fe	Zn	Rb	Sr	Zr	Ca	K	Pb
temper-tia	Tiwanaku	Clay	4470.09	6671.65	47739.18	152.7	133.77	548.75	178.01	18866.92	23066.44	53.92
302a_339t	Taraco	Fired Clay Mix	3712.93	128.4	43586.52	47.38	96.84	99.08	204.67	61406.24	17646.59	16.32
104-339t	Taraco	Fired Clay Mix	3703.7	329.29	45449.23	40.46	86.47	101.91	213.81	41994.89	14479.78	20.64
188a-60t	Taraco	Fired Clay Mix	5396.12	200.26	32975	81.52	116.98	130.07	210.1	6203.89	21807.6	19.22
333a-60t	Taraco	Fired Clay Mix	4940.89	320.05	42358.22	72.42	103.92	85.99	159.7	13416.28	23362.14	16.15
297-60t	Taraco	Fired Clay Mix	3681.3	264.38	26136.62	39.51	73.56	67.84	223.28	21342.37	18433.85	10.15
356-60t	Taraco	Fired Clay Mix	4037.48	274.07	44765.09	67.23	118.38	102.27	162.66	16358.63	23790.55	17.07
mf-lk-2	Chiripa	M.F	3618.16	403.6	36596.38	69.15	104.84	202.31	247.82	10395.09	30784.58	26.35
mf-lk-6	Chiripa	M.F	4358.6	420.11	48473.26	83	144.61	209.42	211	14800.16	28711.85	27.12
mf-lk-8	Chiripa	M.F	3884.17	352.25	54599.14	94.71	120.23	172.32	230.07	8152.29	31024.23	27.77
mf-lk-7	Chiripa	M.F	4230.8	569.69	58688.38	95.69	132.73	256.89	245.34	12952.29	30363.43	33.36
mf-lk-4	Chiripa	M.F	3871.52	538.81	42972.55	81.24	104.23	122.83	207.01	14635.83	23493.07	21.82
mf-lk-3	Chiripa	M.F	3841.52	582.82	59964.41	77.68	164.25	255.75	173.87	16484.46	35862.16	27.62
mf-lk-1	Chiripa	M.F	4451.12	359.26	46783.27	88.94	113.08	127.2	211.29	9335	28801.57	21.56
mf-lk-9	Chiripa	M.F	3882.28	560.69	46864.45	59.44	104.96	215.74	254.9	11289.64	23337.93	18.77
mf-lk-5	Chiripa	M.F	3980.83	457.73	46213.15	112.81	110.44	154.26	246.06	8345.78	25120.06	26.91
mf-lk-10	Chiripa	M.F	4001.37	388	48329.91	67.58	97.78	192.1	283.45	10597.1	28157.64	23.46
tia-temper-luis	Tiwanaku	Temper	3504.15	665.67	26947.46	91.95	86.09	371.67	161.03	20785.17	23688.94	31.03

Quantx EDXRF Vs. Niton EDXRF (Portable)

Sample	Ti		Mn		Fe		Zn		Rb		Sr		Zr		Pb	
	QuantX	Niton	QuantX	Niton	QuantX	Niton	QuantX	Niton	QuantX	Niton	QuantX	Niton	QuantX	Niton	QuantX	Niton
43	3944.59	4392.76	199.00	172.87	50304.33	6997.24	86.26	47.76	103.50	103.08	86.10	85.65	326.60	356.38	53.81	27.61
78	3502.66	4904.18	173.43	84.35	17840.13	1861.16	64.40	48.49	123.38	120.72	166.83	156.04	279.79	295.70	29.47	16.99
90	4122.64	5173.49	217.84	207.98	31282.11	3862.61	110.83	80.78	147.93	143.96	155.21	146.78	235.34	246.82	62.37	23.28
170	3834.71	5194.02	377.01	368.47	34252.83	4884.04	103.63	82.95	117.02	129.90	93.08	99.11	240.69	278.19	36.80	23.67
159b	3753.41	5019.40	170.22	137.50	38134.72	5478.53	78.80	36.12	108.60	118.35	89.36	96.82	258.72	304.54	32.72	24.56
5156-18	3067.10	2852.38	519.42	508.77	26587.70	3185.73	88.08	83.86	162.80	164.39	196.08	201.02	153.67	159.03	43.87	25.58
6589-12	3775.54	4283.35	952.91	663.50	32398.81	4167.58	100.37	105.84	119.63	117.76	566.58	715.34	228.08	265.33	41.35	24.99
7074-1	2986.55	3680.00	535.76	489.82	25399.54	3287.81	97.49	81.59	135.55	151.57	353.28	363.88	158.59	167.21	42.22	29.38
7074-2	2893.66	3212.19	846.06	930.00	26424.95	3130.11	107.84	86.17	157.14	163.65	157.28	154.03	183.45	186.63	47.99	25.81
7074-3	2629.27	3446.46	439.84	419.83	24854.71	3387.22	94.90	94.20	152.11	165.88	170.46	178.22	187.39	213.42	41.10	28.99
7174-15	3992.78	5597.91	333.71	315.79	30906.01	4175.80	101.14	99.48	143.67	151.11	158.72	164.53	234.08	260.61	34.24	26.22
7517-28	3230.95	2700.69	439.84	506.34	23417.61	2797.19	119.10	97.41	172.45	168.41	254.56	260.93	180.52	200.24	57.62	34.04
7654-35	2202.50	3298.80	523.61	540.90	19740.26	3266.66	139.66	93.42	148.07	182.71	355.71	216.42	155.57	183.03	55.40	31.83
7707-3	3701.38	5297.54	371.46	250.15	38622.56	4237.16	117.95	88.72	166.12	164.32	134.71	134.45	190.48	208.62	30.97	26.63
bs-100	3687.23	4579.61	676.50	817.13	34239.70	4762.58	88.18	87.18	126.42	131.04	747.08	803.79	192.36	198.92	45.62	23.86
bs-1003	2609.66	2973.37	531.53	483.95	24618.19	3066.69	109.66	96.52	172.30	178.45	153.64	148.40	181.57	203.77	47.73	31.59
bs-1005	4809.49	5461.30	619.27	645.53	43186.55	5811.94	135.22	105.86	120.95	121.00	955.28	1053.77	212.00	189.12	39.17	29.02
bs-1006	5663.91	6804.13	391.60	600.79	31888.53	3902.86	110.56	76.33	140.78	131.60	517.64	500.61	296.29	309.96	40.14	37.39
bs-1007	4815.61	4955.90	485.40	489.49	35372.40	4805.27	119.59	90.45	149.26	138.33	506.03	544.25	253.40	251.91	31.66	19.99
bs-1008	3018.52	3022.39	465.46	414.62	28162.88	3137.63	103.44	80.78	168.19	166.88	175.82	181.11	165.56	175.12	45.96	27.57
BS-1012	3569.49	4315.62	385.16	355.21	35855.12	5220.25	97.16	81.16	122.20	123.66	473.96	473.24	198.40	213.12	41.14	23.88

