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Bronze Age Economic and Social Practices in the Central Eurasian Borderlands of China (3000-1500 BC): An Archaeological Investigation

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A dissertation submitted in partial satisfaction of the

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by

Chenghao Wen

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ABSTRACT OF THE DISSERTATION

Bronze Age Economic and Social Practices in the

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Doctor of Philosophy in Archaeology

University of California, Los Angeles, 2018

Professor Lothar von Falkenhausen, Chair

It is a widely accepted fact that the cultural interaction between Northwest China and its westerly Eurasian counterparts about 2000 BC generated far-reaching impacts on both sides. Through the study of material culture in its archaeological contexts it is often possible to identify what goods were exchanged by way of which routes. However, less attention has been paid to exploring the cultural mechanisms that explain the nature, extent and specific cultural processes behind these cultural interactions. Taking Northwest China as its point of departure, this dissertation attempts to understand long term developments in Bronze Age Central Eurasia from a multi-scalar spatial perspective by focusing on the socio-economic dynamics among the region's various cultural communities.

Based on analysis of currently available mortuary data, I reconstruct the middle-range oasis societies along the Hexi corridor, characterized by a low degree of social differentiation and an agnate-centered or patrilineal organization. Meanwhile, the comparative analysis on

contemporaneous cemeteries also reveals the underlying heterogeneity of these middle-range oasis communities, which gave rise to social tensions and was enmeshed with mobility and interaction on a regional scale. In addition, a dynamic social life is reflected by the social practice of communal activities and gatherings at both intra- and inter-community scales; this can also be observed archaeologically through the lens of a study of drinking vessels. Seeking to understand material-culture distribution patterns in Northwest China with a focus on the Qijia culture and its neighbors from a bottom-up perspective and with an emphasis on human agency, I interpret their interactions by means of a trade-diaspora model. Moreover, I revist the longstanding controversy over the Seima-Turbino technological phenomenon and reveal the underlying socio-economic processes in the transmission of metallurgy across Eurasia through an investigation of the development of metallurgy in the Eurasian Metallurgical Province. Comparative study of the Andronovo cultural-historical community in present-day Siberia and Kazakhstan and analogous remains in Northwest China suggests the formation of interregional economic complexity under the stimulus of metallurgy under the Andronovo horizon. By scrutinizing this interconnected economic network, this dissertation provides an alternative perspective for understanding the macro-cultural processes that developed throughout the first half of the second millennium BC, both in Northwest China, (which is culturally a part of Central Eurasia), and in the East Asian heartland.

The dissertation of Chenghao Wen is approved.

Nancy Levine

John K. Papadopoulos

Min Li

Lothar von Falkenhausen, Committee Chair

University of California, Los Angeles

2018

To my beloved family, my mother, father and brother

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Acknowledgments

I have no regret in life experience during my five-year study in the Cotsen Institute of Archaeology at UCLA but am complaining how time flies. Thanks to the generous contributions made by the late Lloyd Cotsen (1929-2017), this world-class institute is able to accommodate world-class scholars and also a diversity of graduate students from all over the world. It is my great honor to be a part of this congenial intellectual family in the past five years.

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2016**.** Preliminary field report of archaeological survey at Toudaoshazi site, Alxa Left Banner, Inner Mongolia, China. *Archaeology and Cultural Relics* 考古与文物, Issue 1:9-16. (in Chinese)

2016 (second author). The ICP-MS analysis on the composition of painted pottery and the pigment in the Siba period (1950-1550BC). In Gansu Provincial Institute of Cultural Relics and Archaeology, School of Archaeology and Museology at Peking Univeristy (eds.) *Jiuquan Gan'guya* 酒泉干骨崖 (The excavation report of the site at Gan'guya, Jiuquan, Gansu), Appendix 3. Beijing: Wenwu Chubanshe. (in Chinese)

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Awards

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September 2017	Phi Beta Kappa Alumni Association International Scholarship

Notes on transliteration

In this dissertation I follow a modified version of the Library of Congress (LC) transliteration system for Russian. In some cases, the commonly accepted spellings are used instead, especially for some established place names ending with й (e.g., Semey, not Semei). Bold letters in the table below indicate transliterations that are different from the standard and applied in this dissertation.

Й in the Cyrillic alphabet is transliterated as i, same as и. Hard sign (usually transliterated as a double apostrophes '') and soft sign (usually as a single apostrophe ') are omitted here (one exceptional case is "Kuz'mina", following the conventional transliteration). Ю and Я is transliterated as the more commonly used Yu and Ya rather than IU and IA. If not pointed out specifically, Ы always and exclusively corresponds to the Latin letter y.

Pinyin is used for the Romanization of Chinese instead of the obsolete Wade-Giles system.

Romanization tables for Russian transliteration (modified) applied in this dissertation

Russian letters	Romanization	Russian letters	Romanization
А(а)	A(a)	Р(р)	R(r)
Б(б)	B(b)	С(с)	S(s)
В(в)	V(v)	Т(т)	T(t)
Г(г)	G(g)	У(у)	U(u)
Д(д)	D(d)	Ф(ф)	F(f)
Е(е)	E(e)	Х(х)	Kh(kh)
Ё(ё)	Ë(ë)	Ц(ц)	TS(ts)
Ж(ж)	Zh(zh)	Ч(ч)	Ch(ch)
З(з)	Z(z)	Ш(ш)	Sh(sh)
И(и)	I(i)	Щ(щ)	Shch(shch)
Й(й)	**I(i)**	**Ъ(ъ)**	**- (omit)**
К(к)	K(k)	Ы(ы)	Y(y)
Л(л)	L(l)	**Ь(ь)**	**- (omit)**
М(м)	M(m)	Э(э)	È(è)
Н(н)	N(n)	**Ю(ю)**	**YU(yu)**
О(о)	O(o)	**Я(я)**	**YA(ya)**

Chapter I Introduction

It is widely accepted that the Eurasian steppe played an important role in interregional cultural exchange in the Bronze Age. Especially at the turn of the third to the second millennium BC, this region witnessed a period of thoroughgoing cultural interactions involving the transmission of technological innovations, such as the metallurgy of copper and its alloys, the domestication of the horse, and the invention of the two-wheeled chariot etc., which are thought to have been accompanied by population migration and language dispersion. Northwest China, which is both geographically and culturally part of Central Eurasia, has been recognized as an important intermediary area, a link between the more westerly inland of Central Eurasia and the East Asian heartland to the east. However, due to the limited amount and poor quality of archaeological data available, previous studies on the issue of cultural exchange in this region were mostly occupied with identifying material cultural items on both sides and then connecting the dots in order to infer possible routes of communication. Little attention was paid to regional or local contexts or to the specific cultural processes that may help us understand the nature and extent of the interregional interactions.

Taking Bronze Age Northwest China as its point of departure, this dissertation aims to develop a synthesis of the processes of cultural interaction involving that area at both regional and interregional scales. Under a socio-economic framework, this cultural interaction is perceived as a manifestation of economic exchange, or trade in goods and personnel, as an epiphenomenon of social processes. Instead of taking the exogenous transmission (or long-distance exchange) of material culture at the continental scale as a decisive factor for local cultural development, this synthesis places an emphasis on endogenous social context, dynamics and cultural agency in the processes of trans-cultural interaction. By means of different temporal orientations, it comprehensively explores and interprets contemporaneous archaeological data and situates them in long term processes. By doing so it is possible to distinguish between gradually cumulative processes and periods dominated by alternative impulses that influenced social and economic domains in local contexts.

More detailed discussions of related conceptual frameworks and theoretical perspectives will be developed in Chapter II. Chapter III and IV will set the stage by summarizing the natural and cultural history of Central Eurasia. Some critical archaeological issues related to relevant research regions are raised in Chapter IV and echoed in the following chapters. Chapter V mainly focuses on reconstructing the social context of the Hexi corridor oases during the first half of the second millennium BC through mortuary analysis of major cemeteries. Building on that, some aspects of social life among those middle-range societies revolving around the theme of ritual are partially revealed through the lens of communal consumption, i.e. drinking, as elaborated in Chapter VI. The cultural milieu and social network having been reconstructed in the two preceding chapters, the regional dynamics among several contemporaneous cultural entities (the Qijia culture and its neighbors) are identified and interpreted from the perspective of trade in Chapter VII. Parallel to the regional cultural processes in Northwest China, the other thread of cultural development in the adjacent forest-steppe and steppe regions in Central Eurasia is also highlighted: metallurgy, one of the most important techno-economic stimuli of social development throughout the Bronze Age. By revisiting the classic issue of the Seima-Turbino technological phenomenon across all of Eurasia, the trans-cultural transmission of metallurgy is placed in an anthropological framework in Chapter VIII, which provides the basis for developing a better understanding of the analogous archaeological evidence in Northwest China. In Chapter

IX, a second wave of techno-economic stimuli represented by the Andronovo cultural horizon at about the second quarter of the second millennium BC, and its influence on the socio-economic processes in Northwest China, are examined. In Chapter X some preliminary conclusions are summarized, and some hypotheses and remaining questions are proposed for future exploration.

Chapter II Conceptual framework and theoretical perspectives

This chapter mainly discusses some major conceptual frameworks and theoretical perspectives that will be pertinent to the current study. No one theory can cover the myriad facets of cultural interaction, the key theme for the wide temporal and spatial ranges involved in this dissertation. Different from the abstract and descriptive use of the term “cultural interaction” in traditional cultural-historical narratives, a theoretical stand is taken here that cultural interaction could and should be perceived in the framework of economic anthropology. In other words, a socio-economic perspective should be applied to understand the complicated processes implied by cultural interaction. It may not be comprehensive to grasp all aspects of cultural interaction. But economic anthropology is definitely one of the most fundamental and salient perspectives.

Primitive economy and kinship

A substantivist point of view on the primitive economy systematically proposed by Sahlins (1972) is the point of departure for the socio-economic framework in this dissertation. Therefore, the term “economy” here is interchangeable with provisioning and refers to “the interchange with his natural and social environment, in so far as this results in supplying him with the means of material want satisfaction” (Polanyi 1957:243). The substantivist school is justified to argue that, different from the modern market economy, reciprocity and redistribution were the major economic mechanisms for primitive societies. While this is good for exorcising anachronistic modernism in anthropological economy, it has too often resulted in replacing it with an equally anachronistic primitivism (Sherratt and Sherratt 1991:353). Undeniably, the substantivist stance risks eliminating possible circumstances of self-interested economic behaviors. Therefore, to some extent, the formalist stance is also justified in a prehistoric context. Rather than taking sides with this long-standing debate between substantivist and formalist schools, a contingent and combinational approach to the study of primitive economy and trade is preferred (Oka and Kusimba 2008).

In primitive societies economic production is mainly confined to the household scale (Domestic Mode of Production) and organized by domestic groups and kinship relations. Unpredictable variations in manpower of the household always lead to domestic economic failure, which can be rescued by exchange or trade (Sahlins 1972:69). For instance, trade in the Huon Gulf system by neighboring middlemen circulates both specialized craft products and food production inside the system and thus plays an important role in evening out the unbalanced distribution of resources and food crisis (Hogbin 1951). In this context, exchange or trade, following the social principle of reciprocity, is an epiphenomenon of social needs resulting from certain intrinsic social mechanisms, and thus the economy is a process embedded in a great variety of social institutions (Polanyi 1957:245; Sahlins 1972:279). Besides the basic social needs of livelihood, other critical social needs for the reproduction of community also must be satisfied by means of exchange or trade; for example, social obligations, debts and payments engendered in ritual processes (e.g., birth, initiation, marriage, curing and death) and other communal activities (e.g., feasting). But emphasis of the institutionalization of primitive economy should never be at the expense of human agency. As exchange is a moral conduct in a kinship-based society with a concentric social distance, any economic activity outside the internal tribal sphere would risk unpredictability in reciprocity. Thus, a self-motivated social device such as trade partnership would balance those uncertainties in economic activities and ensure the social well-being in the long term. The Siassi traders in Melanesia, for example, constitute critical sources of bride wealth for their trade partners, a resource without which a man in this region cannot take a wife (Harding 1967).

Kinship is ubiquitous to all human societies. The kinship system is established to prescribe the rules of marriage, which is conducive to human reproduction. One fundamental fact of the kinship system, according to Lévi-Strauss (1969 [1949]), is the development of alliance between groups through the exchange of women, that is, marriage. Social solidarity based on descent is an important mechanism to ensure social sustainability among primitive societies. Marriage is essentially an elementary social practice that extends descent-based solidarity to a much larger social or spatial scale. Therefore, the succession of descent and the cementing of alliances in marriage rules and practices are not mutually exclusive but two aspects of one critical social issue: the successful reproduction of one social group. As an important form of social exchange, trade, particularly the inter-cultural exchange of materials, always cuts across kinship systems, and in most cases is even conditioned by the latter. By means of marriage exchange, two social groups establish an alliance within the kinship system and thus extend descent-based solidarity to a much larger social and spatial scale, which in turn facilitates and institutionalizes trading activities between those two groups (Lévi-Strauss 1969 [1949]:63). The cementing of social alliances through marriage is especially critical for long distance trade, which always moves across a broad landscape with complicated political, economic, social, and ideological tensions that can result in great uncertainty and risks to physical safety (Dalton 1975:102).

Kinship is also critical for the social well-being of a household. Following the death of one family member, one of the most important questions in the post-burial phase is how to redistribute or inherit the deceased’s social role (e.g., the head of household), rights (e.g., sexual right over women), duties (e.g., social debts) and property (e.g., production tools, land, house and livestock, personal items). Without a system of inheritance and succession, the intergenerational transmission of rights and property would be disturbed, resulting in disorganized social life and thus impairing the well-being of the whole community. It is because of the kinship system that inheritance laws are always defined. Generally, there is a correspondence between rules of transmission and rules for membership in a kin group (kinship). For example, monosexual inheritance (male to male, female to female) always happens in a unilineal descent group (e.g., patrilineal or matrilineal); while diverging inheritance (to both sexes) always corresponds to a bilateral kinship system (patrilineal plus matrilineal), and finally, cross-sexual inheritance is always connected to alternating kin groups (e.g., stem-family, joint family) (Goody 1962:318). Such social mechanisms as rules of inheritance usually influence economic dynamics at a household scale, and ultimately, at a community scale. For instance, rules of inheritance over land in an agricultural society directly influence the pattern of land use. If only the first-born son can inherit land (a.k.a. agnatic seniority), other male descendants in the same family have to disperse to other arable lands for survival, which finally results in the expansion of the agricultural economy as well as kinship networks over a broad territory. In contrast, if land is equally divided among all descendants, then the same piece of land will be intensively cultivated, which usually results in agricultural intensification.

Economic systems, trade, and cultural interaction

Trade, broadly defined as the reciprocal traffic, exchange, or movement of materials or goods through peaceful human agency, is an indicator of, and dialectically, a prime motive for inter-cultural contact (Renfrew 1969). It is also common sense that trade is not solely a distributional phenomenon. As a part of an economic system, trade cannot be separated from other processes such as production and consumption (Kohl 1975:45; Renfrew 1969). Meanwhile, trade cannot be considered apart from other subsystems such as technological, subsistence, symbolic and social subsystems as defined by Renfrew (1975). Hence, change in one subsystem is necessarily reflected in the others. Social subsystems, for example, will be affected by changes in trade, and meanwhile, the trade also controls the organization and directs the scale of production (Kohl 1975:46). Due to the intrinsic anti-surplus within the domestic mode of production among primitive communities, exchange for social needs and livelihood is necessary and thus requires the intensification of production in the long-run (Sahlins 1972:86). It is true that trade should be treated as an epiphenomenal result of internal and structural processes (Chang 1975). Not only does trade promote contact between different groups of people; it also creates extra demands for new goods produced by new technology (Renfrew 1969:154). New technology can be introduced to one social system by chance, but the local development and intensification of production is a corollary of local needs embedded in a pre-existing economic infrastructure and social dynamics. The production and circulation of non-utilitarian goods such as items of adornment and display, for example, always play a vital role in mobilizing social demand and generate a sort of fly-wheel effect for the whole economic system (Sherratt 1976). This can also well explain why, when metallurgy is available, the percentage of non-utilitarian ornaments in the metal assemblage is no smaller than that of utilitarian tools.

Cultural interaction represented by material remains is a central theme in archaeology. Placing material culture in an economic context (production, distribution, consumption, recycling, and discard) and understanding involved cultural processes should be the point of departure for archaeological inquiries on the nature and extent of cultural interaction. Taking the metallurgy of copper/alloyed copper objects as an example, in the process of production it is necessary to differentiate metallurgy from metalworking. The former refers to a complete technological sequence including mining, smelting, melting, casting and processing; while the latter mainly refers to a part of the whole metallurgical process, e.g., melting and casting with ingots, re-melting finished metal objects and hammer-working finished products. The intrinsic complexity of the whole production processes of metallurgy encourages task specialization in each independent but meanwhile interlocked procedure, a.k.a. prescriptive technology (Franklin 1999). Besides technological processes for the manufacture of material remains, a whole behavioral chain participating in the life history of an artifact before and after it is deposited in an archaeological context should also be comprehensively considered (Schiffer 1978). For example, the cultural behaviors involved in distribution (e.g., trade), consumption (e.g., functions and use context), and recycling (e.g., inheritance and heirloom) and even disposal (e.g., dwelling and mortuary contexts) also condition the archaeological pattern of metal objects. That is, without systematic evidence of metallurgy, a number of copper objects found *in situ* alone do not necessarily imply that they were locally produced, let alone the possibility of the indigenous emergence of metallurgy.

Economic imbalance based on uneven distribution of resources and resulting economic interaction between the binary core and periphery is the core argument of the world systems model (Wallerstein 1974). Compared to old paradigms in cultural interaction such as acculturation, interaction spheres and so on, the world system model stresses the economic dynamics between different parties. However, the uncritical use of this model in pre-capitalist contexts, as Kohl (2003:9) points out, has been misleading, especially in its problematic binary division of core and periphery. World systems theory, with its emphasis on the unequal power relations between core and periphery, also seems invalid in multiple research contexts. In Bronze Age Central Eurasia, the sociopolitical context was characterized by institutionalized non-uniformity, which leaves the definition of core and periphery by and large open to debate (Frachetti 2012). Even though a world system existed in Eurasian steppe, it would be too unstable and too multiplex to permit the growth of deeply structured power relations of “dominance” and “inequality” (Kohl 1987). The same situation also existed in the Bronze Age Aegean: cores were multiple and peripheries are practically impossible to identify (Sherratt 2009). Actually, in most prehistoric contexts, the “world system” on a regional scale presents no essential difference from a self-sufficient hamlet or village, and thus loses its explanatory power. Except for its theoretical contribution from the perspective of understanding the cultural interactions involved in economic dynamics, the world system model seems to only describe a cultural phenomenona at macro scale.

The recent development of the world system model in archaeology has resulted in the proposal of alternative models such as trade diaspora model, distant-parity model (Stein 1999), and the post-colonial perspective with an emphasis on situated agency and social practice (Dietler 2010; Gosden 2004). Different from the structured world system model and its top-down perspective, these alternative theories try to de-structuralize the model so as to develop a more nuanced understanding of cultural dynamics from a bottom-up perspective, and thus stress individual motives, local cultural agency and fluid power relations. The trade diaspora model is especially noteworthy in this context. Compared to the concept of migration, which predominates the traditional cultural-historical narratives, the concept of diaspora situates population mobility in more specific circumstances, defined by political, economic and even ideological factors. It thus offers more descriptive and analytical power in understanding what actually happened during processes of population movement driven by economic motives. Moreover, the intrinsic relationship between homeland and host community also makes the concept of diaspora serviceable and versatile in the post-colonial discourse on identity construction and cultural negotiation (Lilley 2004). Trade diaspora, as one of the most common types of diaspora (Cohen 2008:18), has become familiar to archaeologists through Classical studies on the Greek and Roman colonization of the Mediterranean. The term "trading diaspora" was first used by Abner Cohen (1969) in his classic ethnographic study on the Hausa migrants in West Africa. A precise definition of trade diaspora was given by Cohen (1971:267):

> A diaspora of this kind is distinct as a type of social grouping in its culture and structure. Its members are culturally distinct from both their society of origin and from the societies among which they live. Its organization combines stability of structure but allows a high degree of mobility of personnel. It has an informal political organization of its own which takes care of stability of order within the one community, and the co-ordination of the activities of its various member communities in their perpetual struggle against external pressure. It tends to be autonomous in its judicial organization. Its members form a moral community which constrains the behavior of the individual and ensures a large measure of conformity with common values and principles. It also has its own institutions of general welfare and social security. In short, a diaspora is a nation of socially interdependent, but spatially dispersed, communities.

Different from other kinds of diasporas, economic well-being (e.g., commercial profit, secure control on raw material, circulation of goods and market etc.) is the primary consideration and ultimate goal of a trade diaspora. For this purpose, efficiency of communication and maintenance of relations of trust are critical for the sustainability of trade diasporas. In order to achieve those goals, various cultural strategies are developed. One of the most important cultural strategies, according to Cohen (1971), is the development of a moral community to maintain cultural distinctiveness and internal uniformity. By doing so, the whole community then can survive when they face external pressures in a strange territory. In ethnographic contexts it is always associated with a certain religion, or a kinship system governed by endogamy to construct a network of trust and credit, fundamental for any cross-cultural trading activities. Meanwhile, the community adapts to the local culture for more efficient communication in the exchange network. A cultural middle-ground or hybridization thus gradually develops inside a trade diaspora. Hence, in terms of material culture, we shall observe a high uniformity in a trade diaspora on the one hand; on the other hand, it should be distinctive from its homeland, and thus display some characteristics of cultural in-betweenness, a negotiation between the place of origin and the host community.

The emergence of trade diaspora is the result of economic expansion. The scale and organizational form of trade diaspora is extremely flexible and greatly dependent on the power relations with the host community besides other critical factors for economic well-being (Curtin 1984:7). Some diasporic communities are temporary and socially marginal in the host community, while others are long-lived and maintain social autonomy. In some extreme cases, the trade diaspora comes to dominate the host community (Stein 2002:32). The variability of trade diaspora offers a salient framework to encompass a broad range of cross-cultural interactions, and provides a convenient concept for archaeologists to understand the problematic scenario in which cultural identity reflected by material culture sometimes is ambiguous and difficult to define. It poses a great challenge to identify trade diasporas in archaeological practice, insofar as the issue of ethnicity or identity is a major concern. Following Stein (2002:36), I agree that the identity of foreigners can be effectively explored on two different levels: the ostensible cultural elements in the community level including public ritual, style of dress and burial practice; and more restricted ones on the domestic level reflected by culinary practice (e.g., dining pottery vessels) and craft technology to manufacture domestic paraphernalia. It is also justified to keep in mind that material culture with non-local styles could also find its way into local contexts by mechanisms beyond trade diasporas.

Anthropological technology and the cross-cultural transmission of technology

In the anthropology of technology, any technique is considered the physical rendering of mental schema, which are always under the control of the so-called social representations of technology (Lemonnier 1992:6). Social representations are the backdrop of specific knowledge, which eventually determine the gestures or operational sequences by which people manufacture specific objects. Simply speaking, social representations are a mixture of ideas concerning realms other than matter or energy, the mental processes embedded in a broader, symbolic (value and belief) system (Lemonnier 1993:4). Technology is thus socially structured, and therefore, it is unrealistic to separate “technical” from “social” aspects (Lemonnier 1993:5).

The other important concept in the anthropology of technology is the operational sequences proposed by Leroi-Gourhan (1993). Once a project schema or template is developed, a series of gestures are conducted to materialize the project schema, resulting in a finished object at the end. Due to various constraints, both on the physical/material and the mental/ideological levels, on each step of the operational sequences technical choices must be made so as to continue to the next step. Conceived as such, the whole operational sequence is more like a flexible process in which practical possibilities are compromised to material or mental constraints by the actor (Schlanger 1990). No doubt, the actor always has a logical system in order to decide which gesture should be utilized and which should be avoided or dismissed. The logical system is, once again, mainly under the control of the complexity of social representations. Technological choices naturally become a core means by which the whole technological system and its social connotations can be explicitly perceived (Lemonnier 1993:6). Technological choices can be voluntary and conscious, or totally unconscious as part of the *habitus*. They include all available choices for a society in the contexts of the natural environment, cultural traditions, or contacts with other societies. All these different choices could have produced the same kind, or nearly the same kind, of result. However, due to some reason related to social representations mentioned before, a specific choice is made. It is the motivation or mechanism behind the specific choice that is of interest in anthropology. As such, the study of technological choices cannot be detached from contextual analysis of specific cases, through which the cultural contexts of motivation can then be understood. The other side of the coin is the intentional resistance or avoidance of some options, the actor nonetheless being aware of it. In other words, the absence of a technical feature or trait for a society does not necessarily mean it is unknown to the local people.

Specific knowledge, or know-how, is another major component of social representations of technology. Unconscious and conscious mental operations or schemes comprise a know-how system, which cannot be learned through language alone (Lemonnier 1992:74). This leads to another critical question: how is technological knowledge shared and transmitted? Taking metallurgy as an example, specific knowledge of such a complicated and specialized craft is probably transmitted by means of apprenticeship, in which the bodily performance (gestures) of a master is observed and then imitated by apprentices through long time practice (Roberts et al. 2009; Wendrich 2012). The framework of apprenticeship and mechanisms of knowledge transmission are critical for us in understanding the broad dispersion of metallurgy, in addition to trade/exchange mechanisms. Likewise, the hypothesized role of itinerant craftsmen (Childe 1958:111) in the transmission of metallurgy should be taken seriously. Furthermore, social representations of technology can also reflect other social scenarios and networks, including, but not limited to, marriage and kinship networks; sodalities or alliances based on sex, age, social status, occupation etc.; temporary or permanent unions based on common interests and purposes (e.g., trade partnership, pastoral partnership, and hunting partnership); as well as commensal consumption (e.g., drinking and feasting in ritual scenarios or other social activities). It is in these social networks that technological choices and specific knowledge are exchanged, transmitted, and dispersed.

Ritual processes, ritual economy and social interaction

In the pattern of rites of passage, first proposed by van Gennep (1960 [1908]) and later seminally elaborated and developed by Turner (1969), the funeral rite is one of the most important rites of passage in the human life cycle. By means of the processes of funeral rites, the deceased is transformed from a ghost into an ancestor, transferred from the Land of the Living to the Land of the Dead. The dead is assumed to go through three phases: the separation of ghost from the living body, a transitional/liminal phase without any status and belonging, and a re-aggregation to the Other World with a new status as an ancestor (van Gennep 1960 [1908]:164). Another important implication of the rites of passage is a parallel between the dead and the living in each phase of the funeral rites (Goody 1962:46), as first revealed by Hertz (1960 [1907]) in his classic study on the Dayak of Borneo. Just as the dead, the bereaved also goes through a tripartite process: the separation from the living community by all kinds of taboos, a transitional phase without any status, and re-joining to the living community at the end. This parallel between the living and the dead thus provides a reference to establish a universal connection between the deposition of the dead underground and the funeral rites conducted and experienced by the living above ground. Meanwhile, it also reminds us that each phase of funeral rites should be explained from the perspectives of both the dead and living.

Beyond the religious considerations and symbolic parallels in funeral rites, we should not lose sight of economic factors through the rites of passage: that is, the economic practices of the living, i.e., provisioning and consuming. For the living community, the provision of food and drink is necessary in each phase of the rites of passage, not only for the bereaved themselves, but also for the mourners and visitors from far away. Economic practices involved in funeral rituals have been systematically recorded by Goody (1962) in the case of the LoDagga in Ghana. The whole funeral ritual is comprised of four consecutive ceremonies: the burial ceremony, the second ceremony or Diviner's Beer, the Bitter Funeral Beer, and the Cool Funeral Beer (Goody 1962:44). As the names of those ceremonies suggest, drinks made of grain porridge are necessary in each phase of the funeral rituals. In other words, the success of funeral rites directly depends on the economic capacity of the bereaved. Actually, the postponement between consecutive phases in the funeral ritual has already been noticed and partly explained by Hertz (1960 [1907]:31) from an economic perspective, which was later developed as the concept of ritual economy (Metcalf 1981; Wells 2006). Among the Dayak, in addition to the time necessary for a body to totally decompose into a skeleton therein signifying successful transferal to the ancestral world, the bereaved also need time to be economically prepared for the feasts involved in the whole range of funeral rituals, especially the final feast to celebrate the liberation of the dead and the living from the rites of passage (Hertz 1960 [1907]:54). Hence, difference in time spent throughout the whole processes of funeral rituals shall be expected according to the economic situation of the family of the dead. Bereaved with means accomplish the funeral rituals in less time than poor families, who have to accumulate sufficient wealth in order to support the whole ritual process, and thus a long gap is expected between the primary burial and the secondary burial or post-depositional disturbance (Metcalf 1981). Certainly, social debts are also generated among community members in the negotiation between ritual obligation and economic capacity. As a result, the payment of social debts adds another dynamics layer to social interaction, as far as the principle of reciprocity is concerned.

Two of the most seminal developments in the rites of passage made by Turner (1969:94) are the concepts of liminality and communitas. The former is similar to the liminal phase of rites of passage first proposed by van Gennep (1960 [1908]). It refers to the intermediary or transitional status of the "threshold people" who are going through a rite of passage. Hence, ambiguity, in-betweenness, statuslessness ("neither here nor there") is the major characteristic of liminality or liminal personae. Secular distinctions of rank and social status in the liminal phase are thus removed and the whole social group is temporarily homogenized and transformed to a special entity that Turner (1969:96) terms as *communitas*. The concept of communitas is a powerful framework for examining the nature of communal activities, for example, drinking, feasting, and performance along with ritual processes, during which social cohesion is the central thread. In light of communitas, alcoholic beverages – often utilized as a social lubricant -- served in feasting and performance are just a basic means by which the status of communitas can be achieved as soon as possible. The bodily experience of drunkenness between "existen" and "ecstasy" is a perfect scenario of liminality, and thus communitas is formed. In this anti-structural setting, all social institutions are temporarily eliminated and thus social mobility is accelerated, as reflected by the negotiation of social relations in, for instance, peacemaking in feuds, or the alliance-building of factions. Likewise, aggressive or violent behaviors not allowed in the normal social order can also be excused in this context (Phol 1998). In the framework of a ritual economy, communal contexts for various economic processes create particular kinds of social dynamics that condition interactions among people, materials, and meanings (Spielmann 2012). Festive consumption (feasting) provisioned by households is always intertwined with broader social relations and prestige structures, and thus effectively facilitates the interconnectivity of social groups (Monaghan 2012).

Chapter III Setting the stage: the natural landscape of Central Eurasia

III.1 A brief history on geographic concepts: Central Asia, Inner Asia, and Central Eurasia

Any geographic concept is a cultural construct of a space, always constructed with reference to the place where the agent originates or stands. As the largest landmass on earth, the Eurasian continent has been artificially divided into two counterparts: Europe in the west and Asia in the east. The systematic and scientific exploration of the Asian part of the Eurasian landmass, initiated by European travelers and geographers no later than the first half of the nineteenth century, has also been a process of spatial perception from the perspective of Eurocentrism. This Eurocentric ideology also underlies in some well-established geographic concepts, such as those of the Near East/Middle East and Far East. Rather than exhaustively examining the etymology and toponomy of different parts of the Eurasian continent, I will focus on the region concerned with my research, that is, Central Eurasia as compared to other commonly used equivalents: Central Asia and Inner Asia. The specific and physical boundaries of these different geographic concepts, no doubt, are always shifting with the contingencies of time as well as a scholar's research paradigm and research interests, in addition to geopolitical fluctuations.

The concept of Central Asia (*Asie centrale*) was first used in 1843 by the German geographer Alexander von Humboldt to define the vast area between five degrees south and five degrees north of 44.5°N which he considered the middle of the Asian landmass. This geographic area is bounded by the Ustyurt Mountains and Greater Khingan Mountains to the west and east, respectively. In 1862, Russian geographer Nicolay Khanykoff proposed a basic criterion to define Central Asia: the absence of rivers flowing into the open sea. A more clearly defined Central Asia was later proposed by another German geographer, Ferdinand Richthofen. He divided Asia into two counterparts - central and peripheral – based on differences in their physical and geological formation. For the central part of Asia, that is, Inner Asia, he employed Khanykoff's proposal of using hydrographical characteristics to define boundaries in four directions: the Altai Mountains to the north, the Tibet to the south, the Pamir plateau to the west and the Khingan Mountains to the east[1]. It should be pointed out that in nineteenth century Russian literature, the two geographic concepts – Central Asia (*Центральная Азия*) and Middle Asia (*Средняя Азия*) – were always interchangeable as synonym[2].

Compared to the concept of Central Asia, Inner Asia is a more culturally-loaded concept, as demonstrated by Owen Lattimore (1940). In his work, Lattimore shows that the Inner Asian frontiers that border China proper mainly include four regions: Manchuria to the northeast, Inner and Outer Mongolia to the north, Xinjiang to the west and Tibet to the southwest (1940:9-20). These highlands closely encircle lowland China proper, with great contrast in elevation and physical landscape. Between the highlands and lowlands, the Great Wall perfectly meanders as an artificial demarcation. Hence Inner Asia in Lattimore's framework is more culture/ideology-oriented and naturally associated with some binary concepts, such as barbarian versus civilized, nomadism versus sedentism. The specific geographical coverage of Inner Asia, however, is not explicitly illustrated until another of his works was published in 1950. In the introduction of this book, Lattimore (1950) also compares the terminology of "Central Asia" and "Inner Asia". He defines Inner Asia as a landmass from which an outlet to the sea is absent. Thus Inner Asia covers a vast territory, including Xinjiang, Tibet, Kashmir and part of the Indian Frontiers, Afghanistan, the Asiatic Republics of the former USSR, Outer Mongolia, and Inner Mongolia.

[1] This brief survey on geographic concepts of Central Asia is primarily based on Myroshnikov (1992).

[2] The two Russian concepts *Центеральная Азия* and *Средняя Азия* are always translated as the same one "Central Asia" in English. In order to highlight the difference between these two concepts, Central Asia and Middle Asia are applied here as their English equivalents respectively.

Other territories, such as Iran and the Manchurian provinces of China, which do have an outlet to the sea, also share many similarities with Inner Asia. Therefore, they are also included as a part of Inner Asia in Lattimore's (1950: viii-ix) proposal. Due to the geopolitical fluctuations following the October Revolution in the Russian Empire, coverage of Middle Asia (*Средняя Азия*) in Russian literature was narrowed down to the areas between the Caspian Sea to the west and Dzungarian Alatau to the east, namely, so-called Soviet Middle Asia[1] (*Советская Средняя Азия*, including present-day Kazakhstan, Kirgizstan, Tajikistan, Turkmenistan and Uzbekistan). Another once interchangeable concept, Central Asia (*Центеральная Азия*) in Russian literature, however, is more or less congruent with Inner Asia as proposed by Lattimore.

The cultural connotations of the concept "Inner Asia" was further elaborated by Denis Sinor from a distinctive perspective. Rather than considering Inner Asia a unit defined primarily by its hydrographic characteristics, Sinor places more value on the cultural aspects and casts Inner Asia in a negative light. The whole Eurasian continent is first marked by several main centers of agricultural civilizations lying to its edges: Europe, the Mesopotamian civilizations, Iran, India, Southeast Asia and China, from west to east. The massive area beyond these sedentary civilizations to the north is thus defined as Inner Asia (Sinor 1990). Accordingly, the geographic expansion of Inner Asia is larger than the landlocked regions proposed by Lattimore. The northern and eastern boundary of the Inner Asian cultural area reaches the Arctic Ocean and the Pacific Ocean at its apex.

[1] In English literature Soviet Central Asia is the default equivalent for *Советская Средняя Азия*.

Figure III.1 Map of Central Eurasia

In Sinor's framework, the geographic concept of "Central Eurasia" is always interchangeable with Inner Asia (Sinor 1969, 1970). As an expedient and general geographic concept, Central Eurasia has become a popular term in recent decades to designate the macro-region that extends from the Black Sea to the Gansu corridor in China and from Siberia to the Iranian plateau at the edge of the Pamir and Himalaya Mountains. Relatively free of cultural and ideological baggage, this neutral geographic concept is now generally accepted. Specific geographic boundaries are also flexible depending on one's research interests and objectives. In light of its flexibility, the geographic concept of Central Eurasia will also be applied to cover the regions that will be referenced in my dissertation: Southern Siberia, Central Asia, Northwest China (Xinjiang, Gansu, Qinghai) and adjacent parts of North China (or the so-called Northern Zone, including Inner Mongolia, northern Shaanxi and Shanxi) (Figure III.1). All those areas are also covered by the geographic concept of Inner Asia.

III.2 The physical geography of Central Eurasia

III.2.1 Western Siberia

Western Siberia is the largest geographical unit in Central Eurasia. It extends from the Ural Mountains to the west to the Yenisei River to the east, and reaches northern Kazakhstan steppe as its southern boundary (near present-day Semey[1]) and the Kara Sea (southern part of the Arctic Ocean) to the north. With a width of 1000-1900 kilometers and meridian length of 2500

[1] This city was also known as Semipalatinsk in the former Soviet Union period.

kilometers, this gigantic geographic unit covers an area as large as three million square kilometers[1].

Geology and Geomorphology

In geology, the structure of the West Siberian platform is distinct from its neighboring blocks - the Eastern European platform to the west and the Siberian platform to the east - due to rock foundations formed during the Paleozoic Era (541-252.17 Mya). The main part of the West Siberian platform was created by the Hercynian mountain-building event in the Late Paleozoic Era (380-280 Mya), which also resulted in the uplift of the Ural ridges in the direction of the meridian. The Mesozoic deposit (252-66 Mya) in western Siberia is characterized by marine and continental facies with indicators of sandy loam. The average elevation of the Mesozoic deposit reached an altitude of 2500-3500 meters in some lowlands formed during the Paleozoic Era. The marine sediment structure in western Siberia lasted until the cooling event of the Neogene period (23-2.58 Mya). Great changes in the landscape of western Siberia happened in the Quaternary period (2.58-0 Mya). During this period, western Siberia went through some short subsidence in altitude, but the sedimentary structure is still composed of loose deposits from alluvial, glacial, lacustrine and marine facies. In some locations the depth of the Quaternary deposit can reach 200-250 meters. The development of several estuaries in the Yenisei, Ob and other major rivers also indicates some temporary marine ingressions. Compared to the northern part of western Siberia, the southern zone presents lower resolution in its geological history. Only some early tectonic activities have been recognized. Those activities led directly to the formation of a hydrographic network in the southeastern part of western Siberia, especially in the Kulundin and

[1] The following survey of geography is primarily based on: Gvozdetskii and Mikhailov (1963); Alpatev et al. (1976); Shahgedanova (2002).

Baraba regions. The lower layer of Quaternary sediments is composed of alluvial sandy loam, lying below the contemporary sea level, 200-240 meters. Some pre-glacier deposits and loam containing tundra floral fossils in the upper Quaternary suggests a cold environment in the territory of western Siberia. Vegetation was probably dominated by coniferous forests and an admixture of birch and alder at that time. The whole Quaternary period was characterized by oscillations between glacial and interglacial events. Western Siberia went through four major glaciations: Yar, Samarov, Tazov and Zyrya in chronological order. Paleobotanical assemblages formed after the last glaciations (Zyrya) indicate a drier and warmer climate than that of the present day.

The relief of contemporary western Siberia was first formed during the transitional period between the Paleogene and Neogene (around 23 Mya). Even though this gigantic geographic unit is always generally designated as a “plain”, its geomorphologic characteristics are far less homogeneous than commonly thought. Lowlands with altitudes of 50-150 meters above the sea level dominate the northern (Ust-Ob, Khett, Pur and northern Yamal Lowlands) and central (Khanty-Mansiisk, Mid-Ob, Surgut Lowlands) parts of western Siberia. Several meridian strips of low hills (200-250 meters in altitude) lay in some parts of western, southern and eastern territories, such as North Sosvin, Trans-Urals, Ishim, Pri-Ob and Chulym-Yenisei Plateau, Vakh-Ket, Upper Tazov, Middle Tazov and the Tanam hills. Besides those hilly strips, an east-west low hill belt Vasyugan, lays in the alluvial plain between the Ob and Irtysh River.

Alluvial plains between rivers are the most dominant type of plain in western Siberia. River valleys are relatively rare in this area. River valleys usually developed in plains cut through by slow calm rivers. The average width of a river in this area is 50-80 meters. Due to the gravity of deflection and the direction of rivers currents (from south to north), most river valleys' right banks are eroded badly and characterized by steep cliffs, while wide and low terraces are well developed on the left banks. This situation can be found in some major rivers such as the Ob, Irtysh and Yenisei.

Climate

Western Siberia is characterized by a typical continental climate: long and cold winters, short and hot summers. Two pressure systems interact during the cold period: the high pressure air masses centered in the southern part of western Siberia, and the low pressure air masses centered in the south of the Kara Sea and the northern peninsula. In winter, this area is dominated by the continental air masses from eastern Siberia (the highest pressure area in Siberia), and continental pressure is strengthened by the influx of high pressure air masses from the North Pole. Under the gravity of deflection, the prevailing wind is always southwestern in direction. Western Siberia is under the control of low pressure air masses in the warm period of the year with a slight north wind or north-west wind prevailing during the summer.

Throughout the year the temperature difference is quite slight between northern and southern areas, with an average distance of 2000 km. The annual average temperature in western Siberia varies in different regions. Winter is characterized by long-lasting freezing temperatureS (the absolute minimum temperature in the tundra forest area can reach -65℃ according to historic records). Spring is very short, dry and relatively freezing. Spring does not come until after April in some forest areas. Temperatures quickly rise in May, always accompanied by occasional cold fluctuations. The warmest season is July, with annual temperatures ranging from 3.6℃ in north coastal areas and 21-22℃ in the southern steppes.

The majority (75%-80%) of annual precipitation is concentrated in the summer and autumn months (May-October), thanks to the wet air masses from the west, specifically from the Atlantic Ocean. Peak precipitation falls in July and August. The average volume of precipitation in the rainy season can reach 70-100 cm in some areas near the east bank of the Yenisei River. In tundra and steppe zones, heavy snow and blizzards occur frequently in winter, with unevenly precipitation. The cyclical retreat and advance of glaciers was the main theme of climatic change in the Quaternary period (2.58 Mya~). The Siberian plains experienced at least two glaciations during the early Pleistocene: the Mansi and the Shaitanka glaciations, separated by the Talagaikin interglacial period. Intense cooling of the ground finally led to the expansion of permafrost across the whole of Siberia during the LGM (Last Glacial Maximum). During the transitional period between the Pleistocene and Holocene, the southern boundary of permafrost retreated northward dramatically and continued to retreat until the Holocene climatic optimum. The ground temperature increased 3-4℃ above contemporary levels and the southern limit of permafrost was 300 km farther north than at present. Aeolian deposits of loess formed sparsely in some areas of Southern Siberia (e.g., interfluvial plains and river terraces) in the dry and cold period, while a thick horizon of loess developed in the foothills of the Central Asia mountains and in the intermontane basins.

River system

Rivers and lakes developed abundantly in the western Siberian plains. The total number of rivers in this area is estimated at 2000, and their accumulative length is more than 250,000 km. Due to inclination from south to north in the landscape’s relief, all major rivers in this area, including the Ob, Irtysh, and Yenisei River discharge into the Kara Sea to the north. In some concave lowlands the drainage of atmospheric precipitation becomes very difficult; as a result, surface runoffs always converge and are trapped in the form of swamps, which are commonly found in the Vasyugan area between the Ob and Irtysh River. Due to the relatively even relief, the drop in elevation of river courses is very low. For example, the course of the Ob between Novosibirsk and its estuary is as long as 3000 km; however, the drop in elevation is only 90 m. Rivers in this area are supplied by snow-melt water and atmospheric precipitation in spring and summer (70-80%).

The artery of western Siberia is the Ob River and its major tributary is the Irtysh River. The drainage area of this river system is as large as three million square kilometers. The Ob River originates in the mountainous area nearby Biisk in Altai Krai. The length of its course in the western Siberian plains is 3676 km. The contribution of water supply to the Ob also varies as it cuts through different ecological zones. Generally, the forest-steppe zone in the south contributes much less. The volume of influx into the Ob rises noticeably while it passes the Tundra zone in the north. As the second most abundant river in Siberia, the average volume of the Ob can reach 15,000 m^3 per second, almost twice the volume of the Volga River. The drop in elevation of the Ob is very slight (no more than 1 cm/km), leading to a very slow speed of current (0.5 m per second on average).

Figure III.2 Map of the Ob river system in western Siberia

The Ob drainage network is made up of seven tributaries: the Irtysh, Chulym, Ishim, Tobol, Vakh, Ket and Konda. The Irtysh River, with a length of 4248 km, is the largest one among these tributaries. It originates in the Altai Mountains in northern Xinjiang (China), and flows northwest through the dry steppes in Kazakhstan. All tributaries of the Irtysh flow through the southern limit of the Taiga. The Ishim and Tobol converge into the Irtysh before it merges with the Ob near Khanty-Mansiisk.

Another major artery is the Yenisei River, which demarcates the geographical units between western and central Siberia. With a maximum runoff volume of 130,000 m^3 per second, the

Yenisei River is the most abundant river in Siberia. The headwater of the Yenisei originates in the Sayan-Altai ridges in northwestern Mongolia. As with the Ob, the Yenisei flows in the meridian direction, following the western edge of Central Siberian Highlands and finally emptying out into the Kara Sea. All tributaries of the Yenisei flow into it from the east, from the Central Siberian Highlands such as the Selenge River, the Angara-Lake Baikal and the Lower Tunguska.

Due to the long and extremely cold winter, the rivers in western Siberia are frozen most of the year, especially for the lower courses in high latitudes. The lower course of the Ob River, for example, is icebound from the beginning of November for as long as 220 days. When the upper course in a moderate latitude begins to thaw in early spring, the lower course is still icebound. Thus serious ice congestion always happens and can cause flooding along the upper course. Long frozen periods also lead to a very limited period of possible navigation. The Ob near Novosibirsk has a navigation period of 185-190 days, while there are only 155 days open in the lower course. On the other hand, the long frozen period also makes cross-river east-west transportations possible during the cold season.

Ecological Zones, Vegetation and Fauna

The differentiation of the ecological landscape in the meridian direction is another prevailing characteristic of the physical geography of western Siberia, as well as the whole of Siberia on a broader scale. Generally speaking, the landscape of vegetation gradually changes from the steppe in the south to taiga and finally to tundra in the north according to climatic conditions. Between each relatively homogeneous vegetation belts there is a transitional zone with intermingled characteristics in vegetation: forest-steppe between steppe and taiga belt, forest-tundra between taiga and tundra belt.

The tundra zone in western Siberia is mainly distributed north of the Arctic Circle (66.5°N), including the Gydan Peninsula and the Kara Sea Island. Because of permafrost, the erosion of the landscape is very weak throughout the year. Frozen ground only partly thaws during the ephemeral warm season. The climate in the tundra is very severe. Summer is short and cool; winter is long-lasting and freezing, accompanied by strong winds. Annual precipitation is relatively low (200-350 mm). Thus, the diversity of vegetation in the tundra belt is also rather low. Dwarf shrubs, mosses and lichens occupy the broad treeless landscape. Reindeer (*Ranifer tarandus*), Arctic fox (*Alopex lagopus*), Lemming (*Lemmus sp.*), snowy owl (*Nyctea scandiaca*), ptarmigan (*Lagopus mutus*) comprise the major fauna groups in the belt of the tundra. The southern limit of the tundra belt is separated from the taiga forest by a transitional forest-tundra zone.

The taiga or forest belt, six times larger than the tundra belt, occupies the largest area (1.8 million km^2) of western Siberia. Its southernmost boundary lies near the line of Tyumen-Tara-northern Novosibirsk-Krasnoyarsk. Compared with the tundra zone, the taiga belt has moderate climatic conditions. The annual precipitation on average is 400-500 mm. The winter in the taiga is cold, overcast and snowy; while the summer is humid and warm (the maximum temperature in July is around 18℃ in southern limit). The total number of days of free-frost in the southern edge of the taiga can reach 115-120. Agricultural activity in this area is still sustainable, even though it is much more limited in scale compared with the steppe and forest-steppe areas in the south. For most parts of the taiga, due to the cold and humidity that hinders the degradation of fallen leaves and their transformation into organic nutrients, the soil in general is very barren. The taiga forest zone can be divided into four sub-zones based on differentiation in the composition of vegetation: northern taiga, central taiga, southern taiga and needle-small leaved forest, and needle-birch forest from north to south.

The faunal composition in the taiga forest belt is more diverse than in neighboring areas. Many typical species inhabit the area: brown bear (*Ursus arctos*), lynx (*Lynx lynx*), wolverine (*Gulo gulo*), pine marten (*Martes martes*), otter (*Lutra lutra*), Siberian weasel (*Kolonocus sibircus*), sable (*Martes zibellina*). Hoofed mammals (ungulates) in this area are mainly the moose (*Alces alces*) and Siberian roe deer (*Capreolus capreolus pygargus*). In addition, there are many different species of rodents: squirrel, fly squirrel, chipmunk and muskrat and others, as well as various kinds of grouses (e.g., wood grouse, hazel grouse) and birds (e.g., Eurasian jay, Eurasian nutcracker, and black woodpecker).

The forest-steppe area is an important transitional ecological zone between the taiga forest in the north and steppe zones in the south. The distribution of the forest-steppe in western Siberia is quite limited, a narrow belt between northern Kamensk-Tyumen-northeastern Novosibirsk in the north and Chelyabinsk-Petropavlovsk-Omsk in the south. Dispersed blocks of forest-steppe also penetrate into the piedmont of the Altai Mountains near Barnaul. The forest-steppe landscape shows transitional characteristics: clusters of admixture of birch, aspen and willow stand out on the vast steppe. The forest coverage is much lower and the climate in general more continental, making the overall environment more hospitable to humans. The temperature in winter on average is around -19℃, while in July the average temperature is around 19℃. Almost half of the annual precipitation is concentrated in July and August (around 170 mm in total). The precipitation in the winter season makes a contribution of 15% to the annual total precipitation. The growing season in this area can reach as long as 150 days. However, when the temperature quickly rises in spring, the great temperature difference between the ground surface and the deep horizon of soil (semi-permafrost) makes the infiltration of moisture difficult. This leads to the leaching of surface minerals, and organic humus can only penetrate to a very limited depth, 40-50 cm on average. The soil type of the forest-steppe is mainly black soil (Chernozem) with rich humus, which is most suitable for agriculture. Black soil is widely distributed in the Baraba Lowlands, Tobol-Ishim and Ob-Irtysh accumulative plains. The faunal assemblage in the forest-steppe also demonstrates transitional characteristics. The most typical species are various kinds of rodents, including gopher, hamster, hare, jerboa, vole, and lemming. Predatory animals include wolf, Corsac fox, ferret, weasel and ermine.

The southernmost ecological zone in western Siberia is the steppe belt. It belongs to a continuous steppe belt from the Black Sea in the west all the way to northern Mongolia in the east. In western Siberia, the steppe belt reaches northern Kazakhstan (Kustanai-Semei) as its southern limit. The climate in the steppe is very typically continental: dry and hot in summers, and cold in winters. The period of free-frost can be as long as 170-175 days with an annual accumulative temperature of 2000-2400℃. However, the annual precipitation is no more than 300 mm. Peak precipitation falls in summers with an average of 35-40mm. Due to the dry and hot wind, evaporation in the steppe is very high, which greatly offsets the effectiveness of precipitation. Surface runoff is almost absent in the steppe save its only artery –the Irtysh River. Saline lakes and desiccated lakes are very common in some concave landscapes. The soil type in the steppe is fertile black soil and dark-brown soil with rich humus. The average depth of black soil is 60-65 cm, and in some locations it can reach 80-120 cm. The floral composition in the steppe is rather homogenous, vast grassland dotted by occasional clusters of birch and aspen being the characteristic landscape. Feather grass, forbs, and fescue are some typical grasses commonly seen in the steppe. The faunal assemblage of the steppe is quite diverse; as many as 60 different species of mammals inhabit the steppe. Most of them are rodents such as hare, jerboa, gopher, vole, hamster, and steppe lemming. Predatory animals include wolf, weasel, ermine, and badger as well as some predatory birds such as the steppe eagle, buzzard and small falcon. There are also various small birds like the lark, little bustard, pipit and ortolan. In addition, aquatic birds such as duck, goose, coot and gull are very common around lakes, especially in summer.

Natural Resources

Russian Siberia has the most abundant reserves of forest in the world. Besides the rich timber resources concentrated in the vast taiga, pasture land is also widely distributed throughout the forest-steppe and steppe belts. Ferrous metal mines such as iron and manganese richly aggregate at the southern edge of the taiga. In the southern part of western Siberia a number of saline lakes produce abundant table salt and Glauber's salt (sodium sulfate mineral). Raw materials for construction such as sand, clay, limestone, granite and diabase can also be commonly found in the southern and western part of western Siberia.

III.2.2 Southern Siberia and Circum-Altai areas

In the archaeological literature another geographic sub-area of western Siberia is more often discussed: southern Siberia. Southern Siberia covers the ecological zones that lie to the south of western Siberia; that is, the forest-steppe and steppe belts where the environment is more hospitable to humans, and therefore has always served as an arena of cultural development throughout history. In the east of southern Siberia, these continuous ecological belts are broken up by mountains such as the relatively low but wide ranging Sayan-Altai.

Southern Siberia is characterized by uprising mountain chains that separate it as a relatively isolated geographic unit. The southern Siberian mountainous zone covers a large territory, extending from the Altai Mountains in the southeast of western Siberia to the ranges near the Pacific Ocean in the east. It can then be divided into several sub-regions, surrounded by some key landmarks: the Altai Mountainous, Kuznetsk Alatau, Tuva Basin, Pre-Baikal region, Trans-Baikal region and Stanovoy Range (Outer Khingan Range). Given their relevance to the current research, only the western part of the southern Siberian mountainous area will be examined in the following sections; namely, the surrounding mountainous areas surrounded by the Altai Mountains (Circum-Altai mountainous areas), the most pronounced landscape in southern Siberia. This relatively homogeneous geographical unit is divided into four political entities in four directions: Sayan-Altai areas on the Russian side, western Mongolia, northern Xinjiang and eastern Kazakhstan.

III.2.2.1 Sayan-Altai

The Sayan-Altai area generally covers all mountainous areas in the eastern part of southern Siberia, including the aforementioned Altai area, Kuznetsk Alatau, and Tuva surrounding the high-rising Altai mountain ridges and its eastern extension – the Sayan Mountains (including western and eastern Sayan). The boomerang-shaped Sayan-Altai ridges cut the thousand-mile continuous steppe belt into two parts: the southern Siberian steppe in the west and the Mongolian steppe in the east. The Altai Mountains meanders northwest-southeast and merge into the Gobi Desert in southern Mongolia. The average elevation of the Altai ranges is 2000-3000 meters.

The Belukha Mountain’s elevation of 4506 m makes it the highest point in all of southern Siberia. Generally speaking, the central and eastern parts of the Altai have much higher elevation on average (3000-4000 m) and the tops of the mountains are covered by snow and glaciers all through the year. These snow-capped mountains supply the arteries of western Siberia with the majority of their water. The Sayan range system includes two ridges that range in different directions: the western Sayan to the southwest-northeast and the eastern Sayan to the northwest-southeast. The average elevation of the Sayan ranges is slightly lower than the Altai, between 1500 and 2300 meters. The highest peak of the Sayan mountain system is the Munku-Cardyk Mountain with an elevation of 3491 meters in the eastern branch of the Sayan Mountains. There are also a number of basins scattered among uprising ridges in the Sayan-Altai: the Kuznetsk basin on the west side of the Kuznetsk Altau; the Minusinsk and Chulym-Yenisei basins surrounded on three sides by the Kuznetsk Alatau in the west, western Sayan in the south and eastern Sayan in the east; the Tuva basin lying between western Sayan in the north and Tannu Ola in the south. With less severe climates and more hospitable environments, these basins served as the major arenas for cultural development in prehistoric and historic periods.

The climate in Sayan-Altai is less continental than its neighboring areas in southern Siberia. Summer is much cooler due to the high altitude; winter is less warm but with more abundant precipitation (35%-40% of annual precipitation). The seasonal average temperature is greatly influenced by its complicated relief, sometimes, even reversed based on different altitudes. For instance, the average temperature in January in mountainous basins with a much higher elevation is always 3-4℃ higher than in adjacent areas with lower elevation. In summer, the average temperature decreases as elevation rises at an approximate rate of 0.3-0.8℃/100 m. Due to the barrier of high elevation, precipitation varies greatly between windward slopes and leeward slopes. With a prevailing western wind or northwestern wind from the Atlantic Ocean in the warm season, generally speaking, western slopes with an average elevation of 1000-2000 mm can receive as much annual precipitation as 1500-2000 mm. By contrast, some mountainous basins or highlands lying on the western slope, e.g., the Ukok plateau (with an elevation of 2200-2600 meters), receive annual precipitation less than 300 mm. Hence good quality pastures always lies on the western slope of mountains, where seasonal transhumance has often been practiced by pastoralists both in ancient times and in the modern era. On the eastern or leeward slope, dry and hot winds (fyën) always blow from ridge to lower piedmont in summer and result in the creation of a steppe landscape at the foot of mountains.

Due to the abundant glaciers on the tops of mountains, river valleys are fully developed in the Sayan-Altai region. Mountainous rivers with short ranges and rapid currents supply the major rivers in western Siberia. The Katun and its tributaries the Argut, Chuya, Biya, Bukhtarma, Charysh, Anui and Chulyshman rivers are typical of the Sayan-Altai area. Besides these rivers, there are also a number of lakes. Large ones among them include the Markakolskoe Lake and the Teletskoe Lake.

The vegetation in Sayan-Altai demonstrates typical characteristics of vertical zonation. The vegetation changes from steppe, forest to alpine tundra as elevation rises. The average altitude of the timber line varies in different locations: 1700-1800 meters in the northern Altai and 2000-2300 meters in the central and western Altai. Mountainous steppe is mainly distributed in the western, southern and most parts of the northern side of the Altai Mountains with varied altitudes according to different geomorphologies. For example, the elevation of the Chui steppe in the southern slope of the Altai can reach as high as 1800 meters. The floral assemblage in the Chui steppe is comprised of various grasses: needle grass (*Stipa glareosa*), needleleaf sedge (*Carex duriuscula*), prairie sagewort (*Artemisia frigida*), ephedra (*Ephedra distachya*) and other common meadow grasses. Above the mountainous steppe grows the most widely-distributed vegetation in Sayan-Altai area - mountainous forest. Alpine meadow, moss, lichens, and rock dominate the surface landscape with an elevation of around 2000 meters or higher.

Various natural resources besides timber and pasture are also richly deposited in the Sayan-Altai; for instance, fossil fuels in the forms of coal, petro oil and gas. In addition, as its name suggests, in its intimate association with gold (Altai literally means the golden mountains) the Sayan-Altai area, particularly the so-called Rudny Altai (southwestern Altai), is well known for its immense reserves of polymetallic ores, such as iron (Fe), zinc (Zn), lead (Pb), tin (Sn), mercury (Hg), gold (Au), tungsten (W) and molybdenum (Mo) and other rare metals. Precious or semi-precious stones and minerals are also richly deposited in the Sayan-Altai.

III.2.2.2 Western Mongolia

Western Mongolia here refers to the vast territory straddling the Mongolian Altai in the west and the Khingai Mountains in the east of the contemporary Mongolian People's Republic. It borders with Russian southern Siberia to the north, Chinese Xinjiang to the west, and Chinese Inner Mongolia to the south through the big boomerang of the so-called Sayan-Altai mountain system. It covers three major geographical units: the Mongolian Altai in the west and southwest, the Gobi in the southernmost of Mongolia, and the Great Lake Depression between the Altai and Khangai Mountains[1].

[1] The following synthesis on physical geography is based on these works: Dugarov (2016); Jacobson-Tepfer et al. (2010); Murzaev (1948).

The Altai Mountains extend into the territory of Mongolia as far as 1500 km northwest-southeast and finally merge into the southern Gobi. Along with the Sayan ridges in the north, the Altai Mountains block the whole Mongolian plateau from the less humid air masses from the Atlantic Ocean in the far west. Thus an arid landscape dominated by steppe, desert and semi-desert formed. The average elevation of the Mongolian Altai is between 3000 and 3500 meters. The highest point is located on the Tavan Bogd (in Mongolian this literally means "five saints") massif – the Khüiten (literally meaning "freezing") Peak, which is shared by Russia, China and Mongolia, has an elevation of 4374 meters. The yearlong snowcapped Tavan Bogd is the ultimate source of the largest river in western Mongolia – the Khovd, which meanders north, east and south to its end in the Great Lake Depression straddling the Altai and Khangai mountains. The southern part of Mongolia is occupied by the extensive Gobi. It borders the Alashan (Alxa) plateau in Inner Mongolia and eastern Xinjiang.

The climate in western Mongolia is typically continental due to its location in the deep heart of the Eurasian continent. Temperature fluctuations are great not only seasonally but also daily (as great as 20-30℃). Winter is dry and bitterly freezing without effective precipitation, especially in the southern part of Mongolia. The lowest temperature in January can drop to -50℃. Summer is warm and short with more effective precipitation (accounting for 60-86% of annual precipitation).The hottest month, July, has an average temperature of 17℃. On average, the annual precipitation in Mongolia is less than 300 mm and thus is considered an arid zone.

Surface runoffs in this area greatly depend on the snow-melt from the glaciers nearby. The Tsagan-Gol, for instance, originates in the Potanin Glacier in the Altai Mountains. Due to strong evaporation and infiltration, the rivers in western Mongolia always have a short range and empty into inland lakes. The Selenga River and its major tributary the Orkhon River, sourcing from the northern slope of the Khangai, converging to Lake Baikal, and finally merging into the Yenisei, is the largest out-flowing river system in the territory of Mongolia. The Mongolian Altai glaciers also sustain the major headwater of the Irtysh River, the so-called Khara Irtysh (or the Black Irtysh) in the upper stream. The Khara Irtysh originates in the southwestern slope of the Mongolian Altai, and flows west through the piedmont of the Xinjiang Altai before it empties into the Zaysan Lake in eastern Kazakhstan. There are also many lakes scattered across the Great Lake Depression. All of them are drainless and enclosed by extensive sand steppe. As a result, saline marshes and desiccated lakes are very common. The largest lake in the Great Lake Depression is the Ubsu-Nur with a water body area as large as 3350 km^2. Due to its salinity, the water is not drinkable or used for daily life. Other smaller lakes such as the Khara-Us-Nur and Khara-Nur have great reserves of freshwater.

Thanks to the general aridity of the environment, the forest coverage for all of Mongolia is as low as 8%. The forest is mainly concentrated in the forms of alpine or forest taiga at high elevations. The major species comprising these forests are common needleleaf and broadleaf flora, such as cedar, fir, spruce, pine and birch. Typical grassland (grassland steppe) covers around 26% of the whole territory, and is mainly distributed throughout the northern part of Mongolia, which shares great similarities in landscape with southern Siberia. More than 40% of Mongolia is occupied by barren desert, semi-desert and the Gobi. Specifically in western Mongolia, there are four types of land cover depending on elevation: grassland (1500 meters), forest (1700-2000 meters), high tundra (2000-3000 meters) and barren uplands (above 3000 meters). The least hospitable zones in summer are the barren valleys and uplands, where the grass cover is sheer. Good quality grassland is usually distributed along narrow valleys with meandering streams. Areas where rivers converge are always hospitable for flora and thus support rich faunal clusters as well (e.g., birds). Large mammals living in mountainous forest areas include wild sheep (argali), wild goat (ibex), snow leopard, bear, moose, wild deer, and roe deer and so on, while in the steppes antelopes, wolves and small rodents are very common. Some of most distinctive species in Central Asia inhabit the southern desert and semi-desert areas, such as wild ass (onager), wild horse (Przewalski's horse) and wild camel.

Mongolia is well known for its rich reserves of various mineral resources. Tavan Tolgoi in the southern Gobi province has one of the largest untapped coal deposits in the world. Cu-Mo ores deposits are richly distributed throughout northern Mongolia, including the Erdenetiin Oboo, one of the ten largest copper mines in the world. Recently rich copper and gold ores have also been detected and exploited in Oyu Tolgoi (literally meaning "turquoise hills") in the southern Gobi desert. Other metallic ores and minerals such as zinc, lead, silver, quartz and fluorite are also abundant throughout the territory of Mongolia.

Even though the high Altai Mountains divide the west-east continuity of the landscape into various micro-regions and make the overland crossing and communications difficult on both sides. There are still many intermontane passes or corridors that allow people to pass through. The role of water tanks in the Sayan-Altai naturally creates connectivity among various basins along the water road. For instance, the headwaters of the Yenisei and Ob in Sayan-Altai offer passes from the mountainous highlands to forest-steppe, steppe and basins (e.g., the Minusinsk basin in the north and Tuva basin in the south). Through history, there have been various established passes over the Sayan-Altai ridges, such as the Durbet Davaa, Indentrin Davaa, Ulaan Davaa, the Irvestiin Davaa between Russia and Mongolia as well as the Bituu Khanasyn

Davaa, Ikh Turgenii Davaa, Irmegtiin Davaa, Baga Davaatyn Davaa, and Khairtyn Davaa between Mongolia and northern Xinjiang in China.

III.2.2.3 Eastern Kazakhstan and Central Asia

Eastern Kazakhstan is separated from Xinjiang by the high but discontinuous Dzungarian Mountains (Alatau). Along with central Tianshan[1] and the gigantic Pamir (literally meaning "roof of the world") to the south, these series of mountains comprise the eastern boundary of a commonly known geographic division: Central Asia[2].

Even though Central Asia lies to the west of Tianshan and theoretically is much closer to the sources of wet air masses, it still does not escape the domination of aridity. Roughly abiding by the line connecting the northern shores of three major water bodies in Central Asia (namely, the Caspian Sea in the west, the Aral Sea in the middle and the Balkhash Lake in the east), the whole of Central Asia can be divided into northern and southern parts according to degree of aridity. The northern part, mainly including central and northern Kazakhstan, has a semi-arid climate and hence vast dry steppe covers the landscape, while the southern part is characterized by barren desert or semi-desert (e.g., the Karakum desert and Kyzylkum desert). However, the mountainous areas around the Pamir-Tianshan-Dzungarian mountain system stand out as

[1] Here the commonly accepted "Tianshan"(literally means "heavenly mountains") in the Pinyin is used instead of the Wade-Giles "Tien Shan".

[2] In the former Soviet Union, Central Asia as a geographical unit narrowly construed mainly designated the four republics: Uzbekistan, Tajikistan, Kirgizstan and Turkmenistan, in addition to adjacent southern and southeastern Kazakhstan. Gigantic central Kazakhstan was treated as one independent unit, while northern Kazakhstan was commonly allocated to the unit of western Siberia by Soviet geographers. In the post-Soviet Union era, the boundary of Central Asia narrowly defined commonly includes all five republics or five "-stans". Here the latter definition is preferred.

independent units due to the characteristic of vertical zonality in vegetation and relatively abundant precipitation[1].

The mountainous system in Central Asia has three major components: the Tianshan and Pamir separated by the Fergana valley, as well as the Kopet Dag separated by the Tajik depression. The first two systems were formed by the collision of the Indian and Eurasian plates. Tianshan is older than the Pamir. The Kopet Dag, contemporaneous with the Pamir, was formed by the collision between the Iranian block and Eurasian plate during the Cenozoic era. The average elevation of central Tianshan is about 3100 meters, encircled by some lower denuded peneplains. Thus the Tianshan mountainous system is characterized by step-like geomorphology. The Pamir can be divided into its western and eastern parts, according to differences in topography. The western part, mainly confined within Central Asia, is characterized by relatively high elevations and narrow valleys with steep slopes. The highest point is the Garmo peak, with an elevation of 7482 meters. By contrast, eastern Pamir is characterized by highly elevated plateau. The Kongur Tagh in China Xinjiang has the highest elevation, at 7649 meters.

The climate in Central Asia is temperate continental in type. Summers are hot, cloudless, and dry, while winters are moist and relatively warm in the south and cold with severe frosts in the north. Precipitation through the year is less than 300 mm in most areas, and much less in southern deserts. However, the mountainous area around Tianshan is an exception, the annual average precipitation sometimes reaching 500 mm in the western piedmonts, and some locations even receiving as much as 800 mm. Winters in mountainous areas are relatively mild, especially in the

[1] The following synthesis is mainly based on: Gerasimova and Murzaev 1968; Shahgedanova 2002, Chapter 12 and 16.

western slope. Temperature inversions always occur in the foothills and lower mountains and thus cause foothills to be warmer than surrounding plains. Thereupon, the relatively mild climate at low and middle elevation provides conditions for agriculture where water is available. For example, the upper limit of arable agriculture on average in the Tianshan can reach 2500-2800 meters (for cereals like barley, wheat and oats), while in the Pamir it can extend to around 3500 meters.

The relief of Central Asia is dominated by plains, such as the northern Kazakhstan plain and Turanian plain near the Caspian Sea. A few uplands rise to a relatively low elevation, scattered between the Caspian Sea and the Aral Sea, including the Ustyurt plateau and adjoining Krasnovodsk and Mangyshlak uplands. The rising of the Pamir plateau in southeastern Central Asia resulted in the formation of a number of river valleys across the vast plains, such as the Zeravshan, Syrdarya, Amudarya, and Chu river valleys. The alluvial deposits brought by these rivers, especially the Amudarya, the second largest river sediment discharge in the world after the Yellow River in China, consist of desert formed in the Pleistocene and even earlier periods. The aeolian-alluvial sandy desert, e.g., the Karakum between the Amudarya and Kopet Dagh and the Kyzylkum between Amudarya and Syrdarya, are the two most typical examples. Longitudinal dune ridges are dominant in Central Asia, but only some of them are entirely aeolian in orgin. Mobile sand dunes (barchans) are less widespread but scattered in areas such as the central Fergana depression, the southern margin of the Upper Khoresm oasis, and some major wells and water sources.

The river network in Central Asia is less developed. The Irtysh river system, cutting through the northeastern corner of Kazakhstan, including its two major tributaries - the Ishim and Tobol

River in northern Kazakhstan - is the only out-flowing river. Other major rivers, such as the Amudarya, the Syrdarya, the Ili River, the Zeravshan River and the Chu River in the southern part of Central Asia, either empty into landlocked lakes or are lost in the desert before reaching watersheds. The perennial glaciers on top of Tianshan and Pamir are the single most important sources of water for the rivers.

Vegetation can be divided into three groups according to the ecological conditions: semi-desert vegetation in the northern part, and desert vegetation in the southern part, as well as floodplain vegetation along river valleys. Steppe covers one fourth of the landscape in northern Kazakhstan. Relatively abundant water (200 mm on annual average) and fertile chernozem soils support lush grasses such as that of the *Festuca* genus (*Festuca sulcata*), feather grass (*Stipa lessingiana*), junegrass (*Koeleria cristata*), and crested whitegrass (*Agropyron pectiniforme*) and so on. The average height of the plants is about 27-37 cm. In central Kazakhstan, the typical vegetation of the semi-desert zone is comprised of the *Stipa* genus (feather grass) and *Artemisia* species (sagebrush). Psammophytic plants can be commonly found on the sandy river terraces of eastern Kazakhstan. The desert vegetation of central and eastern Kazakhstan is distinguished by the absence of grasses and the more xerophilous *Artemisia* species, various dwarf shrubs represented by the *Salsola* and numerous ephemeral plants. Floodplain forest (tugai) accompanied by shrubs and tall grasses is the major floral assemblage in river valleys. The most important tree species in the tugai are *Populus diversifolia* and *P. pruinosa*. Another floodplain flora is shrub thicket composed of several *Tamarix* species. The fauna in semi-desert and desert Central Asia is generally the same as in Xinjiang and Mongolian Altai. Wild horse (tarpans), Asiatic wild ass (kulan), and wild antelope (saiga), and Caspian tiger are major large mammals. However, due to anthropogenic reasons, some of them are extinct (e.g., wild horse, Caspian tiger). The most common species in the desert and semi-desert are consistently rodents, which provide the major food source for carnivores such as polecat, fox, and spotted wildcat. Birds are all common species seen in other areas such as the raven, eagle, owl, and buzzard. Reptile species like the racerunner (*Eremias carinata*), agama (*Agama sanguinolenta*), and sand boa (*Eryx miliaris*) are commonly encountered in desert or semi-desert areas.

III.2.3 Northwest China

III.2.3.1 Northern Xinjiang (Dzhungar Basin)

The south and southwest slope of the Altai Mountains is within the Xinjiang Uyghur Autonomous Region, the largest administrative division in China (1.6 million km^2). Due to its location in the heartland of Inner Asia and its homogenous aridity, Xinjiang as a geographic unit is an important component of the arid land of Northwest China. It shares long borderlines with multiple countries such as Mongolia, Russia, Kazakhstan, Kirgizstan, Tajikistan, Afghanistan, Pakistan and India. In its geological structure, Xinjiang can be divided into two sub-units: the Dzungarian Basin in the north and the Tarim Basin in the south, with the Tianshan mountains straddling the middle as the demarcation. The overview of physical geography hereinafter will mainly focus on the northern and eastern part of Xinjiang, which can be divided into several sub-units: the Altai-Qoqek forest-steppe zone, Dzungarian basin and Turfan-Hami basins[1].

In the foothills of the Altai Mountains lies the so-called Altai-Qoqek forest-steppe zone. It includes three micro-regions: the Altai mountainous area, the interfluvial plains between the Ulungur River and Irtysh River, and the Dzungarian mountainous area. The Ulungur River,

[1] The following synthesis of physical geography in northern Xinjiang is mainly based on: Chen X. 2010. Chapter 14, 15, 17, and 18.

originating from the southern slope of the Mongolian Altai, confines the forest-steppe zone as its southern limit. Not fully enclosed by the Dzungarian ridges in the west, the forest-steppe zone extends into the eastern Kazakhstan mountainous areas around the Zaysan Lake. Besides the Ulungur River, the Irtysh River is also supplied by many other smaller rivers originating from the southern slope of the Altai: the Haba River, Burqin River, Kelan River and Khara Irtysh River. The Ulungur Lake and Kanas Lake are the two major lakes in this area. The climate in this area is temperate continental. Winter is long and cold; summer is short and cool. The annual average temperature is 0.5-6.9℃. The annual average temperature in the foothill plains is higher than in the mountainous areas, but the annual precipitation is the opposite: it increases according to elevation. For instance, the annul precipitation in some piedmont areas with relatively low elevation is 200-300 meters; however, in the high alpine areas (e.g., the Kanas Lake) precipitation can rise to 1000 mm because more wet air from the west is caught by the high rising Altai. The forest has an elevation 1300-2600 meters and contains the same major species as the northern slope. Steppe is scattered through some foothills of the Altai Mountains and Dzungarian ridges, and belongs to the southern Siberian forest-steppe and Eurasian steppe belts.

The Dzungarian basin to the south of the Altai Mountains is the second largest basin in China. One third of its land surface is dominated by desert or semi-desert. In the center of the basin lies the Gurbantunggut desert, which is the second largest desert in China, sandwiched by narrow fluvial plains to the north and a number of oases scattered at the foot of Tianshan to the south. The only major river in the basin is the Manas River. It originates from the northern slope of Tianshan, flows northward and disappears in the west edge of the basin. The Ebinur Lake in the west rim of the basin has the lowest point in elevation (189 meters above the sea level). Besides restricted plains, there are several intermontane basins or lowlands such as the Bortala lowlands in the western edge, the Barkol (Balikun) lowlands in the eastern edge and the Daban-Chaiwopu basin south of Urumqi. The west of the Dzungarian Basin has several openings, such as the Irtysh river valley, Emin river valley and Dzungarian Alatau, that connect to eastern Kazakhstan. Vegetation in the basin is scarce. The floral assemblage is dominated by desert-steppe plants, including tamarisks, desert poplars, elms, saksauls, silverberry, camelthorns, and kalidium genus shrubs.

The largest mountainous system in Central Asia, the Tianshan Mountains, crosses nearly the entire region from west to east, a length of 3000 km. The section within the territory of China is also given the name of Eastern Tianshan, distinguished from its western part in Central Asia. The average elevation of the Tianshan ridge can reach 4000 meters (the highest point Tomur/Jengish Choqusu at 7439 m). Just as the Altai in the north, Tianshan mountainous areas also receive abundant precipitation due to their high elevation, especially the northern slope. The developed glaciers on the top of Tianshan supply a number of rivers (more than 100), flowing from south to north, and feed the continuous oases at the foothill in the northern slope. Vegetation on the Tianshan shows vertical differentiation: alpine forest, mountainous forest, forest-steppe and steppe, from high to low elevation. Due to its optimum precipitation and temperature, the steppe in the northern slope produces much more good quality pasture than its southern counterpart.

The continuity of the Tianshan range in Xinjiang is broken up by the intermontane depression named Dabancheng (literally meaning “the city of pass”) to the east of Urumqi. The following section, which still belongs to the Tianshan range, is also called Bogdo Shan. It finally merges into the Gobi desert around another well-known mountainous pass - Xingxingxia (literally meaning “starry valley” due to the abundant deposit of quartz nearby) connecting to the Hexi corridor in the east. To the south of Bogdo Shan lies a series of depressions represented by the two major ones: the Turfan basin in the west and the Hami basin in the east. These two basins straddle the Tianshan (Bogdo Shan) in the north and lower Qoltag range in the south. The landscape in this area is homogeneous due to its extremely arid environment. Located in the heartland of Inner Asia, the Turfan-Hami depressions are beyond the reach of wet air masses travelling thousands of miles from the Atlantic Ocean to the west and the Pacific Ocean to the southeast. The Bogdo Peak, with an elevation of 5445 meters, is the highest point in this area. The lowest point is Ayding Lake at 154 meters below sea level, which is also the lowest point in China and the second lowest point on the Earth, following the Dead Sea. The Tianshan in the north also serves as the major source of water for the depression. Because of its extreme aridity surface runoff in this area is very rare. Hence most of the snow-melt basically seeps underground and the aquifer is lifted when it meets with some low hills on the edge of the basin (e.g., the Flaming Mountains lying to the north of the Turfan basin) and comes out of the ground surface in the form of springs. A distinctive and ingenious irrigation technology, the Qanat channel, was introduced and has been used for a long time by local people in Turfan and Hami to retrieve underground water. The present landscape in this area was mainly formed during geological periods. The vast Gashun Gobi lying between the Hami basin and Lop Nur, resulted from the aridity erosion of flood-accumulating gravels. Similar geological mechanisms also produced the well-known Black Gobi along the Mazong Shan on the border of Xinjiang and Gansu due to the erosion and oxidization of manganese mineral in rocks. The flora and fauna in this area share great similarities with the aforementioned Dzungarian basin and adjacent Mongolian Altai, both in distribution and in composition.

III.2.3.2 Gansu-Qinghai region (the Hexi corridor and adjacent areas)

The Gansu-Qinghai region (always acronymized as Gan-Qing in Chinese literatures) comprises most of arid Northwest China. As a geographical unit, it usually designates the highland massif in the northwest of China proper. It is more or less congruent to the historical geographical concept *Hexi*, which literally means "west of Huanghe River" (the Yellow River). Due to the homogeneous aridity in this region, it belongs to the northwestern arid zone, which is one of the tripartite ecological zones in China (the other two being the eastern monsoon zone and the Qinghai-Tibet/Qingzang plateau zone) (Zhao, S.Q. 1983). As an administrative concept, Northwest China generally includes the broader territory of three present-day provinces and two autonomous regions: Shaanxi, Gansu, Qinghai, Ningxia Hui Autonomous Region and Xinjiang Uyghur Autonomous Region. Considering the historical importance of the Hexi corridor (sometimes also called the Gansu corridor) and its particular physical characteristics in Northwest China, the following synthesis will mainly focus on the Hexi corridor and its adjacent arid or semi-arid land such as the western Inner Mongolia (Alashan plateau), and the northern edge of the Qingzang plateau[1].

[1] The following synthesis mainly consulted Chen X. (2010), Chapter 12, 13, 19, and 20.

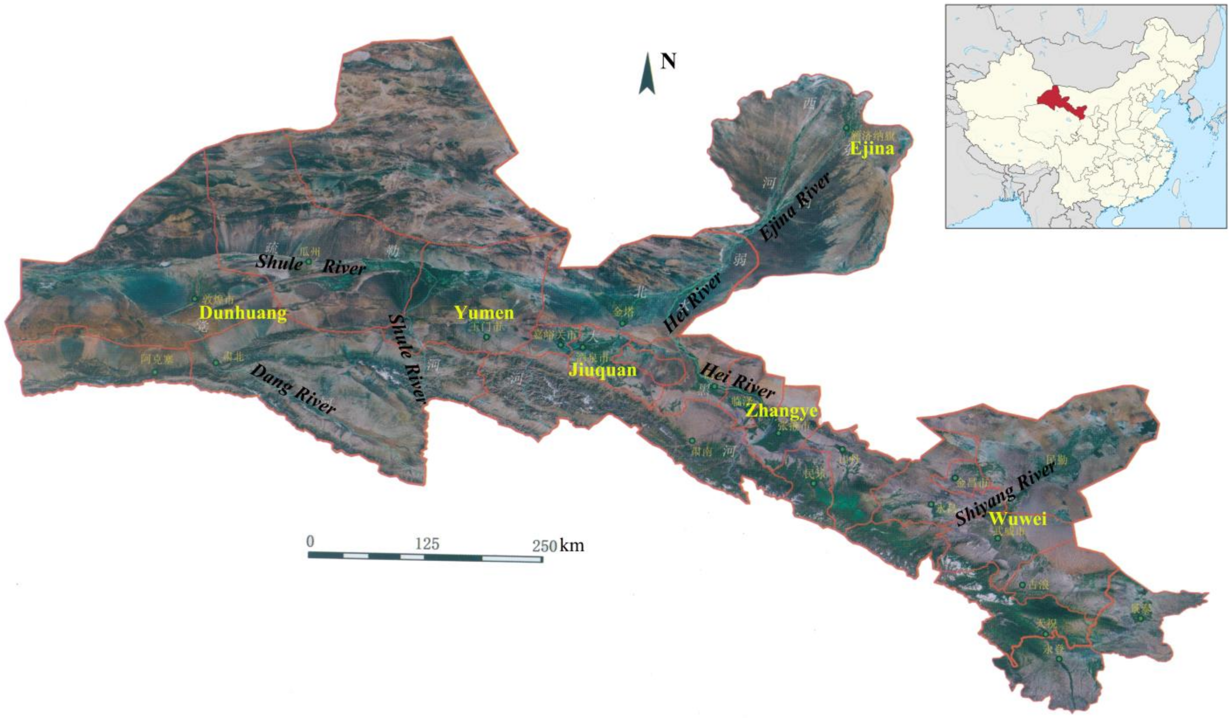


Figure III.3 Satellite map of the Hexi corridor

(After GSWKY and BDKWX 2011, plate 1)

In geography the Hexi corridor mainly designates the narrow and elongated depression sandwiched between the Qingzang plateau to the south, bounded by the Qilian-Altyn Mountains and the Alashan plateau to the north, bounded by the Mazong Shan-Heli Shan-Longshou Shan range. It extends northwest-southeast, starting at the northwestern slope of the Wushao Ling and ending at the Kara Nur near the borderline between Xinjiang and Gansu. The total length of corridor is about 1020 km; the width on average is 50-60 km. The narrowest section around Nan Shan in Yongchang prefecture is around 20 km, while the trumpet-shaped western end in Dunhuang with a width of 140 km, is the widest section (GSWKY and BDKWX 2011; Figure III.3).

In geology, the Hexi corridor belongs to a transitional zone between the Qilian fold belt to the south and the Bei Shan (Heli Shan-Longshou Shan) fold belt and the Alashan uplift to the north. The Qilian mountainous system is comprised of a number of parallel ranges on the edge of the Qingzang plateau. The average elevation of the Qilian Mountains is 3000-4000 meters. The tops of the Qilian Mountains are covered by perennial glaciers that provide the source of water for all river systems in the Hexi corridor. By contrast, the Bei Shan, made up of a range of eroded mountains, has a much lower elevation of 1500-2500 meters. The high-south and low-north relief determines the directions of surface runoff flowing from south to north, perpendicular to the directionality of corridor. The whole corridor is not homogeneous in relief, comprised of a series of basins, which from east to west are the Wuwei basin, the Yongchang basin, the Shandan basin, the Zhangye basin and the Jiuquan basin. The elevation of the corridor on average is 1000-1500 meters, with an inclination higher in the southeast and lower in the northwest.

The Alashan plateau lies between the Hexi corridor in the south and the Mongolian Gobi in the north; thus the physical environment is more arid than the former and shares great similarities with the latter. In geomorphology, the Alashan plateau stands out as an independent unit, framed by a series of mountains on its edges: the Mazong Shan to the west, the Heli-Longshou Shan to the south, the Helan Shan-Yin Shan to the east, and the Mongolian plateau to the north. The weathering of extreme aridity along with aeolian processes erodes the ground surface of the Alashan plateau into quasi-plains or plateau plains. The average elevation of the Alashan plateau is 900-1400 meters. 93% of ground surface is occupied by vast sandy desert and stony deserts (the Gobi); as a result, environmental capacity is extremely low. The western section in the Ejina banner, thanks to the influx of the Hei River from the Qilian Mountains, has developed hospitable oases along the river valley and terminal lakes. In the east, Helan Shan provides a source of water for small rivers in the western slope, and thus alluvial plains at the foothills are also able to accommodate a small population. Besides these two regions, remaining areas are covered by barren deserts (Badain Jaran desert, Tengger desert, and Ulan Buhe desert).

Due to the rising of the Qingzang (Qinghai-Tibet) plateau and its barricade against moisture, along with its location deep in the continent of Inner Asia, the Hexi corridor has an arid environment in general. As with other regions of Inner Asia, the Hexi corridor is dominated by a typical continental climate. Summers are hot and dry, and winters are freezing and windy. Annual precipitation is scarce throughout the whole corridor, usually less than 300 mm. The moist air masses from the Pacific Ocean to the southeast and the Indian Ocean to the southwest are the major sources of atmospheric precipitation in summers; nevertheless, their influence is very restricted at the eastern end of the corridor. The amount of annual precipitation linearly decreases from southeast (250 mm on average) to northwest (less than 100 mm on average) in the corridor. In winters the Siberian anticyclone is dominant and causes cloudless, freezing, and dry weather. As a result of the valley effect, strong wind lasts all through the year in the corridor, especially the frequent and strong wind in Guazhou (the former Anxi County) at the western end of the corridor making it known by the titlte "the bank of wind in the world". However, an analogy can be made between the Hexi corridor and the Pamir piedmont in Central Asia, considering the characteristics of mountainous areas in each context: specifically, precipitation increases with the rising of elevation around the water tank. Even though the average amount also decreases from southeast to northwest, the piedmonts and intermontane basins in the Qilian Mountains still receive relatively abundant precipitation, compared with their lower counterparts in the corridor along the same longitude. Thus these areas are capable of limited pastoral production.

