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Human Mobility and Community Organization among Early Bronze Age Hunter-Gatherers of the Lake Baikal Region, Siberia

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Human Mobility and Community Organization among Early Bronze Age Hunter-Gatherers of the Lake Baikal Region, Siberia

A dissertation submitted in partial satisfaction of the

requirements for the degree Doctor of Philosophy

in Anthropology

by

Benjamin Alexander Shepard

2016

ABSTRACT OF THE DISSERTATION

Human Mobility and Community Organization

among Early Bronze Age Hunter-Gatherers of the Lake Baikal Region, Siberia

by

Benjamin Alexander Shepard

Doctor of Philosophy in Anthropology

University of California, Los Angeles, 2016

Professor Jeanne E. Arnold, Chair

This dissertation examines mobility practices among hunter-gatherer groups who inhabited the Cis-Baikal region of Siberia (Russia) during prehistory, using archaeological and geochemical data. I argue that new methods of assessing human mobility enable insights into other aspects of social organization, including political structure, and employ these data to test hypotheses about mobility and sociopolitical aspects of Late Neolithic and Early Bronze Age life ways. I also describe the results of a large-scale examination of jade (nephrite) ornaments from Early Bronze Age burials throughout the Cis-Baikal region and in neighboring areas of Eurasia. These objects provide a novel means of understanding status competition and macro-regional interaction through

prestige goods exchange among hunter-gatherers, and illuminate previously unseen differences in dominant political strategies that local groups employed throughout the Cis-Baikal. I then present archaeological evidence from broader Eurasian contexts to assess the involvement of Cis-Baikal hunter-gatherer groups in the larger Bronze Age, and demonstrate that meaningful interconnections developed during this period. Finally, I present possible political economic mechanisms as well as specific venues that may have enabled local actors within the Cis-Baikal to produce sociopolitical changes documented here.

The dissertation of Benjamin Alexander Shepard is approved.

John Papadopoulos

Charles Stanish

Gregson Schachner

Andrzej W. Weber

Jeanne E. Arnold, Committee Chair

University of California, Los Angeles

2016

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Greg Schachner also deserved my thanks. Greg has been generous with his time and energy, always able to provide thoughtful and detailed commentary that helped me (and continues to help me) develop as a scholar. Every student should be so lucky as to have an adviser like Greg (more than one, ideally). Despite his other responsibilities, Greg has always managed to find ways to devote himself to my dissertation project and to other projects I have undertaken, and I have benefitted tremendously from his hard work. I like to think that the comments I received from Greg were particularly crucial in helping to elevate my thesis to the level of 'barely coherent.' Our candid, down-to-earth discussions became an important part of the writing process for me, and I look forward to many more in the future.

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Shepard, B.A. Reconsidering Methodological Holism in the Middle Holocene Cis-Baikal's "Post-Hiatus" Period. *Известия Иркутского Государственного Университета. Серия «Геоархеология. Этнология. Антропология» [The Bulletin of the Irkutsk State University "Geoarchaeology, Ethnology, and Anthropology" Series]* 1(2):196-202. **2013**

Shepard, B.A. Political economic reorganization among non-state societies: a case study using Middle Holocene mortuary data from the Cis-Baikal, Russia. *Journal of Anthropological Archaeology* 31:365-380. **2012**

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CHAPTER ONE

INTRODUCTION

Introduction: Hunter-Gatherer Complexity and Political Economy[1]

"Political economy" refers to economic activities that occur beyond the family level, and to the ways that social actors employ economic surpluses to achieve political goals (e.g., Earle 2000; Hastorf and D'Altroy [Eds.] 2002; Johnson and Earle 2000). In contemporary archaeology, the term is used most often in discussions of complex polities that feature specialized laborers, large-scale monumental constructions, and agricultural surpluses. However, the breadth of the political economy concept in fact creates a potential for comparative discussion of a far more diverse range of societies occupying different levels of sociopolitical complexity, and practicing different methods of food procurement.

Despite this, over the last several decades, many archaeological researchers focusing on hunting-and-gathering societies have tended to shy away from contributing to the comparative study of political economy, and research focusing on food producers has tended to exclude hunter-gatherers from these comparisons as well. Together, these factors have enabled what Arnold et al. (2015) describe as an "agricentric bias" in the study of political organization[2]. As a result, traditional studies of this topic often began with – and in some cases, *still* employ – an assumption

[1] Parts of this dissertation have been published elsewhere. These sections are indicated in the text with footnotes (Chapter Six).

[2] See Arnold et al. 2015 for a discussion of this gap in anthropological research on hunter-gatherer social organization and of the dearth of comparison of social organization across subsistence methods. Exceptions to this trend are also discussed.

that sociopolitical complexity only developed with the domestication of plant and animal species, and present hunter-gatherers – groups defined by their *subsistence practices* – as a monolithic, non-hierarchical *organizational* type (Arnold 1996b; Arnold et al. 2015).

In fact, assumptions about the intrinsic limitations to social complexity that all hunter-gatherer societies face have repeatedly proven to be false, and attributes such as egalitarianism are far from universal among these groups. The seminal *Man the Hunter* volume (Lee and DeVore [Eds.] 1968) set the tone for hunter-gatherer studies as an anthropological subdiscipline focusing on the study of acephalous, peaceful, egalitarian groups, exhibiting little potential for storable resources (due to an absence of domesticated crops and high levels of mobility).

In the 1990s, anthropologists and archaeologists documented several cases of sociopolitical complexity among hunter-gatherers, in areas such as the Columbia Plateau of Canada and the United States (Hayden 1997; Hayden and Schulting 1997), the southern coast of California (e.g., Arnold 1993, 1996a), and coastal Florida (Dietler 2008; Marquardt 1985), to name just a few particularly well known examples. These cases featured common attributes including sustained control of nonkin labor by elites, and heritable status distinctions, and thus provided support for arguments for decoupling subsistence methods from sociopolitical practices in anthropological theories of cultural complexity (Arnold 1993, 1996a; Hayden 1997).

The Study of Political Economic Variability

One important theme to emerge from studies of hunter-gatherer complexity in the 1990s was the existence of considerable *variability* within seemingly monolithic societal types. In fact, similar arguments about variability in sociopolitical organization among non-state societies more broadly became a major topic of discussion in anthropology during the 1970s and 80s (e.g., Feinman and Neitzel 1984; Renfrew 1974). These studies, along with the emergence of dual-processual theory in the 1990s (e.g., Blanton et al. 1996; Blanton 1998; Feinman 1995, 2000; Peregrine 2001) provided an important approach for disentangling different attributes of sociopolitical complexity. Dual-processual theory approaches human societies and sociopolitical complexity not exclusively in terms of hierarchical complexity – a topic that received considerable focus in most 20th century archaeology – but also in terms of a second, distinct dimension of complexity. This second dimension – political economy – focuses not on hierarchy (centralization), but instead on types of strategies that leaders employ as they direct flows of surplus resources in order to reproduce social structures that empower them.

More specifically, dual-processual theory outlines two opposing "poles" in terms of political economic organization, and its advocates suggest that within a given context, actors will tend toward one or the other, producing one of two types of "antagonistic political economy" (Blanton et al. 1996:7). Most importantly, this aspect of sociopolitical complexity is independent from the development of hierarchy, and thus, political economic variation by definition can exist at all levels of hierarchical complexity.

In sociopolitical systems catering to what dual-processual theorists have labeled the "corporate" political economic mode, actors attempt to incentivize followers to participate in subsistence intensification and other collective labor activities in order to produce surpluses. Systems where these strategies dominate are *inclusive* in the sense that political decision-makers strive to include as many participants as possible into economic activities, thereby maximizing the outputs of efforts at intensification. These systems tend to feature ideologies and rhetoric emphasizing cooperation between individuals (rather than social distinctions among them). At the same time, corporate polities do have the potential to feature internal social distinctions, and the inclusive rhetoric that political actors tend to promote in these contexts is just that – a form of *rhetoric*, that may in some cases serve to obscure social (e.g., Blanton et al. 1996; Feinman 2011). Ritual themes such as age- and gender-based initiation into widely accessible categories are common in corporate political economic systems, as are inclusive events celebrating these shared identities (e.g., Feinman 2011). Actors in these contexts also tend to elevate themes of fertility, renewal, and collective subsistence activities to important symbolic roles (e.g., Blanton et al. 1996; King 2003).

In contrast, in the "network/exclusionary" mode, political actors attempt to distinguish themselves from observers, thereby creating or reproducing social differences among participants in these systems (Blanton et al. 1996). Network/exclusionary strategies focus on cultivating support by asserting distinctions at the local level (between leaders and followers). Political actors in these contexts acquire prestige by asserting their likeness to other elites (often non-local) through participation in long-distance elite economic, political, and kinship networks.

These attempts at distinction often involve what Blanton et al. (1996) described as "patrimonial rhetoric" – an ideology that enables individuals to assert claims to exclusive statuses held by distinct kin groups. Symbolic practices that together constitute patrimonial rhetoric include some combination of polygyny, ranked descent groups, and a clan structure. Similarly, "prestige goods" systems, involving the display of exotic, labor-intensive, and non-local forms of wealth, represent another means by which political actors in network/exclusionary contexts can distinguish themselves from peers while simultaneously asserting their connection to other non-local elites (see also Renfrew 1987 for an illuminating discussion of this phenomenon, which they labeled "peer-polity interaction").

Contrasting Political Economic Models

It is worth highlighting several key contrasts between these two political economic modes. First, the ways that political actors display material culture to legitimize their roles differs considerably within corporate and network/exclusionary settings. In contexts where corporate political economic strategies dominate, material wealth – in the form of exotic and labor intensive objects that serve to showcase individual elites' access to (and monopoly power over) specialized production and exchange networks – tends to play less of a politicized role. As such, "prestige goods strategies" are relatively rare in corporate contexts. Instead, political actors enacting corporate strategies tend to use widely accessible material types in rituals and other activities involved in social reproduction, as well as those that do not require costly specialist labor to produce. As stated above, salient political symbols often feature universal themes such as those relating to renewal, fertility, and subsistence tasks, as well as initiation into "universal" roles (life-cycle roles: reaching reproductive age, attaining skill in subsistence activities, marriage).

In contrast, in network/exclusionary political systems, actors employ wealth and prestige goods, attempting to monopolize access to these objects (or the specialist labor involved in their production) to highlight dissimilarities between themselves and surrounding commoners. Material culture involved in social reproduction in these contexts often involves symbols that reference specific – rather than general or universal – themes or persons. As stated above, wealth objects in network/exclusionary systems often serve to link distant elites together in relationships of mutual support and likeness, thus creating or maintaining homogeneity among social actors at the supra-local scale (among elites capable of possessing exotic wealth and prestige goods) while also creating heterogeneity at the local level (between elites and commoners).

Individuals also employ different methods of financing political events in contexts where each of these political economic strategies dominate. In corporate settings, political actors cultivate support by redistributing resources that they and their followers produce as a result of subsistence regimes involving intensification. Earle (1997) has described this as "staple finance." Because of the bulky nature of subsistence goods relative to their economic value, the systems where political actors employ subsistence goods as a form of finance feature major constraints on their geographic boundaries (Earle 1997; Johnson and Earle 2000). In these systems, political actors tend to focus on redistribution of bulk goods primarily at the local scale. In cases where complex, hierarchical polities extend *beyond* this scale, local administrative centers tend to serve as important central points for the redistribution of *locally produced* surpluses (rather than redistributing bulk subsistence goods produced in a single area to supporters throughout an entire polity).

In contrast, in systems where network/exclusionary political strategies dominate, political actors employ objects that exhibit relatively low weight for their value (prestige goods). Earle (1998; DeMarrais et al. 1996) has described strategies focusing on these types of objects as "wealth finance" strategies (see also Chase-Dunn and Hall 1997). These objects facilitate transactions over relatively long distances, enabling aspiring elites to create relationships at the supra-local level. Blanton et al. (1996:4; see also King 2003:8; Strathern 1969) underscore the highly competitive and unstable nature of these exchange networks, which often feature more debt relationships between individuals than actual prestige goods in circulation at any given time. Long chains of network participants, resulting from network/exclusionary political economic strategies also have the potential to transcend cultural boundaries, stretching over considerable geographic distances, even when direct face-to-face meetings between end-members of these networks do not occur. In such cases, elite network participants in different local areas often choose to emulate widespread “elite” styles, despite differing cultural contexts.

These cross-cultural interactions have the potential to produce what some have described as an “international style” of sorts (e.g., Blanton et al. 1996; Chase-Dunn and Hall 1997; King 2003; Peregrine 2001) that links enterprising political actors involved in these competitive exclusionary systems through common forms of symbolism, similar to what Renfrew (1987) described in the “peer-polity interaction sphere” concept. This form of political economy contrasts in important ways with the bulk goods systems that serve as a focus of political economies in inclusive, corporate settings. Corporate political economies usually feature locally-focused polities with relatively small geographic extent. Without the use of prestige goods and their high value-to-weight ratios as a medium of finance, political actors have less ability to extend their reach beyond the local level.

Causes of Political Economic Variation

These contrasting models of political economies have proven useful in a variety of global contexts, and provide potential for important cross-cultural study of sociopolitical evolution and variation. Some (e.g., Pauketat 2007; Saitta 2005:386-387) have criticized dual-processual theory for its failure to explain the underlying causes of political economic shifts, arguing that these concepts merely provide a new typological scheme. It is true that some works employing a dual-processual framework have certainly stopped short of investigating the causes of political economic changes that they identify. However, dual-processual theory does indeed provide a model of conditions that stimulate the development of different political economic modes.

Blanton et al. (1996) argue that the corporate emphasis on inclusivity and the redirection of labor towards subsistence intensification is advantageous under conditions where such intensification is possible. For example, among Mesoamerican state-level polities, corporate political economic systems specifically thrived in the Basin of Mexico, where easily irrigable alluvium enabled large-scale returns on labor investment in the form of agricultural surplus (Blanton et al. 1996:7). In contrast, network/exclusionary strategies thrive in contexts where local elites can exert control over raw material involved in prestige goods systems or on peripheries between core areas (Blanton et al. 1996:7).

For example, Earle (1997, 2000) discussed northern European polities during the Bronze Age, when elites relied on the control of prestige goods networks (wealth finance) and their ability to redistribute these objects to followers in exchange for political control. These polities were located in areas that were relatively marginal in terms of their subsistence productivity. However, their geographic placement made it possible for local political actors to control the movement of trade goods throughout the broader regions where they were situated.

In an early but related discussion on the topic of political economy in small and intermediate scale societies, Strathern (1969) observed considerable variation among New Guinea Highlands "Big-Man" societies, which he related to ecological differences and potential for surplus production. More specifically, Strathern described two types of these systems – which he labeled "home production" and "finance production." In the contexts where political actors emphasized home production, these actors employed "pig festival" events to cultivate prestige by marshalling followers to contribute pigs for local ceremonies. Because of the size and difficulty of transporting and provisioning pigs over long distances, contributions necessarily came from *local* supporters. Often, these supporters were kin or affines, related to an organizer through marriage.

In contrast, in areas where large-scale pig production was impossible (due to low potential for horticultural intensification), Big Men turned to the moka and the tee, two forms of long-distance prestige goods systems. In contexts where this strategy (finance production) predominated, political actors created long chains of debt relationships that extended over considerable distances. Big Men in these contexts used the social networks they had produced to acquire prestige and support through association with other Big Men, and through the redistribution of prestige goods they were able to procure through these networks.

Notably, the two types of political economy that Strathern observed in the New Guinea Highlands correspond closely to the dual-processual models outlined by Blanton et al. (1996), and provide valuable insights into the role of environmental variation in incentivizing individual decisions that structure broader aspects of sociopolitical organization. This case study also demonstrates the relevance of these models for the study of societies exhibiting low levels of hierarchical complexity.

Political Economy among Siberian Hunter-Gatherers

I investigate the theme of political economic variation in small-scale societies using the Cis-Baikal region of Siberia, Russia, as a case study. In some ways, this area exemplifies the trends discussed above. The Cis-Baikal – located to the north and west of Lake Baikal (in the Irkutsk oblast' of the Russian Federation) – contains perhaps the richest archaeological evidence for Holocene lifeways of hunter-gatherers in the entire subarctic, as Weber (1994:1) observed in an early English-language paper on the region's archaeology. Over the last 20 years, research on the prehistory of the Cis-Baikal has ballooned into a large-scale international endeavor, in the form of the Baikal Archaeology Project (renamed the Baikal Hokkaido Archaeology Project in 2011, hereafter "BHAP" – see Chapter Two for further discussion).

Throughout this thesis, I employ several datasets to test hypotheses about political economy derived from dual-processual theories of sociopolitical complexity. Each provides insights into ancient political economy at a different geographic scale (micro-regional, regional, macro-regional). I begin by outlining previous archaeological research in the Cis-Baikal region (Chapter Two).

In Chapters Three and Four, I develop an approach to assess hunter-gatherer political economic organization on the basis of human mobility practices and employ geochemical evidence to evaluate changes in mobility patterns within the Cis-Baikal's Little Sea micro-region during the Late Neolithic and Early Bronze Age. Mortuary practices in that area (Shepard 2012) suggest a transition from inclusive corporate strategies to network/exclusionary ones at this time, and geochemical studies provide an additional line of evidence to use in order to assess this argument. While the use of geochemical data for the study of mobility is not uncommon in contemporary archaeology (e.g., Hard and Katzenberg 2011; Kusaka et al. 2012; Thornton 2011; Weber and Goriunova 2013; Scharlotta and Weber 2014), their use in investigations of sociopolitical organization – among hunter-gatherers, no less – is a rarity. Chapters Three and Four provide a test case for more future studies in this vein. Further, the large-scale nature of the dataset I employ here, which builds upon several decades of incremental advances in isotopic research on human remains from the Cis-Baikal enables a depth of research unparalleled in most other global research contexts (see Weber and Goriunova 2013).

In Chapter Five, I investigate Early Bronze Age political economy at the regional scale, employing data on jade artifacts (prestige goods) that may have served as a means of financing political undertakings during this period. I describe the production sequence for these ornaments and investigate local differences in their production and exchange. Using these data, I test several expectations that emerge from dual-processual theory about differences in local engagement with political strategies involving these ornaments throughout the region. In addition to examining ancient political economy through the lens of nephrite ornamental goods, I also attempt to demonstrate both the promise and the feasibility of studying Cis-Baikal artifacts in future iterations of BHAP research.

In Chapter Six, I discuss larger-scale interactions that appear to have developed under an Early Bronze Age network/exclusionary political economic focus. More specifically, I examine macro-regional-level interactions during this period, demonstrating that Cis-Baikal hunter-gatherers may have taken advantage of newfound connections to groups inhabiting neighboring regions. These interactions likely occurred primarily through relatively short-term interactions at large, face-to-face events (see Chapter Six for discussion). By presenting Cis-Baikal hunter-gatherer groups within a specific geographic and historical context, I attempt to dispel the common premise that these and other hunter-gatherers existed in isolation, subject only to local ecological stimuli. I demonstrate instead that hunter-gatherers in the Cis-Baikal maintained at least limited contacts with external groups, exposing themselves to historic processes occurring beyond the boundaries of the region. At the same time, these contacts created new political and economic opportunities for enterprising hunter-gatherers in the Cis-Baikal to transform social structure during ritual aggregation events and through the use of novel mobility strategies.

CHAPTER TWO

CIS-BAIKAL CULTURE-HISTORY

Culture-History of the Cis-Baikal

The Cis-Baikal region of Siberia (Russia) occupies the west coast of Lake Baikal – the deepest freshwater body on earth and the largest in terms of volume – and the area to the north and west, spanning from 52° N to 58° N and 101° E to 110° E (Figure 2.1). The region is a mosaic of steppe, forest-steppe, and taiga landscapes, with major rivers interspersed. Several rivers flow into Lake Baikal, including the Upper Angara, at the lake's northern tip; the Selenga, on the southern coast (southeast of the Cis-Baikal proper); and the Barguzin, located in the Trans-Baikal (east of the Cis-Baikal). The Angara River (as opposed to the aforementioned *Upper* Angara), is the only river that flows out of Lake Baikal, beginning on the southwest coast of the lake and extending northwest though the Cis-Baikal region, before joining the Yenisei River and flowing north to the Arctic Ocean. In addition, although it does not connect with Lake Baikal, the headwaters of the Lena River are located in the Baikal'skii Mountain Range, only ~10 km west of the lake's coast. This river flows north on a circuitous path to the Arctic Ocean. The East Sayan Mountains – an eastern branch of the Altai Mountain Range – with elevations as high as 3,200 m asl, are located in the west of the Cis-Baikal, and other mountain ranges (the Baikal'skii and Primorskii) line the lake's western shore.

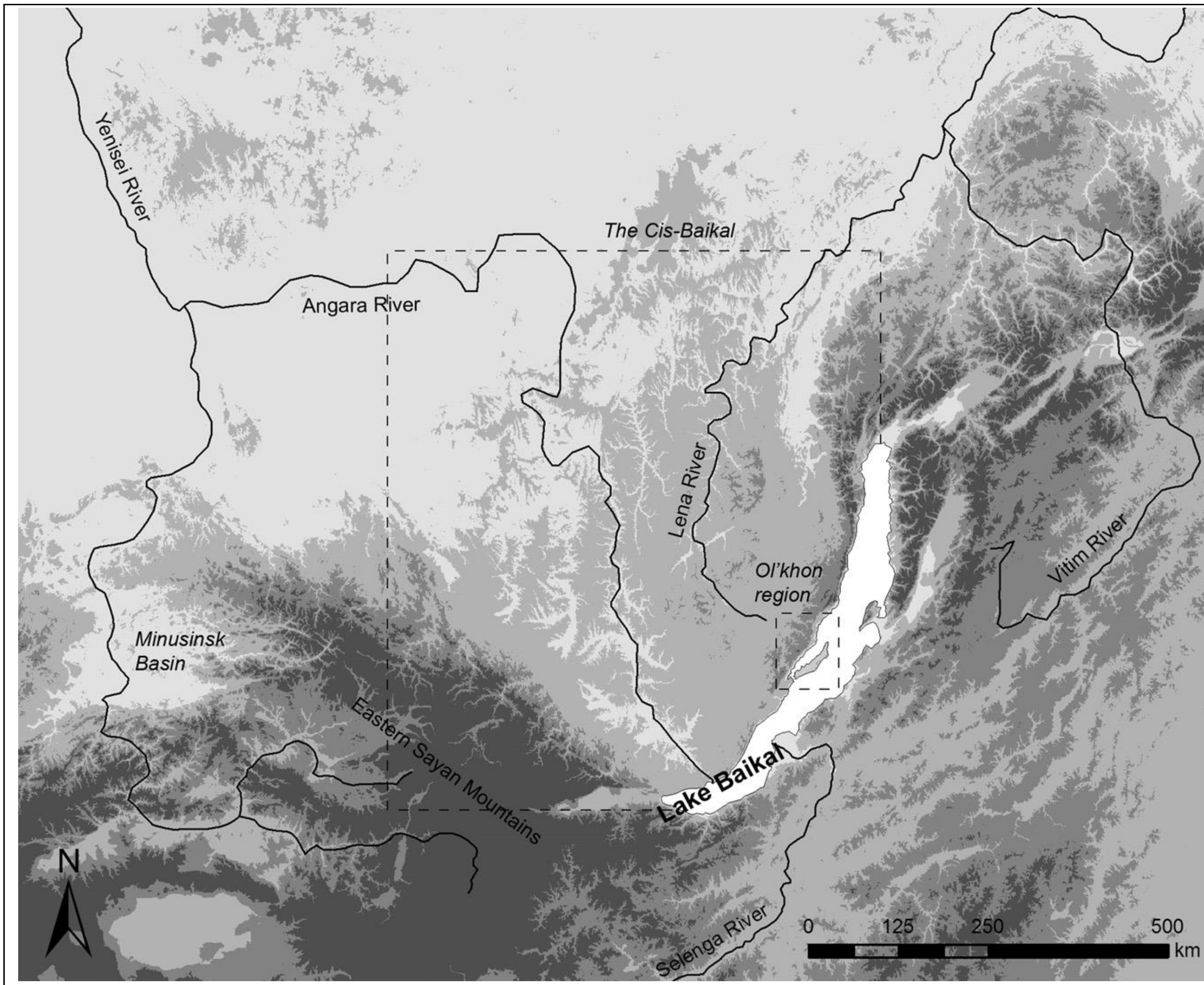

Figure 2.1. Map of the Cis-Baikal. Little Sea micro-region is indicated here as "Ol'khon region."

For the purposes of this discussion, the Cis-Baikal can be divided into several distinct 'micro-regions,' each presenting unique resources and subsistence opportunities for ancient hunter-gatherer groups. These include the Angara River Valley, the upper Lena Valley, the Little Sea, and the South Baikal. The Angara River features a mixture of steppe (concentrated toward the south, near the river's headwaters) and forest-steppe. This micro-region features by far the most productive fisheries in the Cis-Baikal, although their productivity and the specific fish species present over the ~1000 km course of the river varies considerably (e.g., Kozhov 1950; Losey et al. 2012; Weber 2003; Weber and Bettinger 2010; Weber et al. 2002, 2011). Fish species found along the Angara include black grayling, lenok, taimen (particularly in the upper Angara, nearest to the lake); Siberain dace, arctic grayling, freshwater perch, northern bike, burbot, roach, humpback whitefish, lenok, taimen, and humpback whitefish (between the confluence of the Angara and the Irkut in the south, and Bratsk in the north); humpback whitefish, Siberian sturgeon, Siberian starlet, Siberian dace, and arctic grayling (north and west of Bratsk; Weber 2003:62). Kozhov (1950) reported overall aquatic resource productivity values for these broad sections of the Angara as 2816, 735, and 2916 kg/year/km (for the sections from the headwaters of the Angara to the confluence with the Irkut, the confluence with the Irkut to Bratsk).

In contrast, the densities of aquatic resources in the upper Lena River are relatively low (e.g., Losey et al. 2012; Weber et al. 2011). Fish species available in this area would have included the arctic grayling, taimen, lenok, perch, and pike, and these would have been most easily caught in the seasonally productive areas where the Lena intersected with other rivers and in particularly deep areas (e.g., Losey et al. 2012:140). Fishing practices in these areas remain poorly studied, and will require revisitation with new excavations and fine-meshed screening techniques (Losely et al. 2012). Kozhov (1950) reported aquatic resource productivities of ~228 kg/year/km for the upper Lena.

The Little Sea micro-region contains no rivers that rival the productivity of the Angara, but the relatively shallow west coast of Lake Baikal (the “Little Sea” for which this micro-region is named) provides a reliable although low-density aquatic resource base (consisting of both fish and Baikal seal). Several species of fish use the Sarma River, located on the mainland side of the Little Sea micro-region, for spawning, including black grayling, during early spring (Losey et al. 2012:131). Other species such as whitefish use the Little Sea’s Mukhor Bay to spawn in the fall, before lake becomes covered in ice (Losey et al. 2012:133). This micro-region is largely dominated by steppe landscape, and mountains along the coast would have provided opportunities for hunting ungulates. The South Baikal coast contains similar fisheries to the Little Sea, featuring predictable and year-round subsistence opportunities. Ungulates such as red deer, roe deer, elk, and musk deer, are also present throughout the region (although the latter two prefer forested areas), and would have been most easily hunted in winter (Turov 2010, Weber and Bettinger 2010).

Archaeologists first took an interest in the Cis-Baikal region during the 19th century, with discoveries of large prehistoric sites (e.g., Vitkovskii 1889) such as Kitoi, which enjoyed considerable importance within the discipline as "the world's largest Stone Age cemetery" (see discussion in Okladnikov 1950). Another early site excavated within the Cis-Baikal was Glazkovo, where a mixture of lithic and metal artifacts were found (e.g., Ovchinnikov 1904). The former was excavated by Vitkovskii (1889) in the 1880s, while Ovchinnikov (1904) made his discoveries at Glazkovo by salvaging archaeological materials uncovered during the construction of the Irkutsk branch of the Trans-Siberian Railway during the 1890s.

Throughout the first half of the 20th century, archaeological research in the region revealed a wealth of new data, particularly from mortuary sites along the Angara and upper Lena Rivers (at least in part tied to the construction of hydroelectric dams on the Angara). Oladnikov (1950, 1955) employed these data in his synthetic culture-history of the region, which maintains its importance in the study of Cis-Baikal prehistory today. Archaeologists have continued to produce new data throughout the 20th and 21st centuries (e.g., Dudarek and Lokhov 2014; Gerasimov and Chernykh 1975; Goriunova 1997; Konopatskii 1982; Okladnikov 1974, 1975, 1976, 1978; Savel'ev 1981 [Ed.]; Weber et al. [Eds.] 2010, 2012; Ziablin 1959), and in the recent past this research has become increasingly international, with the development of the Baikal Archaeology Project (renamed the

"Baikal-Hokkaido Archaeology Project" [hereafter, "BHAP"] in 2011), based at the University of Alberta (Canada), and directed by Andrzej Weber.

The BHAP has made important strides in archaeological understandings of regional prehistory, and has also stimulated the development of novel approaches to the study of hunter-gatherer adaptations more broadly. These approaches include osteological (Lieverse et al. 2010, 2016; Waters-Rist et al. 2011), geochemical (Haverkort et al. 2008, 2010; Katzenberg and Weber 1999; Katzenberg et al. 2009, 2012; Lam 1994; Scharlotta and Weber 2014; Weber et al. 2002; Weber and Goriunova 2013), chronological (Nomokonova et al. 2013; Schulting et al. 2014; Weber et al. 2005, 2006, 2010; 2016a), and zooarchaeological (Losey et al. 2008; Nomokonova et al. 2010) methods, and ongoing research affiliated with the BHAP continues to provide promising results and novel approaches.

The vast majority of the region's mid and late Holocene archaeological record comes from human burials. The culture-history of the Cis-Baikal is based largely on data from human burials (Weber and Bettinger 2010 suggested that the total amounts to over 1000 individuals dating to the Mesolithic – Early Bronze Age), and absolute dates for culture historic units come from radiocarbon dates on human bone. During the 1980s, regional archaeologists began to employ radiocarbon dates to assess absolute ages of mortuary traditions that Okladnikov identified, reordering his culture-historic sequence (Weber 1995). Since that time, new radiocarbon data and refined methods have enabled far more accuracy and precision for these dates.

Most recently, AMS radiocarbon dates from paired sets of human and faunal remains have produced a refined chronology that employs atmospheric calibrations as well as a freshwater reservoir effect that corrects for the incorporation of "old carbon" into human bone (Nomokonova et al. 2013; Schulting et al. 2014; Weber et al. 2016a). This refined chronology (employed throughout this dissertation, except where otherwise noted) provides important groundwork for future archaeological research in the Cis-Baikal. However, some obstacles still remain. In particular, Weber et al. (2010:36-37) have observed that the radiocarbon calibration curve for the Holocene features several flat sections that make investigations of key culture-historic transitions difficult. These flat sections are situated at ~7200-7000 cal BP (Early Neolithic-Middle Neolithic transition), ~6200-6000 cal BP (Middle Neolithic-Late Neolithic transition), ~5300-5050 cal BP (Late Neolithic-Early Bronze Age transition), and several other periods of less importance. Below, I briefly outline the major attributes of culture-historic periods under study here.

Mesolithic

The assertion that a "Mesolithic" period of burial activity existed prior to the well-documented Early Neolithic has been controversial. Bazaliiskii's (2010:54-63) typological assessment identified several burials that he assigned to the Late Mesolithic "Khin" (n=5) and "Shchukino" (*n*=19) traditions employed by Okladnikov (1950). Among other features, these burials contained large quantities of lithic prismatic blade inserts, but exhibited considerable variability. However, several studies over the last two decades have called the chronological distinction of the Mesolithic and Neolithic into question based on overlapping absolute dates of the two complexes (e.g., Weber et al. 2010; Weber and Bettinger 2010:492). More recently, new AMS radiocarbon data (Schulting et al. 2015; Weber et al. 2016a) that incorporated a correction for the Freshwater Reservoir Effect ("FRE") have confirmed that several graves from the Cis-Baikal do clearly predate the Early Neolithic start date, spanning from 8600-7450 cal BP (n=10).

Early Neolithic

The development of the Neolithic in the Cis-Baikal was marked by the appearance of formal burial practices as well as ceramic technologies and ground lithic objects (axes, adzes, knives, composite fishhooks) (Okladnikov 1950; Weber 1995:9-11). Burials from the Early Neolithic period also commonly contained lithic microblades, a common trait among groups throughout Northern and Central Asia during the Late Pleistocene and Early Holocene (e.g., Brantingham et al. 2013; Lie 1998; Volkov and Zhambaltarova 2011:22). Early Neolithic mortuary practices exhibited significant regional variation; cemeteries located in the Angara River Valley and in some sites in the South Baikal are associated with the "Kitoi" mortuary tradition, named for the Kitoi cemetery, located at the confluence of the Kitoi and Angara Rivers. Kitoi graves have often been identified based on the presence of ochre and composite fishhooks as well as the specific orientation of interments (northeast or southwest, although variation was not uncommon among these interments). In addition, a number of local traditions also exist throughout the Cis-Baikal that have been differentiated on the basis of burial posture, artifact types, and the use of ochre (Bazaliiskii 2010a; Konopatskii 1982; Okladnikov 1950).

Dates for the Early Neolithic may also have varied between regions of the Cis-Baikal (Weber et al. 2010; Weber and Bettinger 2010). The South Baikal Early Neolithic (represented by the recently-excavated Shamanka II cemetery) ranging from ~8000-6800 cal BP, and those for the Angara River exhibiting a somewhat shorter (~8000-7000 cal BP) timespan. The far less populous Little Sea micro-region and Lena River Valley were believed to feature Early Neolithic dates ranging from ~8000-7200 cal BP (Weber et al. 2010:42).

Early Neolithic cemeteries ranged in size, several containing over 100 individuals (Bazaliiskiy and Savelyev 2003; Mooder et al. 2005), and some burials from this period featured large concentrations of artifacts (Bazaliiskii 2010a:69). Lokomotiv cemetery, located on the Angara River (in the modern city of Irkutsk), contained a large number of interments from this period, some of which were found with numerous composite fishhooks, marmot incisor pendants, and arrowheads (Bazaliiskiy and Savelyev 2003:21). The largest Early Neolithic cemeteries were concentrated in the Angara River Valley and on the lake's southwest coast, while very few Early Neolithic burials have been located in other areas (Weber et al. 2002; Weber and Bettinger 2010).

Broadly, diet during the Early Neolithic was characterized by a heavy focus on fish (contrasting with later dietary diversification). This is evident both in terms of grave goods relating to fishing (Okladnikov 1950) and isotopic signatures found in human bones (Katzenberg et al. 2012; Weber et al. 2002, 2011). On the basis of isotopic evidence (carbon, nitrogen), Weber et al. (2002:272, 277-278) demonstrated heavy reliance on local aquatic resources surrounding the cemeteries where Early Neolithic individuals were interred. These inter-site differences in isotopic signatures of diet among Early Neolithic cemeteries were interpreted as signs of localized subsistence regimes that suggested the existence of relatively little flow of individuals between local procurement areas tethered to specific rivers (Weber et al. 2002:279). Weber et al. (2002) suggested that the relatively local focus of Early Neolithic subsistence activity might have rendered communities subject to frequent food shortages. Differences in the prevalence of osteoarthritis of the knee between Early Neolithic males and females imply that males – featuring a higher proportion of knee osteoarthritis than contemporaneous females *or* groups from subsequent periods – may have undertaken frequent logistical foraging excursions from these home bases

(Lieverse 2010:145-147). These excursions did not necessarily involve leaving the "local areas" (micro-regions) discussed above.

On the basis of demographic profiles from Early Neolithic cemeteries, some suggest that Early Neolithic featured "fewer children, smaller families, more adult males than females, and more prime age males than old males" than did local hunter-gatherer groups in later periods (Weber et al. 2002:281). More recent osteological research indicates that Early Neolithic groups on the Angara River experienced greater amounts of physical strain than their contemporaries in the South Baikal. These patterns are consistent with arguments that Early Neolithic groups on the Angara River may have faced considerable demographic pressure, requiring intensified use of logistical mobility strategies (e.g., Lieverse et al. 2016). Lieverse (2010:151; see also Weber et al. 2002) showed a significantly higher rate of enamel hypoplasia among Early Neolithic groups than among groups from subsequent periods, which she attributed to "poorer community health associated with less effective adaptive strategies."

While cemeteries as large as those documented for the Cis-Baikal's Early Neolithic are somewhat uncommon throughout Eurasia during the same time period, a number of analogues do exist from the wider region. Although Lieverse (2010:141) has suggested that the Cis-Baikal case is unique because local hunter-gatherer groups used cemeteries to lay claim to a wide range of resources, I argue that both the role of cemeteries in group-level territorial claims (e.g., Goldstein 1981; Price and Brown [Eds.] 1985) and the wide range of resources they laid claim to (in fact, all of these cemeteries were located on rivers or on the lake's coast; Weber and Bettinger 2010) are common among transegalitarian societies both within Eurasia and globally. Other hunter-gatherer cemeteries from the early portions of the Middle Holocene – such as Fofanovo in the Trans-Baikal (Lbova et al. 2008) or Oleneostrovski in Karelia (Northeastern Europe; O'Shea and Zvelebil

1984:35) are thought to have asserted similar claims on local resources at the level of the "descent group."

The decline of the Early Neolithic remains poorly understood, although it is possible that environmental stimuli may have been involved in the decline of cemetery usage at this time (Weber et al. 2008a). In an attempt to address questions of climate change during the Holoecene in the Cis-Baikal, White and Bush (2010:13-14) recently synthesized information on fluctuations in earth's orbital parameters, atmospheric CO_2 concentrations, and regional environmental proxies to extrapolate macro-regional prehistoric climate changes during the Holocene. In particular, these data suggested a shift from humid to arid conditions at the Early-Middle Holocene transition, and showed that this period also featured increased variation in local temperatures.

Thus, while the precise effects of this climatic shift on Early Neolithic groups' subsistence regimes remain unclear, it appears likely that climate may have played a role in the emergence of novel cultural patterns during the Middle Neolithic (White and Bush 2010:17). At the same time, Weber and Bettinger (2010:495) caution that because this climatic shift may have taken place during such a long period of time, the possibility does remain that it either post-dates *or* significantly predates the Middle Neolithic hiatus.

Middle Neolithic

Weber et al. (2006, 2010, 2016a) have demonstrated conclusively that the millennium-long timespan designated as the "Middle Neolithic" (~7000-6000 cal BP) featured an abandonment of ritual burial practices in the Cis-Baikal. Of 488 radiocarbon dates from human bone samples that were available at the time of a 2010 publication, for example, Weber et al. (2010) demonstrated that only one featured a range that overlapped at all with the Middle Neolithic (LOK_1980.002.01, uncalibrated age range: 5700 +/- 50 BP; Weber et al. 2010:43). New attempts to apply a FRE correction to Cis-Baikal radiocarbon dates produced a similar gap for the Middle Neolithic (although the single apparent Middle Neolithic sample was not included in these studies), spanning from 6800-5700 cal BP (Weber et al. 2016a).

Based on what appears to be a total lack of burials from this period, the Middle Neolithic likely witnessed a stop in cemetery use (Weber 1995; Weber and Bettinger 2010). It is also noteworthy that due to the flattening of the radiocarbon calibration curve at the end of the Early Neolithic and the large standard deviations (n=5) or low collagen yields (n=1) in the dates of the six oldest Late Neolithic burials, the actual beginning and end of the Middle Neolithic "hiatus" in burial activities remain difficult to pinpoint at present (Weber et al. 2010:43). Weber et al. (2008a:2) suggested that the Middle Neolithic hiatus in burial ritual activities may indicate a decline in labor-intensive fishing practices and in social complexity more broadly, which seems to be a reasonable assertion on the basis of developing paleoclimate reconstructions (see above). At the same time, it is important to note that at least limited evidence suggests that while cemetery ceased during this period, people remained in the region, despite a population *decline* (rather than disappearance; Kuzmin 2007:127; Weber et al. 2016a).

As stated above, this period may have witnessed a major demographic collapse, and was followed by an appearance of groups practicing novel burial traditions during the Late Neolithic (Weber 1995). Osteological (Gerasimova 1981; Mamonova 1980) and genetic (Mooder et al. 2005, 2010; Schurr et al. 2010) evidence collected from prehistoric skeletal samples and modern populations show that 'pre-' and 'post-hiatus' groups exhibited distinct attributes. This finding is consistent with the population bottleneck/replacement hypothesis advocated by Weber (1995). For example, Schurr et al. (2010) have demonstrated that Early Neolithic groups in the Cis-Baikal featured mtDNA haplogroups that differed from those found among most Siberian indigenous groups from the contemporary period. In contrast, mtDNA signatures for Late-Neolithic and Early-Bronze-Age "post-hiatus" groups in the Cis-Baikal not only differ from those of Early Neolithic groups, but also appear consistent with historic Siberian populations such as Evenks, Buryats, Tuvans, and Mongolians, providing further support for the argument that the Middle Neolithic hiatus in burial practices may have involved a biological discontinuity of some sort (e.g., migration or population bottleneck).

The "post-hiatus" period

Following the extended hiatus in burial activities within the Cis-Baikal, these practices resumed sometime after 6000 cal BP (5700 cal BP when FRE correction is implemented; Weber et al. 2016a). During the late 1990s and early 2000s, many scholars described the period beginning at this time as the "post-hiatus," the "Isakovo-Serovo-Glazkovo" stage, or "Late Neolithic-Bronze Age" (e.g., Lieverse et al. 2010, 2016; Weber and Bettinger 2010; Weber et al. 2002; White and Bush 2010). In large part, this trend can be attributed to the very small number of Late Neolithic samples in collections accessible to the BHAP (e.g., Weber et al. 2016a, see below) and to suggestions in Weber (1995) and Weber et al. (2002), that:

> there were probably more similarities than differences between Serovo [Late Neolithic] and Glazkovo [Early Bronze Age] assemblages. The most conspicuous differences include copper

> alloy artifacts and new pottery styles in Glazkovo. We believe that these phenomena should be considered to be less significant aspects of hunter-gatherer adaptations as a whole, however useful they may be as culture-historical markers. (Weber et al. 2002:288).

These statements – which were only meant to provide justification for the broad research question the authors employed in a single study – seem to have proliferated in technical studies of Cis-Baikal prehistory. While there were certainly similarities between these groups, there is considerable reason to expect that important differences between Late Neolithic and Early Bronze Age hunter-gatherers in the Cis-Baikal. Most notably, the culture-historic synthesis that Okladnikov (1950) proposed in the first half of the 20th century essentially described a long period of sociopolitical transition between what Okladnikov viewed as the earliest and most egalitarian groups (Serovo and Isakovo) and those groups he believed were the latest, most complex, and inegalitarian (Kitoi and Glazkovo). As stated above, radiocarbon dating efforts starting in the 1980s have re-ordered Okladnikov's original chronology, so that the two broad groupings ("early" – Serovo/Isakovo; "late" – Kitoi/Glazkovo) Okladnikov identified based primarily on mortuary assemblages are now known to date to the Late Neolithic (Serovo/Isakovo) and the Early Neolithic (Kitoi) and Early Bronze Age (Glazkovo), respective. While the chronology of these groups has changed somewhat, I suggest that the contrast Okladnikov (1950, 1955) observed between sociopolitical structures of these groups remains indicative of potentially important cultural differences.

Given the length of the post-hiatus period (~6000-4000 cal BP, 5700-3700 cal BP when FRE correction is applied, Weber et al. 2016a), and the important events known to have occurred outside the Cis-Baikal during its two-millennia timespan, lumping the Late Neolithic and Early Bronze Age into a single analytical unit may gloss major social shifts among Cis-Baikal hunter-gatherers. Further, while these analytical units ("pre-" and "post-hiatus") permit archaeologists to ask comparative questions (regarding convergent cultural adaptations among populating living under relatively similar environmental conditions), they may also prevent questions about diachronic, internal social change (because the Early Neolithic and post-hiatus analytical units appear *not* to represent a continuous cultural trajectory, and were instead separated by almost 1000 years).

In contrast with the broad chronological brushstrokes involved in the Western "post-hiatus" designation, most Russian scholars continued (after Okladnikov 1950) to employ more fine-grained terminology for culture historic units, distinguishing between the Late Neolithic and Early Bronze Age, as well as within these broad groupings (e.g., Goriunova 2002; Goriunova and Novikov 2010; Turkin and Kharinskii 2004; see discussion in Chapter Six).

Within the last decade, some western researchers have also made calls to revisit cultural change within the so-called post-hiatus period (McKenzie 2010; Shepard 2012; Weber 1995:158; Weber et al. 2002:290). One recent study employed data from the Little Sea micro-region to compare mortuary practices among these two culture-historic units, demonstrating that the transition between the Late Neolithic and Early Bronze Age represents a case of sociopolitical reorganization (Shepard 2012).

Late Neolithic

The Late Neolithic – spanning from 5700 – 4900 cal BP (correcting for FRE; Schulting et al. 2014; Weber et al. 2016a) – featured a resumption of funeral ritual activity in the form of the Serovo, Isakovo, and other burial traditions. During this period, funeral participants tended to arrange the dead so that they were oriented perpendicular to rivers, with their heads pointing away (Serovo) or parallel to rivers with their heads pointing upstream (Isakovo; Weber and Bettinger 2010:496). On the lake's shore in the Little Sea micro-region (which lacks major rivers), Late Neolithic interments were usually oriented to face north or northwest (Goriunova 1997). Late Neolithic cemeteries tended to be relatively small, often containing fewer than ten interments (Okladnikov 1950). Grave goods typical of the Late Neolithic include ceramic vessels, polished knives, bows with bone braces, and arrowheads. A relatively homogenous distribution of these grave goods among Late Neolithic interments led Okladnikov (1950:267) to suggest that low levels of social inequality existed among these groups.

While many sets of Late Neolithic human remains have been lost since their original excavations (e.g., Weber et al. 2016a:10), making the study of this period somewhat incompatible with the bioarchaeology-focused research goals of the BHAP (but see Chapter Four for discussion of "rediscovered" remains), Late Neolithic archaeological collections are available in published sources and in Russian museum contexts. On the basis of existing archaeological literature from the Little Sea micro-region, Late Neolithic burial practices in that area appear to have featured a corporate political economic emphasis (Shepard 2012). Multiple burials were relatively common (>50% of individuals were interred in collective graves), suggesting an emphasis on communal – rather than individual – representations. "Tiered" grave layouts also suggest that Serovo individuals may have occasionally reopened old burial pits in order to inter additional dead, thereby asserting continuity with ancestral figures, although difficulties in establishing the timing of tiered multiple burials make this interpretation somewhat speculative (Goriunova 1997). Similar practices have been observed in Late Neolithic graves on the upper Lena (Okladnikov 1978).

Serovo groups in the Little Sea micro-region also appear to have excluded children from some types of burial ritual (although the same may not have been the case at Late Neolithic cemeteries in other micro-regions). The unique burial treatment for young (and, presumably, uninitiated) individuals in the Little Sea micro-region, involving interment in graves containing multiple burials – is consistent with models of the corporate political economic mode and its emphasis on communal identities and indoctrination into inclusive corporate institutions (Shepard 2012).

During the Late Neolithic, both within the Little Sea micro-region and more broadly, Cis-Baikal funeral participants appear to have placed relatively few preservable grave goods in burials. Graves that did contain artifacts were dominated by types of implements that Okladnikov (1950:267, my trans.) described as being "of absolute necessity to every forest hunter." Late Neolithic people used exotic materials such as green nephrite exclusively for the production of implements (knives, axes, and adzes), many of which broke before or during interment in burials, suggesting actual use in productive activities. Lithic fish sculptures (widely believed to have served as fishing lures) and ceramic vessels found in Serovo graves may provide exceptions to the "utilitarian" character of Serovo grave good assemblages, and their presence in these contexts suggests an emphasis on subsistence resources and activities directly related to subsistence and consumption in funeral symbolism. While only two such statues were found in the Little Sea micro-region in one recent study (Shepard 2012), both were associated with adults interred in multiple burials at a single site (Sarminskii Mys, the largest Serovo cemetery in the micro-region and among the largest in the Cis-Baikal; see Chapter Four). More recent studies have documented other instances of these statues both within the Little Sea and elsewhere throughout the Cis-Baikal (O.I. Goriunova, personal communication, May 2016). On the basis of these and other unique patterns with respect to this cemetery, Sarminskii Mys (which is discussed in detail in the following chapters) appears to have been a center of corporate activity in the Late Neolithic (Shepard 2012).

Early Bronze Age

The Cis-Baikal Bronze Age began at about 3000 BC with the emergence of the Glazkovo burial tradition (Weber et al. 2016a provide a range of 4900 – 3700 cal BP when FRE correction is employed). The term "Bronze Age" is a source of frequent confusion for non-area specialists, however, as local groups continued to subsist by hunting-and-gathering, and no evidence for state-level polities, urbanism, agriculture, animal herding, or other common attributes of the Eurasian Bronze Age exists for the Cis-Baikal during this period (e.g., Haverkort et al. 2008:1278; Okladnikov 1955; Weber 1995). Early Bronze Age groups tended to inter their dead parallel to rivers, with heads oriented downstream in riverine locales or to the southwest in the Little Sea micro-region (Weber and Bettinger 2010:496). Cemeteries dating to this period were sometimes quite large, containing up to 100 individuals (Weber 1995:109-111). Burial treatment often varied considerably among individuals within Early Bronze Age cemeteries, and some graves contained large concentrations of exotic and labor-intensive objects (Okladnikov 1955). Early Bronze Age groups also arranged graves in rows, which some (e.g., Okladnikov 1955, 1978) have interpreted as an expression of novel emphasis on certain types of kin-based relationships (see Chapters Four and Six for discussion).

Several studies of Early Bronze Age mortuary variation in the Little Sea micro-region (McKenzie 2010; Shepard 2012) indicate that funerals may have served to reinforce distinctions between individuals (in contrast to suggestions about Late Neolithic funerary themes of homogeneity, see above). McKenzie (2010) described two Little Sea cemeteries – Kurma XI and Shamanskii Mys – as so-called "exclusionary" sites, featuring only prime-aged adults, and only a subset of those buried within the broader area. These sites also featured significantly higher proportions of micro-regional exotic grave wealth (see below) than did other cemeteries, reinforcing arguments that different cemetery locales may have broadcast different messages about distinctions among Bronze Age groups (Shepard 2012). In contrast, Little Sea "community cemeteries" (e.g., the well-studied site of Khuzhir-Nuge XIV) appear to have featured funeral rituals for a wider demographic segment (children and older adults as well as prime-aged adults; McKenzie 2010). At the same time, even within so-called community cemeteries, spatial distinctions existed for types and quantities of grave goods, as well as with respect to ages of interred individuals (McKenzie 2010; Metcalf 2006).

Unlike Late Neolithic groups, Early Bronze Age funeral participants in the Little Sea micro-region also interred children in all forms of burials (single as well as multiple interments), and in some cases accompanied these interments with considerable grave wealth (Shepard 2012). These patterns demonstrate several overall departures from mortuary practices during the preceding Late Neolithic, all consistent with a shift from widespread use of inclusive corporate political economic strategies and an emphasis on initiation and subsistence themes at funeral events, toward so-called network/exclusionary strategies, focusing on status distinctions between individuals, exotic and labor-intensive forms of wealth, competition for prestige among (aspiring) supra-local elites, and long-distance trade (Shepard 2012).

Novel types of artifacts that appeared in burial ritual during the Early Bronze Age may also be indicative of political economic shifts. In particular, the adoption of polished jade (nephrite) body ornaments at this time may represent one example of a prestige goods focus. The widespread use of these objects also suggests the development of long-distance contact with the Vitim River Basin, located approximately 1000 km to the northeast of the Little Sea micro-region, where white nephrite is naturally available (Sekerin and Sekerina 2000, see Chapter Five for discussion).

Similarly, sources of the metal artifacts found in Early Bronze Age graves in the Cis-Baikal have been debated since Ovchinikov first discovered copper tools during a construction project in the city of Irkutsk in 1897 (Goriunova and Novikov 2010:240-2; Okladnikov 1955:58). Early suggestions that Cis-Baikal hunter-gatherers obtained these objects through trade with surrounding groups in the Minusinsk Basin (e.g., Petri 1922; Podgorbunskii 1928), located to the west of the Cis-Baikal, have largely been replaced by arguments for local production (see Chapter Six for discussion). Broadly, models positing that Early Bronze Age Cis-Baikal metal artifacts were produced locally by hunter-gatherer groups employ limited evidence on the types of artifacts present in the archaeological record (e.g., lithic polishing and sharpening tools, possibly used for metal objects), as well as dissimilarities in terms of elemental concentrations in metal artifacts found in different regions (e.g., Sergeeva 1981a, 1981b; Khavrin 1997; see Chapter Six for discussion). At the same time, the initial development of metalworking in the Cis-Baikal likely attests to some form of interaction that Cis-Baikal hunter-gatherers had with groups of incipient pastoralists in surrounding regions. This pattern of the diffusion of metalworking is consistent with the model employed throughout the Eurasian steppe and its margins during the Early Bronze Age (e.g., Anthony 2007; Hanks and Doonan 2009; Kohl 2005; Koriakova and Epimakhov 2004). These connections are revisited in Chapter Six.

Evidence for increases in long-distance interaction within the Cis-Baikal during the Early Bronze Age comes from several lines of archaeological evidence. In particular, diachronic data on the degree of variation within and between regions in burial practices and osteological patterning support the argument that the Cis-Baikal's Early Bronze Age inhabitants engaged in more long-distance interaction. Normative burial practices during the Late Neolithic may have varied somewhat on a geographical basis; Bazaliiskii (2010a), for example, listed four variants of mortuary ritual during this period, corresponding to different areas of the Cis-Baikal. In contrast with the geographic variation of Late Neolithic burial practices, Okladnikov (1978:101, my translation) suggested based on the overall similarity of Early Bronze Age burial practices throughout the Cis-Baikal that the Glazkovo phenomenon represented a "cultural integration of a sort, now embracing the entire area of the Cis-Baikal."

The potential causes of the Late Neolithic-Early Bronze Age transition have received little attention by western scholars, and Russian literature has also focused on other topics. This lack of research is unproblematic if the change is viewed as purely epiphenomenal: a stylistic shift in the orientation of interments and little else. However, recent studies (such as the investigation of Little Sea mortuary practices discussed above) have suggested that not only stylistic changes, but fundamentally political ones occurred during this period as well. As increasingly large quantities of high-resolution dates become available for burials from the Cis-Baikal, it seems likely that the coarse-grained comparison of these two millennium-long periods (the Late Neolithic and the Early Bronze Age) will be replaced by more detailed approaches to culture change that are sensitive to differences both between and *within* established culture-historic units (see Scharlotta and Weber 2014; Weber et al. 2016b for examples of this approach at the Early Neolithic site of Shamanka

II). However, current data provide a clear justification for the use of the broad chronological scale of this research.

Owing in part to the lack of research on the topic, potential causes for the Late Neolithic – Early Bronze Age social change are somewhat varied. For example, in their recent survey of BHAP research on Cis-Baikal prehistory, Weber and Bettinger (2010) mentioned the existence of important differences in population sizes (inferred from cemetery populations) and suggested that these may have affected the lifeways of mid and late Holocene groups within the Cis-Baikal. In contrast, in his 20th century culture-historic synthesis of Cis-Baikal prehistory, Okladnikov (1950, 1955) presented the Early Bronze Age as a period of drastic cultural shifts, at least in part resulting from interaction between Cis-Baikal hunter-gatherers and external groups.

To the extent that the Late Neolithic-Early Bronze Age transition does indicate a shift from corporate- to network-oriented political economic strategies among Cis-Baikal hunter-gatherers, dual-processual theory also provides several hypotheses regarding the potential causes of this shift (e.g., Blanton et al. 1996). Blanton et al. (1996:7) suggest that network strategies proliferate in marginal environments that are not conducive to subsistence intensification, as well as along trade routes, especially those involved in prestige goods systems. Similarly, environmental (or technological) changes that lessen outputs of subsistence intensification in a given area may also incentivize a move away from a corporate focus toward network/exclusionary strategies (e.g., Blanton et al. 1996). Unfortunately, environmental change in the ancient Cis-Baikal remains poorly understood, particularly at chronological scales conducive to studying the Late Neolithic – Early Bronze Age transition. Findings from future environmental studies of the Cis-Baikal will thus have important implications for the development of models concerning sociopolitical changes in the region.

Several other obstacles to the in-depth study of these questions require more research in the future. First, the local focus of BHAP research over the last two decades has tended to present hunter-gatherer adaptations within the region as purely the results of local factors. This model of cultural change and its causes is representative of broader trends in the discipline, and discourages researchers from investigating large-scale contextual shifts necessary for dual-processual theory to be applicable (see Chapter Six for discussion). More broadly, BHAP research has focused on questions of subsistence and mobility, leaving topics of political organization largely uninvestigated. In particular, these studies have focused relatively little on the role of funeral rituals – the very sources of the human remains that have been studied so extensively by BHAP researchers – as anything other than sources of human remains. By treating the funeral as a politically charged activity, where individuals constructed narratives about individual and collective identities, continuity, and value, I suggest that it is possible to recast these events in a manner conducive to the study of hunter-gatherer political economy (e.g., Shepard 2012; see discussion in Chapters Four, Five, and Six).

CHAPTER THREE

OVERVIEW OF GEOCHEMICAL METHODS FOR THE STUDY OF HUMAN MOBILITY IN THE CIS-BAIKAL

Introduction

This chapter describes the approach I employ in this dissertation in order to study the individual migrations and seasonal mobility strategies that hunter-gatherer groups undertook in the mid and late Holocene Cis-Baikal. Along with long-distance relationships that local groups would have established through ritualized exchange and ceremonial gatherings – often involving short-term movements (see Chapters Five and Six) – the mobility strategies and migrations I study in the following two chapters provide an important window into interconnections among local hunter-gatherer groups during the Late Neolithic and Early Bronze Age. Below I outline principles of isotope geochemistry and human physiology that enable the use of isotopes of strontium (Sr) for identifying both short-term as well as seasonal and permanent migrations. I also provide a brief summary of previous uses of stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in human bone collagen within the Cis-Baikal, as these studies have been instrumental for investigating local variation in prehistoric mobility.

Principles of strontium isotope geochemistry for archaeological purposes

Studies of animal mobility in the ecological and biological sciences have employed data on relative isotopic concentrations of different elements in organic remains for several decades (e.g., Gosz et al. 1983; Koch et al. 1992; Radloff et al. 2010), and for almost as long, archaeologists have worked to refine these methods for use in human contexts (e.g., Ericson 1985; Ezzo et al. 1997; Price et al. 1994). Due to several similarities between strontium and calcium atoms, the strontium atom is well-suited to the task of reconstructing the movements of individuals. Both of these alkaline earth metal elements have a +2 valence and similarly sized ionic radii (strontium's 1.32 Å radius is only slightly larger than 1.18 Å for calcium), enabling small quantities of strontium atoms to substitute for calcium in the formation of various chemical compounds in natural settings where strontium is abundant. In studies of animal (and human) mobility, this substitution is particularly relevant in biominerals such as hydroxyapatite, which is produced within the human body and incorporated into bone and tooth enamel, incorporating strontium isotopes from the surrounding environment.

Although four isotopic configurations exist for strontium – ^{84}Sr, ^{86}Sr, ^{87}Sr, and ^{88}Sr (Ezzo 1994; Faure 1986) – only two are commonly measured for the study of human mobility: ^{86}Sr and ^{87}Sr (Budd et al. 2000; Ericson 1985; Price et al. 2002). These are denoted as such based on their different atomic masses of ~86 and ~87 atomic mass units. It is particularly important that these two isotopes of strontium have different origins, and that ^{87}Sr forms only through the radioactive decay of an isotope of Rubidium (^{87}Rb). Geochemical studies that employ these two isotopes of strontium to investigate mobility are built on the understanding that once a given mineral forms and stops exchanging atoms with its surrounding environment, all changes to the initial ratio of ^{87}Sr to ^{86}Sr within the mineral represent endogenous processes (the radioactive decay of ^{87}Rb atoms into ^{87}Sr atoms). Thus, within any mineral, strontium isotopic ratios vary predictably based on two factors (Table 3.1):

(1) First, the *initial amount* of ^{87}Rb in a given object (at the time of formation) affects its $^{87}Sr/^{86}Sr$ value, as ^{87}Rb serves as "fuel" to create ^{87}Sr over time through radioactive decay. While strontium atoms substitute for calcium, rubidium – an alkali metal – substitutes for alkali metals (such as potassium) in natural mineralization processes. Therefore, rocks such as basalt (high-calcium, low-potassium) feature low $^{87}Sr/^{86}Sr$ values relative to granites (low-calcium, high-potassium) and other similar rocks (Faure and Mensing 2005; Faure and Powell 1972).

(2) In addition, the amount of time that has passed since a mineral's initial formation also has considerable impact on the strontium isotopic ratio ($^{87}Sr/^{86}Sr$ value), since this time determines the proportion of the original ^{87}Rb that will decay into ^{87}Sr.[3]

TABLE 3.1. THEORETICAL MODEL OF STRONTIUM ISOTOPIC RATIOS IN ROCKS OF DIFFERENT AGES AND COMPOSITION

		Time passed since initial formation of a mineral	
		Young	Old
Ratio of Rb/Sr at Time of mineral's formation	Low	Low $^{87}Sr/^{86}Sr$ Ratio	Intermediate $^{87}Sr/^{86}Sr$ Ratio
	High	Intermediate $^{87}Sr/^{86}Sr$ Ratio	High $^{87}Sr/^{86}Sr$ Ratio

As minerals weather through natural processes such as erosion, they contribute strontium atoms into the surrounding ecosystem in proportion to their internal compositions. Thus,

[3] It should also be noted that while $^{87}Sr/^{86}Sr$ ratios in a mineral do change over geological timespans with the decay of ^{87}Rb into ^{87}Sr, the half-life of ^{87}Rb (4.7×10^{10} years [Gregoricka 2013]) is long enough that $^{87}Sr/^{86}Sr$ ratios can be treated as essentially *stable* over archaeological timescales (e.g., Bentley 2006:141). Thus, archaeologists should view $^{87}Sr/^{86}Sr$ values *detected* in artifacts and organic materials such as bone and dental enamel as essentially identical to their values during the prehistoric periods of interest to archaeologists (e.g., Gregoricka 2013; Thornton 2011).

ecosystems in areas featuring primarily old rocks with high initial ratios of Rb/Sr will feature relatively high quantities of ^{87}Sr relative to ^{86}Sr (e.g., Bentley 2006; Hoddell et al. 2004; Price et al. 2002). Organisms that consume nutrients from their surrounding environments (plant and animal tissues, groundwater and minerals) incorporate this eroded material into their bodies. Finally, because of the relatively small difference in the mass of ^{87}Sr and ^{86}Sr, the two isotopes react at essentially similar rates in biological processes, each substituting for calcium relative to their abundance in dietary sources (e.g., Elias et al. 1982; Faure and Powell 1972). Thus, within a given geological context, although the *concentration* of Sr substituting for Ca in tissues decreases at higher trophic levels (known as *biopurification*; Bentley 2006; Elias et al. 1982), $^{87}Sr/^{86}Sr$ *ratios* remain constant between food sources and organic tissues in their consumers (Blum et al. 2000; Graustein 1989; Likins et al. 1960; Price et al. 2002).

The ages of bedrock minerals that contribute strontium to the environment often vary at relatively large regional or micro-regional scales (e.g., Ericson 1985; Knudson and Tung 2011; Price et al. 2002). $^{87}Sr/^{86}Sr$ values range from higher than 0.710 in bedrock formations that are very old (more than 100 mya) and that feature high initial Rb/Sr ratios, to less than 0.704 in relatively recent (0.10 mya) rocks with low initial Rb/Sr ratios (Bentley 2006; Gregoricka 2013). In some very old samples, such as Archean rocks documented by Moorbath et al. (1975) that dated to ~ 3.7 billion years ago, geological researchers have documented $^{87}Sr/^{86}Sr$ ratios as high as 1.65, while other rocks of similar age but featuring low initial Rb/Sr ratios exhibited considerably lower $^{87}Sr/^{86}Sr$ ratios (Bentley 2006; Price et al. 2002; Weber et al. 2003). Moorbath et al. (1975), for example, demonstrated that among very old rocks (>3 billion year old), $^{87}Sr/^{86}Sr$ ratios varied considerably depending on initial Rb concentration from ~0.76 – ~1.65.

Strontium geochemical applications to human mobility over the lifespan

While broad terms like "nomadic" or "mobile" may have some utility in characterizing the overall extent to which people in a given social context move around their landscape, the non-specific nature of these terms often raise more questions than they answer (e.g., Binford 2001; Kelly 2013; Barnard and Wendrich 2008). Here, I attempt to focus on individual movement at relatively specific time-scales. Because human bone continuously remodels during an individual's lifetime, incorporating strontium from dietary sources, strontium isotopic ratios observed in bulk bone samples can serve as a representation of diet that an individual consumed over long periods of time (ranging from several years to several decades in dense cortical bone, which remodels extremely slowly; e.g., Bentley 2006; Hill 1998). These long-term dietary *averages* for strontium isotopic ratios in bone can present problems for some types of demographic comparisons, as any two bone samples likely represent different periods of an individual's lifetime, potentially of different lengths (Hill 1998).

Tooth enamel provides a means of assessing an individual's whereabouts over relatively short and relatively specific periods during the lifespan. Periods of tooth enamel formation are well-understood, and many archaeological studies have used strontium isotopic ratios from this material as a proxy for the geological catchment area that an individual occupied during a relatively limited number of years (usually as few as three to five, depending on the specific element). After the initial formation of tooth enamel, hydroxyapatite – which makes up 98% of this material by weight (Lowenstam and Weiner 1989) – is chemically inactive and preserves its initial isotopic ratio (Lowenstam and Weiner 1989). Hydroxyapatite in tooth enamel is also well-protected against the effects of diagenesis, unlike bone (e.g., Budd et al. 2000; Copeland et al. 2010; Haverkort et al. 2008; Lee-Thorp and Spondheimer 2003). For example, recent studies of fossil rodent teeth from Sterkfontein and Swartkrans (South Africa) have demonstrated that while fossil rodent dentine featured up to ~50% diagenetic strontium, fossil *enamel* from these teeth appeared essentially unchanged from its values at the time of original enamel formation (Copeland et al. 2010; see also Budd et al. 2000; Lee-Thorp and Spondheimer 2003).

Several recent studies (e.g., Haverkort et al. 2008; Nystrom et al. 2011; Weber and Goriunova 2013) demonstrate that enamel from molars provides a particularly useful dataset to assess mobility patterns during discrete periods of the lifecourse, as each of these teeth (denoted "M1," "M2," and "M3") mineralizes during essentially *non-overlapping* age intervals (Table 3.2). Together, molars also represent a wider age range than any other combination of teeth. Building on these observations, Weber and Goriunova (2013) have recently extended this logic to suggest that each molar represents a distinct phase of an individual's life history, providing insights into unique demographic groups.

M1, they suggest, reflects the diet of young (~0 to 3–4 year-old) children. Within the mid and late Holocene Cis-Baikal (the "post-hiatus" period, see above), they suggest that this age range corresponds to the period during which individuals would have consumed almost exclusively breastmilk (Waters-Rist et al. 2011). Thus, M1 $^{87}Sr/^{86}Sr$ values provide a proxy primarily for catchment areas that nursing mothers would have employed. Weber and Goriunova (2013) suggest that M2 serves as a proxy for actual foraging activities and overall catchment areas from which young children (2–3 to 7–8 years old) would have consumed resources. M3 shows the diet of individuals on the cusp of adulthood, developing from ages 7–10 to 12–16. At this age, individuals likely would have engaged in seasonal mobility practices not dissimilar from those of adults, and may also have moved into new residential groups following marriage (e.g., Kelly 2013). This interpretive framework enables the archaeological study of human mobility patterns throughout the lifecourse (rather than focusing exclusively on individuals' birthplaces, for example, as many studies have tended to do).

TABLE 3.2. HUMAN AGE RANGES REPRESENTED BY MOLAR ENAMEL

Element	Age of formation begins	Age of formation ends
M1 enamel	0	3–4
M2 enamel	2–3	7–8
M3 enamel	7–10	12–16

After Haverkort et al. 2008, Hillson 1996; White et al. 2011

Strontium isotope geochemistry and the study of hunter-gatherer lifeways

Many strontium studies in archaeology focus on identifying large-scale, one-time migrations that people in the past undertook by comparing individual samples' "place of origin" (enamel values, ideally from M1 or another element that mineralizes early in life) to "local" geological values (See Pollard 2011 for a critique of this approach). In these studies, individuals exhibiting $^{87}Sr/^{86}Sr$ values outside of the local range are assumed to have *immigrated* to the area under study at some point after the formation of the element exhibiting a non-local signature. These studies often implicitly employ an agro-centric, or "sedentary" bias, assuming that once individuals became members of a given community or village, they consumed resources from a uniform set of "local" geological values, and that all other "locals" also consumed resources from the immediate area (e.g., Nystrom et al. 2011; Price et al. 2000; Wright et al. 2010).

While this assumption of sedentism and a uniform, highly localized pattern of resource use *may* often have some validity among agriculturalists and pastoral groups (but certainly not in all cases, see Schachner 2012), intra-group variation in mobility patterns and resource procurement areas has been well-documented among hunter-gatherer groups (e.g., Binford 2001, 2006; Burch 2005; Kelly 2013; Lee and DeVore [Eds.] 1968). Year-to-year variation in resource procurement areas may also characterize mobility strategies that some hunter-gatherers employ, again complicating the interpretation of $^{87}Sr/^{86}Sr$ ratios as representations of a single, "local" "village" procurement area.

Further, while many studies use geochemical data from tooth enamel as a proxy for an individual's birthplace, this interpretation of enamel $^{87}Sr/^{86}Sr$ ratios makes several implicit assumptions. Multiple factors, including but not limited to the geological catchment areas where individuals procured food all contribute to enamel $^{87}Sr/^{86}Sr$ values. These factors include the *length of time* an individual resided in a given geologic zone during the formation of a given element, as well as the potential *mixing* of multiple geologic signatures that can arise from residential moves. Further, enamel in most teeth begins developing only *after* an individual is born, and only over the course of several years. Thus, far from representing a single place where an individual was *born*, the geochemical signature in a bulk sample of tooth enamel likely represents a relatively long period of time, and – among relatively mobile hunter-gatherer groups – may represent many separate foraging events or forays in different areas.

Novel methods such as enamel micro-sampling create new possibilities to document intra-individual variation in geochemical signals (and movements) with extremely high resolution, but also present comparative problems relating to specific lengths of time represented (e.g., Burt and Garvie-Lok 2013; Eerkins et al. 2011; Scharlotta and Weber 2014; Scharlotta et al. 2013). Here, however, I employ traditional bulk sampling methods rather than micro-sampling, and instead approach foraging ranges and the potential *mixing* of distinct geochemical signals through the use of inter-group variance (e.g., Bentley 2006; 2013).

Over the lifecourse, changes in variance for $^{87}Sr/^{86}Sr$ values between multiple samples in a group may suggest different degrees of mixing and movement. Several archaeologists have suggested that instead of exclusively using $^{87}Sr/^{86}Sr$ ratios in an attempt to locate an area of origin for an *individual*, the study of $^{87}Sr/^{86}Sr$ variation *at the population level* can also provide insights into broader questions of mobility and social structure (e.g., Bentley 2006, 2013; Pollard 2011). In particular, Bentley (2013) has advocated for comparing *variances* of groups that can be identified based on other (archaeological or osteological) characteristics. For example, in an analysis of agro-pastoralists at Early Neolithic Linearbandkeramik sites in Central Europe (~7500 — ~7000 cal BP), a higher variance among females when compared to males enabled Bentley (2013) to suggest patrilocal marriage patterns, with some women immigrating to lowland sites from economically marginalized highland communities.

Similarly, in an analysis of Early Bronze Age hunter-gatherers in the Cis-Baikal region, Haverkort et al. (2008) interpreted a decrease in $^{87}Sr/^{86}Sr$ variance for M1–M3 as evidence of increasing mobility from early childhood to early adulthood. Molar $^{87}Sr/^{86}Sr$ ratios exhibited greater homogeneity as individuals aged, with M1 representing development *in utero* and infancy, M2 representing childhood, and M3 representing adolescence. This homogenization of $^{87}Sr/^{86}Sr$ signatures over the early stages of the life-cycle suggested that by adolescence, individuals participated in mobility practices that *mixed* isotopic signatures from geochemically distinct patches throughout the landscape. This mobility regime was broadly shared among Early Bronze Age hunter-gatherers.

The study discussed above (Haverkort et al. 2008) also implicitly demonstrated that among mobile populations, differences in group-level variance for enamel $^{87}Sr/^{86}Sr$ values do not necessarily indicate different home bases for these groups. Rather, isotopic differences of this sort may in some cases indicate different *degrees of mobility*, involving more foraging trips or larger foraging radii relative to a seasonal camp or home base. Another possibility when group variances differ is that groups may have used similar areas but that their diets focused on different types of resources, which themselves drew upon different geological catchment areas (but were available in the same place, perhaps seasonally). Below I discuss previous research in the Cis-Baikal that has characterized different potential dietary sources' $^{87}Sr/^{86}Sr$ values in order to assess group-level mobility patterns as well as individual migrations.

Strontium geochemistry in the Cis-Baikal

The Cis-Baikal region is particularly amenable to studies of strontium isotopic variation due to its highly variable bedrock geology. The region can be divided into several major geological deposits (Figure 3.1). Archean and Proterozoic granites dominate in the Little Sea micro-region and along the northwest coast of the lake, with $^{87}Sr/^{86}Sr$ values ranging from ~0.720–0.735 (Galazii [Ed.] 1993). Further inland, in the Upper Lena River valley and continuing to the west along most of the Angara River Valley, Lower Paleozoic (Cambrian and Precambrian) limestones exhibit $^{87}Sr/^{86}Sr$ values of ~0.709 (Huh et al., 1994). On the west bank of the Angara River (and also at its headwaters on the southwest coast of Lake Baikal), these formations give way to Mesozoic and some Quaternary deposits. Archean and Proterozoic formations with similar expected values to those found along the west coast of the lake and in the Little Sea micro-region occur along the southern and western edge of the lake and extend into the East Sayan Mountains. Finally, to the east of Lake Baikal, Lower Paleozoic rocks predominate, although some Quaternary formations also occur (e.g., Haverkort et al. 2008, 2010; Weber and Goriunova 2013).

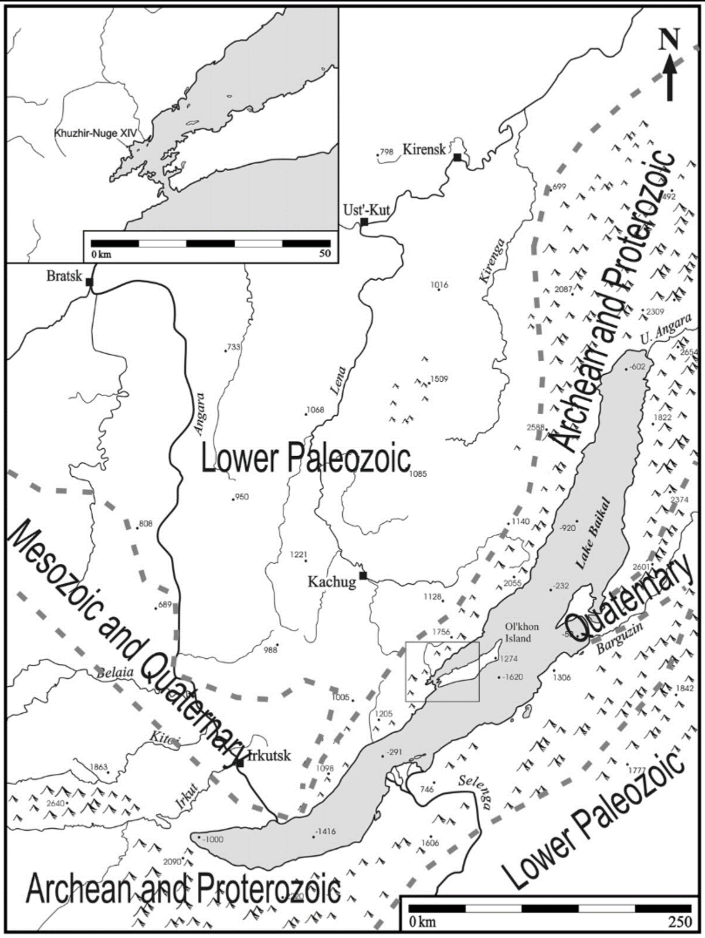

Figure 3.1. Map of geological zones in the Cis-Baikal.

In recent decades, several specifically archaeological studies have been undertaken in the Cis-Baikal that have characterized geochemical variability with respect to $^{87}Sr/^{86}Sr$ values. Results from these studies provide a comparative dataset for human samples, including those collected for this dissertation (Tables 3.3, 3.4, 3.5, 3.6, 3.7, Appendices 1-4). Initial attempts to characterize local $^{87}Sr/^{86}Sr$ variability (Weber et al. 2003, Haverkort et al. 2008, 2010) employed animal bone. In part, this collection strategy was based on suggestions by Price et al. (2002) that osteological remains of animals with spatially-limited foraging ranges should provide the most effective way to estimate local biologically-available strontium values (as opposed to background *geological* values that may not be accessible in the food chain, as represented by geochemical samples). Subsequent studies (Scharlotta and Weber 2014) employed leaf and water samples from areas throughout the Cis-Baikal in order to provide a high-resolution map of regional isotopic variation. Each of these types of data provides insights into geochemical variation at a different scale, which I discuss below. In this dissertation I am concerned primarily with variation between micro-regions, although I discuss finer-scale differences where they are relevant.

Faunal indicators of local strontium isotopic variability in the Cis-Baikal

Data on strontium isotopic ratios from faunal samples previously collected throughout the Cis-Baikal provide a general approximation of large-scale $^{87}Sr/^{86}Sr$ variation in the region. When compared to more spatially-constrained values that leaves and soil samples provide $^{87}Sr/^{86}Sr$ values from fauna represent a broad average of biologically available strontium in the Cis-Baikal region. Unlike plants, which draw exclusively on geochemical signals in groundwater and soil immediately surrounding the area where they grew, animals – particularly those that move relatively long distances during their lifetimes – draw upon food resources from a wider area. This averaging effect is particularly relevant for animals at higher trophic levels (e.g., Burton et al. 1999). These animals may consume foods from a variety of geological catchment areas, and each of these food sources may also represent an average of strontium inputs that draw upon different geological formations.

High trophic-level animals and other migratory species may also move between different catchment areas, incorporating local resources from each of these areas into their diets (e.g., Copeland et al. 2010). This *averaging effect* of fauna (particularly at higher trophic levels and among groups that migrate relatively long distances, crossing between geochemical zones) has important implications for interpreting isotopic data at the group level. In particular, the overall $^{87}Sr/^{86}Sr$ variance for species that occupy high trophic levels or that engage in frequent migrations should be lower than the variance for a species that covers less ground during life, or for flora – which draw exclusively on highly localized chemistry for their nutrient intake (e.g., Bentley 2006).

Terrestrial fauna

In terms of terrestrial faunal results, the mainland of the Little Sea micro-region, which is characterized by Archean and Proterozoic granite formations, featured the highest overall $^{87}Sr/^{86}Sr$ values of all areas under study here (ranging from 0.712423–0.746144; mean=0.72789, s.d.=0.01452, n=9; Table 3.3, Appendix 1). Within the Little Sea micro-region, samples collected from Ol'khon island exhibited slightly lower values than those on the mainland side (mean=0.71681, s.d.=0.00442, n=15), and all $^{87}Sr/^{86}Sr$ values above 0.725 (n=4) were found on the mainland. However, these two areas within the Little Sea micro-region did not exhibit a statistically significant difference in values (Mann-Whitney U = 88, 2-tailed p-value=0.234). Most micro-regions showed consistently lower $^{87}Sr/^{86}Sr$ values than the Little Sea. For example, values for terrestrial fauna from the Upper Lena River valley (n=10) ranged from 0.70882–0.71097 (mean=0.70991, s.d.=0.00086), and those from the Angara River were roughly similar (n=10, mean=0.70934, s.d.=0.00033). Every sample from both the upper Lena River and the Angara River (except for the three samples from the Western Angara) exhibited values below all of those seen in the Little Sea, and only seven terrestrial faunal samples collected from all areas outside of the

Little Sea exceeded that micro-region's lowest value of 0.71117 (this value was from a ground squirrel collected on Ol'khon Island). These values included a mouse and two red deer with $^{87}Sr/^{86}Sr$ values ranging from 0.71128 to 0.71680, that were collected on the west side of the Angara River at the Gorelyi Les habitation site.

The Western portion of the middle Angara exhibited relatively high $^{87}Sr/^{86}Sr$ values when compared to other areas of the Angara River (mean = 0.71228, s.d. = 0.00257, n = 5; Table 3.3, Figure 3.2). Even so, however, faunal samples from the middle Angara River all fell within the range of 0.70889 – 0.71183, with the exception of the single sample exhibiting an elevated $^{87}Sr/^{86}Sr$ value of 0.71680. The middle Angara River's east/west divide in terms of $^{87}Sr/^{86}Sr$ values has been observed and discussed elsewhere (Haverkort et al. 2008, 2010). When samples from the western side of the middle Angara were excluded, the range for the 15 remaining $^{87}Sr/^{86}Sr$ values diminished considerably (minimum value = 0.70889 – 0.71073, n = 15). Using the +/– 2 s.d. approach advocated by Price et al. (2002), the Angara River's north/east geological catchment area exhibited a range of 0.70852 – 0.71041 (mean=0.70947, s.d.=0.00047).

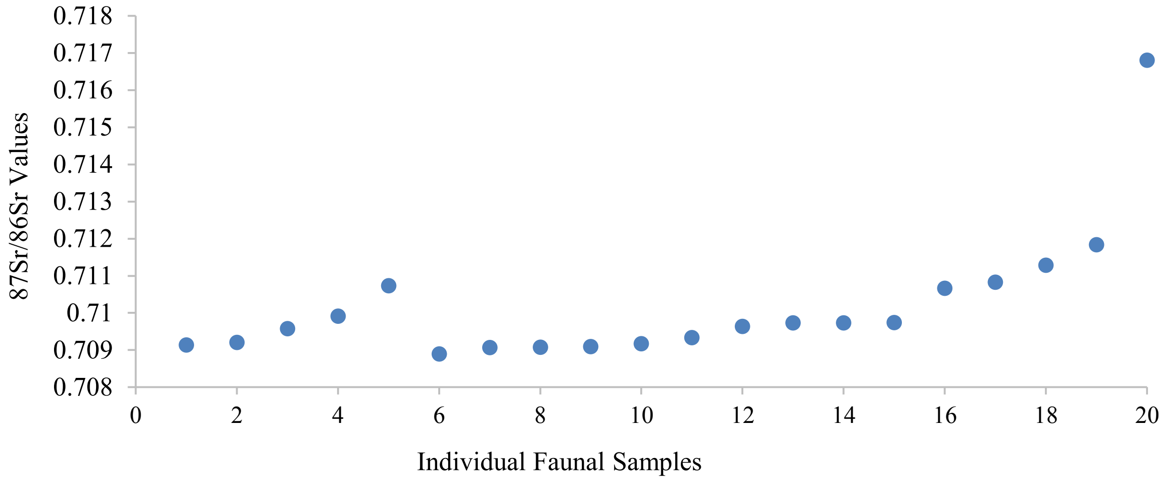

Figure 3.2. Terrestrial faunal $^{87}Sr/^{86}Sr$ values from the Angara River
1–5. Middle Angara Valley (Bratsk)
6–15. Middle Angara Valley, East
16–20. Middle Angara Valley, West

Four other samples from the entire Cis-Baikal exhibited values above the minimum seen in the Little Sea micro-region (0.71117), all of which were collected at Sagan-Zaba. This site is located on the west coast of Lake Baikal, to the south of the Little Sea micro-region, also in the Archean and Proterozoic zone. Samples from this area exhibited considerable variability, with values ranging from 0.70694 to 0.73934 (n =25, mean=0.71171, s.d. = 0.00684). Included in these values were region's four lowest $^{87}Sr/^{86}Sr$ ratios (below 0.70830) along with a single high outlier of 0.73934, well above the next highest value of 0.71558 (Appendix 1). It is possible that this individual – a red deer – could have consumed resources in the Little Sea micro-region before eventually migrating south to Sagan-Zaba, however, this explanation seems unlikely for several reasons. First, the west coast of Lake Baikal features bedrock formations of similar geological age to those found in the Little Sea micro-region (Figure 3.1), which are likely to produce similar $^{87}Sr/^{86}Sr$ values. Second, data on the strontium isotopic ratios found in water samples collected at the Anga River, located near Sagan-Zaba, indicate similarly high values for local water sources (see below).

The anomalous value for this sample may have resulted from many factors that could not be explored here. It is possible, for example, that this individual was young enough at the time of death that the isotopic signature preserved in its bone featured no mixing and only an unadulterated signature for a relatively small area. When this individual was excluded from the Sagan-Zaba sample, the +/– 2 s.d. approach produced a local range of 0.70593–0.71475 for terrestrial fauna.

TABLE 3.3. COMPARISON OF MICRO-REGIONAL FAUNAL DATA (TERRESTRIAL)

	Average	Minimum	Maximum	s.d.	n
Baikal, Little Sea, Mainland	0.72789	0.71242	0.74614	0.014524	9
Baikal, Little Sea, Ol'khon	0.71681	0.71117	0.72258	0.004421	15
Baikal, Southwest coast	0.70976	0.70958	0.70994	0.000255	2
Baikal, West Coast*	0.71034	0.70694	0.71558	0.00220	19
Middle Angara valley	0.70971	0.70913	0.71073	0.000651	5
Middle Angara valley, East	0.70934	0.70889	0.70974	0.000332	10
Middle Angara valley, West	0.71228	0.71066	0.71680	0.002569	5
Tunka Valley	0.70979	0.70849	0.71112	0.000858	14
Upper Lena valley	0.70991	0.70882	0.71097	0.000729	10
Upper Angara Valley	0.71035	–	–	–	1

*One outlier was removed from this sample (see above).

Aquatic fauna

$^{87}Sr/^{86}Sr$ values for aquatic fauna were similarly distinct when micro-regions were compared (Appendix 2). The sample size for the Little Sea micro-region consisted of only three individuals, all northern pike (*Esox lucius*). All three of these samples exhibited higher $^{87}Sr/^{86}Sr$

values than any other aquatic faunal samples from any micro-region of the Cis-Baikal with the exception of those from the west side of the Angara River, once again demonstrating the uniquely high $^{87}Sr/^{86}Sr$ signature of these areas within the overall region. This “Little Sea signature” provides an important contrast with the “Baikal signature” of aquatic fauna from the rest of the lake, creating the possibility to distinguish diets of individuals consuming resources that resided primarily or exclusively in one of these two basins.

It is also noteworthy that aquatic samples exhibited lower values on average than terrestrial samples. For example, in the upper Lena, aquatic samples (n=9) exhibited a range of 0.70887–0.70895 (mean = 0.70888, s.d. = 0.00006), significantly lower than the terrestrial faunal range for that micro-region that was discussed above (Mann-Whitney U = 6.5, 2-tailed p-value = 0.0019). Fauna from Lake Baikal itself exhibited values consistent with water values for the lake as reported elsewhere (n = 9, mean = 0.70853, s.d. = 0.00015; Kenison-Falkner [1992] reported a value of 0.7085 for the lake). Again, these values were well below those seen in terrestrial faunal samples in areas along the shore of the lake (the Little Sea and West Baikal). This low $^{87}Sr/^{86}Sr$ value for aquatic fauna (including Baikal seals) has important implications for interpreting human enamel values. In particular, it would appear that terrestrial fauna alone do not provide a good model for expected values from Neolithic and Bronze Age human $^{87}Sr/^{86}Sr$ samples, as human diet during these periods also incorporated aquatic resources (e.g., Katzenberg and Weber 1999; Losey et al. 2008; Weber et al. 2002).

TABLE 3.4. COMPARISON OF MICRO-REGIONAL FAUNAL DATA (AQUATIC)

	Average	Minimum	Maximum	s.d.	n
Baikal	0.70853	0.70818	0.70874	0.00015	9
Little Sea	0.71652	0.70985	0.72829	0.01023	3
Upper Angara	0.70886	0.70878	0.70900	0.00012	3
Middle Angara	0.70912	0.70880	0.70968	0.00049	3
Middle Angara – East	0.70836	0.70811	0.70879	0.00027	6
Middle Angara – West	0.70985	0.70907	0.71137	0.00082	6
Upper Lena	0.70888	0.70881	0.70895	0.00006	9

Floral samples

Leaf data collected by Scharlotta and Weber (originally published in Scharlotta 2012) broadly confirmed previous findings from faunal samples, while also adding considerable spatial resolution to current models of the regional distribution of $^{87}Sr/^{86}Sr$ values. Upper Lena valley values from floral samples featured a low range despite the large quantity of samples and broad geographic area from which they were collected (Tables 3.5 and 3.6, Appendix 3). These values ranged from 0.70875 – 0.71267, exhibiting a mean of 0.71020 (n=48, s.d.=0.00090). As indicated by the micro-region's homogeneous bedrock geology (Table 3.1), the upper Lena appears to feature relatively homogeneous (and consistently low) $^{87}Sr/^{86}Sr$ values.

In contrast, the Little Sea micro-region showed considerable variation, as well as higher values on average, with a mean of 0.71933 (n = 20, s.d. = 0.01143). Notably, when leaf samples from this micro-region were separated based on their location (on the mainland vs. on the Ol'khon Island), values differed somewhat, with mainland samples exhibiting a higher mean (n=14, mean=0.72199, s.d.=0.01282) than island samples (n=6, mean=0.71312, s.d.=0.00158). This difference was not evaluated for statistical significance because of small sample size for Ol'khon

Island floral samples. However, it is notable that these values did appear to parallel faunal data for the micro-region (above).

The lowest $^{87}Sr/^{86}Sr$ value in the Little Sea micro-region was 0.71057, while high values exceeded 0.75000; a sample from the Sarma River exhibited a value of 0.75020, and another from the same collection site showed a similarly high value of 0.74850. Overall, then, $^{87}Sr/^{86}Sr$ values for leaf samples from the Little Sea micro-region were higher than those from the Upper Lena valley. In fact, only a single leaf value from the Little Sea micro-region fell below 0.71200 (at Shamanskii Mys, located on the Ol'khon Island). It is also noteworthy that the values surrounding the Sarma River – including two values taken directly from the river itself, as well as the two values from nearby Khuzhir-Nuge XIV – were the highest in the micro-region (n=4, mean=0.73875, s.d.=0.01237).