Sample	Ti		Mn		Fe		Zn		Rb		Sr		Zr		Pb	
	QuantX	**Niton**	**QuantX**	**Niton**	**QuantX**	**Niton**	**QuantX**	**Niton**	**QuantX**	**Niton**	**QuantX**	**Niton**	**QuantX**	**Niton**	**QuantX**	**Niton**
bs-1013	5030.96	6066.68	593.90	1117.96	40481.72	5139.89	114.52	83.79	103.34	109.78	947.52	940.42	248.55	306.85	61.26	21.19
BS-1017	2980.53	2881.18	789.70	827.91	31898.28	3960.18	104.57	84.86	104.24	106.20	310.90	326.06	203.02	223.16	49.80	40.69
bs-1024	5014.20	4449.00	1086.29	1513.29	41855.89	5715.29	138.38	93.58	128.50	117.68	718.98	768.77	271.99	276.56	52.16	32.21
bs-1025	3993.44	4870.32	348.97	488.43	26937.01	3737.20	166.14	79.66	157.59	145.31	280.39	293.20	245.59	241.78	34.01	25.74
bs-1026	4018.88	4590.08	378.88	339.64	33399.43	4126.11	123.94	108.92	187.28	184.19	170.52	162.67	214.78	219.52	46.70	28.22
bs-103	2669.95	3137.94	427.12	393.35	24302.62	3059.77	118.50	98.33	153.89	153.35	133.55	130.57	180.73	213.28	41.34	31.20
bs-104	4221.61	5008.43	441.74	467.80	35756.90	5643.52	133.43	131.17	127.94	133.20	608.77	595.55	215.19	225.50	42.94	29.10
bs-105	2627.61	2513.45	505.92	421.52	25710.80	3351.61	115.81	92.36	163.34	164.17	157.68	155.08	183.89	190.83	46.58	32.45
bs-106	4385.92	4713.54	661.00	710.86	42608.01	5639.68	136.61	109.21	149.65	145.12	573.48	518.87	218.51	222.20	45.82	32.17
BS-108	3695.28	4305.16	565.74	583.96	35860.64	5227.97	106.39	98.56	112.97	123.58	729.85	717.66	177.64	201.35	41.71	28.66
bs-110	3903.26	4278.10	385.65	407.76	35202.83	4598.74	111.28	93.44	127.83	121.28	612.73	611.47	226.65	234.69	41.44	19.82
bs-112	4033.86	5101.74	343.45	368.14	35615.31	4919.55	92.81	61.14	100.64	101.20	624.41	662.91	245.19	266.53	36.56	29.06
bs-113	4142.97	4697.97	482.01	458.89	40043.41	5461.97	106.86	81.55	142.78	143.39	685.90	672.36	204.29	229.04	41.17	26.69
BS-63	3257.15	3831.82	288.80	446.48	25433.80	3368.80	79.82	68.74	137.81	152.35	199.50	204.46	195.48	204.44	46.30	28.08
BS-66	2628.07	3599.45	552.78	594.33	24329.70	3834.89	92.50	88.74	150.08	168.92	182.96	178.55	173.79	182.73	42.98	28.52
BS-74	4162.77	4888.21	852.62	1007.03	37981.62	5239.50	105.14	85.52	125.18	124.60	552.86	575.26	224.53	247.72	46.48	30.53
bs-75	2746.12	3286.32	486.15	436.57	25505.61	3176.36	100.05	93.75	166.12	172.06	217.05	218.44	162.53	175.35	42.78	36.01
bs-76	2667.09	2989.77	438.81	582.12	22241.05	2915.23	119.15	108.30	159.56	172.82	218.84	223.64	140.43	150.40	44.96	31.58
bs-82	5783.95	6823.80	501.71	632.45	48302.90	7026.85	115.24	86.94	104.68	105.06	740.57	800.07	291.64	350.03	55.70	33.69
bs-83	2397.80	2394.45	546.69	677.85	21866.12	2424.31	100.75	86.11	176.76	176.63	155.61	184.26	140.18	161.86	42.28	27.42
bs-92	4330.85	5543.19	515.74	504.51	41367.35	5931.55	96.74	62.83	132.18	139.82	385.91	386.46	250.19	271.98	42.99	22.97
bs-93	3666.84	3382.19	527.84	541.12	37351.20	4581.77	107.83	87.16	146.09	141.79	752.92	811.42	264.48	272.53	48.85	25.08
bs-94	2685.09	3831.81	522.86	462.91	25771.61	3553.96	109.65	102.32	179.34	189.20	167.76	163.21	129.43	152.44	46.94	27.54
bs-95	3445.36	3791.75	581.44	385.52	33396.16	4241.68	131.13	96.67	172.67	165.01	191.50	191.09	154.79	169.77	42.98	33.14
bs-96	3666.50	4172.99	601.35	593.58	37877.67	5176.53	121.39	108.05	149.52	151.65	352.74	364.91	210.74	235.62	47.19	26.41
bs-97	2742.08	2483.44	516.66	537.55	26081.82	2369.85	105.66	84.01	162.44	173.57	153.25	159.69	179.93	197.21	38.37	35.43
bs-98	3588.12	3526.33	590.13	1031.53	31438.83	3862.63	110.34	98.17	124.74	126.88	625.58	615.91	183.03	190.18	34.45	26.15
thinsection 1-1	5049.47	4396.62	421.59	518.47	39646.21	4738.63	125.54	98.02	110.73	117.06	983.22	626.11	287.87	216.85	45.79	26.10
thinsection 1-2	5950.83	4325.41	884.92	518.85	51546.14	4485.68	107.82	81.39	55.60	125.54	649.66	705.00	170.06	215.36	26.53	24.60

INAA data

Sample #	Paste	Site Name	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu
xrf-bs-1062	1 or 2	KU	17.1377	42.1198	0.4537	33.7271	7.1104	2.7687	2.8178	82.7566	13.8721	71.1696	10.1261	1.5518
xrf-bs-1063	1 or 2	KU	6.0912	87.5473	0.4674	73.3332	12.5905	2.5011	3.1645	141.2643	14.7208	65.7363	3.0133	3.2513
xrf-bs-1064	1 or 2	KU	5.1474	52.6956	0.3442	36.9199	6.7056	2.6999	2.6947	98.5193	10.0266	56.1602	9.1817	1.5661
xrf-bs-1065	1 or 2	KU	9.4570	52.1758	0.3801	39.5200	8.1133	2.9471	2.0594	100.0203	14.2770	91.5780	9.1429	1.8790
KU7519-9	1 or 2	KU	25.6751	101.5163	0.3532	67.4412	10.9073	1.7703	2.6810	181.1931	14.6738	74.6894	9.6264	2.4886
ku 7727 bs 101	1 or 2	KU	7.9214	45.5990	0.4373	36.0226	6.9193	2.8051	2.8368	83.4347	9.4366	63.6300	10.4219	1.5365
KU7508sl14-5	1 or 2	KU	13.5233	42.5454	0.3534	30.9898	6.2127	3.5008	2.6077	81.8711	10.6771	34.6658	7.7203	1.3229
KU7590sl5-6	1 or 2	KU	19.7208	64.0070	0.3203	49.9836	8.3612	1.7417	2.7053	117.2369	13.3692	61.0896	8.0558	2.0414
KU5308-55	1 or 2	KU	17.1882	42.8349	0.3646	40.7749	7.1944	1.9603	2.6120	86.4796	12.2136	49.3185	9.2309	1.6822
KU5308-56	1 or 2	KU	27.6942	30.3171	0.3109	24.1910	5.0463	2.6763	1.9296	60.1126	14.8853	40.0200	8.6889	1.1485
KU7578/23	1 or 2	KU	16.2470	40.4740	0.3717	36.8175	6.3207	2.2233	2.0513	76.8879	10.5270	63.1325	10.2379	1.4695
ku 7725 bs 104	1 or 2	KU	24.4310	48.2056	0.3235	41.3301	8.2674	2.4202	2.7149	97.9034	11.8717	59.9065	8.4586	1.8355
xrfbs1024	1 or 2	KU	19.6338	79.7353	0.3674	50.9643	8.6759	1.2986	2.5613	139.5788	13.3210	55.0249	8.3568	2.0632
ku 7707 bs 100	1 or 2	KU	18.0142	39.2727	0.3481	34.0271	6.3302	1.7229	1.9372	75.3262	11.4042	70.6140	11.6699	1.5189
ku 7725 bs 102	1 or 2	KU	25.2258	51.0013	0.3669	43.5625	8.3312	1.2752	2.6401	96.7555	12.6143	60.6769	10.9330	1.9033
xrf-bs-1066	17 or 18	KU	11.7927	40.6549	0.3585	33.5899	6.3173	2.5254	2.3257	76.8897	10.8854	65.8282	9.8165	1.5330
xrf-bs-1067	17 or 18	KU	11.0366	41.3114	0.3241	34.4708	6.9025	3.5666	2.2429	82.9778	11.9495	63.9484	11.3377	1.5172
xrf-bs-1074	17 or 18	KU	27.5965	61.6002	0.5875	44.5961	9.2482	1.6069	4.0519	105.9272	12.8828	63.5636	9.8042	1.9563
xrf-bs-1073	17 or 18	KU	22.3413	44.9231	0.3699	35.8481	6.9168	6.0731	2.3644	93.6495	11.1267	33.8153	14.7438	1.1969