The river system is less developed in the corridor. There are three major runoff systems from east to west: the Shiyang River, the Hei River and the Shule River. All of them originate in the Qilian Mountains in south, flow northward, cut through the corridor and disappear in terminal lakes or are absorbed by the deserts on the southern edge of the Alashan plateau. The Shiyang River is the confluence of several smaller rivers originating in the eastern section of the Qilian Mountains. Its total length is about 300 km. It flows through Gulang, Wuwei and Yongchang county and disappears in the terminal Qingtu Lake in the Minqin depression in the south of the Tengger desert. The Hei River in the middle of the corridor is the largest river system. Its source lies in the Qilian Mountains, then the river stem flows northward through the Zhangye depression, Linze and Gaotai. It is usually called Ruo Shui after it enters into the territory of Inner Mongolia. Due to the flat relief in this area, the river stem swings into a braid-shape and bifurcates into the Muren Gol to the west and Emune Gol to the east, finally emptying into the terminal lakes of Gashun Nur and Subo Nur, respectively. The Shule River in the west of corridor has the same source of water as the other two rivers, but rather than flowing northward it flows parallel to the corridor, westwards. The upper stream is also called the Changma River. After receiving the influx of the Dang River in Dunhuang, the Shule River ends in the terminal Lop Nur in eastern Xinjiang. The eastern branches of the Shule River system, the Baiyang River and Shiyou River, flow northward through Yumen and end in the present-day desiccate Huahai basin. Together with aeolian erosion and weathering, the river system also plays an important role in the formation of the geomorphology of the corridor. The debris of glaciations are transported by rivers and dropped when the gradient decreases abruptly. Thus, a number of alluvial fans can be commonly found at the foothills along the Qilian Mountains where the rivers emerge out of onto the flat plains, such as the largest Changma alluvial fan in Yumen. The surface of alluvial fans is usually covered by a thick layer of grabbles or cobbles, forming a landscape of stony desert (the Gobi). Due to aridity and evaporation, the river water always penetrates underground after flowing through the alluvial fan for some distance, then comes out of the ground surface in the form of springs or marshes on the edge of the alluvial fan with higher elevation. Oases are then formed around the major sources of water, e.g., the river valley, wells, and springs, where most settlements are usually located.

Vegetation in corridor is similar to that of other arid areas in Central Asia. It can be divided into a mountainous vegetation system and an alluvial plain vegetation system. Vertical zonality of vegetation can be observed in the Qilian Mountains: mountainous desert or semi-desert, meadow steppes, forest-steppe, subalpine shrub and tall-grass meadows, and alpine low-grass meadows. However, because of the spatial difference in thermal and moisture resources, the altitude of each vegetation zone and its variety of floral species greatly fluctuate in composition. Generally speaking, the whole of the Qijian Mountains are divided into eastern and western sections by the Taolai River (one of the major tributaries of the Hei River). The eastern section, which receives more moisture from monsoon air masses, has more developed zonality than its western counterpart. The average altitude of the same vegetation zone usually ascends when it moves from the eastern to western section. The floral assemblage also varies in species according to difference in section and aspect (leeward and windward). The coverage of vegetation in alluvial plains in the corridor is very low. Plants and trees mainly cluster in oases; some shrubs also grow in the desert and semi-desert. The leading families among them are the *Calligonum* genus, *Nitraria* genus, *Tamarix* genus, *Salsola* genus, *Ephedra* genus, *Zygophyllum* genus, *Haloxylon* genus and *Astragalus* genus, which can tolerate aridity. Some ephemeral plants grow fast in the watershed, especially after precipitations and can increase the coverage of vegetation up to 40-50%

in wet seasons. The low ranges in the northern boundary of the corridor, namely, the Mazong Shan, Heli Shan and Longshou Shan, have typical semi-desert vegetation. The composition is very monotonous: *Stipa* genus is the prevailing species and occasionally coexists with *Zygophyllaceae*, *Sympegma regelii, Anabasis* genus and *Ephedra* genus. Forest is absent in these denuded mountains due to aeolian erosion and weathering. The faunal assemblage also shares many similarities with that of northern Xinjiang and Central Asia. Reptiles, ungulates, and rodents, such as liazards (*Lacertilia*), fox (*Vulpes corsac*), weasel (*Vormela peregusna*), wild ass (*Equus hemionus*), wild camel (*Camelus bactrianus*), *Gerbillinae*, and *Dipodidae* are the leading species in desert and semi-desert areas.

Mineral resources are richly deposited in the Hexi corridor. Fossil fuels such as coal can be found in the mountains along the corridor. Petrol oil is richly reserved in the Jiuxi depression, especially the Laojunmiao in Yumen. Ferrous ores like iron (Fe), Chromium (Cr) are mainly reserved in the western and northern sections of the Qilian Mountains, for example, the well-known iron mine in Jingtieshan. There are various nonferrous metallic ores that have been detected, such as copper (Cu), nickel (Ni), lead (Pb), zinc (Zn), tin (Sn), gold (Au), silver (Ag) and others. Other non-metallic ores such as Arsenic (As), serpentine, granite, salt, fluorite, quartz, gypsum and talc are also found in the corridor (Sun J.H. et al. 1986).

Chapter IV Setting the stage: the cultural landscape of Bronze Age Central Eurasia

IV.1 The archaeology of Central Eurasia in the Bronze Age: a brief review of tempo-spatial framework and some critical issues

Eurasian archaeology with a focus on the Eurasian steppes is probably one of the most dynamic fields in world prehistory studies. Enthusiasm about steppe archaeology has seemingly reached a peak in recent decades, represented by the publication of several benchmarks in the literature (Anthony 2007; Boyle et al. 2002; Hanks and Linduff 2009; Jones-Bley and Zdanovich 2002; Kohl 2007; Koryakova and Epimakhov 2007; Levine et al. 1999; Peterson et al. 2006; Popova et al. 2007). However, the problems with explanation and interpretation of archaeological material in steppe archaeology are by no means less tenuous than the research history itself (Kohl 2006:3; Anthony 2006:40). As a result, it is almost impossible to have an exhaustive review of the tempo-spatial complex covering such a gigantic territory, and it would be redundant considering the publications with detailed review of archaeological materials and research questions in recent years (Hanks 2010; Koryakova and Epimahov 2007). Thus, I will mainly focus on the archaeological literature and research in the last decades in some key areas, and tease out some key questions based on a brief review of some critical archaeological cultures[1] (or phenomenona) in Central Eurasia around the early second millennium BC (Middle-Late Bronze Age). My major concern will be social context, including subsistence economy, trade and exchange, technological innovation and social differentiation etc. Following a conventional division of Central Eurasia, my review will be organized by these culturally important geographic divisions

[1] Archaeological culture is an expedient analytical concept widely used by archaeologists to designate certain recurring assemblage of artifacts from a specific archaeological context that may be associated with a particular human society in the past. For a comprehensive critical thinking in this concept, please refer to Ehrich (2017), Chapter 1 and 2.

Table IV.1 Chronology of Bronze Age Central Euraisa

Cis-Urals (steppe-forest steppe)	Eneolithic in Pri-Kam	4000	1600
	Yamnaya	3350	2450
	Abashevo	2200	1800
	Early Srubnaya	1940	1610
	Srubnaya	1730	1410
Trans-Urals (forest steppe-forest)	Eneolithic Urals	4300	2900
	Early Bronze	2470	2200
	Tashkov	2290	1889
	Koptyakov	2150	1250
	Seima-Turbino complex	2120	1500
	Andronovo (Fedorovo)	1980	1510
	Cherkaskul	1600	1250
	Barkhatovo I	1310	1000
	Barkhatovo II	1220	780
Trans-Urals (steppe-forest steppe)	**Sintashta**	2010	1770
	Petrovka	1880	1740
	Andronovo (Alakul)	1900	1450
	Alakul-Fedorovo	1780	1530
	Transitional period	920	820
Baraba forest-steppe	Ust-Tartas	4500	2500
	Odinovo (early stage)	2900	2500
	Odinovo (late stage)	2300	1900
	Krotovo (early stage)	2900	2500
	Krotovo (the final phase of early stage)	2500	2100
	Late Krotovo	1900	1800-1700
	Andronovo (Fedorovo)	1800	1500
	Mixed Krotovo-Andronovo	1700	1400
	Irmen	1400	1100
	Late Irmen	1000	800
Minusinsk Basin	**Afanasevo**	2900	2500
	Okunev	2200	1900
	Andronovo (Fedorovo)	1900	1500
	Karasuk (classic)	1400	1000
	Late Karasuk	1200/1100	900
Mongolian Altai	**Afanasevo**	3000	2500
	Chemurchek	2250	1800
	Munkh-khairkhan	1700	1400
	Mongun-taigin	1400	1200
Russian Altai, Upper Ob River	**Afanasevo**	3700	2600
	Yelunino	2200	1800
	Andronovo (Fedorovo)	2000	1700
	Irmen, Sargary-Alekseevka	1700	900
	Transitional period	800	700

4500 4000 3500 3000 2500 2000 1500 1000 500BC

(Major archaeological cultures mentioned in the text are bolded; absolute date intervals are also highlighted in black solid. After Molodin et al. 2014b:145, figure 2) in Central Eurasia: the Southern Urals, Trans-Urals (Zaural) (Pri-Tobol), Ob-Irtysh interfluves, Circum-Altai regions, and finally, Northwest China (Table IV.1).

IV.1.1 Southern Urals

The most apparent archaeological features in the Trans-Urals from the early second millennium BC are probably the cluster of so-called fortified settlements represented by Sintashta and Arkaim sites scattered in the South Trans-Ural plains (Figure IV.1). Various labels, such as 'Sintashta-Arkaim', 'Sintashta-Peterovka', and 'Country of Towns (*Strana gorodov*)' come from the archaeological excavations of these two representative sites, referring to the archaeological complex in the Southern Urals during the transitional period from the third to the second millennium BC (2010-1740BC) (Hanks et al. 2007; Zdanovich and Batanina 2002; Zdanovich and Zdanovich 2005; for an exhaustive review of Sintashta studies see Hanks and Doonan 2009; for the research history of Sintashta culture, see Zdanovich 2002a). Twenty-two enclosed settlements have been found so far, but only a few of them have been excavated: Sintashta, Arkaim, Kuisak and Ustye. Among these excavated settlements, only the Sintashta settlement and part of the Arkaim cemetery have been published in great detail so far (Gening et al. 1992; Zdanovich 2002).

Since the discovery and investigation of Sintashta in the 1970s, interpretation has always been connected to the identification of Indo-European language-speaking Indo-Aryans (Renfrew 2002; Kuzmina 2002), even though exploration of these issues is notoriously arduous and has invited long-lasting critiques (Kohl 2006, 2007; Lamberg-Karlovsky 2002, Shnirelman 1999). However, as more field work had been done and more details have been revealed, research questions have gradually turned to more specific concerns about subsistence economy, metallurgical production, social organization and differentiation by means of inter-disciplinary perspectives in recent years. Most issues are still open to debate due to the limited availability of archaeological material. Questions include: what is the nature of these enclosed settlements? To what extent can they be related to metallurgical production? What is the subsistence economy like? How were these ancient societies organized based on their settlement patterns and attached kurgans?

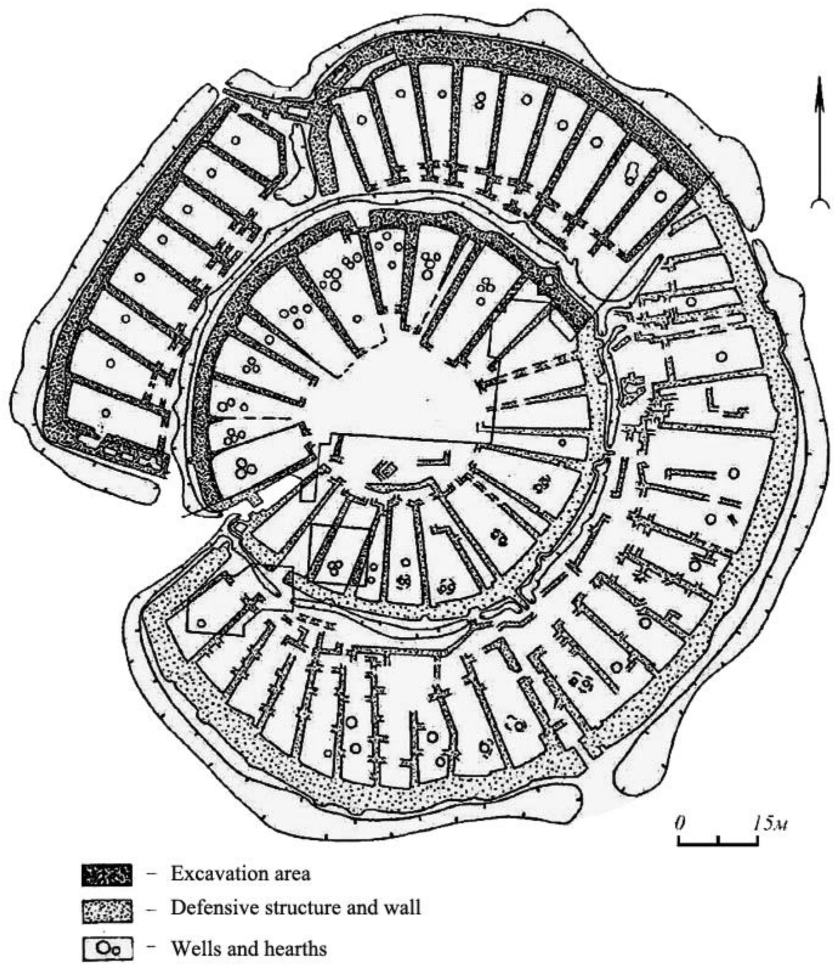


Figure IV.1 The plan of Arkaim

(After Zdanovich and Batanina 2002)

According to excavations and surveys of some enclosed settlements, the stratigraphic context between different geometric layouts in a given settlement provides reliable evidence for the chronological sequence of enclosed settlements with different patterns. Generally, they can be categorized in three groups based on the overall pattern in chronological sequence from early to late: oval, round and rectangular-shaped settlements (Zdanovich and Batanina 2002; Zdanovich and Zdanovich 2005). Almost each settlement has three to four construction phases, which suggests continuous use over a long time. Different patterns of settlement were replaced by one another in some cases (e.g., Stepnoe, Ustye, Rodniki, and Isinei); although the reason for this replacement over time is still unclear. Evidence of fire destruction from Alandskoe, Sintashta and Bersaut (Zdanovich and Batanina 2002:123) suggests that fire, or flaws in the planning of the fortification system leading to the destruction of the settlement in warfare (if the primary function of these enclosed settlements is indeed fortification, as is commonly held by archaeologists), were not the primary factors in determining pattern replacement, as settlements still maintained the same pattern after reconstructions. Apparently, it is necessary to find an answer in the social dynamics within each settlement, which also calls for more micro-scale field work in the future.

Even though the label of “country of towns” is still controversial and metaphorical, we should not stop exploring the possible social organization reflected by the settlement pattern. As for the function, as mentioned above, fortification of these enclosed settlements is the popular explanation among archaeologists. However, when we consider the function of these enclosures from an exterior perspective, focused on threads and attacks from groups in neighboring areas, we ignore the importance of maintaining interior control over the population living within these enclosures. It could have been a centralized power in terms of politics, military, ritual, or even identity that shaped the settlement. This idea can be clearly read through the concentric interior structure of oval and circle enclosures represented by the most well-known site, Arkaim. In this context, two hypothetical models of productive organization raised by Kohl (2007:177, 178) will be important here: the ‘Gulag model’ and the ‘gold-rush model’. Even though these two models are raised in the context of mining activities in Cis-Urals Kargaly (near Orenburg), considering the intimate connections between these enclosed settlements and metallurgical activities detected in most ‘fortified settlements’, they are appropriate to apply in the case of the ‘country of towns’. As recent fieldwork in Stepnoe suggests, the emergence of Sintashta-Arkaim enclosed settlements is indeed directly related to the development of metallurgy (Hanks and Doonan 2009; Doonan et al. 2014). The gold rush production model is preferred by Kohl in interpreting mining production in Kargaly due to intensive production in obvious seasonal rhythms and the absence of smelting and casting in mining areas: “highly intensive mining activities, seem to have taken place without the coercive presence of an overarching centralized state” (Kohl 2007:178). By contrast, we saw a greatly different picture on the other side of Ural Mountains: these outpost-like settlements are insularly scattered over a broad area (as wide as 90,000 km^2). If the chronological scheme based on settlement pattern is reliable, estimation of the nearest distance between two contemporaneous settlements would be at least 20 km (for example, Zhurumbai and Olgino). The loose distribution pattern of these enclosed settlements makes more sense in terms of the gold rush model: that is, these settlements probably distributed and spread out because of the existence of potential mining locations across a broad area. On the other hand, we have not seen too much evidence of seasonally intensive production in mining or smelting processes east of the Ural Mountains, as suggested by millions of animal bone remains in Kargaly in the west of the Ural Mountains (Chernykh 2002). Meanwhile, enclosed settlement patterns are almost absent in Kargaly but are signatures of the east. The distinctiveness of Sintashta settlements strongly suggests the emergence of a totally new social strategy in organization, different from western neighbors, who probably echoed the 'Gulag model' with centralized coerciveness in politics, military or ritual. Considering the cultural similarity between the contemporaneous Sintashta and Abashevo cultures on both sides of Ural Mountains, adaptation and change in social strategy during the exploration of new territory makes sense. The degree of social complexity among these enclosed settlements is not as high as most archaeologists once assumed: villages comprised of independent communities probably would be more accurate than the label of "country of towns".

Once we try to examine these seemingly enigmatic settlements from the perspective of interiority, the role of military fortification that is imposed by and consequentially related to a so-called 'warrior aristocracy' (Anthony 2006) fades away automatically. The limited amount of bronze weaponry unearthed, in addition to the absence of direct evidence of osteological trauma among individuals, sufficiently denies the possibility of large-scale and frequent warfare in this area during Middle-Late Bronze Age. Even though the possibility of small-scale conflicts between different groups cannot be ruled out, this does not necessarily mean that the intensification of conflict and warfare played a key, transformative role in the processes of Sintashta genesis as argued by Anthony (2009:48). The topographical characteristics of Sintashta settlements and their location deliberately close to marshy and meandering streams rather than on the top of heights also suggest that the subsistence economy (water source and winter fodder), rather than fortification and defense against enemies, was the prime mover. Evidence from attached kurgans also attests that the stereotype of 'pastoral warriors' imposed on Sintashta communities is an anachronistic image. Although many kurgans have been looted, even complete ones have not yielded many metal artifacts, let alone bronze weapons (Hanks et al. 2015:336). Dozens of chariots were found in some high-ranking kurgans (Zdanovich 2002b), but their small number does not commeasure with the assumed scale of intensified warfare over such a broad territory.

Mortuary data are always treated as important for archaeologists in reconstructing the past societies. Central Eurasia is not an exception. The large amount of kurgans protruding from the uniform landscape of the Eurasian steppes naturally attracts much attention. The volume of earth mounds and the number of graves underneath, as well as the grave goods contained, are always used as the criteria to judge the social rank of the occupants. The volume of earth is always calculated as an index of the amount of labor invested. Building on that, further interpretation of social structure and organization becomes possible (Hanks et al. 2015). It seems plausable in most cases that the creation of kurgan were important cultural events. Once we treat kurgan as constitutional components of the whole landscape of the Eurasian steppes and examine them from a processual perspective, understanding social organization by means of mortuary analysis becomes quite complex and hence calls for more rigorous investigation. Records of deliberate disturbance and reuse of kurgans by later populations who lived in the same areas are common in Eurasian archaeology. In some cemeteries dating back to the Early Bronze Age in western Transcaucasia, evidence shows that later people continued to use the same tombs by clearing out earlier occupants in graves (Chernykh 1992:79). Recent excavation in Qinghe, Xinjiang have also unraveled a slab-lined tomb dating back to 1500 BC but occupied by a much later deceased, around 800 BC (Guo W. 2016). Likewise, the same phenomenon can also be observed in the Arkaim necropolis, kurgan 25 (Zdanovich 2002b). There are 23 tombs found under the mound of kurgan 25, arranged in a concentric pattern with two aligned tombs in the center, tomb 9 and tomb 10. Tomb 10 was dug by tomb 11 right in the center (Zdanovich 2002b:18, figure 6; figure

22). Pottery sherds with protuberated decoration (so-called “pearl motif”) from the tomb 11 suggest that it belongs to a much later period (Zdanovich 2002b:45, figure 25-3). If all deceased were not buried in this kurgan at the same time, the pattern of concentricity then strongly suggests a process of gradual formation of kurgan with large amounts of earth. When more deceased were buried around the earlier tombs, the size of the earth mound would also correspondingly increase and finally an earth mound with a large footprint was formed as sort of landmark in the landscape. The modification of earlier kurgans could be accomplished either in a short time period or over a long time span. Considering the homogeneous landscape of the Eurasian steppes, the kurgans protruding from the grassland were so preeminent that they were always preferred by later people for the placement of their deceased relatives, revisited and even reused frequently over time. The Solntse II cemetery, associated with the Ust’ye settlement in the Southern Urals, is another good example of this cultural practice (Hanks 2015:329). However, the arrangement of tombs in the same kurgan shows a similar pattern to that of the typical Sintashta settlements. The shared concentricity between cemetery and settlement probably suggests the existence of a sort of social solidarity structured on clan, political or military coercion, or pherhaps even ritual identification.

Without any doubt, the social organization of Sintashta and its correlation with metallurgic production is a critical issue in understanding the Bronze Age society in the steppes. The emergence of fortified constructions in the South Ural Mountains is traditionally assumed to be the corollary of intensification of metallurgic production under elite control. However, reexamination of the scale of metallurgic production based on archaeological evidence does not support that assumption (Hanks and Doonan 2009:340). The scarcity of unearthed metal objects and related metallurgic remains seemingly supports the hypothesis that Sintashta’s metallurgic production continuted without centralized control by social elites, the scale of production very limited. The metal production toolkit was dominated by simple objects such as knives, axes, awls, rivets and ornaments. The absence of metal prestige goods in Sintashta kurgans does not support the assertion of centralized control imposed by social elites either. Recent systematic survey of Stepnoe proves that Sintashta metallurgy was segmented, with only part of the technical processes undertaken at the settlement. The low quality of copper ore in that area along with the evidence of extensive prospecting activities suggest that metallurgic production in the east Urals could not have been anything but metallurgic experiment (Hanks and Doonan 2009:349).

It is commonly agreed that the subsistence system of the Sintashta culture was dominated by a stock-breeding economy (Kocintsev 2010; Gaiduchenko et al. 2010). Major domestic animals were cattle, sheep and horse as well as a small number of goats, displaying the typical constitution of a pastoral economy. However, evidence of wild animals, such as wild ass, wild boar, deer, elk and antelope shows that occasional hunting also contributed to the meat source of the Sintashta population in a small percentage. In recent years, due to the application of sieving techniques, a large amount of fish bones found suggests that fishing probably played no less important a role in the subsistence economy than the stock breeding in the settlement of Kamennyi Ambar (Stobbe et al. 2013). The results of floatation from multiple Sintashta settlements, meanwhile, show that agriculture was not practiced by the Middle Bronze Age population until much later, around the first millennium BC. It is quite clear that the Sintashta economy was exclusively dominated by stock-breeding and fishing in the steppes. Some wild plants, like feather grass, could be used as raw materials for handcrafts, as well as food and animal fodder (Rühl et al. 2015:421). The dominance of stock breeding to some degree constrains the scale of metallurgy and made intensive metallurgical production only possible in the winter, the free time of animal husbandry. This probably explains the low abundance of archaeological evidence of metallurgy found so far. However, evidence from five excavated settlements (Alandskoe, Ustye, Kamennyi Ambar, Kamennaya rechka III and Mochishche) is still incommensurate with the broad territory across which 22 settlements scatter. Some basic questions, such as how contemporaneous settlements connect with one another and whether they specialize in different productive industries, are still open to debate, and thus, systematic survey in the areas between settlements should be considered and conducted in the future.

IV.1.2 Trans-Urals

The Trans-Urals (the region between the east of the Urals and the west of the Tobol River--a major tributary of the Irtysh River) is another important region for the development of Bronze Age cultures, especially the so-called Pri-Tobol area. During a long period before the early Bronze Age (the second half of the fifth millennium -the first half of the third millennium BC), the material cultures in the Trans-Urals maintained a high level of homogeneity, as reflected by the predominance of combing-pit style decoration on pottery vessels. This homogeneity was probably resulted from frequent interactions between different social groups in this region dwelling not only in the same east-west ecological belt but also across different meridian ecological belts.

Some of the late Neolithic (the second half of the fourth millennium BC) archaeological remains found in this region are represented by the Boborykin culture, probably created by the hunter-fisher-gatherer communities living in the southern taiga forest. The pottery vessels of this culture reflect interactions between aboriginal communities represented by the combing-pit ornamented pottery and the influx of cultural communities from the Cis-Urals and Southern Urals represented by the pottery vessels with pointed bottoms, a signature of the Yamnaya culture

(3800-2200 BC) in the Circum-Pontic steppes (Zakh 2008:75; Morgunova 2014:237). However, this cultural interaction seemed to be unilateral and outweighed by the influence from the steppes to the south. The aboriginal cultural tradition marked by combing-pit pottery seemed not to impose any influence on the south until the turn of the third to the second millennium BC, following the formation of the early phase of the Andronovo cultural communities--the Petrovka-Alakul cultural communities--in the Southern Urals, as well as Western and Northern Kazakhstan. Due to the interaction between aboriginal combing-pit pottery groups—the Tashkov culture (2290-1890BC) in the upper Tobol River—there developed a hybridized Koptyakov culture (2150-1250BC) in the Trans-Urals near Yekaterinburg, and soon after the Fedorovo culture (1980-1510BC) (Stepfanov and Korochkova 2004; Zakh 2008:131). The predominance of combing ornaments among Fedorovo type pottery is exactly the fingerprint of the combing-pit pottery tradition in the forest-steppe and southern taiga regions.

In addition to pottery manufacture traditions, the metallurgy was also brought to the forest-steppe following the dispersal of the Circum-Pontic metallurgical communities, especially during the middle and late phase of the Yamnaya culture—the classic Yamnaya (3300-2600 BC) and the Poltavkin cultural communities (2600-2200BC). Cultural connections between the Circum-Pontic and western Siberia had been established since the Eneolithic period, as indicated by the emergence of the Bolshemys culture (3500-3000BC) in the Barnaual-Biisk Pri-Ob region and the Gorny Altai. The sudden appearance of pottery vessels with pointed bottoms and zigzag combing ornamentation in the Bolshemys culture greatly resemble those of the Repin culture (3800-3300 BC), the proto-type of the Yamnaya culture. This cultural connection was not so apparent until the classic Yamnaya period (3300-2600 BC). During that period, the Afanasevo culture (3300-2500 BC) in Barnaual-Biisk Pri-Ob region developed based on the aboriginal combing-pit pottery tradition. The uniformity of metal assemblage, style and chemical composition shared between the Circum-Pontic and the Pri-Ob regions reaffirmes their long-lasting metallurgical connection (Morgunova 2014:227-36). Even the unique practice of using meteorite iron to make bi-metallic objects found in the Yamnaya culture was also absorbed by the Afanasevo culture in the Minusinsk Basin (Teploukhov 1929). Typical Yamnaya pottery and metal assemblages unearthed at the Verkhnyaya Alabuga cemeteries in the upper Tobol River provid solid intermediary evidence for this relay-station communication (Potemkina 1985:152). Compositional analysis of metal objects from the Verkhnyaya Alabuga suggests that the source of copper ores was mainly Northern Kazakhstan, beyond a small portion from the Cis-Urals. The dispersal of metallurgists from the Circum-Pontic region, quite reasonably, was likely responsible for the exploitation of mineral ores in the Trans-Urals. Moreover, the existence of rich copper ores deposited in northern and eastern Kazakhstan was believed to be a major motivation for the dispersal of metallurgical specialists at the inter-regional scale (Molodin et al. 2014a:31).

The influx of steppe cultural communities into the Pri-Tobol region also brought great change in the local subsistence economy, which transformed from an appropriative economy to stockbreeding no later than the end of the third millennium BC. Statistics on the type site of the Koptyakov culture at Cheremukhovyi Kust show that 97% of identifiable faunal remains is made up of domesticated animals including cattle (63%), sheep/goat (29%) and horse (16.4%) (Zakh 2008:139). A young kill-off age of horses suggests that horse was probably a major source of meat, which recalls the subsistence pattern of the Botai horse-hunter communities in northern Kazakhstan in the second half of the fourth millennium BC (Levine 1999b). However, in broad areas beyond the steppe and forest-steppe, limited stockbreeding was still complemented by traditional hunting, fishing and gathering. The mosaic pattern of this subsistence economy resulted in complexity in social interaction at intra- and inter-community scales, which was to some degree disguised by a homogeneous decorative style in pottery. The highly entangled social network in the forest-steppe and southern taiga in the Trans-Urals provided the highway for the swift spread of innovative metallurgical techniques—the Seima-Turbino Phenomenon, which will be covered in later chapters.

IV.1.3 Ob-Irtysh River Interfluves

The vast territory located between the two major rivers in Siberia, the Ob River and the Irtysh River, is another important Bronze Age cultural arena. This area can be divided into three ecological units based on the vegetation: the forest uplands between the upper Irtysh and upper Ob (sometimes this area is also considered part of the Mountainous Altai region as part of Central Asia), the steppes and forest-steppe between the middle Irtysh and middle Ob, also labeled as Baraba, Baraba Plains, Baraba forest-steppe or Lowland Baraba in the archaeological literature (Molodin 1985:7), and the south taiga forest in the lower Irtysh and lower Ob. Among them, only the Baraba plain had been investigated and excavated systematically, which made it possible to establish a relatively complete culture-historical framework in Southern Siberia. Hence I would like to mainly focus on the Baraba plain and its interaction with other ecological zones by its waterways.

The early Metal Age (the first half of the second millennium BC) is represented by several archaeological cultures in Baraba: the Ust-Tartas culture (4500-2500BC) in the Eneolithic and early Bronze Age, the Odinovo culture (2900-1900BC) and the paralleled Krotovo culture (2900-1700BC) through the middle Bronze Age (Molodin 1985; Molodin et al. 2014b). The latter two cultures shared great similarities in material culture. Ornamentation on pottery is mainly dominated by so-called combing-pit motifs (Grebenchat-Yamoch) formed by impressing and pricking, which continued the technological traditions of the precedent Neolithic culture in this area (Molodin 1977:30) and contrasts greatly with the contemporaneous ceramic assemblages in Southern Urals. Round-bottomed or egg-shaped pottery vessels are the major forms in this region, flat-bottomed vessels less commonly found. Bronze artifacts were found in small numbers from a few settlements in the Bairyk and Odinovo cultures; for example, two knife fragments were found at the site Vengerovo-3 (Molodin 1985:24). A few pottery crucibles were found evidence of small scale metallurgical production. Large amounts of microlithic and bone tools as well as wild animal bone remains suggest that hunting and fishing were still the major modes of the subsistence economy in the early Bronze Age Baraba (Molodin 1985:26).

An obvious change in material culture appears during the Krotovo period. Pottery vessels with flat bottoms gradually become dominant. In addition to abundant microlithic and bone tools, metallurgical production suddenly flourished in this period as well. Many metal objects and two-pieced casting molds were found in the Sopka-2 settlement (Molodin 1985:59, 62). Typological comparisons of bronze objects suggest that the metallurgical production of the Krotovo culture was greatly influenced by multiple metallurgic traditions in different time periods. The idol-shaped bronze knives with double edges, for example, highly resemble the ones found in the Srubnaya culture in the Cis-Urals. Single-edged knives, conical-end bracelets and socketed axes indicate influence from the Andronovo community (Molodin 2014). In addition, casting molds of leaf-shape spearheads and axes with rhomboid motifs are consistent with the typical Seima-Turbino tradition (Molodin 1983). According to the stratigraphic context, as Krotovo features were dug by Andronovo ones (Fedorovo period) at Sopka-2, the upper limit of the Krotovo culture cannot be later than the Fedorovo culture. Updated radiocarbon dating on the materials from the Baraba plains demonstrates that the absolute date of Late Krotovo culture lieS within the 20^{th} – 18^{th} century BC, and the range of the Andronovo culture (Fedorovo type) is 19^{th} – 16^{th} century BC, both of which are half a millennium earlier than traditionally expected (Molodin 1985:88; Molodin et al. 2012; Molodin and Polosmak 2014:1642).

The Samus culture is another Bronze Age culture that mainly covered the southern taiga and pine forest between the Ob and its tributary the Tom River (near the city Tomsk). Contemporaneous with Krotovo culture in Pri-Ob Novosibirsk, it can also be dated back to the first half of the second millennium BC (Molodin and Polosmak 2014:1644). The most interesting distinction of the Samus culture from other Middle Bronze Age cultures is the forest landscape where most remains and sites are found. There is no great difference in ceramics from other known cultural groups: the comb-impressed and stamping ornamentation are the major style on pottery vessels, even though grooved ornamentation also appears as a new style. A number of bronze artifacts as well as metallurgical remains (stone casting molds) were found in the site of Samus IV (Kosarev 1981:100, figure 36). Among the bronze items there are some very distinctive anthropomorphic and zoomorphic representations (Kosarev 1981:100, figure 36:6-9; Molodin 1977:148, plate 61-6), absent in the forest-steppe areas and probably used by the southern taiga people in ritual activities. Moreover, the style of spearhead represented by the stone casting molds are highly similar to typical Seima-Turbino spearheads. The casting molds of shaft axes also reflect the strong influence from the Seima-Turbino phenomenon (Kosarev 1981:100, figure 36:1-5).

The subsistence mode of these early Bronze Age people was still dominated by an appropriative economy of fishing, hunting and gathering. Wild animal faunal remains are commonly found from the Krotovo and Samus cultures, such as roe deer, elk and bear. A considerable proportion of fish bones shows that fishing was still a major food source. Sheep/goat, horse, cattle and dog were also found in some settlements (e.g., Cherno-ozere 4), which probably suggests the existence of small scale stock breeding in some suitable areas of the Baraba plains (Matyushchenko 1973). Evidence of agricultural economy is very scarce in this area, also the overall situation in the western Siberian plains. Some recent evidence may explain the absence of agriculture, especially in the case of the Southern Urals; it suggests that even very limited cereal cultivation was not possible until the Late Bronze Age when the climate became more arid in forest-steppe areas during the end of the second to the first millennium BC (Ryabogina and Ivanov 2011:100). This preliminary conclusion probably also applies to the case of the Baraba forest-steppe.

A few early Bronze Age settlements have been found in this area. One of the most well-known is the site Sopka-2. Almost 800 tombs (including around 100 kurgans) as well as thick dwelling remains made it unique among its contemporaneous neighbors. The whole cemetery was continuously used from the Neolithic until the Middle Ages (Molodin 2001). More than half of the tombs (around 500 tombs, including Sopka-2/4, Sopka-2/5 cemeteries) were attributed to the Krotovo and Late Krotovo periods, when metallurgical production reached a peak in the middle Irtysh River. Another important archaeological monument found in this area is the Rostovka cemetery. It is located on the southern bank of the Om River near the city Omsk, where the Irtysh and the Om River converge. It is well-known for its abundance of bronze objects and always cited as one of the most typical Seima-Turbino features in western Siberia from the early second millennium BC. If other chance finds are also included (Molodin and Neskorov 2010), then the middle Irtysh River is the area with the most abundant distribution of Seima-Turbino style bronze objects. Naturally, some argued that it is the middle Irtysh River where the center of Seima-Turbino metalworking was located (Matyushchenko 1978). If the tin source of Rostovka bronze objects was indeed imported from Mountainous Altai, as Chernykh (1989) argues, then it makes sense that the middle Irtysh River became the metalworking center for Seima-Turbino phenomenon, considering the advantage of water course transportation. Chemical analysis of bronze objects from the Andronovo culture and Seima-Turbino phenomenon from the Rostovka cemetery shows that there was a high correlation between the cultural attribution (typology) and chemical composition of bronze objects. The average concentration of tin for Seima-Turbino style artifacts is 6-12%, much higher than that of the Andronovo (4.5% on average). It turns out that the two bronze daggers from the Rostovka cemetery with high arsenic concentration are closer to the style of the Srubnaya-Andronovo culture, which was dominated by arsenic bronze (Chernykh 1992:224; Matyushchenko 1978:32). The co-existence of multi-recipe copper alloys, more importantly, suggests the complexity of metallurgical traditions and their interactions. We will come back to this point in later chapters.

As mentioned regarding Krotovo metallurgical production, the Andronovo cultural-historical community, especially the Fedorovo, was another influential cultural entity in the south of the Baraba forest-steppe. Even though chronological order of the Alakul and Fedorovo types, two major variations of the colossal Andronovo cultural-historical community, was once debatable regarding the, the most current consesus is that they were basically contemporaneous and their lower limit can be dated back to the late first half of second millennium BC (around 18th century BC) (Molodin and Polosmak 2014:1645). The Fedorovo culture covered a much broader area from the Southern Urals in the west to the Tian Shan Mountains in the east and had a great influence on neighboring areas in terms of metallurgical production (Chernykh 1992:210). The late phase of the Sintashta culture in the Southern Urals-- the Petrovka culture in western and northern Kazakhstan--is generally accepted as the origin of the Fedorovo culture (Zdanovich 1983). The major stimulus for metallurgy in the Andronovo community is traditionally attributed to western precedents, such as the Abashevo-Sintashta communities in the Southern Urals (Chernykh 1992:214). Results of chemical analysis on the Andronovo bronze artifacts demonstrate that tin mines had already been extensively exploited and that tin was applied as an additive in tin-bronze alloy production (the average tin concentration is 3~10%). Central Kazakhstan and Soviet Central Asia (mainly Turkmenistan) were believed to have been the major sources of copper after extensive survey (Chernykh 1992:212). Recent studies in the Zeravshan valley in Uzbekistan provide substantive evidence of tin mines that can be securely dated back to the Andronovo period (middle to late second millennium BC). Meanwhile, some earlier radiocarbon dates also suggest the possibility of much earlier exploitation of tin mines around 24th -18th century BC (Garner 2015). As archaeological remains left by earlier people are usually destroyed and hence hard to detect, especially in the case of mining activities. The archeological evidence from north Kazakhstan, especially along the Ishim River, also shows that a passageway for interactions between the middle Irtysh and northern and central Kazakhstan had already been opened no later than the Early Bronze Age (Parzinger 2014:1630). The well-known Eneolithic site of Botai (3500-3000 BC), characterized by the large scale horse hunting for food, is located just on the right bank of the Iman-Burluk river, a tributary of the Ishim River in north Kazakhstan, which eventually empties into the Irtysh River (Levine 1999a:39). After the decline of the Botai-Tersek culture, the Sintashta-Peterovka culture, which also engaged with horse husbandry in the same area, rose. Even though the origin of horse domestication is still unclear, the importance of the horse for the steppe or forest-steppe people in north Kazakhstan past and present is unnecessarily to stressed here. It is generally accepted that the horse was probably tamed and used in traction or packing before it was extensively ridden by nomadic people in the Late Bronze Age (Levine 1999a). Considering the popularity of horse iconography among Seima-Turbino bronze knives and scepters, it is reasonable that domesticated horses could have been widely used by the Seima-Turbino metallurgists. Meanwhile, the horse probably once played an important role in the processes of metallurgical production, for instance in the procurement of raw material, as well as the trade and exchange of finished objects.

IV.1.4 Circum - Altai Region

The Altai Mountain is located on the crossroad intersecting by the Kazakhstan steppe in the west, the Mongolian steppe in the east, as well as the Minusinsk Basin in the north and the Dzungar Basin in the south. It provides water to multiple rivers that flow across broad Siberia in meridian: the Irtysh, Ob and Yenisei rivers, which, in turn, then provide a natural passageway for interactions between different groups of people scattered throughout Siberia. The rich ore deposits of copper, gold, and especially of tin mines, made this area attractive to Bronze Age people (Chernykh 1992). In addition, the variety of ecological niches created by variance in altitude also greatly attracted nomadic pastoralists in the Late Bronze Age, as evidenced by large quantities of rock art left in the mountainous corridors (Molodin and Cheremisin 1999). Following, I will briefly review social contexts of the major archaeological cultures covering multiple macro-regions around the Altai Mountain: the Upper Irtysh (Northeast Kazakhstan), Mountainous Altai (Gorny Altai), and Xinjiang Altai.

The chronological framework of this region was first established by the sites found in the Minusinsk Basin by Teploukhov (1929). The Afanasevo (2900-2500BC), Okunev (2200-

1900BC) and Andronovo (Fedorovo) (1900-1500BC) cultures provide the major chronological parameters from the Eneolithic to the Middle Bronze Age in this area. In the mountainous Altai, this framework was adjusted based on autochthonous cultures such as the Afanasevo, Karakol and Yelunino cultures (2200-1800BC) (Stepanova 2001). Besides these major archaeological cultures, the preeminnently influential trans-cultural phenomenon in this area during the early second millennium BC was the aforementioned Seima-Turbino phenomenon. In the metallurgical province system proposed by Chernykh (1992), the Altai mountainous area is argued to have been the major source of tin ores for Seima-Turbino bronze artifacts and therefore was seen as the origin of the Seima-Turbino tradition. Before we touch on this critical issue, it might be important to overview the earlier cultural contexts in this area so as to have a better understanding of this trans-cultural phenomenon.

In the mountainous Altai, the Afanasevo culturae was mainly distributed throughout the Upper Ob River near the northern piedmont of the Altai Mountains, especially along the Katun River valley. At least 30 sites, including settlements and cemeteries, have been surveyed or excavated so far. Multiple radiocarbon dating samples show that the Afanasevo culture can be dated back to the first half of the third millennium BC (Kiryushin et al. 2010:70). Polished stone axes and egg-shaped pottery vessels with pine-leaf zigzag motifs are the common cultural remains uncovered from Afanasevo settlements and tombs. In additon, there were also a small amount of copper objects found, including broad-leaf knives and shaft-hole axes, which are consistent with the metal assemblages commonly found in the Circum-Pontic metallurgic province (Chernykh 1992:87). The tradition of kurgans covered by rocks with a single burial in the center was also practiced by the Afanasevo culture. The assemblage of grave goods is very simple, sometimes consisting of only one egg-shaped pottery vessel. The deceased was buried in a supine position with bent legs, and the body was always sparkled with red ochre. A predominate percentage of domestic animal bones including sheep/goat (80% on average), cattle and horse uncovered from settlements demonstrates that stockbreeding was the major mode of subsistence economy among Afanasevo groups. In some sites a large amount of wild animal bones is also found (Tyurina 2010). This suggests that hunting could have been a complementary strategy in some seasons or some regions when stock-breeding was not optimal. Besides the northern slope of the Altai Mountains and the Minusinsk Basin, some sporadic remains from the southern slope (Xinjiang Uygur Autonomous Region, China) are also attributed to the Afanasevo culture due to similarities in the style of pottery or basketry vessels and the characteristics of physical anthropology in, for instance, the Gumugou cemetery in Lobnor, Ke'ermuqi in Xinjiang Altai (Molodin and Alkin 2012). Especially the evidence from Ke'ermuqi (Chemurchek) suggests tenuous cultural connections with the Afanasevo culture in the northern Altai Mountains.

Following the Afanasevo culture, during the transitional period from the third to the second millennium BC, another cultural surge appeared in the mountainous Altai: the Yelunino culture. The Yelunino culture was first discovered in the Pri-Ob areas between Barnaul and Biisk in Gorny Altai, defined as the early Bronze Age cultural complex in the Upper Ob (Kiryushin 2002, 2003:46). Abundant cultural remains, including pottery vessels, stone tools, bone and horn tools, and quite a number of metallurgical products were uncovered from dozens of settlements and cemeteries along the Katun River valley, such as the Teleutskii Vzvoz-I cemetery (Kiryushin et al. 2003) and the Brezovaya Luka site (Kiryushin and Tishkin 1995). The pottery remains of the Yelunino culture are characterized by stepping comb motifs or retreating belt impressions on flat-bottomed vessels. However, the decoration still shares great similarities with that of western neighbors such as the Samus and Krotovo cultures in the Ob-Irtysh interfluves (Kiryushin and

Grushin 2001). This suggests frequent interactions between the Middle and Upper Ob-Irtysh River valley. The subsistence economy was still dominated by stockbreeding of cattle, sheep and a small percentage of horses (Kosintsev 2003:240). Abundant broomcorn millet seeds deposited in some tomb pits also suggest that agricultural cultivation was practiced in suitable areas for the purpose of human food or animal fodder (Ponomareva 2003:215). Radiocarbon dating of the Yelunino culture from the Teleutskii Vzvoz-I lies in the range of 2150-1900 BC (Kiryushin et al. 2003:106).

Beyond the aforementioned contribution of a reliable chronological framework, the other great value of the Yelunino culture to archaeologists is that it provides substantive evidence for the origin and formation of the Seima-Turbino style. Arrow heads from the Yelunino culture greatly contrast with others in their hafting: they usually have a long projected base by which they can be inserted into the hole on the end of the arrow shaft, rather than being simply attached to the split end of an arrow shaft (Figure IV.2:5-7). The alternative way of assembling the shaft and arrow head would be inserting the tip of the shaft into a hollow socket at the base of an arrowhead. This joint method can be found in one bronze arrowhead unearthed from tomb 29 at the Teleutskii Vzvoz-I cemetery (Kiryushin et al. 2003:277; Figure IV.2:8,) and the bone spearhead from the settlement at Berezovaia Luka (Kiryushin 2002:243; Figure IV.2:9). Especially the former example could have been a prototype of typical Seima-Turbino spearheads. The typical socketed axe first invented in the Seima-Turbino tradition is another example. Certainly the most convincing connection between the Yelunino and Seima-Turbino is a number of bronze artifacts unearthed from the Yelunino cultural context, attributed to the Seima-Turbino tradition, including single edge knives with zoomorphic (commonly horse) pommel and rhombus motifs on the tangs (Kiryushin 2002:252; Figure IV.2:3), furcated-base spearheads with either hooks or loops on one side, sometimes neither of them (Kiryushin 2002:255-58, figure 151-154). Zoomorphic motifs are also commonly found on the highly polished stone staffs, even though the exact function of these rod-shaped stone artifacts is still unclear (Kiryushin 2002:233; Figure IV.2:10,11). However, very few socketed axes with rhombus motifs and double-edged knives have been found in Yelunino contexts. This probably suggests local characteristics of the Seima-Turbino bronze assemblage. In addition to typical zoomorphic pommel knives with single edges, round pommel knives were also found as part of the Yelunino culture (Kiryushin 2002:225; Figure IV.2:1, 2), as well as knives with upturned tips (Kiryushin 2002:225; Kiryushin and Kliukin 1985:83; Figure IV.2:4). The former type of knife was found in the Bronze Age site at Zhukaigou (around 1600 BC) in Ordos, North China (NMWKY 2000, plate 30:2); the latter type of knife can be commonly found in the sites of early Bronze Age cultures of Northwest China, such as the Qijia (2300-1500 BC) and the Xichengyi-Siba cultural complex (1880-1530 BC) (Mei J.J. 2003:53, figure 4,5).

Figure IV.2 Metal (1-5,8), stone (6,7,10-16) and bone objects (9) of the Yelunino culture

(1-4. Metal knife 5,8. Metal arrow head 6,7. Microlithic arrow head 9. Bone spearhead 10-15. Stone rod 16. Stone vessel with carved decoration. All after Kiryushin 2002)

The influence of the Yelunino culture seemed to traverse the Altai Mountains, as reflected by the Chemurchek culture, mainly distributed throughout the Xinjiang Altai (Kovalev 2005; Zhang Y.Z. 2007). According to the chronological framework established in the northern Altai, artifacts unearthed from the Ke'ermuqi (Chemurchek) cemetery can be attributed to multiple time periods: the egg-shaped pottery jars and *dou*-shaped incense burners (Zhang Y.Z. 2007; XJSKKY 1981:26; Figure IV.3:1-6) demonstrate influence from the Afanasevo culture; stone rods with anthropomorphic or zoomorphic representations (XJSKKY 1981:26; Figure IV.3:8,9) are signatures of the Okunev culture, while commonly found stone vessels are consistent with ones of the Yelunino culture (Kiryushin 2002:240; XJWKY 2013a:18, figure 9-5; Figure IV.3:7). In addition, two sets of bivalve stone casting molds found in the Ke'ermuqi cemetery show cultural affiliation with the Andronovo metallurgical tradition, especially the spade casting mold (Figure IV.3:10,11). The archaeological context in southern slopes of the Altai Mountains clearly shows that cultural interaction in the Circum-Altai areas during the early second millennium BC was more complicated than traditionally assumed. Due to the absence of more comprehensive data, the specific mechanisms behind these cultural dynamics are by and large speculative and call for future work in the southern piedmont of the Altai Mountains.

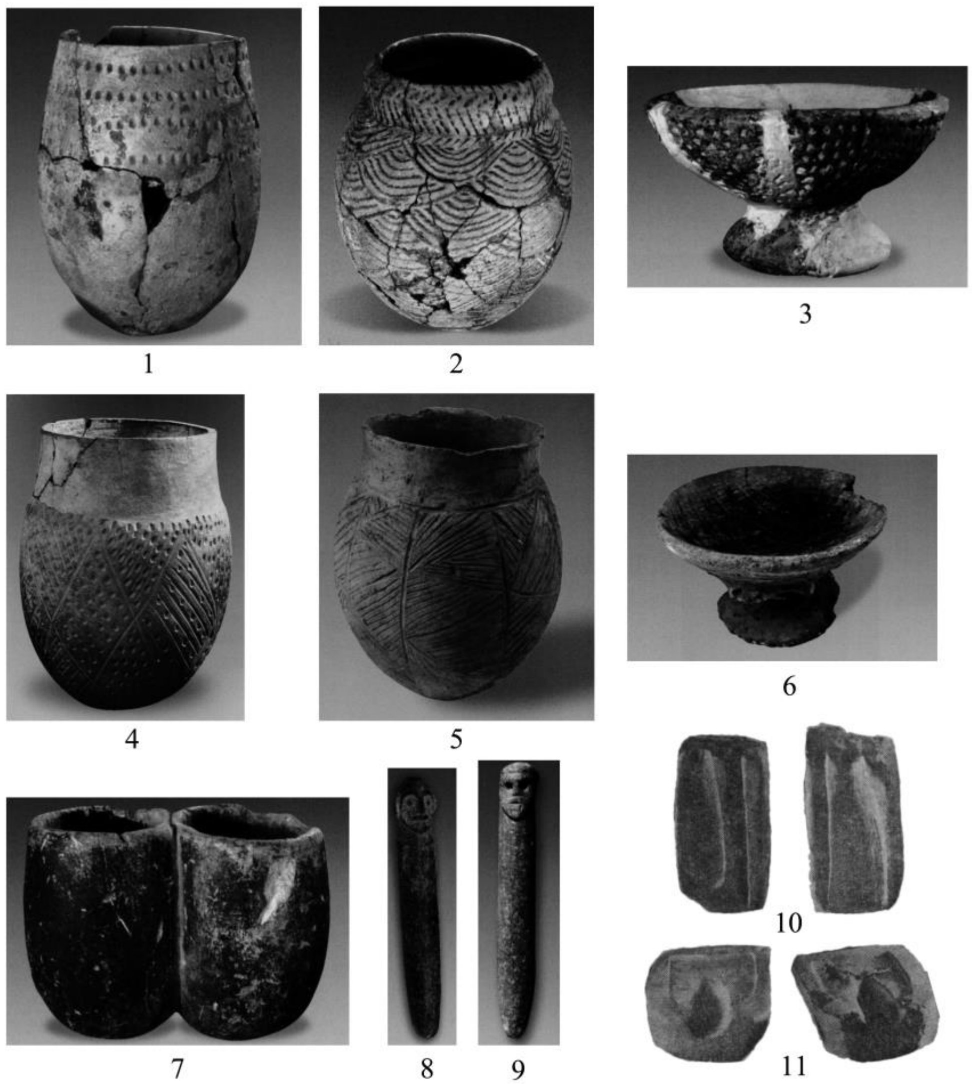


Figure IV.3 Artifacts of the Chemurchek culture in Xinjiang Atai

(1,2,4,5. Egg-shaped pottery vessels 3,6. Incense burners 7. Joint stone vessel 8,9. Anthropomorphic stone rods 10,11. Stone bivalve casting molds. 5,6 were collected from Bu'erjin county, after Zhang Y.Z. 2007; the rest unearthed from the Ke'ermuqi cemetery: 1,2 from M16; 3 from M24; 7 from M3; 10,11 from M17; the rest unknown. After XJSKKY 1981)

IV.1.5 Northwest China

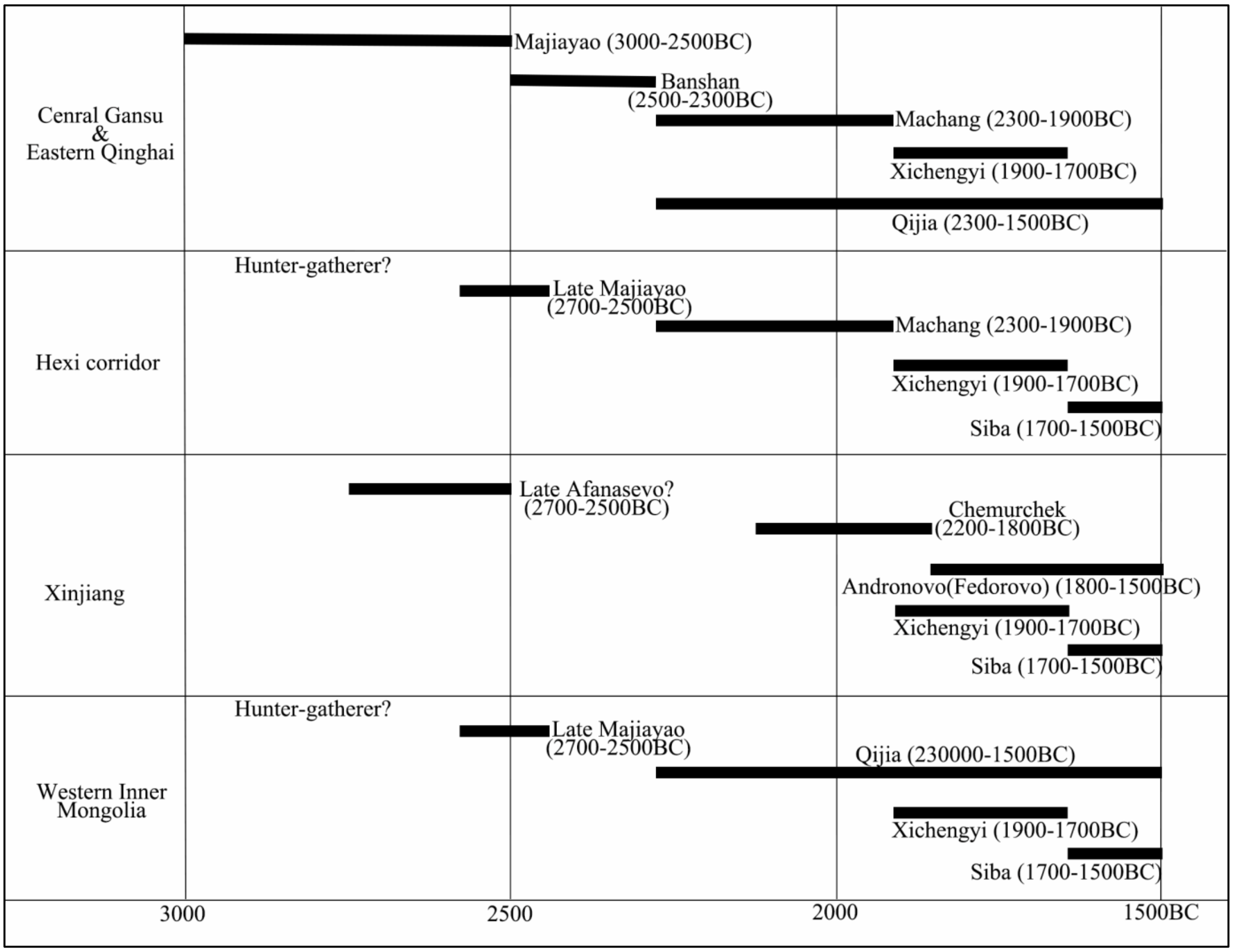
The earliest archaeological remains identified in Northwest China are those of the painted pottery cultures named under an overarching archaeological culture—the Majiayao culture

(3000-1900 BC). Thanks to the identification of the Shilingxia Phase (3300-2900BC) of the Late Yangshao culture in eastern Gansu, now it is quite clear that the Majiayao culture was an offshoot of the Yangshao culture (Miaodigou Phase, 4000-3500BC) in the Guanzhong Basin around the middle of fourth millennium BC (Yan W.M. 1978; Ding J.X. 2010). Based on typological study of painted pottery, the Majiayao culture was divided into three continuous phases: the Majiayao Phase (3000-2500BC), the Banshan Phase (2500-2300 BC), and lastly, the Machang Phase (2300-1890 BC). The material culture of the Majiaoyao communities represented by the predominant painted pottery shows great homogeneity and continuity through time. A change in material culture cannot be observed until the Late Machang Phase, or more precisely, the Xichengyi culture (1880-1680 BC), a recently identified archaeological culture in Northwest China, identified by recent fieldwork at the site of Xichengyi (GSWKY 2014). Based on the Xichengyi culture, another important cultural entity—the Siba culture (1670-1530BC) was formed and marked the culmination of the Bronze Age in Northwest China (Table IV.2).

The formation of the Majiayao culture directly resulted from the westward dispersal of farming communities from the Guanzhong Basin. The spread of early farmers was probably caused by population pressure generated by the establishment of an agricultural economy in the Miaodigou phase of the Yangshao culture (4000-3500 BC) (Zhao Z.J. 2017). So far, fewer than 30 Majiayao sites have been identified in Central Gansu, eastern Qinghai and the Hexi corridor. According to the spatial distribution of these type sites, early Majiayao farmers seemingly preferred to settle in hilly flanks and spread westward along piedmonts (Ding J.X. 2010:79). This spatial pattern can also be observed in the earlier Pre-Majiayao period--the final Miaodigou Phase (around 3500BC) —when farmers from the Guanzhong Basin first appeared on the northeastern edge of the Tibetan Plateau, as indicated by the typical Miaodigou painted pottery assemblages found at

Hulijia(ZSKKYGG and QHWKY 2001) and Yangwapo (QHWK 1984). Ecological diversity along the piedmonts could have provided the subsistence basis to offset the seasonal or annual shortfalls when an agricultural economy was first introduced to these new territories. Meanwhile, pre-existing hunter-gatherers living in the piedmonts (e.g., the Eneolithic site at Layihai in Guinan; See Gai P. and Wang G.D. 1983) and their interactions with early farming communities could also have been an important socio-economic factor in the formation of archaeological patterns in space. Statistics of faunal remains from Dadiwan (GSWKY 2006:908-9), the first stop after the famers migrated out of the Guanzhong Basin, showed a high percentage (80%) of wild game. The same pattern is also found among other early Majiayao sites. It seems that the predominance of a foraging economy among those first farmers did not change until the second phase of the Majiayao culture. During that period, Majiayao farming communities began to dwell at a large scale along major river valleys, such as the Tao River valley in Central Gansu. In the late phase of the Majiayao culture, farmers expanded westwards to the upper Yellow River in the Tibetan Plateau and the Hexi corridor in the final phase (around 2500BC) (Ding J.X. 2010:81-2). This unprecedented colonization of the Hexi corridor oases by the Majiayao farmers, as shown in later chapters, generated far-reaching influence at the inter-regional scale.

Table IV.2 Chronology of major archaeological cultures in Northwest China



So far almost all available data on the Majiayao culture are from dwelling sites. By contrast, the mortuary data are scarce (only seven graves have been reported and all were attributed to the late phase of the Majiayao), and almost nonexistent in the early phase of the Majiayao period. Besides this sampling bias, this bizarre archaeological pattern could also reflect the social reality of those early foraging-farming communities to some degree. They could have disposed their deceased by a means with low archaeological visibility, according to their ritual or ceremonial program. The predominance of painted pottery vessels, especially large capacity vats, appeared in the middle and late phase of the Majiayao period, seeming to suggest the importance of ritual at the community scale probably in the form of communal consumption, for social cohesiveness and solidarity. However, ritual emphasis on community seems to decline abruptly and shift to a household scale during the following Banshan period (2500-2300BC), suggested by dramatic changes in the style and assemblage of painted pottery vessels, which probably resulted from the lasting expansion of agricultural communities and corresponding changes in social-economic domains (Li S.C. 1998; Zhang C. 1994). The rise of the household economy in the second half of the third millennium BC in Northwest China provids the economic context for understanding the social dynamics during the turn of the third to the second millennium BC in this region. I will elaborate on this issue in later chapters.

After the cultural reconfiguration of the Banshan period, another period of peak spatial expansion of the Majiayao culture occurred during the Machang period (2300-1900BC). The marginal Hexi corridor oases were widely occupied by Machang communities (Li S.C. 1998). Isotopic analysis of the human and animal remains suggested that Machang communities practiced millet agriculture and also raised domestic animals such as pigs, dogs, cattle, and sheep/goats as meat sources. No later than the Late Machang phase (around 1900BC), crops first domesticated in West Asia such as wheat, barley and oat began to be introduced into the local diet. However, they never replaced the staple food millet until the Final Bronze Age – Early Iron Age (Atahan et al. 2011; Ma M.M. et al. 2014). Almost contemporary with those exotic crops was another innovative technology introduced into Northwest China from its westerly neighbors: the metallurgy of copper and its alloys. One bronze (tin-copper) knife unearthed from the Late Majiayao context (2882-2504BC, calibrated) at Linjia site in Dongxiang (GSWG et al. 1984) had been believed to be the evidence of the aboriginal emergence of metallurgy in China (Figure IV.4:2). Due to the incompleteness of published data, it is unknown whether this bronze knife was found *in situ* or intruded into the earlier cultural context from the superimposed Qijia matrix. Considering the sophisticated alloy of this bronze knife (BGXY 1981), the latter circumstance is more convincing. The morphology of the bronze knife is analogous to those of the Andronovo horizon. By contrast, a fragment of curved bronze knife unearthed from the site at Jiangjiaping in Yongdeng dating back to the Late Machang phase (2195-1782BC, calibrated) (Zhang X.Z. et al. 1980:63) is more reliable in arguing that bronze objects had been used in Northwest China during this period. Due to the absence of evidence of metallurgical production associated with the bronze knife from Jiangjiaping, it is still unclear whether it was imported or locally produced. Undisputable archaeological evidence of local metallurgical production did not surface until the next period--the Xichengyi culture (1880-1680BC, calibrated) in the Hexi corridor.

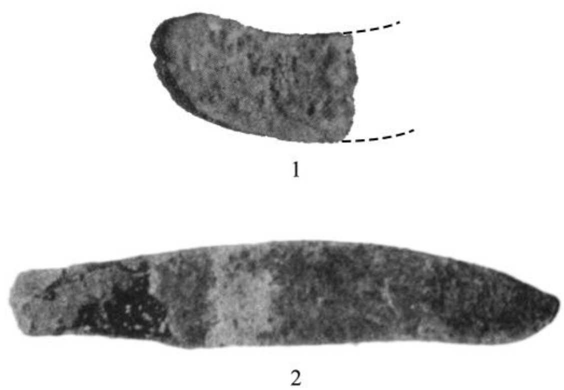


Figure IV.4 Bronze knives unearthed in Gansu

(1. Jiangjiaping site, Yongdeng 2. Linjia site, Dongxiang. Length: 1.unknown 2. 12.5cm
1 after BGXY 1981, 2 after GSWG et al. 1984)

The Xichengyi culture has recently been proposed as a replacement for the previous "Transitional Type" in the development of painted pottery in the Hexi corridor due to the sound stratigraphic evidence and rich cultural remains yielded by the site of Xichengyi in Zhangye, Gansu (GSWKY 2014; GSWKY et al. 2015; Li S.C. 2014). The "Transitional Type" remains were first identified in 1986 during a joint archaeological survey in the Hexi corridor (GSWKY and BDKWX 2011). The painted pottery found with distinctive but uniform motifs was difficult to attribute to any known archaeological culture (Figure IV.5). Nevertheless, typological study accurately places this group of distinctive painted pottery in the temporal range between the Machang and Siba cultures, and thus it was understood as a cultural phenomenon in the final phase of Machang culture. Later field work at Ganguya for the first time has provided clear stratigraphic evidence of this distinctive assemblage and suggested an earlier typological scheme. Considering its uniqueness in cultural attributes and independence in temporal and spatial distribution, the assemblage was expediently named a "Transitional Type" of the Machang culture (Li S.C. 1993). The establishment of this so-called "Transitional Type", recently revised as the Xichengyi culture, has proved seminal both for its reconstruction of the prehistoric cultural -historical sequence in Northwest China and the critical clue it provides in deciphering the cultural complexity at the turn of the third to the second millennium BC, during which cultural interaction and reconfiguration are the major themes all across the western and northern borderlands of China proper. One of the most important implications it offers us is the separation of painted pottery remains from the Qijia culture in the Hexi corridor. As will be elaborated in later chapter (Chapter VII), the adoption of painted pottery, by whatever means, from the aboriginal Xichengyi neighbors into the typical Qijia repertoire made the Qijia trade diaspora in the Hexi corridor culturally distinctive. The co-existence of the Qijia and Xichengyi assemblages in archaeological contexts indicates substantial interaction between them. Nevertheless, the difference in spatial distribution of these two entangled assemblages demonstrates the complexity of this intercultural interaction. The percentage of both cultural markers in archaeological contexts varies depending on geographical locations. There seems to have been a demarcating line in Jiuquan: archaeological contexts in the region east of Jiuquan usually contain a "mixed" assemblage made up of both signatures; while to the west, a "pure" Xichengyi assemblage is always found without any typical Qijia cultural markers (Li S.C. 2014). Apparently, the Xichengyi culture and the Qijia culture overlapped temporarily but were spatially discrete cultural entities. In later chapters (Chapter VII) I will explain this cultural entanglement in the framework of economic anthropology instead of cultural-historical narratives.

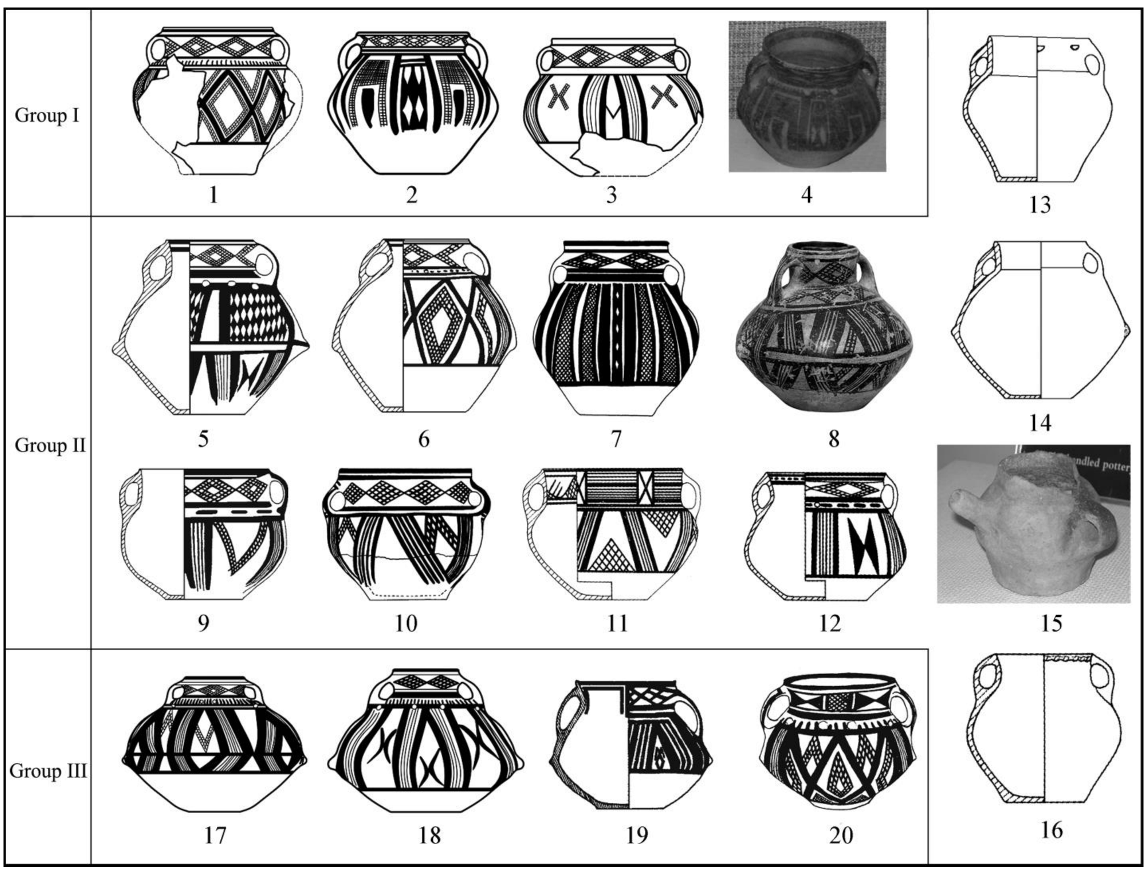


Figure IV.5 Typological scheme of the Xichengyi pottery assemblage (from early to late: Group I, II, and III)

(After Li S.C. 2014, figure7)

The Siba culture was first named after an assemblage of painted pottery with a unique decorative style found at the site of Sibatan in Shandan in the middle of the Hexi corridor (An Z.M. 1959). The thick black pigment painted on the sand-tempered paste with scarlet slip immediately distinguished the assemblages of painted pottery found at Sibatan from any known archaeological cultures of that time (e.g., the Majiayao, Qijia, Xindian, Siwa and Shajing cultures). Meanwhile, the predominance of pottery vessels with handle(s) among the assemblage also suggested cultural proximity to the Machang phase of the Majiayao culture. However, due to the absence of archaeological contexts with collected artifacts, the chronological position of Siba style pottery was still not determined until more systematic fieldwork was conducted at the sites of Huoshaogou, Ganguya and Donghuishan in 1970-80s (Li S.C. 1993). Now it is quite clear that the Siba culture was descendant of the Majiayao painted pottery culture through the preceding Xicehngyi culture, and meanwhile also received profound influence from other cultural entities such as the Qijia culture.

The Siba communities mainly dwelled in the oases along the northern piedmonts of the Qilian Mountains. Unearthed fanual and floral remains suggested that the Siba communities practiced a mixed economy: millet-planting agriculture along with stockbreeding of cattle and sheep/goats. The percentage of agricultural cultivation and stockbreeding seemed to vary in different regions according to climatic conditions. For example, pastoral animals like sheep/goat probably accounted for a larger part of daily life in the western part of the Hexi corridor than in the eastern counterparts. Newly introduced crops such as wheat, barley and oat had already been widely cultivated during the Siba period, even though millets still predominated the daily diet (Atahan et al. 2011; Flad et al. 2010). Metallurgy continued to develop during the Siba period and became more sophisticated, as indicated by the composite cast bronze mace head unearthed from the

Huoshaogou cemetery (Figure IX.14:6). Meanwhile due to the influence of Andronovo metallurgical communities in the west, Siba metal assemblages display high uniformity in style with westerly neighbors, while a small group of idiosyncratic metal objects (e.g., mirror-like plaques) also suggests cultural negotiation according to local agendas.

Parallel to the Machang Phase, Xichengyi culture, and Siba culture, there was another influential cultural entity in Northwest China: the well-known Qijia culture (2300-1500 BC). The Qijia culture was named after the type site Qijiaping (Ch'i-Chia-P'ing, Figure IV.7:3), first discovered and excavated by Andersson (1943) in 1923-1924. Based on characteristics of the pottery assemblage retrieved at Qijiaping, Andersson wrongly dated it to Pre-Yangshao culture in the Central Plains and thus attributed it to the first phase of Chinese prehistory. Doubt was cast on this chronology in the wake of later fieldwork conducted in Gansu by the Chinese archaeologists Xia Nai in 1945 and Pei Wenzhong in 1947. Xia's (1948) seminal field initiatives in Yangwawan corrected the relative chronology of the Qijia phase by sound stratigraphic evidence, while Pei (1987:236) first proposed the "Qijia culture" as designating the same cultural remains of the Qijia phase in Andersson's scheme. Qijia culture was first defined by a typical pottery assemblage made up of "Kammkeramik" (pottery with comb-impression patterns) and "amphora" (two handled beaker) found at Qijiaping, together with other red or bluff fine clay pottery vessels (Andersson 1943:78) (Figure IV.6). Excavation after the 1950s at the sites of Huangniangniangtai, Dahezhuang, Qinweijia and others yielded abundant remains from mortuary and dwelling contexts, and thus greatly expanded our perception of the Qijia culture. According to estimates from recent survey data, the total number of archaeological sites attributed to the Qijia culture has reached one thousand, covering a vast area including Gansu (mainly central and eastern Gansu) and adjacent southern Ningxia, western Shaanxi, and eastern

Qinghai (GJWWJ 2011). Radiocarbon dates for the Qijia culture mainly concentrate in the second half of third millennium to the first half of the second millennium BC (2300-1500BC). Even though hundreds of sites have been registered as Qijia culture in archaeological surveys, only a limited number of major sites have been excavated: the cemetery at Huangniangniangtai in Wuwei, the Qinweijia and Dahezhuang sites in Yongjing, the Qijiaping site in Guanghe, the Gamatai cemetery in Guinan, the Liuwan cemetery in Ledu, the Shizhao-Xishanping site in Tianshui, and more recently the Mogou cemetery in Lintan, the Changning site in Datong, and the Jinchankou site in Huzhu (Figure IV.7).

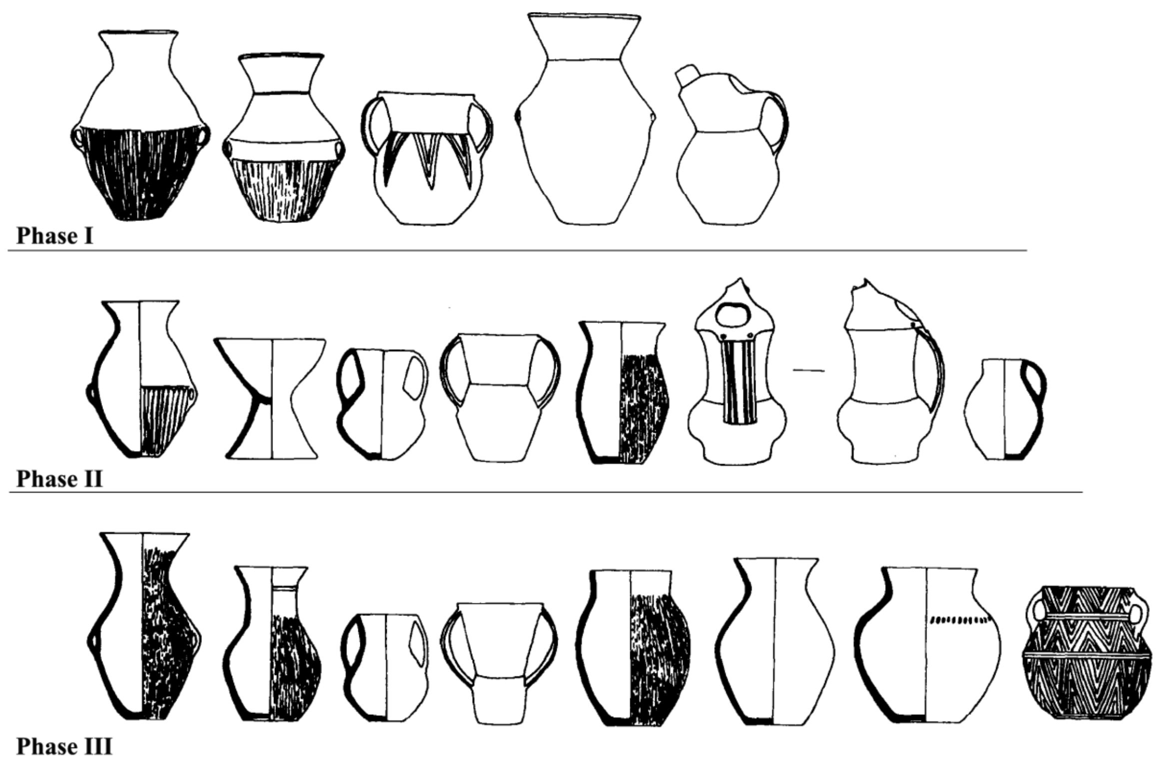


Figure IV.6 Typology of pottery assemblages in the Qijiaping site

(After Shui T. 2001:202, figure 6)

By now, the cultural- historical trajectory of the Qijia culture is quite clear. The Qijia culture, as a variant of the second phase of the Keshengzhuang culture in the western Guanzhong Basin, originated from the Caiyuan culture in eastern Gansu and southern Ningxia. The Qijia assemblage swiftly spread along the piedmont bounded by the Qinling Mountains and the eastern edge of the Qinghai-Tibetan Plateau, crossed the upper Yellow River then reached the Huang River valley[1], the eastern Hexi corridor, and even the southern edge of the Gobi Desert (Liang X.P. 1994; Zhang Z.P. 1987). If we assume that the formation of the Majiayao culture (around the end of the fourth millennium BC) resulted from the first wave of the dispersal of farming communities originating in the Guanzhong Basin, then the East-West spread of the Qijia culture can be seen as the second wave of movement one millennium later. The spatial and chronological in-betweenness of the Qijia culture makes it a prime example of cultural interaction between Central Eurasia to the west and the Central Plains to the east in the Bronze Age. Traditional interpretations based on cultural-historical reconstruction lose its validity before the complicated archaeological patterns. Due to updates in fieldwork in recent decades, the pattern of inter-cultural interaction between those contemporary cultural entities has gradually surfaced, especially in the framework of social-economical anthropology.

As with other contemporary cultural entities, the isotopic analysis of human and domesticated fauna of the Qijia communities suggests that C4 plants (probably millets) were the staple food. Although exotic crops such as wheat and barley appear in archaeological contexts, quite surprisingly, they never replaced millets as staple foods until the first millennium BC (Ma M.M. et al. 2013; 2014). Exotic crops, especially barley, could have been loaded with particular cultural meanings and thus consumed in different contexts from the traditional millets.

[1] Please note the Huang River (湟水) is a major tributary of the Yellow River (黄河) in Qinghai Province.

Considering the social contexts in Northwest China, one possibility is that imported wheat and barley, together with other ingredients, may have been used to ferment ceremonial drinks (see Chapter VI). Domesticated animals (e.g., pigs, dogs, cattle, sheep/goats) as well as wild game were sources of meat for Qijia communities. Their percentages varied in different ecological niches. Generally, pigs were more commonly raised among communities in river valleys in Central Gansu, while pastoral animals were preferred in westerly and arid areas. The hunting of wild animals was still a major source of meat for communities dwelling in the piedmonts and montane valleys, such as the Qijia communities at Changning and Jinchankou (Figure IV.7:8,9).

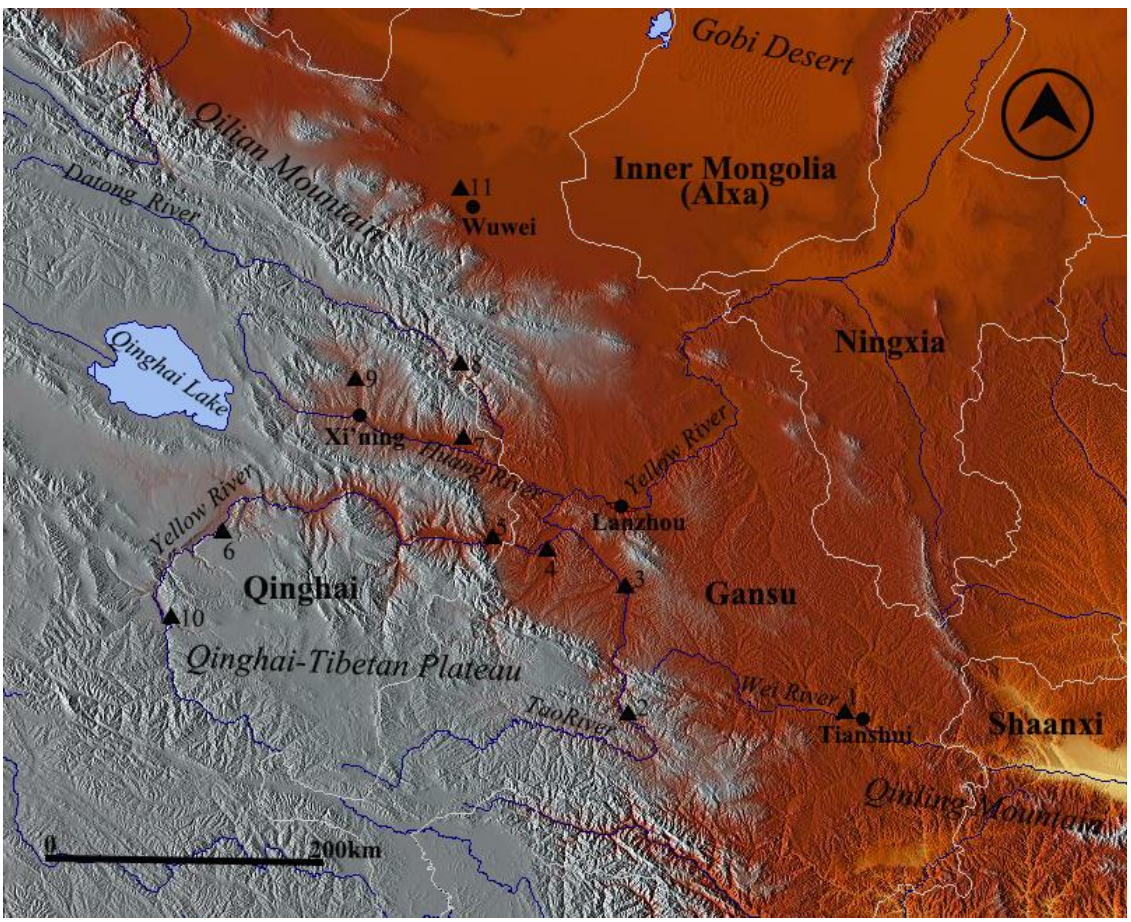


Figure IV.7 Distribution of major sites of the Qijia culture mentioned in the text

(1. Shizhao-Xishanping 2. Mogou 3.Qijiaping 4. Dahezhuang-Qinweijia 5. Lajia 6. Gamatai 7. Liuwan 8. Jinchankou 9. Changning 10. Zongri 11. Huangniangniangtai)

Metallurgy was always assumed to be a core cultural marker of the Qijia culture. As a result, the Qijia culture has been taken for granted as the progenitor of Bronze Age culture in early China. It is in fact the case that so far, most early metal objects (copper and alloyed copper) have been found within the archaeological context of the Qijia culture. But the occurrence of metal objects does not necessarily mean that those objects were produced by the Qijia communities themselves. First, as to the issue of production, it is necessary to differentiate between metallurgy and metalworking. The former refers to the whole sequence of the production of metal objects, including mining, smelting, casting, and processing (e.g., annealing, forging, and polishing). Metalworking only includes a part of the sequence, including (re)melting, casting, and processing. So far, no sound evidence of metallurgy (e.g., ores, furnaces, slags, and bellow nozzles) has been found in any known Qijia site, which have the highest occurrence (around one thousand) in field survey. It seems that Qijia communities did not develop metallurgical production. Future data could prove that they may have engaged in metalworking, at its best. However, besides the production of metal objects, it is also necessary to consider other cultural processes resulting in the formation of archaeological evidence, such as exchange or trade, redistribution, consumption, recycling and discarding (Schiffer 1972). Anthropological perspectives in socio-economy and technology are also the conceptual pillars for related discussions in later chapters.

IV.2 Concluding remarks

Bronze Age cultural entities in Central Eurasia and their trajectories of development offer a continental, long-term backdrop for understanding Northwest China during the Bronze Age. Only by means of this long-term scale can we distinguish momentary cultural impetus from gradually accumulative cultural processes (Lamberg-Karlovsky 1975). The impetus responsible for the rise of the Arkaim and Sintashta metallurgical complexes was rooted in metallurgical development in local contexts since the late fourth millennium BC. In the Trans-Urals region, especially the Ob-Irtysh interfluvial regions, the aboriginal cultural trajectory gradually changed under the influence of metallurgy. This technological impetus worked within pre-existing interaction networks across ecological zones in the meridian direction, although this is always de-emphasized or even neglected under the predominance of migration theory in the formation of Bronze Age Eurasia.

Chapter V A reconstruction of Bronze Age societies in Northwest China: mortuary analysis in the Hexi corridor

V.1 Huoshaogou Cemetery

The Huoshaogou cemetery is located in the modern village of Qingquan, 67 km southeast of Yumen city, Gansu province (Figure V.1). The cemetery is near the west end of the Hexi Corridor and borders Hami city in eastern Xinjiang, where another major Bronze Age cemetery at Tianshan Beilu[1] is located. Another Bronze Age cemetery at Ganguya, which will be studied in the current chapter, is located 120 km southeast of the cemetery. It was discovered in 1974 and first excavated in 1976 and then again in 1990 and 2005. 380 graves in total were uncovered in three field seasons and yielded more than 2000 artifacts made of various materials, including pottery, stone, bone, copper/bronze, gold and precious stones (Figure V.2).

Based on the typology of pottery assemblage, the whole cemetery is divided into three phases: phase I and II with two sub-phases (Ia, Ib, IIa, IIb), respectively, and phase III (Figure V.3). The radiocarbon dating on fauna samples randomly retrieved from 32 tombs suggest a more narrow distribution of absolute date between 1695-1600BC (68.7% probability), or 1737-1534 BC (95.4% probability). It is estimated that the whole cemetery was used in a period of 200 years.

[1] "Tianshan Beilu" literally means 'Tianshan North Road', a main north-south road in the downtown of Hami. A large cemetery containing more than 700 graves was uncovered when this road was constructed in 1988. The data sorting of the cemetery is still currently in progress. For a brief introduction to the cemetery please refer to Chang Xi'en (1989). The distance between Tianshan Beilu and the Huoshaogou cemeteries is about 295 miles (475 km).