Outside of the Little Sea micro-region, a single set of high leaf values were also found at Listvianka, located at the mouth of the Angara River, along the shore of Lake Baikal (considered here as part of the "Upper Angara"). Although leaf values from Listvianka (0.73284 and 0.75225) are among the highest recorded for the entire region, it is noteworthy that other nearby samples collected on the upper Angara exhibited considerably lower $^{87}Sr/^{86}Sr$ values (n=16, mean=0.71118, s.d.=0.00153, max=0.71430). The fact that this uniquely high set of values is situated directly on the coast of Lake Baikal may explain the divergence among micro-regional values (with the upper Angara), since the coast features Archean and Proterozoic bedrock formations, as opposed to the Mesozoic and Quaternary formations located inland and further downstream in the Angara River micro-region (Figure 3.1).

TABLE 3.5. AVERAGE PLANT DATA VALUES BY MICRO-REGION*

	Average	Minimum	Maximum	s.d.	n
Baikal – West Coast	0.71303	0.70783	0.71713	0.00324	13
Little Sea	0.71933	0.71057	0.75020	0.01143	20
Middle Angara – East Coast	0.70978	0.70974	0.70982	0.00005	2
South Baikal	0.71015	0.70673	0.71812	0.00209	79
Upper Lena	0.71020	0.70875	0.71267	0.00090	48
Upper Angara	0.71467	0.70951	0.75225	0.01077	18

*Based on values reported in Scharlotta 2012.

TABLE 3.6. AVERAGE PLANT VALUES WITHIN THE LITTLE SEA MICRO-REGION BY SUB-AREA

	n	Mean	s.d.	Minimum	Maximum
Ol'khon Island	6	0.71312	0.00158	0.71057	0.71545
Mainland	14	0.72199	0.01282	0.71203	0.75020

Water values

Drinking water constitutes another source of biologically available strontium, often carrying sediment with $^{87}Sr/^{86}Sr$ values that are distinct from local food resources. Kenison Falkner et al. (1992) reported overall $^{87}Sr/^{86}Sr$ values of 0.7085 for water in Lake Baikal itself, representing a mixture of geologically weathered material surrounding the lake and its tributaries, as well as rainwater. For the Upper Lena River, several studies have documented $^{87}Sr/^{86}Sr$ values of 0.70893 (Huh and Edmond 1997; Huh et al. 1998). More recently, Scharlotta and Weber collected water samples from rivers and streams throughout the region in order to provide higher resolution for reconstructions of geochemical variation in the Cis-Baikal (see Scharlotta 2012). While these samples are not completely representative of the entire region (no coverage of the mid and lower Angara valley), they do broadly echo patterns seen in plant and faunal data, in particular regarding high values in the Little Sea micro-region relative to other areas (Table 3.7, Appendix 4).

Water samples collected from the Little Sea micro-region and from the west coast of Lake Baikal near the Anga River (~7 km northeast of Sagan-Zaba, discussed above) exhibited considerably higher values than those found in other micro-regions, reaffirming the relatively high values of Archean and Proterozoic formations along the coast of Lake Baikal. Overall, these results are consistent with values of 0.70983, as reported by Huh and Edmond (1997). Of 16 water samples collected in the upper Lena micro-region, only one exhibited a value above 0.70900 (Ilikta River, $^{87}Sr/^{86}Sr$ = 0.70917). The elevated measurement for the Ilikta River is notable because this sample was the only one collected from the easternmost headwaters of the upper Lena, very close to the geological formations situated along the coast of the lake.

Within the Little Sea micro-region, water values were generally higher; only two of the six samples exhibited values below 0.71000, both of which were collected directly from Lake Baikal (0.70902 and 0.70922). These two values were also higher than those reported by Kenison Falkner (1992; 0.7085), and likely represent a mixture of the Lake's (low) $^{87}Sr/^{86}Sr$ signal and relatively high values of water in the Sarma River and surrounding Archean and Proterozoic bedrock. Notably, the water sample collected on the upper Angara at Listvianka (located on the shore of Lake Baikal, ~1 km east of the Angara River's confluence with the lake) exhibited a low value (0.70895), presumably reflecting the $^{87}Sr/^{86}Sr$ values of the lake itself, with relatively low contribution from the immediately surrounding geological formations.

TABLE 3.7. AVERAGE WATER VALUES BY MICRO-REGION*

	Average	Minimum	Maximum	s.d.	n
Baikal – West Coast	0.73280	0.70877	0.77350	0.02736	5
Little Sea	0.72333	0.70902	0.73835	0.01318	6
Middle Angara – East	0.70791	–	–	–	1
South Baikal	0.70969	0.70711	0.71373	0.00146	26
Upper Lena	0.70856	0.70814	0.70917	0.00029	16
Upper Angara	0.70981	0.70895	0.71169	0.00098	6

*Based on values reported in Scharlotta 2012.

Summary of all environmental findings

Overall, geochemical data from faunal, floral, and water samples collected throughout the Cis-Baikal provide the potential to distinguish several distinct micro-regional signatures that can serve as a basis for studying ancient human mobility throughout individuals' lives. Here I employ terrestrial faunal data to provide first-order approximations for expected local $^{87}Sr/^{86}Sr$ signatures of the Cis-Baikal's micro-regions, using additional data from aquatic fauna as well as leaf and water samples to revise these values where this is possible.

Terrestrial samples from the upper Lena River valley consistently exhibited low $^{87}Sr/^{86}Sr$ values (~0.71000). Using the +/– 2 s.d. approach for terrestrial faunal values, as advocated by Price et al. (2002), produces a local $^{87}Sr/^{86}Sr$ range of 0.70845 – 0.71137 (mean=0.70991, s.d.=0.00073). The +/– 2 s.d. ranges of values for both aquatic fauna and water samples (0.70876 – 0.70900 and 0.70798 – 0.70914, respectively) were unsurprisingly similar to one another, and considerably lower than the maximum values from the terrestrial local range. Although upper Lena groups appear to have consumed a greater component of diet in the form of terrestrial game than hunter-gatherers in other areas of the Cis-Baikal (e.g., Weber et al. 2011), it is still the case that aquatic foods are expected to have played a relatively important role in diet among inhabitants of this micro-region. Thus, human samples from the upper Lena should exhibit values in the lower half of the local terrestrial range (consistent with a major aquatic component in diet).

When all faunal values collected along the Angara River were combined (n=20) into a single unit and the +/– 2 s.d. approach was applied to them, this micro-region exhibited a range of 0.70664 – 0.71370 (mean=0.71017, s.d. = 0.00176). However, the range of these values is clearly inflated by a single sample from Gorelyi Les (0.71680), as it was the only sample from the micro-region with an $^{87}Sr/^{86}Sr$ signal greater than 0.71183 (Figure 3.2). When this single outlier was removed from the sample, a mean value of 0.70982 (n=19, s.d. = 0.00085) was produced. $^{87}Sr/^{86}Sr$ values along the Angara River varied at the micro-regional scale. Leaf data suggest that the coast was characterized by extremely high values (Listvianka; >0.730), but terrestrial fauna and other samples from farther inland were broadly similar to those seen in the upper Lena River valley (~0.71000). One exception to this was the western shore of the Angara, where geochemical signatures seem to be influenced by Archean and Proterozoic formations in the East Sayan Mountains, and exhibited values above 0.71000.

Two areas exhibited much higher $^{87}Sr/^{86}Sr$ values, and both were situated directly on the Archean and Proterozoic formations along the west coast of Lake Baikal. One of these was the Anga River, where $^{87}Sr/^{86}Sr$ values exhibited a mean of ~0.710 (one high-valued outlier was removed from this sample for all descriptive statistics, see above). Using the +/– 2 s.d. method, terrestrial faunal values for this area produced a wide local range of 0.70694 – 0.71558 (mean=0.71034, s.d.=0.00220, n=19). Samples from this coastal area exhibited a large variation (0.70694 – 0.73934, n=19).

The Little Sea also exhibited consistently high $^{87}Sr/^{86}Sr$ values. When all terrestrial faunal samples from this micro-region were treated as a single group, they produced a large range

(0.70016 – 0.73937, using the +/– 2 s.d. method). However, the minimum values on the mainland and on the Ol'khon island side were 0.71242 (n=9) and 0.71117 (n=15), respectively. This difference in minima for $^{87}Sr/^{86}Sr$ values in terrestrial samples on the mainland and Ol'khon Island sides of the Little Sea micro-region has the potential to enable distinctions between individuals who subsisted primarily on either side of the micro-region.

Some tentative distinction within the Little Sea micro-region was also possible; the Sarma River and its immediate surroundings exhibited very high values (~0.74000), and the geological source for these values likely contributed its higher $^{87}Sr/^{86}Sr$ signal to other mainland faunal and leaf samples, which seem to have exhibited higher values than those from Ol'khon Island. Finally, aquatic fauna from the Lake exhibited low values (~0.70800 – 0.70900), so that human individuals who consumed high proportions of seal and other foods with an aquatic signal should exhibit lower $^{87}Sr/^{86}Sr$ signals than the terrestrial values from their respective micro-regions.

Stable isotope variation in carbon and nitrogen: review

Before discussing trends in the human enamel data analyzed for this dissertation, it is also necessary to briefly review the use of stable isotopes of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) in the archaeological study of the mid and late Holocene Cis-Baikal. Archaeologists working in the region have employed these approaches since the mid-1990s with the goal of assessing dietary variability within the region (Katzenberg and Weber 1999; Lam 1994; Weber et al. 2002). Isotopic analyses have been used to document differences in food resources that hunter-gatherer groups employed, and have also enabled archaeologists to make inferences about mobility patterns and the seasonal rounds that the region's ancient hunter-gatherer inhabitants used.

Broadly, in human samples within the Cis-Baikal, differences in carbon isotopic ratios ($\delta^{13}C$) are primarily attributable to dietary emphasis on either terrestrial game or aquatic resources. Terrestrial game exhibits a relatively narrow range of *low* $\delta^{13}C$ values, while aquatic resources exhibit a considerable range of $\delta^{13}C$ values. Weber et al. (2011:532) explain $\delta^{13}C$ variation in aquatic foods in terms of differences in the primary productivity of different freshwater systems throughout the Cis-Baikal, while Schulting et al. (2014) focus on differences in the food-chain within the lake itself, noting the effects that aquatic species' consumption of attached green algae (available in near-shore environments) or phytoplankton (found throughout the lake's water column) can have on $\delta^{13}C$ values.

Further, plants in the Cis-Baikal employ the C3 photosynthetic pathway (e.g., Katzenberg et al. 2012; Svyatko et al. 2013; Weber et al. 2011) and thus exhibit low $\delta^{13}C$ values (~ –20‰ to –30‰, as opposed to ~ –5.5‰ for C4 plants; e.g., Bartelink 2009; O'Leary 1988; van der Merwe 1982). Although the effects of fractionation (e.g., Fry 2006; Lee-Thorp et al. 1989) raise these values slightly (~2 – 5‰ per trophic level; e.g., DeNiro and Epstein 1981; Weber et al. 2002; Svyatko et al. 2013), terrestrial herbivores that consume these plants exhibit consistent and relatively low $\delta^{13}C$ values as well (Weber et al. 2002, 2011). This has important implications for interpreting human diet from stable isotopic data, as human diets with a large terrestrial herbivore component are also expected to exhibit low $\delta^{13}C$ values.

Nitrogen isotopic ratios ($\delta^{15}N$) vary as a result of fractionation that occurs at each trophic level, so that species consuming resources from higher trophic levels exhibit higher $\delta^{15}N$ values (Schoeninger and DeNiro 1984). Thus, depleted $\delta^{15}N$ values indicate greater reliance on plants and terrestrial herbivores, which occupy low trophic levels, while enriched $\delta^{15}N$ signatures indicate greater reliance on aquatic food sources, due to the greater number of trophic levels in aquatic ecosystems (e.g., Bartelink 2009; Katzenberg et al. 2012; Richards et al. 2001; Weber et al. 2002, 2011). In particular, the Baikal seal (*Phoca sibirica*) and shallow-water piscivorous fish inhabiting the Little Sea and the South Baikal littoral area would have produced enriched $\delta^{15}N$ values in human groups consuming these resources (e.g., Weber et al. 2002, 2011). Seal is especially unique because while it occupies the apex of the food-chain and consistently exhibited the highest $\delta^{15}N$ values, its $\delta^{13}C$ values were relatively *low* (Weber et al. 2011).

Figure 3.3 and Appendix 5 present previously published data on stable isotopic signatures ($\delta^{13}C$ and $\delta^{15}N$) from human bone collagen dating from the Early Neolithic to the Early Bronze Age. These results were produced at the University of Calgary, under the supervision of M.A. Katzenberg (see Katzenberg et al. 2009; 2012; Weber et al. 2002 for a review of sample extraction methods and laboratory protocols). Individuals who were less than seven years old at death are grouped separately and excluded from all statistical analyses (below), since these individuals' relatively recent consumption of breast milk may lead to elevated $\delta^{13}C$ and $\delta^{15}N$ values that do not relate directly to middle Holocene groups' subsistence practices.

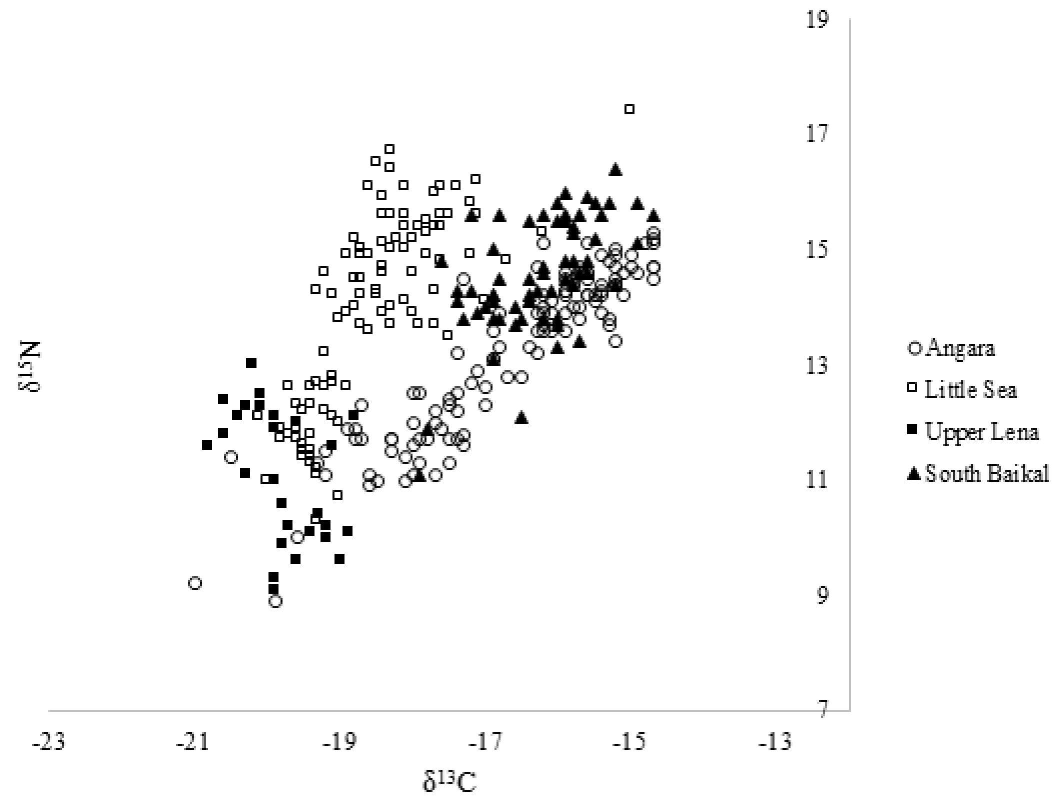

Figure 3.3. Stable carbon and nitrogen samples for all Cis-Baikal individuals over age 7 (data from Weber et al. 2011).

TABLE 3.8. SUMMARY STATISTICS FOR STABLE ISOTOPE VALUES FROM THE CIS-BAIKAL*

	Angara Valley Late Neolithic and Early Bronze Age		Little Sea GF + GFS Diet		Upper Lena Late Neolithic and Early Bronze Age		Early Neolithic Southwest Baikal	
	$\delta^{13}C$	$\delta^{15}N$	$\delta^{13}C$	$\delta^{15}N$	$\delta^{13}C$	$\delta^{15}N$	$\delta^{13}C$	$\delta^{15}N$
Mean	–18.2	11.6	–18.2	14.0	–19.6*	10.6	–16.3	14.6
s.d.	0.9	0.8	3.8	1.6	0.5	1.0	0.7	1.0
Range	4.5	3.9	1.8*	7.1	1.8	3.0	3.2	5.3
Minimum	–21.0	8.9	–20.1	10.3	–20.6	9.1	–17.9	11.1
Maximum	–16.5	12.8	–18.3**	17.4	–18.8	12.1	–14.7	16.4
Count	43	43	101	101	20	20	62	62

*Data reported in Weber et al. 2011.
**These cells were entered incorrectly in the original publication, and have been corrected here.

As documented previously (e.g., Weber et al. 2002, 2011), these data cluster into relatively discrete groups corresponding to the different micro-regions of the Cis-Baikal (Table 3.8, Appendix 5, Figure 3.3). Within Figure 3.3, samples from the Angara River valley exhibited relatively high $\delta^{13}C$ values (mean = - 18.2‰, s.d. = 0.9) and low $\delta^{15}N$ values (mean=11.6‰, s.d.=0.8), indicating a negligible role in diet for seal and high-trophic-level fish, and a focus on watercourses with high primary productivity such as the Angara River and its tributaries (Weber et al. 2011). In contrast, the South Baikal – which is represented here exclusively by Early Neolithic samples that provide only a tentative micro-regional comparison with later periods examined in this dissertation – exhibited relatively high values for both $\delta^{13}C$ and $\delta^{15}N$ ($\delta^{13}C$ mean= -16.3‰, s.d.=0.7; $\delta^{15}N$ mean=14.6‰, s.d.=1.0). These values suggest a diet drawing on high-trophic-level foods such seal, which would have been available in the South Baikal during some seasons, as well as aquatic resources from watercourses with high primary productivity such as the upper Angara (Weber et al. 2011)[4]. Samples from the upper Lena River indicated a diet focused on game and fish resources from the relatively low-primary-productivity upper Lena River, as indicated by consistently low $\delta^{13}C$ and $\delta^{15}N$ signatures among all individuals under study (Late Neolithic and Early Bronze Age $\delta^{13}C$ mean= –19.6‰, s.d.=0.5, $\delta^{15}N$ mean=10.6‰, s.d.=1.0).

In addition, Weber et al. (e.g., 2011) distinguish two dietary clusters among samples collected from the Little Sea micro-region (Figure 3.4). One of these clusters exhibited enriched values for $\delta^{13}C$ and $\delta^{15}N$ (–19.3‰ to –18.3‰ and 13.2‰ – 17.4‰, respectively; Table 3.9), representing a "local" "game-fish-seal" (GFS) diet. The other, which essentially overlaps with diets seen among Upper Lena Valley sources, Weber et al. (2011) label a "non-local" "game-fish" (GF) diet. In other words, the individuals represented by this low-$\delta^{13}C$, low-$\delta^{15}N$ cluster would have consumed diets featuring terrestrial game and fish from beyond the boundaries of the Little Sea.

Despite the "GFS" title they use to describe the "local" diet of Little Sea individuals, Weber et al. (2011:539) stress that the difference between the GF and GFS diets is more complex than the simple inclusion or dearth of Baikal seal in diet. Because Baikal seals exhibit a diagnostically *low*-$\delta^{13}C$ signature, removing seal from local "GFS" diets would produce *higher* $\delta^{13}C$ values overall. In fact, individuals exhibiting GF diets exhibited low values for both $\delta^{13}C$ and $\delta^{15}N$, suggesting more far-reaching differences in foods consumed by individuals in these two dietary clusters. This pattern provides further support to interpret the GF diet as non-local.

On the basis of these stable isotopic data, Weber et al. (2011:543) suggest that, with the exception of the Little Sea micro-region:

[4] Recent work on stable isotope ratios from human samples at Shamanka II has indicated variation in dietary focus among individuals interred at this site during the Early Neolithic, as well as important chronological distinctions *within* this broad period (Weber et al. 2016b).

> foraging covering all micro-regions and all main food groups available, or even partial mixing, appears unlikely during [the Neolithic and EBA]. Food procurement of every territorial unit was spatially limited and focused on game and aquatic resources available within each micro-region regardless of the fact that the distances separating these areas, although variable, are never really substantial and the connecting routes lack significant geographic barriers.

Isotopic evidence from carbon and nitrogen thus appear to suggest that each of the Cis-Baikal's micro-regions served as a focal point for a distinct seasonal round, practiced by only a subset of hunter-gatherers within the greater Cis-Baikal. However, while these data indicate that overall subsistence rounds among local hunter-gatherers were distinct and relatively small-scale, *short-term* movements that would have occurred on a yearly basis – or even less frequently – such as those that may have been involved in ritualized exchange (see Chapter Five) or supra-band aggregation events (see Chapter Six), are likely not detectable using bulk isotopic sampling methods employed in these studies, which provide values reflecting *average* resource consumption over long timespans (a minimum of 3-4 years for tooth enamel used in bulk studies of $^{87}Sr/^{86}Sr$ [see above]; usually > 5 years for bone collagen used in studies of variation in isotopes of carbon and nitrogen).

TABLE 3.9. SUMMARY STATISTICS FOR STABLE ISOTOPE VALUES FROM THE LITTLE SEA*

	Little Sea GFS		Little Sea GF	
	$\delta^{13}C$	$\delta^{15}N$	$\delta^{13}C$	$\delta^{15}N$
Mean	–17.6	14.9	–19.4	11.9
s.d.	4.4	0.9	0.3	0.6
Range	1.0	4.2	1.2	2.5
Minimum	–19.3	13.2	–20.1	10.3
Maximum	–18.3	17.4	–18.9	12.8
Count	70	70	31	31

*Data presented in Weber et al. 2011.

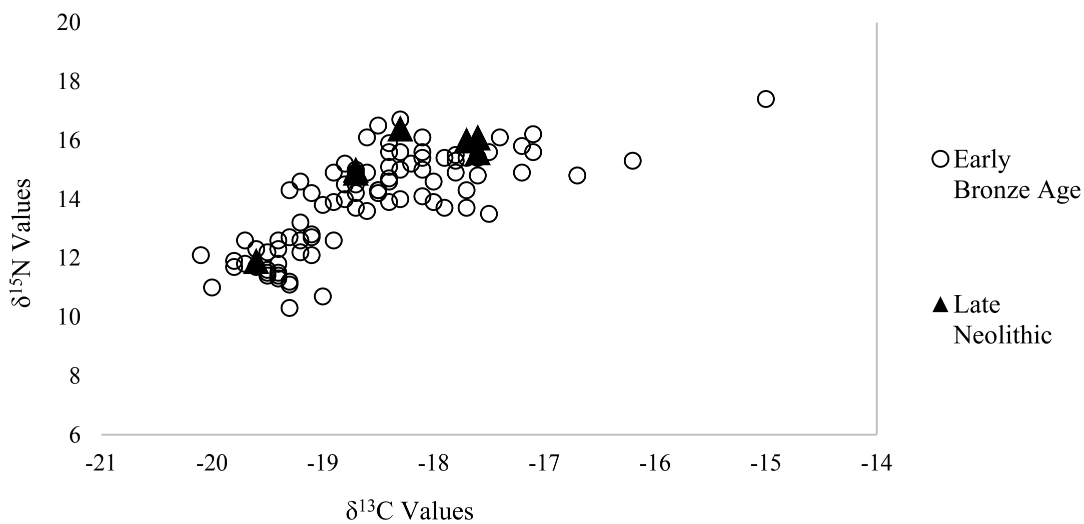

Figure 3.4. Stable isotope values for Late Neolithic and Early Bronze Age individuals from the Little Sea micro-region (Calgary dataset).

Previous syntheses of stable isotopic data in the Cis-Baikal

A recent study of $^{87}Sr/^{86}Sr$ variation in bulk samples of tooth enamel collected from first molars (M1) of 25 mid and late Holocene hunter-gatherers from Cis-Baikal cemeteries demonstrates the utility of geochemical approaches in this context. This study examined 24 Early

Bronze Age individuals as well as one Early Neolithic individual[5] from the Khuzhir-Nuge XIV cemetery (~3 km southwest of the mouth of the Sarma River, located on the mainland coast of Lake Baikal's Little Sea micro-region), and demonstrated that less than half of these individuals appear to have spent their childhoods (during formation of M1, 0 to ~3 – 4 years old) in the Little Sea micro-region, where the cemetery is located (Haverkort et al. 2008; Weber and Goriunova 2013). More specifically, Weber and Goriunova (2013) suggested that Early Bronze Age $^{87}Sr/^{86}Sr$ values for M1 could be divided into two groups: one "non-local" – with $^{87}Sr/^{86}Sr$ values ranging from 0.70966 – 0.71196 (n=13), and one that exhibited higher $^{87}Sr/^{86}Sr$ values, ranging from 0.71288 – 0.71679 (n=10), representing individuals who were born locally, with M1 values corresponding to terrestrial faunal values from the Little Sea micro-region. After Price et al. (2002), Weber and Goriunova (2013:340) produced a local $^{87}Sr/^{86}Sr$ range by calculating a 2 s.d. range around the mean value for this local group of ten individuals (0.71451 +/– 0.001306 = 0.71189 – 0.71712).

Weber and Goriunova (2013) employed data on $\delta^{13}C$ and $\delta^{15}N$ from bone collagen for individuals at Khuzhir-Nuge XIV (based on analyses conducted at the University of Calgary) and suggested that among the individuals exhibiting non-local $^{87}Sr/^{86}Sr$ M1 values, one group exhibited $\delta^{13}C$ and $\delta^{15}N$ values that overlapped with "Game-Fish" diets of individuals interred in the Upper Lena River Valley ("GF," n=6). The remaining individuals with non-local $^{87}Sr/^{86}Sr$ signatures featured $\delta^{13}C$ and $\delta^{15}N$ values corresponding to local "Game-Fish-Seal" diets ("GFS," n=6). Thus, among individuals whose $^{87}Sr/^{86}Sr$ values indicated early childhoods spent *outside* the Little Sea

[5] Recent unpublished dates produced by BHAP participants at the Oxford Radiocarbon Accelerator Unit that incorporate corrections for the Freshwater Reservoir Effect have led to a revision of the age of this feature, once thought to be Late Neolithic (Andrzej Weber, personal communication, May 2016). The individual in this grave (No. 7 at Khuzhir-Nuge XIV, see below) is thus treated as Early Neolithic throughout this dissertation to reflect the revised date.

micro-region, one group appeared to have consumed *local* resources later in life (GFS diets), while a second group of individuals with non-local $^{87}Sr/^{86}Sr$ signatures consumed resources that differed from the local diet (GF diets).

According to this interpretation, a large portion of individuals interred at Khuzhir-Nuge XIV must have immigrated to the Little Sea micro-region at some point after early childhood. Weber and Goriunova (2013) propose the Upper Lena River Valley as the most likely source of these non-local individuals, based on that micro-region's proximity and the $\delta^{13}C$ and $\delta^{15}N$ values from human samples there. Upper Lena groups may have employed a variety of seasonal round strategies, one of which could have involved yearly migration to the Little Sea during sealing season (thus producing high $\delta^{15}N$ values, due to the high trophic level of the Baikal seal). A second distinct seasonal round may have involved yearly movements to the Little Sea micro-region *without* consuming seal resources (thus producing lower $\delta^{15}N$ values, while still accounting for their burial within the Little Sea micro-region). A third strategy would have involved a relatively localized seasonal round primarily confined to the Upper Lena Valley (thus not visible among Little Sea micro-region samples), as has been documented previously (e.g., Weber et al. 2011). Others (Haverkort et al. 2008) interpret these $^{87}Sr/^{86}Sr$ data as indicators of *permanent* migrations to the Little Sea micro-region by individuals born in the Upper Lena River Valley. However, it is noteworthy that no human enamel $^{87}Sr/^{86}Sr$ values from the upper Lena micro-region were available for comparison in this study. The analyses presented here incorporated enamel samples from the upper Lena River, enabling a reassessment of this interpretation (see Chapter Four).

The study described above focused on samples from a single site (Khuzhir-Nuge XIV) and all but one of the 25 samples dated to a single period – the Early Bronze Age. Within the Little Sea micro-region, the Late Neolithic remains even more understudied, and little comparison of isotopic indicators for diet and mobility during these two periods has been undertaken, mostly because of the scarcity of the Late Neolithic burials in the area. This is particularly true of $^{87}Sr/^{86}Sr$ data; until the present study was completed in 2015, only a single interment believed to date to the Late Neolithic had been analyzed (Khuzhir-Nuge XIV, Grave No. 7). However, recent redating attempts that incorporated a correction for the Freshwater Reservoir Effect (FRE) on radiocarbon dates now indicate an *Early* Neolithic age for this interment. All three molars from this Early Neolithic individual exhibited the lowest $^{87}Sr/^{86}Sr$ values seen among all samples from the micro-region where it was interred, a finding which is strongly suggestive of a non-local origin (Haverkort et al. 2008). The “non-local” “GF” diet that this 25 to 35 year old probable male exhibited provides further support for this claim (Weber and Goriunova 2013).

It is also important to note that previous studies (Haverkort et al. 2010) have analyzed a limited quantity of samples (M1, M2, and M3 elements from 13 individuals) from the Angara River cemetery of Ust’-Ida for $^{87}Sr/^{86}Sr$ variation (Figure 3.5, Appendix 6). The M1 dataset featured three individuals (all Late Neolithic) with values above 0.71100. These three individuals were separated from the main cluster of Late Neolithic and Early Bronze Age values by a gap of ~0.0005, suggesting that these three individuals may have experienced different life histories than their contemporaries. One of these individuals (interred in Grave No. 11) exhibited an M1 value of 0.71335, well above any of the values for other individuals at the site and nearly above the +/– 2 s.d. faunal range for the Angara River determined on the basis of terrestrial fauna. It is possible that this individual spent the early portion of their life in the western Angara region, or some other area exhibiting enriched $^{87}Sr/^{86}Sr$ values.

Two other individuals at this site (Graves No. 20 [Individual 2] and 38) also exhibited values above the main cluster (0.71111 and 0.71134, both ~0.00090 above the highest value within that group (Figure 3.5). Beacause of the small quantity of samples for these two periods (n=6 (Late Neolithic), 4 (Early Bronze Age), I have lumped all samples together into a single group for statistical purposes, excluding only the three Late Neolithic outliers (with values above 0.71100). When the +/– 2 s.d. approach was applied to these samples, they produced a "local" M1 range of 0.70925 – 0.71041 (Table 4.2). These values fall within the range predicted for the Angara (using the +/- 2 s.d. method on terrestrial faunal samples). Values for individuals from Ust'-Ida provide an important comparative dataset for contemporaneous individuals from different micro-regions within the Cis-Baikal. In Chapter Four, I conduct an analysis of previously published $\delta^{13}C$ and $\delta^{15}N$ data for the Late Neolithic and Early Bronze Age in the Little Sea micro-region. I also describe new $^{87}Sr/^{86}Sr$ data from Late Neolithic and Early Bronze Age contexts throughout the region (focusing on the Little Sea) in an attempt to assess changes in mobility patterns during the Late Neolithic-Early Bronze Age transition.

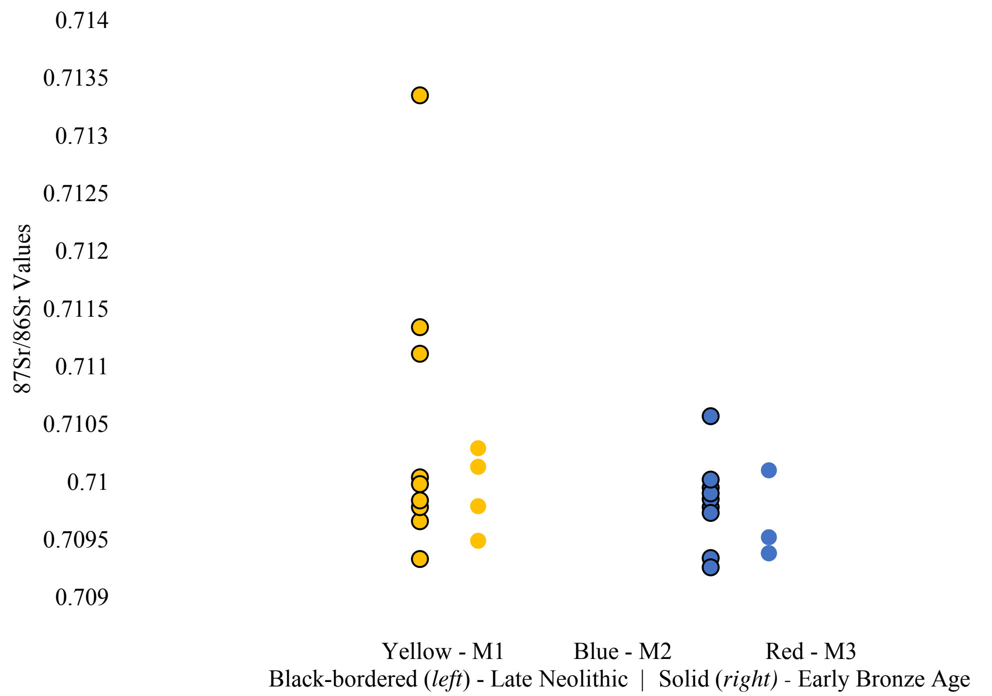

Figure 3.5 – Ust'-Ida $^{87}Sr/^{86}Sr$ Variation (data from Haverkort et al. 2010).

CHAPTER FOUR

GEOCHEMICAL DATA ANALYSIS

Introduction

This chapter provides an analysis of geochemical data ($^{87}Sr/^{86}Sr$ ratios) from mid and late Holocene human enamel samples that illuminate patterns of movement and interconnection among Cis-Baikal hunter-gatherers during these time periods, focusing on the Late Neolithic and Early Bronze Age. Where possible, I employ geochemical signatures discussed in the previous chapter that characterize local areas at micro-regional (and smaller) scales in order to highlight specific areas where individuals appear to have been born or traveled at different points during their lives.

In addition to $^{87}Sr/^{86}Sr$ values from previously-analyzed human samples – primarily from Early Bronze Age individuals at Khuzhir-Nuge XIV cemetery, located in the Little Sea micro-region – this analysis also includes new data from a variety of Late Neolithic and Early Bronze Age cemeteries in the Little Sea micro-region and the upper Lena Valley. These samples enable a broader investigation of micro-regional variation and chronological change. I employ samples from the upper Lena primarily in order to assess previous assertions about interconnections between Early Bronze Age inhabitants of this micro-region and those of the nearby Little Sea (e.g., Weber and Goriunova 2013; Weber et al. 2011). While several human enamel samples from the Early Neolithic and Early Bronze Age have been analyzed for $^{87}Sr/^{86}Sr$ ratios (Scharlotta and Weber 2014) all of these values To date, no human samples from the upper Lena have been analyzed for human enamel $^{87}Sr/^{86}Sr$ values. Below, I first briefly revisit the political economic models described above (Chapter One) as they relate to expectations about human mobility and human enamel $^{87}Sr/^{86}Sr$ values in Late Neolithic and Early Bronze Age samples from the Little Sea micro-region.

Geochemical implications for hypothesized political economic changes in the mid and late Holocene Little Sea

Data presented in this chapter relate to the hypotheses regarding political economy outlined above (see Chapter Two), and also help to illuminate regional variability in mobility practices and diet more broadly. Elsewhere (Shepard 2012, 2013), I have employed dual-processual theory (e.g., Blanton 1998; Blanton et al. 1996; Feinman 1995, 2000; Peregrine 2001) to suggest that within the Little Sea micro-region, a shift away from a predominantly corporate-focused political economic strategy to a predominantly network/exclusionary one occurred at the Late Neolitihc-Early Bronze Age transition. Here I describe the differences between these political economic modes as they relate to archaeological implications for ancient human mobility.

At the broadest scale, dual-processual theorists distinguish two opposing strategies that aspiring political actors employ – "corporate" and "network/exclusionary" – and suggest that these strategies have far-reaching structural effects (e.g., Blanton et al. 1996). According to Blanton et al. (1996), in contexts where corporate political economic strategies dominate, political actors employ inclusive rhetoric such as common ancestral figures, communal identities, and inclusive corporate institutions to mobilize locally-available labor for relatively intensive (local) subsistence activities (see also Earle 1997; Feil 1987; Renfrew 1974; Strathern 1969). Strathern's (1969) description of the "home finance strategy" among 20th century horticulturalists in highland New

Guinea illustrates these corporate practices, showing how aspiring elites relied on local kin and affines to produce resources for redistribution at political events such as feasts.

In contrast, according to dual-processual theory, in contexts where network/exclusionary political economic strategies dominate, aspiring elites employ strategies that emphasize individual distinction. To achieve these goals, political actors attempt to associate themselves with circumscribed forms of capital such as personal wealth, special status based on descent, and coalitions or alliances with distant groups (e.g., Blanton 1998; Blanton et al. 1996; Feinman 1995, 2000; see Shepard 2012, Chapter Two [above] for discussion of evidence for these political economic modes in the mid and late Holocene Little Sea micro-region).

Although relatively unexplored in recent archaeological works (but see King 2003), these different forms of political organization should produce distinct patterns with respect to individual mobility in small-scale societies such as those that inhabited the Cis-Baikal during the mid and late Holocene. At the largest scale of analysis, the Late Neolithic and Early Bronze Age should feature archaeological signatures corresponding to the distinct political economic strategies that I hypothesize were dominant during these periods (corporate and network/exclusionary, respectively). Because of the focus on widespread participation in relatively intensive local subsistence production in corporate political strategies, I suggest that samples from Late Neolithic individuals should tend to exhibit "local" $^{87}Sr/^{86}Sr$ signatures, indicating common focus on intensive production and shared consumption of resources within the local area. This is particularly true for *adult foraging areas*, as the expectation relates to the seasonal foraging, fishing, and sealing activities that adults conducted (rather than to individuals' birthplaces, *per se*).

I would also note that even among anthropologists who have treated hunter-gatherer economies as capable of only very limited intensification (e.g., Johnson and Earle 2000; Price

1995), aquatic resources often represent an exceptional and *at least somewhat-intensifiable* resource (e.g., Johnson and Earle 2000; Price 1995; see Arnold et al. 2015). As discussed above (see Chapter Two), Losey et al. (2012) observe that the Little Sea, and in particular the Sarma River – the largest river within the micro-region – were less rich in terms of aquatic resource density and fish spawning runs than Cis-Baikal rivers such as the Angara and upper Lena. However, relative to much of the west coast of Lake Baikal, Losey et al. (2012:131) view the Sarma and the Little Sea as exceptionally productive. In particular, they note that the Sarma currently serves as a spawning ground for black grayling, a "highly prized fatty fish" (Losey et al. 2012:139). On the Anga River, to the south of the Little Sea, Losey et al. (2012:139) cite historical sources indicating that an individual could catch 49-82 kg of grayling in a day during spawning events, which lasted for 7-10 days.

Losey et al. (2012; see also Weber 2003; Weber et al. 2002, 2011) suggest that aquatic resources in the Little Sea itself would have been available throughout the year, requiring relatively small amounts of labor and little organization. Importantly, however, aquatic resources in the Little Sea would have served as a reliable source of food, and would have been relatively immune to overfishing with the technology available (e.g., Losey et al. 2012, Weber et al. 2011). Thus, to the extent that aspiring elites attempted to "intensify" production of aquatic resources in the Little Sea itself, output from this intensification would have been small in scale.

Given the relatively low-density nature of these resources, I envision that attempts at intensification would have involved extracting surplus labor from kin and other local community members to produce more of these easy-to-obtain resources (e.g., Dietler 1996; Strathern 1969). Thus, to the extent that political actors during the Late Neolithic pursued corporate strategies (involving small-scale intensification of subsistence activities and redistribution of these resources within inclusive corporate institutions), individuals from this period should exhibit isotopic signatures that indicate consumption of resources from the Sarma River and the Little Sea, and this signature should be widespread among samples from this period. I note that I employ a broad definition of the concept of intensification here, including not only any attempts to increase subsistence productivity per unit of time or labor, but also any combination of attempts at putting more people to work, devoting more time to subsistence activities, or employing additional fishing nets.

In contrast, in network/exclusionary contexts, political actors are expected to devote considerable resources both to competing for prestige and political recognition and marshalling support over long-distances (e.g., Blanton et al. 1996; Earle 1997; Renfrew 1974). These forms of competition produce interconnections at the regional level (Blanton et al. 1996; Hayden and Schulting 1997; Renfrew 1987). Thus, Early Bronze Age groups should exhibit a greater mixture of local *and non-local* $^{87}Sr/^{86}Sr$ signatures. This expectation relates specifically to the areas Early Bronze Age groups would have included in the seasonal round in order to maintain supra-local connections, acquire non-local marriage partners, and cultivate long-distance political support. Because Little Sea $^{87}Sr/^{86}Sr$ values were higher than almost any other area in the Cis-Baikal, this hypothesis dictates that Early Bronze Age individuals should exhibit *low* $^{87}Sr/^{86}Sr$ ratios relative to the local Little Sea environmental signatures. This expectation applies to variation in *adolescent and adult foraging areas* (as measured in M3 values), rather than to variation in individuals' places of birth (as measured by M1 values).

The life-histories of deceased individuals are also expected to produce different patterns at the level of individual cemeteries. In corporate settings, where cemeteries would have primarily served integrative functions, burial populations are expected to come from a diverse cross-section of society. At present, there remains some question as to whether all Little Sea cemeteries or only a subset served as corporate centers during the Late Neolithic (Shepard 2012). However, the majority of the sample used in this dissertation dating to the Late Neolithic came from Sarminskii Mys, which clearly *did* play the role of a corporate center during that period (based on the site's size and the emphasis on a common ritual involving multiple burials). Funeral activities that Late Neolithic groups conducted at this site are expected to have symbolically integrated individuals regardless of their early life-histories (represented by M1, and to a lesser extent, M2 values).

In contrast, in network settings, political actors would have conducted funerals with the intention of reinforcing distinctions between individuals (and/or between lineages). In these contexts, individual cemeteries should contain relatively narrow cross-sections of Early Bronze Age society. In particular, a given site should feature relatively homogeneous life-histories relative to the overall range of Early Bronze Age life-histories seen throughout all sites in the Little Sea micro-region. This expectation refers primarily to the areas where individuals were born (again represented primarily by M1 values, but also by M2 values to a lesser extent).

Similarly, at the scale of individual burial features, the corporate-versus-network/exclusionary divide should be evident in terms of the role of multiple burials. I have argued (Shepard 2012) that in corporate settings, funerals employing multiple burials would have served an integrative function, enforcing or reproducing communal relationships. Thus, similar to the logic discussed above for cemeteries, graves containing multiple individuals should feature diverse cross-sections of individuals from Late Neolithic society, represented by heterogeneous $^{87}Sr/^{86}Sr$ signatures (to the extent that these existed during the Late Neolithic). To the extent that corporate ideologies emphasize communal identities and inclusion irrespective of individuals' background or kinship ties, these heterogeneous $^{87}Sr/^{86}Sr$ signatures are expected to be particularly evident for M1 and M2 values, representing the areas where individuals were born.

In contrast, in contexts where the network/exclusionary strategies predominate, burial ritual is expected to play a role in a broader "patrimonial" ideology, by supporting elite competition and exclusionary efforts (e.g., Blanton et al. 1996). To the extent that graves and burial ritual served as materializations of this patrimonial rhetoric, rows of graves and graves containing multiple individuals should exhibit homogeneous $^{87}Sr/^{86}Sr$ signatures, corresponding to distinct kin groups' territorial claims or "home ranges" (e.g., Burch 1998, 2005). This expectation refers primarily to the areas where individuals were born (again, represented by M1 and M2 values), although it is also possible that a network/exclusionary ideology may involve ritually distinguishing individuals or kin groups that employed different foraging areas as adolescents and adults (M3 values).

Description of samples

Here I employ $^{87}Sr/^{86}Sr$ values from human enamel on 139 first through third adult molars from 67 individuals at cemeteries in the Cis-Baikal. More specifically, I investigated human samples from 13 cemeteries in the Little Sea micro-region (n=54 individuals) and the upper Lena Valley (n=13 individuals; Appendix 7; Figures 4.1, 4.2, and 4.3). Details on the collection, processing, and analysis of these samples can be found in Appendix 8. I also employ data on 70 human molars previously analyzed by the BHAP from the Khuzhir-Nuge XIV cemetery (located in the Little Sea micro-region). The latter set of samples were analyzed by Dr. Caroline M. Haverkort at the Radiogenic Isotope Facility, Department of Earth and Atmospheric Sciences, University of Alberta, and represent 25 individuals (1 Early Neolithic [previously thought to date to the Late Neolithic, see above], 24 Early Bronze Age). The Little Sea dataset contained two Early Neolithic, 16 Late Neolithic and 61 Early Bronze Age individuals (including the 25 individuals from previous works; Haverkort et al. 2008; Appendix 7).

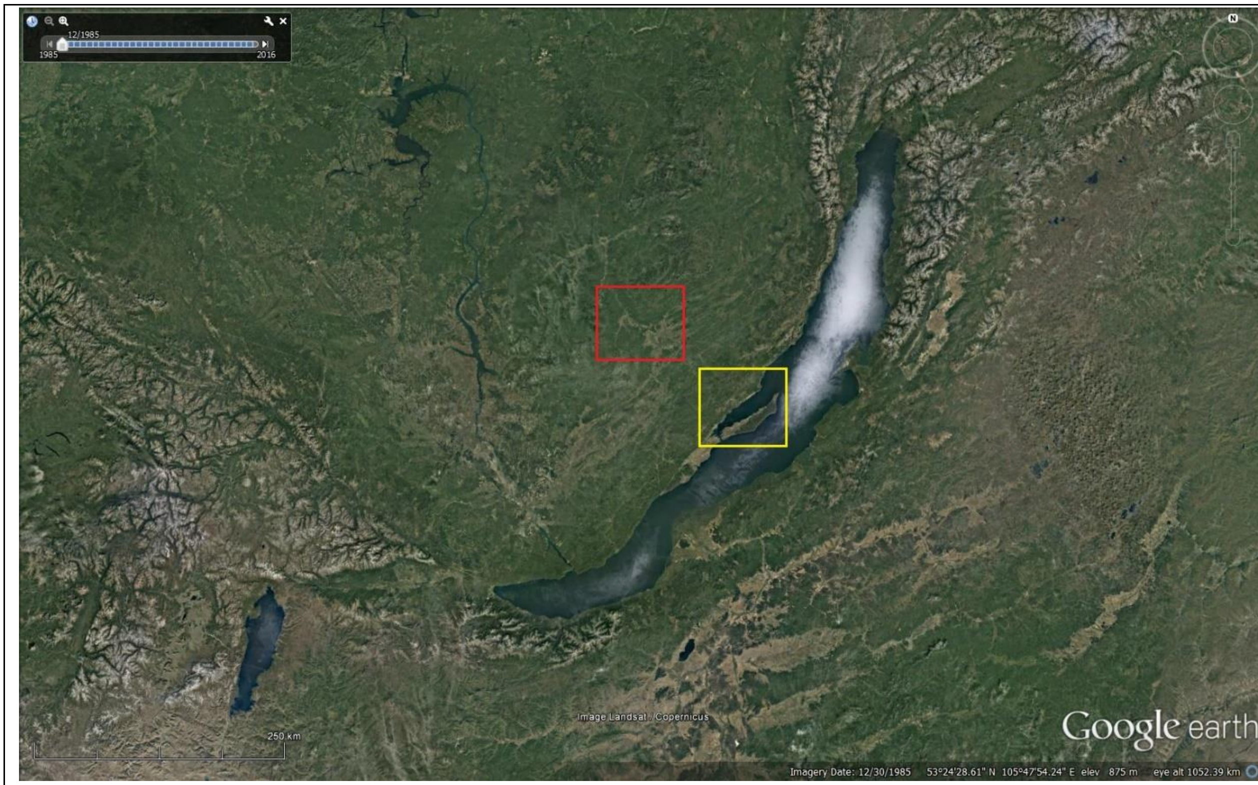

Figure 4.1. Map of the Cis-Baikal highlighting micro-regions discussed in the text. The yellow rectangle indicates the Little Sea micro-region, the upper Lena River micro-region is in red. Map credit: Google earth v.7.1.5.1557, using Landsat / Copernicus data. http://landsat.gsfc.nasa.gov.

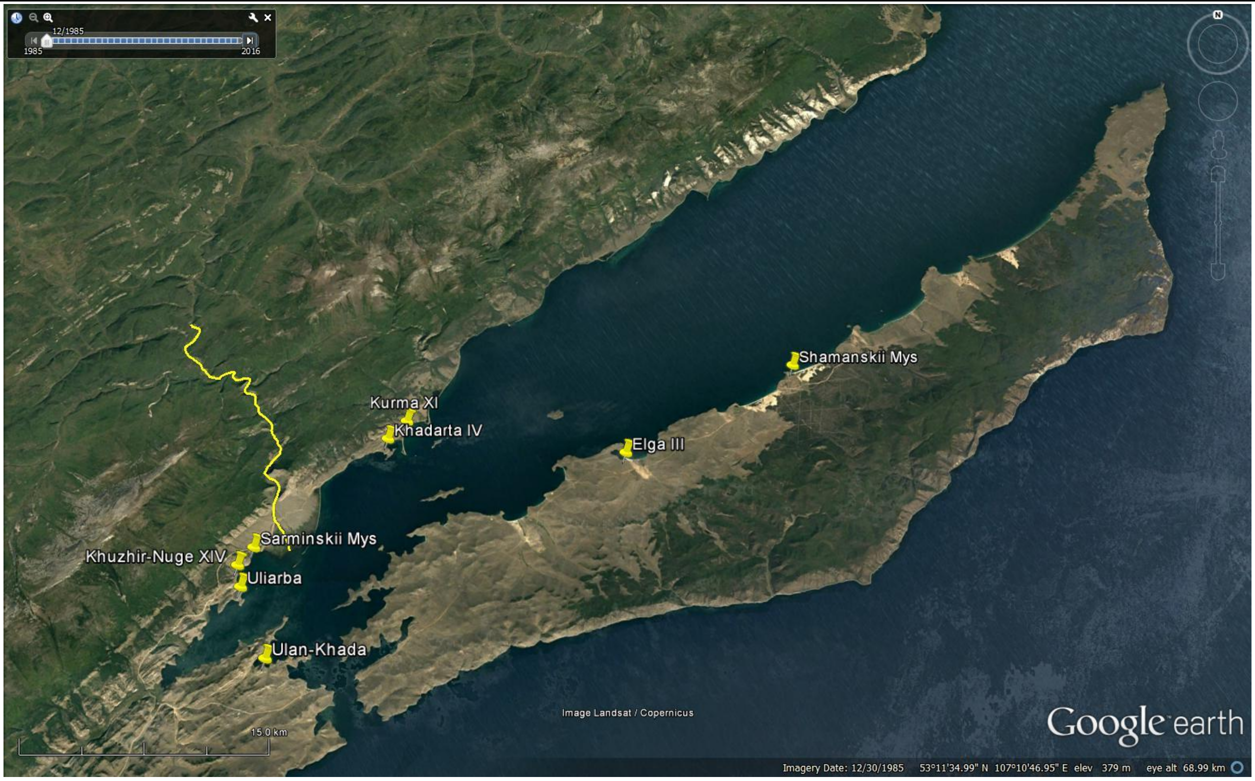

Figure 4.2. Map of the Little Sea micro-region, featuring sites mentioned in the text. The Sarma River is indicated here with a yellow line. Map credit: Google earth v.7.1.5.1557, using Landsat / Copernicus data. http://landsat.gsfc.nasa.gov.

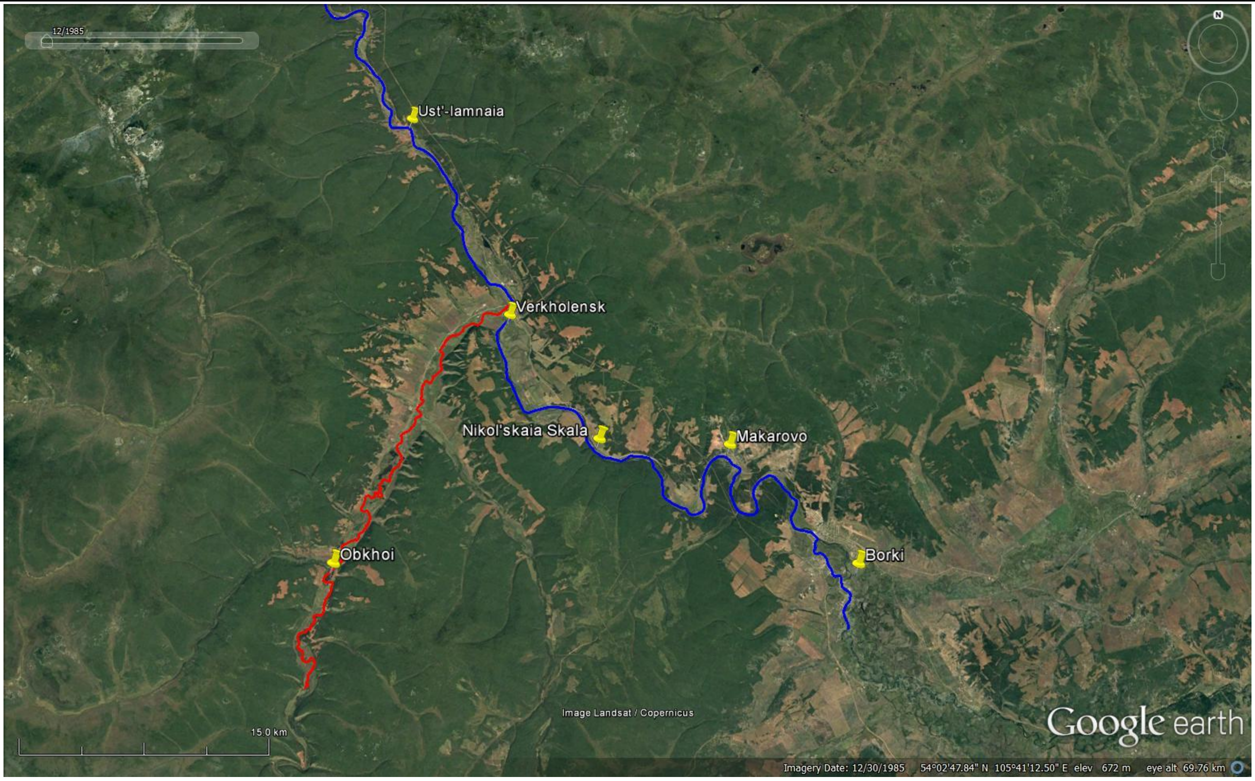

Figure 4.3. Map of the upper Lena River, featuring sites mentioned in the text. The Lena River is indicated here with a blue line, the Kulenga is indicated with red. Map credit: Google earth v.7.1.5.1557, using Landsat / Copernicus data. http://landsat.gsfc.nasa.gov.

Upper Lena samples were included in this research mainly to establish a baseline for comparison with apparent "immigrants" interred in the Little Sea micro-region. Because of the small sample size and uncertain provenience of several of these individuals, I do not attempt to conduct chronological comparisons within this group. While previous studies have investigated strontium isotope ratios in human tooth enamel from upper Lena sites (e.g., Scharlotta and Weber 2014), data presented here represent bulk enamel samples as opposed to micro-samples using laser ablation, and are thus directly comparable with previous BHAP studies (e.g., Haverkort et al. 2008, 2010; Weber and Goriunova 2013). Sampling methods for both of these sets of samples were identical, as the sampling method I employed here was specifically designed to allow comparison with previous BHAP samples. Archaeological ages for the upper Lena individuals included here are discussed below.

Description of sites included in this study: upper Lena micro-region

This study provides the first data on $^{87}Sr/^{86}Sr$ values from bulk samples of human molar enamel for mid and late Holocene individuals interred in the upper Lena Valley. Sites included in this study from the upper Lena include Borki, Obkhoi, Silinskaia, Makarovo, Ust'-Iamnaia, Ust'-Tal'ma, Nikol'skaia Skala, and Verkholensk. All of these sites are located in the "southern" cluster of upper Lena cemeteries (Schulting et al. 2015). Archaeological data for several of these sites exist only in the form of unpublished field reports, and in many cases detailed information on burial treatments, sex and age data, and culture-historic attribution were not available. All of these sites with the exception of Obkhoi and Ust'-Tal'ma are located along the Lena River (within 1 km), while the latter two sites are situated on the Kulenga (a southern/left tributary of the Lena), 5-10 km upstream from the confluence of the two rivers (Figure 4.3). Below I provide brief outlines of each of the upper Lena cemeteries for which data were available. Scharlotta and Weber (2014) conducted preliminary micro-sampling for a small group of individuals from some of these sites, although these data are not directly compatible with the data I employ in this dissertation (based on bulk sampling of human enamel).

Silinskii. Silinskii cemetery was excavated in 1983 as part of the Lena Branch of the Complex Archaeological Expedition of the Irkutsk State University ("KAE IGU"; Belonenko and Menshchagin 2000). The site was located on the left bank of the river, ~4 km upstream from the Kartukhai village. Notably, the Neolithic and Bronze Age Shishkino petroglyphs are located ~200 m downstream from Silinskii, on the opposite side of the Lena River. Belonenko and Menshchagin (2000:61) suggested that these petroglyphs may have played some role in Early Bronze Age discourse surrounding funeral activities at Silinskii, as the three features that contained human remains were oriented to face Shishkino (see Chapter Six for further discussion of the relationship between rock art sites and cemeteries in the Cis-Baikal). On the basis of grave goods such as mother-of-pearl beads interred with both of the individuals included in this study and a bronze knife interred with the younger of the two (8 to 11 years old; Grave No. 1), Belonenko and Menshchagin (2000) interpreted these graves as Early Bronze Age.

Nikol'skaia skala. The Nikol'skaia skala cemetery (referred to both as Nikol'skaia Skala [Bazaliiskii et al. 1996; Weber et al. 2002] and Nikol'skii Grot [Weber et al. 2011]) is located on the right bank of the upper Lena River, ~4 km downstream from the Shishkino petroglyphs (Bazaliiskii et al. 1996). In 1982, salvage excavations were conducted at the site that revealed two tiered burials, each containing multiple individuals. One radiocarbon date (Weber et al. 2002) suggests a Late Neolithic date for this site, and Bazaliiskii et al. (1996) similarly attributed it to the Late Neolithic *Serovo* culture-historical grouping based on a fishhook found with the uppermost interment in Grave No. 1.

Verkholensk. Verkholensk cemetery has a long history in Cis-Baikal archaeological research, and represents the largest known cemetery dating to the Neolithic and Early Bronze Age on the upper Lena (e.g., Okladnikov 1955, 1978). The site is located on the right bank of the Lena, ~600 m upstream from its confluence with the Kulenga River. Although previous excavations took place at the site, P.P. Khoroshikh conducted the first well-documented, small-scale excavations at Verkholensk in 1949 (four graves excavated). In 1950-1951, A.P. Okladnikov continued this work under the auspices of the Buriat-Mongol Archaeological Expedition. These three field seasons produced a total of 39 graves, which Okladnikov (1978) separated into a broad “Archaic Period” (Neolithic) and an Early Bronze Age set. The samples included here were excavated later, as part of a salvage project under the auspices of the Neolithic Branch of the KAE IGU, in 1998 (Bazaliiskii 1998). These three cairns were located ~15 m south of the original (1949-51) excavations, and featured an adult female (Grave No. 1), a young adult female (Grave No. 2, not included in this study), and an older adult female (Grave No. 3). Based on grave construction, the presence of mother-of-pearl beads (Graves No. 1 and 3) and a bronze needle (in Grave 3), both of the samples included in this study appear to date to the Early Bronze Age.

Other sites. The remaining upper Lena sites feature no available published data, although in some cases samples from these sites were employed in synthetic reports conducted by Russian scholars and by the BHAP (e.g., Alekseev and Mamonova 1979; Scharlotta and Weber 2014; Weber and Bettinger 2010; Weber et al. 2002). Borki and Obkhoi were excavated in 1971; Borki contained three graves, and Obkhoi contained 12; in both cases, all were assigned to the Early Bronze Age. No information was available for the excavations at Ust’-Iamnaia (1982), Ust’-Tal’ma (1976), or Makarovo (1980), although each of these provided samples that contributed to this study, all of which were housed in the Irkutsk State University.

Description of sites included in this study: Little Sea micro-region

This study uses $^{87}Sr/^{86}Sr$ human molar enamel data from five cemeteries in the Little Sea micro-region: Elga III, Khuzhir-Nuge XIV, Kurma XI, Sarminsii Mys, and Shamanskii Mys. Only Khuzhir-Nuge XIV has been sampled for bulk enamel $^{87}Sr/^{86}Sr$ tests, although limited micro-sampling for elemental and $^{87}Sr/^{86}Sr$ values has also been conducted at Shamanskii Mys and Khuzhir-Nuge XIV (see Scharlotta and Weber 2014).

Khuzhir-Nuge XIV and Sarminskii Mys. Both Khuzhir-Nuge XIV and Sarminskii Mys are located on the northeast section of the Khuzhir-Nuge Bay, located near the Sarma River (Khuzhir-Nuge XIV ~3 km from the river; Sarminskii Mys ~1 km), and contained abnormally large cemetery populations (89 and 39 individuals, respectively). Khuzhir-Nuge XIV was excavated by Drs. O.I. Goriunova (Irkutsk State University) and Andrzej Weber (University of Alberta) from 1997 to 2001 as part of the joint Russo-Canadian Baikal Archaeology Project (Goriunova et al. 2010, Weber et al. 2007, 2008). O.I. Goriunova directed excavations at Sarminskii Mys, which took place from 1985 to 1987 as part of the Little Sea Branch of the KAE IGU (Goriunova 1997).

Both sites contained interments from multiple culture-historic periods, although in different proportions. Khuzhir-Nuge XIV featured a single Early Neolithic grave (No. 7) as well as 78 from the Early Bronze Age. Sarminskii Mys contained a single Early Neolithic grave (No. 22) as well as 13 from the Late Neolithic and 10 from the Early Bronze Age (recent AMS radiocarbon dating efforts indicate that one single burial at Sarminskii Mys, previously thought to date to the Late Neolithic, is in fact Early Neolithic in age [Weber et al. 2016a], while oen grave at Khuzhir-Nuge XIV previously thought to date to the Late Neolithic has now been reassigned to the Early Neolithic [Andrzej Weber, personal communication, May 2016). Both sites also featured multiple distinct spatial clusters of graves (see below; Figure 4.4, 4.5).

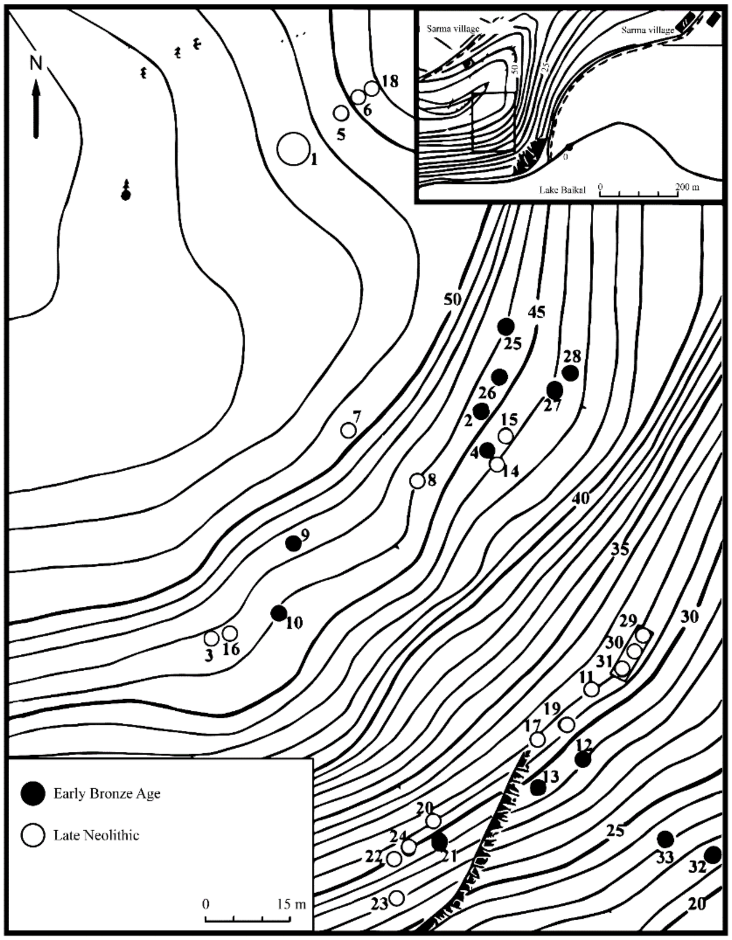

Figure 4.4. Map of Sarminskii Mys site layout (adapted from McKenzie 2010).

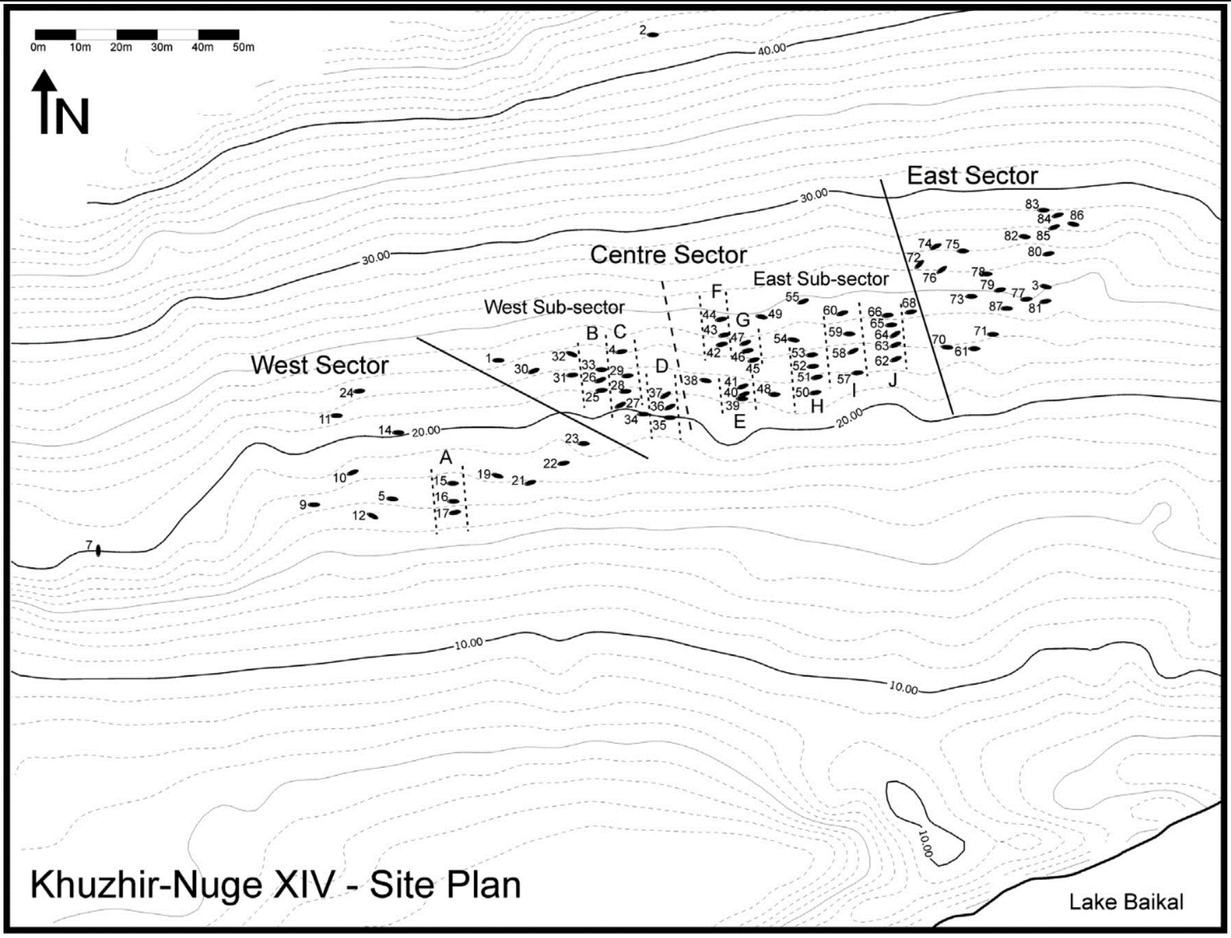

Figure 4.5. Map of Khuzhir-Nuge XIV with grave clusters, rows, and orientations indicated (adapted from Weber 2012).

Kurma XI. Kurma XI is located on the Little Sea's northwest (mainland) coast, ~15 km northeast of the Sarma River. A single grave at Kurma XI (Grave No. 8) was excavated by A.V. Kharinskii (Irkutsk State Technical University) in 1994. The remaining excavations at this site were conducted from 2002 to 2003, directed by Drs. O.I. Goriunova and Andrzej Weber. The cemetery contained graves dating to the Early Neolithic and the Early Bronze Age (Weber 2012), distributed between two spatial clusters. Early Bronze Age interments at this site featured relatively large numbers of grave goods, and all individuals present were over the age of 15 at the time of death, indicating that they may have enjoyed some sort of special status during life (e.g., McKenzie 2010; Shepard 2012).

Shamanskii Mys and Elga III. Both Shamanskii Mys and Elga III are located on the central northern shore of the Ol'khon Island (Figure 4.2). Elga III was situated on a slope near the shore of Lake Baikal, and also overlooked a small inland lake (Khonkhoy). Along with Iron Age materials, a single Neolithic grave at Elga III was excavated in 1959 as part of the Leningrad Branch of the Institute of Archaeology, USSR Academy of Sciences. The site was investigated further in 1988, when the Little Sea Branch of the KAE IGU excavated five additional Neolithic graves (Goriunova 1997). Shamanskii Mys (described in older literature alternately as Mys Burkhan or Khuzhir, see Konopatskii 1982) is situated on a peninsula along the northwest coast of the Ol'khon Island. The site featured 11 graves ranging in age from the Early Neolithic to the Early Bronze Age. Both the Late Neolithic and Early Bronze Age components of the site featured unique interments for their respective periods (Shepard 2012, see below).

$\delta^{13}C$ and $\delta^{15}N$ datasets

This dissertation also employs data on $\delta^{13}C$ and $\delta^{15}N$ ratios in human samples from different areas of the Cis-Baikal in order to investigate life-history patterns in the years prior to individuals' deaths. In most of the early work conducted by the Baikal-Hokkaido Archaeology Project (BHAP), these stable isotopic analyses of carbon and nitrogen were undertaken at the University of Calgary's Isotope Science Laboratory, under the supervision of Dr. M.A. Katzenberg (e.g., Katzenberg et al. 2009, 2012; Weber et al. 2011; but see also Lam 1994). More recently, BHAP researchers have conducted this work at the Oxford Radiocarbon Accelerator Unit (ORAU) in the United Kingdom (e.g., Bronk Ramsey et al. 2014; Schulting et al. 2014, 2015; Weber 2012; Weber et al. 2016a). As noted recently by Schulting et al. (2015), these studies demonstrate an offset between $\delta^{13}C$ and $\delta^{15}N$ values for the two datasets. Although the difference between these two datasets tends to be relatively small for any individual sample (≤ 1 ‰ in most cases for both $\delta^{13}C$ and $\delta^{15}N$), this offset is inconsistent. Rather than attempting to produce an offset correction – thereby creating considerable uncertainty for corrected values – here I have selected to employ stable isotope dataset from the University of Calgary Isotope Science Laboratory in all cases where I engage in high-resolution comparisons. This decision enables me to include samples from the large Khuzhir-Nuge XIV cemetery, for which only a small number of individuals have been analyzed at the ORAU as of now. Individuals from the Khuzhir-Nuge XIV cemetery represent a large portion of the sample I employ here, and it was deemed crucial to employ a dataset for $\delta^{13}C$ and $\delta^{15}N$ with good coverage of this site. For broad comparisons between the two periods (e.g., comparing average dietary values for the Late Neolithic and Early Bronzer Age), I also discuss Oxford data separately (I note these exceptions below wherever they occur). For coarse-grained comparisons of the two culture-historic groups in question, I also employ a single *combined* ("Averaged") dataset that incorporates stable isotopic values from the ORAU and Calgary laboratories.

Unfortunately, much of the $\delta^{13}C$ and $\delta^{15}N$ data available from both of the two stable isotope datasets (Oxford, Calgary) feature problems correlating individual samples with specific individuals from multiple burials at the Sarminskii Mys cemetery. These samples were originally collected in a manner that has made it impossible to associate available values with specific individuals described in the literature or with collections housed in the Irkutsk State University's "Baikal Region" Scientific-Research Center, and thus, with the $^{87}Sr/^{86}Sr$ data that I describe here.

In general, I have excluded all $\delta^{13}C$ and $\delta^{15}N$ data from previous BHAP samples for which there was any uncertainty as to the specific individual in question. As a result, the Late Neolithic dataset of individuals with known $\delta^{13}C$, $\delta^{15}N$, and $^{87}Sr/^{86}Sr$ values was small enough to prevent any meaningful synthesis of these datasets. Instead, I discuss the Late Neolithic exclusively in terms of strontium enamel values.

For both the Late Neolithic and Early Bronze Age datasets, I discuss patterning in terms of clusters of $^{87}Sr/^{86}Sr$ values separately for each tooth, first at the micro-regional level and then by chronological group (for Little Sea samples). Because of the small sample size and uncertain provenience of upper Lena individuals employed here, I do not attempt to conduct chronological comparisons within this group. These clusters are often somewhat subjective, and in many cases the two datasets are small enough that it is difficult to evaluate the importance of gaps in these values. However, this approach enables me to separate strontium enamel data into potentially meaningful groupings and then to evaluate these grouping against other attributes. Below I provide a brief summary of overall patterning in the $^{87}Sr/^{86}Sr$ data from each element and micro-region under study here. For the Little Sea micro-region, I discuss individual elements by time period. I then revisit the hypotheses outlined at the beginning of this chapter.

Overall patterning in $^{87}Sr/^{86}Sr$ data

An initial comparison of $^{87}Sr/^{86}Sr$ results from Little Sea and upper Lena River valley reveals clear differences between the two micro-regions (Tables 4.1 and 4.2). As predicted based on geological and environmental samples reported in the previous chapter (Chapter Three), $^{87}Sr/^{86}Sr$ ratios for each element were significantly lower for upper Lena River valley individuals than for Little Sea micro-region samples (M1: Mann-Whitney U=117, 2-tailed p-value=0.0003, n=69 [Little Sea], 11 [upper Lena]; M2: Mann-Whitney U=109, 2-tailed p-value=0.0001, n=63 [Little Sea], 12 [upper Lena]; M3: Mann-Whitney U=87, 2-tailed p-value=0.0015, n=49 [Little Sea], 10 [upper Lena]). These micro-regional differences are consistent with previous findings for stable isotopes of carbon and nitrogen, which suggested locally-focused subsistence practices among mid and late Holocene hunter-gatherers in the Cis-Baikal (e.g., Weber et al. 2002, 2011).

Because the hypotheses outlined above most pertain to distinct segments of individuals' life-histories, I present $^{87}Sr/^{86}Sr$ data (and data on stable isotopes of carbon and nitrogen, where these were available) in terms of each of the three elements (M1 through M3) analyzed here. I then provide a synthesis and discussion of these data.

TABLE 4.1 $^{87}Sr/^{86}Sr$ VALUES FOR ALL MOLARS BY MICRO-REGION

	M1		M2		M3	
	Upper Lena	Little Sea	Upper Lena	Little Sea	Upper Lena	Little Sea
Mean	0.71012	0.71282	0.71014	0.71226	0.71018	0.71183
s.d.	0.00188	0.00329	0.00222	0.00212	0.00192	0.00182
Minimum	0.70915	0.70915	0.70906	0.70903	0.70912	0.70906
Maximum	0.71551	0.72660	0.71707	0.71777	0.71541	0.71664
N	11	69	12	63	10	49

TABLE 4.2. HYPOTHESIZED "LOCAL" $^{87}Sr/^{86}Sr$ VALUES FOR UPPER LENA AND ANGARA MOLARS BY MICRO-REGION

	M1		M2		M3	
	Upper Lena	Angara River	Upper Lena	Angara River	Upper Lena	Angara River
Mean	0.70940	0.70983	0.70941	0.70968	0.70941	0.70971
s.d.	0.00019	0.00029	0.00024	0.00029	0.00015	0.00029
Minimum	0.70915	0.70933	0.70906	0.70926	0.70912	0.70931
Maximum	0.70966	0.71029	0.70981	0.71010	0.70959	0.71029
n	9	10	10	12	8	13
Range (mean +/– 2 s.d.)	0.70902-0.70978	0.70925-0.71041	0.70893-0.70989	0.70910-0.71026	0.70911-0.70971	0.70913-0.71029

Angara River and Upper Lena River "local ranges" are discussed in the previous chapter and below. The Angara River dataset employed here to derive a local range was originally published by Haverkort et al. (2010).

TABLE 4.3. LITTLE SEA $^{87}Sr/^{86}Sr$ VALUES FOR ALL MOLARS BY TIME PERIOD

	M1		M2		M3	
	Late Neolithic	Early Bronze Age	Late Neolithic	Early Bronze Age	Late Neolithic	Early Bronze Age
Mean	0.71482	0.71221	0.71317	0.71195	0.71343	0.71146
s.d.	0.00474	0.00234	0.00267	0.00183	0.00215	0.00154
Minimum	0.70940	0.70917	0.70903	0.70926	0.70906	0.70934
Maximum	0.72660	0.72126	0.71777	0.71709	0.71664	0.71598
n	17	51	16	47	9	40

Patterning in First Molar $^{87}Sr/^{86}Sr$ data

Upper Lena micro-region M1 values

M1 data for the 11 upper Lena River individuals analyzed here (Table 4.1, Figure 4.6) mostly fall within the $^{87}Sr/^{86}Sr$ range predicted for the micro-region on the basis of local faunal samples (see previous chapter; +/– 2 s.d. range: 0.70845 – 0.71137). As seen in Figure 4.6, a main cluster of nine individuals exhibited consistent, low values between 0.70915 and 0.70966 (n=9;

mean= 0.70940, s.d.=0.00019;). All values within this group fall within the lower half of the micro-region's +/– 2 s.d. terrestrial range. This finding is consistent with consumption of aquatic foods by individuals who inhabited the upper Lena micro-region.

The two other individuals for whom M1 samples were available from the upper Lena micro-region, a young adult who could not be sexed from the 1980 excavations at Makarovo (Grave No. 1), and an adult male (age 20+) excavated in 1971 at Obkhoi (Grave No. 13) – exhibited higher values. One of these (Makarovo, Grave No. 1) exhibited an M1 $^{87}Sr/^{86}Sr$ value of 0.71551, well above even the range predicted exclusively on the basis of local terrestrial fauna. Thus, it seems that this individual must have spent the early portion of their life outside the upper Lena valley.

The other outlier individual (Obkhoi, Grave No. 13) exhibited an $^{87}Sr/^{86}Sr$ value of 0.71120, at the upper end of the local terrestrial faunal signature determined in the previous chapter by the +/– 2 s.d. method (0.70845 – 0.71137). Although this individual value was within the predicted range, it is notable that his M1 value actually exceeded values for all faunal samples from the upper Lena micro-region. If this individual was born (and remained) in the local area during their early childhood, he would have had to consume a diet of virtually no aquatic foods for the entirety of this period. Since all human $\delta^{13}C$ and $\delta^{15}N$ samples from the prehistoric Cis-Baikal imply some contribution of fish to diet (Weber et al. 2002, 2011), it is unlikely that this individual consumed a diet that exclusively consisted of terrestrial resources.

It also does not appear likely that Obkhoi's location and the $^{87}Sr/^{86}Sr$ values of geological formations surrounding the site are related to this difference in values, both because the underlying bedrock geology surrounding this site is similar to rest of the micro-region and because other individuals sampled from nearby sites (e.g., Ust'-Tal'ma) exhibited low values (Ust'-Tal'ma, 1976 excavation, Grave No. 1, $^{87}Sr/^{86}Sr$ value=0.70915). Thus, this individual's signature is best explained as non-local. However, in any case, it is clear that this individual's childhood differed from the other upper Lena samples analyzed here.

Unfortunately, relatively few $\delta^{13}C$ and $\delta^{15}N$ values that would enable independent evaluation of the uniqueness of these two outlier individuals were available from Upper Lena human bone collagen samples. While no values were available for Makarovo, Grave No. 1, the outlier individual interred at Obkhoi, Grave No. 13 exhibited a $\delta^{13}C$ value of –20.3‰ and a $\delta^{15}N$ value of 11.1‰, well within the predicted range for the Upper Lena "GF" diet (Weber et al. 2002, 2011). While this individual may have been born non-locally (based on M1 values, representing the first 3 to 4 years of life), in later life he appears to have consumed a diet consistent with other locals.

When the +/– 2 s.d. approach was applied to the remaining nine "locals," it produced a range of 0.70902-0.70978, which I employ here as a hypothesized range of $^{87}Sr/^{86}Sr$ values for M1 samples from individuals raised in the upper Lena micro-region. These M1 values have important implications for the interpretation of enamel M1 values belonging to individuals interred in other areas of the Cis-Baikal. For example, in previous analyses of human samples from the Little Sea micro-region (Weber and Goriunova 2013, see discussion in previous Chapter Three), a group of 13 individuals exhibiting low M1 $^{87}Sr/^{86}Sr$ values (relative to other Early Bronze Age samples from Khuzhir-Nuge XIV cemetery) were designated as likely immigrants from the upper Lena. However, when these values are compared to the nine "local" M1 values from individuals interred in the upper Lena Valley, all but one sample (Khuzhir-Nuge XIV, Grave No. 77, $^{87}Sr/^{86}Sr$ value = 0.70966) actually exceed the upper Lena's +/– 2 s.d. range. The rest of these individuals exhibited M1 values from 0.70997 to 0.71196, well above the maximum value of 0.70978 for the nine upper

Lena individuals discussed here. This finding suggests that the early life-histories of these "non-local" individuals from Khuzhir-Nuge XIV may have differed both from other Little Sea micro-region individuals and from the majority of those interred in the upper Lena Valley.

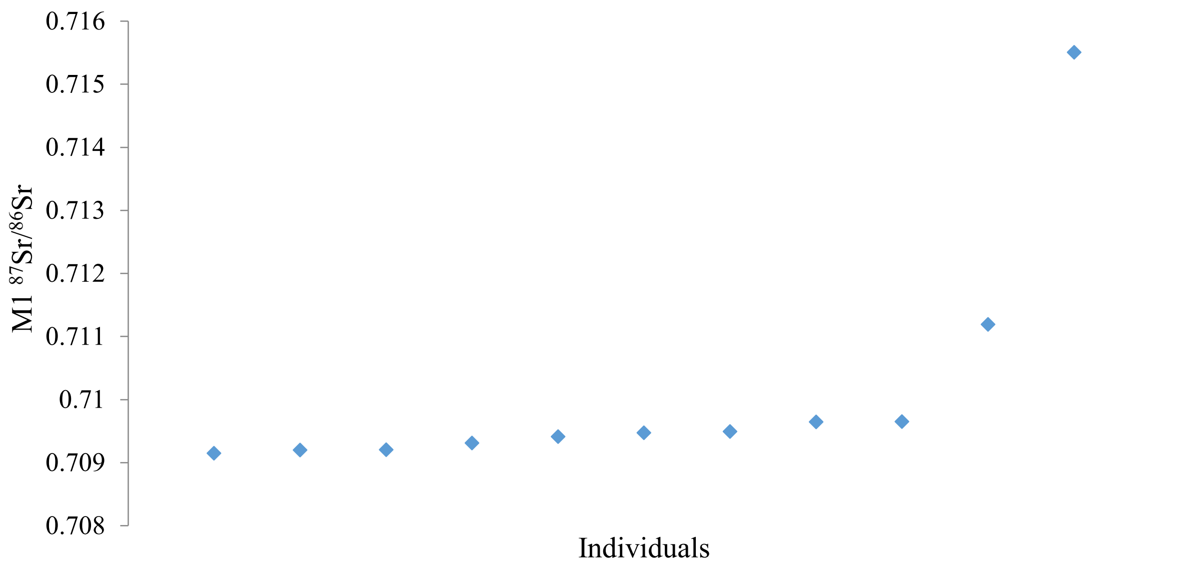

Figure 4.6. M1 $^{87}Sr/^{86}Sr$ values for individuals interred in the upper Lena micro-region.

Little Sea micro-region M1 values

For the Little Sea micro-region, $^{87}Sr/^{86}Sr$ values for first molars exhibited considerable heterogeneity, with a mean $^{87}Sr/^{86}Sr$ value of 0.71282 and a range of 0.70915 to 0.72660 (n=69, s.d.=0.00329). Seven of these individuals (10.1%) exhibited values within the local range for the upper Lena Valley (as determined through the +/– 2 s.d. method, employed with human samples for the upper Lena; Appendix 7). These included the two Early Neolithic M1 values (Sarminskii Mys, Grave No. 22; Khuzhir-Nuge XIV, Grave No. 7), as well as two from the Late Neolithic (Sarminskii Mys, Grave No. 31, Individuals 1 and 3), and three from the Early Bronze Age (Khuzhir-Nuge XIV, Graves No. 2, 58 [Individual 1], and 77).

When determining a local range for the Little Sea micro-region, Weber and Goriunova (2013) observed a break in the distribution of M1 values available for the Early Bronze Age component of Khuzhir-Nuge XIV, from 0.71196 to 0.71288. It is noteworthy that this pattern is not present in the updated M1 dataset (Figure 4.7). In this study, M1 values from seven individuals (all but one dating to the Early Bronze Age) fell into this range (Appendix 7), including four from Khuzhir-Nuge XIV (Graves No. 27 [Individual 2], 48, 50, and 53) that were not sampled in the original study because all featured an incomplete array of molars.

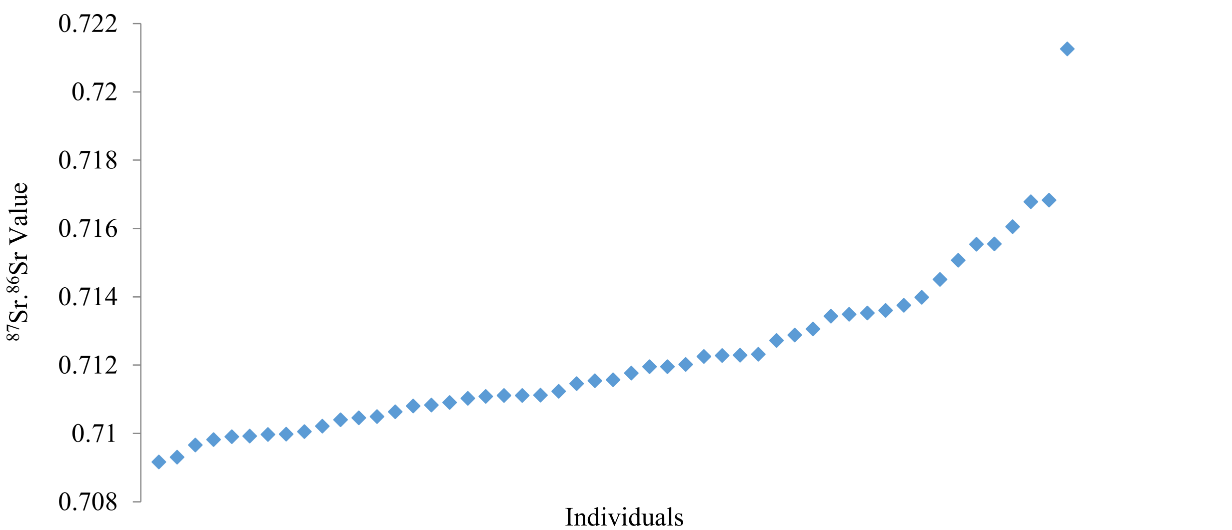

Figure 4.7. Early Bronze Age M1 $^{87}Sr/^{86}Sr$ values.

The Little Sea dataset was large enough to enable a comparison of the Late Neolithic and Early Bronze Age, and when values for these periods were analyzed separately, clear differences emerged that call into question any "lumped" analysis of the entire mid and late Holocene as a single dataset for the micro-region (Table 4.3, Figures 4.8, 4.9, 4.10). The difference between M1 values for the two periods exhibited statistical significance at the 0.05 level (Mann-Whitney U = 569, 2-tailed p value = 0.0183, 16 [Late Neolithic], n=51 [Early Bronze Age]). These different values suggest differences in geological catchment areas from which children and nursing mothers drew food resources – either due to different mobility practices or due to an emphasis on different diets within the same areas.

Variances for M1 values in the Late Neolithic and Early Bronze Age samples also differed significantly (F-test p-value=0.0001, n=16 [Late Neolithic], 51 [Early Bronze Age]), indicating greater diversity among Late Neolithic M1 values. The Late Neolithic featured nine individuals (56.3% of the total sample) with M1 values outside of Weber and Goriunova's (2013) "local" range of 0.71189 to 0.71712. Individuals exhibiting these "non-local" values were almost equally split between the two ends of this continuum; four featured values below 0.71189, and five featured values above 0.71712.

Similarly, the Early Bronze Age sample featured 28 individuals (54.9% of the total sample) with "non-local" values. However, only one of these individuals (Khuzhir-Nuge XIV, Grave No. 19, 1.9% of the total sample) exhibited a value *above* Weber and Goriunova's (2013) local range, compared to five individuals from the Late Neolithic (31.3% of the total sample). A Freeman-Halton Extension for the Fisher's Exact Test (for two-by-three cell contingency tables) indicates that these two periods differed significantly in terms of the proportions of individuals with values above and below the local range (Freeman-Halton Extension for Fisher's Exact Test 2-tailed p-value=0.0021; Table 4.4).

Overall, then, these two periods exhibited several significant differences that hint at changes in mobility and diet over the course of the Late Neolithic and Early Bronze Age. These included differences in values (Mann-Whitney U Test, Freeman-Halton Extension for Fisher's Exact Test) and variance (F-test). It would appear on the basis of these data that a large number of individuals interred in the Little Sea micro-region during the Early Bronze Age may have been born in other areas (specifically those featuring lower $^{87}Sr/^{86}Sr$ values). It is also possible that these individuals consumed a greater proportion of their diet from non-local terrestrial resources or aquatic resources from outside of the Sarma River and the Little Sea proper. In either of these cases, it is likely that Early Bronze Age groups would have employed different mobility strategies from hunter-gatherers during the Late Neolithic in order to procure these "non-local" resources.