Sample #	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th
xrf-bs-1062	38625.8	6.0185	32.06	153.17	1.2488	14.5172	434.71	1.0854	0.8766	12.7995
xrf-bs-1063	36915.7	7.0849	57.70	70.57	0.3583	13.2067	1432.43	1.4188	1.2875	13.1189
xrf-bs-1064	32364.6	7.6295	18.90	122.61	1.0015	11.6507	708.36	1.3045	0.7632	12.5944
xrf-bs-1065	42253.0	5.3177	40.02	154.27	0.8885	14.9520	838.07	1.0636	0.8031	13.0777
KU7519-9	41062.9	6.8509	38.51	100.21	1.0543	12.9726	930.41	1.4653	1.0034	16.2512
ku 7727 bs 101	32749.3	8.2077	0.00	122.99	0.8904	11.8413	656.27	1.2360	0.8394	11.4767
KU7508sl14-5	30987.4	6.3970	0.00	127.17	0.9601	9.8186	427.35	1.3714	0.8344	13.3512
KU7590sl5-6	37270.6	8.1253	43.33	96.70	0.9851	11.0353	956.95	1.0539	0.7563	11.4094
KU5308-55	35140.5	7.8184	34.30	119.85	0.9910	10.9813	612.96	1.0939	0.8200	12.5618
KU5308-56	29999.3	5.7424	33.45	113.02	1.2683	9.2056	522.96	0.9668	0.6706	9.6785
KU7578/23	35543.6	8.6929	31.54	101.86	1.1452	10.8597	708.54	1.0387	0.7409	10.3110
ku 7725 bs 104	39057.9	6.6716	29.24	130.60	0.8269	13.2914	569.17	1.2251	0.8343	13.0760
xrfbs1024	41060.4	9.2399	0.00	106.25	0.6943	12.2509	874.02	1.2129	0.8426	14.6672
ku 7707 bs 100	33563.1	5.8394	0.00	131.01	1.2317	12.4971	822.70	0.8844	0.7681	10.2235
ku 7725 bs 102	44277.2	8.8947	0.00	108.56	1.1658	12.8905	731.56	1.2107	0.9187	12.0907
xrf-bs-1066	32722.3	7.0857	0.00	117.15	0.8510	11.5720	714.77	0.9374	0.6899	10.7228
xrf-bs-1067	38798.4	6.2505	0.00	155.82	1.1476	13.1786	564.93	1.0019	0.7619	15.5559
xrf-bs-1074	44423.4	7.4634	0.00	99.50	1.0248	13.1172	604.78	0.9878	1.1525	11.5497
xrf-bs-1073	29147.3	5.6148	0.00	162.35	1.9259	9.0851	155.94	1.2595	0.7940	28.3396

Sample #	Zn	Zr	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
xrf-bs-1062	97.56	188.41	90343.4	1245.1	21011.1	5.2306	27571.1	514.37	9069.3	4351.5	110.07
xrf-bs-1063	84.40	221.02	118980.9	2062.1	22871.5	5.7600	21713.2	741.30	24928.1	4155.4	86.62
xrf-bs-1064	63.23	204.18	85399.6	1205.1	14348.2	4.2468	23711.3	363.98	13650.8	4541.3	87.30
xrf-bs-1065	103.10	188.50	96796.5	912.3	21137.7	4.0988	31911.8	497.30	14312.6	3813.8	98.72
KU7519-9	92.57	207.55	86564.0	1780.8	26817.7	5.7961	25700.8	1433.33	17460.8	4029.6	120.89
ku 7727 bs 101	70.67	237.05	89256.5	1007.3	15085.7	4.8580	22538.0	359.37	13638.9	4224.8	89.97
KU7508sl14-5	78.96	195.58	80023.3	1240.9	17002.6	4.5238	29124.7	568.97	12521.1	2959.0	64.64
KU7590sl5-6	72.27	200.62	87002.2	1436.5	21356.0	4.7126	19113.8	663.87	17320.2	4525.6	98.57
KU5308-55	81.32	219.57	88591.0	1213.4	14290.6	4.7901	21402.8	452.30	12088.5	3237.7	95.41
KU5308-56	85.06	153.63	70661.0	1373.3	15503.2	3.3549	24704.2	589.59	12119.3	2750.7	75.03
KU7578/23	68.42	252.19	80358.9	1289.9	19481.6	4.6938	19474.6	433.94	13963.5	4395.5	91.56
ku 7725 bs 104	95.40	204.66	91713.4	1383.8	17611.2	4.9733	25123.7	399.40	12224.8	4386.6	119.73
xrfbs1024	91.43	292.00	90304.5	1410.0	23421.6	5.2161	21864.9	784.20	14890.5	4308.3	104.48
ku 7707 bs 100	74.81	175.97	87804.7	1412.8	25855.9	3.9749	25715.8	512.23	13411.3	4249.4	106.82
ku 7725 bs 102	98.05	265.24	91733.7	982.6	25908.4	5.0222	20047.8	635.71	12515.9	3728.9	96.41
xrf-bs-1066	78.51	243.96	87161.4	914.4	18581.5	4.2279	23227.4	463.89	14097.6	4068.3	94.84
xrf-bs-1067	104.47	166.66	92840.0	1451.2	17217.4	4.2764	27764.6	558.17	11089.2	3341.7	94.31
xrf-bs-1074	89.01	218.95	75779.4	1136.8	19436.2	5.1642	18384.3	990.43	11176.4	3696.1	85.69
xrf-bs-1073	77.50	178.54	86608.6	1223.8	11630.8	4.5932	27817.4	693.28	8200.3	2568.9	62.46

Sample #	Paste	Site Name	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu
xrf-bs-1072	17 or 18	KU	40.9497	36.9128	0.5320	31.4183	6.4624	3.2167	3.2629	74.2673	8.8272	56.9261	12.3117	1.3257
xrf-bs-1071	17 or 18	KU	23.1409	55.5394	0.3477	36.8543	7.4839	1.6422	2.4467	104.8836	11.4686	57.1447	8.0245	1.6759
xrf-bs-1070	17 or 18	KU	45.0108	35.2591	0.4801	29.5399	6.1157	3.4243	3.0822	70.9325	9.2741	55.6906	11.9433	1.2360
xrf-bs-1069	17 or 18	KU	10.9589	35.5214	0.3405	28.4720	6.1103	3.1893	2.2863	66.4709	9.2970	32.9526	7.7696	1.2275
xrf-bs-1068	17 or 18	KU	39.3064	46.8613	0.3353	38.5624	7.1848	2.4888	2.2572	89.0741	11.8553	51.9677	8.1513	1.6964
ku 7725 bs 99	17 or 18	KU	31.2003	43.6644	0.4315	39.1438	7.3636	2.9055	2.5094	88.5296	15.8322	82.8110	9.3245	1.6908
xrf-BS1023	17 or 18	KU	24.6649	48.0552	0.3914	42.0304	7.5272	2.3927	2.8339	95.2006	11.9191	59.3531	8.1756	1.7099
xrfbs-1022	17 or 18	KU	13.3281	45.0305	0.3838	34.3740	6.7145	2.5915	2.8406	89.8734	11.1253	60.1136	11.5138	1.4412
KU5150_p18	17 or 18	KU	27.1919	41.4169	0.3738	33.7280	6.4427	6.1702	2.4277	80.8289	9.7511	38.3399	15.5342	1.1440
ku 7727 bs 96	17 or 18	KU	29.1292	44.1943	0.4588	35.6060	7.1657	3.0147	2.7628	81.1376	13.0052	54.1162	12.0725	1.5175
ku 7725 bs 106	17 or 18	KU	19.3381	94.3832	0.4234	50.2414	7.9577	2.0952	2.5544	153.6676	13.5527	66.7628	9.7584	1.6996
xrf-bs-1057	3	KU	18.5349	41.1207	0.3665	28.3164	5.4463	7.4880	2.4666	75.0506	7.6095	30.8146	13.0002	0.8283
xrf-bs-1058	3	KU	17.9167	43.6495	0.3432	33.2782	6.3507	8.1384	2.3431	81.6242	7.6492	28.9546	16.2005	1.0654
KU7727-7	3	KU	20.8246	37.5778	0.3456	26.1196	5.4195	6.2978	2.3607	75.5189	6.2522	27.0764	12.1708	0.8569
xrf-bs-1059	3	KU	29.4114	36.3270	0.4122	29.8596	6.0647	5.4297	2.7400	73.1987	8.1742	40.4960	14.8674	1.0781
xrf-bs-1060	3	KU	19.6470	40.8203	0.3436	28.2353	5.2954	8.2046	2.1952	80.7875	4.8665	23.6915	15.0859	0.7914
xrf-bs-1061	3	KU	18.9143	43.7722	0.3742	30.4118	6.2186	7.1088	2.3729	80.9414	7.5291	29.1201	13.7747	0.9914
pet5	3	KU	19.6114	43.6389	0.3473	31.7046	5.4711	7.8985	2.3545	77.8611	7.0426	31.1613	13.4104	0.8464
sc-KU7659-28	3	KU	20.5982	39.7583	0.3246	29.4350	5.8277	7.3649	2.1713	80.7958	11.0332	31.4530	13.5031	0.9763
sc-KU7659-16	3	KU	16.5934	42.7872	0.3850	30.8208	6.2425	8.1063	2.5220	80.1459	7.6128	31.6178	14.3513	1.0292
SC-ku7654-35	3	KU	34.3120	42.5026	0.3178	30.2619	5.6792	7.2379	2.1335	99.1904	14.9806	25.3900	13.4712	0.8850
ku 7725 bs 95	3	KU	23.4379	40.9085	0.3631	31.5880	6.3294	5.1438	2.4404	82.8132	10.3113	38.3713	13.5716	1.0892