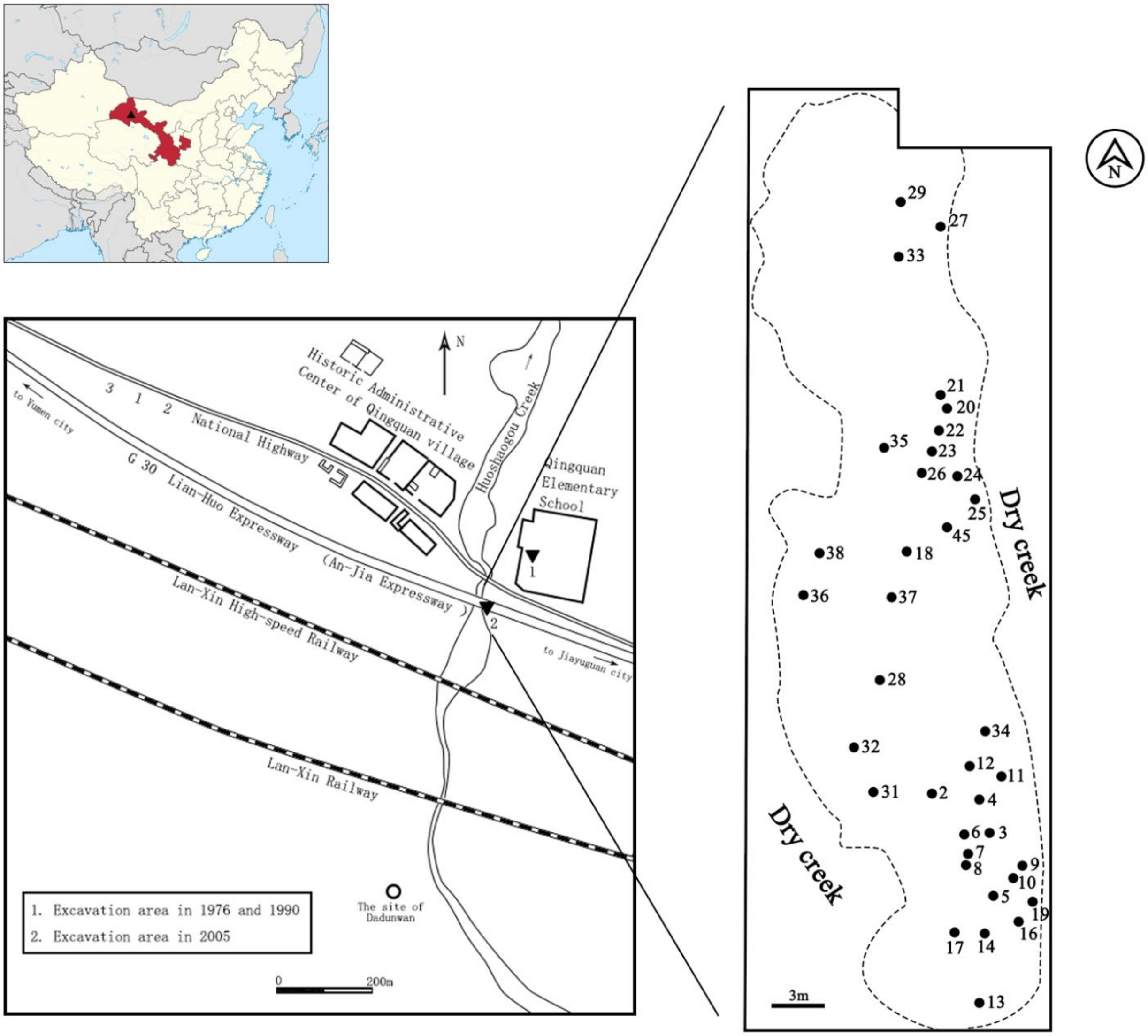


Figure V.1 Location of Huoshaogou cemetery (upper and lower left) and plan of the excavation area in 2005 (right)

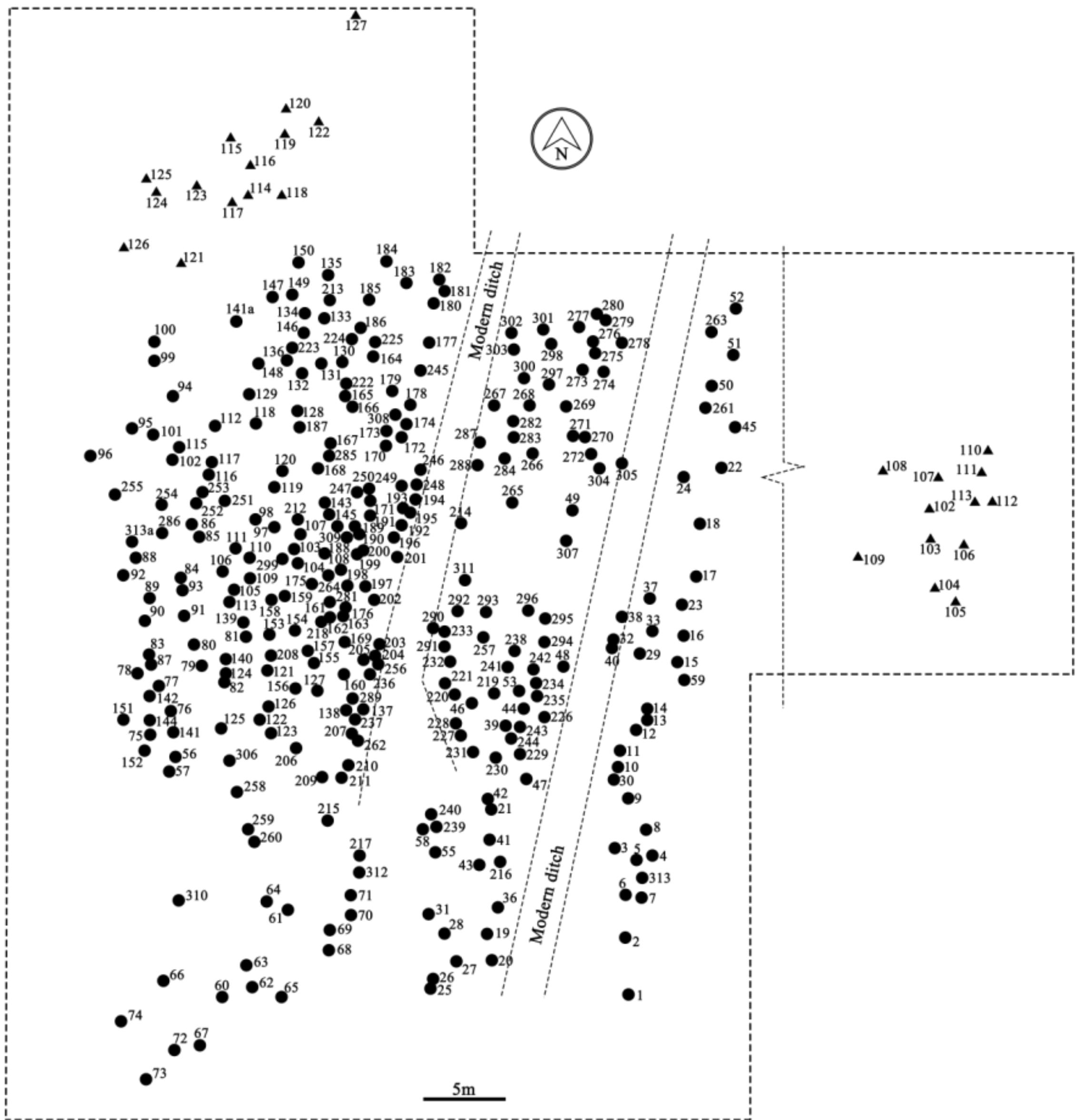


Figure V.2 Plan of Huoshaogou cemetery

(Solid circles stand for the tombs uncovered in 1976; solid triangles in 1990)

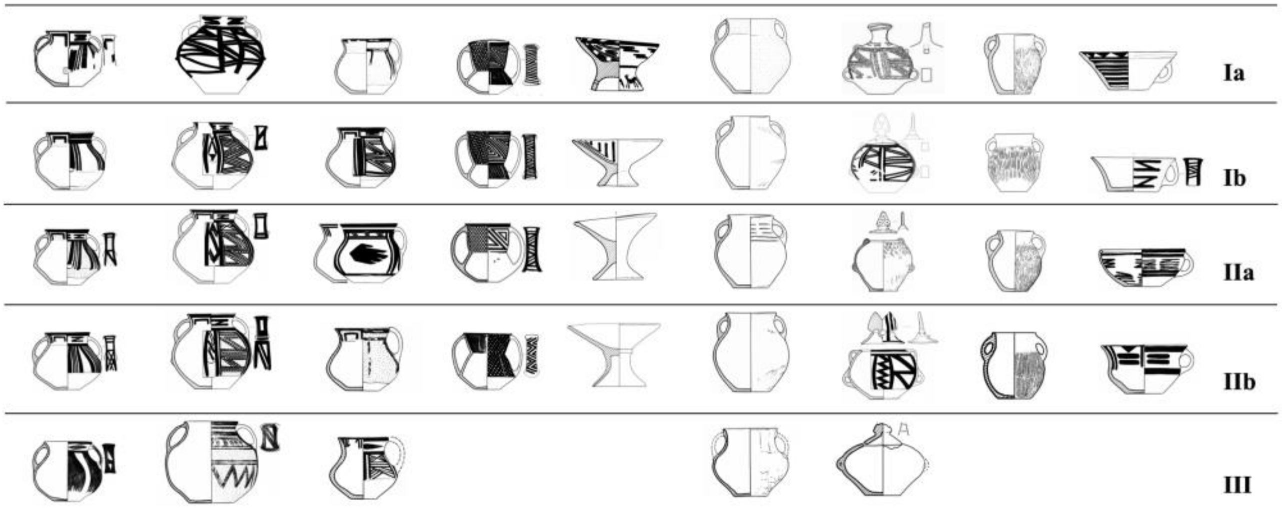


Figure V.3 Pottery typology scheme of Huoshaogou cemetery

V.1.1 Demographic structure

The minimum number of individuals (MNI) in the graves from all field seasons is 411 (including all age groups and sexes). Among them tha ages of only 298 individuals can be determined, and 211 have been identified as adults, accounting for 51% of the total population. The majority of adult graves (204 adults) were retrieved from the 1976 field season (Table V.1).

Table V.1 Demographic structure of Huoshaogou cemetery (1976 field season)

sex	Sub-adult	Adult	Total
Undetermined	27	4	31 (12.3%)
Female	3	90	93 (36.8%)
Female?	6	7	13 (5.1%)
Male	6	102	108 (46.7%)
Male?	7	1	8 (3.2%)
Total	49 (19.4%)	204 (80.6%)	253 (100%)

As the figures show, the proportion of sub-adults (including infants and children) is much lower than expected among pre-demographic transition societies (50% or higher 70%) (Morris 1987:57; Papadopoulos 2005:377-80; Weiss 1973). The ratio between male and female (including probable male and female) is 109:100. This is hardly surprising due to the incomplete sample size. If all samples with identified age from all field seasons (298 individuals) are taken into consideration (Table V.2), the proportion of the sub-adult group increases to 29.2%. Among all individuals with determined sex (250 out of 411), 123 are male (or probable male) and 127 are female (or probable female). If these results are reliable, then the sex ratio is close to 96.85:100. This makes sense, given the death rate of birthing women in pre-industrial societies is much higher. Further, based on current statistics, the relatively balanced sex ratio also excludes the possibility that one sex was preferred and thus intentional infanticide was practiced in the Huoshaogou community.

Table V.2 Distribution of age groups at Huoshaogou cemetery

Age	**0-3**	**3-12**	**12-20**	**20+**	**20-35**	**35-50**	**50+**	**Total**
Group	Infant	Child	Adolescent	Adult	Young Adult	Mature Adult	Old Adult	
Number	12 (4%)	35 (11.7%)	40 (13.4%)	21 (7%)	109 (36.6%)	55 (18.5%)	26 (8.7%)	298 (100%)

If we assume that the death rate was standard across the period of use of the cemetery, we can apply the formula *p=na/t* (Morris 1987:74) to calculate the approximate size of the living adult community represented by deceased adults. In the formula, *p* stands for the living adults community, *n* the number of deceased adults, *a* the average age of deceased adults, and *t* the period of use. In the case of Huoshaogou cemetery, the estimation of the adult community is:

$p=(na)/t=(211*30.75)/200=32.44$

A community of 33 adults in any period of time when the cemetery was in use cannot be an overestimate. The actual population of the adult community represented by the cemetery could be double or even triple the estimation (60~100 adults). Because of the absence of settlement data associated with the cemetery, this estimation unfortuanately cannot be tested against independent evidence (e.g., the average size of household).

The problem of underrepresentation is more obvious among sub-adult groups, especially the infant group. If we exclude the preservation factor, the low occurrence of infants (12 out of 298) probably suggests that the majority of dead infants were buried in a separate plot, if they were indeed interred, or disposed of other funeral rites with low archaeological visibility (e.g., tree/sky burial, water burial etc.). The burial of some infants in adult graves probably suggests special treatment owing to social status, cause of death or other ritual considerations.

V.1.2 Burial facility

All graves found in the Huoshaogou cemetery are inhumations. Only one child burial (76YHM253) showed burning traces on the lower limbs with charcoal and ash beneath the skeleton. It is assumed that the child was partially cremated in the tomb pit before interment. As to grave structure, there are two types: pit graves and shaft graves (Figure V.4). They have rectangular openings in the ground with dimensions of 1.85 (average length) by 0.81 (average survived width), and the average survived depth is 0.59 meters. According to the original burial records, 220 (57.9%) were identified as pit graves and 143 (37.6%) as shaft graves. However, because of pre-excavation disturbance[1], many shaft graves could have been razed and mislabeled

[1] The original terrain of the cemetery was graded by bulldozers so as to build a new elementary school on it.

pit graves[1]. Hence the percentage of shaft graves should be much higher than recorded. Moreover, post-depositional disturbance also leads to the loss of the original grave depth. Thus, calculation of the volume of graves as a parameter for energy expenditure is impossible in this case.

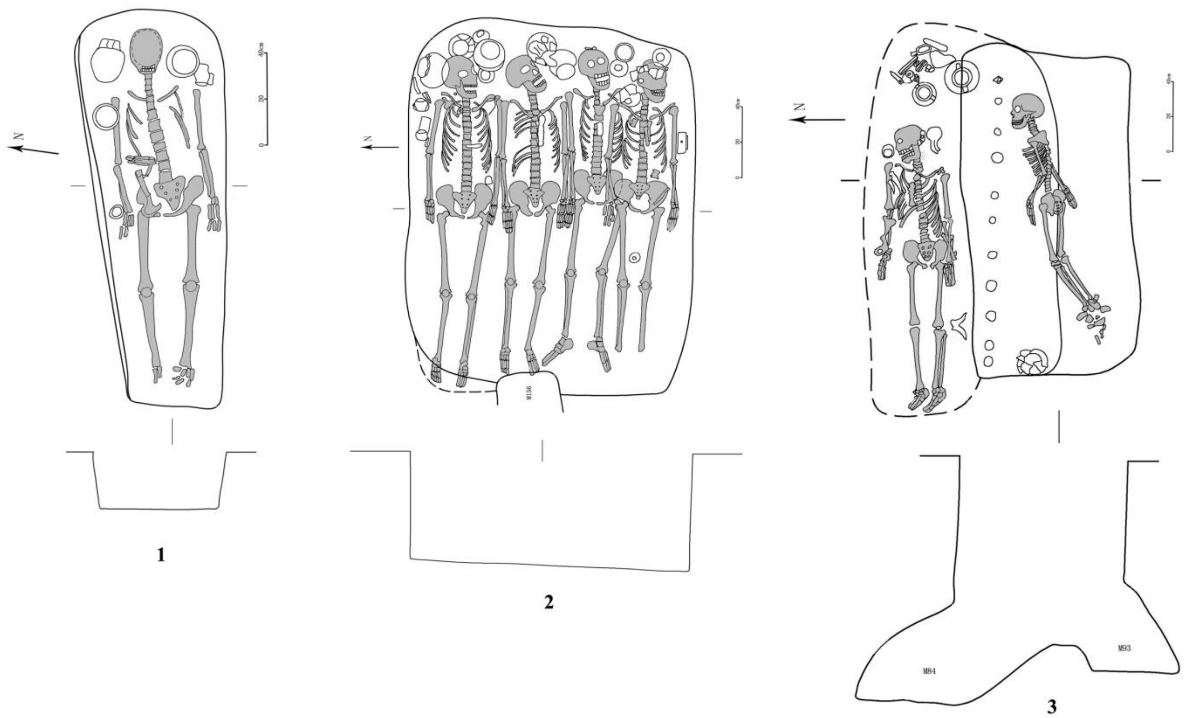


Figure V.4 Burial examples in Huoshaogou cemetery
(1. 76YHM18 2. 76YHM127 3. 76YHM84&93)

Pit graves are quite simple in construction: a pit is vertically dug into earth and the the deceased is deposited onto the floor at the bottom. Shaft graves can be assumed to be extended versions of

[1] This can be found in the original burial records, which reported extremely narrow widths (e.g., 40-50 cm) for some pit graves. This seems unlikely in practice. In those cases, the excavators probably mistook the overlapping part of the shaft and the chamber as the width of a 'pit grave'.

pit graves in the construction process: a vertical pit is first dug into earth as a shaft (about two meters deep) at the bottom of which a side chamber is then dug out on either side along the elongated axis, finally forming a boot-shaped cross-section (Figure V.4:3). The deceased is deposited in the side chamber. Because in most cases the burial chamber floor is lower than the shaft, a step-like platform (a so called "secondary platform") is created. This feature is more a functional consequence of the construction process than an indicator of social status, as traditionally assumed about Bronze Age cemeteries in Central China. The capacity of the side chamber is quite limited, holding only one deceased. Hence, subsequent deceased: 1) are stacked atop the former, if there is still room, 2) are placed beside the former, therein moving the skeleton, 3) totally replace the former, leaving their skeletons scattered on the secondary platform. In the first case, if there is no room for the second individual, a new chamber will be opened at the opposite side and thus double side chambers are formed (Figure V.4:3). Sometimes in order to accommodate more deceased, a two-tiered wood structure could have been used, as suggested by post holes in the four corners of the side chamber (e.g., 76YHM124).

Based on some surviving evidence, most deceased were originally placed on a wood plank or woven straw mattress. Only in one case (76YHM144) was a partially preserved coffin framework found. Scattered fragments of lacquer also suggest the use of lacquer to coat and probably decorate the surface of the coffin. In most cases, lime powder or ochre was sprinkled at the bottom of pit graves before the coffin or mattress holding the body was lowered down. The burial facilities complex for shaft graves is quite noteworthy. After the deceased is placed in the chamber, the chamber is fenced by a line of wood rods 10 cm apart from each other (Figure V.4:3). Then, a straw mattress sheet is placed against the wood fence to close the chamber. This special way of closing the burial chamber can be nothing but temporary. It is reasonable to assume that the shaft tunnel leading to the side chamber was not backfilled with earth but kept open or semi-open (temporarily covered by wood planks, twigs, or bark etc.) for a time (years or decades) so as to facilitate the re-entering of the chamber for whatever reason (e.g., depositing later deceased members of the same descent group, regularly revisiting the deceased, contributing food and drink to the dead, or practicing some rituals that required moving the deceased's skeleton etc.). Recently, the discovery of a Bronze Age cemetery at Mogou in Lintan County, Gansu provides more solid evidence for this characteristic burial facility in prehistoric Northwest China (Xie et al. 2009; GSWKY and XDWYKYZ 2009).

It is inferred that the shaft tunnel was not backfilled until burial space is depleted. A tomb marker such as mound or grave stone was probably absent on the ground, judging from the fact that earlier graves are always dug by latter ones in the same plot. Alternatively, a tomb marker made of organic materials could have been established on the ground. It probably did not survive when the later grave was constructed.

V.1.3 Body treatment

324 out of 380 graves have a determined orientation. There is great uniformity in orientation; the majority of the cemetery is of eastern orientation, some graves east-north-east or northeast in orientation (Figure V.5). Throughout the whole cemetery, only one tomb is oriented to the north (76YHM95). The deceased is a 25 year-old male flexed to the right, a minor practice in the cemetery. This unusual orientation together with its marginal location in the cemetery probably suggests unique social status or identity of the deceased.

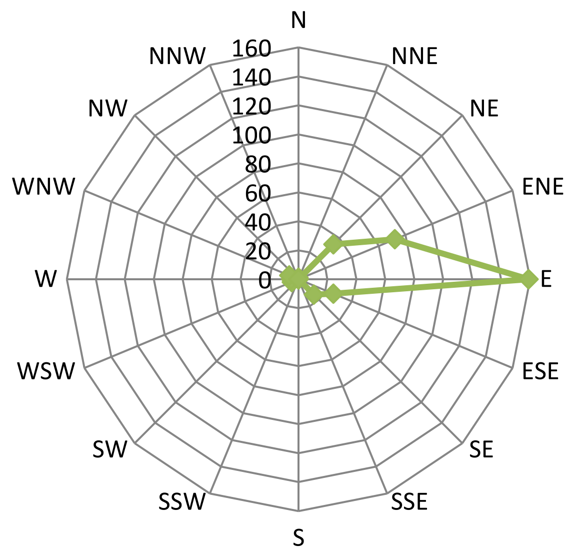


Figure V.5 Distribution of orientation in Huoshaogou cemetery

Most graves (332, 87.4%) yielded well preserved human skeletons. Single burials predominate throughout the cemetery (279, 73.4%), while multiple burials are infrequent (38 double burials - 10%; ten triple burials - 2.6%; four quadruple burials - 1.1%; one decuple burial - 0.3%). Among double burials, 16 (43.2%) are adult females with a sub-adult, nine are adult males with a sub-adult (24.3%), four are males with male burials (10.8%), three are females with female burials (8.1%), and three are females with male burials (8.1%), two are sub-adults with sub-adult burials (5.4%). If one adds the first two categories together, the majority of double burials (67.5%) is adult with sub-adult, followed by same sex burials (18.9%). Joint burials of two sub-adults are quite rare.

Among 334 tombs with identifiable positions, 81.7% (273 tombs) are supine extended, 3.9% (14 tombs) are prone extended and 6.6% (22 tombs) are flexed. Extended burials lie flat (on the back or front) with four limbs straight, face up or on either side. There is no difference in facing direction by age and sex. Flexed burials lie on either side with four limbs flexed. Although the population in flexed position is small, there seems to be a difference correlated with sex: among 12 tombs with the deceased in flexed position and with determined sex, all males (seven tombs) lie on their right sides, and only two females lie in same position; while the deceased who lie on their left sides (three tombs) are all females. The Fisher's Exact Test[1] suggests that there is a significant difference between sexes (p=0.04545<0.05). For the moment, it is still uncertain whether this "male-right, female-left" pattern among flexed burials applies to other contemporary cemeteries.

The boundary between primary and secondary burials in the cemetery is not clear-cut in some cases. This is because many burials, especially single burials, were exhumed or disturbed intentionally after the primary deposition. The majority of skeletons in single burials were moved from their original anatomical position, or totally absent. This phenomenon is even more common among multiple burials. Owing to limited space in the burial chamber, the earlier deceased were moved or superimposed in order to accommodate the latter ones. Hence, the sequence of deposition in multiple burials can be judged from the anatomical completeness of the skeleton. The more disturbed the skeleton, the earlier was it deposited, and vice verse. Generally, it takes at least three years to for a body to decompose and skeletonize. Thus, the completeness of skeleton can also be used to crudely estimate the time gap of deposition between different individuals in the same burial.

If we assume that the disturbance of the deceased's skeleton resulted from ritual activity, we may conclude that the deceased's ancestors must have played an important role in the daily life of the

[1] Fisher's Exact Test is a statistical significance test. Please refer to https://stats.idre.ucla.edu/sas/whatstat/what-statistical-analysis-should-i-usestatistical-analyses-using-sas/ for more information.

local community. Tombs are constructed in such a way that facilitates the revisiting of ancestors. The interaction between the living and the dead could have occurred through the manipulation of the ancestral body as a relic in ceremonial scenarios with some pragmatic purposes: either to fortify the solidarity based on descent relationships, or to ensure the well-being of the living according to certain religious considerations.

V.1.4 Social organization

Stratigraphy and burial sequence is an effective means of investigating the social organization, especially in the cases of the multiple burials (Parker Pearson 2000:114). Stratigraphic patterns found among Early Bronze Age round barrows of Wessex in southern England during the Beaker period, for example, suggest a patrilineal society: adult males are buried first and followed by dependants (other adults and children), when adult females are buried first they are more rarely followed by adult males than by other age and sex groups (Parker Pearson 2000:115). In other words, the sex of the individual first buried adult determines the diversity of sex and age profile of those later buried in the same grave. If a society is patrilineal and the first buried is an adult male, then we expect a large diversity of later deceased buried in the same grave. By the same token, if the first buried is an adult female, the diversity of sex and age profile of later buried members will be more restricted.

In order to test whether the same pattern can be observed among multiple burials in the cemetery at Huoshaogou, we selected 19 multiple burials with sound burial sequence from a total population of 52 multiple burials. Although not all first buried deceased are adult males (13 are adult males, five are adult or adolescent females and one is an unsexed adult), the probability that the first buried is an adult male is high (the probability estimates 68.4% by the Proportion Test). Because the diversity of age and sex following the first buried is of most importance here, network analysis is an ideal method for visualizing the pattern of connection between the ordinal age and sex profiles.

As Figure V.6 shows, it is clear that if the first buried is an adult male the connectivity to other age and sex groups is more extensive than that of an adult female. Basically, there is no restriction on the age and sex profile of later buried individuals as long as the first buried is an adult male. Almost all varieties of age and sex combinations (female-female, male-child, male-female, male-female-child) are connected to the vertex of an adult male, which is unparallel in the frequency of connections, suggested by the huge size of circle. Compared to an adult male, the vertex of an adult female has a very restricted variety of connections to other age and sex profiles; only the ordinal combination of female-male, and female-child exist.

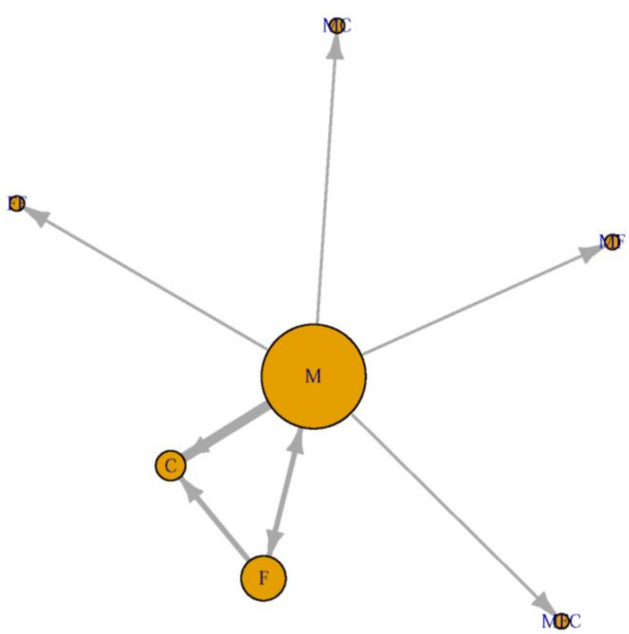


Figure V.6 Network of the deceased by age and sex in multiple burials

[C= children, or sub-adult; F= adult female, M= adult male.
The combination of different age groups clockwise: FF= female-female; MC= male-child; MF=male-female; MFC=male-female-child. The loops of vertices themselves, e.g., C→C, F→F, M→M, are removed for better visibility.

The size of circle stands for the size of sample of corresponding category (the larger the circle, the larger the number of samples), the direction of arrow stands for the burial sequence (from first buried to latter buried); and the width of line stands for the weight or frequency (the wider the line, the higher the frequency with that connection)]

Based on the analysis above, we observe the same pattern of burial sequence among the multiple burials at Huoshaogou as hypothesized at the beginning of this section. I conclude that the Huoshaogou community was probably a patrilineal society in which adult males were at the center of descent groups and kinship systems. However, we must keep in mind that the amount of analyzed data (19 graves, accounting for 5% of all excavated) is quite small and thus the confidence level of these results is compromised (One-sample Proportion Test with continuity correction of 19 out of 52 multiple burials yields a high p-value=0.071>0.05. The estimate of the proportion of the sample is 36.5%, not too high to be statistically representative). With this object in mind, another independent line of evidence is needed in order to explore social organization, namely, grave goods analysis, as will be discussed in the following section.

V.1.5 Grave goods

Grave goods are the central component of mortuary analysis. According to the "representationist" school in mortuary analysis, grave goods buried in mortuary contexts can directly represent the social persona of the deceased (Binford 1971; Brown 1971; Saxe 1970). Even though this statement has received a lot of critiques due to its neglect of ritual processes (Bloch 1982; Hodder 1982; Metcalf and Huntington 1991; Parker Pearson 2000), it has made it possible for archaeologists to investigate mortuary data by formal analysis. It is believed in the current study that each interment represents the systematic application of a series of prescriptive and proscriptive directives relevant to that individual (O'Shea 1984:35). In other words, it is assumed that the treatment of the deceased should be consistent with that individual's social position in life (O'Shea 1984:38). However, we must not lose sight of the fact that archaeologists excavate burials and not whole funerals (Morris 1987:36). Thus, the total range of cultural directives may not be observed in a mortuary context, and consequently, the social dimensions of the deceased can only be conditionally inferred, rather than considered a one-to-one correspondence.

Meanwhile, I also accept the basic assumption that material culture is not passive and has an agency in manipulating all interested parties, especially in a funerary context, a social arena where different social tensions and dynamics play out and negotiate with one another (Hodder 1982; Parker Pearson 2000; Chapman 2000). The disposal of the deceased together with all grave goods is under the total control of the living. Even though the "reflectionist" school places great stress on ritual processes and to some degree breaks down the stereotype that mortuary data are patterned and static as commonly argued by the "representationist" school, focus on the deceased and related material expressions (i.e. grave goods, monuments, landscape) has made it not substantially different from the latter. In recent decades, alternative perspectives have placed increasing emphasis on the interaction between the dead and the living. The major concern of mortuary study thus has shifted from the deceased to the living as well as their social well-being (Fahlander and Oestigaard 2008; Pauketat 2010; Rakita and Buikstra 2005). However, the reconstruction of social organization by means of identifying evidence of social differentiation would lay a solid base for understanding of the interaction between the dead and the living and the agency of the funeral.

An interment should also be examined from the perspective of formation processes so as to dismiss any undesirable distractions -- for instance, when material culture accidentally appears in a mortuary context due to cultural or natural disturbances. Besides accidental deposition, there are two more depositional pathways that concern archaeologists most: intentional deposition and coincidental deposition (O'Shea 1984:23). The former corresponds to the category of "material culture off the body", such as pottery vessels, tools and weapons, while the latter crudely corresponds to "material culture on the body" (Parker Pearson 2000:9), mainly including a variety of ornaments (i.e. tattoos, earrings, nose rings, necklaces, bracelet and hair pins etc.). The clothing of the dead is the only exception: it is material culture on the body, but it could be considered either intentional or coincidental deposition, if it survives in an archaeological context.

The analytical dichotomy of "material culture off the body" and "material culture on the body" originates from the classification of objects as *technomic* or *sociotechnic*, first proposed by Binford (1962) and later developed by Peebles (1971, Peebles and Kus 1977) to define the nature of burial inclusions. It is assumed that *technomic* artifacts are mainly related to socioeconomic production, while *sociotechnic* artifacts usually have a more symbolic meaning that can indicate social differentiation and ranking. Meanwhile, material culture may have different values according to its origins. Exotic goods require more labor and energy to retrieve over a long distance, and thus always embody more value or prestige than local counterparts. The divisions of *technomic* versus *sociotechnic*, material culture off the body versus on the body, local versus exotic, are still useful in the current study, as far as social differentiation is concerned.

One widely accepted criterion that most archaeologists follow to judge whether a cemetery represents a complex society is whether the material culture is differentiated by age and sex (Binford 1971). The common assumption is that in a complex or ranked society material culture or grave goods is differentiated across age and sex, while in simple or middle range society, age and sex are the major features defining social persona. It has been proven that a shift away from age and sex as primary features of the social persona in complex societies is not the case (O'Shea 1984:5-8). The case study of Iron Age Athenian burials clearly shows that both age and sex are still important in defining social persona (Morris 1987) and are still fundamental dimensions for archaeologists in exploring social organization in mortuary analysis.

In order to eliminate as much noise as possible in mortuary data, I only selected primary single burials with determined age and sex (175 tombs in total, almost 50% of the whole cemetery) as subjects of analysis. As shown in the last section, the Huoshaogou community was probably organized patrilineally. Thus, we expect an unbalanced distribution of grave goods between sexes: adult males should predominate either in the quality or in the quantity of goods. First, I calculated the diversity of grave goods in each tomb and used it as parameter to test whether there is a significant difference between sexes. Among 175 tombs, there are 70 female tombs and 69 male tombs. The distribution of diversity in each sex group is almost normal. Thus Student's T-Test is applied to test the difference of means of diversity between sexes:

```
Welch Two Sample t-test

data:  hsg_f$n and hsg_m$n
t = -2.1352, df = 129.2, p-value = 0.03464
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.98845721 -0.07572498
sample estimates:
mean of x mean of y
 5.214286  6.246377
```

Although the T-Test results clearly show that there is a significant difference (p=0.035<0.05) of means between sexes, the estimates of means of diversity are quite close: 5.21 for females and 6.25 for males. Male tombs do have more diversity in burial goods than female ones, but the difference is not significant at all. In order to develop a more comprehensive comparison between different sex groups (probable male, probable female and undetermined sex), the Analysis of Variance (ANOVA) is applied:

```
summary(hsg.comp.aov1)
             Df Sum Sq Mean Sq F value  Pr(>F)
sex           4  120.9  30.226   3.873 0.00489 **
Residuals   170 1326.8   7.805
---
Signif. codes:  0 ?**?0.001 ?*?0.01 ??0.05 ??0.1 ??1
```

First, the analysis of variance of sex groups shows that there is a significant difference between sex groups (p=0.005<0.05). But one needs to pinpoint which pairing of sex groups has more significant difference than any others. So one may apply Tukey's Honest Significant Difference method to generate 95% confidence intervals in the difference of means between sex groups with p-values:

```
TukeyHSD(hsg.comp.aov1)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = n ~ sex, data = hsg_comp_sing)

$sex
           diff        lwr      upr     p adj
F-?   1.3392857 -0.4827812 3.161353 0.2577556
F?-?  2.2361111 -0.7747113 5.246934 0.2479866
M-?   2.3713768  0.5459419 4.196812 0.0040208
M?-?  3.4583333 -1.2587188 8.175385 0.2601926
F?-F  0.8968254 -1.8308853 3.624536 0.8940744
M-F   1.0320911 -0.2746480 2.338830 0.1931695
M?-F  2.1190476 -2.4225309 6.660626 0.6998707
M-F?  0.1352657 -2.5946959 2.865227 0.9999209
M?-F? 1.2222222 -3.9130537 6.357498 0.9652659
M?-M  1.0869565 -3.4559742 5.629887 0.9646002
```

As the results above show, a significant difference (p=0.004) is only detected in the pairing of male-undetermined sex groups (Figure V.7). Although the pairing of male-female yields a low p-value (0.19>0.05), it is not low enough to be statistically significant. For the moment, it is only safe to say that adult males always have larger diversity in grave goods than sub-adults (undetermined sex). Surprisingly, there seems no significant difference in the diversity of grave goods between adult males and adult females. In order to develop a clear picture of the differentiation in age and sex groups, I collapsed the age groups into three categories (adult, child and infant), and again applied the ANOVA:

```
summary(hsg.comp.aov)
             Df Sum Sq Mean Sq F value Pr(>F)
age.group     2   26.1  13.046   1.578  0.209
Residuals   172 1421.6   8.265


TukeyHSD(hsg.comp.aov)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = n ~ age.group, data = hsg_comp_sing)

$age.group
          diff       lwr       upr     p adj
C-A -0.9505992 -2.336459 0.4352605 0.2392705
I-A -1.1092199 -4.202258 1.9838180 0.6738125
I-C -0.1586207 -3.449855 3.1326138 0.9928683
```

As the results above show, no statistical significance is detected in any pair. In other words, different age groups do not have significant differences in the diversity of their grave goods (p=0.209>0.05) (Figure V.8). However, we must keep in mind that there is a great population bias in each age group: among all 175 primary single tombs, there are only 29 children and five infants. The percentage of sub-adult is 19%, which is much lower than the generally expected value in a prehistoric society (50%~70%). As mentioned in the demography section, the population of sub-adults in the whole cemetery is absolutely underrepresented. Thus, it is reasonable that these children and infants who were singly buried in a cemetery where adults predominated must have had some special privileges in social status or the hereditary system, if the community was indeed organized patrilineally. Their ownership of equally diverse grave goods endorses this inference.

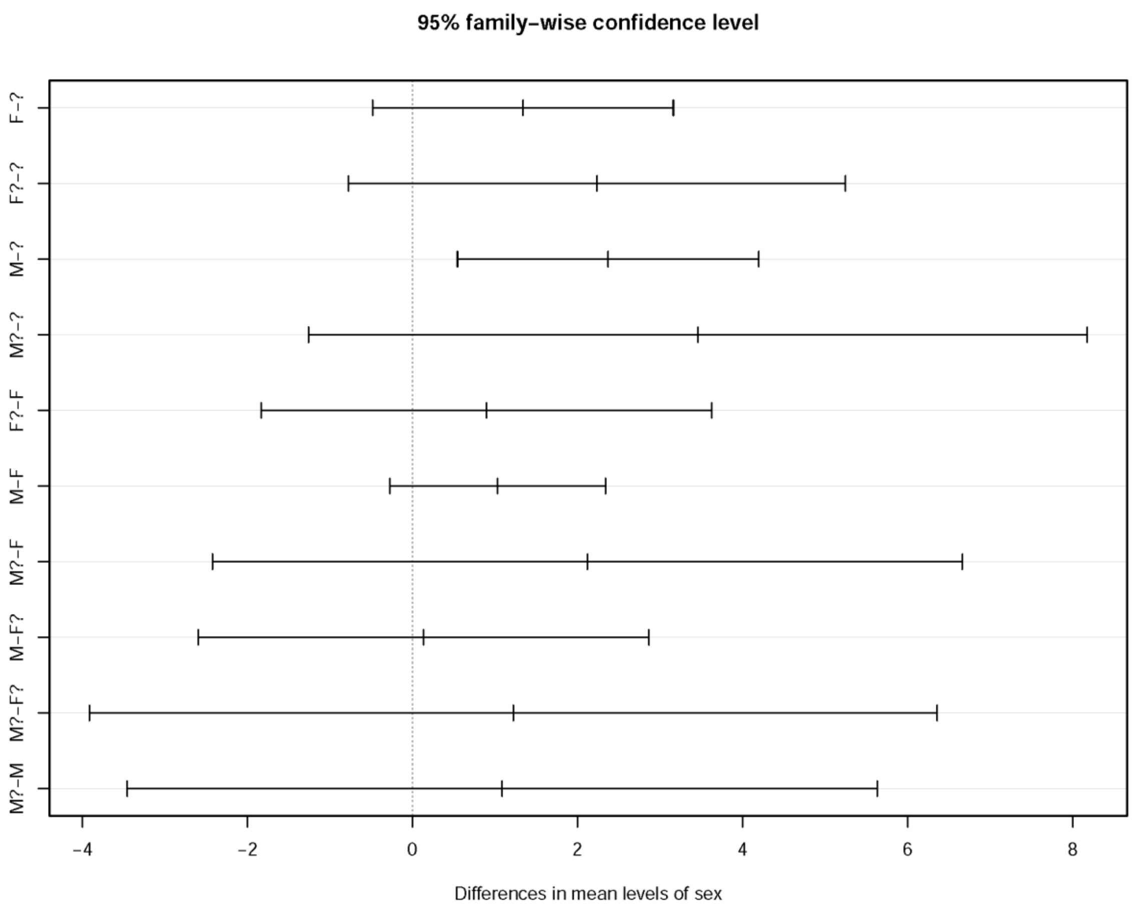


Figure V.7 Confidence interval of difference of means between sex groups

(If the dash line of zero value intersects with any confidence interval, it means there is no significant difference in that group)

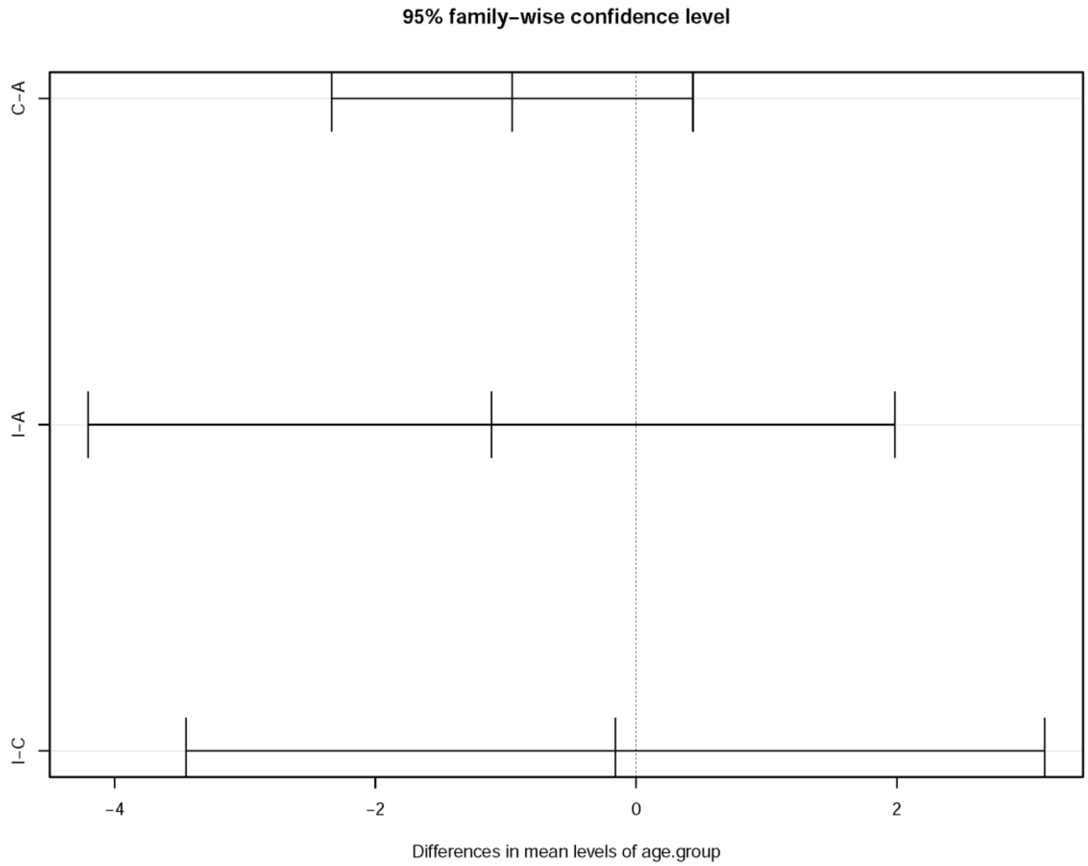


Figure V.8 Confidence interval of difference of means between age groups

(If the dash line of zero value intersects with any confidence interval, it means there is no significant difference in that group)

A brief summary of the statistical analysis above: there is no statistically significant difference in the diversity of grave goods between adult males and adult females. But a significant difference is observed between adult males and undetermined sex groups (predominated by sub-adults and a few adult individuals). A small number of sub-adults have grave goods as diverse as adults' (including males and females), which probably suggests special social status.

However, quantitative statistics on the diversity of grave goods is only one parameter in understanding the material culture system, and it may not be the most effective one. Therefore, one should also include the qualitative dimension to figure out whether the same pattern remains. First of all, one can use correspondence analysis (CA) to explore whether different categories of grave goods correspond to different age and sex groups. Then, one can apply linear model analysis (LMA) to find out whether certain categories of grave goods are indicators of age and sex groups, or to determine the extent of correspondence between grave goods and age and sex groups. As with the statistical computation above, I use primary single burials as my dataset (178 tombs in total). There are in total 42 categories of grave goods (excluding four cases of undiagnosed bark remains) in the whole cemetery (Table V.3).

Table V.3 Classification of grave goods at Huoshaogou cemetery

Pottery	**Stone**	**Metal**		**Bone**
Clay flute	Agate	Gold	Metal needle	Bone awl
Painted pottery	Jade	Metal arrowhead	Metal nose ring	Bone needle
Plain pottery	Shaft smoother	Metal awl	Metal plaque	Bone spreader
Potsherds	Stone chisel	Metal axe	Metal spearhead	Bone tube
Spindle Whorl	Stone flake	Metal bracelet	Metal spreader	Boar tusk
	Stone knife	Metal button	Metal tube	Cowrie
	Stone macehead	Metal chisel	Silver	Fauna
	Stone vessel	Metal earring		Perforated disc
	Turquoise	Metal finger ring		
	Whetstone	Metal knife		
	White beads	Metal macehead		

This correspondence analysis plot (Figure V.9) on the grave goods of various age and sex groups shows that there is a strong pattern correlation between certain grave goods and certain age and sex groups. The tombs form two clusters along the horizontal dimension (Dim1): one cluster to the left of the origin with some variables (categories of grave goods, i.e. clay flute, spindle whorl, white beads etc.) concentrated on the same side, the other cluster to the right with other variables (i.e. stone knife, metal spreader, metal knife etc.) on the same side. The left cluster is apparently associated with adult females and children, while the right cluster is associated with adult males and a few sub-adults. However, there are two variables more distant from the origin, meaning that they are more discriminating than other variables. These two variables probably rescale the overall pattern and make the left cluster overlap more. Hence one might re-generate the plot of correspondence after removing these two variables (Figure V.10). Now we can observe a clear pattern of grave goods in terms of age and sex. The categories of pottery (including plain pottery and painted pottery) and fauna are nearest to the origin, meaning that they are less discriminating than other variables (that is, more evenly distributed throughout all tombs, regardless of age and sex). The left cluster has more adult females, children, and a few infants. Clay flutes, spindle whorls, white beads, perforated discs, cowries, bone needles, agate, and turquoise are associated with this cluster. By contrast, the right cluster is dominated by adult males, a few children and only one infant; the categories of stone knife, metal knife, jade, metal awl, metal spreader, boar tusk, gold, metal button are associated with this cluster. It seems that grave goods with socio-economic functions conform to the division of labor between sexes: spindle whorls often occur in female tombs, while male tombs always yield stone knives, metal knives, metal awls and bone awls.

Figure V.9 Plot of correspondence analysis on selected graves goods

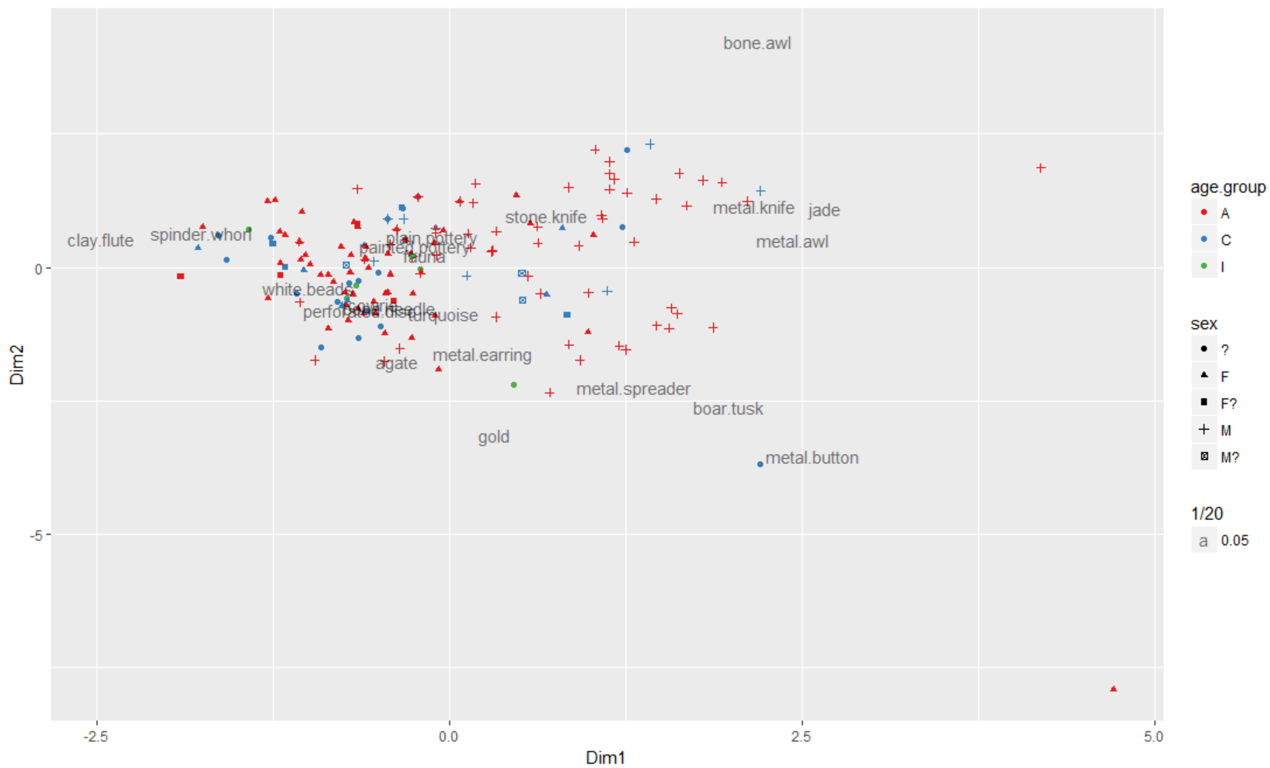


Figure V.10 Plot of correspondence analysis on selected grave goods

(After removing stone macehead and metal plaque)

The vertical dimension (Dim 2) explains the differentiation between production tools (*technomic* artifacts) and ornaments (*sociotechnic* artifacts). All positive values along Dim 2 are *technomic* artifacts except jade, while all negative values are ornaments except metal spreaders and bone needles. According to the original mortuary records, most bone needles were uncovered around the deceased's head. This probably suggests that the function of bone needles were multivalent. This probably applies to the metal spreader as well. Another noteworthy point is that jade objects are closely associated with production tools mainly manipulated by adult males, such as stone knives, metal knives and metal awls. If we assume jade objects to be icons of social wealth, this would probably suggest adult males enjoyed higher economic status by monopolizing socio-economic production that could bring more profit. By contrast, only a few categories of production tools, spindle whorls and bone needles, are identified with the cluster of adult females. It is reasonable that weaving and sewing could have been major socio-economic occupations for adult or sub-adult females. In addition, the categories of pottery are slightly skewed toward the left cluster, which might suggest the use of pottery and probably the manufacture of pottery were more associated with females. Moreover, based on mortuary records, perforated discs (made of mussel shell or marble) were always attached as decoration to the large pottery jars with cutoff lids, probably used for the fermentation of ceremonial drinks (see Chapter VI). In addition, drink fermentation was probably a major domestic chore for women in addition to cooking, child care, cleaning, and weaving.

Correspondence analysis on grave goods of the Huoshaogou community displays typical characteristics of a simple society: grave goods are mainly socio-economic artifacts and faithfully reflect a sexual division of labor. However, we shall keep in mind that some rare goods (i.e. metal macehead, metal plaque etc., with an occurrence in the cemetery of less than five) have been removed from the analysis. If added back to the plot the picture becomes more complicated (Figure V.11).

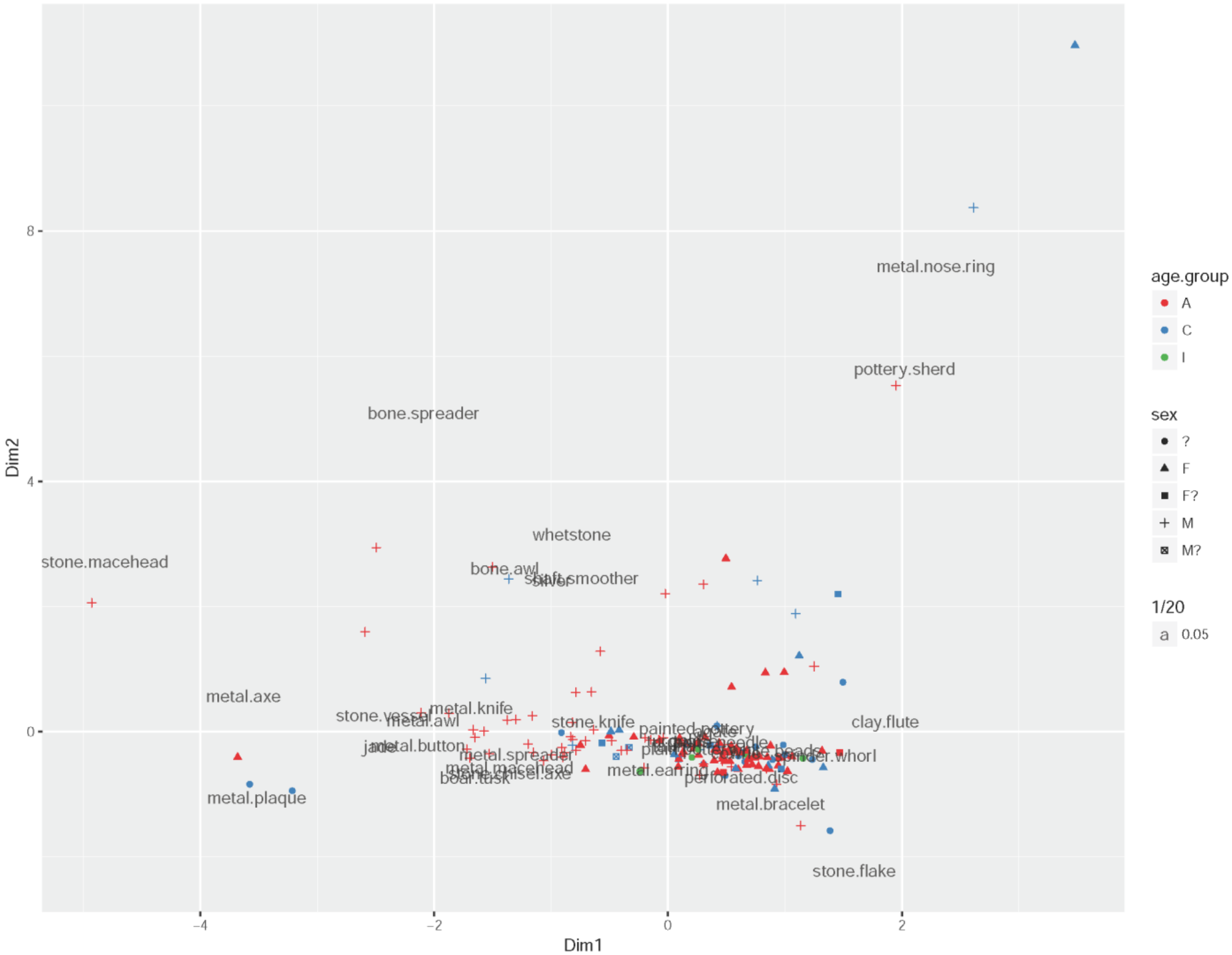


Figure V.11 Plot of correspondence analysis with all categories of grave goods

As the plot shows, more variance between different categories of grave goods and age and sex groups can be observed. Yet the pattern of sexual differentiation identified above still holds. A strong clustering pattern can be observed to the right of the origin in which adult females and sub-adults predominate. Meanwhile, several discriminating variables are scattered around that cluster, such as stone maceheads, stone vessels, metal maceheads, metal nose rings, metal axes, metal plaques, and metal bracelets etc. These variables share the same characteristics: their occurrence rate in all observations (179 tombs) is less than 3% (five cases). In terms of age and sex these variables are all associated with adult males except metal plaques, metal bracelets and metal nose rings, which also occur in a few children's burials. If one defines these variables as rare goods and assumes that they are loaded with more symbolic meaning as regards social status, then one can conclude that the group of adult males indeed has much higher social status than other age and sex groups. Meanwhile, one should not lose sight of a very limited number of adult females who also boast the same rare repertoire as male counterparts, in addition to a few children's burials with "rich" grave goods. Ranking probably existed in the prehistoric community at Huoshaogou.

Table V.4 Classification of graves goods at Huoshaogou cemetery

	Material culture *off* the body		**Material culture *on* the body**
Local	Bone awl	Metal needle	Agate
	Bone needle	Metal spearhead	Boar tusk
	Bone spreader	Metal spreader	Metal bracelet
	Bone tube	Perforated disc	Metal earring
	Clay flute	Pottery	Metal plaque
	Fauna	Stone chisel	Metal nose ring
	Metal arrowhead	Stone flake	Metal finger ring
	Metal awl	Stone knife	Metal button
	Metal axe	Stone shaft smoother	Metal tube
	Metal chisel	Spindle whorl	
	Metal knife	Whetstone	
Exotic	Jade		Cowrie
	Metal macehead		Gold
	Stone macehead		Silver
	Stone vessel		White beads

In order to improve correspondence plot visibility, one might collapse all categories of grave goods into four categories based on archaeological context (material culture on the body and off the body) and the source of the object (local versus exotic in material or style) (Table V.4): local manufactured material culture off the body (**n1**), local manufactured material culture on the body (**n2**), exotic material culture off the body (**n3**), and exotic material culture on the body (**n4**). A new plot of correspondence analysis might be generated according to those four categories (Figure V.12). In this plot one observes a clear pattern of association: n1, n2 and n4 explain the major cluster in the upper right, while n3 alone separates a small group of cases from that cluster with a clear-cut boundary, which also proves that this classification is effective in the correspondence analysis. The small group defined by n3 includes 13 cases across all age groups: nine adult males, two adult females, one child and one infant. This is a strong signal of social rank. The inclusion of a child and an infant also suggest that social rank is probably hereditary and ascriptive rather than achieved. The category of n3 consists entirely of exotic goods: the macehead with West Asian origin, the stone vessel with Southern Siberian or Altai origin, and the jade with probable Xinjiang origin. These exotic goods and their low occurrence throughout the cemetery strongly indicate that their social value and symbolic meaning was probably associated with personal wealth and social status.

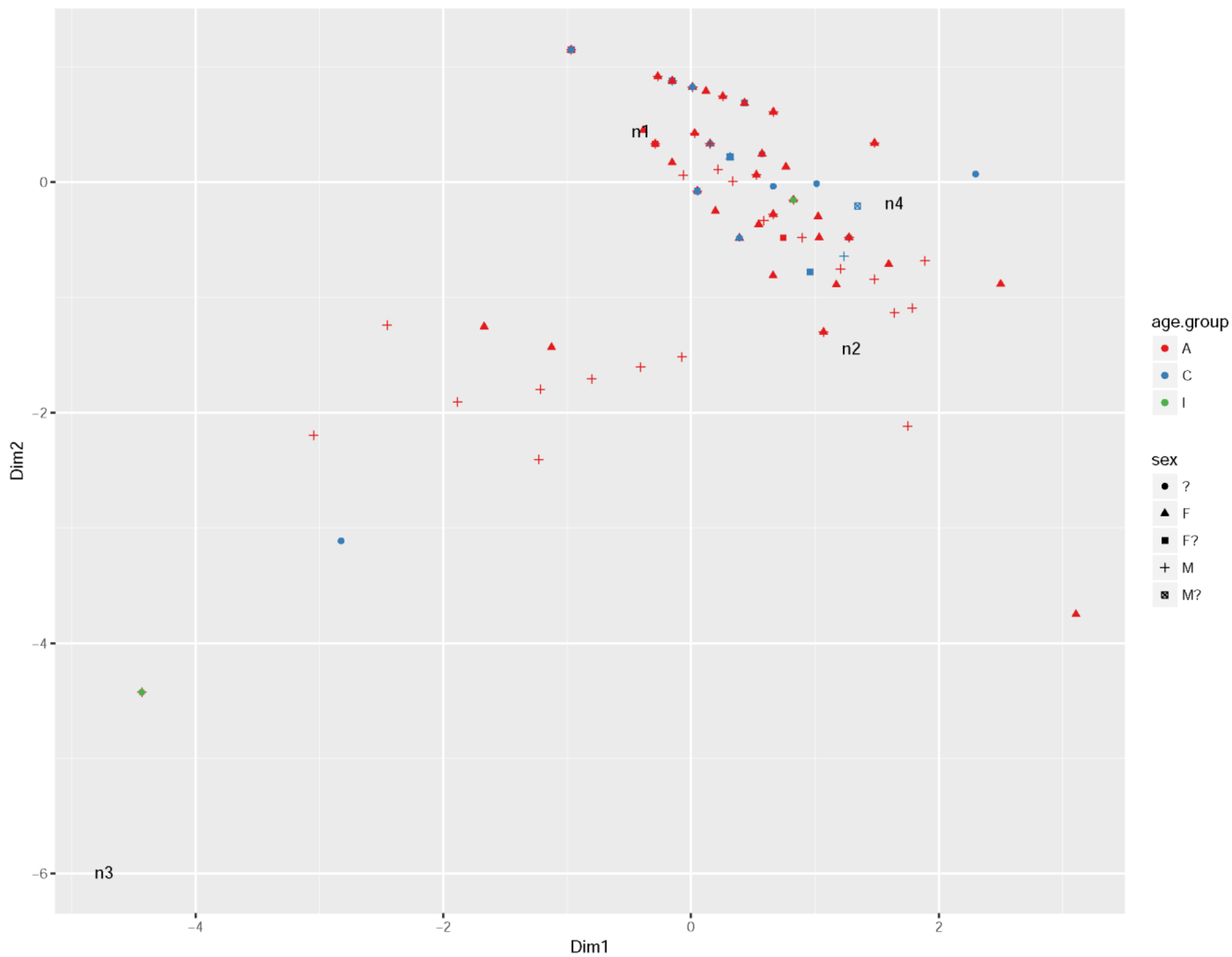


Figure V.12 Plot of correspondence analysis after the re-classification of grave goods

However, correspondence analysis is only an exploratory technique that highlights the underlying patterns of correlation in the dataset. Thus, one also should apply explanatory multivariate techniques to test those correlations. Following, linear regression analysis will be applied to refine correlations between categories of graves goods and age and sex groups. In order to compute this linear model, one first needs to generate contingency tables (Two-way tables) of sex groups and each category of grave goods, as well as age groups and each category of grave goods. II use the statistical software R for all computations. Because I mainly deal with categorical variables, I first codify the contingency tables to facilitate the computation of linear model coefficients. Here I apply the most commonly used coding scheme, the dummy coding method. All linear model coefficients between different categorical variables and each category of grave goods are summarized in the table (Table V.5).

For better statistical representativeness, I selected 23 categories of grave goods with an occurrence rate above 2.8% (five out of 178 observations). A fine-grained classification scheme for age and sex is applied to identify any discriminating correspondence. Generally, more statistically significant coefficients are identified between categories of grave goods and sex groups, while fewer for age groups. This probably suggests that sexual differentiation was stressed above age in the Huoshaogou community. There are several issues need further discussion. First, owing to a high occurrence rate (above 60%), correlations between pottery and faunal remains and age and sex groups are excluded, even though statistically significant coefficients are suggested. Secondly, one observes several pairs of strong correlations: adult female and spindle whorl ($p=0.003<0.05$); metal awl ($p=0.0005$), metal knife ($p=1.08e-06$), stone knife ($p=1.94e-06$) and jade ($p=0.0262$) with adult males; metal plaque ($p=0.0281$), cowrie ($p=0.0007$), turquoise ($p=0.0046$), white beads ($p=4.72e-05$) with unsexed sub-adults (infants and children). These statistical computations confirm the same pattern already identified in the exploratory plot. Although a higher *p*-value is yielded for the stone macehead, its absence in other categories of age and sex suggests it was monopolized by adult males. The same situation applies to jade objects. Other categories also yield slight differentiation between age and

Category	Intercept (?)	sex2 (F)	sex3 (F?)	sex4 (M)	sex5 (M?)	Occurance rate(178 in total)	Intercept (I)	age2 (C)	age3 (AD)	age4 (A)	age5 (YA)	age6 (MA)	age7 (OA)
N	25	70	9	70	3	-	5	22	23	14	63	30	20
Plain pottery	**9.62e-08**	**0.0042**	0.0772	**0.0027**	**0.0498**	74.01%	**4.98e-05**	0.1060	0.7740	0.4840	0.9750	0.8730	0.6420
Painted pottery	**<2e-16**	0.5380	0.9040	0.2070	0.3000	83.05%	**4.05e-06**	0.6960	0.7080	0.4230	0.7440	0.7140	0.5950
Metal plaque	**0.0281**	0.0590	0.2561	0.5877	0.4695	3.39%	1.0000	0.3150	1.0000	0.4530	0.8520	0.7050	0.5840
Metal earring	0.1425	0.8924	0.7685	0.8924	**0.0005**	8.47%	1.0000	0.5120	0.5290	1.0000	0.4640	0.8050	0.1540
Metal button	0.1810	0.4600	0.7880	0.1290	0.6610	10.17%	0.1450	0.3080	0.6450	0.2100	0.5320	0.6520	0.5130
Metal awl	0.5476	0.6057	0.1597	**0.0001**	0.1499	15.82%	1.0000	0.8030	0.4720	0.4560	0.3070	0.2610	0.1750
Metal knife	0.5860	0.8410	0.6180	**1.08e-06**	0.8580	22.03%	1.0000	0.8223	0.1324	0.0947	0.3582	0.0645	0.3282
Metal spreader	1.0000	0.5512	1.0000	0.1373	**0.0086**	4.52%	1.0000	1.0000	0.6750	1.0000	0.6250	0.3250	0.6340
Stone knife	0.3784	**0.0277**	0.4203	**1.94e-06**	**0.0011**	40.11%	1.0000	0.7010	**0.0437**	0.1526	**0.0393**	**0.0218**	0.0954
Stone macehead	1.0000	1.0000	1.0000	0.0638	1.0000	2.82%	1.0000	1.0000	1.0000	1.0000	0.5390	0.4090	1.0000
Spindle whorl	**0.0427**	**0.0003**	0.2566	0.2011	0.4700	25.99%	0.3120	0.9340	0.7800	0.8040	0.6210	1.0000	0.3660
Bone needle	0.0658	0.2134	0.3034	0.5903	0.5123	24.29%	1.0000	0.2900	0.4160	0.5270	0.1350	0.2030	0.2490
Bone awl	1.0000	1.0000	1.0000	0.0638	1.0000	2.82%	1.0000	1.0000	0.2860	1.0000	0.8360	1.0000	0.2260
Clay flute	**0.0106**	0.3708	**0.0193**	**0.0279**	0.3991	6.21%	1.0000	0.1290	1.0000	1.0000	0.5710	0.5670	0.6780
Fauna	**7.96e-06**	**0.0286**	0.0706	0.0527	0.4384	64.41%	**0.0055**	0.6727	0.7399	0.6878	0.6067	0.7726	0.4028
Cowrie	**0.0007**	0.9580	0.1947	0.6548	0.9627	31.07%	0.3380	0.4790	0.5210	0.5970	0.5390	0.5540	0.6680
Turquoise	**0.0046**	0.1210	0.3745	0.2392	0.1964	40.11%	**0.0003**	**0.0057**	0.1746	**0.0405**	0.1282	0.1959	**0.0227**
Gold	1.0000	0.4650	1.0000	0.2730	1.0000	2.82%	1.0000	1.0000	0.5990	1.0000	0.8380	0.4110	0.5510
White beads	**4.72e-05**	0.3072	0.6150	0.0621	0.2459	25.42%	**0.0023**	0.1910	0.2399	**0.0444**	0.1029	0.0577	**0.0222**
Jade	1.0000	1.0000	1.0000	**0.0262**	1.0000	3.95%	1.0000	1.0000	1.0000	0.4860	0.4870	0.4830	1.0000
Boar tusk	0.3370	0.5960	0.6210	0.3470	0.7530	4.52%	**0.0319**	0.0525	0.0516	0.5965	0.0817	0.1837	0.1486
Agate	0.5200	0.1570	0.1330	0.5280	0.8330	10.73%	1.0000	0.7690	0.2590	0.6600	0.4430	0.6580	0.2010
Perforated disc	0.0607	0.1579	0.0859	0.7948	0.5373	23.73%	0.3010	0.9320	0.7750	0.8000	0.9120	0.6320	0.6430

Table V.5 Summary of lineal model coefficients between different variables
(All values with statistical significance, that is, smaller than 0.05, are highlighted in bold)

sex groups, i.e. bone needle, agate, but they does not reach levels of statistical significance. This probably results from the limited number of samples in each sub-category.

If this qualitative classification of grave goods is effective, one might ask, can one identify some patterns in the distribution of graves goods -- for example, a cluster of tombs with high occurrence of exotic or prestigious goods? I first appled cluster analysis based on the grave goods via the K-means clustering method[1]. However, the best resolution yielded was two clusters, which suggested great homogeneity in grave goods. After introducing the qualitative classification scheme into the clustering computations, I received a much clearer pattern of clustering (Figure V.13). In the heatmap plot, one can clearly observe the contribution of each category of grave goods to each tomb. For the tombs on the left edge of the dendrogram, there is a higher concentration of all four categories of grave goods, which probably suggests their relative high social status. By column, a consistent pattern can be observed in the contribution of each observation between the n2 and n4 category, which suggests a strong co-existence relationship. However, n3 immediately stands out; it hardly co-exists with either n2 or n4. There are only two cases where jade (n3) coexists with gold (n4): 76M79 and 76M11. Likewise, gold co-exists neither with maceheads nor with stone vessels. In fact, all categories in n3 and n4 have very few co-occurrence cases. If we assume the category of n4 (i.e. cowrie, turquoise, gold, silver and white beads) is more associated with wealth, and that n3 (i.e. jade, maceheads, stone vessels) is more connected to social prestige and political authority, then we may conclude that the dimensions of economic wealth and political power are independent from each other in the community at Huoshaogou.

[1] https://www.mattpeeples.net/kmeans.html

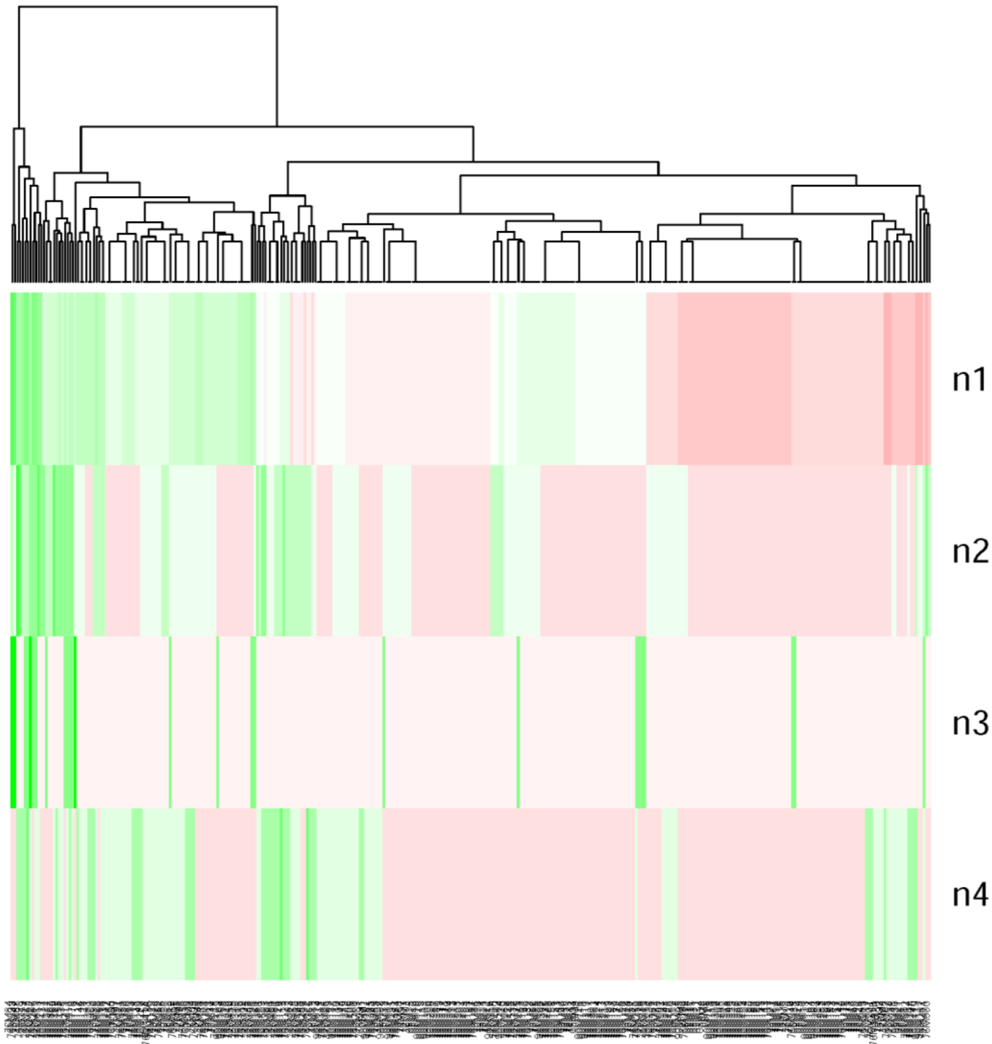


Figure V.13 Heatmap of different categories of grave goods by rows (n1-4)

(Green stands for positive values, red stands for negative values, white stands for zero values)

The spatial distribution of rare grave goods in the cemetery also suggests a scattered pattern of different kinds of rare goods (Figure V.14). Only in very few cases (i.e. 76M79, M84, M124, M299 etc.) can one find co-occurrence of at least two different kinds of rare goods. However, there seem to be several loose clusters of certain categories of rare goods. Taking maceheads as an example, the whole cemetery can be divided into four plots based on the presence of maceheads: the northern zone (A) centered around 76M136; the middle zone (B) that can be divided into two sub-zones: the mid-northern zone centered around 76M84 - M299 - M250, the mid-southern zone centered around 76M76 - M127 - M262; the southern zone (C) centered around 76M310 - M64 - M70; and the mid-eastern zone (D) centered around 76M244 - M10. Due to the disturbance of modern ditches, it is unclear whether zone E was spatially attached to zone A, or whether zone D was originally attached to zone B. Besides those five plots, there are four more clusters of tombs without any inclusion of rare goods lying in the peripheries: zone F to the south of zone D, the eastern zone G, the northwestern zone H, and the southern-most cluster uncovered in 2005.

Based on current data, zone B, probably including zone D, is the center of the whole cemetery, which has the largest density of interments as well as burials including rare goods. Although divisions between zone A and E, zone B and D are not secure, the layout of four marginal plots, zone C, F, G and H, clearly indicate the intentional spatial division of the whole cemetery, which established during the early use phase of the cemetery (Figure V.15). The relatively "poor" graves, together with their marginal locations, probably suggest relatively low social status as descent groups.

V.1.6 Summary

By means of mortuary analysis of Huoshaogou cemetery, we may reconstruct the social context of early Bronze Age Northwest China. This agro-pastoralist community at the western end of the Hexi corridor was not as simple in social organization as it seems. Even though sexual difference was mainly based on the division of labor in social-economic production, males were more pronounced in socio-economic and probably also in political domains. The relative homogeneity reflected by grave goods distribution does not preclude the existence of social ranking across age and sex. Unique burial practices with emphasis on agnates also entailed the dominance of males in descent organization. Among high status individuals with exotic grave goods, a more nuanced differentiation between social wealth and social prestige or political authority probably suggests unequal and decentralized accessibility to rare resources with different individuals and groups, due to intrinsic social interactions and tensions in the Huoshaogou community. The social characteristics and dynamics presented above are points of departure for us to develop a better understanding of the momentum of cultural interaction in early Bronze Age Northwest China and adjacent regions.

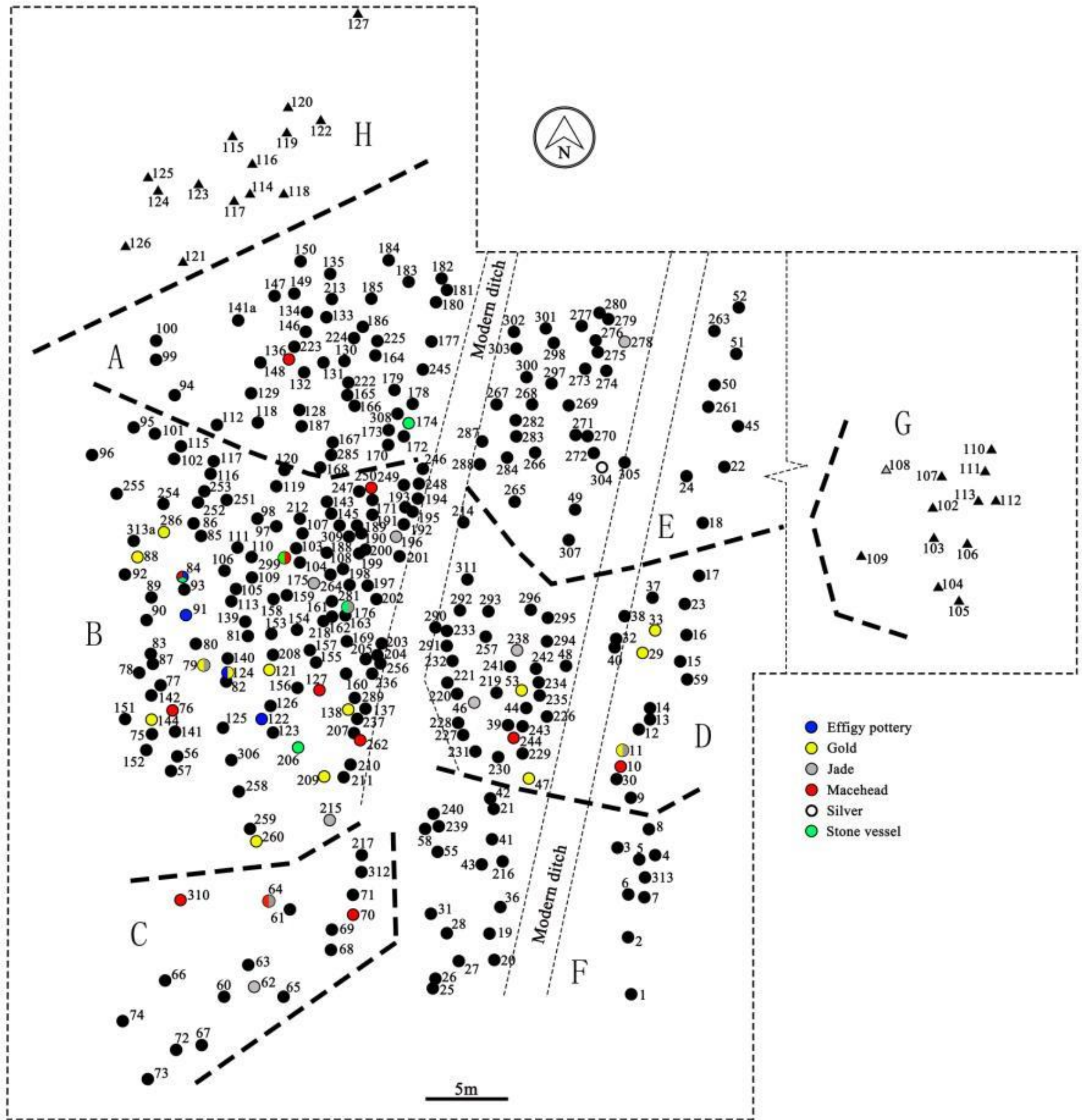


Figure V.14 Spatial distribution of rare grave goods in Huoshaogou cemetery

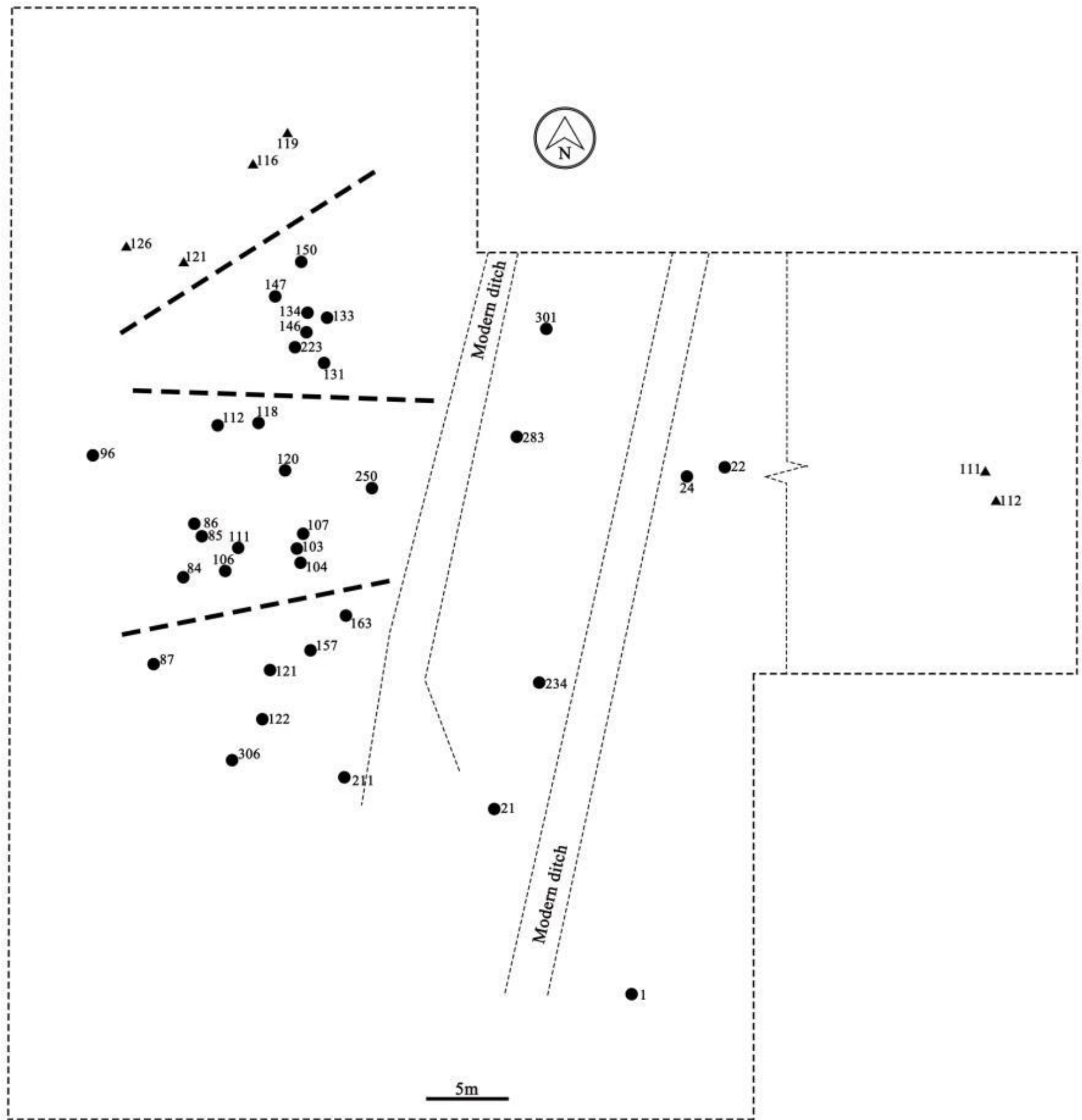


Figure V.15 Spatial distribution of tombs in Period I

V.2 The Siba cemetery at Donghuishan: a ritual economic perspective

Besides Huoshaogou, there is another contemporary Bronze Age cemetery in the eastern Hexi corridor: the Donghuishan cemetery. The cemetery is located in the village of Liuba, Minle county, near an alluvial fan in the northern piedmont of the Qilian Mountains. The distance from Huoshaogou in the northwest is 184 miles (297 km). The site of Xichengyi, recently discovered as the earliest metallurgical center in the Bronze Age Hexi corridor, is located 33 miles (53 km) northwest of the cemetery (Figure V.16).

The site of Donghuishan was discovered in 1958 during a local archaeological survey. Several graves were exposed when an irrigation canal was constructed and cut through the eastern section of the site in the 1970s. The situation became worse throughout the next decade, resulting from constant erosion by irrigation water. Archaeologists conducted rescue excavations in 1987 and yielded 249 tombs dating back to the early Bronze Age (GSWKY and JDBKY 1998). All tombs were concentrated in a rectangular plot of 35 by 15 meters (Figure V.16). The irrigation canal cut through the central axis of the cemetery from south to north and seriously damaged the center of the cemetery, where a largest density of graves would be expected. Thus, a total number of 300 tombs in the original cemetery would not be an overestimate. Based on the typology of unearthed pottery assemblages, the relative date of the cemetery is contemporary with Huoshaogou cemetery, attributed to the early phase of the Siba culture. One charcoal sample yielded a radiocarbon date of 3770±145 BP (calibrated).