TABLE 4.4 FISHER'S EXACT TEST WITH FREEMAN-HALTON EXTENSION FOR 2x3 CELL CONTINGENCY TABLE

	< Local Range	Local Range	> Local Range
Late Neolithic	4	7	5
Early Bronze Age	27	23	1

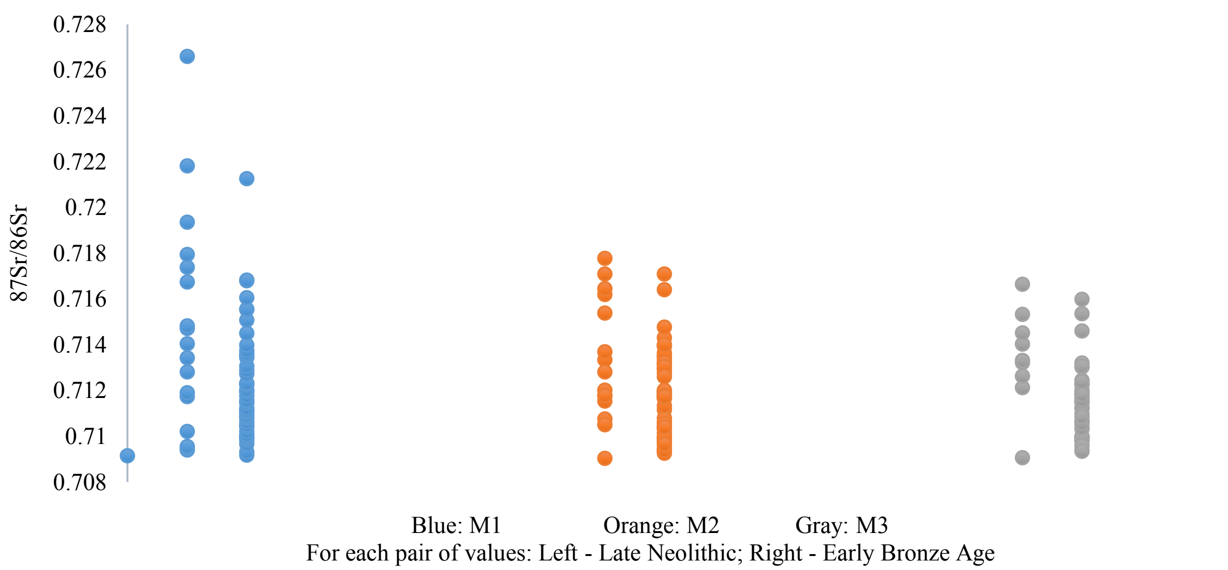

Figure 4.8. Little Sea $^{87}Sr/^{86}Sr$ values for all molars by time period.

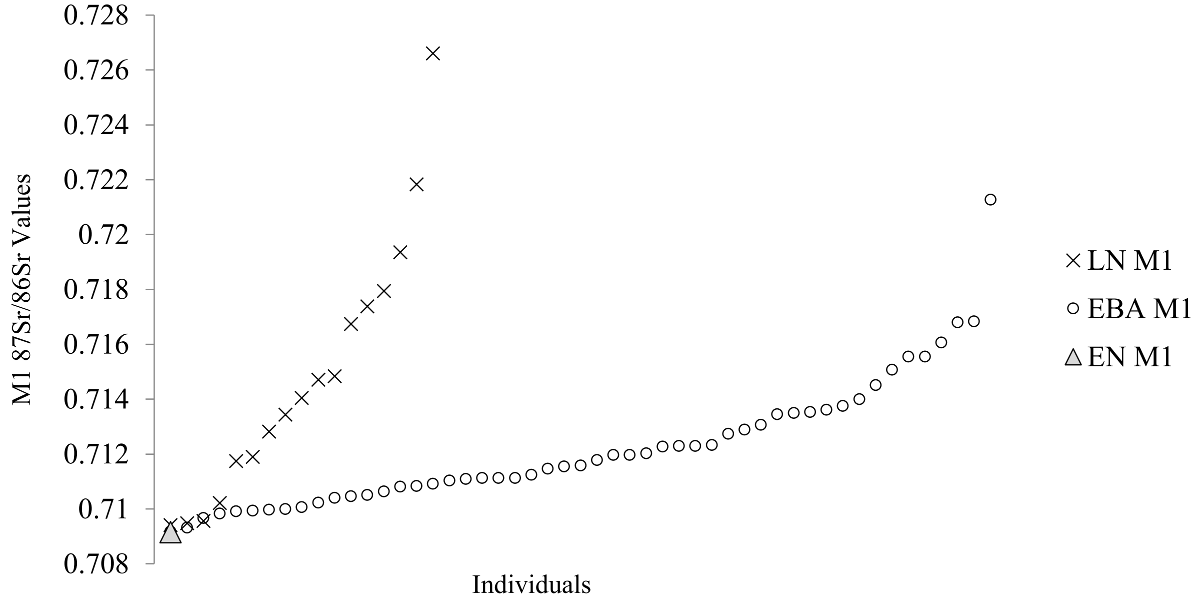

Figure 4.9. Little Sea M1 $^{87}Sr/^{86}Sr$ values by time period.

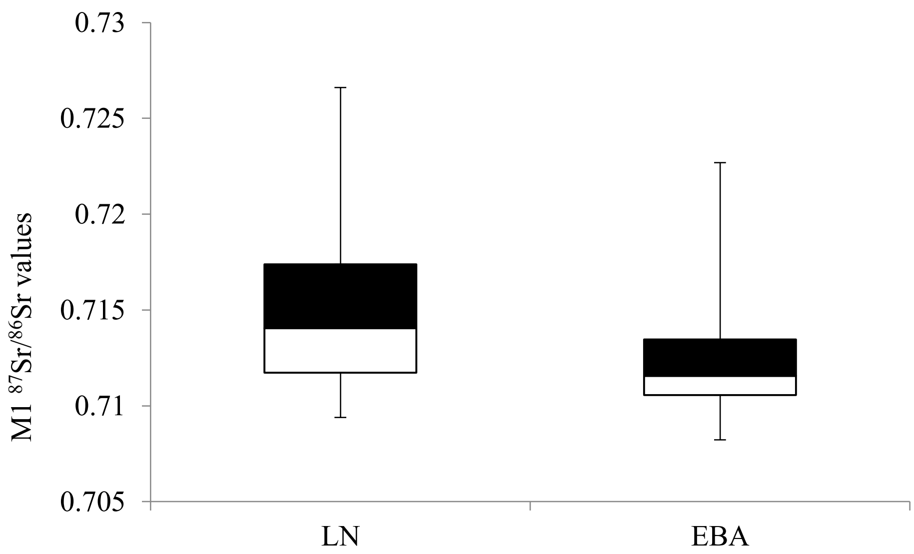

Figure 4.10. Boxplot of Late Neolithic and Early Bronze Age M1 values for Little Sea samples.

Little Sea micro-region M1 values: Late Neolithic

The Late Neolithic M1 dataset exhibited a range of $^{87}Sr/^{86}Sr$ values between 0.70948 and 0.72660 (Figure 4.11, n=16, mean= 0.71516, s.d. = 0.00468). For the purposes of discussing overall patterns in the data, I identify three heuristic clusters within this dataset, with values of 0.70948 to 0.71021 (Cluster 1, n=3), 0.71173 to 0.71483 (Cluster 2, n=7), 0.71674 to 0.71935 (Cluster 3, n=4), as well as two outliers that exhibited extremely high $^{87}Sr/^{86}Sr$ values of 0.72172 and 0.72660 (Elga III, Grave No. 5, and Sarminskii Mys, Grave No. 11A, individual 4). Although these heuristic clusters were determined based only on visual assessment, they provide a useful beginning for a discussion of geochemical variability in the Little Sea.

The Late Neolithic cluster exhibiting the lowest $^{87}Sr/^{86}Sr$ values (Cluster 1) contained three individuals interred at Sarminskii Mys. Two of these individuals exhibited values within the local range for the upper Lena River, as determined using the main cluster of values from the human M1 enamel (0.70902 to 0.70978, see above). These two individuals were interred together in a triple burial at Sarminskii Mys (Grave No. 31, Individuals 1 and 3). A third individual interred in the same grave (Grave No. 31, Individual 2), also exhibited a notable M1 value (0.71935), among the *highest* in the Late Neolithic dataset (in the fourth quartile and the highest cluster, above Weber and Goriunova's [2013] local range of 0.71189 to 0.71712). Thus, it appears that the Late Neolithic individuals interred in this grave consumed food resources from a diverse set of areas, all outside of the local range, and different from one another.

Another individual in Cluster 1 (Sarminskii Mys, Grave No. 11[A], Individual 1) exhibited a value of 0.71021, slightly above the range determined above for the upper Lena, but below the Little Sea micro-region's "local" $^{87}Sr/^{86}Sr$ signature that was determined by Weber and Goriunova (2013).

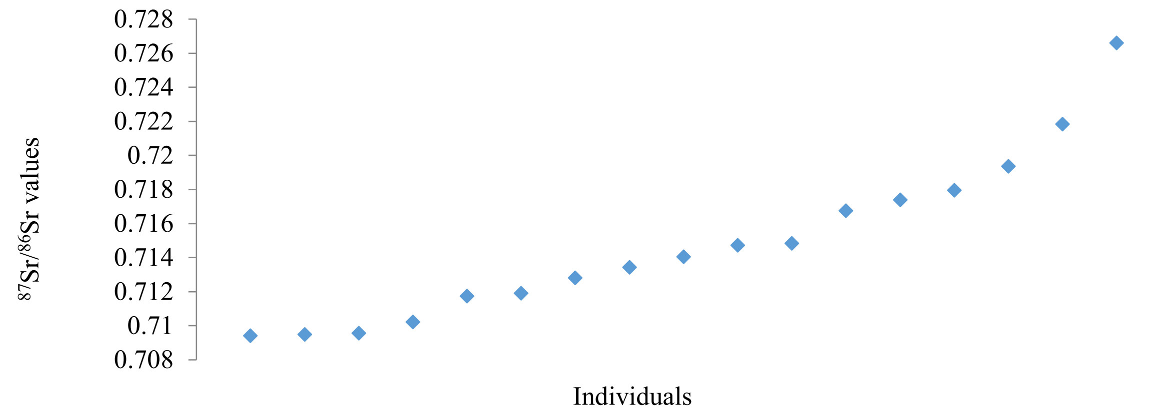

Figure 4.11. Little Sea M1 Late Neolithic $^{87}Sr/^{86}Sr$ values.

Little Sea micro-region M1 values: Early Bronze Age

The Early Bronze Age M1 dataset featured $^{87}Sr/^{86}Sr$ values ranging from 0.70917-0.72126 and an inter-quartile range of 0.00298 (0.71049 to 0.71347). These values clustered unevenly, however (Figures 4.9 and 4.10). For the purposes of discussion, I divide Early Bronze Age M1 data into heuristic clusters, with values of 0.70917 – 0.70931 (Cluster 1, n=2), 0.70966 – 0.71233 (Cluster 2, n=32), 0.71273 – 0.71306 (Cluster 3, n=3), 0.71344 – 0.71399 (Cluster 4, n=6), and 0.71451 – 0.71683 (Cluster 5, n=7). In addition, an adult female interred at Khuzhir-Nuge XIV (Grave No. 19) exhibited an exceptionally high $^{87}Sr/^{86}Sr$ value of 0.72126.

While data on stable isotopes of carbon and nitrogen from human bone collagen were generally absent for Late Neolithic samples, these data were largely available for individuals dating to the Early Bronze Age (e.g., Weber et al. 2011). A total of 43 individuals from the Early Bronze Age featured $^{87}Sr/^{86}Sr$ values for M1 as well as paired $\delta^{13}C$ and $\delta^{15}N$ data (Figure 4.12, Appendix 7). M1 $^{87}Sr/^{86}Sr$ values did not exhibit a strong correlation with either $\delta^{13}C$ or $\delta^{15}N$ (n=35 when all Early Bronze Age individuals below age seven were removed from the sample to correct for the effects of breastfeeding on $\delta^{13}C$ or $\delta^{15}N$ values; R^2=0.0647 for $\delta^{13}C$, p-value = 0.14022, 0.2128 for $\delta^{15}N$ p-value = 0.0053. R^2 values increased somewhat when outliers [discussed below] were removed from the sample, but still were below 0.5). Below I discuss the clusters I identified on the basis of $^{87}Sr/^{86}Sr$ values in terms of these stable isotopic data (on $\delta^{13}C$ and $\delta^{15}N$ values) where possible.

The two graves with the lowest $^{87}Sr/^{86}Sr$ values (Cluster 1) contained an unsexed individual aged 25-35 at death (Khuzhir-Nuge XIV, Grave No. 58.1) and another individual that could not be aged or sexed (Khuzhir-Nuge XIV, Grave No. 2). While no $\delta^{13}C$ or $\delta^{15}N$ values were available for the individual in Grave No. 2, the adult interred in Grave No. 58 (Individual 1) exhibited a $\delta^{15}N$ value in the GFS range (14.8‰). However, a $\delta^{13}C$ value of -16.7‰ for this individual was an outlier among Little Sea individuals sampled here. While these values are not so far outside the Little Sea range as to indicate that the individual interred at Khuzhir-Nuge XIV in Grave No. 58 (Individual 1) *must have* spent the period of their life represented by these stable isotope values in a different micro-region, it is interesting to note that Weber et al. (2011) observed similar $\delta^{13}C$ values among Early Neolithic samples interred in the South Baikal (Figure 3.3).

Because almost no stable isotopic values for carbon and nitrogen were available from Early Bronze Age samples in the South Baikal during this analysis (but see Weber et al. 2016a for new data from ORAU), here I use Early Neolithic data as a proxy for Early Bronze Age diets in that area. While Early Neolithic diets and mobility practices likely differed somewhat from later Early Bronze Age practices, these values provide a starting point to assess micro-regional geochemical differences. These data suggest that the individual interred at Khuzhir-Nuge XIV, Grave No. 58 (Individual 1) may have spent their adult life at least partially in an area both outside the Little Sea micro-region and outside the area where other individuals exhibiting low M1 $^{87}Sr/^{86}Sr$ values resided (possibly in the South Baikal).

Notably, another individual who was designated a probable male, aged 35 to 50 years at death was also interred in Grave No. 58 (Grave No. 58, Individual 2), along with this "South Baikalian" young adult. This second individual also exhibited a relatively low value for M1 (0.71083; this value fell within Cluster 2) as well as a GFS diet ($\delta^{13}C$ and $\delta^{15}N$ values of –17.6‰ and 14.8‰, respectively). This $\delta^{13}C$ value appears closer to Little Sea values, but is also not outside the range of the South Baikal (See discussion in previous chapter; Table 3.8). While it remains possible that these values represent a GFS diet within the Little Sea micro-region, it is interesting to note that they are also consistent with the South Baikal.

Cluster 2 contained a total of 32 individuals, with relatively continuous M1 $^{87}Sr/^{86}Sr$ values ranging from 0.70966 – 0.71233. $\delta^{13}C$ and $\delta^{15}N$ values were available for 27 of these, and spanned the full range of values for $\delta^{15}N$, with nearly as much variation for $\delta^{13}C$ (Figure 4.12). Eight individuals from Cluster 2 exhibited the lowest $\delta^{15}N$ values of all Early Bronze Age samples ($\delta^{15}N$=10.3‰ – 11.8‰). Seven of these were interred at Khuzhir-Nuge XIV (Graves No. 27 [Individual 1], 35 [Individuals 1 and 2], 37 [Individuals 1 and 2], 59 [Individual 1], 77), and one was interred at Kurma XI (Grave No. 1).

This 11.8 cutoff was lower than the highest "GF" values that Weber et al. (2011:543) observed in their study of $\delta^{13}C$ and $\delta^{15}N$ values throughout the Little Sea micro-region. However, individuals with higher $\delta^{15}N$ values that still fell within the "GF" range showed greater diversity in terms of their strontium isotopic ratios (Figure 4.12). Of the eight individuals in Cluster 2 with $\delta^{15}N$ values in this "low-GF" group ($\delta^{15}N$=10.3‰ – 11.8‰), seven also exhibited the lowest $\delta^{13}C$ values of the entire Early Bronze Age dataset ($\delta^{13}C \leq -19.4$‰). Most of the individuals in Cluster

2 that exhibited $\delta^{15}N$ values of 11.8 or lower could not be sexed, although two were males (Appendix 7; Kurma XI, Grave No. 1 and Khuzhir-Nuge XIV, Grave No. 27, ages 25-30 and 35-50, respectively), and one was a probable male (Khuzhir-Nuge XIV, Grave No. 35.1, aged 18 to 20). When $\delta^{13}C$ and $\delta^{15}N$ values of individuals in Cluster 2 (n=27) were compared to those from other clusters (n=16), values differed significantly ($\delta^{13}C$ Mann-Whitney U=319, 2-tailed p-value=0.0099; $\delta^{15}N$ Mann-Whitney U=321.5, 2-tailed p-value=0.0083). This difference largely owes to the presence of GF diets with especially low $\delta^{13}C$ and $\delta^{15}N$ values (even for the GF range that Weber and Goriunova [2013] describe).

Cluster 2 also featured several individuals with *high* $\delta^{13}C$ or $\delta^{15}N$ values, possibly indicating unique dietary regimes (Figure 4.12). A young male (age 18 to 20) interred at Khuzhir-Nuge XIV (Grave No. 51) exhibited $\delta^{13}C$ and $\delta^{15}N$ values of -17.5‰ and 13.5‰, respectively ($^{87}Sr/^{86}Sr$ value=0.71109). These values set this individual apart from the rest of the Little Sea Early Bronze Age sample. The M1 value of 0.71109 is below the minimum of Weber and Goriunova's (2013) local range for the Little Sea micro-region, suggesting a non-local birth, and the $\delta^{13}C$ and $\delta^{15}N$ values for this individual fall within the range that Weber et al. (2011) documented for the South Baikal Early Neolithic (Figure 3.4). Thus, it is possible that this individual spent both their early life and the 5-10 years prior to their death outside the Little Sea.

Individuals with associated $\delta^{13}C$ and $\delta^{15}N$ data assigned to Clusters 3-5 (exhibiting $^{87}Sr/^{86}Sr$ values ranging from 0.71273 – 0.71683) all featured $\delta^{13}C$ and $\delta^{15}N$ values that placed them outside of the low-GF dietary group in the lower left quadrant of Figure 4.12, although one member of Cluster 5 (Kurma XI, Grave No. 15) exhibited a "GF" signature. Two individuals with particularly high M1 $^{87}Sr/^{86}Sr$ values (within Cluster 5, in the 4th quartile of M1 $^{87}Sr/^{86}Sr$ results) were interred next to one another at Khuzhir-Nuge XIV (Graves 63 and 64, $^{87}Sr/^{86}Sr$ values of

0.71606 and 0.71679, respectively). One was 16 to 18 years old at death and could not be sexed (Grave No. 63) and the other was a male, age 25 to 35 at death (Grave No. 64). These individuals appear to have consumed local diets during youth and local GFS diets in the years prior to their deaths ($\delta^{13}C$ values of -17.9‰ and -17.6‰, $\delta^{15}N$ values of 15.4). It is notable that the similar life histories of these two individuals – as represented by stable isotopes of carbon, nitrogen, and strontium, appear to have parallels in the similar treatments they received in death.

To establish a local set of M1 values for these data, I calculate a range of 2 s.d. around the mean of all $^{87}Sr/^{86}Sr$ values from M1 clusters associated exclusively with "local" GFS diets (after Price et al. 2002; Weber and Goriunova 2013). The adult female outlier that exhibited an extremely high $^{87}Sr/^{86}Sr$ value (Khuzhir-Nuge XIV, Grave No. 19) was excluded from this analysis due to the gap between the M1 value for this individual and all others from the Early Bronze Age. This approach produced a range of 0.71169 – 0.71716 (n=16; Clusters 3 – 5). When this approach was expanded to include Early Bronze Age *and* Late Neolithic individuals with values that fell within the range of Early Bronze Age M1 Clusters 3 – 5, it produced nearly identical values of 0.71176 – 0.71710 (n=22). Both sets of values are similar to Weber and Goriunova's (2013) local range of 0.71189 – 0.71712. It is also noteworthy that the minimum values for these ranges correspond to the minimum boundary for the Late Neolithic M1 Cluster 2 (0.71173), which appeared to feature individuals born locally.

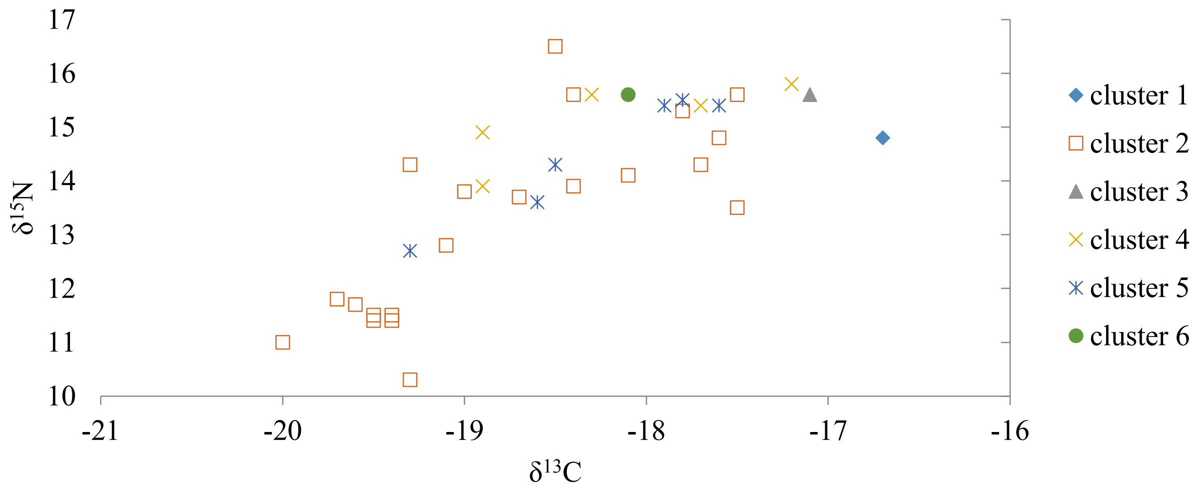

Figure 4.12. Early Bronze Age $\delta^{13}C$ and $\delta^{15}N$ values from bone collagen, grouped by M1 $^{87}Sr/^{86}Sr$ heuristic cluster.

For the above figure, individuals were assigned to heuristic groups based on $^{87}Sr/^{86}Sr$ values. Only EBA individuals are included here. Cluster 1: 0.70917 – 0.70931 (n=1). Cluster 2: 0.70966 – 0.71233 (n=21). Cluster 3: 0.71273 – 0.71306 (n=1). Cluster 4: 0.71344 – 0.71399 (n=5). Cluster 5: 0.71451 – 0.71683 (n=6). Cluster 6: 0.72126 (n=1, this individual was an outlier). Only individuals with available $^{87}Sr/^{86}Sr$, $\delta^{13}C$, and $\delta^{15}N$ values are included in this figure, although cluster ranges were determined based on all available $^{87}Sr/^{86}Sr$ values. Individuals younger than seven years old at death are not included here to control for the effects of weaning on carbon and nitrogen isotopic signatures.

Little Sea micro-region M1 values: Early Neolithic

The two Early Neolithic M1 elements analyzed in this study exhibited some of the lowest $^{87}Sr/^{86}Sr$ values of 0.70915 (Sarminskii Mys, Grave No. 22) and 0.70940 (Khuzhir-Nuge XIV, Grave No. 7). This suggests either a different local dietary regime than the diets that later groups employed (most likely emphasizing resources from the lake) or that this individual employed a different geological catchment area outside of the Little Sea micro-region. Previous studies of Early Neolithic subsistence patterns in the Cis-Baikal suggest greater emphasis on aquatic resources during this period, which is consistent with these data.

Patterning in Second Molar $^{87}Sr/^{86}Sr$ data

Upper Lena micro-region M2 values

The M2 data for the upper Lena samples showed similar clustering to the M1 dataset (Figure 4.13). A "main group" contained 10 individuals and exhibited a range of values from 0.70906 to 0.70981 (n=10, mean=0.70941, s.d. = 0.00024). Using the +/– 2 s.d. method advocated by Price et al. (2002), these 10 individuals produce a "local" range of 0.70893 – 0.70989 for M2. These values correspond almost perfectly with the local range determined above using M1 values for this micro-region. In fact, local individuals' M2 values, representing the diets and mobility patterns of older children, are not expected to be identical to M1 values, since mobility patterns and diets may have changed as children aged. The correspondence of upper Lena M1 and M2 datasets suggests that these age groups primarily consumed local resources throughout childhood, and that these resources were likely similar. In particular, it is noteworthy that the main groups for the upper Lena M1 and M2 samples appear to have exhibited similar variances (F-Test p-value=0.4853, n=9 [M1], 10 [M2]), indicating no difference in overall mobility between the two groups that these sets of molars represent.

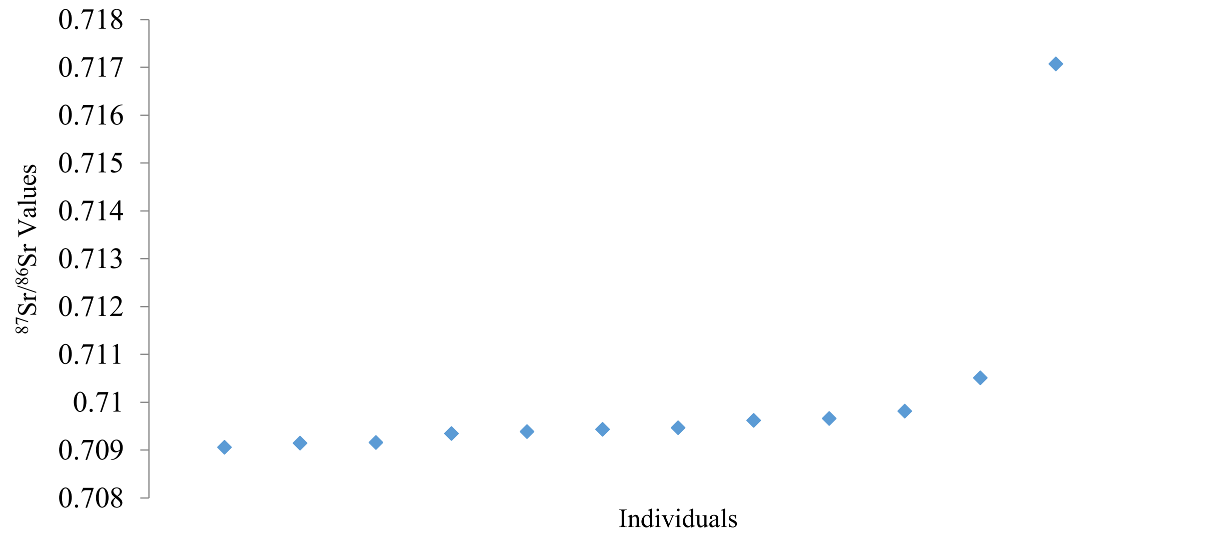

Figure 4.13. M2 $^{87}Sr/^{86}Sr$ values for upper Lena individuals.

As discussed above, M1 $^{87}Sr/^{86}Sr$ values can be interpreted as an indicator of the foraging area of nursing mothers, as the enamel for these teeth generally forms before age five. In contrast, M2 values represent later childhood, and can thus be taken as a representation of mobility practices for family groups that included more self-sufficient (weaned) children. The lack of distinction between these two sets of values (for M1 and M2) is consistent with arguments that upper Lena groups practiced highly mobile lifestyles or large-scale food-sharing, with nursing women consuming similar resources (from similar areas) to those that other individuals – who could have potentially participated in relatively short foraging trips – consumed. Another possible interpretation of this data is that nursing women and older children may have practiced similar mobility patterns, but that these may have differed somewhat from the movements (and related diets) of groups of adolescents and adults, particularly adult males and women who were not nursing or caring for older children. These interpretations are discussed in greater detail below.

A young adult male (age 20 to 25 at death) interred at Obkhoi (Grave No. 13, discussed above) exhibited a slightly elevated M2 $^{87}Sr/^{86}Sr$ value of 0.71051, consistent with his elevated

M1 value (0.71120). Another clear outlier for the upper Lena M2 dataset was interred at Makarovo (Grave No. 1, discussed above). This individual again exhibited an extremely high M2 value (0.71707) that exceeded M2 values from all but one individual from either the upper Lena or the Little Sea. Relative to other individuals interred in the upper Lena, the outlier values that this individual exhibited for M1 and M2 suggest a unique early life history. Further, the elevated M2 value that this individual produced indicate a diet or catchment area not only for the local area, but for Cis-Baikal hunter-gatherers more broadly. At the very least, it is clear that this individual must have spent the later portion of their childhood outside the upper Lena Valley.

Little Sea micro-region M2 values

For the Little Sea micro-region, some clustering was apparent in the overall M2 dataset (n=63; Figure 4.14). The distribution of values for the two periods hint at similar patterns to those documented for the M1 dataset, with the Late Neolithic exhibiting a higher maximum, minimum, first and third quartile, and median values than the Early Bronze Age (Figure 4.15, 4.16). A Mann-Whitney U Test did not reveal a significant difference in values between the Late Neolithic and Early Bronze Age samples, although the p-value approached significance (Mann-Whitney U=455, 2-tailed p-value=0.0930, n=47 [Early Bronze Age], 15 [Late Neolithic]).

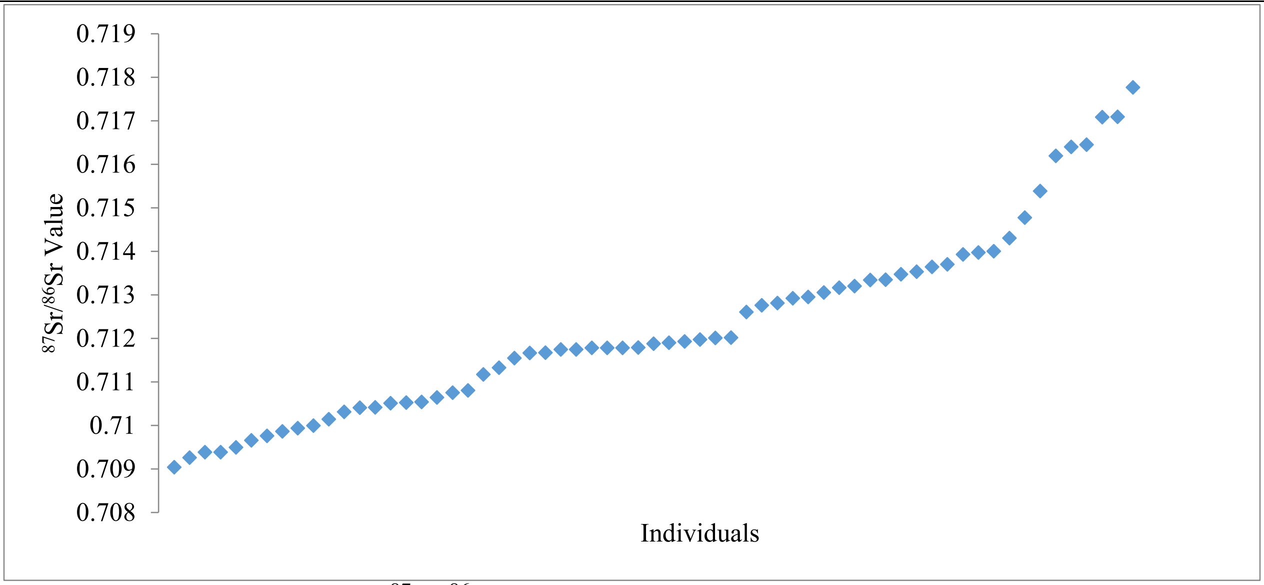

Figure 4.14. M2 $^{87}Sr/^{86}Sr$ values for little sea micro-region individuals.

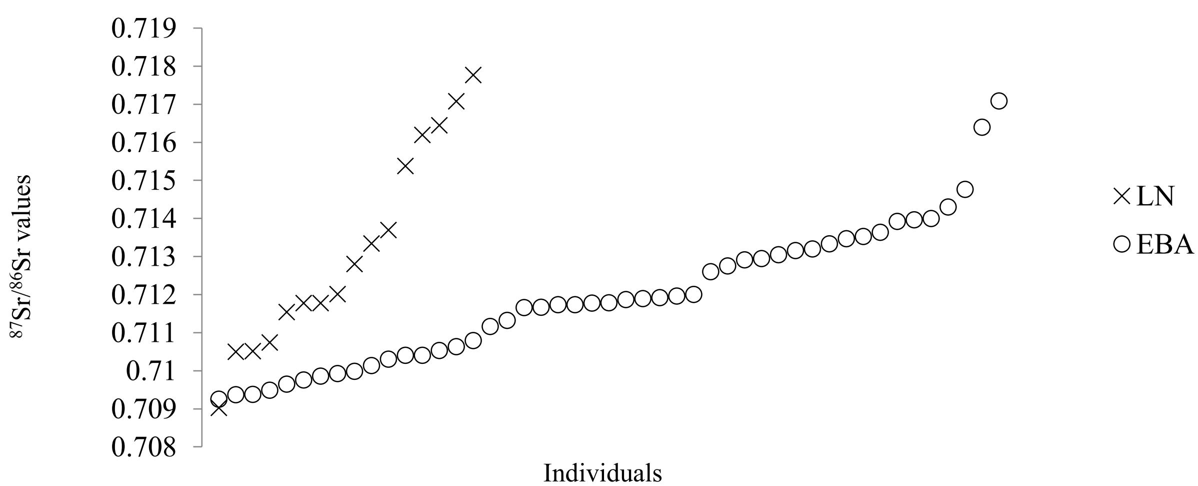

Figure 4.15. Little Sea micro-region M2 $^{87}Sr/^{86}Sr$ values by time period.

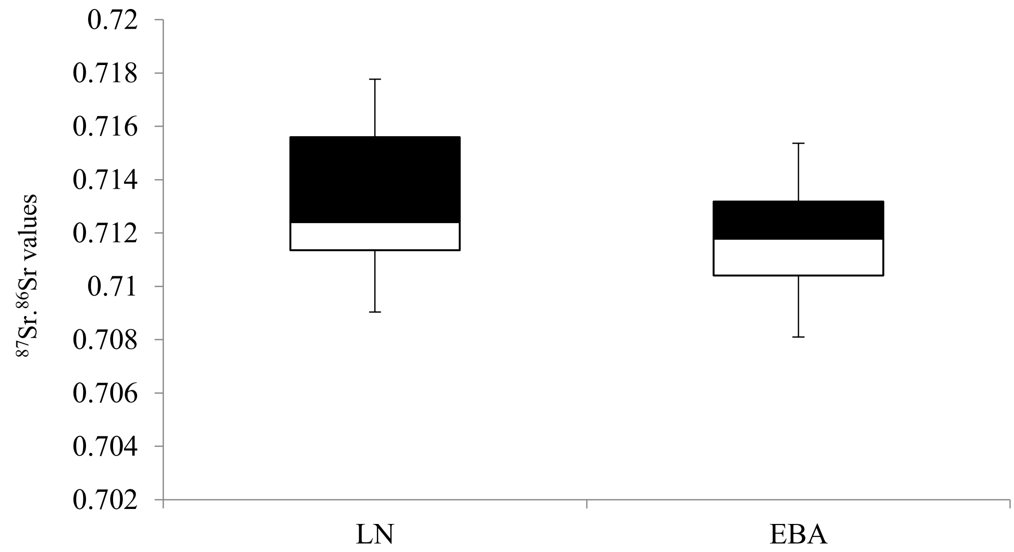

Figure 4.16. Boxplot of Late Neolithic and Early Bronze Age M2 $^{87}Sr/^{86}Sr$ values for Little Sea individuals.

While the values of Late Neolithic and Early Bronze Age M2 datasets did not exhibit significant differences, an F-test revealed a significant difference between the variances of two periods (p-value=0.0547, n=15 [Late Neolithic], 47 [Early Bronze Age]). Again, Late Neolithic individuals exhibited a wider distribution of values than the Early Bronze Age dataset. The Late Neolithic dataset (n=15) featured only one individual with an M2 value in the upper Lena "local" range (0.70893 – 0.70989), while the Early Bronze Age (n=47) featured seven. A Fisher's Exact Test revealed no statistically significant difference between these two patterns (2-tailed p-value=0.6667), indicating that both periods featured roughly similar proportions of individuals who experienced late childhood mobility and dietary regimes like those of upper Lena populations.

It is also interesting to note that Late Neolithic dataset featured a discontinuity between the single sample exhibiting a non-local signature (0.70903) and the next-lowest $^{87}Sr/^{86}Sr$ values (0.71051). In contrast, the Early Bronze Age dataset featured a more continuous gradient from low to intermediate values (0.70926 – 0.71201; Figure 4.15). The relatively small number of available samples from the Late Neolithic make it difficult to draw conclusions about the nature of this gap. However, it is plausible that this continuous range of relatively low Early Bronze Age values indicates that children during this time period consumed different diets or engaged in different mobility patterns than their Late Neolithic ancestors, who appear to have exhibited a clear-cut difference between non-local (low) and local (intermediate) M2 $^{87}Sr/^{86}Sr$ values.

No M2 samples from either of the two periods under study here featured values between 0.71202 and 0.71260. This gap may indicate that some meaningful difference between broad catchment areas (and related mobility strategies) affected young individuals of both periods during M2 formation. Curiously, this break in M2 $^{87}Sr/^{86}Sr$ values corresponds well with Weber and Goriunova's (2013) observation that the M1 data from the Early Bronze Age component at Khuzhir-Nuge XIV featured a gap between $^{87}Sr/^{86}Sr$ values of 0.71196-0.71288. The proportion of individuals above and below this gap did not differ significantly between the two periods (χ^2=1.06, p-value=0.3032, df=1).

The exact range of values for this gap differed only slightly between the Late Neolithic and Early Bronze Age samples. For the Late Neolithic dataset, it occurred between 0.71202 and 0.71281, while the Early Bronze Age gap ranged from 0.71201 – 0.71260. It was impossible to test the correlation of $^{87}Sr/^{86}Sr$ ratios and isotopes of carbon or nitrogen among Late Neolithic groups due to the extremely limited data on these isotopes for these samples. However, the fact that both the Late Neolithic and Early Bronze Age datasets featured gaps at similar points is suggestive. For the Early Bronze Age sample, when individuals were grouped based on $^{87}Sr/^{86}Sr$ values ($\leq$ 0.71201, n=21; $\geq$ 0.71260, n=15), $\delta^{15}N$ values for the two groups exhibited considerable difference that approached statistical significance (Mann-Whitney U=214.5, 2-tailed p-value = 0.0703), with the high-$^{87}Sr/^{86}Sr$-values group also exhibiting higher $\delta^{15}N$ values. Although these groups did not exhibit a significant difference in terms of $\delta^{13}C$ values (Mann-Whitney U=194, 2-tailed p-value = 0.246), it appears likely that some meaningful dietary distinction between individuals whose childhood diets featured lower and higher $^{87}Sr/^{86}Sr$ values.

Little Sea micro-region M2 values: Late Neolithic

Late Neolithic samples from the Little Sea micro-region's Late Neolithic exhibited values between 0.70903 and 0.71777 (Figure 4.15, n=15, mean=0.71333, s.d.=0.00268). Several clusters of $^{87}Sr/^{86}Sr$ values could be distinguished within these data, with values of 0.71051 – 0.71051 (Cluster 1, n=2), 0.71155 – 0.71202 (Cluster 2, n=4), 0.71281 – 0.71370 (Cluster 3, n=3), and 0.71539 – 0.71777 (Cluster 4, n=5). In addition, a single outlier with a low $^{87}Sr/^{86}Sr$ value (0.70903) was interred in a multiple burial at Sarminskii Mys, (Grave No. 31, Individual 1). This was the only Late Neolithic sample exhibiting an M2 value that fell within the upper Lena "local" M2 range (0.70893 – 0.70898, see above). This adult male (age 30 to 40) also exhibited an M1 value within that element's "upper Lena" range (0.70940).

The lowest cluster contained two individuals with M2 $^{87}Sr/^{86}Sr$ values ranging from 0.70903 to 0.71051 (M2 Cluster 1). These individuals were interred at Sarminskii Mys (Graves No. 11B, and 31 [Individual 3]). One of these was designated as a probable male (Sarminskii Mys, Grave No. 11B), and one was designated as a probable female (Sarminskii Mys, Grave No. 31, Individual 3; Appendix 7). One of these individuals exhibited M1 values within the upper Lena range, while the M1 value for Sarminskii Mys, Grave No. 11B (0.71190) was above this range and was within the Little Sea micro-region's local range. This individual appears to have spent the earlier part of their life in the Little Sea micro-region, but may have spent the majority of their later childhood (represented by M2 values) in geological catchment areas with lower $^{87}Sr/^{86}Sr$ signatures.

The next cluster (M2 Cluster 2) contained four individuals, interred at Sarminskii Mys (Graves No. 11A [Individual 1] and 19 [Individuals 1 and 2]) and Elga III (Grave No. 1), with $^{87}Sr/^{86}Sr$ values ranging from 0.71155 – 0.71202. Only one of these individuals – an older adult female interred at Sarminksii Mys, Grave No. 19 (Individual 2, 45 to 49 years old at death) – could be sexed. All of these individuals exhibited M1 values in the lower half of the range for that element, indicating at least somewhat consistent early life histories.

Another cluster of three individuals exhibited M2 $^{87}Sr/^{86}Sr$ values between 0.71281 – 0.71370 (M2 Cluster 3). These individuals were interred at Sarminskii Mys (Graves No. 17, 19 [Individual 4], and 31 [Individual 2]). Only one, a 20 to 35-year-old male (Sarminskii Mys, Grave No. 17) could be sexed. All three individuals exhibited relatively high M1 $^{87}Sr/^{86}Sr$ values ($\geq$ 0.71471, exceeding terrestrial faunal maxima for all areas considered in the previous chapter, except for the Little Sea, the west coast of Lake Baikal, and the western Angara valley). It appears that these individuals spent their late childhoods in the local area.

M2 Cluster 4 was somewhat diffuse, consisting of five individuals with high M2 $^{87}Sr/^{86}Sr$ values ranging from 0.71539 – 0.71777 (Sarminskii Mys: Grave No. 11A, Individuals 2, 3, and 4; and Grave No. 30, Individual 1; Elga III, Grave No. 5). Only one of these individuals – Elga III, Grave No. 5 – could be sexed; this individual was classified as a probable female. The lowest M1 value among individuals in this cluster was 0.71404, which is also higher than the terrestrial faunal maxima for all areas in the Cis-Baikal except for the Little Sea, west coast of Lake Baikal, and the western Angara valley. These individuals most likely spent their entire childhoods locally. Within this cluster, the two individuals who exhibited the highest M2 $^{87}Sr/^{86}Sr$ values (Elga III, Grave No.

5: 0.71708; and Sarminskii Mys, Grave No. 11A, Individual 4: 0.71777) also exhibited the highest strontium isotopic values for M1 (0.72182 and 0.72660, respectively), again indicating continuity in diet and geologic area during early and late childhood.

Little Sea micro-region M2 values: Early Bronze Age

For the Early Bronze Age, M2 $^{87}Sr/^{86}Sr$ values ranged from 0.70926-0.71709 and exhibited an inter-quartile range of 0.0027 (0.71041 – 0.71318). For heuristic purposes, I identify three somewhat diffuse clusters, with $^{87}Sr/^{86}Sr$ values of 0.70926 – 0.71132 (M2 Cluster 1, n=18), 0.71166 – 0.71201 (M2 Cluster 2, n=11), 0.71260 – 0.71477 (M2 Cluster 3, n=16), and two outliers with values of 0.71640 and 0.71709 (Figure 4.15). Of the 47 Early Bronze Age individuals for whom M2 $^{87}Sr/^{86}Sr$ values were available, 36 featured $\delta^{13}C$ and $\delta^{15}N$ data and were over the age of seven at death (individuals below age seven were removed due to breastfeeding effects). M2 $^{87}Sr/^{86}Sr$ values appear somewhat correlated with $\delta^{13}C$ values (R^2=0.683, n=36, p-value = 0.1235), but did not exhibit a strong correlation for $\delta^{15}N$ (R^2=0.2061, n=36, p-value = 0.0054). Below I discuss each of these clusters in more detail, comparing $\delta^{13}C$ and $\delta^{15}N$ values where relevant.

M2 Cluster 1 featured $^{87}Sr/^{87}Sr$ values ranging from 0.70926 – 0.71132, and thus likely represented late childhoods spent outside the local area. Seven of these individuals exhibited values within the M2 local range for the upper Lena River (0.70893 – 0.70989). The proportion of individuals with upper Lena values did not differ significantly for the two periods (Fisher's Exact Test 2-tailed p-value=0.6673). It is also noteworthy that of the 12 individuals in M2 Cluster 1 with associated $\delta^{13}C$ and $\delta^{15}N$ values, seven exhibited "non-local" GF diets (Figure 4.17). In contrast, of 24 individuals with $^{87}Sr/^{86}Sr$ values above the range for M2 Cluster 2, only one featured a GF diet, demonstrating a significant difference between the diets of adults who spent their late childhoods in the non-local area, as opposed to the seasonal rounds and areas represented by the M2 Cluster 2 signature (Fisher's Exact Test 2-tailed p-value=0.00064). Five individuals with M2 values consistent with upper Lena samples featured associated $\delta^{13}C$ and $\delta^{15}N$ data. All but one of these individuals featured GF diets, and the GFS individual (Khuzhir-Nuge XIV, Grave No. 58, Individual 1, discussed below) also appears to have had a unique life history for the micro-region (see above).

Three outliers stood out in M2 Cluster 1. First, an unsexed individual (age 12-15) interred at Khuzhir-Nuge XIV (Grave No. 77) exhibited a $\delta^{15}N$ value of 10.3‰, below the rest of the GF group of Little Sea micro-region samples (Figure 3.3, Appendix 5 This individual exhibited M1 and M2 values of 0.70966 and 0.70949, respectively. All of these data (M1 and M2 values, $\delta^{13}C$ and $\delta^{15}N$ values) are consistent with the upper Lena micro-region. An unsexed adult (age 25 to 35 at death) interred at Khuzhir-Nuge XIV (Grave No. 58.1) also exhibited a uniquely high $\delta^{15}N$ value of –16.7‰, the highest of all samples examined in this study. Another individual – Khuzhir-Nuge XIV, Grave No. 48 (M2 $^{87}Sr/^{86}Sr$ value=0.71174) – exhibited a high $\delta^{15}N$ value of 16.5‰ (discussed above).

Further, although sex data for Little Sea individuals featuring M1 and M2 values were each relatively poor, when these datasets were combined, a tentative analysis of $^{87}Sr/^{86}Sr$ values with respect to gender was possible. This combined dataset included individuals who could be sexed but lacked either M1 or M2 elements to sample for this study. 22 males and eight females dating to the Early Bronze Age featured $^{87}Sr/^{86}Sr$ data for either M1 or M2 ("probable males" and "probable females" were included here). Eight males exhibited at least one non-local $^{87}Sr/^{86}Sr$ value for M1 or M2, indicating use of non-local catchment areas for some prolonged period in early life. Females differed significantly from males, as seven of the eight females exhibited at least one non-local value for either M1 or M2 (Fisher's Exact Test 2-tailed p-value=0.035).

Although these results must be viewed as only tentative because of the sample size of this dataset, it is possible to suggest here that differences existed in the Early Bronze Age with respect to rates of male and female permanent migrations to the Little Sea. One plausible interpretation is that Early Bronze Age groups in this part of the Cis-Baikal employed patrilocal post-marital residence practices. Among societies subsisting primarily by hunting-and-gathering, cross-cultural comparisons have demonstrated a correlation between reliance on fishing and patrilocal post-marital residence practices (e.g., Ember 1975). Thus, given the importance of fishing (and other aquatic foods such as seal) in the Little Sea's Early Bronze Age (e.g., Losey et al. 2008; Weber et al. 2011), this finding is unsurprising.

M2 Cluster 2 featured $^{87}Sr/^{86}Sr$ values ranging from 0.71166 – 0.71201. $\delta^{13}C$ and $\delta^{15}N$ values for individuals in this cluster essentially occupied the entire range observed among all Little Sea samples, with the exception of values in the lower portion of the GF dietary cluster ($\delta^{15}N \leq$ 11.8). M2 Cluster 3 values ranged from 0.71260 – 0.71477, and exhibited values in the GF cluster's low group ($\delta^{15}N \leq 11.8‰$) as well as in the higher-valued transitional group with $\delta^{15}N$ values from 12.7‰ – 13.2‰, indicating considerable dietary diversity later in life for locally born individuals.

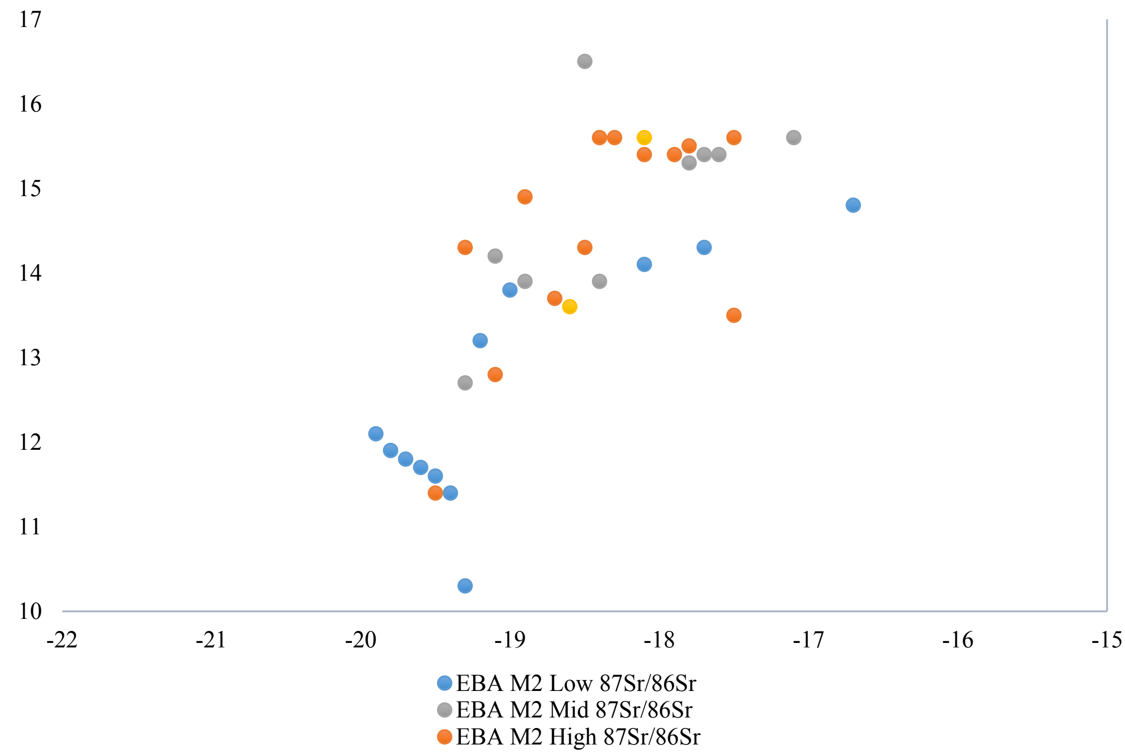

Figure 4.17. Early Bronze Age $\delta^{13}C$ and $\delta^{15}N$ values from bone collagen, grouped by M2 $^{87}Sr/^{86}Sr$ values.

Little Sea micro-region M2 values: Early Neolithic

Only one Early Neolithic individual provided an M2 value (Khuznir-Nuge XIV, Grave No. 7). This adult male individual exhibited M1 values identical to those of individuals from the upper Lena, while his M2 values were relatively high both for that area and for the Angara River Valley, suggesting that he may have spent at least some of his later childhood somewhere else. Although human enamel values from the Anga River and the South Baikal were not available for this study, both of these micro-regions represent possible areas of residence for this individual. It is also possible that during later childhood, this individual consumed a mixture of resources from non-local areas and from the Little Sea micro-region, which would account for this intermediate M2 value.

Patterning in Third Molar $^{87}Sr/^{86}Sr$ data

Upper Lena micro-region M3 values

M3 data for the upper Lena individuals exhibited variation similar to M1 and M2 datasets for this micro-region (Figure 4.18, range: n=10, 0.70912 – 0.71541, mean=0.71018, s.d.=0.00192). Again, a "main" cluster featured low values similar to those in the large clusters for M1 and M2, this time ranging from 0.70912 – 0.70959 (n=8, mean=0.70941, s.d.=0.00015), consistent with diets featuring both local terrestrial and aquatic fauna. This main cluster M3 range appears similar to the local M1 or M2 ranges, and a Kruskal-Wallis H Test revealed no significant differences between their distributions (Kruskal-Wallis H=0.03, df=2, p=0.9851). These consistent values for the majority of individuals in the M1, M2, and M3 datasets suggests little change in the relative contribution of local terrestrial and aquatic fauna to diet during the early lives of upper Lena Valley hunter-gatherers.

Two other individuals exhibited values above the range of the main cluster. One of these – Makarovo, Grave No. 1, exhibited an extremely high value of 0.71541, and featured similarly high values for M1 and M2. As stated above, no $\delta^{13}C$ or $\delta^{15}N$ values from bone collagen were available for this individual, making it impossible to determine diet or mobility patterns during later life. However, strontium isotopic ratios for all three molars clearly indicate a non-local early life-history. Another unsexed and unaged individual interred at Obkhoi (Grave No. 7), exhibited a relatively high M3 value of 0.71120. This value does fall within the local terrestrial faunal range, although it is high enough that it implies either (a) a local diet containing a high proportion of terrestrial fauna or (b) a significant contribution of non-local resources to diet. This individual lacked a first molar for analysis, but it is noteworthy that their M2 value – 0.70906 – fell within the main cluster of values for the local region.

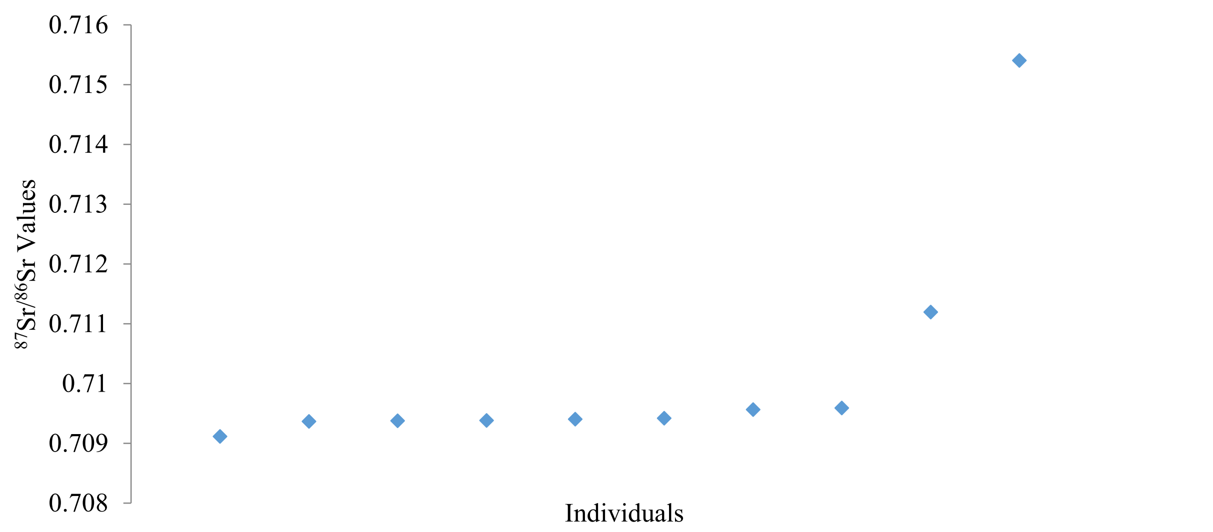

Figure 4.18. Upper Lena M3 $^{87}Sr/^{86}Sr$ values.

Little Sea micro-region M3 values

M3 $^{87}Sr/^{86}Sr$ values for samples from the Little Sea micro-region ranged from 0.70906 – 0.71664 (n=49, mean=0.71183, s.d.=0.00182). Only three of these individuals (6.1%) exhibited values within the local M3 range for the upper Lena Valley, although the Early Neolithic interment at Khuzhir-Nuge XIV (Grave No. 7) essentially overlapped with the minimum threshold. A Mann-Whitney U Test revealed that the Late Neolithic and Early Bronze Age samples exhibited significant differences, although the sample size for the Late Neolithic was small (Mann-Whitney

U=289, 2-tailed p-value=0.0004; Table 4.3, Figures 4.19, 4.20). Of the eight Late Neolithic M3 samples examined here, all featured relatively high values (0.71212 – 0.71664) that are consistent with "local" diets (using any of the +/– 2 s.d. approaches outlined above). In contrast, the Early Bronze Age samples featured a cluster with much lower values (n=34, 0.70934 – 0.71245). Six individuals exhibited values above the range of this diffuse cluster (> 0.713; 15% of total sample). In contrast, six of the eight available M3 $^{87}Sr/^{86}Sr$ values from the Little Sea's Late Neolithic dataset featured values within this range (> 0.713; 75% of the sample), underscoring the significant difference between M3 values for these periods (Fisher's Exact Test 2-tailed p-value=0.0016).

Little Sea micro-region M3 values: Late Neolithic

The Late Neolithic sample contained only nine individuals, and exhibited a mean value of 0.71398 (s.d.=0.00149). Despite the much larger range of M1 values in individuals from this period, it is notable that the variances of M1, M2, and M3 datasets for the Late Neolithic did not exhibit statistically significant differences (Table 4.3; Kruskal-Wallis H=1.37, df=2, p-value =0.5041). Individuals from this period did not exhibit any obvious clustering for M3, although this may be a result of the relatively small sample size. The Early Bronze Age dataset, in contrast, did exhibit some clustering (see below). As stated above, all Late Neolithic M3 values were within the local Little Sea M1 range determined above. This convergence of $^{87}Sr/^{86}Sr$ values over the early lives of individuals from the Late Neolithic suggests a common set of mobility practices - as well as other practices that involved sharing resources, such as subsistence intensification and redistribution through feasting – among adults during this period. Given the fact that these values fell within the local range, it also appears that Late Neolithic from the Little Sea groups subsisted primarily on resources from the local area.

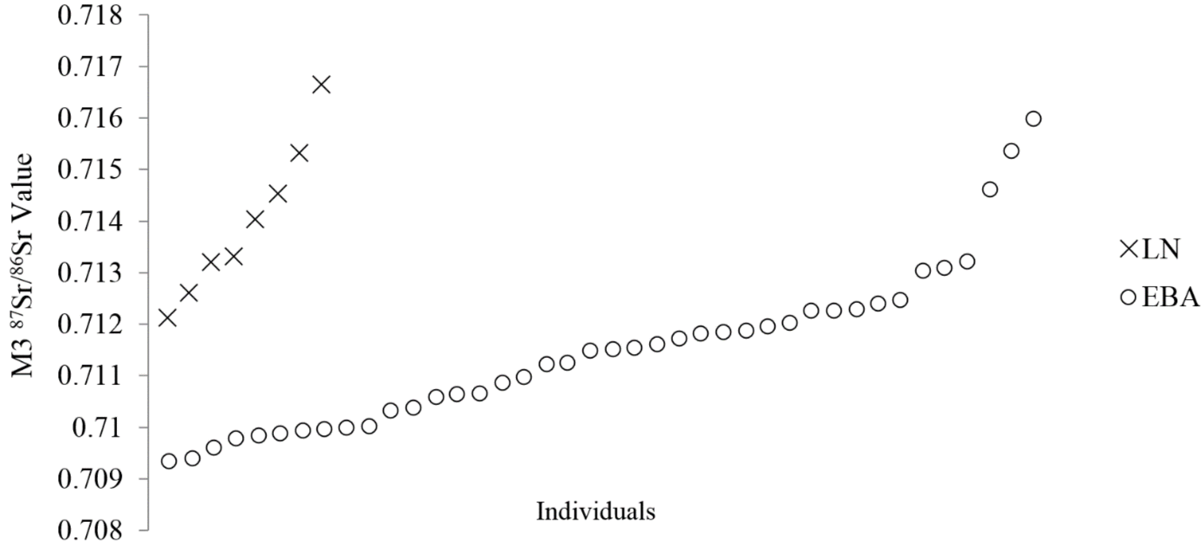

Figure 4.19. Little Sea micro-region M3 $^{87}Sr/^{86}Sr$ values by time period.

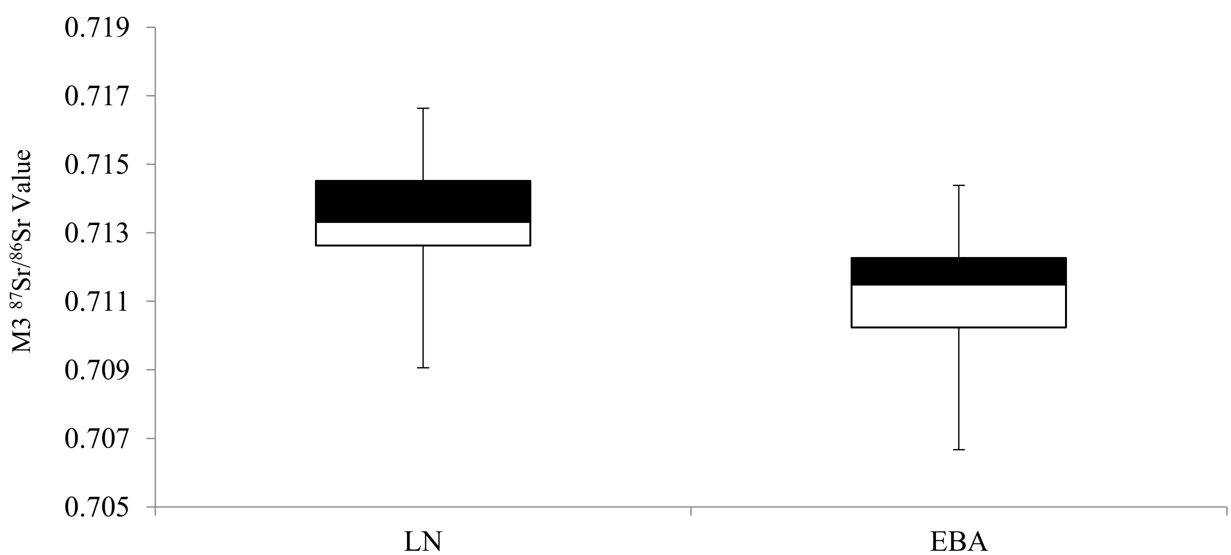

Figure 4.20. Boxplot of Late Neolithic and Early Bronze Age M3 $^{87}Sr/^{86}Sr$ values for Little Sea samples.

Little Sea micro-region M3 values: Early Bronze Age

Overall, M3 values for the Early Bronze Age dataset were relatively continuous, with one cluster of 34 individuals exhibiting values from 0.70934 – 0.71245 (M3 Cluster 1). The remaining six individuals featured elevated values (0.71302 – 0.71598). This pattern repeats the one seen in the smaller dataset presented by Weber and Goriunova (2013), in which most M3 values fell below the "local" M1 range. I interpret this pattern as an indication that teenage individuals in the Little Sea micro-region consumed a large portion of diet in the form of aquatic fauna with a "Baikal" signature (rather than from the Little Sea) or non-local terrestrial fauna. As mentioned above, Early Bronze Age M3 $^{87}Sr/^{86}Sr$ ratios converge at significantly lower values than Late Neolithic samples, suggesting dietary differences and differences in geological catchment areas that these groups accessed.

Of the 40 Early Bronze Age samples from the Little Sea micro-region for whom M3 $^{87}Sr/^{86}Sr$ values were available, 31 also had associated data for stable isotopes of carbon and nitrogen (Appendix 7). M3 $^{87}Sr/^{86}Sr$ values appear somewhat correlated with $\delta^{13}C$ and $\delta^{15}N$ ratios. For $\delta^{13}C$, an R^2 value of 0.3739 (n=31, p-value = 0.0003) indicated limited relationship between $^{87}Sr/^{86}Sr$ and $\delta^{13}C$ values. For $\delta^{15}N$, this relationship was similar (R^2= 0.3629, n=31, p-value = 0.0004). The nine individuals with $\delta^{13}C$ values of -19.3 or lower also exhibited low M3 $^{87}Sr/^{86}Sr$ values at or below 0.71085 (Khuzhir-Nuge XIV, Graves No. 27, 32, 34, 35.1, 35.2, 37.1, 37.2, 77, and 86). These same individuals also exhibited the lowest $\delta^{15}N$ values of the 40 samples for which all types of stable isotopic data were available, ranging from 10.3‰ – 12.3‰.

In order to facilitate comparison, I divide the individuals within the relatively diffuse M3 Cluster 1 for whom $\delta^{13}C$ and $\delta^{15}N$ data were available (n=26) into equal halves based on their M3

$^{87}Sr/^{86}Sr$ values (Figure 4.21). All samples with GF diets exhibited $^{87}Sr/^{86}Sr$ values that fell within M3 Cluster 1. Only one of the GF individuals had an $^{87}Sr/^{86}Sr$ value within the upper half of M3 Cluster 1, and this individual exhibited a relatively high GF signature (Khuzhir-Nuge XIV, Grave No. 1 [Individual 1]; $\delta^{13}C = -19.1‰$, $\delta^{15}N = 12.8‰$). In contrast, all individuals in the low-GF dietary cluster of GF diets (n=9, $\delta^{15}N \leq 12.3‰$) occupied the lower half of M3 Cluster 1.

Within the low-GF dietary cluster, an unsexed individual who was 14 to 17 years old at death (Khuzhir-Nuge, Grave No. 37, Individual 2) was the only individual exhibiting a “GF” diet and an M2 $^{87}Sr/^{86}Sr$ value outside of the lowest dietary cluster (discussed above). This individual appears to have had a complex and unique life-history, spending the earliest years of their life in a non-local area (M1 value=0.71091), and then consuming resources with relatively high strontium isotopic ratios during childhood (M2 value=0.71276), before returning to a low-$^{87}Sr/^{86}Sr$ catchment area during their teenage years (M3 value=0.70993). Interestingly, while no M2 values were available, M1 and M3 values for the other individual interred in Grave No. 37 (Individual No. 1, also aged 14 to 17 years old at death) were nearly identical to those seen in Individual No. 2. At least to the extent that these patterns are comparable (given the absence of M2 data reflecting late childhood), the two individuals appear to have inhabited similar areas at the same intervals during their lives. A third individual in this grave was less than one year old at death.

Four of the individuals in the lower half of M3 Cluster 1 exhibited GFS diets (Khuzhir-Nuge XIV, Graves No. 10, 39, 45, and 46). Two of these (Graves No. 39 and 45) were designated as relatively young during osteological examination (ages 9-11 and 8-10, respectively), although M3 development and mineralization appeared to have been complete by the time of death (Haverkort et al. 2008). Both of these individuals (as well as the adult interred in Grave No. 46) were interred in the cemetery’s center-west cluster (see below), and exhibited M1 and M2 values (as well as $\delta^{13}C$ and $\delta^{15}N$ values) consistent with consumption of Little Sea terrestrial and aquatic resources (Appendix 7), although their M3 values suggest either an extreme dietary contribution from aquatic resources (with a "Baikal" signature, containing at least some contribution of seal to diet) or non-local catchment areas during this period of their lives. Given the high $\delta^{15}N$ values these individuals exhibited, I view aquatic resources as a more likely major dietary source for these individuals before they died during late childhood.

Two *adult* individuals (Khuzhir-Nuge XIV, Graves No. 10 and 46, ages 20 to 25 and 25 to 35, respectively) with $^{87}Sr/^{86}Sr$ values in the lower half of M3 Cluster 1 also exhibited GFS diets. Unlike the two young individuals discussed above, these individuals both exhibited consistently low $^{87}Sr/^{86}Sr$ values prior to the periods represented by M3 (M1 and M2 values ranged from 0.71006-0.71041). These individuals appear to have come to the Little Sea micro-region after the formation of M3.

Two more small clusters with elevated $^{87}Sr/^{86}Sr$ values each featured three individuals. One of these clusters (M3 Cluster 2, $^{87}Sr/^{86}Sr$ range=0.71302 – 0.71320) contained only individuals interred at Khuzhir-Nuge XIV (Graves No. 11, 12, and 57 [Individual 2]), two of whom were interred in the West Sector of the cemetery's Early Bronze Age component (Graves No. 11 and 12). The highest cluster of $^{87}Sr/^{86}SR$ values (M3 Cluster 3, $^{87}Sr/^{86}Sr$ range=0.71460 – 0.71598) contained individuals interred at Khuzhir-Nuge XIV (Graves No. 63 and 64) and Shamanskii Mys (1975 excavation, Grave No. 1). Of the six individuals in these two (high-value) clusters, five were associated with $\delta^{13}C$ and $\delta^{15}N$ values, and all of these exhibited GFS diets (Figure 4.21; $\delta^{13}C \geq -18.7‰$, $\delta^{15}N \geq 13.6‰$).

It is also interesting to note that three of the six individuals with high $^{87}Sr/^{86}Sr$ values were designated as males, and another was designated as a probable male. The two remaining individuals could not be sexed. This finding may suggest that during early adulthood (represented by M3 values), a special set of mobility and dietary practices existed only for certain males, who preferentially consumed local terrestrial game as well as fish from the Little Sea (and only minimal resources from Lake Baikal itself). However, it is also entirely possible that the unsexed individuals within this sample represent females; small sample size and poor demographic data for these samples makes any interpretation only tentative.

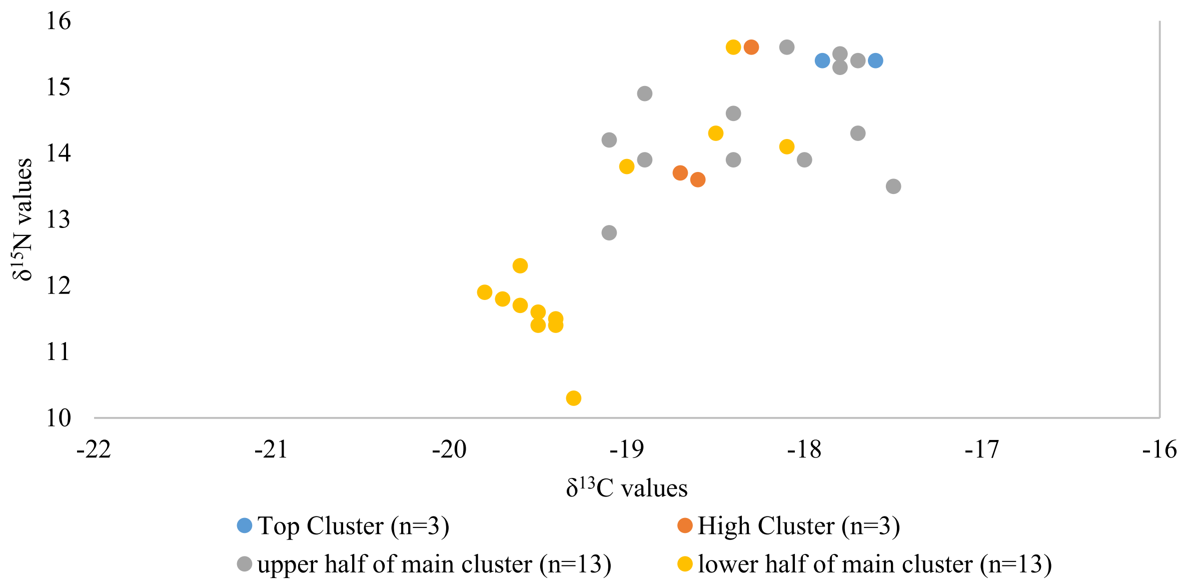

Figure 4.21. Early Bronze Age $\delta^{13}C$ and $\delta^{15}N$ values from bone collagen, grouped by M3 $^{87}Sr/^{86}Sr$ values.

Changing Mobility Patterns and Stable Isotopes of Carbon and Nitrogen

In addition to $^{87}Sr/^{86}Sr$ values from human molars summarized above, previously-published data on $\delta^{13}C$ and $\delta^{15}N$ variability within the Little Sea micro-region also enable a limited assessment of changes to human mobility patterns at the Late Neolithic-Early Bronze Age transition. Unfortunately, in some cases where multiple Late Neolithic individuals were interred together, these data could not be linked to a specific individual within the grave feature (see above). Late Neolithic graves with available $\delta^{13}C$ and $\delta^{15}N$ data (n=6) included several individuals from the Sarminskii Mys cemetery (three individuals from Grave No. 11, two from Grave No. 19, and one from Grave No. 24). Early Bronze Age individuals (n=90) were included for Khuzhir-Nuge XIV, Kurma XI, Shamanskii Mys, and Sarminskii Mys cemeteries (Figure 3.4, Appendix 9).

As discussed earlier, the dataset from this area formed two broad clusters: a GFS diet, with $\delta^{13}C$ values ranging from -19.3‰ to -18.3‰, and $\delta^{15}N$ values ranging from 13.2‰ to 17.4‰ (Weber et al. 2011:543), and a GF diet with $\delta^{13}C$ ranging from -20.1‰ to -18.9‰, and $\delta^{15}N$ values ranging from 10.3‰ to 12.8‰. While the proportion of individuals exhibiting the local GFS diet decreased slightly from the Late Neolithic to the Early Bronze Age (from 100.0% to 66.7%), this change was not statistically significant in the Calgary dataset (two-tailed Fisher's Exact Test p-value = 0.1622). Thus, it appears that the relative size of groups employing the GF vs. GFS diets may have remained relatively similar in the Little Sea micro-region during the Late Neolithic and Early Bronze Age.

However, sample sizes for this comparison were extremely small for the Late Neolithic group (n = 6 and 61 for the Late Neolithic and Early Bronze Age, respectively). Because of the coarse-grained nature of this comparison ("GF" versus "GFS"), it was possible to combine the ORAU and Calgary datasets into a single "Averaged Stable Isotope Dataset" (Appendix 9). For this comparison, values from analyses conducted at the University of Calgary and ORAU were both used, and these values were combined (averaged) where values were available from both labs. This approach resulted in a larger sample size for the Late Neolithic and Early Bronze Age. A test of difference in the proportions of individuals exhibiting GF diets during the two periods approached significance (two-tailed Fisher's Exact Test p-value = 0.0626). This result is consistent with the hypothesis that Late Neolithic groups emphasized locally-available resources (seals), and sheds light on the difference in mobility practices seen in M3 data above, with Late Neolithic individuals in the Little Sea exhibiting "local" M3 $^{87}Sr/^{86}Sr$ signals relative to those of later Early Bronze Age groups.

TABLE 4.5. RESULTS OF "AVERAGED STABLE ISOTOPE DATASET" FOR THE LITTLE SEA MICRO-REGION

	n	Mean $\delta^{13}C$	Mean $\delta^{15}N$	$\delta^{13}C$ s.d.	$\delta^{15}N$ s.d.	GF Diets	GFS Diets
Late Neolithic	11	-17.7	15.7	0.6	0.6	0	11
Early Bronze Age	102	-18.5	14.1	0.8	1.6	28.0	74.0

Moreover, when the GFS diet groups from the Late Neolithic and Early Bronze Age were compared using the Calgary dataset, these two periods did appear to differ in terms of their $\delta^{15}N$ values (Late Neolithic mean = 15.7‰, s.d. = 0.6, Early Bronze Age mean = 14.9‰, s.d. = 0.9; n = 6 and 61, respectively), although $\delta^{13}C$ values were identical (Late Neolithic mean = –18.1‰, s.d. = 0.5; Early Bronze Age mean = –18.1‰, s.d. = 0.8). These two sets of values did exhibit significant differences in terms of their $\delta^{15}N$ values (Mann-Whitney U=283.5, 2-tailed p-value = 0.0278, n=6 [Late Neolithic] and 61 [Early Bronze Age], Appendix 7). However, for this dataset, $\delta^{13}C$ values among these groups did not exhibit significant differences (Mann-Whitney U=204.5, 2-tailed p-value = 0.646).

When the ORAU (Oxford) stable isotopic data (Appendix 10; Figure 4.22) on carbon and nitrogen were employed instead of the Calgary data (employed elsewhere in this paper, see above), the Late Neolithic and Early Bronze Age datasets for individuals with GFS diets (n=9 and 39, respectively) appeared to differ for $\delta^{13}C$ (Late Neolithic mean = –17.3‰, s.d. = 0.5; Early Bronze Age mean = –18.3‰, s.d. = 0.6) and $\delta^{15}N$ (Late Neolithic mean = –15.8‰, s.d., = 0.6; Early Bronze Age mean = –15.1‰, s.d. = 1.0). These groups exhibited a significant difference for $\delta^{15}N$ (Mann-Whitney U=259, 2-talied p-value=0.0285, n=9 [Late Neolithic] and 39 [Early Bronze Age]). For $\delta^{13}C$, these values also exhibited a significant difference (Mann-Whitney U=313, 2-talied p-value=0.0003, n=9 [Late Neolithic] and 39 [Early Bronze Age]). Notably, the ORAU dataset includes only a small number of individuals from Khuzhir-Nuge XIV; most of the individuals sampled for this analysis came from other cemtereies in the micro-region (e.g., Schulting et al. 2014; Weber et al. 2016a).

Finally, when the "Averaged Stable Isotope Dataset" was employed for a comparison of the $\delta^{13}C$ and $\delta^{15}N$ values among individuals exhibiting "GFS" diets, they exhibited a significant difference for both $\delta^{13}C$ (Mann-Whitney U=585.5, 2-talied p-value=0.0198, n=11 [Late Neolithic] and 74 [Early Bronze Age]) and $\delta^{15}N$ (Mann-Whitney U=624, 2-talied p-value=0.0047, n=11 [Late Neolithic] and 74 [Early Bronze Age]).

While the large difference in sample sizes as well as the small sample of Late Neolithic individuals for these datasets renders this evidence somewhat tentative, these provide support for the assertion that "local" diets during the Late Neolithic differed from those that local hunter-gatherers employed during the Early Bronze Age. Late Neolithic diets may have featured relatively greater contributions from aquatic (high trophic-level) sources such as seal. Early Bronze Age "local" diets featured relatively greater contributions from sources that occupied lower trophic levels (such as terrestrial fauna). The relatively low (but also more variable) $\delta^{13}C$ values for the ORAU Early Bronze Age dataset also coincide with diets featuring greater proportions of terrestrial fauna. It is also conceivable that these low $\delta^{13}C$ values could have resulted from increased consumption of seal meat, but given the similar (or even lower) $\delta^{15}N$ values that Early Bronze Age individuals exhibited, this interpretation seems unlikely.

Thus, these data imply that Early Bronze Age groups had diets that differed from their Late Neolithic predecessors. As discussed above, these groups also exhibited M3 $^{87}Sr/^{86}Sr$ signatures indicating differences in diet and mobility patterns. Both of these datasets are consistent with a greater emphasis on non-local resources and related mobility practices that would have involved moving beyond the boundaries of the Little Sea micro-region more frequently during the Early Bronze Age. It is quite possible that $\delta^{15}N$ enrichment of Late Neolithic samples relative to those from the subsequent Early Bronze Age is an artifact of the large difference in sample sizes, but it is also possible that this difference reflects a real change in the resources that hunter-gatherer groups within the Little Sea micro-region consumed, especially in light of other indications of dietary changes outlined above.

Notably, Late Neolithic individuals' high M3 $^{87}Sr/^{86}Sr$ values suggest little dietary emphasis on seals – which exhibit low $^{87}Sr/^{86}Sr$ values that characterize the open waters of Lake Baikal. However, the high $\delta^{15}N$ values of Late Neolithic individuals in the Little Sea contradict this interpretation, placing all individuals from this period within the "GFS" dietary group. Thus, based on available M3 $^{87}Sr/^{86}Sr$ ratios and limited data on stable isotopic values for carbon and nitrogen in bone collagen, it appears that the Late Neolithic-Early Bronze Age transition involved a shift from adult diets focusing on local terrestrial resources and local (Little Sea) aquatic resources to one featuring a greater emphasis on non-local resources. These "non-local" resources include terrestrial game with catchment areas outside of the Little Sea. It is also possible that Early Bronze Age groups continued to consume aquatic resources, but that a greater proportion of these were procured during foraging trips outside the Little Sea micro-region. However, recent evidence from archaeological work at habitation sites around the Little Sea and at Sagan-Zaba indicates little or no dietary emphasis on fish that would have exhibited a "Baikal" signature, such as omul' (e.g., Losey et al. 2008, 2012). It is thus clear from these data that Early Bronze Age groups in the Little Sea employed dietary strategies and related mobility regimes that enabled them to circulate over relatively large areas beyond the boundaries of the zone of intensive resource procurement that existed during the Late Neolithic.

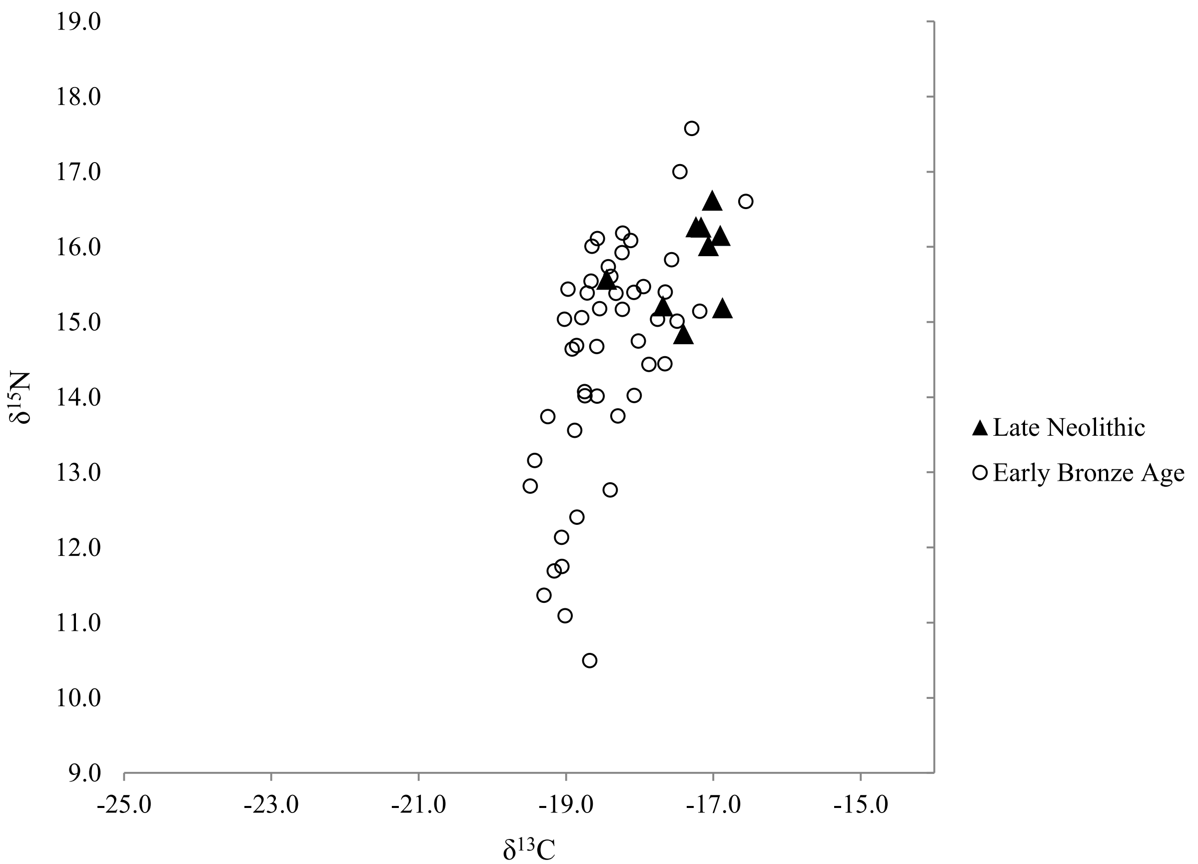

Figure 4.22. ORAU δ^{13}C and δ^{13}C data for little sea individuals over age 7.

Relationships among Individuals Interred within Multiple Burials

Below, I examine the hypotheses regarding heterogeneous life-histories in the mid and late Holocene Little Sea micro-region outlined at the beginning of this chapter. I discuss these hypotheses at multiple scales, ranging from the comparison of Late Neolithic and Early Bronze Age multiple burials to larger comparisons of diversity within entire cemetery populations. The dataset employed in this study contained nine graves with multiple burials, from which $^{87}Sr/^{86}Sr$ values were available for at least two individuals from a given feature. This small dataset enabled limited testing of the extent to which individuals interred in this type of feature experienced similar life-histories.

Three of these features (Sarminskii Mys, Graves No. 11A, 19, and 31) dated to the Late Neolithic. Graves No. 19 and 31 each contained three individuals with available $^{87}Sr/^{86}Sr$ data, and Grave No. 11A contained four (although an additional individual was interred beneath the same cairn, in a separate pit, and could thus be considered part of the same burial feature). Six multiple burials included in this study for which at least two individuals featured $^{87}Sr/^{86}Sr$ data dated to the Early Bronze Age, containing a total of 13 individuals. All of these features were from the Khuzhir-Nuge XIV cemetery; five featured data on two individuals (Graves No. 35, 36, 37, 58, and 59), and one featured three (Grave No. 27). Both the Late Neolithic and Early Bronze Age graves with multiple burials included in this study were concentrated at corporate centers during their respective time periods (Shepard 2012), enabling a comparison of the strategies that political actors used in these contexts over time.

Multiple burials: Late Neolithic

The Late Neolithic graves containing multiple burials included in this study were all located on a single slope overlooking Lake Baikal, in a line roughly 30-32 m above lake level. This linear cluster contained approximately half of the Late Neolithic graves at the Sarminskii Mys cemetery, and all of the multiple burials there (Figure 4.4; Goriunova 1997, 2002). Other Late Neolithic graves containing single interments were scattered throughout the site, and some were nearly isolated.

Within the Late Neolithic sample of graves with burials, M1 values within each of these graves were somewhat divergent, with ranges of 0.01639, 0.00513, and 0.00987 (Table 4.6). These values essentially spanned the entire range of values for the Late Neolithic M1 dataset. Grave No. 11A exhibited the greatest range, featuring one individual assigned to each of the three $^{87}Sr/^{86}Sr$ clusters of M1values as well as one of the two high-valued outliers from the M1 dataset. An additional individual interred under the same cairn (Grave No. 11B) exhibited an M1 value in M1 Cluster 1. The three individuals from Grave No. 19 for whom M1 $^{87}Sr/^{86}Sr$ values were available exhibited somewhat less variation, with values assigned to M1 Clusters 2 and 3. Grave No. 31 also showed considerable range, with individuals assigned to M1 Cluster No. 1 and 3.

M2 values were also available from the ten Late Neolithic individuals from graves with multiple interments discussed above, as well as from Grave No. 11B. Grave No. 11A featured individuals assigned to M2 Cluster 2 (n=1) and to Cluster 4 (n=3). The individual interred under the same cairn (Grave No. 11B) was assigned to M2 Cluster 1. Grave No. 19 featured individuals assigned to M2 Clusters 2 (n=2) and 3 (n=1), and Grave No. 31 featured individuals assigned to M2 Clusters 1 (n=1) and 3 (n=1), as well as one individual designated as an outlier with a distinctly low $^{87}Sr/^{86}Sr$ value that was consistent with the upper Lena M2 sample (Table 4.6). M3 values for the Late Neolithic dataset were relatively scarce (n=6), and only Grave No. 19 featured multiple individuals for whom M3s were analyzed (n=3). As the M3 dataset for the Late Neolithic could not be separated into heuristic clusters, I instead note only that $^{87}Sr/^{86}Sr$ values for individuals from this grave exhibited a range of 0.00189 (from 0.71263 – 0.71452). When compared to the overall range of 0.00758 (0.70906 – 0.71664) for all Late Neolithic M3 values, these values appear relatively homogeneous.

While statistical analysis for these multiple burials is impossible due to small sample size for each feature, this distribution suggests that during the Late Neolithic, some factor other than the area where an individual was born governed inclusion in multiple burials. All three multiple-burial features under examination here contained individuals with M1 and M2 values distributed over much of the spectrum of $^{87}Sr/^{86}Sr$ signals from that period. For M3, the range of values seen in multiple burials may have been considerably narrower.

It is also noteworthy that Katzenberg et al. (2012) reported a single set of bone collagen $\delta^{13}C$ and $\delta^{15}N$ values from Sarminskii Mys, Grave No. 31 (analyzed at the Isotope Science Laboratory at the University of Calgary). This individual exhibited a $\delta^{15}N$ value of 10.8‰ – well below the lower limit of the "local" GFS diet. The $\delta^{13}C$ value of –17.5 for this individual was markedly higher than the highest values of all Late Neolithic and Early Bronze Age individuals from the Lena River Valley, but was consistent with Angara River results from the Late Neolithic and Early Bronze Age (Table 3.8). Unfortunately, this sample could not be clearly assigned to a specific individual from the grave, and thus has not appeared in other BHAP publications (e.g., Weber et al. 2011). Consequently, this individual was not included in Appendix 5. However, it is clear that this value did come from *one* of the three individuals from Grave No. 31 (and that only one of these three individuals was sampled successfully). Thus, despite uncertainty as to provenience *within* Grave No. 31, it is noteworthy here for the purposes of assessing diversity in life-histories among individuals interred together in multiple interments that this Late Neolithic interment of three adults featured one individual who consumed a diagnostically "Angara River Valley" diet during the final years of their adult life.

Graves with multiple burials: Early Bronze Age

Of the five Early Bronze Age double burials studied here, three featured ranges of 0.001 or less (Graves No. 35, 36, and 37[6]) and one featured a range of 0.00166 (Grave No. 58). Thus, it would seem that most of these multiple burials exhibited M1 values within a relatively narrow range of $^{87}Sr/^{86}Sr$ values, which is consistent with the interpretation that individuals interred in these types of features generally shared similar life-histories. Most of these individuals were assigned to M1 Cluster 2, except for Khuzhir-Nuge XIV, Grave No. 58 (Individual 1), whose low value of 0.70917 fell within the distinctly low – and most likely upper Lena – M1 Cluster 1 range. In addition, one of the two individuals interred in Grave No. 59 (Individual 2) was assigned to M1 Cluster 4, and exhibited a value of 0.71375. Thus, the two individuals in Grave No. 59 do not appear to have spent identical portions of their lives in similar areas, and the relationship between them cannot be ascertained.