Sample #	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th
xrf-bs-1072	54289.6	7.6182	32.25	136.61	1.6711	12.4158	269.81	1.2757	0.9567	11.9254
xrf-bs-1071	37459.1	6.9638	0.00	119.96	0.7422	12.9650	608.67	1.0824	0.8144	12.9937
xrf-bs-1070	51289.0	8.0865	0.00	135.76	1.2278	12.0735	244.16	1.2672	0.8582	11.4287
xrf-bs-1069	29740.6	5.7785	0.00	135.50	0.8105	8.8478	296.29	1.2518	0.8007	12.6897
xrf-bs-1068	38878.8	7.3719	0.00	108.52	1.1517	10.7758	727.36	0.9843	0.7776	11.4641
ku 7725 bs 99	42834.0	6.2927	35.32	133.48	1.3398	14.7238	568.53	1.0805	0.9134	12.7046
xrf-BS1023	38868.9	6.1395	0.00	123.70	0.8697	13.3874	629.44	1.0896	0.8022	12.4778
xrfbs-1022	30478.9	7.8413	0.00	127.13	1.1745	12.9766	474.26	1.3005	0.8067	12.9572
KU5150_p18	32178.9	5.2577	31.96	168.45	1.8637	9.9818	167.75	1.2005	0.8384	25.7331
ku 7727 bs 96	41431.5	7.1531	42.54	134.65	1.4387	12.2386	366.29	1.0491	0.8671	12.6244
ku 7725 bs 106	41640.0	7.2391	58.48	137.85	1.1433	13.1168	577.91	0.9649	0.8773	16.5198
xrf-bs-1057	24705.8	6.2332	0.00	157.63	1.9872	7.8433	138.36	1.3199	0.6738	27.7671
xrf-bs-1058	26336.7	5.7601	0.00	175.26	2.3492	7.7081	150.66	1.1815	0.6425	26.6857
KU7727-7	23461.8	6.4605	0.00	142.44	1.9004	6.8975	116.77	1.1641	0.6246	25.9672
xrf-bs-1059	26821.0	6.0927	0.00	159.45	1.9074	9.7451	174.22	1.2680	0.8002	21.5454
xrf-bs-1060	23311.9	5.5904	0.00	172.73	1.8046	6.6188	168.63	1.2375	0.5798	32.5378
xrf-bs-1061	23933.6	5.4564	0.00	161.25	1.7033	7.8900	184.69	1.3446	0.6115	30.0782
pet5	25048.3	6.0608	0.00	164.49	2.0752	7.8276	137.49	1.3318	0.5650	28.8726
sc-KU7659-28	27728.7	5.1571	25.47	170.12	1.7336	8.1924	186.79	1.1753	0.6794	26.8225
sc-KU7659-16	25575.4	4.8005	32.84	177.19	1.8245	8.2842	200.11	1.2260	0.7744	30.3979
SC-ku7654-35	24516.7	6.0574	29.64	166.22	1.7626	6.7912	185.07	1.2087	0.6490	28.2089
ku 7725 bs 95	31261.6	5.2397	22.81	163.61	1.5456	9.9096	236.16	1.1630	0.7536	24.5210

Sample #	Zn	Zr	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
xrf-bs-1072	69.61	208.41	71383.3	1021.3	9751.5	5.3703	22770.2	317.11	6622.6	4393.1	94.05
xrf-bs-1071	90.24	165.76	86606.4	1337.2	18202.3	4.4605	23066.5	388.80	12525.9	4003.7	104.27
xrf-bs-1070	65.95	220.00	74023.4	1027.0	8665.0	5.3424	24091.6	300.29	6399.9	4231.2	98.61
xrf-bs-1069	88.52	156.60	76543.4	939.5	14243.9	3.9149	31441.4	745.02	8807.3	2913.5	56.14
xrf-bs-1068	80.34	237.40	82483.5	1228.6	18795.5	4.9268	20830.5	611.81	15019.8	3456.2	100.41
ku 7725 bs 99	100.30	182.94	92587.2	1174.4	16810.3	5.0443	22715.6	678.74	9567.1	3960.5	113.81
xrf-BS1023	100.47	208.11	87688.7	1305.9	18068.8	5.1171	23408.6	442.96	12281.7	4539.5	108.72
xrfbs-1022	75.02	231.92	89299.9	894.1	13434.1	5.3241	24662.0	511.00	10398.6	4843.4	92.42
KU5150_p18	77.43	142.19	85320.9	762.6	15218.8	4.5064	31901.6	478.17	7812.0	2814.3	74.58
ku 7727 bs 96	97.56	197.00	82706.7	860.5	16400.5	6.4572	24955.5	627.82	9073.7	3474.0	98.90
ku 7725 bs 106	111.30	231.56	92007.1	1206.2	19090.1	4.3732	25042.3	1000.86	9896.1	4021.4	107.30
xrf-bs-1057	76.94	191.99	78475.1	605.8	14970.1	3.8826	35502.7	781.40	8136.1	2604.7	59.47
xrf-bs-1058	75.37	184.55	78393.5	661.3	11267.4	4.2638	33225.4	665.32	8905.4	2216.7	56.44
KU7727-7	66.14	223.97	66645.0	503.1	35177.6	4.1746	28772.5	827.98	7863.8	2571.8	47.35
xrf-bs-1059	65.63	180.59	74797.1	607.3	17255.3	4.7712	29552.3	379.01	8980.1	3333.7	67.05
xrf-bs-1060	72.60	198.42	82702.7	707.7	9755.5	3.7156	33854.9	480.50	9979.8	2002.8	44.02
xrf-bs-1061	86.12	144.59	82222.9	699.2	10338.8	4.1231	33276.8	563.11	8875.3	2136.0	62.51
pet5	74.61	173.31	76848.1	449.2	14488.6	3.5623	34598.7	777.11	8531.0	3590.8	52.00
sc-KU7659-28	91.54	154.36	75831.7	564.5	18984.7	3.5654	37334.0	1070.70	8779.2	1990.3	66.41
sc-KU7659-16	84.12	168.20	76764.7	547.2	20390.9	3.5408	35220.7	702.16	8709.1	2103.6	48.76
SC-ku7654-35	73.89	181.79	74549.9	791.6	10915.6	3.5365	43424.5	810.40	8974.1	2186.9	58.52
ku 7725 bs 95	78.48	170.57	83219.5	1469.2	11505.1	4.0598	29335.6	454.99	7272.0	2874.8	61.83