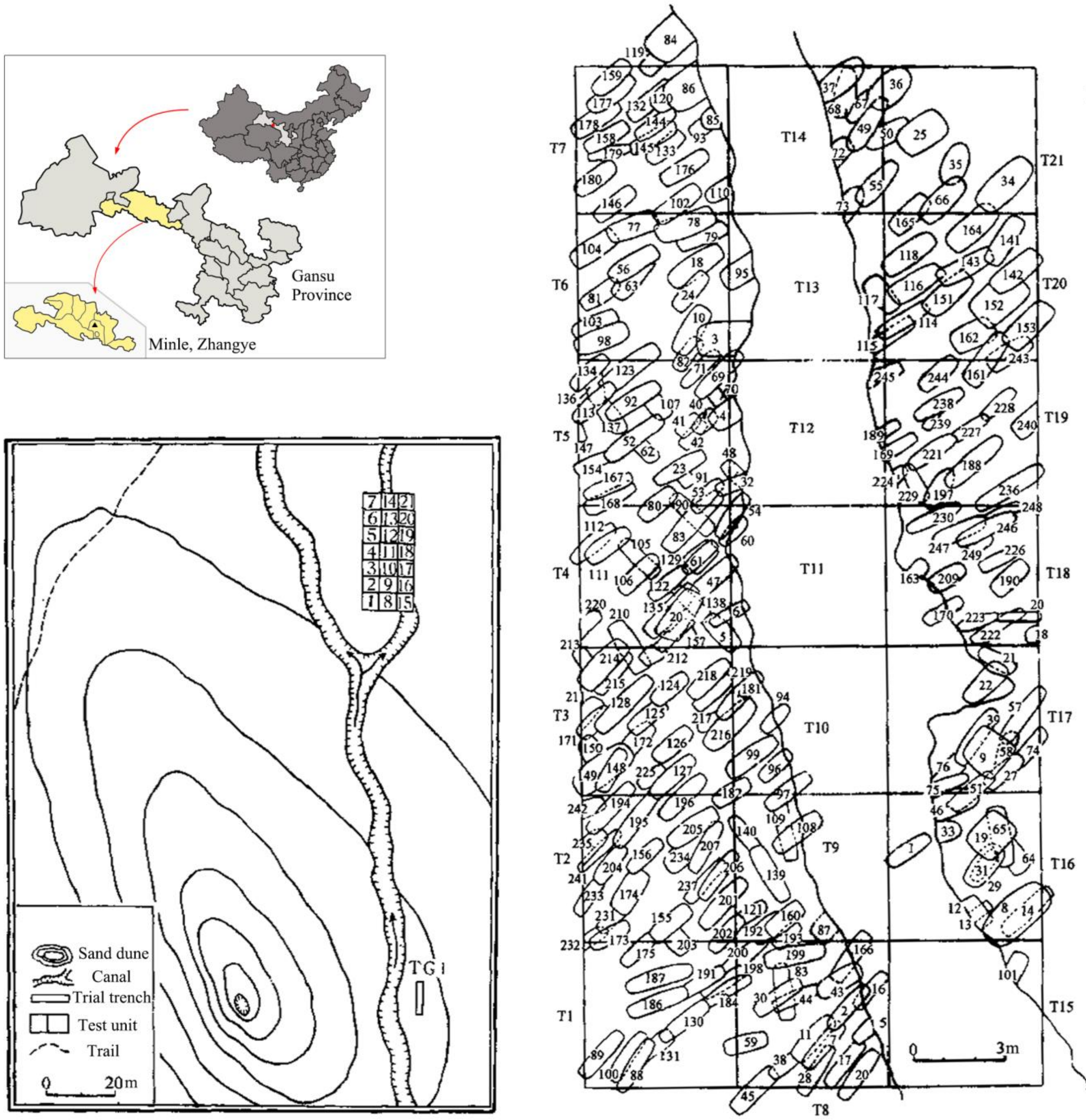


Figure V.16 Location (left) and the plan (right) of Donghuishan cemetery

(After GSWKY and JDBKY 1998, figure 2, 20)

A high degree of homogeneity can be observed across all aspects of the mortuary data in Donghuishan cemetery: burial facility, orientation, body position and the assemblages of burial goods. Different from the boot-shaped graves at Huoshaogou rectangular pit tombs are the most

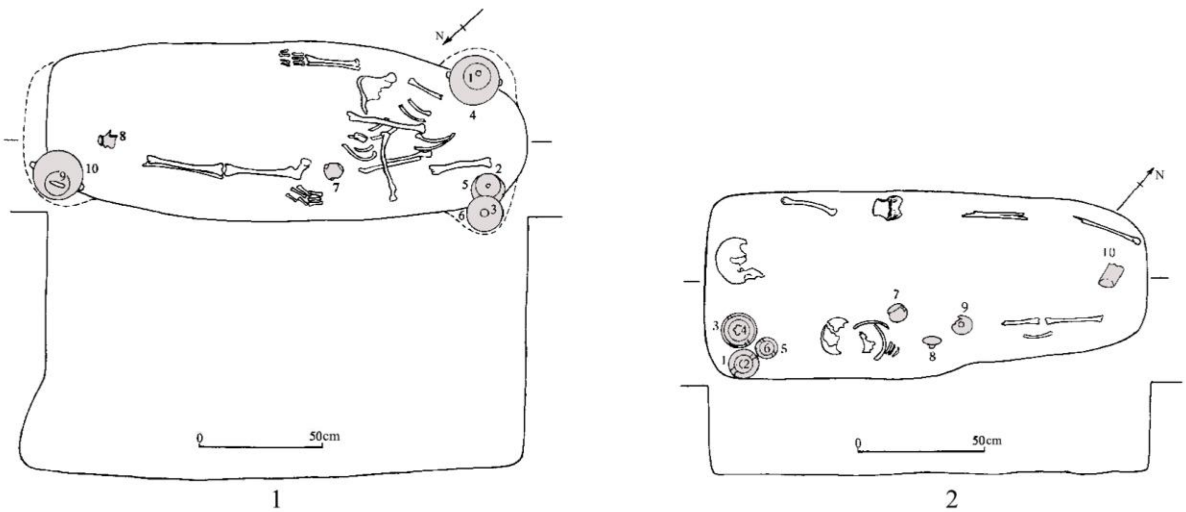


Figure V.17 Burial examples in Donghuishan cemetery

(1. M92 2. M59. After GSWKY and JDBKY 1998, figure24, 28)

popular form of burial (76.7%), followed by pit tombs with niches near the head or feet of the body (22.9%). The average dimensions of pit tombs are 1.7 in length, 0.6 in width and 0.4 meters in depth (Figure V.17). The estimation of grave volume is positively correlated to the quantity of grave goods according to Pearson's Correlation Test (*p*-value=0.0026, the estimate of coefficient of correlation is 0.22). NE-SW is the predominant orientation at 88%, and only 10% of tombs orientated NW-SE. Secondary burials or disturbed primary burials are common in all tombs. Due to the poor preservation of bodies *in situ*, among all 249 tombs, only 96 are identified as single burials (38.6%), and 54 tombs have double or multiple individuals (21.7%). There are 221 individuals that can be determined by age and sex: 91 male adults (41.2%) and 62 female adults (28.1%). Due to a large percentage of individuals with undetermined sex (68 individuals, 30.8%), it is still too early to argue that there is a great imbalance between sexes in the demographic structure. However, a burial bias against sub-adult individuals, especially infants or children

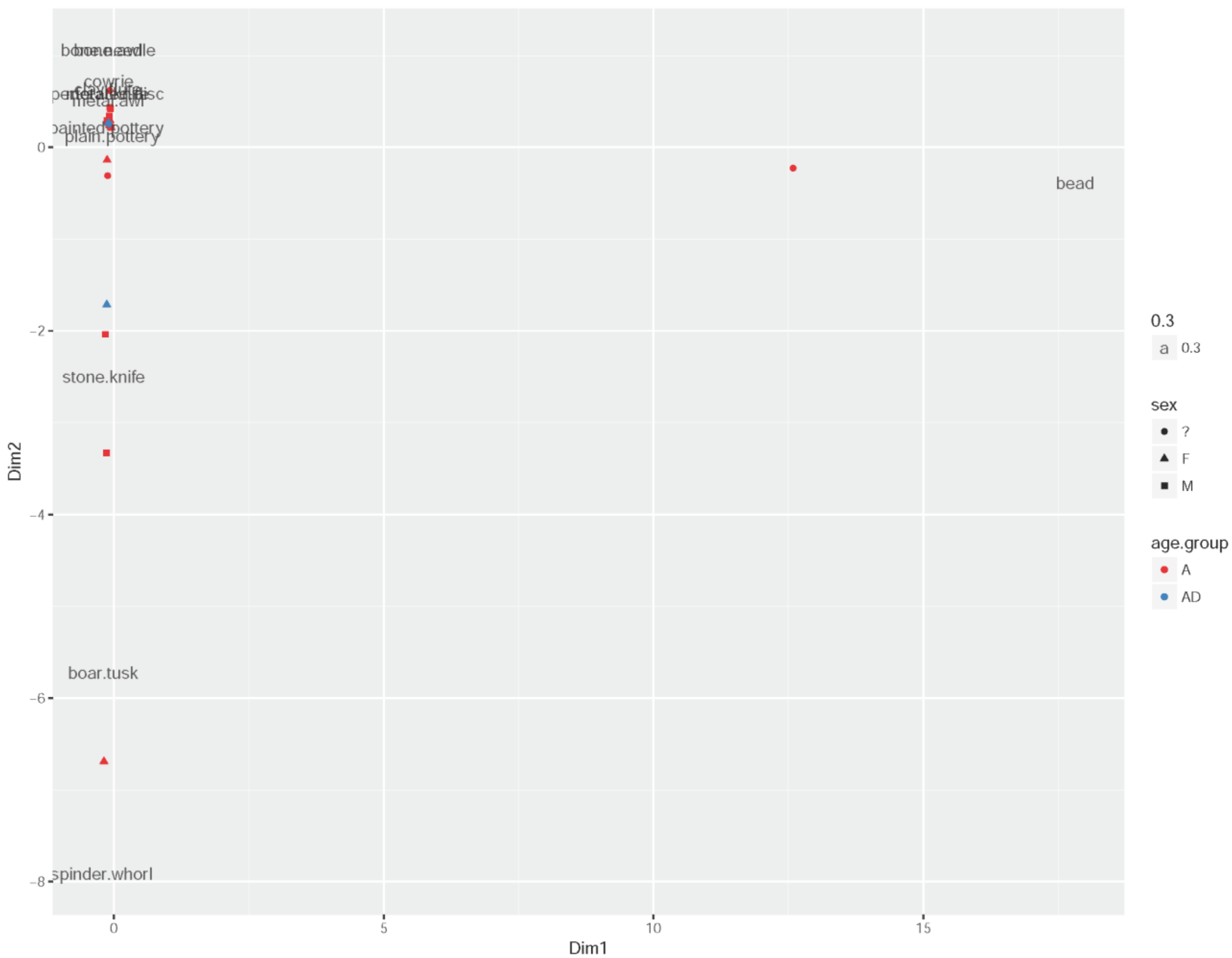


Figure V.18 Plot of correspondence analysis on the grave goods from Donghuishan cemetery with reference to age and sex groups

(under 12 years old), can be clearly discerned in the cemetery: 178 out of 221 individuals are adults (80.5%), 30 adolescents (13.6%), 11 children (5%), and two infants (0.9%). Again, the population of infants and children is greatly underrepresented in the cemetery due to alternative mortuary practices or a separate burial space. There is no qualitative differentiation in the assemblage of grave goods, either (Figure V.18). Pottery vessels are the major burial repertoire for the tombs (632 items in total). Only 62 tools and ornaments made of different materials (stone, bone and metal) are found in 249 tombs. This extremely low diversity and abundance in grave goods makes the quantification of mortuary data ineffective in identifying social differentiation.

However, the dominant burial practice in the Donghuishan cemetery, of disturbed burials, makes it stand out against other contemporaries. Human remains in more than 218 tombs (87.6%) were disturbed to varying degrees, resulting in the dislocation of components from their original anatomic locations and even the absence of major components such as heads, femurs, and feet (Figure V.17). Only 12 individuals are primary burials with slight post-depositional disturbance (e.g., the absence of phalanges in a few cases). In some extreme cases, almost all human remains were removed and only some undiagnosable fragments left.

Mortuary data is the result of funeral rituals, one of the most important rites of passage in the human life cycle (Turner 1969; van Gennep 1960 [1908]). The death of one member of a social group means the void of his/her social persona/role in the original social context. In the same vein, death can always causes some disturbance in the *status quo* of the living community to varying degrees. No matter what the motivation for funeral rites is, the well-being of the living community and the continuity of social development should be the point of departure as well as the ultimate consideration in funeral practice. It is the social well-being of the living that motivates all interactions, both physical and metaphysical, between the living and the dead (Rakita and Buikstra 2005). Hence it is straightforward that varying preservation of human remains is the direct result of funeral rituals (including post-depositional ritual, or "double funerals" as seen in Hertz's (1960 [1907]) classic study) directed by the living. Therefore, it is reasonable that the more disturbed the skeleton of the deceased, the more the ritual investment of the living. Even though there may be no qualitative difference in grave goods, the degree of disturbance could be used as an independent parameter to investigate social differentiation, if there is any.

The completeness of skeletons at Donghuishan can be divided into three tiers from the most disturbed to most complete (Table V.6). It is assumed that more ritual investment by the living is input for one tier of degree of completeness than the next higher tier; for example, a Degree I human skeleton has been ritually invested in to a greater extant that a Degree II skeleton. If energy expenditure in funeral rites is conditioned by the social status of the deceased in life, then one should expect that a lower degree of completeness predicts higher social status and vice versa. In the case of Donghuishan social status can be measured by other parameters, e.g., the volume of the grave, the quantity of grave goods, the inclusion of rare goods etc. Hence, one expects a significant correlation between degrees of completeness and other parameters in the representation of social status.

Table V.6 Degree of completeness at Donghuishan cemetery

Degree of completeness	**Description**
I	The most disturbed; only one or no diagnosable components of skeleton left
II	The human skeleton is disturbed with no more than 6 diagnosable components left
III	The human skeleton is disturbed, but at least half of the body remains complete

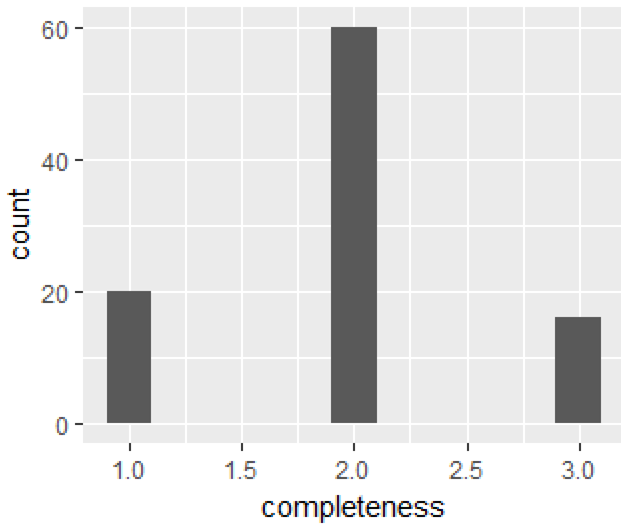


Figure V.19 Distribution of degrees of completeness of human skeletons at Donghuishan cemetery

(The integers 1, 2 and 3 in the *x* axis stand for the corresponding degree of completeness, I, II and III)

In order to eliminate as much noise as possible in statistical computations I chose only single burials (96 tombs) as my dataset. As the bar plot shows (Figure V.19), the degrees of completeness in those 96 tombs are normally distributed. However, one would expect a positively or negatively skewed pattern of distribution if there were a positive/negative correlation between social status and degrees of disturbance. First, I apply the correlation test to figure out whether there are any correlations between the degree of completeness and other variables (e.g., the total number of grave goods, the volume of grave). As the degree of completeness is ordinal data, Spearman's Rank Correlation Test is applied to estimate the correlation coefficient:

```
        Spearman's rank correlation rho

data:  dhs.sin5$vol and dhs.sin5$completeness
S = 54797, p-value = 0.05728
alternative hypothesis: true rho is not equal to 0
sample estimates:
```

```
      rho
0.2205209

      Spearman's rank correlation rho

data:  dhs.sin5$num and dhs.sin5$completeness
S = 122980, p-value = 0.1062
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.1659188
```

As the two tests above show, no significant correlation is identified in either pair of variables. The estimate of the correlation coefficient (*rho*) between the degree of completeness and the volume of grave is low, 0.22 (p-value=0.057>0.05), and for the total number of grave goods, the estimate generates a much lower value, 0.17 (p-value=0.11>0.05). In order to eliminate bias resulting from arbitrary classification of the degree of completeness, I also calculate the specific means of each variable with a 95% confidence interval (CI) (Table V.7, Figure V.20). There is a significant difference in means of the volume of graves between Degree I and II. However, the confidence interval of Degree III basically overlaps with the other two tiers and thus indicates no significant difference among them. The same situation can also be observed in the statistics of the number of grave goods in each tier. Based on the above statistics, significant correlations exist between the completeness of the skeleton, the volume of the grave and the number of grave goods. If disturbance of the deceased is a necessary rite of passage in transforming the dead to an ancestor, then one might argue that this funeral rite was universally practiced, regardless of grave goods and grave volume.

Table V.7 Statistical indexes of the volume of graves according to degree of completeness at the Donghuishan cemetery

completeness	n	median	mean	sd	se	lowerCI	upperCI
1	20	0.207	0.284482	0.238395	0.053307	0.17291	0.396055
2	60	0.4405	0.50735	0.307433	0.039689	0.427932	0.586768
3	16	0.34	0.505895	0.432723	0.108181	0.275313	0.736478

(n – number of samples; sd – standard deviation; se- standard error; lower CI- the minimum value of the mean confidence interval; upper CI- the maximum value of the mean confidence interval)

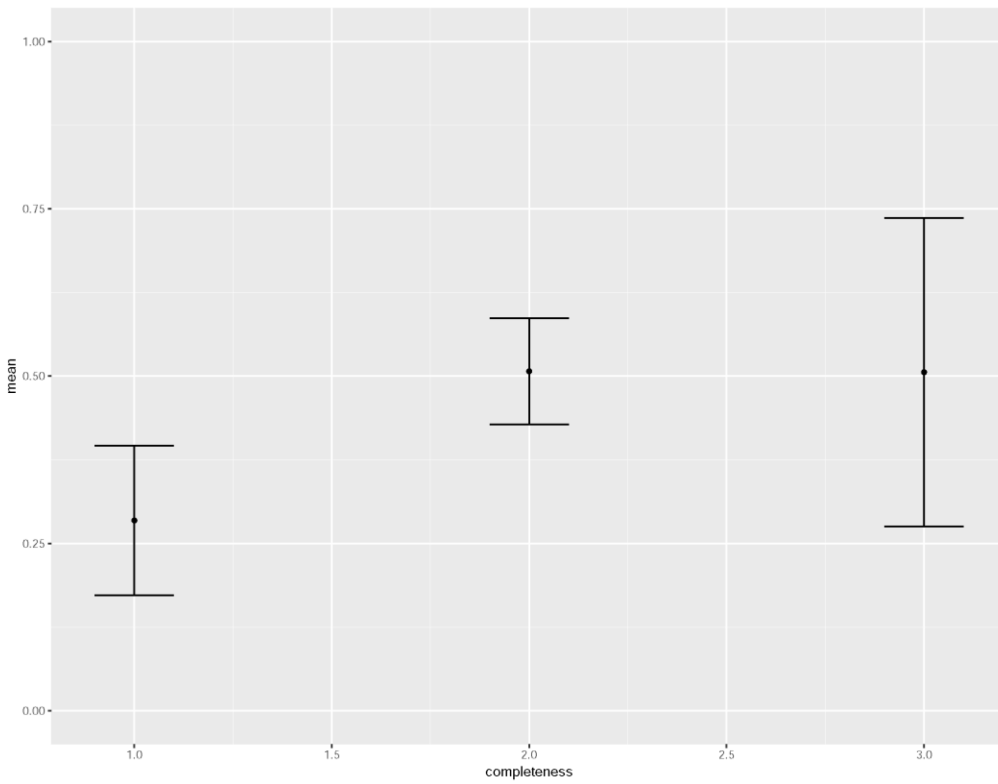


Figure V.20 Plot of the confidence interval of the mean volume of graves in each tier of degree of completeness at Donghuishan cemetery

Table V.8 Statistical indexes of the number of grave goods according to degree of completeness

completeness	n	median	mean	sd	se	lowerCI	upperCI
1	20	2	2.65	2.942877	0.658047	1.272691	4.027309
2	60	2.5	3.216667	3.30942	0.427244	2.361753	4.07158
3	16	4	4.8125	4.261748	1.065437	2.541575	7.083425

(n – number of samples; sd – standard deviation; se- standard error; lower CI- the minimum value of the mean confidence interval; upper CI- the maximum value of the mean confidence interval)

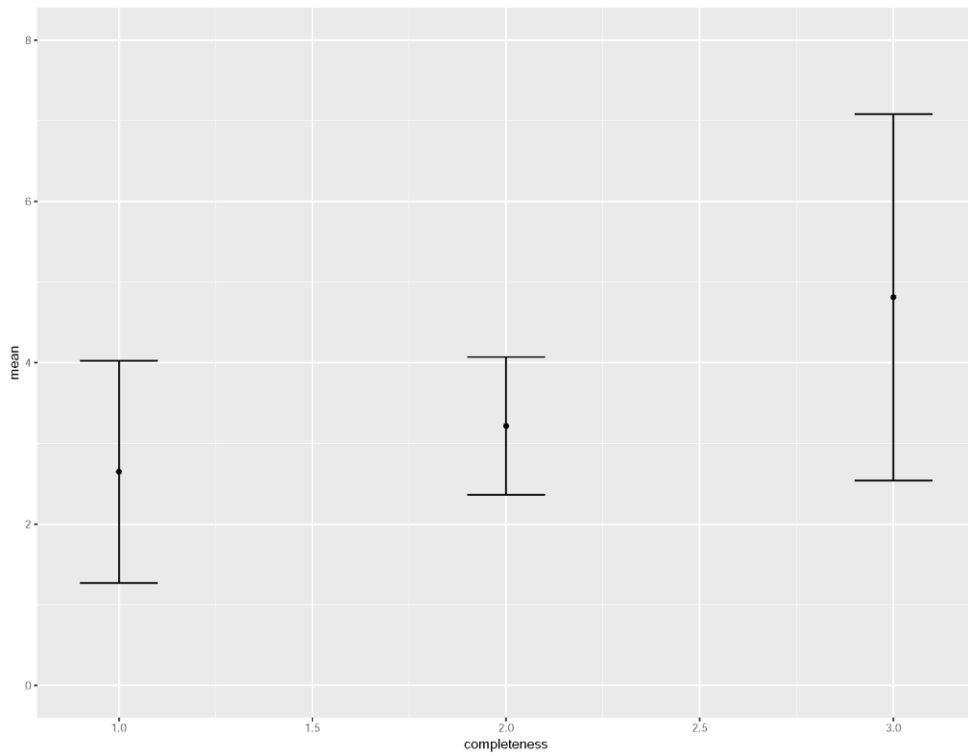


Figure V.21 Plot of the mean confidence interval of the number of grave goods in each tier of degree of completeness at Donghuishan cemetery

Besides the correlation test between degree of completeness and other quantitative variables, one also should determine whether degree of completeness is correlated to certain age and sex groups, or n other words, whether disturbance of the deceased occurs preferentially with some age and sex groups. First, the distribution of sexes in each tier of completeness is not skewed, nor is the distribution of age groups (Figure V.22). The Pearson's Chi-square Correlation Test also suggests insignificant correlation between the degree of completeness and the groups by age (p-value=0.265>0.05) and sex (p-value=0.05004>0.05). The same test is also applied to other categorical variables such as orientation and burial facility. However, high p-values, 0.36 for orientation and 0.26 for burial facility, suggest that they are probably independent from each other.

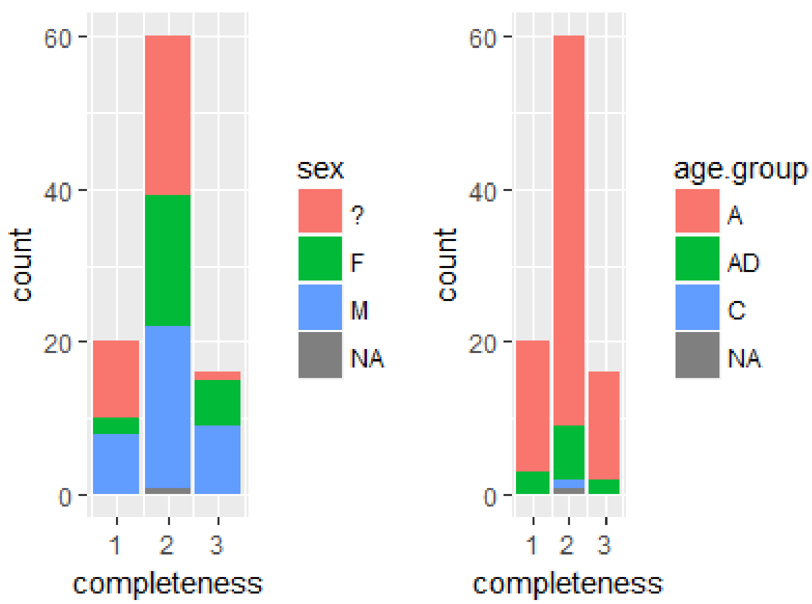


Figure V.22 Distribution of sex and age groups in each tier of degree of completeness at Donghuishan cemetery

By means of a series of statistical tests, I come to a preliminary conclusion: the postmortem disturbance of the deceased as a funeral rite probably has no significant correlation with other mortuary variables, including grave volume, the number of grave goods, or any mortuary groups by age, sex, orientation and burial facility. It was probably a universal funeral rite practiced at

Donghuishan community without any consideration of the social status of the deceased. However, a significant difference exists between the first two tiers of degree of completeness in terms of grave volume. In other words, the most disturbed skeletons tend to be buried in smaller graves, while larger graves always accommodate relatively complete skeletons. Meanwhile, we should be cautious in calculating grave volumes in that most graves are only the remaining rather than the original depth. Moreover, the incompleteness of the whole cemetery adds additional uncertainty to any conclusive argument.

If one takes the stand that body treatment, as with other mortuary variables such as grave volume and the abundance of grave goods, is an effective and independent indicator of the social status of the deceased in life, and that it is also conditioned by ritual processes, then one must ask: why do qualitatively universal rites still produce quantitatively different body treatments in terms of the degree of completeness of the skeleton? Is there any tension in social differentiation disguised by surface homogeneity? Or are differences in degrees in disturbance of the deceased means of manifesting differentiation in social status under certain social contexts?

If we make a synchronic comparison, the unique pattern of mortuary data in Donghuishan cemetery immediately stands out. The extremely low occurrence of exotic goods such as cowrie (3/698), gold (1/698) and bead (2/698) in the cemetery reveals a great contrast with its western neighboring community at Huoshaogou.As it is much closer to the early metallurgical center at the site of Xichengyi than its contemporaries, its low abundance of metal objects (13/698) seems contradictory to its geographical proximity. The post-burial exhumation of the deceased could increase or decrease the original repertoire of grave goods, but it cannot explain everything. Therefore, I argue that the distinctiveness of the mortuary pattern at Donghuishan cemetery can be explained by cultural mechanisms that filter the deposition of grave goods, especially the categories of goods mentioned above. In the context of funerals, one of the most important cultural mechanisms that regulate the life history of material culture is the system of inheritance. The redistribution of the deceased's social role, rights, duties and property is one major agenda in the post-burial phase. In the process of the transmission of property and associated rights and duties from the deceased to other social members, social tensions and conflicts will play out and be negotiated by all interested parties throughout the process of the funeral ceremony (Goody 1962).

In archaeological context, taking the disturbance of the skeleton as an example, the dislocation of the deceased indicates a gap (three to seven years at most) between primary deposition and post-depositional disturbance. The ceremony associated with secondary disturbance, no matter how long the gap between it and the first burial ceremony, still comprises an independent phase in the whole funeral rite that probably spans for years[1]. However, in most cases, archaeologists focus on the physical dislocation of the dead, while associated ceremonial activities that happened on the ground are neglected or taken for granted. Following the ritual economy framework (Chapter II), I propose a hypothesis: if a secondary burial involving the dislocation or disturbance of the skeleton is the major standard by which to judge whether the whole funeral rite is successfully fulfilled, as commonly found in many ethnographic communities, the degree of disturbance of the skeleton at best would be an archaeological indicator of the gap between those two funeral ceremonies, and thus can be correlated to the economic capability of the

[1] The time span of funeral rites greatly varies. Among the Dayak, for example, the period of funeral ceremonies could be as long as three to seven years, equal to the time required for the flesh to decompose, leaving only the skeleton. By then, a second funeral will be held to celebrate the dead's smooth transformation into an ancestor (Hertz 1960 [1907]).

bereaved. The well-to-dos could fulfill ritual obligations in such a short time span that the body of the deceased may not have been totally decomposed. By contrast, poor families would take advantage of the time necessary for the natural decomposition of the body to accumulate sufficient capital. Simply speaking, a lower degree of completeness of the skeleton suggests a longer gap between two depositional events, and thus probably indicates weaker economic ability of the bereaved; while a higher degree of completeness should entail strong economic ability of the family of the dead.

Specifically, in the archaeological context of Donghuishan cemetery, besides hierarchical difference in the degree of completeness of the skeleton, one also finds good correspondence between the first two tiers of degree of completeness and the volume of graves (Figure V.20). Even though the 95% confidence interval of the third degree mostly overlaps with the first two tiers, the statistics on the ten single burials with the most complete skeletons in the whole cemetery yield a higher mean value in the volume of graves (0.57 m^3) than the average volume of all 96 single burials (0.47 m^3). The average number of grave goods in these ten graves (6.1 items) is also larger than that in all single burials (3.4 items). Unsurprisingly, the grave (M127) including the largest number of grave goods (15 items) accommodates an almost complete skeleton with only a few components dislocated or absent (GSWKY and JDBKY 1998:149). This fits perfectly with the model hypothesized earlier.

V.3 Concluding remarks

In this chapter, mortuary analysis of two major cemeteries dating back to the first half of second millennium BC, the Huoshaogou and Donghuishan cemeteries, demonstrates a complicated picture of Bronze Age communities dwelling in an ecologically marginal region. Two agro-pastoralist communities that aggregated around oases in the Hexi corridor developed distinctive social structures, reflected by their mortuary data. The Huoshaogou community located in the western part of the arid corridor placed emphasis on agnate-centered social organization (e.g., patriclan). Frequent cultural exchange driven by increasing population mobility in Central Eurasia around the early second millennium BC provided a perfect backdrop for cultural connections between the Huoshaogou community and its western neighbors. Cultural exchange directly or indirectly influenced the local value system, then channeled and manipulated by the established social structure. The owndership of exotic and prestigious goods by a restricted minority (probably some privileged families) also suggests that the social structure conditioned the pattern of economic connection on a regional scale. The relatively abundant grave goods yielded by the Huoshaogou cemetery indicate, on the one hand, its dynamic role in the regional economy; on the other hand, they also imply a different social organization and inheritance system from the contemporaneous Donghuishan community, where I did not identify any noticeable inequality by conventional analysis of material culture. However, an underlying subtext of economic inequality in the community disguised by homogeneity in material culture is betrayed by hierarchical treatment of the deceased in terms of ritual economic investment. Institutionalized post-depositional disturbance as an important component of funeral rites provideD a ritual venue to fortify solidarity among the Donghuishan community by generating inconsecutive periods of communitas status (Turner 1969), and meanwhile also provided a social theater on which various social tensions and differentiations played out.

Nevertheless, comparison of these two cemeteries clearly shows regional complexity and intrinsic differentiation in social, economic, and even ritual domains. It is this differentiated structure on an intra-regional scale that generated the interlocked cultural connections among the oases communities along the Hexi corridor. Due to the absence of systematic data from contemporary dwelling sites, it is still unclear how and to what extent Bronze Age societies along the Hexi corridor were differentiated internally, and how internal social tensions motivated and conditioned patterns of population mobility on an inter-regional scale. The answer to these questions calls for more systematic field work in the future.

Chapter VI Social dynamics in Bronze Age Northwest China through the lens of drinking

VI.1 Drinking as a social practice

Food is a social fact. The consumption of food, including eating and drinking, comprises the major component of social life, and for this reason has been an enduring theme of discussion (generally referred to as "feasting") among anthropologists (Appadurai 1981; for comprehensive reviews, see Hayden and Villeneuve 2011; Mintz and Du Bois 2002). The preparation and consumption of food along with its material paraphernalia has broader cultural significance; its multiple social dimensions include, but are not limited to, subsistence economy, political economy, social status and identity, and even beliefs and ideology (Goody 1982; Crowther 2013). Likewise, as a major component of food consumption, drinking - in most cases, the consumption of alcoholic beverages as a form of liquid food – provides a fundamental perspective in understanding society, both in cultural anthropological and archaeological spheres (Dietler 2006). One thing should be pointed out before proceeding: focus on drinking in the present study never comes at the expense of its counterpart, eating. Rather, focus on drinking in this dissertation is a practical strategy, imposed by the availability of research data. Moreover, drinking can happen in various social scenarios beyond feasting, but feasting cannot be feasting without drinking. The omnipresence of drinking in both everyday and ceremonial contexts makes it a salient means of approaching social life.

Early studies on drinking emphasized its pathological implications, and thus drinking, which mistakenly became interchangeable with drunkenness, was always reduced to a social problem in anthropology under the functionalist paradigm. Since the 1970s great advances have been made both in theoretical frameworks and methodologies. In structuralistic and semiotic discourse, drinking proved to be a potential case study for addressing the embeddedness of cultural practices in peoples' ways of life (Heath 1987). This shift in research paradigm facilitated the proliferation of studies on pre-industrial societies from the perspective of drink consumption (Hagaman 1980) and the implications of drinking practices for the understanding of ancient and prehistoric societies in more temporal depth (Dietler 1990).

It might well be better to place drinking in the theoretical framework of practice without trying in all cases to determine explicit reasons. The universality of drinking among ethnographically documented societies should be seen as a product of cultural habitus or disposition, that is, a social practice. Instead of asking questions such as why people drink, we should ask how drinking, as a social practice, is embedded in social structure as a manifestation of agency, by means of which actors and social structures interplay. In other words, the broader cultural significance and implications of drinking in some society should be considered first.

Food is never as simple as it appears; neither is drinking. It is not drinking behavior or related paraphernalia but social relations embodied by drinking with which we shall be concerned here. In the discourse of political economy, drinking in the context of feasting is always seen as a major stimulant not only for psychological experience but also for social relations and the power dynamics embodied in the drinking practice (Dietler and Hayden 2001; Wiessner and Schiefenhövel 1996). I argue that drinking as a social practice among small-scale societies is probably one of the most important social vehicles and expressions of agency in everyday life. By means of materialized drinking in various social contexts, the most valued symbolic capital is accumulated and thus social dynamics are driven.

VI.2 Drinking in ethnographic context: empirical evidence

In light of the above theoretical discourse on drinking, we should ask the following specific questions: 1) in what kinds of social contexts is drinking practiced? and 2) how is it embedded in negotiations of different social relations, and to what extent? In order to answer these questions, one must resort to ethnographic and ethnoarchaeological studies on drinking, which offer a necessary point of reference and systematic context for developing a better understanding of this social practice. Rather than treating ethnographic context as reference system that can be directly projected onto the explanation of archaeological data, I will tease out some generic parameters highlighted in ethnographic contexts, such as technological processes of drinking production, identity indicators (e.g., gender, age, and social status) correlated with drinking consumption, and social spheres (e.g., the political, economic, and ideological spheres) involved in these processes, I then apply these parameters as prompts for questions that help interpret the archaeological data.

VI.2.1 The production of drinking

A drink, or an alcoholic beverage, is a liquid with a varying volume of alcohol (ethanol) fermented from available grains (e.g., maize, millet, barley, wheat, and rice etc.), fruits (e.g., grape, plum, banana etc.), tuberous roots (e.g., sweet potato, cassava etc.), or even dairy products (e.g., mare’s milk etc.). Beer and wine are two major categories of alcoholic drink in ethnographic records. The former in particular refers to all alcoholic drinks made from grains (or using grain as the principal ingredient), while the latter refers to drinks made from fruits. Here I mainly focus on beer, a common alcoholic drink among agrarian societies.

Different from wine, which is produced by a direct fermentation of the sugar in fruits, beer requires an extra technical process in order to first convert the starch into sugar. Then fermentation proceeds, in which the sugar is converted into alcohol in an acidic and anaerobic environment with the help of yeasts - *S. cerevisiae* or *S. bayanus* (McGovern 2009:5). The conversion of starch into sugar requires the diastase that is produced by germinated/malted grains (e.g., most commonly used is germinated barley in modern beer brewing). Beer brewing includes three major phases: preparing, mashing/cooking, and fermentation. Specific technical procedures may be added or removed in each phase depending on different kinds of grains and technological traditions. Thus, the whole technological process can vary greatly, depending on temporal and spatial dimensions (Jennings et al. 2005).

The first phase is the preparation of fermentable grains. The purpose of this technical process is to create conditions facilitating the conversion of the starch in grains into sugar. In most cases, grains are soaked in water and then dried in shade for germination, which on average takes at least one or two days. For some grains, like maize used in brewing *chicha* in Peru, it can take four to five days to grow an inch-long sprout (Hayashida 2008:163). After malting, germinated grains need to be grinded into flour, or simply masticated in the mouth. Extra malt will be saved without grinding for the next batch. Other processes in this phase before the soaking of grains also include grain threshing/winnowing and selection. Archaeological signatures for this phase probably include the pots used to soak grains and grinding stones (e.g., *mano* and *metate*).

The second phase is mashing/cooking, followed by cooling. The major purpose of cooking is to hydrolyze the starch in the grains in preparation for conversion into sugar. Meanwhile, boiling water can also kill any undesired bacteria that could spoil the mash. After the mashed grains cool down, airborne yeast will turn it sour and thus provide the acidic environment for later fermentation. In the case of millet beer brewing in Kenya, hydrolyzation and acidification of grain starch ("first fermentation") is done with cold water before adding malts; the roasted sour porridge lumps will then be cooked together with malted grains in boiling water (Dieler and Herbich 2006). In coastal Peru, depending on the percentage of malted grain flour added before cooking, this process could be repeated as needed by brewers in different regions (Hayashida 2008). Generally, the more malted grains added, the more diastase produced, and thus the starch is converted into sugar faster, requiring less time to brew the beer. The use of pure malted maize flour to brew *chicha* will shorten the whole brewing process to two or three days, compared to five or six days by using mixed flour (Hayashida 2008:165). After the mashed grain or porridge cools down, separation of liquid from the dregs is required before the filtered mash is transferred into a vessel to ferment. Sieving or filtering can be done with a piece of textile, woven basketry, or other available and expedient instruments beneath which a pot with a wide opening is usually placed to receive the filtered liquid. A ladle is necessary to transfer the mash from the cooking vessel to the filter. As many ethnographic cases show, ladles made of organic materials, such as a half split gourd or calabash, are commonly used in these processes. Possible material evidence of this step surviving in archaeological contexts will not be different from everyday cooking: cooking pots, hearths with charcoal remains, and receptacles with wide openings.

The last step is fermentation. It is the most critical step in determining how successfully the filtered mash will convert into alcohol with a palatable flavor. Depending on the circumstances of fermentation, extra yeast (*S. cerevisiae* or *S. bayanus*) will be added or not. Usually the residual yeast from the last successful batch absorbed or attached to the inner wall of fermenting vessels will be sufficient. Due to the required acidic and anaerobic environment for fermentation, a jar or pot with a narrow or restricted neck is preferred by brewers (Arthur 2003; Dietler and Herbich 2006; Hayashida 2008; Moore 1989). The opening is then sealed with wood, leather, or other inorganic materials together with plastic substances (e.g., resin, mud or flour dough). No matter what kind of material is used, the ultimate purpose is to keep the fermenting jar as airtight as possible. Fermentation usually takes one or more days before the drink can be served.

Raw material, time and labor invested in the production of drink are three major parameters for measuring the economic value of products. According to preliminary statistics on some ethnographic societies, ten kilograms of hulled rice can produce 750 ml of rice beer among the Hmong in Baan Chan Kham, while the same weight of maize can produce about 500 ml of maize beer (Hayden 2005:291). That is, the ratio of input/output can be as low as one kilogram of grains ultimately producing about 0.05-0.075 L of alcoholic drink. It is estimated that 20-30% of the total yearly calories for most individuals in a feast are acquired from alcoholic drinking (Dietler 2001:81). If recreational everyday consumption is also included, quite a large percentage of surplus grains must be processed for alcohol brewing every year, either in the household or at the community scale. Most ethnographic records suggest that drink production is usually a household-scale activity, even in a state context (Moore 1989). The consumption of drink happens in both everyday and ceremonial contexts and creates great demands on production, requiring a high frequency of brewing, even every one or two weeks in some cases (Dietler and Herbich 2006). Some unexpected situations, such as sudden death and other emergencies, can increase the frequency of brewing in a certain period and thus shorten the interval between two batches. The time required for one batch of brewing ranges from at least six days up to 12 days or even longer, depending on the kind of grain, its availability, and technological choices in production and other natural conditions (seasonality with varying temperature and humidity, and even altitude). This means that every time a drink is needed, it must be prepared at least one week in advance. Brewing is very labor-intensive. Considering the low input/output ratio, at least dozens of kilograms of grains must be selected, malted and grinded for one batch enough for household consumption, not to mention large-scale consumption of drinking in festival or ceremonial contexts, where hundreds of liters of drink are consumed. Besides the efforts involved in the preparation of grains, water and fuel are also needed in large amounts, calling for additional labor and time investment.

Beer brewing in most ethnographic cases is exclusively women's work, even though a few examples of male brewers are also recorded (Moore 1989:688). Yet, despite their role as the major producers of alcoholic beverages, women are always excluded from consumption scenarios, in which males predominate. Beer brewing, as with other household crafts or chores, such as weaving, pottery making, cooking, cleaning and child care in most cases, is also a major arena where the labor division by sex is established and thus social dynamics between sexes is negotiated constantly.

VI.2.2 The consumption of drinking as social theater

Due to its low alcohol content (generally 3-5%), beer cannot be stored for more than one week, even under anaerobic conditions. As a result, fermented beer must be consumed as soon as possible. Otherwise, it will turn sour (finally becoming vinegar) and spoil in a few days (Jennings et al. 2005). It is this limited shelf life that restricts its transportation to a rather short distance. In preindustrial societies without innovations in storage and transportation technology, the geographical sphere of beer production greatly overlaps that of consumption. However, this does not necessarily mean that the drink produced in one location can only be consumed by local people. To the contrary, if population mobility is considered (it could and should be considered), alcoholic beverages can also be consumed by people who originally dispersed from a much larger geographic scale than the local community, for instance, the beer drinking party *tesguinada* among the Tarahumara (Raramuri) people in Northern Mexico (Kennedy 1963). Social gatherings due to whatever reason (e.g., work party, festivals, ceremonial feastings, friend visiting etc.) are the most common scenarios in which the presence of alcoholic drink is mandatory.

Besides some pragmatic motives (e.g., in ancient Europe the making of beer was one major method to preserve surplus grains[1]), the consumption of drink is one of the most important social activities either in mundane or in ceremonial contexts. It is in the context of consumption that various social relations and power networks are kneaded and entangled. A social gathering revolving around drinking provides the most important theater for strengthening kinship solidarity and aggregation, resolving disputes, making political alliances and factions, building up social relations outside kinship or marriage circles. In other words, drinking is an important social lubricant. Alcoholic drink is also a well-known stimulant and especially necessary in ritual contexts, e.g., during rites of passage (van Gennep 1960 [1908]) that include birth, initiation, marriage, and death rituals. Drinking in these contexts, together with other forms of bodily performance, such as eating, dancing and singing, enables the relations between human, as well as human and non-human entities, to be established and negotiated. In order to achieve certain psychological states by which connections between human and non-human entities can be established, alcoholic drinking with low alcohol content is always fortified by the addition of various psychoactive substances, according to most ethnopharmacological records. Moreover, alcoholic drinking has always been considered a substitute for water for hygienic reasons, especially when the quality of local drinking water cannot be guaranteed (Jennings et al. 2005).

[1] John K. Papadopoulos, personal communication, May 5, 2018.

The consumption of drink also provides feedback, positive or negative, as regards the production of drink and more specifically, the reputation of brewers. Even though in most cases women brewers are excluded from drinking scenes, this lack of power can be compensated by the good reputation, or symbolic capital as proposed by Bourdieu (1977), attained by the tasty drink they produce. Moreover, extra amounts of brewed drink could be exchanged or sold to others; thus brewing can offer women some economic leverage (Hagaman 1980:206). Furthermore, women as important social agents play a critical role in many social domains, the most important of which is marital exchange. Population mobility driven by marital exchanges makes the mobility of technology and ideology always embodied in the form of material cultures possible. By the same token, we should not exclude the possibility that brewing technology along with drinking customs and protocols could be dispersed with women by marital exchanges intra-/inter-regionally in any given period.

VI.3 Drinking in an archaeological context: a case study on the Siba pottery

The above review of ethnographic contexts offers us some empirical parameters for understanding the role of drinking in society as well as possible material evidence signaling the practice of drinking. Of course, in archaeological context the identification of drinking can only be inferred from surviving material remains, such as the tool kits or pottery vessels that served in the different phases of the drink-production process, as well as their concentration and distribution patterns in a settlement context. Traditionally, the inference of drinking practice in a society greatly relies on typological and stylistic analysis of pottery vessels that are assumed to have been used for fermenting, serving or drinking alcoholic beverages. Chemical analysis on organic residue absorbed in pottery sherds or attached to the interior surface of ceramic vessels can reveal the use context of the analyzed samples and thus indicate probable functions through concrete evidence. In recent decades, organic residue analysis with a focus on the biomarkers of alcohol or additions of psychoactive substances has provided an alternative and feasible method of identifying the existence of alcohol drinking in a society (Crown and Hurst 2009; Crown et al. 2012; Henderson et al. 2007; McGovern et al. 2004).

In the late Neolithic of Northwest China, painted pottery, along with plain pottery, is a major form of material culture, omnipresent in settlement and mortuary contexts. A great variety of pottery vessels with black, red, and occasionally white pigments painted on a bluff surface comprise the repertoire of the Majiayao culture (3000-1890 BC). This tradition of painted pottery declined after the Machang phase (2300-1890 BC) but resumed by the following Xichengyi and Siba cultures (1880 -1530 BC), the beginning of the Bronze Age in Northwest China. The distribution area of this painted pottery mainly includes eastern Qinghai and the whole of Gansu province (Yan W.M. 1978). Previous research has mainly focused on the construction of a temporal and spatial framework through typological seriations of painted pottery. Little attention has been paid to the life history of painted pottery, its use context in social, economic and ritual domains, as well as its cultural implications. Although some studies have touched on the symbolic meanings of decoration, interpretations are far from satisfactory because of the authors' disregard of the cultural context (Zhang P.C. 1990). Before answering the "why" question, one must first figure out the "what" and "how" questions: for what purpose was painted pottery manufactured, and how was it manufactured and then distributed? The second question has been answered in recent systematic study of painted pottery through physic-chemical analysis (Hung L.Y. 2011), while the first question seemes to have been ignored or taken for granted. Archaeologists agree that understandings of material culture must be placed in context. Use context is the fundamental point of departure for interpretations concerning technological, economic, social and ritual domains. Although traditional typological studies of pottery vessels cannot determine their specific functions, it is worthwhile to propose a hypothesis that can be tested against other methods such as metric measurement of pottery capacity, scientific analysis of organic residues etc. Following, I will try to identify the practice of drinking by study of the Siba pottery assemblage retrieved from the Huoshaogou cemetery (Chapter V.1), one of the major early Bronze Age cemeteries in Northwest China.

VI.3.1 Introduction: archaeological context

The Huoshaogou cemetery is located in Qingquan village, 67 km east of Yumen city in Gansu province, Northwest China (Figure V.1). The major part of the cemetery, including 313 tombs, was excavated in 1976. Additional scattered tombs were uncovered in the salvage excavations in 1990 and 2005, and thus the total number of tombs reached 380. The three field seasons yielded abundant grave goods made of various materials, such as pottery, stone/jade, metals (copper/bronze/gold/silver) and bone/antler (GSWKY forthcoming). From about two thousand grave goods, over half is consist of various categories of pottery. Typological and stylistic studies of this pottery attribute it to the Siba culture of the early Bronze Age (the first half of the second millennium BC). The high similarity in typology between the Siba and the preceding Machang phase (2300-1890 BC) pottery also suggests cultural continuity over time (Li S.C. 1993).

The pottery from the Huoshaogou cemetery mainly consists of receptacles of varying sizes. The majority among them consists of pots with restricted necks and two handles (Figure VI.1). Almost all pottery was made of sand-tempered paste, using either coarse or fine sand as temper. Black pigment painted on a reddish slip is commonly found among the fine-sand tempered pottery, while plain pottery is generally impressed by cord marks. Soot traces outside the surface of many coarse sand tempered pots below the neck suggest that the vessels were used in cooking over a fire before they found their ways into the graves. By contrast, cooking soot is totally absent from all painted pottery vessels and neckless jars. Based on this fact, along with these vessels restricted necks and orifices, I propose that they were probably used to store liquid; this, in my opinion, was especially true of the neckless jars with lids, as will be highlighted in the following section.

Before proceeding to the study of material evidence, one point should be kept in mind: material cultures buried in mortuary contexts are always the results of intentional disposition dominated by social ideology and ritual rationale (Parker Pearson 2000). As the original use context of the grave goods has already been detached and re-embodied, caution is required in functional interpretation. Meanwhile, mortuary contexts, especially primary burials, provide relatively closed taphonomical environments. Even though it is risky to infer original use contexts based on analysis of grave goods, tombs still can provide useful information on how pottery was used at the moment it was disposed.

VI.3.2 A technological study of neckless jars

Neckless jars stand out among the Huoshaogou pottery repertoire both for their size and their stylistic design. Among all 56 complete examples (including reconstructed ones) only one fourth is painted, but even the plain ones are nevertheless notable on account of their appearance. Their most noteworthy characteristic is their distinctive manufacturing technique, especially in forming the lid. Quite different from the ordinary process of forming a separate lid and then attaching it to the opening of a pot, the lid and the body of neckless jars were first formed as a whole, and the lid was cut off from the top. Based on formation traces left on the inner wall, the production process can be reconstructed as follows (Figure VI.2): first, like all other vessels, the jar was clay-coiled layer by layer from the bottom. Then, when it had reached a desired height, rather than leaving a wide opening as was the common practice, coiling continued inward until there was no room to lay another coil, leaving a small cylindrical hole in the center of the dome-shaped top (Figure VI.3:3). On the top of the last coil, another component (in most cases a triangle shaped knob) was attached to close the vessel. Thirdly, a circle of desired diameter was marked by some pointed tool on the surface of dome as a guideline. A thin and sharp cutting tool

Figure VI.1 Pottery assemblage from tomb 212, Huoshaogou cemetery

(Notice the large neckless jar with a total height of 35.5cm in the center of the back row and the decoration on one side of the lid knob. Photo by author in August 2013, Lanzhou)

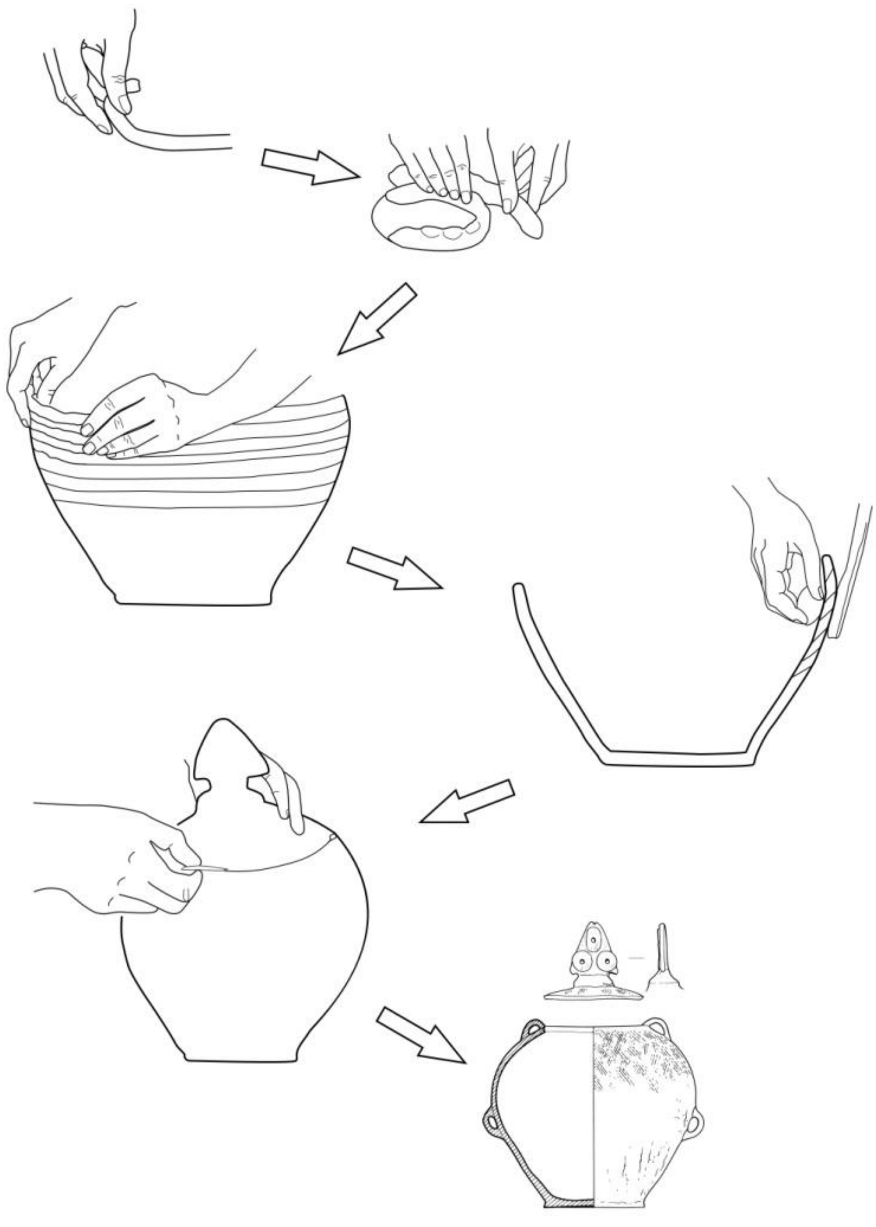


Figure VI.2 Reconstructed flow chart of the formation of neckless jars

(probably a metal knife or a microlithic blade) was then applied to cut off the top part of the dome along the guide line, and then the cut off piece is lifted to form the lid. Before the application of a cutting tool, a starting point was first made by piercing a pointed stick into the paste in a proper location right above one upper handle. It is from this pierced small hole that the cutting tool was inserted according to the circular guide line. In some cases the drawing of a guide line was skipped and the lid was cut off so arbitrarily that the lid is not symmetrically round at the edge. If so, the pierced starting point played another role as visual clue for placing the lid correctly: as long as the piercing hole, which was finally bisected by cutting (one half is on the edge of the lid, the other half on the edge of the opening), could be recovered when the lid was replaced, the edges of the lid and opening touch so closely that little seam remains between them (Figure VI.3:1, 3). Even though slight deformations happened during firing, since the contraction coefficient is almost consistent for the vessel body and lid, respectively, the lid still fits snugly on the opening.

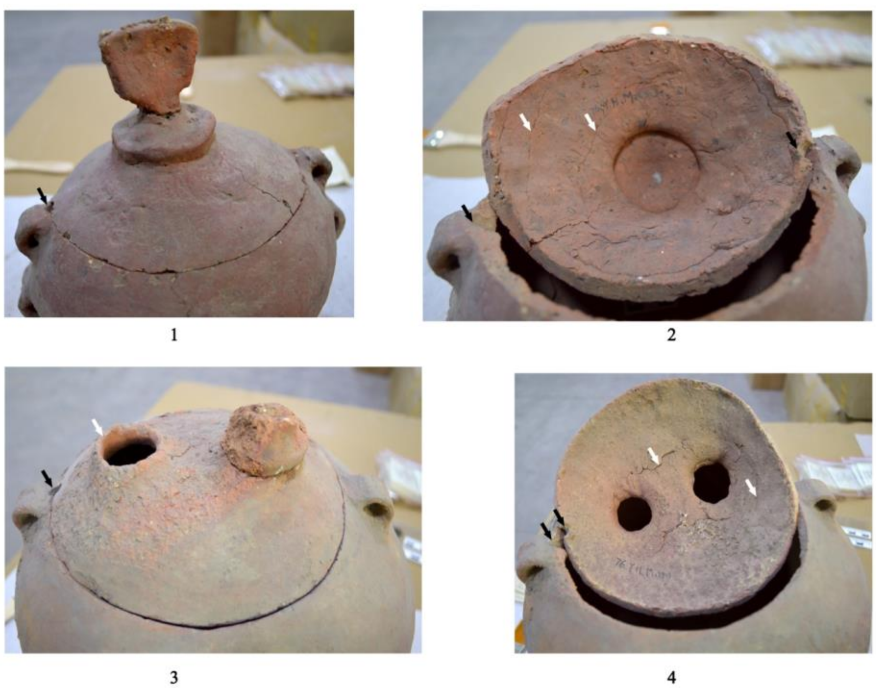


Figure VI.3 Technical details of the formation of neckless jars

(1-2. 76YHM258:3; 3-4. 76YHM183:1)

(Black solid arrows indicate the starting point of cutting/visual clue; white solid arrows indicate the join interface between coils. Photo by author in August 2016, Lanzhou)

Figure VI.4 A complete painted neckless jar from Huoshaogou cemetery (76YHM213:1)

(Notice the three dents on the triangle shaped lid knob, as indicated by black solid arrows. Photo by author in August 2016, Lanzhou)

When compared to the regular practice of forming the pot and lid separately, this special formation technique offers advantages in manufacturing efficiency. Even more straightforwardly, this technique is also an ingenious way of ensuring air-tightness. Although the jars were made of paste tempered with coarse sand, the total absence of any pyrogenic traces on the exterior surfaces suggests that they were used for storage rather than as cooking vessels. Moreover, their highly incurved rim (an indicator of low accessibility) and large sizes (an indicator of low transportability) suggest that they were more stationary in their original use contexts, and that greater weight was placed on closure of the vessel and the security of its contents. This is confirmed by the relatively high degree of hardness of the ware (at least 4-4.5 on the Mohs scale[1]), due to a high firing temperature and resulting in higher vitrification and lower porosity rates than in other pottery from the Siba culture. Lastly, the noticeable lid knob decoration probably indicates the visual and ceremonial importance of these jars. Originally, three perforated discs made of white marble or marine mussel shells were always adhered to one side of the triangle shaped knob (Figure VI.1). *In situ*, these decorative discs had in most cases become detached and dropped nearby due to the degradation of the organic adhesive, but round shallow indentations on the knobs give secure visual clues for their original installation (Figure VI.4). When all these factors are considered, one may hypothesize that this distinct category of pottery, the neckless jar with cutoff lid, was probably used to ferment alcoholic drinks.

VI.3.3 Capacity measurement of Siba pottery vessels

In addition to analysis of the manufacturing technology and stylistic features of pottery vessels, capacity is another useful criterion for determining the function of containers (Rice 1987:224). Thus, in order to reconstruct the use context of neckless jars, their capacity was measured. There are two major methods of measuring the capacity of an intact pottery vessel: direct measurement with water or a free-flowing solid (e.g., sand), and indirect measurement based on profile illustrations. In most situations, due to lack of access to the samples and considerations of conservation, direct measurement is not practical, and thus indirect measurement is preferable. Generally two major computing methods are applied for indirect measurement: one is traditional geometric computation, and the other is the summed cylinders method. The former method has been criticized for producing large errors due to the idealized addition of analogous geometric shapes (e.g., a neckless jar will be treated as an ovaloid with the truncated segment of a circle)

[1] This can be inferred if compared with the hardness of steel scalpels (4-4.5 in Mohs scale), used to scrape samples from the interior wall of pottery jars for later organic residue analysis. For many samples the steel scalpel was not effective to remove even a trivial amount of pottery powder from the interior wall.

(Rice 1987:220), while the latter is more accurate. The application of calculus in the so-called "bevel walled cylinders method" computation yields an immense improvement in accuracy of the capacity measurements (Senior and Birnie III 1995). A web-based applet[1] for capacity measurement by this method has recently been developed by archaeologists, which makes computation more accessible (Engels et al. 2009). All following measurements of the Siba pottery presented are the results of computations based on the profile illustrations of pottery by this online calculation applet. Accuracy of capacity is greatly dependent on the precision of illustration, and thus the results are only approximate, even though all pottery profiles were illustrated by specialized technicians. The scale for capacity measurement is liters (L). One may be confident that all computation results are accurate to 0.01 liter. Considering use context in reality, the measurement of effective maximum capacity is more anthropologically meaningful and calculated here as well. Different from theoretical maximum capacity, effective maximum capacity considers the limit in volume of liquid that can be held in the container without spillage even when the container is transported. Thus, for vessels with flared orifices, the height of liquid level is calculated from 0.5 cm below the rim/lip of vessel rather than the end point of rim/lip (Figure VI.5:1,3,4) except for painted amphorae because of their limited capacity (Figure VI.5:2).

Based on the method described above, a total of 537 vessels were measured for capacity. Four vessels of uncertain periodization were removed from the following statistical computation, reducing the total number of samples to 533, almost half of the total number of registered vessels (around 1100 items/sets). That is, computation of these samples should be statistically representative. Selected samples were mainly divided into seven categories by vessel form:

[1] This user-friendly applet can be found following the link here: http://capacity.ulb.ac.be/index.php

amphora (Figure VI.5:2), bowl/dish (Figure VI.5:3), cordmark pot (Figure VI.6:1), cup/mug (Figure VI.6:3), neckless jar/cutoff jar (Figure VI.5:1), restricted neck pot (Figure VI.6:2) and two handled pot (THP) (Figure VI.5:4). During the computation process, the difference between the theoretical maximum capacity (calculated from the end point of rim/lip) and the effective maximum capacity (calculated from the 0.5 cm below the rim/lip) was estimated; it ranges from 0.01-0.03 L (or 10-30 cc). Such a slight difference can be neglected in statistical computation. The statistical results reflect the real situation more or less truthfully.

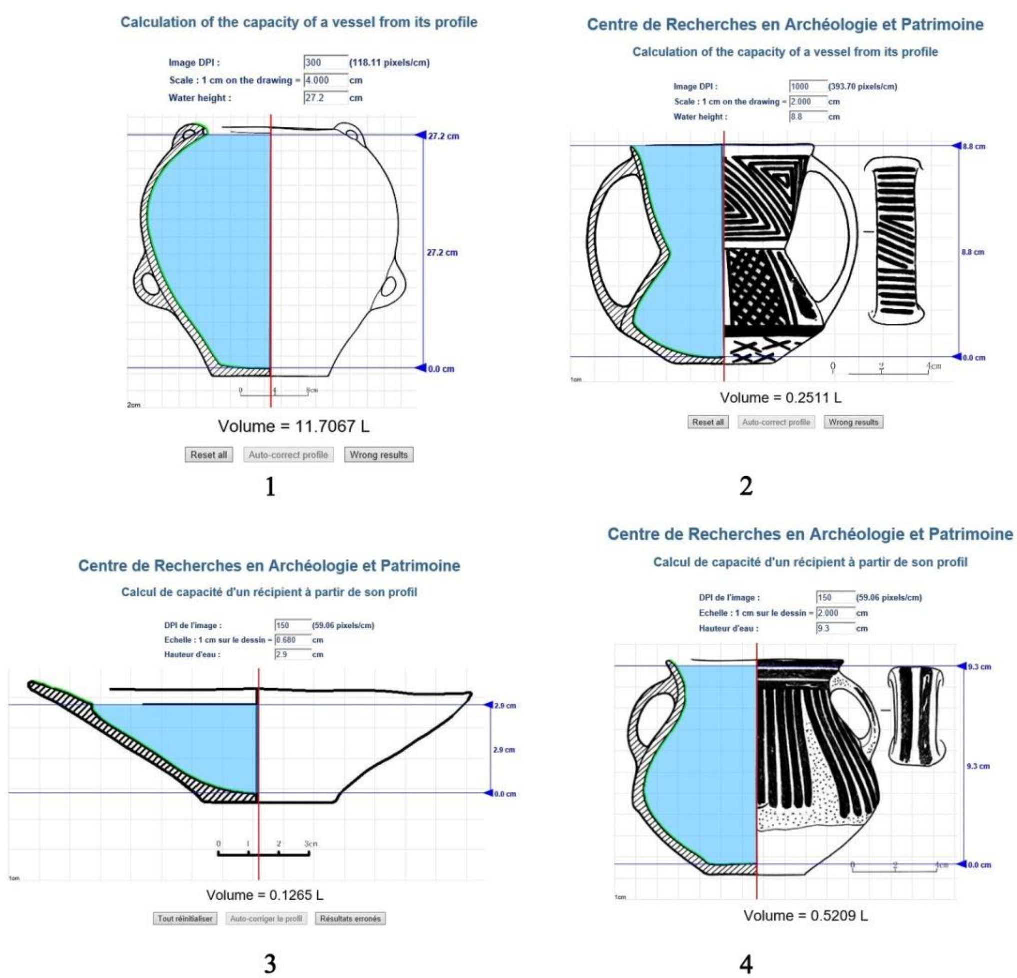


Figure VI.5 Capacity measurements for different categories of vessels from Huoshaogou cemetery (based on the online calculation applet)

(1. Neckless jar 2. Amphora 3. Bowl/dish 4. Two handled pot/THP)

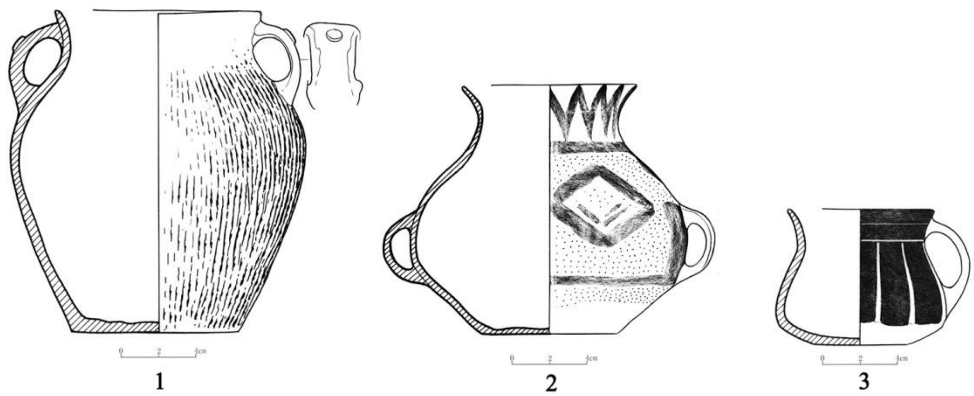


Figure VI.6 Major categories of vessels from Huoshaogou cemetery

(1. Cordmark pot 2. Restricted neck pot 3. Cup)

Overall, more than 75% (the thrid Quartile) of samples have a capacity of less than 1.85 L, while the maximum value is almost ten times the mean value regardless of category (Table VI.1). When category is considered, the distribution of capacity shows a clear differentiation pattern: the neckless jar immediately stands out from the other six categories in capacity and range of spread (Figure VI.7). However, it is still unclear whether there is a statistically significant difference among the different categories, and how confident the statistical significance is, if so. Meanwhile, as shown in Figure VI.7, excluding amphorae and restricted-neck pots, the capacities of all other categories are more or less asymmetric in distribution. For example, an upward (positive) skew can be observed in the categories of cordmarked pot, neckless jar and two-handled pot. But a partial skew in distribution does not affect further statistical calculations of the mean of capacity across all categories. Hence, the mean capacity and its confidence interval (at the 95% confidence level) is computed as a parameter for the purpose of comparison (Table VI.2; Figure VI.8). In order to make sure that computation of the mean capacity is representative of the whole population, of which the total number is unknown, it is still necessary to test results against a normal distribution model. Technically, there are two ways to correct asymmetric distribution: one is transformation by different algorithms (e.g., square, cube, square root, logarithm, negative reciprocal), and another is resampling (e.g., the most common resampling method in statistics - bootstrap) (Drennan 2009:57). Compared to the former method, resampling can generate a normal distribution of samples without changing the original scale. Hence, the statistical results are still intuitive. By contrast, the application of an algorithm to the batch of sample will transform the original scale and sometimes result in negative values (e.g., the negative reciprocal algorithm, -1/x). Because the mean capacity and its confidence interval is of greater concern to this study, a basic bootstrap on the mean of capacity for each category and its confidence interval (at 95% confidence level) is calculated via the statistical computing environment R. The resampling batch is generated based on the mean capacity of each category. The number of bootstrap replicates is 1000 times with replacement. This can be done in R with the command *boot* (data.frame,function(sample.mean), 1000). The generated resampling structure can then be inquired through the command *boot.ci* for the confidence interval. Finally, the confidence interval of mean capacity will be reported in four different statistic methods: normal, basic, percentile and BCa (adjusted percentile). The statistical results show that the difference in value between the confidence interval of means of the original batch and that of the bootstrap batch is so slight that it can be neglected (Table VI.3). On the whole, the ranking of different categories with regards to capacity previously displayed (Figure VI.8) is statistically representative and reliable.

Table VI.1 Numeric indexes of vessel capacity at Huoshaogou cemetery (scale: Liter)

Minimum	**1st Quantile**	**Median**	**Mean**	**3rd Quantile**	**Maximum**
0.090	0.460	0.730	1.326	1.850	12.2

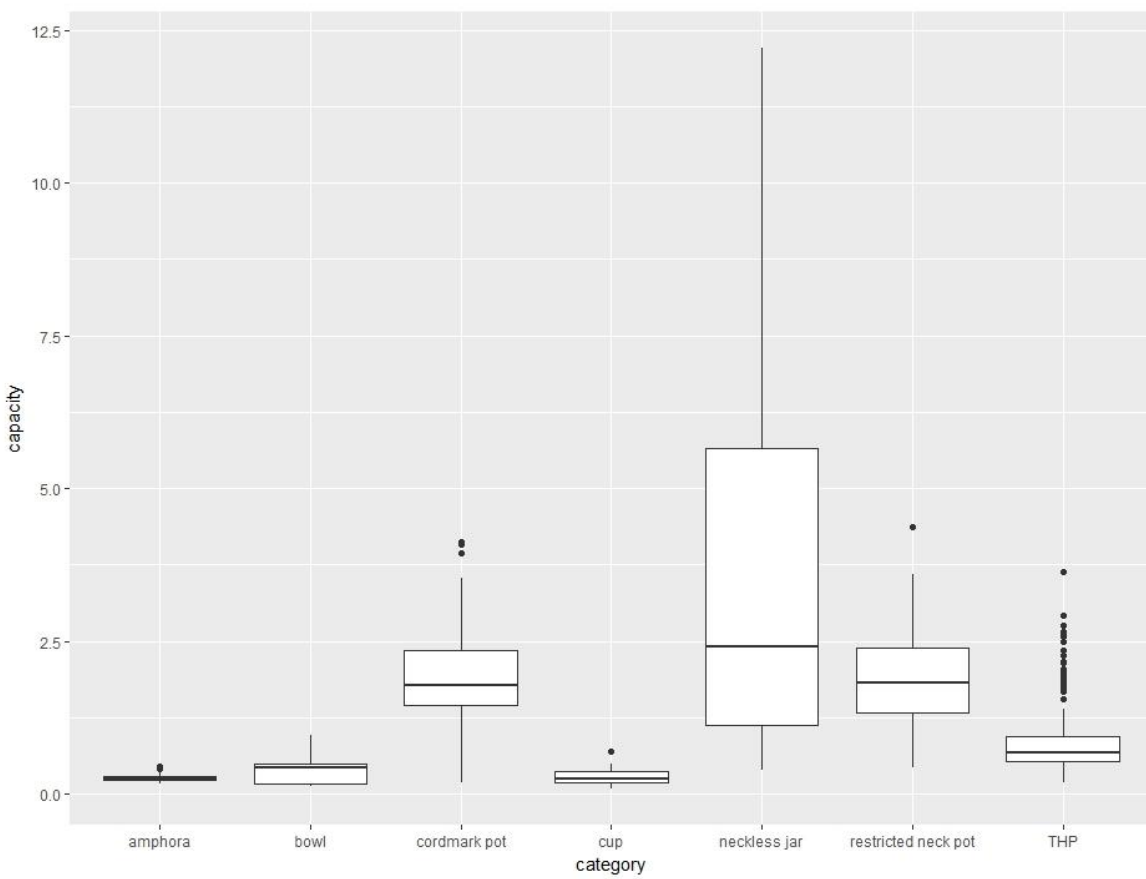


Figure VI.7 Boxplot of capacity with different categories of vessels from Huoshaogou cemetery

Table VI.2 Numeric indexes of capacity by category (original batch)

category	n	median	mean	sd	se	lowerCI	upperCI
Amphorae	39	0.25	0.261795	0.066129	0.010589	0.240358	0.283231
Bowl	13	0.44	0.394615	0.251549	0.069767	0.242606	0.546625
Cordmark pot	65	1.78	1.836308	0.938787	0.116442	1.603688	2.068928
Cup	34	0.255	0.280294	0.133337	0.022867	0.233771	0.326818
Neckless jar	56	2.41	3.631964	3.104312	0.414831	2.800624	4.463304
Restrcited neck pot	58	1.815	1.914138	0.813405	0.106805	1.700264	2.128012
THP	268	0.68	0.926269	0.669823	0.040916	0.84571	1.006828

(Notes: n - number of sample; sd – standard deviation; se – standard error; CI: confidence interval at 95% confidence level)

Table VI.3 Comparison of confidence interval (CI, at 95% confidence level) of mean between original batch and bootstrap batch (percentile confidence interval)

		A	B	CP	C	NJ	RNP	THP
Original batch	Lower CI	0.2404	0.2426	1.6037	0.2338	2.8006	1.7003	0.8457
	Upper CI	0.2832	0.5466	2.0689	0.3268	4.4633	2.1280	1.0068
Bootstrap batch※	Lower CI	0.2421	0.2701	1.6120	0.2333	2.8560	1.7050	0.8473
	Upper CI	0.2836	0.5246	2.0550	0.3253	4.4730	2.1220	0.8505

(A- amphorae, B- bowl, CP- cordmark pot, C-cup, NJ- neckless jar, RNP- restricted neck pot, THP- two handled pot.
※ The bootstrap confidence interval at 95% confidence level slightly varies according to the different methods. Displayed are the results of the percentile method after rounding to four decimal places)

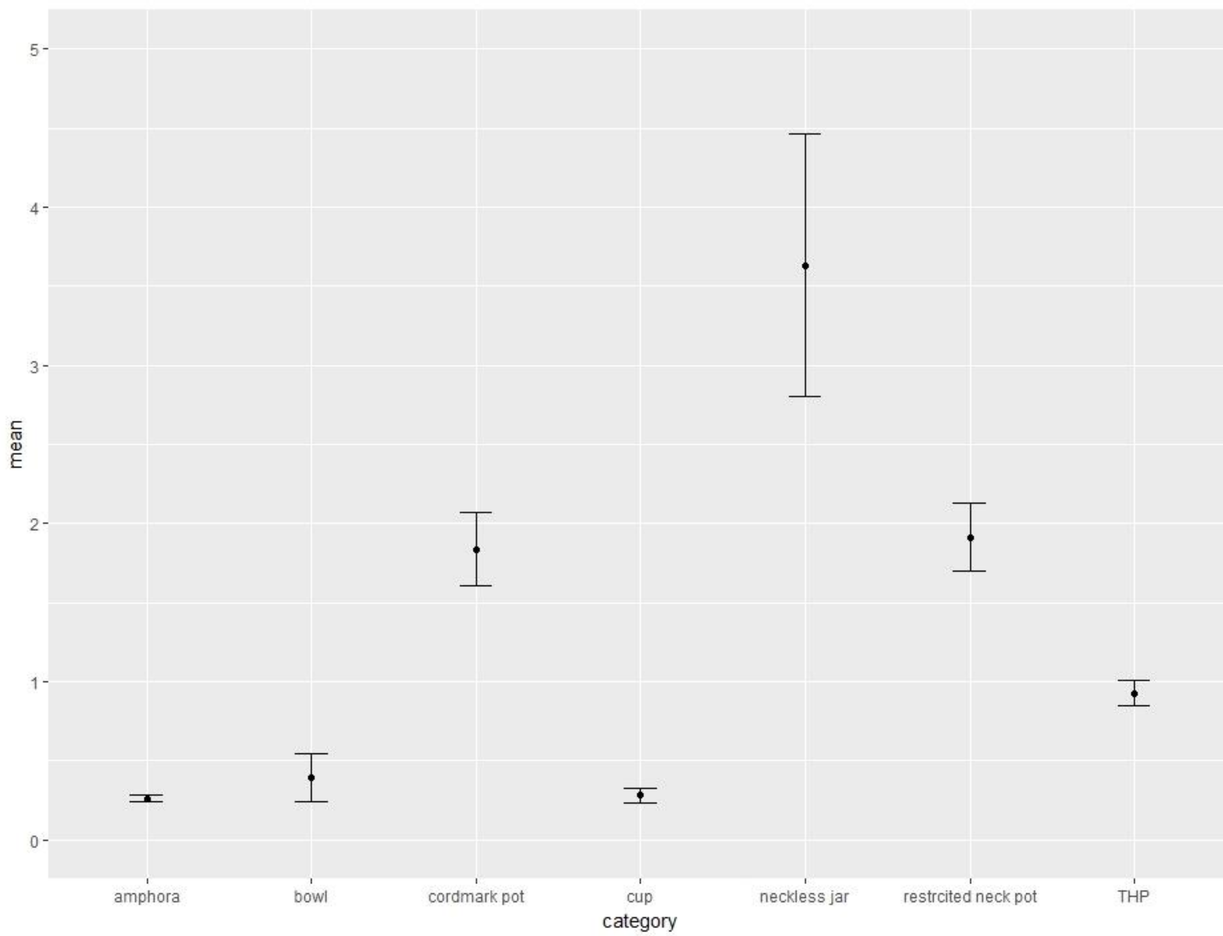


Figure VI.8 Confidence interval of the means of capacity by different categories

As the plot in Figure VI.8 clearly shows, the mean capacity values vary according to different categories. First, the mean confidence intervals of amphora, bowl/dish and cup categoeis greatly overlap, which means that these three categories do not present significant differences with respect to mean capacity. Similarities can also be observed between the cordmark pot and restricted neck pot categories. More interestingly, a four-tier hierarchical pattern is clearly based on the mean capacity from large to small: the first tier - neckless jars (the confidence interval of mean capacity is between 2.86 and 4.47 L at 95% confidence level); the second tier - cordmarked pots (1.61-2.06 L) and restricted-neck pots (1.7-2.12 L); the third tier – two handled pots/THP

(0.847-0.851 L); the remaining amphorae (0.24-0.28 L), bowls (0.27-0.52 L) and cups (0.23-0.32 L) comprise the fourth tier. Correspondence between capacity and vessel type probably indicates the functional specialization of each category. Moreover, the mean capacity for each tier is almost twice that of the next lower tier, while the tier on top of the hierarchical pyramid is almost eight to nine times larger in capacity than the lowest tier. If neckless jars were used to ferment alcoholic drinks and one small cup is counted as one serving per person, then the total amount of drink from one batch could provision eight to nine persons. According to available settlement data from the Siba period, a dwelling unit ranges from 15 to 34 m^2 in area (GSWKY et al. 2014). If a mean density of 6 m^2 per person is applied (Brown 1987; Casselberry 1974; Kolb 1985), the average size of one nuclear family sharing the same roof during the Siba period should be three to six persons. This means that the amount one batch of fermentation could have fulfilled a household's need (if children and women were excluded from the consumption of alcoholic drink), leaving a small surplus. If the presumed use context of the first and last levels of vessel-capacity hierarchy were true--that is, preparation and drinking of beverages--the restricted neck pot in the second level of the hierarchy could be reasonably explained as a serving vessel for drink.

However, the pattern presented above is only a broad brush stroke across about 400 years, spanning three periods and five phases. In order to develop a more complex and nuanced understanding of the correspondence between different categories, periodization is also included in the statistical computation (Figure VI.9). Due to the small number of samples in periods 1a and 3 (13 and 20 samples, respectively), the statistics for different periods have been mainly computed using the samples from periods 1b, 2a and 2b.

As the plots show, during period 1b the hierarchical discrimination between different categories in capacity is still not too distinct. A significant difference is only observed between the neckless jar and categories of amphora, cup and THP as well as between the restricted neck pot and the amphora, cup and THP (Figure VI.10). A much clearer four-tier hierarchical pattern does not appear until period 2a (Figure VI.11). Compared to the preceding period, the standard deviation in capacity for each category is much smaller, which probably indicates a more standardized capacity for each category. In the period 2b, this four-tier hierarchical pattern seemingly decreases to three tiers (Figure VI.12). No matter how significantly the difference between categories changes over time, the capacity of neckless jars always is significantly different from the rest. The reason for the variations across time in the average capacity for each category is still unclear. Lastly, interpretations of variance in capacity over time within different vessel categories should be undertaken cautiously, because arbitrariness in changes that accompany the periodization of individual vessels cannot be avoided in practice.

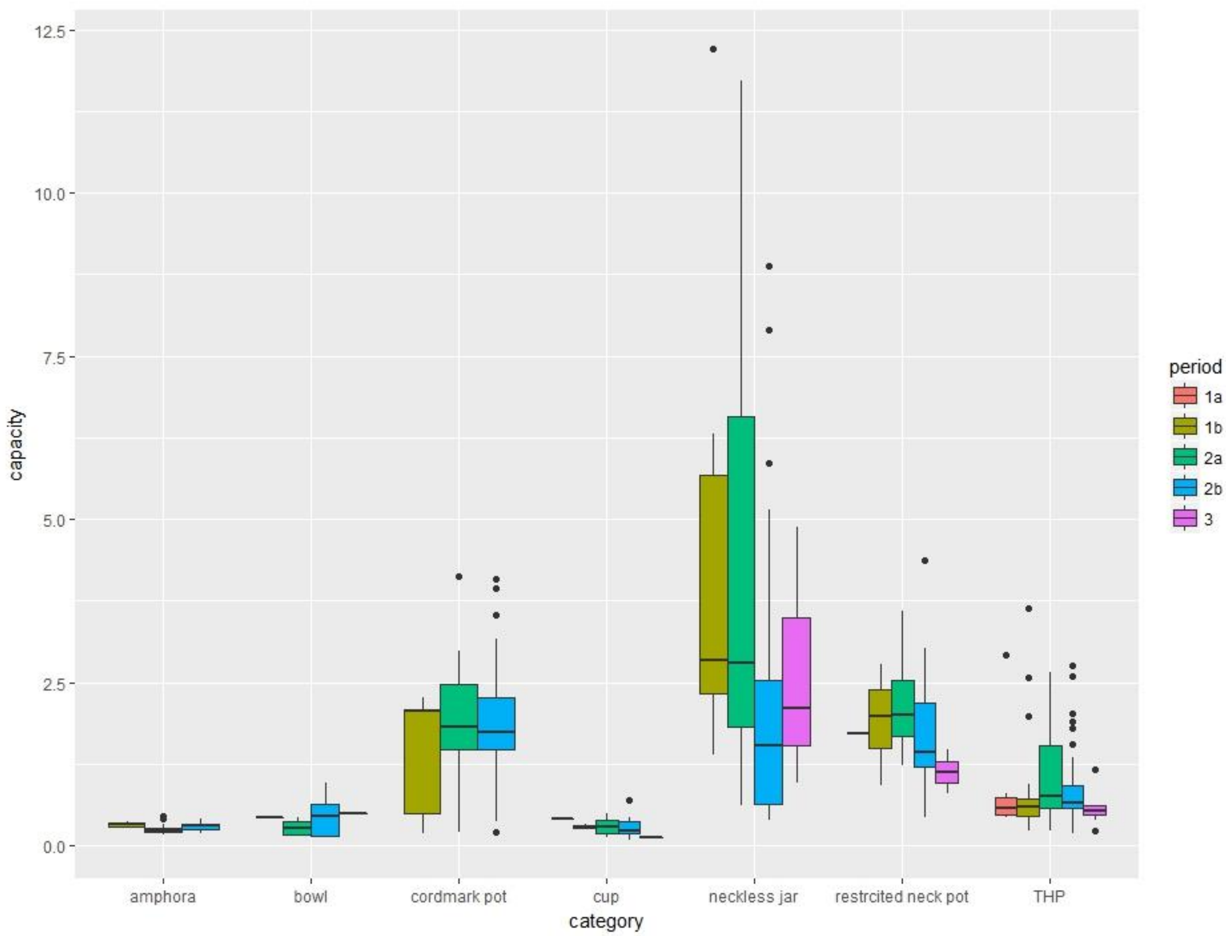


Figure VI.9 Distribution of capacity of different categories of vessel by period

VI.4 Organic residue analysis of neckless jars

By means of qualitative and quantitative analysis above on Siba pottery, we may hypothesize the general functions of different categories of vessels. However, all evidence presented thus far is still indirect. If one is to determine vessel function more confidently, analysis of direct evidence is desirable. Because of their enclosed form and intact preservation, neckless jars are ideal for conducting organic residue analysis. It should be kept in mind that all pottery vessels, including complete and reconstructed ones, had been cleaned with water both on the exterior and on the interior, before they were registered and deposited into the warehouse in the 1970s. Hence no organic residue is visible to the naked eye on the surfaces of the interior walls of the vessels sampled. In order to optimize results, the sampling strategy chosen was to scrape pottery powder from the interior wall near the bottom of each vessel. This analysis was undertaken at the Gansu Institute for Cultural Relics and Archaeology in 2016. A scalpel was used for scraping, and disposable surgical gloves were worn throughout the sampling process to protect the samples from secondary contamination. The amount of sample obtainable varied among different individual vessels due to differences in hardness and accessibility of the interior wall near the bottom. Because the amount required for gas chromatography is quite small (3-5 mg), most samples retrieved were sufficient for lab analysis (Table VI.4). Samples were stored in labeled ziplock bags and sent to the UCLA Pasarow Mass Spectrometry Laboratory for organic residue analysis.

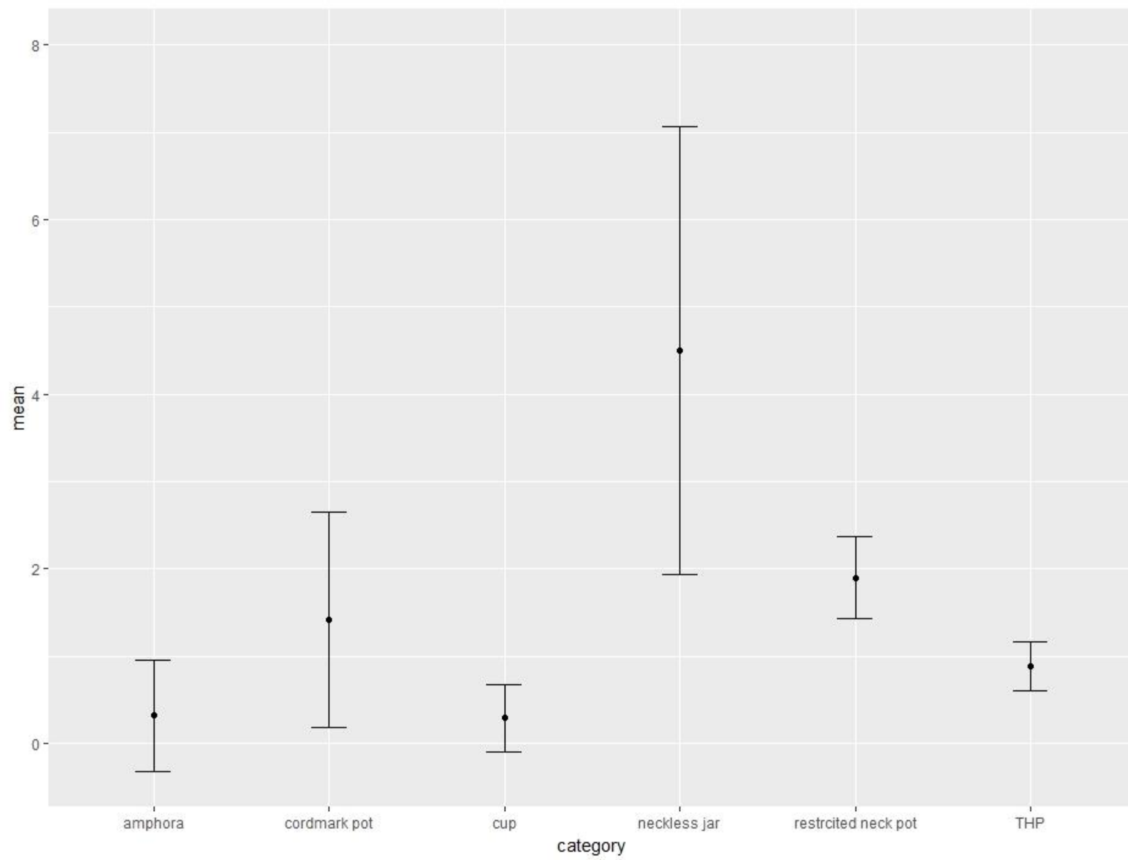


Figure VI.10 Confidence interval of the mean capacity of samples from period 1b
(68 samples in total)

VI.4.1 Method

We used the following protocol to prepare samples for Gas Chromatography-Mass Spetrometry (GC-MS) analysis: first, we transferred one sample (pottery fine powder) into a test tube and added 2 mL of extraction solution made of chloroform ($CH\text{-}Cl_3$) and methanol ($CH_3\text{-}OH$) (2:1 by volume). Then the test tube was placed on the Vortex mixer for 30 seconds, and then sonicated for 30 minutes. After that, the test tube was vortexed again for 30 seconds and then centrifuged at 1500 g for 15 minutes. Afterwards, we transferred supernatant liquid into a second test tube, then added another 1 mL of extraction solution to the sample and repeated the extraction procedures detailed in the first step. After two extraction procedures, we pooled supernatants, discarded the depleted pottery powder, and then dried the sample in a vacuum. Then, we added 200 μL ethyl acetate and transferred the sample into an injector vial, and then dried it in a vacuum. After that, we add 50 μL benzene to capture final traces of water and dried the sample in a vacuum again. Next, we added 50 μL methoxylamine in pyridine (2%) and capped the vial, which we kept at 60°C for 30 minutes to convert keto-functions into their methyloxime forms and then dried in a vacuum again. Following this, we added 50 μL ethyl-acetate and 50 μL BSTFA with 10% TMCS, and then kept the sample at 60°C for another 30 minutes in order to convert all hydroxyl-, carboxyl- and amino-functions into their corresponding trimethylsilyl derivatives. Finally we fed 1 μL of the resulting mix into the GC/MS instrument. The functioning of this instrument has been explained in great detail in other publications (cf. Barnard et al. 2007b: 48-56).