Overall, it is notable that all of these ranges of M1 $^{87}Sr/^{86}Sr$ values from individual burial features containing multiple interments dating to the Early Bronze Age were less than *any* of the

[6] Despite the presence of a third individual in the grave, Khuzhir-Nuge XIV, Grave No. 37 is described here as a double burial because this third individual was less than one year old at death. No enamel values from this individual were available due to its young age.

three Late Neolithic multiple burials' M1 ranges (Table 4.6). This reduction in the range of M1 values – a proxy for the diversity in life-histories of individuals interred in these features – is even more noteworthy given that all Late Neolithic multiple burials considered here featured more individuals than the Early Bronze Age double burials under consideration. I suggest that although tentative, this pattern is consistent with the interpretation that Early Bronze Age burial practices served as a venue for ritual participants to distinguish – rather than homogenize – segments of society on the basis of individuals' life-histories.

The single Early Bronze Age triple burial (Grave No. 27) featured a range of 0.00402 for M1, lower than either of the two Late Neolithic triple burials (0.00513 and 0.00987). It is also noteworthy that this grave featured individuals of different ages: an older adult male (35 to 50 years old at death) and two children (Individuals 2 and 3 were 0 to 11 and 4 to 6 years old at death, respectively). These two children exhibited "local" M1 values (0.71233 and 0.71399, assigned to M1 Clusters 2 and 4). The one child who also featured an M2 value (Individual 2) featured a nearly-identical M2 value to the M1 value for Individual 3. It is entirely possible that these young individuals occupied similar geological catchment areas during their lives, with the development of M2 for Individual 2 overlapping with the development of M1 for Individual 3 (Appendix 7).

In contrast, the adult individual (Grave No. 27, Individual 1) exhibited values of 0.70976 – 0.70997 for M1-M3, suggesting an early life spent outside the Little Sea micro-region (up to and including adolescence). The low $\delta^{15}N$ value of this individual suggests that he most likely spent the majority of his adult life in the upper Lena as well. The two younger individuals interred in this feature exhibited $\delta^{15}N$ values of 14.5 and 14.6, but at least one (age 4 to 6) appears to have been young enough that this value was likely influenced by the effects of breastfeeding. On the basis of these data, it appears unlikely that the three individuals interred at Khuzhir-Nuge XIV, Grave No. 27 experienced similar life histories in terms of mobility or diet; while the two children in the grave appear similar in this regard, the older male interred with them exhibited all of the hallmarks of a non-local upper Lena life history. Again, the exact relationship between the life-history of this adult and the two children interred with him are unclear.

Only one of the Early Bronze Age double burials featured two M2 values (Grave No. 35). These values were nearly identical, and exhibited a difference of 0.00026 ($^{87}Sr/^{86}Sr$ values of 0.71080 and 0.71054). Similarly, only two multiple burials from this period featured more than one M3 value (Graves No. 35 and 37). These two pairs exhibited low ranges of 0.00027 and 0.00007, providing tentative support for the suggestion that multiple burials tended to contain individuals with similar life-histories. $\delta^{13}C$ and $\delta^{15}N$ values were also consistent in four of the six Early Bronze Age multiple burials: $\delta^{13}C$ values differed by less than 1.0 and $\delta^{15}N$ values differed by 0.3 or less.

The two individuals in Grave No. 59 constitute an exception to this pattern, and exhibited a much greater difference. The GF diet of Individual 1 was consistent with their low M1 $^{87}Sr/^{86}Sr$ value, while the "local" GFS diet for Individual 2 was consistent with their "local" M1 $^{87}Sr/^{86}Sr$ value. Thus, while some exceptions existed (Graves No. 27 and 59), these data were broadly consistent with the interpretation that multiple burials contained individuals with common life-histories. Even in exceptional cases such as the triple burial in Grave No. 27, it appeared possible that the two children interred in that feature may have shared a common life-history, and their M1 values (0.71233 and 0.71399) were in keeping with "local" birth. In contrast, the adult male in this feature appeared to have spent the majority of his life elsewhere, and his relationship to the two younger individuals in this feature cannot be explained without additional data.

Grave rows at Khuzhir-Nuge XIV

Early Bronze Age hunter-gatherers who buried their dead at Khuzhir-Nuge XIV appear to have arranged much of the site so that graves occupied rows (Figure 4.5). Notably, this differs from the way that Late Neolithic groups organized the graves at Sarminskii Mys, where essentially only a single row existed (Figure 4.4). Okladnikov (e.g., 1955, 1978) suggested that arrangement in rows was unique to the Early Bronze Age, and proposed that it may have reflected kinship ties. Importantly, these row arrangements are not the results of sampling strategy, and have been duplicated at numerous Early Bronze Age sites by archaeologists employing a variety of approaches to excavating cemeteries. Moreover, in many cases, grave coverings are visible on the surface prior to excavation, so that row arrangements are easy to detect. It is thus possible to apply the same logic employed above for multiple burials to rows of graves in the Early Bronze Age. More specifically, I suggest that in contexts where the patrimonial rhetoric associated with network/exclusionary political economic strategies predominates, individuals interred in a given row of graves should exhibit relatively homogeneous life histories, particularly in terms of the areas where they were born (see above).

Weber and Goriunova (2013) identified 10 rows of at least three graves each at Khuzhir-Nuge XIV (designated as Rows A–J). The dataset examined here contained $^{87}Sr/^{86}Sr$ data for at least two individuals from nine of these rows (Table 4.6; Rows A–E, G–J). Unlike Early Bronze Age multiple burials, which feature relatively few individuals sampled for $^{87}Sr/^{86}Sr$ values, the number of individuals in these rows was large enough to serve as a useful comparison to Late Neolithic graves with multiple interments (Table 4.6).

The range of M1, M2, and M3 values for each of the Late Neolithic multiple burial features tends to be larger than the corresponding range of values for Early Bronze Age rows. For example, in all but one case, the M1 ranges for multiple burials dating to the Late Neolithic (0.01639, 0.00988, and 0.00513) – representing the difference between the highest and lowest M1 values – were higher than the nine M1 ranges for Early Bronze Age rows of graves. A single row at Khuzhir-Nuge XIV, featuring three M1 values, exhibited an M1 range of 0.00567, which was still lower than two of the three M1 ranges for Late Neolithic multiple burial features. M2 ranges were roughly similar for the two periods. M3 ranges for the two Late Neolithic multiple-burial features with at least two data points exceeded the ranges of any of the five rows from the Early Bronze Age with comparable data (Table 4.6).

TABLE 4.6. GRAVES WITH MULTIPLE BURIALS AND ROW CHARACTERISTICS AT SARMINSKII MYS (LATE NEOLITHIC) AND KHUZHIR-NUGE XIV (EARLY BRONZE AGE)

Row	M1 range (n)	M2 range (n)	M3 range (n)	Individuals included in this study
Late Neolithic Multiple Burials (Sarminskii Mys)				
11A	0.01639 (4)	0.00575 (4)	- (1)	11A.1, 11A.2, 11A.3, 11A.4
11 (A and B)	0.01639 (5)	0.00725 (5)	0.00191 (2)	11A.1, 11A.2, 11A.3, 11A.4, 11B
19	0.00513 (3)	0.00192 (3)	0.00189 (3)	19.1, 19.2, 19.4
31	0.00988 (3)	0.00377 (3)	- (1)	31.1, 31.2, 31.3
Early Bronze Age Grave Rows (Early Bronze Age)				
A	0.00145 (3)	0.00130 (3)	0.00074 (2)	15, 16, 17
B	0.00012 (2)	- (0)	- (0)	26, 33
C	0.00402 (4)	0.00377 (3)	0.00006 (2)	4, 27.1, 27.2, 27.3
D	0.00174 (6)	0.00339 (4)	0.00132 (5)	35.1, 35.2, 36.1, 36.2, 37.1, 37.2
E	0.00042 (2)	- (1)	- (1)	39, 40
G	0.00467 (2)	0.00278 (2)	0.00059 (2)	45, 46
H	0.00164 (3)	0.00284 (3)	- (1)	50, 51, 53
I	0.00458 (5)	0.00421 (4)	0.00155 (3)	57.2, 58.1, 58.2, 59.1, 59.2, 60
J	0.00567 (3)	0.00183 (3)	0.00138 (2)	63, 64, 65

Despite a relatively small number of Late Neolithic graves containing multiple burials for comparison, it appears that hunter-gatherer groups during the Late Neolithic and Early Bronze Age employed multiple burials somewhat differently. While Late Neolithic graves with multiple burials contained individuals with relatively diverse life histories in terms of mobility (as evidenced by large ranges of M1 and M3 values among individuals interred together in these features), Early Bronze Age multiple burials and rows of graves signaled the relatively homogeneous life histories of individuals interred within them. At the same time, differences existed *between* values for Early Bronze Age rows.

Relationships between Cemeteries

While this study included data from two Late Neolithic and four Early Bronze Age cemeteries from the Little Sea micro-region, a detailed comparison of geochemical signatures for these sites is difficult due to the small sample sizes of all but one site from each period. Although the Late Neolithic sample from Sarminskii Mys was reasonably large (n=15 individuals total in this study, although not all featured M1-M3 values), the Elga III cemetery (Late Neolithic) featured only two individuals who could be sampled for this study. The Early Bronze Age sample was larger overall, but only Khuzhir-Nuge XIV provided a relatively large sample size (n=48 individuals, again, not all featured M1-M3 values). More specifically, Kurma XI and Sarminskii Mys each featured five individuals dating to the Early Bronze Age, and Shamanskii Mys featured three (Table 4.7, Appendix 7).

TABLE 4.7. CEMETERY CHARACTERISTICS (FOR COMPARISON OF $^{87}Sr/^{86}Sr$ RANGES)

Cemetery	M1 range (n)	M2 range (n)	M3 range (n)	Individuals included in this study
Late Neolithic Cemeteries				
Elga III	0.01009 (2)	0.00554 (2)	– (1)	1, 5
Sarminskii Mys	0.01712 (14)	0.00874 (13)	0.00321 (7)	17, 19.1, 19.2, 19.4, 29.1, 30.1, 31.1, 31.2, 31.3, 11A.1, 11A.2, 11A.3, 11A.4, 11B
Early Bronze Age Cemeteries				
Khuzhir-Nuge XIV	0.01209 (42)	0.00783 (37)	0.00664 (35)	2, 4, 5, 10, 11, 12, 14, 15, 16, 17, 19, 26, 27.1, 27.2, 27.3, 32, 33, 34, 35.1, 35.2, 36.1, 36.2, 37.1, 37.2, 38, 39, 40, 44, 45, 46, 48, 50, 51, 53, 55, 57.2, 58.1, 58.2, 59.1, 59.2, 60, 63, 64, 65, 68, 77, 80, 86
Kurma XI	0.00692 (4)	0.00465 (3)	– (0)	1, 10, 14, 15, 16
Sarminskii Mys	0.00166 (3)	0.00330 (5)	0.00261 (4)	2, 4, 10, 12, 33
Shamanskii Mys	0.00329 (2)	0.00268 (2)	0.00385 (3)	1972.2, 1973.3, 1975.1

The small number of individuals in this dataset is such that a detailed comparison of $^{87}Sr/^{86}Sr$ signatures at multiple sites from both the Late Neolithic and Early Bronze Age cannot be undertaken confidently. However, preliminary remarks based on these data are possible. The Late Neolithic corporate center of Sarminskii Mys featured the largest range of M1 values, suggesting relatively diverse early life histories or birthplaces among individuals interred there. The two Late Neolithic individuals interred at Elga III also exhibited variation similar to the range for the entire Late Neolithic dataset (Grave No. 1 was assigned to the relatively low-valued M1 Cluster 2, while Grave No. 5 was classified as one of two high-valued outliers). In addition to representing the areas where individuals spent their early lives, these M1 data also provide insight into the home ranges that women employed while nursing young infants. In this sense, M1 data from Late Neolithic individuals interred at Sarminskii Mys suggest diverse mobility practices (at least in terms of the home ranges they incorporated) among the families of individuals interred at that site.

The single Early Neolithic individual interred at Khuzhir-Nuge XIV exhibited low (non-local) values for all three molars as well as for their adult diet (represented by stable isotopes of carbon and nitrogen in bone collagen). Because only a single individual dating to this period has been excavated from this site (and may have been the only one interred there at the time, although two additional unexcavated graves may have been contemporaneous; Andrzej Weber, personal communication, May 2016), it is not clear whether life history, place of birth, or some other characteristic was the driving force behind the decision to inter this individual there. The only other Early Neolithic value – an M1 from the single Early Neolithic individual interred at Sarminskii Mys – was also low enough to indicate non-local birth (Appendix 7).

In the Early Bronze Age sample, Khuzhir-Nuge XIV exhibited an M1 range greater than either of the two Late Neolithic sites, although this may be a product of different sample sizes. Not surprisingly, the range of values for individuals interred at Khuzhir-Nuge XIV did not differ significantly from other sites in the Little Sea micro-region (n=42 [Khuzhir-Nuge XIV], 9 [other cemeteries], Mann-Whitney U=213, 2-tailed p-value=0.5619). However, when Khuzhir-Nuge XIV was analyzed in terms of grave rows (above), it became clear that Early Bronze Age hunter-gatherer communities organized this cemetery so that individual rows were relatively homogeneous in terms of individuals' early life histories. Thus, while variation existed at the site level, other smaller-scale distinctions within the cemetery encoded differences in life history.

McKenzie (2005, 2010) identified three distinct spatial clusters (described as "Sectors" in Weber and Goriunova 2013 – the same terms are used here for consistency) of graves at Khuzhir-Nuge XIV (Figure 4.5), and showed that these clusters featured different proportions of various broad groupings of grave goods ("tools," "ornaments," "unworked faunal elements"), as well as overall grave wealth. The East Sector was further divided into three Sub-Sectors – South, Northeast, and Northwest (Weber and Goriunova 2013). The Northwest Sub-Sector featured six individuals, all of whom exhibited GFS diets. In contrast, the other two Sub-Sectors contained predominantly GF diets (n=12) only one individual with a GFS diet (Grave No. 80, Individual 2). Graves in the East Sector also tended to be relatively "wealthy" in terms of grave goods assemblages. A large proportion of the individuals interred in the Centre Sector were young individuals, many of whom were placed in multiple interments. The use of fire in funeral ritual appears to have been a common element of mortuary ritual in this area of Khuzhir-Nuge XIV, and more of these individuals featured GFS diets (68.3% – 28 of 41 analyzed). The cemetery's West Sector featured individuals with GFS diets, low artifact diversity, and little use of fire in burial ritual. Grave disturbance was common in the West Sector, although less common than in the cemetery's East Sector (McKenzie 2010; Weber and Goriunova 2013).

This study adds to the number of individuals from Khuzhir-Nuge XIV for whom $^{87}Sr/^{86}Sr$ values are available, with a total of 35 in the Centre Sector, three in the East Sector, and nine in the West Sector. Weber and Goriunova (2013), also subdivide the Centre Sector at Khuzhir-Nuge XIV into East and West "Sub-Sectors" (Figure 4.5). Because a gap of 5-10 m separates these two concentrations of graves, I view this spatial distinction as potentially meaningful and thus employ the East and West Sub-Sector designations below. It is also noteworthy that in addition to the isolated Early Neolithic individual at Khuzhir-Nuge XIV, one Early Bronze Age grave (No. 2) featuring a single individual was located more than 50 m north of the other graves at the site. Although this grave was isolated, below I designate it as the "North Sector" for the purposes of comparison.

Several trends were evident with respect to the distribution of $^{87}Sr/^{86}Sr$ values in the grave clusters at Khuzhir-Nuge XIV (Table 4.8; Figures 4.23, 4.24, 4.25). The West Sector featured higher M1 values than other clusters (for a comparison of all clusters with n>5 [Centre-East, Centre-West, and West Sectors], Kruskal-Wallis H=5.91, df=2, p-value=0.0521, mean ranks=20.4 [Centre-East], 15.3 [Centre-West], 27.8 [West]). In contrast, the West Sub-Sector of the Centre Sector featured relatively low values. Both the isolated grave to the north of the main cemetery (Grave No. 2) as well as the one individual who was sampled from the East Sector exhibited low values, indicating non-local early childhoods. M2 values were somewhat more mixed, although the West Sub-Sector of the Centre Cluster again showed low values relative to the West Sector (for a comparison of all clusters with n>5 [Centre-East, Centre-West, and West Sectors], Kruskal-Wallis H=4.98, df=2, p-value=0.0829, mean ranks=17.9 [Centre-East], 12.9 [Centre-West], 24 [West]). Again, both the single individual from the East Sector with available data for M2 (Grave No. 77) and the isolated northern grave (No. 2) showed low values for this element (Figure 4.24). $\delta^{13}C$ and $\delta^{15}N$ values were available for the individual interred in Grave No. 77 were consistent with a GF diet.

M3 data echoed these patterns; the West Sub-Sector of the Centre Cluster exhibited low values, while the West Sub-Sector of the Centre Cluster exhibited relatively low values (for a comparison of all clusters with n>5 [Centre-East, Centre-West, and West Sectors], Kruskal-Wallis H=13.52, df=2, p-value=0.0012, mean ranks=18.8 [Centre-East], 6.3 [Centre-West], 19 [West]). The three individuals from the East Sector exhibited intermediate values.

An unsexed 12-15-year-old individual interred in Grave No. 77 (East Sector), who featured data from all three molars, exhibited relatively consistent values for these elements (Appendix 7; 0.70949 – 0.71032), suggesting a relatively consistent life history. Unlike the other two individuals from this cluster for whom data on M3 $^{87}Sr/^{86}Sr$ values were available, this individual exhibited a GF dietary signature, indicating consistent absence of seals from diet throughout their life. This "non-local" signature is not unexpected, given that the formation period for M3 – which produced a "non-local" signature – overlaps with the period of life that this individual's bone collagen signature for $\delta^{13}C$ and $\delta^{15}N$ represent (see above). This cluster of burials clearly featured diversity in terms of life-histories, at least insofar as adult mobility and dietary patterns are concerned; while the individual interred in Grave No. 77 appears to have spent the majority of their life in areas outside the Little Sea (as indicated by a "GF" dietary signature, along with low values for the entire molar series), others samples investigated from this cluster showed signs of "local" diets.

Patterning within the Early Bronze Age component of Khuzhir-Nuge XIV suggests that while the overall distribution of $^{87}Sr/^{86}Sr$ values for each element (enamel from each molar) exhibited considerable variability at the site level, Early Bronze Age hunter-gatherers employed spatial distinctions within the site (at the level of large clusters of graves, rows of graves, and individual graves featuring multiple interments) to group individuals based similar or even identical life histories. Based on data from Sarminskii Mys (and extremely limited data from Elga III), Late Neolithic hunter-gatherers apparently approached this matter differently, interring individuals with diverse life histories together in a single cluster of that site, and even within individual graves.

TABLE 4.8. COMPARISON OF $^{87}Sr/^{86}Sr$ VALUES BY ELEMENT AND SECTOR AT KHUZHIR-NUGE XIV

Khuzhir-Nuge XIV Sector	M1 range (n)	M1 median	M2 range (n)	M2 median	M3 range (n)	M3 median	Individuals included in this study
East	(1)	-	(1)	-	0.71032-0.71245 (3)	0.71085	77, 80, 86
Centre-East	0.70917-0.71679 (19)	0.71196	0.70926-0.71477 (18)	0.71186	0.70997-0.71598 (12)	0.71185	38, 39, 40, 44, 45, 46, 48, 50, 51, 53, 55, 57.2, 58,1, 58.2, 59.1, 59.2, 60, 63, 64, 65, 68
Centre-West	0.70983-0.71399 (12)	0.71112	0.70939-0.71393 (9)	0.71054	0.70934-0.71125 (9)	0.70993	4, 26, 27.1, 27.2, 27.3, 32., 33, 34, 35.1, 35.2, 36.1, 36.2, 37.1, 37.2
West	0.71006-0.72126 (9)	0.71349	0.71041-0.71709 (8)	0.71308	0.70996-0.71320 (8)	0.71182	5, 10, 11, 12, 14, 15, 16, 17, 19
North	(1)	-	(1)	-	(1)	-	2

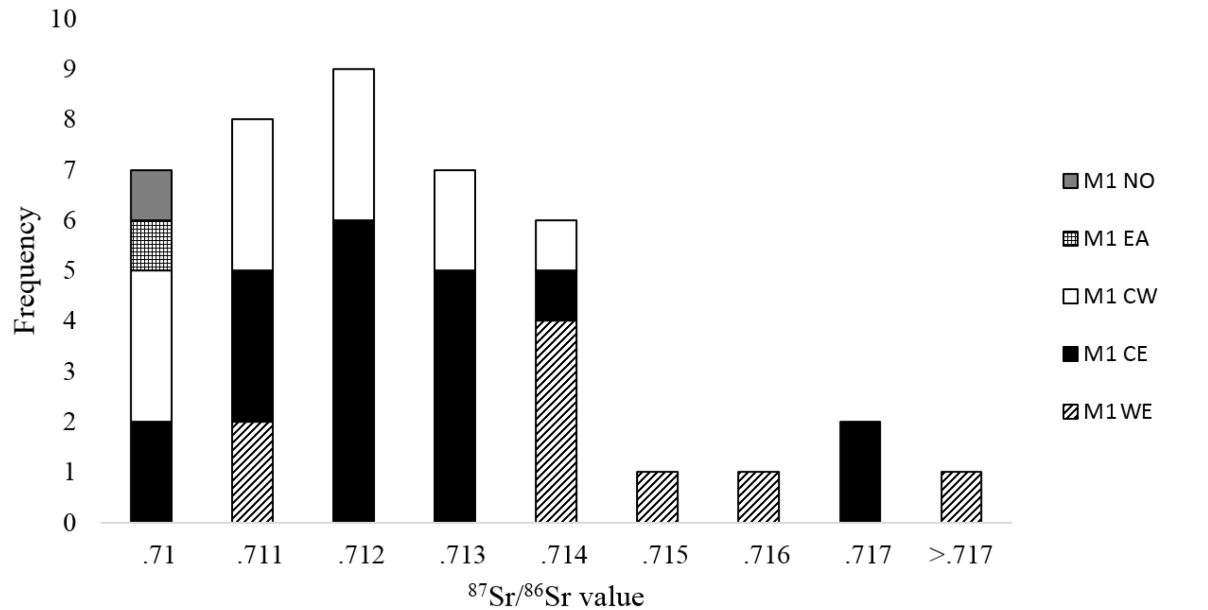

Figure 4.23. Khuzhir-Nuge XIV M1 $^{87}Sr/^{86}Sr$ values by spatial cluster.
NO = North Sector, EA = East Sector, CW = Centre Sector (West Sub-Sector), CE = Centre Sector (East Sub-Sector), WE = West Sector.

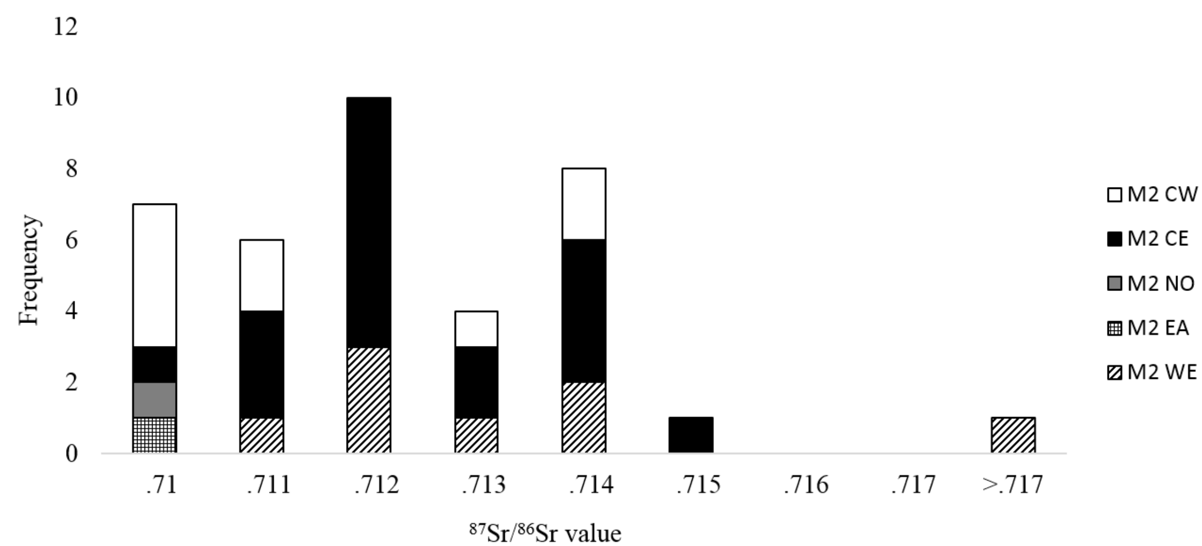

Figure 4.24. Khuzhir-Nuge XIV M2 $^{87}Sr/^{86}Sr$ values by spatial cluster.
CW = Centre Sector (West Sub-Sector), CE = Centre Sector (East Sub-Sector), NO = North Sector, EA = East Sector, WE = West Sector.

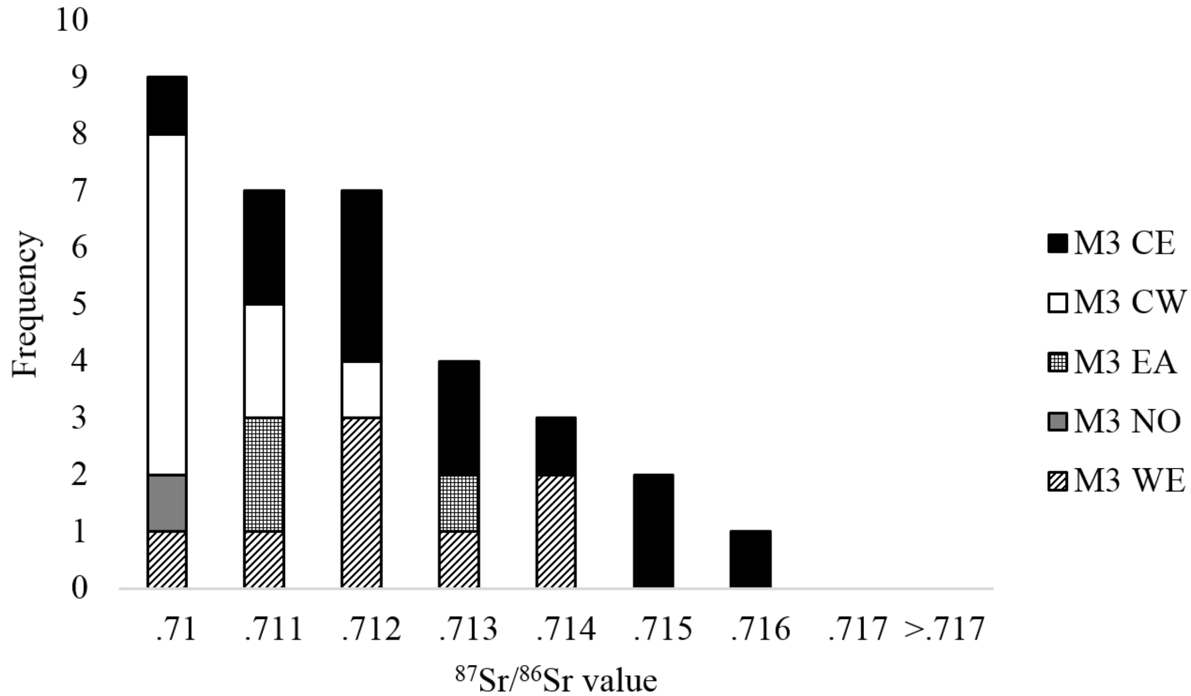

Figure 4.25. Khuzhir-Nuge XIV M3 values by spatial cluster.
CE = Centre Sector (East Sub-Sector), CW = Centre Sector (West Sub-Sector), EA = East Sector, NO = North Sector, WE = West Sector.

Community cemeteries and cemetery development over long timespans

Both of the two large Little Sea cemeteries studied here (Sarminskii Mys during the Late Neolithic and Khuzhir-Nuge XIV during the Early Bronze) featured individuals with diverse life histories. These cemeteries contained notably large contentrations of individuals: Mamonova (1980:68), for example suggested prior to the excavation of Sarminskii Mys that Late Neolithic cemeteries generally contained no more than ten graves (with two exceptions at Serovo and Bratsk, which contained 11 and 13, respectively). Similarly, the Early Bronze Age component at Khuzhir-Nuge XIV was among the largest cemeteries from this period throughout the Cis-Baikal (Goriunova et al. 2012 [Eds.]). During the main use-periods at both of these sites (a long portion of the Late Neolithic in the case of Sarminskii Mys, a long portion of the Early Bronze Age in the case of Khuzhir-Nuge XIV), the mid- and late-Holocene groups who maintained active cemeteries at these locales did so with the knowledge that previous, isolated interments existed there already.

The single Early Neolithic adult (age 30-35 at death) designated as a probable female at Sarminskii Mys (Grave No. 22) exhibited a low $^{87}Sr/^{86}Sr$ value of 0.70915 for M1. This individual was believed to date to the Late Neolithic (e.g., Goriunova 1997) until a recent AMS radiocarbon analysis and freshwater reservoir effect correction produced a much earlier date of 6942 +/- 64 cal BP (Weber et al. 2016a). While it is possible that the Early Neolithic individual had a diet that was common among "local" individuals during the Early Neolithic, it is impossible to tell due to the extremely small number of contemporaneous samples from the Little Sea micro-region ($\delta^{13}C$ and $\delta^{15}N$ values of -17.9‰ and 12.8‰, from the ORAU suggest a GF diet). At Khuzhir-Nuge XIV, the single Early Neolithic grave (No. 7) that was separated from the Early Bronze Age component of the site by over 30 m featured an adult individual (designated as a probable male, age 25-35 at death) who exhibited low $^{87}Sr/^{86}Sr$ values ranging from 0.70906 – 0.71075.

It is interesting to note that these interments – containing individuals who were long-dead by the main periods when local groups used Sarminskii Mys and Khuzhir-Nuge XIV – may have been treated differently by the Late Neolithic and Early Bronze Age users of the two sites. It is particularly important to note that these graves would have been visible on the surface to subsequent groups, and in most cases, stone coverings of these graves remain visible even today (e.g., Weber et al. 2007). To date, these Early Neolithic are the only two from this period in the Little Sea micro-region for whom bulk M1 $^{87}Sr/^{86}Sr$ values are available, although Scharlotta and Weber (2014) employed micro-sampling techniques on six Early Neolithic individuals interred at Khotoruk cemetery. At present, the Early Neolithic micro-sampling data provided by Scharlotta and Weber (2014) cannot not be compared to the bulk samples discussed in this thesis due to the different sampling methods employed (although future work may present opportunities to attempts such comparisons). However, it is noteworthy that some of these individuals appear to have spent their childhoods locally, while others may have been born non-locally.

While Late Neolithic groups at Sarminskii Mys (Figure 4.4) constructed several graves directly around Grave No. 22 (Graves No. 20, 23, 24), Early Bronze Age groups using this site mostly interred their dead lower on the slope (Graves No. 12, 13, 32, 33), or in a relatively isolated cluster north of the Late Neolithic graves analyzed here (Graves No. 2, 4, 25-28), and ~10 m east of the closest Late Neolithic grave (no. 8). A lone adult female (20-35 years old at death) assigned to the Early Bronze Age – who featured a burnt cranium and no grave goods (Grave No. 21) – was situated near the Early Neolithic and Late Neolithic graves in the southwest cluster.

In contrast, individuals conducting funerals at Khuzhir-Nuge XIV maintained a considerable distance from the non-local Early Neolithic grave at the site when selecting locations for new interments (Figure 4.5). While it remains possible that up to two other Early Neolithic graves were situated near Grave No. 7 at Khuzhir-Nuge XIV (Andrzej Weber, Personal communication, May 2016), these graves were also distant from the Early Bronze Age clusters at the site, suggesting similar attempts to maintain symbolic distinctions between groups. Some of the Late Neolithic clusters at Sarminskii Mys developed in this isolated manner as well, but the presence of the single older grave there in what eventually became a relatively large Late Neolithic cluster suggests some attempt at inclusion.

Similarly, at Kurma XI (Figure 4.26), two large spatial clusters essentially distinguished Early Neolithic individuals (northern cluster) from those interred during the Early Bronze Age (southern cluster; Weber et al. 2012). The northern cluster contained all of the Early Neolithic graves at the site (n=6) as well as two Early Bronze Age interments (Graves No. 25 and 26) that were buried in unique "flexed/sitting' positions.

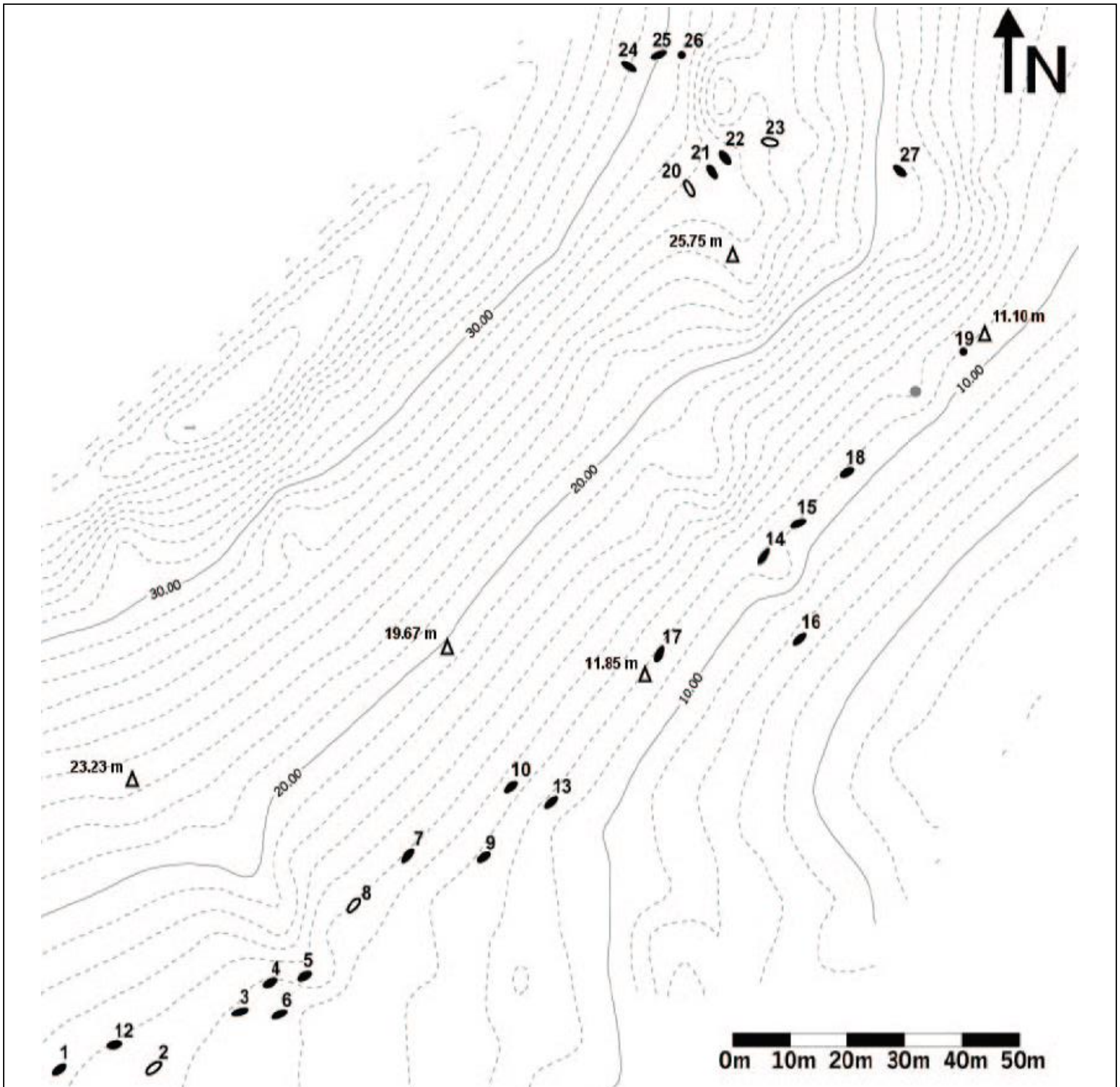

Figure 4.26. Kurma XI Map (adapted from Weber 2012).

At Shamanskii Mys, Late Neolithic funeral participants interred their dead in the northernmost area of the cemetery (1975 excavation, Graves No. 2 and 3, 1976 excavation, Grave

No. 1), relatively far (> 50 m) from the single Early Neolithic interment that would have already been present at the site. Notably, these three Late Neolithic graves featured some of the "wealthiest" and most distinctive interments dating to the Late Neolithic (particularly in terms of grave goods), and I suggest that this site may have served as a locus for relatively exclusionary funeral strategies during the Late Neolithic.

In contrast, all three of the Early Bronze Age individuals from Shamanskii Mys analyzed here were interred in a cluster together with all but one of the other Early Bronze Age graves at the site (which was isolated, see Figure 4.27). This cluster also featured a single Late Neolithic interment (1975 excavation, Grave No. 2) of an older adult male (age 45 to 50 at death). While no isotopic data were available for this Late Neolithic individual, I have noted his uniquely "wealthy" grave goods assemblage relative to others from the Late Neolithic (Shepard 2012:374).

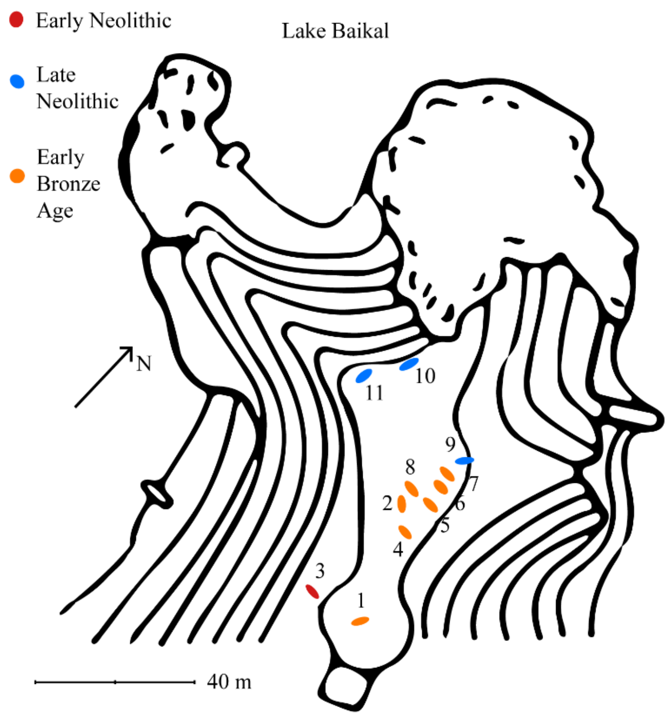

Figure 4.27. Map of Shamanskii Mys cemetery (adapted from Konopatskii 1982:45).
1. 1972 excavation, Grave No. 1. 2. 1972 excavation, Grave No. 2.
3. 1972 excavation, Grave No. 3. 4. 1973 excavation, Grave No. 1.
5. 1973 excavation, Grave No. 2. 6. 1973 excavation, Grave No. 3.
7. 1973 excavation, Grave No. 4. 8. 1975 excavation, Grave No. 1
9. 1975 excavation, Grave No. 2. 10. 1975 excavation, Grave No. 3.
11. 1976 excavation, Grave No. 1.

Local groups who constructed the Early Bronze Age section of Shamanskii Mys around this particular grave may have done so in part due to the distinctive qualities of the man interred in it; it is particularly noteworthy that individuals interred in the Early Bronze Age component of Shamanskii Mys featured notably high quantities of grave goods, like the unique Late Neolithic interment they surrounded (Shepard 2012:374). This may suggest an attempt by Early Bronze Age groups to mobilize the narratives that existed around unique individuals and identities from the Late Neolithic for their own purposes. In this case, that Late Neolithic narratives surrounding the dead and the specific features where elaborate burial rituals had occurred would have had to persist over hundreds of years. Given the infrequent placement of Early Bronze Age graves near those dating to the Late Neolithic at Little Sea cemeteries, this interpretations seems especially plausible.

The range of $^{87}Sr/^{86}Sr$ values among the three Early Bronze Age individuals from Shamanskii Mys sampled here was relatively high (the three available M3 values ranged from 0.71151 to 0.71536), and indicates differences in their life-histories. This pattern of Early Bronze Age heterogeneity at Shamanskii Mys is consistent with previous interpretations of the site as a "specialized" – rather than a "community" – cemetery (McKenzie 2010). McKenzie (2010:102) has described specialized cemeteries as places where Early Bronze Age groups came together to bury and honor "individuals of a distinct status, perhaps relating to their role as hunters." While bone/antler harpoons and other fishing paraphernalia (including lures and composite fish hooks) were relatively common in interments at Shamanskii Mys (Konopatskii 1982), the Early Bronze Age sample also was notable for the extremely high proportion of individuals associated with white nephrite ornaments and, to a lesser extent, other exotics (metal, green nephrite; Shepard 2012:376). Thus, while Early Bronze Age groups may have celebrated individuals' roles as successful hunters through interment at Shamanskii Mys (e.g., McKenzie 2010; Okladnikov and Konopatskii 1974), it is also possible that Early Bronze Age groups associated this site – and, by extension, individuals they memorialized there – with access to wealth and long-distance social networks (Shepard 2012).

Conclusions

Above, I outlined several hypotheses regarding geochemical patterning in Late Neolithic and Early Bronze Age environmental samples, which I review here in light of data presented in this chapter. At the broadest level, I suggested that Late Neolithic groups in the Little Sea micro-region employed corporate political economic strategies, placing greater dietary emphasis on local resources and practices involving local subsistence intensification. Consequently, I suggested that individuals from this period should feature M3 values corresponding to "Little Sea" geological catchment area. I suggested that Early Bronze Age groups, in contrast, employed network/exclusionary political economic strategies that enabled the construction and maintenance of long-distance interconnections. Corresponding mobility practices would have featured a larger seasonal rounds that incorporated non-local geological signatures (resulting in lower $^{87}Sr/^{86}Sr$ values), and larger contributions to diet from terrestrial game. Again, these patterns relate specifically to seasonal mobility strategies and foraging radii that adults would have employed, and thus should be most evident in M3 values (as well as stable isotopic values of carbon and nitrogen in adult bone collagen).

While Late Neolithic and Early Bronze Age M3 $^{87}Sr/^{86}Sr$ values exhibited similar *variances* (F-Test p-value=0.9937, n=8 [Late Neolithic], 40 [Early Bronze Age]), the two datasets did converge at values that differed significantly. Late Neolithic groups appear to have consumed resources from the local area when compared to the Little Sea's subsequent Early Bronze Age inhabitants. While Late Neolithic consumption appears to have focused on local resources, Early Bronze Age diets featured a larger component of other resources – either aquatic foods from outside the Little Sea or non-local terrestrial game. Given the absence of archaeological evidence for Holocene focus on species such as omul' and white fish that would have exhibited a "Baikal" $^{87}Sr/^{86}Sr$ signature, the former explanation seems unlikely.

In either case, the dietary resources reflected in relatively low Early Bronze Age M3 $^{87}Sr/^{86}Sr$ values would have been less susceptible to efforts at intensification than the aquatic resources from the Sarma River that appear to have been a focus of Late Neolithic diet. Both the Calgary and ORAU stable isotopic datasets for carbon and nitrogen from human bone collagen also indicated that Late Neolithic groups consumed relatively high proportions of high-trophic-level aquatic resources, while Early Bronze Age groups appear on the basis of these data to have engaged in a seasonal round that employed either terrestrial fauna from areas outside the Little Sea micro-region. Further support for the dietary change discussed here was seen in the stable isotope values ($\delta^{13}C$ and $\delta^{15}N$) for Late Neolithic and Early Bronze Age individuals who exhibited GFS ("local") diets. Namely, values within the GFS group appear to have shifted between the Late Neolithic and the Early Bronze Age; Late Neolithic individuals in this group exhibited significantly higher values than their Early Bronze Age counterparts, indicating less emphasis during the Late Neolithic on terrestrial game and other low-trophic level (generally terrestrial) resources.

Late Neolithic and Early Bronze Age individuals exhibited important differences at smaller scales as well. In particular, M1 and M2 data indicate that Late Neolithic groups interred individuals with relatively diverse early life-histories together within graves containing multiple burials (as well as within larger features such as grave clusters and cemeteries). I have suggested that this inclusive interment pattern corresponds to the inclusive rhetoric of corporate political economic systems, which emphasize identities that are available to relatively broad segments of society.

In contrast, Early Bronze Age groups who conducted funerals in the Little Sea micro-region appear to have enforced a more rigid separation between individuals with different early life-histories. At Khuzhir-Nuge XIV, rows of graves (and larger grave clusters as well) distinguished non-local individuals and local individuals. In several cases, individuals with nearly-identical $^{87}Sr/^{86}Sr$ values (presumably indicating similar home ranges during life) were interred together in a row of graves or within a single grave feature. These patterns provide support for arguments that Late Neolithic and Early Bronze Age groups in the Little Sea micro-region used funeral ritual and the symbolism surrounding burial differently, and are consistent with the hypothesized corporate and network/exclusionary political economic modes described above.

CHAPTER FIVE

PRESTIGE GOODS CIRCULATION AND NEPHRITE ORNAMENTS IN THE EARLY BRONZE AGE CIS-BAIKAL

Introduction

Over the last several decades, archaeological researchers working within the framework of the Baikal-Hokkaido Archaeology Project (BHAP) have published a number of studies of mid and late Holocene groups inhabiting the Cis-Baikal region of Siberia, Russia. These studies have provided high-quality bioarchaeological data on prehistoric hunter-gatherer adaptations in northeast Eurasia, while also positioning the Cis-Baikal as a testing ground for innovative methods in bioarchaeology and the anthropological sciences (e.g., Haverkort et al. 2008, 2010; Lieverse et al. 2009, 2010, Link 1999; Katzenberg et al. 2009, 2012; Scharlotta and Weber 2014; Scharlotta et al. 2013; Waters-Rist et al. 2011; Weber and Goriunova 2013; Weber et al. 2002, 2005, 2010, 2011). However, at least in English-Language publications on the region's prehistory, current research on the Cis-Baikal focuses considerably less on data regarding material culture (but see Mckenzie 2010; Scharlotta et al. 2016; Shepard 2012; Shepard et al. 2016). In this sense, the archaeology conducted by the BHAP – particularly when featured in English-language publications – differs considerably from traditional Russian-language literature on the Cis-Baikal, where a robust tradition of inquiry into prehistoric material culture continues to thrive (e.g., Bazaliiskii 2010a, 2010b; Novikov and Dolganov 2008; Goriunova and Novikov 2010; Goriunova et al. 2004, 2007; Kungurova et al. 2008; Novikov et al. [Eds.] 2010; Pavlova 2010, 2012; Sergeeva 1981b; Volkov and Zhambaltarova 2011)[7].

Here, I suggest that the lack of attention to material culture data in English-language literature on Cis-Baikal prehistory serves as an obstacle for attempts to investigate inter-group interactions and political structure among the region's mid and late Holocene hunter-gatherer inhabitants. In particular, I argue that the study of artifacts, including sourcing studies and investigations of prehistoric exchange, can provide a unique perspective on short-term interactions that are easily missed in bioarchaeological studies focusing on isotopic signatures from bulk samples of human skeletal and dental remains (see discussion in Chapter Three; see also Scharlotta and Weber 2014 for geochemical approaches that *are* sensitive to individuals' short-term movements).

A large body of ethnographic data indicates that relatively short-term events – large, face-to-face gatherings including ceremonial feasts, coming-of-age celebrations, funerals, and so-called "trade fairs" – play particularly important roles in social reproduction in small-scale and transegalitarian societies (e.g., Burch 2005; Chase-Dunn and Mann 1998; Hayden 2009; Hayden and Schulting 1997; Helms 1998; Jackson 1991; Janetski 2002; Meyer and Thistle 1995; Shepard et al. 2016; Spielmann 2002; Whallon 2006; Zvelebil 2011; see Chapter Six for discussion). These events serve as opportunities for interaction beyond the local group, giving individuals the opportunity to create and maintain relationships with relatively distant kin and affines. While the isotopic data discussed in Chapters Three and Four reflect individuals' long-term diets and movements (e.g., seasonal and multi-seasonal foraging patterns), material culture data can provide

[7] In addition, BHAP research also differs from archaeological work taking place in neighboring regions of Eurasia – which tends to emphasize long-distance, cross-cultural interconnections (see Chapter Six for discussion).

an important complement to information gleaned from these bioarchaeological approaches. Traditional archaeological data (on material culture) thus may be useful to shed light on events such as those listed above – which may not have had detectable effects on geochemical signatures in bulk samples of tooth enamel and bone collagen – but may have had important impacts on prehistoric political structure nonetheless.

In the next two chapters, I first employ artifacts from the Cis-Baikal region to demonstrate a relatively robust, regional-level system of interactions between groups with distinct "home ranges" identified on the basis of isotopic data (outlined in Chapters Three and Four). I focus on evidence from the Early Bronze Age, suggesting that during this period, local groups within the Cis-Baikal participated in an integrated system of exchange of exotic materials, forming what anthropologists focusing on other study areas would describe as an "international style" (Blanton et al. 1996; King 2003; Peregrine 2001). These data (specifically, nephrite ornaments; this chapter) also provide at least limited support for the argument that by the Early Bronze Age, Cis-Baikal hunter-gatherers engaged to varying extents in "prestige goods strategies" aimed at cultivating political status through association with exotic forms of labor-intensive and visually-stunning "wealth" that indexed participation in long-distance exchange networks

I then discuss evidence suggesting that this system of interactions may also have extended well beyond the boundaries of the Cis-Baikal, and that local groups within the region may have created and participated in long-distance networks with hunter-gatherers and groups practicing incipient forms of pastoralism in neighboring regions. To this end, I describe evidence for nephrite ornament circulation beyond the boundaries of the Cis-Baikal (this chapter) as well as evidence from other media and themes found throughout the macro-region (Chapter Six). Finally, I conclude by discussing possible *mechanisms* that may have enabled these interactions to occur. Specifically, I focus on types of events – and relatedly, specific loci – that may have featured large, face-to-face interactions between groups, and archaeological evidence for such events at these sites (see Chapter Six).

Material Culture Indicators of Interconnections within the Cis-Baikal

While recent isotopic evidence has been used to portray relatively distinct micro-regional regimes or "home ranges" among mid Holocene inhabitants of the Cis-Baikal (e.g., Weber et al. 2002, 2011), archaeological data complicate these models considerably. For example, during the Early Neolithic, Late Neolithic, and Early Bronze Age, funeral participants in all micro-regions of the Cis-Baikal interred polished tools made from green nephrite with deceased individuals. The green nephrite that the region's inhabitants used in order to make these tools is widely believed to have come from a relatively circumscribed area located to the west and south of the Angara River (Figure 5.1), and thus was not available throughout the Cis-Baikal (e.g., Goriunova et al. 2007; Okladnikov 1955; Sekerin and Sekerina 2000, see below). In this sense, the circulation of green nephrite – whether as raw materials or finished tools[8] – provides a clear indication that individuals must have moved between micro-regions or that groups with non-overlapping home ranges must somehow have interacted with one another throughout the mid Holocene.

[8] Notably, green nephrite tools and production debris have also been recovered from habitation sites dating to these periods (e.g., Okladnikov 1950, 1955).

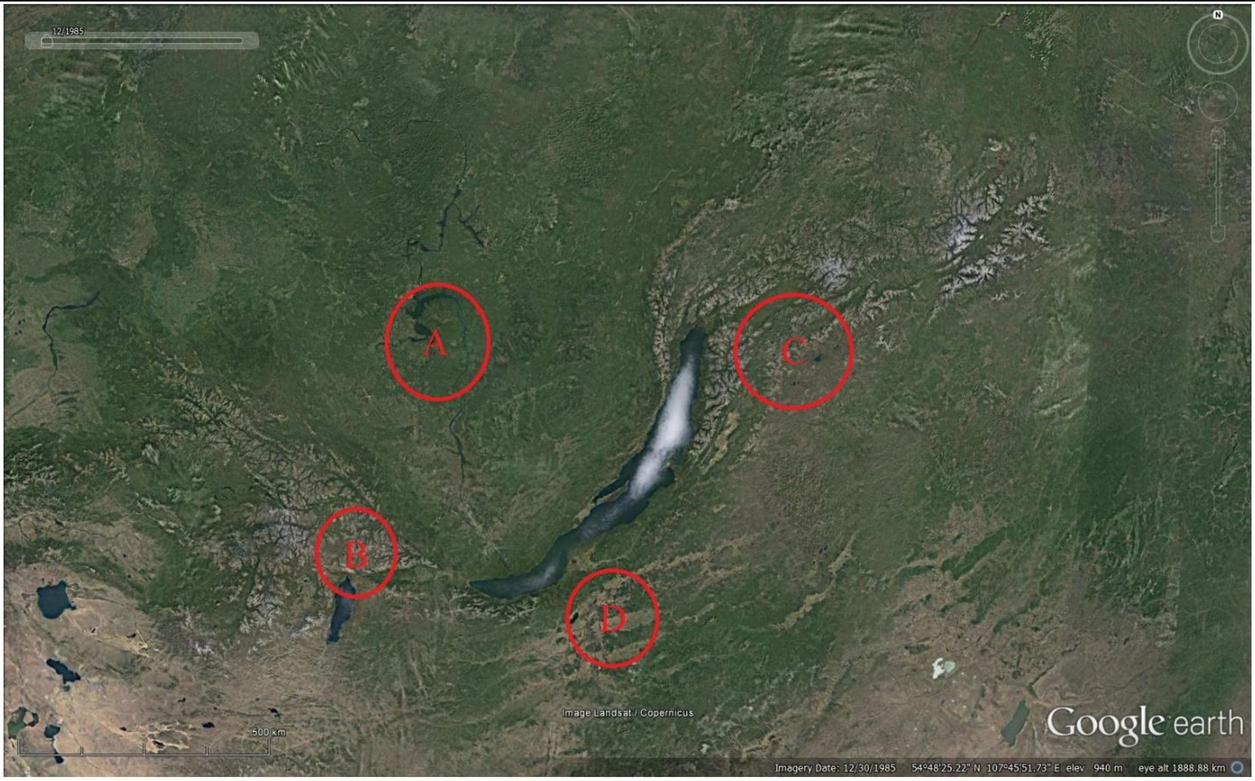

Figure 5.1. Map of Lake Baikal and surrounding regions, with areas mentioned in Chapter Five. A. Bratsk slate sources. B. East Sayan Mountain (green) nephrite sources. C. Vitim River Highland nephrite sources. D. Selenga River and location of Fofanovo cemetery. Map credit: Google earth v.7.1.5.1557, using Landsat / Copernicus data. http://landsat.gsfc.nasa.gov.

Other lithic artifacts provide similar evidence for regional-level interactions (although this evidence is sometimes less clear-cut, owing to the visually-distinctive qualities of nephrite). Macroscopic mineralogical comparisons suggest, for example, that slate chopping tools found at the Verkholensk cemetery on the upper Lena River (Okladnikov 1955:174, 1978), may also have been "imported" to the upper Lena micro-region from sources on the lower stretches of the Angara, near Bratsk. The appearance of these materials at sites far from their sources again hints at the existence of interconnections between areas that appeared *disconnected* in terms of stable isotopic evidence alone (e.g., Weber et al. 2011).

To the extent that available data on artifact types and their frequencies throughout the Cis-Baikal enable comparison of the Late Neolithic and Early Bronze Age, it is also noteworthy that during the Early Bronze Age, regional-level interconnections may have differed in scale from the locally-focused seasonal rounds that Cis-Baikal hunter-gatherers (particularly in the Little Sea micro-region) practiced during the Late Neolithic. For example, Bazaliiskii's (2010:74-85) survey of Cis-Baikal graves, although anecdotal, delineated four local variants in Late Neolithic funerary practices, each corresponding to distinct areas (the Little Sea and upper Lena micro-regions, as well as different areas of the Angara River Valley).

These local distinctions appear to have declined during the Early Bronze Age, as hunter-gatherers throughout the region began to employ the same sets of mortuary protocols and artifact types more widely (Okladnikov 1955, 1978:101). This finding has been interpreted as an indication of increasing interaction across micro-regional boundaries during the Early Bronze Age (e.g., Okladnikov 1955; Khlobystin 1987; Shepard 2012)[9]. In addition, expressions of the Cis-Baikal's Early Bronze Age Glazkovo groups are found over a wider area than those associated with Late Neolithic Serovo and Isakovo groups (including in the South Baikal and on the Selenga River delta in the Trans-Baikal, which is consistent with arguments for increases in inter-group interaction during the Cis-Baikal's Early Bronze Age).

Aspects of ritual culture also appear to have changed between these periods. Early Bronze Age inhabitants of the Cis-Baikal employed several novel types of objects at ritual events, including anthropomorphic symbols (depicted in a variety of media, see Chapter Six for

[9] Goriunova (e.g., 2002; Goriunova et al. 2004) and others (Khlobystin 1987; Turkin and Kharinskii 2004) also distinguished several mortuary traditions within the Cis-Baikal Bronze Age, but made these distinctions on a chronological basis, not a geographic one. The groups they identified appear in essentially all areas of the Cis-Baikal. For example, Goriunova (2002, Goriunova et al. 2004, see also Turkin and Kharinskii 2004) described a "Shumilikha Stage" and a "Mukhor Stage" of the Cis-Baikal Bronze Age. However, unlike Late Neolithic mortuary traditions, burials assigned to these categories have been found throughout the region.

discussion), polished white nephrite "discs" and "rings," and other ornaments made of shell, clay, metal, and various non-nephrite lithic materials (e.g., Novikov and Dolganov 2008; Weber and Goriunova 2003; Goriunova et al. 2007; Okladnikov 1955).

The terms "disc" and "ring" (the latter is also sometimes referred to as a "bracelet") refer to two distinct forms of nephrite ornament that Okladnikov (1955) distinguished anecdotally, based on his extensive work with the region's Early Bronze Age mortuary record. Both discs and rings are essentially flat, circular, and highly polished, but the former (discs) feature a central aperture that is relatively small in diameter in comparison to the diameter of the entire object (Figure 5.2; see below for details). Rings, in contrast, feature large central apertures and a thin body relative to an object's overall diameter.

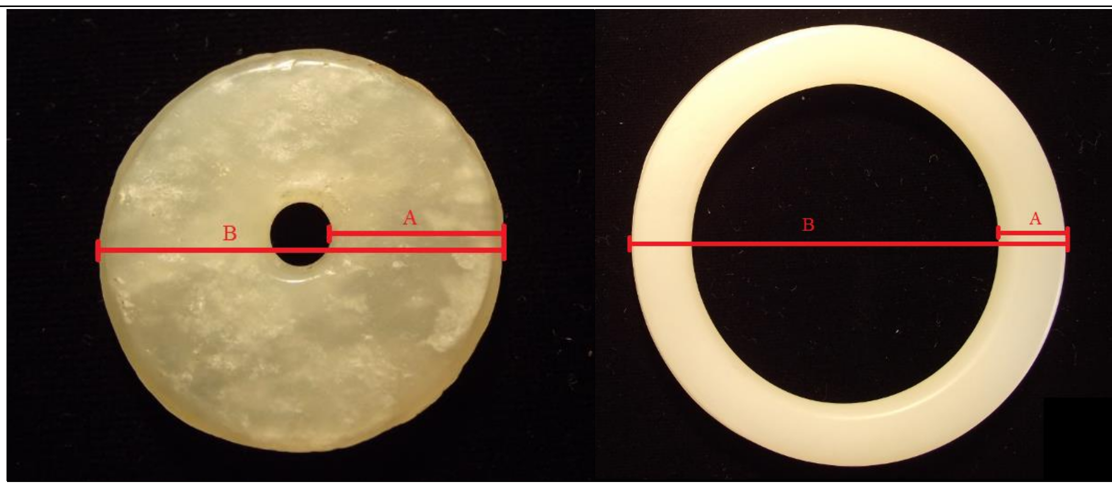

Figure 5.2. Disc (left) and ring (right) attributes. "Discs" exhibit relatively high width/diameter ratios (A/B $\geq$ 0.36, while rings feature thin bodies relative to overall ornament diameter, resulting in low width/diameter ratios (A/B $\leq$ 0.25).

These objects featured prominently in Early Bronze Age burial ritual, as groups throughout the Cis-Baikal displayed them on funerary headgear and chest-covers (e.g., Okladnikov 1955; Goriunova et al. 2007). Okladnikov (1955) also observed Early Bronze Age anthropomorphic sculptures of individuals wearing similar chest covers (Figure 5.3). These figures have often been interpreted as spirits or ancestral figures, and their depiction with chest-coverings may serve as a testament to the close association between human bodies that Early Bronze Age groups memorialized at ceremonial events and new forms of body ornamentation during this period (see discussion in Chapter Six).

Figure 5.3. Carved bone pendant depicting an anthropomorph wearing a chest cover, from Ust'-Uda cemetery (adapted from Khlobystin 1987:415).

I have suggested elsewhere that the Early Bronze Age adoption of these ornamental technologies for use in ceremonial display contexts is not a random development within the region's culture-history, and instead, that these novel forms of material culture reflect both an aesthetic shift and a closely-related shift in the sorts of political strategies that individuals employed. These strategies involved the display of exotic, labor-intensive, and durable wealth in order to index participation in long-distance, exclusive social networks (the "network/exclusionary strategy" [Blanton et al. 1996]), and appear to have differed from the inclusive, subsistence-focused political strategies ("corporate strategies" [Blanton et al. 1996]) that dominated in Late Neolithic iconography and material culture (at least in the Little Sea, Shepard 2012).

In the next section, I present data on the forms of nephrite ornaments and their distribution at the regional level in order to explore Early Bronze Age political economy in the Cis-Baikal. I begin by discussing the unique physical properties of nephrite that make it well-suited for use as a prestige good. I then outline the locations of nephrite outcrops that Cis-Baikal hunter-gatherers would have employed to obtain the raw materials for these ornamental objects. I then describe current models of nephrite ornament production processes in the Early Bronze Age Cis-Baikal, drawing primarily on published work by Okladnikov (1955) and others (Darwent 1998; Sax and Ji 2013; Semenov 1941, 1966). Using data on formal attributes of nephrite discs and rings that I collected in museum contexts in Irkutsk, Russia, as well as digitized images from Russian publications, I use these models to assess regional-level interactions and variation in political strategies that hunter-gatherers employed throughout the Cis-Baikal.

Properties of Nephrite

Nephrite is one of two types of rock – along with jadeite – that geologists and gemmologists categorize as "jade" (Harlow and Sorenson 2004). While jadeite and nephrite are somewhat similar in appearance, they differ in terms of their structure and chemical makeup (Beck 1984; Bradt et al. 1973; Darwent 1998:6-10). At the elemental level, jadeite is rich in aluminum and sodium (chemical formula: $NaAlSi_2O_6$), and is sometimes referred to as "pyroxene jade" because of its single-chain (pyroxene) structure of tetrahedral silicate molecules. In contrast, nephrite is an aggregate of tremolite-actinolite-series amphiboles, rich in magnesium, calcium, and iron (chemical formula: $Ca_2[Mg, Fe]_5Si_8O_{22}[OH]_2$). In nephrite, these tremolite-actinolite amphiboles exhibit a microcrystalline, interlocking or "felted" structure (Harlow and Sorenson 2004), which has several important implications for nephrite's use in both contemporary and prehistoric settings.

First, nephrite's fibrous structure prevents conchoidal fracture, making it unfit for use in flake tool production (Darwent 1998:6). The felted, microcrystalline nature of interwoven tremolite-actinolite bundles also makes it possible for an artisan using proper equipment to polish nephrite surfaces extremely finely, giving it a reflective and visually-stunning quality. For this reason, nephrite samples with smaller individual tremolite-actinolite molecules are traditionally particularly valuable (Wen and Jing 1992). In this sense, nephrite's fibrous structure makes it ideal not only for groundstone chopping tools and other objects that endure considerable amounts of force, but also for prestige goods and objects intended to retain value over long periods.

Nephrite exhibits a Mohs' hardness value of roughly six (reports differ somewhat: Dematte [2006:217] and Sax and Ji [2013] provide a range of values from 6.0 – 6.5, Lu et al. [2005] use a value of 6.5, Rapp [2004] provides a lower range of 5.0 – 6.0, and Wang [2011:687] gives only a minimum value ["higher than 5"]). This value makes nephrite difficult to cut or carve, even with bronze and iron implements (Sax and Ji 2013:1067, see also Semenov 1968:68). The felted, microcrystalline structure of tremolite-actinolite-series amphiboles in nephrite also gives it a very high toughness, making it extremely labor-intensive to work, but also highly durable during use. Experimental studies of nephrite and other raw materials from the British Columbia Plateau demonstrate the considerable time expenditures involved in producing blanks for nephrite groundstone tools. Using a sandstone saw, Darwent (1998:35-36) was able to achieve an average cutting speed of 1.455 mm/hr for nephrite, as opposed to 2.52 mm / hour for greenstone, another material commonly used for polished axes and celts in other global contexts (e.g., D'Amico 2005; Darwent 1998) and 3.15 mm / hour for serpentine.

Geographic Distribution of Nephrite in the Study Area

Several geographic areas have been proposed as sources for the nephrite that Cis-Baikal hunter-gatherers made into tools (and ornaments during the Early Bronze Age; Goriunova et al. 2007; Okladnikov 1955; Sekerin and Sekerina 2000). During the 19th and early 20th century, these included outcrops in China and Central Asia. In his monographs on the Cis-Baikal's Neolithic and Early Bronze Age, Okladnikov (1950, 1955) argued that the East Sayan Mountains – Russia's largest nephrite-bearing region (Kolesnik 1966:9) – represented the most likely source of this nephrite. East Sayan sources of nephrite – now extensively studied – first attracted the attention of geological researchers in the 1880s (Fersman 1960). Centered around the Kitoi, Onot, Urik, and Belaia Rivers, these East Sayan outcrops feature nephrite that is predominantly *green* in color (Goriunova et al. 2007; Kolesnik 1966; Sekerin and Sekerina 2000; Suturin and Zamaletdinov 1984). However, Okladnikov (1955) also argued for an East Sayan origin of the *white* nephrite that Early Bronze Age groups worked into ornamental forms and placed on the dead at funeral ceremonies, believing these outcrops had yet to be discovered.

More recently, geological research on nephrite has demonstrated that although both white and green nephrite are structurally similar, as described above, the processes responsible for the development of these two color varieties differ, as does the local geology of areas where they tend to develop. The more common of these varieties, green nephrite develops at contacts between serpentinite and silica-rich ricks such as plagiogranite, greywacke, argillite, or chert, through a process of chemical alteration to serpentinite parent material by calcium-rich fluids ("calcium metasomatism;" Harlow and Sorenson 2004:14). This process has been well-documented within the East Sayan Mountains (e.g., Kolesnik 1966; Suturin and Zamaletdinov 1984, as well as the Ural Mountains of Western Siberia).

In contrast with green “serpentinite replacement” nephrite deposits (Harlow and Sorenson 2005), white nephrite develops along the edges of dolomitic rocks that are exposed to silicic fluids, and features a high proportion of *tremolite* (high-Mg, low-Fe). Notably, “dolomite replacement” geological features are relatively rare at the global scale, and tend to produce relatively small (low-volume) deposits (Harlow and Sorenson 2005). To date, dolomite replacement processes – as represented by white nephrite outcrops – have not been conclusively documented in the East Sayan Mountains, although several white nephrite alluvial cobbles have been attributed to rivers with East Sayan Mountain sources anecdotally, based solely on 18th and 19th century oral testimony from locals (e.g., Okladnikov 1955).

The absence of any *clear* sources of white nephrite in the East Sayan Mountains is striking given the relatively intensive study of the region for nephrite sources (hundreds of which have been documented) both during and prior to the soviet period (to say nothing of ongoing nephrite prospecting work in the area; A.P. Sekerin, personal communication, August, 2013; Sekerin and Sekerina 2000). On this basis, it appears unlikely that East Sayan white nephrite deposits were available to Cis-Baikal hunter-gatherers prehistorically, either due to their extreme scarcity or their actual absence altogether.

Dolomite replacement outcrops were first documented in Russia in the late 1970s (Sekerin and Sekerina 2000:158) in the Vitim River highlands, 600 km northeast of Lake Baikal. Notably, visual characteristics of nephrite from Vitim River sources correspond well with those of archaeological artifacts from the Early Bronze Age Cis-Baikal, and it is now widely believed that Cis-Baikal groups used rocks from these relatively distant sources to produce Early Bronze Age ornaments (e.g., Goriunova et al. 2007; Metcalf 2006; McKenzie 2006; Sekerin and Sekerina 2000; Shepard 2012).

Procuring white nephrite from this remote area would have required considerable labor investment on the part of Cis-Baikal hunter-gatherers. Given the distance of raw material sources from the Cis-Baikal, access to white nephrite would have required either (a) long-distance social ties (for indirect procurement through exchange or gifting), or (b) overland travel to source areas for direct procurement. Working nephrite cobbles into highly-polished finished goods also represented a major investment of time and labor, as documented in studies of nephrite working from other global contexts (e.g., Darwent 1998; Semenov 1968; see above). Despite these difficulties, Early Bronze Age groups produced sizeable quantities of standardized ornaments from this material (Okladnikov 1955, see below), and the occurrence of these objects in all micro-regions of the Cis-Baikal is again suggestive of the existence of Early Bronze Age interconnections throughout the region and beyond.

Early Stages of Nephrite Ornament Production

Throughout the Cis-Baikal, worked green nephrite alluvial cobbles (all apparently from "serpentinite replacement" deposits, based on their deep green color) have been found at cemeteries, representing different stages of the tool production process (Figure 5.4). In contrast, no traces of the early production stages for white "dolomite replacement" nephrite objects have been recorded in the Cis-Baikal (or in the Vitim River Basin, although this absence of evidence may at least in part be a result of poor archaeological sampling along the Vitim River, see Ineshin et al. 2006 for discussion). Okladnikov (1955:187) and Semenov (1968) both suggested that initial stages of ornament production likely involved working with relatively small, river-worn white nephrite cobbles, and these activities may have taken place at ephemeral (and understudied) sites on the Vitim and its tributaries, where cobbles would have been available.

Figure 5.4. Sawed green nephrite cobble, featuring snap scar. From Glazkovo cemetery, Ovchinnikov (1890s) excavations.

During white nephrite ornament production, individuals would have first reduced a nephrite cobble into thin, flat slabs for subsequent cutting and polishing, while also drilling a central aperture into this slab (Semenov 1968). Semenov (1968:67-68; see also Okladnikov 1955:176-180) employed experimental studies and use-wear analysis to demonstrate two possible methods of producing nephrite ornaments from these worked nephrite slabs. The first of these two methods involved cutting a circular series of short incisions into a flattened slab, using a drill made of chert or bronze (like Sax and Ji [2013], Semenov [1968:68] found that a mixture of water and an extremely hard, abrasive material, such as grains of corundum [Moh's hardness: 9.0] or diamond [Moh's hardness: 10.0] would be necessary to saw or drill nephrite effectively using this method). An ornament producer would then continue to use this combination of mineral grains, water, and a sharp cutting tool to deepen and consolidate grooves until those on each side nearly came into contact.

A second method of shaping nephrite slabs into workable ornament blanks involved "machine processing" using a wooden drilling mechanism mounted on a nephrite slab. An individual would rotate the "arm" of this mechanism (containing an attached drill-bit) in a circular motion while applying downward pressure, eventually creating a deep, round groove in a circular pattern on the surface of a nephrite slab. This process would be repeated on both sides of the nephrite blank, so that both surfaces featured grooves at roughly identical distances from the object's central aperture. According to Semenov (1968), this method involved a considerable time expenditure (55-60 hours) to produce a single nephrite ornament. Regardless of the cutting method used, this middle stage of nephrite ornament production would result in the production of a flat nephrite slab with a deep, circular groove on each side. An individual could then break – or "snap" – the deeply-incised object along this incision. On a flat nephrite slab, this method would produce a single, circular ornament, featuring a central aperture (a "disc").

This separation of a disc from a slab would have left distinct archaeological traces, in the form of disc "negatives" (slabs with empty, circular features in their centers). In addition (and of more importance for the purposes of this discussion), traces of this process are also visible on finished artifacts themselves, in the form of a thin, protruding "rib" on the outer edges of discs, where they broke (along grooves established through labor-intensive cutting and sawing). These ribs are analogous to "snap scars," which are commonly seen on groundstone technologies such as nephrite celts in Siberia and Canada (e.g., Darwent 1998:48). Surfaces of these discs could then be polished before they were used in ornamental displays.

Notably, the same method of breaking a nephrite slab along prepared grooves to produce a disc was not only used on slabs. Early Bronze Age groups in the Cis-Baikal also appear to have used this method on the outer edges of *already-completed* discs in order to subdivide them into a *disc* (the inner section of a subdivided ornament) and a *ring* (the outer/edge section). Several discs show evidence of this separation process (discussed below in greater detail). Okladnikov (1955:178) described one characteristic example of this "subdivision process" at the cemetery of Semenovo, located on the Angara River. This large disc featured an incised, circular groove composed of short, discontinuous, linear impressions that deepened at their center (Figure 5.5), which Okladnikov suggested represents an unfinished attempt to divide the disc into two ornaments. In rare cases, Early Bronze Age graves also contained multiple nephrite ornaments with identical coloring that fit perfectly inside one another (and featured corresponding snap scars), suggesting that they were likely separated from a single disc, most likely sequentially (Figure 5.6; Okladnikov 1955:178). On the basis of these observations, Okladnikov (1955:271) suggested that Early Bronze Age groups may have frequently subdivided nephrite discs, thereby reducing the average sizes of discs while inflating the overall number of ornaments in circulation.

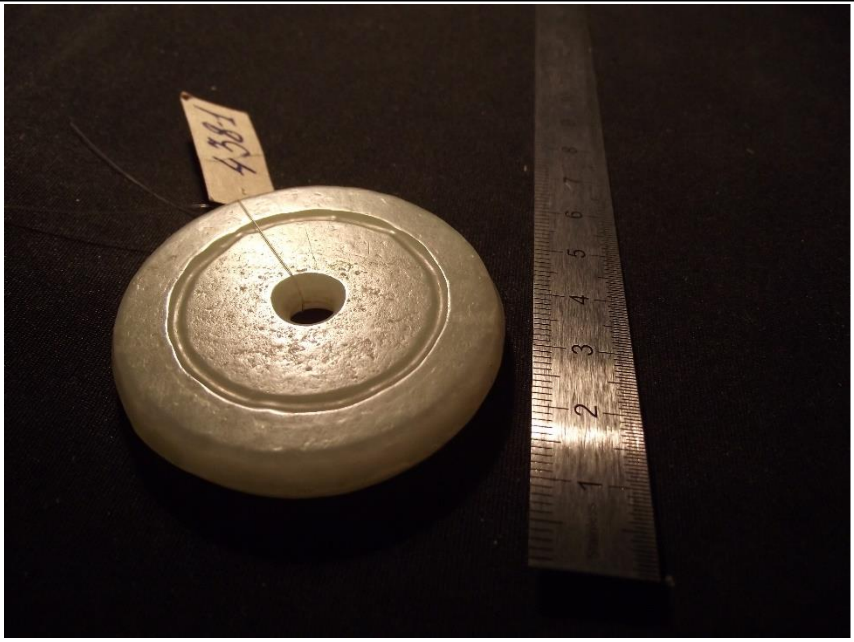

Figure 5.5. White nephrite disc from Semenovo cemetery (1933 excavations) featuring ring production groove composed of short, linear incisions (object ID: KRA-438-1).

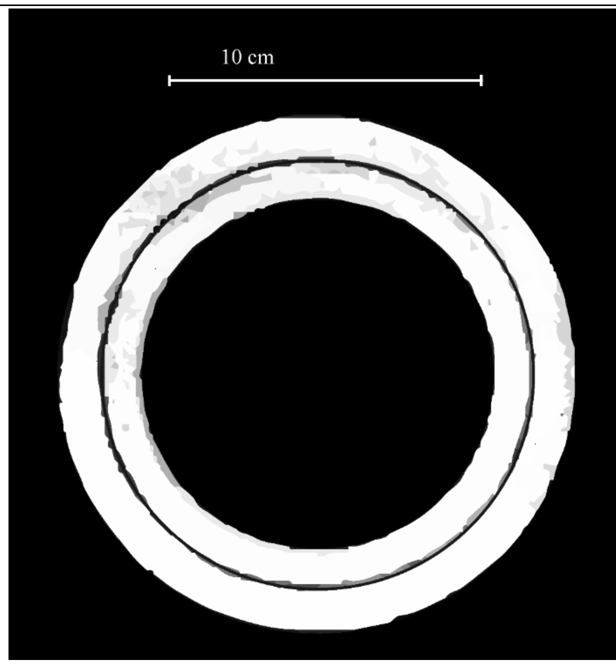

Figure 5.6. Adjoining rings from Fofanovo cemetery (adapted from Okladnikov 1955:184).

These suggestions provide an important starting point for an investigation of the ways that Early Bronze Age hunter-gatherer groups provided, displayed, and exchanged nephrite ornaments in the Cis-Baikal. The non-local source of white nephrite provides evidence that the circulation of these objects may have transcended not only micro-regional, but regional boundaries as well. Below, I apply these models of production to data on nephrite ornaments' forms and geographic distributions in order to examine long-distance interconnections in the Early Bronze Age Cis-Baikal and the political economic strategies that maintained them. More specifically, I revisit hypotheses about production methods for nephrite ornaments that Okladnikov (1955) and Semenov (1968) outlined, using new data collected since the publication of Okladnikov's (1955) culture-historic syntheses in the 1950s. These new data enable an assessment of individuals' choices about the production, reproduction, and exchange of labor-intensive and exotic ornamental goods. Further, I argue that these data indicate the existence of long-distance interactions, as well as diverse political strategies at the regional level.

Data Collection

In order to produce a large-scale, regional dataset on artifacts recovered from Cis-Baikal sites dating to the Early Bronze Age, I employed two data collection methods for this dissertation. First, I conducted direct analyses of artifacts housed in the Irkutsk State University, the Irkutsk Province Regional History Museum, as well as the Irkutsk State Technical University, during 2011-2012. These objects were assessed visually to determine their composition ("nephrite," "non-nephrite"), as differences between nephrite and other materials such as kaolinite and calicite that were commonly used for Early Bronze Age ornaments are readily apparent. I then collected measurements on each object's overall diameter, thickness, the diameter of the central aperture, and the width of the ornament body from the edge of the aperture to the outer edge of the object.

Where applicable, I also noted the presence of non-metric traits on these artifacts, including concentric grooves, other incisions that may represent part of ornament separation attempts, the presence of "snap scars," and breakages. As an addition to this dataset of objects that could be directly measured, I also collected data on nephrite ornaments from textual descriptions, digitized line drawings, and published photographs, in cases where objects could not be located in museum contexts or where access to these collections was impossible. Together, these approaches produced information on the shape and dimensions of a total of 195 nephrite discs, rings, and intermediate objects from within the Cis-Baikal (Appendix 12).

The completeness of archaeological collections, as well as published data employed in this study, differed somewhat by micro-region. For example, since most sites in the Little Sea micro-region were excavated after the mid-20th century (and are housed at the Irkutsk State University Department of History – Archaeology, Ethnology, and History of the Ancient World Branch; e.g., remains from Khuzhir-Nuge XIV, Kurma XI, Sarminskii Mys), relatively complete access to archaeological collections from this area was possible. Further, a recent publication by Goriunova et al. (2007) provided a list of all nephrite objects excavated in that micro-region prior to 2007, as well as a bibliography of sources with more information about the objects in question. No similar bibliographic index was available for other micro-regions, and most materials excavated in the early 20th century – many from the Angara and upper Lena River Valleys – could not be located in the collections I studied. Fortunately, for materials from the Angara River, detailed descriptions did exist in publications such as Okladnikov's (1974, 1975, 1976) series of monographs on the cemeteries of the upper, middle and lower stretches of the Angara River, and in the 1981 publication of remains from Shumilikha (["Ust'-Belaia II]; Savel'ev et al. 1981).

Data on nephrite ornaments from the upper Lena River Valley were more problematic, as most of the materials excavated in this region remain unpublished, and many of the original field notes and artifacts have been lost (Zubkov 2010). Verkholensk cemetery (Okladnikov 1978) is a notable exception to this lacuna in Cis-Baikal mortuary data. Additionally, Zubkov (2010) recently published a synthesis of available data on the upper Lena sites excavated by Okladnikov in 1928-1930 and 1941, improving local coverage for this area considerably. In total, this dataset included 83 nephrite discs, rings, and intermediate circular ornaments from the Angara River, 35 from the upper Lena, and 67 from the Little Sea, enabling a robust comparison of micro-regional ornament forms. Discs outnumbered rings by more than double in this sample (134 to 52), a similar ratio to the ratio of 76/37, seen in Okladnikov (1955:176).

Overall Patterning

Discs and ring distinctions

Data on formal attributes of nephrite ornaments enabled a more detailed, quantitative analysis of differences between discs and rings. For this analysis, I employed measurements of ornaments' overall diameter and the width of the ornament body from central aperture to edge (Figure 5.2). These two values provided a width/diameter ratio for each ornament. Because this analysis employed ratio data and therefore did not require any specific *unit* of measurement, I also calculated a width/diameter ratio for digitized images that lacked a scale (using pixels as a unit of measurement). Objects reported in textual descriptions that lacked images were excluded from this analysis resulting in the inclusion of data on 151 nephrite discs, rings, and similar ornaments (Figure 5.7).

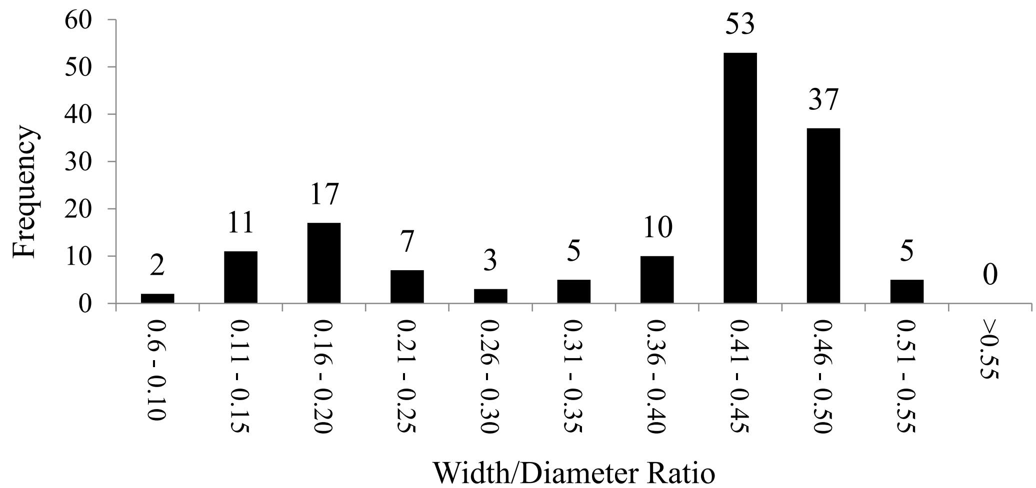

Figure 5.7. Distribution of width/diameter ratios for nephrite ornaments.

The distribution of width/diameter ratios revealed two broad groups of objects – one featuring a wide body (from inner aperture to outer edge) relative to overall diameter, and another featuring relatively large aperture sizes and low body widths relative to overall diameter. More specifically, a larger group of objects (N=105) featured width/diameter ratios concentrated in the 0.36 – 0.55 range, indicating wide ornament bodies relative to their overall diameters. A smaller cluster of objects (n=38) exhibited relatively low width/diameter ratios with values between 0.06 – 0.25, indicating thin ornament bodies (low width) relative to overall diameter. Based on this analysis, I classify all nephrite ornaments with a width/diameter ratio ranging from 0.26 – 0.35 as "indeterminate" in terms of object type (with one exception, see below). Ornaments with ratios above 0.35 are classified as discs, and those with width/diameter ratios below 0.25 are classified as rings.

Eight objects exhibited intermediate width/diameter values, ranging from 0.26-0.35. These ornaments exhibited diameters ≤ 4.2 cm, although most were considerably smaller (Appendix 11). Of these, one particularly unique white nephrite ornament with an intermediate width/diameter ratio from outside the Little Sea micro-region was found at the Lokomotiv-Raisovet cemetery (1997 excavations, Grave No. 15, Object 8), located in the Angara River micro-region (in the modern city of Irkutsk). The outer edge of this object was almost completely flat. In nearly all other cases, nephrite ornaments were convex on their outer edges, and the perfectly cylindrical inner aperture of this unique intermediate form was situated so that the edge intersected the ornament's flat, polished surface at a right angle (Figure 5.8). This perfectly cylindrical inner aperture differed from all other Early Bronze Age ornaments (but may have been present in several rare cases on Early Neolithic ornaments during the eighth millennium cal BP [V.I. Bazaliiskii, personal communication, August, 2012).

Figure 5.8. Nephrite ornament from Lokomotiv-Raisovet (1997 excavations) Grave No. 15, Object 8 (IGU-LOR-15-8).

It is also noteworthy that recent attempts to date graves from this cemetery indicate that all individuals tested (n=13; Weber et al. 2006) are Early Neolithic in age. Similarly, a recent synthesis by Bazaliiskii and Savel'ev (2008) listed 117 radiocarbon ages from Lokomotiv-Raisovet and nearby Lokomotiv cemetery, all of which corresponded to the Early Neolithic. Thus, it is entirely possible that this object is not representative of Early Bronze Age ornament production practices. On this basis, I exclude this object from further discussion. Other "intermediate" ornaments are discussed below where relevant, but here it is noteworthy that the bimodal distribution of width/diameter ratios seen here provides empirical support for the disc/ring distinction.

Aside from data on width/diameter ratios, measurements of nephrite ornaments also illuminate aspects of the production process and help to remove outliers from further analyses (Figure 5.9). Discs exhibited a range of diameters from 1.1-9.5 cm (n=124), with a median value of 3.05 cm. Rings, in contrast, exhibited larger diameters, ranging from 1.6-12.9 cm (n=45), with a median value of 5.1 cm. Only a single "ring" featured a diameter value below 2.5 cm (Shumilikha, 1986, Grave No. 1, Object No. 2, listed in Appendix 11 as "intermediate," see below), and this object appears to have been an outlier in other ways as well, featuring a width/diameter ratio of 0.24, placing it close to the range of indeterminate values for the disc/ring distinction. Aperture sizes also differed for discs and rings. Discs exhibited aperture sizes from 0.1-1.2 cm (n=86), while ring apertures were considerably larger, ranging from 0.9 – 10.8 cm (n=31). Again, the minimum value listed here for ring aperture size is misleading, as a single outlier (again, Shumilikha, 1986, Grave No. 1, Object No. 2) exhibited a value of 0.9 cm, well below the next lowest value of 1.7 cm. Because of the abnormal form of this object, I designate it as an intermediate ornament rather than as a ring.

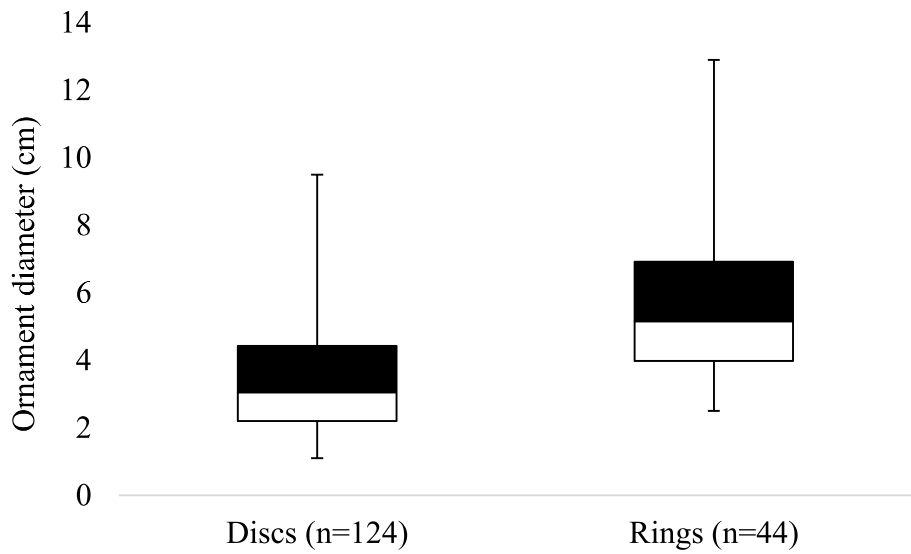

Figure 5.9. Disc and ring diameters.

Given the range of disc diameters (<9.5 cm), ring aperture sizes are noteworthy in that all rings were large enough to serve as an "outer edge" of at least *some* of the discs from the Cis-Baikal sample under study here, and some rings featured aperture sizes large enough to suggest that they could have been removed from even the largest discs seen in the Cis-Baikal. Particularly large rings included two adjoining fragments found at Kurma XI, Grave No. 5 (Object No. 69-1), that formed a complete ring with an aperture size of 10.8 cm (Figure 5.10; diameter 12.9 cm), and the ring from Grave No. 9 at Shumilikha featured an aperture size of 10.0 cm (diameter: 12.5 cm; Savel'ev et al. 1981:61-62).

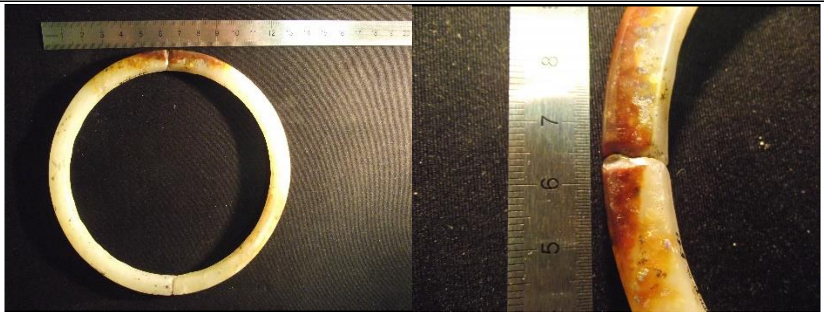

Figure 5.10. Adjoining ring fragments (IGU-KXI-5-69-1 and 2) from Kurma XI, Grave No. 5. Left. Ring halves. Right. Close-up of radial notch/groove.

The overall patterning in terms of diameters of discs and apertures of rings is consistent with the model of ornament separation described above. This model involves the production of relatively large discs initially, followed by the successive removal of rings (and disc shrinkage) over the lifespan of these objects. The frequent presence of "snap scars" on discs' outer edges also supports this model.

