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## McCown Archaeobotany Laboratory Reports

### Title

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### Permalink

<https://escholarship.org/uc/item/2c9554wv>

### Journal

UC Berkeley McCown Archaeobotany Laboratory Reports, 16

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### Publication Date

1990-08-30

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PALEOETHNOBOTANY AT TIWANAKU

by

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Paper Presented at the 4th Mesa Redonda of Bolivian Archaeology  
30 August, 1990 La Paz, Bolivia

Paleoethnobotany is a relatively young sub-discipline within the field of archaeology. As its name implies, it is the study of human-plant interactions in the past, most commonly through analysis of botanical remains recovered from archaeological sites. Prior to the development of water flotation systems which mechanically separate carbonized plant remains from the surrounding soil matrix, the study of past human-plant interactions was limited to large carbonized macro-remains encountered during excavation, or to those relatively rare contexts, such as coastal Peru and Chile, where botanical remains preserve in an uncarbonized state. With the advent of water flotation, our database has expanded dramatically, and plant remains have become another necessary domain of archaeological data analysis, along with ceramics, lithics, and faunal materials.

In the study of Tiwanaku civilization, the importance of paleoethnobotanical analyses is even more pointed. One salient aspect of the Tiwanaku cultural complex is the omnipresent raised fields. Clearly the great urban concentration and expansion of the Tiwanaku Empire was in large part enabled by these remarkable field systems. Yet how can one understand the dynamics of an agricultural system without studying the plants themselves? So, too, the study of Tiwanaku religious and ideological structures are intimately tied to the plant world -- the concern with the agricultural cycle, the ritual use of hallucinogenic

plants, ideology surrounding the consumption of food and drink. At every level of Tiwanaku culture -- economic, religious, domestic, even interpersonal -- plants played an utterly essential role. Thus the study of the botanical remains is a very important part of Proyecto Wila Jawira's ongoing investigations at Tiwanaku.

First let me describe the process of water flotation itself. Then I will explain the sampling strategy employed at Tiwanaku, and I'll conclude with a few brief comments on preliminary results of analysis which is being conducted at Dr. Christine Hastorf's paleoethnobotanical laboratory at the University of Minnesota.

As I mentioned before, in most environments, including the altiplano, the only botanical remains which are preserved archaeologically are those which have been carbonized. Large carbonized remains, usually wood, can be recovered during the course of excavation or during the screening of excavated soil. But the majority of carbonized botanical remains are too small to be readily observed or retained by 5mm screens. Luckily, one characteristic of carbonized plant remains is that they float in water. Volumes of soil which, to the naked eye, contain little or no carbonized material can yield a remarkable quantity of botanical remains when processed with water.

#### FLOTATION PROCESS

I had hoped to have slides illustrating this machine and its functioning, but unfortunately was unable to do so.

The water flotation system in use at Tiwanaku is a modified version of a machine designed by Dr. Patty Jo Watson and her colleagues for use in excavations in the midwestern United States. The system consists of a pump which pumps water from a well through a hose into a shower head located inside a 50-gallon barrel. The water is regulated by a spigot and the rate of flow can be constantly adjusted. Fitting within this larger barrel is a smaller, inner one which has as its bottom a 0.5mm mesh. Both barrels have outflow "mouths" which fit within one another.

The outer barrel is filled with water and the inner barrel placed within it, resting on metal crossbars located a short distance above the shower head. The soil sample is poured into the inner barrel. The action of the water from the shower head, along with some help from human hands, causes all of the soil and silt -- anything less than 0.5mm in size -- to pass through the screen at the bottom of the inner barrel. It also encourages the carbonized botanical remains to float to the top, where they are carried out the outflow and into a bucket which also has a 0.5mm mesh as its bottom. Inside of the bucket is a piece of chiffon of a very fine mesh which catches and contains the floating remains while allowing water to pass. These remains are dried and sent to the paleoethnobotany lab, where the seeds of different species of plants are separated, identified, and counted.

The heavy fractions -- the ceramics, lithics, bone, and other cultural and non-cultural material too large to pass through the screen of the inner barrel are removed and separated for analysis here in Bolivia. These heavy fractions are an important complement to the materials recovered during excavation because they are point-provenienced samples of a constant known volume. Hence questions involving artifact density, or which require finer spatial control than a 2x2m unit, can be addressed by analysis of these heavy fractions.

With this flotation system, we can process between 15 and 25 eight-liter samples every day, depending on the type of soil sampled.

#### SAMPLING STRATEGY

1989 was the first season where a systematic sampling strategy was employed. Prior to that time, an unsystematic sampling strategy used -- samples were taken more or less at the archaeologist's individual choice, usually when it was deemed there might be some interesting botanical remains there, that is, when carbon was visible to the naked eye. Although still a common practice in archaeology, and while some botanical remains can be recovered in such a manner, unsystematic collection inhibits good paleoethnobotanical analysis for a number of reasons.

As mentioned above, botanical remains often occur where they are not visible to the naked eye, and these remains are usually missed in an unsystematic collection. Unsystematic

sampling also makes statistical analyses more difficult and less reliable. Many important questions, such as those about the spatial distribution of activities across the site, cannot begin to be addressed with unsystematically collected samples. If all one wants is a "laundry list" of species present on the site, perhaps an unsystematic sampling strategy would suffice.