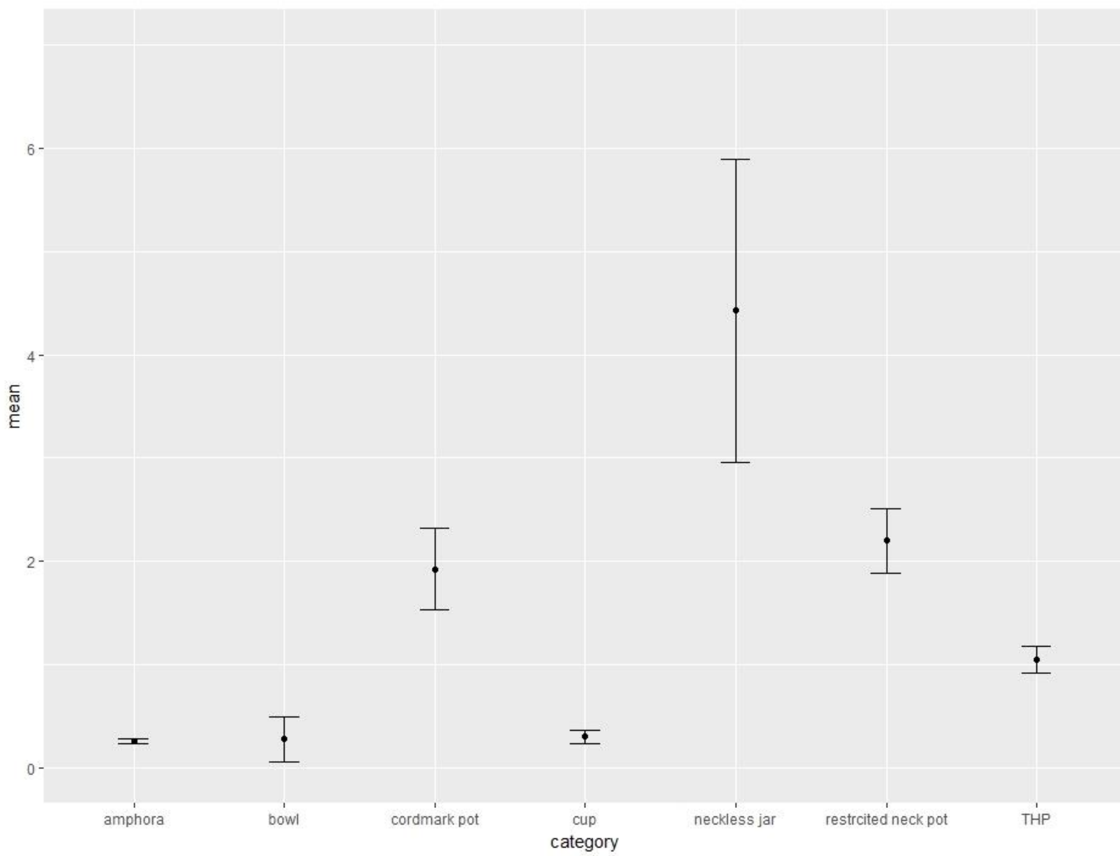


Figure VI.11 Confidence interval of the mean capacity of samples from period 2a

(230 samples in total)

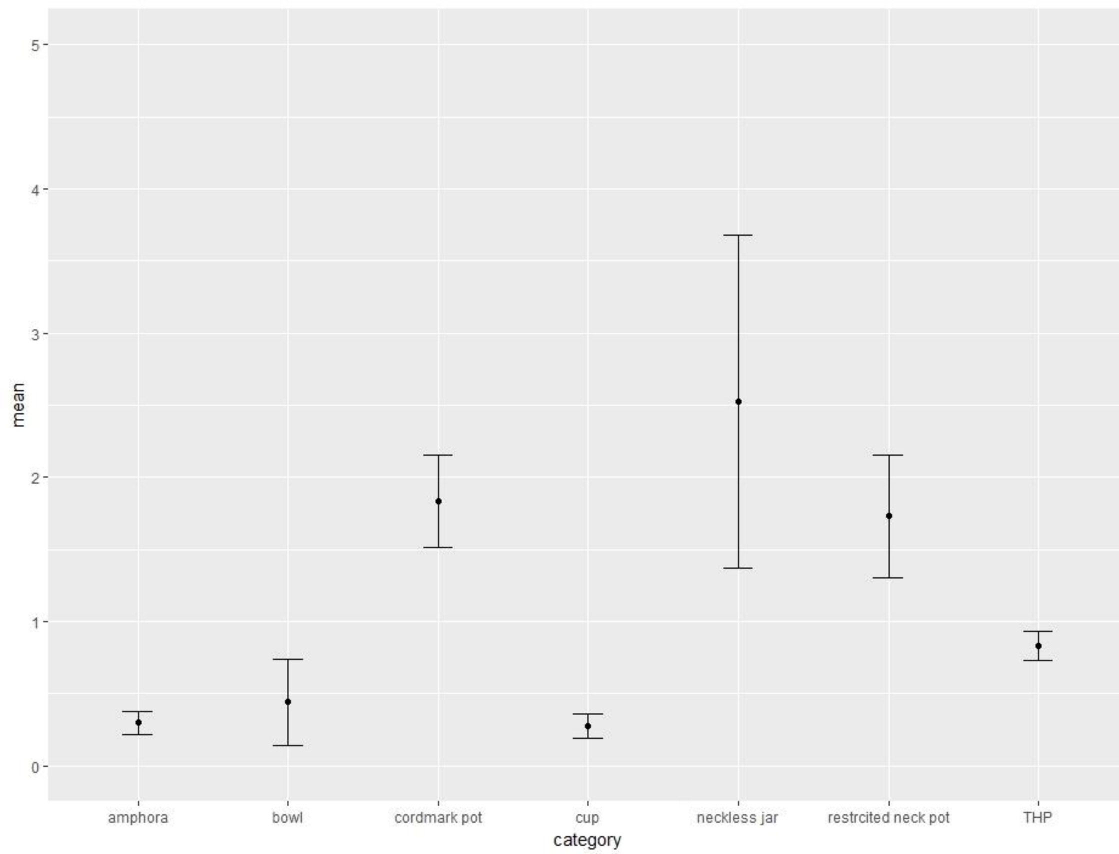


Figure VI.12 Confidence interval of the mean capacity of samples from period 2b (202 samples in total)

VI.4.2 Results

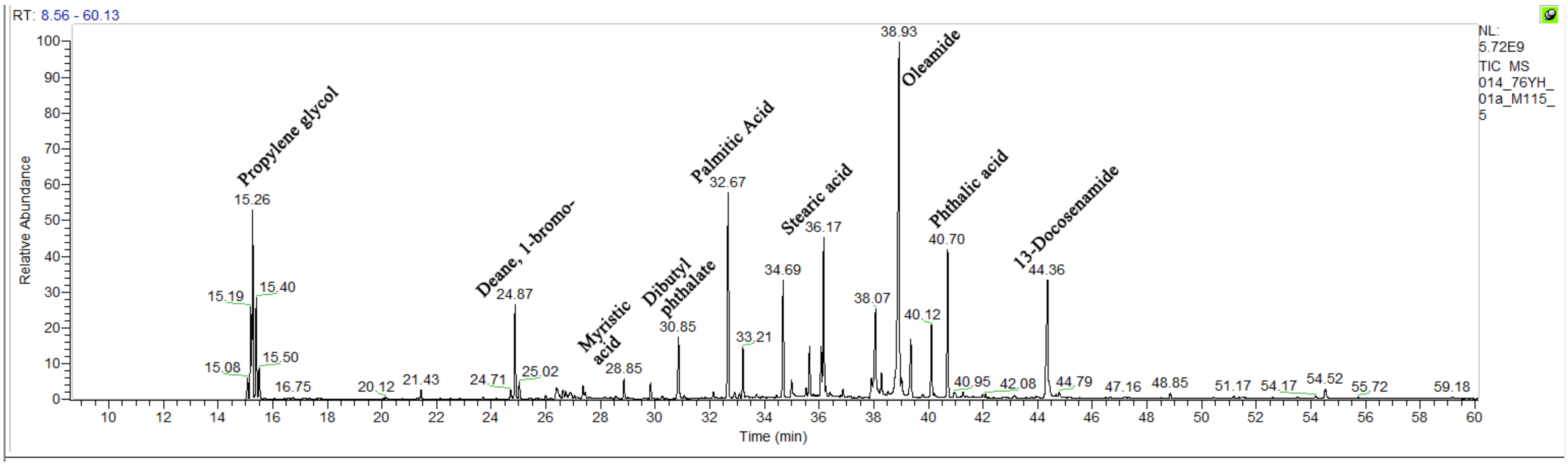
The determination of results detected by the GC/MS is based on retention time and comparison of the unknown mass spectra with recorded library. For each peak in the chromatogram there is a probability of determining it to be a certain molecular constituent, depending on the degree of agreement between unknown and known molecules. Usually, the molecule with the highest probability will be chosen to represent that peak from a list of probable molecular constituents (Figure VI.13, Figure VI.14). Although it is very rare, one peak could also represent more than one molecule, especially when the resolution of the GC/MS is insufficient to separate them (Barnard et.al 2007b:56).

A total number of 18 samples from 18 individual vessels were analyzed by the GC/MS. Two contained an insufficient amount for extraction (Table VI.4). Among those analyzed, all three samples from stone vessels did not yield any organic molecules. Hence, only 15 samples yielded effective results. Most of them are neckless jars. Because of the great homogeneity in the chromatograms of the samples from neckless jars, I selected two of them and present their chromatograms present their chromatograms, along with one sample from an amphora lavishly decorated by turquoise plaques (Figure VI.15:3) and one from a unique effigy pot (Figure VI.15:4).

Table VI.4 List of samples for organic residue analysis

	ID	Type	Sample portion	Period	Notes
1	76YHM206:21	stone vessel	interior wall near the bottom	Siba	no organic molecule detected
2	76YHM84:7	stone vessel	interior wall near the bottom	Siba	no organic molecule detected
3	76YHM291:14	stone vessel	interior wall near the bottom	Siba	insufficient sample
4	76YHM174:8	stone vessel	interior wall near the bottom	Siba	no organic molecule detected
5	76YHM174:14	stone vessel	interior wall near the bottom	Siba	insufficient sample
6	76YHM116:12	amphorae	interior wall near the bottom	Siba	(See Figure VI.15:3)
7	Gansu 8	effigy pot	interior wall	Siba	(See Figure VI.15:4)
8	76YHM258:3	neckless jar	interior wall near the belly	Siba	
9	76YHM213:1	neckless jar	interior wall near the	Siba	

			bottom		
10	76YHM259:1	neckless jar	interior wall near the bottom	Siba	
11	76YHM270:1	neckless jar	interior wall near the bottom	Siba	
12	76YHM115:5	neckless jar	interior wall near the bottom	Siba	(See Figure VI.15:1)
13	76YHM164:1	neckless jar	interior wall near the bottom	Siba	
14	76YHM263:3	neckless jar	interior wall near the bottom	Siba	
15	76YHM183:1	neckless jar	interior wall near the bottom	Siba	
16	76YHM216:4	neckless jar	interior wall near the bottom	Siba	(See Figure VI.15:2)
17	76YHM153:20	neckless jar	interior wall near the bottom	Siba	
18	76YHM212:7	neckless jar	interior wall near the bottom	Siba	
19	76YHM133:3	neckless jar	interior wall near the bottom	Siba	
20	76YHM232:6	neckless jar	interior wall near the bottom	Siba	



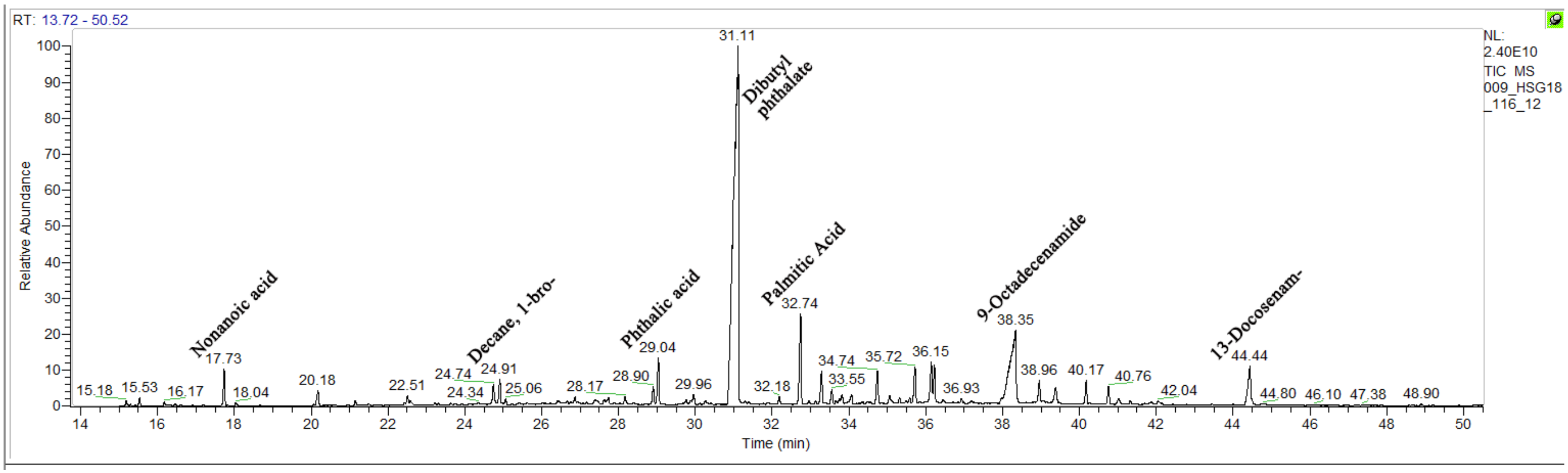


Figure VI.13 Chromatograms of organic residue analysis on Siba pottery
(Above: neckless jar-76YHM115:5; Below: amphorae-76YHM116:12)

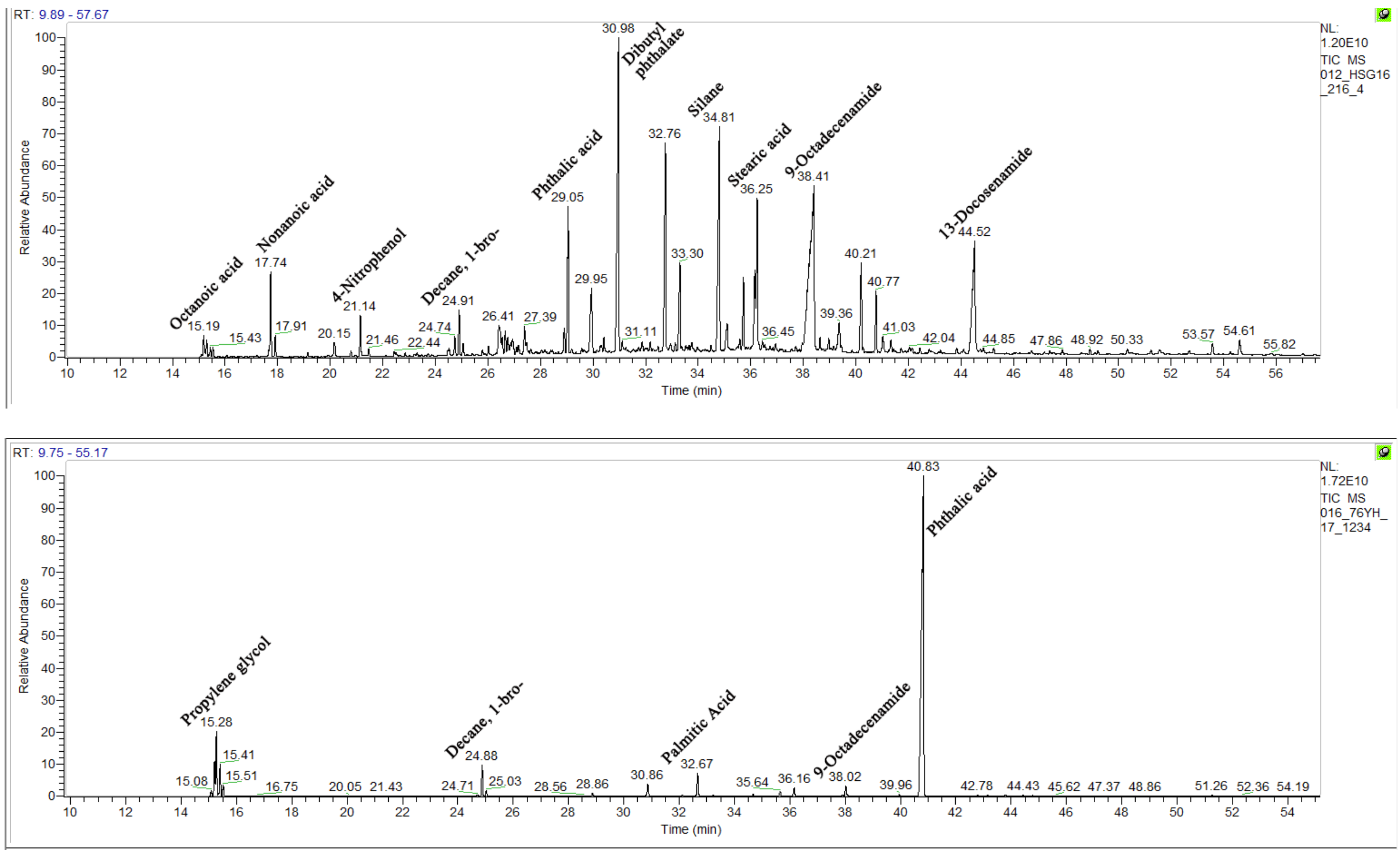


Figure VI.14 Chromatograms of organic residue analysis on Siba pottery
(above: neckless jar-76YHM216:4, below: anthropomorphic pot-Gansu 8)

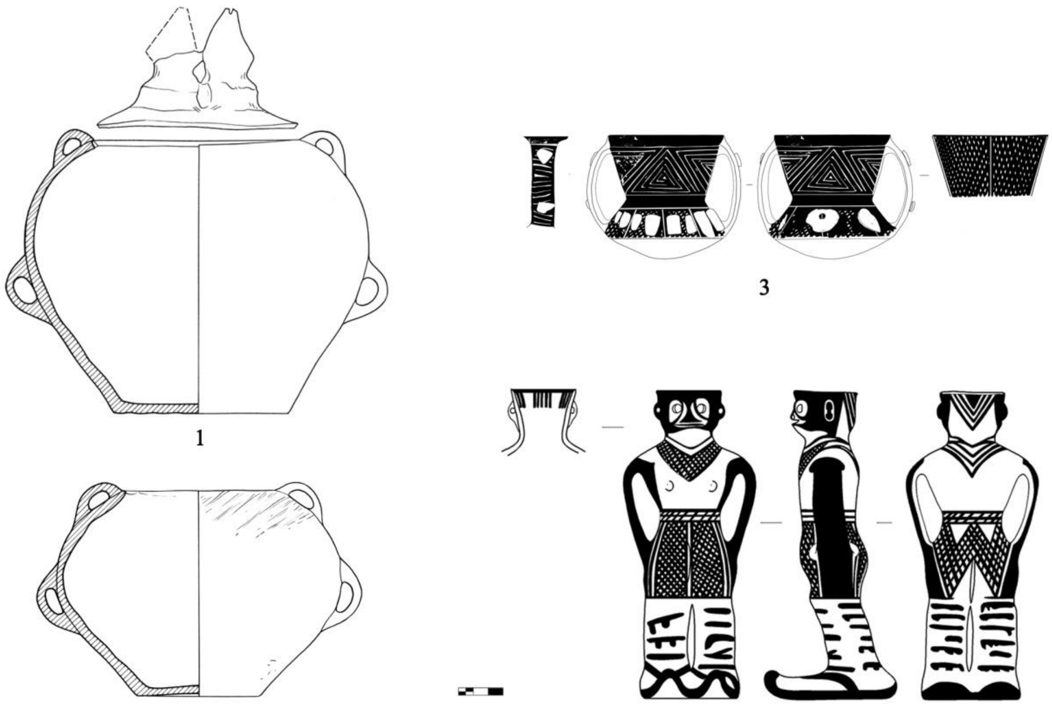


Figure VI.15 Pottery samples for residue analysis

(1,2. Neckless jars 3. Amphora with turquoise and mussel shell inlays 4. Effigy pot) (1, 2. Illustrated by Kou Xiaoshi 3. Illustrated by Jing Xiaoqing 4. Illustrated by Sun Mingxia)

Each peak in the chromatogram is identified after comparison with the embedded library. More details of each peak are also presented (Appendix 1). Although no biomarkers of fermented alcoholic beverages or psychoactive substances (e.g., ephedrine, cannabinoid, morphinan etc.) were detected, the results are still worth discussing. First, a variety of fatty acids was detected in all samples. Most of them, such as myristic acid, oleic acid, erucic acid and caprylic acid, can be commonly found in plants and animal fats. This suggests that these vessels were indeed utilized as receptacles for some food made of plants or animal products. It is impossible to identify specific species of plants and animals by current methods. Second, some unique fatty acids, for example, the 11-Octadecenoic acid and the octanoic/caprylic acid, naturally found in the fat of ruminants and in the milk of various mammals, indicate the use of secondary products from domestic animals such as cattle and sheep/goat. The omnipresence of remains of sheep/goat in Siba mortuary contexts supports this inference. Lastly, the coexistence of plant and animal fatty acids in the neckless jars and amphora, if they were not used to contain different kinds of food, probably suggests the presence of a kind of liquid beverage comprised of plants and animal products produced and consumed by the local community.

VI.4.3 Discussion

Organic residue analysis is never as easy as it appears. As the results presented above show, it is never straightforward for archaeologists to make simple correlations based on the molecules detected. Complicated lab work processes aside, interpretation of results is the ultimate challenge. Multiple factors need to be considered contextually before any causal correlations are established between hypothesized archaeological contexts and the lab data. These factors include, but are not limited to, the production process, recycling processes, depositional environment, conservation conditions, sampling strategy and contamination, lab processing and contamination, data selection (known as data massage) and interpretation etc. (Barnard et al. 2007a).

As to whether residue analysis reveals aspects of the pottery production process or the hypothesized liquid contents of the vessel, the former possibility can be eliminated without any question, because any organic tempers inside the pottery paste would have been burnt during the firing process and thus could not have found their way into the pottery powder samples. By contrast, the latter processes (that is, the production of liquid content, or fermentation), could have been factors that produce noise in the interpretation of our lab data. In ethnographic contexts, organic substances (e.g., resin, animal fat or vegetable oil) are commonly applied to the interior walls of ceramic vessels in order to decrease porosity. The possibility that such common organic substances find their way into lab data cannot be eliminated.

Moreover, one cannot be certain that these neckless jars were never recycled before they were placed into tombs. It is still unclear whether the same categories of pottery vessels from dwelling contexts have the same use context as ones from mortuary contexts, as far as the extent to which the samples reflect use in dwellings is concerned. Due to the absence of available data on Siba pottery assemblages from settlement contexts, the possibility of distraction from recycling cannot be eliminated either. Moreover, dispositional environment is another significant distracting factor. Even if the pottery had retained its original function even until just before it was placed into the tomb chamber, organic substances adhering to its interior surfaces, if there were any, could have decomposed after thousands of years in the ground (Eerkens 2007). In taphonomic context the flow of liquid content inside pottery is never unidirectional. The exchange between the surrounding soil matrix and the liquid content can happen throughout the dispositional process. Without analyzing any reference samples from the soil matrix surrounding the vessel analyzed noise resulting from the dispositional environment cannot be eliminated.

As the possiblility of contamination from sampling and lab processing is the same across all analyzed samples as long as sampling and lab procedures remain consistent, any errors may be ignored. Some commonly detected substances, for instance, phthalate, a man-made organic molecule generally from plastic lab implements, can be eliminated immediately (Barnard et al. 2007b). Lastly, data presented after comparison with an existing library is no more than a probable various combinations of all detected molecules. Thus, arbitrariness of data selection and later interpretation is unavoidable. All factors above considered, scientific analysis of organic residue can never provide definite results if other cultural and non-cultural contexts of artifacts have not been examined.

Based on organic residue analysis of the Siba samples, compelling evidence for the hypothesized function of the neckless jar is still quite meager. Nevertheless, the probability that the neckless jar was a major implement in the fermentation of alcoholic beverages in Siba society cannot be rejected. If we place it in a much broader archaeological context, as will be presented soon, this probability increases.

VI.5 A broader look at neckless jars in Northwest China

By means of the above qualitative and quantitative analysis on Siba pottery with a focus on the neckless jar, we have established a promising correlation between the form and function of the neckless jar. Building on this, we can take a broader look at archaeological remains with the same formal characteristics from a diachronic perspective. Hence we can develop a better understanding of their cultural significance. Even though these vessels have not yet been sampled for residue analysis, the following formal analysis will provide a hypothetical framework for future work. The use of neckless jars was never monopolized by Siba society. It actually appears in archaeological context no later than the Banshan phase of the Majiayao culture (the mid of the third millennium BC). As a technological invention of the highlanders in Northwest China, the distribution of the neckless jar in synchronic and diachronic dimensions could also lend us some insights into the social contexts regarding political, economic, ideological and ritual domains.

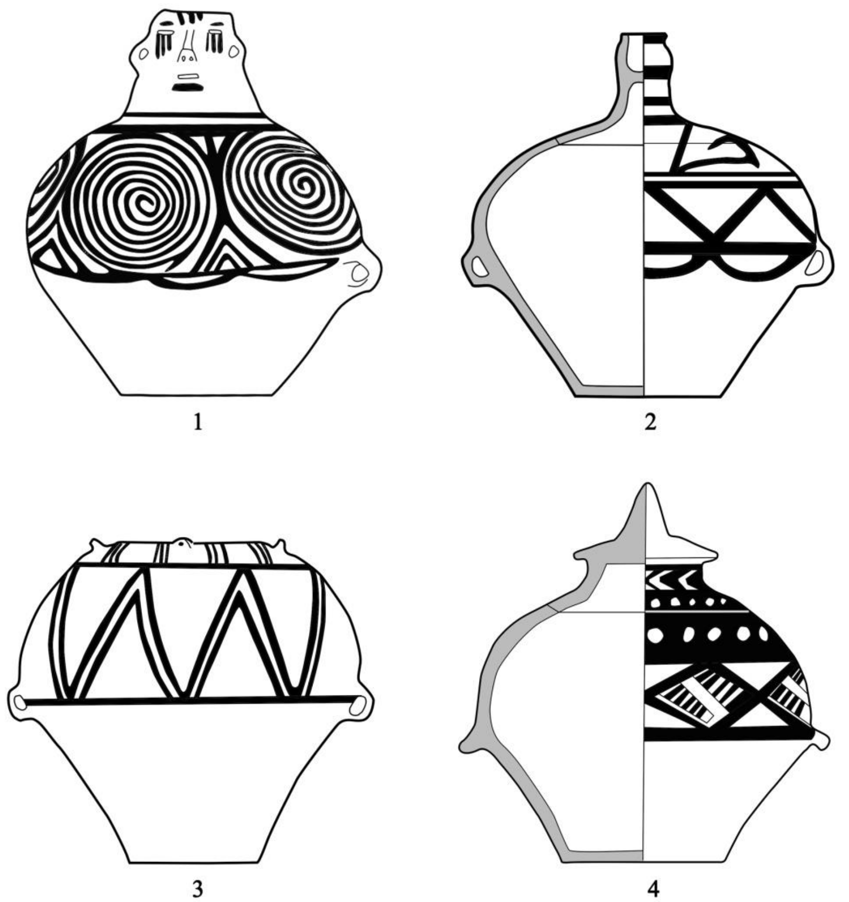


Figure VI.16 Painted pottery jars in the Machang phase from Liuwan cemetery, Ledu, Qinghai province (Catalogue No.: **1.** 216:1; **2.** 1364:1; **3.** 799:21; **4.** 66:1. Height: **1.** 22.4 cm; **2.** 28.5 cm; **3.** 30 cm; **4.** 13.5 cm. Illustrations are reproduced by author after QHWGK and ZSKKY 1984)

Large quantities of neckless jars (163 in total) with cutoff lids have also been found in tombs of the preceding Machang phase (2300-1890 BC) of the Majiayao culture (3000-1890 BC) at the Liuwan cemetery (QHWGK and ZSKKY 1984:123). The high degree of similarity in form between the neckless jars from the Machang phase and the Siba culture indicates the former as the prototype of the latter (Figure VI.16:2-4; Figure VI.17). Even though the neckless jars of the

Machang phase have never been examined through organic residue analysis, based on unmistakable technical characteristics, especially their cutoff lids, it is assumed that they could have functioned in the same way as the Siba counterparts.

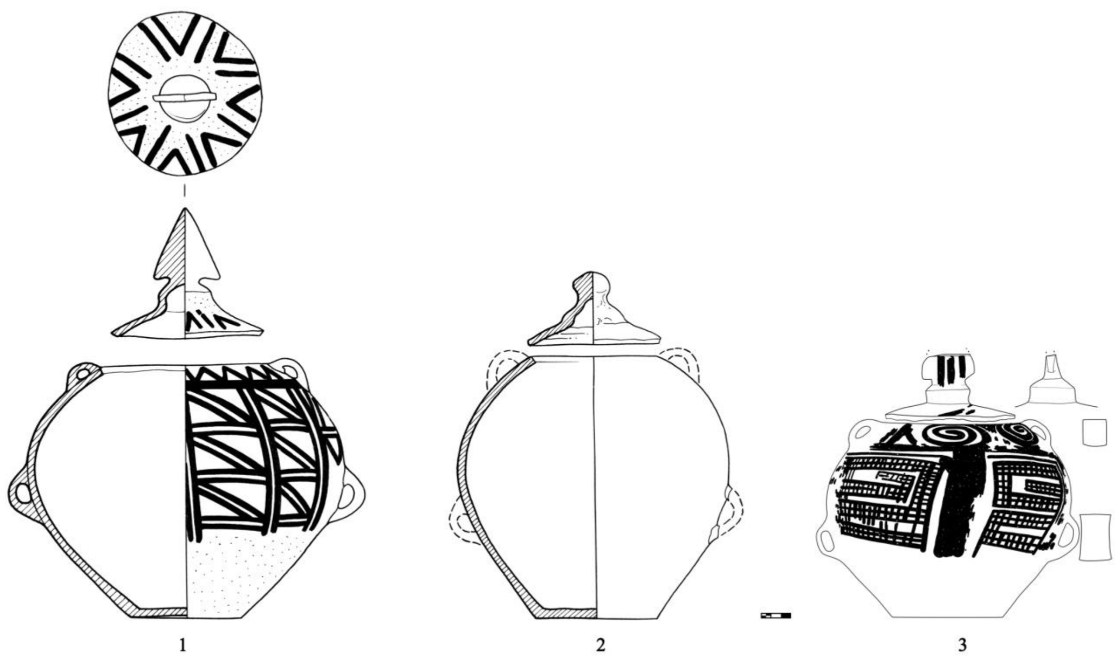


Figure VI.17 Neckless jars of the Siba culture from Huoshaogou cemetery

(1. 76YHM104-1; 2. 76YHM17-2; 3. 76YHM86-1. 1, 2 illustrated by Kou Xiaoshi; 3 illustrated by Sun Mingxia)

The decorative knob of a miniature neckless jar probably suggests close association in actual use context (Figure VI.16). Similar examples can also be seen in some other detached cutoff lids unearthed from the Liuwan cemetery (QSWGK and ZSKKY 1984:127, figure 87:3, 6). Due to the absence of records on vessel contents when unearthed, their specific function is still unclear. It is alleged that some painted pottery jars with two lower handles from the Machang tombs contained "water-like clear liquid" when they were unearthed (Wang Guoshun[1], personal communication). It is still unclear whether the liquid content was fermented drink, its degraded form, or pure water. However, contemporaneous finds from the Xiahaishi cemetery (2190-1965 BC, calibrated) (Ma M.M. et al. 2014:245) in the Honggu district, located 30 km east of Liuwan cemetery in the same river valley (the Huangshui river valley), provides promising evidence as to organic residue held in the neckless jar and other categories of vessels (GSWKY 2008). All organic grain residues were not preserved well and only survived in the form of grey ash. Nevertheless, isotopic analysis on human skeletal remains indicates a predominant consumption of C4 crops probably millet (Ma M.M. et al. 2014). Eight neckless jars out of 416 pottery vessels were unearthed from the Xiahaishi cemetery. Only two of them were found with organic ash content. However, the original cutoff lids of these two neckless jars are absent and the rim of one jar is also damaged. It is assumed that these jars were probably recycled before being placed into the tombs. Whether the organic ash found inside is the result of the degradation of dry grains (probably millet) or the dregs of fermented beverages (probably millet beer, if so) calls for further analysis of organic residues.

Besides regular forms with cutoff lids among the neckless jars unearthed from the Liuwan cemetery, another kind of jar with anthropomorphic effigy is also noteworthy (Figure VI.16:1). Even though they are slightly different from the regular neckless jars in formation technique and scarce in quantity, their distinctive anthropomorphic representations can be unmistakably connected to the stray lids (Figure VI.18) attributed to the preceding Banshan phase (2600-2300

[1] Wang Guoshun was one of the archaeological excavation team members for the Liuwan cemetery in the field seasons from 1975 to 1978. He is a current staff member of the Liuwan Painted Pottery Museum in Ledu, Qinghai province, which houses tens of thousands of artifacts unearthed from this colossal cemetery (1500 tombs in total). This information was related by him when the author visited the museum in the summer of 2013. The excavators took for granted that the liquid was water due to its clear color, so none of the liquid was sampled and saved for further analysis; instead, it was discarded before the vessels were taken into the storeroom.

BC). So far there are only three lids reported[1], while the serrated rims of the lids clearly indicate that they share the same formation technique as the neckless jars commonly found in the Machang phase. It can be firmly inferred that these serrated lids were originally mounted on top of neckless jars, which were destroyed for unknown reasons when they were looted. So far, these lids are the earliest known examples of neckless jars with cutoff lids. These lids shared great similarity in the way the human face is represented: a piriform head with hollowed-out eyes and mouth. A slightly opened mouth and head at a lifted angle provides a vivid snapshotof an ongoing ritual scene. The leveled face with truncated front in one lid (Figure VI.18:3) seems like a representation of a masked ritual practitioner. A pair of well-preserved "horns" on top of the head (Figure VI.18:3) with hollow cavities in the center indicates that some organic materials (like birds' feathers) were stuck into the "horns" to decorate the whole set of vessels in their original use context. Of course, the possibility cannot be excluded that headdresses made of birds' feathers in bright colors could have been worn by actual practitioners. The same horn-like feature can also be found in the other two samples (Figure VI.18:1, 2) where, however, it is badly preserved. The "horns" on the top of one head are totally lost, leaving two round-based scars (Figure VI.18:1). The scallop-shaped ears with pierced holes could also have held some ring-like decorations, like earrings worn in reality (Figure VI.18:2). Scattered remnants of pigment on the face and around the neck probably mirror actual body tattoo.

[1] K5473 and K5472 were bought by J.G.Andersson (1943:240) from local villagers who alleged the Banshan cemetery as the original provenience of these two lids. The violet red serrate decoration also proves that these lids were typical Banshan style. The provenance of the third (K11038:5) is more complicated: it was bought by J.G.Andersson in Paris from the Wannieck firm, while its original provenience was unknown. But based on its form and decorative pattern, it should have been looted from a Banshan phase tomb in the Gansu or Qinghai areas. The zigzag pattern on the lid surface also indicates a style attributed to the late Banshan phase and the early Machang phase.

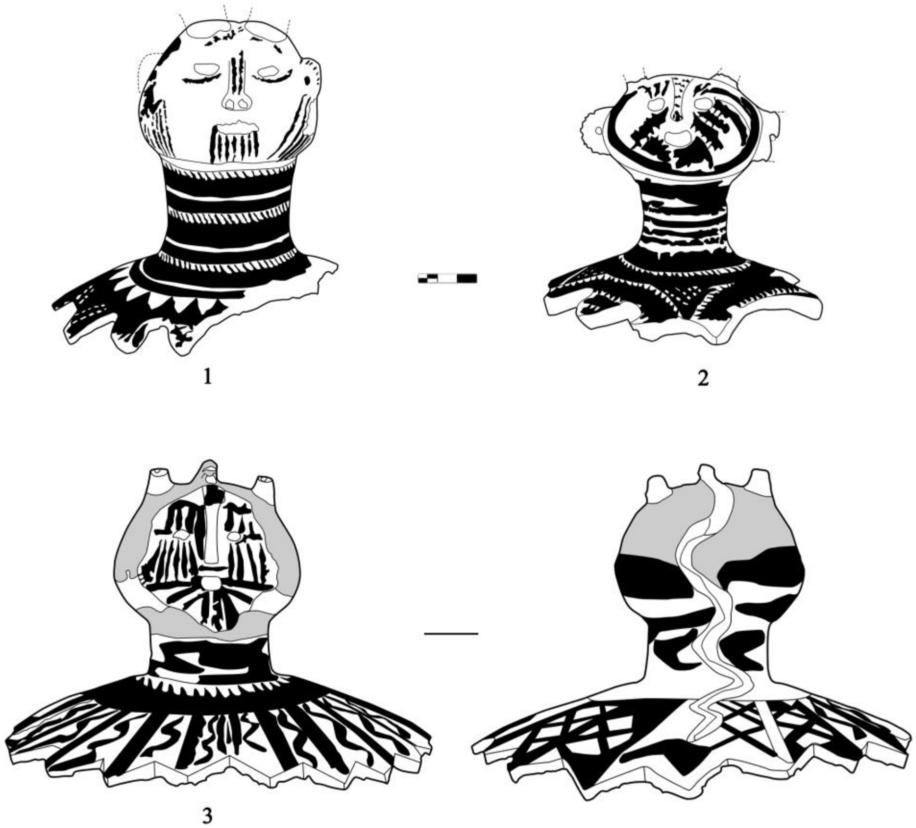


Figure VI.18 Lids with anthropomorphic representations from the Banshan phase
(1. K5473 2. K5472 3. K11038:5. Reproduced by the author after Andresson 1943, plate 186 and 187)

What most intriguingly distinguishes the third lid from the other two is the representation of a wandering serpent that rests its head with an open mouth on top of the human head (Figure VI.18:3). The association between ritual specialist and animal agent is quite common in primitive ritual activities, or so-called shamanism, a universal religious practice in Siberia and surrounding parts of Inner Asia (Znamenski 2003). If so, the functional interpretation of these cutoff lids (especially the neckless jars to which they were attached but did not survive) in the context of fermentation of alcoholic beverages makes much better sense. If the hollowed-out cavities on the human faces impaired the air-tightness necessary for fermentation, it could have been filled by viscid materials (e.g., dough, mud, resin etc.). Taking one step back, even if these lids were not necessary components for fermenting vessels but rather applied as lids for other functional vessels such as censors, the cavities on the human face would work well in releasing smoke, which could have facilitated ritual activities by helping participants enter an altered state of consciousness. No matter the functional interpretation, there should be no doubt that these anthropomorphic lids functioned more ritually than mundanely.

If we return to the examples from the Liuwan cemetery, we can observe that the nearly the same style of effigy continued to be used durin the following Machang phase (Figure VI.16:1). One major difference in form is the creation of openings. Rather than cutting off the serrated lids from the top of neckless jars, the jars from Liuwan have a semicircular opening on the top of the human head. But other details remain the same as precedents in the Banshan phase, especially patterns of facial tattoos. These intact vessels also provide possible analogies to the form of the neckless jars detached from effigy lids; in addition, the repetition of spirals on the upper half of the belly probably indicates the visual effect of an altered state of consciousness after the consumption of the contents stored in the vessel. The presence of painted decorations only in the upper part of the vessel body (Figure VI.16) clearly indicates the context in which these vessels were used: they were placed on the floor, while users stood, sat, or squatted on the floor, the lower part of vessel not visible from their perspective.

Other neckless jar from the Liuwan cemetery with four evenly distributed pegs near the rim (Figure VI.16:3) indicates another diachronic connection with counterparts in the Majiayao phase. The neckless jars found in this period are characterized by beak-shaped pegs, generally four or six in number, evenly distributed around the orifice (Figure VI.19). Except for one miniature sample (Figure VI.19:3), the average height for most samples is around 30 cm. A stray find jar in Sanping, Yongjing has the largest dimensions (with a height of 50 cm) among all the Majiayao pottery assemblages found so far (Figure VI.19:5). All samples with black pigment paintings also share great similarity in the style of decoration. The repetition of S-shaped streamlines, together with concentric spirals, generates a special visual experience echoing that of the aforementioned Machang counterparts (Figure VI.16:1). The formation technique for the openings among these jars cannot be confirmed due to the absence of hands-on examination, but the uneven rim with angled lip observed in one example (Figure VI.19:6) suggests clear traces of cutting, while the cutoff lid, if there was one, was detached for whatever reason before the vessel was deserted in the corner of the house.

However, another scenario for the installation of the lid for these neckless jars may be more cogent, considering the even numbered pegs around the orifice. That is, the opening of these neckless jars may have been covered by a sheet of leather then fastened by cordage to the outward-curved pegs. Meanwhile, the use of leather as lids also would explain the universal absence of lids from all these neckless jars, not excluding even some found *in situ* (Figure VI.19:1,6). If so, once again, the air-tightness of the whole vessel is emphasized by this kind of closure technique, which is essentially the same in design conception as successors with cutoff lids.

Figure VI.19 Neckless jars with beak-shaped pegs from the Majiayao phase (3300-2600 BC)

(1. H55:34, Linjia site, Dongxiang, Gansu; 2. Stray find in Qin'an, Gansu; 3. Stray find in Wudu, Gansu; 4. Stray find in Niutougou, Lintao, Gansu; 5. Stray find in Sanping, Yongjing, Gansu; 6. F7:1, Linjia site, Dongxiang, Gansu.
Height: 1. 31 cm; 2. unknown; 3.11 cm; 4. 33 cm; 5. 50 cm; 6. 28 cm
1-4 reproduced after Zhang P.C. 1990; 5 after An Z.M. 1956: plate 1; 6 after GWG et al. 1984)

1

2

Figure VI.20 Painted pottery jar of the Majiayao phase (1) and painted pottery drum of the Banshan phase (2)

(Notice the pegs around the orifice. Photo by the author in September 2016, Gansu Provincial Museum, Lanzhou)

Certainly, the installation of lids on neckless jars could have been achieved in several ways. This is shown by one small painted pottery jar with a lid unearthed from the Wangbaobaocheng cemetery (from the final stage of the Majiayao phase, around 2600 BC) in Lanzhou (GBWG 1975) (Figure VI.20:1). In this case, the four beak-shaped pegs seem to have the same function of fastening cordage that fixed the pottery lid in such a way that it would not have moved when the vessel was transported. Pegs of the same form can also be found on the pottery drums of the Banshan phase (Figure VI.20:2). A skin was clearly stretched over one end of such a drum with the help of pegs. By the same token, it is reasonable to infer that the same closure technique was applied to neckless jars during the earlier Majiayao phase. Another noteworthy point regarding this pottery drum is the artistic combination of a drinking vessel on one end with a drum on the other end. The combination of two objects with totally different functions into one could only have made sense if these dual functions were necessary in some use context, for instance, in a ceremonial scenario in which drinking and performing were essential components.

VI.6 Concluding remarks

Emphasis on drinking as one important aspect of social life among the highlanders in prehistoric Northwest China is a cornerstone of our attempt to develop a better understanding of the social dynamics and processes behind archaeological material cultures. In this chapter, I have taken the Siba pottery assemblage as a point of departure with a particular focus on the neckless jar. By means of stylistic and formal analysis, quantitative measurement of vessel capacity, as well as chemical analysis on organic residue, I argue that the neckless jar with cutoff lid is a material-culture signature of the social practice of drinking. By teasing out diachronic connections in form and style, furthermore, I identify neckless jars of a variety of styles in the preceding Machang, Banshan and Majiayao phases. The omnipresence of this vessel type in the highlands of Northwest China probably suggests that drinking as a social practice among inhabitants of that area was established no later than the end of the fourth millennium BC. The cultural processes and myriad aspects of social life embedded in this practice will be addressed in the following chapters.

Chapter VII Economic dynamics in Bronze Age Northwest China: Qijia and its neighbors from a trading network perspective

VII.1 Introduction

In the past decades, research on the Qijia culture mainly focused on tempo-spatial reconstruction and its cultural-historic trajectory based on pottery typology (Chen P. 2013; Chen X.S.2012; Debaine-Francfort 1995; Fitzgerald-Huber 1995, 2003; Shui T. 2001; Ren R.B. 2015; Zhang Z.P. 1987). Due to the incompleteness of published data on excavated sites, the periodization of pottery typology of the Qijia culture in different regions is still debated among Chinese archaeologists. Generally, temporally speaking, the Qijia culture (2300-1500 BC) coexisted with the final phase of the Majiayao culture (the Machang Phase, 2300-1890BC), the Xichengyi culture (1880-1680 BC), and the Siba culture (1670-1530BC) in the Hexi corridor. Hence, the intermediary position of the Qijia culture—both spatially and chronologically—naturally makes it a focal point for discussions on so-called East-West cultural exchange. One of the most critical issues involving the Qijia culture is the origin, development and transmission of metallurgy in early China. The discovery of early copper objects from the Huangniangniangtai cemetery in the late 1950s and other Qijia sites made the Qijia culture the primary candidate for comparison with metallurgic production at the site of Erlitou, the presumed first political center of Bronze Age China. Thus, the Qijia culture is assumed to be one important intermediary linking the Central Plains to the Eurasian Steppe and Central Asia, and even the major donor of metallurgical knowledge to play a crucial role in the statecraft of early Chinese civilization (An Z.M. 1993; Fitzgerald-Huber 1995, 2003). In the late 1970s, the mass discovery of early metals at the Huoshaogou cemetery and the systematic analysis of the early metal objects from the Hexi corridor have to some degree changed the dynamics of interpretations on early metallurgy in Northwest China and adjacent areas: Northwest China is now seen not as a passive receiver and intermediate of early metallurgy, but as in other areas in the world, an active agent in developing local repertoires based on its cultural trajectory (Li S.C. 2005; Li S.C. and Shui T. 2000; Mei J.J. 2003). Nevertheless, due to the absence of a technological-system perspective in earlier discussions, the misconception that copper objects are equal to metallurgical production is taken for granted, and thus the role of the Qijia culture in early metallurgy and cultural interactions at large is fundamentally misunderstood. I argue that an understanding of the Qijia culture must be understood from the perspective of economic process, including production, redistribution and circulation, and consumption. The study of East-West cultural interactions should not be over-simplified in order to identify exogenous and superficial similarities in material culture and then connect the dots so as to delineate possible routes of transmission. Instead, the quest for endogenous cultural processes and social mechanisms behind material evidence should be the main agenda. Only in this way can we develop a complete and thorough understanding, not only of the role of Qijia culture in its regional context, but also of the whole of Northwest China. In order to achieve this goal, in this chapter I will interpret the Qijia culture and its interactions with contemporaries from a socio-economic perspective.

I propose that the high mobility of Qijia communities resulted from their social marginality in relation to pre-existing Majiayao communities (the Machang Phase). A high uniformity of material culture and burial practice indicates that strong social cohesion was maintained effectively within the Qijia communities during mobility, probably through a drinking ritual represented by the omnipresent and stylistically unique amphora beakers. Social marginality prompted Qijia communities to dwell on ecological peripheries, which then became frontiers for the new epoch of mobility in Eurasia. By taking advantage of its social marginality, the Qijia communities dispersed in all directions with strong strategic considerations. Those considerations are: occupation of the nexus of exchange of population and goods (trade diasporas in the eastern Hexi corridor, Alashan (Alxa), and Ordos, even as far south as the middle Yangzi River); control of the trade of rare resources and goods (copper/bronze, jade, turquoise); strengthening of that control over critical resources through marriage alliances or trade partnerships, especially with regards to the metallurgy supply chain represented by the Xichengyi and the later Siba communities in the Hexi corridor. To be clear, Qijia communities were not involved in the production of copper/bronze, but mainly engaged in the redistribution and circulation of metal products. The detachment of Qijia communities from early metallurgical production in Northwest China is beneficial in developing a more nuanced understanding of the social dynamics and complexity of social networks at an inter-regional scale. Lastly, it is the endogenous social interactions resulting from social needs that made cultural connections in Central Asia and the Eurasian Steppe possible. The great variation in the cultural material of different regions also suggests that early cultural connections were more indirect than direct, as I will discuss in the following section.

VII.2 Social marginality and the mobility of Qijia communities

The transitional period from the end of the Neolithic to the early Bronze Age (the end of the third millennium BC – the first half of the second millennium BC) in Northwest China was also a period of transformation in social structures: 1) the decline of the predominating Neolithic entity in Northwest China, the Majiayao culture tha lasted for more than one thousand years (3300-

1900 BC), 2) the reconfiguration of the Bronze Age successors of the Majiayao culture in the Hexi corridor, the so-called Xichengyi culture and Siba culture, and 3) the second influx of agricultural communities, the Qijia culture, an offshoot from the agricultural center in the western Guanzhong Basin. Before the Qijia dwelt and developed in the lower Tao River valley as its center in the late third millennium BC, a dramatic social change had been happening among the predominant cultural regime – the Majiayao – in this area. The Machang communities that had formed around 2300 BC very soon divided into two population clusters as reflected in the spatial distribution of archaeological sites: one centered in the Huang River valley, a major tributary of the Yellow River; another linearly aligned along the northern piedmont of the Qilian Mountains in the eastern Hexi corridor (Wuwei, Yongchang, Jinchang, Shandan and Zhangye etc.) (Li S.C. 1998). The change in the distribution of these populations during the Machang phase generated far-reaching influence on the cultural momentum in Northwest China during the early Bronze Age. First, ecologically marginal areas – the scattered oases in the Hexi corridor – were exploited on a large scale for the first time by the leap-frogging of agriculturalists to optimal ecological niches in this arid area, and thus made the cultural connections with more western neighbors possible in the early second millennium on an inter-regional scale. Secondly, on a regional scale, the movement of the population center also changed the nexus of the social network, which drove potential movement of populations across environmental, social or cultural borders in the forms of trade, pilgrimage, craft guilds, and other social activities revolving around rites of passage in life (e.g., initiation, marriage, and funeral etc.).

A simple statistical analysis of the number of sites in the Yellow River-Huang River valley (region A) and the Tao-Daxia River valley (region B) shows that two contemporaries, the Machang phase and the Qijia culture, wer spatially separated (Figure VII.1). An absolute majority of Machang communities (around 628 sites) aggregated in the region A. By contrast, only 76 have been identified south of the Yellow River, or in region B. As for the Qijia culture, even though the quantity of sites (around 480) north of the Yellow River is one and half times more than that in the south (around 320), the actual density of sites in region B is much higher than in region A, if the suggestion that region A is three times larger than region B is not an overestimate. There is no doubt that the Tao-Daxia River valley was the center of the Qijia communities.

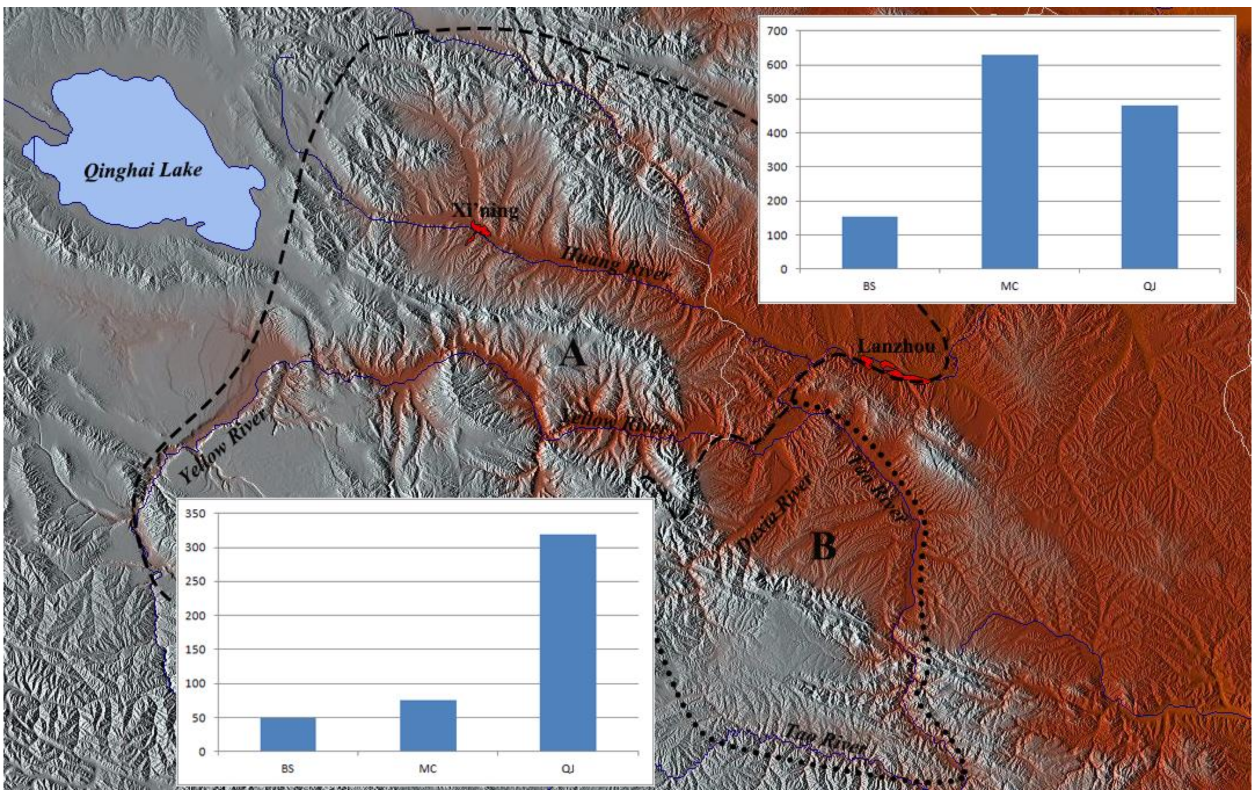


Figure VII.1 Statistics on the number of archaeological sites in the Yellow River- Huang River valley (region A, upper right plot) and the Tao-Daxia River valley (region B, lower left plot) by period

(BS- Banshan phase, 2500-2300BC; MC –Machang phase, 2300-1900BC; QJ- Qijia culture, 2300-1500BC) [Data source: GJWWJ (1996, 2011). The data in region A covers eastern Qinghai province as a whole, Lanzhou city (Chengguan district, Qilihe district, Honggu district, Xigu district, Gaolan county, Yongdeng county, Yuzhong county) and Jingyuan county. Region B covers Hezuo city, Kangle county, Lintao county, Lintan county, Linxia county, Minxian county, Weiyuan county, Xiahe county, Yongjing county and Zhuoni county. The direct distance between Xi'ning and Lanzhou is about 200 km/124 miles]

Diachronically, we can observe northwestward movement of the center of the Majiayao culture: the Banshan communities, the successor of the first Majiayao agricultural colonists had totally abandoned their ancestral land in the upper Wei River valley in southeastern Gansu and settled in the lower Tao River valley as well as the Huang River valley further to the north. Later on, the successor of the Banshan communities, the Machang group, totally withdrew from the lower Tao River valley and moved to the Huang River valley. In addition, another population center developed in the eastern Hexi corridor, which directly contributed to the formation of the first Bronze Age cultures in this area. The reason for this shift in population center is still unclear. However, exogenous pressure resulting from the influx of the Qijia community seems unconvincing (Li S.C. 1998:184). Farmland, the most valuable production means for agricultural communities, is generally redistributed based on the principle of primacy among social groups ("first come, first served"). Thus, later incoming Qijia communities may not have imposed competitive pressure on pre-existing Majiayao descendants as far as control over the limited farmland in river valleys was concerned. Climate change is probably an external impetus but could not have been a decisive factor (An C.B. 2003). Therefore endogenous tensions within social groups—tensions due to certain social mechanisms in politics, economy and ritual domains—should be examined for interpretation.

As to subsistence economy, there seems no substantial difference in the composition of major crops (e.g., broomcorn and foxtail millets) between the Qijia and Machang agricultural communities. Thus, the spatial separation of these two agricultural communities probably resulted from the natural occupation of farmland according to the principle of primacy. Based on survey data in the Qijia heartland, the Tao-Daxia River valley, the Qijia community always dwelt on the same sites that either the Majiayao or the Banshan had abandoned. The abandonment of previous arable land is unthinkable unless necessitated by uncontroallable factors, e.g., the depletion of fertility. However, the great imbalance between the settlement and mortuary data of the Majiayao culture impedes further exploration of the agricultural system of Majiayao communities. For some unknown reasons (probably a food crisis resulting from crop failure), at the end of the Majiayao phase the number of archaeological sites suddenly plunged and led to a more restricted distribution of Banshan sites at the beginning of the second half of the third millennium BC. This radical change in the design styles and assemblages of polychromic pottery is a strong signal of social transformation during the transitional period from the Majiayao to the Banshan phase (Li S.C. 1998). The disappearance of large pottery vessels with visually attractive décor (Figure VI.16:1, Figure VI.19:1-5) commonly found in the Majiayao phase probably indicates a transformation in the ritual domain. The previously valued strategy of cultivating social cohesion by means of communal consumption (e.g., feasting indicated by a large volume of painted pottery bowls) during collective ritual activities, as depicted on the polychromic pottery (Figure VII.2), does not function any longer. Compared with the material culture from the preceding Majiayao phase, reduced uniformity and increased diversity found among the Banshan communities in different sub-regions (Zhang C. 1994) also endorses the idea of the decline of social cohesion during the post-Majiayao period.

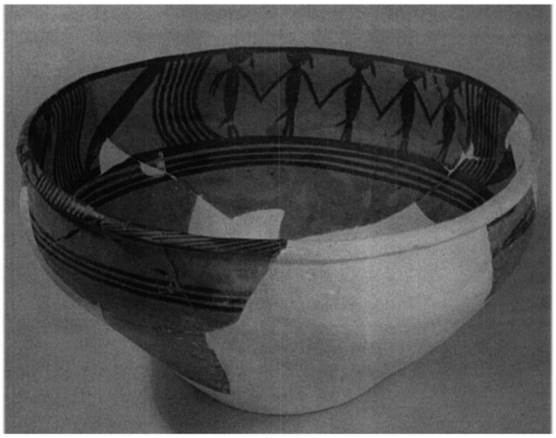


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Figure VII.2 Polychromic pottery bowls from the Majiayao culture (Majiayao phase)

(1. Shangsunjiazhai, Datong, Qinghai; 2. Mozuizi, Wuwei; 3. Zongri, Tongde, Qinghai, cat.no.: 95TZM157:1; 4. Zongri, Tongde, Qinghai, cat.no.: 95TZM192:2)
(**-1**, reproduced after QHSWK 1978, plate 1; **-2**, after Li, S.C. 2001, figure 3-5; **-3**, **-4** after Ge, S.B. and Chen, H.H. 1999, Pp.66-67. The orifice diameters: **-1**. 29 cm; **-2**. 29 cm (data source: Sun S.L. 1993.); **-3**. 24.2 cm; **-4**. 24.5 cm)

As the statistics above demonstrate, the center of gravity during the Banshan phase had already been moving to the Huang River valley. According to the survey data (GJWWJ 2011), the archaeological remains attributed to the Machang phase throughout the Tao River valley (including Lintan, Lintao, Minxian and Zhuoni counties) is totally absent. In other words, the Tao River valley during the late third millennium BC, probably due to the depletion of fertility plus other social-economic factors, was uninhabitable and thus became a depopulated zone. This idea is also supported by the later incoming of Qijia agriculturalists from the southeast of Gansu, who sparsely occupied the same sites abandoned by Majiayao precessors, e.g., the Qijia dwellings at Wajiaping just beside the Majiayao site (Pei W.Z. 1987:240-1). Likewise, typological studies of Qijia pottery also indicate that the early phase of the Qijia community was mainly centered in some river valleys in the eastern edge of Qinghai-Tibetan Plateau, that is, the Huang-Yellow River valley (e.g., the Liuwan site) (Shui T. 2001; Zhang Z.P. 1987).

The similarity in subsistence economy between the contemporaneous Machang and Qijia communities in the Huang-Yellow River valley may have resulted in unavoidable competition over agricultural resources. Hence, later incoming Qijia communities were destined to be marginalized in social and economic niches under the primacy principle. Some of them had to occupy the upper range of the river valley at a higher elevation, e.g., the sites at Changning, Jinchankou, and Gamatai, than their Machang contemporaries who predominated in the Huang River valley. Taking the upper Yellow River valley as an example, archaeological remains of the Machang phase are absent west of the Guide Basin, while Qijia cultural remains have been found as far west as Guinan and the Gonghe Basin near Tongde, just 100 km north of the mountainous glaciers that provide the source water for the Yellow River (GJWWJ 1996). Interestingly, in most of those marginal areas, the earlier cultural markers of the Majiayao phase have also been found—a cultural superimposition pattern similar to that observed in the Tao River valley. The temporal gap between the Majiayao phase (3000-2700 BC) and the Qijia culture (2300-1500 BC) excludes any direct transmission of social knowledge from the former to the latter, and thus favors the notion that Qijia communities settled here due to ecologically based choices for their subsistence economy. The Tao River valley did not accommodate a dense population until the end of the third millennium BC, as indicated by a series of Qijia sites dated to the middle to late phase of the Qijia culture in this region, such as the sites at Dahezhuang, Qinweijia, and Qijiaping etc. The retreat of Qijia communities back to the Tao River valley, I argue, primarily resulted from social tensions with contemporary Machang communities in the north that were probably spurred by climate change at the turn of the third to the second millennium BC in this area (An C.B. et.al 2003). The movement of Qijia communities towards more marginal or deserted areas leads directly to cultural connections among previously isolated areas, for example, between the Hexi corridor and the Huang River valley by way of the Biandu Pass through the Qilian Mountains. Meanwhile, the occupation of montane valleys by Qijia communities also made the exploration of vertical ecological belts possible, which in turn provided more diversity in the structure of the subsistence economy than in contemporary Machang communities who mainly subsisted on cereals and swine in riverine plains or oases. Economic diversity increased economic resilience and sustainability; moreover, it also prompted the logistic mobility[1] of Qijia communities between different ecological niches, and thus channeled Qijia communities into various scenarios of contact with other social groups, such as hunter-gatherers and early pastoralists in more remote regions.

[1] The concept of logistic mobility was first proposed by Binford (1980) to describe a pattern of mobility for hunter-gatherer groups in which only segments of the band, or a small groups of people, travel in search of resources. The counterpart of logistic mobility is residential mobility.

VII.3 Taking advantage of marginality: Qijia trade diasporas

Above, I briefly explained how the social marginality of Qijia communities led to a pattern of population mobility and new social dynamics with contemporaries on a regional scale. However, logistic mobility motivated by the needs of the subsistence economy cannot explain some quite “bizarre” outliers beyond the heartland of the Qijia communities. It is those Qijia outliers that substantially defined the cultural connectivity of the Qijia community. Examples include the site of Huangniangniangtai in the eastern Hexi corridor, the isolated Qijia hoards found at the foothills of Helan Mountain, and the sparse Qijia communities transplanted in the northern Loess Plateau at the site of Zhukaigou (Figure VII.3:6). Highly uniform pottery assemblages (e.g., amphora beakers, jars with angled shoulders) with typical Qijia signatures (e.g., reddish pottery color, polished surface and fine clay paste) as well as unique burial practices (e.g., extended male paired with flexed female in double burial) found in those sites clearly show their Qijia identity. Previous studies have already observed the wide distribution of Qijia remains in Northwest China and material connections with neighboring areas by traditional typology or descriptive comparisons (Chen X.S. 2012; Fitzgerald-Huber 1995, 2003; Ma M.Z. 2009; Mei J.J. 2003; Zhang Z.P. 1987). Nevertheless, no model has been proposed to answer the questions of how and why the Qijia material culture is patterned in such a way. Following, I would like to apply an alternative socio-economic perspective, that is, the trade diaspora[1] model (Chen P.C. 2014; Cohen 1969; Stein 2002), to the interpretation of Qijia cultural patterns and try to develop a more nuanced understanding of cultural interactions and possible underlying socio-cultural mechanisms through the study of material culture.

[1] The classic use of the word, usually capitalized as Diaspora and used only in the singular form, was mainly confined to the study of the Jewish case. The classical meaning of diaspora was systematically expanded since the 1960s and 1970s. For more background introduction on the concept of diaspora, please see Cohen (2008), Chapter 1.

VII.4 Qijia trade diasporas: archaeological evidence

In archaeological practice, the identification of trade diaspora is not ao easy as simply following Abner Cohen's precise definition of trade diaspora (Chapter II) and then finding corresponding material evidence. Cohen's definition only works in ethnographic context. Therefore, a broad and loose definition of trade diaspora is preferred in archaeological practice: a trade diaspora is a socially independent, spatially dispersed, and economically engaged community. The first two criteria are quite straightforward in an archaeological context, while the third probably needs further explanation. I argue, an economically engaged community is mainly defined by the following aspects, if not coterminous with them: 1) the location of the community is critical to raw material procurement, population movement and transportation of goods; 2) community members are closely engaged in economic processes, e.g., specialized craft production, circulation of exotic goods and consumption of goods derived from regional or inter-regional trade; 3) some community members may accumulate certain amounts of social wealth and thus social differentiation may emerge. According to these standards, due to the quality and completeness of published data, only a few Qijia sites are examined and identified as trade diasporas. Nevertheless, it does not necessarily mean they are the only trade diasporas druing the Qijia phase. This case study, inspired by Chen's (2014) groundbreaking application of the trade diaspora model in Chinese archaeology, is a tentative interpretation of the Chinese data by providing an alternative perspective to the cultural- historical paradigm, under which cultural element analysis—the extension of typology at its best—is the only methodological option for addressing cross-cultural interaction issues.

VII.4.1 The Qijia diaspora at Huangniangniangtai

The Huangniangniangtai site is located in the village of Huangniangniangtai, Liangzhou district, 2.5 km northwest of Wuwei city (Figure VII.3:3), the eastern gateway of the Hexi corridor. It was first discovered in a surface survey in 1957 and underwent four excavations in 1957, 1959 and 1975 (GB 1960b, 1978). The data published for the first three excavations are quite brief, and thus many details are not retrievable based on published reports (even a plan of the excavation area is absent). Most of the data analyzed in this section comes from the report of the fourth excavation published in 1978. Based on all available data, the site at Huangniangniangtai is a multi-component site covering a time period from the end of the third millennium to the beginning of the second millennium BC. The first three excavations yielded 26 tombs, 42 ash pits and 5 dwellings with plastered living floors and large amounts of artifacts made of pottery, stone, bone and copper (Figure VII.4).

Among the painted pottery vessels are some with unique painted motifs for which one cannot find exact parallels in either the typical Qijia or the Majiayao culture (Machang phase), such as the painted pottery with rhomboid motifs filled with net-patterned painting (Figure IV.5:5-7) that was first proposed as the "Transitional Type" (Li S.C. 1993) and assumed to be the remains of the transitional period from the late Machang to the early Siba culture. Recently it has been officially termed the Xichengyi culture due to the excavation of the site of Xichengyi (Figure VII.3:4) in Zhangye (GSWKY 2014; Li S.C. 2014). The coexistence of Xichengyi style painted pottery with typical Qijia amphorae in archaeological contexts clearly indicates their contemporariness. That means that the Qijia culture, for a quite long time, overlapped with the late phase of the Machang culture and the Xichengyi culture. The combination of typical Xichengyi motifs with the unmistakable Qijia amphora design in some examples clearly shows evidence of hybridization among Qijia diasporas at Huangniangniangtai in the Hexi corridor (Figure VII.3:3). The Qijia community, non-painted pottery users, apparently adopted the painted pottery tradition of the local Machang-Xichengyi communities when they moved into the Hexi corridor. Interestingly, the hybridized Qijia amphora was first found in the Liuwan cemetery, a major transplanted Qijia community transplant in the Huang River valley. A similar painted amphora beaker (Figure VII.5:2) unearthed at the site of Huangniangniangtai was found in a dwelling context (F8), dated to the earliest phase of occupation. The fact is that this kind of hybridized Qijia amphora has never been found in the Tao-Daxia River valley heartland. The uniqueness and blending in style as well as the restricted use context of these quintessentially Qijia amphora beakers, define the Qijia community at the site of Huangniangniangtai as a diasporic community.

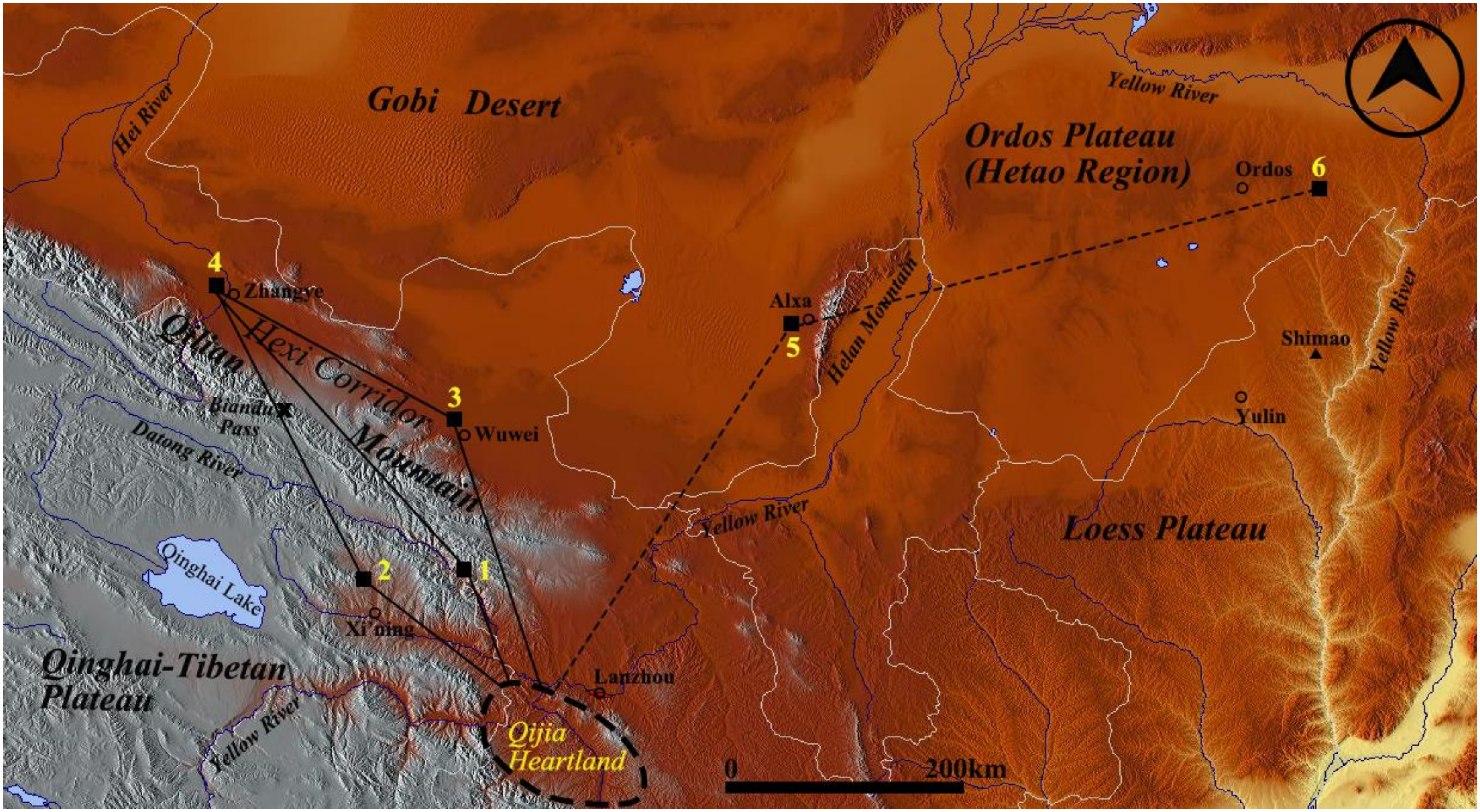

Figure VII.3 Major Qijia diasporas (solid square) and their conceptual connections with the Qijia heartland

(1. Jinchankou 2. Changning 3. Huangniangniangtai 4. Xichengyi 5. Lujuanshan 6. Zhukaigou)

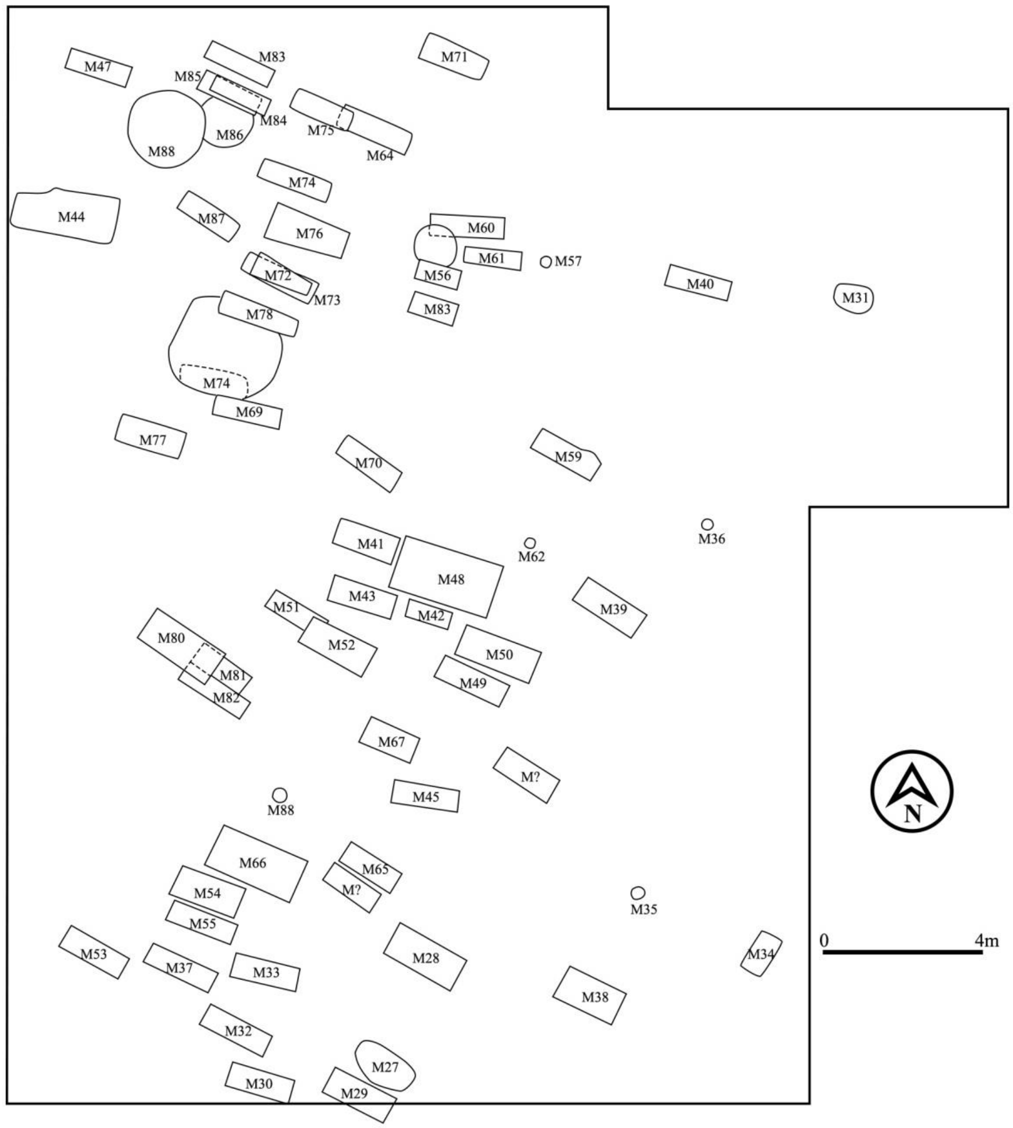

Figure VII.4 Plan of Huangniangniangtai cemetery

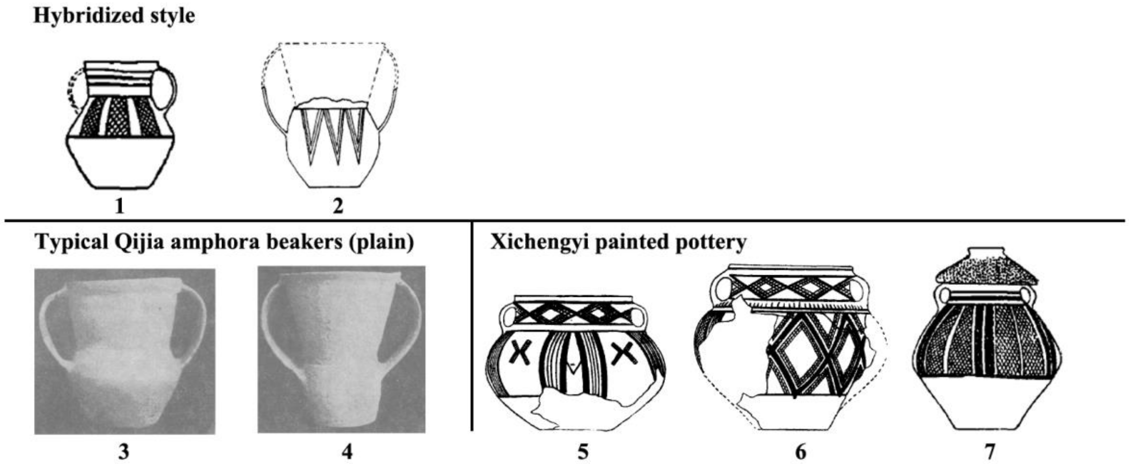

Figure VII.5 Pottery assemblage unearthed from Huangniangniangtai cemetery

(1,7. unknown provenience; 2. F8:6; 3,4 tomb 24; 5,6. tomb 6)
(1,7 after GB 1960a, figure 7:4,5; 2 after GB 1978, figure 20:9; 3,4 after GB 1960b, plate 5:1,2; 5,6 after GB 1960b, figure 10:1,4)

Besides pottery remains, a small number of copper objects were also found. Most of them were tools and ornaments such as awls, knives, scrapers and rings (Figure VII.6). None was unique in the Xichengyi metallurgical repertoire. Moreover, no evidence of metallurgical production (e.g., copper ores, smelting furnaces, slags, or molds) has been reported either from the Huangniangniangtai site or from any other type sites in the heartland of the Qijia culture. Chemical analysis of metal components shows that all of these objects were made of pure copper with trace impurities, which agrees with the technological characteristics of metal objects found in the metallurgical center at Xichengyi (Chen G.K et.al 2015). The absence of local metallurgical production and high uniformity in shape and chemical components indicate that the metal objects found at Huangniangniangtai were probably imported from western neighbors – the metallurgical community represented by the Xichengyi culture. Statistical analysis of unearthed copper objects in terms of quantity displays a spatial pattern of fall-off abundance correlated with distance from source (Figure VII.7), a clear indicator of the trade of metal objects by Qijia diasporic communities.

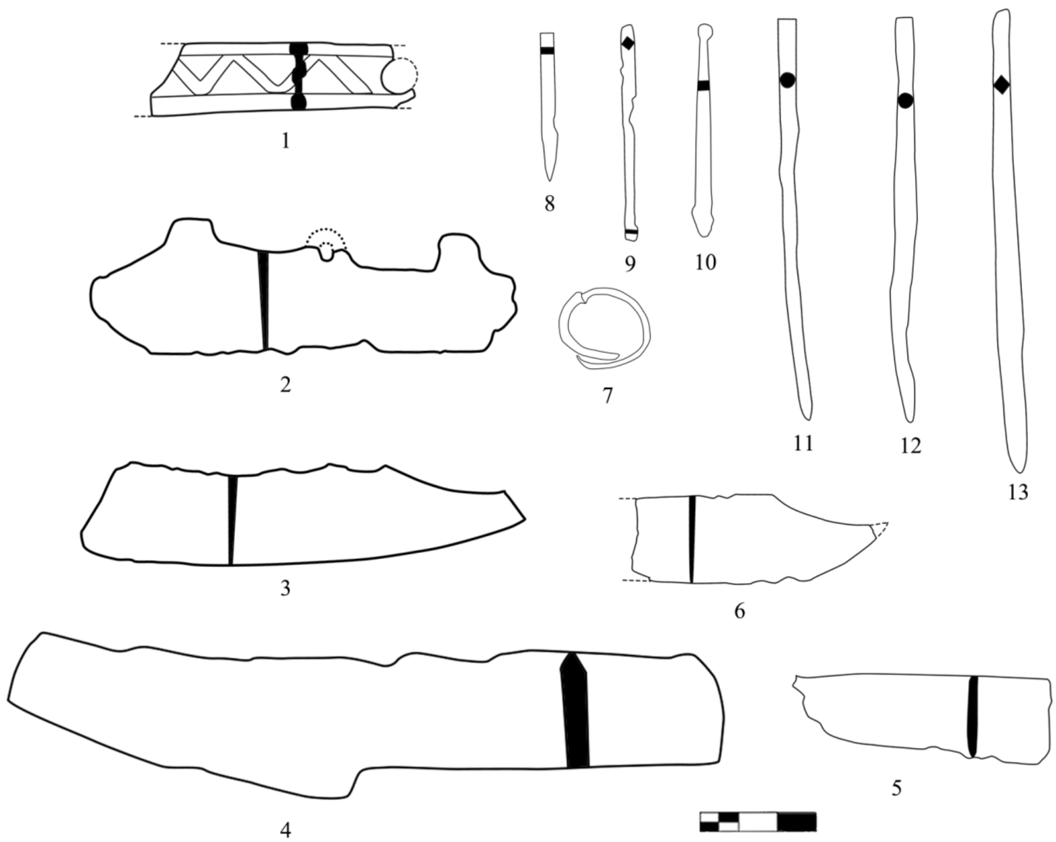

Figure VII.6 Copper assemblage unearthed from Huangniangniangtai cemetery

(1. Knife hilt 2. Leather scraper[1] 3-6. Knives 7. Finger ring 8-13. Awls)
(4,5,10 after GB 1978; the rest after GB 1960b)

[1] For the functional inference of this knife-shaped object and its hafting method please refer to Chapter VIII.