Abnormal ornament forms

Most of the objects designated here as discs were perfectly or almost perfectly circular, although exceptions to this pattern did exist. These included two "discs" from Shumilikha (Grave No. 41, IGU-SHU-31-10; Figure 5.11) and Kurma XI (Grave No 19, IGU-KXI-19-18G, Figure 5.11), that featured an unrounded shape, possibly indicating incomplete attempts at disc production or another unfinished production activity. Because the production processes for these objects appear to have been similar to those used for other ornaments, I categorize these non-circular objects as "discs," along with specimens featuring conventional, circular edges. In addition to the two unique discs specimens (or possible discs-in-progress) discussed above, several other disc-like objects were rectangular or "subrectangular" in shape, including two examples from Anosovo

(Grave No. 2, KRA-1013-40) and Kaiskaia Gora (Figure 5.11, Okladnikov 1955:184). Okladnikov (1955:176) listed five of these "right-angled" objects from graves in the Cis-Baikal dating to the Early Bronze Age, although the specific sites where they were found are unclear.

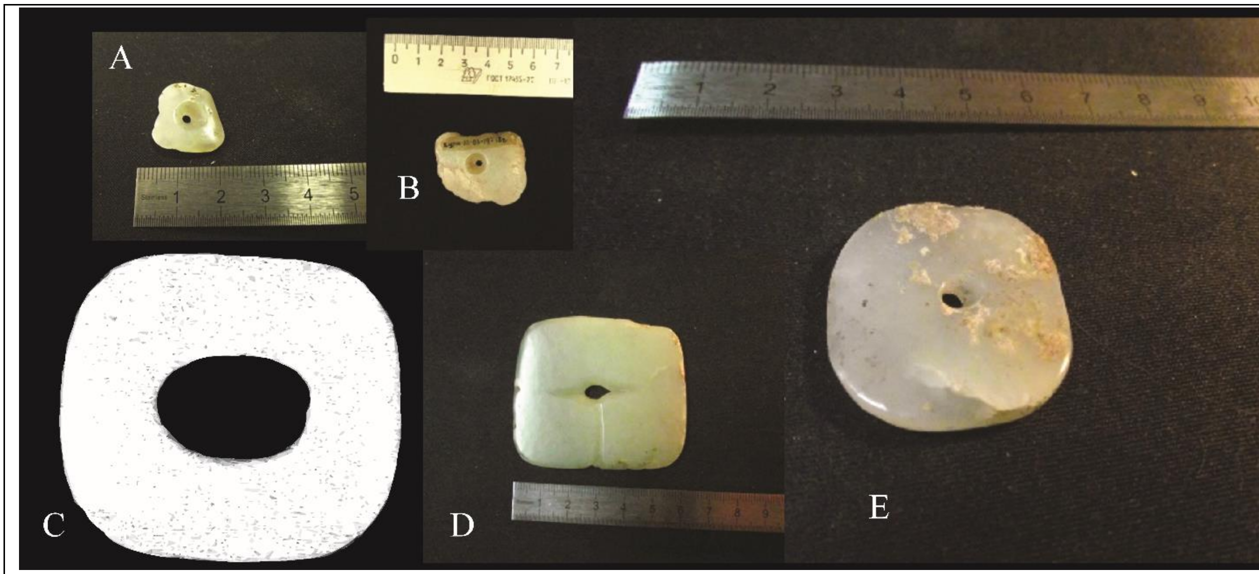

Figure 5.11. Irregular ornaments.
A. Irregularly shaped ornament (IGU-SHU-31-10) from Shumilikha cemetery, Grave No. 41.
B. Irregularly shaped ornament (IGU-KXI-19-18G) from Kurma XI, Grave No. 19.
C. Subrectangular ornament from Kaiskaia Gora cemetery, Angara River (adapted from Okladnikov 1955:184).
D. Rectangular ornament (KRA-6809), provenience unknown (no scale provided).
E. Subrectangular ornament (KRA-1013-40) from Anosovo cemetery, Grave No. 2.

While the majority of discs featured completely polished, flattened surfaces, 14 of these objects featured a circular groove (10.4% of the total disc sample). In all cases where these grooves were observed, they were located on *both* sides of the disc in question, although the extent of cutting sometimes differed between the two sides. In all cases, grooves were present in roughly equivalent positions relative to one another (on both sides of an ornament). Grooved discs may represent either an early stage in an ongoing process of ring production or an abandonment of this task. All grooved discs for which data were directly available featured grooves that were at least

0.6 – 0.8 cm from the disc's central aperture (n=8). Thus, if the subdivision of these ornaments had been completed, the inner disc would have had a radius of at least this size (and all resulting ornaments would have been within the range of radii seen among discs). Similarly, in all cases except for one disc that featured a fragmented (and subsequently thinned) outer edge (see below), grooves were situated far enough from objects' outer edges, so that an intentional fracture along these incisions would have produced a viable ring.

In some instances, discs featured short, discontinuous incisions with varying depths, corresponding to early stages of Semenov's first method of disc production (described above). For example, two discs from Semenovo (KRA-438-1, Figure 5.5) and Sarminskii Mys (IGU-SM-2-14, Figure 5.13) featured grooves of this sort (with discontinuous incisions that were inconsistently sized). This pattern likely indicates that an initial incision had already taken place, but that the grooves in question had not yet been deepened at the time these objects were interred.

A unique disc from the 1986 salvage excavations at Shumilikha (IGU-SHU-1986-1-1) provides an illustration of the next phase of ornament production. The surface of this disc – which featured a deep and continuous groove on both sides – contained numerous, extremely fine, linear scratches radiating from the groove. These scratches likely represent the stage during which initial grooves on both sides were deepened through the use of coarse mineral grains and water (see above). This stage would have occurred prior to final polishing and separation of a completed disc and ring. It is possible that this unique disc ultimately remained in an incomplete stage of production due to a fracture that appears to have developed along its outer edge (possibly during the groove deepening stage; Figure 5.12). Fractures during polishing may have occurred somewhat commonly, as evidenced by other discs evidencing similar aborted attempts at ring production, coupled with edge fractures.

Another disc, from Khuzhir-Nuge XIV, Grave No. 24 (IGU-KNXIV-24-62), featured an incomplete ring (still attached) that exhibited a rough (fractured) edge. This edge was partially repolished after the fracture occurred, reducing the prospective ring's thickness so much that the separation of a second, thin-bodied ornament was likely no longer possible.

Figure 5.12. Discs featuring incomplete rings.
A. Disc with groove from Sarminskii Mys (IGU-SM-2-14).
B. Disc from Shumilikha (IGU-SHU-1986-1-1), 1986 salvage excavations, featuring a continuous groove and radial scratches (representing incomplete polishing).
C. Disc from Khuzhir-Nuge XIV, Grave No. 24 (IGU-KNXIV-24-62), featuring worn groove and fracture edge.

In cases where relatively large discs *lacked* concentric grooves, I suggest that unique raw material defects may have provided obstacles to successful ring removal. For example, large discs from Uliarba, Grave No. 35 (IGU-ULI-1976-5-19), Glazkovo Vokzal (1904 excavations, KRA-6087), and Semenovo Grave No. 3 (1933 excavations, KRA-444-1), appear to have featured defects in the form of radial "hairline" or subsurface fractures, that might have prevented Early Bronze Age hunter-gatherers from adding grooves without risking eventual breakage of the existing disc as well as the ring that would be produced (Figure 5.13).

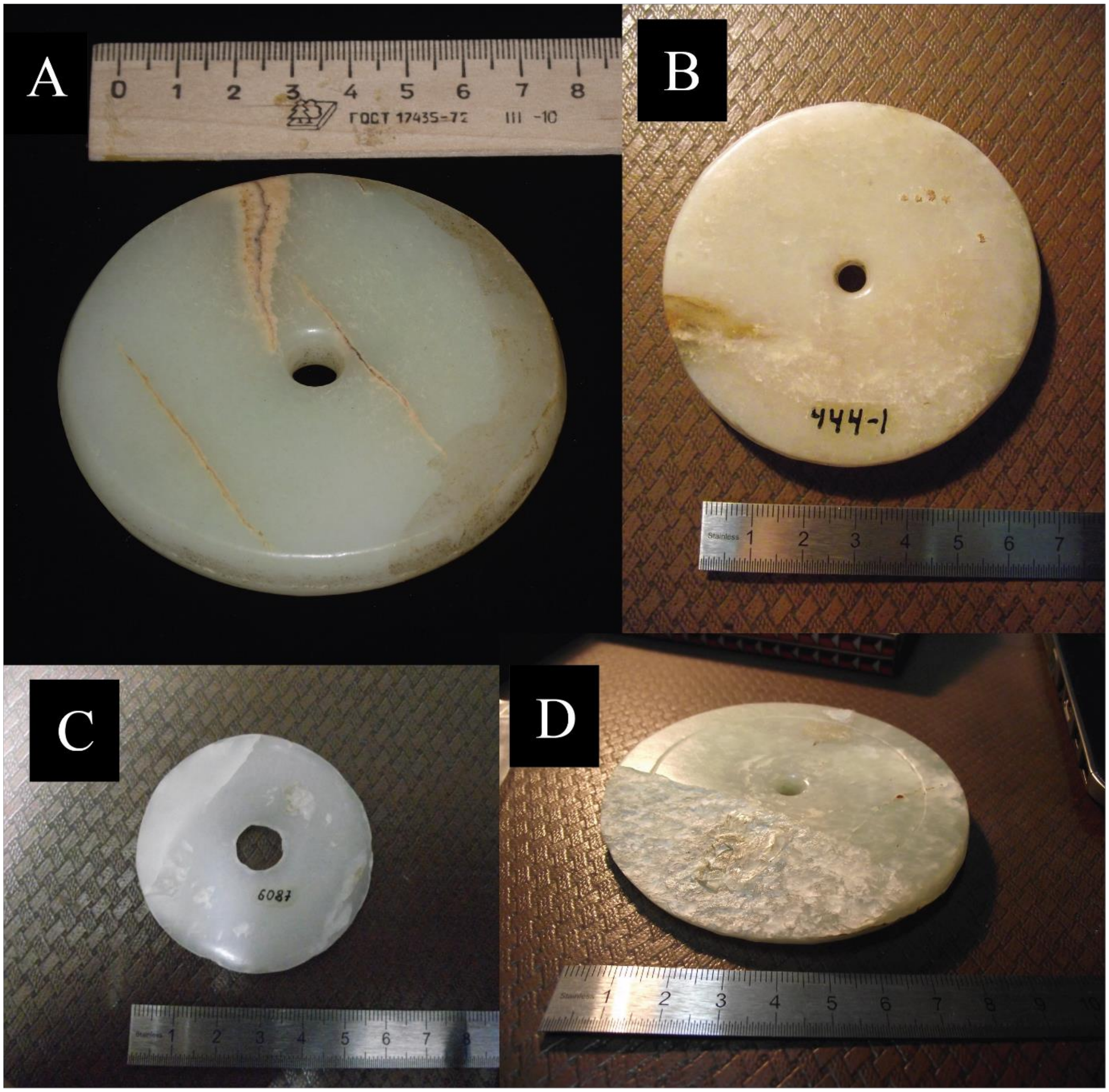

Figure 5.13. Large discs featuring obstacles to ring removal.
A. Disc from Uliarba, Grave No. 35 (IGU-ULI-1976-5-19), featuring subsurface defects.
B. Disc from Semenovo, 1933 excavations, Grave No. 3 (KRA-444-1), featuring subsurface defect.
C. Disc from Glazkovo Vokzal, 1904 excavations (KRA-6087).
D. Disc from Balushkino (KRA-531-1), featuring edge fracture and ring production evidence.

Somewhat similarly, two large discs from Balushkino (KRA-531-1, Figure 5.13) and Sarminskii Mys (IGU-SM-2-14, Figure 5.12) featured grooves (representing incomplete attempts at ring separation), as well as unique traits that hint at possible causes for the abandonment of ring separation efforts. In the case of the large Balushikino disc, this object appears to have broken so that further cutting efforts would have risked destroying both the disc and future ring entirely. The large disc from Sarminskii Mys lacked clear evidence of breakage, but did feature a second, partially-drilled central aperture. This may indicate that the original aperture was somehow off-center or otherwise out of place, preventing attempts to efficiently grind and polish this disc in order to deepen the initial groove and separate a ring. It is also possible that the unfinished aperture was produced first, and that the artisan working on this ornament had to abandon it for some reason.

On the basis of these data, several conclusions can be drawn about the production of nephrite discs and the subsequent removal of rings. Barring cases where preexisting internal imperfections (and those that developed during ornament production activities) threatened to cause disc breakage, Early Bronze Age groups appear to have subdivided discs until they reached relatively small sizes (in some cases, as small as 1 – 2 cm). Given the emphasis on successive acts of reduction as well as successive changes to ornament forms, here I suggest that reduction sequence and chaine-operatoire models (e.g., Shott 2003), adapted from other types of reductive technology (lithic core-and-flake tool manufacture) provide a useful analogue for nephrite ornament production (e.g., Kelly and Todd 1988; Morrow 1997; Odell 2004). In models of lithic core-and-flake production, each successive flake removal is expected to impact a core in predictable ways. Models of ground stone manufacture also provide parallels that are especially helpful given the labor-intensive nature of working with this type of material (e.g., Adams 2014).

The process of subdividing nephrite discs into smaller discs (and rings) is similar to chaine-operatoire models in the sense that it also involved the production of an initial, standardized form (a disc), followed by successive reductions that caused predictable changes to it. Initial stages of the life-history of a disc are represented by particularly large discs, while large rings such as those seen at Kurma XI (Grave No. 5) and other sites throughout the Cis-Baikal (Novyi Kachug "Zvezdochka," Shamanskii Mys, Ust'-Uda; Appendix 11) indicate relatively early stages of removal ring from "new" discs. In contrast, relatively small discs, and rings with relatively small diameters may represent later stages in a series of ring removals.

Using the model of nephrite ornament production discussed here, I suggest that it is possible to investigate aspects of Early Bronze Age political economy in the Cis-Baikal. In the next sections, I discuss the circulation of nephrite ornaments as well as variation in production strategies at the regional level. While this study represents only a preliminary step towards an archaeology of hunter-gatherer political economy in the Early Bronze Age Cis-Baikal, I suggest that it demonstrates the potential of further work on the topic, employing regional (rather than site-focused) material culture data.

Micro-regional variation in nephrite ornament distribution and engagement with the prestige goods strategy

Within the mid and late Holocene Cis-Baikal, I suggest that hunter-gatherer political actors employed nephrite objects for a variety of social and ceremonial purposes as part of a so-called "prestige goods strategy" that is commonly associated with network/exclusionary political economies (e.g., Blanton et al. 1996). By studying micro-regional variation in the ways that groups engaged with these objects and the strategies they represented, I argue that it is possible to gain critical insights into Early Bronze Age political economy throughout the Cis-Baikal.

Elsewhere, I have discussed the correspondence between physical attributes of nephrite ornaments in the Cis-Baikal and those that anthropologists, archaeologists, and sociologists have described for objects they label “prestige goods” (Shepard 2012). Broadly, these attributes include nephrite’s toughness (which enable it to retain value over long timespans while also making it a particularly labor-intensive material to work), its visually unique qualities (which make it difficult to “fake” with other raw materials), and its material scarcity due to the distance of nephrite sources from the Cis-Baikal.

Uses of prestige goods commonly outlined in literature on economic anthropology include the construction and maintenance of social networks through gift-giving or exchange, (especially between distinct social groups and over large geographic distances), the creation and repayment of debt (often in order to finance life-cycle ceremonies such as weddings, funerals, or other events), as well as attempts to consolidate prestige through displays of rare, exotic, and labor intensive materials (e.g., Dalton 1977; Earle 1997, 2000; Friedman and Rowlands 1977; Gould 1966; Chase-Dunn and Hall 1997; Hayden 2009; Helms 1992; Kan 1989). Where objects attain the status of prestige goods, taking on these types of critical roles in processes of social reproduction, individuals able to gain monopolistic control over them are able to aquire considerable political authority.

At the same time, it is important to note that the use of prestige goods represents only *one* strategy that individuals can use in order to achieve status and other broader political goals, but not *the only* strategy available. For example, in the context of transegalitarian horticulturalist groups in highland New Guinea, Strathern (1969) described two distinct approaches to marshalling the economic resources and political support necessary to finance feasts and other types of political spectacles.

The first of these approaches, which Strathern labeled “home production,” involved incentivizing supporters (usually kin) to contribute locally-available surpluses for events that promised to provide collective benefits. When pursuing these stragies, political actors made guarantees to local kin about shared (group-level) rewards in the form of prestige and wealth upon successful completion of planned feasts or other events. The *local* aspect of this “home financing” strategy is particularly important, as the long-distance transportation of resource surpluses would have been particularly costly in small-scale and transegalitarian societies (Earle 1997, 2000; Chase-Dunn and Hall 1997). Because home finance thus requires *local surpluses*, individuals engaged with this strategy primarily in areas where local subsistence intensification is possible. For example, Strathern (1969) observed that among highland New Guinean groups, those inhabiting areas where horticultural intensification was possible engaged to a far greater extent with home finance strategies.

In contrast, in areas where subsistence intensification was not possible or was relatively unproductive, Strathern (1969) observed that political actors employed what he termed a “finance strategy.” In these contexts, instead of focusing on cultivating political support and extracting economic surplus from local kin, political actors financed ceremonial spectacles and other political undertakings by intensifying long-distance relationships. The high value-to-weight ratio of prestige goods made these objects ideal for long-disatnce exchange, unlike subsistence products and other “bulk goods” (Dalton 1977; Friedman and Rowlands 1977; Chase-Dunn and Hall 1997; Helms 1992; Kristianson and Larsson 2005; Peregrine 2001; Strathern 1969).

Because it was possible to transport and exchange these wealth finance media over long distances (and potentially across ethnic or linguistic boundaries), widespread engagement with the “finance strategy” had the potential to produce long chains of individual connections, debts, affinal ties, and alliances that extended over large areas, often transcending local cultural practices. Peregrine (2001) has described these long-distance, cross-cultural systems of interconnection that form as a result of prestige goods exchange as an "international style." The extensive qualities of wealth finance strategies (associated with the network/exclusionary political economic mode) provide an important contrast with the locally-focused tendencies of home finance systems.

The circulation of these special goods, although particularly important in elite-level competition, involved not only distant, competing groups of high-status individuals. Instead, supra-local prestige goods economies and the exclusionary strategies they engendered among long-distance, elite network participants must be understood in terms of interactions that originated at the local level, with non-elite actors contributing the crucial surplus labor that financed status-building projects by local leaders (e.g., Blanton et al. 2996; Earle 2002; Martindale 2009; Strathern 1969; Wiessner 2009).

Two points from this discussion are particularly important regarding the use of wealth finance/prestige goods strategies. First, this strategy serves an important role specifically in network/exclusionary political economic systems. The appearance of nephrite ornaments during the Early Bronze Age coincides with a shift toward the network/exclusionary political economic mode at that time, as seen in other forms of evidence (Chapters Four and Six, Shepard 2012). It is also important to note that the extent to which the groups described by Strathern (1969) engaged in either finance or home production strategies differed between geographic areas; where subsistence intensification was possible, groups depended less on prestige goods strategies, and more on home production and reliance on local relationships that enabled aspiring leaders to marshall surpluses required for various political undertakings. In contrast, Strathern (1969) suggested that finance production systems (and related network/exclusionary political economies, to use Dual-Processual terms outlined in Blanton et al. 1996) were likely to develop in areas featuring little potential for subsistence intensification.

The political economic models described here make it possible to generate and test several predictions about the spatial distribution of different ornament types discussed above, as well as measurements for these ornaments. First, at the regional level, intensive reliance on the network/exclusionary strategy – and, consequently, on the use of prestige goods – should be especially pronounced in areas where subsistence intensification and home production strategies were least viable (e.g., Strathern 1969; Blanton et al. 1996:7-8). As stated above, differences in micro-regional potential for subsistence surpluses existed at the regional level (Chapter Four). In particular, the Little Sea and upper Lena micro-regions featured relatively low-density subsistence resources that would have been largely unresponsive to attempts at intensification (Losey et al. 2012; Weber et al. 2011).

As a result, several patterns should be evident for nephrite discs and rings in these relatively resource-poor micro-regions. First, discs in the Little Sea and upper Lena should be *smaller* than those in the more productive Angara River Valley, with these smaller discs representing more attempts during the life-history of these objects to remove rings from their outer edges. More broadly, disc size can be seen as a representation of local engagement with political strategies involving subdividing discs, with smaller discs indicating an emphasis on producing additional ornaments for exchange and gifting purposes.

Similarly, these resource-poor areas are expected to feature a high proportion of discs relative to rings, as discs would have represented opportunities for subsequent ring production (and thus for additional attempts to cultivate long-distance relationships). In this sense, I suggest that actors in the Little Sea and upper Lena would have preferentially chosen to part with ornaments that could no longer be subdivided (rings), while maintaining access to divisible objects that could enable additional exchanges and contacts.

In contrast, the Angara River Valley should feature relatively low emphasis on finance production when compared to these two less productive micro-regions. Discs in this micro-region should be relatively large, indicating only a minimal emphasis on prestige goods strategies that involved dividing ornaments to produce extra exchange opportunities. In addition, rings in the Angara Valley should represent a higher proportion of the overall assemblage than in relatively resource-poor areas like the upper Lena River and Little Sea micro-regions. These rings would have come to the micro-region through long-distance exchanges with non-local groups. Below, I address these hypotheses about micro-regional patterning in the forms and overall distribution of nephrite ornaments and political economic strategies in the Early Bronze Age Cis-Baikal.

Micro-Regional Patterning for Nephrite Ornaments

Disc sizes

When discs from the upper Lena, Little Sea, and Angara River were compared, diameter sizes differed significantly between each micro-region (n=22, 48, and 52, respectively; One-way ANOVA df=2, F=9.03, p-value = 0.0022). While discs from the upper Lena and Little Sea were relatively small, with median values of 2.7 cm and 2.8 cm, respectively (Table 5.1, Figure 5.14), those that were recovered from burials in the Angara River Valley were considerably larger, with a median value of 4.0 cm. This median diameter value for discs from the Angara River was outside of the interquartile range (above the third quartile value) for discs from either the upper Lena or the Little Sea as well, underscoring the significant difference in sizes among these different micro-regional samples.

TABLE 5.1. DISC DIAMETERS BY MICRO-REGION

	Mean (cm)	s.d.	Minimum (cm)	Maximum (cm)	n
Angara River	4.3	1.84	1.5	9.5	52
Little Sea	3.1	1.65	1.1	8.7	48
Upper Lena	2.8	1.07	1.3	5.6	22

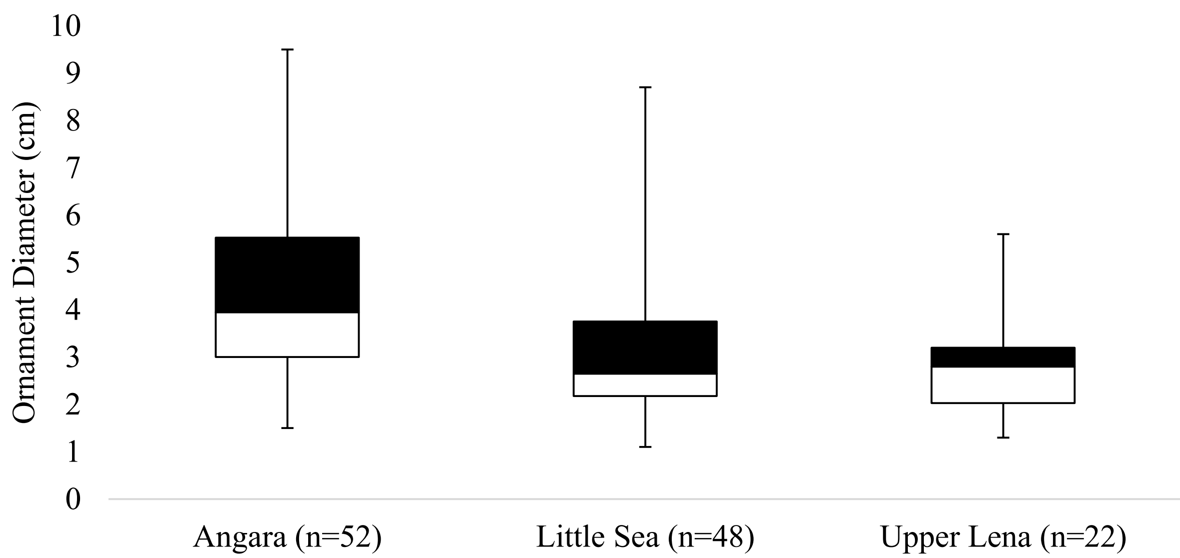

Figure 5.14. Disc diameters by micro-region.

It is also notable that while the maximum value for diameter among discs from the Little Sea micro-region was roughly similar to the maxima for discs from the Angara River, a closer inspection reveals two outliers with diameters of 8.1 cm and 8.7 cm (Appendix 11). One of these exceptionally large discs (Uliarba, Grave No. 35, IGU-ULI-1976-5-19) featured a subsurface defect that may have threatened to cause a breakage in the event of future cutting attempts (see above). The other (Sarminskii Mys, Grave No. 2, IGU-SM-2-14) contained evidence for initial attempts at ring removal, although these attempts were not completed, possibly due to issues with the location of the aperture (traces of a second aperture were visible, see discussion above). In contrast, while one of the five largest Angara River discs also featured ring removal grooves (Balushkino, KRA-531-1), the next four largest discs from this micro-region featured no traces of attempts to subdivide them (Semenovo, KRA-444-1, did feature a subsurface defect that may have prevented such attempts, but the rest of these ornaments lacked similar traits).

Broadly, the significant difference in micro-regional disc sizes is consistent with hypotheses discussed above, regarding micro-regional differences in engagement with strategies involving ring removal. Exceptionally large discs were present in all micro-regions (as were exceptionally large rings, see below), but groups in areas where individuals were expected to focus on wealth finance and prestige goods production appear to have removed rings more frequently (and from large discs, in all but a few exceptional cases).

Ring sizes

The number of rings for which data were available was considerably smaller than the number of discs (Table 5.2). Even with the additional rings that were available from published images and textual references, it was only possible to directly measure 25 rings from the Angara River, and the Little Sea and upper Lena micro-regions featured even fewer (nine and five, respectively). It is clear from this small sample of rings that each micro-region featured at least some extremely large rings ($\geq$ 10.0 cm in diameter, Appendix 11). Micro-regional ring diameters did not differ significantly (Kruskal-Wallis H=1.88, df = 2, p=0.3906), although this may be a result of small (and uneven) sample sizes for the upper Lena and Little Sea.

This tentative pattern of similar ring sizes in the different micro-regions under study here is interesting, given the clear difference in disc sizes between the same areas. The small sizes of discs in the upper Lena and Little Sea suggest that rings produced in these areas should have been smaller as well, on average. The fact that local patterning in ring sizes did not correspond well to disc sizes at this geographic scale provides support for the argument that Cis-Baikal hunter-gatherers exchanged nephrite ornaments beyond the boundaries of individual micro-regions. At the same time, I stress that these patterns are at best extremely tentative, given the small datasets available here.

TABLE 5.2. RING DIAMETERS BY MICRO-REGION

	Mean (cm)	Minimum (cm)	Maximum (cm)	Median (cm)	Standard Deviation	n
Angara River	5.3	2.5	12.5	4.6	2.46	25
Little Sea	6.7	3.2	12.9	5.1	3.67	9
Upper Lena	7.1	4.4	10.9	5.3	2.99	5

Disc/ring ratios by micro-region

As discussed above, the ratios of discs to rings within a given area have the potential to provide important information about local engagement with the network/exclusionary (finance) strategy. In order to assess patterning with respect to the relative frequencies of discs and rings, I employ two datasets on the distribution of ornaments within the Early Bronze Age Cis-Baikal (Table 5.3). In his monograph of the Early Bronze Age Cis-Baikal, Okladnikov (1955:176, 363-

367) included a list and table showing the frequencies of nephrite ornaments in the micro-regions that had been studied up to that time. I provide these data, updated with additional artifacts recovered in new excavations, in Table 5.3 (conducted during and after the 1950s; e.g., at Shumilikha, throughout the Little Sea micro-region, and additional excavations at Semenovo and Ust'-Uda [Okladnikov 1974, 1975, 1976; Savel'ev et al. 1981])[10].

TABLE 5.3. "DM" AND "IM" DATASETS OF MICRO-REGIONAL DISC AND RING RATIOS

Micro-Region	Rings and half rings*, **	Discs	Ring/disc Ratio
Angara River (*in parentheses: summary of values reported in Okladnikov 1955, with additions where applicable from Savel'ev et al. 1981, Okladnikov 1974, 1975, 1976)*	28 (48)	54 (54)	0.52 (0.89)
Upper Lena River (*in parentheses: summary of values reported in Okladnikov 1955, with additions where applicable from Zubkov 2010*)	6 (17)	29 (31)	0.21 (0.55)
Little Sea micro-region (*in parentheses: values reported in Goriunova et al. 2008*)	13 (22)	49 (54)	0.27 (0.41)

*multiple half-rings were counted as a single ring in cases where they may have come from a single object
** Parentheses values represent the IM Dataset, which included values recorded in literature on nephrite ornaments. Non-parentheses values represent the DM Dataset, which included only those ornaments that I was able to measure directly.

[10] A similar table to the one originally published in Okladnikov (1955) that was featured in a recent publication by Goriunova et al. (2007) also provided a summary of all nephrite ornaments recovered from graves in the Little Sea micro-region (where almost no archaeological excavation had occurred by the time of Okladnikov's publication). These data are included here as well.

I refer to data compiled from these sources as the "indirect measurement" ("IM") dataset, as I did not require that objects were measured directly in order to be included here. Although sample sizes for this dataset were relatively large, these data feature certain drawbacks. In addition to the extremely limited information that Okladnikov provided on the individual artifacts he included in his study, no clear definition is listed on the precise distinction that Okladnikov employed to separate rings and discs. In addition to this "IM" dataset, I also provide a smaller, but more reliable dataset on nephrite ornaments that I collected directly for this dissertation, using direct measurements of artifacts in archaeological collections or digitized images. While this dataset lacks the large-scale coverage of early 20th century materials (mostly from the Angara and Lena) in Okladnikov's (1955) publication, all artifacts I include were measured (and classified as a rings or discs) directly, based on criteria discussed above. Below, I refer to this dataset as the "Direct Measurement" ("DM") dataset (corresponding to Table 5.3). Each of these datasets was collected using internally consistent procedures, so that ring/disc ratios can be compared between micro-regions *within* the DM or IM datasets.

Several patterns emerge when these two datasets are used to compare micro-regional ring/disc ratios and overall ornament frequencies. In all micro-regions, discs appear to have outnumbered rings, although the actual ratio varies somewhat depending on the sources used. The IM dataset featured nearly similar frequencies of rings and discs in the Angara River Valley, with a total of 48 rings and 54 discs, while for the objects that I was able to measure directly (DM Dataset), the ratio of rings to discs was considerably lower (0.52, as opposed to 0.89). In either case, it is notable that the ratio of discs to rings in the Angara River valley was considerably higher than the ring/disc ratios in either the upper Lena or Little Sea micro-regions (DM dataset: Chi-square statistic = 5.03, p-value = 0.081; IM dataset: Chi-square statistic = 6.28, p-value = 0.043).

Based on these data, rings appear to have been more common relative to discs in the Angara River Valley than in either of the other two (less productive) micro-regions under study here, as predicted by the prestige goods model.

Per capita ornament frequencies by micro-region

Per capita ornament frequencies also enable an examination of the circulation of white nephrite prestige goods. In order to compare per capita ornament frequencies, I employed estimates form Weber and Bettinger (2010) on the number of Early Bronze Age graves and interments in each micro-region, along with data on the total number of discs and rings in each micro-region from both the LM and the DM datasets (Table 5.4). On the basis of these data, the upper Lena appears to have featured the highest per capita disc and ring frequency (0.603 ornaments / individual using the DM dataset, 0.828 ornaments / individual using the IM dataset)[11]. The Angara River and Little Sea micro-regions featured considerably lower per capita ornament frequencies (DM dataset: 0.402 and 0.307, respectively; Chi-squared statistic = 17.123, p-value = 0.00019; IM dataset: 0.500 and 0.376. Chi-squared statistic = 36.987, p-value <0.00001).

[11] It is possible, however, that some of the interments featuring graves goods included here lacked corresponding data on demographics (and thus, that the population figures provided in Weber and Bettinger [2010] may underestimate the number of individuals that have been recovered from this micro-region; Zubkov 2010).

TABLE 5.4. PER CAPITA NEPHRITE DISC AND RING FREQUENCIES BY MICRO-REGION

	Angara River	Upper Lena	Little Sea
Early Bronze Age Individuals Excavated (Weber and Bettinger 2010)	204	58	202
Total nephrite discs and rings – DM (IM)	82 (102)	35 (48)	62 (76)
Nephrite discs and rings per capita	0.402 (0.500)	0.603 (0.828)	0.307 (0.376)
Nephrite discs per capita (see Table 5.3) DM (IM)	0.265 (0.265)	0.500 (0.534)	0.243 (0.267)

When per capita *disc* frequencies were compared (Table 5.4), a similar pattern emerged, with the upper Lena exhibiting significantly higher per capita disc frequencies than the other two micro-regions under consideration here (DM dataset: Chi-square statistic = 15.37, p-value = 0.00046; IM dataset: Chi-square statistic = 17.44, p-value = 0.000163). These data are broadly consistent with a Vitim River source for the nephrite that Early Bronze Age groups in the Cis-Baikal used in order to fashion discs and rings. More specifically, the high per capita frequency of white nephrite ornaments in the upper Lena may suggest that this micro-region, and the Lena River (which connects to the Vitim northeast of Lake Baikal), may have served as an important conduit for the movement of nephrite raw materials into the Cis-Baikal.

Ring fragmentation

It is also interesting to note that some of the rings included in this study were found as fragments, often described in existing literature on the subject as “half-rings” (Figure 5.15; Okladnikov 1955). In many cases, these half-rings appear to have been intentionally broken, featuring traces of cutting or sawing in radial groove pattern. For example, as discussed above, Weber et al. (2012:38) suggested that the broken rings from Grave No. 5 at Kurma XI (IGU-KXI-5-69-1, -2, -3, and -4) featured linear notches that enabled their breakage. Once broken, these rings appear to have been weathered, creating relatively worn surfaces where the break had occurred. Four similarly fragmented rings were found in the Angara River (Ust'-Uda [1933 excavation], Grave No. 4 [Okladnikov 1975:138-143]; Shumilikha, Grave No. 9 [Savel'ev et al. 1981:61]; Semenovo [1957 excavation], Grave No. 6 [Okladnikov 1975:33]; and Shivera, Grave No. 11 [KRA-1018-2]), although one of these (Shivera) may have broken during or after deposition (Okladnikov 1975:132, 291). Four rings from the upper Lena were fragmented as well, representing two-thirds of the rings from that micro-region for which data on artifacts' preservation were available. One of these, from Korkino cemetery, featured no wear on the fractured surface, and thus may represent unintentional breakage during or following deposition. Unfortunately, no published data that could provide contextual detail were available for this cemetery.

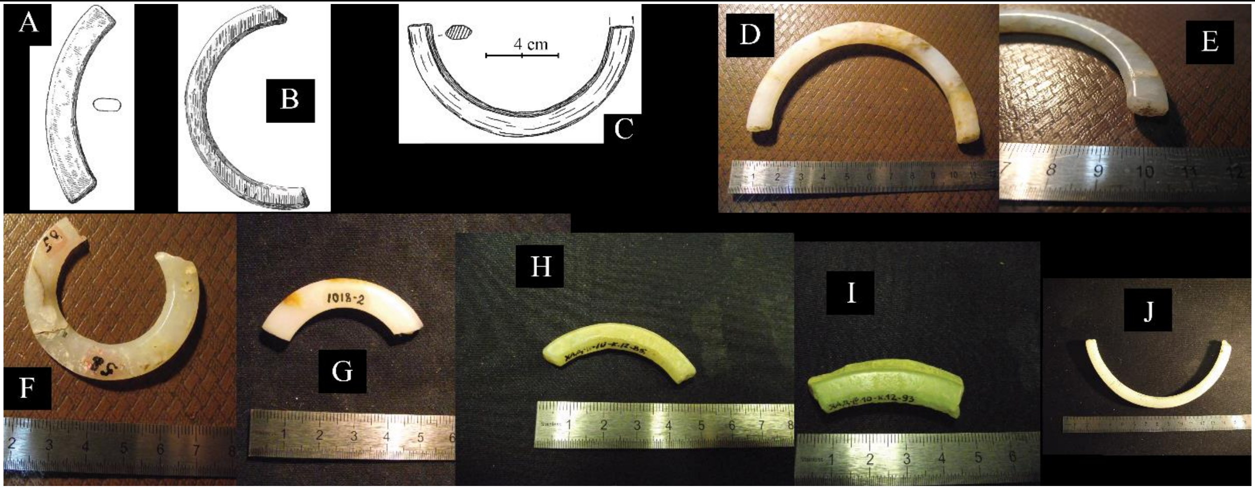

Figure 5.15. Fragmented "half-rings." A. Semenovo (1957 excavation), Grave No. 6 (adapted from Okladnikov 1975:33). B. Ust'-Uda (1936 excavation), Grave No. 4 (adapted from Okladnikov 1975:138-143). C. Shumilikha, Grave No. 9, half-ring (adapted from Savel'ev et al. 1981:61). D. Novyi Kachug "Zvezdochka," Grave No. 2 (KRA-31-1]. Ring half (the adjoining half-ring [KRA-31-2] could not be located in Irkutsk Kraevedcheskii Muzei collection and is not mentioned in Zubkov 2010:143, but see Okladnikov 1955:366). E. Close-up of radial notch/groove. F. Korkino, Grave No. 2 (KRA-58). This object is not listed in Okladnikov (1955), although two rings and one disc were listed in other graves from that site. G. Shivera, Grave No. 11 (KRA-1018-2). H. Khadarta IV, Grave No. 12 (IGU-KHA-12-85). I. Khadarta IV, Grave No. 12 (IGU-KHA-12-93). J. Kurma XI, Grave No. 5 (IGU-KXI-5-69-4).

The relative frequencies of ring fragmentation differed by micro-region (Freeman-Halton Extension for Fisher's Exact Test 2-tailed p-value=0.01776; Table 5.5). Groups in the Little Sea and upper Lena micro-regions appear to have employed intentional fragmentation with greater relative frequency than those on the Angara River, and mostly (if not exclusively) on large rings. One possible interpretation of pattern is that Early Bronze Age individuals in subsistence-poor micro-regions such as the upper Lena and the Little Sea used ring fragmentation – like disc subdivision – as another means of maximizing the number of additional ornaments that a single disc could furnish.

TABLE 5.5. FISHER'S EXACT TEST WITH FREEMAN-HALTON EXTENSION FOR 2X3 CELL CONTINGENCY TABLE

	Angara River	Upper Lena	Little Sea
Fragmented rings *(multiple fragments of a single ring are counted as one object)*	4 (14.3%)	4 (66.7 %)	5 (38.5 %)
Whole rings	24 (85.7%)	2 (33.3%)	8 (61.5%)

Only two fragmented rings from the sample I employed in this study exhibited diameters less than 9.0 cm, demonstrating the tendency to use particularly large objects for fragmentation. One of these was from the Shivera cemetery (Grave No. 11, KRA-1018-2), on the Angara River, and may have fragmented during or following deposition (see above). The other was excavated at Korkino (KRA-58), on the upper Lena, and may also represent a fragmentation that occurred either post-depositionally or during deposition (see above).

Thus, in all areas, the strategy of dividing rings into halves appears to have been focused specifically on the largest ornaments. Although relatively few samples were available for which direct measurement was possible, it is noteworthy that the largest rings in each micro-region were all broken into half-rings in this manner (Appendix 11). For example, while diameter measurements could be collected for only two of the broken rings from the Little Sea micro-region, others from that area which were too fragmentary to measure appear to have been extremely large as well (e.g., Kurma XI, Grave No. 5, IGU-KXI-5-69-4; Khadarta IV, Grave No. 12, IGU-12-85 and IGU-12-93; Figure 5.15).

Cis-Baikal nephrite ornaments at the macro-regional level

As stated above, isotopic data indicate that Early Bronze Age groups in the Cis-Baikal largely maintained seasonal migration rounds within distinct, micro-regional settings (e.g., Little Sea, upper Lena, Angara River, South Baikal; Weber et al. 2011). However, data on Early Bronze Age *artifacts*, including lithic tools and nephrite ornaments presented in this chapter, suggest the existence of a system of interactions *beyond* this local scale. Cis-Baikal hunter-gatherer groups may in fact have produced (and subsequently divided) these objects with the specific intention of transmitting them to members of non-local groups (particularly to those in high-productivity areas like the Angara River), in order to cultivate long-distance political support. In fact, white nephrite ornaments also appear to have circulated well beyond the boundaries of the Cis-Baikal (Figure 5.16). At the same time, the relatively low frequencies of these objects outside of the Cis-Baikal leave little doubt that Early Bronze Age groups within the region served as the main producers of nephrite ornaments.

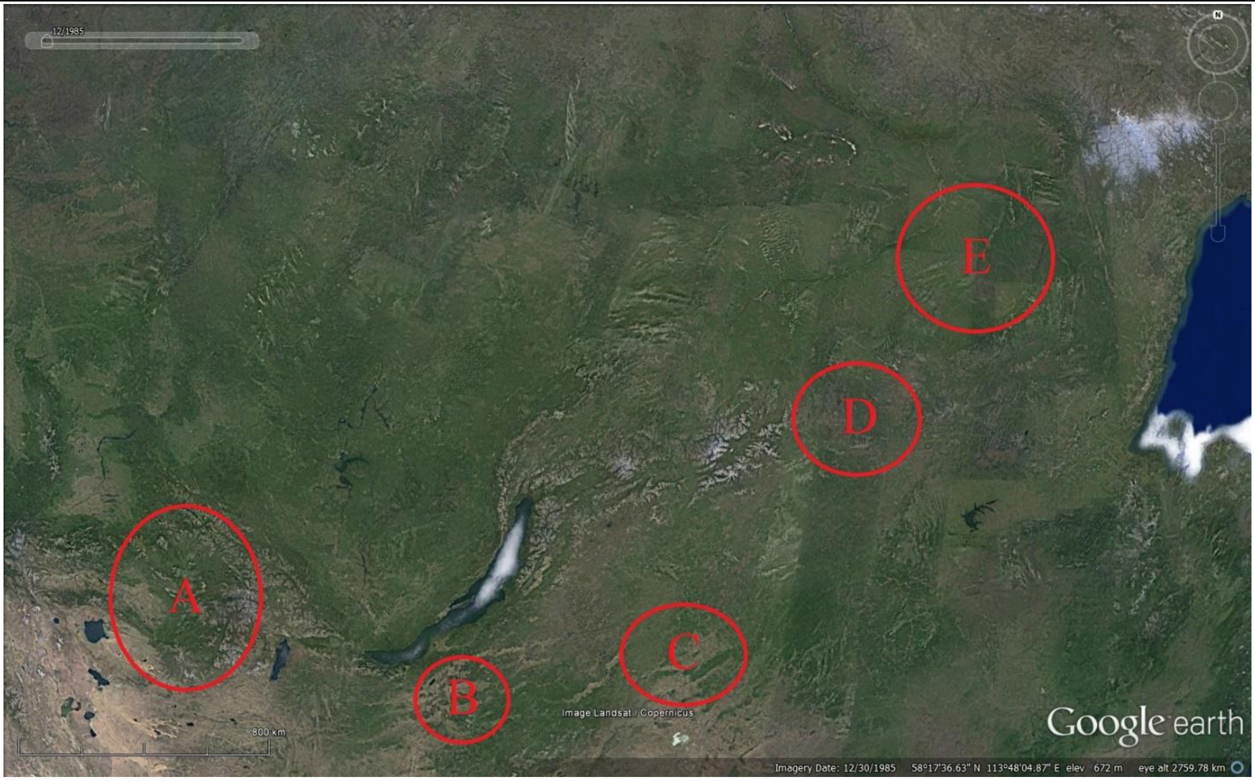

Figure 5.16. Macro-regional map, featuring areas discussed in Chapter Five discussion of "macro-regional" interconnections. A. Minusinsk Basin and location of Okunevo sites. B. Lena River and location of Kullaty campsite. C. Trans-Baikal and location of Bureinsk Karaul and Duroi. D. Olekma River and location of Malaia Dzhikimda cemetery. E. Selenga River and location of Fofanovo cemetery. Map credit: Google earth v.7.1.5.1557, using Landsat / Copernicus data. http://landsat.gsfc.nasa.gov.

For example, several sites along the middle Lena featured white nephrite discs (n=2) and rings (n=5; Appendix 11). Two white nephrite discs were found in a relatively "rich" grave at Malaia Dzhikimda, located on the left bank of the Olekma River. Both of these discs were situated on the deceased individual's cranium and face (Alekseev 1996:32-33). These objects may have served as parts of ritual headgear (see Chapter Six). Interestingly, both of these nephrite ornaments featured radial grooves, unlike similarly-sized discs seen in the Cis-Baikal. Another white nephrite disc was recovered from the Kullaty campsite (located on the Kullaty River, ~35 km south of Yakutsk; Okladnikov 1970).

Similarly, at Diring-Iuriakhsk, Fedoseeva (1992) described five nephrite rings that were identical in terms of style to those found in the Cis-Baikal Early Bronze Age. All of these rings were placed in graves. Together, the presence of these objects in Yakutia, to the northeast of the Cis-Baikal – as well as the large proportion of rings relative to discs – suggests that, at least to a limited extent, groups inhabiting the middle Lena area may have engaged with Cis-Baikal hunter-gatherers. More specifically, I suggest that the relatively high proportion of white nephrite rings to discs in Early Bronze Age Yakutian contexts attests to attempts by Cis-Baikal hunter-gatherers to maintain relationships with distant groups while maintaining the potential to produce additional rings (by preferentially keeping discs).

Sites in the Trans-Baikal and Amur River drainage also appear to contain these diagnostically Glazkovo objects. As mentioned above, the Fofanovo cemetery, located on the Selenga River, contained two particularly large white nephrite rings from the 1936 excavations conducted by Gerasimov (Okladnikov 1955:178; Figure 5.6). Further to the east, Grishin (1981) described a white nephrite ring and disc at Bureinsk Karaul and Duroi, respectively. Okladnikov (1955:367) listed six other white nephrite ornaments at sites in the Trans-Baikal, all of which were rings or ring fragments.

Again, I suggest that the presence of white nephrite ornaments in this area, all carried out in the well-documented style of Cis-Baikal material culture, indicates at least limited interaction between inhabitants of these areas, as well as the extension of the Cis-Baikal "prestige goods" system beyond the region's boundaries (see next chapter for discussion of other media involved in this macro-regional interaction and exchange). The apparent preference to use rings for this purpose is consistent with a model of rings as "trade goods" exported by producers in the Cis-Baikal.

Examples of Early Bronze Age nephrite ornaments (discs and rings) also exist in Western Siberia, most famously at cemeteries assigned to the Seima-Turbino culture (or “transcultural phenomenon”), where white nephrite rings have been discovered in a variety of burial contexts (Koriakova and Epimakhov 2007) These objects are widely believed to have been produced from the same nephrite that Cis-Baikal groups employed (Anthony 2007; Kiselev 1951:64; Koriakova and Epimakhov 2007:108-109). In addition, several lithic discs, rings, and pendants were found in Okunevo graves, associated with the Okunevo culture (25^{th} – 20^{th} centuries cal BC) in the Minusinsk Basin (west of the Cis-Baikal, see Chapter Six for further discussion), although specific material types used to produce these objects were not listed (Vadetskaia 1986). For example, Grave No. 8 at Verkhnyi Askiz I, Kurgan I (located in the southwestern Minusinsk Valley, on the Askiz River), contained three lithic discs with perforations at the center (Khavrin 1997). Another Okunevo grave at Esino IV (Grave No. 2) featured at least seven small lithic rings (Podol’skii 1997:125), and a unique perforated pendant at Chebaki (see Chapter Six) may also have been fashioned from nephrite. In addition to these, Vadetskaia (1986:36-40) described numerous lithic ornaments in the form of discs, rings, and pendants, in Okunevo contexts, although again, the raw material used to make these objects is unclear in publications.

Overall, I suggest that the macro-regional appearance of at least small quantities of lithic – and specifically nephrite – ornaments exhibiting clear stylistic parallels with those found in Early Bronze Age contexts from the Cis-Baikal provides a tantalizing glimpse at potential long-distance interactions that crossed regional boundaries in Early Bronze Age Eurasia. While these large-scale interactions have received little attention in archaeological literature on the Cis-Baikal (at least in English), a large body of evidence – of which nephrite ornaments constitute one component –

suggests that they may have played an important role in Early Bronze Age social organization (see next chapter).

Conclusion

Broadly, on the basis of data presented in this chapter, it appears likely that Early Bronze Age hunter-gatherers inhabiting different micro-regions of the Cis-Baikal participated in a large-scale system of interaction and exchange that crossed the boundaries of local areas within the region. Several key patterns emerged to support this hypothesis, also indicating important differences in political economic strategies that local groups employed throughout the Cis-Baikal.

At the broadest level, the Early Bronze Age appearance of white nephrite to produce ornaments constitutes particularly strong evidence for the development of prestige goods systems in the Cis-Baikal during this period. White nephrite appears to have come exclusively from distant, circumscribed sources in the Vitim River highlands, and would have provided a lightweight and highly durable, visually distinctive, and labor-intensive medium that was difficult to imitate using other material types. For all of these reasons, white nephrite would have been particularly well-suited to use as a prestige good.

In areas where subsistence intensification would have been possible – particularly the Angara River – I hypothesized that individuals would not have focused on employing prestige goods strategies, and instead would have employed so-called "home production" strategies. As a result, discs in this highly-productive area were expected to be large, indicating relatively few attempts by local individuals to create extra opportunities for long-distance exchange by subdividing ornaments. In contrast, in areas with relatively little potential for subsistence intensification – the upper Lena and Little Sea – aspiring elites would have needed to rely on social networks beyond their local kin in order to finance feasts and other political spectacles. In these areas, I hypothesized that discs would be relatively small on average, representing frequent subdivision of these objects into additional rings. Measurements taken on rings and discs in the different micro-regions studied here were consistent with these hypotheses, suggesting local differences in engagement with prestige goods strategies.

I also hypothesized that in these resource-poor areas (the Little Sea and upper Lena), individuals would have preferentially kept discs over rings. Discs would have served as a store of additional potential rings, and keeping discs would have thus enabled individuals to maintain the option of conducting future exchanges and building long-dsitance relationships. For this reason, resource-poor areas were expected to feature relatively high proportions of discs. Data on the proportions of discs and rings found in different micro-regions were consistent with these hypotheses, providing further support for arguments about local differences in engagement with prestige goods strategies in the Cis-Baikal. It is also noteworthy that discs were particularly common in the upper Lena micro-region on a per capita basis. This finding is consistent with a Vitim River source of the white nephrite that was used to make these ornaments (due to the proximity of the Vitim River and the upper Lena).

Distinctive Cis-Baikal styles of white nephrite ornaments have also been found in neighboring regions, suggesting possible connections between local hunter-gatherer groups and Bronze Age pastoralists and hunter-gatherers in other areas. The long-distance nature of nephrite circulation during this period is consistent with the conception of a prestige goods economy, which is expected to cross cultural boundaries as a result of supra-local elite networks. Chapter Six presents ideas about possible contexts (types of events) in which these Early Bronze Age ornaments may have been used, as well as common styles of display that political actors would have employed to display them to broadcast political messages about social status and success in long-distance competition.

CHAPTER SIX

ARCHAEOLOGICAL EVIDENCE FOR MACRO-REGIONAL INTERCONNECTIONS AMONG CIS-BAIKAL HUNTER-GATHERERS OF THE MID AND LATE HOLOCENE[12]

Introduction

In previous chapters of this dissertation, I discussed bioarchaeological data (Chapters Three and Four) and data on material culture (Chapter Five) that suggest the existence of at least limited regional-level interactions among Cis-Baikal hunter-gatherers in the Late Neolithic and, perhaps to a greater extent, in the Early Bronze Age. In this chapter I discuss larger-scale connections and interactions between Early Bronze Age[13] hunter-gatherer inhabitants of the Cis-Baikal and inhabitants of other regions of Siberia.

I begin by contrasting archaeological research traditions in surrounding regions with work on the Cis-Baikal, and argue that while a large body of literature in Siberian archaeology has long emphasized the importance of macro-regional interconnections among Bronze and Iron Age *pastoralists*, this research has tended to overlook the possibility that hunter-gatherer groups participated in these networks as well (e.g., Anthony 2007; Chernykh 1992, 2008; Frachetti 2012; Frachetti and Mar'yashev 2007; Hanks 2010; Kohl 2006). I then discuss ethnographic cases that

[12] Parts of this chapter were published in: Shepard et al. 2016.

[13] While some of the Siberian Bronze Age cultures I discuss in this chapter have been designated elsewhere as "Eneolithic," "Early Bronze Age," and "Middle Bronze Age" on the basis of typological criteria, here I use the term "Early Bronze Age" to describe all cultural groups that were contemporaneous with Cis-Baikal Glazkovo hunter-gatherers. This designation allows me to maintain consistency with English-language publications by scholars in the Baikal-Hokkaido Archaeology Project, which also categorically refer to Glazkovo groups as "Early Bronze Age."

highlight the potential for long-distance, “inter-societal” connections among hunter-gatherer societies, and thus contrast with traditional models of these types of societies as universally isolated.

Next, I provide summaries of several lines of evidence for Early Bronze Age macro-regional interconnections, synthesizing previously published data from Russian and English sources. Broadly, these lines of evidence include shared metallurgical practices and artifact forms, similarities in the content and style of artistic depictions, and the widespread appearance of common methods of body ornamentation. I also describe several unique Early Bronze Age interments in the Little Sea micro-region where some of these traits co-occurred, which I suggest illustrate the macro-regional trends discussed here particularly clearly.

Finally, I outline possible mechanisms that Cis-Baikal hunter-gatherers may have employed in order to produce large-scale interconnections (and macro-regional stylistic similarities) during the Early Bronze Age. In particular, I suggest that ritual aggregation events, where individuals from beyond the boundaries of individual domestic groups came together, would have played a major role in regional and macro-regional integration processes that occurred during this period. In this sense, I note that many of the material types I discuss below serve not *only* as evidence that large-scale interconnections came to exist throughout northern Eurasia by the Early Bronze Age; these objects *also* provide a glimpse into the social contexts where individuals from the Cis-Baikal and elsewhere were able to spread Eurasian Bronze Age practices, ideologies, and institutions. In this sense, the forms of material culture presented in this chapter reinforce arguments for the role of *events* – inter-group aggregations such as coming-of-age ceremonies, seasonal gatherings, and other rituals – as platforms where individuals created macro-regional connections through status competition and coalition-building, exchange, and ritualized displays.

Unfortunately, poor chronological controls exist for most of the data that I employ in discussions of culture-historic groups outside the boundaries of the Cis-Baikal in this chapter. While these relatively poor temporal data often serve as an obstacle for developing high-resolution chronologies, this level of resolution is generally sufficient to assign objects to broad culture-historic groupings for the purpose of this dissertation.

Eurasian Connections and Bronze Age Pastoralism in Archaeological Literature

Narratives of mid and late Holocene sociopolitical development in the Eurasian steppe and forest-steppe vary considerably, but most emphasize the emergence of interconnections that cross-cut cultural and political boundaries, beginning in the Bronze Age (see examples in Anthony 2007; Bader et al., eds., 1987; Chernykh 1992; Frachetti 2012; Hanks 2010; Kohl 2006; Koriakova and Epimakhov 2007; Petri 1926). The subjects of this research are mostly pastoralists: groups whose subsistence strategies focused to at least some extent on domesticated livestock, and who made seasonal movements in order to provision these animals (particularly in the eastern Steppe; see Frachetti 2012). Because they occurred at predictable times and on a relatively frequent (seasonal) basis, these movements by herders and their herds are thought to have enabled connections to form across the steppe and forest-steppe, as groups spread apart and re-aggregated (e.g., Kohl 2006; Wright 2007).

Although the literature on Bronze Age Eurasia emphasizes the long-distance connective role that pastoralism in particular played, it is also clear that seasonal movement and aggregation, as well as inter-group trade partnerships and marriages – all practices that could have supported the development of macro-regional interconnections – have existed among a wide range of small-to intermediate-level societies. These include groups practicing not only pastoralism, but also hunting and gathering subsistence strategies (e.g., Jackson 1991; Janetski 2002; Meyer and Thistle 1995; Wiessner 1982; 2009).

Various scholars (e.g., Arnold et al. 2015; Burch 2005:237-239; Chase-Dunn and Hall 1997; Jackson 1991; Wolf 1982) have observed a tendency in archaeologists' treatment of small-scale and especially hunter-gatherer societies to portray these groups as isolated social units, disconnected from global and historical context. Recent English-language research on the archaeology of mid and late Holocene Cis-Baikal illustrates this tendency, focusing largely on local adaptations and relatively little on the potential for connections to historic and geographic processes occurring at larger (macro-regional, inter-societal) scales. The geographic scale that archaeologists working in the Cis-Baikal have employed contrasts sharply with that employed in research on the surrounding Eurasian steppe, where researchers tend to study interactions occurring over wider areas, and invoke concepts such as migration (e.g., Anthony 2007), the large-scale diffusion of Bronze Age institutions (e.g., Frachetti 2012), and the macro-regional integration of Bronze Age economy (e.g., Kohl 2005) both to explain patterns in archaeological data and as a framework for generating new research questions.

In addition to the differing geographic scales of hunter-gatherer versus pastoralist archaeologies, this difference in the scales of research in the Cis-Baikal and neighboring regions also owes to the unique research objectives of the Baikal-Hokkaido Archaeology Project ("BHAP"). Since the early 1990s, the BHAP has collected a large corpus of bioarchaeological data in order to gain insights into individual-level variation in past human behavior throughout the Cis-Baikal ("the individual life history approach" – see Weber and Bettinger 2010; Weber and Goriunova 2013; Zvelebil and Weber 2013). This research is ongoing, and has provided a number of important insights on the region's complex prehistory (see Chapter Two; Weber and Bettinger 2010; Weber et al., eds. 2010 for a review).

Ethnography of Hunter-Gatherer Macro-Regional Connections

Inter-societal interconnections among hunter-gatherers, like those among pastoralists, result at least in part from mobility strategies that feature movements corresponding to changes in the availability of resources throughout the year. Such movements, often referred to as the "seasonal round," not only affect hunter-gatherers' geographic locations relative to resources, but also other aspects of community organization, such as the size of co-residential groups, which fission and re-aggregate according to these seasonal factors. Periodic, predictable population aggregations also enable group members to maintain social relationships and reproductive networks over large geographic scales, beyond the immediate family unit (e.g., Kelly 2013; Zvelebil 2011). In this sense, face-to-face interactions between unrelated individuals at aggregation events enable what Fitzhugh et al. (2011:91, emphasis in original) refer to as "*supra-band* information sharing," as well as the exchange of material goods over large distances or ecological boundaries (e.g., Burch 2005; Meyer and Thistle 1995; Whallon 2006).

A prime example of aggregation events among hunter-gatherers comes from the late prehistoric and early historic periods in northwest Alaska, where groups from across the region congregated at various locales every year for a form of multi-group aggregation called "trade fairs" (Burch 2005). Jackson (1991:266) described these events as points of "intersystem articulation […] in essence, a periodic, large, spatially and temporally predictable gathering of unrelated hunter-gatherers, often representing ethnically and linguistically distinct groups." At these events, attendees from far-flung territories lived together at productive and easily accessible coastal locales and river confluences during part of the summer or early fall. Trade fairs lasted for two weeks or more, with groups arriving at different times, such that the total number of participants at any one time could range from 400-500 to more than 2,000 (Burch 2005; Jackson 1991). In some cases, attendees of northwest Alaskan trade fairs traveled more than 300 km to participate.

Burch (2005) described these events as important opportunities for individuals to seek out potential mates from outside the local group. In addition, trade fair participants used these events to exchange resources as well as information. These exchanges often occurred through semi-formal, ritualized trade partnerships between non-kin or fictive kin who inhabited non-overlapping foraging areas during the rest of the year (Burch 2005; Jackson 1991; Johnson and Earle 2000:176). Despite the enormity of some of these aggregation events (relative to the 6-40 person size of average co-residential units; Burch 2005), it is noteworthy that not all individuals from participating social groups attended trade fairs. However, individuals who did not directly participate still received goods or information indirectly, through local redistribution networks (Johnson and Earle 2000:176-177).

A staggered series of aggregation events occurred during the summer and fall throughout northwest Alaska and beyond, so that no one trade fair single-handedly integrated all of the disparate groups involved in this macro-regional network. Instead, North Pacific hunter-gatherers produced extended chains of ritualized trade partnerships and aggregation events that connected family groups both *within* and *between* ‘local’ areas, while also carrying goods and information from Northeast Asia to coastal and then inland Alaska, as well as further south, along the Northwest Coast and interior plateau of North America (Burch 2005; Galm 1994; Jackson 1991:272).

Inter-group systems of interaction are also well-documented for hunter-gatherers inhabiting northern California (e.g., Bean and Vane 1978; Chase-Dunn and Hall 1997:121-148; Kroeber and Gifford 1949). For example, during the late prehistoric and early historic periods, yearly World Renewal ceremonies of the Tolowa, Karok, Yurok, Hupa, and Wiyot played a similar connective role. Hosts of these ceremonies endeavored to bring together large groups of people (sometimes numbering in the thousands) in order to cultivate prestige by displaying wealth (Bean and Vane 1978:663-664; Kroeber and Gifford 1949). Here, as in many hunter-gatherer intergroup systems, attendees of ceremonial events came from different ethnic backgrounds, polities, and areas, and conversed in multiple languages. Exotic and labor-intensive goods such as large obsidian bifaces held particular importance in ritual displays at aggregation events. These objects appear to have been made from raw materials procured at distant sources, and were brought into local circulation through trade with external groups (Gould 1966).

On the northwestern Plateau of North America, Hayden and Schulting (1997) argued for the existence of a regional "interaction sphere" during late prehistory. In their view, this system was maintained through elite competition to control and display exotic forms of wealth. Despite a background of cultural heterogeneity that included distinct local subsistence practices, social structures, and languages across the Plateau region, several object types, including goods made from nephrite, obsidian, and marine shell, held common symbolic value and circulated throughout the entire Plateau interaction sphere (Darwent 1998; Galm 1994; Hayden and Schulting 1997). While Hayden and Schulting focused primarily on *objects* that circulated within this system of regional-level interaction and competition, rather than on identifying the specific *venues* where people would have conducted exchanges, they did note that large face-to-face ritual aggregation events such as mortuary displays likely served as a platform for competition and thus for the creation and maintenance of long-distance interconnections (Hayden and Schulting 1997:75).

In each of these cases, hunter-gatherers constructed systems of interconnections that extended beyond the boundaries of individuals' procurement areas or of "local" groups. Within these systems, aggregation events and ritual gatherings held a particularly important role, often serving as venues for interaction with external groups and the broader world, particularly in the form of competition between elites. This supra-local interaction at aggregation events involved meetings between people with different linguistic and ethnic backgrounds who occupied different – and sometimes quite distant – territories during much of the year. It is also noteworthy that aggregation events also enabled an exchange of *people* between unrelated family units, providing an important source of potential marriage partners for participating individuals (see Chapters Three and Four for discussion). Within these large-scale networks, special raw material types and various worked objects appear to have circulated over large areas through elite competition networks, attaining widespread symbolic value throughout these areas. These labor-intensive or exotic objects often played a part in aggregation events, where aspiring elites used them to reinforce status claims (see Chapter Five for discussion).

These observations serve as a basis for the study of potential interconnections among Cis-Baikal hunter-gatherers. In previous sections of this dissertation, I reviewed current models of Cis-Baikal culture-history (Chapter Two) and discussed the evidence for interconnections at each of three scales. Cyclical movements related to a distinct seasonal round that existed for each micro-region of the Cis-Baikal would have provided connections among communities at the "local" scale (see Chapters Three and Four). At this social and geographic scale, individuals would have interacted relatively frequently, and these interactions would often have centered on mundane activities such as basic subsistence.

At a larger scale, regular (albeit less frequent) movements of people and the exchange of objects *between* micro-regions would have connected communities across the "regional" landscape (see Chapters Three and Four for a discussion of movement of *people*, Chapter Five for a discussion of the movement of *objects* at these scales). These types of interactions may have been tied to the seasonal round as well, and likely occurred most often at ritual aggregation events. Within the Little Sea micro-region, where isotopic data presented in Chapter Four showed a statistically significant difference in the frequencies of "non-local" males and females, it appears that intermarriage (or some other process involving immigration of females into the area) may have produced affinal relationships and interconnections across micro-regional boundaries. Like the ritual exchanges of nephrite ornaments discussed in Chapter Five, these affinal relationships are expected to have persisted after the actual marriage events where they were celebrated (e.g., Helms 1998).

At the largest geographic scale, which I discuss in this chapter, sporadic, short-term movements, mostly likely involving ritual activities, would have connected Cis-Baikal hunter-gatherers at least indirectly with groups inhabiting neighboring regions such as Yakutia, Western Siberia, and the Trans-Baikal. Although the intensity of these "macro-regional" connections may have been relatively low (especially at any single aggregation event) and likely varied over time, I suggest that these connections impacted the material culture that Cis-Baikal hunter-gatherers employed during the Early Bronze Age, and had important implications for local political and economic processes as well. Below, I discuss several broad classes of evidence for Early Bronze Age interactions at the macro-regional level. These include similarities in metal objects and the development of metallurgy, the spread of anthropomorphic depictions on multiple media, and the appearance of common ornamental forms that appear to have been used at ritual gatherings.

Macro-Regional Institutional Sharing in Bronze Age Eurasia

Cis-Baikal metallurgy and Eurasian interconnections

Archaeologists have long viewed copper and bronze metal artifacts, which became relatively common among Early Bronze Age hunter-gatherers in the Cis-Baikal, as evidence of a diffusion or migration of metalworking groups across the Eurasian steppe during the late sixth and early fifth millennia cal BP (see Goriunova and Novikov 2010 for a review of Bronze Age research on the Cis-Baikal; see also Anthony 2007; Chernykh 1992, 2008; Khlobystin 1987; Kiselev 1951; Kohl 2006; Koriakova and Epimakhov 2007 for broad macro-regional overviews).

Within the Cis-Baikal, metal objects from the Early Bronze Age have been recovered almost exclusively from cemeteries (e.g., Okladnikov 1955). Common forms for these artifacts at Cis-Baikal sites include blades from knives, needles, and fishhooks, as well as rings, tubes, and other ornaments (see below; Figure 6.1; see below, Khlobystin 1987; Okladnikov 1955; Sergeeva 1981a; Pavlova 2010, 2012). Spectrographic analyses of these artifacts conducted throughout the 20^{th} and 21^{st} centuries indicate major differences in their elemental compositions, which Okladnikov (1955:57; see also Sergeeva 1981a, 1981b) interpreted as evidence of a separation between two distinct phases of the Early Bronze Age Glazkovo culture.

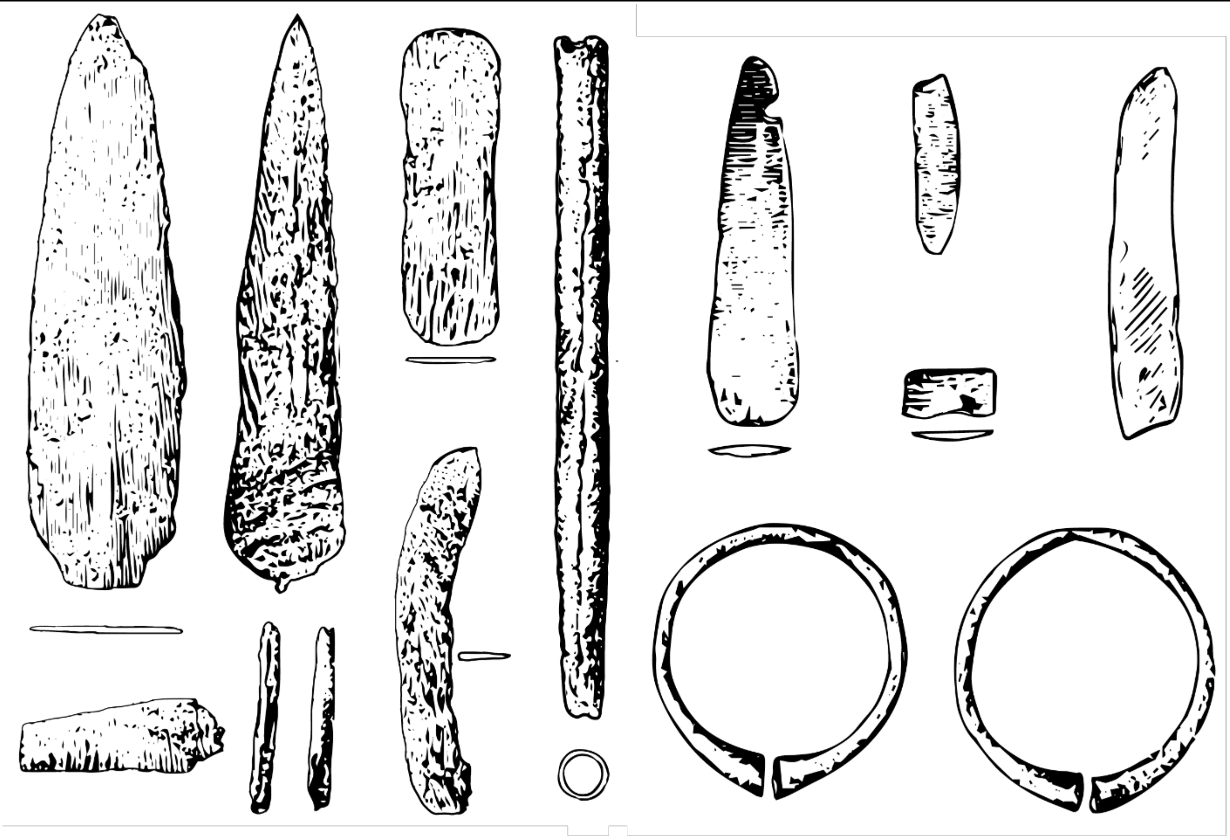

Figure 6.1. Cis-Baikal Metals (adapted from Okladnikov 1955:32 and Bader et al. [Eds.] 1987).

According to Okladnikov (1955) during the first of these phases – the "Eneolithic" – local groups employed metal artifacts that exclusively contained unalloyed copper. During the subsequent Bronze Age, Cis-Baikal hunter-gatherers interred some of their dead with bronze tools and ornaments[14]. More recently, other researchers (e.g., Kharinskii et al. 2009) have argued that this two-period chronology is not supported by available radiocarbon data, and that bronzes may in fact have been among the earliest metals in the region. Similarly, recent work on Glazkovo metals excavated in the Little Sea micro-region demonstrates a mixture of artifacts made from

[14] The term "bronze" refers to artifacts that contained intentional metal alloys in addition to copper, although both bronze *and* copper artifacts featured trace amounts of other metallic elements (e.g., Okladnikov 1955:58).

“pure” copper, as well as arsenical and tin bronzes (Pavlova 2010; 2012; Pavlova [2012] also notes a unique silver ring interred at Kurma XI, Grave No. 15).

While the full chronology of the adoption of metallurgy in the Cis-Baikal remains unresolved, formal analyses do enable a broad assessment of Cis-Baikal hunter-gatherers’ interactions with external, metalworking groups. Okladnikov (1955) noted general similarities between copper blades and other metal artifacts found in the Cis-Baikal and those of the Minusinsk Basin’s “Eneolithic” Afanas’evo culture (Table 6.1), while Khlobystin (1987:340; see also Goriunova et al. 2004) argued that greater similarities existed with metal forms associated with later Okunevo groups (suggesting either a later spread of metalworking practices into the Cis-Baikal or a convergence of regional metallurgical traditions during the second half of the fifth millennium BP). Sites associated with Afanas’evo and Okunevo groups are concentrated along the Yenisei River and its tributaries in the Altai Mountains, to the west of the Cis-Baikal (e.g., Kiselev 1951; Tsybiktarov 2006; Vadetskaia 1986). These sites provide clear evidence of at least limited pastoral subsistence practices, with faunal assemblages dominated by sheep, goat, and cattle, as well as wild taxa such as roe deer (e.g., Griaznov 1999; Vadetskaia 1986). Svyatko et al. (2013) have also recently used isotopic ($\delta^{13}C$ and $\delta^{15}N$) data to demonstrate that fishing also held an important role in Afanas’evo and Okunevo diet.

TABLE 6.1. MINUSINSK BASIN BRONZE AGE CULTURE-HISTORY*

Minusinsk Basin Culture-Historic Groups			Cis-Baikal Comparison****	
Period	Centuries (cal BC)	Number of Samples Analyzed	Period	Centuries (cal BC)
Afanas'evo**	29th — 25th	5	Glazkovo	29th — 17th
Okunevo	25th — 20th	19		
Andronovo	18th — 16th/15th	9		
Karasuk***	14th — 9th	16		

*Adapted from Svyatko et al. 2009

**Svyatko et al. (2009) suggest that earlier radiocarbon dates for Afanas'evo-associated contexts (as early as 39th century BC) likely are biased by the use of wood that predates the culture-historic unit in question.

***Legrand (2004:140) notes that attempts to produce radiocarbon dates for Karasuk have generally come from samples attributed to a relatively late phase of this culture-historic group's development.

****From Weber et al. (2016a). These dates include a correction for Freshwater Reservoir Effect (FRE).

Shared artifact forms between the Cis-Baikal's Early Bronze Age Glazkovo groups and the Minusinsk Basin's Okunevo culture include hammered tools such as needles and fishhooks. Glazkovo and Okunevo knives were also similar, and were relatively common in both contexts. Knife blades lacked both a stem and a central ridge, and were often attached at an angle to socketed handles made from bone or other perishable materials (Figure 6.2; e.g., Khlobystin 1987:332; Okladnikov 1955:33-35; Vadetskaya 1986:31). For example, in the 1975 excavations at Shamanskii Mys (Grave No. 1), an adult male (age 30-35 at death) featured a copper knife blade still embedded in a poorly-preserved wooden handle (Konopatskii 1982).

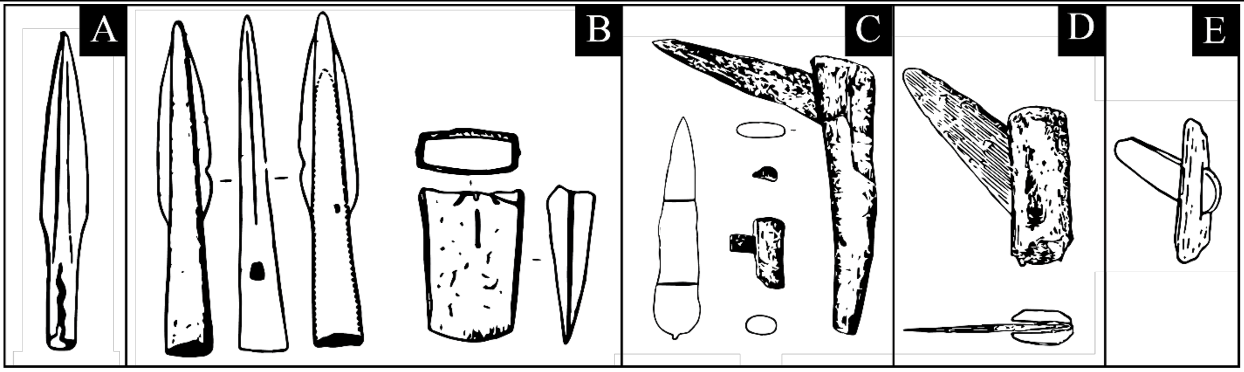

Figure 6.2. Okunevo and Cis-Baikal metal tools.
A. Okunevo spear point (adapted from Vadetskaia 1986:31). B. Cis-Baikal Spear point and axe head (adapted from Drozdov and Dement'ev 1974:226). C. Glazkovo knives (adapted from Okladnikov 1955:35). D. Glazkovo knife (adapted from Okladnikov 1976:239). E. Okunevo knife (adapted from Vadetskaia 1986:31).

To the extent that forms of tools *differed* between Glazkovo and Okunevo groups, Glazkovo groups appear to have used metal primarily to produce relatively small, thin tools such as knives (the most common Glazkovo metal object). In contrast, Okunevo groups also produced large chopping tools or military equipment (cast bronze spear- and axe-heads; Figure 6.2). Noting this difference, Okladnikov (1955:44) proposed that Cis-Baikal hunter-gatherers employed alternative, locally-available materials (green nephrite) to produce similar types of equipment (such as hypertrophic axes and adzes).

More recently, however, archaeological research within the Cis-Baikal has revealed at least one object resembling these "military" implements, which appears to date to the Early Bronze Age. The object in question is a copper celt, interred with an adult female at Shumilikha, a Cis-Baikal cemetery located at the confluence of the Angara and Belaia (Figure 6.3, 6.4; in older literature, this site is often labeled "Ust'-Belaia II," e.g., Goriunova 2002; Savel'ev et al. 1981). This object featured two "ears" or "lugs" along the sides (one of these ears broke prior to the object's deposition), as well as several linear ridges on its surface. Okladnikov (1970) noted that linear ridges like these were common on the surfaces of metal tools throughout Bronze Age Siberia.

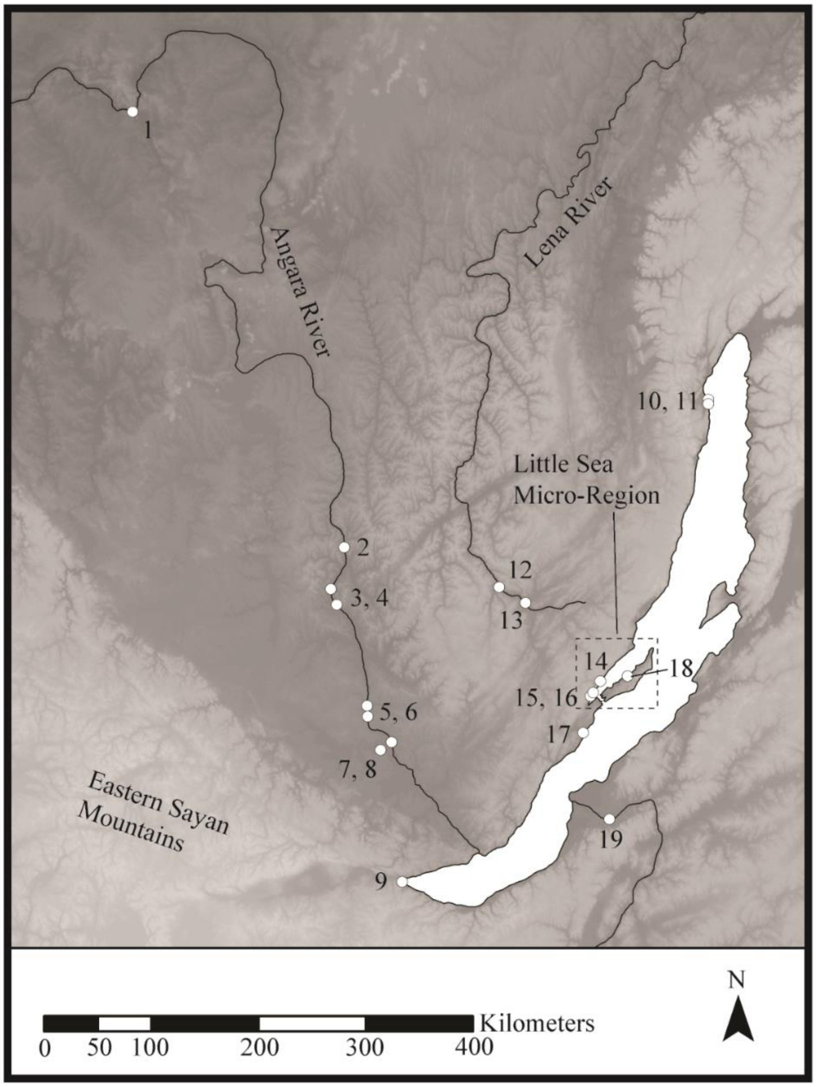

Figure 6.3. Regional sites discussed in Chapter Six.
The Cis-Baikal region, with sites mentioned in the text. 1. Ust'-Kova. 2. Serovo. 3. Ust'-Uda. 4. Shivera. 5. Ust'-Ida. 6. Semenovo. 7. Mal'ta. 8. Shumilikha. 9. Shamanka II. 10. Krasnyi Yar. 11. Baikal'skoye III. 12. Verkholensk. 13. Shishkino. 14. Kurma XI. 15. Sarminskii Mys. 16. Khuzhir-Nuge XIV. 17. Sagan-Zaba. 18. Shamanskii Mys. 19. Fofanovo.

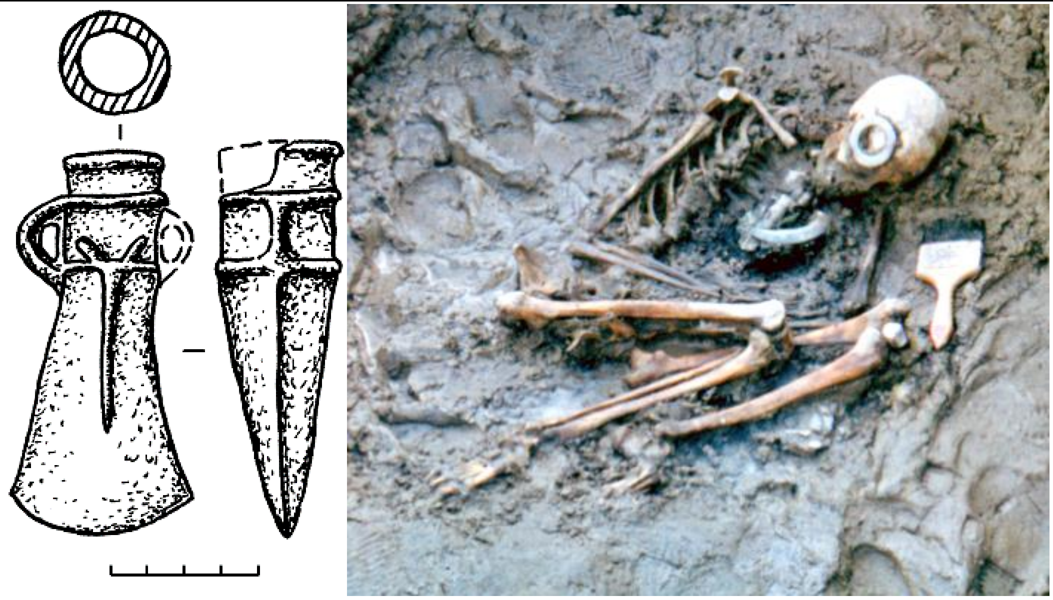

Figure 6.4. Shumilikha, Grave No. 37 images. *Left*. Metal celt from Shumilikha, Grave No. 37. *Right*. Interment from which the celt was recovered.

Along with its unique form (when compared to Early Bronze Age Cis-Baikal metal artifacts), the double-sided casting technique used to produce this celt initially led researchers to note parallels with Late Bronze Age Seima-Turbino and Karasuk material cultures of Southern Siberia (Table 6.1; Sergeeva 1981b:28). Khlobystin (1987), for example, attributed this celt to the Shivera culture, a Late Bronze Age development within the Cis-Baikal, believed to be contemporaneous with Karasuk culture-historic groups located outside the Cis-Baikal. Okladnikov (1950, 1955) identified the Shivera grouping only very generally, on the basis of 12 graves from Ust'-Uda and Shivera cemeteries[15] (on the middle Angara River) however. For this reason, I suggest that both the specific chronological position of the Shivera culture-historic unit as well as its discrete nature (as *separate* from the Early Bronze Age "Glazkovo") remain poorly understood.

[15] In Goriunova and Novikov (2010:244), Ust'-*Uda* (усть-уда) was incorrectly translated as Ust'-*Ida* (усть-ида; italics added to emphasize different spellings), a different cemetery that is also located on the Angara River. While both cemeteries feature Bronze Age components, Ust'-Ida was excavated after Okladnikov's death, by V.I. Bazaliskii (Irkutsk State University, Russia; see Tiutrin and Bazaliiskii 1996).

Similarly, Sergeeva (1981a) conducted spectrographic analyses on a large sample of Bronze Age metal artifacts from sites throughout Southern Siberia (see below), demonstrating that metals assigned to the Shivera culture were compositionally identical to some samples associated with the Glazkovo culture. On this basis, she suggested that these "Shivera-age" objects be reassigned to the 'second stage' of the Glazkovo culture-historic period (thus designating them as contemporaneous with bronze Glazkovo artifacts dating to the Early Bronze Age).

However, limited radiocarbon evidence from an individual in the grave at Shumilikha containing the unique celt also enable some discussion of the specific date when this artifact was interred. In an early assessment of radiocarbon ages for burials throughout the Cis-Baikal region, Mamonova and Sulerzhitskii (1986, 1989) reported an uncalibrated radiocarbon age of 4100 +/- 50 BP (GIN-4065) for this individual. While this date is similar to uncalibrated dates for other Early Bronze Age individuals within the region (e.g., Mamonova and Sulerzhitskii 1986; Weber et al. 2010), the lack of associated $\delta^{15}N$ stable isotope and collagen yield data lower the utility of this result, making it impossible to correct for Freshwater Reservoir Effect ("FRE"; Bronk Ramsey 2014; Schulting et al. 2014; Weber et al. 2016a). The lack of data on the collagen yield for this sample is of less concern here, as this burial was located in the Angara River micro-region, where collagen yields for mid and late Holocene skeletal material tend not to be so low as to bias radiocarbon dates (Weber et al. 2006).

Weber et al. (2016a) list nine uncalibrated ^{14}C dates from Early Bronze Age samples in the Angara River Valley. When FRE corrections were applied (corrections were based on each sample's $\delta^{15}N$ value), all but one of these corrected ("modelled") calibrated dates was at least 129 years *older* than the original uncalibrated date (Weber et al., this volume; see also Bronk Ramsey et al. 2014; Schulting et al. 2014). On this basis – and in the absence of $\delta^{15}N$ data for the individual with whom the Shumilikha celt was interred – it appears likely that the archaeological age of this individual is *at least* 4100 cal BP.

A date of >4100 cal BP for this interment is noteworthy in that it falls into the same range as the broad suite of Early Bronze Age sites in the Cis-Baikal, rather than a post-*Glazkovo* Late Bronze Age, as had been previously suggested for the Shivera grouping, to which this feature was assigned (e.g., Khlobystin 1987; Okladnikov 1955; see also Goriunova and Novikov 2010:251-252; Goriunova 2002, for a broader discussion of the Shumilikha site). Kharinskii et al. (2009:121) observe that double-sided casting techniques and elongated decorative elements like those found on this object are also common in Okunevo metal artifacts, providing further support for a mid-/late-fifth millennium BP date for this object. It is also important to note that this date only relates indirectly to the time when the celt was actually produced. As such, this object may have circulated as a form of prestige good for a considerable amount of time before the death of the individual with whom it was interred (see Chapter Five; below for a discussion of possible uses of this object).

In addition to the Shumilikha celt discussed above, other metal objects from sites within the Cis-Baikal also exhibit at least limited similarities to non-local metal "weaponry." In a survey of archaeological research in the Lower Angara micro-region (located in the northern Cis-Baikal), Drozdov and Dement'ev (1974) noted a unique bronze point from a spear as well as a bronze celt fragment from the first cultural layer at Ust'-Kova (Figure 6.2). The spearpoint featured a socket for mounting onto a shaft, and was approximately 20 cm in length. The celt was broken at the base so that its length could not be determined, although the fragment was ~9 cm in length. While the authors suggested a Late Bronze-Early Iron Age ("Tagar") chronological designation, the objects also appear similar to Samus' objects from the third millennium BC (e.g., Kosarev 1984:113) and, more broadly, to earlier (Early Bronze Age) material from areas surrounding the Cis-Baikal in the steppe and taiga. While I do not mean to suggest that these objects *necessarily* date to the Early Bronze Age, it seems possible, given recent metal finds from this period within the Cis-Baikal and surrounding regions of southern Siberia, that their chronology may warrant revisiting.

It is also noteworthy that despite similarities in a broad suite of the overall forms and uses of metal objects in the Cis-Baikal and nearby regions, Early Bronze Age hunter-gatherers in the Cis-Baikal appear to have produced the objects that they employed locally (Sergeeva 1981a). In a large-scale examination of elemental compositions of Bronze Age metal artifacts from the Minusinsk Basin, Cis-Baikal, and Transbaikal, Sergeeva (1981a) noted a characteristic absence of several elements in Cis-Baikal metals. These elements, which were common in low concentrations in metals from the other regions in question, included zinc, titanium, and to a lesser extent, cobalt and gold. On this basis, Sergeeva suggested that most Cis-Baikal metal objects were produced locally, as opposed to from the same sources as metals found in the Transbaikal or Minusinsk Basin (see also Khavrin 1997). While the local production of metal by hunter-gatherer groups is of considerable interest for a variety of reasons, for the purposes of this discussion I emphasize that *formal* similarities between Cis-Baikal and Minusinsk Basin metal objects may suggest at least some degree of continued interaction across regional boundaries during the Early Bronze Age.

Early Bronze Age anthropomorphic depictions throughout the Cis-Baikal and across Siberia

During the Early Bronze Age, groups inhabiting both the Cis-Baikal and neighboring regions also incorporated novel imagery with anthropomorphic symbols into various aspects of their material culture (Goriunova and Novikov 2009). Throughout the Cis-Baikal, for example, Early Bronze Age groups produced anthropomorphic figurines using bone, antler, and metal. The majority of Glazkovo figurines that archaeologists have recovered were made from organic material, and portray standing individuals in an *en face* (frontal) orientation, with engraved faces (e.g., Figure 6.5; Okladnikov 1955; Studzitskaia 1987b). In this sense, the individuals or groups who produced these objects appear to have employed a rigid set of rules when producing them. These objects have been found exclusively in burial contexts, often in pairs, such as at Ust'-Uda and Semenovo cemeteries, both located on the middle stretch of the Angara River. Some of these carved figurines also depict two adjoining individuals standing side-by-side, once again with a frontal view, such as in graves at Verkholensk cemetery, on the upper Lena River, and at Ust'-Ida cemetery, on the middle Angara (Figure 6.5).