Sample #	Paste	Site Name	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu
ku 7725 bs 94	3	KU	24.1242	44.3156	0.3268	38.2833	8.8770	7.3763	2.1162	93.2087	10.2666	34.2405	14.7243	1.4727
ku 7727 bs 103	3	KU	21.4054	41.8134	0.3512	30.2778	5.8021	7.0513	2.4348	77.0775	5.6749	28.3596	14.2913	0.9258
ku 7727 bs 97	3	KU	17.6211	74.4044	0.3524	46.6345	7.7361	7.6247	2.3680	87.0414	12.6997	28.0536	14.2325	1.1533
ku 7665 bs 105	3	KU	24.4582	37.8454	0.3074	28.5650	5.3762	8.0020	1.9865	75.5662	6.6055	25.8402	15.5435	0.8236
sc-KU7654-36	3	KU	23.3523	37.8636	0.3473	28.2559	5.4894	8.5670	2.1734	75.5871	6.2689	22.0756	16.1195	0.8294
XRF-bs-85	1 or 2	SN	23.4152	49.7895	0.4434	39.6400	7.5673	2.8077	2.5806	99.0965	12.7624	62.2546	10.9109	1.7591
XRF-bs-55	1 or 2	SN	8.9576	34.1833	0.3036	25.9893	5.1005	2.4525	1.6980	60.5014	9.4382	46.3519	9.3342	1.2090
XRF-bs-67	1 or 2	SN	32.5217	41.0083	0.3458	34.9193	6.6962	3.2050	2.0455	73.8659	11.4744	53.4978	8.5965	1.5537
xrf-bs-90	1 or 2	SN	16.8520	36.2606	0.3825	28.9713	6.0773	3.8324	2.4128	60.8413	12.2924	34.8324	9.3660	1.3556
XRF-bs-91	1 or 2	SN	17.8359	46.2857	0.2928	37.9433	6.8325	3.3742	2.3487	93.4875	11.0945	73.3120	13.9523	1.5636
XRF-bs-87	1 or 2	SN	21.6188	48.7560	0.3079	37.9365	6.8785	2.2640	2.4001	98.8027	13.0707	55.4548	9.2271	1.6776
xrf-bs-84	1 or 2	SN	24.9452	43.6861	0.3624	38.2275	7.4938	1.9993	2.8379	92.2621	13.2937	59.7530	9.2625	1.8074
SN7074-17	1 or 2	SN	23.8662	35.0342	0.3313	31.2061	6.3970	2.8940	2.6468	68.6120	11.2471	47.0035	10.2126	1.4342
SN7074-6	1 or 2	SN	16.4872	44.6052	0.3726	34.3026	6.8768	5.3755	3.0295	84.5256	11.0260	49.9125	18.7360	1.4525
xrfbs1021	1 or 2	SN	17.2809	50.2788	0.3283	38.1658	7.3662	2.2978	2.3573	100.2819	12.0417	65.0615	10.6966	1.7685
xrfbs1019	1 or 2	SN	13.1184	43.1151	0.2963	32.7802	6.5540	2.4477	2.4899	87.4430	12.1808	51.5351	8.0219	1.6122
xrfbs1015	1 or 2	SN	15.1998	56.2280	0.2651	48.4954	8.4396	2.3807	2.0790	113.1141	11.7406	44.5421	5.3700	2.2479
xrf-BS_1011	1 or 2	SN	26.5880	40.3923	0.2966	35.9303	6.2522	2.2829	2.3333	80.2968	14.4070	56.2544	10.7370	1.4201
xrfbs1014	1 or 2	SN	11.0462	66.1341	0.3374	59.9538	9.6918	2.8848	3.1083	116.1621	13.6441	47.0100	7.2632	2.5809
xrf-bs-1018	1 or 2	SN	7.6317	72.7382	0.3017	58.8278	9.6957	2.5168	2.5686	133.2488	13.8964	59.3327	5.6902	2.5101
XRF-bs-57	17 or 18	SN	16.1039	45.7823	0.3375	43.5840	7.2077	2.2888	2.4689	86.9620	11.8968	51.9134	8.7915	1.7086
XRF-bs-69	17 or 18	SN	17.8493	41.9619	0.3339	39.0271	7.0711	2.8466	2.6161	86.7172	14.6132	59.9428	9.7583	1.6669

Sample #	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th
ku 7725 bs 94	27547.1	4.7943	22.35	183.77	1.6847	8.8222	194.94	1.2028	0.7285	26.8558
ku 7727 bs 103	23224.2	6.4623	0.00	159.60	1.8665	7.1260	165.57	1.2381	0.6556	28.1778
ku 7727 bs 97	23737.4	6.1225	16.26	163.53	1.7992	7.2371	153.45	1.3087	0.7239	28.9799
ku 7665 bs 105	24564.9	6.5884	0.00	166.63	1.7768	6.9193	167.56	1.2407	0.5424	27.3404
sc-KU7654-36	21353.5	6.3548	0.00	177.94	1.7869	6.1804	143.18	1.2551	0.6267	28.8328
XRF-bs-85	39073.7	7.4639	0.00	134.10	1.1145	13.3368	721.70	1.1577	0.9122	13.7599
XRF-bs-55	31204.9	7.6185	0.00	132.89	1.0717	10.3211	558.12	1.1291	0.5160	12.1561
XRF-bs-67	38282.6	7.2749	38.31	100.38	1.1947	11.0313	738.66	1.0698	0.7788	10.2021
xrf-bs-90	35129.8	5.4525	39.52	155.66	1.1615	10.1918	426.31	1.1992	0.7513	13.1775
XRF-bs-91	36601.3	6.0287	0.00	156.34	1.3681	13.3580	769.40	1.1393	0.7992	17.0555
XRF-bs-87	37078.4	7.8886	33.78	126.60	1.0772	12.2254	769.16	1.0668	0.8428	13.4527
xrf-bs-84	37949.8	7.4074	51.34	130.52	1.0955	12.2659	785.15	1.1266	0.9592	12.2153
SN7074-17	39907.3	8.2101	0.00	117.44	1.3883	10.2758	481.93	1.0126	0.8663	11.8084
SN7074-6	33299.6	7.0108	24.33	179.90	1.5201	10.7763	445.60	1.3231	0.8284	20.6879
xrfbs1021	42200.8	9.9029	0.00	123.65	1.1080	12.7158	755.40	1.1299	0.9296	12.0920
xrfbs1019	33873.9	7.9493	40.79	113.82	1.1285	10.3682	877.46	1.0762	0.7743	12.3715
xrfbs1015	32535.2	7.9865	48.12	96.92	0.3882	10.2411	1348.34	1.2767	0.8862	12.8978
xrf-BS_1011	39593.4	8.6043	0.00	131.39	1.1891	11.5214	628.01	0.9813	0.7149	12.0400
xrfbs1014	39347.9	8.8376	53.68	109.12	0.5585	11.2482	1113.15	1.2281	1.0799	15.6223
xrf-bs-1018	36787.0	9.3347	55.11	110.89	0.4520	11.9558	1071.39	1.3236	0.9657	15.1174
XRF-bs-57	38371.1	6.5853	23.83	116.22	1.2692	12.1883	689.34	1.0111	0.8447	12.0377
XRF-bs-69	38883.1	8.5360	48.21	120.97	1.2107	12.7981	820.76	1.1636	0.8345	12.4771