But with systematic sampling, that is collecting a standard volume from every provenience, every context, every unit, level, and feature on the site, so many more interesting questions can be addressed. With systematic sampling, quantification of plant remains becomes vastly more reliable; more sophisticated and varied statistical measures can be employed with confidence. Thus not only are the answerable questions expanded, but the answers themselves are more reliable with a systematic sampling strategy.

Taking samples from every locus on the site may seem like an incredible amount of dirt, but with mechanized flotation and experienced workers, flotation is the fastest and least costly part of the paleoethnobotanical endeavor. In the past 2 1/2 months, we have processed nearly 800 samples, and will float more than 1,000 more by the end of the year. And once a sample has been floated, its volume is so reduced that storage is a small consideration, and the data is preserved, available permanently for future

analyses. It can be returned to time and time again to answer new questions unimagined today.

For these reasons, a systematic sampling strategy has been employed at Tiwanaku and affiliated sites for the past two seasons.

#### RESULTS

Laboratory analysis over the past year has focused primarily on samples from the domestic area east of the Akapana mound, excavated in 1989 by John Janusek and Martin Giesso. Also analyzed were the unsystematically collected samples from the 1986 and 1987 seasons at Lukurmata.

The samples from Lukurmata were rather remarkable for their lack of domesticates. The majority of taxa identified were wild and weedy plants. This was a surprising result for samples from a site whose probable reason for being was management of the huge raised field complexes of the Pampa Koani. The explanation undoubtedly lies in part in the lack of a systematic sampling strategy. The samples taken were often from areas where although visible carbon (fuel remains of wood and dung) are abundant, seeds are not -- such as hearths which were regularly cleaned. The samples were also often quite small -- sometimes less than 2 liters -- and this undoubtedly affected recovery. In addition, other than samples for C14 testing, carbonized material encountered in the screens was not routinely saved. It is often in this larger-than-5mm



size range that many domesticates can be found, particularly potatoes and other tubers.

The samples from the 1989 season at Tiwanaku have not yet undergone a full statistical analysis, but there are some clear and important differences from the Lukurmata material. The incidence of domesticates is higher, as is the variety of domesticates recovered. Quinoa and caniwa are common, maize and tubers occur regularly, and domestic legumes and chile pepper were also recovered. The richest contexts, both in number of seeds and variety of taxa, were trash pits and ash pits. Analysis of the spatial distribution of different taxa across the domestic area is currently underway, but unfortunately results are not yet available.

Obviously analysis of the 1990 material has not yet begun, but a cursory inspection has shown that these samples are even richer, with more domesticates. Not surprisingly, samples from the urban core of Tiwanaku appear "cleaner" in that the highest densities of botanical remains occur in discrete secondary deposits such as ash and trash pits. This is in striking contrast to previous work done in Dr. Hastorf's lab from sites in the Upper Montaro Valley in Peru, where botanical remains were more common in less discrete contexts, such as floors and outside house walls. Analysis of samples from outlying sites in the Tiwanaku Valley (those excavated by Jim Mathews and Juan Alberecin)

will show whether this is, as I suspect, a true urban-rural difference in deposition of food refuse.

Also striking about the Tiwanaku material is the presence of plants not native to the altiplano. The chenopodia quinoa and caniwa, several varieties of potatoes, and tubers such as mashua, oca, and ullucu, were domesticated here on the altiplano quite early (c. 3000 BC). Other common domesticates, maize and chile pepper for example, do not grow well if at all in the Tiwanaku Valley and hence indicate trade with the warmer, more fertile lowlands. Maize is particularly interesting given its extreme ritual importance clearly attested to in Inka times, and probably at Tiwanaku as well. In Dr. Hastorf's lab we are currently conducting a study to determine whether different preparations and uses of maize (as cancha, as chicha, etc.) can be definitively determined from its archaeological remains. Although still in preliminary stages, results are promising.

Botanical remains do not just represent food remains, however. Dozens of human uses of plants result in their carbonization and preservation archaeologically. The wild and weedy species so common in every sample may represent use as fuel, as building material, or accidental inclusion by being blown or trampled into fire areas by humans and animals.

Fuel use is another interesting issue. Although trees are comparatively quite rare in the Tiwanaku Valley, nearly

every sample we have analyzed contains wood remains. At Tiwanaku, wood and dung, primarily camelid dung, appear to be the major fuel sources, in contrast again to some of the Monataro sites where corn cobs appear to have been a significant fuel source. This fall we will be undertaking a study of dung, to see if the large number of weed seeds found in the samples may in fact come from the burning of dung as fuel rather than burning of the weeds themselves.

As you can see, these studies are still in the very preliminary stages. With systematically collected data across time and space, we will be able to answer some interesting questions, such as : what are the differences in plant usage among different households of different status, of different times, and in different parts of the valley ? Does trade in non-native food products vary across these variables of time, location, and status ? Are the plants used in ritual contexts significantly different from those in domestic ones ? How does fuel use vary through time and across the sites ? Unfortunately I am unable to answer any of these questions today, but I hope I have outlined how and why we will be able to do so in the near future.