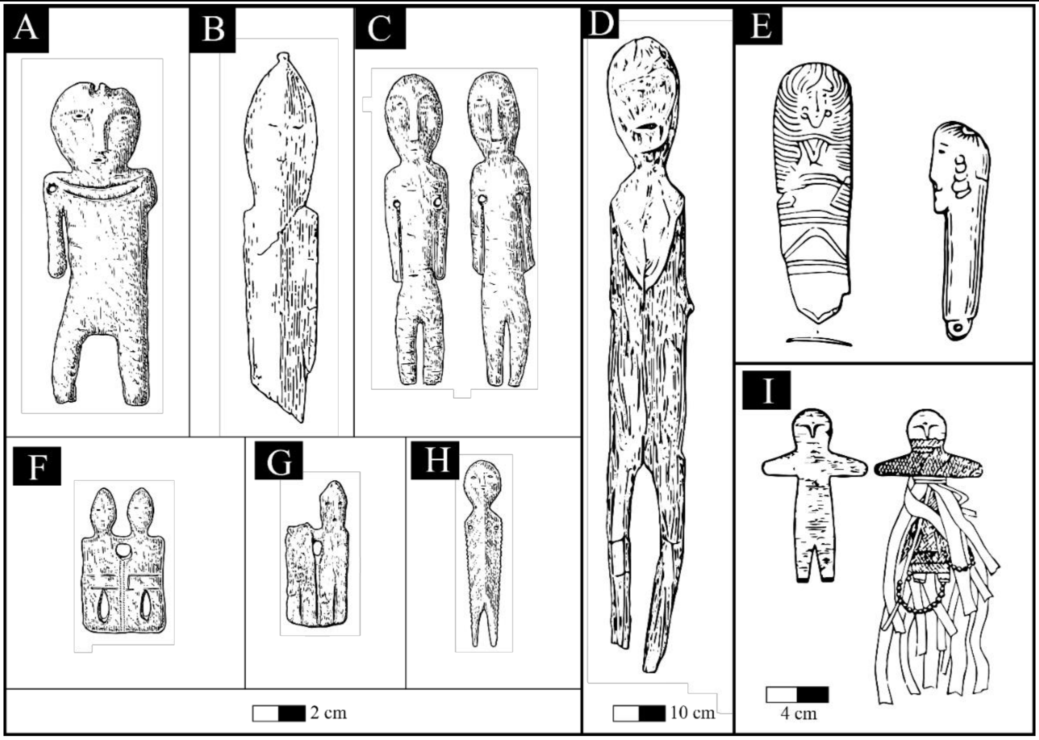

Figure 6.5. Anthropomorphic figurines mentioned in the text. A. Ust'-Uda (adapted from Khlobystin 1987:415). B. Kullaty (adapted from Khlobystin 1987:412). C. Ust'-Uda (adapted from Khlobystin 1987:415). F. Verkholensk (adapted from Khlobystin 1987:415). G. Ust'-Ida. H. Shumilikha (adapted from Khlobystin 1987:415). D. Gorbunovo peat bog (adapted from Studzitskaia 1987a:399). E. Stone anthropomorphic depictions from Okunevo contexts (adapted from Vadetskaia 1986). I. Southern Evenk metal anthropomorphic figurines (adapted from Turov 1974).

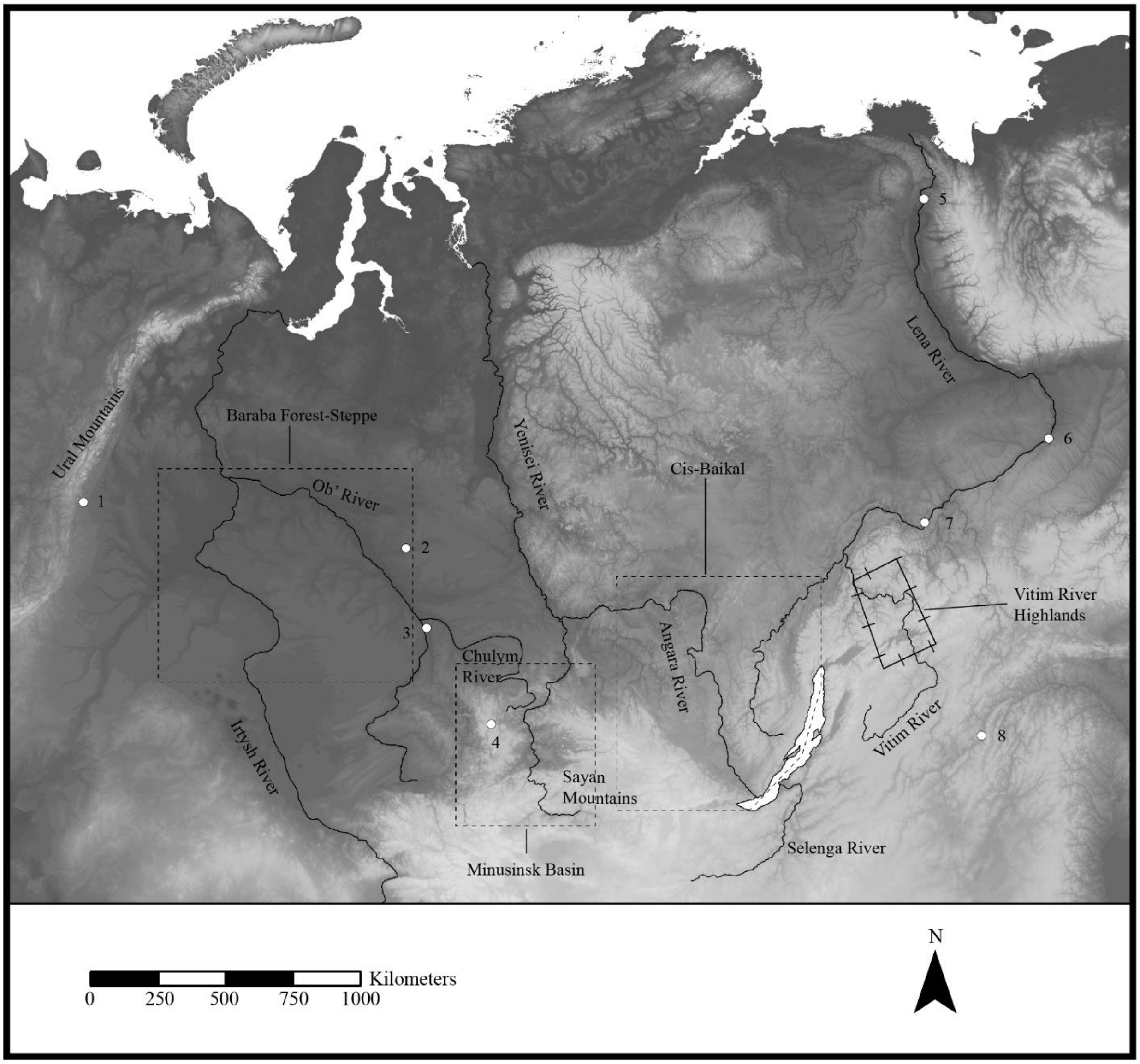

Figure 6.6. Macro-regional map.
Macro-regional sites discussed in the text. 1. Gorbunovo peat bog. 2. Napas'. 3. Zav'yalovo, Samus' IV. 4. Chebaki. 5. Ichcheleekh. 6. Kullaty. 7. Suruktaakh-khaya. 8. Shilkinsk Cave.

In most cases where graves were sufficiently undisturbed that the layout of the deceased and associated grave goods at the time of burial could be determined, carved anthropomorphic figurines were located on the chests of deceased individuals. Broadly, the occurrence of anthropomorphic figures with formal similarities to one another in similar contexts throughout the Early Bronze Age Cis-Baikal may suggest common ritual practices or forms of symbolism at the regional scale during this period. Notably, although numerous sculptures of fish have been documented in graves dating to the Late Neolithic, no Late Neolithic anthropomorphic sculptures have been documented.

Notably, most of the macro-regional stylistic similarities discussed below appear primarily in ritual contexts (e.g., in burials, as cult symbols, on rock art panels). In this sense, it is possible that Early Bronze Age groups in the Cis-Baikal primarily used ritual events, rather than mundane daily activities, as a venue to display their adherence to supra-local styles. However, domestic contexts in the Cis-Baikal are less well-studied, making it difficult to evaluate evidence of the role of macro-regional themes and broader forms of interconnection in mundane, domestic, non-ritual settings.

However, one form of domestic evidence for macro-regional stylistic convergence, however, is the appearance of patterned, pearl-shaped depressions (жемчужины) in Glazkovo clay vessels (Goriunova and Vorob'eva 1986). For example, in the Early Bronze Age Layer B[16] at Ulan-Khada – a site located in the Little Sea that featured Neolithic and Early Bronze Age graves as well as evidence of long-term habitation – ceramic vessels were recovered that featured these pearl-shaped impressions, unlike lower layers at the site (Goriunova and Khlobystin 1992:47-48). These pearl-shaped design elements were common on Late Neolithic and Bronze Age ceramics throughout Western Siberia as well (e.g., Alekseev 1996:77; Kosarev 1981; Matiushchenko 1973). Pottery of this period in the Cis-Baikal featured other analogues with western Siberian ceramic styles as well, such as the use of zoomorphic and solar symbols (e.g., Goriunova and Novikov

[16] To clarify, "Layer B" here is from the Russian, and is not an English "B." The layer directly above Layer B was Layer Б, the next lower layer was Layer Г.

2009) as well as the use of a "retreating spatula" technique (also observed by Goriunova and Khlobystin [1992] on ceramics from Layer B at Ulan-Khada).

During the Early Bronze Age, Cis-Baikal groups also depicted anthropomorphic forms on other media, including ceramic vessels. Eight ceramic vessels dating to the Early Bronze Age have been found within the Cis-Baikal that feature frontal views of anthropomorphs (standing in an *en face* orientation; Figure 6.7; Goriunova and Novikov 2009). Some of these anthropomorphic depictions on ceramics feature pointed heads, similar to those found on contemporaneous Early Bronze Age bone and antler sculptures such as the ones from Bratsk (Okladnikov 1955:296) and Verkholensk (Shepard et al. 2016; see Figure 6.5). Goriunova and Novikov (2009:80) also note that in some cases, anthropomorphic depictions on ceramic vessels featured bifurcated horns, recalling possible "shamanic" themes that became common throughout Siberia during the Bronze Age (see below).

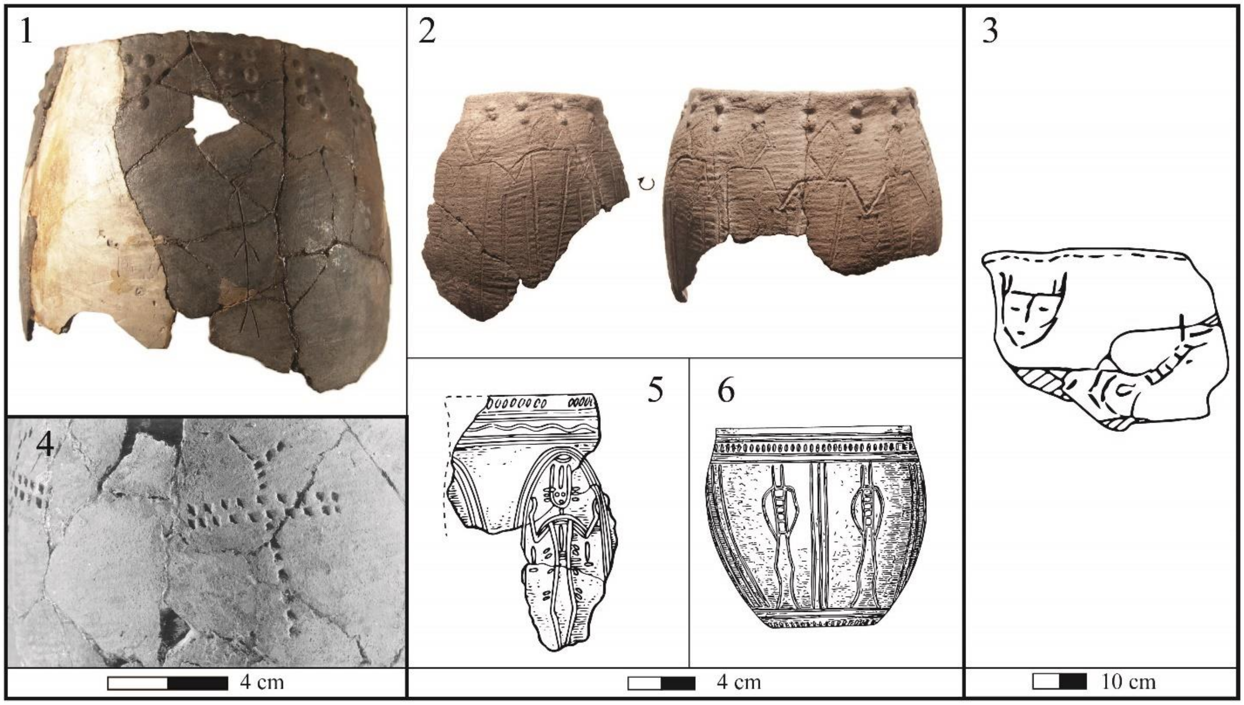

Figure 6.7. Ceramic depictions of anthropomorphs.
Anthropomorphic depictions on ceramic media mentioned in the text. A. Plotbische (photo by E. Korshunov). B. Khadarta IV (photo by E. Korshunov). C. Kizhirovskoye (Early Iron Age, Western Siberia). D. Tushama. E. Samus' IV (adapted from Studzitskaia 1987a:399). F. Samus' IV (adapted from Kosarev 1987:381).

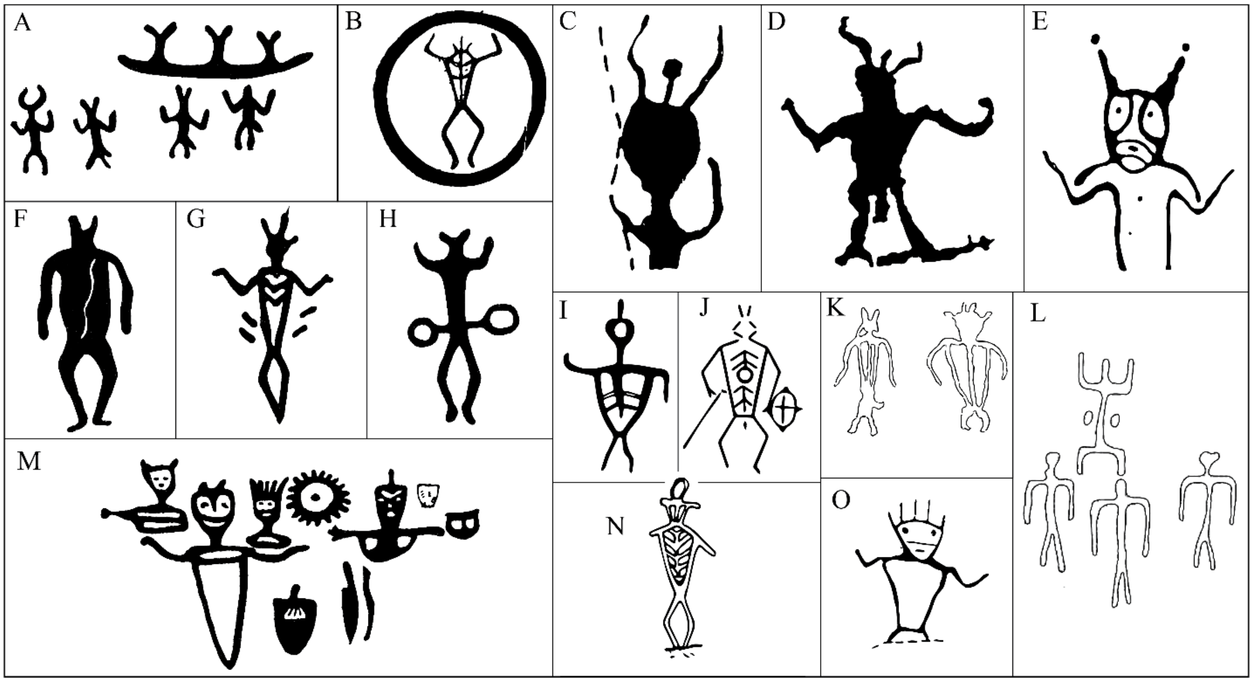

Figure 6.8. Rock art anthropomorphic imagery from the Cis-Baikal and other Northern Eurasian contexts. A. Shishkino (adapted from Studzitskaia 1987b:417). B. Mal'ta (adapted from Studzitskaia 1987b:417). C. Okunevo figure from Mugur-sargol (adapted from Devlet 1997:248, image 2). D. Okunevo figure from Mugur-sargol (adapted from Devlet 1997:248, image 1). E. Okunevo figure from kamyshta (adapted from Devlet 1997:248, image 5). F. Sagan-Zaba (adapted from Studzitskaia 1987b:417). G. Lower Angara (adapted from Studzitskaia 1987b:417). H. Lower Angara (adapted from Studzitskaia 1987b:417). I. Aya bay, lake Baikal [adapted from Devlet 2001:44). J. Mount Ukir (adapted from Devlet 2001:44). K. Tretii kamennyi ostrov (adapted from Okladnikov 1966:249, image 2 and Okladnikov 1966:247, image 1). L. Ust'-Kova, lower Angara (adapted from Okladnikov 1966:317, image 1). M. Aldan River, Yakutia. N. Bolshaia Kada (adapted from Devlet 2001:44). O. Okunevo figure from Shalabolino (adapted from Devlet 1997:248, image 4).

In addition, it is also noteworthy that similar anthropomorphic themes appear on rock art throughout the Cis-Baikal and southern Siberia as well, although this line of evidence is considerably more tenuous due to the difficulties inherent in dating these materials (see below). While direct dating of rock art remains impossible, most scholars of the region agree that Cis-Baikal rock art during the Early Bronze Age also began to include standing anthropomorphic figures in similar poses to those found on ceramics and in sculptures (in a frontal/*en face* orientation, often featuring horns; Figure 6.8; e.g., Goriunova and Novikov 2009; Okladnikov 1966:131).

As noted above, many of the artistic conventions concerning anthropomorphic imagery that appeared in Cis-Baikal Early Bronze Age material culture were not unique to the region (e.g., Goriunova and Weber 2003; Goriunova and Novikov 2009; Okladnikov 1966; Studzitskaya 1987B; Tsybiktarov 2006). For example, on the taiga to the northeast of the Cis-Baikal, a Bronze Age burial assigned to the Ymyyakhtaakh culture, located on the Kullaty River (a tributary of the middle Lena) featured an antler anthropomorphic figure essentially identical to Glazkovo designs (Figure 6.8; Okladnikov 1970:138-140). Glazkovo-style anthropomorphic imagery has been found on Ymyyakhtaakh ceramics as well, such as in layer VII (the Early Bronze Age component) of Ulakhan-Segelennyakh, a multilayered habitation site in southern Yakutia's Olekma River Basin (Khlobystin 1987:339; Dyakonov 2012).

Parallels also exist between Early Bronze Age Cis-Baikal anthropomorphic sculptures and those found in the Minusinsk Basin, as well as in steppe and forest-steppe areas of Western Siberia (Okladnikov 1955:297-298). In particular, while their specific execution differs markedly from Cis-Baikal examples, unprecedented stone stele associated with Okunevo groups frequently featured anthropomorphic imagery, supporting arguments for macro-regional fluorescence of broad anthropomorphic themes on multiple media during the Early Bronze Age (Figure 6.9, e.g., Savinov 1997). Okunevo burials also often featured stone slabs carved with anthropomorphic designs. Again, specific designs of these anthropomorphs differ from contemporaneous anthropomorphic sculptures from the Cis-Baikal, but suggest that within these relatively distant cultural contexts, similar fundamental concepts became relevant in Bronze Age discourse (see below).

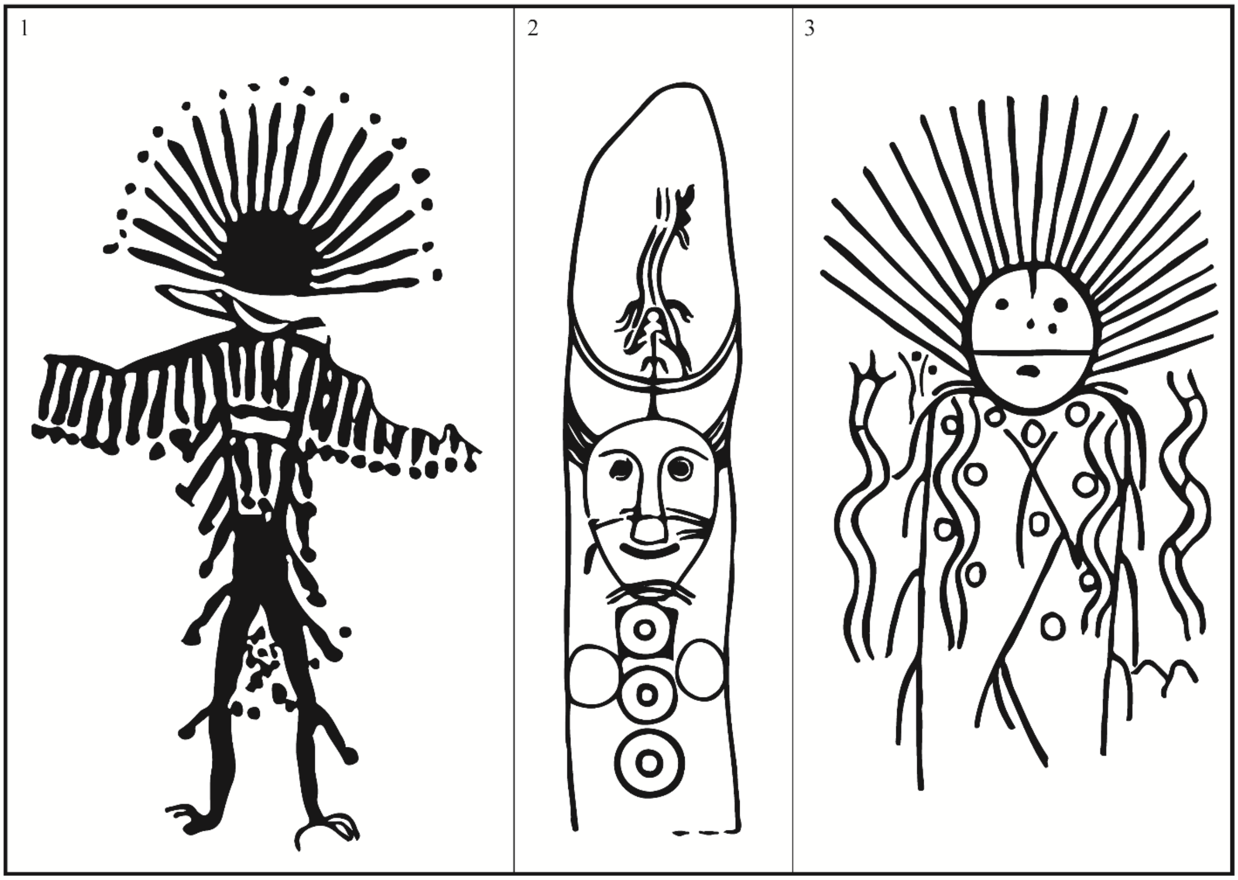

Figure 6.9. Okunevo stone stele carvings, featuring body ornamentation. 1. Karakol (adapted from Devlet 1997:250). 2. Erbinsk (adapted from Leont'ev 1997:227). 3. Onkhakov Ulus (adapted from Devlet 1997:250).

A recent synthesis of anthropomorphic sculptures collected from peat bogs in the Trans-Urals in Western Siberia (Chairkina 2014) indicates that groups in this region may have produced their own local variants of this widespread theme by carving wood statues (although it is also noteworthy that some of these statues actually appear to predate the Bronze Age considerably). While Trans-Urals wood figurines were often larger than those found in the Cis-Baikal (and were produced on different media: wood), their formal characteristics show similarities (Figure 6.5; Chairkina 2014:83).

Features of Trans-Urals sculptures that exhibit similarities to those seen on figurines from the Early Bronze Age Cis-Baikal include: (1) the depiction of supraorbital arches and noses on the same plane relative to surrounding (concave) features, (2) rectangular noses, (3) concave mouths, and (4) the depiction of anthropomorphs in a standing posture. Chairkina (2014) suggests that wood anthropomorphic figurines like these may have been more common during the Bronze Age but that without special preservation conditions (such as the Trans-Ural peat bogs where these objects were found), their successful recovery is unlikely. Studzitskaia (1987B:345) made a similar assertion regarding prehistoric anthropomorphic depictions in the Cis-Baikal, raising the possibility that wood figurines may have been relatively common in Cis-Baikal preshistory despite their absence from the archaeological record.

As mentioned above, in addition to sculptures with stylistic similarities to objects from the Early Bronze Age Cis-Baikal, some Western Siberian ceramics dating to this period also contain horned anthropomorphs similar to those seen in Cis-Baikal ceramics and rock art. Throughout Siberia, rock art depictions of anthropomorphic figures with forked horns have often been interpreted as depictions of shamanic figures engaged in ritual dances (e.g., Goriunova and Weber 2003; Devlet 1997:247-248; Okladnikov 1948, 1966:129-130; Vadetskaya 1986:33). Tsybiktarov (2006:179), for example, has argued that during the Western Mongolian Neolithic, rock art mostly portrayed animals, while Eneolithic and Early Bronze Age styles featured a new set of themes, especially those relating to anthropomorphic ancestor figures or “horned protoshamanic beings” (Tsybiktarov 2006:33). Broadly, the appearance of these anthropomorphic themes as well as common trends in their execution throughout the macro-region may reflect a widespread adoption of shared symbolism during the Early Bronze Age (Tsybiktarov 2006; Studzitskaia 1987b).

Metal "medallions" depicting anthropomorphs serve as one particularly unique set of materials that indicate common symbolic themes in the Cis-Baikal as well as other areas of Siberia during the Early Bronze Age (Figure 6.10). The first of these objects, which featured an anthropomorphic figure inside a circular frame, was found in a burial at Kurma XI, in association with a young adult male (Figure 6.11; Grave No. 1). This object featured two horn-like extensions above the head, clear depictions of eyes, a mouth, and a nose, as well as a central "torso" and arc-shaped "arms."

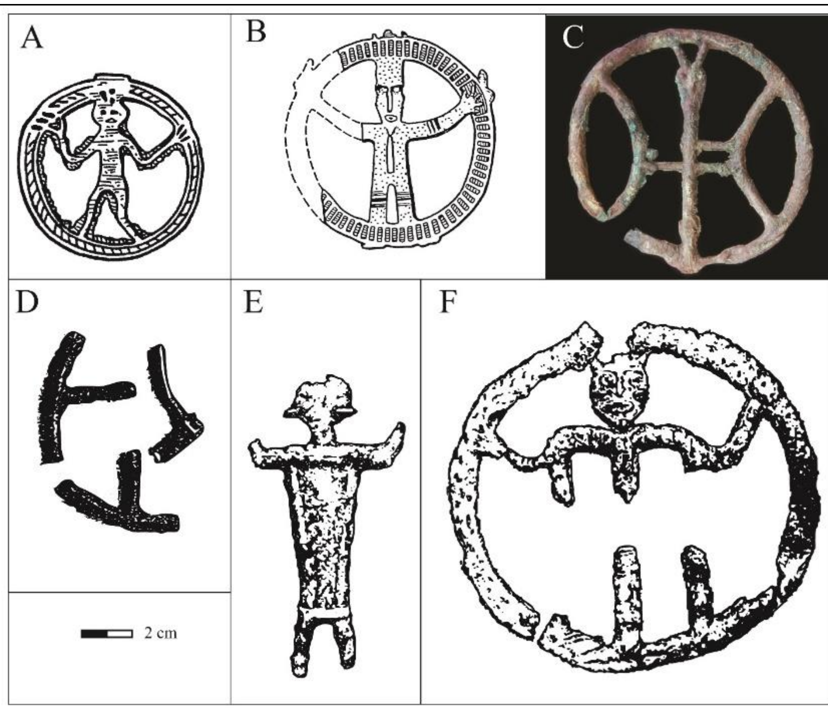

Figure 6.10. Metal medallions. Metal anthropomorph depictions mentioned in the text. A. Western Siberian example from Zav'yalovo 1A (adapted from Kosarev 1984:215). B. Western Siberian example from Napas (adapted from Kosarev 1984:215). C. Kurma XI (photo by Andrzej Weber). D. Uliarba (adapted from Goriunova et al. 2004:29). E. Ust'-Kova (adapted from Leont'ev 2014:106). F. Ust'-Kova (adapted from Leont'ev 2014:106).


Figure 6.11. Kurma XI, Grave No. 1 (photo by Andrzej Weber).

The medallion interred with this individual was recovered from the base of the individual's sternum, and was associated with birch bark fragments that may have been part of a bag in which the object was stored (Weber et al. 2012:29). The medallion was made of a tin-alloyed bronze, using the open-casting technique. Two separate soldered areas suggest that it may have been broken and restored at least twice in prehistory (Goriunova and Weber 2003). The individual who wore this object featured a GF ("non-local") diet, and non-local (low) $^{87}Sr/^{86}Sr$ values for M1, indicating considerable time during early life and immediately prior to death spent outside the local area (Appendix 7). Using the FRE correction developed for the Little Sea micro-region, Weber et al. (2016a) assigned this individual an age of 4152 +/- 101 cal BP (again, well within the bounds of the Early Bronze Age, rather than a post-Glazkovo date, which some have suggested). In addition to the medallion that was placed on this individual's chest (possibly within a birch bark bag), this individual was also associated with ~40 pendants made from perforated red deer canines. These were concentrated around the individual's cranium, and appear to have made up some sort of ornamental headgear. A single white nephrite ring found in the right orbit was also likely part of this headgear.

Similarly, an Early Bronze Age burial at Ust'-Kova, located on the lower Angara River, contained two bronze anthropomorphic figures, situated on the deceased individual's chest, inside the remains of a skin bag (Figure 6.10; Leont'ev 2014). Both of the Ust'-Kova figures depicted standing individuals with arms bent upwards at the elbows. One of the two featured horns, and stood inside a circular frame (although the second may have also originally featured a frame that subsequently broke due to oxidation; Leont'ev 2014). This interment featured a number of other artifacts, including 22 perforated red deer teeth (pendants) that were situated on the individual's chest. The presence of one of these metal anthropomorphic figurines on the lower Angara (Ust'-Kova) is particularly noteworthy, given the general lack of extremely "rich" burial assemblages there (Dudarek and Lokhov 2014:75).

Another unique object with possible similarities to the two sets of metal anthropomorphs mentioned above was found at the Uliarba cemetery, located in the Little Sea region, roughly 2 km south of Khuzhir-Nuge XIV. An isolated Early Bronze Age grave from this site (Grave No. 19) was located ~20 m uphill (north) from a row of graves in the southern area of the site (Graves No. 1-3, 16), and ~30 m downhill (south) from the main cluster of graves (Figure 6.12). Grave 19 contained a single individual, who could not be aged or sexed. This grave was extremely "rich" in terms of grave goods, including white nephrite ornaments, two green nephrite axes, and several other unique objects (see below; Shepard 2008). Among these objects was a cluster of seven "arc-shaped" metal fragments that appear to have come from a single (broken) object (Figure 6.10). These fragments were found beside the interred individual's stomach, and Goriunova et al.

(2004:31) suggested on the basis of their tight concentration that they were originally interred in a bag or pouch.

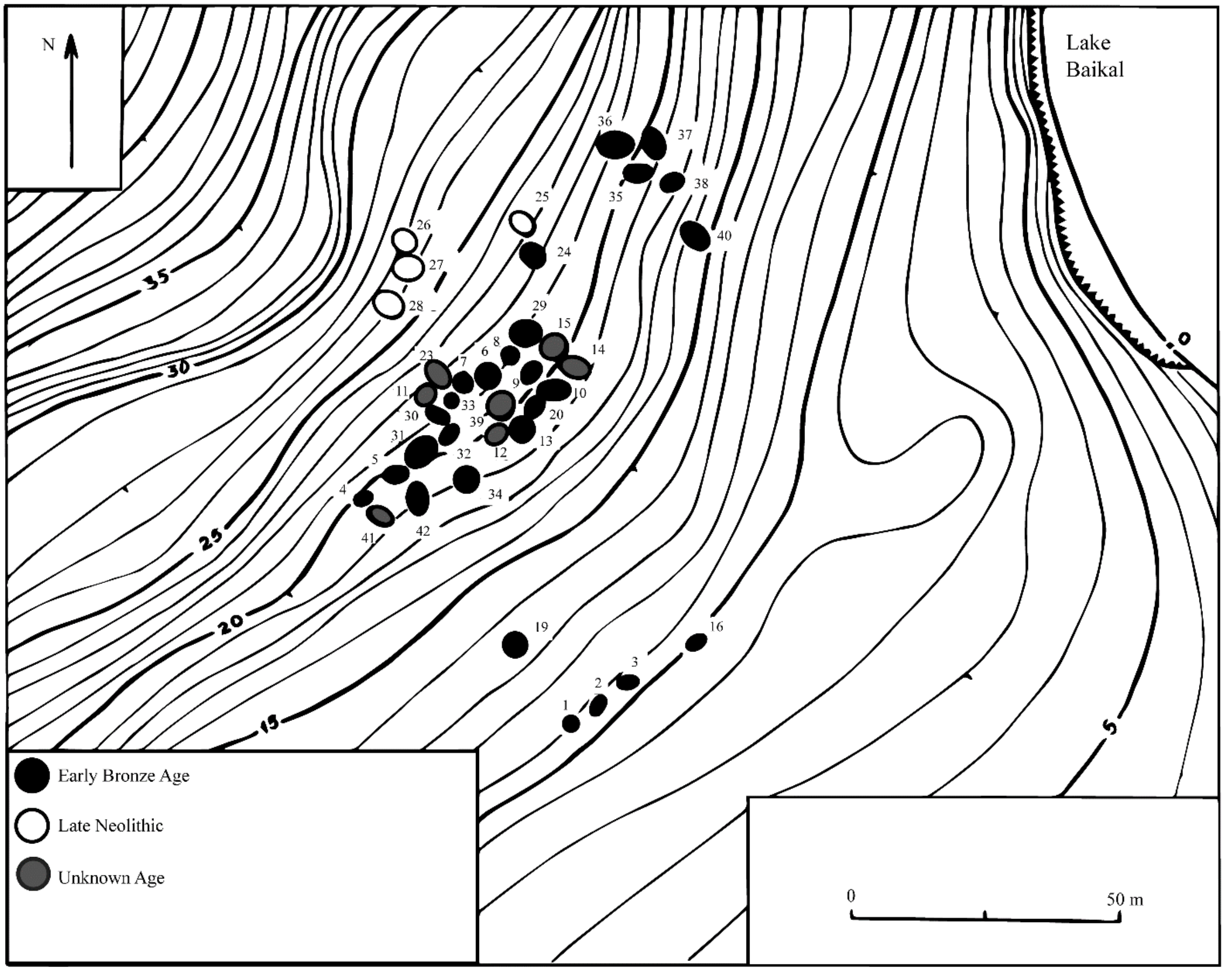

Figure 6.12. Map of Uliarba cemetery (adapted from McKenzie 2010).

Although it is entirely possible that the object these fragments came from was unrelated to the circular-framed anthropomorphic figures discussed above, the similar context (in a bag, on or near the chest/torso area) as well as the similarities in the forms of these unique artifacts (particularly the Kurma XI figurine, as both featured linear or curved "limbs" with relatively uniform thickness) suggests at least a possibility that the isolated individual interred in Grave No. 19 was also associated with a metal anthropomorphic figure.

It is interesting to note that while the figurine at Kurma XI appears to have broken multiple times and to have been repaired each time (see above), it is possible that the Uliarba metal framed figure also broke prior to interment, but was not repaired. It is also possible that the fragmentation of this figurine could have occurred *after* the original burial took place, especially given that the grave appears to have been looted in antiquity, based on (1) the ring-shaped cairn, (2) the scattered ribs, shoulder blades, and vertebrae, and (3) the absence of a skull for this individual (Goriunova et al. 2004). 15 perforated red deer teeth were located near this individual's right arm.

The overall forms of anthropomorphic metal figurines from Ust'-Kova and Kurma XI (and, possibly, Uliarba as well) exhibit striking similarity to another Early Bronze Age metal anthropomorphic figure, recovered from the Zav'yalovo 1A settlement, associated with the distant Samus' culture (Figure 6.6; synchronous with Okunevo; e.g., Koriakova and Epimakhov 2007:104), located in the Tom-Chulym River Valley in Western Siberia (Figure 6.10; Studzitskaia 1987a). All of these figures feature frontal views of anthropomorphs standing upright, and most show these anthropomorphs within circular frames, their arms bent upwards at the elbows. A second Samus'-style metal figure sharing many of these characteristics was found at the Napas' settlement on the Tym River (Figure 6.10), though its chronology is uncertain (Kosarev 1984:211). A Samus' settlement (Samus' IV) also featured anthropomorphic imagery on ceramics, similar to examples found in the Cis-Baikal (Goriunova and Novikov 2009; Studzitskaia 1987a).

Novel Bronze Age forms of body adornment

Both within the Cis-Baikal and throughout neighboring regions, Early Bronze Age groups also employed a number of novel ornamental types in relatively consistent ways to adorn the bodies of deceased individuals at funeral events. White nephrite (Chapter Five) was one such novel and visually distinctive material. As discussed above, standardized white nephrite ornaments, which were particularly widely distributed within the Cis-Baikal, have also been found in Yakutia, as well as the Transbaikal, along the middle and lower Lena River, and in cemeteries belonging to the Seima-Turbino cultural horizon, located in Western Siberia (Fedoseeva 1992; Grishin 1981; Kiselev 1951), and possibly in Okunevo graves (although in small quantities; e.g., Khavrin 1997:67). Hunter-gatherer groups within the Cis-Baikal placed these objects on the chests and heads of deceased individuals in burials, and groups in other contexts appear to have adhered to similar practices.

Other diagnostically Glazkovo ornament types have also been found in regions surrounding the Cis-Baikal (Okladnikov 1970:141). For example, Shilkinsk cave, located on the left bank of the Shilka River in the Transbaikal, featured a disturbed single-individual interment with two white nephrite rings and mother-of-pearl beads of the Glazkovo type, as well as ceramic fragments and lithic tools exhibiting a mixture of local designs and those associated with the Glazkovo tradition (Okladnikov 1960).

Other ornament types that appear to have been shared by Early Bronze Age inhabitants of the Cis-Baikal and those in surrounding regions include "semi-lunar" pendants (Figure 6.13). Within the Cis-Baikal, these have been recovered from burials at Sarminskii Mys, Shamanskii Mys, and Kurma XI in the Little Sea micro-region, and at Ust'-Ida and Semenovo, on the Angara

River. These objects were made from lithic materials, and were finely polished over their entire surfaces. All featured a single perforation (often with a cross-cutting groove) near the circular edge of the pendant.

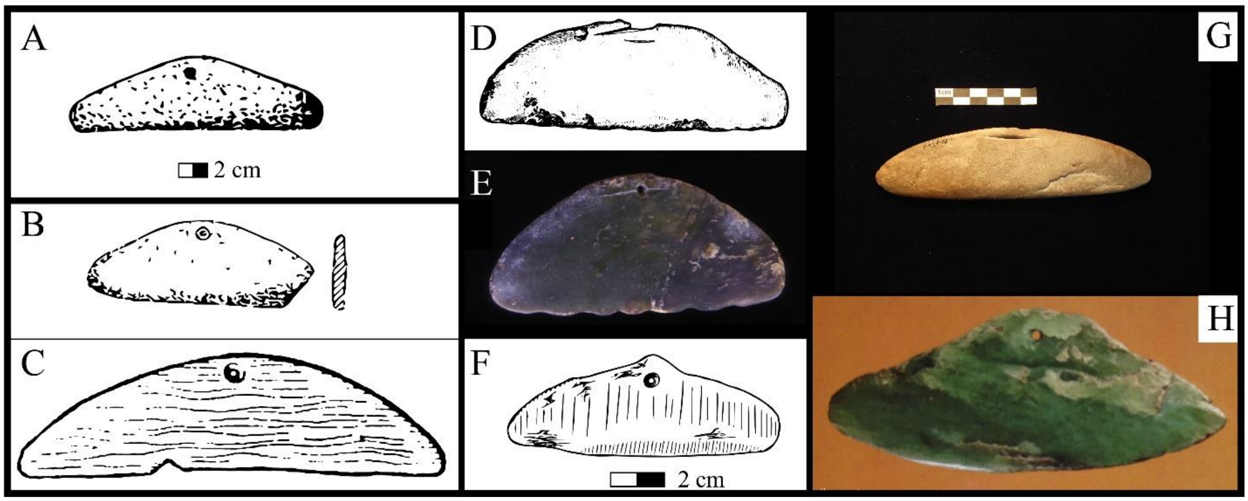

Figure 6.13. Semi-lunar pendants. Lithic semi-lunar pendants discussed in text. A. Western Siberian example from Sopka II (adapted from Khavrin 1997:157). B. Western Siberian example from Samus' (adapted from Khavrin 1997:157). C. Okunevo example from Chernoviaia VIII (adapted from Vadetskaia 1986:31). D. Semenovo (adapted from Okladnikov 1975:187). E. Kurma XI (photo by Andrzej Weber). F. Sarminskii Mys (adapted from Goriunova et al. 1998:6). G. Ust'-Ida. H. Shamanskii Mys (Okladnikov 1981:78; the length of this semi-lunar pendant is listed in the text as 13.2 cm).

Within the Cis-Baikal, semi-lunar pendants were made from a variety of lithic materials. While all Little Sea specimens were green nephrite – most likely of East Sayan or Dzhida River origin – the Angara River objects were white nephrite (Semenovo) and another, non-nephrite lithic material (Ust'-Ida). The Sarminskii Mys "semilunate" was placed near the cranium of the individual with whom it was interred, while at Ust'-Ida, a perforated semi-lunar object was located in the area of an individual's missing cranium. The Semenovo and Shamanskii Mys specimens were found near the upper bodies of the individuals with whom they were interred. The Kurma XI semi-lunar pendant was recovered on the left side of the deceased individual's waist, inside a bag made of birch bark (along with other objects, including several lithic ornaments). The positioning of the bag, however, may have been a result of disturbance, as the upper body of this individual was entirely absent from this interment (Weber et al. 2012:55).

Although very few individuals were interred with these unique objects, it is interesting to note that all three of the individuals interred with semi-lunar pendants for whom sex could be determined (all three were Little Sea individuals) were females (Goriunova et al. 1998; Konopatskii 1982; Weber et al. 2012). It is thus plausible on the basis of these limited data that at least in the Little Sea micro-region, Early Bronze Age hunter-gatherers interred semi-lunar pendants with deceased individuals to commemorate a special status unique to females. At the same time, the extremely small nature of this dataset make it impossible to draw any firm conclusions currently.

Notably, Molodin (1985:43-44) listed seven semi-lunar pendants and one additional fragment from Early Bronze Age contexts in the distant Baraba forest-steppe (Western Siberia). According to Molodin, these objects were commonly found on or near crania in burials, suggesting that they served as components of ritual headgear (Molodin 1985). Vadetskaya (1986:32, 37) described similar "lithic, moon-shaped, discs with a perforation" from multiple Okunevo burials, which she interpreted as part of a "Bronze Age ritual complex" (Figure 6.13). While these semi-lunar pendants do show some variability *even within* the Cis-Baikal, their general formal similarities and the similar contexts from which they were recovered throughout Siberia may indicate some overarching symbolic relationship (see also Goriunova and Novikov 2012:147-148; Khavrin 1997:157).

It is also interesting to note that the Shumilikha copper celt discussed above was interred on the chest of an adult female found in a double burial, containing carbonized cedar nuts (*Pinus* *sibirica*) in the hollow socket where this object would have been mounted on a handle. This arrangement implies that the celt was likely not mounted at the time of the burial, and may have instead served as a pendant. Similarly, Molodin (2014:53) describes a celt with a cavity among the "metal pendants" found in Late Krotovo (late 5th-early 4th millennia BP) burials at Tartas-1, located on the Baraba forest-steppe between the Ob' and Irtysh Rivers in Western Siberia, which may indicate common ornamental uses of metal objects as ornaments over a wide area.

At the Cis-Baikal's Shivera cemetery, a cylindrical bronze object that may have represented a snake (Khlobystin 1987:341; Okladnikov 1975:124-125) was interred on the chest of an adult individual within a double burial (Grave No. 5) that was assigned to the Shivera culture. This object featured a socketed (hollow) end as well as a perforated end in the shape of a zoomorphic face. These perforations may indicate that like the celt from Shumilikha, this object was not mounted on its socketed end at the time of the funeral ritual, and instead served as a pendant (Okladnikov 1955).

Vadetskaya (1986) showed a similar image of an almost-identical, elongated, metal, cylindrical object with a zoomorphic design in her descriptions of Okunevo cult paraphernalia, and Studzitskaia (1997:254-255) described snake-like figures in Okunevo art as well (Figure 6.14). While the relatively ornate Cis-Baikal metal objects discussed here could have been used for purposes other than those directly connoted by their forms, it appears that common uses for these objects in ritual activities existed between distant Siberian Groups during the Early Bronze Age.

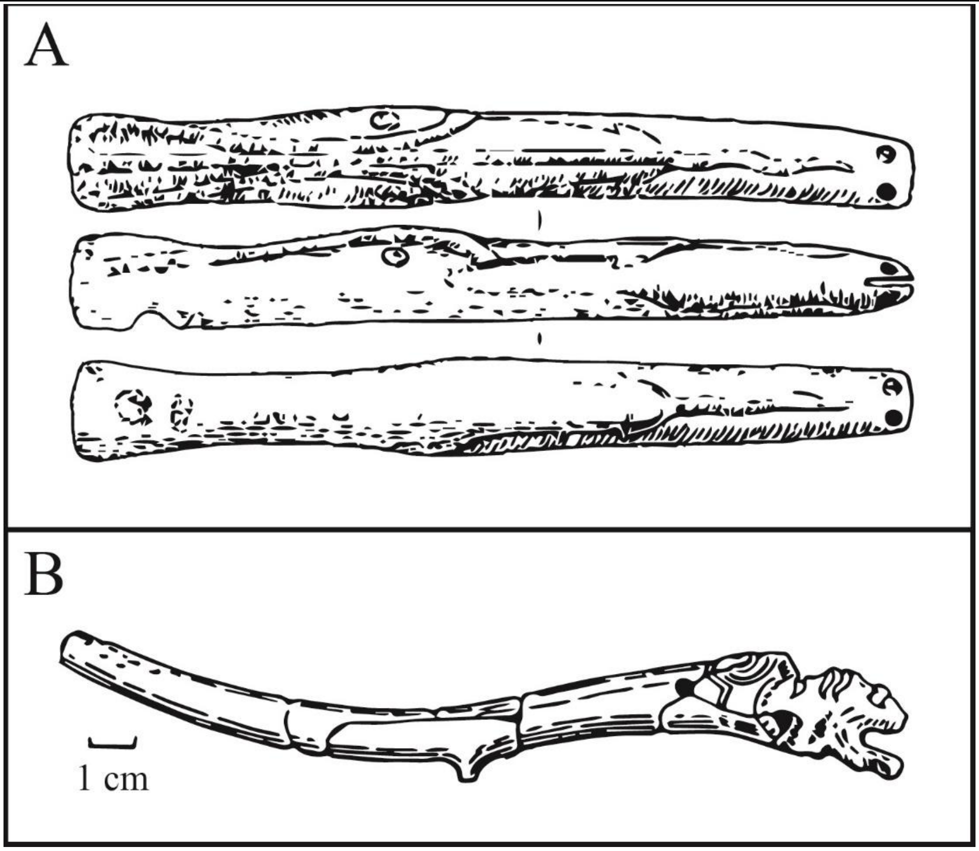

Figure 6.14. Metal zoomorphic ornaments. A. Cis-Baikal Shivera zoomorph (adapted from Okladnikov 1975:126). B. Okunevo zoomorph (adapted from Vadetskaia 1986).

Glazkovo hunter-gatherers often wore many of the ornaments discussed above as part of headgear oron "frontlets" (alternately referred to in Okladnikov 1955 as "передник" [frontlet] or "нагрудник" [breastplate]. Here I use the term "frontlet" as "breastplate" implies a single, solid "plate" covering an individual's chest, while the objects discussed here were often composites of many smaller ornamental pieces). These frontlets featured a set of ornaments – usually polished nephrite discs and rings, beads, perforated animal teeth, metal tubes and rings, and unique forms such as semi-lunar pendants and exotic metal pieces – arranged on individuals' chests. Similar arrangements appeared in numerous Glazkovo interments in all micro-regions of the Cis-Baikal. Ethnographic analogies with Tungusic groups suggest that Glazkovo hunter-gatherers may have worn this type of clothing specifically at ritual gathering events (Okladnikov 1955:149). The exclusive appearance of the ornaments that decorated these frontlets (anthropomorphic figures and other ornaments) in burial contexts also provides support for this interpretation.

It is also noteworthy that most anthropomorphic sculptures and medallions within the Cis-Baikal were found on the chest or stomach area of the deceased individuals they accompanied, suggesting that they were worn as part of this ritual garb (e.g., Drozdov 1974). In a discussion of the newly-discovered figures at Ust-Koda, Drozdov (1974:271) pointed out that the two matching anthropomorphic figures in an interment at that site were the first in the Cis-Baikal that *lacked* perforations that would have enabled individuals to use these objects as ornamental pendants. Relatedly, Drozdov also pointed out that these were the first anthropomorphic sculptures found in the Cis-Baikal that were *not* interred on the chest or stomach of the individuals they were interred with, suggesting some uncommon use. While the specific role these sculptures would have played is not clear, (Drozdov suggested that they may have been part of a "domestic shrine"), it is clear that they represent only a minority of Early Bronze Age figurines. In some cases, sculptures also featured carved areas on their chests and stomachs, which may have represented Glazkovo-style frontlets (Okladnikov 1955:288).

Not only were objects similar to the ornaments discussed above recovered in other regions surrounding the Cis-Baikal, but they often exhibited similar placement within interments, suggesting that groups in these distant regions may have engaged in common forms of ritual display. In addition to the interment at Shilkinsk Cave (discussed above), Okladnikov (1955:147-149) described the remains of a frontlet in a grave on the Ichchileekh River, a left tributary of the lower Lena, located in the Arctic Circle (Figure 6.4). The set of objects arrayed on this frontlet included distinctly Glazkovo-style mother-of-pearl beads and an identical layout to arrangements in Glazkovo interments. Also northeast of the Cis-Baikal (although much closer), Yakutian rock art on the middle Lena River often depicts anthropomorphs with parallel horizontal lines on their chests that may represent frontlets (Alekseev 1996:75).

There is also evidence that groups to the west of the Cis-Baikal used ornaments in similar ways as Cis-Baikal hunter-gatherers, both in Baraba forest-steppe burials (e.g., Molodin 1985:42) and in the Minusinsk Basin, on Okunevo anthropomorphic sculptures and stele that feature depictions of frontlets and headgear (Bobrov and German 2015; Maksimenkov 1981; Okladnikov 1955:297; 1966:135).

Shamanism and Shamanic Themes in the Early Bronze Age Cis-Baikal

The ornaments and styles discussed above are notable for their shared use in ceremonial displays as objects that decorated the human body. The common use of frontlets decorated with exotic ornaments – and particularly with anthropomorphic figurines – in ritual contexts throughout prehistoric Siberia is interesting in light of ethnographic data. Similar practices have also been documented ethnographically among a number of Siberian populations. For example, in their discussion of Yakut groups inhabiting the middle Lena River (northeast of Lake Baikal) during the 20th century, Tokarev and Gurvich (1964:278) described shamans wearing elaborate ritual constumes, including an *emeget*, a flat copper effigy representing an ancestral shamanic figure. Similarly, Okladnikov (1955:304) related Cis-Baikal anthropomorphic sculptures to idols that Anisimov (1940) documented among northern Yeniseian Evenk groups in his ethnographic work on the Podkammennaia Tunguska River. These northern Evenk groups used similar figurines in order to contain the spirits of ancestral members of patrilineal kin groups.

Turov (1974) described other metal figurines that historic southern Evenk groups (occupying the area between the Angara and Yenisei Rivers) used for similar purposes, also embedded in a kinship-oriented ideology (see also Drozdov 1974:231 for discussion of figurines depicting ancestral spirits among Evenk, Yakut, and Buryat groups). Among these southern groups of Evenk hunter-gatherers, families maintained claims on clearly-delineated territories, and avoided entering territories belonging to non-kin due to the threat of physical and spiritual violence (Turov 1974). Evenk ancestral spirits – as represented by metal figurines (Figure 6.5), played an important role in this cosmological system, serving as protectors of the territories that their surviving kin used in the seasonal round. It is interesting to note that both the stylized facial attributes and overall forms of historic Evenk figurines – as well as practices surrounding their frequent pairing on ritual clothing (Figure 6.15; e.g., Okladnikov 1955:305), and storage in bags made of elk hide (Turov 1974) – exhibit similarities to Early Bronze Age examples from the Cis-Baikal.

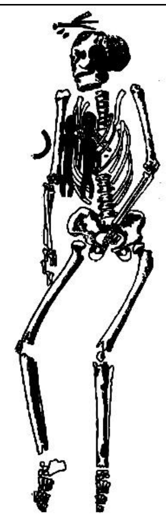

Figure 6.15. Glazkovo burial from Ust'-Uda cemetery (adapted from Okladnikov 1955:352).

Similarly, Anuchin (1914) observed Ket shamans wearing frontlets that featured anthropomorphic figures, and suggested that these represented heroic shamanic ancestors. Among the Ket, some individuals were believed to inherit a "shaman's gift" (*qut*; also the word for a shaman's song) through their lineages (Vajda 2010). Like the Evenk example above, *qut* were conceptualized as anthropomorphic spirits, and individuals who received the gift gained access to spirit helpers known as "sky people" (*esdeng*; Vajda 2010:133; see also Jordan 2001; Price 2001). Vajda (2010:135) listed several objects that a shaman received during the many stages of their training, including a pendant worn on the chest, and metal (iron) pendants used to symbolize access to additional spiritual helpers. During shamanic rituals Ket shamans wore these pendants on their coats.

Although Vajda (2010:140) suggested that "elaborate social forms of shamanism" relate to the arrival of "steppe peoples" on the Yenisei during the Iron Age, recent and well dated-finds at Kurma XI and Ust'-Kova (as well as materials from older excavations at Uliarba, potentially) suggest that certain elements of Siberian shamanism may exhibit considerable longevity in Siberia, both in the Cis-Baikal and elsewhere. Anthropomorphic figurines became common on other (nonmetal) media during the Early Bronze Age as well, and appear to have been used for similar purposes, in similar contexts to metal ones. Notably, Cis-Baikal variants of anthropomorphic themes and their use as pendants and medallions do not appear to significantly postdate their initial development elsewhere in the steppe and forest-steppe, suggesting a broadly contemporaneous development there.

Within the Cis-Baikal, I suggest that the fluorescence of anthropomorphic sculpture in ritualized forms of display such as burials may reflect novel ideological conventions that emerged in the fifth millennium BP, and that development was intimately connected to aggregation events featuring inter-group gatherings. As discussed above, during this period, local groups appear to have increasingly turned from relatively inclusive political strategies that existed during the Late Neolithic to relatively exclusionary ones that relied on competition over access to long-distance networks and exotic wealth (Shepard 2012). The use of these anthropomorphic figures as markers of exclusive ancestral claims, as seen among historically-documented groups, corresponds well with dual-processual models that posit the use of patrimonial rhetoric in contexts featuring intensified network political economic strategies (Blanton et al. 1996; Dalton 1997:194). Just as the rules surrounding inheritance of kin-guardian figurines (and the social roles these objects represented) were instrumental in determining authority among historic southern Evenk groups (Anisimov 1940; Okladnikov 1955:304), anthropomorphic sculptures in the Early Bronze Age Cis-Baikal may also have represented one means by which aspiring elites asserted claims on ancestral roles and privileges at large public display events.

Vajda (2010) also listed other forms of regalia that Ket shamans used, including bearskin, bear paws, and bones of bears (bear shamans and *kandelok* shamans), and iron depictions of eagle claws (eagle shamans). Objects similar to these (although not made from iron) have been recovered from Early Bronze Age contexts in the Cis-Baikal, where they appear to have served as part of the frontlets that became common during the period. Some (e.g., Devlet 2001:50-51) even go so far as to suggest that a highly decorated "jacket" in the context of rock art or human burials may serve as an indication that the depicted or interred individual was a shaman or some other form of ritual participant. Although I view this and other blanket claims of Bronze Age Siberian shamanism somewhat skeptically (e.g., Aseev 2007; see Shepard 2012:375), I note that several Glazkovo graves featured multiple exotic and ornamental "shamanic" objects in association with single individuals.

I suggest that these unique cases represent relatively strong candidates for Early Bronze Age shamans. Below, I discuss several of these cases from the Little Sea micro-region in order to illustrate a possible Cis-Baikal variant of a phenomenon that appears to have taken on macro-regional significance during this period. In particular, I focus on individuals interred with exotic ornaments (medallions, semi-lunar pendants) and anthropomorphic figurines. I also describe other, more ubiquitous ornamental objects associated with these individuals, as well as relatively uncommon grave goods – in particular, unmodified faunal elements.

The isolated interment in the northern sector of Khuzhir-Nuge XIV (Grave No. 2, see above) featured a talon from a Eurasian eagle-owl (*Bubo bubo*), bear (and musk deer) teeth, as well as fragments of mandibles from a beaver and two foxes (Weber et al. 2008b:38-41). While these objects were located near the interred individual's tibia, the collapsed cairn and the absence of most of the axial skeleton (ribs, sternum, vertebrae) and pelvis indicate that post-depositional looting may have occurred there (Weber et al. 2008b:39-40). As noted above, this individual was also interred in an isolated area of the site.

The isolated Early Bronze Age grave (No. 19) at Uliarba featured a similar set of faunal elements and ornaments, including rabbit paws, two bear molar fragments, white nephrite discs and rings, as well as over a dozen pendants made from perforated deer teeth (Goriunova et al. 2004). This individual was also associated with the arc-shaped metal fragments discussed above that may have been part of a metal anthropomorphic figurine like the one found with the young adult male interred at Kurma XI, Grave No. 1. Again, the concave shape of the stones in the cairn of this grave, as well as the absence of a cranium and much of the axial skeleton make it difficult to evaluate the initial position of grave goods (Goriunova et al. 2004:29). The presence of several objects in the fill of the grave pit (rather than in direct association with the interred individual) further support the interpretation that either post-depositional looting or rodent burrowing may have affected the layout of objects in this feature.

Grave No. 1 at Kurma XI featured another individual interred with a number of interesting faunal elements and ornaments (Weber et al. 2012). These included a beaver mandible and 35 deer tooth pendants arrayed around the cranium, as well as a white nephrite ring (found in the right orbit, presumed to have been part of a piece of headgear), and the metal medallion discussed above (located on the individual's sternum). Although this grave was not isolated like the two discussed above (Khuzhir-Nuge XIV, Grave No. 2; Uliarba, Grave No. 19), it is interesting to note that this grave was located at the extreme southwest edge of Kurma XI, along with two other relatively isolated graves (Nos. 2 and 12; Figure 4.26). Of these two nearby features, Grave No. 2 contained no human remains, and only a single fragment of a lithic (non-nephrite) disc. Grave No. 12, however, contained the remains of an unsexed adult (age 20+ at death) who was associated with a green nephrite semi-lunar pendant (above). Other notable grave goods in Grave No. 12 included a nephrite ring, hare paws, a fragment of a sable mandible, lithic discs, and a metal tube that was presumably used as an ornament, as well as talc fishhook shank with an anthropomorphic design (Weber et al. 2008b). Again, this interment lacked most of the axial skeleton and featured a ring-shaped cairn, indicating possible post-depositional disturbance. Perhaps as a consequence of this disturbance, most grave goods were concentrated to the left of the area where the (absent) pelvis would have been located (Figure 6.16).

Figure 6.16. Kurma XI, Grave No. 12 (photos by Andrzej Weber).

Another isolated grave, this one from Shamanskii Mys (1972 excavations, Grave No. 1; Figure 4.27) featured the highly disturbed skeleton of an adult female (age 20-40 at death) who was interred with unique grave goods that exhibit a connection to Bronze Age styles discussed above. This individual was associated with a semi-lunar pendant, as well as a rodent mandible, several nephrite discs, and deer teeth pendants. The upper body of this individual was highly disturbed (Figure 6.17) and the cairn featured a large open ring, from which three nephrite discs were recovered, indicating post-depositional disturbance of some sort (Konopatskii 1982).

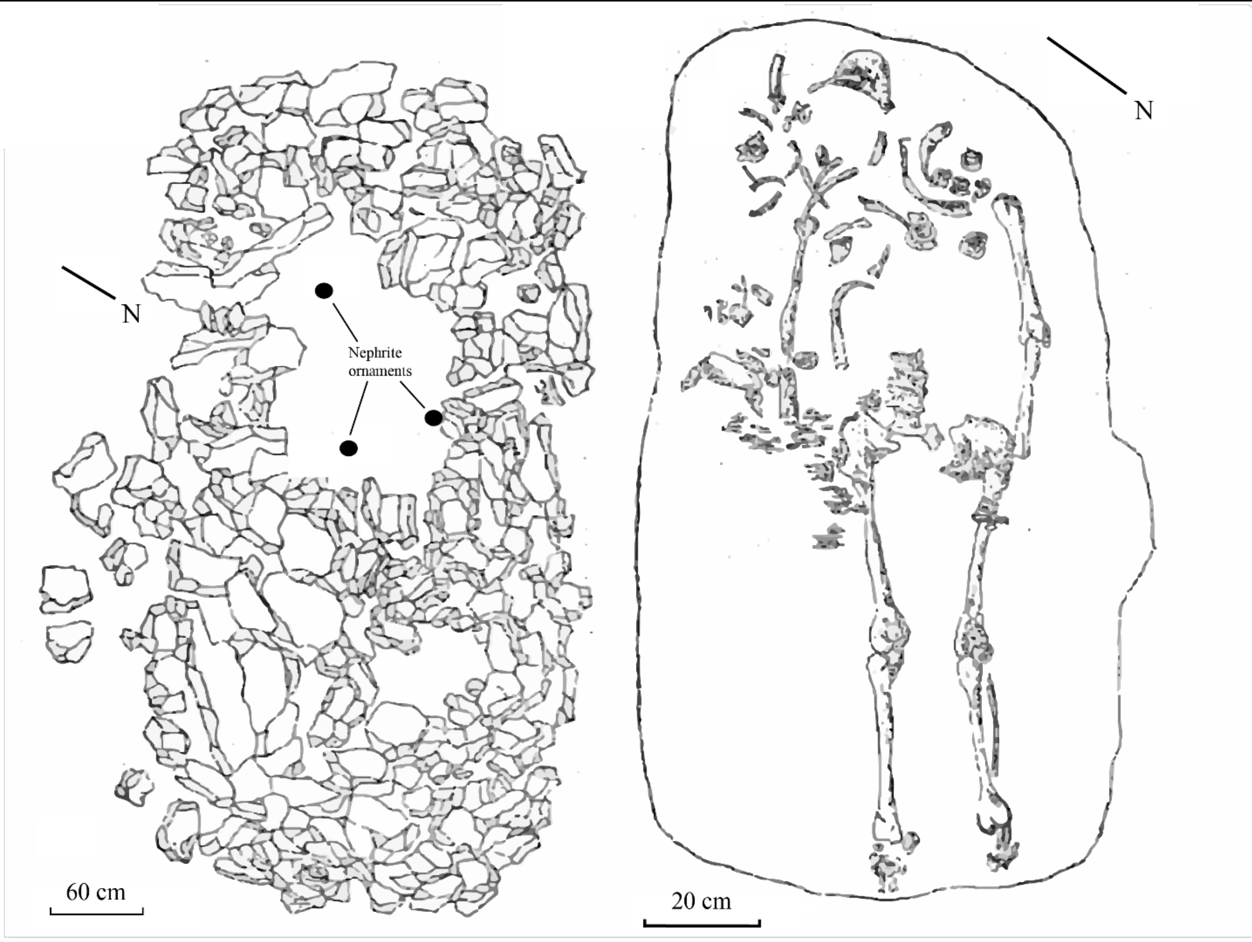

Figure 6.17. Shamanskii Mys, 1972 excavations, Grave No. 1.
Left. Surface of feature. 1. White nephrite ornaments. Right. Feature's interior (adapted from Konopatskii 1982).

While strontium isotopic ratio values are not available from the individuals interred in Grave No. 12 at Kurma XI, Grave No. 1 (1972 excavation) at Shamanskii Mys, or Grave No. 19 at Uliarba (and are not likely to be, as no crania or mandibles were recovered from these disturbed graves [Goriunova et al. 2004; Konopatskii 1982]), data on the isolated grave at Khuzhir-Nuge XIV (Grave No. 2) and the individual interred in Grave No. 1 from Kurma XI both suggest non-local early life-histories (Appendix 7).

At Kurma XI (Grave No. 10), another unique individual designated as a probable male (age 18-25 at death) exhibited similarities to those discussed above. Objects that this interment had in common with others discussed above included a fragment of a sable mandible, three owl claws, a phalanx from a prey bird, fragments from a metal knife, six lithic ornamental discs, and a fragment of a fox mandible (Weber et al. 2012). Most of these objects were concentrated in a cluster near the cranium, although several discs were found directly on the cranium, and appear to have been mounted on some form of headgear (Figure 6.18). This male individual exhibited an M1 $^{87}Sr/^{86}Sr$ value that fell within the "local" range (Appendix 7), and was interred in the site's central cluster. While M2 and M3 values were not available for this individual, it appears likely that he spent the early portion of his life within the Little Sea micro-region.

Figure 6.18. Kurma XI, Grave No. 10 (Photo by Andrzej Weber).

An older adult female at Sarminskii Mys also was associated with relatively unique grave goods comparable to those discussed above. These included a nephrite semi-lunar pendant (Grave No. 12), as well as multiple intricately-made fish lures, unmodified bird bones, a northern pike (*Esox lucius*) mandible, and a fragment of a bronze knife (Goriunova et al. 1998). Although no explicit references to the placement of these objects were available, Goriunova et al. (1998, adapted here as Figure 6.19) provided a figure indicating that animal tooth pendants were concentrated near the individual's pelvis or wrists, while other grave goods were located to the left of the cranium. This interment was located near the main cluster of Late Neolithic graves at the site, as well as another grave that dated to the Early Bronze Age (Grave No. 13, which was relatively "poor" in terms of grave goods, featuring a nephrite knife and bone point [Goriunova et al. 1998]). Only M2 $^{87}Sr/^{86}Sr$ values were available for this individual (Sarminskii Mys, Grave No. 12), and they suggest that she spent her late childhood in the local area (Appendix 7).

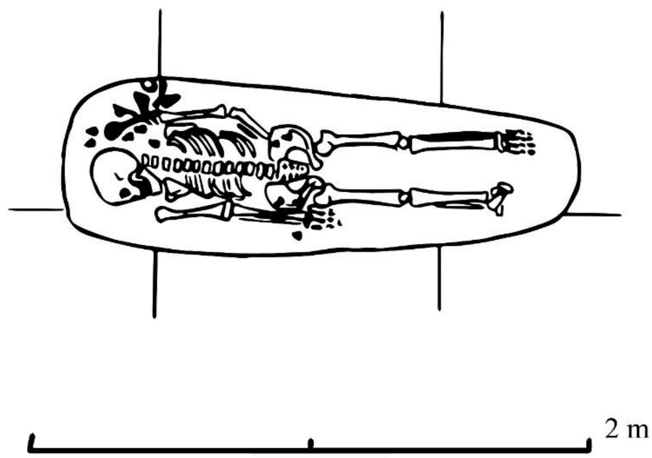

Figure 6.19. Sarminskii Mys, Grave No. 12 (adapted from Goriunova et al. 1998).

Overall, several factors stand out about these potential "shamanic" burials from the Cis-Baikal's Little Sea micro-region. First, most were located in at least relatively isolated areas of their respective cemeteries. Two exceptions to this pattern – Grave No. 12 at Sarminskii Mys and Grave No. 10 at Kurma XI – both exhibited "local" $^{87}Sr/^{86}Sr$ values for available M1 and M2 samples, which may provide an explanation for their inclusion in these cemeteries' main clusters. It is also of interest that the majority of these interments featured considerable post-depositional disturbance in the form of either scattering or actual removal of upper body elements including crania.

In a study of grave disturbance at Khuzhir-Nuge XIV, Robertson et al. (2008) found that 40.3% of graves at that site could be conclusively categorized as “disturbed.” This disturbance appeared to have been the result of deliberate human action focused on removing skulls and upper bodies of interred individuals (Robertson et al. 2008:310). Notably, Robertson et al. (2008) suggested on the basis of ethnographic data on shamanism among Sel’kup groups in the Krasnoyarsk Krai (Western Siberia) that these practices may have parallels in historic practices that dictated special treatments for skulls of shamans (Zaitseva 1996). Unfortunately, this disturbance made it impossible in almost all cases discussed above to assess the use of “frontlet” arrangements. However, the *disposal* of these distinctive, ornamental objects – which appear to have had analogues throughout the macro-region – may support an argument that the individuals associated with these objects enjoyed some form of special status.

Mechanisms for Early Bronze Age Macro-Regional Interaction

Overall, several lines of material culture evidence thus suggest that macro-regional connections linked the Cis-Baikal’s Early Bronze Age Glazkovo culture to groups inhabiting neighboring regions during this period. First, a number of diagnostically Glazkovo styles and artifact forms appear in relatively low quantities in regions outside the Cis-Baikal. These include nephrite and mother-of-pearl beads and other ornaments, as well as bone, ivory, and antler anthropomorphic figures. In addition, artifacts such as a copper celt at the Shumilikha cemetery, a bronze tube with a snake design from the Shivera cemetery, and circular bronze pendants featuring anthropomorphic designs, all exhibit similarities to forms found throughout the broader macro-region (also in small quantities). Other aspects of the Cis-Baikal's Early Bronze Age archaeological record, including common imagery and the layout of objects in burials (e.g., on frontlets and headgear) seem to have external analogues in practices that developed throughout the steppe and forest-steppe during the Bronze Age as well.

In light of the apparent similarities of some social institutions that existed among Cis-Baikal hunter-gatherers and inhabitants of other regions of Siberia, below I discuss mechanisms that may have facilitated their spread. It should be noted that what follows is only a preliminary assessment of such mechanisms and that much future work will be required to examine these ideas further.

Frequent (e.g., seasonal) aggregations likely characterized Holocene hunter-gatherers' mobility practices in the Cis-Baikal, and would have produced contexts where individuals could interact beyond the scale of the immediate kin group. Within the Cis-Baikal, aggregation events likely took place in seasonally productive areas capable of supporting relatively large groups for multiple weeks. Weber et al. (2011; see also Scharlotta and Weber 2014) raised the possibility that spring sealing activities served as an impetus for seasonal aggregations in the Little Sea micro-region, for example, and suggested that individuals from outside the micro-region (the upper Lena Valley) may have attended these events. Losey et al. (2012) discuss micro-regional variation in the productivity of subsistence resources throughout the Cis-Baikal, and emphasize the greater potential for aquatic surplus production in the Angara River Valley. This micro-region featured dense seasonal concentrations of easily-harvestable freshwater fish, which likely also enabled seasonal aggregation events. However, it is difficult to assess direct evidence of aggregation events on the basis of current settlement data, as habitation sites have received considerably less attention than cemeteries in Cis-Baikal archaeology (but see Losey et al. 2012; Nomokonova et al. 2015).

The presence of large clusters of cemeteries, particularly in the Cis-Baikal's most productive areas, does suggest at least some form of population aggregations at funeral rituals. Although it is not clear from direct evidence whether these events drew attendees from the micro-regional scale or from the wider Cis-Baikal region, cross-culturally, funerals and other life-cycle events commonly serve integrative roles beyond the immediate family level in small- and intermediate-scale societies, enabling face-to-face interaction between unfamiliar or only distantly-related attendees (e.g., Hayden 2009). Strontium isotopic data from human tooth enamel clearly indicate that some individuals interred in the Little Sea micro-region and upper Lena River valley were born outside these areas, raising the possibility that funerals may have been attended not only by "locals," but also by non-local groups with affinal ties to surviving community members. In this sense, funeral events would also have served as effective contexts for political aggrandizement among the Cis-Baikal's hunter-gatherer groups, especially during the Early Bronze Age, when Cis-Baikal hunter-gatherers appear to have adopted political strategies emphasizing membership in long-distance networks and exclusive access to supra-local styles (Shepard 2012). As such, participation in ritual events such as funerals may have gained new value during the Early Bronze Age, due to political and "networking" opportunities participants enjoyed.

Martindale (2009) has described a similar case among the Northern Tsimshian, as people ascribed objects meaning based on their association with Europeans. Despite the value of European goods as symbols of access to distant and increasingly crucial trade networks (see also Gijanto 2011:645 for a similar discussion of West African cases). Northern Tsimshian individuals could only obtain trade goods by offering furs, access to which could only be reliably controlled through the redistribution of surplus subsistence resources at ceremonial events. Thus, the frequency of redistributive ceremonies increased dramatically among the Northern Tsimshian during this period, as aspiring leaders strategically employed these events to turn subsistence resources into access to wealth, which they parlayed into social status through control of European exchange and display of exotic trade goods (Martindale 2009:69). In this sense, changing frequencies of ceremonial events may provide information on the political and economic strategies that underlay these events, rather than accurately reflecting demographic patterns (Shepard 2012).

Similarly, in his discussion of political economic organization among the late precontact and early postcontact Creek peoples in the southeastern United States, Wesson (2008:152) has described a process through which European trade goods took on considerable importance in Creek social life for their prestige value, although not necessarily for their functional superiority. During the Early Bronze Age, Cis-Baikal hunter-gatherers may have had similar opportunities to obtain exotic and circumscribed goods, enabling them to assert personal connections to distant groups and to cultivate prestige that these long-distance ties represented for local followers. Elsewhere I have suggested that these opportunities may have been available particularly during the Early Bronze Age, as groups in nearby regions of Siberia began engaging in novel subsistence, mobility, and production techniques (Shepard 2012). Funerals during this period may have simultaneously served as opportunities to secure access to "trade goods" through competition and reproduction of long-distance network access while also allowing participants to *display* these labor-intensive and exotic goods, thus translating them into social capital (Hayden 1998). Again, I stress that this sort of use of funeral ritual does not seem to have operated during the Late Neolithic, which featured different political motivations and accompanying aesthetics.

In this sense, I suggest that funerals are implicated in a process of "entanglement" (Thomas 1991), and that archaeologists must be careful when attempting to treat all funeral activities as if they played identical roles in their respective social contexts. In the Cis-Baikal, funerals – which in some micro-regions may have increased in frequency in the Early Bronze Age relative to the previous Late Neolithic period (Weber and Bettinger 2010) – are best viewed not as a reflection of underlying cultural adaptations, but instead as a practice that individuals increasingly used in order to create contexts for political aggrandizement (Shepard 2013, *sensu* Pauketat 2007:76). This political aggrandizement – in addition to novel mobility practices seen among incipient mobile pastoralists – may have played an important role in the macro-regional spread of Bronze Age social institutions. In this sense, it is noteworthy that this shift from relatively *localized* political support networks during the Late Neolithic to an increasingly *supra-local* system during the Early Bronze Age that featured increased competition over access to long-distance connections was accompanied by a macro-regional spread of common styles and forms.

Interestingly, in the nearby Minusinsk Basin, archaeologists have recovered no burials dating to the Neolithic (Svyatko et al. 2009), suggesting that funeral ritual activities – or at least those that left visible archaeological traces – subsequently increased considerably. While numerous graves have been associated with the area's "Eneolithic" Afanas'evo culture, Svyatko et al. (2009:249) noted that only a single burial was believed to date to the Neolithic (from the Bateni site). Recent radiocarbon dates suggest an Okunevo age for this individual as well, however, further highlighting the shift that took place in the region at the beginning of the third millennium BC. Although it is entirely possible that the Late Neolithic-Early Bronze Age transition reflects entirely different political economic underpinnings in the Cis-Baikal and the middle Yenisei region, I suggest that funerals in both areas may have enabled actors to pursue similar strategies involving the cultivation of status through long-distance connections, display of exotic wealth, and maintenance of so-called patrimonial rhetoric.

The distances that Siberian groups either exchanged or transported raw materials in order to produce these exotic and labor-intensive styles and forms during the Early Bronze Age may also have rendered these objects especially conducive to high valuation and cult status (Chapter Five; e.g., Blanton et al. 1996; Helms 1992). The consistent and exclusive appearance of exotics such as white nephrite rings and discs in Early Bronze Age ritual display contexts certainly supports this interpretation, as does the relatively formalized use of these objects on specific parts of the body. In this sense, it is quite possible that material flows from external territories into the Cis-Baikal played an important role in Early Bronze Age competition among aspiring elites at ritual aggregation events.

Limited evidence does suggest that Early Bronze Age groups held feasts in spaces associated with funeral rituals in particular. Some cemeteries from this period featured fragments of ceramic vessels scattered around the perimeters of grave pits, which may represent taphonomic processes acting on feasting debris (Goriunova et al. 2010a). Some graves also contain ash lenses or hearth features that may have resulted from cooking activities. One notable example in this regard is Shamanskii Mys, a cemetery on the northwest coast of Ol'khon Island in the Little Sea micro-region. Shamanskii Mys is located on a narrow peninsula featuring a large rock protrusion that would have been easily visible from afar (Figure 4.27). The high visibility of Shamanskii Mys, along with the relative difficulty of accessing the promontory on which the site is located, make it an ideal and highly unique location for ritual feasting activities (Hayden 2001).

The site featured an unusually large assemblage of seal carcasses scattered near grave features (Konopatskii 1982). Several Early Bronze Age graves and nearby hearths at Shamanskii

Mys contained seal remains, ceramic fragments, and other objects (Konopatskii 1982:31), and small pits at the site also contained entire seal skeletons. Konopatskii (1982:84) argued that faunal evidence from this site represented evidence of seal-hunting rites and associated feasts. It is also noteworthy that seal remains at Shamanskii Mys disproportionately belonged to the "newborn" category, unlike at contemporaneous habitation sites that contained mostly remains of older subadults and adults (Nomokonova et al. 2013; Weber et al. 1998). Weber et al. (1998) demonstrated that Late Neolithic, and, to a greater extent, Early Bronze Age groups, transported seal pup carcasses to Shamanskii Mys from the opposite (southeast) coast of the Ol'khon Island, providing further support for the site's special, ritually charged role. It is also noteworthy that the special transport of seal pup carcasses to Shamanskii Mys took place specifically during the spring (Weber et al. 1998), indicating that Cis-Baikal hunter-gatherers used the site seasonally to consume special food resources.

A mixture of graves dating to the Early Neolithic, as well as the Late Neolithic and Early Bronze Age suggest that among Cis-Baikal hunter-gatherer groups, the tradition of using Shamanskii Mys for ritual activities had deep roots by the Early Bronze Age. During this period, interments at this site featured especially large quantities of exotic grave goods relative to those at surrounding cemeteries, hinting at the special nature of rituals conducted there (Shepard 2012). While it is not clear to what extent ritual aggregations associated with seal-hunting activities in the Little Sea micro-region attracted participants from outside the Cis-Baikal, isotopic studies do suggest that at least during the Early Bronze Age, some hunter-gatherers from outside the micro-region may have attended seal-hunts (see above), and ritual features at Shamanskii Mys provide evidence for a potential aggregation venue.

Throughout Siberia, rock art panels may also have marked locales where ritualized aggregations occurred both prior to and during the Early Bronze Age. For example, cliff drawings at Suruktaakh-khaya, located on the Markha River in Yakutia, exhibited evidence of repeated use and ritualized activity in the form of repeated "offerings" of lithic artifacts (Okladnikov 1970:92-98). Rock art images on a cliff wall at the site included anthropomorphic and zoomorphic figures, and were associated with several layers of cultural deposits. The lowest layer included projectile points made from a non-local lithic material that were fully intact, as well as other lithics and Glazkovo-style mother-of-pearl beads (Okladnikov 1970:92-94). Okladnikov (1970:98) suggested that Suruktaakh-khaya and other similar examples of Siberian rock art may have served as "clan shrines" where hunter-gatherer groups conducted rituals during seasonal aggregations, not unlike those documented ethnographically among Siberian groups (e.g., Tokarev and Gurvich 1964:280).

Similar rock art depictions appear in all micro-regions of the Cis-Baikal as well (e.g., at Sagan-Zaba Bay, Shishkino, Mal'ta, in the Little Sea, the upper Lena, and Angara River Valleys, respectively), and may represent shamans and shamanic activities that appear to have become widespread during the Bronze Age throughout much of Siberia (see also Goriunova and Weber 2003; Okladnikov 1966; Studzitskaia 1987b, Tsybiktarov 2006). For example, the Glazkovo cultural layer associated with anthropomorphic cliff art at Shishkino contained a large concentration of faunal bone and an Early Bronze Age ceramic vessel (also decorated with anthropomorphic figures). Khlobystin (1987:332) interpreted this as evidence of ritual activity associated with the rock art at the site. It should be noted, however, that ages of rock art inscriptions themselves were determined typologically, and must thus be treated cautiously.

In his discussion of the forest-steppe of the Krasnoyarsk krai (an administrative unit within the Russian Federation that overlaps roughly with the Yenisei River Valley), Makarov (2005:166-

168) argued that although this region's material culture differs in important ways from the material culture of the Early Bronze Age Cis-Baikal:

> the territorial borders of Early Bronze Age culture envelop the entire area of the Krasnoyarsk forest-steppe and sub-taiga areas. In the north and north-east, [Early Bronze Age culture] comes into contact with the practically unstudied contemporaneous cultures from Taiga areas of the middle Yenisei and lower Angara, and in the south, [it comes into contact with] Afanas'evo, Okunevo, and Andronovo cultures that developed one after another in the Minusinsk Basin (Makarov 2005:166-167).

At the same time, Makarov observed that "anthropological data [osteological studies] indicate the proximity of the Neolithic population of the Middle Yenisei to the mongoloid type found in the Cis-Baikal" (Makarov 2005:168, cites Alekseev 1961, 1963). In her discussion of lower Angara rock art styles, Zaika (2012) notes similarities between petroglyphs in this area and those of the Minusinsk Basin's Okunevo groups, suggesting that the lower Angara may have served as an important transitional zone between Early Bronze Age groups beyond the boundaries of the Cis-Baikal. The similarity of archaeological materials found at Ust'-Kova – located to the east of the middle Yenisei River, on the lower Angara – appear to support this view of a relatively continuous Bronze Age cultural sphere that extended beyond the boundaries of the Yenisei Valley.

Others (e.g., Formozov 1969; Okladnikov 1959; Studzitskaia 1997) have observed specific similarities between what they described as "cosmological themes" depicted in rock art within the

Cis-Baikal and on various media by Okunevo groups in the Yenisei River Valley. According to these authors, Okunevo rock art often featured scenes in which a creature with a combination of attributes resembling a bear, wolf, bird, and serpent pursued the sun in what they referred to as a "cosmic hunt" (Figure 6.20; e.g., Ernits 2010; Okladnikov 1959; Studzitskaia 1997). Studzitskaia (1997:251-253) described this scene as the "calling card" of the Okunevo culture (she reported that more than 20 depictions of this scene had been found in Okunevo contexts as of 1997, on stone slabs, petroglyphs, stele, and sculptures). Ernits (2010) also viewed Okunevo rock art as unambiguous depictions of a cosmic hunt motif that was common throughout Siberia during this period. This theme was also common among indigenous Siberian groups during the historic period (Okladnikov 1950, 1959).

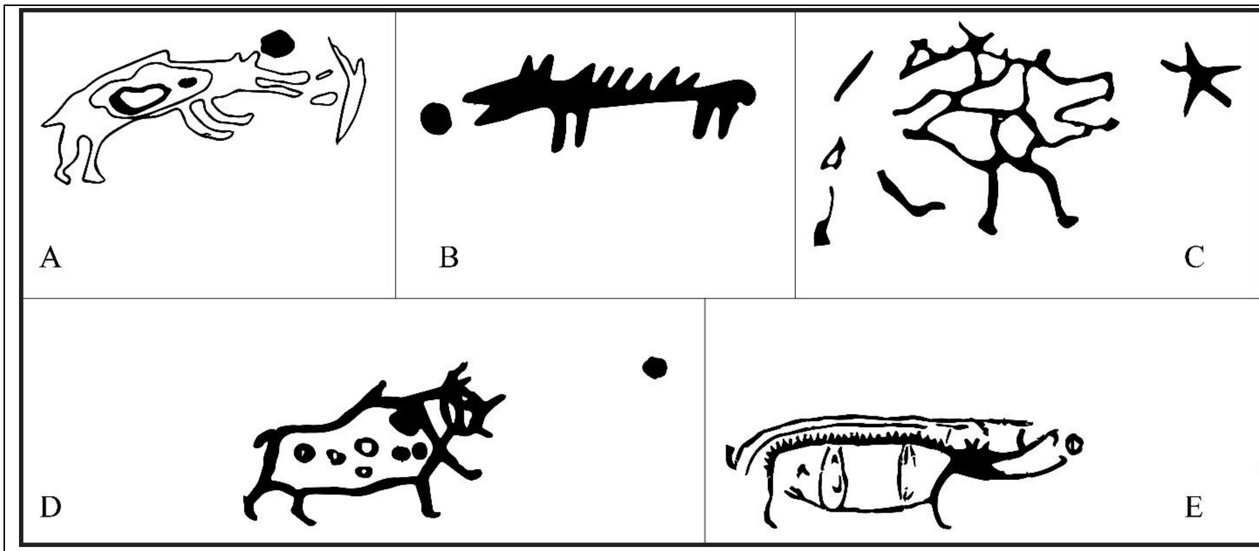

Figure 6.20. Cosmic hunt imagery from throughout Siberia. A. "Sun eater" from Tom, West Siberia (adapted from Ernits 2010). B. "Sun eater" from Arbi(adapted from Ernits 2010). C. Okunevo depiction at Kantegir I (adapted from Studzitskaia 1997:259). D. Okunevo depiction at Shalabolino (adapted from Studzitskaia 1997:259). E. Glazkovo depiction at Shishkino (adapted from Studzitskaia 1997:262).

Like West Siberian (Okunevo) “cosmic hunt” depictions, Cis-Baikal rock art also featured similar fantastical creatures, although the style in which they were depicted may have differed somewhat from archetypal Okunevo representations (Studzitskaia 1997:258). For example, the profile view of an open-mouthed creature in the Shishkino petroglyphs appears similar to Okunevo depictions at Chernovaia VIII, Shalabolinsk, and Arbi (Studzitskaia 1997), and may have been depicted pursuing a similar circular object, located directly in front of its face. These similarities suggested to Studzitskaia that some contact must have existed between Bronze Age inhabitants of the Cis-Baikal and Okunevo groups. Notably, Formozov (1969; see also Okladnikov 1966) also saw similarities between creatures depicted at Shishkino, on the upper Lena River, and those of seen in Okunevo art – especially in terms of the “skeletal” (cross-hatched) styles of their bodies.

In addition to petroglyphs as potential aggregation sites that may have at least occasionally featured inter-ethnic interactions, Siberian groups during later phases of the Bronze Age also appear to have constructed “fortified shrines” called Sves, both in the Minusinsk Basin and the Cis-Baikal (e.g., Gotlib 1997; Kharinskii et al. 2009). The first archaeological excavations at Sve sites took place in the 1980s around the Minusinsk Basin (Leont’ev 1986), and ceramic finds demonstrated that they dated to the Okunevo period (and the subsequent Karasuk period, in many cases). These structures featured walls made from stacked stone slabs (without any binding matrix) and were situated on hilltops. While the consistent placement of these walled sites on or near the top of hills suggests that they may have served as fortifications, there is some reason to interpret them also as ritual centers where periodic aggregations may have taken place.

The Chebaki Sve, near the Chernyi Iyus River (a left tributary of the Chulym River; see Figure 6.6), featured large concentrations of pottery – over 35 Okunevo vessels in total – and 12.5 thousand fragments of animal bone (Gotlib 1997:143). Notably, of the 1204 faunal elements that could be identified, a full 85% belonged to wild fauna (Gotlib 1997:145). Chebaki also featured several artifacts that are not usually associated with Okunevo material culture. These include pendants made from exotic lithic materials and eight elongated lithic points that were unique for the Minusinsk region, but resembled lithics found in Early Bronze Age contexts within the Cis-Baikal (Gotlib 1997:144, 2008:61). The large concentration of faunal bones, ceramics, and objects likely involved in ritual display (and rarely found in domestic contexts), as well as the presence of seemingly non-local (and possibly even Early Bronze Age Cis-Baikal) material culture, provide at least limited support for an interpretation of this site as a ritual aggregation center.

Within the Cis-Baikal, Sves (locally known as Shibete [шибэтэ]) have also been documented, though their study remains extremely preliminary in this region (Kharinskii 2007). While these sites appear to postdate the Early Bronze Age Glazkovo phenomenon, Emel'yanova and Kharinskii (2008) emphasize the long-standing ritual traditions that may have existed at specific locales where Cis-Baikal groups eventually constructed sves. For example, Baikal'skoye III, which was located atop a cliff overlooking the northern shore of Lake Baikal, contained a "walled shrine" (sve) dating to the Late Bronze Age, as well as six semi-subterranean pithouses from an earlier occupation. These structures are the only published example of this type of architecture in the Cis-Baikal (see also Tetenkin 2007:16-17).

Only one pithouse structure at Baikal'skoye III has been excavated, and radiocarbon dates (from charcoal and undefined faunal bone) from the basal level corresponded to the mid-seventh to early sixth millennia cal BP (Middle and Late Neolithic; Emel'yanova and Kharinskii 2008:159). Emel'yanova and Kharinskii (2008:162) propose that at this site and others within the Cis-Baikal, sve constructions may represent a Late Bronze Age continuation of the long-standing practice of ritualized gatherings near rock art panels situated on high cliff walls, and at the

Neolithic and Early Bronze Age cemeteries often situated atop those cliffs. It is also noteworthy that at Krasnyi Yar, approximately two km north of Baikal'skoye III, human burials produced radiocarbon dates in the Early Bronze Age, as well as diagnostically Glazkovo copper and nephrite artifacts (Kharinskii et al. 2009:124), further supporting an argument for the longstanding ritual significance of this locale prior to the Late Bronze Age construction of a sve there.