Sample #	Zn	Zr	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
ku 7725 bs 94	73.04	173.47	80195.1	819.2	11690.5	4.0022	41861.0	609.68	8019.6	2894.6	67.50
ku 7727 bs 103	73.01	211.74	74105.9	443.1	15268.3	3.8335	30095.2	586.26	8728.0	2552.7	50.39
ku 7727 bs 97	70.95	200.11	74425.8	504.0	12638.0	3.8527	32455.6	745.29	8495.8	2371.4	47.09
ku 7665 bs 105	76.99	211.88	84222.1	480.8	9189.7	3.2970	33956.2	535.69	10118.4	2698.3	47.68
sc-KU7654-36	59.33	213.89	72921.7	547.6	17266.7	3.4014	41981.5	644.06	9429.9	2195.1	44.37
XRF-bs-85	83.98	222.16	92459.6	1163.1	19378.3	4.9905	21549.2	471.36	13905.7	3698.1	92.80
XRF-bs-55	90.33	230.32	85254.2	1080.7	11868.3	3.0402	20970.1	192.80	11062.2	5342.3	92.18
XRF-bs-67	82.76	236.04	81206.4	1317.1	18801.0	4.1831	21021.4	578.05	11854.4	3260.4	94.75
xrf-bs-90	92.33	192.84	81012.3	1162.4	24271.9	4.4891	40632.0	913.31	9784.0	3058.1	75.80
XRF-bs-91	82.31	172.57	96815.6	1005.4	19824.3	4.5453	29698.7	439.81	12725.5	3935.8	89.40
XRF-bs-87	82.70	201.07	90592.5	1220.0	19054.3	5.0640	23141.1	542.00	15004.0	3684.3	104.25
xrf-bs-84	81.65	186.92	88872.2	1232.9	19131.5	5.1244	23885.1	368.55	12184.2	4545.7	104.99
SN7074-17	74.29	204.56	73786.9	879.2	14361.5	5.1554	22490.4	557.27	8322.4	2728.1	87.04
SN7074-6	92.90	211.18	86941.1	855.9	15158.1	4.6906	36020.2	467.30	10715.7	3533.0	79.18
xrfbs1021	86.38	241.84	87226.1	1121.2	21184.6	5.0007	22330.8	490.87	12390.3	4144.0	100.97
xrfbs1019	81.17	197.98	84203.8	1142.9	23993.0	4.0382	22946.1	471.10	12527.8	3617.7	76.66
xrfbs1015	76.67	227.25	105685.6	1645.0	20136.8	4.2443	23636.6	739.85	23140.9	3629.3	69.88
xrf-BS_1011	91.63	216.40	88533.5	1150.5	16201.9	4.4457	21979.9	422.53	10721.0	3578.3	101.08
xrfbs1014	96.03	219.34	116810.3	1559.9	16287.1	5.4936	21143.7	867.47	18294.3	4974.0	99.49
xrf-bs-1018	92.71	260.96	112222.7	1649.6	16244.4	5.5255	25832.2	607.03	17438.4	4943.3	85.02
XRF-bs-57	103.30	157.77	88540.1	990.8	23922.2	4.4854	20130.6	595.35	9650.7	3543.3	87.37
XRF-bs-69	95.67	224.89	89552.3	1082.5	18094.6	5.1010	21259.6	563.47	12313.5	3875.5	105.31

Sample #	Paste	Site Name	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu
xrf-bs-73	17 or 18	SN	12.2222	32.9729	0.3683	28.6303	6.0840	3.7016	2.5874	68.3611	9.4643	34.8042	8.9451	1.2110
XRF-bs-88	17 or 18	SN	15.9208	45.2604	0.3209	37.7034	7.6506	2.9782	3.0630	89.7706	13.9543	85.1102	9.8762	1.7524
SN7074-19	17 or 18	SN	19.2053	77.3973	0.3451	52.2750	8.0144	7.5561	2.2698	81.3729	5.7186	29.3389	15.7035	1.2643
SN7074-15	17 or 18	SN	20.7396	45.4703	0.2951	39.9812	7.4163	2.5167	2.4393	103.0642	15.0510	63.1006	10.4466	1.7879
SN7074-22	17 or 18	SN	32.7427	39.3716	0.3873	36.5030	7.0447	2.5140	3.1467	71.8413	11.8701	47.8736	13.2411	1.4775
SN7074-25	17 or 18	SN	13.4939	47.7373	0.2950	40.6207	7.4612	2.1926	2.5906	99.3014	13.7104	58.3903	9.1517	1.7406
xrf-BS_1009	17 or 18	SN	16.9992	44.8430	0.3306	41.6274	7.6501	2.8644	2.7258	104.2394	12.7181	57.2522	9.8482	1.7912
xrfbs1016	17 or 18	SN	51.5453	56.0353	0.3261	60.1102	9.8247	2.3982	3.2012	101.1334	13.5751	75.4692	8.9935	2.3387
xrf-bs-1001	17 or 18	SN	14.3123	49.1393	0.2741	50.1507	7.8927	2.5671	2.2256	97.5668	12.9322	62.4455	9.9233	1.9571
xrf-BS_1004	17 or 18	SN	30.6176	40.0324	0.3008	37.5603	6.4091	2.6756	2.2717	83.2403	12.5268	70.0164	9.8144	1.5602
xrfbs1002	17 or 18	SN	14.8880	86.7867	0.2148	48.7332	6.9054	2.0900	2.4352	143.3961	11.6800	47.9435	13.4339	1.5896
xrf-BS_1010	17 or 18	SN	32.4342	68.7874	0.2906	54.8363	8.2501	1.6973	2.2928	126.7518	11.8495	59.9051	7.2187	2.0597
xrf-bs-1005	17 or 18	SN	12.3019	48.6857	0.3020	40.8569	7.2585	2.1444	2.3144	112.7643	15.3096	80.2163	9.1193	1.8335
xrf-bs-1051	3	SN	21.1326	44.8619	0.4488	34.4601	6.8323	7.5790	2.8438	85.6666	7.6852	30.1604	13.0811	1.1840
xrf-bs-1050	3	SN	21.1207	45.3370	0.4612	35.9872	6.7623	6.7822	2.6695	86.3664	8.4189	29.9682	12.9685	1.1935
xrf-bs-1052	3	SN	21.6737	42.1350	0.3988	31.7257	6.1651	7.4492	2.1744	82.3971	7.4613	27.0169	15.2731	1.0414
xrf-bs-1053	3	SN	20.7546	40.6371	0.4101	30.1772	5.5328	8.1397	2.2400	81.1367	4.7293	22.4009	14.9192	0.8260
xrf-bs-1054	3	SN	19.6037	45.9299	0.4422	36.4644	6.2110	7.3201	2.8864	108.8498	6.3777	25.6428	13.8898	0.9410
xrf-bs-1055	3	SN	29.3493	38.5151	0.3964	34.1637	5.8793	6.3895	2.3928	74.0418	7.2629	32.9775	14.0727	0.9776
xrf-bs-1056	3	SN	23.8648	44.8498	0.3543	34.0376	6.3977	8.0508	2.3015	103.6353	13.1348	26.0474	15.1952	1.0639
xrf-bs-72	3	SN	20.3476	37.9282	0.3724	28.6076	5.3007	7.3750	2.2152	78.7355	7.0615	27.1330	14.4243	0.8395
SN7074-2	3	SN	21.7605	43.3080	0.4051	32.6806	5.8427	7.5722	2.1992	82.9667	5.1682	25.7585	14.4054	0.8897

Sample #	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th
xrf-bs-73	29775.3	5.7743	0.00	142.87	1.0302	9.7660	281.23	1.3381	0.7879	16.1445
XRF-bs-88	38579.2	6.3461	49.98	147.98	0.9864	14.0101	651.87	1.0618	0.9399	12.8607
SN7074-19	26586.7	6.2175	17.42	175.33	1.7045	7.4209	237.15	1.1734	0.7292	28.2543
SN7074-15	39214.8	6.6401	35.54	132.96	1.0373	13.5762	933.76	1.1330	0.8114	12.7235
SN7074-22	38889.6	8.9439	46.56	125.24	1.9480	11.0512	379.14	0.9182	0.9975	11.6770
SN7074-25	39847.2	7.2680	31.62	118.26	1.2939	12.6421	765.99	1.0232	0.8193	12.1365
xrf-BS_1009	40787.5	7.0030	0.00	136.30	1.3224	12.5415	774.66	1.1560	0.9386	12.8705
xrfbs1016	44366.2	7.8461	57.47	117.36	0.9116	14.9345	696.11	1.2040	1.1350	13.3751
xrf-bs-1001	38035.2	9.2461	28.92	121.74	0.8991	11.7450	1014.49	1.2270	0.8255	12.0160
xrf-BS_1004	35584.7	6.2481	0.00	130.09	0.8424	11.8603	877.99	0.9761	0.7146	11.1438
xrfbs1002	34341.9	6.0264	0.00	119.57	0.7613	9.8950	962.46	1.0133	0.6767	15.4677
xrf-BS_1010	40880.8	6.0850	38.55	88.58	1.0280	11.8292	1072.32	0.9750	0.9540	12.0210
xrf-bs-1005	39991.7	6.4028	39.96	123.38	1.0805	13.7286	1116.26	1.0400	0.7456	12.1239
xrf-bs-1051	24886.4	6.3988	45.88	154.68	2.0122	7.4792	187.30	1.2306	0.9220	28.1338
xrf-bs-1050	24677.9	6.5588	25.62	153.94	1.9951	7.6003	195.03	1.2371	0.9232	27.4593
xrf-bs-1052	26293.0	5.9419	23.94	172.04	1.8569	7.5635	211.01	1.1172	0.7086	26.1017
xrf-bs-1053	20789.2	5.7045	30.14	168.18	1.8983	6.1015	157.27	1.3112	0.6492	32.1866
xrf-bs-1054	22146.1	5.9095	19.04	153.36	1.6629	7.2699	174.48	1.4475	0.7023	36.5173
xrf-bs-1055	28706.7	6.4963	0.00	158.51	1.5830	8.5755	239.93	1.1384	0.6961	26.7853
xrf-bs-1056	25448.4	5.9780	36.22	173.23	1.9608	7.0354	216.40	1.1519	0.6968	27.8817
xrf-bs-72	25772.1	6.2928	36.00	167.53	1.8049	7.4120	221.26	1.2079	0.5632	29.6717
SN7074-2	23586.5	6.9112	0.00	165.02	1.9151	6.8430	178.85	1.3038	0.6551	30.5227