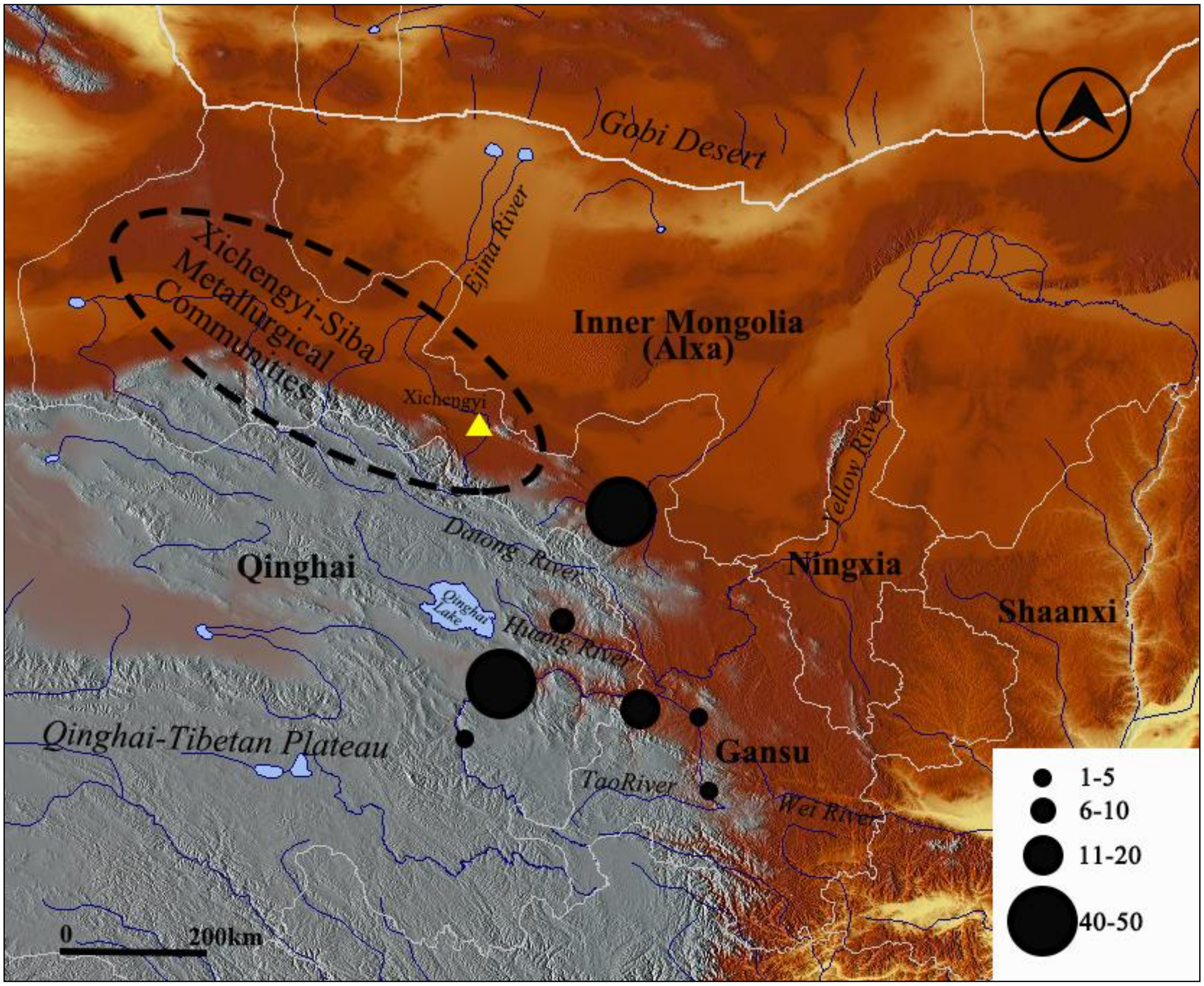

Figure VII.7 Spatial distribution of copper objects in Bronze Age Northwest China

(The location of the metallurgical center at Xichengyi is highlighted by a yellow triangle)
(Data source: Liu X.T. and Li W.Y. 2007:13-15, table 3)

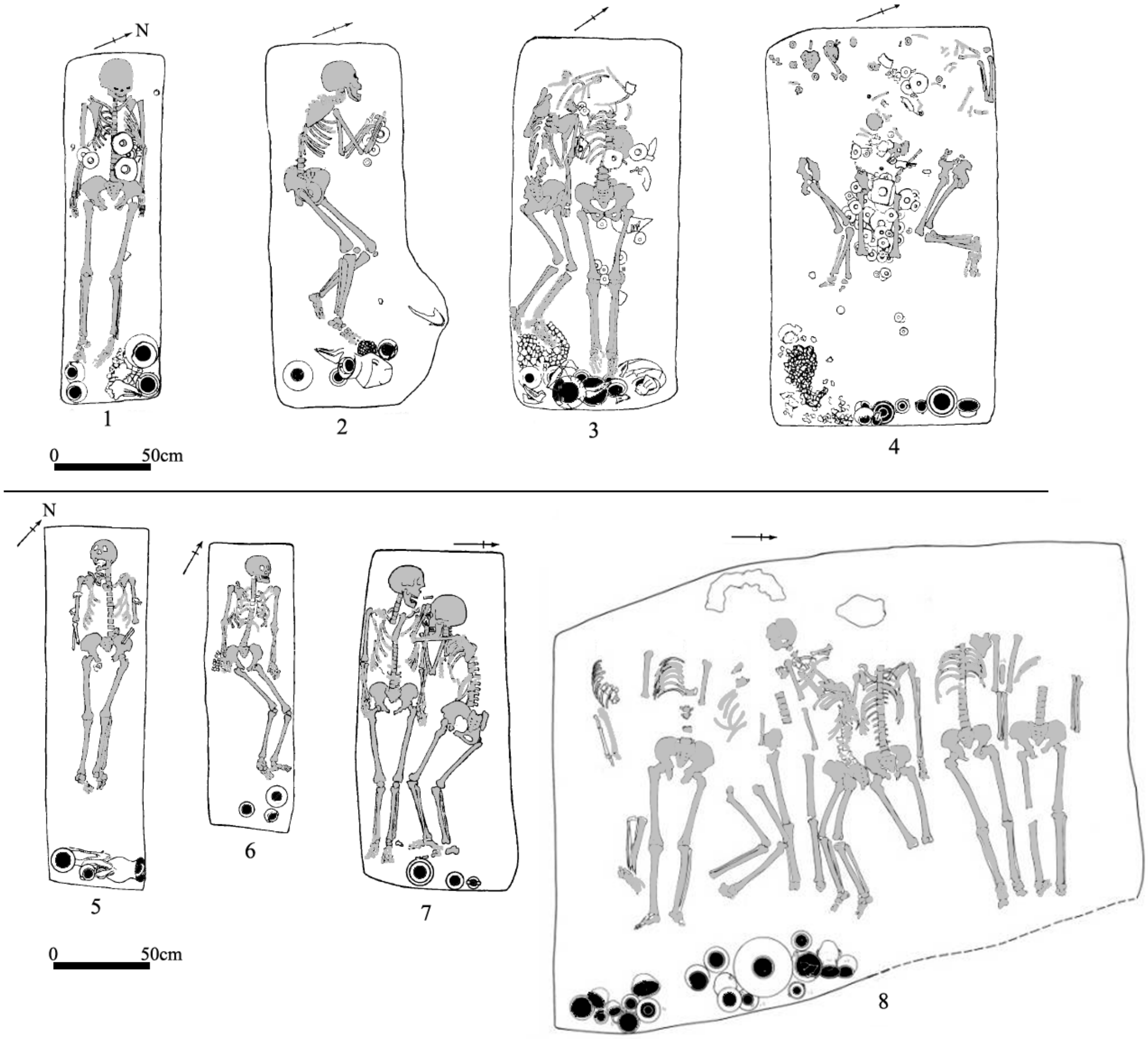

Figure VII.8 Comparison of burial practices of the Qijia diaspora (upper row) and heartland (lower row)

(1-4. Huangniangniangtai cemetery: M83, M59, M52, M48. After GB 1978;
5-7. Qinweijia cemetery: M89, M56, M105. After ZKKYGG 1975;
8. Qijiaping cemetery: M110. After Chen P. 2013)

VII.4.2 Social differentiation in the Qijia diaspora

The burial practices found at Huangniangniangtai, as with the material culture, displays similarity as well as uniqueness with counterparts in the heartland. Compared with the typical Qijia burial practice found among the type sites at Dahezhuang, Qinweijia and Qijiaping, the burials at Huangniangniangtai show no difference in form: pit tombs, single burial in extended position with a northwest primary orientation, a small percentage of joint burials, male-dominated burial representation in multiple burials of two sexes (male in an extended position with face up, with the female always flexed facing the male deceased), burials with faunal remains (mainly pig mandibles, sometimes sheep or dog skulls, or sheep/goat scapular for scapulimancy), in addition to burials with regular pottery vessels (Figure VII.8). The content of burials at Huangniangniangtai, however, immediately stands out from heartland counterparts in the quality and quantity of valuable grave goods; the deposition of stone disks and stone tokens is primarily practiced at Huangniangniangtai (Figure VII.8:1-4). These disks are usually made of jade-like rock andwere processed by labor-intensive techniques (Figure VII.9). The same well-selected materials were also used for stone tokens, originally stored in a textile or leather pouch and then placed at the feet of the deceased as a symbol of personal wealth (Figure VII.8:3,4). Based on preliminary statistics and comparison with contemporaries in the heartland, this special burial repertoire is a clear signal of social differentiation in this diasporic community.

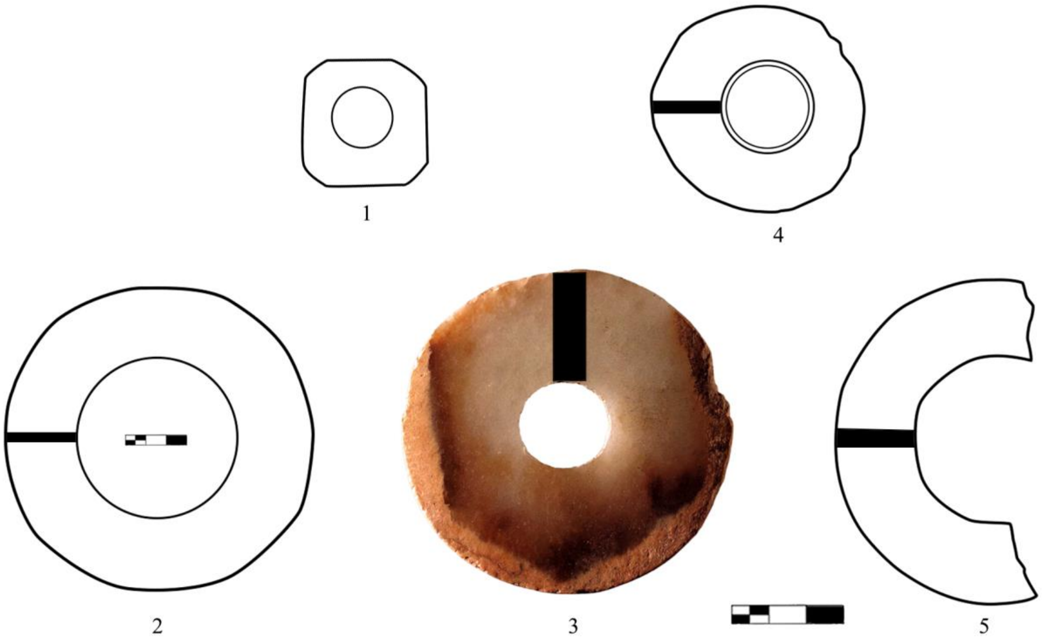

Figure VII.9 Jade objects unearthed from Qijia burials

(1,2. Haizangsi[1]; 3-5. Huangniangniangtai)
(1,2 after Liang X.Y. and Liu M.D. 1993; 3 after GB 2006, pp.63; 4,5 after Yang B.D. 2005, figure 54)

The statistics on 43 single burials at Huangniangniangtai shows that there are mainly five categories of high quantity grave goods: stone tokens (frequency of occurrence: 505), pottery vessels (111), stone disk (52), pig mandibles (17) and turquoise beads (11). Among them, a significant correlation is detected between stone disks and stone tokens. Spearman's rank correlation *rho* is estimated at 0.44 (p-value=0.003<0.05). Correlation tests on the pairs of stone disks and pig mandibles (p-value=0.25>0.05) as well as stone tokens and pig mandibles (p-value=0.1>0.05) all suggest insignificant correlations. The Fisher's Exact Test on stone disks and pig mandibles also yields a high p-value (0.126>0.05), which suggests that they are probably

[1] The dimensions of No.1 jade disk is absent in the original report. The scale given on the lower right only applies to the jade objects from Huangniangniangtai (No.3-5).

independent. If the deposition of pig mandibles and valuable stone objects in the burials is an indicator of certain social dimensions that could correlate to the social status of the deceased, then we could argue that pig mandibles and valuable stone objects stand for different or independent social dimensions, e.g., social rank, social prestige, personal wealth etc. Correspondence analysis shows that there is clearly differentiation in the quantity of grave goods among these 43 single burials (Figure VII.10). Tomb 59, for example, includes 11 stone disks and 62 stone tokens for an adult, while 11 adult tombs have no grave goods. Likewise, cluster analysis of all burials indicates that valuable stone objects and other major categories of grave goods are mainly concentrated in a small number of burials, most of which are multiple burials (Figure VII.11). Burial 48, for instance, containing three deceased adults, yields the largest number of valuable stone objects (83 stone disks and 304 stone tokens) in the whole cemetery (Figure VII.8:4).

Social differentiation throughout the Qijia diaspora at Huangniangniangtai also contrasts significantly with contemporaries in the heartland. In the case of the Qinweijia cemetery, grave goods are mainly made up of production tools and faunal remains. No differentiation can be observed based on the quantity and quality of the highly homogeneous grave repertoire (Figure VII.12). This pattern also exists at the cemetery of Dahezhuang (Figure VII.13). Valuable objects commonly found at Huangniangniangtai are very rare in the heartland: only two stone disks are found among 138 burials at Qinweijia, while none is found at Dahezhuang cemetery. If those stone objects were fungible goods, we could argue that the Qijia diasporic community had more access to social wealth than their heartland peers.

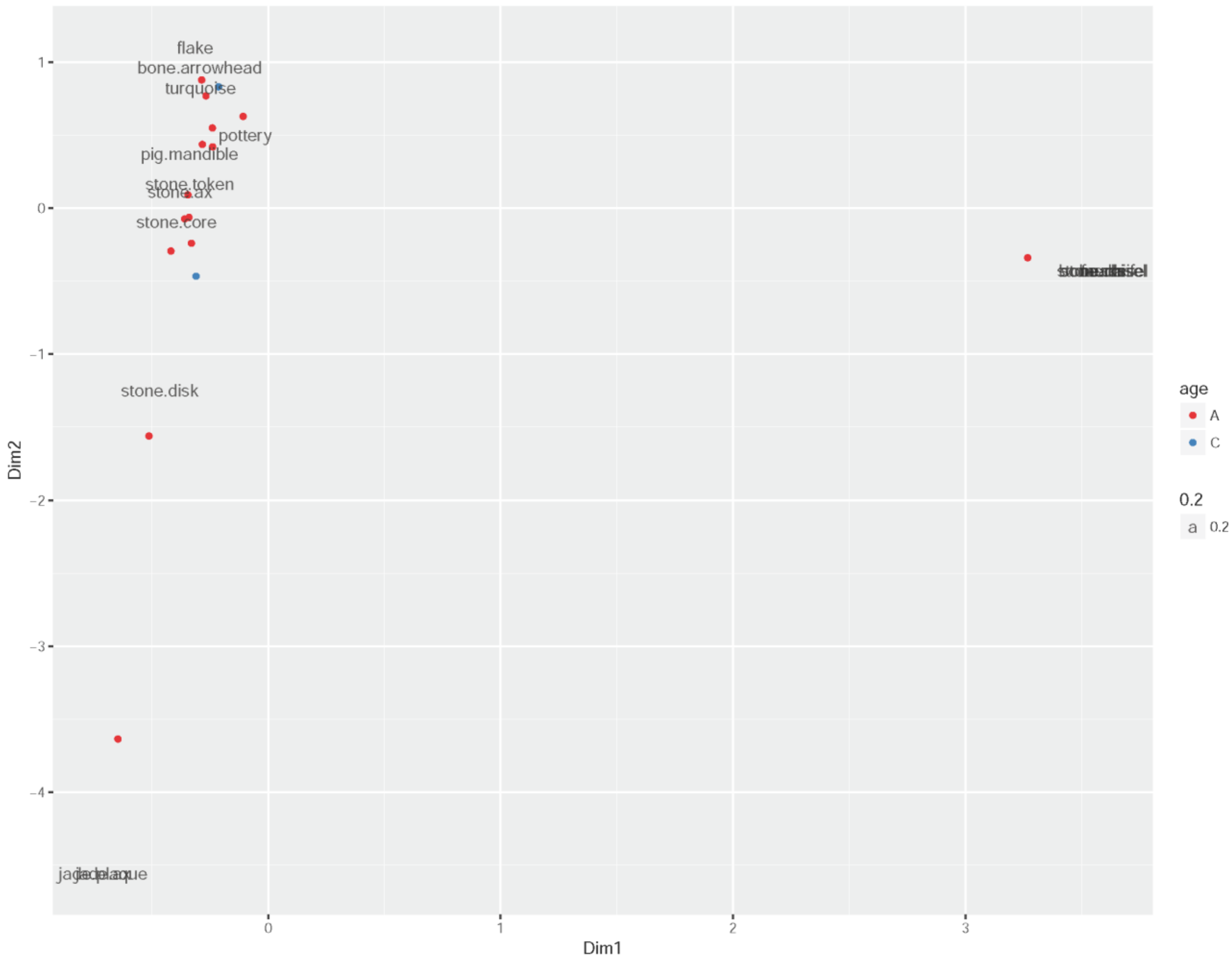

Figure VII.10 Correspondence plot of grave goods at Huangniangniangtai cemetery

VII.4.3 Craft production at Huangniangniangtai

The intra-/inter-community economic differentiation observed above, I argue, directly results from regional economic activities in which the Qijia traders played an important role. Besides imported goods commonly found in the Qijia diasporic community, there is also other archaeological evidence to show how the Qijia diaspora community actively engaged in the regional economy. One of the most convincing pieces of evidence is the lapidary production (probably specialized) of the Qijia diaspora at Huangniangniangtai, a relative complete technological process (*Chaîne opératoire*) reflected by archaeological evidence.

Among the 26 tombs recovered in the first three excavations, stone disks are commonly buried with the deceased. Most of them are made of green stone with nephrite-like physical properties. In addition, in some cases stone slabs of white or green color are laid beneath the extremities of the deceased (GB 1960:56). Although more details on those stone slabs are not given in the brief report, similar remains encountered in later excavations indicate that those stone slabs were actually raw materials, or blanks, for lapidary production, indicated by clear scoring-snapping traces (GB 1978:431). In tomb 40 recovered in 1975, three raw stone slabs were placed on both the hands and hip, in addition to a stone disk on the chest, of the deceased. The same arrangement was also found in tomb 32, 52 and 76 (GB 1978:425).In tomb 83 one stone core, the by-product of core drilling for perforation on stone disks, is found around the left shoulder of the deceased together with other 6 stone disks (GB 1978:426). It is reported that 14 other stone cores were also found in burials or midden pits. This combination of raw stone/jade slabs, cores and finished stone disks all suggests that the complete reduction sequence of stone/jade disks existed at Huangniangniangtai.

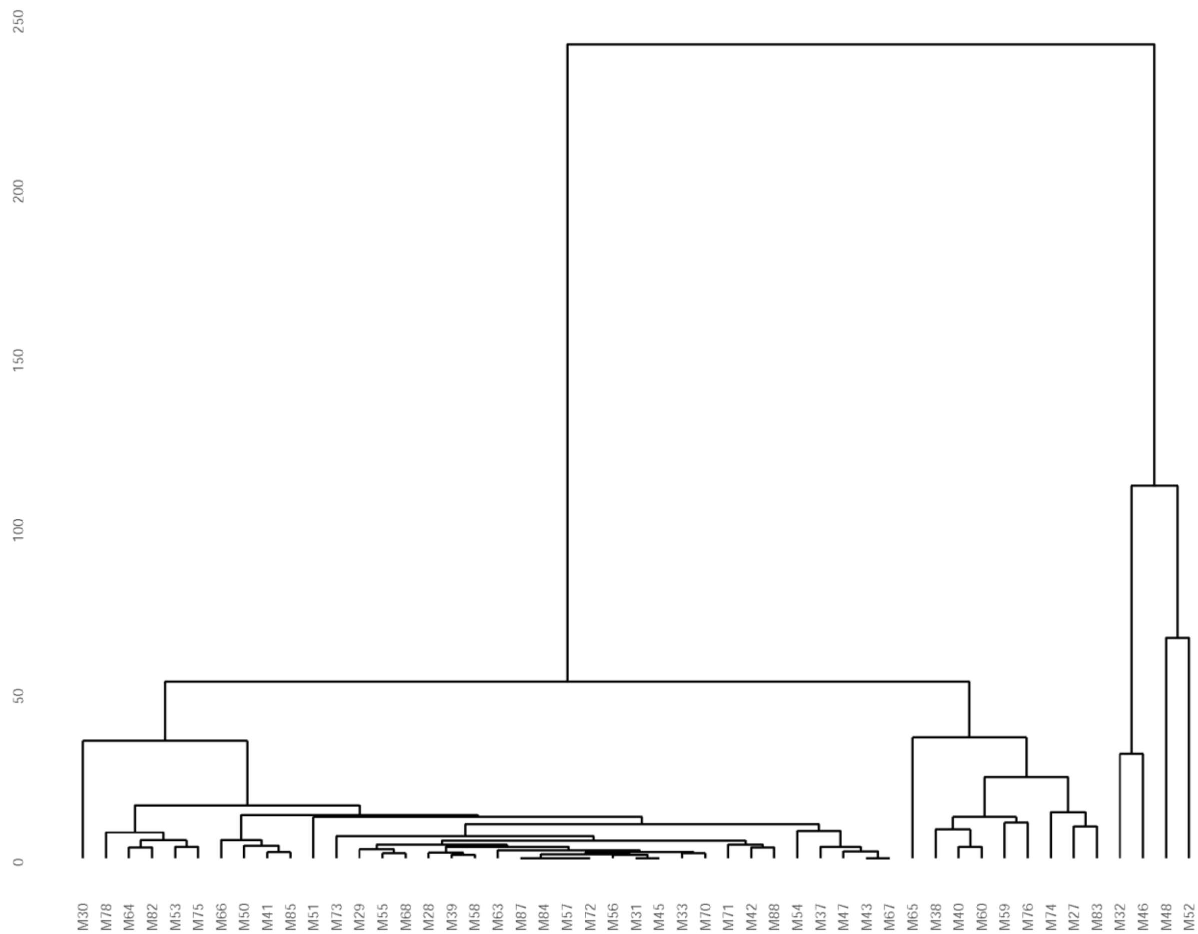

Figure VII.11 Cluster of burials according to the quantity of grave goods at Huangniangniangtai cemetery (including all burial cases with grave goods)

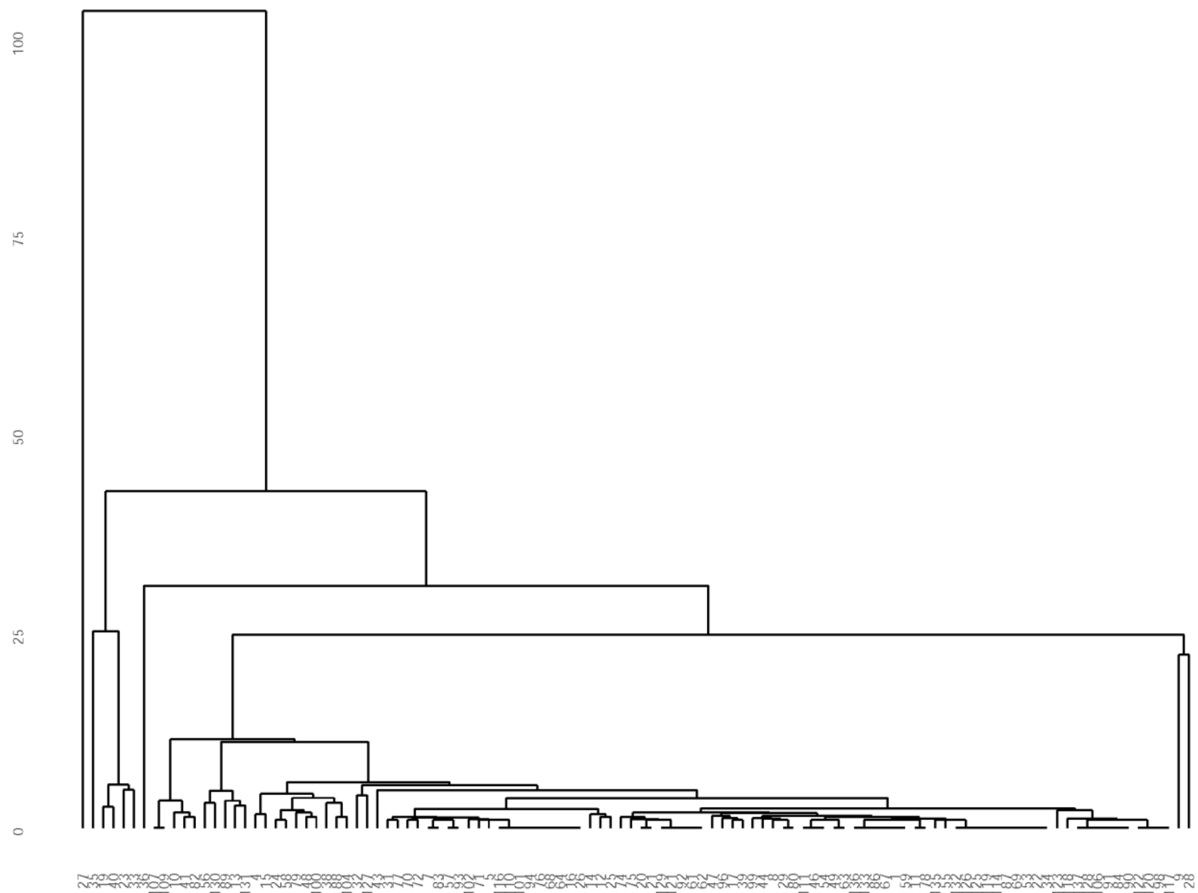

Figure VII.12 Cluster of burials at Qinweijia based on the quantity of grave goods

As for the direct archaeological evidence of lapidary workshops, whether or not a lapidary workshop existed is still unknown for the moment due to the limited excavation area at Huangniangniangtai. Nevertheless, it is noteworthy to mention one stray find at Haizangsi, less than 2 km northeast of Huangniangniangtai. It was discovered by chance during the construction of an artificial lake near the Haizang River in 1983-1985 (Figure VII.14). The unearthed assemblage of artifacts shows great similarity with those at Huangniangniangtai and thus is cross-dated to the Qijia period. A complete assemblage including pottery, stone, copper, jade and bone objects suggests that they were originally deposited in a mortuary context, rather than evidence of a lapidary workshop as alleged by the authors (Liang X.Y. and Liu M.D. 1993). More interestingly, the retrieved jade objects, accounting for the largest percentage among all objects, also cover the complete operational sequence of lapidary production: raw nephrite, blanks, half-finished products, debitage and finished products including disks, bracelet, adzes, axes and knives etc. The re-occurrence of archaeological evidence indicating the whole reduction sequence of jade objects at Huangniangniangtai and adjacent Haizangsi suggests that there must have been specialized lapidary workshops in the Qijia diasporic community. Raw nephrite could have been mined from the Qilian Mountains in the south or some potential nephrite mines further west of the Hexi corridor, such as the nephrite mine uncovered at Mazongshan (GSWKY et.al 2010). However, the processing of raw nephrite was locally conducted. Considering the high labor and time investment needed for jade reduction, the finished products were probably exchanged and circulated in a regional trading network.

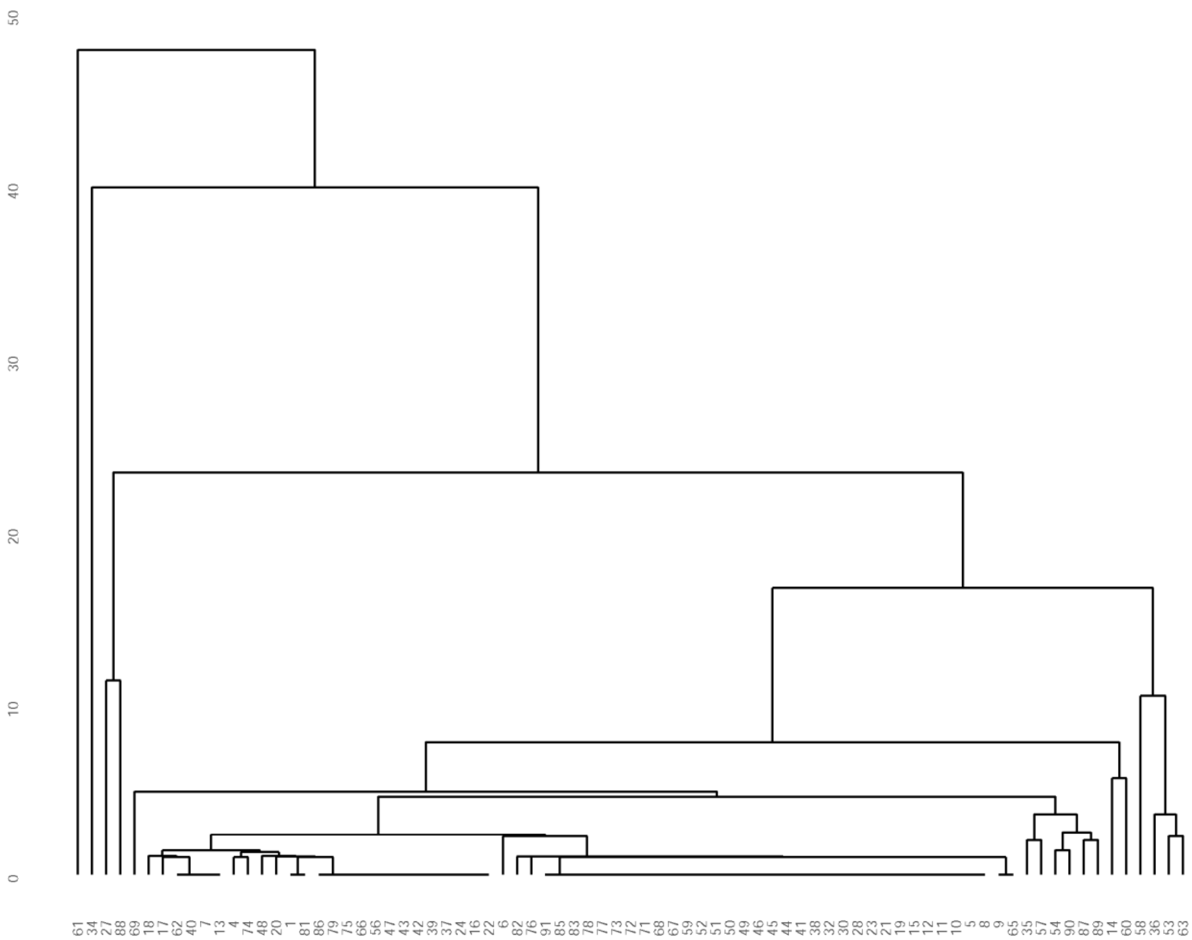

Figure VII.13 Cluster of burials at Dahezhuang based on the quantity of grave goods

Due to the absence of a lapidary workshop in archaeological context, the scale, density and intensity of lapidary production in the Qijia diasporic community is still unclear. However, the large number of jade objects found in mortuary contexts predicts specialized lapidary craft somewhere in proximity to Huangniangniangtai and Haizangsi. Meanwhile, we also need to keep in mind that lapidary production could not have been the only specialized craft among the Qijia diasporic communities. Other categories of material culture with low archaeological visibility should not be neglected, such as textile, leather, wood (including lacquerware), food, drink and

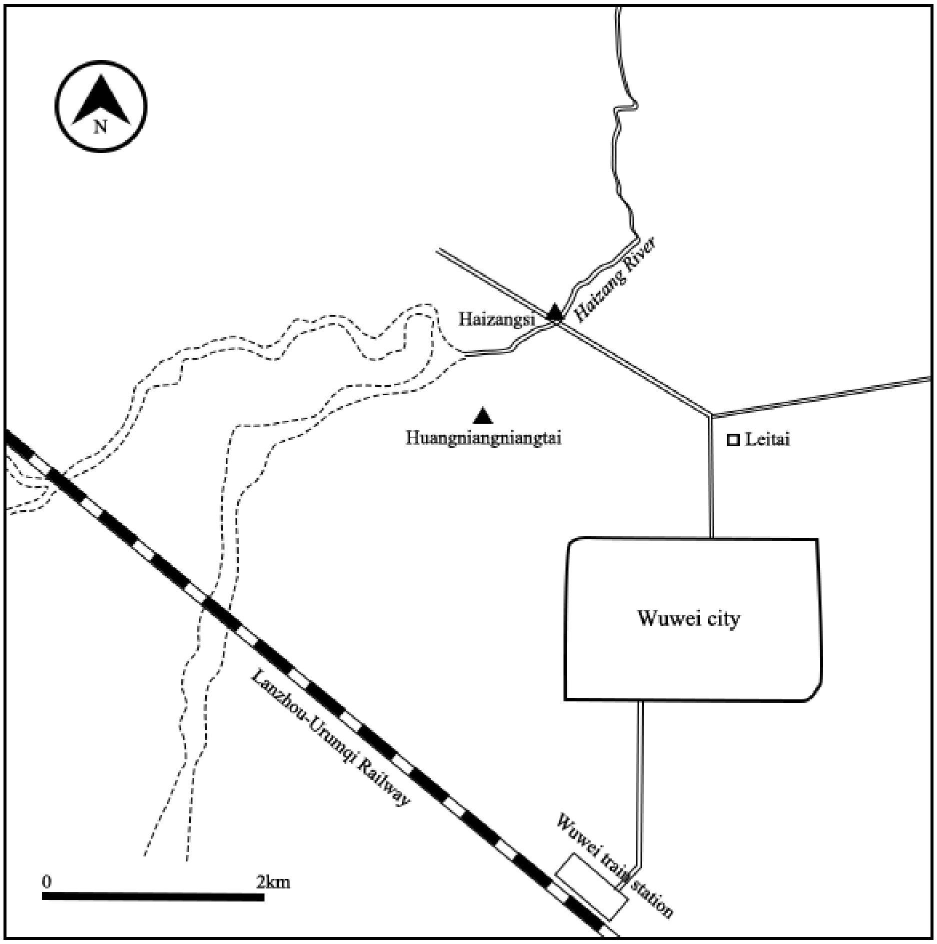

Figure VII.14 Location of Huangniangniangtai and Haizangsi

necessary ingredients (e.g., salt). So far, surviving direct evidence of textiles from the Qijia period has been observed through impressions or fragments on the surface of unearthed pottery vessels at Dahezhuang (Figure VII.15). The textile material is inferred as hemp, an important economic crop cultivated since the Majiayao period (3300-2700BC) (XSXZY and GB 1984). The pattern of weaving is a plain weave with single warp and weft. The thread count per square centimeter is 11 warps by 11 wefts. A more dense thread count is observed on another finer fragment (ZKKYGG 1974:57). However, in most cases, indirect evidence of textile craft, e.g., spindle whorls, is more present in burials and dwelling sites. Due to the absence of evidence, the type of loom (horizontal or vertical) used for textile weaving and the scale of textile production (e.g., individual, household, community) cannot be inferred for the moment. As for the raw material used for textiles, besides hemp as the traditional source of fiber, we should not lose sight of another important material: wool, which could have been exploited by oasis farmers practicing a mixed economy no later than the early second millennium BC. A recent study on the faunal remains unearthed from the Siba horizon (1680-1530 BC) at Xichengyi indicates a much older kill-off age among domestic sheep and thus suggests that the exploitation of secondary products, such as wool and dairy, rather than the procurement of meat was the primary purpose for sheep farming (Song Y.B. et al. 2016).

1

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Figure VII.15 Textile imprints on the surface of Qijia amphora from Dahezhuang

(1. M34:6 2. M75:1. After ZKKYGG 1974, plate 6)

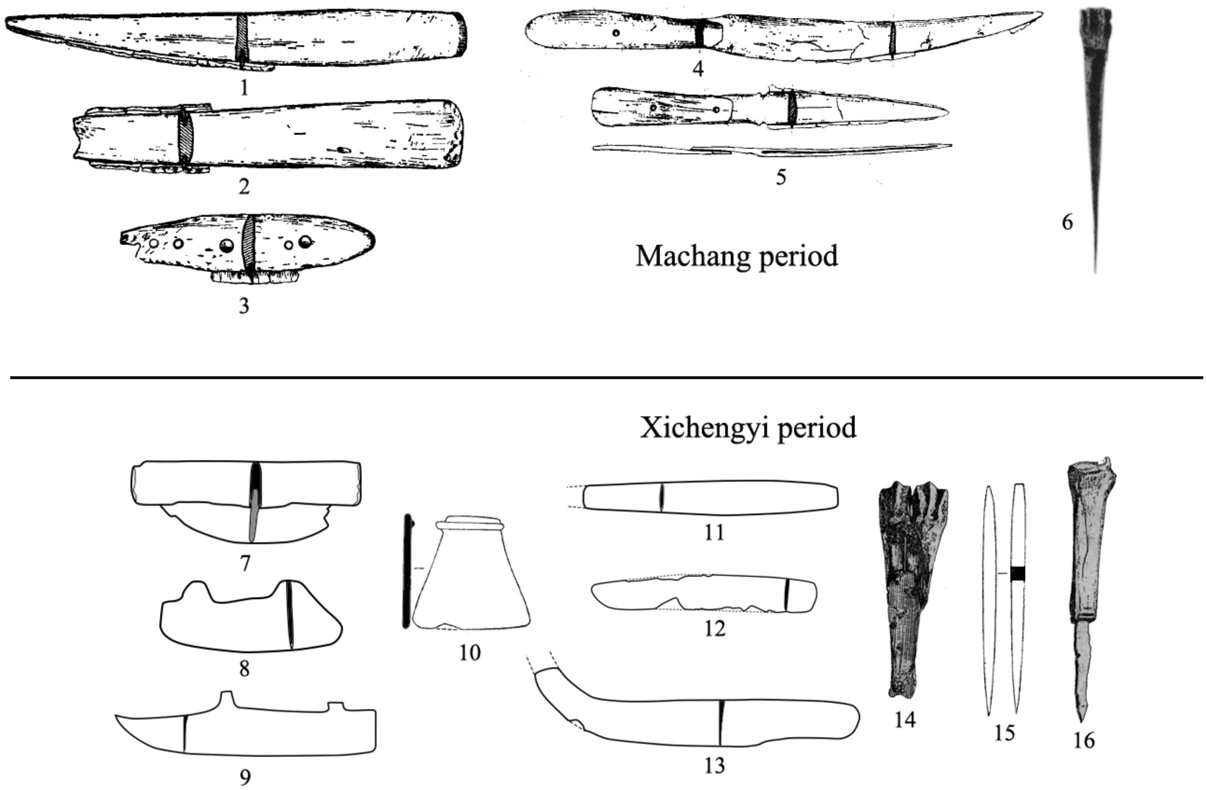

Figure VII.16 Leatherworking toolkits in the Machang and Xichengyi periods

(1,4.Microlithic knives 2,5. Microlithic daggers 3. Microlithic scraper 6. Bone awl
7-10,13. Copper scrapers 11,12,14. Copper knives 15,16. Copper awls)
(1-6. Yuanyangchi, Yongchang 7. Weijiataizi (Qinweijia),Yongjing 8,9,13. Tianshanbeilu, Hami 10,15. Qinweijia, Yongjing 11,12,14,16. Zongzhai, Huzhu. 1-3 after GB and WDWP 1982,figure 17; 6 after GB and WDWP 1982, plate 15; 4,5 after GB and WDWP 1974, figure 10; 7,9 after Li S.C. 2003, figure 10; 8,13 after Lü et al. 2001, figure 15; 10,15 after ZKKYGG 1975, figure 12; 11,12,14,16 after QHWKD 1986, figure 8 and 9)

Apart from textiles, another category of material culture always invisible in archaeological context but necessary in prehistoric daily life is leather. So far there is no direct evidence of leather products from archaeological contexts of the Qijia period. Some potential indirect evidence could offer a crude picture of this important craft production. As mentioned in the following chapter, the curved knife commonly found in the Seima-Turbino metal assemblage was inferred as a scraper for leather processing. The same kind of metal scraper was also found in multiple Bronze Age sites in Northwest China, such as Tianshanbeilu in Hami, Huangniangniangtai, and Qinweijia (Figure VII.16:2, 7-9). This bone-mounted metal tool was the exact continuation of its composite microlithic precedent in the late Neolithic (Figure VII.16:1-5). Meanwhile, traditional microlithic technology still continued for quite a long time, as indicated by the persistence of microlithic remains in Qijia and Siba contexts. Based on the comparison of toolkits in the late Neolithic and early Bronze Age, it is clear that the new material of copper and its alloys was first applied to craft production (probably leatherworking) once the technology of metallurgy was available. This is also reflected by the predominance of categories of metal knives and awls in early Bronze Age Northwest China (Li S.C. 2005). Bone needles and awls are useful for sewing textiles, but they are less efficient than metal awls to work durable and flexible leather products. Early metal knives are diverse in typology, which suggests wide functional applications in daily life. Among them there is one distinctive type of metal knife commonly found in Bronze Age Northwest China: a metal knife with curved tip (Figure VII.16:7-9, 13).This kind of knife, I argue (see Chapter VIII.3), is a specialized metal tool for leatherworking. The curved tip is an ergonomical design for hafting when it is changed from top-mounted to side-mounted. This curved knife is designed to efficiently remove the membrane and grease off fresh animal skins without risk of damaging them.

Besides leatherworking toolkits, there is other possible indirect evidence of leather use in the Qijia diasporic community. As shown in some burials at Huangniangniangtai, a pile of stone tokens is always found at the feet of the deceased (Figure VII.8:3, 4). The stone token pile is so regularly shaped that they could only have been achieved by intentional arrangement or, more likely, originally stored in a leather pouch (or perhaps a textile pouch). The stone token pile superimposed on the feet of the deceased in tomb 52 at Huangniangniangtai (Figure VII.8:3) indicates the use of a leather pouch to store the stone tokens. Another later example from the Siba period, however, provides convincing indirect evidence of leather shoes with turned-up toes[1], as represented on an anthropomorphic pottery vessel from the Huoshaogou cemetery (Figure VI.15:4). More interestingly, the anthropomorphic figure standing with arms akimbo also represents textile clothing around the collar and hips. Textile clothing was depicted by a net or rhomboid patterned motif, which suddenly predominated among Xichengyi type painted pottery vessels. Inference from the painted motif makes especially good sense if we keep in mind that copper metallurgy reached a peak in the Xichengyi and following Siba periods. Traditional craft production of textile and leather was probably intensified by economic motivation to exchange for innovative metal products.

By archaeological analysis of material cultures at the site of Huangniangniangtai, I argue that the site represents a typical trade diaspora established by the Qijia community in a geographically important location: the eastern terminus of the Hexi corridor. A comparative study of the material culture suggests that the Qijia community at Huangniangniangtai had already developed cultural distinctiveness from heartland counterparts in a relatively marginal region. The occurrence of imported copper objects and other exotic goods indicates the economic engagement of the Qijia diaspora in a regional exchange network. Meanwhile, a relatively complete technological sequence reflected by jade objects suggests the possibility of local lapidary production, the products of which could have been circulated and exchanged for imported goods. This dynamic economic engagement brought about the accumulation of wealth and finally resulted in the emergence of social differentiation at both the intra- and the inter-

[1] This special style of shoes, based on ethnographic analogies commonly found in Central Balkans and other areas, is an adaptation to the rocky and mountainous environment. It is designed in such a way that can keep one from stubbing one's toes in the rocky terrain (Barber 1994:144-5).

community scales. The local development of metallurgy in the Hexi corridor since the end of the third millennium BC added a new economic dimension to the preexisting regional exchange network and intensified other craft productions, such as that of textile and leather. We may infer that the Qijia trade diaspora at Huangniangniangtai played an important role in the regional economic network.

VII.5 Interpreting the entangled Xichengyi and Qijia: a trade perspective

According to the tempo-spatial framework of Northwest China, we already knew that the Xichengyi culture and the Qijia culture overlapped temporally but were spatially discrete cultural entities. However, the nature of inter-cultural interaction and its underlying subtexts in the social, political, economic, ritual and ideological domains are beyond the reach of interpretation under a traditional cultural-historic paradigm. Alternatively, by placing this cultural-historical sequence into an anthropological explanatory framework, I argue that the cultural entanglement between the Xichengyi and Qijia cultures observed in their material cultures is an epiphenomenon of the expansion of regional trading networks. Different from the strategic trade diasporas established by Qijia traders, the sparse transplanted Qijia signatures into the heartland of the Xichengyi metallurgical community represent yet another economic strategy that the Qijia community used to cement its social well-being: trade partnerships or alliances.

VII.5.1 Xichengyi-Qijia trade alliance: archaeological evidence

The aforementioned cultural entanglement between the Xichengyi and Qijia communities, I argue, can be interpreted as the result of trade alliances or trade partnerships cemented by marriage exchange. The establishment of trade (and marriage) alliances with the Xichengyi community represents the strategic expansion of Qijia trade diaspora with the purpose of securing the supply of some extensively needed commodities, including raw materials (copper ores, nephrite, turquoise), metal products (tools and adornments), exotic goods (steatite beads, cowries etc.), foods (barley, wheat, sheep/goat), and other perishable craft products (leather, basketry, and textiles) transferred from more westerly regions by the Xichengyi communities. The Xichengyi communities, as the first people to acquire metallurgical know-how in Northwest China, had developed a sophisticated metallurgical industry. So far the earliest archaeological evidence of metallurgy in the Hexi corridor has been identified at the sites of Xichengyi in Zhangye, Ganggangwa and Huoshiliang in Jinta, and Xitugou in Dunhuang (Figure VII.17). Metallurgical remains such as copper ores, furnaces and crucible fragments, bellow nozzles, slags, and metal scraps found in these sites always coexist with the typical Xichengyi painted pottery assemblage (BKDYCY and GSWKY 2015; Chen G.K. 2017; GSWKY 2014). However, so far no metallurgical evidence has been found in the eastern part of the Hexi corridor, although some typical Xichengyi markers have been identified *in situ* with the Qijia assemblage (e.g., Wuba in Minle, Huangniangniangtai in Wuwei and Changning in Datong; Figure VII.17:1-3). Neither has any sound evidence of metallurgy been reported from any Qijia site in Central Gansu, the heartland of the Qijia culture with the highest occurrence in archaeological survey. The spatial pattern of the distribution of metallurgical loci and associated archaeological contexts has excluded any reason for involving the Qijia community in early metallurgical production in Northwest China[1].The Xichengyi community was the major agent responsible for the formation

[1] This does not exclude any possibility that the Qijia communities could have been involved in some *metalworking* activities such as the re-melting of finished objects and re-casting for their own needs, or modifying imported metal objects by hammer working.

of the Northwest China Metallurgical Focus, which was an organic component of the Eurasian Metallurgical Province (Chernykh 1992:194).

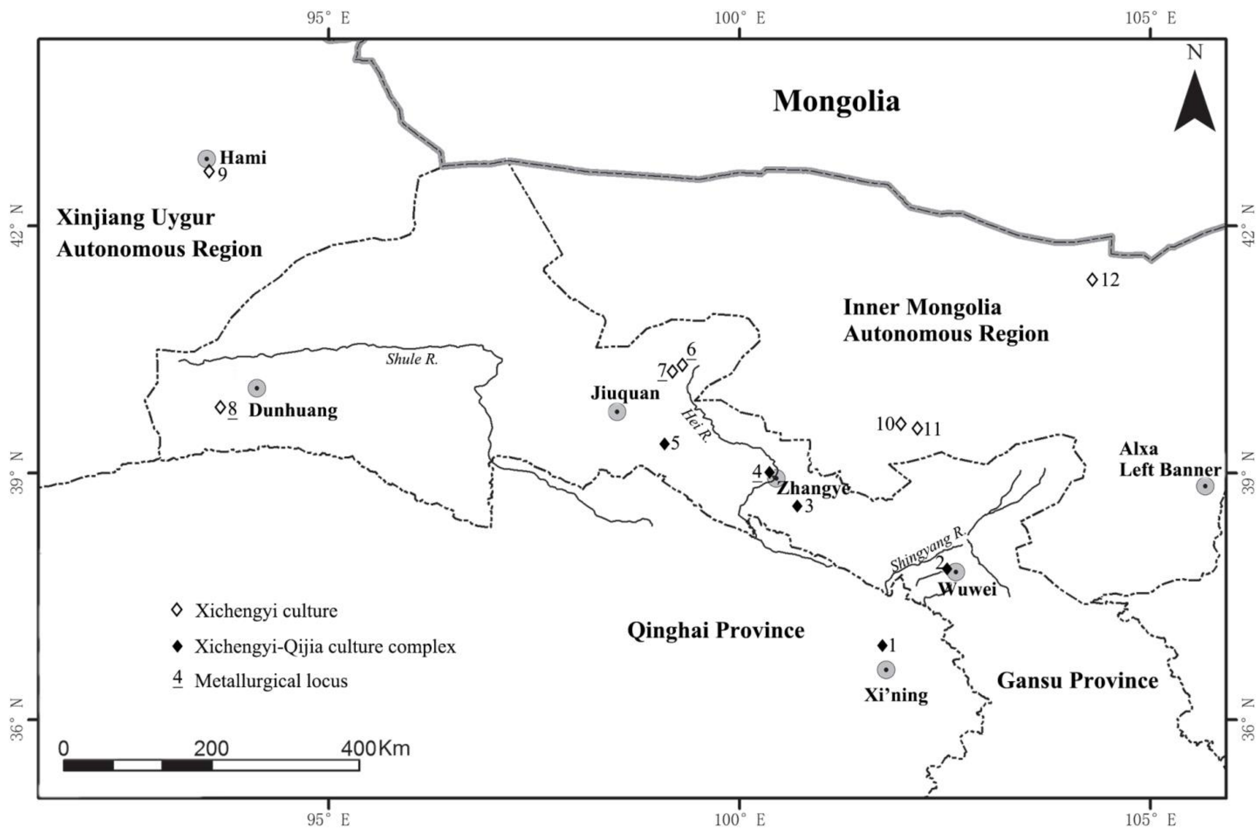

Figure VII.17 Location of Xicheng and Qijia sites in the Hexi corridor

(Qijia sites with sparse Xichengyi markers: 1. Changning 2. Huangniangniangtai; Xichengyi sites with sparse Qijia markers: 3. Wuba 4. Xichengyi 5.Xihetan; Xichengyi culture type sites: 6. Huoshiliang 7.Ganggangwa 8. Xitugou 9. Tianshanbeilu 10. Xidabusutu 11. Bilutu 12.Suhongtu. After Chen G.K. 2017)

Besides the type sites of Xichengyi culture found in the Hexi corridor, sparse amounts of typical Xichengyi remains have also been found in the Hami oasis further to the west (e.g., the Tianshanbeilu cemetery), on the southern edge of the Badan Jilin Desert (e.g., Xidabusutu, Bilutu), and in the Gobi-Desert (e.g., Suhongtu) (Figure VII.17:10-12). Although no archaeological matrix has been found associated with the Xichengyi remains in the latter two locations, painted pottery sherds dating to the late Majiayao phase (~2700 BC) found in the same locations suggest that a cultural connection had long been established between the Hexi corridor and the Gobi-Desert (BDKWX and NMGAB 2016; NMGWKY et al. 2014). The presence of typical Xichengyi painted sherds on the southern edge of the Gobi-Desert at the site of Suhongtu probably indicates that the Xichengyi specialist-traders were moving along the edge of the Badan Jilin-Gobi-Desert and were engaging in economic exchange with the pastoralists and hunter-gatherers living in the South Altai Mountains. This connection is also attested by evidence found in the Outer Mongolia Gobi-Desert, as indicated by the sparse occurrence of painted pottery sherds with typical Xichengyi motifs at the site of Tugrigiin-shirèt (Novgorodova 1989:60).

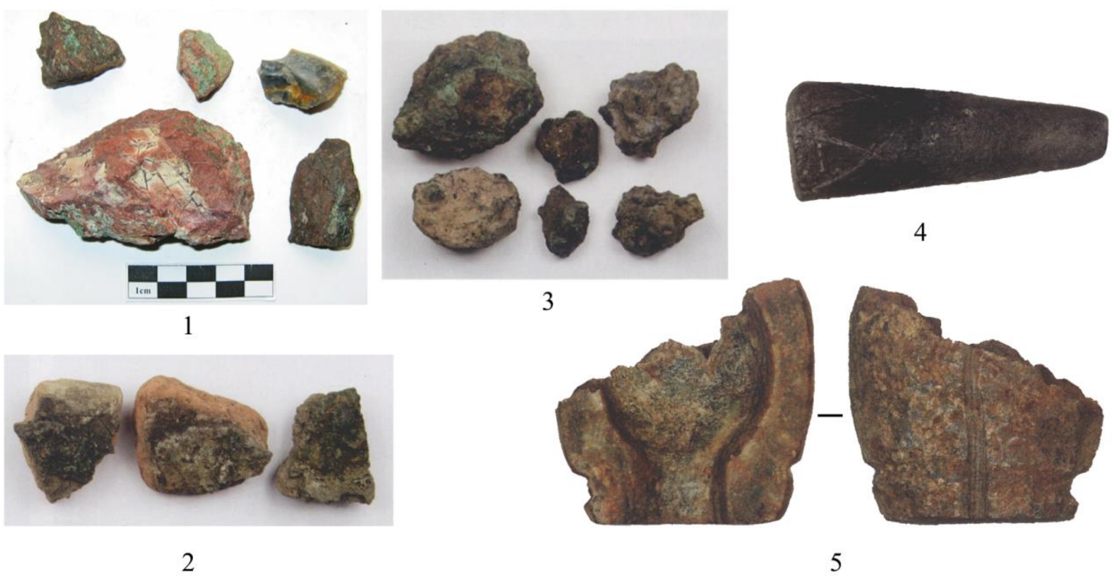

Figure VII.18 Metallurgical remains from the Xichengyi site, Zhangye

(1. Ores 2. Furnace/crucible fragments 3. Slags 4. Bellow nozzle 5. Stone mold
1-4. Xichengyi period 5. Siba period. After GSWKY 2014; BKDYCY and GSWKY 2015)

Compared to the tenuous connection between the Hexi corridor and its northern desert neighbors, archaeological evidence for Xichengyi-Qijia cultural entanglement is more solid. Besides the archaeological pattern observed in the material cultures, the isotopic signature of human skeletons provides alternative evidence for developing a nuanced understanding of cultural interaction between the Xichengyi and Qijia. An intramural burial (tomb 4) of a young woman found at Xichengyi is noteworthy. She was buried with typical Qijia cultural marker – a tripod *li* and a typical Xichengyi painted ewer (Figure VII.19). The tripod *li* is small in size (probably used as a beaker rather than as a cooking vessel), but it is typologically the same as counterparts found in the Qijia heartland. More interestingly, the isotopic signature of the tomb occupant's skeleton and teeth shows that she was an out-of-towner; she was not locally born but moved to the current location after she was an adult, and lived there for quite a long time before she died and was buried with members of her current community (Zhao C.Y. 2012). Therefore, the tripod *li* buried with her was probably a cultural identity marker of her agnatic community, the Qijia communities to the east. Due to the absence of comparative data from other neighboring areas, it is still undetermined whether she was from the Qijia heartland far away or a much closer Qijia diaspora in the eastern Hexi corridor. Although this is the only available isotopic signal for the moment and thus too isolated to be sound evidence of exogamy, it at least suggests that marriage with outside communities—probably the Qijia communities in the east—occurred. Marriage exchange was probably bilateral, as indicated by the sparse amounts of typical Xichengyi cultural markers found in Qijia contexts.

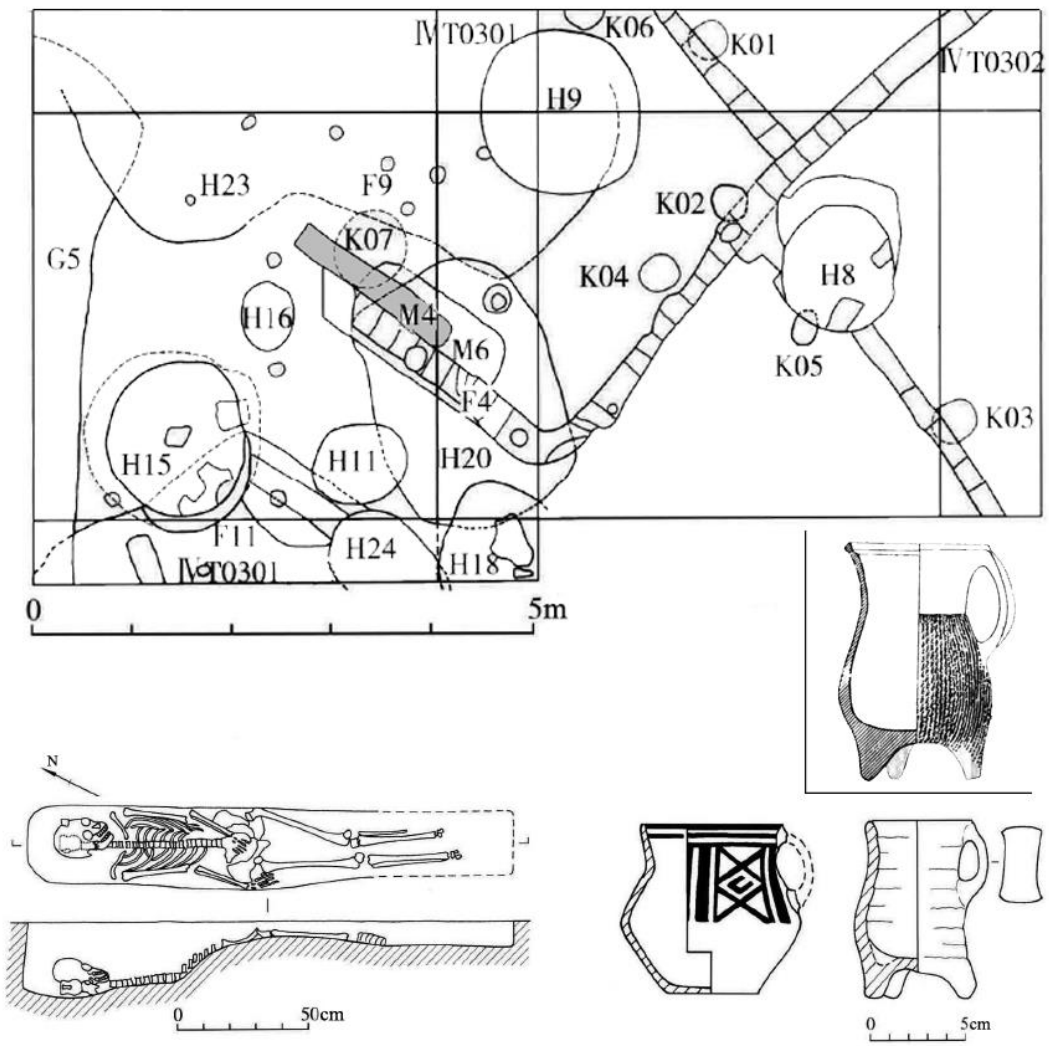

Figure VII.19 Intramural burial (colored grey) found at Xichengyi and its burial goods as well as analogous tripod *li* from the Qijia heartland (Qinweijia site)
(After GSWKY et al. 2015)

The cementation of marriage alliances between the Xichengyi and Qijia would naturally pave the way to trade alliances. Besides the channels of bridewealth and dowry (in the form of copper ornaments and tools, as well as domestic animals such as cattle/sheep/goat), the exchange of material cultures was mainly realized by means of trade, especially bulky goods such as food and raw materials for craft production. Agricultural crops originally from West Asia (e.g., barley and wheat) have been identified in Qijia communities that strategically occupied important corridors, e.g., the site at Changning in the Beichuan River Valley and the site at Jinchankou in the Datong River Valley. Both river valleys are geographically linked to the Central Hexi corridor in Zhangye via the well-known Biandu Pass in the Qilian Mountains (Yang Y. 2014; Zhao Z.J. 2009). No doubt, Xichengyi communities were important intermediaries that could not be circumvented along the transmission route to exotic crops. This has already been demonstrated by the occurrence of barley and wheat at Xichengyi (GSWKY 2014). The raw jade (nephrite) unearthed at Xichengyi also provides a possible clue for the source of the raw material used in lapidary production by the Qijia diasporic communities (Huangniangniangtai) (GSWKY 2014). Any trade is a two-way relationship. In return, the Qijia communities dwelling in ecologically marginal regions (e.g., the montane river valleys on the eastern rim of Qinghai-Tibetan Plateau) probably provided oasis metallurgists with upland forest products and raw materials necessary for craft production such as mineral ores, game meat, pelt and animal bone/tusk, bird's feather, forest hardwood, bark, beeswax, resin, basketry and cordage. The composition of faunal remains unearthed from the Qijia site at Changning in the Beichuan River Valley shows a surprisingly high percentage of wild species (34%), even though domestic animals, including sheep/goat, pig and cattle contributed the majority (66%) of the meat consumed by the local community (Li L. 2012). The occurrence of rare hunted species (e.g., sable, lynx, and leopard) apparently indicates that some wild animal resources were tapped not for subsistence purposes but for craft production, and, very likely, trading activities (e.g., animal skin or processed fur or leather).

The absence of metallurgical evidence from any type sites of the Qijia culture suggests that the social need for metal objects among Qijia communities had to be satisfied by the Xichengyi metallurgical communities. Thus, the flow of finished metal products from the latter to the former community is expected. Moreover, the pattern of archaeological evidence also suggests that cutting-edge technology may have been either intentionally monopolized by Xichengyi communities and their direct cultural descendants – Siba communities, or intentionally avoided by Qijia communities due to certain ideological factors or social taboos[1] (Rowlands 1971:216). In the former circumstance, the inter-generational transmission of technology (e.g., metallurgy may have been only inherited patrilineally) and social institution of apprenticeship (e.g., only boys reaching a certain age may have been eligible to learn metallurgy, or apprentices may not have been allowed to learn from their specialist fathers) will be worth exploring when better archaeological data are available in the future. As far as current data are concerned, it is still undetermined whether circumstances of the former or the latter kind better explain the imbalance in the spatial distribution of the metallurgical industry in early Bronze Northwest China.

VII.6 The Qijia diasporas in Alashan (Alxa) and Ordos

Besides the cementation of trade alliances with the Xichengyi community in the west, Qijia communities also expanded their economic engagements in other directions, such as the western flank of the Helan Mountains in the north, then reaching the Ordos Plateau further to the east. So far, archaeological evidence for eastward expansion is quite meager and most comes only from the ground surface without sound archaeological context, such as the characteristic Qijia pottery sherds found near the sand dunes at Toudaoshazi in the Alxa Left Banner (BDKWX and NMGAB 2016b). Only one typical Qijia assemblage with archaeological context (a midden pit) has been identified at the Lujuanshan site near the Alxa Left Banner (Figure VII.3:5).

[1] It is very common in ethnographical records that the metal smiths are always treated as social deviates with positive or negative supernatural power.

Considering that the Xichengyi trading networking had reached as far north as the site at Suhongtu, it is not surprising to find evidence of contemporary Qijia traders in the southern part of the corridor that linked the Gobi-Desert in the north and the eastern Hexi corridor in the south. Limited by the low quality and abundance of archaeological data, for the moment, it is only safe to argue that sparse Qijia diaspora, or a group of traders, explored the oases in the western flanks of the Helan Mountains, but probably at a much smaller scale in time and space than the trade diapora at Huangniangniangtai.

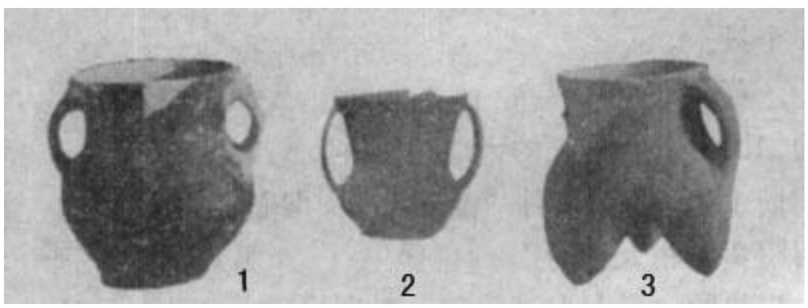

Figure VII.20 Qijia assemblage found at Lujuanshan, Alashan

(1. Double-handled jar 2. Amphorae 3. Tripod *li*. After Qi Y.H. 1962)

Compared to the Alaxa Plateau, more systematic archaeological evidence of the Qijia diaspora has been identified in the Ordos Plateau at the site of Zhukaigou (Figure VII.3:6). The typological study of pottery has divided the duration of the site into five phases extending from the beginning until the middle of the second millennium BC (NMGWKY and EB 2000). A small number of typical Qijia markers, fine polished amphora beakers or three handled beakers of brick-red color (Figure VII.21), immediately stand out from the highly homogeneous pottery assemblage of grey color and varying decor. According to the typological scheme of the associated pottery, these Qijia beakers are attributed to the third phase (estimated absolute date 1800 BC). Although archaeological evidence of typical Qijia dwellings is absent from Zhukaigou, these unmistakable Qijia signatures may suggest local contact with Qijia traders. The nature of this contact still remains unclear. More interestingly, other lines of evidence also point to the same conclusion, for instance, non-local products such as turquoise beads, cowrie shells, and metal objects (copper-alloyed knife, awl, needle, earring, etc.) suddenly appear in the third phase, if in small quantities. A new value system accompanied by new goods also manifested itself in the exterior decoration on *li* cooking vessels tripods, as an emulation of cowrie shells (NMGWKY and EB 2000:240-241, figure 195-6).

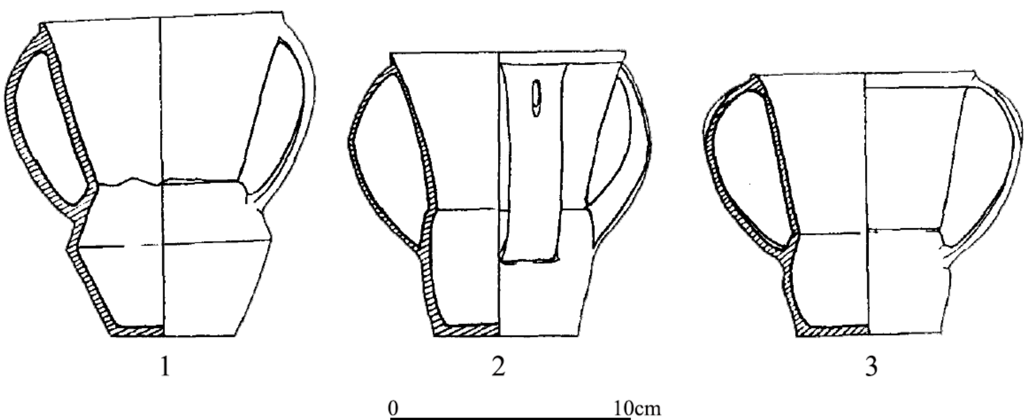

Figure VII.21 Typical Qijia beakers found at Zhukaigou

(1,3. Amphorae 2. Tri-handled beaker; 1. M3002:3 2. M1048:2 3. M1051:2. After NMGWKY and EB 2000: 260, figure 207)

Communication between the local people in the Ordos Plateau and Qijia traders makes good sense from an economic perspective. The cultural importance of the Ordos Plateau no needs emphasis here. Especially as more updated field work is undertaken in adjacent regions, its role as cultural crossroad gradually surfaced. Masonry settlements uncovered along both sides of the Yellow River and its tributaries in the Loess Plateau—for example, the sites of Bicun in Xingxian, Shiluoluoshan in Jiaxian, and especially the peerless masonry enclosure found at Shimao[1]—indicate population concentration at the beginning of the second millennium BC in the Ordos Plateau. The shared ritual jade-working industry among those settlements suggests the existence of a long established network of exchange since the end of the third millennium BC. The nature and development of this exchange network is chronologically beyond the scope of current research.

VII.7 Concluding remarks

Different from the strategic expansion of the Qijia community in the form of trade diaspora, the archaeological evidence uncovered at the site of Xichengyi and other type sites in the Hexi corridor indicates alternative socio-economic strategies: marriage alliances and their natural extension into economic trade alliances. Social needs resulting from the fulfillment of social obligations under the principle of reciprocity were the basic motivation for intensified craft production, including that of archaeologically visible metallurgical and lapidary products as well as invisible leather, textiles, basketry, and even food. The extensive exchange of personnel and material culture items on a regional scale provided the impulse for the flourishing of craft production and the introduction of new goods, new technology and new ideology on an inter-regional scale. Xichengyi communities, as the gateway communities at a cultural frontier, absorbed and internalized those innovations and passed them on to neighbors through long-

[1] For the up-to-date field reports on these sites, see SXKY and XXWL 2016; SXKY 2016; SXKY et al. 2013.

established exchange networks. The Qijia communities, mobile as they were thanks to trade diasporas and marriage or trade alliances with neighboring regions, played an important role in this sort of relay-station mode of cultural transmission. Far-flung trading networks based on the social exchange of personnel and material-culture items even reached population centers in the Ordos Plateau and the Loess Plateau during the first half of the second millennium BC, as represented by the site of Zhukaigou. Through those intermediaries innovative goods, technology (e.g., metallurgy) and ideology were then introduced to the Central Plains by way of pre-existing trading networks along the middle Yellow River, and eventually contributed to the rise of the Bronze Age in the East Asian heartland.

Chapter VIII Metallurgy and the trans-cultural transmission of technology in Central Eurasia: rethinking the Seima-Turbino Trans-cultural Phenomenon

VIII.1 Critical review of the Seima-Turbino Phenomenon

It has been more than one century since the discovery of metal objects—forked spearheads, socketed axes, leaf-shaped knives and curved knives with zoomorphic pommels (Figure VIII.1)—in the style we now identify as the Seima-Turbino style. The initial discovery took place at the Berezovka-Omary cemetery along the Lower Kama River (Ponomarev 1886), but its value was not appreciated until similar metal objects were found at the Seima cemetery on the Lower Oka River and retrieved from the Borodino Hoard in the Bessarabia region in Moldavia (Chernykh and Kuzminykh 1989:6). The excavation, in 1924-1927, of the Turbino cemetery[1] revealed strong cultural similarities to the Seima finds (Spitsyn 1926); hence such finds have come to be commonly referred to as Seima-Turbino. Discussion of the cultural characteristics, attribution, dating and origins of these unique metal assemblages has never stopped, and it still continues today. By 2011, a total of 629 metal objects and 35 casting molds all of Seima-Turbino style had been found. The number of metal objects attributed to the Samus-Kizhirovo type (Post-Seima-Turbino), considered one major successor of the Seima-Turbino type in Chernykh and Kuzminykh's typological system, amounts to 234, plus 25 casting molds (Kuzminykh 2011). In recent years, additional sporadic findings attributed to the Seima-Turbino or Samus-Kizhrovo type have further increased the total number (Grushin et al. 2006; Karlovich 2016; Molodin and Neskorov 2010; Shafenkova 2015). The spatial distribution of Seima-Turbino metal objects is unparalleled in vastness; it extends along a diagonal line from Finnish Scandinavia in the

[1] Metal objects looted from the Turbino (Shustovo) cemetery had been familiar to local collectors long before the formal archaeological excavations by A.V. Schmidt in 1920s. According to Bader, a socketed axe looted from the same cemetery had been purchased by A.A.Krasnopolskii for his personal collection in 1889. The cemetery thus had been looted no later than 1889 (See O.N.Bader 1964:58).

northwest to the western edge of the East Asian heartland in the southeast, covering most of the Eurasian continent (Figure VIII.2). Seima-Turbino metal objects have been found to be associated with a variety of pottery assemblages attributed to different regional archaeological cultures. Eurasian archaeologists have thus come to speak of the “Seima-Turbino (Trans-cultural) Phenomenon” (STP) (Chernykh and Kuzminykh 1989). The great stylistic uniformity of these widely dispersed metal objects, as well as their vast territory of distribution, has greatly intrigued archaeologists, inspiring a debate that has continued for more than a century. In this chapter, I will give a brief overview of the current state of research into the STP with the aim of teasing out the achievements and shortcomings of past studies. I then propose an alternative research perspective and offer my own thoughts on how to understand this prehistoric phenomenon. Due to the large volume of previous studies, my brief review cannot be exhaustive; instead, I mainly focus on some major works on this topic from recent decades.

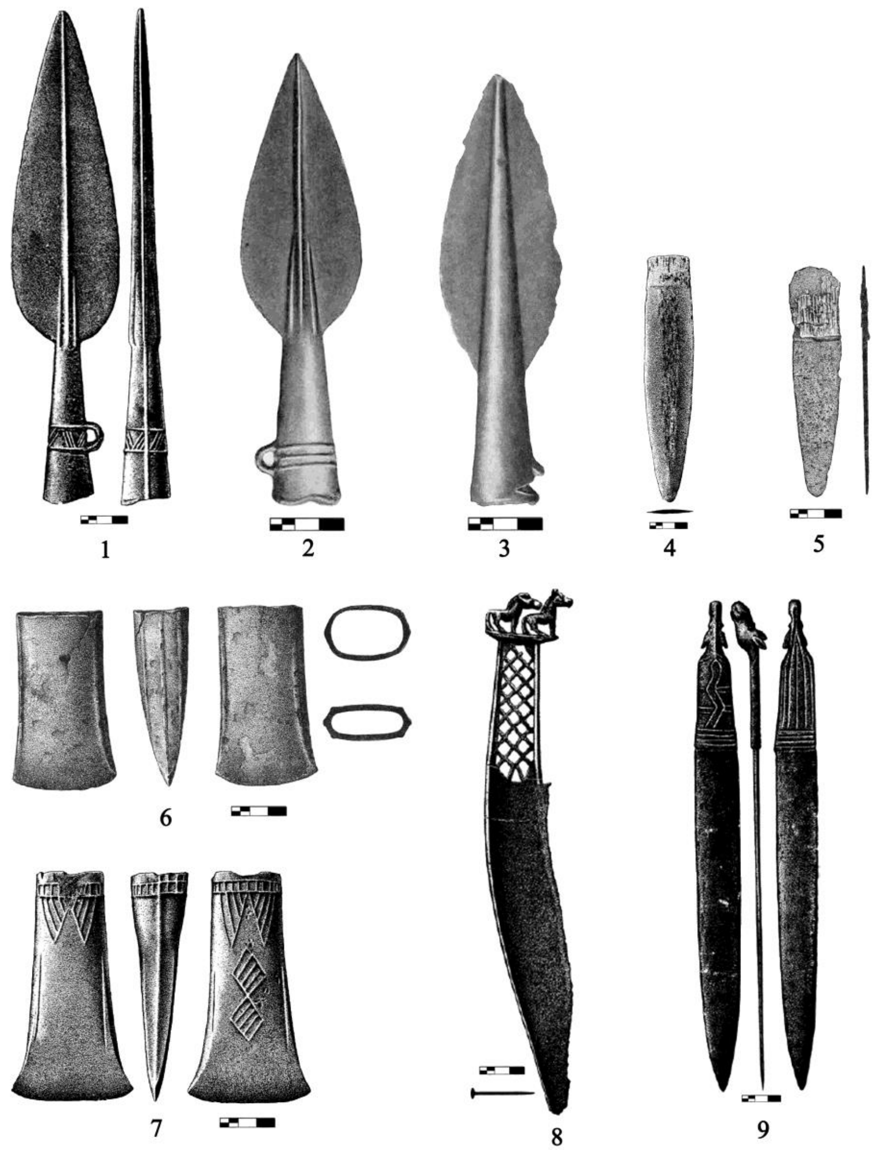

Figure VIII.1 Metal objects from Seima and Turbino cemeteries

(1-3. spearheads 4-5,9. double-edged knives (daggers) 6-7. socketed axes 8. curved knife)
(1-7. Turbino cemetery, after Bader 1964, figure 34, fig38-b, figure 39, figure 73, figure 82, figure 75, figure 43, figure 64; 8-9. Seima cemetery, after Bader 1970, figure 52, figure 50)

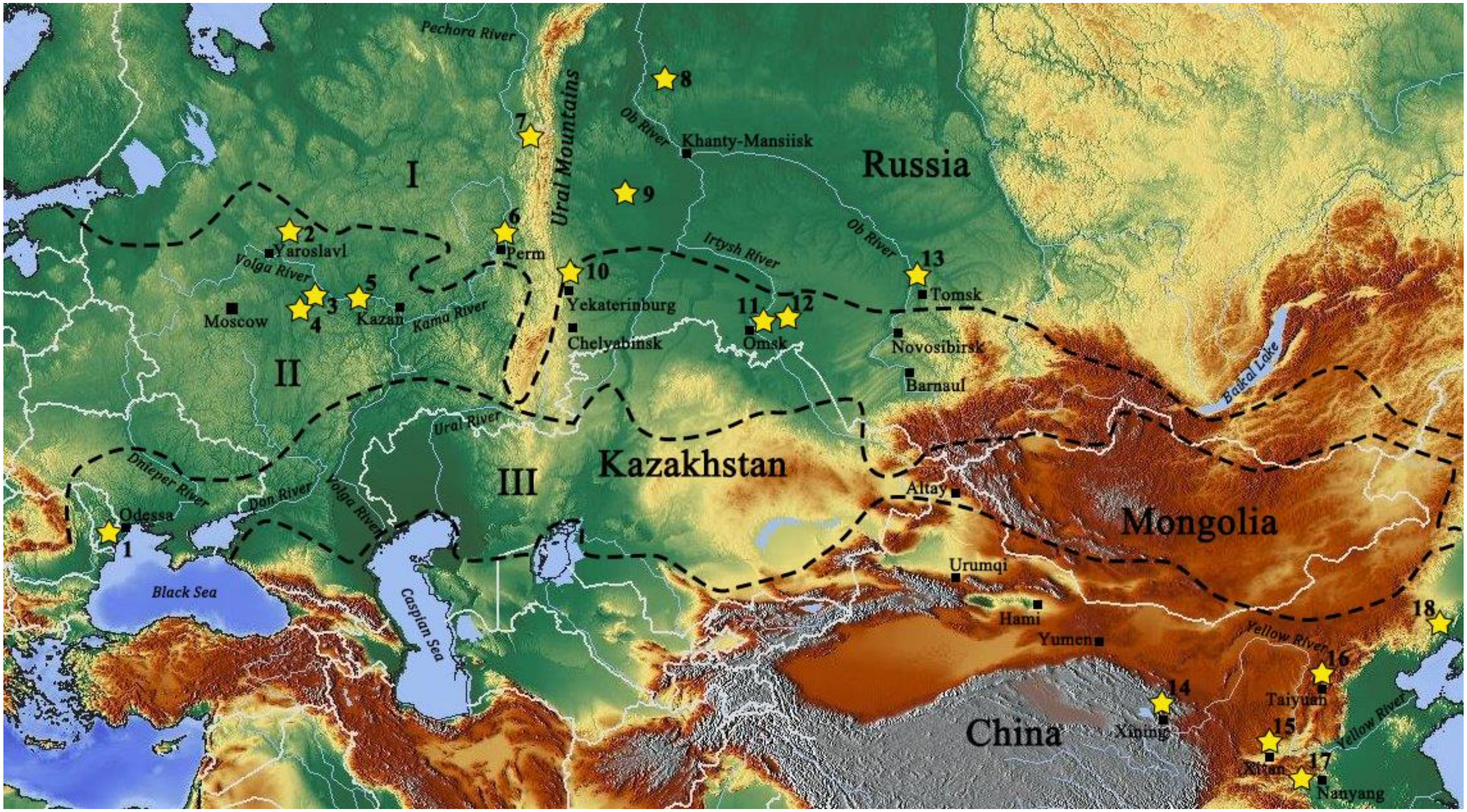

Figure VIII.2 Major archaeological sites/cemeteries containing Seima-Turbino style objects in Eurasia (solid triangle) and nearby present-day cities (solid square)

1. Borodino hoard 2. Galich hoard 3. Seima cemetery 4. Reshnoe cemetery 5. Yurino (Ust-Vetluga) cemetery 6. Turbino cemetery 7. Kanin cave 8. Tovkurtlor-3 cemetery 9. Satyga XVI cemetery 10. Shaitanskoe Ozero II 11. Rostovka cemetery 12. Sopka-2 13. Samus 14. Shenna, Qinghai 15. Xi'an, Shaanxi 16. Taiyuan, Shanxi 17. Xiawanggang, Henan 18. Chaoyang, Liaoning (Dash lines indicate the approximate boundaries between different vegetation zones: I. taiga forest belt II. forest-steppe belt III. steppe belt)

The seminal work of Chernykh and Kuzminykh (1989) will serve as a good point of departure. Theirs was the first published systematic research on metal objects attributed to the STP. By means of typology, the metal collections were divided into various “Terminal Typological Categories” (KTR[1]), for instance, celt/socketed axes (K), spearheads (KD), knives (NK), daggers (KZh), chisels (Chk) and ornaments (U), and then subcategories were assigned based on the differences in size, proportion and surface decoration (K2, K4, K6…). This standardized classification has proved effective and convenient in practice and is still adopted and revisited. Among the 442 finished objects and 30 casting molds (up to 1989), the quantity of three major categories – socketed axes, spearheads and knives/daggers – accounted for 76% (Chernykh and Kuzminykh 1989:38, table 1). Through morphological comparison, Chernykh and Kuzminykh distinguished typical assemblages of STP metal objects with unmistakable signatures - forked spearheads (Figure VIII.1:1, 2), socketed axes (Figure VIII.1:6, 7), leaf-shaped knives (Figure VIII.1:4, 5), and daggers with sculptured pommel (Figure VIII.1:8, 9) - from other metallurgical traditions, such as the Eurasian Metallurgical Provinces represented by the Abashevo-Sintashta cultures in the steppe (Figure VIII.3). Based on typological distance from the typical assemblage, Chernykh and Kuzminykh thus identified the late phase of the STP, the Samus-Kizhirovo type, or so-called Post-Seima-Turbino type (1989:144), characterized by the appearance of peg holes in spearhead sockets, the rectangular proportions with socketed axes, and decrease of assemblage variety (double-edged knives faded out).

However, as far as chronology is concerned, due to the low fidelity of the original archaeological contexts (the disturbance and destruction of cemeteries, the absence of pottery in features, and

[1] The acronyms presented in the brackets are the direct transliterations of Russian terminology. Therefore, there is no corresponding between the English translations and its Russian equivalents. This applies to all similar situations through the whole chapter.

the scarcity of complete dwelling sites) of these metal objects, typological categories are descriptive with little reference to the relative chronological sequences of different sub-categories. Besides the periodization of two phases, that is, the early period of classic Seima-Turbino type and the Post-Seima-Turbino type, the whole STP seemed a gigantic and homogeneous plate. It is this homogeneity in material culture that makes Chernykh and Kuzminykh (1989: 262) conclude that the dispersion of typical STP objects swept the forest-steppe belt in a short time period no more than two hunderd years. Due to the absence of radiocarbon dating, the chronology of the STP in early studies mostly relied on adjacent areas that had reliable and accurate chronological sequences, such as the Mycenaean civilization in the Balkans and the Shang civilization in East Asia heartland (Chernykh and Kuzminykh 1989:258). Accordingly, the upper limit of the absolute date swung between no earlier than the 15th century BC and much later, to the final Bronze Age and early Iron Age (11-8th century BC) (Chlenova 1972:138). Until the 1980s when radiocarbon dating was applied to a sample from the Elunino cemetery in Altai, a relative accurate absolute date of the STP was fixed to the 17th century BC (Kiryushin 1985). In recent decades, with the widespread application of radiocarbon dating, the upper limit of the STP has been pushed back to the second half of the 22nd century BC (2140 BC) (Epimakhov et al. 2005:97), and the most updated absolute date range of the STP is around the end of the third millennium BC – the early second millennium BC, such as 22nd – 18/17th century BC (Chernykh 2013), or 2120-1500 BC[1] (Molodin et al. 2014:145), or 2150-1950 BC (Anthony et al. 2016:12), respectively.

[1] A much later lower limit of absolute dating with STP by Molodin is resulted from the inclusion of Samus-Kizhirovo type, which is traditionally considered as Post-STP assemblage by the main stream viewpoint and thus excluded from the classic STP dating range. Therefore, 2120-1500 BC given here can be considered as the dating range of the Pan-STP.

The other remarkable contribution made by Chernykh and Kuzminykh is their quantified studies of metallic components by means of spectral and chemical analysis, a most epochal endeavor at that time. By means of chemical analysis, the application of tin ore as an artificial additive for copper alloys (copper-tin, copper-tin-arsenic) in the STP collection was identified and proved as a reliable signature to distinguish it from its southern neighboring arsenic-dominated alloy collections (copper-arsenic, copper-arsenic-antimony, copper-silver and silver-copper), namely, the Abashevo-Sintashta metallurgical tradition in the steppe zone. Based on the

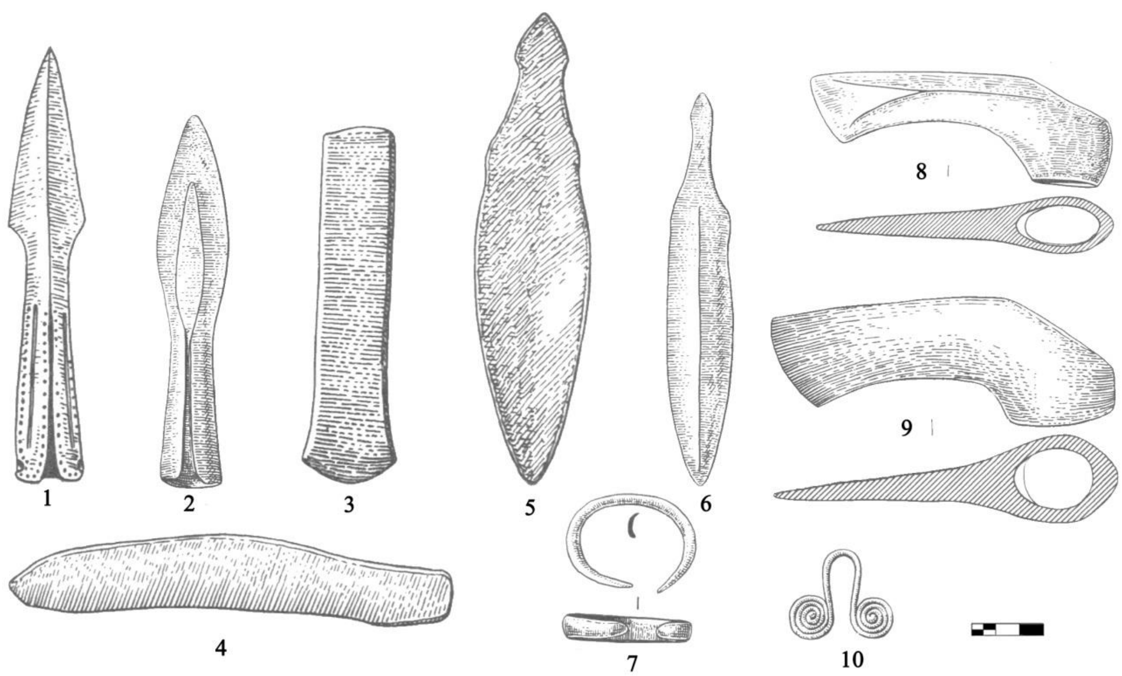

Figure VIII.3 Metal objects of Abashevo-Sintashta cultures

(1,2. spearheads 3. adze 4-6. knives 7. bracelet 8, 9. shaft-hole axes 10. ornament)
(Southern Urals region: 1, 5. Verkhne-Kizylskii hoard; 3, 8. Malo-Kizylskoe village; 4. Beregovskoe site; Don-Volga region: 2. Tyunino 6. Vvedenki Kurgan, tomb 2; 7.Podkletnoe, Kurgan 10, tomb 4; 9. Latnoe 10. Khokholskii, Kurgan 1, tomb 1. All after Bader et al. 1987, figure 61, 64.)

study of mineral ore sourcing, especially tin ores, the Rudny Altai[1] in Eastern Kazakhstan and Southern Siberia was pinpointed as a major source of tin, and thus the Gorny (mountainous) Altai region was inferred as the most probable origin of early STP objects (Chernykh and Kuzminykh 1989:175). Based on chemical and physical analysis of metal objects across the Eurasian continent, Chernykh and Kuzinminykh could also extrapolate the direction of STP dispersion from the Altai in the east to the Eastern Europe and even to Scandinavia in the west. The appearance of the STP was seen as the onset of so-called Eurasian Metallurgical Province (EAMP) in Chernykh's metallurgical system and marked the beginning of the Late Bronze Age (Chernykh 1992:190), characterized by the popularity of tin bronze. Besides the broad use of tin bronze, the STP also made another contribution to technological innovation in metallurgy: the thin-walled casting technology represented by socketed axes and spearheads. This technological innovation became possible with two prerequisites. One is the addition of tin ores that greatly strengthenED the fluidity of molten copper; the other is the use of clay cores enclosed by bivalve molds in such a way that a hollow socket can be formed to receive the haft. The influence of the latter innovation can still be observed among early metal assemblages from the East Asian heartland in the second quarter of the second millennium BC.