Conclusions

While some of the existing English literature on the Cis-Baikal Early Bronze Age has tended to frame the region and its hunter-gatherer inhabitants as largely isolated from macro-regional historic processes, evidence for interconnections at the macro-regional level appears relatively strong. Hunter-gatherer groups in the Early Bronze Age Cis-Baikal show ties to contemporary "steppe cultures" of the Minusinsk Basin, Eastern Trans-Baikal, and Yakutia, as well as more distant areas (e.g., the Samus' culture of the Middle Ob' River and the Krotovsk culture of the Baraba forest-steppe). Most importantly, the strength of this argument for macro-regional interconnections lies not in any single convergent aspect of Siberian material culture during the Early Bronze Age, but in a broad suite of cultural forms and ritual practices. These included shared themes found in artistic depictions and symbolism on multiple media, as well as metal artifact designs, raw material imports into the Cis-Baikal (e.g., alloys for bronze, white nephrite), and the export of materials in finished forms (white nephrite rings in particular).

Recently, discussions of the development of large-scale Bronze Age interconnections in Eurasia have focused on the role of:

> Emerging networks and flexible interactions among mobile pastoralists [that] had a transformative effect on the economy and social organization of the region and set the groundwork for later economic and ideological ties among regional societies within and beyond the steppe (Frachetti 2012:20; see also Anthony 2007; Kohl 2006).

Within the Cis-Baikal, however, remains of animal domesticates and evidence of mobile pastoralism are absent from the Early Bronze Age archaeological record, despite the clear presence of local linkages to macro-regional material culture as well as broad patterns of symbolism and practice. While the eventual adoption of pastoralism in the Cis-Baikal remains understudied at present (see Bader et al., eds. 1987; Kharinskii 2005), it is clear that this process did not begin until long after the onset of the Early Bronze Age in the region. I suggest that mobility strategies of Cis-Baikal hunter-gatherer groups may have presented similar opportunities in terms of the frequently-cited long-distance connectivity thought to have driven the spread of metalworking and herding technologies and novel ideologies on the Bronze Age steppe. Further, I suggest that local groups likely experienced their own largely political incentives to participate in this macro-regional system (Shepard 2012).

Early Bronze Age political actors in the Cis-Baikal – and particularly within the Little Sea micro-region – appear to have turned toward so-called “network/exclusionary” political economic strategies, outlined in the mid and late 1990s by Dual-Processual political theorists (e.g., Blanton 1998; Blanton et al. 1996; Earle 2000; Feinman 1995, 2000; King 2003). According to the Dual-Processual model, inclusive corporate strategies emphasize subsistence production (and intensification) at the local geographic scale, while actors employing network/exclusionary strategies pursue status through individual- or kin-group-level *distinction* and competition over access to long-distance interaction networks and exotic wealth (for a review of evidence of "network/exclusionary" strategies in the Early Bronze Age Cis-Baikal, see Chapters Two, Four, and Five; Shepard 2012). Importantly, these long-distance networks are expected to extend beyond the geographic boundaries of any single, "local" polity.

In contexts where network/exclusionary strategies dominate, actors compete over access to non-staple resources for display and redistribution, a tactic that Johnson and Earle (2000) have described as "wealth finance" (e.g., Blanton et al. 1996; Chase-Dunn and Hall 1997; Johnson and Earle 2000; Strathern 1969). These types of wealth correspond to Dalton's (1977) "primitive valuables" or to the "prestige goods" concept that Friedman and Rowlands (1977) outlined. These exotic forms of wealth or prestige goods would have served as a means of indexing individuals' participation in non-local networks (e.g., Graeber 1996; Hayden 1998; Johnson and Earle 2000:257), and can be seen as elements of a widespread aesthetic or "international style" that characterizes elite competition in network/exclusionary contexts.

These objects would have been particularly potent to their users in ritual aggregation events where individuals could display them before large gatherings in order to demonstrate successful participation in exclusive, long-distance networks (e.g., Chase-Dunn and Hall 1997; Earle 2000; Kristiansen and Larsson 2005; Renfrew 1987). In addition to similarities in exotic forms of wealth that appear to have been widespread throughout the macro-region during the Early Bronze Age, other forms of evidence including common layouts of grave goods as well as broad sets of motifs in rock art and sculpture hint at common forms of discourse surrounding elements of this international style.

Notably, isotopic data from the Little Sea micro-region (Chapters Three and Four) indicate that local hunter-gatherers made considerable changes to their subsistence practices and related mobility strategies during the Early Bronze Age. While the adult seasonal round for Late Neolithic groups in this micro-region appear to have focused on relatively intensive production of local aquatic resources, Early Bronze Age adults appear to have consumed more non-local terrestrial game (Chapter Four). This pattern is consistent with an argument that Early Bronze Age groups foraged over larger areas than their Late Neolithic predecessors, which would have facilitated interconnections across micro-regional boundaries.

As discussed above, Early Bronze Age hunter-gatherers throughout the Cis-Baikal also began to employ common mortuary rituals, and the territory where groups conducted these rituals expanded beyond its Late Neolithic boundaries (into the South Baikal and the Selenga River Delta; see Chapter Two). At the same time, Early Bronze Age practices within the Cis-Baikal appear to have taken on many of the same novel attributes seen contemporaneously outside the region, and may have developed syncretically, along with the emerging Bronze Age steppe and forest-steppe cultures.

Given the evidence for relatively discrete local (micro-regional) diets among Early Bronze Age hunter-gatherers (Weber et al. 2011), I suggest that the interactions involved in producing macro-regional interconnections in the Cis-Baikal likely resulted mainly from relatively short-term migrations and attendance at predictable seasonal aggregation events. In this sense, Early Bronze Age groups still appear to have employed distinct "home ranges," but the sizes of these home ranges ("foraging radii") may have expanded. Large-scale ritual aggregations and associated short-term migrations are not uncommon among ethnographically-documented hunter-gatherer populations. Various sites both within the Cis-Baikal and beyond its boundaries may have served as venues for multi-ethnic population aggregations, the exchange of goods, and the transmission of ideas, and provide opportunities for future research on this topic.

CHAPTER SEVEN

CONCLUSION

Interconnections in the ancient Cis-Baikal

In the preceding chapters, I employed several lines of geochemical and archaeological evidence to gain insights into prehistoric interconnections among hunter-gatherer inhabitants of the Cis-Baikal region of Siberia (Russia). I argued that these interconnections – although certainly of interest to some subdisciplines of anthropology in their own right – could also shed light on political organization and changes in social structure that took place within the region during the mid and late Holocene.

For the purposes of discussion, I suggest that these interconnections operated at three broad geographic and temporal scales, which I describe in more detail below. These scales correspond roughly to the different chapters of this dissertation (Chapters Three-Four, Five, and Six, see below). At the smallest spatiotemporal scale, I suggested in Chapter Four that relatively mundane, locally-focused subsistence activities that groups within each of the Cis-Baikal's distinct micro-regions practiced would have produced local connections (the *micro-regional* scale). At a slightly larger scale, in Chapter Five, I suggested that although they likely occurred less frequently, inter-group aggregations with participants from multiple micro-regions of the Cis-Baikal also took place periodically, and would have produced connections at the *regional* scale.

Rather than carrying out these interactions as a part of mundane, domestic-group-level subsistence activities, local communities created long-distance interconnections of this sort primarily at large, face-to-face ceremonies marking life-cycle events (and at other rituals). These relatively infrequent connective events often involved the redistribution and exchange of prestige goods, as well as feasting (as discussed in Chapters Five and Six). Finally, I suggested in Chapter Six that some form of interconnection also appears to have linked hunter-gatherer groups in the Cis-Baikal to groups, symbols, and practices from neighboring and more distant regions throughout northern Eurasia. These cross-cultural interconnections (linking groups together at the *macro-regional* scale) most likely resulted from infrequent and in some cases indirect interactions that were far from mundane in nature.

Relying on ethnographic and ethnological literature, I suggested that long-distance interconnections and events that enabled them (those connecting individuals and groups beyond the micro-regional scale) were driven at least in part by political motivations and the pursuit of prestige. At the same time, widespread engagement with social strategies emphasizing long-distance connections as a source of political capital may have varied by time and place. Below, I first discuss the evidence for interconnections among Cis-Baikal hunter-gatherer communities at each of the three scales outlined here. I then discuss several implications of these interconnections for current understanding of political economy in the ancient Cis-Baikal.

Evidence for micro-regional interconnections

Evidence for the existence of robust interconnections among Cis-Baikal hunter-gatherer groups at the micro-regional scale comes from a variety of sources. Previous research by Weber et al. (2002, 2011; see also Haverkort 2010; Katzenberg and Weber 1999; Katzenberg et al. 2012) provided a clear indication that distinct dietary regimes characterized the individuals interred in each of the Cis-Baikal's different micro-regions. Dietary distinctions were clearest for data on variation in isotopes of carbon and nitrogen ($\delta^{13}C$ and $\delta^{15}N$). These data not only illuminated broad dietary differences between the inhabitants of various micro-regions within the Cis-Baikal, but also enabled considerable insights into the specific subsistence practices that different local groups employed. Although less systematic, it is also noteworthy that archaeological data suggest at least some degree of micro-regional variation in burial ritual, which is consistent with arguments for the existence of distinct, local communities of practice and dense interconnections between domestic groups within micro-regions throughout the Cis-Baikal (e.g., Bazaliiski 2010; Goriunova 1997).

Isotopic data presented in Chapter Four provided a number of insights in terms of modeling micro-regional interconnections and related seasonal rounds and subsistence behaviors. This chapter focused primarily on comparing patterns of geochemical variability among Late Neolithic and Early Bronze Age groups – particularly within the Cis-Baikal's Little Sea micro-region (although this chapter also presented new data on $^{87}Sr/^{87}Sr$ variation from the upper Lena micro-region as well as preexisting data of this type from other areas). More specifically, I hypothesized that Late Neolithic groups in the Little Sea micro-region employed relatively intensified subsistence practices focusing on local subsistence resources that would have been susceptible to intensified production. In contrast, I hypothesized that Early Bronze Age groups would have employed a seasonal round that was more varied between individuals, featuring less focus on either subsistence intensification or large-scale redistribution of subsistence resources.

I also hypothesized that Early Bronze Age subsistence strategies would feature a greater influence from a "non-local" geochemical signature, since groups during this period would have selected mobility strategies that enabled the construction and maintenance of relationships with people in distant areas. In particular, I suggested that the contrast between Late Neolithic and Early Bronze Age political strategies (and related choices about mobility practices) should be reflected in $^{87}Sr/^{86}Sr$ values specifically from third molars, which represent the practices of individuals in later adolescence and early adulthood (as opposed to early or later childhood, represented by M1 and M2, respectively). While $^{87}Sr/^{86}Sr$ variances for the two periods did not differ significantly, M3 values for these samples were consistent with the hypothesized pattern; Late Neolithic values indicated an emphasis on local aquatic resources that would have been succeptible to intensification by corporate groups, while the Early Bronze Age pattern was consistent with consumption of terrestrial fauna (with at least some component of diet coming from non-local sources) or aquatic resources from outside the Little Sea proper (deep water fish, Baikal seal).

These patterns suggest not only dietary differences between the two periods under study – they also indicate broader changes in individuals' habitual movements that served as part of the seasonal round. I reiterate that these changes in the "local" component of diet between these periods are consistent with arguments that Little Sea hunter-gatherers during the Early Bronze Age engaged in mobility practices that involved spending more time (and consuming more resources) in areas beyond the boundaries of the Little Sea micro-region more frequently than their Late Neolithic predecessors had done. These mobility strategies also connected intricately into political changes that occurred during the Early Bronze Age, as hunter-gatherers throughout the Cis-Baikal appear to have turned to political strategies and ideologies that privileged long-distance interactions and non-local elite competition.

In this sense, the shift in diet represented by M3 $^{87}Sr/^{86}Sr$ data presented here indicates *not only* a shift away from subsistence practices dominated by a focus on intensifiable resources that could have supported corporate political economic strategies (or "home finance strategies," to use the language of Strathern [1969]). In addition, Early Bronze Age diets among Little Sea groups also represent more far-ranging mobility strategies that would have enabled groups to pursue long-distance supporters and greater engagement in emerging prestige systems. Both of these changes – although directly pertinent to diet and mobility – thus had important political implications that enable an assessment of changing political economic organization (see Chapter Four).

Regional-level connections

In addition to evidence for the widespread use of mobility strategies that would have permitted interaction beyond the boundaries of the Little Sea specifically during the Early Bronze Age, isotopic data from both the Late Neolithic and Early Bronze Age also hinted at considerable interconnections between micro-regions and at large-scale inter-group relationships at the regional level. For example, data on 87Sr/86Sr values from first molars - representing individuals' whereabouts for the several years around the time they were born – indicate that a number of individuals interred at cemeteries in the Little Sea and upper Lena were born in other areas of the Cis-Baikal. In the Little Sea, where chronological data enabled a statistical comparison of these two periods, it is notable that this pattern characterized both the Late Neolithic and Early Bronze Age, suggesting at least some degree of connection during both periods.

In some cases, "non-local" individuals interred in Little Sea cemeteries during the Early Bronze Age appear to have received treatments that were distinct from the majority of locally-born individuals (these distinctions do not appear to have been relevant to spatial placement of interments during the Late Neolithic, although more geochemical data from sites dating to this period and from isolated graves or clusters specifically will help to evaluate this claim further). In any case, both periods – regardless of the specific treatments that non-local individuals received – exhibited clear geochemical evidence for the movement of people between micro-regions of the Cis-Baikal.

Archaeological data also supported the assertion that interconnections existed between Cis-Baikal micro-regions. Chapter Five presented data on the production, distribution, and uses of nephrite ornaments as a means to assess the political economic system(/s) that operated within the Early Bronze Age Cis-Baikal. While I discuss the political economic implications of patterns outlined in that chapter below (see next section), here I note that the forms and geographic distribution of these objects appeared to correspond to a model of long-distance prestige goods exchange that extended throughout the entire region. Based on ethnographic analogues with other small- and intermediate-scale societies, I suggest that the exchange of these objects likely took place at short-term aggregation events.

Chapter Six described other forms of material culture evidence (metals, anthropomorphic symbols, styles of ornamental garb, rock art) that also may have figured into ritualized displays at large, face-to-face gatherings throughout the Cis-Baikal, again highlighting regional-level interconnections among Early Bronze Age groups. Other forms of data provide clear indications of much longer-term interconnections within the region that were not limited to the Early Bronze Age. For example, the green nephrite and slate that Cis-Baikal groups employed in order to produce knives, axes, adzes, and other implements throughout the entire Holocene must all have been procured in several relatively circumscribed areas (see Chapter Five). Seasonal mobility strategies involved in procuring these materials either directly (from their geologic sources) or indirectly (through interaction and exchange with other groups) would both have created the potential for interconnections beyond the micro-regional scale to develop among the region's inhabitants.

Macro-regional-level connections

At the largest spatiotemporal scale, I suggested in Chapter Six that aspects of Early Bronze Age material culture also exhibited parallels to contemporaneous material culture forms from neighboring and distant areas throughout Eurasia. Shared material culture included several specific types of metal objects (and metallurgical practices more broadly), the widespread appearance of anthropomorphic symbols (depicted on a variety of media including bone, antler, metal, stone, and clay), and common ornamental designs and layouts. The white nephrite that Cis-Baikal hunter-gatherers employed to produce body ornaments during the Early Bronze Age also appears to have been imported from non-local sources to the northeast of the region, again indicating some form of connection with distant groups. Finished nephrite ornaments have also been found in small quantities in Bronze Age graves from neighboring regions, suggesting not only stylistic connections, but actual exchange as well.

These stylistic similarities may indicate more than a convergence in material culture alone. Material culture data presented here also suggest common symbolic referents that operated throughout much of the region (e.g., shamanism, ideologies placing high regard on the possession of exotic forms of wealth). Common depictions of shamanic rituals and common uses of anthropomorphic figurines and metal ornaments in ritualized forms of display serve as two examples, both of which retained their common symbolic meaning throughout much of Siberia and northern Eurasia into the historic period. Regardless of the precise symbolic meaning of these widespread forms of material culture, these data also suggest more broadly that some kind of interconnection existed between regions of prehistoric Eurasia. I have argued that the types of interactions that would have enabled Cis-Baikal hunter-gatherer groups to selectively adopt these stylistic, technological, and ritual practices most likely took place rarely, at highly politically charged ritual aggregation events. In many cases, these events may have linked distant groups together only indirectly, following a "down-the-line" model (see Chapter Six, Shepard et al. 2016).

Political economic investigation of the ancient Cis-Baikal

In the preceding chapters I also made the argument that these interconnections – although interesting in their own right and contributing to a growing study of the Eurasian Bronze Age world-system by researchers from a variety of theoretical and national traditions – are also connected to a shift in political economic organization that took place within the Cis-Baikal during the mid and late Holocene. This shift – which I have previously investigated specifically on the basis of mortuary data from the Cis-Baikal's Little Sea region – involved a transformation of Late Neolithic sociopolitical structure that corresponded to what Blanton et al. (1996) described as "corporate" political economic strategies. Corporate strategies employed inclusive rhetoric in order to draw additional labor for communal subsistence and related ceremonial projects; symbolic efforts to assert homogeneity among participants; reinvestment of surplus labor and capital into subsistence intensification and redistribution to participants; and focused on relatively small geographic areas. It is also important to note that these strategies are believed to be most adaptive in areas where political actors and local groups can make significant returns on additional labor from followers and on attempts at subsistence intensification.

In contrast, during the Early Bronze Age, I argued that these strategies were replaced to at least some extent by a focus on what Blanton et al. (1996) described as "network/exclusionary" strategies. Political actors employing these strategies emphasized individual (and kin-group) distinctions through the use of exotic and labor-intensive "prestige goods" and competition with other elites or aspiring elites. Systems where these strategies predominate often produce interconnections over much larger geographic areas, owing at least in part to the nature of elite competition and prestige goods exchange – both of which become inherently long-distance pursuits in "network/exclusionary" contexts (e.g., Helms 1992; Renfrew 1987). Within these contexts, political actors also employ rhetorical and symbolic measures in attempts to cement their elite status claims. These include efforts to cultivate genealogical distinctions, both elevating costs associated with marriage exchanges, and also elevating individuals' status, in cases where they can assert a connection to high-status lineages. Network/exclusionary strategies are thought to be particularly beneficial to political actors in contexts where they can make large economic gains by harnessing existing (or developing) networks of exchange or other types of interaction that are both locally controllable and required for social reproduction by external groups (in particular, areas where trade routes exist).

Geochemical data presented here provide support for this hypothesized political shift in the Cis-Baikal's Little Sea micro-region at some point during the transition between the Late Neolithic and the Early Bronze Age, and – along with archaeological data presented in Chapter Five and Six – also enabled a detailed investigation of Early Bronze Age political practices and interconnections involved in this political economic system. In particular, it is noteworthy that individuals appear to have employed strategies emphasizing the subdivision and exchange of white nephrite ornaments to a greater extent in areas where the potential for subsistence intensification was lower (the upper Lena and Little Sea, as opposed to the Angara River Valley). These low-productivity areas featured large relative frequencies of heavily worked ornaments: small primarily discs, presumed to have had multiple rings removed by the time they entered the archaeological record. In contrast, in the Angara River Valley, discs tended to be large – indicating that local groups placed little emphasis on subdividing these objects into multiple ornaments. Rings in this area were relatively common compared to discs, resulting from long-distance exchange with distant producers in other micro-regions of the Cis-Baikal.

These nephrite ornaments thus appear to have served as a medium for interconnections at the regional (and macro-regional) scale, possibly changing hands several times and creating important social and political ties along the pathways by which they were transmitted between Vitim Highlands groups (or the Cis-Baikal hunter-gatherers who procured them from that distant area) and inhabitants of the Angara River Valley and other micro-regions of the Cis-Baikal. In some cases, these objects also appear to have been involved in exchanges beyond the boundaries of the Cis-Baikal as well.

Another aspect of political economic strategies that emerged from the geochemical and archaeological data discussed here was the so-called "patrimonial rhetoric" that political actors in network/exclusionary contexts employ in order to cultivate prestige. The Early Bronze Age featured several novel artifact forms, one of the most distinctive being the anthropomorphic figurines that Cis-Baikal hunter-gatherers appear to have produced on a variety of media (discussed in Chapter Six). These included rock art and ceramic designs, as well as metal, stone, and – most commonly – bone and antler. Ethnographic analogues for these figurines are relatively common among historic Siberian groups, and often represented specific ancestral figures of individual family lineages.

Other evidence for the use of patrimonial rhetoric among Early Bronze Age groups includes the linear rows of graves at some cemeteries dating to this period. While these rows have long been interpreted as indicative of kin relationships (e.g., Okladnikov 1955), the geochemical evidence presented in Chapter Four provided strong support for the argument that individuals in these rows exhibited relatively common early life histories – including shared patterns of mobility, and diets, later in life. The same was true of Early Bronze Age graves containing multiple individuals; when compared to multiple interments dating to the Late Neolithic, Early Bronze Age multiple interments featured relatively "tight" sets of isotopic values in most cases. Overall, these findings are consistent with an increased focus on distinctions between kin-groups.

In anthropological and archaeological studies of social change among hunter-gatherer societies, changes in diet and mobility practices are most often explained in terms of new opportunities and challenges presented by environmental stimuli (see Arnold et al. 2015). In rare instances, some studies also treat internal societal factors – demographic pressures, most commonly – as conditions that would have enabled such changes (e.g., Prentiss et al. 2014). At the same time, it is noteworthy that *political* and *economic* reorganization provides another well-documented impetus for changes in diet and mobility practices among hunter-gatherers and other small- or intermediate-scale societies. Far-reaching examples of groups involved in the historical northern Eurasian and North American fur trade (e.g., Forsyth 1992; Glavatskaia 2002; Golovnev 1993; Karacharov 1999; Lelièvre and Marshall 2015; Meyer and Thistle 1995) serve as but one example. Most importantly, many of the groups that were ultimately entwined in this political and economic system came to be so entwined not only due to pressures exerted by economic and political forces from external (state-level) polities, but also due to the agency of internal actors (e.g., Wolf 1982), who worked to transform subsistence and mobility practices to fit new economic and political opportunities (for additional discussion of social transformation in small- and intermediate-scale societies during periods of increasing interconnection to the outside world, see Burch 2005; Martindale 2009; Thomas 1991; Wesson 2008).

Events and the archaeological study of political economy

One important aspect of this work has been the attention paid not only to understanding the Late Neolithic and Early Bronze Age political economic *systems* (to a greater extent here, I have focused on the Early Bronze Age, due to the relatively small amount of available data on the Late Neolithic), but also to understanding the roles of specific *events* in the production and maintenance of these systems. While Chapters Three and Four of this dissertation focused primarily on diet and mobility, and thus on relatively mundane, repetitive activity in the lives of ancient hunter-gatherers, Chapters Five and Six emphasized the importance of ceremonial aggregations as mechanisms for the transmission of prestige goods, the sharing of ideas, and the production of long-distance social ties. These events were also venues for ceremonial displays, the production of group identity, and individual attempts to cultivate political status.

While BHAP research to date has devoted a considerable amount of energy to develop models regarding the frequent, repetitive subsistence activities that ancient Cis-Baikal groups engaged in, I suggest that a focus on the role of events has considerable promise for understanding social organization among Cis-Baikal hunter-gatherers. These events – both in contexts where corporate strategies predominated and those where political actors employed network/exclusionary strategies – would have held considerable importance in the reproduction or transformation of social structure (Dietler 1996; Hayden 2009; Shepard 2012; Spielmann 2002).

Given the emphasis on data from cemeteries and on the topic mobility in current literature by the BHAP, a shift toward an "eventful" approach to the archaeology of the Cis-Baikal seems well within the boundaries of possibility for the next decade of research in the region. In particular, funerals would have served as events where living communities could vie for opportunities to cement or manipulate relationships between attendees, while also creating bonds with ancestral and future kin. Although they often appear mundane and apolitical at first glance, movements –

including the seasonal round and daily subsistence pursuits – were closely entwined with these aggregation events, as were the broad mobility strategies that groups adopted during the Early Bronze Age, which enabled their participation in newly emerging political systems and supporting ideologies (see Lilièvre and Marshall 2015).

Conclusions: Social Change in the Late Neolithic and the Early Bronze Age

Much of this discussion has revolved around the assertion that political economic variability within the Early Bronze Age Cis-Baikal related to environmental variability – specifically the potential for subsistence intensification and increasing yield by adding additional labor input within different micro-regions. However, it is also important to note that within the Little Sea micro-region, a political shift appears to have taken place between the Late Neolithic and Early Bronze Age. While it is entirely possible that some form of environmental transition could have enabled this political reorientation, poor paleoenvironmental data relating to this time period make this assertion highly speculative at present. A more empirically grounded interpretation of causes for this shift might instead incorporate the wealth of existing historical and archaeological data on economic and sociopolitical developments in the Eurasian macro-region between 5000-4000 cal BP – as well as sociological and anthropological literature on social organization in small- and intermediate-level societies – in order to understand the novel choices that Cis-Baikal hunter-gatherers began to make during this period.

A wide variety of Russian and western scholars (e.g., Anthony 2007; Chernykh 1992, 2008; Frachetti 2012; Kohl 2006; Koriakova and Epimakhov 2007) have stressed the growing political importance of long-distance forms of interconnection in the Eurasian Bronze Age, emphasizing these strategies' reliance on new forms of mobility that the gradual emergence of herding practices across the steppe enabled. However, Cis-Baikal hunter-gatherers likely practiced similar forms of seasonal mobility (and isotopic data from the Little Sea micro-region are consistent with an interpretation that these individuals actually engaged in *greater* seasonal mobility than their Late Neolithic predecessors), enabling them to also pursue connections to this growing macro-regional system.

Of particular importance here, new high-resolution dates currently being produced at the Oxford University Radiocarbon Unit (ORAU) will facilitate considerably more detailed analyses of change over time in mobility practices and political economic orientation within the prehistoric Cis-Baikal. While for this study, it was only possible to distinguish two broad periods for the purposes of comparison (Late Neolithic and Early Bronze Age, each lasting roughly a millennium), a large corpus of high-resolution AMS radiocarbon dates for Cis-Baikal individuals interred in Cis-Baikal cemeteries that will become available over the next decade will enable entirely different forms of analysis that can provide new insights (see Weber et al. 2016b for an example of these approaches).

At the same time, the broad chronological groupings I employed in this analysis illuminated important aspects of social change within the Holocene Cis-Baikal that have been understudied by BHAP researchers working primarily in English. In particular, the existence of interconnections not only within the Cis-Baikal region (downplayed by recent isotopic research), but also across the macro-regional landscape shed new light on the Bronze Age world more broadly. General portrayals of hunter-gatherer societies have often focused on long-distance connections as an adaptive strategy in response to ecological stimuli on the part of local groups, but rarely as an impactful component of broader world-systems. The historical importance of hunter-gatherer connections to surrounding societies is treated with even less importance in instances where hunter-gatherer groups interacted with food-producers, often presumed to have exhibited greater sociopolitical complexity. In the case of the prehistoric Cis-Baikal, however, it is clear that Cis-Baikal hunter-gatherers both participated in interactions with external groups, and *made use of* these interactions, cultivating the prestige value and political weight of interconnectedness and long-distance support in instances where these tactics were possible. These interactions appear to have had important impacts on social developments both within the Cis-Baikal and beyond its boundaries, as Eurasian steppe and forest-steppe societies became increasingly connected during the Bronze and Iron Ages.

At the broadest level, this research has employed models of sociopolitical organization most commonly used in studies of hierarchically complex, food-producing societies, in order to demonstrate that not only hierarchical variation – which is well-documented among hunter-gatherer societies, despite an entrenched, agricentric bias (Ames 2001; Arnold 1993, 1996a, 1996b; Arnold et al. 2015; Hayden 1994) – but also variation in specific forms of political economy, existed among hunter-gatherer societies. Like in societies employing food production techniques and exhibiting high levels of hierarchical complexity, the political actors under study here responded to a variety of factors in making strategic decisions to achieve political goals. In some cases, these factors were environmental in nature, involving potential subsistence outputs and the relative value of additional followers' labor when resources were particularly plentiful for harvesting. In other cases, however, these tactics were also influenced by broader historical and economic forces, including new patterns of mobility and new levels of receptivity to prestige goods strategies among neighboring groups in nearby regions. I suggest that a greater focus on placing hunter-gatherers within both historical and political economic frameworks represents a productive approach to illuminating processes of ancient social change among these groups.

APPENDIX 1. $^{87}Sr/^{86}Sr$ TERRESTRIAL FAUNAL DATA FOR THE CIS-BAIKAL

BHAP Sample no.	Species	Region	Source	$^{87}Sr/^{86}Sr$ Value	2 s.e.	Publication Source
2008.057	Ground squirrel	Baikal, Little Sea, Mainland	–	0.71242	–	Scharlotta and Weber 2014
2000.229	Ground squirrel	Baikal, Little Sea, Mainland	Khuzhir-Nuge cove	0.71254	0.000037	Haverkort et al. 2008
1993.151	Moose (p)	Baikal, Little Sea, Mainland	Sagan-Zaba	0.71502	0.000022	Haverkort et al. 2008
1991.054	Moose (p)	Baikal, Little Sea, Mainland	Tudugu	0.73142	0.000018	Haverkort et al. 2008
2008.056	Ground squirrel	Baikal, Little Sea, Mainland	–	0.73437	–	Scharlotta and Weber 2014
1998.238	Ground squirrel	Baikal, Little Sea, Mainland	Sarma Canyon, entrance	0.74330	0.00003	Haverkort et al. 2008
2008.051	Deer	Baikal, Little Sea, Mainland	–	0.74614	–	Scharlotta and Weber 2014
1997.068	Ground squirrel	Baikal, Little Sea, Mainland	Khuzhir-Nuge cove	0.71329a	0.000019	Haverkort et al. 2008
1997.059	Ground squirrel	Baikal, Little Sea, Mainland	Khuzhir-Nuge cove	0.71373a	0.000019	Haverkort et al. 2008
2008.069	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.71117	–	Scharlotta and Weber 2014
1991.109	Red deer (p)	Baikal, Little Sea, Ol'khon	Shamanskii Mys	0.71163	0.000051	Haverkort et al. 2008
1991.104	Red deer (p)	Baikal, Little Sea, Ol'khon	Shamanskii Mys	0.71176	0.000013	Haverkort et al. 2008
1991.108	Red deer (p)	Baikal, Little Sea, Ol'khon	Shamanskii Mys	0.71218	0.000009	Haverkort et al. 2008
2000.23	Ground squirrel	Baikal, Little Sea, Ol'khon	Shara-Nur Lake	0.71220	0.000027	Haverkort et al. 2008
2008.074	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.71339	–	Scharlotta and Weber 2014
2008.061	Hare	Baikal, Little Sea, Ol'khon	–	0.71485	–	Scharlotta and Weber 2014
2008.07	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.71873	–	Scharlotta and Weber 2014
2008.08	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.71909	–	Scharlotta and Weber 2014
2008.068	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.71945	–	Scharlotta and Weber 2014
2008.076	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.72070	–	Scharlotta and Weber 2014
2008.075	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.72079	–	Scharlotta and Weber 2014
2008.065	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.72112	–	Scharlotta and Weber 2014
2008.072	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.72253	–	Scharlotta and Weber 2014
2008.071	Ground squirrel	Baikal, Little Sea, Ol'khon	–	0.72258	–	Scharlotta and Weber 2014

2001.691	Red fox	Baikal, Southwest coast	Bol'shie Koty	0.70994	0.00006	Haverkort et al. 2008
2002.39	Red deer	Baikal, Southwest coast	Kultuk	0.70958	0.000031	Haverkort et al. 2008
2008.088	Roe deer	Baikal, West Coast	Sagan-Zaba	0.70694	–	Scharlotta and Weber 2014
2008.115	Roe deer	Baikal, West Coast	Sagan-Zaba	0.70791	–	Scharlotta and Weber 2014
2008.082	Roe deer	Baikal, West Coast	Sagan-Zaba	0.70813	–	Scharlotta and Weber 2014
2008.126	Roe deer	Baikal, West Coast	Sagan-Zaba	0.70828	–	Scharlotta and Weber 2014
2008.094	Roe deer	Baikal, West Coast	Sagan-Zaba	0.70914	–	Scharlotta and Weber 2014
2008.092	Roe deer	Baikal, West Coast	Sagan-Zaba	0.70937	–	Scharlotta and Weber 2014
2008.118	Ground squirrel	Baikal, West Coast	Sagan-Zaba	0.70944	–	Scharlotta and Weber 2014
2008.128	Ground squirrel	Baikal, West Coast	Sagan-Zaba	0.70963	–	Scharlotta and Weber 2014
2008.091	Deer	Baikal, West Coast	Sagan-Zaba	0.71023	–	Scharlotta and Weber 2014
2008.13	Ground squirrel	Baikal, West Coast	Sagan-Zaba	0.71051	–	Scharlotta and Weber 2014
2008.131	Ground squirrel	Baikal, West Coast	Sagan-Zaba	0.71054	–	Scharlotta and Weber 2014
2008.112	Ground squirrel	Baikal, West Coast	Sagan-Zaba	0.71055	–	Scharlotta and Weber 2014
2008.117	Roe deer	Baikal, West Coast	Sagan-Zaba	0.71072	–	Scharlotta and Weber 2014
2008.122	Roe deer	Baikal, West Coast	Sagan-Zaba	0.71101	–	Scharlotta and Weber 2014
2008.086	Roe deer	Baikal, West Coast	Sagan-Zaba	0.71112	–	Scharlotta and Weber 2014
2008.105	Red deer	Baikal, West Coast	Sagan-Zaba	0.71216	–	Scharlotta and Weber 2014
2008.085	Roe deer	Baikal, West Coast	Sagan-Zaba	0.71485	–	Scharlotta and Weber 2014
2008.129	Mouse	Baikal, West Coast	Sagan-Zaba	0.71558	–	Scharlotta and Weber 2014
2008.089	Red deer	Baikal, West Coast	Sagan-Zaba	0.73934	–	Scharlotta and Weber 2014
2001.774	Red deer	Middle Angara valley	Bratsk	0.70913	0.000025	Haverkort et al. 2008
2001.773	Red deer	Middle Angara valley	Bratsk	0.70920	0.000029	Haverkort et al. 2008
2001.76	Red deer	Middle Angara valley	Bratsk	0.70957	0.000045	Haverkort et al. 2008
2001.777	Moose	Middle Angara valley	Bratsk	0.70991	0.000025	Haverkort et al. 2008
2001.757	Bear	Middle Angara valley	Bratsk	0.71073	0.000032	Haverkort et al. 2008
2001.671	Hare	Middle Angara valley, East	Batchai	0.70889	0.000026	Haverkort et al. 2008

2002.417	Ground squirrel	Middle Angara valley, East	Ida River	0.70906	0.00005	Haverkort et al. 2008
2002.419	Red fox	Middle Angara valley, East	Ida River	0.70907	0.000035	Haverkort et al. 2008
2002.427	Roe deer	Middle Angara valley, East	Ida River	0.70909	0.000014	Haverkort et al. 2008
2001.669	Moose	Middle Angara valley, East	Batchai	0.70917	0.000015	Haverkort et al. 2008
2002.423	Roe deer	Middle Angara valley, East	Ida River	0.70933	0.000012	Haverkort et al. 2008
2002.429	Roe deer	Middle Angara valley, East	Ida River	0.70963	0.000018	Haverkort et al. 2008
2002.383	Hare	Middle Angara valley, East	Ida River	0.70973	0.000013	Haverkort et al. 2008
2002.384	Hare	Middle Angara valley, East	Ida River	0.70973	0.000011	Haverkort et al. 2008
2001.697	Moose	Middle Angara valley, East	Batchai	0.70974	0.000017	Haverkort et al. 2008
1993.081	Red deer (p)	Middle Angara valley, West	Belaia River, Gorelyi Les	0.71066	0.000018	Haverkort et al. 2008
2002.397	Ground squirrel	Middle Angara valley, West	Belaia River	0.71082	0.000029	Haverkort et al. 2008
2002.396	Ground squirrel	Middle Angara valley, West	Belaia River	0.71128	0.000018	Haverkort et al. 2008
1993.079	Red deer (p)	Middle Angara valley, West	Belaia River, Gorelyi Les	0.71183	0.000022	Haverkort et al. 2008
1993.094	Red deer (p)	Middle Angara valley, West	Belaia River, Gorelyi Les	0.716800	0.000022	Haverkort et al. 2008
2008.016	Cow	Tunka Valley	-	0.70849	–	Scharlotta and Weber 2014
2008.008	Sable	Tunka Valley	Arshan	0.70859	–	Scharlotta and Weber 2014
2008.013	Mouse	Tunka Valley	Arshan	0.70875	–	Scharlotta and Weber 2014
2008.015	Cow	Tunka Valley	-	0.70884	–	Scharlotta and Weber 2014
2008.014	Ground squirrel	Tunka Valley	-	0.70962	–	Scharlotta and Weber 2014
2008.019	Cow	Tunka Valley	-	0.70977	–	Scharlotta and Weber 2014
2008.017	Cow	Tunka Valley	-	0.70987	–	Scharlotta and Weber 2014
2008.03	Horse	Tunka Valley	-	0.70988	–	Scharlotta and Weber 2014
2008.021	Cow	Tunka Valley	-	0.71010	–	Scharlotta and Weber 2014
2008.018	Cow	Tunka Valley	-	0.71020	–	Scharlotta and Weber 2014
2008.04	Horse	Tunka Valley	-	0.71021	–	Scharlotta and Weber 2014
2008.035	Horse	Tunka Valley	-	0.71058	–	Scharlotta and Weber 2014
2008.039	Horse	Tunka Valley	-	0.71106	–	Scharlotta and Weber 2014

2008.02	Cow	Tunka Valley	–	0.71112	–	Scharlotta and Weber 2014
2003.704	Wolf (p)	Upper Angara valley	Lokomotiv-Raisovet, Grave 8	0.71035	0.000013	Haverkort et al. 2008
2002.358	Mouse	Upper Lena valley	–	0.70882	0.000017	Haverkort et al. 2008
2002.362	Red fox	Upper Lena valley	–	0.70927	0.000016	Haverkort et al. 2008
2002.364	Roe deer	Upper Lena valley	–	0.70950	0.000013	Haverkort et al. 2008
2009.139	Cow	Upper Lena valley	Shemetovo	0.70953	–	Scharlotta and Weber 2014
2009.14	Cow	Upper Lena valley	Shemetovo	0.70955	–	Scharlotta and Weber 2014
1991.013	Dog (p)	Upper Lena valley	Obkhoi	0.70969	0.000015	Haverkort et al. 2008
2002.361	Lynx	Upper Lena valley	–	0.71027	0.000062	Haverkort et al. 2008
2002.37	Roe deer	Upper Lena valley	–	0.71056	0.000052	Haverkort et al. 2008
2002.366	Roe deer	Upper Lena valley	–	0.71092	0.000084	Haverkort et al. 2008
2002.36	Lynx	Upper Lena valley	–	0.71097	0.000039	Haverkort et al. 2008

APPENDIX 2. $^{87}Sr/^{86}Sr$ AQUATIC FAUNAL DATA FOR THE CIS-BAIKAL*

BHAP Sample no.	Species	Micro-Region	Source	$^{87}Sr/^{86}Sr$ Value	2 s.e.
1998.013	Baikal sturgeon	Baikal	–	0.70818	0.000013
1998.014	Baikal sturgeon	Baikal	–	0.70857	0.000015
1997.111	Omul'	Baikal	–	0.70852a	0.000023
1997.113	Omul'	Baikal	–	0.70851a	0.000019
1997.114	Omul'	Baikal	–	0.70855a	0.000018
1993.098	Seal	Baikal	–	0.70857a	0.000016
1993.1	Seal	Baikal	–	0.70858a	0.000019
1993.101	Seal	Baikal	–	0.70858a	0.00002
2008.095[17]	Baikal seal	Baikal	Sagan-Zaba (Baikal, West coast)	0.708742	–
2000.546	Northern pike	Baikal	Little Sea	0.70985	0.000025
2000.547	Northern pike	Baikal	Little Sea	0.71141	0.000018
2001.707	Northern pike	Baikal	Little Sea	0.72829	0.000016
2001.765	Arctic grayling	Middle Angara	Bratsk	0.7088	0.000023
2001.766	Arctic grayling	Middle Angara	Bratsk	0.70888	0.000027
2001.767	Arctic grayling	Middle Angara	Bratsk	0.70968	0.000039
2002.449	Burbot	Middle Angara, East	Ida River	0.70824	0.000029
2002.45	Burbot	Middle Angara, East	Ida River	0.70813	0.000022
2002.451	Burbot	Middle Angara, East	Ida River	0.70879	0.000018
2002.444	Prussian carp	Middle Angara, East	Ida River	0.70856	0.000031
2002.445	Prussian carp	Middle Angara, East	Ida River	0.70831	0.00002
2002.452	Prussian carp	Middle Angara, East	Ida River	0.70811	0.000022
2002.406	Dace	Middle Angara, West	Belaia River	0.71004	0.000034
2002.409	Dace	Middle Angara, West	Belaia River	0.71137	0.000029
2002.41	Dace	Middle Angara, West	Belaia River	0.70928	0.000031

[17] This value was reported in Scharlotta and Weber (2014).

2002.4	Perch	Middle Angara, West	Belaia River	0.70907	0.000023
2002.401	Perch	Middle Angara, West	Belaia River	0.70983	0.00003
2002.403	Perch	Middle Angara, West	Belaia River	0.70951	0.000021
2002.307	Black grayling	Upper Angara	Irkutsk	0.70878	0.000034
2002.308	Black grayling	Upper Angara	Irkutsk	0.709	0.000032
2002.309	Black grayling	Upper Angara	Irkutsk	0.7088	0.000019
2002.354	Dace	Upper Lena	–	0.70888	0.000019
2002.356	Dace	Upper Lena	–	0.70881	0.000018
2002.357	Dace	Upper Lena	–	0.70882	0.000014
2002.342	Perch	Upper Lena	–	0.70895	0.000021
2002.343	Perch	Upper Lena	–	0.70895	0.000015
2002.344	Perch	Upper Lena	–	0.70895	0.000017
2002.345	Roach	Upper Lena	–	0.70881	0.000013
2002.346	Roach	Upper Lena	–	0.70887	0.000016
2002.347	Roach	Upper Lena	–	0.70889	0.000018

*Reported in Scharlotta 2012.

APPENDIX 3. $^{87}Sr/^{86}Sr$ PLANT DATA FOR THE CIS-BAIKAL*

ID	Site	Plant Type	Longitude	Latitude	$^{87}Sr/^{86}Sr$	Micro-Region
E2009.399	Dolon-Bogot	birch	52°36'23"	106°08'42"	0.712124	Baikal west coast
E2009.400	Dolon-Bogot	pine	52°36'23"	106°08'42"	0.709535	Baikal west coast
E2009.406	Popovo	birch	52°43'49"	106°17'28"	0.716746	Baikal west coast
E2009.407	Popovo	larch	52°43'49"	106°17'28"	0.717134	Baikal west coast
E2009.412	Petrovo	birch	52°44'59"	106°21'01"	0.707832	Baikal west coast
E2009.413	Petrovo	pine	52°44'59"	106°21'01"	0.709014	Baikal west coast
E2009.419	Khotoruk	larch	52°47'50"	106°30'50"	0.712528	Baikal west coast
E2009.420	Khotoruk	pine	52°47'50"	106°30'50"	0.71614	Baikal west coast
E2009.426	Narim-Kurei	larch	52°50'43"	106°29'16"	0.715368	Baikal west coast
E2009.427	Narim-Kurei	pine	52°50'43"	106°29'16"	0.716263	Baikal west coast
E2009.478	Tazhyren' Steppe	pine	52°53'42"	106°37'10"	0.711935	Baikal west coast
E2009.479	Tazhyren' Steppe	pine	52°53'42"	106°37'10"	0.711699	Baikal west coast
E2009.432	Shamanskii Mys	larch	53°12'11"	107°20'36"	0.710569	Little Sea – Ol'khon
E2009.433	Shamanskii Mys	larch	53°12'11"	107°20'36"	0.712683	Little Sea – Ol'khon
E2009.437	Khuzhir	larch	53°10'40"	107°20'03"	0.713666	Little Sea – Ol'khon
E2009.438	Khuzhir	larch	53°10'40"	107°20'03"	0.713234	Little Sea – Ol'khon
E2009.440	Khadai	larch	53°03'52"	107°03'54"	0.713131	Little Sea – Ol'khon
E2009.441	Khadai	larch	53°03'52"	107°03'54"	0.715448	Little Sea – Ol'khon
E2009.444	Kurkut Bay	larch	53°00'39"	106°48'15"	0.7151	Little Sea - Mainland
E2009.445	Kurkut Bay	larch	53°00'39"	106°48'15"	0.716693	Little Sea - Mainland
E2009.447	Kurma	larch	53°10'59"	106°58'27"	0.712968	Little Sea - Mainland
E2009.448	Kurma	larch	53°10'59"	106°58'27"	0.712076	Little Sea - Mainland
E2009.451	Sarma	pine	53°08'28"	106°53'32"	0.712026	Little Sea - Mainland
E2009.452	Sarma	pine	53°08'28"	106°53'32"	0.712385	Little Sea - Mainland
E2009.455	Sarma	pine	53°08'36"	106°53'27"	0.714079	Little Sea - Mainland

E2009.456	Sarma	pine	53°08'36"	106°53'27"	0.716878	Little Sea - Mainland
E2009.460	Sarma	birch	53°06'48"	106°50'21"	0.748496	Little Sea - Mainland
E2009.461	Sarma	larch	53°06'48"	106°50'21"	0.750199	Little Sea - Mainland
E2009.467	Khuzhir-Nuge	birch	53°05'09"	106°47'24"	0.726098	Little Sea - Mainland
E2009.468	Khuzhir-Nuge	larch	53°05'09"	106°47'24"	0.73022	Little Sea - Mainland
E2009.473	Kulura	larch	53°01'01"	106°44'25"	0.722925	Little Sea - Mainland
E2009.474	Kulura	larch	53°01'01"	106°44'25"	0.717705	Little Sea - Mainland
E2009.172	Oloi	birch	52°55'09"	105°10'37"	0.709744	Middle Angara - East
E2009.173	Oloi	birch	52°55'09"	105°10'37"	0.709818	Middle Angara - East
E2009.191	Andrianovskaia	birch	51°48'34"	103°47'18"	0.714414	South Baikal
E2009.192	Andrianovskaia	pine	51°48'34"	103°47'18"	0.713661	South Baikal
E2009.197	Angaselka	birch	51°43'21"	103°42'02"	0.711874	South Baikal
E2009.198	Angaselka	pine	51°43'21"	103°42'02"	0.716004	South Baikal
E2009.203	Kultuk	birch	51°44'04"	103°38'12"	0.711531	South Baikal
3E2009.204	Kultuk	birch	51°44'04"	103°38'12"	0.71069	South Baikal
E2009.211	Bystroe	birch	51°43'56"	103°25'57"	0.711031	South Baikal
E2009.212	Bystroe	pine	51°43'56"	103°25'57"	0.710951	South Baikal
E2009.219	Tibelti	birch	51°46'45"	103°13'19"	0.709721	South Baikal
E2009.220	Tibelti	pine	51°46'45"	103°13'19"	0.709569	South Baikal
E2009.225	Zun-Murino	birch	51°44'07"	102°52'41"	0.709737	South Baikal
E2009.226	Zun-Murino	pine	51°44'07"	102°52'41"	0.709855	South Baikal
E2009.232	Shabartaika	birch	51°43'01"	102°43'43"	0.710365	South Baikal
E2009.233	Shabartaika	pine	51°43'01"	102°43'43"	0.7097	South Baikal
E2009.239	Guzhiry	birch	51°47'42"	102°4'3"	0.71019	South Baikal
E2009.240	Guzhiry	pine	51°47'42"	102°4'3"	0.711257	South Baikal
E2009.245	Dalakhai	birch	51°48'01"	102°58'31"	0.710757	South Baikal

E2009.246	Dalakhai	birch	51°48'01"	102°58'31"	0.710669	South Baikal
E2009.251	Nikol'sk	spruce	51°43'06"	102°35'23"	0.708958	South Baikal
E2009.252	Nikol'sk	pine	51°43'06"	102°35'23"	0.708475	South Baikal
E2009.257	Tagarkhai	birch	51°52'32"	102°26'41"	0.709891	South Baikal
E2009.258	Tagarkhai	larch	51°52'32"	102°26'41"	0.709719	South Baikal
E2009.262	Il'chir Lake	larch	52°0'2"	101°01'17"	0.713761	South Baikal
E2009.263	Il'chir Lake	larch	52°0'2"	101°01'17"	0.713422	South Baikal
E2009.266	Il'chir Lake	larch	51°57'39"	100°57'05"	0.717476	South Baikal
E2009.267	Il'chir Lake	larch	51°57'39"	100°57'05"	0.718116	South Baikal
E2009.270	Ch. Irkut	larch	51°54'04"	100°45'30"	0.709765	South Baikal
E2009.271	Ch. Irkut	larch	51°54'04"	100°45'30"	0.709778	South Baikal
E2009.274	Ch. Irkut	birch	51°47'54"	100°42'32"	0.706728	South Baikal
E2009.275	Ch. Irkut	birch	51°47'54"	100°42'32"	0.706904	South Baikal
E2009.277	B. Irkut	birch	51°46'12"	100°42'33"	0.709739	South Baikal
E2009.278	B. Irkut	birch	51°46'12"	100°42'33"	0.710665	South Baikal
E2009.281	Irkut	larch	51°44'58"	100°43'56"	0.709765	South Baikal
E2009.282	Irkut	larch	51°44'58"	100°43'56"	0.710119	South Baikal
E2009.286	Aerkhan	larch	51°41'50"	100°52'18"	0.708671	South Baikal
E2009.287	Aerkhan	pine	51°41'50"	100°52'18"	0.708716	South Baikal
E2009.293	B. Khara-Gol	birch	51°39'16"	101°15'05"	0.710034	South Baikal
E2009.294	B. Khara-Gol	pine	51°39'16"	101°15'05"	0.710003	South Baikal
E2009.300	Khalagan	birch	51°37'56"	101°33'23"	0.709494	South Baikal
E2009.301	Khalagan	larch	51°37'56"	101°33'23"	0.709476	South Baikal
E2009.307	Nilovka	birch	51°40'45"	101°40'46"	0.7096	South Baikal
E2009.308	Nilovka	pine	51°40'45"	101°40'46"	0.709358	South Baikal
E2009.314	Turan	birch	51°38'55"	101°41'12"	0.708391	South Baikal
E2009.315	Turan	pine	51°38'55"	101°41'12"	0.708264	South Baikal

E2009.321	B. Zangisan	birch	51°40'00"	101°49'43"	0.709353	South Baikal
E2009.322	B. Zangisan	pine	51°40'00"	101°49'43"	0.70957	South Baikal
E2009.326	Arshan	pine	51°55'02"	102°25'34"	0.709551	South Baikal
E2009.327	Arshan	pine	51°55'02"	102°25'34"	0.709587	South Baikal
E2009.330	Arshan	larch	51°55'06"	102°25'25"	0.709368	South Baikal
E2009.331	Arshan	larch	51°55'06"	102°25'25"	0.709424	South Baikal
E2009.335	Arshan	birch	51°52'06"	102°30'14"	0.709167	South Baikal
E2009.336	Arshan	pine	51°52'06"	102°30'14"	0.707136	South Baikal
E2009.342	Tunka	birch	51°44'20"	102°30'11"	0.708471	South Baikal
E2009.343	Tunka	pine	51°44'20"	102°30'11"	0.708951	South Baikal
E2009.346	Ulan-Gorkhon	birch	51°41'23"	102°30'41"	0.712028	South Baikal
E2009.347	Ulan-Gorkhon	birch	51°41'23"	102°30'41"	0.712059	South Baikal
E2009.352	Okhor-Shibir	birch	51°37'55"	102°21'50"	0.711535	South Baikal
E2009.353	Okhor-Shibir	larch	51°37'55"	102°21'50"	0.71425	South Baikal
E2009.360	Kiren	birch	51°40'34"	102°08'49"	0.708765	South Baikal
E2009.361	Kiren	pine	51°40'34"	102°08'49"	0.708986	South Baikal
E2009.364	Kultuk	birch	51°41'15"	103°41'37"	0.707739	South Baikal
E2009.365	Kultuk	birch	51°41'15"	103°41'37"	0.707639	South Baikal
E2009.367	Bezymiannaia	birch	51°35'42"	103°54'34"	0.711125	South Baikal
E2009.368	Bezymiannaia	birch	51°35'42"	103°54'34"	0.710069	South Baikal
E2009.373	Sukhoi Ruchei	birch	51°37'37"	103°47'45"	0.708605	South Baikal
E2009.374	Sukhoi Ruchei	pine	51°37'37"	103°47'45"	0.711905	South Baikal
E2009.523	Tunka	birch	51°44'33"	102°26'01"	0.708581	South Baikal
E2009.524	Tunka	birch	51°44'33"	102°26'01"	0.708973	South Baikal
E2009.525	Tunka	pine	51°44'33"	102°26'01"	0.708529	South Baikal
E2009.526	Tunka	pine	51°44'33"	102°26'01"	0.707794	South Baikal
E2009.527	Tunka	pine	51°44'33"	102°26'01"	0.709776	South Baikal

E2009.528	Mondy	birch	51°41'53"	100°52'28"	0.709878	South Baikal
E2009.529	Mondy	birch	51°41'53"	100°52'28"	0.709641	South Baikal
E2009.530	Mondy	birch	51°41'53"	100°52'28"	0.709435	South Baikal
E2009.531	Mondy	larch	51°41'53"	100°52'28"	0.707794	South Baikal
E2009.536	Zun-Murino	birch	51°44'30"	102°47'14"	0.709776	South Baikal
E2009.537	Zun-Murino	pine	51°44'30"	102°47'14"	0.709878	South Baikal
E2009.542	Tory	birch	51°46'30"	103°01'25"	0.709641	South Baikal
E2009.543	Tory	pine	51°46'30"	103°01'25"	0.709435	South Baikal
E2009.001	Baiandai	birch	53°07'13"	105°38'31"	0.709952	Upper Lena River
E2009.002	Baiandai	birch	53°07'13"	105°38'31"	0.710224	Upper Lena River
E2009.007	Khogot	spruce	53°13'40"	105°51'04"	0.709011	Upper Lena River
E2009.008	Khogot	spruce	53°13'40"	105°51'04"	0.708929	Upper Lena River
E2009.018	Khogot	birch	53°16'56"	105°54'18"	0.708891	Upper Lena River
E2009.019	Khogot	larch	53°16'56"	105°54'18"	0.70896	Upper Lena River
E2009.029	Manzurka	birch	53°30'26"	106°01'37"	0.70978	Upper Lena River
E2009.030	Manzurka	larch	53°30'26"	106°01'37"	0.709945	Upper Lena River
E2009.040	Kharbatovo	birch	53°48'31"	105°58'47"	0.710573	Upper Lena River
E2009.041	Kharbatovo	pine	53°48'31"	105°58'47"	0.709897	Upper Lena River
E2009.050	Ilikta	birch	53°49'25"	106°24'54"	0.711422	Upper Lena River
E2009.051	Ilikta	spruce	53°49'25"	106°24'54"	0.711192	Upper Lena River
E2009.061	Makrushina	birch	53°52'50"	106°15'40"	0.710731	Upper Lena River
E2009.062	Makrushina	pine	53°52'50"	106°15'40"	0.711043	Upper Lena River
E2009.073	Malye Goly	birch	53°54'38"	106°09'29"	0.710312	Upper Lena River
E2009.074	Malye Goly	pine	53°54'38"	106°09'29"	0.710546	Upper Lena River
E2009.082	Zhigalovo	birch	54°46'07"	105°08'39"	0.711487	Upper Lena River
E2009.083	Zhigalovo	pine	54°46'07"	105°08'39"	0.711883	Upper Lena River
E2009.088	Vorob'eva	birch	54°34'38"	105°14'48"	0.709874	Upper Lena River

E2009.089	Vorob'eva	pine	54°34'38"	105°14'48"	0.710792	Upper Lena River
E2009.094	Zapleskino	birch	54°21'58"	105°15'00"	0.710142	Upper Lena River
E2009.095	Zapleskino	pine	54°21'58"	105°15'00"	0.710459	Upper Lena River
E2009.101	Verkholensk	birch	54°06'44"	105°34'06"	0.7091	Upper Lena River
E2009.102	Verkholensk	pine	54°06'44"	105°34'06"	0.710748	Upper Lena River
E2009.108	Magdan	birch	53°37'34"	105°17'56"	0.709258	Upper Lena River
E2009.109	Magdan	larch	53°37'34"	105°17'56"	0.708889	Upper Lena River
E2009.114	Magdan	birch	53°37'41"	105°17'21"	0.709252	Upper Lena River
E2009.115	Magdan	pine	53°37'41"	105°17'21"	0.708751	Upper Lena River
E2009.123	Ikhinagui	birch	53°44'32"	105°19'53"	0.709809	Upper Lena River
E2009.124	Ikhinagui	larch	53°44'32"	105°19'53"	0.709184	Upper Lena River
E2009.128	Obkhoi	birch	53°58'34"	105°26'47"	0.710131	Upper Lena River
E2009.129	Obkhoi	pine	53°58'34"	105°26'47"	0.709934	Upper Lena River
E2009.134	Shemetovo	birch	54°01'03"	105°26'47"	0.709883	Upper Lena River
E2009.135	Shemetovo	pine	54°01'03"	105°26'47"	0.709992	Upper Lena River
E2009.145	Kartukhai	birch	54°02'17"	105°37'17"	0.710993	Upper Lena River
E2009.146	Kartukhai	pine	54°02'17"	105°37'17"	0.711913	Upper Lena River
E2009.150	Shyshkino	birch	54°00'07"	105°43'48"	0.710488	Upper Lena River
E2009.151	Shyshkino	pine	54°00'07"	105°43'48"	0.710735	Upper Lena River
E2009.155	Mys	birch	54°01'55"	106°24'15"	0.711096	Upper Lena River
E2009.157	Mys	spruce	54°01'55"	106°24'15"	0.711151	Upper Lena River
E2009.163	Kachug	birch	53°58'53"	105°51'41"	0.709212	Upper Lena River
E2009.164	Kachug	larch	53°58'53"	105°51'41"	0.709836	Upper Lena River
E2009.169	Polovinka	birch	53°07'07"	105°40'44"	0.710089	Upper Lena River
E2009.170	Polovinka	birch	53°07'07"	105°40'44"	0.709924	Upper Lena River
E2009.385	Bulga	birch	52°58'04"	105°44'18"	0.710596	Upper Lena River
E2009.386	Bulga	larch	52°58'04"	105°44'18"	0.710573	Upper Lena River

E2009.391	Kosaia Step	birch	52°52'03"	106°01'55"	0.712669	Upper Lena River
E2009.392	Kosaia Step	larch	52°52'03"	106°01'55"	0.70914	Upper Lena River
E2009.176	Sosnovyi Bor	birch	52°39'01"	104°30'59"	0.709648	Upper Angara
E2009.177	Sosnovyi Bor	birch	52°39'01"	104°30'59"	0.709514	Upper Angara
E2009.185	Moty	birch	52°04'24"	103°54'14"	0.710747	Upper Angara
E2009.186	Moty	pine	52°04'24"	103°54'14"	0.7122	Upper Angara
E2009.379	Gramatukha	pine	51°56'46"	103°48'42"	0.714123	Upper Angara
E2009.380	Gramatukha	fir	51°56'46"	103°48'42"	0.714298	Upper Angara
E2009.483	Listvianka	birch	51°51'38"	104°51'11"	0.732844	Upper Angara
E2009.484	Listvianka	larch	51°51'38"	104°51'11"	0.752254	Upper Angara
E2009.490	Bol'shaia Rechka	birch	51°57'06"	104°44'50"	0.712507	Upper Angara
E2009.491	Bol'shaia Rechka	pine	51°57'06"	104°44'50"	0.712047	Upper Angara
E2009.498	Karolok	birch	52°08'18"	104°34'14"	0.710242	Upper Angara
E2009.499	Karolok	pine	52°08'18"	104°34'14"	0.710399	Upper Angara
E2009.504	Central Park	birch	52°16'25"	104°17'40"	0.709915	Upper Angara
E2009.505	Central Park	larch	52°16'25"	104°17'40"	0.709861	Upper Angara
E2009.511	Lokomotiv	birch	52°17'15"	104°15'13"	0.70993	Upper Angara
E2009.512	Lokomotiv	birch	52°17'15"	104°15'13"	0.710209	Upper Angara
E2009.518	Ershi	birch	52°13'22"	104°19'27"	0.711526	Upper Angara
E2009.519	Ershi	pine	52°13'22"	104°19'27"	0.71177	Upper Angara

*Reported in Scharlotta 2012.

APPENDIX 4. $^{87}Sr/^{86}Sr$ WATER SAMPLES FOR THE CIS-BAIKAL*

Sample ID	Site	Sample Type	Latitude	Longitude	$^{87}Sr/^{86}Sr$	Micro-Region
E2009.395	Bugul'deika	water	52°50'27"	106°04'58"	0.708772	Baikal, West Coast
E2009.396	Bugul'deika	water	52°32'52"	106°03'49"	0.712713	Baikal, West Coast
E2009.403	Dolon-Bogot	water	52°36'23"	106°08'42"	0.747744	Baikal, West Coast
E2009.416	Anga	water	52°47'57"	106°30'59"	0.773498	Baikal, West Coast
E2009.423	Gorkhon	water	52°51'01"	106°28'51"	0.721274	Baikal, West Coast
E2009.436	Lake Baikal	water	53°12'11"	107°20'36"	0.709215	Little Sea
E2009.443	Lake Baikal	water	53°01'05"	106°53'47"	0.709018	Little Sea
E2009.450	Lake Kurma	water	53°10'59"	106°58'27"	0.725122	Little Sea
E2009.454	Lake Baikal	water	53°08'28"	106°53'32"	0.738304	Little Sea
E2009.464	Sarma	water	53°06'48"	106°50'21"	0.738351	Little Sea
E2009.477	Kulura	water	53°01'01"	106°44'25"	0.719998	Little Sea
E2009.175	Kuda	water	52°55'56"	104°51'25"	0.707906	Middle Angara – East
E2009.207	Kultuchnaia	water	51°44'04"	103°38'12"	0.710194	South Baikal
E2009.208	Bol'shaia Bystraia	water	51°43'51"	103°23'13"	0.709803	South Baikal
E2009.215	Sredniaia Tibelti	water	51°45'41"	103°15'17"	0.71013	South Baikal
E2009.216	Irkut	water	51°46'39"	103°14'41"	0.709274	South Baikal
E2009.229	Zun-Murino	water	51°43'56"	102°51'40"	0.7099	South Baikal
E2009.236	Irkut	water	51°43'03"	102°35'13"	0.708856	South Baikal
E2009.248	Tsagan-Ugun	water	51°48'01"	102°58'31"	0.712292	South Baikal
E2009.261	Kitoi	water	52°02'56"	101°05'53"	0.710705	South Baikal
E2009.265	Ch. Irkut	water	51°57'23"	100°56'35"	0.713728	South Baikal
E2009.269	Suser	water	51°54'20"	100°45'27"	0.709777	South Baikal
E2009.273	Ch. Irkut	water	51°54'04"	100°45'30"	0.709639	South Baikal
E2009.280	B. Irkut	water	51°46'12"	100°42'33"	0.707106	South Baikal
E2009.284	Irkut	water	51°44'58"	100°43'56"	0.708778	South Baikal
E2009.289	Aerkhan	water	51°41'50"	100°52'18"	0.707332	South Baikal
E2009.290	Irkut	water	51°40'26"	101°01'06"	0.708622	South Baikal

E2009.297	B. Khara-Gol	water	51°39'16"	101°15'05"	0.709827	South Baikal
E2009.304	Khalagan	water	51°37'56"	101°33'23"	0.7091	South Baikal
E2009.311	Ekhe-Ukhgun'	water	51°40'45"	101°40'46"	0.709145	South Baikal
E2009.318	Irkut	water	51°38'55"	101°41'12"	0.708823	South Baikal
E2009.325	B. Zangisan	water	51°40'00"	101°49'43"	0.70961	South Baikal
E2009.329	Kyngarga	water	51°55'02"	102°25'34"	0.709181	South Baikal
E2009.339	Tunka	water	51°44'24"	102°31'53"	0.708783	South Baikal
E2009.349	Ulan-Gorkhon	water	51°41'23"	102°30'41"	0.712939	South Baikal
E2009.356	Okhor-Shibir	water	51°37'55"	102°21'50"	0.70954	South Baikal
E2009.357	Irkut	water	51°42'49"	102°25'50"	0.708816	South Baikal
E2009.370	Bezymiannaia	water	51°35'42"	103°54'34"	0.709962	South Baikal
E2009.023	Khodontsa	water	53°22'33"	106°00'24"	0.708508	Upper Lena River
E2009.034	Manzurka	water	53°43'24"	105°59'37"	0.708692	Upper Lena River
E2009.055	Ilikta	water	53°49'25"	106°24'54"	0.709166	Upper Lena River
E2009.056	Lena	water	53°50'22"	106°20'41"	0.708926	Upper Lena River
E2009.057	Biriulka	water	53°51'54"	106°20'18"	0.708852	Upper Lena River
E2009.078	Anga	water	53°56'14"	106°02'49"	0.70836	Upper Lena River
E2009.079	Tutura	water	54°47'23"	105°14'06"	0.708485	Upper Lena River
E2009.086	Lena	water	54°39'54"	105°13'05"	0.708653	Upper Lena River
E2009.099	Gul'ma	water	54°12'53"	105°27'08"	0.708143	Upper Lena River
E2009.112	Magdan	water	53°37'34"	105°17'56"	0.708409	Upper Lena River
E2009.119	Kulenga	water	53°40'41"	105°19'16"	0.708305	Upper Lena River
E2009.120	Inei	water	53°43'12"	105°20'03"	0.70855	Upper Lena River
E2009.141	Tal'ma	water	54°01'12"	105°29'57"	0.708145	Upper Lena River
E2009.142	Kulenga	water	54°06'01"	105°35'05"	0.708222	Upper Lena River
E2009.161	Anga	water	53°58'41"	106°11'15"	0.708729	Upper Lena River
E2009.168	Lena	water	53°56'38"	105°53'04"	0.708816	Upper Lena River

E2009.182	Irkut	water	52°04'34"	103°53'34"	0.709821	Upper Angara
E2009.487	Listvianka	water	51°51'38"	104°51'11"	0.708946	Upper Angara
E2009.494	Bol'shaia Rechka	water	51°57'06"	104°44'50"	0.71169	Upper Angara
E2009.495	Karolok	water	52°08'08"	104°34'42"	0.709119	Upper Angara
E2009.508	Ushakovka	water	52°17'48"	104°17'43"	0.709761	Upper Angara
E2009.515	Irkut	water	52°17'46"	104°14'23"	0.709514	Upper Angara

*Reported in Scharlotta 2012.

APPENDIX 5. STABLE CARBON AND NITROGEN ISOTOPIC DATA FOR ALL CIS-BAIKAL HUMAN SAMPLES*

Cemetery	Master ID	Archaeological Age	Sex	Ind. Age	Sample ID	C/N Ratio	Collagen Yield	$\delta^{13}C$	$\delta^{15}N$	Micro-Region	Dietary Type
Lokomotiv	LOK_1980.002.01	Early Neolithic	Female	20–25	1992.008	3.2	8.7	-14.7	15.2	Angara River	–
Lokomotiv	LOK_1980.002.02	Early Neolithic	Undet.	35–39	1992.009	3.2	11	-16.3	13.9	Angara River	–
Lokomotiv	LOK_1980.002.04	Early Neolithic	Undet.	25–35	2001.272	3.1	8.9	-16.2	13.9	Angara River	–
Lokomotiv	LOK_1980.004	Early Neolithic	Female	25–35	1992.011	3.3	7.6	-15.9	14.3	Angara River	–
Lokomotiv	LOK_1980.007	Early Neolithic	Female	35–50	1992.012	3.3	15.7	-15.3	14.8	Angara River	–
Lokomotiv	LOK_1980.008	Early Neolithic	Female	35–50	1992.013	3.3	19.3	-15.0	14.9	Angara River	–
Lokomotiv	LOK_1980.009	Early Neolithic	Female	20+	2001.112	3.6	3.8	-17.1	12.9	Angara River	–
Lokomotiv	LOK_1980.010.01	Early Neolithic	Male	20–25	1992.015	3.2	17.8	-15.2	14.9	Angara River	–
Lokomotiv	LOK_1980.010.02	Early Neolithic	Male	20–25	1992.016	3.1	6.3	-15.2	14.7	Angara River	–
Lokomotiv	LOK_1980.010.03	Early Neolithic	Female	50+	1992.017	3.1	15.5	-14.8	15.1	Angara River	–
Lokomotiv	LOK_1980.010.04	Early Neolithic	Male	30–35	2001.233	3.1	8.8	-15.6	14.6	Angara River	–
Lokomotiv	LOK_1980.011	Early Neolithic	Male	50+	1992.019	3.1	15.5	-14.7	15.1	Angara River	–
Lokomotiv	LOK_1980.012	Early Neolithic	Female	18–22	2001.23	3.1	15.1	-15.5	14.2	Angara River	–
Lokomotiv	LOK_1980.014.01	Early Neolithic	Male	50+	1992.021	3.2	20.9	-14.7	14.7	Angara River	–
Lokomotiv	LOK_1980.014.03	Early Neolithic	Undet.	10–11	2001.247	3.2	14	-15.9	13.6	Angara River	–
Lokomotiv	LOK_1980.014.04	Early Neolithic	Male	19–22	1992.024	3.1	18.8	-16.2	14	Angara River	–
Lokomotiv	LOK_1980.015	Early Neolithic	Male	20–35	1992.025	3.3	1.5	-15.2	14.4	Angara River	–

Lokomotiv	LOK_1980.016	Early Neolithic	Male	45–55	2001.238	3.2	18.1	-15.2	14.4	Angara River	–
Lokomotiv	LOK_1980.017	Early Neolithic	Male	35–50	1992.027	3.1	18.3	-15.6	14.2	Angara River	–
Lokomotiv	LOK_1980.018	Early Neolithic	Female	20+	1992.028	3.2	13	-15.7	14.7	Angara River	–
Lokomotiv	LOK_1980.019	Early Neolithic	Male	50+	2001.098	3.1	15.1	-15.2	15	Angara River	–
Lokomotiv	LOK_1980.020.01	Early Neolithic	Female	20–29	1992.03	3.1	14.9	-15.3	13.7	Angara River	–
Lokomotiv	LOK_1980.020.02	Early Neolithic	Male	35–50	2001.089	3.1	17.4	-15.4	13.9	Angara River	–
Lokomotiv	LOK_1980.021	Early Neolithic	Female	50+	1992.032	3.6	17.1	-14.7	15.3	Angara River	–
Lokomotiv	LOK_1981.013	Early Neolithic	Male	25–30	2001.139	3.2	6.7	-16.2	15.1	Angara River	–
Lokomotiv	LOK_1981.023	Early Neolithic	Male	20–25	1992.039	3.2	7.2	-15.4	14.4	Angara River	–
Lokomotiv	LOK_1981.024.01	Early Neolithic	Undet.	12–15	1992.04	3.1	15.4	-15.3	13.8	Angara River	–
Lokomotiv	LOK_1981.024.02	Early Neolithic	Male	40–45	2001.324	3.1	15.5	-15.0	14.7	Angara River	–
Lokomotiv	LOK_1981.024.04	Early Neolithic	Undet.	7.5–11.5	2001.151	3.2	7.1	-14.7	14.5	Angara River	–
Lokomotiv	LOK_1981.024.05	Early Neolithic	Male	25–35	1992.044	3.3	10.8	-16.1	13.9	Angara River	–
Lokomotiv	LOK_1981.024.06	Early Neolithic	Undet.	7–10	2001.11	3.2	13.6	-15.7	14	Angara River	–
Lokomotiv	LOK_1981.025.02	Early Neolithic	Female	20–22	1992.047	3.2	2.2	-15.4	14.3	Angara River	–
Lokomotiv	LOK_1981.025.03	Early Neolithic	Probable Female	25–35	1992.048	3.2	8.3	-15.2	14.5	Angara River	–
Lokomotiv	LOK_1981.025.04	Early Neolithic	Male	35–45	1992.049	3.1	17.3	-18.3	11.7	Angara River	–
Lokomotiv	LOK_1983.026	Early Neolithic	Male	20+	1992.05	3.2	5.3	-15.6	14.5	Angara River	–
Lokomotiv	LOK_1984.027	Early Neolithic	Male	15–18	2001.262	3.2	11.6	-16.8	13.3	Angara River	–

Lokomotiv	LOK_1984.028	Early Neolithic	Female	35–40	2001.257	3.1	13.3	-16.1	14.1	Angara River	–
Lokomotiv	LOK_1984.029	Early Neolithic	Probable Female	30–40	2001.22	3.2	9.8	-15.6	14.2	Angara River	–
Lokomotiv	LOK_1985.030.02	Early Neolithic	Male	35-40	1992.055	3.1	10.5	-15.9	13.9	Angara River	–
Lokomotiv	LOK_1985.031.01	Early Neolithic	Female	20+	1992.056	3.1	17.8	-16.2	14.2	Angara River	–
Lokomotiv	LOK_1985.031.02	Early Neolithic	Male	25–30	1992.057	3.1	14	-16.9	13.1	Angara River	–
Lokomotiv	LOK_1985.033	Early Neolithic	Male	35–50	1992.058	3.1	8.8	-15.9	14.2	Angara River	–
Lokomotiv	LOK_1985.034	Early Neolithic	Female	35–45	2001.115	3.2	8.2	-15.9	14.3	Angara River	–
Lokomotiv	LOK_1985.035	Early Neolithic	Undet.	20+	2001.166	3.1	4.2	-15.4	14.9	Angara River	–
Lokomotiv	LOK_1985.036	Early Neolithic	Female	20–25	2001.264	3.2	14.7	-15.8	14.5	Angara River	–
Lokomotiv	LOK_1986.037	Early Neolithic	Female	25–29	2001.188	3.1	14.1	-15.9	14.5	Angara River	–
Lokomotiv	LOK_1988.038.01	Early Neolithic	Female	50+	2001.363	3.1	15.5	-14.7	14.7	Angara River	–
Lokomotiv	LOK_1988.038.02	Early Neolithic	Female	35–45	2001.365	3.2	14.5	-15.9	14.6	Angara River	–
Lokomotiv	LOK_1988.039	Early Neolithic	Female	20–25	1992.065	3.3	12.7	-15.6	14.6	Angara River	–
Lokomotiv	LOK_1990.040	Early Neolithic	Male	20+	2001.334	3.1	17.7	-16.1	13.6	Angara River	–
Lokomotiv	LOK_1990.041.01	Early Neolithic	Female	15–20	1992.067	3.1	12.8	-16.3	13.2	Angara River	–
Lokomotiv	LOK_1990.041.03	Early Neolithic	Undet.	20+	1992.069	3	6.9	-16.2	13.6	Angara River	–
Lokomotiv	LOK_1990.042	Early Neolithic	Male	35–50	1992.07	3.3	10.9	-15.7	14.6	Angara River	–
Lokomotiv	LOK_1990.043.02	Early Neolithic	Female	35–50	1992.071	3	14.2	-14.9	14.6	Angara River	–
Lokomotiv	LOK_1990.044.01	Early Neolithic	Male	35–39	2001.254	3.1	12.7	-15.5	14.1	Angara River	–

Lokomotiv	LOK_1990.044.02	Early Neolithic	Male	30–39	1992.073	3.1	13.2	-15.7	13.8	Angara River	–
Lokomotiv-Raisovet	LOR_1980.001	Early Neolithic	Male	30–34	2001.267	3.1	13.7	-15.8	14.4	Angara River	–
Lokomotiv-Raisovet	LOR_1980.003.01	Early Neolithic	Male	30–35	1992.001	3.2	11	-16.7	12.8	Angara River	–
Lokomotiv-Raisovet	LOR_1991.006.01	Early Neolithic	Male	35–39	1992.003	3.2	12.8	-15.8	14	Angara River	–
Lokomotiv-Raisovet	LOR_1991.006.02	Early Neolithic	Male	50+	1992.004	3.3	18	-15.6	15.1	Angara River	–
Lokomotiv-Raisovet	LOR_1991.007.01	Early Neolithic	Male	50+	1992.006	3.4	7.8	-15.1	14.2	Angara River	–
Lokomotiv-Raisovet	LOR_1991.007.02	Early Neolithic	Female	15–20	1992.007	3.1	19.5	-18.9	11.9	Angara River	–
Lokomotiv-Raisovet	LOR_1997.011	Early Neolithic	Female	20–25	2001.283	3.2	9.5	-15.1	14.6	Angara River	–
Lokomotiv-Raisovet	LOR_1997.011	Early Neolithic	Female	20–25	2001.284	3.2	8.4	-16.3	14.7	Angara River	–
Lokomotiv-Raisovet	LOR_1998.012	Early Neolithic	Undet.	10–12	2001.293	3.1	11.1	-15.2	13.4	Angara River	–
Lokomotiv-Raisovet	LOR_1998.013.02	Early Neolithic	Undet.	8–12	2001.297	3.1	11.4	-16.2	13.7	Angara River	–
Lokomotiv-Raisovet	LOR_1998.013.03	Early Neolithic	Female	25–35	2001.291	3.1	8.2	-16.3	13.6	Angara River	–
Lokomotiv-Raisovet	LOR_1998.013.04	Early Neolithic	Female	20–25	2001.226	3.2	6.1	-16.4	13.3	Angara River	–
Lokomotiv-Raisovet	LOR_998.014	Early Neolithic	Male	30–39	2001.12	3.2	5.2	-15.4	14.2	Angara River	–
Lokomotiv-Raisovet	LOR_998.015.01	Early Neolithic	Female	20–35	2001.303	3.2	16.5	-16.9	13.1	Angara River	–
Ust' Belaia	UBE_1962.005	Early Neolithic	Undet.	20+	1992.119	3.2	16.6	-17.4	13.2	Angara River	–
Ust' Belaia	UBE_1962.008	Early Neolithic	Undet.	20+	1992.121	3.3	9.2	-16.9	13.6	Angara River	–
Ust' Belaia	UBE_1962.009.00	Early Neolithic	Undet.	20+	1992.122	3.3	8.9	-16.8	13.9	Angara River	–
Kitoi	KIT_0000.000	Early Neolithic	Undet.	20+	1997.275	3.3	14.7	-17.3	14.5	Angara River	–

Ust' Ida	UID_1987.001.01	Late Neolithic	Female	20+	1992.074	3.4	19.1	-19.9	8.9	Angara River	–
Ust' Ida	UID_1987.005	Late Neolithic	Undet.	7–9	1992.077	3.3	17.8	-17.5	12.3	Angara River	–
Ust' Ida	UID_1987.006	Late Neolithic	Male	35–50	1992.078	3.3	13.5	-17.4	11.7	Angara River	–
Ust' Ida	UID_1987.010	Late Neolithic	Undet.	7.5–11.5	1992.082	3.2	21.5	-17.7	12.2	Angara River	–
Ust' Ida	UID_1987.011	Late Neolithic	Female	35–50	2001.169	3.3	14.7	-18.0	11.1	Angara River	–
Ust' Ida	UID_1987.012	Late Neolithic	Male	50+	1992.084	3.1	21.9	-18.3	11.5	Angara River	–
Ust' Ida	UID_1988.014	Late Neolithic	Male	18–20	1992.085	3.2	14.1	-18.1	11	Angara River	–
Ust' Ida	UID_1988.016.01	Late Neolithic	Male	25–35	1992.087	3.2	17.2	-18.8	11.7	Angara River	–
Ust' Ida	UID_1988.016.02	Late Neolithic	Male	50+	1992.088	3.3	23.2	-19.2	11.5	Angara River	–
Ust' Ida	UID_1988.018	Late Neolithic	Undet.	11–13	1992.09	3.2	21.7	-18.3	11.7	Angara River	–
Ust' Ida	UID_1989.020.01	Late Neolithic	Male	18–24	1991.053	3.2	15.9	-17.2	12.7	Angara River	–
Ust' Ida	UID_1989.020.02	Late Neolithic	Female	20–40	2001.182	3.3	16.8	-17.7	11.1	Angara River	–
Ust' Ida	UID_1989.022	Late Neolithic	Female	15–20	1992.095	3.3	21.6	-18.7	11.7	Angara River	–
Ust' Ida	UID_1989.025.03	Late Neolithic	Undet.	7.5–11.5	2001.203	3.3	14.5	-18.0	11.6	Angara River	–
Ust' Ida	UID_1989.026.01	Late Neolithic	Undet.	13–15	2001.191	3.3	18.8	-17.5	11.3	Angara River	–
Ust' Ida	UID_1989.026.04	Late Neolithic	Undet.	10–12	2001.134	3.3	18	-17.6	11.9	Angara River	–
Ust' Ida	UID_1989.030	Late Neolithic	Female	50+	2001.122	3.2	19.1	-18.8	11.9	Angara River	–
Ust' Ida	UID_1989.031	Late Neolithic	Undet.	10–12	1992.108	3.3	17	-18.0	12	Angara River	–
Ust' Ida	UID_1989.032	Late Neolithic	Undet.	8–10	2001.196	3.1	18.7	-18.5	11	Angara River	–

Ust' Ida	UID_1989.032	Late Neolithic	Undet.	7.5–11.5	1992.109	3.2	20	-18.1	11.4	Angara River	–
Ust' Ida	UID_1990.033.02	Late Neolithic	Undet.	13–16	2001.218	3.3	17.7	-17.5	11.7	Angara River	–
Ust' Ida	UID_1991.036.02	Late Neolithic	Female	30–40	2001.339	3.2	19.9	-17.9	11.3	Angara River	–
Ust' Ida	UID_1993.044.01	Late Neolithic	Undet.	9–10	2001.341	3.3	17.4	-17.4	12.5	Angara River	–
Ust' Ida	UID_1993.044.03	Late Neolithic	Undet.	11–12	2001.137	3.3	16.8	-17.0	12.6	Angara River	–
Ust' Ida	UID_1994.052	Late Neolithic	Female	60+	2001.332	3.3	18.9	-16.5	12.8	Angara River	–
Ust' Ida	UID_1994.053.01	Late Neolithic	Undet.	9.5–11.5	2001.194	3.3	7.7	-17.0	12.3	Angara River	–
Ust' Ida	UID_1994.054	Late Neolithic	Male	50+	1995.007	3.1	17.3	-17.9	12.5	Angara River	–
Ust' Ida	UID_1994.055.02	Late Neolithic	Male	15–18	2001.357	3.3	16.1	-17.3	11.6	Angara River	–
Ust' Ida	UID_1995.056.01	Late Neolithic	Male	35–50	2001.184	3.3	17.2	-17.5	12.4	Angara River	–
Ust' Ida	UID_1985.056.02	Late Neolithic	Undet.	9–11	2001.37	3.3	14.7	-18.6	11.1	Angara River	–
Ust' Ida	UID_1987.007	Early Bronze Age	Male	20+	2001.127	3.3	12.9	-17.4	12.2	Angara River	–
Ust' Ida	UID_1989.019	Early Bronze Age	Male	30–35	1992.091	3.3	15.7	-18.7	12.3	Angara River	–
Ust' Ida	UID_1989.029	Early Bronze Age	Male	50+	1992.106	3.3	15.6	-17.3	11.8	Angara River	–
Ust' Ida	UID_1991.037	Early Bronze Age	Female	35–50	1992.112	3.3	23	-19.6	10	Angara River	–
Ust' Ida	UID_1991.039	Early Bronze Age	Female	25–35	2001.33	3.3	13.3	-17.9	11.7	Angara River	–
Ust' Ida	UID_1991.040.01	Early Bronze Age	Female	25–35	1992.115	3.4	19	-21.0	9.2	Angara River	–
Ust' Ida	UID_1991.042	Early Bronze Age	Female	50+	1992.117	3.2	21.8	-20.5	11.4	Angara River	–
Ust' Ida	UID_1993.045	Early Bronze Age	Male	25–35	1993.07	3.2	21.4	-19.3	11.3	Angara River	–

Ust' Ida	UID_1994.047	Early Bronze Age	Male	30–40	1994.004	3.3	12.8	-18.6	10.9	Angara River	–
Ust' Ida	UID_1994.049	Early Bronze Age	Probable Female	20+	2001.117	3.3	15.8	-17.8	11.7	Angara River	–
Ust' Ida	UID_1994.051	Early Bronze Age	Male	20+	1995.003	3.3	14.7	-17.7	12	Angara River	–
Lokomotiv	LOK_1980.005	Early Bronze Age	Undet.	9–11	2001.273	3.4	4.9	-18.0	12.5	Angara River	–
Ust' Belaia	UBE_1987.002	Early Bronze Age	Undet.	20+	1992.123	3.2	21.2	-19.2	11.1	Angara River	–
Kurma XI	KUR_2003.022	Early Neolithic	Probable Female	50+	2003.027	3.3	8.2	-19.0	12	Little Sea	GF
Khuzhir-Nuge XIV	K14_1997.007	Late Neolithic	Probable Male	25–25	1997.198	3.6	4.9	-19.6	11.9	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.027.01	Early Bronze Age	Male	35–50	1998.387	3.5	6.2	-19.7	11.8	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.028	Early Bronze Age	Female	20+	1998.307	3.4		-19.1	12.7	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.032	Early Bronze Age	Female	50+	1998.31	3.4	3.1	-19.5	11.6	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.034	Early Bronze Age	Male	25–35	1998.39	3.4	6	-19.8	11.9	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.035.01	Early Bronze Age	Male	18–20	2001.597	3.3	4.3	-19.6	11.7	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.035.02	Early Bronze Age	Undet.	8–10	1998.313	3.3	5	-19.4	11.4	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.036.01	Early Bronze Age	Undet.	35–50	1998.325	3.3	19.8	-19.1	12.8	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.037.01	Early Bronze Age	Undet.	14–17	1998.32	3.4	7.4	-19.4	11.5	Little Sea	GF
Khuzhir-Nuge XIV	K14_1998.037.02	Early Bronze Age	Undet.	14–17	1998.393	3.3	4.7	-19.5	11.4	Little Sea	GF
Khuzhir-Nuge XIV	K14_1999.059.01	Early Bronze Age	Undet.	35–50	1999.148	3.6	8.1	-20.0	11	Little Sea	GF
Khuzhir-Nuge XIV	K14_2000.061	Early Bronze Age	Undet.	20+	2000.16	3.3	5.4	-19.1	12.1	Little Sea	GF
Khuzhir-Nuge XIV	K14_2000.066	Early Bronze Age	Male	35–50	2000.152	3.3	14.6	-19.3	11.1	Little Sea	GF

Khuzhir-Nuge XIV	K14_2000.070	Early Bronze Age	Undet.	35–50	2000.155	3.3	14.1	-19.0	10.7	Little Sea	GF
Khuzhir-Nuge XIV	K14_2000.071	Early Bronze Age	Undet.	12–15	2000.147	3.4	10	-18.9	12.6	Little Sea	GF
Khuzhir-Nuge XIV	K14_2000.077	Early Bronze Age	Undet.	12–15	2000.169	3.4	1.6	-19.3	10.3	Little Sea	GF
Khuzhir-Nuge XIV	K14_2000.080.01	Early Bronze Age	Undet.	Undet.	2000.122	3.4	0.2	-19.4	11.8	Little Sea	GF
Khuzhir-Nuge XIV	K14_2001.081	Early Bronze Age	Male	35–50	2001.617	3.3	1.6	-19.2	12.6	Little Sea	GF
Khuzhir-Nuge XIV	K14_2001.082	Early Bronze Age	Undet.	20–25	2001.61	3.3	8.9	-19.4	12.3	Little Sea	GF
Khuzhir-Nuge XIV	K14_2001.083	Early Bronze Age	Undet.	20+	2001.607	3.6	9	-20.1	12.1	Little Sea	GF
Khuzhir-Nuge XIV	K14_2001.084	Early Bronze Age	Undet.	13–19	2001.611	3.3	11.9	-19.3	11.2	Little Sea	GF
Khuzhir-Nuge XIV	K14_2001.085	Early Bronze Age	Undet.	20+	2001.609	3.3	10.9	-19.2	12.2	Little Sea	GF
Khuzhir-Nuge XIV	K14_2001.086	Early Bronze Age	Undet.	20–25	2001.614	3.4	17.9	-19.6	12.3	Little Sea	GF
Khuzhir-Nuge XIV	K14_2001.087	Early Bronze Age	Male	35–50	2001.616	3.6	9.2	-19.4	12.6	Little Sea	GF
Kurma XI	KUR_2002.001	Early Bronze Age	Male	25–30	2002.11	3.2	10.3	-19.5	11.5	Little Sea	GF
Kurma XI	KUR_2002.009	Early Bronze Age	Undet.	20+	2002.151	3.2	12.3	-19.7	12.6	Little Sea	GF
Kurma XI	KUR_2002.012	Early Bronze Age	Undet.	20+	2002.127	3.2	11	-19.8	11.7	Little Sea	GF
Kurma XI	KUR_2002.015	Early Bronze Age	Probable Male	17–18	2002.135	3.2	13.9	-19.3	12.7	Little Sea	GF
Kurma XI	KUR_2003.019	Early Bronze Age	Probable Male	20–30	2003.012	3.2	5.6	-19.4	11.3	Little Sea	GF
Sarminskii Mys	SMS_1987.021	Early Bronze Age	Female	20+	1994.023	3.3	20.9	-19.5	12.2	Little Sea	GF
Khotoruk	KHO_1977.003.01	Early Neolithic	Undet.	20+	1991.043	3.5	2.4	-17.0	14.1	Little Sea	GFS
Kurma XI	KUR_2003.024	Early Neolithic	Probable Female	20–35	2003.035	3.5	5.9	-18.0	15.2	Little Sea	GFS