Sample #	Zn	Zr	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
xrf-bs-73	99.99	154.01	76551.9	954.3	17329.3	4.3370	30970.5	659.76	9415.3	2570.9	61.94
XRF-bs-88	85.75	186.86	91699.0	1414.3	17781.5	4.9388	32522.7	400.20	11199.1	4099.8	135.13
SN7074-19	79.58	165.58	80542.8	621.2	10448.3	4.9785	31852.3	507.64	9031.1	2009.4	51.72
SN7074-15	88.96	178.69	93442.8	1073.3	19524.1	4.3981	22239.9	554.82	13721.9	3212.7	96.39
SN7074-22	87.90	217.03	72083.9	2079.4	17971.1	5.4296	20280.1	490.43	4732.1	3221.3	98.46
SN7074-25	90.06	190.17	89357.5	1074.9	18228.4	4.4297	24347.9	759.63	11199.2	3603.1	95.30
xrf-BS_1009	83.59	167.97	90188.0	1311.9	21873.1	5.0527	30937.5	325.60	12052.0	3740.5	97.26
xrfbs1016	84.85	194.87	90048.0	1345.5	18442.4	5.7679	21821.4	457.83	10324.2	4446.1	106.41
xrf-bs-1001	85.97	231.09	93400.6	1183.8	22849.0	4.4048	23383.5	625.28	16003.9	4049.3	97.51
xrf-BS_1004	78.20	165.36	80841.4	1035.5	20801.5	3.7707	25098.5	550.36	12883.2	3923.0	90.11
xrfbs1002	82.95	151.74	84957.8	1358.5	24306.7	3.8508	27418.7	488.05	16895.3	3578.7	72.19
xrf-BS_1010	78.77	179.56	81270.0	1108.8	23269.1	5.0884	17573.5	896.41	15982.3	3995.4	93.75
xrf-bs-1005	84.73	173.42	104840.3	1136.2	23987.1	4.4263	21036.3	718.23	16765.0	4247.8	101.14
xrf-bs-1051	75.83	175.25	73243.7	678.0	30893.7	4.7357	30866.5	859.50	8400.1	2354.5	49.32
xrf-bs-1050	66.97	183.62	70411.7	552.0	29241.8	4.7418	29805.6	823.49	8718.8	2404.0	52.96
xrf-bs-1052	73.82	152.71	74211.4	580.1	14041.3	3.7649	32881.7	554.89	9504.5	2117.1	49.98
xrf-bs-1053	63.14	160.00	76928.2	469.0	7775.8	3.7833	33918.7	379.08	9828.6	2328.8	38.89
xrf-bs-1054	68.25	158.87	82972.4	689.1	12024.2	3.8215	29255.3	403.05	9810.3	2178.7	41.99
xrf-bs-1055	71.99	175.38	81916.1	724.0	14819.5	3.7886	30559.4	416.61	8071.6	1945.0	56.55
xrf-bs-1056	70.26	181.03	73177.0	591.6	17232.6	3.8470	34629.4	951.42	9077.0	1874.3	57.50
xrf-bs-72	75.19	170.28	82589.2	604.7	10882.1	3.1211	29342.3	580.82	8875.4	1794.1	49.07
SN7074-2	65.91	196.86	70616.5	520.1	12736.2	3.6137	29793.7	600.35	9076.5	2118.5	42.63

Sample #	Paste	Site Name	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu
XRF-bs-63	3	SN	24.0822	47.2261	0.3841	34.4284	6.0892	6.3577	2.1074	90.7563	7.6040	29.2941	14.2019	0.9773
XRF-bs-66	3	SN	22.5185	40.8347	0.3867	38.3179	6.1941	6.8150	2.5426	93.4742	8.4178	31.6610	13.5793	1.1088
XRF-bs-83	3	SN	19.6148	44.3333	0.4218	34.9989	6.0122	9.3069	2.1469	83.0631	7.8656	22.3531	14.5797	0.8974
xrf-BS1003	3	SN	25.5816	43.7438	0.4440	33.3661	6.0284	8.3530	2.5050	80.4933	6.0014	28.1159	15.3510	0.9356
xrf-bs-75	3	SN	23.0711	41.4202	0.3872	30.0081	5.8375	8.3125	2.1199	103.2780	12.3923	26.1226	14.3716	0.9504
7087-10	3	SN	24.9638	47.9820	0.4385	38.1080	6.7997	7.3151	2.4256	95.6715	8.0710	33.1759	16.9247	1.0485
SN7074-14	3	SN	23.5639	45.4975	0.4473	36.3227	6.6700	7.6885	2.5043	87.3552	6.9841	32.6006	14.2192	1.0762
Clay 234	Red Brown	Taraco	14.7015	51.2899	0.4369	44.9926	8.7989	3.2797	3.6363	105.6720	15.2957	70.3834	12.8518	2.0219
Clay 90	White	Taraco	41.5444	38.3744	0.4480	32.4431	5.9861	3.2057	3.2575	85.4142	12.0737	71.0392	19.4259	1.2074
Clay 78	White	Taraco	9.4431	31.7662	0.4223	28.7902	4.9933	3.4789	3.2634	69.8618	7.4011	53.0905	15.4061	0.9772
Clay 103	Light Brown	Taraco	39.4903	31.2511	0.3880	29.8718	5.6774	3.2022	2.8093	65.5443	10.4647	42.5999	10.4396	1.1388
Clay 325a	Red Brown	Taraco	25.8122	56.4716	0.4081	51.4433	8.7816	3.5863	3.2731	106.6333	15.4156	87.6973	15.1833	1.7982
Clay 333b	Red brown	Taraco	14.1935	60.2571	0.4173	48.7634	9.4135	3.4370	3.8277	127.0072	13.3503	97.5402	18.6685	2.0856
Clay 296	Red Brown	Taraco	29.0338	42.6972	0.4382	36.3071	7.5029	3.3092	3.7209	96.9406	15.0325	66.8316	12.1717	1.5841
Clay 362	Light Brown	Taraco	38.4516	47.9040	0.3473	41.5204	8.0295	2.3274	3.2131	93.1662	10.4104	62.5493	14.1841	1.7655

Sample #	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th
XRF-bs-63	26105.3	6.4553	0.00	153.65	1.8977	7.4486	243.07	1.2470	0.6731	31.6588
XRF-bs-66	27705.2	6.3854	0.00	167.15	2.0308	8.0646	216.88	1.2830	0.7712	28.2827
XRF-bs-83	21732.7	5.9490	36.71	177.73	1.8540	6.1980	184.85	1.2448	0.6537	31.9425
xrf-BS1003	24501.4	6.2049	0.00	171.87	2.0748	7.2994	137.94	1.3071	0.6700	30.3913
xrf-bs-75	25633.8	6.0747	0.00	163.14	1.9508	6.9078	231.33	1.2089	0.5962	30.0113
7087-10	27649.6	5.2224	273.28	182.78	1.6951	9.0480	153.77	1.2997	0.7168	31.7677
SN7074-14	25322.6	6.0929	0.00	167.81	1.9797	7.8261	181.78	1.3070	0.7766	29.5737
Clay 234	47734.5	6.5717	42.26	183.85	1.6165	17.0511	198.53	1.2634	1.2477	16.5586
Clay 90	35060.5	8.9344	40.60	167.03	1.9225	15.7307	132.46	1.4131	0.9228	15.0093
Clay 78	18046.0	10.3148	0.00	138.07	1.3316	12.1841	221.31	1.3573	0.7915	12.4651
Clay 103	49978.3	10.2494	0.00	86.43	2.0230	8.7030	46.07	0.8790	0.8527	10.6114
Clay 325a	51057.8	4.2231	71.86	205.20	1.9248	18.7443	98.62	1.1661	0.9326	16.8218
Clay 333b	53899.8	4.8017	40.55	229.62	1.5734	20.5446	124.08	1.2386	1.2533	19.3674
Clay 296	43812.2	7.1317	48.43	173.09	1.3307	15.7319	104.39	1.3479	1.1469	15.7999
Clay 362	38656.3	6.9196	32.23	157.21	1.2372	15.9535	157.97	1.2409	1.0113	16.4482