Thanks to Chernykh and Kuzminykh's chemical-metallurgical studies, great advances have been made in understanding the technological complexity of the STP. The complex patterns of alloyed components disguised by the stylistic uniformity of dispersed metal objects were eventually uncovered (1989:170). With the Ural Mountain as a demarcation, the whole dispersion area of

[1] Rudny (рудный) in Russian means "mineral". Rudny Altai is one of the world's largest volcanogenic massive sulfide provinces. It is located in the west of the Altai Mountains, 540km long and 75-180km wide with a directionality of NW-SE extending from Russia to Northwest China across eastern Kazakhstan. It is famous for its immensely rich deposits of polymetallic ores, including copper (Cu), lead (Pb), zinc (Zn), gold (Au) and silver (Ag) and other base and precious metals.

the STP can be divided into western (Eastern Europe) and eastern (Western Siberia) blocks. The former is dominated by multiple alloys besides tin bronze, such as native copper, arsenic bronze, arsenic-antimony bronze and even silver-copper alloy, the latter by relative uniformity: arsenic, tin, copper and their alloys. Meanwhile, differences in metallic components were also supported by stylistic studies. Taking the socketed axe as example, plain or simply ornamented socketed axes are more concentrated in the western block, while richly decorated ones with rhombic and triangular patterns are more common in the eastern block. The complexity of alloys in the west of the Ural Mountains clearly suggests the use of local mineral ores to cast metal objects of STP style. The copper mines (Tash-Kazgan) and silver mines (Nikolskoe) in the Ural Mountains were indicated as probable sources of the copper and silver used in the European part of the STP objects (Chernykh and Kuzminykh 1989:172). The appearance of tin bronze across the whole STP areas seemingly suggests the existence of a "road of tin", which extended from the Rudny Altai to the Eastern Europe. However, due to the absence of isotopic and metallographic studies on metal objects, it is still impossible to pinpoint sources of copper ores and evaluate the extent of recycling in metallurgical production.

Besides two blocks characterized by technological differences, based on clusters of findings, ten metalworking bases or centers were identified: the Sayan-Altai and the middle Irtysh River (centered by the Rostovka cemetery) in Siberia, the middle Kama River (centered by the Turbino cemetery), the lower Kama River, the lower Oka River (centered by the Seima and Reshnoe cemeteries), the Pechora River (centered by the Kanin cave), in addition to two other less object-rich centers, the upper Volga and Circum-Baltic areas (Chernykh and Kuzminykh 1989:197). Interestingly, some pairs of high correspondence in metallurgical recipe have been highlighted: the Turbino cemetery and the Sayan-Altai; the Kanin cave and the Rostovka cemetery; the Seima cemetery and the Reshnoe cemetery. The last pair, due to their closeness in distance, is quite reasonable, while the first two pairs are strong signals of east-west connections between different sub-regions of the STP.

Furthermore, the scale of research has also been narrowed to a cemetery, that is, spatial analysis of the metal objects with different alloys in the largest cemetery, the Turbino cemetery. The whole cemetery was divided into three zones - north, middle and south - based on stylistic and metallic-chemical analysis, and therein three different clans were identified (Chernykh and Kuzminykh 1989:208). Periodization has to rely on the stylistic analysis of metal objects due to the total absence of pottery remains (only one pottery vessel has been found in the whole cemetery). Without other independent chronological parameters, it is premature to establish links between the material culture and the population's identity. In fact, correspondence between style and alloy does not exist for most samples, as already suggested (Chernykh and Kuzminykh 1989:209, figure 99, 100). Leaving these problems alone for the moment, the method itself - chemical analysis to trace mineral sources - never comes without questions. From the perspective of mineralogy and geology, the complexity of ore deposits and their huge differences in chemical components, either trace or major elements, over a short distance nearly makes clear-cut distinguishing between different ore sources impossible (Thompson 1958; Kohl 2007:168). What makes this complex situation even worse are the myriad cultural behaviors associated with every phase of metallurgy or metalworking: prospecting, mining, transportation and distribution (of raw materials), smelting, casting, recycling, heat or cold working, transportation and distribution (of ingots, half-finished or finished objects), trade/exchange, not to mention the complex patterns of behaviors involved in the discard/disposal phase, which eventually resulted in the archaeological contexts from which our interpretations depart (Schiffer 1972).

Even though the complex nature of the STP was also ackonwledged by Chernykh and Kuziminykh, cultural interpretations of the formation and dispersion of the STP were oversimplified, characterized as a group of aggressive warriors' and sophisticated craftsmen's long distance migration from the east to the west (Chernykh and Kuzminykh 1989:216, 271-273). This interpretation is too arbitrary to be sound. First, it is unjustified to link an archaeological culture with a certain group of people sharing a kind of identity or ethos inferred from a style of material culture alone. As mentioned before, this direct connection neglects the roles of other factors, including but not limited to trade/exchange, technological choices, and symbolic meanings of material culture, which could have complicated cultural processes. Second, stylistic analysis of metal objects alone can hardly assign an identity as specific as "warriors", especially when whether the spearheads and knives really functioned as weapons in battle is still open to debate. Scenarios in which spearheads are used as symbols of social status are not foreign to most anthropologists. Even though there has been a significant increase in the size of STP collections in the past decades, considering the vast territory throughout which it was dispersed (almost 3.3 million square miles), they are better categorized as rare goods. On the scale of cemetery or settlement, the frequency of the occurrence of spearheads is much lower than that of other categories of metal objects, and thus it is more reasonable to consider them symbolic items, even though the possibility of occasional use in battles or hunting cannot be totally excluded.

Besides problematic interpretations of the STP, analysis of the specific technological processes (*Chaîne opératoire*) of metallurgy or metalworking, that is, how a metal object is made, is almost absent in Chernykh and Kuzminykh's work. Although very few settlements with metallurgical remains of the STP have been found across the continent, it is still possible to infer technological processes from the large reservoir of finished metal objects themselves, especially since traceology was well established by USSR archaeologists since the 1930s (Semenov 1964). Even though it is unrealistic to attempt to conduct traceological studies about use contexts on most metal objects due to patina and poor preservation, traces of manufacture are still clear enough to observe and reconstruct technological processes, as shown in the following section. Unfortunately, most manufacturing traces were not presented in detail when metal objects were described and classified in Chernykh and Kuzminykh's work.

As a brief summary, so far studies on the STP have made great progresses on some basic issues, such as cultural attribution and characteristics, chronology, and distribution. However, a satisfactory consensus on the cultural processes of the STP and the cultural motivations behind it, that is, the how and why questions, is still hard to achieve. In the next section, I will reexamine the STP through the framework of anthropological technology and offer alternative perspectives for understanding the STP by means of technological tradition, innovation and choices.

VIII.2 The STP through the framework of anthropological technology

No matter how diverse cultural interpretations of STP might be, it was no doubt a technological tradition or innovation that took place around 2000 BC and swept across most part of the Eurasian continent (Korochkova and Spiridonov 2015). It is justified to explore this cultural phenomenon through the framework of anthropological technology before any further cultural interpretations are made. Every technique is a complex system comprised of multiple interlocking components, including material, energy, objects (means of work), gestures (operational sequences/*Chaîne opératoire*), and the lastly and importantly, specific knowledge (know-how) (Lemonnier 1992:6). The whole production process, taking bronze metallurgy as an example, can be generalized as mining, roasting (especially necessary in the case of sulfide copper ores), smelting and melting, casting and fabrication (Figure VIII.4). In most circumstances, phases of raw material procurement, raw material preparation and primary production have low visibility in archaeological contexts. What we mostly rely on in archaeological studies, basically, are the products of the final phase, or the first phase in some cases. Surviving evidence of the former includes finished/half-finished products, ingots, and scraps, slags from the smelting, fragments of molds and cores, and at best, features of furnaces/hearths, even workshops; the later includes ancient mine wells/tunnels, stone hammers, bone/horn tools, and waste heaps. Thus, the incompleteness of material evidence calls for great cautiousness in any interpretations directly made from finished metal products, or more accurately, archaeological metal artifacts. Taking one step back, even if production processes were complete enough to make direct inferences, the boundaries between arbitrary categories (finished/half-finished products, ingots, and scraps) are quite fluid. The circumstances in which finished objects were used as ingots, re-melted and then cast into the desired forms are never isolated events (Sherratt 1997[1976]; Rowlands 1971). Together with the recycling of metal spillages and scraps, the last phase of metallurgy could well run by itself as an independent sub-system, if know-how were not a barrier. The unavoidable nightmare of remelting and recycling metal objects should not prevent archaeologists from interpretation, but it is a good reminder to keep in mind. This reminder shows how risky it is to determine the source of specific ore mines based only on chemical analysis of a metal object without taking cultural considerations into account. Hence the anthropology of technology could and should be introduced in order to deepen our understandings of the complexity of technological phenomena. Following, I will reconstruct the operational sequences of the STP assemblage so as to identify technological choices and the social scenarios probably implied. For the metal assemblages of the STP, I will mainly focus on two characteristic items, the socketed axe and the spearhead, as case studies.

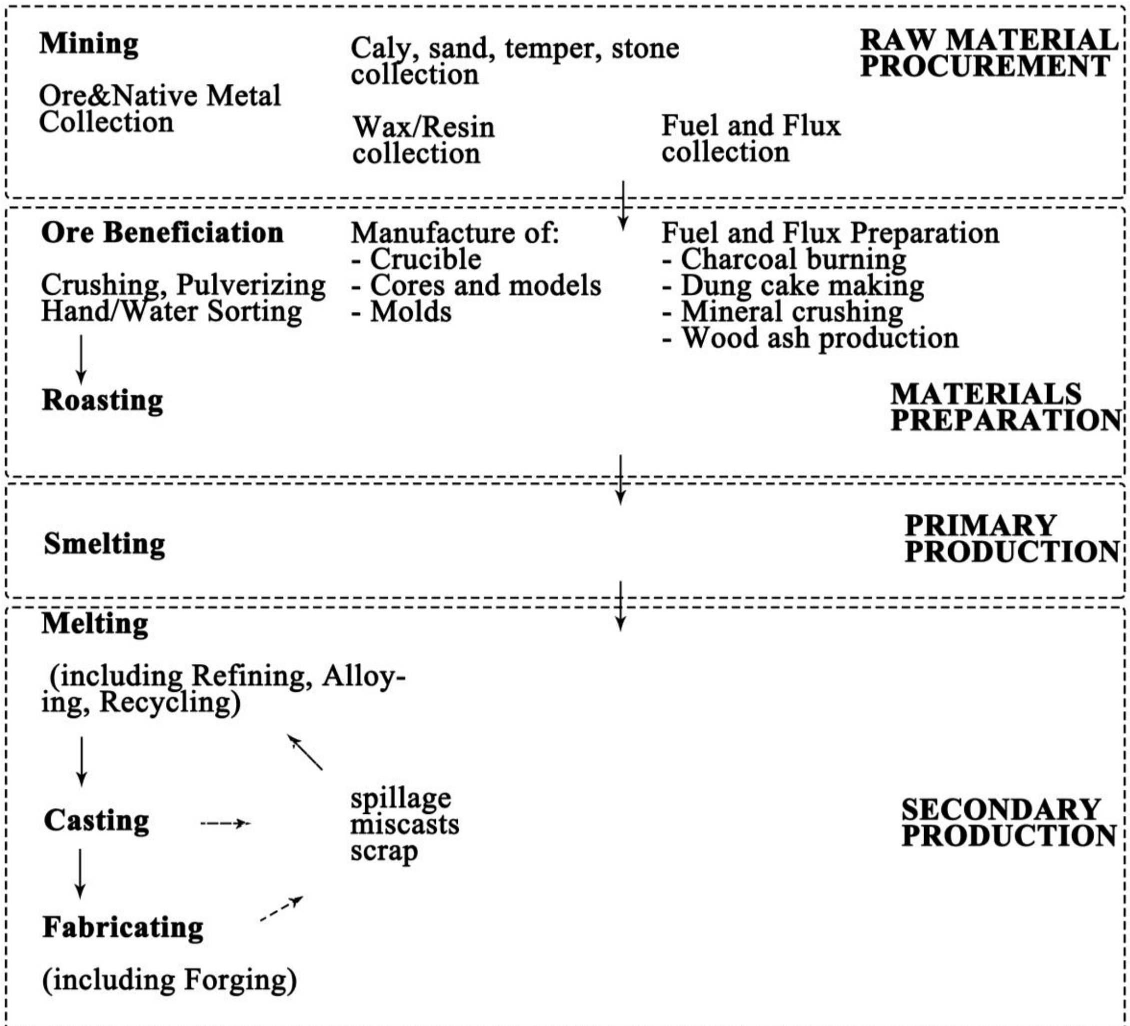

Figure VIII.4 Flow chart of technological processes for copper metallurgy

(Reproduced after Miller 2007:146, figure 4.11)

VIII.2.1 The production processes of the STP metal assemblage

The reconstruction of operational sequences is the first step in identifying technological choices. As a result of the long-lasting enthusiasm for understanding the ore sourcing of ancient metallurgy in the USSR, unfortunately, specific production processes of metal objects were largely overlooked in early research (Pronin 2010). Even though some newer techniques, such as radiography (X-ray examination) and metallography were introduced and applied to some archaeological collections (Naumov 1963), they were far less popular than spectral and chemical analysis. The study of the STP assemblage is no exception. Basic descriptions of metalworking techniques besides metallic component analysis, such as annealing, forging, hot working, and cold working, are hardly present in Chernykh and Kuzminykh's work, not to mention radiographic and metallographic examinations, which are critical for understanding ancient production processes. It is not my intention to apply these two techniques here but to raise the necessity of these perspectives for ancient metallurgy and metalworking studies on the STP assemblage in future research. Here I choose two representative objects of the STP as a point of departure: the socketed axe and spearhead. Compared to other categories, such as knives, daggers or chisels, the socketed axe and spearhead require more complicated casting techniques, spefifically the application of a core enclosed by molds thus forming thin-walls. As already mentioned, cast-as-a-whole sockets for axes and spearheads is the signature that distinguishes the STP metallurgical tradition from its steppe neighbors. However, the casting of sockets was taken for granted and thus not paid too much scrutiny. By means of examinations of the casting traces left on the surface of metal objects, production processes, especially casting techniques, can be reconstructed. Certainly, the reconstruction of production processes is inferential and still needs to be tested against scientific examination and laboratory analysis, especially radiographic and metallographic analysis as mentioned above.

The procurement of copper and other metallic ores for STP metal objects is still far from clear due to limited archaeological evidence. According to Chernykh and Kuzminykh (1989), several possible locations were highlighted as the potential mine sources for STP metal objects, such as the Tash-Kazgan in the eastern flank of the Ural Mountains and the Rudny Altai in Eastern Kazakhstan. So far the only well-studied Bronze Age copper mine in the southern Ural Mountains is the ancient Kargaly mine, dated back to the second third of the second millennium BC, a few hundred of years later than the STP (Chernykh 2002). Due to the fact that ancient mining was an extractive activity and always dug over the earlier mining tunnels, the possibility that a given mine was first mined much earlier time cannot be totally excluded. Due to the scarcity of related archaeological remains, procurement processes can only be inferred from analogy with the ancient Kargaly mine. Neither has definite evidence of ancient mines contemporaneous with the STP in the Rudny Altai been found so far. In the Central Asia, alternatively, studies on a Bronze Age tin mine found in the Zeravshan River Valley show evidence of early tin ore exploitations (2400-1900BC). The symbiosis of copper-tin ores in Mushiston also provides an alternative explanation of the emergence of tin bronze (Garner 2015). Besides the procurement of copper and other metallic ores, the quarrying of soft stones, especially steatite/soapstone, is also necessary for the manufacture of stone molds for later casting. Considering the traditional use of chlorite in the Near East and Central Asia for vessel-making (Kohl 1974) and pyrotechnic steatite beads in the Indus Valley (Vidale 1995), steatite naturally became a candidate for early bronze casting molds. Beyond the surface value of soft stone quarrying in trans-craft borrowing, a long existing exchange network centered on steatite and its products (delicate vessels and beads) linking the Indus Valley in the east and Egypt in the west across Central Asia and the Near East, should be considered the broad backdrop for the flourishing of the exchange of copper and tin ores among these regions during the Bronze Age.

The roasting of copper ores is necessary for sulfide ores. Because of the nature of copper deposits, generally, oxidized copper and native copper may be found in the near-surface layer. As the surface copper crop is exhausted and the mining goes deeper underground, the secondary enrichment zone with high concentrations of sulfide copper will be exploited (Thompson 1958; Tylecote 1992:10). Besides copper, sulfide ores also contain abundant arsenical and antimony minerals. Unlike oxide copper, sulfide copper cannot be reduced to metal by heating it with charcoal. Before smelting, it needs to be roasted at a low temperature with oxidized atmosphere and thus the sulfur will be dismissed in the form of volatile oxides. The appearance of sulfur in finished metal objects is a good indicator of incompleteness or the absence of roasting before smelting. The roasting of sulfide ores is by no means as simple as igniting firewood under a pile of copper ores; it also requires constant vigilance in order to ensure that the adequate temperature is maintained (Thompson 1958). However, the process of roasting leaves very few archaeological traces besides burnt features on activity surfaces. Based on available STP data, most metal objects have more or fewer impurities in composition, such as arsenic, antimony, zinc, nickel, etc., which clearly indicate the exploitation of deep mines for sulfide copper ores and roasting processes with nuanced manners and degrees (Thompson 1958:4).

Details of the smelting of copper ores can be inferred from the archaeological evidence of slag heaps, discarded furnaces, and tuyeres. Generally, in order to decrease transportation costs, copper ores are always smelted near copper mines and then transported to metallurgical workshops in the form of ingots. Thus, very little evidence of smelting can be found in the vicinity of settlements. The major products of smelting – the ingots – are rarely encountered among the STP assemblages. So far there is only one suspicious fragment of an ingot reported from the Kanin cave, which was identified by the excavator as a fragment of an axe (Figure VIII.5:10). The long distance between currently known ancient mining areas (e.g., Rudny Altai) and major metallurgical centers (e.g., middle Irtysh River) of the STP suggests that most raw copper ores, if there were any, could have been roasted and smelted near the mines. Certainly, the possibility of transporting bulky ores from mines to metallurgical bases via the developed river systems also makes sense, especially as contemporaneous production settlements beyond the cemeteries in western Siberia have not yet been uncovered. The coexistence of multiple impurities, such as arsenic, antimony, iron, lead, and silver, within high tin (>10%) alloy items probably indicates that the co-smelting technique (sulfide copper ores with cassiterite/tin oxide) was probably applied to the STP assemblage. The major purpose of smelting is to acquire more pure and concentrated copper; thus, in the case of sulfide copper ores, flux is necessary to add in order to achieve this goal. Sand (silica), limestone and iron oxide are some common fluxes that absorb the gangue in the form of slags. The choice of different fluxes depends on the components of the gangue. If the gangue is high in silica it needs iron oxides or manganese oxides; if low in silica and high in iron, it requires the addition of silica as sand (Tylecote et al. 1977:306). Even though the iron element found in some finished metal objects could be the result of pyrite mixed into sulfide ores, the possibility that iron oxide is intentionally added and eventually makes its way to the finished products cannot be eliminated. The omnipresence of ochre chunks (with iron oxide as the major component) coexisting with metallurgical features in Shaitanskoe Ozero (Serikov 2013:283) probably suggests that the use of ochre as flux in smelting was more reasonable than its conventionally assumed use as a sacred pigment in rituals. The relatively high volume of calcium and silicate among Kanin cave metal objects indicates the probable use of limestone and sand as flux in the smelting processes (Kanivets 1964:69, table 2).

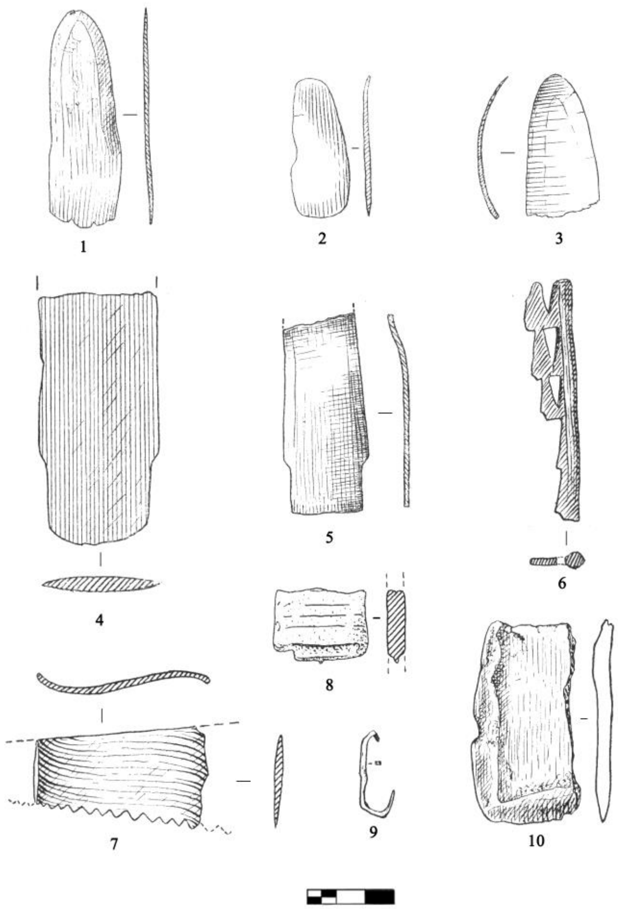

Figure VIII.5 Metal assemblage from the Kanin cave

(1-5. knives 6, 8. knife hilts 7. saw 9. fishing hook/peg for wooden vessel? 10. fragment of axe?)
(After Kanivets 1964, figure 21, 22)

Before melting the ingots into molten liquid, the preparation of stone (or clay) molds should be accomplished. A typical cluster of casting molds was uncovered from the craftsmen/founder's tomb (tomb 21) in the Rostovka cemetery (Figure VIII.6). Almost all of them are made of limestone. These bivalve stone molds require significant labor investment to prepare, compared with the clay examples. Based on traces on the surface of these stone molds, the manufacturing processes can be inferred as follows: first, two stone blanks need to be chipped/sculpted, then polished to a flat platform on every side; then, a blank or template of the desired object made of wood is pressed onto the flat side so as to delineate the contour of the desired object with any hard pointed tools or pigment chunks (e.g., ochre); based on the contour lines carved or delineated on the flat surface, microlithic or metal chisels, awls, and knives will then be applied to carve out the mold print to a desired depth (the differences in depth between the two pieces of mold will cause asymmetric proportions in the profile of as-cast objects, see Chernykh and Kuzminykh 1989, figure 7:7; figure 8:2,7). After the cavity is formed, two molds will be closed together with the template inside to see whether they fit. After adjustments and modifications, some marks will be carved on both sides across parting lines for later accurate enclsoing before casting (Figure VIII.7:2). Some molds are also grooved on their exterior surfaces so as to be tied together with sinews, rawhide thongs, or fiber cordage during casting. Evidence of mortises and tenons on the fixation interfaces for the two pieces of the mold has not been observed so far. In other instances, several fine channels will be carved on the bottom boundary of the mold print in order to release gas during casting (Figure VIII.7:3). Compared to clay molds, stone molds made of soft stone (e.g., steatite) have multiple technical benefits, such as durability and high recyclability, as a result of high heat resistance and heat capacity. However, it requires more time and labor investment to scoop out the mold cavity and also necessary preheating before the pouring of molten copper. The endurance of stone molds together with their labor-intensiveness inspire craftsmen to take advantage of every inch of the mold surface, for example, not a small number of stone molds have more than one pair of mold prints for two or three different kinds of objects (Figure VIII.6:2,5). All the mold prints on one piece/pair of molds serves as a good representation of the product repertoire of one period. If the mobility of craftsmen is considered, these all-in-one stone molds make good sense as to economic expediency and efficiency for so-called itinerary craftsmen.

For flat solid items, such as awls, adzes, chisels, knives and rods, no core is needed. Some of them can also be cast with one-piece flat molds, rather than enclosed bivalve molds. But for items with sockets, like socketed axes and spearheads, in addition to two leaves of well-registered molds, a clay core is essential. Owing to the fact that no settlement with metallurgical activity contemporaneous with the typical STP assemblage has been uncovered, the reconstruction of clay cores can only be inferred from the late phase of the STP, that is, the Samus-Kizhrovo type assemblage represented by the Samus IV site, where quite a number of core fragments were found (Figure VIII.8). Moreover, the casting traces on metal objects can also provide some details on the installation of clay cores.

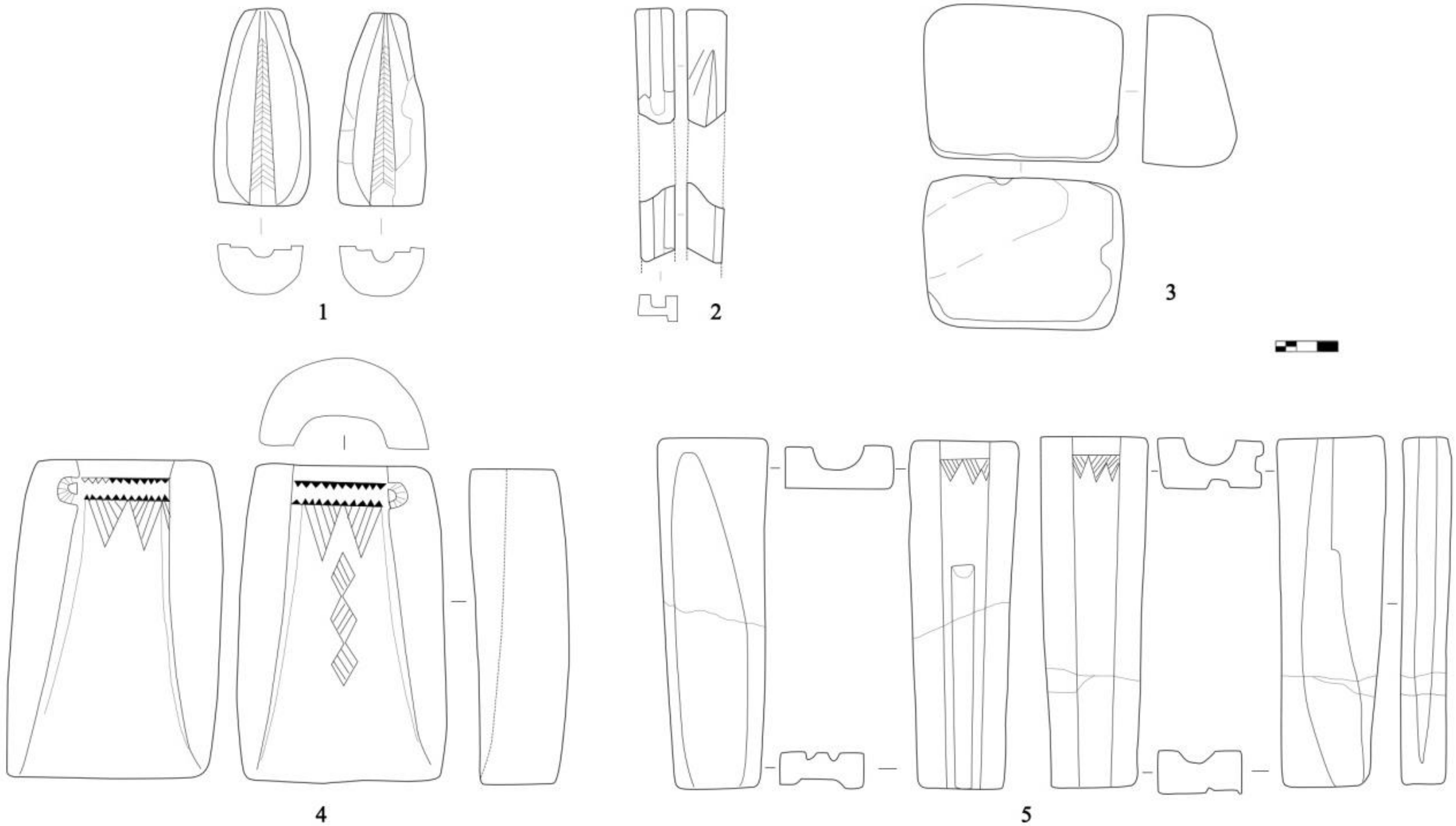

Figure VIII.6 The stone casting molds from the tomb 21, Rostovka cemetery

(Cast items from mold prints: 1. arrowhead 2.awl and knife 3. blank for knife(?) 4. socketed axe 5.curved blade chisel, curved knife and awl)
(Reproduced after Matyushchenko and Sinitsyna 1988, figure 36, 38)

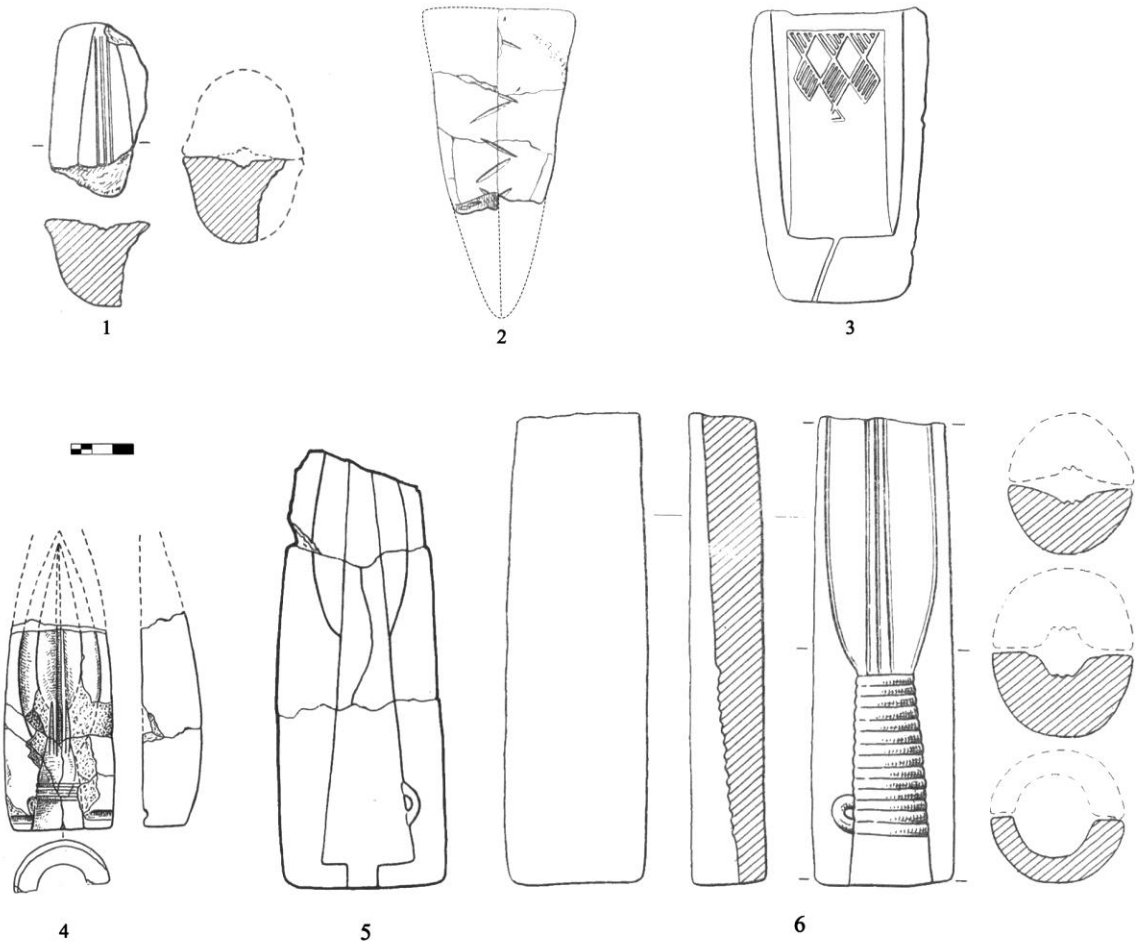

Figure VIII.7 Stone casting molds for spearheads and socketed axes of the STP

(1, 6. Samus IV 2.Ostyatskii Zhivets VI 3.Tyukovo 4.Kalantyr 11 5.Mosolovka)
(After Chernykh and Kuzminykh 1989, figure 36, 48, 75, 79, 81, 82)

Taking socketed axe as example, first, a T-shape clay core must be used to form the socket. Because the lower part of the mold for axes is closed so as to form an edge, the molten copper must be poured from the upper opening, where the clay core is closed. Even numbers of vertical grooves are symmetrically carved onto the protrusion (head) part of the T-shaped clay in order to introduce molten copper into the mold cavity. Hence, the protruding part can rest on the mold opening and keep the lower part of the core suspended in the right position. The protruding part also requires an extra component built on top of the stone mold; it should be a funnel-shaped runner made of clay with the bottom closely attached around the protruding part of the core (Figure VIII.9). After molten copper is poured through the runner and filled into every part of the mold cavity, extra molten copper will spill out and thus forms bumps around the socket opening. During the processes of fabrication, these bumps will be removed and then polished. Some are not so well polished, such that the base of the bumps can still be observed in some cases (Figure VIII.10). The principle of installing the clay core for spearheads is the same as that of socketed axes except for morphological differences. Generally, the thickness of the wall for the spearhead socket is much thinner than that of the socketed axe, which leaves a much narrower space for molten copper to fully fill in before cooling down. A vertical groove runner in the middle of the spearhead leaf must be carved so as to speed the flow of molten copper during a restricted time window. Thus the middle rib is formed in the cast spearhead. The transitional part, or the bottleneck between the socket and the base of spearhead leaf where the clay core ends, is especially critical for the passing of molten copper. The flow speed of molten copper through that bottleneck directly determines the final quality of casting. As a result, more parallel grooves are carved to facilitate the fluidity, which eventually form the "fork" – the signature of the typical STP spearhead. It is proposed that the "fork" should be considered more a technical strategy to guarantee the superb quality of the spearhead than a stylistic remnant of the hafting technique, as argued by some scholars (Hu B.H. 2015). If so, some spearheads, which have long fork ribs running parallel to the middle rib even reaching the end point, can also be coherently explained from a technological perspective rather than the traditional assumption that the ribs are a chronological benchmarker (Figure VIII.7:1,6). Likewise, the "fork" shank structure cannot be found among spearheads with a hollow middle rib, because the middle rib itself already served as a good runner for the flowing of molten copper (Figure VIII.7:5), making the "forks" redundant.

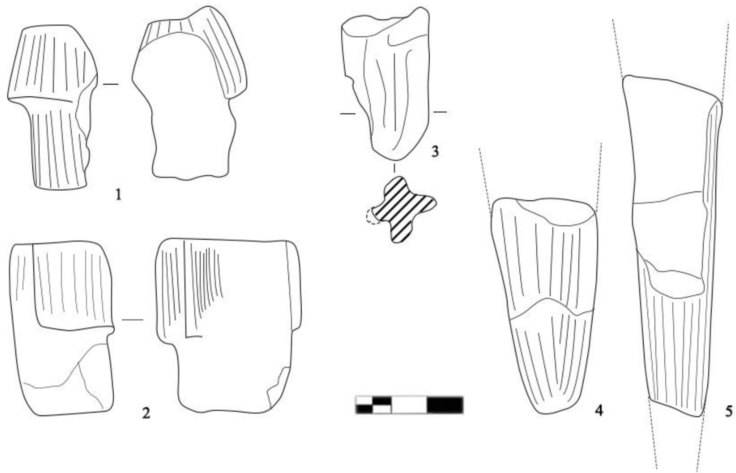

Figure VIII.8 Fragments of clay cores found at the Samus IV site

(1,2. T-shaped cores 3.cross-shaped core 4,5. conical cores)
(After Matyushchenko 1973, figure 12)

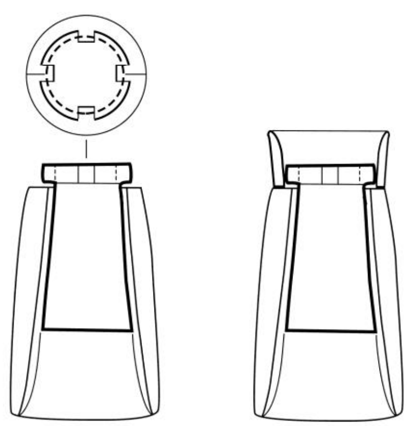

Figure VIII.9 Conceptual reconstruction of a suspended clay core (bold black line) (left) and mounted pouring runner for socketed axe mold (right)

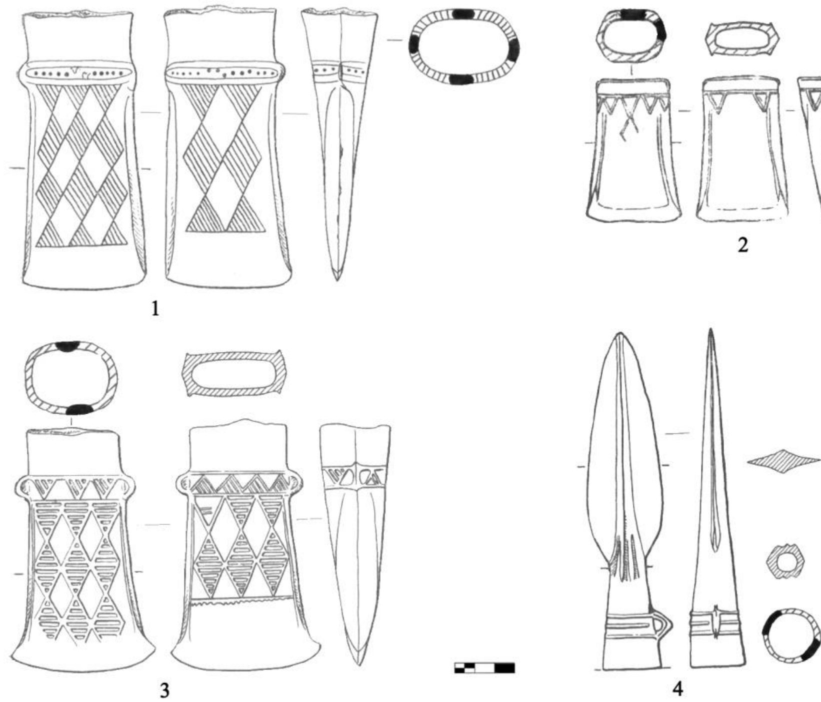

Figure VIII.10 Casting bumps (solid black part) around the socket opening

(1, Tenga 2. Sopka 2 3.Voinovka-Gilevaya 4. Ustyanka. After Chernykh and Kuzminykh 1989, figure 15,36,78)

Besides the T-shaped core, a trunnion core was probably also invented and applied to cast spearheads. This can be inferred from one spearhead stone mold (Figure VIII.7:4). The vertical section of this core has a cross shape; two symmetrical trunnions are attached on the upper part of core at a right angle to the core. Accordingly, there are two shallow grooves carved on the interface of thetwo pieces of the mold to receive the trunnions. In a casting position (vertically erected in a small pit) the two trunnions will keep the core level in case it slides down to block the transitional area between the socket and the leaf. The two trunnions will also form two peg holes on the socket for the fixation of the shaft. The appearance of trunnions is an innovation for the fixation of clay cores. Peg holes are just by-products and should not be considered the primary motivation for the application of trunnions. Single peg holes cast on the sockets of spearheads, technically, could not have been the consequence of trunnion cores and should be considered earlier than the latter if the logic of technical evolution from simple to complex is universal.

The last step after casting is fabricating, a series of work on as-cast objects, such as forging (including working), polishing, sharpening, and even mounting on the haft. When arsenic copper alloy predominated during the early and middle Bronze Age, forging was necessary for arsenic copper cutting tools (e.g., axes) to improve the hardness of their edges. For example, a copper alloy with 2.6% of arsenic has a hardness of 65-70 on the Vickers scale (H_v) as cast, while its hardness (150-160 H_v) is almost doubled after worked (e.g., anneal, cold and hot working). However, arsenic copper has a hardness ceiling in a 50% reduction cold working condition; a proportion of arsenic beyond 3% has little effect on worked hardness improvement any more (Scott 1991:82-3). Even though the addition of tin improves the hardness of metal objects as cast, the forging (both cold and hot working)—a traditional working technique for native copper—is still practiced and it indeed greatly strengthens the hardness of tin bronze (Scott 1991; Tylecote 1992:10). Due to the absence of metallographic data on the STP assemblage, it is still unclear whether they were worked after casting and to what degree. Many socketed axes with edges skewed from the central parting line probably indicate working traces on the edges, if deformation did not result from frequent chopping and cutting (Figure VIII.11). Spearheads with open/forged sockets (Figure VIII.3:1, 2; for more examples see Chernykh and Kuzminykh 1989, figure 25), rather than cast-as-a-whole sockets, are obviously a cultural signature of steppe metallurgical centers in the south, as mentioned at the beginning. Thus, a small number of this kind of spearhead appeared in the typical STP assemblage, clearly indicating technological interaction in a north-south direction. More interestingly, the tradition of forging sockets was still practiced among Sintashta metallurgists, though they were aware of the thin-walled casting technique from their neighbors in the north.

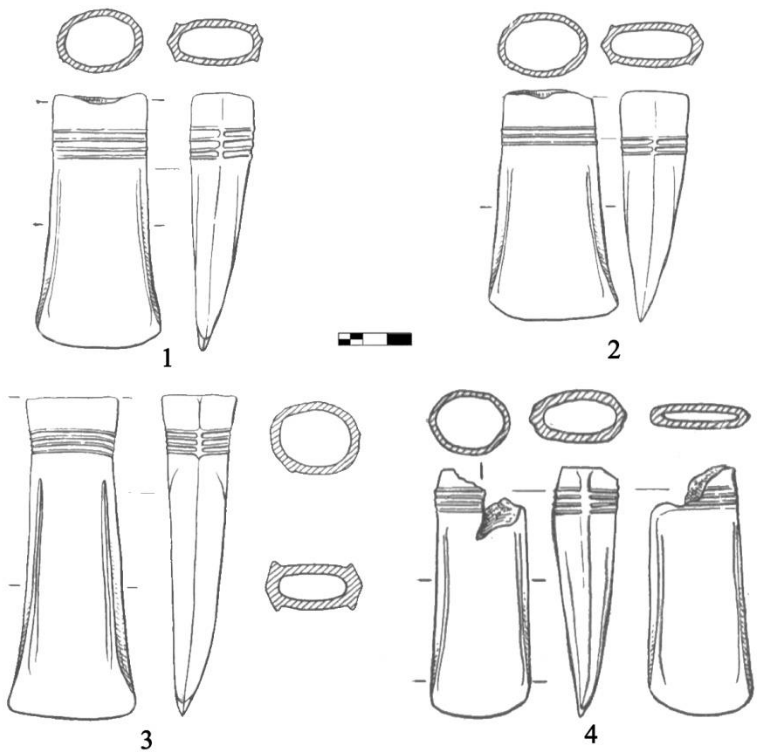

Figure VIII.11 Socketed axes with skewed edges

(3. Reshnoe cemetery, the rest: Turbino I cemetery. After Chernykh and Kuzminykh 1989, figure 7, 8)

VIII.3 The use contexts of the STP assemblage: a case study on the curved knife

The use context of material culture is critical for us in reconstructing social life. Even though it is almost impossible to conduct tracological studies on corroding metals, we can still surmise the possible uses of the STP assemblage based on their morphology and frequency. Socketed axes and knives are the two most common categories among the STP assemblage. The former would seem quite serviceable in the forest-steppe and taiga forest ecological niche, where deforestation is generally practiced for everyday life (e.g., house construction, fire fuel, tools, and other wood crafts), while the latter must have had multifaceted functions in people's daily lives. Compared with these two utilitarian tools, the function of the spearhead becomes more ambiguous. Even though technically it can be used as weapon in conflicts or hunting scenes, its limited quantity may suggest restricted access to possession or use in reality.

Because most metal objects were uncovered from mortuary contexts, original use contexts can be hardly elucidated. However, relatively closed mortuary contexts also provide unique perspectives on the social contexts of metal objects and their cultural meanings beyond the contexts of archaeological coexistence. It is not my purpose here to reconstruct the specific purpose of each category of metal objects but to reconstruct the social contexts that material culture signifies. Specifically, based on inference of the practical use of metal objects within archaeological contexts, I hope to highlight the interaction between different crafts (i.e., metallurgy and skin processing) so as to understand technology in economic processes. In addition, by means of a case study on the metal scraper, I hope to offer a nuanced perspective of the negotiation between technological choice and social representation in the processes of technological transmission.

Besides the aforementioned three categories of characteristic metal objects--forked spearhead, socketed axes and leaf-shaped knives—there is one more unique category of metal tool commonly found in the STP assemblage, that is, the curved knives. This kind of curved knife is similar to the curved daggers lavishly decorated in shape but, probably, totally different in function. Here I use curved knives to designate the crescent-shaped blades and knives with curved features on the edge or tilting tip (Figure VIII.12). Based on ethnographic analogy, I propose that these curved knives were tools for leatherworking, a major craft among the forest-steppe and taiga people. The limited quantity of metal curved knives found among the STP assemblage probably suggests a more complicated cultural process in which metallurgical technology was transmitted, filtered and adopted.

As with other organic material cultures like cordage, textile and basketry, animal skin products, or more broadly leather, do not survived well in most archaeological contexts (except in waterlogged conditions). However, the role of leather in the past should never be underestimated due to its invisibility in archaeological contexts. On the contrary, leather has broad utilitarian purposes in the manufacture of clothes (including shoes and gloves), containers, cordage, tents and other tools applicable to various crafts (e.g., drum skins in ritual music instruments, leather bags of bellows for metallurgy). Especially for prehistoric peoples who lived in forest-steppes and taiga forest areas and depended on hunting and fishing, skin processing and leatherworking naturally accounted for a great part of their daily lives and thus should be considered a major component of their social practice. In historic times, the exchange of animal skin products has played a critical role in Siberian people's economies, for instance, as fur was sold to traders for money and also used to pay taxes in tsarist Russia (Levin and Potapov 1964). Even though solid evidence of leatherworking is always absent from archaeological contexts, processing tools made of durable materials like stone, pottery, metal and bone, can survive. Inference as to the function of specific tools for leatherworking has greatly relied on ethnographic analogy. Simple analogical connections between style/form and function should be avoided due to their superficial and unsound inferences (Wylie 1988), but ethnographic analogy will never be faulty or misleading as long as considerations of relevance rather than superficial evidence are evaluated to build up the form-function connection between subject and source (Wylie 1985).

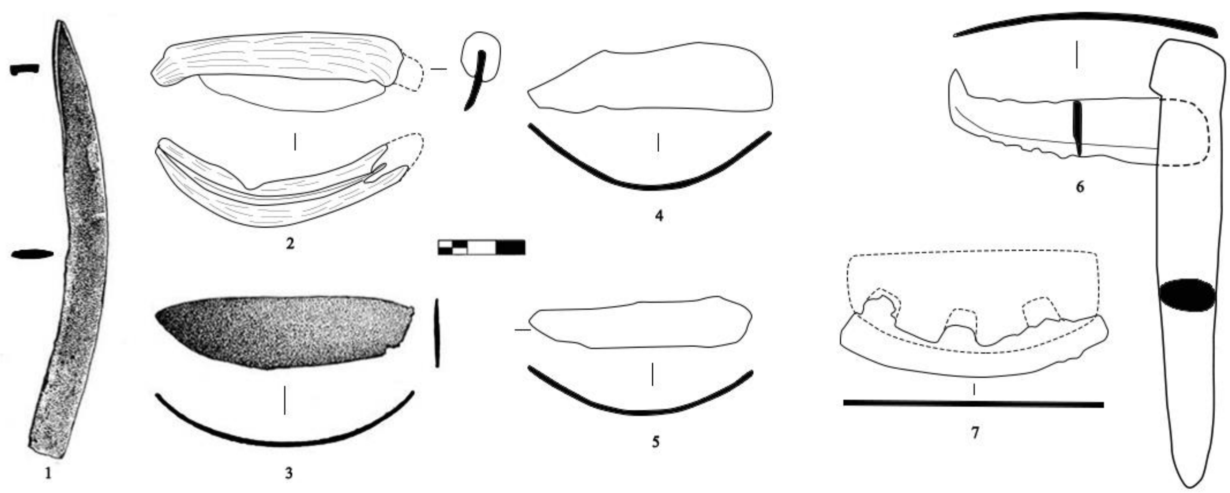

Figure VIII.12 Curved knives (leather scrapers)

(1,3. Turbino I cemetery, 2,4,5. Seima cemetery 6,7. Rostovka cemetery)
(1,3: reproduced after Bader 1964, figure 81, 82; 2,4,5: reproduced after Bader 1970, figure 55;
6,7: reproduced after Matyushchenko and Sinitsyna 1988, figure 35, 76)

The connection between scrapers and leather products can only be inferred indirectly due to the detachment of leatherworking tools and leather products from most archaeological contexts. To be clear, the hypothesis proposed here that curved knives in the STP assemblage were probably used as leatherworking scrapers simply provides a possibility of function. Certainly, without proof to the contrary from microscopic studies on use traces, curved knives could have had alternative functions (e.g., harvesting plants as sickle); however, the connection between leather remains and curved knives makes better sense than any other possibilities. In fact, scarce leather remains were indeed found with STP metal objects, such as leather sheath of a dagger/knife in the Rostovka cemetery (Matyushchenko and Sinitsyna 1988:13, figure 11-4) and leather ropes attached to some spearhead sockets *in situ* (Grushin 2006). If the accessibility of metallurgy and metal objects was still restricted in some regions during certain time periods, but this could never happen to leatherworking. At least, the existence of leatherworking provides an alternative perspective into the social contexts beyond more visible metallurgical evidence, as metal objects can never be the only items flowing in exchange networks intra/inter-regionally. Leather products, along with other archaeologically invisible items (e.g., textile, wood products, and even salt), could have been used as fungible commodities for exchange with metal objects, considering their universality and high economic value determined by time and labor investment.

The relevance of the forms of scrapers and their function to leatherworking can be observed from ethnographic studies on technical processes, or operational sequences of leatherworking. Technically, leather should be distinguished from animal skins by its non-putrescible nature under warm and moist conditions (Thomson 2006). This special nature is achieved through a lengthy technical process in which a fresh animal skin is dehaired, bated, fleshed, and tanned (van Driel-Murray 2009; Table VIII.1). Even though specific processes can vary across time and space, the scraping procedure is universal for the processing of both fur (with hair retained) and leather (with hair removed). In archaeological contexts, only tools made of durable materials (including bone, stone, and metal, occasionally wood) and related features (e.g., pits, ceramic vats) can survive. As the identification of features of leatherworking by means of biological markers is possible but not so feasible in practice (Hall and Kenward 2011), only scrapers are left to archaeologists in most cases.

Table VIII.1 Major technical processes of leatherworking

Procedure	Tools or structure	Residue	Time required
De-hairing	Scrapers (wood, bone, stone, metal), pits, vats	Hair	1-5 days
Bating	Pits,vats, rods	Alkaline or acid substances	A few hours to 10 days
Fleshing	Scrapers (wood, bone, stone, metal), pits, vats	Fat or flesh scarps	A few hours
Tanning (optional)	Pits, vats, water channels, rods	Deposits of finely ground vegetable matter	9-12 months
Drying	Wood frames, cordage	(None)	Weeks to months

(After van Driel-Murray 2009)

Scraping is a necessary procedure in the removal of any potentially harmful organic substances that otherwise would ruin the product. Thus scrapers in various forms comprise the most important repertoire of tools for leatherworking. According to the contexts in which the animal skins are placed, scrapers have corresponding forms on their edges; scrapers with convex edged will be used if the skins are placed on a flat board or stretched out on a wood frame (Figure VIII.13:7), while ones with concave edged will be more efficient if the skin is placed or stretched across a log with an arched surface. Traditional scrapers commonly found among ethnographic records are commonly composed of a haft and blade, the direction of hafting perpendicular to the working edge (Figure VIII.13:2-5). This could also be the way in which most microlithic scrapers were installed on wood hafts in prehistoric times.

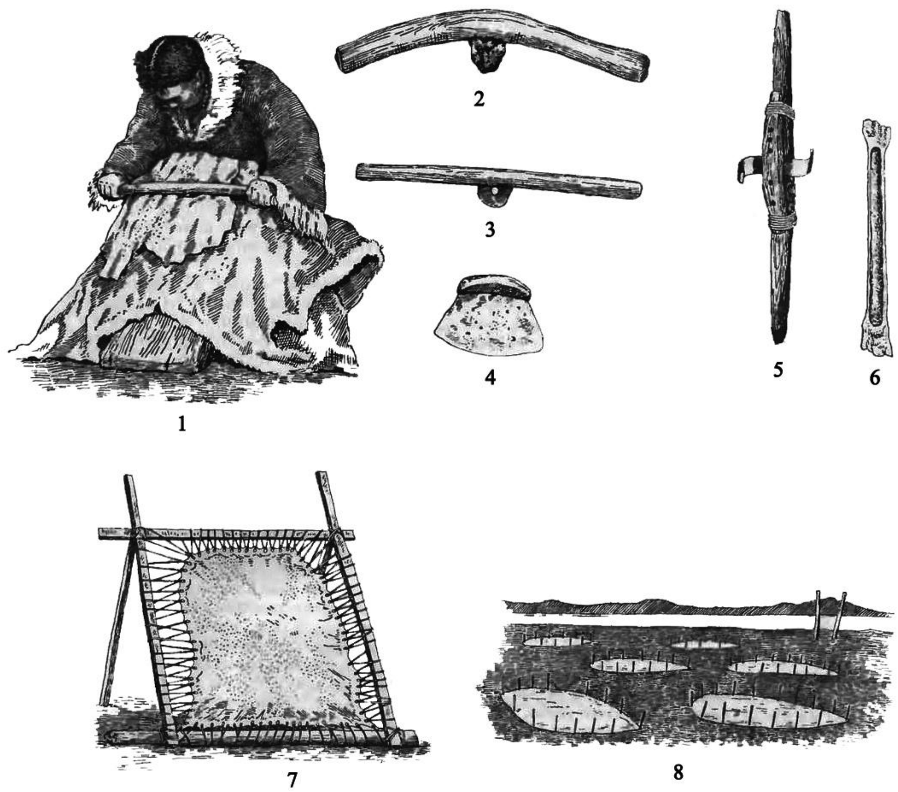

Figure VIII.13 Skin scraping and scrapers in ethnographic records

(1-4. Processing skins and the scrapers used among the Chukchi people;
5,6. The scrapers used by the Nganasans people in the northern Siberia;
7,8. Dry the processed skins by stretching out on frame or on the ground
After Levin and Potapov 1964:575,807)

Besides scrapers with metal blades (Figure VIII.13:3-5), microlithic blades (Figure VIII.13:2), animal bones (Figure VIII.13:6), and wood, and even pottery sherds are also broadly used. The omnipresence of crescent-shaped bone tools made from animal pelvises or mandibles with polish traces in Bronze Age archaeological contexts throughout Eurasia provides solid evidence of the long-lasting practice of leatherworking with bone scrapers. In most cases, fragments of metal knives and awls are found with these bone scrapers in deserted dwelling features that could have been huts for leather processing (Podobed et al. 2015).

The great similarities between ethnographic scrapers and the curved knives/blades found in archaeological context provide convincing evidence for functional inference about the latter, especially for bent crescent-shaped blades (Figure VIII.12:3-5), among the STP assemblage. The relatively intact scraper found in the Seima cemetery clearly indicates the means of installing a metal blade into the horn haft (Figure VIII.12:2). Another curved knife from the Turbino cemetery was probably used as scraper (Figure VIII.12:1), considering that both edges of the pointed tip were intentionally rolled up rather than sharpened as commonly perceived. A pointed end with rolled up edges, obviously, is designed in such a way as to install a wood or bone haft, rather than to stab or cut. The sickle-like instrument found in the Rostovka cemetery (Figure VIII.12:6) was probably used for skin processing as well. The unique design of the blade with tilting tip makes it easier to skin carcasses and separate membrane and fat from skin without damaging it. The other curved bronze blade with three protrusions on the back from the same cemetery (Figure VIII.12:7) would more reasonably be used as a scraper, rather than a zoomorphic pedant as suggested (Matyushchenko and Sinitsyna 1988:57). Another interesting point highlighted by ethnographic data is the morphological differences between scrapers used by different sexes. For example, scrapers with a short horizontal haft on the back of the blade (Figure VIII.13:4) are commonly held by women, while ones with a long horizontal haft (Figure VIII.13:2, 3) are always used by men (Levin and Potapov 1964:807). Whether the same mechanism also caused the differences in the forms of scrapers found in archaeological contexts needs further investigation. Unfortunately, due to the poor preservation of human skeletons in uncovered cemeteries (e.g., nothing but teeth were found from most tombs of the Turbino cemetery, while only one relatively intact skull was identified as female in the entire Seima cemetery), the correlation between metal objects and sex and age is indeterminable for most major cemeteries. However, better resolution in sex and age of the deceased from the Rostovka cemetery provides a chance to discuss the social dimensions of the metal objects.

The durability and sharpness of metal scrapers are the major technical advantages they have over other kinds of materials. Thus, it is natural to observe the dominance of metal scrapers for leatherworking once metallurgy is accessible. However, in fact, the percentage of suspected metal scrapers is not commensurate with such a popular craft. On the contrary, in most cases the microlithic scrapers inherited from the Epipaleolithic era are still the dominant leatherworking tools. The reasons that lead to this consequence could have been multifaceted. First, the small quantity of curved metal knives could have been the result of their absence from mortuary contexts, in which people would not like to deposit metal scrapers for whatever reasons. Second, other categories of metal objects, especially regular double edged knives, could also have been used as scrapers. Thus the curved metal knife identified as a scraper above is just a transitional form between the traditional microlithic composite scraper and multi-functional double edged knives. Before more settlement/dwelling contexts with STP metal assemblages are uncovered, the first hypothesis cannot be nullified. Likewise, as long as the double edged knife cannot be defined as having had a single specific function, the possibility that it was used as scraper exists. In fact, some double edged knives indeed have bent bodies when they unearthed and could have been used as scrapers (Figure VIII.5:3), if the bending was not the result of ritual damage as most Russian archaeologists have suggested. The third possibility is restricted access to metal. Because of the rarity of metal and metallurgical techniques, more omnipresent microlithic tools were more preferred. The low density of the STP metal assemblage already implies this point to some degree. Restricted access to metal resources, in turn, endorsed the first and second explanation. The rarity of metal resources forced people to prolong the use life of objects (rather than terminate them in mortuary context) and develop multifaceted functions for consideration of expediency. Lastly, the social representations that usually determine the fate of technological choices should never be excluded. In other words, the mindset or ideological systems people developed around specific materials or technologies should be considered critical factors that result in the patterns of material culture we observe. The case study, for example, of the manufacture of bone tools among the Native Alaskan outpost in California in the 19th century clearly indicates how social representations (pre-contact technological traditions and attached worldviews) influenced technological choices and the use of metal tools in bone production (Wake 1999).

VIII.4 The social contexts of the STP assemblage: a case study of the Rostovka cemetery

Due to the dominance of mortuary data on the STP assemblage, the social context of metal objects must rely on mortuary analysis. However, as most major cemeteries (e.g., Seima, Turbino) hardly yielded human skeletons, which are critical for the identification of sex, age and social status, I must resort to the Rostovka cemetery, even though the total number of tombs is not large (38 tombs in total). The Rostovka cemetery is located in the southern bank of the Om River near the village of Rostovka, 15 km east of the city Omsk in western Siberia (Figure VIII.2:11). As one of the major cemeteries attributed to the STP, it is well known for the rich metal objects and casting molds recovered, along with other grave goods made of many materials, such as gold, jasper, lapis lazuli, and nephrite. During three field seasons in three years

(1966-68), 38 tombs were uncovered (Matyushchenko and Sinitsyna 1988). Almost all tombs are single burials but one (four individuals were identified, one child, two males, and one female, in tomb 8). Among all uncovered tombs, a little more than half of them (20 tombs, 53%) can be sexed, while the sexual identity of the skeletal remains from the remaining 18 tombs (47%) cannot be determined. Hence the following statistical results cannot be convincingly representative of the whole cemetery, but still can shed some light on the social context of metal objects to some degree.

All statistical computing and the visualized results displayed in the following were generated by the free software environment R[1]. Due to the limited data on sex and age, the data on tomb dimensions are quite complete among all uncovered tombs (except one badly destroyed tomb). Therefore, tomb dimensions (mainly length and width; original depth of tomb pit is unavailable for all tombs) and approximate area are introduced as extra statistic parameters. These parameters make sense in the understanding the social context of mortuary data, considering their hypothesized correlation to social differentiation by means of labor investment in tomb construction (Tainter 1978). It is my intention here to determine whether mortuary variables (such as tomb area and quantity of certain category of grave goods) have any differentiation by means of sex and age. Due to the poor preservation of human skeletons, definite age range is only available in 16 tombs (42%), fewer than the half of all samples. In addition, all identifiable skeletons ranging from 20-40 years old are adults. Therefore, age will not be considered a statistically valid variable for the following computations.

[1] https://www.r-project.org/

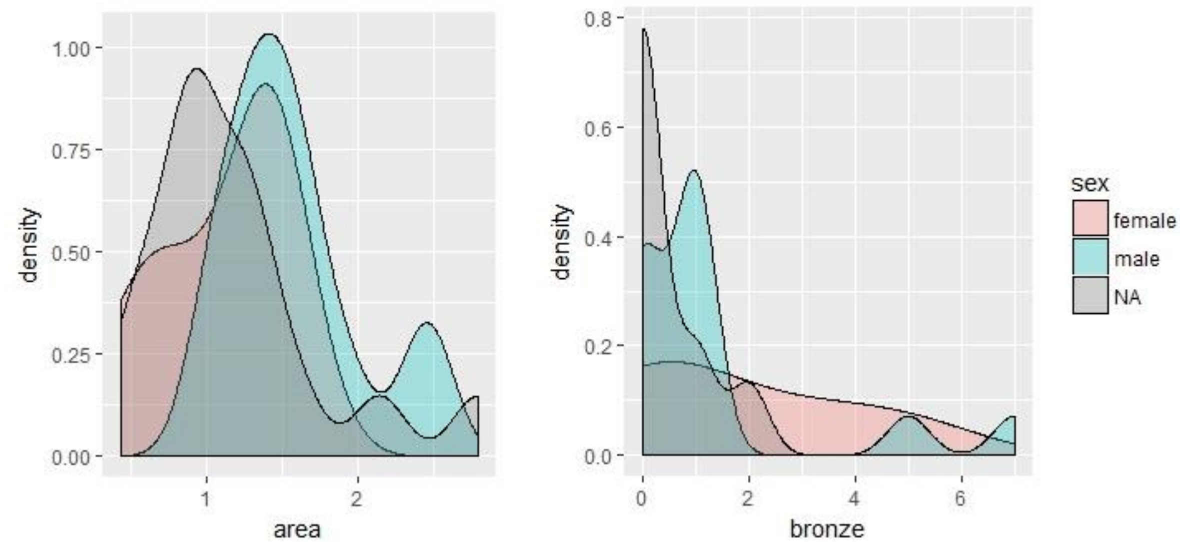

Figure VIII.14 Density distribution of tomb areas and quantity of bronze items (color by sex)

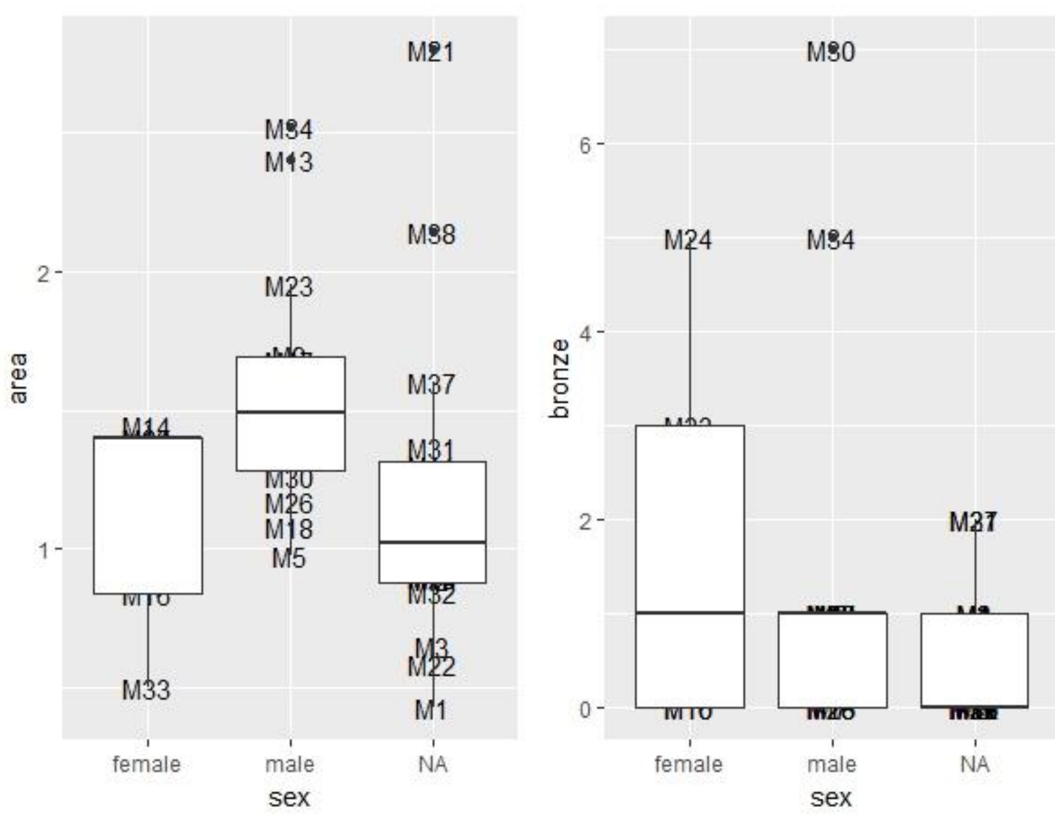

Figure VIII.15 Boxplots of tomb areas and quantity of bronze items (with outliers identified)

First, it is important to check whether the samples are normally distributed before any statistical computing or tests. As the plots above show, the density of tomb area is a nearly normal distribution, while the quantity of bronze items from the tombs is heavily skewed (Figure VIII.14). The same distribution pattern can also be observed from the boxplot graphs (Figure VIII.15). The mean (average) tomb area for female individuals is a slightly smaller than for male counterparts. More samples of the former are spread out less than 1.5 m^2, while the latter is more normally distributed. There seems to be a small differentiation between the sexes in tomb area. However, taking bronze grave goods (including spearheads, celts, knives and awls) as parameters, even though the mean of bronze items is the same between the sexes, female tombs tend to contain more bronze items than males ones. On both boxplot graphs, we find the outliers in tomb area and bronze items exclusively in male tombs, among tombs with identifiable sexes. The outliers in tomb area (M13, M21, M34, M38) and bronze items (M30, M34) are especially interesting and thus invite further investigation. However, tombs with unidentifiable sexes should not be overlooked. Considering the large percentage of NA values (47%), any conclusion inferred from above graphs can only be conditional for the moment.

Table VIII.2 Confidence interval of the mean of tomb area

sex	n	median	mean	sd	se	lowerCI	upperCI
female	5	1.4	1.117	0.425788	0.190418	0.588315	1.645685
male	14	1.49	1.568214	0.458298	0.122485	1.303601	1.832828
NA	17	1.02	1.182422	0.600153	0.145559	0.873852	1.490992

(n- number; sd- standard diviation; se- standard error; lower CI- the minimum confidence interval; upper CI- the maximum confidence interval. Same hereafter)

Table VIII.3 Confidence interval of the mean of quantity of bronze items

sex	N	median	mean	sd	se	lowerCI	upperCI
female	5	1	1.8	2.167948	0.969536	-0.89186	4.491863
male	14	1	1.357143	2.060886	0.550795	0.167222	2.547063
NA	17	0	0.411765	0.712287	0.172755	0.04554	0.777989

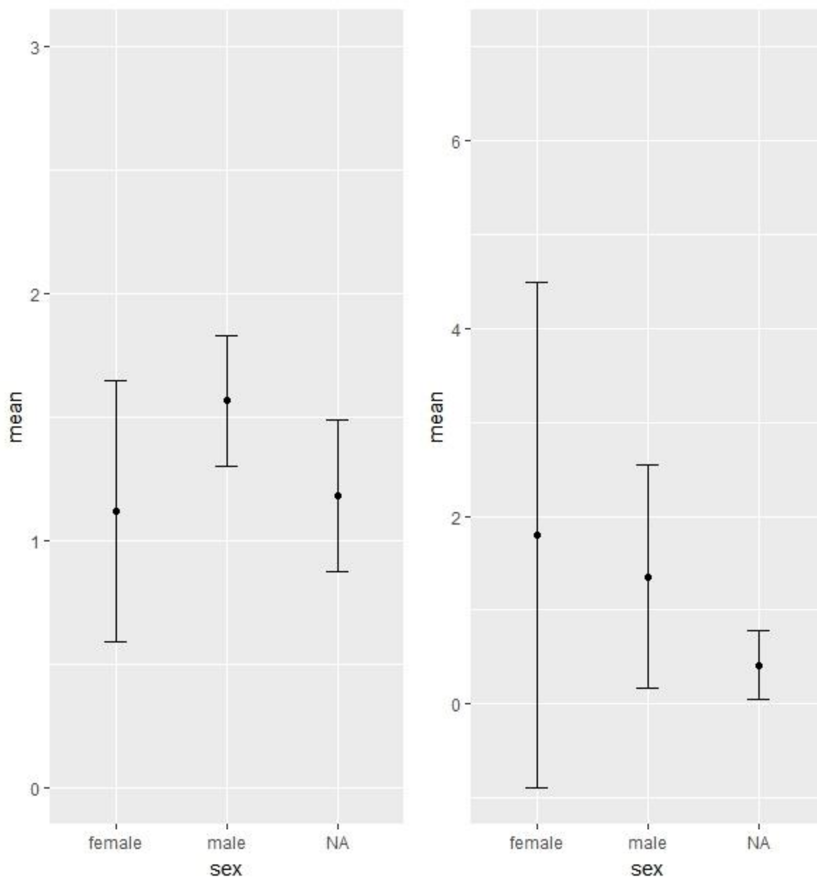

Figure VIII.16 Confidence interval plots of mean tomb areas (left) and bronze grave goods (right)

In order to figure out whether differences in statistical significance exist between sexes in tomb area and bronze grave goods, the confidence interval (at 95% level) of the mean of each variable needs to be computed (Table VIII.2, Table VIII.3). The corresponding plots (Figure VIII.16) show that the confidence intervals of the means of tomb areas and bronze grave goods for both sexes largely overlap. Thus no statistically significant difference between sexes in tomb areas and bronze grave goods can be determined for the moment, if all NA values are excluded. If tomb area representing labor investment in construction is a reliable parameter for social status, we could conclude that males seem to have a higher status than females in the Rostovka cemetery. As for the bronze burial goods, situation is different; females were buried more bronze items than males, and thus seem to have a status no lower than males if bronze items were indeed highly valued as rare goods by the society. However, as with the aforementioned inferences, these ideas cannot be conclusive as long as NA values cannot be eliminated.

Statistical computation also highlights some interesting outliers in both tomb areas and in bronze grave goods. Tomb 13 (M13) has the second largest tomb area in the whole cemetery (2.4 by 1 meter) with an orientation of west-east. The male deceased was buried with no ostentatious grave goods but four stone arrowheads, one ceramic sherd, and one bone scraper. The male individual in tomb 30 was buried with the largest number of bronze items: two spearheads, two celts, one knife and two awls. Besides these bronze items, a rich quantity of microlithic blades and ceramic sherds were also found in the vicinity of the tomb pit. One small stone mold was also found inside the tomb, which may indicate the social occupation of the deceased (a metallurgist/founder?). If the richness of grave goods does correlate with the social occupation of the deceased, tomb 21 yields the largest amount of stone molds across the whole cemetery, which would be another good example confirming that correlation. The deceased with the largest tomb area (2 by 1.4 meters) and unidentifiable sex was buried with two bronze celts, three stone arrowheads, and most attractively, one gold ring (probably an earring). Considering the rarity of gold throughout the entire cemetery (five gold rings in total uncovered), it must have a higher value than bronze counterparts. We may conclude that social occupation has a positive correlation with social wealth, if stone molds are a straightforward indicator of an individual's social occupation as a metallurgist/founder. However, other tombs with gold rings (M32, M33, M34) yield no metallurgical craft remains at all. This suggests social occupation is a sufficient but not a necessary condition for social wealth.

In tomb 34, correlation between the tomb area (2.8 by 0.9 meters) and the amount of bronze items (five items) is present yet again. In addition, the male deceased was buried with one gold earring, an indicator of social wealth. However, another outlier in tomb areas, tomb 38, yields no bronze items at all except for some microlithic scrapers, two pieces of astragali, and a chunk of ochre. If disturbance could be excluded and the burial repertoire were complete for each tomb, then correlation between tomb areas and bronze items as proposed earlier could be overturned. In fact, evidence of secondary burial or posthumous disturbance is present throughout nearly all uncovered tombs. All things considered, the social contexts of the STP assemblage cannot be affirmed based on the *status quo* of available data. But some conventional wisdom might be challenged. Some items that traditionally assumed to be the signatures of warrior (i.e., bronze spearheads and bone armors) were found across sexes and with age groups other than adults (a child aged nine to ten in tomb 2).

VIII.5 Concluding remarks

In this chapter, I analyze the STP assemblage through the framework of anthropological technology and thus develop a better understanding of the production process of bronze assemblages as well as the probable technological choices that happened during that process. Besides the technological processes of production, the use contexts of the typical STP repertoire, especially the curved knife, are also inferred. I also highlight another important impetus, the craft of leather/fur working, as probably motivation for the circulation and exchange of STP metals. The reconstruction of the social contexts of the STP assemblage in the case of Rostovka cemetery also suggests a complicated picture in which different social dimensions (i.e. sex, social occupation and social wealth) find their ways into the social representations of the metal assemblage. Oversimplified perceptions of the STP as a population bounded by a uniform identity that swept the whole continent with superior technology in metallurgy should be banished once reconsidered from an anthropological perspective. Agency in local choice and preference reflected by technological choices should be emphasized over passive adoption without any consideration of any advances in technology. This tendency is even more obviously reflected by the so-called post-Seima-Turbino dispersions to Northwest China, which will be addressed in the next chapter.

Chapter IX The transmission of metallurgy and the formation of continental economic complexity: the Andronovo horizon and its influence in Northwest China

In the last chapter I mainly examine the STP through the framework of anthropological technology and highlight the technological processes of the STP assemblage. As a technological innovation, the exploitation and use of tin in metallurgy greatly decreased the melting point in smelting copper ore and also improved the fluidity of the molten copper alloy in casting, thereby making the emergence of the typical STP metal assemblages of peerless quality possible. Casting technology for thin-walled hollow objects, involving the application of clay cores, was another innovation made by Eurasian forest-steppe metallurgists. At the same time, this technological innovation resulted in a much narrower range of technological choices in production, as reflected by the highly homogeneous stylistic appearance of the typical STP assemblages (e.g., spearheads with forked stems). Moreover, I also concluded that explanation of the morphological differences between metal assemblages cannot be separated from the social contexts that determined patterns of production, distribution and consumption in local contexts. Technological innovations in metallurgy were already embedded into pre-existing social contexts, as reflected by utilitarian tools, and by more symbolically loaded spearheads and curved knives, once the technology was available. Building on the technological reconstruction of socketed axes in the last chapter, STP spearheads are more relevant to the beginning of the current chapter. As will be demonstrated, the STP spearhead was one of major representations for early technological transmission between Siberian metallurgical centers and their counterparts in Northwest China.

IX.1 The re-classification of the STP spearheads and implications

Distinguishing the typical STP assemblages from other metal assemblages produced by alternative metallurgical traditions is the first step in evaluating the cultural processes involved in the transmission of metallurgy on a continental scale. Successful distinction between the Abashevo-Sintashta metallurigical tradition and the typical STP tradition by Chernykh and Kuzminykh (1989:64) in the case of spearheads laid a solid base for us to build on. Typical STP spearheads can immediately be distinguished from contemporaneous counterparts produced by the metallurgical communities in the Southern Urals steppe, namely, the Abashevo-Sintashta cultural communities, according to the techniques used to form the socket, by either rolling-up by forging or the cast-as-a-whole method. The former technological tradition produced spearheads with fine linear middle ridge vertically running through the entire leaf; by contrast, the latter technological tradition, probably due to the nonuse of tin ores, produced spearheads with protruding a middle ridge (cubic-ridge), which counterbalanced the lower fluidity of molten arsenic copper than tin-copper alloy in casting. Without the use of clay core to form a hollow socket, the stem of the spearhead was cast solid, and thus subsequent hammer working was necessary in order to yield a sheet of desired thickness and to roll it into a socket opening (Figure IX.1:24, 25). According to spatial distribution and relative chronology, the spearheads with Abashevo-Sintashta signatures appeared in the Altai (Figure IX.1:5-8) much later than local STP ones (Chernykh and Kuzminykh 1989:157). Based on this crude time framework, a reclassification of spearheads according to technological tradition is proposed here (Figure IX.1) and the transmission of those two technological traditions will be hypothesized.

Due to spatial proximity, metal products from Southern Urals metallurgical centers easily found their ways into the adjacent Cis-Urals or Eastern Europe, as shown by examples from the Seima cemetery (Figure IX.1:26, 28). This technique was also found in one specimen at the well-known Rostovka cemetery on the Irtysh (Figure IX.1:18). No later than the advent of metallurgical production in the Southern Urals at the beginning of the second millennium BC, in the Rudny Altai the innovative use of tin first produced cast-as-a-whole spearheads with a linear middle ridge running through the narrow leaf (Figure IX.1:1-4). This innovation in metal objects quickly spread westward to the Ob-Irtysh, Trans-Urals and Cis-Urals (Figure IX.1:9-11, 19, 36-39). Interestingly, one cast-as-a-whole spearhead that appeared in the type site of the Abashevo culture in the Southern Urals, was presented with a willow-leaf shape (Figure IX.1:23), suggesting technological influence from Altai. Later, more and more cast-as-a-whole spearheads with broad leaves spread eastwards, as shown by those from the Rostovka cemetery (Figure IX.1:15-17). Inspired by the broad leaf spearheads from the Southern Urals, a similar style also appeared in the metallurgical centers of the middle Irtysh (Figure IX.1:12-14), from which it then spread to the Trans-/Cis-Urals (Figure IX.1:20, 32-35). It is not surprising at all that a great variety of styles of spearheads can be found at the Seima and Turbino cemeteries, the two major consumption terminals in the Cis-Urals. Although sound stratigraphic evidence to support the hypothesized transmission sequence proposed above is still lacking for the moment, the fact that this component of the STP assemblage was not so homogeneous as traditionally assumed cannot be denied. The STP, of course, was never isolated in its formation and development but actively engaged with its counterpart in the steppe, as recently emphasized by Russian archaeologists (Chernykh 2010:262; Koryakova and Epimakhov 2007:110). Recent archaeological work at Shaitanskoe Ozero in the Trans-Urals Yekaterinburg provided sound evidence for the co-existence of these two technological traditions in the archaeological context of the Koptyakov culture (Figure IX.2; Korochkova and Stefanov 2010; 2013).

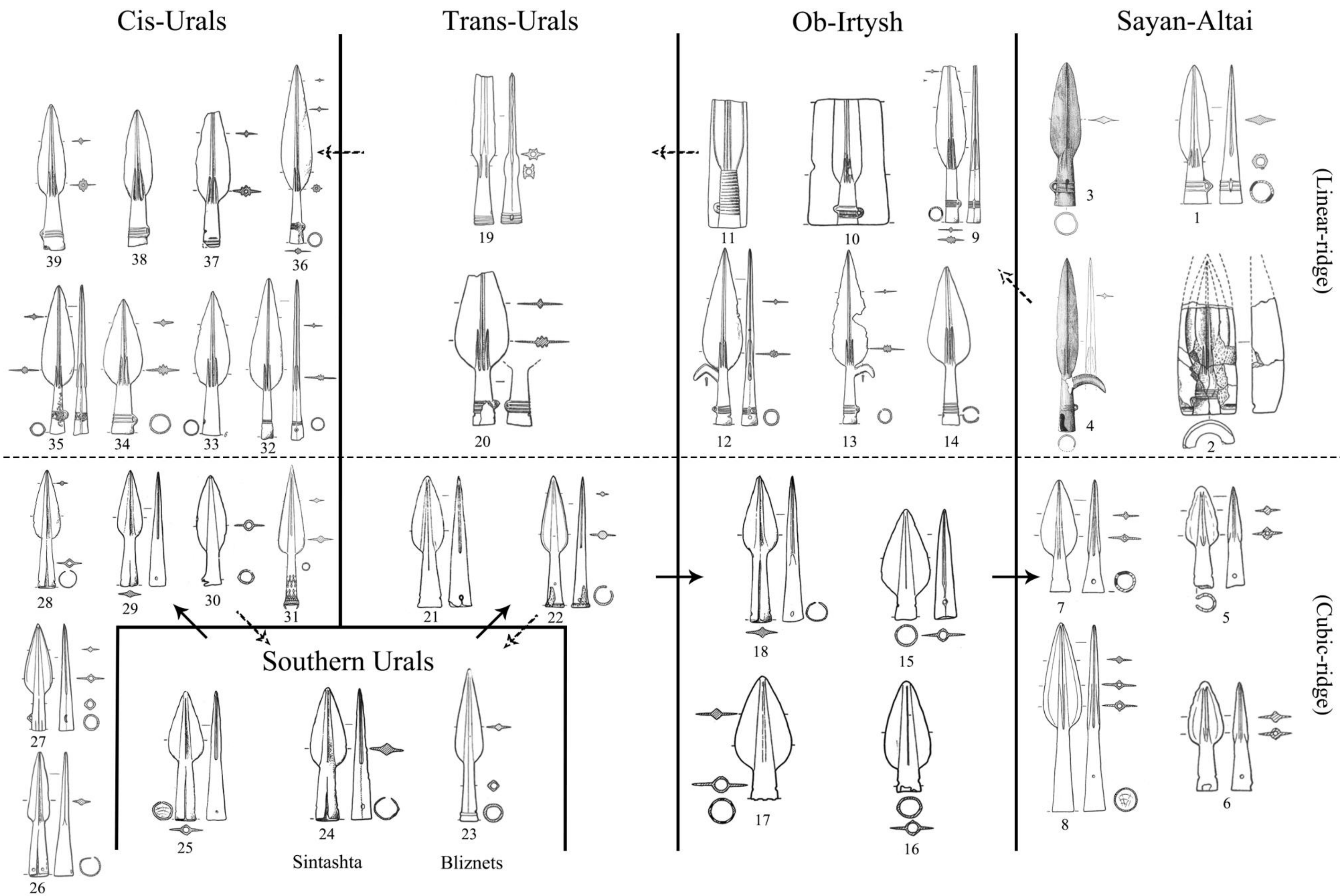
Cis-Urals
Trans-Urals
Ob-Irtysh
Sayan-Altai
(Linear-ridge)
(Cubic-ridge)
Southern Urals
Sintashta
Bliznets
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Figure IX.1 Re-classification of STP spearheads based on technological tradition

(Dash arrowheads indicate the hypothesized transmission direction of the STP metallurgical tradition or forest-steppe tradition; solid arrowheads indicate spearheads of the steppe metallurgical tradition represented by the Abashevo-Sintashta community) (3,4 after Kiryushin 2002:255, figure 151; the rest is after Chernykh and Kuzminykh 1989)
Sayan-Altai region: 1. Ustyanka 2. Kalantyr 3. Charysh 4. Burla 5,6,8. Osinkinskii 7. Zaledeevo
Ob-Irtysh region: 9. Ust-Tara 10. Irtysh 11. Samus IV 12-18. Rostovka
Trans-Urals region: 19. Tyurikovo 20. Kurtai 21. Bekteniz 22. Dzhangeldy V
Southern Urals region: 23. Bliznets 24,25. Sintashta
Cis-Urals region: 26-28, 32-35. Seima 29. Ust- Gaiva 30, 36-39. Turbino 31. Borodino

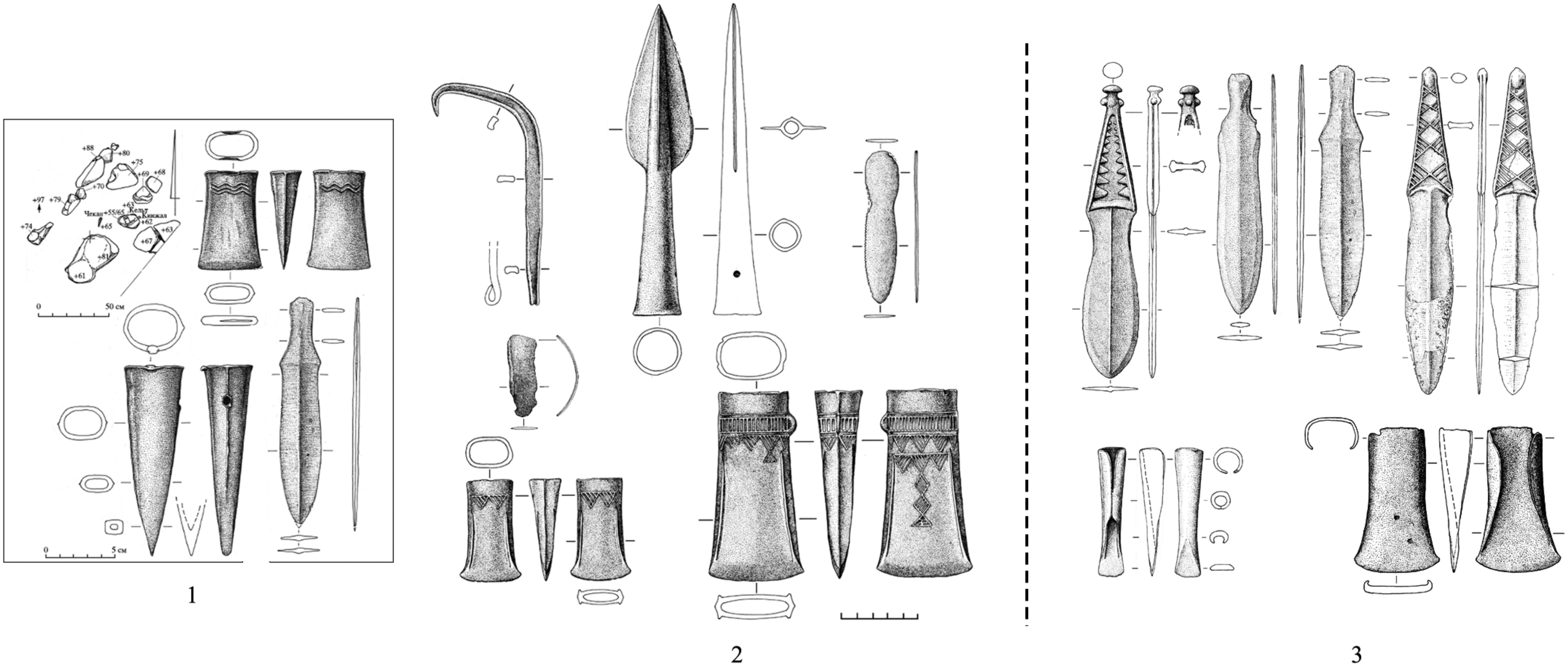

Figure IX.2 Metal assemblage found at Shaitanskoe Ozero in Yekaterinburg (Trans-Urals), Russia

(After Korochkova and Stefanov 2010; 2013; Korochkova and Spiridonov 2016)

(1. The archaeological context of co-existence; 2. Seima-Turbino assemblage 3. Petrovka-Alakul assemblage)

The convergence between these two technological traditions in the first quarter of the second millennium BC, I argue, is the key for developing a nuanced understanding of similar data found in Bronze Age Northwest China.