Shamanskii Mys	SHM_1972.003	Early Neolithic	Undet.	20+	1995.232	3.3	10.8	- 18.3	13.7	Little Sea	GFS
Sarminskii Mys	SMS_1986.011.01**	Late Neolithic	Undet.	8–13	1994.008	3.5	5.4	- 17.7	16	Little Sea	GFS
Sarminskii Mys	SMS_1986.011.02**	Late Neolithic	Male	20–35	1994.009	3.4	15.6	- 18.3	16.4	Little Sea	GFS
Sarminskii Mys	SMS_1986.011.04**	Late Neolithic	Probable Male	20–35	1994.011	3.4	11	- 17.6	16.1	Little Sea	GFS
Sarminskii Mys	SMS_1986.019.01**	Late Neolithic	Male	14–19	1994.013	3.5	36.9	- 18.7	15	Little Sea	GFS
Sarminskii Mys	SMS_1986.019.05**	Late Neolithic	Female	35–50	1994.017	3.4	18	- 17.6	15.6	Little Sea	GFS
Sarminskii Mys	SMS_1987.024	Late Neolithic	Male	35–50	1994.025	3.5	2.6	- 18.7	14.9	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.009	Early Bronze Age	Male	50+	1997.199	3.4	6.6	- 18.7	14.2	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.010	Early Bronze Age	Undet.	20–25	1997.2	3.4	5.2	- 19.0	13.8	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.011	Early Bronze Age	Male	35–50	1997.201	3.3	8.9	- 18.3	15.6	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.012	Early Bronze Age	Undet.	25–35	1997.202	3.4	4.8	- 18.6	13.6	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.014	Early Bronze Age	Male	35–50	1997.203	3.5	5.6	- 18.9	14.9	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.015	Early Bronze Age	Male	25–35	1997.204	3.4	10.1	- 17.7	15.4	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.016	Early Bronze Age	Undet.	7–9	2001.604	3.3	9.4	- 17.8	15.5	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.019	Early Bronze Age	Female	35–50	1997.206	3.5	3.2	- 18.1	15.6	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1997.023	Early Bronze Age	Undet.	20+	2001.602	3.3	1.5	- 17.4	16.1	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1998.027.02	Early Bronze Age	Undet.	9–11	2001.59	3.3	2.4	- 18.0	14.6	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1998.031	Early Bronze Age	Undet.	20+	1998.309	3.3	14.5	- 18.7	14.5	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1998.038	Early Bronze Age	Male	35–50	1998.326	3.4	4.6	- 17.7	14.3	Little Sea	GFS

Khuzhir-Nuge XIV	K14_1998.039	Early Bronze Age	Undet.	9–11	1998.323	3.5	5.1	-18.4	15.6	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.045	Early Bronze Age	Undet.	8–10	1999.155	3.4	5.5	-18.5	14.3	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.046	Early Bronze Age	Male	25–35	1999.128	3.4	10	-18.1	14.1	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.048	Early Bronze Age	Undet.	7–9	2001.629	3.6	8.9	-18.5	16.5	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.049	Early Bronze Age	Undet.	50+	2001.634	3.3	9.8	-18.4	14.7	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.050	Early Bronze Age	Undet.	15–18	1999.187	3.3	4.4	-17.1	15.6	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.051	Early Bronze Age	Male	18–20	1999.138	3.3	4.6	-17.5	13.5	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.053	Early Bronze Age	Male	35–50	1999.144	3.3	2.8	-17.5	15.6	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.055	Early Bronze Age	Male	35–50	1999.143	3.4	3.6	-17.8	15.3	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.057.01	Early Bronze Age	Female	18–20	1999.182	3.3	14.8	-18.8	14	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.057.02	Early Bronze Age	Male	35–50	2001.635	3.4	3.7	-18.7	13.7	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.058.01	Early Bronze Age	Undet.	25–35	2001.633	3.2	6.9	-16.7	14.8	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.058.02	Early Bronze Age	Male	35–50	1999.181	3.3	5.5	-17.6	14.8	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.059.02	Early Bronze Age	Male	18–20	1999.186	3.4	8.5	-18.9	13.9	Little Sea	GFS
Khuzhir-Nuge XIV	K14_1999.060	Early Bronze Age	Female	50+	1999.178	3.5	3.8	-19.1	14.2	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.062.01	Early Bronze Age	Male	20+	2000.136	3.3	5	-17.1	16.2	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.062.02	Early Bronze Age	Undet.	8–10	2001.631	3.4	6.4	-16.2	15.3	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.063	Early Bronze Age	Undet.	16–18	2000.145	3.4	5.8	-17.9	15.4	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.064	Early Bronze Age	Male	25–35	2000.129	3.3	2.6	-17.6	15.4	Little Sea	GFS

Khuzhir-Nuge XIV	K14_2000.073	Early Bronze Age	Undet.	20+	2000.154	3.3	11.1	-17.9	13.7	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.074	Early Bronze Age	Male	25–35	2000.163	3.3	1	-17.8	14.9	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.075	Early Bronze Age	Undet.	20+	2000.165	3.3	9.8	-18.6	16.1	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.076	Early Bronze Age	Undet.	20+	2000.12	3.4	8.8	-18.7	15	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.078	Early Bronze Age	Undet.	20+	2000.131	3.4	7.3	-17.2	14.9	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.079	Early Bronze Age	Undet.	20+	2000.121	3.5	3.4	-18.5	14.3	Little Sea	GFS
Khuzhir-Nuge XIV	K14_2000.080.02	Early Bronze Age	Male	50+	2000.125	3.4	3.6	-18.0	13.9	Little Sea	GFS
Kurma XI	KUR_2002.003	Early Bronze Age	Undet.	20+	2002.13	3.2	13.1	-18.3	15	Little Sea	GFS
Kurma XI	KUR_2002.004	Early Bronze Age	Male	35–44	2002.117	3.2	9.2	-15.0	17.4	Little Sea	GFS
Kurma XI	KUR_2002.005	Early Bronze Age	Undet.	30–35	2002.141	3.2	15.7	-18.4	15.1	Little Sea	GFS
Kurma XI	KUR_2002.006	Early Bronze Age	Female	20–29	2002.113	3.2	5.5	-18.7	14.9	Little Sea	GFS
Kurma XI	KUR_2002.007.01	Early Bronze Age	Undet.	20+	2002.09	3.2	7.4	-18.4	15.9	Little Sea	GFS
Kurma XI	KUR_2002.007.02	Early Bronze Age	Male	20–29	2002.103	3.2	12.8	-18.5	14.2	Little Sea	GFS
Kurma XI	KUR_2002.010	Early Bronze Age	Probable Male	18–25	2002.101	3.2	6.4	-17.2	15.8	Little Sea	GFS
Kurma XI	KUR_2002.013	Early Bronze Age	Male	40+	2002.122	3.2	10	-19.2	14.6	Little Sea	GFS
Kurma XI	KUR_2002.014	Early Bronze Age	Female	30–39	2002.096	3.2	16.2	-19.2	13.2	Little Sea	GFS
Kurma XI	KUR_2002.016	Early Bronze Age	Probable Female	20–30	2002.145	3.2	11	-19.3	14.3	Little Sea	GFS
Kurma XI	KUR_2003.017	Early Bronze Age	Probable Male	20+	2003.016	3.2	9.7	-18.3	16.7	Little Sea	GFS
Kurma XI	KUR_2003.018	Early Bronze Age	Probable Female	17–19	2003.006	3.3	9.7	-18.1	15	Little Sea	GFS

Kurma XI	KUR_2003.025	Early Bronze Age	Undet.	20+	2003.041	3.6	3.8	-18.8	15.2	Little Sea	GFS
Kurma XI	KUR_2003.026	Early Bronze Age	Probable Male	35–50	2003.036	3.4	7.1	-18.2	15.2	Little Sea	GFS
Shamanskii Mys	SHM_1972.001.01	Early Bronze Age	Female	20+	1991.023	3.3	21.1	-18.3	14	Little Sea	GFS
Shamanskii Mys	SHM_1972.002	Early Bronze Age	Male	20+	1991.003	3.4	20.7	-18.4	13.9	Little Sea	GFS
Shamanskii Mys	SHM_1973.001	Early Bronze Age	Male	25–35	1991.024	3.3	23	-17.7	13.7	Little Sea	GFS
Shamanskii Mys	SHM_1973.002	Early Bronze Age	Female	20+	1991.022	3.4	23.2	-18.8	14.5	Little Sea	GFS
Shamanskii Mys	SHM_1973.003.01	Early Bronze Age	Probable Female	20+	1991.002	3.2	15.1	-18.4	14.6	Little Sea	GFS
Shamanskii Mys	SHM_1973.004	Early Bronze Age	Undet.	20+	1991.021	3.5	16.9	-18.6	14.9	Little Sea	GFS
Sarminskii Mys	SMS_1986.012	Early Bronze Age	Female	20+	1997.002	3.4	6.2	-18.1	15.4	Little Sea	GFS
Sarminskii Mys	SMS_1986.013	Early Bronze Age	Male	20+	1997.003	3.3	15.5	-18.7	14.9	Little Sea	GFS
Sarminskii Mys	SMS_1987.009	Early Bronze Age	Male	20+	1997.001	3.4	3	-18.1	16.1	Little Sea	GFS
Makrushina	MAK_1989.001	Early Neolithic	Undet.	20+	1992.124	3.4	14.7	-19.8	10.6	Upper Lena	–
Turuka	TUR_1992.001	Early Neolithic	Undet.	20+	1993.072	3.6	1.5	-20.6	12.4	Upper Lena	–
Turuka	TUR_1992.002	Early Neolithic	Undet.	20+	1993.073	3.5	4.9	-20.8	11.6	Upper Lena	–
Turuka	TUR_1992.003	Early Neolithic	Undet.	20+	1992.127	3.5	9	-20.1	12.5	Upper Lena	–
Turuka	TUR_1992.004	Early Neolithic	Undet.	20+	1992.128	3.6	0.7	-20.4	12.1	Upper Lena	–
Turuka	TUR_1992.005	Early Neolithic	Undet.	20+	1993.074	3.5	7.1	-20.1	12.3	Upper Lena	–
Turuka	TUR_1992.009	Early Neolithic	Undet.	20+	1993.077	3.5	0.9	-20.2	13	Upper Lena	–
Turuka	TUR_1992.010	Early Neolithic	Undet.	35–50	1993.078	3.5	6	-20.3	12.3	Upper Lena	–

Nikolskii Grot	NGT_0000.00	Late Neolithic	Undet.	20+	1992.133	3.4	22.8	-19.9	11	Upper Lena	–
Nikolskii Grot	NGT_1982.001.01	Late Neolithic	Undet.	20+	1992.129	3.4	21.7	-19.1	11.6	Upper Lena	–
Nikolskii Grot	NGT_1982.002.01	Late Neolithic	Undet.	20+	1992.131	3.4	21.8	-19.4	10.1	Upper Lena	–
Zakuta	ZAK_1992.001	Late Neolithic	Undet.	Adult	1994.001	3.4	12.6	-19.9	12.1	Upper Lena	–
Zakuta	ZAK_1994.002	Late Neolithic	Undet.	Adult	1994.002	3.3	20.6	-19.9	11.9	Upper Lena	–
Zakuta	ZAK_1994.003	Late Neolithic	Undet.	Adult	1994.003	3.3	17.7	-20.6	11.8	Upper Lena	–
Borki 1	BO1_1971.001.01	Early Bronze Age	Undet.	20+	1991.028	3.4	23.4	-19.8	9.9	Upper Lena	–
Borki 1	BO1_1971.002.01	Early Bronze Age	Undet.	20+	1991.027	3.3	22.2	-19.7	10.2	Upper Lena	–
Borki 2	BO2_1971.001.01	Early Bronze Age	Undet.	20+	1991.019	3.4	20.3	-19.2	10.2	Upper Lena	–
Borki 2	BO2_1971.003.01	Early Bronze Age	Undet.	20+	1991.018	3.5	20.5	-19.4	10.1	Upper Lena	–
Borki 2	BO2_1971.003.01	Early Bronze Age	Undet.	20+	1991.026	3.4	23.5	-19.0	9.6	Upper Lena	–
Makrushina	MAK_1989.003	Early Bronze Age	Undet.	20+	1992.126	3.4	13.3	-18.8	12.1	Upper Lena	–
Obkhoi	OBK_1971.001.01	Early Bronze Age	Undet.	20+	1991.008	3.3	23.1	-19.2	10	Upper Lena	–
Obkhoi	OBK_1971.001.02	Early Bronze Age	Undet.	50+	1991.012	3.3	15.7	-19.6	9.6	Upper Lena	–
Obkhoi	OBK_1971.003	Early Bronze Age	Undet.	20+	1991.007	3.3	21.4	-19.9	9.1	Upper Lena	–
Obkhoi	OBK_1971.003.04	Early Bronze Age	Undet.	20+	1991.016	3.4	19.7	-19.3	10.4	Upper Lena	–
Obkhoi	OBK_1971.005	Early Bronze Age	Undet.	20+	1991.033	3.4	26.6	-19.9	9.3	Upper Lena	–
Obkhoi	OBK_1971.010	Early Bronze Age	Undet.	25–35	1991.025	3.4	17.9	-19.6	12	Upper Lena	–
Obkhoi	OBK_1971.013	Early Bronze Age	Undet.	20–25	1991.014	3.3	19.5	-20.3	11.1	Upper Lena	–

Obkhoi	OBK_1971.014	Early Bronze Age	Undet.	20+	1991.029	3.5	20.1	- 18.9	10.1	Upper Lena	–
Shamanka II	SHA_1999.007	Early Neolithic	Probable Female	20-30	2002.204	3.2	15.1	- 16.9	13.1	South Baikal	–
Shamanka II	SHA_2000.008	Early Neolithic	Male	35-40	2002.174	3.2	15.7	- 16.8	15.6	South Baikal	–
Shamanka II	SHA_2000.010	Early Neolithic	Male	25-35	2002.213	3.2	13.6	- 16.9	14.2	South Baikal	–
Shamanka II	SHA_2001.011.01	Early Neolithic	Female	18-20	2002.165	3.2	16	- 17.6	14.8	South Baikal	–
Shamanka II	SHA_2001.011.02	Early Neolithic	Male	30-40	2002.164	3.2	1	- 16.9	15	South Baikal	–
Shamanka II	SHA_2001.013.01	Early Neolithic	Probable Female	25-35	2003.652	3.2	19.3	- 15.8	15.4	South Baikal	–
Shamanka II	SHA_2001.013.02	Early Neolithic	Male	35-50	2003.65	3.2	18.8	- 16.4	15.5	South Baikal	–
Shamanka II	SHA_2001.013.03	Early Neolithic	Probable Female	18-19	2002.192	3.2	14.6	- 15.2	14.4	South Baikal	–
Shamanka II	SHA_2001.014.01	Early Neolithic	Male	25-30	2002.178	3.2	11.2	- 15.3	15.8	South Baikal	–
Shamanka II	SHA_2001.014.02	Early Neolithic	Female	20-25	2002.180	3.2	11.6	- 15.4	15.6	South Baikal	–
Shamanka II	SHA_2001.015	Early Neolithic	Male	25-35	2002.207	3.2	17.5	- 15.5	15.8	South Baikal	–
Shamanka II	SHA_2001.016	Early Neolithic	Undet.	20-25	2002.189	3.2	15.5	- 15.9	14.5	South Baikal	–
Shamanka II	SHA_2001.017.01	Early Neolithic	Male	30-40	2002.201	3.2	12.2	- 15.6	14.6	South Baikal	–
Shamanka II	SHA_2001.017.02	Early Neolithic	Male	20-22	2002.198	3.2	7.6	- 14.7	15.6	South Baikal	–
Shamanka II	SHA_2001.018	Early Neolithic	Male	25-29	2002.186	3.2	20.1	- 16.8	14.5	South Baikal	–
Shamanka II	SHA_2001.019	Early Neolithic	Male	25-30	2002.183	3.2	15.7	- 14.9	15.8	South Baikal	–
Shamanka II	SHA_2001.021.03	Early Neolithic	Undet.	16-18	2002.244	3.3	3.4	- 16.0	13.8	South Baikal	–
Shamanka II	SHA_2002.021.01	Early Neolithic	Male	25-30	2002.238	3.2	13.8	- 16.5	12.1	South Baikal	–

Shamanka II	SHA_2002.021.02	Early Neolithic	Male	25-30	2002.241	3.2	15	-16.8	13.8	South Baikal	–
Shamanka II	SHA_2002.022	Early Neolithic	Male	19-22	2002.232	3.3	0.2	-16.0	15.5	South Baikal	–
Shamanka II	SHA_2002.023.01	Early Neolithic	Probable Male	35-45	2002.227	3.2	14.2	-15.6	15.9	South Baikal	–
Shamanka II	SHA_2002.023.02	Early Neolithic	Probable Female	20+	2002.218	3.2	16.9	-15.7	15.6	South Baikal	–
Shamanka II	SHA_2002.023.04	Early Neolithic	Undet.	20+	2002.221	3.2	17.5	-16.5	13.8	South Baikal	–
Shamanka II	SHA_2002.023.05	Early Neolithic	Undet.	20+	2002.223	3.2	20	-16.1	14.3	South Baikal	–
Shamanka II	SHA_2002.024.01	Early Neolithic	Male	25-35	2002.230	3.2	17.9	-15.8	14.4	South Baikal	–
Shamanka II	SHA_2002.024.02	Early Neolithic	Undet.	12-15	2002.235	3.2	13.2	-15.6	14.8	South Baikal	–
Shamanka II	SHA_2003.025.01	Early Neolithic	Female	20-22	2003.562	3.3	17.4	-15.7	14.6	South Baikal	–
Shamanka II	SHA_2003.026.01	Early Neolithic	Probable Female	20+	2003.538	3.2	15.8	-17.3	13.8	South Baikal	–
Shamanka II	SHA_2003.026.02	Early Neolithic	Probable Male	20+	2003.539	3.2	13.6	-17.8	11.9	South Baikal	–
Shamanka II	SHA_2003.027.01	Early Neolithic	Male	35-50	2003.550	3	14.7	-16.3	14.3	South Baikal	–
Shamanka II	SHA_2003.027.02	Early Neolithic	Male	25-30	2003.553	3.1	15.5	-16.4	14.1	South Baikal	–
Shamanka II	SHA_2003.029.01	Early Neolithic	Male	20-30	2003.546	3.1	15.2	-15.7	13.4	South Baikal	–
Shamanka II	SHA_2003.030	Early Neolithic	Male	35-50	2003.56	3.2	18.8	-17.2	14.3	South Baikal	–
Shamanka II	SHA_2003.032	Early Neolithic	Male	35-45	2003.536	3.2	14.1	-16.6	13.7	South Baikal	–
Shamanka II	SHA_2003.033	Early Neolithic	Male	35-45	2003.565	3.2	18	-16.4	14.1	South Baikal	–
Shamanka II	SHA_2004.039	Early Neolithic	Male	40-44	2004.001	3.4	16.4	-16.6	14	South Baikal	–
Shamanka II	SHA_2004.041	Early Neolithic	Male	30-39	2004.007	3.4	18.8	-17.4	14.3	South Baikal	–

Shamanka II	SHA_2004.042.01	Early Neolithic	Female	40-45	2004.013	3.2	20.4	-15.9	14.8	South Baikal	–
Shamanka II	SHA_2004.042.02	Early Neolithic	Female	50+	2004.019	3.4	16.8	-17.9	11.1	South Baikal	–
Shamanka II	SHA_2004.0243	Early Neolithic	Probable Female	35-50	2004.024	3.4	19.6	-16.4	14.5	South Baikal	–
Shamanka II	SHA_2004.044.01	Early Neolithic	Probable Male	50+	2004.027	3.2	14.6	-15.5	15.2	South Baikal	–
Shamanka II	SHA_2004.044.02	Early Neolithic	Undet.	20+	2004.03	3.3	17.1	-16.9	14.2	South Baikal	–
Shamanka II	SHA_2004.045	Early Neolithic	Male	25-35	2004.032	3.5	17	-17.1	13.9	South Baikal	–
Shamanka II	SHA_2004.046	Early Neolithic	Male	25-29	2004.038	3.3	19.7	-15.9	15.6	South Baikal	–
Shamanka II	SHA_2004.047	Early Neolithic	Female	20-25	2004.044	3.3	16.2	-15.8	15.3	South Baikal	–
Shamanka II	SHA_2004.048.01	Early Neolithic	Male	50+	2004.137	3.1	16.2	-16.2	14.6	South Baikal	–
Shamanka II	SHA_2004.049.01	Early Neolithic	Probable Male	17-20	2004.05	3.3	16.1	-16.0	13.7	South Baikal	–
Shamanka II	SHA_2004.049.02	Early Neolithic	Undet.	Adult	2004.056	3.3	18.1	-16.9	14.1	South Baikal	–
Shamanka II	SHA_2004.050.01	Early Neolithic	Male	25-35	2004.102	3.3	19.9	-16.2	14.7	South Baikal	–
Shamanka II	SHA_2004.050.02	Early Neolithic	Male	25-29	2004.108	3.2	18.2	-16.9	13.8	South Baikal	–
Shamanka II	SHA_2004.050.03	Early Neolithic	Male	30-40	2004.116	3.6	17.9	-15.8	14.8	South Baikal	–
Shamanka II	SHA_2004.051	Early Neolithic	Male	20-25	2004.057	3.4	13.1	-15.9	15.5	South Baikal	–
Shamanka II	SHA_2004.052.01	Early Neolithic	Probable Male	20-24	2004.13	3.2	18.1	-16.4	14.2	South Baikal	–
Shamanka II	SHA_2004.053.01	Early Neolithic	Male	20-25	2004.062	3.4	13.4	-16.2	15.6	South Baikal	–
Shamanka II	SHA_2004.053.02	Early Neolithic	Male	50+	2004.068	3.2	17.6	-15.9	16	South Baikal	–
Shamanka II	SHA_2004.054.01	Early Neolithic	Female	17-21	2004.071	3.3	15.9	-17.2	15.6	South Baikal	–

Shamanka II	SHA_2004.054.02	Early Neolithic	Undet.	Adult	2004.076	3.4	15.2	-17.0	14	South Baikal	–
Shamanka II	SHA_2004.055.01	Early Neolithic	Male	35-39	2004.093	3.4	17.5	-17.4	14.1	South Baikal	–
Shamanka II	SHA_2004.057.01	Early Neolithic	Female	25-29	2004.119	3.1	16.9	-15.2	16.4	South Baikal	–
Shamanka II	SHA_2004.057.02	Early Neolithic	Female	25-35	2004.124	3.6	17.9	-14.9	15.1	South Baikal	–
Shamanka II	SHA_2004.058.01	Early Neolithic	Male	35-45	2004.083	3.3	15.7	-16.2	13.8	South Baikal	–
Shamanka II	SHA_2000.009	Early Bronze Age	Probable Female	17-18	2002.169	3.2	14.3	-16.0	13.3	South Baikal	–
Shamanka II	SHA_2004.056.02	Early Neolithic	Undet.	8-10	2004.080	3.3	19.4	-16.0	15.8	South Baikal	–

*Reported in Weber et al. 2011.

**Individuals from multiple burials at Sarminskii Mys could not be clearly associated with specific individuals in Goriunova (1997) or other archaeological and demographic treatments of the site (e.g., Goriunova 2002; Goriunova et al. 1998).

APPENDIX 6. $^{87}Sr/^{86}Sr$ VALUES FROM ANGARA RIVER INDIVIDUALS*

Burial	Master ID	M1 $^{87}Sr/^{86}Sr$	M2 $^{87}Sr/^{86}Sr$	M3 $^{87}Sr/^{86}Sr$	Archaeological Age
19-1	UID_1989.019	0.70949	0.70952	0.70938	Early Bronze Age
29-1	UID_1989.029	0.71013	0.70938	0.70943	Early Bronze Age
45-1	UID_1993.045	0.71029	0.7101	0.70984	Early Bronze Age
48-1	UID_1994.048	0.70979	0.70938	0.70981	Early Bronze Age
06-1	UID_1987.006	0.71004	0.70934	0.70931	Late Neolithic
11-1	UID_1987.011	0.71335	0.71057	0.71009	Late Neolithic
14-1	UID_1988.014	0.70966	0.70978	0.70992	Late Neolithic
20-1	UID_1989.020.01	0.70933	0.70985	0.70968	Late Neolithic
20-2	UID_1989.020.02	0.71134	0.70926	0.70959	Late Neolithic
22-1	UID_1989.022	0.70998	0.70973	0.71029	Late Neolithic
30-1	UID_1989.030	0.70978	0.70995	0.70981	Late Neolithic
38-1	UID_1991.038	0.71111	0.7099	0.70946	Late Neolithic
56-1	UID_1995.056.01	0.70984	0.71002	0.70966	Late Neolithic

*Reported in Haverkort et al. 2010.

APPENDIX 7. ALL GEOCHEMICAL DATA FOR INDIVIDUALS INCLUDED IN THIS STUDY

Site	Feature #	Ind #	M1 $^{87}Sr/^{86}Sr$	M2 $^{87}Sr/^{86}Sr$	M3 $^{87}Sr/^{86}Sr$	Time Period	Sex	Age	$\delta^{13}C$ (Calgary)	$\delta^{15}N$ (Calgary)	Previous Publication for $^{87}Sr/^{86}Sr$	publication for C, N	C/N
Upper Lena Samples													
Borkii	1	1	0.70941	0.70938	0.70939	Early Bronze Age	-	20+	-19.8	9.9	-	weber et al. 2002	-
Makarovo, 1980 excavation	1	1	0.71551	0.71707	0.71541		-	-	-	-	-	-	-
Nikol'skoye	1	1	0.70921	0.70943	0.70941	Late Neolithic	-	20+	-19.1	11.6	-	weber et al. 2002	-
Nikol'skoye	2	1	0.7092	0.70916	0.70912	Late Neolithic	-	20+	-19.4	10.1	-	weber et al. 2002	-
Obkhoi	5	1	-	0.70914	0.70937	Early Bronze Age	f	ad	-19.9	9.3	-	Weber et al. 2002	-
Obkhoi	7	1	-	0.70906	0.7112	Early Bronze Age	-	-	-	-	-	-	-
Obkhoi	13	1	0.7112	0.71051	0.70959	Early Bronze Age	m	20-25	-20.3	11.1	-	Weber et al. 2002	-
Silinskaya	1	1	0.70965	-	-	Early Bronze Age	-	8-11	-	-	-	-	-
Silinskaya	2	1	0.70931	0.70966	-	Early Bronze Age	f	35-40	-	-	-	-	-
Ust'-Tal'ma	1	1	0.70915	0.70934	-		m	20+	-	-	-	-	-
Ust'-Iamnaia, 1982 excavation	1	1	0.70948	0.70962	0.70938		m	35-50	-	-	-	-	-

Verkholensk, 1998 excavation	1	1	0.70966	0.70947	0.70957	Early Bronze Age	f	ad	-	-	-	-	-
Verkholensk, 1998 excavation	3	1	0.70949	0.70981	0.70942	Early Bronze Age	f	older adult	-	-	-	-	-
Little Sea Samples													
Site	Feature #	Ind #	M1 87Sr/86Sr	M2 87Sr/86Sr	M3 87Sr/86Sr	Time Period	Sex	Age	calgary $\delta^{13}C$	calgary $\delta^{15}N$	Specific publication for Sr	publication for C, N	C/N
Elga III, 1988 excavation	1	1	0.71173	0.71155	-	Late Neolithic	-	-	-	-	-	-	-
Elga III, 1988 excavation	5	1	0.72182	0.71708	0.71664	Late Neolithic	pf	ad	-	-	-	-	-
Sarminskii Mys	17	1	0.71471	0.71335	0.71332	Late Neolithic	m	20-35	-	-	-	-	-
Sarminskii Mys	19	1	0.71281	0.71178	0.71322	Late Neolithic	-	16-18	-	-	-	-	-
Sarminskii Mys	19	2	0.71343	0.71178	0.71452	Late Neolithic	f	45-49	-	-	-	-	-
Sarminskii Mys	19	4	0.71794	0.7137	0.71263	Late Neolithic	-	20+	-	-	-	-	-
Sarminskii Mys	29	1	0.71674	-	-	Late Neolithic	m	20+	-	-	-	-	-
Sarminskii Mys	30	1	0.71483	0.71539	-	Late Neolithic	-	9-11	-	-	-	-	-
Sarminskii Mys	31	1	0.70948	0.70903	-	Late Neolithic	m	30-40	-	-	-	-	-
Sarminskii Mys	31	2	0.71935	0.71281	-	Late Neolithic	-	20+	-	-	-	-	-
Sarminskii Mys	31	3	0.70956	0.71051	0.71533	Late Neolithic	pf	20-35	-	-	-	-	-
Sarminskii Mys	11A	1	0.71021	0.71202	0.71212	Late Neolithic	-	20+	-	-	-	-	-

Sarminskii Mys	11A	2	0.71738	0.71645	-	Late Neolithic	-	6-7	-	-	-	-	-
Sarminskii Mys	11A	3	0.71404	0.7162	-	Late Neolithic	-	20+	-	-	-	-	-
Sarminskii Mys	11A	4	0.7266	0.71777	-	Late Neolithic	-	17-20	-	-	-	-	-
Sarminskii Mys	11B	1	0.7119	0.71052	0.71403	Late Neolithic	pm	20+	-18.9	15		katzenberg et al. 2012	3.3
Khuzhir-Nuge XIV	2	1	0.70931	0.70938	0.70938	Early Bronze Age	-	-	-	-	-	-	-
Khuzhir-Nuge XIV	4	1	0.7105	0.70993	0.70988	Early Bronze Age	-	-	-	-	-	-	-
Khuzhir-Nuge XIV	5	1	0.7108	-	0.71194	Early Bronze Age	-	-	-	-	-	-	-
Khuzhir-Nuge XIV	10	1	0.71006	0.71041	0.70996	Early Bronze Age	-	20-25	-19	13.8	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	11	1	0.71349	0.71295	0.7132	Early Bronze Age	M	35-50	-18.3	15.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	12	1	0.71554	0.7164	0.71307	Early Bronze Age	-	25-35	-18.6	13.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	14	1	0.71344	0.71364	0.71227	Early Bronze Age	PM	35-50	-18.9	14.9	Weber and Goriunova 2013	Weber and Goriunova 2013	3.5
Khuzhir-Nuge XIV	15	1	0.71353	0.7119	0.7117	Early Bronze Age	M	25-35	-17.7	15.4	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	16	1	0.71451	0.7132	0.71096	Early Bronze Age	-	7-9	-17.8	15.5	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	17	1	0.71306	0.71188	-	Early Bronze Age	-	5-7	-17.6	14.8	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4

Khuzhir-Nuge XIV	19	1	0.72126	0.71709	0.71161	Early Bronze Age	F	20+	-18.1	15.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.5
Khuzhir-Nuge XIV	26	1	0.71112	-	-	Early Bronze Age	-	4-6	-18.5	14.2	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	27	1	0.70997	0.70976	0.70982	Early Bronze Age	M	35-50	-19.7	11.8	Weber and Goriunova 2013	Weber and Goriunova 2013	3.5
Khuzhir-Nuge XIV	27	2	0.71233	0.71353	-	Early Bronze Age	-	0-11	-18.4	14.5	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	27	3	0.71399	-	-	Early Bronze Age	-	4-6	-18	14.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	32	1	-	0.70999	0.70958	Early Bronze Age	f	50+	-19.5	11.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	33	1	0.71124	-	-	Early Bronze Age	-	3-5	-18.1	15	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	34	1	-	0.70938	0.70934	Early Bronze Age	m	25-35	-19.8	11.9	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	35	1	0.71112	0.7108	0.71063	Early Bronze Age	PM	18-20	-19.6	11.7	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	35	2	0.71157	0.71054	0.71036	Early Bronze Age	-	8-10	-19.4	11.4	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	36	1	0.71146	0.71393	0.71125	Early Bronze Age	-	35-50	-19.1	12.8	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	36	2	0.70983	-	-	Early Bronze Age	-	4-6	-19.6	12.7	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3

Khuzhir-Nuge XIV	37	1	0.70999	-	0.71	Early Bronze Age	-	14-17	-19.4	11.5	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	37	2	0.71091	0.71276	0.70993	Early Bronze Age	-	14-17	-19.5	11.4	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	38	1	0.71103	0.71064	0.71153	Early Bronze Age	M	35-50	-17.7	14.3	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	39	1	0.71196	0.71334	0.71066	Early Bronze Age	-	9-11	-18.4	15.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.5
Khuzhir-Nuge XIV	40	1	0.71154	-	-	Early Bronze Age	-	2-3	-18	19.1	Weber and Goriunova 2013	Weber and Goriunova 2013	3.5
Khuzhir-Nuge XIV	44	1	0.71288	0.71179	0.71186	Early Bronze Age	M	35-50	-	-	Weber and Goriunova 2013	Weber and Goriunova 2013	-
Khuzhir-Nuge XIV	45	1	0.71507	0.71292	0.71056	Early Bronze Age	-	8-10	-18.5	14.3	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	46	1	0.7104	0.71014	0.70997	Early Bronze Age	M	25-35	-18.1	14.1	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	48	1	0.71228	0.71174	-	Early Bronze Age	-	7-9	-18.5	16.5	Weber and Goriunova 2013	Weber and Goriunova 2013	3.6
Khuzhir-Nuge XIV	50	1	0.71273	0.71193	-	Early Bronze Age	-	15-18	-17.1	15.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	51	1	0.71109	0.71397	0.71226	Early Bronze Age	M	18-20	-17.5	13.5	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	53	1	0.71202	0.71477	-	Early Bronze Age	m	35-50	-17.5	15.6	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3

Khuzhir-Nuge XIV	55	1	0.71196	0.71166	0.71183	Early Bronze Age	PM	35-50	-17.8	15.3	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	57	2	0.71046	0.71347	0.71302	Early Bronze Age	PM	35-50	-18.7	13.7	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	58	1	0.70917	0.70926	-	Early Bronze Age	-	25-35	-16.7	14.8	Weber and Goriunova 2013	Weber and Goriunova 2013	3.2
Khuzhir-Nuge XIV	58	2	0.71083	-	-	Early Bronze Age	pm	35-50	-17.6	14.8	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	59	1	0.70992	-	-	Early Bronze Age	-	35-50	-20	11.0	Weber and Goriunova 2013	Weber and Goriunova 2013	3.6
Khuzhir-Nuge XIV	59	2	0.71375	0.71197	0.71147	Early Bronze Age	M	18-20	-18.9	13.9	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	60	1	-	0.71167	0.71226	Early Bronze Age	pf	50+	-19.1	14.2	Weber and Goriunova 2013	Weber and Goriunova 2013	3.5
Khuzhir-Nuge XIV	63	1	0.71606	0.71305	0.7146	Early Bronze Age	-	16-18	-17.9	15.4	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	64	1	0.71679	0.71201	0.71598	Early Bronze Age	M	25-35	-17.6	15.4	Weber and Goriunova 2013	Weber and Goriunova 2013	3.3
Khuzhir-Nuge XIV	65	1	0.71112	0.71117	-	Early Bronze Age	-	5-6	-18.5	14.3	Weber and Goriunova 2013	Weber and Goriunova 2013	3.5
Khuzhir-Nuge XIV	68	1	-	0.71041	-	Early Bronze Age	pm	25-35	-19.9	12.1	Weber and Goriunova 2013	Weber and Goriunova 2013	3.7
Khuzhir-Nuge XIV	77	1	0.70966	0.70949	0.71032	Early Bronze Age	-	12-15	-19.3	10.3	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4

Khuzhir-Nuge XIV	80	2	-	-	0.71245	Early Bronze Age	m	50+	-18	13.9	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Khuzhir-Nuge XIV	86	1	-	-	0.71085	Early Bronze Age	-	20-25	-19.6	12.3	Weber and Goriunova 2013	Weber and Goriunova 2013	3.4
Kurma XI	1	1	0.70991	-	-	Early Bronze Age	m	25-30	-19.5	11.5	-	Weber et al. 2011	3.2
Kurma XI	10	1	0.71361	-	-	Early Bronze Age	pm	18-25	-17.2	15.8	-	Weber et al. 2011	3.2
Kurma XI	14	1	-	0.70965	-	Early Bronze Age	f	30-39	-19.2	13.2	-	Weber et al. 2011	3.2
Kurma XI	15	1	0.71683	0.71178	-	Early Bronze Age	pm	17-18	-19.3	12.7	-	Weber et al. 2011	3.2
Kurma XI	16	1	0.71022	0.7143	-	Early Bronze Age	pf	20-30	-19.3	14.3	-	Weber et al. 2011	3.2
Sarminskii Mys	2	1	0.71177	0.71031	0.71122	Early Bronze Age	pf	20-35	-	-	-	-	-
Sarminskii Mys	4	1	-	0.71174	0.71239	Early Bronze Age	-	20-35	-	-	-	-	-
Sarminskii Mys	10	1	0.71229	0.71316	0.71202	Early Bronze Age	-	20-35	-	-	-	-	-
Sarminskii Mys	12	1	-	0.7126	-	Early Bronze Age	pf	20+	-18.1	15.4	-	Katzenberg et al. 2012	-
Sarminskii Mys	33	1	0.71064	0.70986	0.70977	Early Bronze Age	pf	35+	-	-	-	-	-

Shamanskii Mys, 1972 excavation	2	1	0.71226	0.71132	0.71151	Early Bronze Age	m	40-50	-18.4	13.9	-	Weber et al. 2002	-
Shamanskii Mys, 1973 excavation	3	1	-	-	0.71182	Early Bronze Age	f	20+	-18.4	14.6	-	Weber et al. 2002	-
Shamanskii Mys, 1975 excavation	1	1	0.71555	0.714	0.71536	Early Bronze Age	m	30-35	-	-	-	-	-
Sarminskii Mys	22	1	0.70915	-	-	Early Neolithic	pf	30-35	-	-	-	-	-
Khuzhir-Nuge XIV	7	1	0.7094	0.71075	0.70906	Early Neolithic	PM	25-35	-19.6	11.9	Weber and goriunova 2013	Weber and goriunova 2013	3.6

APPENDIX 8. SAMPLE PROCESSING METHODS

Purification of strontium from human tooth enamel samples was conducted using the ion exchange method outlined by Deniel and Pin (2001). The purification process took place in the clean laboratory and MC-ICP-MS facility at the Max Planck Institute for Evolutionary Anthropology, Department of Evolutionary Anthropology (Leipzig, Germany), and was supervised by Lysann Raedisch and Drs. Michael Richards and Klervia Jaouen. Mechanical cleaning of teeth was conducted using a sonicated diamond saw attachment on a Dremel drill (to remove any observable surface contaminants). Using a diamond edge saw attachment on a Dremel drill, a piece of enamel with mass of ~5-20 mg was cut from near the cemento-enamel junction of each tooth, following methods described in Haverkort et al. (2008), in order to ensure comparability between studies.

Using a magnifying lens and the Dremel drill, the enamel was separated from any adjoining dentine and cleaned by ultrasonication in deionized water; the water was changed multiple times during this process. The enamel samples were transferred to the clean laboratory and dried thoroughly after being rinsed in ultrapure acetone. Samples weighing ∼5–20 mg were placed in separate Teflon beakers and digested at 120°C in 1 ml of 14.3 M HNO3. The solution containing the enamel sample was then evaporated on the hotplate until dry and subsequently mixed with 1 ml of 3 M HNO3. Strontium from each enamel solution was purified using clean, preconditioned 2 ml columns filled with clean Sr-spec resin (EiChrom, Darien, IL). Each sample was reloaded into its respective column three times. The resin containing the strontium was washed twice with 3 M HNO3, after which the strontium was eluted from the resin using ultrapure deionized water into a clean Teflon tube and evaporated on a hot plate until the sample was dry. Each sample was re-dissolved in 3% HNO3 and measured on a Thermo Fisher Neptune MC-ICP-MS instrument (Thermo Fisher Scientific, Dreieich, Germany).

The reference standard SRM 1486 and one beaker blank were measured in parallel for each run of twelve samples. Repeat measurements of the strontium isotope standard SRM 1486 yielded a mean (± SD) $^{87}Sr/^{86}Sr$ ratio of 0.709299±0.00003 (n=7) and the results for the procedural blanks analyzed were negligible. To ensure the accuracy of the data, the international standard SRM 987 was measured, yielding a mean $^{87}Sr/^{86}Sr$ ratio of 0.710295±0.00001 (n=48), and corrected to the accepted value of 0.71024±0.00004 (Johnson et al. 1990; Terakado et al. 1988). Strontium concentrations were estimated using a regression equation between known, stochiometrically determined concentrations (100, 400, and 700 ppb) and 88Sr signal intensities (V) measured for three SRM 987 standards and this method is described in full in Hartman and Richards (2014).

APPENDIX 9. AVERAGED STABLE ISOTOPE DATASET FOR THE LITTLE SEA MICRO-REGION – LATE NEOLITHIC AND EARLY BRONZE AGE INDIVIDUALS

Site	Master ID	Sex	Age	Archaeological Age	Sample ID	$\delta^{13}C$	$\delta^{15}N$	Micro-Region	Dietary Type	Results Origin
Sarminskii Mys	SMS_1986.009	Undet.	20+ y.	Late Neolithic	H 1997.001	-17.2	16.3	Little Sea	GFS	ORAU
Sarminskii Mys	SMS_1986.011.01	Undet.	8-13 y.	Late Neolithic	H 1994.008	-17.5	16.2	Little Sea	GFS	Average
Sarminskii Mys	SMS_1986.011.02*	Male	20–35	Late Neolithic	H 1994.009	-18.3	16.4	Little Sea	GFS	Calgary
Sarminskii Mys	SMS_1986.011.04	Probable Male	20-35 y.	Late Neolithic	H 1994.011, H 2000.512	-17.3	16.4	Little Sea	GFS	Average
Sarminskii Mys	SMS_1986.017	Undet.	20-35 y.	Late Neolithic	H 2000.515	-17.4	14.8	Little Sea	GFS	ORAU
Sarminskii Mys	SMS_1986.019.01	Male	14-19 y.	Late Neolithic	H 1994.013, H 2000.516	-18.2	15.1	Little Sea	GFS	Average
Sarminskii Mys	SMS_1986.019.02	Undet.	56+ y.	Late Neolithic	H 2000.517	-18.4	15.6	Little Sea	GFS	ORAU
Sarminskii Mys	SMS_1986.019.05	Female	36-55 y.	Late Neolithic	H 1994.017, H 2000.518	-17.3	15.4	Little Sea	GFS	Average
Sarminskii Mys	SMS_1987.024	Male	35–50	Late Neolithic	H 1994.025	-18.7	14.9	Little Sea	GFS	Calgary
Sarminskii Mys	SMS_1987.029.02	Undet.	8-13 y.	Late Neolithic	H 2000.521	-17.1	16.0	Little Sea	GFS	ORAU
Shamanski Mys	SHM_1976.001.01	Undet.	20+ y.	Late Neolithic	H 1993.008	-16.9	16.2	Little Sea	GFS	ORAU
Khadarta IV	KHA_2003.003	Undet.	20+ y.	Early Bronze Age	H 2012.002	-18.3	15.4	Little Sea	GFS	ORAU
Khadarta IV	KHA_2010.005	Undet.	20-30 y.	Early Bronze Age	H 2012.006	-17.8	15.0	Little Sea	GFS	ORAU
Khadarta IV	KHA_2010.006	Undet.	20+ y.	Early Bronze Age	H 2012.009	-19.0	15.4	Little Sea	GFS	ORAU

Khadarta IV	KHA_2010.007	Undet.	20+ y.	Early Bronze Age	H 2012.011	-18.6	16.0	Little Sea	GFS	ORAU
Khadarta IV	KHA_2010.008	Undet.	20+ y.	Early Bronze Age	H 2012.014	-18.1	16.1	Little Sea	GFS	ORAU
Khadarta IV	KHA_2010.009	Undet.	35-50 y.	Early Bronze Age	H 2012.015	-18.1	14.0	Little Sea	GFS	ORAU
Khadarta IV	KHA_2010.011	Undet.	35-40 y.	Early Bronze Age	H 2012.018	-17.2	15.1	Little Sea	GFS	ORAU
Khadarta IV	KHA_2010.012	Undet.	35-50 y.	Early Bronze Age	H 2012.020	-18.6	14.0	Little Sea	GFS	ORAU
Khadarta IV	KHA_2010.015	Undet.	35+ y.	Early Bronze Age	H 2012.021	-17.7	14.4	Little Sea	GFS	ORAU
Khuzhir-Nuge XIV	K14_1997.009	Male	50+	Early Bronze Age	H 1997.199	-18.7	14.2	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.010	Undet.	20–25	Early Bronze Age	H 1997.2	-19.0	13.8	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.011	Male	35–50	Early Bronze Age	H 1997.201	-18.3	15.6	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.012	Undet.	25–35	Early Bronze Age	H 1997.202	-18.6	13.6	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.014	Male	35–50	Early Bronze Age	H 1997.203	-18.9	14.9	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.015	Male	25–35	Early Bronze Age	H 1997.204	-17.7	15.4	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.016	Undet.	7–9	Early Bronze Age	H 2001.604	-17.8	15.5	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.019	Female	35–50	Early Bronze Age	H 1997.206	-18.1	15.6	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1997.023	Undet.	20+	Early Bronze Age	H 2001.602	-17.4	16.1	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1998.027.01	Male	35–50	Early Bronze Age	H 1998.387	-19.7	11.8	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_1998.027.02	Undet.	9–11	Early Bronze Age	H 2001.59	-18.0	14.6	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1998.028	Female	20+	Early Bronze Age	H 1998.307	-19.1	12.7	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_1998.031	Undet.	20+	Early Bronze Age	H 1998.309	-18.7	14.5	Little Sea	GFS	Calgary

Khuzhir-Nuge XIV	K14_1998.032	Female	50+	Early Bronze Age	H 1998.31	-19.5	11.6	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_1998.034	Male	25–35	Early Bronze Age	H 1998.39	-19.8	11.9	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_1998.035.01	Male	18–20	Early Bronze Age	H 2001.597	-19.6	11.7	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_1998.035.02	Undet.	8–10	Early Bronze Age	H 1998.313	-19.4	11.4	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_1998.036.01	Undet.	35-50 y.	Early Bronze Age	H 1998.318, H 1998.325	-19.0	12.6	Little Sea	GF	Average
Khuzhir-Nuge XIV	K14_1998.037.01	Undet.	15-20 y.	Early Bronze Age	H 1998.320	-19.2	11.3	Little Sea	GF	Average
Khuzhir-Nuge XIV	K14_1998.037.02	Undet.	15-20 y.	Early Bronze Age	H 1998.393	-19.4	11.6	Little Sea	GF	Average
Khuzhir-Nuge XIV	K14_1998.038	Male	35–50	Early Bronze Age	H 1998.326	-17.7	14.3	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1998.039	Undet.	9–11	Early Bronze Age	H 1998.323	-18.4	15.6	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.045	Undet.	7.5-11.5 y.	Early Bronze Age	H 2003.623, H 1999.155	-18.2	14.4	Little Sea	GFS	Average
Khuzhir-Nuge XIV	K14_1999.046	Male	25–35	Early Bronze Age	H 1999.128	-18.1	14.1	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.048	Undet.	7–9	Early Bronze Age	H 2001.629	-18.5	16.5	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.049	Undet.	50+ y.	Early Bronze Age	H 1999.184, H 2001.634	-18.0	15.3	Little Sea	GFS	Average
Khuzhir-Nuge XIV	K14_1999.050	Undet.	15–18	Early Bronze Age	H 1999.187	-17.1	15.6	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.051	Male	18–20	Early Bronze Age	H 1999.138	-17.5	13.5	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.053	Male	35–50	Early Bronze Age	H 1999.144	-17.5	15.6	Little Sea	GFS	Calgary

Khuzhir-Nuge XIV	K14_1999.055	Male	35–50	Early Bronze Age	H 1999.143	-17.8	15.3	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.057.01	Female	18–20	Early Bronze Age	H 1999.182	-18.8	14.0	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.057.02	Male	35-50 y.	Early Bronze Age	H 2001.646, H 2001.635	-17.7	15.2	Little Sea	GFS	Average
Khuzhir-Nuge XIV	K14_1999.058.01	Undet.	25–35	Early Bronze Age	H 2001.633	-16.7	14.8	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.058.02	Male	35–50	Early Bronze Age	H 1999.181	-17.6	14.8	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.059.01	Undet.	35–50	Early Bronze Age	H 1999.148	-20.0	11.0	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_1999.059.02	Male	18–20	Early Bronze Age	H 1999.186	-18.9	13.9	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_1999.060	Female	50+	Early Bronze Age	H 1999.178	-19.1	14.2	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.061	Undet.	20+	Early Bronze Age	H 2000.16	-19.1	12.1	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2000.062.01	Male	20+	Early Bronze Age	H 2000.136	-17.1	16.2	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.062.02	Undet.	8–10	Early Bronze Age	H 2001.631	-16.2	15.3	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.063	Undet.	16–18	Early Bronze Age	H 2000.145	-17.9	15.4	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.064	Male	25–35	Early Bronze Age	H 2000.129	-17.6	15.4	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.066	Male	35–50	Early Bronze Age	H 2000.152	-19.3	11.1	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2000.070	Undet.	35–50	Early Bronze Age	H 2000.155	-19.0	10.7	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2000.071	Undet.	12–15	Early Bronze Age	H 2000.147	-18.9	12.6	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2000.073	Undet.	20+	Early Bronze Age	H 2000.154	-17.9	13.7	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.074	Male	25–35	Early Bronze Age	H 2000.163	-17.8	14.9	Little Sea	GFS	Calgary

Khuzhir-Nuge XIV	K14_2000.075	Undet.	20+	Early Bronze Age	H 2000.165	-18.6	16.1	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.076	Undet.	20+	Early Bronze Age	H 2000.12	-18.7	15.0	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.077	Undet.	11.5-15 y.	Early Bronze Age	H 2000.169	-19.0	10.4	Little Sea	GF	Average
Khuzhir-Nuge XIV	K14_2000.078	Undet.	20+	Early Bronze Age	H 2000.131	-17.2	14.9	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.079	Undet.	20+	Early Bronze Age	H 2000.121	-18.5	14.3	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2000.080.01	Undet.	Undet.	Early Bronze Age	H 2000.122	-19.4	11.8	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2000.080.02	Male	50+	Early Bronze Age	H 2000.125	-18.0	13.9	Little Sea	GFS	Calgary
Khuzhir-Nuge XIV	K14_2001.081	Male	35–50	Early Bronze Age	H 2001.617	-19.2	12.6	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2001.082	Undet.	20–25	Early Bronze Age	H 2001.61	-19.4	12.3	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2001.083	Undet.	20+	Early Bronze Age	H 2001.607	-20.1	12.1	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2001.084	Undet.	13–19	Early Bronze Age	H 2001.611	-19.3	11.2	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2001.085	Undet.	20+	Early Bronze Age	H 2001.609	-19.2	12.2	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2001.086	Undet.	20–25	Early Bronze Age	H 2001.614	-19.6	12.3	Little Sea	GF	Calgary
Khuzhir-Nuge XIV	K14_2001.087	Male	35-50 y.	Early Bronze Age	H 2001.616	-18.9	12.7	Little Sea	GF	Average
Kulgana	KUL_1977.000	Undet.	20+ y.	early bronze age	H 1991.035	-19.2	13.7	Little Sea	GFS	ORAU
Kurma XI	KUR_2002.001	Male	20-35 y.	Early Bronze Age	H 2002.11	-19.3	11.6	Little Sea	GF	Average
Kurma XI	KUR_2002.003	Undet.	20-35 y.	Early Bronze Age	H 2002.13	-18.1	15.3	Little Sea	GFS	Average
Kurma XI	KUR_2002.004	Male	36-55 y.	Early Bronze Age	H 2002.117	-16.7	16.5	Little Sea	GFS	Average
Kurma XI	KUR_2002.005	Undet.	20-35 y.	Early Bronze Age	H 2002.141	-18.3	15.2	Little Sea	GFS	Average

Kurma XI	KUR_2002.006	Female	20-35 y.	Early Bronze Age	H 2002.113	-18.7	14.8	Little Sea	GFS	Average
Kurma XI	KUR_2002.007.01	Undet.	20-55 y.	Early Bronze Age	H 2002.09	-18.2	15.3	Little Sea	GFS	Average
Kurma XI	KUR_2002.007.02	Male	20-55 y.	Early Bronze Age	H 2002.103	-18.5	14.7	Little Sea	GFS	Average
Kurma XI	KUR_2002.009	Undet.	20-55 y.	Early Bronze Age	H 2002.135, H 2002.151	-19.3	13.6	Little Sea	GFS	Average
Kurma XI	KUR_2002.010	Probable Male	20-35 y.	Early Bronze Age	H 2002.101	-17.4	16.4	Little Sea	GFS	Average
Kurma XI	KUR_2002.012	Undet.	20-55 y.	Early Bronze Age	H 2002.126, H 2002.127	-19.6	11.6	Little Sea	GF	Average
Kurma XI	KUR_2002.013	Male	36-55 y.	Early Bronze Age	H 2002.122	-19.0	14.3	Little Sea	GFS	Average
Kurma XI	KUR_2002.014	Female	20-35 y.	Early Bronze Age	H 2002.096	-19.1	13.4	Little Sea	GFS	Average
Kurma XI	KUR_2002.015	Probable Male	14-19 y.	Early Bronze Age	H 2002.151, H 2002.135	-19.4	12.8	Little Sea	GF	Average
Kurma XI	KUR_2002.016	Probable Female	14-35 y.	Early Bronze Age	H 2002.145	-19.2	14.7	Little Sea	GFS	Average
Kurma XI	KUR_2003.017	Probable Male	20+ y.	Early Bronze Age	H 2003.016	-18.3	16.5	Little Sea	GFS	Average
Kurma XI	KUR_2003.018	Probable Female	17-19 y.	Early Bronze Age	H 2003.005, H 2003.006	-18.4	14.6	Little Sea	GFS	Average
Kurma XI	KUR_2003.019	Probable Male	20-30 y.	Early Bronze Age	H 2003.012	-19.4	12.3	Little Sea	GF	Average
Kurma XI	KUR_2003.025	Undet.	20+ y.	Early Bronze Age	H 2003.040, H 2003.041	-18.5	15.6	Little Sea	GFS	Average

Kurma XI	KUR_2003.026	Probable Male	35-50 y.	Early Bronze Age	H 2003.036	-18.0	15.3	Little Sea	GFS	Average
Sarminskii Mys	SMS_1986.012	Female	20+ y.	Early Bronze Age	H 1997.002	-17.8	15.2	Little Sea	GFS	Average
Sarminskii Mys	SMS_1986.013	Male	20+ y.	Early Bronze Age	H 2000.514, H 1997.003	-18.7	15.2	Little Sea	GFS	Average
Sarminskii Mys	SMS_1987.009	Male	20+	Early Bronze Age	H 1997.001	-18.1	16.1	Little Sea	GFS	Average
Sarminskii Mys	SMS_1987.021	Female	20-35 y.	Early Bronze Age	H 1997.004, H 1994.023	-19.3	12.2	Little Sea	GF	Average
Sarminskii Mys	SMS_1987.033	Undet.	36-55 y.	Early Bronze Age	H 1997.006	-18.3	13.8	Little Sea	GFS	ORAU
Shamanski Mys	SHM_1975.001	Undet.	20-35 y.	Early Bronze Age	H 2000.204, H 1995.235	-17.3	17.6	Little Sea	GFS	ORAU
Shamanskii Mys	SHM_1972.001.01	Female	20-55 y.	Early Bronze Age	H 1991.023	-18.6	14.6	Little Sea	GFS	Average
Shamanskii Mys	SHM_1972.002	Male	36-55 y.	Early Bronze Age	H 1993.005, H 1993.003	-18.7	14.3	Little Sea	GFS	Average
Shamanskii Mys	SHM_1973.001	Male	20-55 y.	Early Bronze Age	H 1993.007, H 1991.024	-17.9	14.6	Little Sea	GFS	Average
Shamanskii Mys	SHM_1973.002	Female	20-55 y.	Early Bronze Age	H 1993.002, H 1991.022	-18.8	15.0	Little Sea	GFS	Average
Shamanskii Mys	SHM_1973.003.01	Probable Female	20+ y.	Early Bronze Age	H 1993.006, H 1991.002	-18.5	15.4	Little Sea	GFS	Average

Shamanskii Mys	SHM_1973.004	Undet.	20+ y.	Early Bronze Age	H 1991.021	-18.5	15.3	Little Sea	GFS	Average

APPENDIX 10. ORAU STABLE ISOTOPIC DATA FOR LATE NEOLITHIC AND EARLY BRONZE AGE LITTLE SEA INDIVIDUALS

Site	MASTER_ID	Age	HSAMP_ID	$\delta^{13}C$	$\delta^{15}N$	DIET
Late Neolithic						
Sarminskii Mys	SMS_1986.009	20+ y.	H 1997.001	-17.2	16.3	GFS
Sarminskii Mys	SMS_1986.011.01	8-13 y.	H 1994.008	-17.2	16.3	GFS
Sarminskii Mys	SMS_1986.011.04	20-35 y.	H 2000.512	-17.0	16.6	GFS
Sarminskii Mys	SMS_1986.017	20-35 y.	H 2000.515	-17.4	14.8	GFS
Sarminskii Mys	SMS_1986.019.01	14-19 y.	H 2000.516	-17.7	15.2	GFS
Sarminskii Mys	SMS_1986.019.02	56+ y.	H 2000.517	-18.4	15.6	GFS
Sarminskii Mys	SMS_1986.019.05	36-55 y.	H 2000.518	-16.9	15.2	GFS
Sarminskii Mys	SMS_1987.029.02	8-13 y.	H 2000.521	-17.1	16.0	GFS
Shamanski Mys	SHM_1976.001.01	20+ y.	H 1993.008	-16.9	16.2	GFS
Early Bronze Age						
Khadarta IV	KHA_2003.003	20+ y.	H 2012.002	-18.3	15.4	GFS
Khadarta IV	KHA_2010.005	20-30 y.	H 2012.006	-17.8	15.0	GFS
Khadarta IV	KHA_2010.006	20+ y.	H 2012.009	-19.0	15.4	GFS
Khadarta IV	KHA_2010.007	20+ y.	H 2012.011	-18.6	16.0	GFS
Khadarta IV	KHA_2010.008	20+ y.	H 2012.014	-18.1	16.1	GFS
Khadarta IV	KHA_2010.009	35-50 y.	H 2012.015	-18.1	14.0	GFS
Khadarta IV	KHA_2010.011	35-40 y.	H 2012.018	-17.2	15.1	GFS
Khadarta IV	KHA_2010.012	35-50 y.	H 2012.020	-18.6	14.0	GFS
Khadarta IV	KHA_2010.015	35+ y.	H 2012.021	-17.7	14.4	GFS
Khuzhir-Nuge XIV	K14_2000.077	11.5-15 y.	H 2000.169	-18.7	10.5	GF
Khuzhir-Nuge XIV	K14_2001.087	35-50 y.	H 2001.616	-18.4	12.8	GF
Khuzhir-Nuge XIV	K14_1998.037.02	15-20 y.	H 1998.393	-19.2	11.7	GF
Khuzhir-Nuge XIV	K14_1999.045	7.5-11.5 y.	H 2003.623	-17.9	14.4	GFS
Khuzhir-Nuge XIV	K14_1999.049	50+ y.	H 1999.184	-17.6	15.8	GFS
Khuzhir-Nuge XIV	K14_1999.057.02	35-50 y.	H 2001.646	-16.6	16.6	GFS

Khuzhir-Nuge XIV	K14_1998.036.01	35-50 y.	H 1998.318	-18.9	12.4	GF
Khuzhir-Nuge XIV	K14_1998.037.01	15-20 y.	H 1998.320	-19.0	11.1	GF
Kulgana	KUL_1977.000	20+ y.	H 1991.035	-19.2	13.7	GFS
Kurma XI	KUR_2003.019	20-30 y.	H 2003.012	-19.4	13.2	GFS
Kurma XI	KUR_2003.025	20+ y.	H 2003.040	-18.2	15.9	GFS
Kurma XI	KUR_2003.026	35-50 y.	H 2003.036	-17.7	15.4	GFS
Kurma XI	KUR_2002.009	20-55 y.	H 2002.135	-18.9	14.6	GFS
Kurma XI	KUR_2002.010	20-35 y.	H 2002.101	-17.5	17.0	GFS
Kurma XI	KUR_2002.012	20-55 y.	H 2002.126	-19.3	11.4	GF
Kurma XI	KUR_2002.013	36-55 y.	H 2002.122	-18.7	14.0	GFS
Kurma XI	KUR_2002.014	20-35 y.	H 2002.096	-18.9	13.6	GFS
Kurma XI	KUR_2002.015	14-19 y.	H 2002.151	-19.5	12.8	GF
Kurma XI	KUR_2002.016	14-35 y.	H 2002.145	-19.0	15.0	GFS
Kurma XI	KUR_2003.017	20+ y.	H 2003.016	-18.2	16.2	GFS
Kurma XI	KUR_2003.018	17-19 y.	H 2003.005	-18.7	14.1	GFS
Kurma XI	KUR_2002.004	36-55 y.	H 2002.117	-18.4	15.6	GFS
Kurma XI	KUR_2002.005	20-35 y.	H 2002.141	-18.2	15.2	GFS
Kurma XI	KUR_2002.006	20-35 y.	H 2002.113	-18.6	14.7	GFS
Kurma XI	KUR_2002.007.01	20-55 y.	H 2002.090	-18.0	14.7	GFS
Kurma XI	KUR_2002.007.02	20-55 y.	H 2002.103	-18.5	15.2	GFS
Kurma XI	KUR_2002.001	20-35 y.	H 2002.110	-19.1	11.7	GF
Kurma XI	KUR_2002.003	20-35 y.	H 2002.129	-17.9	15.5	GFS
Sarminskii Mys	SMS_1986.012	20+ y.	H 1997.002	-17.5	15.0	GFS
Sarminskii Mys	SMS_1986.013	20+ y.	H 2000.514	-18.7	15.4	GFS
Sarminskii Mys	SMS_1987.021	20-35 y.	H 1997.004	-19.1	12.1	GF
Sarminskii Mys	SMS_1987.033	36-55 y.	H 1997.006	-18.3	13.8	GFS
Shamanski Mys	SHM_1975.001	20-35 y.	H 2000.204, H1995.235	-17.3	17.6	GFS
Shamanski Mys	SHM_1972.002	36-55 y.	H 1993.005, H 1993.003	-18.9	14.7	GFS
Shamanski Mys	SHM_1973.001	20-55 y.	H 1993.007	-18.1	15.4	GFS
Shamanski Mys	SHM_1973.002	20-55 y.	H 1993.002	-18.7	15.5	GFS
Shamanski Mys	SHM_1973.003.01	20+ y.	H 1993.006	-18.6	16.1	GFS
Shamanski Mys	SHM_1973.004	20+ y.	H 1991.021	-18.4	15.7	GFS
Shamanski Mys	SHM_1972.001.01	20-55 y.	H 1991.023	-18.8	15.1	GFS

APPENDIX 11. NEPHRITE ORNAMENTS IN THE CIS-BAIKAL AND SURROUNDING REGIONS*

Site Name and Individual ID	Micro-Region	Ornament Diameter	Aperture Diameter (cm)	Width / Diameter Ratio (cm)	Fragment / Complete	Ornament Form	Source Information
			Discs - Cis-Baikal				
Shumilikha	Angara	1.7	0.5	0.37	Complete	Disc	IGU-SHU-1986-1-1
Ust'-Ida Gorodishche	Angara	2.1	0.4	0.39	Complete	Disc	IGU-UIG
Podostrozhnoye 005.01	Angara	2.6		0.47	Complete	Disc	Okladnikov 1975:50
Shumilikha	Angara	2.8	0.4	0.44	Complete	Disc	IGU-SHU
Podostrozhnoye 005.01	Angara	3.0	0.3	0.44	Complete	Disc	Okladnikov 1975:50
Podostrozhnoye 005.01	Angara	3.0	0.5	0.43	Complete	Disc	Okladnikov 1975:50
Anosovo 002.01	Angara	3.1	0.2	0.45	Complete	Disc	KRA-1013-40; Okladnikov 1976:88-96
Pad' Svyataya 001.01	Angara	3.5			Complete	Disc	Okladnikov 1975:17
Pad' Svyataya 001.01	Angara	3.6			Complete	Disc	Okladnikov 1975:17
Shumilikha	Angara	4.0	0.7	0.41	Complete	Disc	IGU-SHU-1986-1-1
Podostrozhnoye 005.01	Angara	4.7	0.7	0.46	Fragment	Disc	Okladnikov 1975:50-51
Glazkovo Tsar'-Devitsa	Angara	5.7	0.5	0.43	Complete	Disc	KRA-7540-2
Glazkovo Vokzal	Angara	5.7	1.1	0.42	Complete	Disc	KRA-6087
Balushkino	Angara	7.5			Complete	Disc	Okladnikov 1955:270; Okladnikov 1974:114
Ust'-Ida 048.01	Angara	7.7	0.3	0.47	Complete	Disc	IGU-UID-48-35
Balushkino	Angara	9.5	0.5	0.48	Complete	Disc	KRA-531-1; Okladnikov 1955:270; Okladnikov 1974:114
Novyi Kachug "Zvezdochka" 004.01	upper Lena	1.7		0.50	Complete	Disc	Zubkov 2010:138
Verkholensk 004.01	upper Lena	2.0	0.1	0.49	Complete	Disc	KRA-2573-51; Okladnikov 1978:10

Staryi Kachug "Belousovo" 001.02	upper Lena	2.1		0.43	Complete	Disc	Zubkov 2010:137
Staryi Kachug "Belousovo" 001.02	upper Lena	2.2		0.46	Complete	Disc	Zubkov 2010:137
Novyi Kachug "Zvezdochka" 004.01	upper Lena	2.2		0.50	Complete	Disc	Zubkov 2010:138
Verkholensk 004.01	upper Lena	2.2	0.1	0.43	Complete	Disc	KRA-2573-50; Okladnikov 1978:10
Staryi Kachug "Belousovo" 001.01	upper Lena	2.8	0.4	0.42	Complete	Disc	Zubkov 2010:137
Staryi Kachug "Belousovo" 001.02	upper Lena	2.8		0.46	Complete	Disc	Zubkov 2010:137
Staryi Kachug "Belousovo" 001.01	upper Lena	2.9	0.4	0.45	Complete	Disc	Zubkov 2010:137
Novyi Kachug "Zvezdochka" 004.01	upper Lena	3.1		0.44	Complete	Disc	Zubkov 2010:138
Staryi Kachug "Belousovo" 001.01	upper Lena	3.2	0.4	0.46	Complete	Disc	Zubkov 2010:137
Novyi Kachug "Zvezdochka" 005.01	upper Lena	3.2	0.3	0.43	Complete	Disc	KRA-5-29-4; Zubkov 2010:139
Staryi Kachug "Belousovo" 001.02	upper Lena	3.5		0.42	Complete	Disc	Zubkov 2010:137
Novyi Kachug "Zvezdochka" 004.01	upper Lena	3.7		0.44	Complete	Disc	Zubkov 2010:138
Tsygenovskii Ulus 001.01	upper Lena	4.0	0.2	0.49	Complete	Disc	KRA-1-67-5
Staryi Kachug "Belousovo" 001.01	upper Lena	4.8	0.4	0.45	Complete	Disc	Zubkov 2010:137
Tsygenovskii Ulus 001.01	upper Lena	5.6	0.5	0.43	Complete	Disc	KRA-1-67-10
Staryi Kachug "Belousovo" 001.01	upper Lena		0.4		Complete	Disc	Zubkov 2010:137
Novyi Kachug "Zvezdochka" 007.01	upper Lena				Complete	Disc	Zubkov 2010:139
Novyi Kachug "Zvezdochka" 007.01	upper Lena				Complete	Disc	Zubkov 2010:139

Shishkino 007.01	upper Lena				Fragment	Disc	Zubkov 2010:139
Shishkino 007.01	upper Lena				Fragment	Disc	Zubkov 2010:139
Kurma XI 007.01 or 02	Little Sea	1.5	0.4	0.36	Complete	Disc	IGU-KXI-7-100; Weber et al. 2012:42-45
Khuzhir-Nuge XIV 042.01	Little Sea	1.6	0.5	0.37	Complete	Disc	IGU-KXNXIV-42-4
Sarminskii Mys 004.01	Little Sea	1.7	0.4	0.41		Disc	IGU-SM-1985-4-24
Sarminskii Mys 004.01	Little Sea	1.9	0.4	0.40		Disc	IGU-SM-1985-4-23
Sarminskii Mys 033.01	Little Sea	1.9	0.4	0.42	Complete	Disc	IGU-SM-33-2
Uliarba 032.01	Little Sea	1.9	0.3	0.41	Complete	Disc	IGU-ULI-1976-2-2-16; Goriunova 2004:37-38
Khuzhir-Nuge XIV 015.01	Little Sea	2.0	0.2	0.51	Complete	Disc	IGU-KNXIV-15-40A
Kurma XI 005.01	Little Sea	2.1	0.4	0.43	Complete	Disc	IGU-KXI-5-73; Weber et al. 2012:37-40
Sarminskii Mys 004.01	Little Sea	2.2	0.3	0.43		Disc	IGU-SM-1985-4-21
Khuzhir-Nuge XIV 085.01	Little Sea	2.2	0.4	0.42	Complete	Disc	IGU-KNXIV-85-51-1
Khuzhir-Nuge XIV 084.01	Little Sea	2.2	0.4	0.39	Complete	Disc	IGU-KNXIV-84-40
Uliarba 031.01	Little Sea	2.3	0.4	0.40	Complete	Disc	IGU-ULI-1976-1-3-7; Goriunova 2004:36-37
Khuzhir-Nuge XIV 085.01	Little Sea	2.5	0.4	0.42	Complete	Disc	IGU-KNXIV-85-51-3
Sarminskii Mys 004.01	Little Sea	2.7	0.3	0.44		Disc	IGU-SM-1985-4-22
Sarminskii Mys 002.01	Little Sea	2.7	0.4	0.43	Complete	Disc	IGU-SM-2-16
Khuzhir-Nuge XIV 085.01	Little Sea	2.7	0.3	0.44	Complete	Disc	IGU-KNXIV-85-51-2
Uliarba 007.01	Little Sea	2.8	0.5	0.46	Complete	Disc	Goriunova et al. 2004:16-18

Uliarba 029.01	Little Sea	2.8		0.40	Complete	Disc	Goriunova et al. 2004:35-36
Khuzhir-Nuge XIV 042.01	Little Sea	3.2	0.4	0.45	Complete	Disc	IGU-KNXIV-42-3
Shamanskii Mys 1972 001.01	Little Sea	3.3		0.37	Complete	Disc	Konopatskii 1982:55-58
Shamanskii Mys 1972 001.01	Little Sea	3.5		0.48	Complete	Disc	Konopatskii 1982:55-58
Khadarta IV 009	Little Sea	3.7	0.5	0.43	Complete	Disc	IGU-KHD-9-46
Sarminskii Mys 002.01	Little Sea	3.7	0.3	0.48	Complete	Disc	IGU-SM-2-15
Khuzhir-Nuge XIV 027	Little Sea	3.9	0.3	0.43	Complete	Disc	IGU-KNXIV-27-11
Kurma XI 019.01	Little Sea	4.0	0.3		Complete	Disc	IGU-KXI-19-18; Weber et al. 2012:69-72
Shamanskii Mys 1972 001.01	Little Sea	4.2		0.48	Complete	Disc	Konopatskii 1982:55-58
Kurma XI 001.01	Little Sea	4.9	0.5	0.45	Complete	Disc	IGU-KXI-1-2; Weber et al. 2012:28-30
Sarminskii Mys 004.01	Little Sea	5.1	0.6	0.44		Disc	IGU-SM-4-20
Kurma XI 018.01	Little Sea	5.9	0.5	0.45	Complete	Disc	IGU-KXI-18-8; Weber et al. 2012:68-69
Uliarba 030.01	Little Sea	5.9		0.48	Complete	Disc	Goriunova et al. 2004:36
Sarminskii Mys 002.01	Little Sea	8.7	0.8	0.45	Complete	Disc	IGU-SM-2-14
Khuzhir-Nuge XIV 005.01	Little Sea		0.4		Fragment	Disc	IGU-KNXIV-5-68
unknown	Unknown Cis-Baikal	2.3	0.5	0.42	Complete	Disc	KRA-VS6830-5
unknown	Unknown Cis-Baikal	2.8	0.5	0.42	Complete	Disc	KRA-14836-5
Semenovo 1957 003.01	Angara	1.5		0.46	Complete	Disc	Okladnikov 1975:29
Churinskii Lozhok 001.01	Angara	1.6			Complete	Disc	Okladnikov 1975:80-81
Pad' Garan'kin Log 002.01	Angara	1.9		0.46	Complete	Disc	Okladnikov 1975:65

Shumilikha 041.01	Angara	2.2	0.2	0.46	Complete	Disc	IGU-SHU-31-10; Savel'ev et al. 1981:15-16
Buret' Sukhaya Pad' II 004.01	Angara	2.3		0.41	Complete	Disc	Okladnikov 1974:126-128
Ust'-Dolgaya 003.01	Angara	2.5			Complete	Disc	Okladnikov 1975:15-16
Ponomarevo 017.01	Angara	2.8	0.4	0.44	Complete	Disc	Okladnikov 1974:101-103
Ust'-Uda 1936 004.01	Angara	3.0		0.43	Complete	Disc	Okladnikov 1975:138-143
Semenovo 1957.002.01	Angara	3.0		0.44	Complete	Disc	Okladnikov 1975:28
Ponomarevo 017.01	Angara	3.0	0.2	0.51	Complete	Disc	KRA-1091-4; Okladnikov 1974:101-103
Ust'-Uda 1956 002.01	Angara	3.2	0.3	0.46	Complete	Disc	Okladnikov 1975:154-155
Ponomarevo 017.01	Angara	3.2	0.4		Complete	Disc	Okladnikov 1974:101-103
Ust'-Dolgaya 003.01	Angara	3.3	0.3	0.44	Complete	Disc	KRA-441-5; Okladnikov 1975:15-16
Malaya Razvodnaya 001.01	Angara	3.5	0.6	0.44	Complete	Disc	Okladnikov 1974:26
Pad' Lenkovka 1933 001.01	Angara	3.8	0.3	0.47	Complete	Disc	KRA-415-51; Okladnikov 1974:131-138
Buret' Sukhaya Pad' II 004.01	Angara	3.8	0.3	0.47	Complete	Disc	Okladnikov 1974:126-128
Pad' Lenkovka 1933 001.01	Angara	3.9			Complete	Disc	Okladnikov 1974:131-138
Ust'-Uda 1936 004.01	Angara	4.1		0.48	Complete	Disc	Okladnikov 1975:138-143
Ponomarevo 017.01	Angara	4.4	0.4		Complete	Disc	Okladnikov 1974:101-103

Bratskii Kamen' 001.02	Angara	4.4	0.6		Complete	Disc	Okladnikov 1976:123-124
Shumilikha 009.01	Angara	4.5	0.4	0.45	Complete	Disc	IGU-SHU-1972-8-233B; Savel'ev et al. 1981:9
Shumilikha 009.01	Angara	4.7	0.6	0.45	Complete	Disc	IGU-SHU-1972-8-233B; Savel'ev et al. 1981:9
Shumilikha 009.01	Angara	4.8	0.8		Complete	Disc	Savel'ev et al. 1981:9
Ust'-Uda 1956 002.01	Angara	5.0	0.5		Complete	Disc	Okladnikov 1975:154-155
Semenovo 1933 001.01	Angara	5.1	0.6	0.44	Complete	Disc	KRA-438-1; Okladnikov 1975:26
Ponomarevo 026.01	Angara	5.3	0.9	0.44	Complete	Disc	Okladnikov 1974:111-112
Ust'-Uda 1936 004.01	Angara	5.4		0.44	Complete	Disc	Okladnikov 1975:138-143
Pad' Lenkovka 1933 001.01	Angara	5.5			Complete	Disc	Okladnikov 1974:131-138
Ponomarevo 014.01	Angara	5.6	1.2	0.40	Complete	Disc	Okladnikov 1974:95-97
Pad' Lenkovka 1933 001.01	Angara	5.6			Complete	Disc	Okladnikov 1974:131-138
Semenovo 1933.003.01	Angara	5.8	0.5		Complete	Disc	Okladnikov 1975:27-28
Ust'-Uda 1936 004.01	Angara	5.8		0.44	Complete	Disc	Okladnikov 1975:138-143
Semenovo 1933 001.01	Angara	6.0	0.5		Complete	Disc	Okladnikov 1975:26
Shivera 003.01	Angara	6.0			Complete	Disc	Okladnikov 1975:124
Semenovo 1933.003.01	Angara	7.5	0.6	0.46	Complete	Disc	KRA-444-1; Okladnikov 1975:27-28
Glazkovo Vokzal	Angara	9.2	0.5	0.47	Complete	Disc	KRA-6088-1; Okladnikov 1955:270-271
Moka 001.01	Angara				Complete	Disc	Okladnikov 1976:105

Ust'-Belaya 1953 001.01	Angara				Complete	Disc	Okladnikov 1975:10
Verkholensk 028.01	upper Lena	1.3		0.38	Complete	Disc	Okladnikov 1978:44-45
Verkholensk 025.01	upper Lena	1.5		0.39	Complete	Disc	Okladnikov 1978:38-40
Verkholensk 020.01	upper Lena	1.8		0.36	Complete	Disc	Okladnikov 1978:29-30
Verkholensk 027.01	upper Lena	2.0		0.40	Complete	Disc	Okladnikov 1978:42-44
Verkholensk 029.01	upper Lena	3.0		0.42	Complete	Disc	Okladnikov 1978:45
Staryi Kachug 1930.002.01	upper Lena					Disc	Zubkov 2010:137-138; Okladnikov 1955
Staryi Kachug 1930.002.01	upper Lena					Disc	Zubkov 2010:137-138; Okladnikov 1955
Khuzhir-Nuge XIV 047.01	Little Sea	1.1	0.2	0.47	Complete	Disc	IGU-?
Khuzhir-Nuge XIV 047.01	Little Sea	1.2	0.2	0.45	Complete	Disc	IGU-?
Kurma XI 016.01	Little Sea	1.5	0.2	0.52	Complete	Disc	IGU-KXI-16-234; Weber et al. 2012:64-66
Uliarba 019.01	Little Sea	1.9		0.43	Complete	Disc	Goriunova et al. 2004:29-31
Khuzhir-Nuge XIV 025.01	Little Sea	2.2	0.4	0.39	Complete	Disc	IGU-KNXIV-25-4A
Khuzhir-Nuge XIV 038.01	Little Sea	2.2	0.4	0.42	Complete	Disc	IGU-KNXIV-38-59
Shamanskii Mys 1975 001.01	Little Sea	2.3	0.3	0.43	Complete	Disc	Konopatskii 1982:62-63
Khuzhir-Nuge XIV 037.02	Little Sea	2.3	0.3	0.45	Complete	Disc	IGU-KNXIV-37-51A
Khuzhir-Nuge XIV 024.01	Little Sea	2.5	0.3	0.45	Complete	Disc	IGU-KNXIV-24-62
Uliarba 009.01	Little Sea	2.5	0.4	0.44	Complete	Disc	Goriunova 2004:18-19
Khuzhir-Nuge XIV 081.01	Little Sea	2.6	0.4	0.44	Complete	Disc	IGU-KNXIV-81-2

Khuzhir-Nuge XIV 025.01	Little Sea	3.0	0.3	0.44	Complete	Disc	IGU-KNXIV-25-4B
Khuzhir-Nuge XIV 082.01	Little Sea	3.3	0.5	0.41	Complete	Disc	IGU-KNXIV-82-19
Shamanskii Mys 1973 001.01	Little Sea	4.0			Complete	Disc	Konopatskii 1982:59-60
Shamanskii Mys 1973 001.01	Little Sea	4.0			Complete	Disc	Konopatskii 1982:59-60
Uliarba 013.01	Little Sea	6.3		0.42	Complete	Disc	Goriunova et al. 2004:20-25
Uliarba 035.01	Little Sea	8.1	0.7	0.46	Complete	Disc	IGU-ULI-1976-5-19; Goriunova 2004:39-44
Rings - Cis-Baikal							
Nizhnyaya Buret' Sukhaya Pad' I 001.01	Angara	2.5	1.7		Complete	Ring	Okladnikov 1974:117-118
Shumilikha	Angara	3.8	2.7	0.14	Complete	Ring	IGU-SHU-1986-1-1
Shumilikha 035.01	Angara	4.1	2.7	0.17	Complete	Ring	IGU-SHU-1973-75; Savel'ev et al. 1981:14
Semenovo 1957 007.01	Angara	4.5	2.9	0.17	Complete	Ring	Okladnikov 1975:33-34
Shumilikha 008.01	Angara	6.9	5.0	0.14	Complete	Ring	Savel'ev et al. 1981:9
Dalkh III 002.04	Kuda Valley	4.7	3.4	0.15	Fragment	Ring	IGSU-DIII-2-4
Dalkh III 002.05	Kuda Valley	5.4	3.8	0.17	Fragment	Ring	IGSU-DIII-2-5
Dalkh III 002.06	Kuda Valley	7.7	6.8	0.12	Fragment	Ring	IGSU-DIII-2-6
Staryi Kachug "Belousovo" 001.01	upper Lena	4.4			Complete	Ring	Zubkov 2010:137
Korkino 002	upper Lena	5.2	3.2	0.19	Fragment	Ring	IGU-KOR-2-58
Shishkino 002.01	upper Lena	5.3	3.6	0.18	Complete	Ring	Zubkov 2010:139
Shishkino 007.01	upper Lena	9.8		0.19	Fragment	Ring	Okladnikov 1955:270; Zubkov 2010:139

Novyi Kachug "Zvezdochka" 002.01	upper Lena	10.9	8.6	0.10	Fragment	Ring	KRA-31-1; Okladnikov 1955:366; Zubkov 2010:143
Shishkino 002.01	upper Lena				Fragment	Ring	Zubkov 2010:139
Kurma XI 012.01	Little Sea	4.0	3.0	0.12	Complete	Ring	IGU-KXI-12-177; Weber et al. 2012:54-58
Uliarba 013	Little Sea	5.1	3.2	0.19	Complete	Ring	Goriunova et al. 2004:20-25
Shamanskii Mys 1973.003.01	Little Sea				Complete	Ring	Konopatskii 1982:61-62
Khadarta IV 012	Little Sea				Fragment	Ring	IGU-KHD-12-93
Khadarta IV 012	Little Sea				Fragment	Ring	IGU-KHD-12-85
Baikal'skoye VI Settlement	Northwest Baikal Coast	5.1	3.2	0.18	Complete	Ring	Kharinskii et al. 2009:97
unknown	Unknown Cis-Baikal	6.4	4.1	0.21	Complete	Ring	KRA-VS6830-6
Shumilikha 012.01	Angara	2.8			Complete	Ring	Savel’ev et al. 1981:11
Shumilikha 012.01	Angara	2.8	1.8	0.17	Complete	Ring	IGU-SHU; Savel’ev et al. 1981:11
Ust'-Uda 1956 007.01	Angara	2.8		0.20	Complete	Ring	Okladnikov 1975:163-164
Ust'-Uda 1956 007.01	Angara	3.6		0.20	Complete	Ring	Okladnikov 1975:163-164
Ust'-Uda 1936 004.01	Angara	3.7		0.23	Complete	Ring	Okladnikov 1975:138-143
Ust'-Uda 1936 004.01	Angara	3.9	2.3	0.21	Complete	Ring	Okladnikov 1975:138-143
Ust'-Uda 1956 007.01	Angara	3.9		0.17	Complete	Ring	Okladnikov 1975:163-164
Ust'-Uda 1956 007.01	Angara	4.5		0.15	Complete	Ring	Okladnikov 1975:163-164
Ponomarevo 003.01	Angara	4.6			Complete	Ring	Okladnikov 1974:66-68
Ponomarevo 003.01	Angara	4.8		0.18	Complete	Ring	Okladnikov 1974:66-68

Shivera 011.01	Angara	5.3	3.7	0.17	Fragment	Ring	KRA-1018-2; Okladnikov 1975:131-132
Shumilikha 007.01	Angara	5.5	3.7		Complete	Ring	IGU-SHU-1972-12-283; Savel'ev et al. 1981:9
Shumilikha 007.01	Angara	5.5	3.7		Complete	Ring	IGU-SHU-1972-12-283; Savel'ev et al. 1981:9
Anosovo 002.01	Angara	5.9	4.4	0.13	Complete	Ring	KRA-1013-42; Okladnikov 1976:88-96
Semenovo 1957 007.02	Angara	6.1			Complete	Ring	Okladnikov 1975:33-34
Anosovo 001.01	Angara	6.2	4.0		Complete	Ring	Okladnikov 1976:87
Shumilikha 037.01	Angara	7.7	4.7	0.21	Complete	Ring	IGU-SHU-11-271; Savel'ev et al. 1981:14-15
Semenovo 1957 007.02.B	Angara	8.3	6.5	0.14	Complete	Ring	Okladnikov 1975:33-34
Ust'-Uda 1936 004.01	Angara	11.0	8.6	0.22	Fragment	Ring	Okladnikov 1975:138-143
Shumilikha 009.01	Angara	12.5	10.0		Fragment	Ring	Savel'ev et al. 1981:9
Semenovo 1957 003.01	Angara			0.14	Complete	Ring	Okladnikov 1975:29
Ust'-Belaya 1953 001.01	Angara				Complete	Ring	Okladnikov 1975:10
Semenovo 1957 006.01	Angara				Fragment	Ring	Okladnikov 1975:33
Uliarba 019.01	Little Sea	3.2		0.18	Complete	Ring	Goriunova et al. 2004:29-31
Khuzhir-Nuge XIV 072.01	Little Sea	3.2	1.8	0.21	Complete	Ring	IGU-KNXIV-72-52
Khuzhir-Nuge XIV 035.01	Little Sea	4.3	3.1	0.13	Complete	Ring	IGU-KNXIV-35-40
Uliarba 013.01	Little Sea	7.0		0.20	Complete	Ring	Goriunova et al. 2004:20-25

Shamanskii Mys 1973 001.01	Little Sea	10.0		0.16	Complete	Ring	Konopatskii 1982:59-60
Kurma XI 005.01	Little Sea	11.0	8.8	0.11	Fragment	Ring	IGU-KXI-5-69-3; Weber et al. 2012:37-40
Kurma XI 005.01	Little Sea	12.9	10.8	0.08	Fragment	Ring	IGU-KXI-5-69-1 and 2; Weber et al. 2012:37-40
Kurma XI 005.01	Little Sea				Fragment	Ring	IGU-KXI-5-69-4; Weber et al. 2012:37-40
Other Artifact Forms - Cis-Baikal							
Kurma XI 012.01	Little Sea	11.5			Complete	Other	IGU-KXI-12-191; Weber et al. 2012:54-58
Bratskii Kamen' 014.01	Angara	1.0		-	Complete	Other	Okladnikov 1976:137-138
Ust'-Ida Gorodishche	Angara	5.3		-	Complete	Other	IGU-UIG
Shivera 001.01	Angara	8.5		-	*	Other	KRA-450-9; Okladnikov 1975:122-124
Uliarba 013.01	Little Sea	8.1		-	Complete	Other	Goriunova 2004:20-25
Uliarba 013.01	Little Sea	10.5		-	Complete	Other	Goriunova et al. 2004:20-25
Shamanskii Mys 1972 001.01	Little Sea	13.2		-	Complete	Other	Konopatskii 1982:55-58
Krasnyi Yar I 005.01	Northwest Baikal Coast			-	*	Other	Kharinskii et al. 2009:124
Glazkovo	Angara	11.5		NA	*	Other	KRA-VS4191-1
Glazkovo	Angara	11.8		NA	Complete	Other	KRA-VS6830-7
Ust'-Ilga 014	upper Lena	8.2		NA	Fragment	Other	KRA-14-1; Uvarov and Nikolaev 1990:140
Ust'-Ilga 015	upper Lena	12.2		NA	Complete	Other	KRA-15-50; Uvarov and Nikolaev 1990:140
unknown	Unknown Cis-Baikal	6.1		0.38	Complete	Other	KRA-6809

Lokomotiv - Raisovet 015-08	Angara	4.2		0.29	*	Indeterminate	IGU-LOR-15-8
Shumilikha	Angara	1.8		0.29	Complete	Indeterminate	IGU-SHU-1986-1-1
Kurma XI 001.01	Little Sea	1.8		0.31	Complete	Indeterminate	IGU-KXI-1-14; Weber et al. 2012:28-30
Uliarba 013	Little Sea	3.1		0.31	Complete	Indeterminate	Goriunova et al. 2004:20-25
Kurma XI 005.01	Little Sea	2.0		0.33	Complete	Indeterminate	IGU-KXI-5-76; Weber et al. 2012:37-40
Shumilikha 041.01	Angara	3.0		0.34	Complete	Indeterminate	IGU-SHU-1973-9; Savel'ev et al. 1981:15-16
Kurma XI 009.01	Little Sea	1.8		0.34	Complete	Indeterminate	IGU-KXI-9-128; Weber et al. 2012:47-49
Shumilikha	Angara	1.6	0.9	0.24	Complete	Indeterminate	IGU-SHU-1986-1-1
Shamanskii Mys 1975 001.01	Little Sea	4.0	1.9	0.28	Complete	Indeterminate	Konopatskii 1982:62-63
Kaiskaia Gora	Angara	8.5		0.28	Complete	Indeterminate	Okladnikov 1955:
*Discs and Rings - Macro-Regional***							
Duroi	Trans-Baikal/Amur (Argun' Valley)	4.6		0.40	Complete	Disc	Grishin 1981:63
Malaya Dzhikimda 1973.01	Yakutia (middle Lena)	4.0		0.37	*Fragment	Disc	Alekseev 1996:32-33
Malaya Dzhikimda 1973.01	Yakutia (middle Lena)	4.0		0.38	*Fragment	Disc	Alekseev 1996:32-33
Kullaty	Yakutia (middle Lena)	2.5	0.9	0.36	Complete	Disc	Okladnikov 1950A:47-48
Diring-Yuryakhsk 002.01	Yakutia (middle Lena)	1.5		0.20	Complete	Ring	Fedoseeva 1992
Bureinsk Karaul	Trans-Baikal/Amur (Argun' Valley)	12.0		0.14	Complete	Ring	Grishin 1981:127

Diring-Yuryakhsk 005	Yakutia (middle Lena)	3.6			Complete	Ring	Fedoseeva 1992
Diring-Yuryakhsk 002.04	Yakutia (middle Lena)	6.5			Complete	Ring	Fedoseeva 1992
Diring-Yuryakhsk 005	Yakutia (middle Lena)	6.7			Complete	Ring	Fedoseeva 1992
Diring-Yuryakhsk 005	Yakutia (middle Lena)	10.7			Complete	Ring	Fedoseeva 1992
Fofanovo	Trans-Baikal (Selenga)	10.9		0.08	Complete	Ring	Okladnikov 1955:269-271
Fofanovo	Trans-Baikal (Selenga)	13.0		0.09	Complete	Ring	Okladnikov 1955:269-271

*Terms used in the "Source Information" column: "IGU" – Irkutskii Gosudarstvennyi Universitet (Irkutsk State University); "KRA" – Irkutskii Kraevedcheskii Musei (Irkutsk Regional History Museum).
**These artifacts are not considered in the majority of statistical analyses in this chapter (until the final "macro-regional" section)

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