Sample #	Zn	Zr	Al	Ba	Ca	Dy	K	Mn	Na	Ti	V
XRF-bs-63	67.59	163.17	81634.4	1116.1	13322.3	3.5258	29406.0	589.23	8968.6	2700.0	50.69
XRF-bs-66	75.08	185.89	77462.3	662.0	13469.2	4.2833	27901.0	858.01	7639.1	2261.0	57.31
XRF-bs-83	68.93	166.68	71636.5	646.5	17156.4	3.6628	36394.9	616.43	10064.9	1755.6	38.30
xrf-BS1003	70.94	178.24	81307.8	694.8	10650.3	4.1329	40506.2	611.04	10111.0	2890.2	56.61
xrf-bs-75	76.78	147.65	77555.9	714.7	10600.7	3.3299	33599.8	1223.99	9688.8	2132.7	47.11
7087-10	70.48	148.34	83835.8	435.0	12571.5	4.1965	35776.5	441.30	10026.2	2562.9	65.37
SN7074-14	74.75	177.02	77265.7	703.3	9706.1	3.9684	32979.5	770.35	9347.8	2551.2	70.07
Clay 234	132.50	158.28	99543.1	567.7	8646.2	6.6224	32447.0	682.99	3494.3	4868.3	121.99
Clay 90	113.96	198.43	87987.4	539.1	7153.3	5.4962	25929.5	169.51	5131.8	5011.1	120.08
Clay 78	58.65	246.34	73674.9	434.2	4393.4	4.5106	22849.1	101.32	6991.0	4701.5	79.32
Clay 103	59.63	274.77	53799.3	327.0	3112.8	5.1905	15659.9	219.84	2266.0	3483.4	81.78
Clay 325a	120.44	119.65	116345.8	570.9	12714.2	6.2191	39077.5	638.01	2654.5	4758.2	164.68
Clay 333b	122.53	153.61	117472.4	593.7	11701.9	6.5559	38801.2	218.85	3246.4	4565.1	151.69
Clay 296	90.44	187.93	85694.3	567.4	19471.2	6.1673	30922.2	451.16	4916.5	4761.4	107.18
Clay 362	155.33	165.92	102376.3	631.0	8349.4	5.4158	23690.0	248.97	4808.3	4820.0	106.06

Sample #	Paste	Site Name	As	La	Lu	Nd	Sm	U	Yb	Ce	Co	Cr	Cs	Eu
Sediment 320		Taraco	2.0399	9.7603	0.0950	12.2556	2.2469	0.8788	0.6194	52.4798	11.3440	21.4005	3.1749	0.4605
Sediment 325b		Taraco	2.7822	14.4466	0.0902	17.0722	2.7553	0.8182	0.6575	29.7864	7.3590	37.3281	3.4151	0.5306
Sediment 71		Taraco	19.5850	17.2043	0.2312	15.4546	3.4160	1.5136	1.4800	38.6591	7.3475	17.3268	3.3880	0.6704
Sediment 60		Taraco	11.9116	7.0447	0.1135	6.1923	1.2908	0.5990	0.7436	13.5089	1.4764	5.9547	2.7844	0.2444
Sediment 339		Taraco	10.1963	13.6489	0.2500	10.8645	2.4703	0.9585	1.5109	20.8713	2.0542	8.1276	1.2960	0.6020
Clay Tia-Akap.	Light Brown	Tiwanaku	45.5010	37.5944	0.4704	32.2089	6.9040	2.9485	2.8226	76.3380	16.0446	48.9182	17.1687	1.6208
Clay Tia-1 (river)	CL_Tia	Tiwanaku	15.6949	42.1893	0.5111	33.6687	7.4361	2.6434	3.3455	83.2688	24.5288	53.8007	18.4643	1.7411
Tia Temper 1		Tiwanaku	68.3200	37.0594	0.1978	28.9028	5.0302	4.8840	1.0283	80.2308	20.6701	20.3106	15.2453	1.1747
Tia Temper 2		Tiwanaku	8.3530	33.5780	0.1971	23.7036	4.0608	0.8539	1.2607	65.5238	9.5474	10.9483	3.4233	0.8999
Clay 85	Orange	Taraco	35.9443	30.9775	0.6203	26.2394	5.5556	3.2674	3.8885	61.1891	8.7213	45.1328	8.0485	1.0879

Sample #	Fe	Hf	Ni	Rb	Sb	Sc	Sr	Ta	Tb	Th
Sediment 320	29021.3	7.3009	0.00	48.64	0.2770	6.5340	130.98	1.0467	0.1739	8.1942
Sediment 325b	29386.8	7.3617	0.00	58.01	0.3233	6.9706	154.21	1.1177	0.1875	10.1146
Sediment 71	19109.1	4.6088	17.15	40.57	1.5127	3.7661	91.93	0.4458	0.4323	5.0140
Sediment 60	5693.1	2.0890	0.00	18.43	0.7669	1.2584	29.81	0.1627	0.2061	1.9919
Sediment 339	9585.5	3.6005	0.00	27.91	0.6866	2.0307	89.57	0.3438	0.4404	3.1407
Clay Tia-Akap.	44035.9	6.0357	49.35	127.24	2.5720	15.5069	229.36	1.1552	0.9010	10.9881
Clay Tia-1 (river)	47240.9	5.3145	45.74	146.23	2.1607	17.6347	168.72	1.1882	0.9468	12.0685
Tia Temper 1	47548.9	6.3550	31.16	120.41	2.3983	7.8808	591.02	1.1236	0.4484	29.1691
Tia Temper 2	21971.6	4.2874	0.00	82.79	0.7214	6.1423	379.28	0.6412	0.4304	5.8712
Clay 85	50599.4	11.0675	33.51	106.13	2.5397	10.2316	57.57	1.0904	0.9532	11.7263

Sample #	**Zn**	**Zr**	**Al**	**Ba**	**Ca**	**Dy**	**K**	**Mn**	**Na**	**Ti**	**V**
Sediment 320	129.42	140.65	111886.4	540.9	24869.1	1.2703	4401.9	928.51	1236.9	3994.4	56.85
Sediment 325b	151.72	158.24	107033.4	512.1	22613.8	1.3349	8197.9	193.53	2420.9	4737.0	51.95
Sediment 71	33.56	106.68	29401.3	330.0	2134.9	2.4556	8120.0	343.59	3076.8	1667.0	46.02
Sediment 60	10.26	49.64	10784.8	59.0	873.9	1.2251	4857.5	68.90	1187.3	770.8	13.10
Sediment 339	25.55	85.67	19819.4	279.9	153817.7	2.7990	8001.6	80.01	3450.5	1111.3	19.36
Clay Tia-Akap.	135.77	137.13	87925.1	533.1	13570.4	5.4950	27347.6	380.91	14349.8	6612.6	154.92
Clay Tia-1 (river)	154.40	137.03	94083.5	344.7	8457.3	5.8588	31305.4	383.51	16000.4	6223.6	151.53
Tia Temper 1	119.87	167.14	91267.3	316.4	28293.5	2.8134	28721.2	3719.38	22926.0	0.0	89.02
Tia Temper 2	69.05	106.36	76917.4	1168.8	22827.8	2.3752	30472.6	858.07	22595.7	3347.2	44.13
Clay 85	72.63	234.92	61470.7	453.9	4156.3	6.3724	18438.0	148.10	2681.7	4074.9	81.03