IX.1.1 Seima-Turbino spearheads in Bronze Age Northwest China: a typological study

So far at least 15 STP metal spearheads have been found within the territory of modern China (Figure IX.3; Table IX.1). According to the above re-classification scheme, those spearheads all are the typical STP spearheads with a linear middle ridge. Excluding one sample found in Chaoyang, Liaoning Province in northeastern China (Figure IX.3:1), the rest were equipped with an eagle-beak shaped hook beneath the bottom of the spearhead leaf. Obviously, they were all inspired by Siberian prototypes such as those unearthed from the Rostovka cemetery on the middle Irtysh (Figure IX.3:12, 13). Cultural connectivity between the Dzungar Basin and the Baraba Plain was naturally facilitated by the Irtysh River, sourced from the southern flank of the Altai Mountains in Xinjiang (Lin Y. 2011). Although hooked spearheads were also found in the Altai region, the slender leaf was so distinct from the counterparts found in China that any direct inspiration in design seems implausible. However, a more detailed examination of samples found in China clearly show a salient stylistic mutation: the disappearance of a forked shank of spearhead—the signature of typical STP spearheads—and a gradually broadened leaf. Based on these differences in stylistic traits, the samples found in China can be grouped into two categories. One is the typical STP spearhead with forked shank (Figure IX.3:1, 2); another is the modified version of the former category without forked shank (Figure IX.3:3-14). Due to the absence of archaeological context with accurate dating parameters (generally pottery) for such samples, it is impossible to determine their date accurately. Logically, it is straightforward that the former group should be earlier than the emergence of the latter group. However, the gap between the introduction of prototypes and the following emulation could be too small to be archaeologically visible.

Besides the signature forked shank, proportion is another effective parameter for distinguishing Chinese examples from Eurasian ones. Based on available measurement, one might calculate and compare length-width ratios (Figure IX.4). Date on the the proportions of the spearheads cluster around two extremes, suggesting that spearheads from China and Rostovka were totally distinct from each other. Generally, spearheads from Rostovka tend to have a much larger length-width ratio (with a range of 3.67-5.13; the average value is 4.46) and are represented by much more slender proportions than Chinese examples, the ratios of which stably range from 2.84 to 3.51 (the average value is 3.07). Meanwhile, a larger variation in ratios for the Rostovka spearheads (with a standard deviation of 0.53) than for Chinese counterparts (with a standard deviation of 0.21) can also be observed (Figure IX.5). If a standardized ratio were an indicator of the identity of one craftsman or workshop, then we might assume that the Rostovka spearheads could not have been produced by the same craftsman or workshop. In the same vein, we might take note of a much smaller variation in ratio among the Chinese examples, suggesting a programmed technical standard followed by one or many craftsmen or workshops.

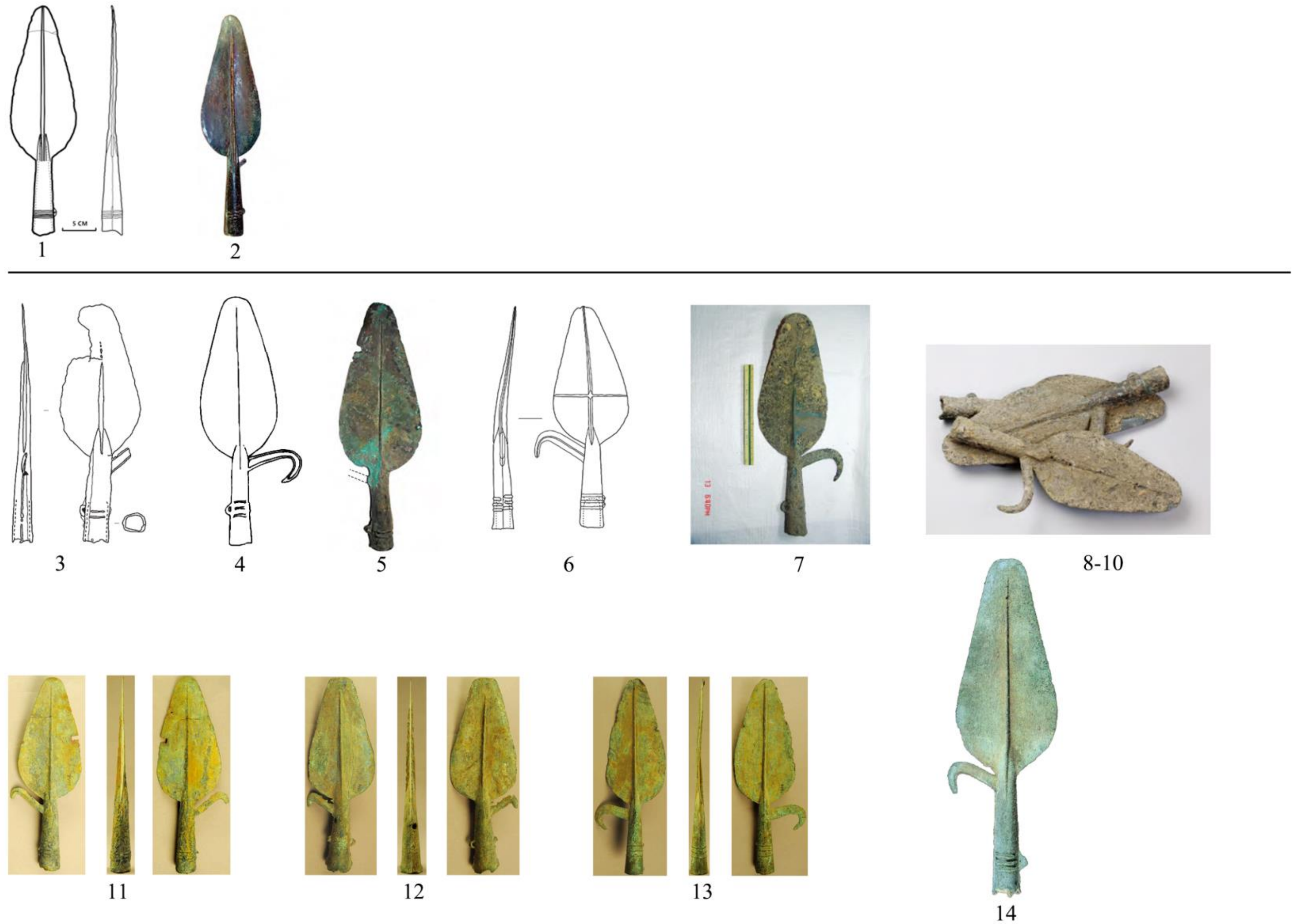

Figure IX.3 Seima-Turbino style spearheads found in China (scale not uniform)

(1.Xiazhangzicun, Chaoyang, Liaoning 2. Shanxi Craft and Art Museum 3.Datong, Qinghai 4. National Museum 5. Shanxi Provincial Museum 6. Shaanxi Provincial Historic Museum 7-10. Xiawanggang, Henan 11-13. Nanyang Municipal Museum 14. Shenna, Qinghai)

Table IX.1 STP style spearheads found in China

No.	Provenience	Context	Hook	Total length	Socket length	Socket diameter	Leaf length	Leaf width	Leaf thickness	Metallic composition	Length-width ratio	Source
1	Chaoyang, Liaoning	Ash pit?	No	34.7	NA	NA	NA	9.9	0.2	Cu-Sn(6.35%)	3.51	Liu X. and Liu R. 2016
2	Shanxi	Stray find	Yes	34.6	NA	2.9	NA	10	NA	Cu (Sn-1.3%)	3.46	Lin M.C. 2015; Liu R. et al. 2015
3	Datong, Qinghai	Stray find	Yes	34.2	16.4	NA	17.8	11.4	0.35	Cu	3.00	Liu X. 2015
4	Unknown	Stray find	Yes	37.9	NA	NA	NA	NA	NA	NA	NA	Li G. 2011
5	Shanxi	Stray find	Yes	36.3	NA	3.2	NA	12.8	0.5	Cu-Sn(3.2%)	2.84	Lin M.C. 2015;
6	Shaanxi	Stray find	Yes	35.8	13.1	3.9	22.7	12	0.25	Cu	2.98	Liu R. et al. 2015; He D.X. 2016
7	Xiawanggang, Henan	Ash pit	Yes	37	13.3	4.5	23.7	12.5	NA	Cu	2.96	Gao J.T. 2015; Lin M.C. 2015
8	Xiawanggang, Henan	Ash pit	Yes	37	13.3	4.5	23.7	12.5	NA	Cu-As(10.3%)	2.96	Gao J.T. 2015; Liu R. et al. 2015
9	Xiawanggang, Henan	Ash pit	Yes	37	13.3	4.5	23.7	12.5	NA	Cu-As(4%)	2.96	Gao J.T. 2015; Liu R. et al. 2015
10	Xiawanggang, Henan	Ash pit	Yes	37	13.3	4.5	23.7	12.5	NA	Cu-As(11.6%)	2.96	Gao J.T. 2015; Liu R. et al. 2015
11	Nanyang-0232, Henan	Stray find	Yes	38	13.5	4	24.5	12.5	NA	Cu-As(3%)	3.04	Liu R. et al. 2015; Liu X. and Hu B.H. 2016
12	Nanyang-0233, Henan	Stray find	Yes	34.7	12.5	4.2	22.2	11.9	NA	Cu (Sn-1.4%)	2.92	Liu R. et al. 2015; Liu X. and Hu B.H. 2016
13	Nanyang-0234, Henan	Stray find	Yes	36.4	12.6	3.4	23.8	11.2	NA	Cu (As-1.1%)	3.25	Liu R. et al. 2015; Liu X. and Hu B.H. 2016
14	Shenna, Qinghai	Ash pit	Yes	61.5	NA	NA	NA	19.5	NA	Cu	3.15	Lin M.C. 2015; Hu B.H.2015
15*	Gansu	Stray find	Yes	30	NA	NA	NA	NA	NA	Cu	NA	Lin M.C. 2015

*This item was identified by the staff of the Gansu Provincial Museum and briefly reported at the end of cited literature. Based on the description, it is not substantially different from other Chinese emulations. Visual details (illustration or photo) are unavailable for the moment.

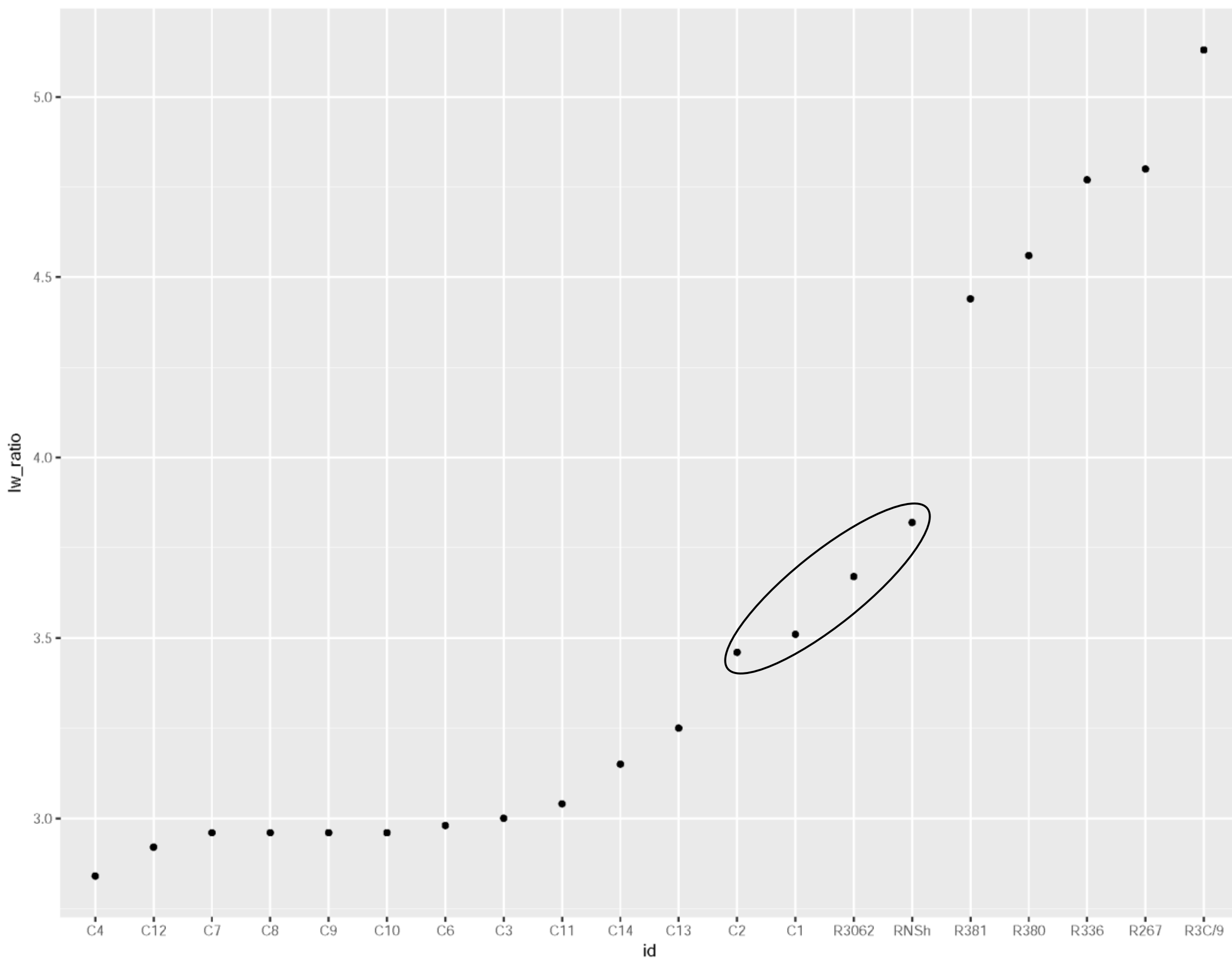

Figure IX.4 Scatter plot of the length-width ratio of the Seima-Turbino style spearheads found in China (sample ID initialed C) and Russia (sample ID initialed R)
(Data source: Matyushchenko and Sinitsyna 1988:69. Four spearheads, two from China and two from Russia; those with close proportions are highlighted by the solid oval)

Two Chinese examples with non-standard ratios, the outliers displayed in the boxplot (Figure IX.5), 3.46 and 3.51, corresponding to samples C1 found in Chaoyang (No.1 in Table IX.1; Figure III.1:1) and C2 found in Shanxi (No.2 in Table IX.1; Figure III.1:2), respectively, are noteworthy. Coincidently, these two outliers are the only two examples with the typical STP signature – the forked shank found in China. Compared to other Chinese examples, their proportions are definitely much closer to the two examples found at Rostovka (Figure IX.6). Chemical analysis of the composition of these samples also indicates great similarity in formula of copper and other metallic minerlas: the sample R3062 (Figure IX.6:1) from M33 at Rostovka is tin-lead bronze (Cu-Sn-Pb), and the sample RNSh (Figure IX.6:2) collected from the same cemetery is tin bronze (Cu-Sn) (Chernykh and Kuzminykh 1989:285-6). The two Chinese samples found in Shanxi and Liaoning were cast using the same formula (tin bronze and tin-copper alloy) (Table IX.1). As mentioned before, the using of tin is one of the most remarkable technological signatures of STP metal products. The signature of tin, along with stylistic homogeneity, points to the possibility that these two Chinese samples may have been directly imported from the middle Irtysh River.

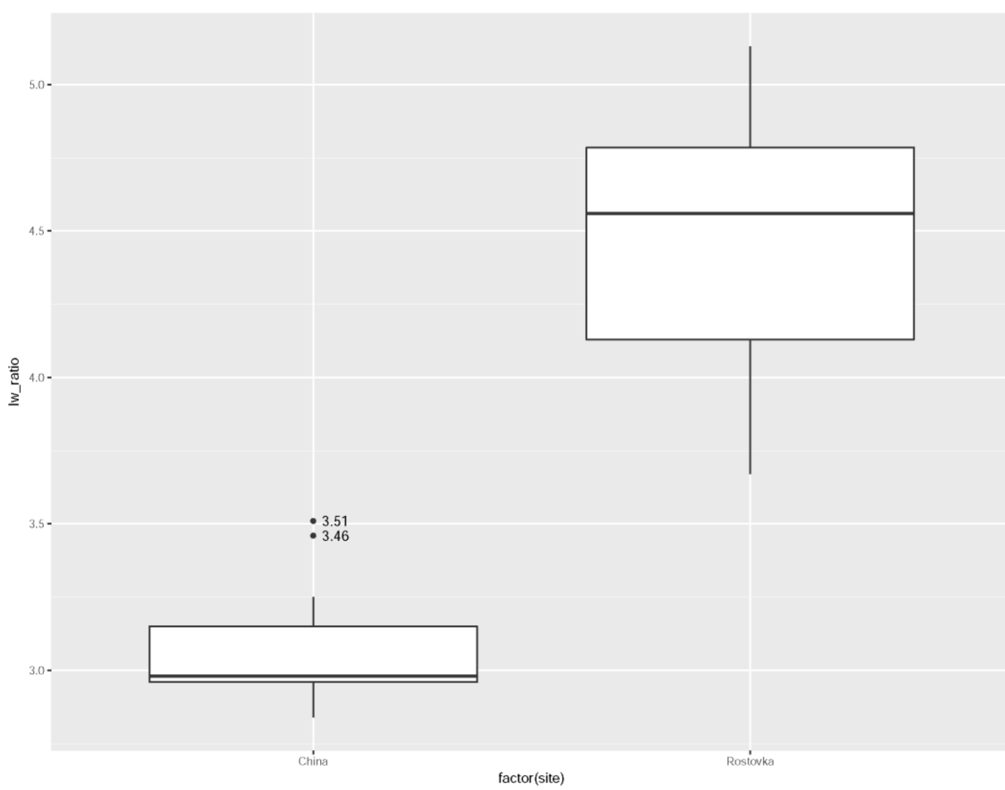

Figure IX.5 Boxplot of length-width ratio distribution of samples from China (left column) and Rostovka (right column)

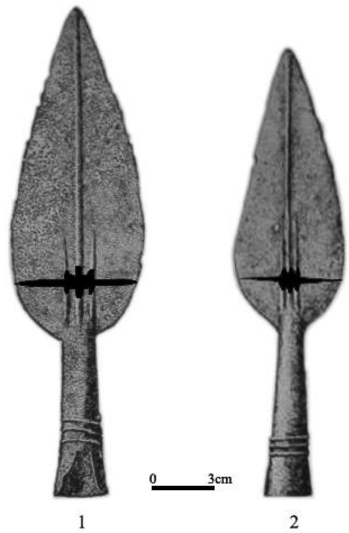

Figure IX.6 Forked spearheads found at Rostovka (1.R3062 2.RNSh)

Following this argument, it can be inferred that the rest of the Chinese samples were all local emulations made with local raw materials, and likely, local techniques, as suggested by the dominance of pure copper and arsenical copper in composition, as well as the absence of the signature—forked shank. Due to the unavailability of tin ores, all Chinese emulations were inferior in quality than their Eurasian counterparts. Meanwhile, the similarity in style but the absence of "core techniques" in casting also suggests that the transmission of metallurgy was probably quite superficial; it happened more in the form of the circulation of goods than in the form of specialist mobility. The inter-cultural transmission of core techniques in metallurgy, as shown in most ethnographic records, is difficult and usually happens in face-to-face circumstances between specialists and apprentices. By the same token, the possibility that itinerant craftsmen were responsible for the emergence of metallurgy in Northwest China cannot be excluded. If it were true, the interregional transmission of metallurgy should have happened no later than the introduction of the STP assemblages into Northwest China. The sparse metal products and metallurgical remains found at Xichengyi (GSWKY 2014) and other sites (e.g., Jiangjiaping in Yongdeng and Linjia in Dongxiang) dating back to the Late Machang phase or even earlier indicate that experimental metallurgy inspired by the Eurasian Metallurgical Province had begun no later than the end of the third millennium BC in Northwest China. It is this local metallurgical experiment that provided the technological preparation for local emulation of the STP assemblage. Based on currently available evidence, it is believed that these Chinese emulations could only have been produced by metallurgical communities in the Hexi corridor during the early second millennium BC, namely, the Xichengyi communities and their descent Siba communities. The range of metallurgical formulae for copper alloys of Chinese emulations such as pure copper, arsenical copper and tin-copper alloy, were never beyond the technological capacity of the Xichengyi metallurgical focus, as shown by recent componential analysis on the metallurgical remains at Xichengyi (Chen G.K. et al. 2015).

The current archaeological pattern of the distribution of STP style spearheads, obviously, is the result of circulation and thus cannot be assumed to be products in their local archaeological contexts. As pointed out in Chapter VII, Qijia communities were responsible for the wide spread of Chinese emulations from the Hexi corridor to the eastern part of China. Some examples unearthed from the Qijia culture matrix (e.g., Shenna site in Qinghai, and probably Xiawanggang site in Henan) indicate close ties between the circulation of those “exotic” metal products and Qijia communities in the form of trade diasporas. Unfortunately, due to the lack of archaeological contexts or associated material cultures, it is impossible to infer the original use context of most spearheads. However, functional explanation of ceremonial or non-utilitarian display based simply on the rounded square point is too loose to account for ones with sharp points (Figure IX.3:13). This rounded shape could have been a result of their as-cast status, without any polishing and sharpening on the edge, so as to enable more convenient transport over a long distance. The stabbing of spearheads, knives or shaft axes vertically into ground *in situ* commonly found with typical STP assemblages in other parts of Eurasia clearly suggests ceremonial or ritual purpose in burial or votive deposition. Similar cases have not been encountered among the Chinese examples. Four spearheads found in the same pit at Xiawanggang could have been a votive deposition (Gao J.T. 2015). However, it is more likely a hoard deposited by some itinerant craftsmen, considering the highly uniform proportions of those specimens as well as their freshly-cast state without any traces of post-casting processes such as hammering, polishing, and sharpening.

IX.2 Beyond the STP: re-evaluating its role in early Bronze Age Northwest China

One of the most important implications drawn from re-classification of STP spearheads at the beginning of this chapter is that the STP technological tradition was not closed at all. On the contrary, the interaction and exchange between forest-steppe (STP) and steppe (Abashevo-Sintashta) metallurgical centers were more dynamic than traditionally assumed. These two technological systems largely overlapped, at least during the first quarter of the second millennium BC. Technological exchange can be clearly observed through stylistic changes in the spearheads on both sides; specifically, in the appearance of a broad-leaf spearhead with lineal middle ridge in the typical STP assemblage (Figure IX.1:14), as well as that of a narrow-leaf spearhead with cast-as-a-whole socket in the Sintashta assemblage (Figure IX.1:23). The appearance of a stubby spearhead in the metallurgical center on the middle Irtysh seems a good example of the convergence of two technological traditions. This spearhead has typical

Abashevo-Sintashta proportions and a cubic middle ridge except a linear ridge redundantly juxtaposed on the cubic ridge (Figure IX.1:15-17). The chemical composition of this kind of spearhead is a tin-arsenic-copper alloy (Cu-Sn-As) (Chernykh and Kuzminykh 1989:288), which to some degree suggests a mixture of two metallurgical formulae of two technological traditions: the arsenical copper of the steppe and the tin bronze of the forest-steppe, respectively. It is widely accepted that transmission of those two metallurgical traditions happened in opposite directions (Chernykh 2010). Hence, the rare STP spearheads found in Chinese territory were quite bizarre in this context; they went against the predominating westward transmission that covered the vast forest-steppe belt in Eurasia. By contrast, the Abashevo-Sintashta metallurgical tradition engaged in a strong eastward expansion that originated in the Cis-Urals and Southern Urals and then evolved into the so-called Sintashta-Petrovka cultural community across the Trans-Urals and northern Kazakhstan and its well-known descent—the Andronovo cultural-historical community in eastern Kazakhstan, Northwest China and the Minusinsk Basin on the Yenisei. With this objective in mind, it seems to be more reasonable to assume that the appearance of STP spearheads in Chinese territory may have resulted from the eastward expansion of the Sintashta-Peterovka metallurgical tradition. The introduction of spearheads with broad leaves, rather than the classic type with narrow leaves, into Northwest China may not have been a coincidence, rather a possible cultural choice from strong steppe technological tradition. Moreover, we should expand our inspection beyond the STP assemblage so as to balance sampling bias. In other words, the sampling bias of current archaeological evidence has greatly distorted our understanding of the nature, extent, and process of early inter-regional cultural interactions, and thus the role of the Seima-Turbino Phenomenon (not an archaeological culture) in the early transmission of metallurgy from Central Eurasia to Northwest China is overestimated by some scholars (Lin M.C. 2015). This innovative technological-cultural phenomenon, at its best, contributed a new repertoire to local metallurgical production in Northwest China. The two most crucial "core technologies" of the STP – the exploitation and use of tin and the thin-walled casting – hardly imposed any substantial influence on the Xichengyi metallurgical centers, at least based on current available evidence. It is not until the next phase—the Andronovo horizon (1800-1500BC)—that the technological signatures of the Eurasian Metallurgical Province begin to surface prominently in the archaeological evidence in Northwest China. The introduction of STP spearheads and their emulations in Northwest China were just harbingers of this unprecedented epoch of inter-regional interaction.

IX.3 The Andronovo cultural-historic community: the rise of interregional economic complexity

The most prominent cultural change that happened in Central Eurasia from the middle to late Bronze Age is probably the formation of the Andronovo community - a gigantic cultural-historic community that dominated the cultural landscape of a vast territory of steppe and forest-steppe belts extending from the Urals in the west to the Minusinsk Basin on the Yenisei in the east (Kuz'mina 2007). Since Teploukhov's (1929) seminal study on the pottery from the village of Andronovo in the Minusinsk Basin, the Andronovo have been long established and well studied by Russian archaeologists (Kuz'mina 2007). Based on their widely distributed material culture items with high uniformity in style, the Andronovo were once seen as a gigantic archaeological culture/horizon that probably represented some ethnic groups. As more and more archaeological work went on in each region, now it has gradually been recognized that the so-called Andronovo culture was no longer a holistic entity but was comprised of many regional archaeological cultures that shared significant similarities in material culture items. Hence, the concept of cultural-historic community (KIO[1]) is preferred in order to describe such an archaeological complex. However, dominated by the traditional cultural-historical paradigm, the interpretation on the formation of the Andronovo community is still by and large confined to the identification of some ethnic or linguistic groups, and thus leaves some important questions unanswered: What does this uniformity in material culture stand for? Why did such a highly uniform cultural phenomenon covering such a broad territory appear in the first half of the second millennium BC? Rather than working with hackneyed migration theories, I agree with most Russian archaeometallurgists and argue that the formation of the Andronovo cultural-historic community should be seen as the result of cultural interaction motivated by a series of socio-economic factors. The one that could and should be considered first in the context of the Bronze Age is metallurgical production. Having directly inherited the metallurgical tradition of the Abashevo-Sintashta at the beginning of the second millennium BC, and meanwhile, having received tin-use techniques from the Seima-Turbino technological tradition, the early phase of the Andronovo community, namely, the Petrovka -Alakul cultural communities were mainly distributed throughout the southern Urals and western and northern Kazakhstan. These communities greatly expanded eastwards to central and eastern Kazakhstan (Tkachev 2007), and even to the Minusinsk Basin on the Yenisei (Maksimenkov 1978). Having engaged with pre-existing Eneolithic communities in each region, the Fedorovo culture developed, assumed to be the culmination of the Andronovo cultural-historical community, as suggested by the forest-steppe or southern taiga cultural markers of Fedorovo type pottery (Stefanov and Korochkova 2004; Zakh et al. 2008). The far-flung eastward expansion of the Alakul/Fedorovo communities was believed to be correlated to increasing need for tin ores (cassiterite) deposited in those regions,

[1] KIO stands for the Russian acronym “Kulturno-Istoricheskaya Obshchest” (Cultural-Historical Community).

especially the Kalbin and Narym Mountains in eastern Kazakhstan, which have the richest reserves of tin ores across the whole Eurasian continent (Chernikov 1960; Tkachev 2014). The spread of metallurgical technology probably resulted from the dispersion of steppe metallurgists and prospectors subsisting on livestock and wild resources. Great social demands for metal deeply rooted in local social contexts (e.g., household production for daily life and the fulfillment of social obligations) may have provided direct incentives for self-interested participation in the metallurgical production system. This sort of “gold-rush model” (Kohl 2007:177-8) explains the broad dispersion of similar material cultures across the same temporal horizon. Meanwhile, the concentration of population with different cultural backgrounds may also lead to cultural hybridization, as suggested by the so-called “non-typical Andronovo” or the hybridized Alakul-Fedorovo culture in central Kazakhstan (Kuz’mina 2007:28; Margulan et al. 1966). Technically, the interlocked production sequence of metallurgical systems encourages task specialization, which in turn creates economic demands on subsistence and thus leads to the intensive exchange of bulk goods such as cattle, sheep/goat, game animals and grains. The impressive volume of fauna remains piled up like a hill found near the Late Bronze Age copper mine at Kargaly clearly indicates the gigantic subsistence demands engendered by specialized metallurgical production (Chernykh 2002). The same situation can also be identified in the Andronovo metallurgical community in eastern Kazakhstan, as represented by the site of Kanai near the Zaisan Lake, characterized by larger percentage of cattle than contemporary sites (Chernikov 1960:167-8). In addition, the rather uniform proportions (orifice diameter is always half the height) of most typical Fedorovo pottery vessels in each region may suggest the emergence of specialized potters in each community. Even though organic materials such as textile, leather, wood and basketry are rarely preserved in most Eurasian archaeological contexts, the insightful hypothesis proposed by Gryaznov (1930) that the signature meanders and shaded triangles on the Andronovo pottery were probably emulations of contemporary textile patterns is still worth keeping in mind. This cross-craft interaction has been clearly observed in the well-preserved baskets unearthed from the dune cemeteries in Xinjiang (Figure IX.7), as explained below.

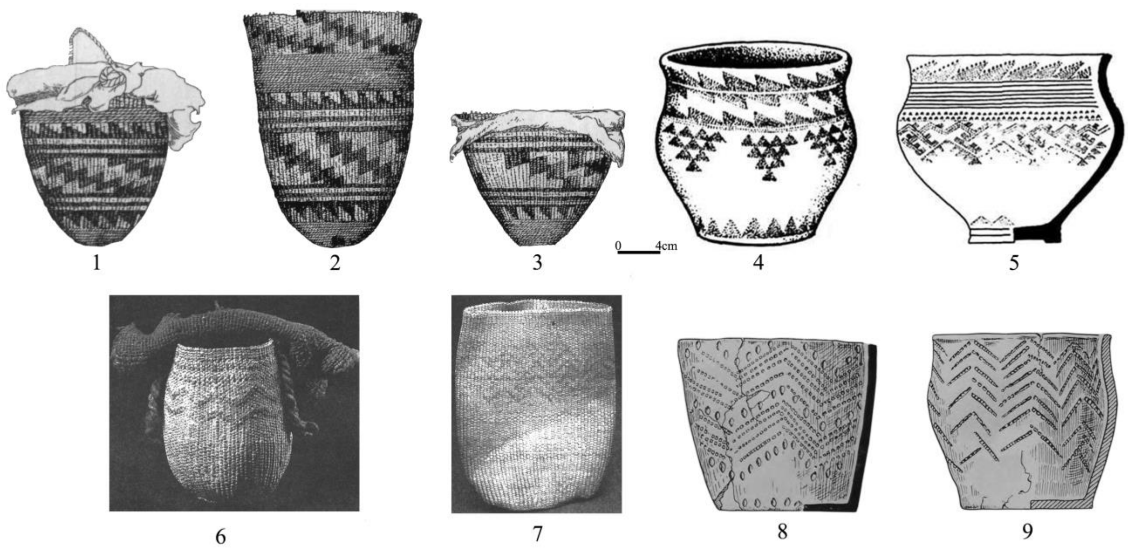

Figure IX.7 Comparison of baskets from Xiaohe cemetery (1-3) and Gumugou cemetery (6, 7) in Xinjiang and Andronovo pottery vessels in central Kazakhstan (4, 5) and eastern Kazakhstan (8, 9)

1. Xiaohe, M4:9 2, 3. Collected (after XJWKY 2002) 4. Begazy 5. Buguly I (after Margulan et al. 1966, table 1) 6, 7. Gumugou, tomb 38 and 41 (after Wang, B.H. 2014) 8. Kanai settlement 9. Kanai cemetery, tomb3 (after Chernikov 1960, table 19)

IX.3.1 The incipient metal using communities in Xinjiang and their contact with the Andronovo horizon

So far early archaeological remains found in the territory of Xinjiang are quite scarce, consisting of only a few cemeteries buried on top of sand dunes in Lop Nor[1], such as the Gumugou cemetery (Figure IX.8) and the well-known Xiaohe cemetery, dating back to the first half of the second millennium BC (Wang B.H. 2014; XJWKY 2004; 2007). One of the most noticeable components in material culture items recovered from those cemeteries is the total absence of pottery. By contrast, a variety of floral resources omnipresent in desert oases such as tamarisk (*Tamarix ramosissima*), cottongrass (*Eriophorum* sp.), hemp (*Cannabis sativa*), reed (*Phragmites australis*), sedge (*Carex* sp.) and soft rush (*Juncus* sp.) were exploited by Caucasoid basket makers to manufacture mundane goods (e.g., food containers, dinning vessels, winnowing baskets, wood basins and bowls) and funeral facilities (coffin, wood stumps above the grave, bunches of ephedra as grave goods). Wheat grains, cattle horns, cattle skins, ibex horns, fishing net and arrow shafts found in those cemeteries suggests a mixed subsistence economy of wheat-planting agriculture, stockbreeding and complementary hunting and fishing. The sophisticated exploitation of the secondary products such as milk, wool and leather clearly indicate specialization in stockbreeding (Xie M.S. et al 2016; Yang Y.M. et al. 2014). Sheep's wool was widely used for twining threads, weaving textiles, and making felt, which then serves as the raw material for clothing. Animal bones were also processed to make ornamental beads, awls and even adhesives (Rao H.Y. et al. 2015). The isotopic signatures of human skeletons also suggest the predominance of stock meat and C3 plants (wheat) in daily life (Zhang Q.C. and Zhu H. 2011). In addition, a small number of metal objects were also found at Xiaohe and indicate

[1] Besides southeastern Xinjiang, the so-called Ke'ermuqi culture (Chemurchek culture) distributed throughout the southern flank of the Altai Mountains is also believed to have been one of the earliest archaeological cultures in Xinjiang.

sophisticated metallurgical repertoires, including copper and its alloys (tin-copper), gold-silver alloy and pure tin (Mei J.J. et al. 2013).

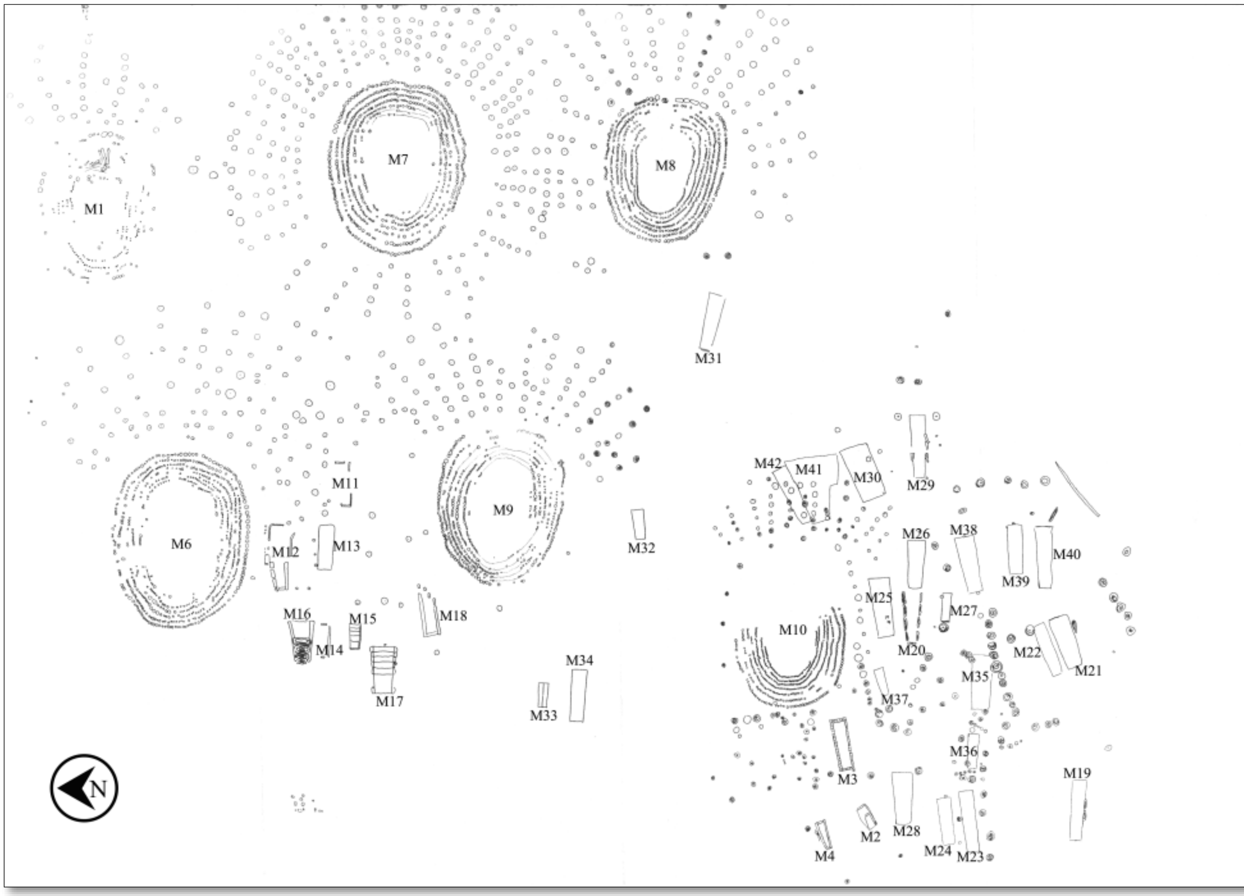

Figure IX.8 Plan of the cemetery at Gumugou, Lop Nor, Xinjiang

(After Wang B.H. 2014)

Radiocarbon dating of the wool textiles from Gumugou (tomb 38) yielded a range of 1875-1530BC (calibrated), wood samples from the same tomb yielded similar results (1878-1677BC, calibrated) (ZSKKY 1992:303-5). Millet grains from the upper layer of the Xiaohe cemetery (tomb 34) yielded a date range of 1690-1450BC (calibrated) (XJWKY 2007:41), while a recent AMS date result, 2030 BC (3980±40BP, calibrated), on a sample from the lowest layer at Xiaohe suggests that these Caucasoid herders had already settled the oases of southeastern Xinjiang at the end of the third millennium BC. Material culture characteristics, along with genetic signatures, indicate these Caucasoid herders as offshoots of the Eneolithic communities of Southern Siberia (Li C.X. et al. 2010).

The expansion of Andronovo economic complexity already reached southeastern Xinjiang no later than 1600 BC, as suggested by the typical Alakul/Fedorovo motifs found among the baskets from the Xiaohe and Gumugou cemeteries (Figure IX.7). Another cultural signature of Andronovo economic complexity is its sophisticated metallurgy. A small number of metal objects unearthed from the upper layer of the Xiaohe cemetery clearly suggest connections with Andronovo communities in central and eastern Kazakhstan. For example, bronze tubes, bronze and gold earrings, and ornamental plaques are all common in the latter context. Componential analysis of those metal objects also show the predominant use of tin (Mei J.J. et al. 2013), an unmistakable signature of the Andronovo metallurgical tradition. An earring made of pure tin further instantiated this connection with eastern Kazakhstan and the flourishing tin mining activities in this region and adjacent Central Asia during the Andronovo horizon (Garner 2015). Some sparse undiagnosable metal fragments from the Gumugou cemetery support earlier use of pure copper, around 1800 BC (Wang B.H. 1983:120). The predominant forging or hot-working technique found in the metal objects from Xiaohe also suggests the continuity of traditional techniques for pure copper with the innovative tin-copper alloy.

IX.3.2 The expansion of Andronovo economic complexity into Northwest China: metallurgical evidence

The influence of Andronovo economic complexity, obviously, had crossed the borderland of eastern Kazakhstan and penetrated into Xinjiang, as mentioned above and suggested by a number of stray finds, especially the metal objects of Andronovo style found around the Dzhungar Basin (e.g., Tacheng/Qoqek, Tuoli/Toli and Urumqi) and the Ili River valley in the southern flank of the Tianshan Mountains (e.g.,Tekesi/Tekes, Gongliu/Tokkuztara and Xinyuan) (Chen and Hiebert 1995; Li S.C. 2005; Li and Dang 1995; Lü E.G., et al 2001; Mei J.J. 2000; Mei and Shell 1999). Interestingly, finds of typical Andronovo metal objects were all located at the piedmonts of mountains, especially the Tacheng-Emin Basin in northwestern Xinjiang and the Ili River valley in western Xinjiang, where most Andronovo metal objects concentrate (Figure IX.9). Bearing in mind the flourishing of mining activities in the ore-rich central and eastern Kazakhstan, the appearance of typical Andronovo metal objects in those two regions seems be the natural expansion of mining and metallurgical activities to potential ore-rich areas along the Tianshan Mountains, Dzhungar Alatau and Tarbagatay Mountain. Two promising ancient copper mines dating back to the second half of the first millennium BC at Nulasai and adjacent Yuantoushan in the Ili River valley had probably been exploited during the Andronovo horizon (Wang B.H. 1985:56). So far, no evidence of prehistoric copper mines has been identified in the Tacheng-E'min Basin. But considering its proximity to the richest tin ore belt in the Kalbin Mountains in eastern Kazakhstan, ancient mines might well be identifyied through future fieldwork.

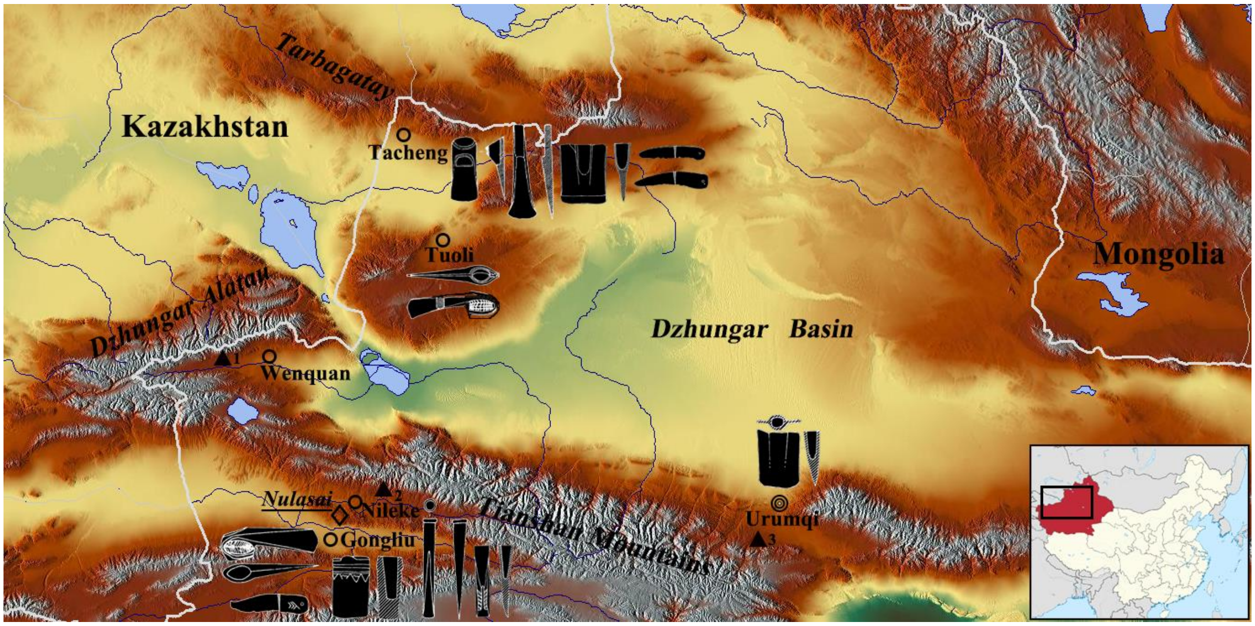

Figure IX.9 Distribution of Andronovo metal objects in Xinjiang

(1.Adunqiaolu 2. Jirentai Goukou 3. Saensayi. The location of the ancient copper mine at Nulasai is underlined. All metal object illustrations are after Li X. and Dang T. 1995)

As for the metallurgical workshops dating back to the Andronovo horizon in Xinjiang, the recently uncovered site at Jirentai Goukou (which literally means “the canyon mouth at the village of Jirentai”) is especially noteworthy (XJWKY et al. 2017). It is located on the third terrace of the west bank of the Kashi River, 23 km northeast of Nileke and 36 km northeast of the ancient copper mine at Nulasai (Figure IX.10:11). The excavation yielded 20 house-like structures, eight graves and as many as thousands of artifacts including pottery, stone, metal and bone objects. Among them, two large house-like structures from the lower layer are very noticeable.

F6 was constructed on leveled ground on the terrace slope with corridor-shaped "apron walls" (Figure IX.10). In the center of the structure a two-chambered furnace was found (Figure IX.10: b). The bottom of the furnace had been burnt red. The superstructure of the furnace is unknown.

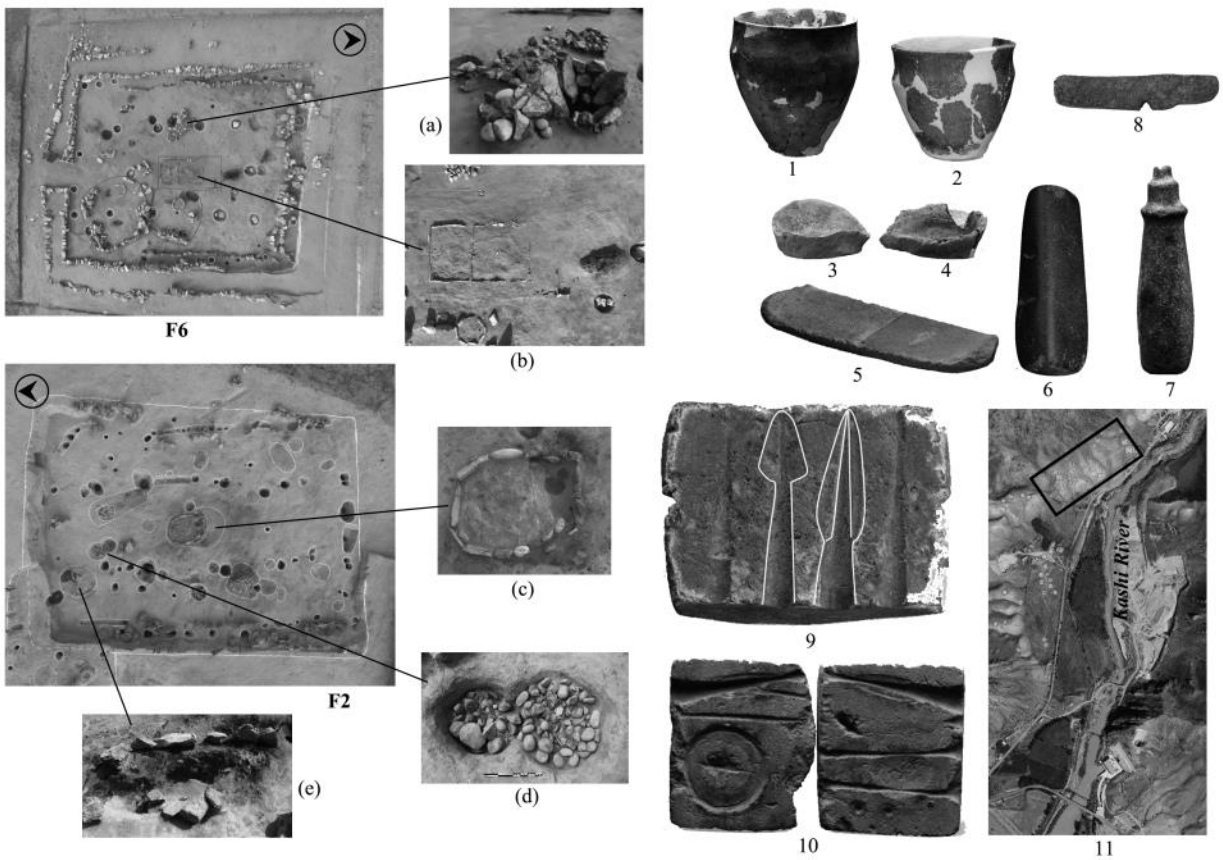

Figure IX.10 Metallurgical workshop found at the site of Jirentai Goukou

(Features: **a**. slab-lined furnace in F6 **b**. double-chambered furnace in the center of F6 with coal heap in the vicinity **c**. central furnace in F2 **d**. figure-eight shaped furnace in F2 **e**. rock lined furnace in F2 with traces of coal)
[Artifacts: 1. pottery vessel (F1:1) 2. pottery vessel (H7:1) 3. crucible (F6:10) 4.crucible (F5:1) 5.metate (F6:26) 6.pestle (F6:31) 7.pestle (F6:17) 8.copper/alloyed knife (F6:20) 9. pottery casting mold (F2:10) 10.pottery casting mold (F2:11) 11. site location of and excavation area indicated by rectangular box. After XJWKY et al. 2017]

The furnace foundation of was lined by stone slabs and some lateral apertures probably functioned as blast holes. An empty section can be observed in the northwest corner, which could have been the major blast hole, which agrees with the prevailing wind direction all throughout the year in this region. A heap of coal[1], the first and also the earliest evidence of the use of coal in Bronze Age Chinese Central Asia, was also found near the northern combustion chamber. Based on its structure and archaeological context, this was probably a roasting furnace for sulfide copper ores. Next to the west of the central roasting furnace a slab-lined pit feature was found (Figure IX.10: a). The slabs were inserted into the ground and formed a conical space, which suggest that it could not have been a typical post hole. The aligned slabs with homogenous material (probably ganister) indicate careful selection of stone type. Even though the content of the pit was not reported, according to analogous metallurgical furnaces in other parts of Eurasia, it was probably a smelting furnace. Stone lining and strong foundations can extend the use life of a furnace, and carefully selected slabs are conditioned by the gangue of the ores, as the type of stone will aid the flux in removing the gangue during the smelting process (Craddock 2000; Forbes 1950:127).

Besides these archaeological features, unearthed artifacts from F6 also confirmed that metallurgy was practiced in this workshop structure. Two polished pestles made of granite and a grinding slab (Figure IX.10:5-7) are necessary for pulverizing roasted copper ore into powder, which is then put into the crucible (Figure IX.10:3, 4) and loaded into the furnace. One finished object, a cast knife (Figure IX.10:8), was also found in this workshop. The type of copper ore, the composition of cast objects and the relevant metalworking techniques, however, are still unknown due to the absence of related lab analysis.

[1] The exploitation and use of coal as fuel in Bronze Age metallurgy was first identified and recorded at the site of Shandasha (Alakul culture) near Orenburg in southern Urals, see Kuz'mina 2007:92.

In a similar structure, F2, analogous archaeological features were also found: a central single-chambered furnace (Figure IX.10: c) for the roasting of sulfide copper ores, and a smelting furnace just to the north (Figure IX.10: d). Different from the smelting furnace found in F6, in F2 a figure-eight shaped bowl furnace was found. Such a furnace usually consists of two bowl-shaped furnaces sunk into the ground and linked together in the form of the Arabic number eight. The front is always deeper than the rare furnace so that the former can receive the slags of the latter. The bottom of the furnaces is always lined by rocks for refractory considerations, as this is where molten copper and slags are collected. This is also the reason why it has been reported that some pebbles found in this "post hole" bore thermal traces.

Associated artifacts from F2 as well as three pieces of casting molds made of fired fine clay clearly indicate the structure was once a metallurgical workshop. One is a single piece mold with impressions on one side (Figure IX.10:9). Based on the dentations on both laterals, it was likely a bivalve casting mold, like its partner (Figure IX.10:10), bounded together by cordage in casting. The casting repertoires of this mold included two socketed awl/chisels and two sockted spearheads, as indicated by the impressions. The socket parts also suggests the use of clay cores in casting. Two spearheads, one with a narrow leaf and the other with a stout triangle leaf are both commonly found in the Andronovo horizon in Eurasia. The second pair is a complete set of bivalve casting molds. The repertoire from of this set of molds includes socketed spearheads with narrow leaves, rods (which can be forged and hammered into sheet or wire to make other smaller objects like earrings, rings and claps etc.), mirrors with shanks, another two metal rods (superimposed by the arch dentation of mirror), and two smaller buttons. These objects are all typical Andronovo style metal items. AMS radiocarbon dating of the samples from the bottom layers in F2 and F6 yielded 3195±35 and 3275±30, respectively. The calibrated calendar year is around 3600 BP, which agrees with the absolute date range of the Andronovo horizon (1800-1500BC).

Although a nearly complete metallurgical operational sequence has been identified at the site of Jirentai Goukou, the nature of ore mining activities for the sake of metallurgical production are still unclear for the moment. It is possible that copper ores could have been transported from the mine at Nulasai, 40 km away. But based on the presence of roasting furnaces and smelting furnaces in the workshop, a copper mine should have been in the vicinity of the site, as far as transportation costs are concerned. The Tianshan Mountains in the north are worth exploring in the future for any potential copper mines besides the mine at Nulasai.

So far, the scope of fieldwork conducted in Xinjiang has been far from commensurate with its broad territory, and thus the actual influence of the Andronovo horizon in Xinjiang could be beyond our current estimate. The recently uncovered dwellings and cemeteries at the site of Adunqiaolu, which lies at the foot of the Alatau in Wenquan (Figure IX.9:1; ZSKKY et al. 2013), the Saensayi cemetery in the southern suburb of Urumqi (Figure IX.9:3; XJWKY 2013b), and the Xiabandi cemetery on the Pamir Plateau (XJWKY 2012) all yielded typical Andronovo (Fedorovo) material culture items such as gold-inlaid bronze earrings with trumpet-shaped ends. The influence of the Andronovo horizon in Xinjiang could not have been limited to the archaeological sites mentioned above. As will be shown below, the profound influence of the Andronovo horizon in the Hexi corridor endorses this assumption.

IX.3.3 Andronovo economic complexity and its influence in the Hexi corridor

After a short transitional period during the late Machang phase, no later than the early 19th century BC, the local Xichengyi culture evolved into the Siba culture. The material culture of the Siba culture displays continuity in style with preceding Xichengyi communities. Meanwhile, social development seemingly reached an apex during the Siba period, characterized by the development of a mixed economy, increased population followed by the expansion to the whole Hexi corridor, the continuation of painted pottery tradition, and most importantly, further development in metallurgy. Moreover, it is during the period of the Siba culture that unprecedented interaction at the inter-regional scale—between the Siba communities and westerly neighbors—has been observed for the first time. As will be shown, Andronovo communities in Xinjiang could have been one of the most important intermediaries in this process, especially for metallurgy.

The Siba culture, as the most predominant cultural community in the Hexi corridor during the first half of the second millennium BC, is well known for having the most abundant metal (copper or alloyed copper) objects unearthed from several cemeteries. Among them, the Huoshaogou cemetery alone (see Chapter V for more details) yielded 320 metal objects, accounting for about 80% of all metal objects found from the Siba period. This makes the metal repertoires from this cemetery an ideal subject for the study of early metallurgy in Northwest China.

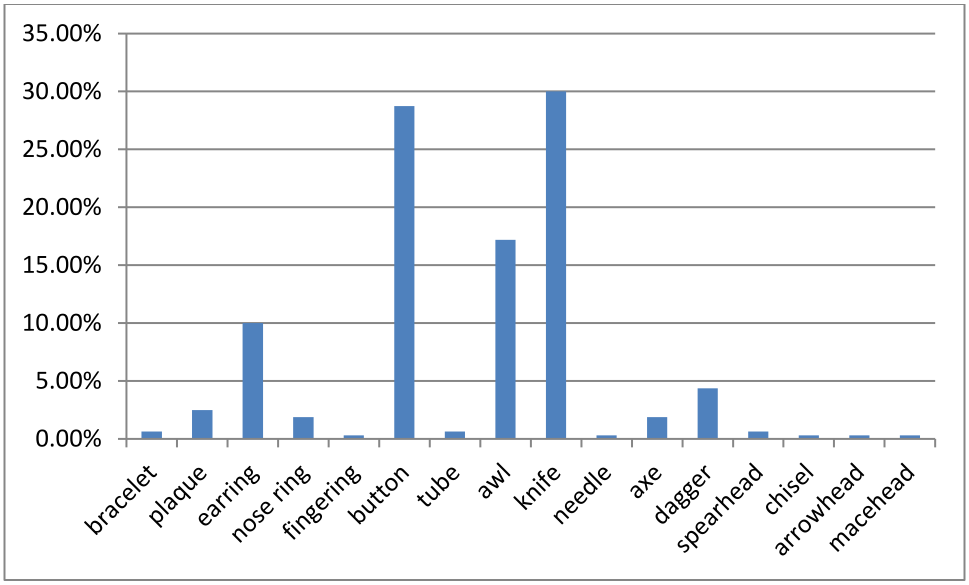

Figure IX.11 Distribution histogram of the metal objects from Huoshaogou

The assemblage of metal objects from Huoshaogou varies greatly in type. Ornaments and tools are the two major categories. Ornaments include buttons (92, accounting for 28.8%), earrings (32, 10%), plaques (8, 2.5%), nose rings (6, 1.9%), bracelets (2, 0.63%), spiral tubes (2, 0.6%) and rings (1, 0.3%). Tools mainly include knives (96, 30%), awls (55, 17.2%), daggers/spreaders (14, 4.4%), axes (6, 1.9%), spearheads (2, 0.6%), chisels (1, 0.3%), needles (1, 0.3%) and a small percentage of weapons and ritual objects (arrowheads and maceheads) (Figure IX.11). This categorical composition agrees completely with the repertoire of the Eurasian Metallurgical Province formed during the early second millennium BC (Chernykh 1992).

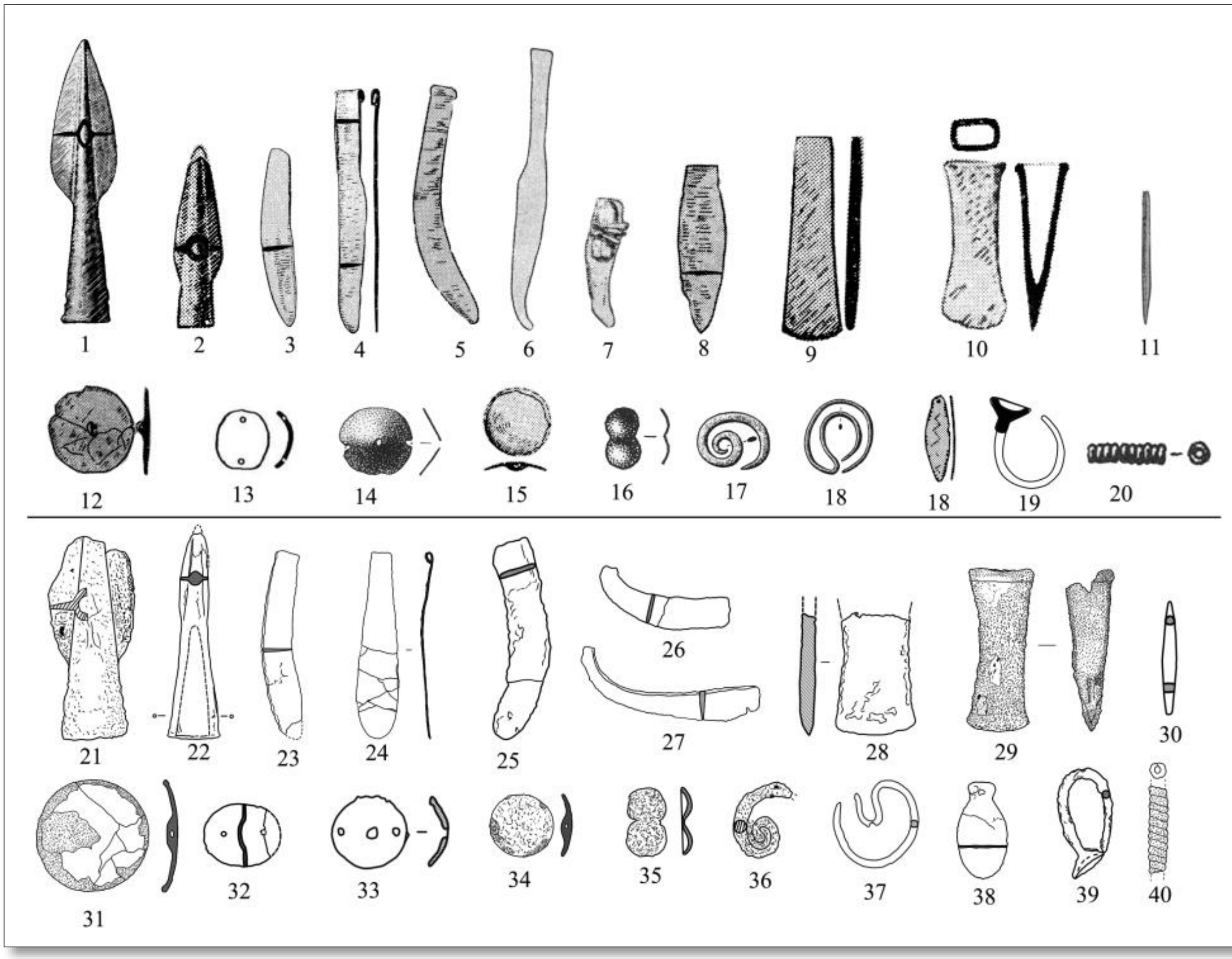

Figure IX.12 Comparison of the metal assemblage of the Andronovo horizon (Alakul/Fedorovo) (upper section) and Huoshaogou cemetery (lower section)

[1-20. Andronovo (Alakul/Fedorovo) metal assemblage 21-40. Siba metal assemblage
1,2,21,22. Spearheads 3-7, 23, 25, 26, 27. Knives 8, 24. Daggers/Spreaders 9, 28. Adzes 10, 29. Socketed axes 11, 30. Awls 12, 31. Mirrors 13-16, 32-35. Buttons 17, 36. Spiral ornaments 18, 37. Ornamental plaques 19, 38, 39. Earrings 20, 40.Ornamental tubes
Alakul culture: 1.Bekteniz 3,5.Petrovka II 4,8.Volosnikovo 9.Èmba 1, Kurgan 3 18. Nurmanbet, Enclosure 16, tomb1 (after Avanesova 1991)
Fedorovo culture: 2. Nurtai, Kurgan 4, Enclosure 1 6.Preobrazhenskoe hoard 7,11. Chernoozer'e 1, Tomb 64 10. Stepnyak 12.Buguly 1, Enclosure 3 13. Central Kazakhstan 15. Orak, tomb 5 19.Yelovka II, tomb 108 (after Avanesova 1991) 14,16,17,20 Yelovka II, tomb 47, 153 and 46 (after Matyushchenko 2004)
Siba culture: 21.YH045 22.90YHM112:1 23.76YHM100:5,4 24.76YHM79:9 25.76YHM219:6 26. 76YHM96:11 27.76YHM252:11 28.76YHM296:1 29,30. 76YHM64:9,10 31.76YHM215:13 32.76YHM310:17 33.76YHM85:5 34.76YHM11:19 35.76YHM124:14 36.76YHM47:13 37.76YHM226:1 38.76YHM127:26 39.90YHM114:2 40.76YHM215:16 (Archive, Gansu Provincial Institute of Cultural Relics and Archaeology/GPICRA)]

In style, the metal assemblage from Huoshaogou is highly similar to the metal objects of the Andronovo horizon found in the Trans-Urals as well as northern, central, and eastern Kazakhstan (Figure IX.12), which suggests that profound metallurgical interactions took place between these regions. In addition to these mundane metal objects, some objects that are rare in Northwest China further suggest strong connections with westerly neighbors due to the expansion of Andronovo economic complexity during the first half of the second millennium BC. Round plaques of mirror-like shape and ornaments on both sides (Figure IX.13), and maceheads made of marble and other semi-precious stones as well as bronze (Figure IX.14), both exemplify this point. Meanwhile, slight differences in style also indicate that Siba communities may have modified imported repertoires according to local tastes. The recently uncovered metallurgical remains (ores, slags, prills, and stone casting molds) and finished objects from the Siba horizon at Xichengyi also suggest that Siba metal objects were produced in local workshops.

The metal assemblage from Huoshaogou had systematically undergone chemical-physical analysis in earlier years (BGXY 1981; Sun S.Y. and Han R.B. 1997). Due to the problematic sampling strategies applied, most of the results are not accurate enough. More accurate than taking samples from surface patinas, the improved strategy of sampling the core area of the section yielded more reliable results (BKDYCY and GSWKY 2003). These updated results show that among 35 samples, most are pure copper (13, 37%), followed by bronze (tin-copper alloy, ten, 29%), and arsenic copper (6, 17%). A small percentage of ternary alloys such as copper-lead-arsenic (Cu-Pb-As) (two samples) and copper-lead-tin (Cu-Pb-Sn) (one sample) were also identified. Interestingly, most tools (e.g., knives, awls, axes) were made of pure copper, while most ornaments (e.g., earrings, nose rings, buttons, mirror-shaped plaques) were alloyed copper.

Among these alloyed copper ornaments, the percentage of tin, arsenic and antimony is not constant and thus indicates more arbitrariness in the alloy recipe. However, according to experimental data on the colors of copper alloys (Mödlinger et al. 2017), alloyed ornaments show strong patterns in hue and reflectance (Figure IX.15). Specifically, all alloyed ornaments including earrings and nose rings (Lab No.909-911, 913), displayed a similar color when cast: yellowish red with high reflectance. In contrast, tools and weapons (e.g., knives, awls, axes, and spearheads) displayed a great variety in color and did not show any coherent patterns in color. More interestingly, one metal button of copper-antimony-silver alloys containing 5.37% antimony (BKDYCY and GSWKY 2003:89), would also have had a similar color (yellowish red with high reflectance), according to experiments on antimony alloys (Mödlinger et al. 2017:20). This example further suggests that there may not have been any fixed formula for the additive metals (e.g., tin, arsenic, antimony, or silver) to make alloyed copper, as long as the color of alloys conformed to chromatic aesthetics, which were probably the most valued parameters for Siba communities in the manufacturing of ornaments. The same recipe and aesthetic scheme is supported by the contemporaneous metal ornaments found at Gamatai, a typical Qijia site in the Qinghai-Tibetan Plateau (QHWKY 2016:189).

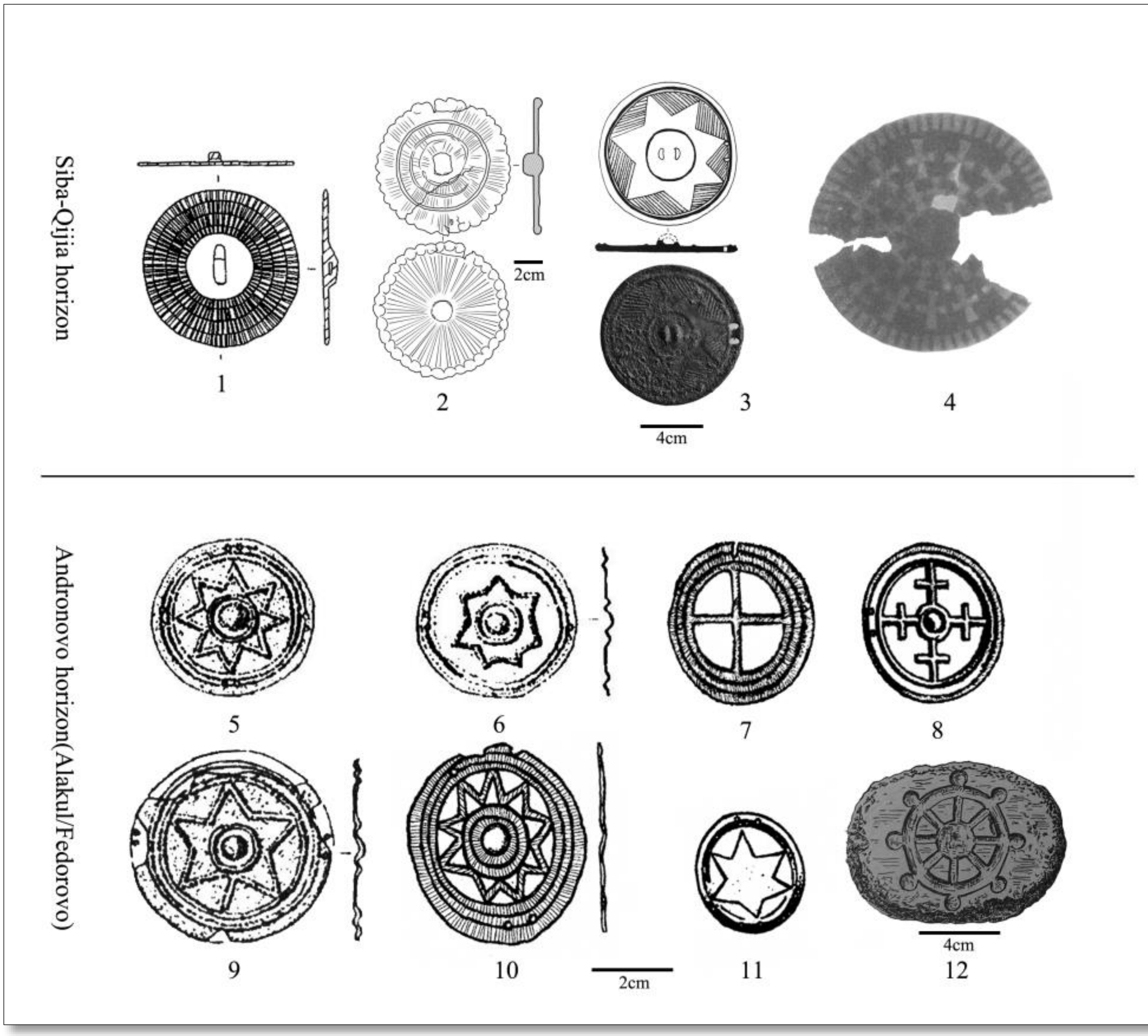

Figure IX.13 Comparison of mirror-like metal plaques of the Siba-Qijia horizon (upper section) and the Andronovo horizion (Alakul/Fedorovo) (lower section)

[1.Tianshanbeilu (after Lü, E.G., et al. 2001) 2.Huoshaogou (Archive, GPICRA) 3.Gamatai (after QHWKY and BDKWX 2016) 4.Erlitou (after ZSKKYEG 1975) 5. Balykty cemetery, Enclosure 14 6.Ayappergen cemetery 9.Nurtai cemetery (after Tkachev 2002) 7.Alakul cemetery 8.Bylkyldak I cemetery 10.Lisakovskii cemetery 11. Bylkyldak III cemetery (after Flek 2010) 12. Kanai, stone mold (after Chernikov 1960)]

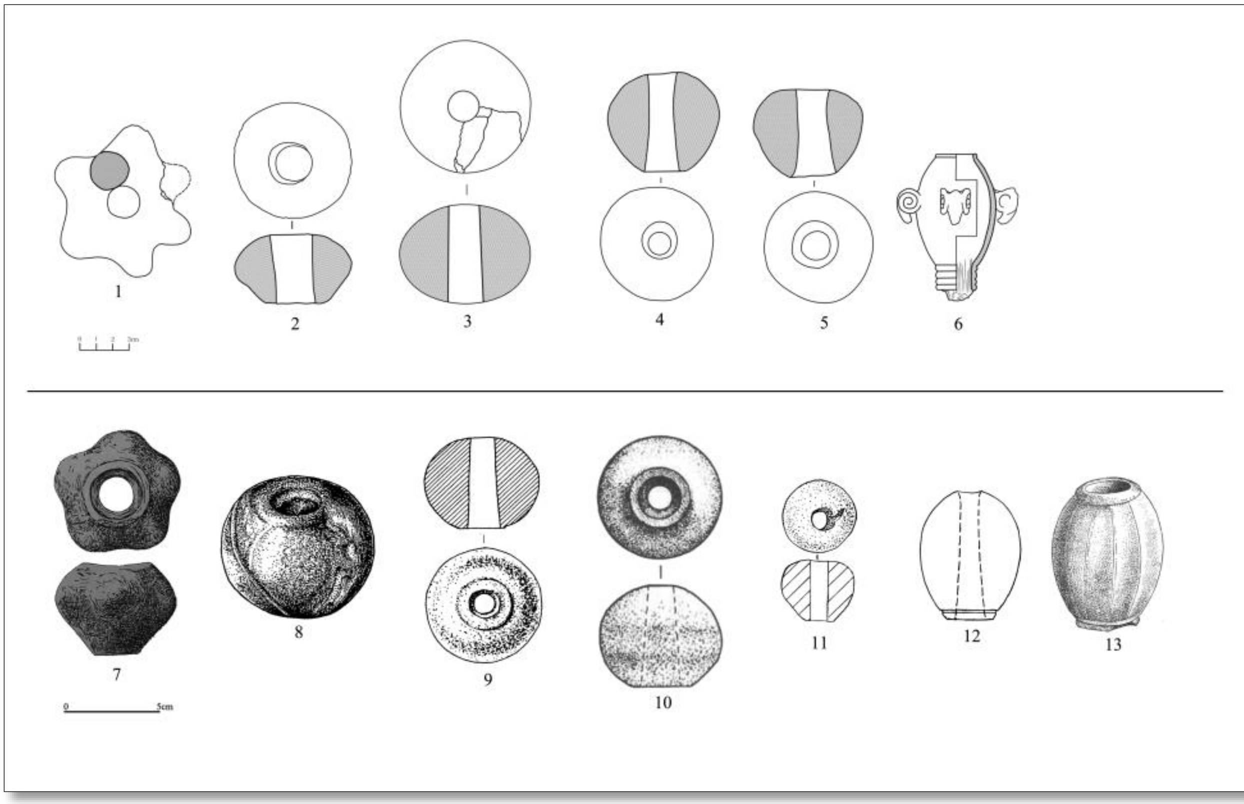

Figure IX.14 Comparison of maceheads from Huoshaogou (upper section) and the Andronovo horizon (Alakul/Fedorovo) (lower section) (6, 13. bronze, the rest stone)

[1. 76YHM250:2 2.76YHM10:1 3.76YHM299:13 4. 76YHM64:14 5.76YHM262:4 6.76YHM310:7 (Archive, GPICRA) 7. Malo-Krasnoyarka, eastern Kazakhstan (after Chernikov 1960) 8. Sopka-2, kurgan 22, tomb 33, burial 178 (after Molodin 2012:153) 9. Sintashta cemetery, tomb 10 10. Kenes, kurgan 2, tomb1 (after Zdanovich 1988:75) 11. Sintashta CIII, tomb1 (after Gening et al. 1992:336) 12. Sintashta CII, tomb7 (after Gening et al. 1992:320) 13. Alakul, kurgan 8, tomb 7 (after Salnikov 1952:58)]

Lastly, it is also noteworthy that the original yellowish red color of the Siba ornaments is close to that of gold. Considering a dozen gold earrings were indeed unearthed from the same cemetery, it makes sense that this specific color choice may have resulted from the intentional emulation of gold, a rare and precious metal used since the Eneolithic period in Central Eurasia.

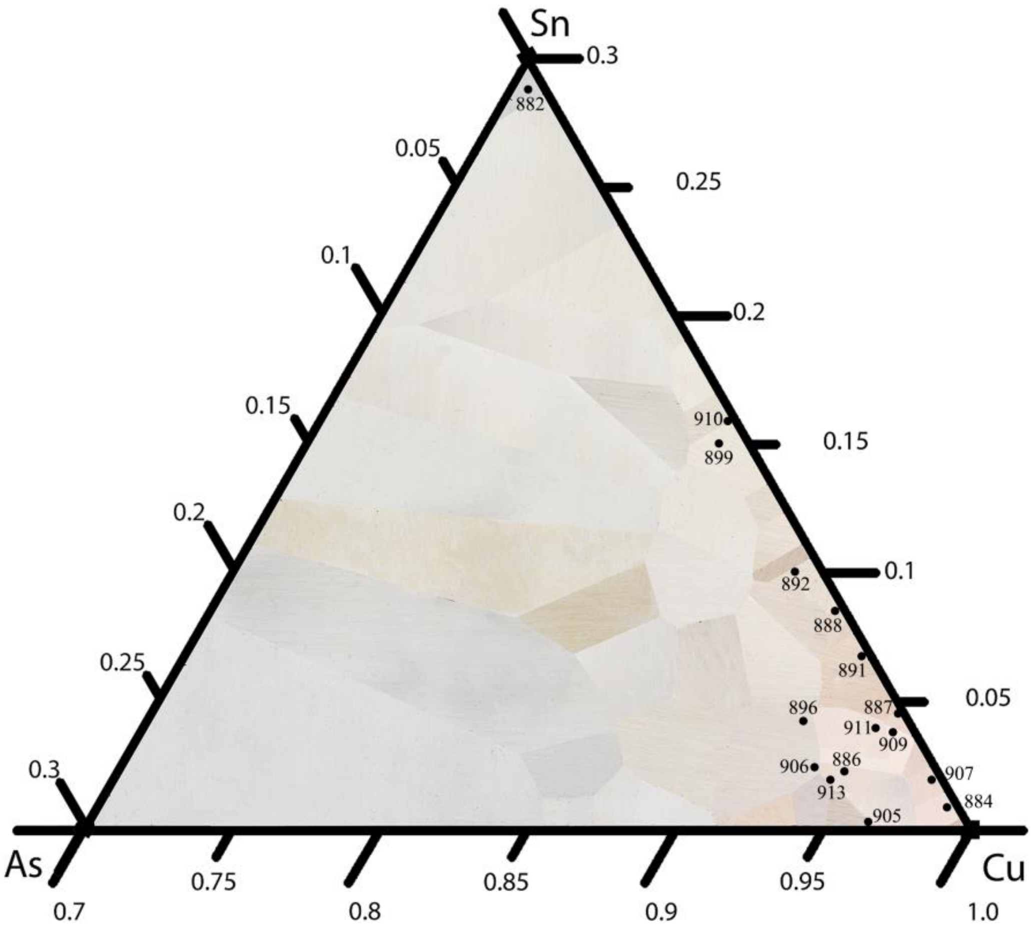

Figure IX.15 Distribution of Siba metal objects in a ternary color diagram (100 wt% Cu, 30 wt% As, 30 wt% Sn)
(Each black dot stands for one analyzed sample; the number beside it stands for its lab number. Data source: BKDYCY and GSWKY 2003, table 2. Please note the distribution of the four ornaments 909, 910, 911 and 913 and their corresponding colors)

Siba metallurgists must have developed an understanding of the ability of alloys to be hardened by working, as suggested by one cast copper axe with hammer working on its edge. They probably began to realize that hammer working could immensely improve the hardness of alloyed tools through hammer working on alloyed ornaments (e.g., earrings, nose rings). Some pure copper objects with iron impurities also suggest that copper ore must have been smelted from sulfide copper ores buried deep underground, rather than native copper or oxide copper deposited near the ground surface (Craddock 2000). This is also attested by the occurrence of sulfur in most alloyed samples, which, in addition, suggests the incompleteness of removing sulfur from the ores during roasting or co-smelting. The use of pure copper for utilized tools seems the technological continuation of the local metallurgical tradition, established since the Xichengyi period. Meanwhile, a high percentage of bronze (Cu-Sn) among analyzed samples also suggests that the use of tin in local metallurgy was probably influenced by the Andronovo metallurgical communities. This is supported by the fact that all tin-copper alloys found thus far basically concentrate in the western part of the Hexi corridor (west of Jiuquan), while the eastern part of the Hexi corridor usually yields more arsenic-copper alloys, a signal of the extraction and use of sulfide copper ores buried deep underground as local mining and metallurgy developed (Li S.C. and Shui T. 2000).

IX.4 Concluding remarks

Based on available archaeological evidence, it seems that profound interaction between Andronovo cultural communities and contemporaneous Siba communities in the Hexi corridor mainly happened in the domain of metallurgy, which was the basic impulse for the broad expansion of the so-called Andronovo cultural-historical community across Central Eurasia. Along with the mobility of pastoralists, mineral prospectors, itinerant metallurgists, and traders, this unprecedented wave of interaction on an inter-regional scale had already entered Xinjiang no later than the second quarter of the second millennium BC. By contrast, the influence of the Seima-Turbino technological tradition on early metallurgy in Northwest China seemed more ephemeral and less profound. The Siba communities, as the gateway communities of the Hexi corridor, undoubtedly engaged in this inter-regional social network and became a part of it. With interlocked social networks probably in the form of trading networks as a backdrop, a variety of imported techniques (e.g., metallurgy), goods (metal objects, gold, silver, paste beads, cowrie shells, pearls, textiles etc.), aesthetics, and value systems (symbols of power represented by maceheads) found their ways into local archaeological contexts, as represented by the unparalleled Huoshaogou cemetery. As an important intermediary, Qijia communities extended entanglement with local metallurgical communities to the Siba culture (1680-1530BC). It is also during this period that the Qijia community reached its peak in regional interaction, as represented by contact with the Erlitou communities rising in the Central Plains. By means of these interlocked social (trading) networks, early Bronze Age Northwest China participated in Central Eurasian social networks. This point cannot be better demonstrated than by the synchronic decline of those important participants across Eurasia around the middle second millennium BC: the collapse of the Andronovo cultural-historical community in the Eurasian steppe, along with economic transformation from transhumance pastoralism to nomadic pastoralism; the disintegration of the Siba cultural regime in the Hexi corridor and the Qijia communities in Central Gansu; and finally, the Erlitou regime in the Central Plains.

Chapter X Conclusion

The cultural interaction between Northwest China and its westerly counterparts about 2000 BC generated far-reaching inpacts on both sides. As a first step, the identification of specific material culture evidence in archaeological contexts makes it possible to link the dots of finds and thus to infer possible routes by way of which those material culture items were exchanged. Building on that, the archaeological data in Northwest China are re-interpreted under the framework of anthropological economy. By doing this, not only has it been possible to envisage what happened but also to interpret why it happened there and then.

We have found that, on the one hand, the mixed economy with an emphasis on arid land farming in Bronze Age Northwest China, formed social tensions on land tenure which then became driving forces for the movement of population in the long term. On the other hand, it also provided alternative economic venues for groups that had become dispersed due to population pressure to top off their subsistence needs by pasturing ungulates such as sheep/goat and cattle in ecologically marginal zones. These marginal zones later became the frontiers of culture contact and strategic locations for resources extraction and communication. Meanwhile, the occupation of vertical ecological niches also facilitated the formation of an imbalanced but inter-dependent economic system at both the intra- and the inter-community scales. As examples for such processes, we may point to the westward expansion of the Qijia communities along the eastern edge of the Qinghai-Tibetan Plateau and the following economic interaction between highland and lowland Qijia communities, and to the complete colonization of the Hexi corridor by the Machang communities.

A social context characterized by a low degree of social differentiation and an agnate-centered organization has been reconstructed through the analysis of mortuary data. This social context must be understood if we are to understand the pattern of cross-cultural interaction at the regional scale, where marriage exchange based on exogamy played an important role. In addition, the mortuary analysis on contemporaneous cemeteries in the Hexi corridor has also revealed that the cultural landscape of that region was far more complex than its highly homogenous natural landscape. A variety of ritual practices at the intra-regional scale with different social and economic subtexts shows the great heterogeneity among the middle-range societies in the oases. It is this heterogeneity in the social, economic and ritual domains that generated multifaceted mechanisms serving to interlock the oasis societies along the Hexi corridor. In that context, we see evidence of a dynamic social life reflected by the social practice of communal activities and social gatherings at the intra- and inter-community scales reflected through the lens of drinking. Through commensal consumption in ceremonial or ritual scenarios, social cohesion as well as social differentiation were contingently achieved. The alcohol-consumption related artifacts omnipresent in those societies are the material manifestation of this dynamic social practice. Portable drinking beakers with characteristic double loop handles were probably manipulated by the Qijia communities as a part of their cultural identity when they moved for manifold reasons, including but not limited to subsistence needs, trade, marital exchange, and other social obligations defined by ritual processes. In addition, the gender inequality rooted in established social organization and resulting from the division of labor in economic activities, in turn, became a stimulus for social interaction. The gender of relatively inferior status (in this case, females in their socioeconomic role as brewers of ritually important drinks), or the *communitas*, probably manipulated the social practice of drinking, to counterbalance the patrilineal social institution. The existence of such internal socio-economic tensions, embedded in multifaceted social dynamics denies any perception of Northwest China as the homeland of one undifferentiated highland society, or as a coherent marginal area that mainly provided natural resources for any presumed core areas in the framework of a world system. A comprehensive understanding of specific social contexts and endogenous dynamics must be our precondition for any attempt to perceive the nature of exogenous factors and their social consequences.

Having thus given up overarching migration and world system models, I seek instead for a bottom-up perspective with an emphasis on human agency, that is, a trade diaspora model in order to understand the archaeological patterns in Northwest China with a focus on the Qijia culture. By placing my emphasis on human agency and internal dynamics, not only is such a model compatible with the presence of population movement, but it explains the nature of such movement in the framework of economic anthropology. Certainly the applicability of the trade-diaspora model is not limited to the case of the Qijia, but can be extended also to other contexts. For instance, the expansion of the Siba metallurgical communities to the oases in Eastern Xinjiang and the Southern Gobi-Desert may also be potentially explained in light of this model once better data are published in the future.

The explanation of the economic expansion of the Qijia communities as a form of trade diaspora prompts further questions: why did the Qijia trade diasporas emerge then and there? Answering those questions requires us to switch from an intra-regional to an inter-regional scale of analysis and to take notice of the development of metallurgy in neighboring regions to the west. The technological innovations associated with the Seima-Turbino phenomenon in the Eurasian forest and forest-steppe at the beginning of 2nd millennium BC provided an important economic-technological incentive for the whole Eurasian Metallurgical Province. Under such a stimulus, the technology of metallurgy was transmitted probably by such agents as itinerant craftsmen, miners, and knowledgeable prospectors, who dispersed with strong socio-economic motivations. The Irtysh River probably provided the highway of transmission in this process which gave rise to the emergence of metallurgy in Northwest China, especially in the Hexi corridor, where rich mineral resources are deposited. Once metallurgy had become rooted in the local context, it generated great technological advantages, which then resulted in imbalanced economic power relations at the regional scale. Hence the Hexi corridor became a socio-economic magnet for its neighboring regions. The mechanical and physical advantages of metal products made they were soon applied to daily craft productions, i.e. the processing of animal skins (leatherworking) and probably the weaving of textiles, the products of which were then exchanged in local exchange systems; they also impacted the utilitarian repertoires necessary for daily life (e.g., foodways). Meanwhile, metal ornaments were also manipulated by local people, occupying the aesthetic niches underlying myriad social interaction scenarios such as marital exchanges and communal consumption activities in which social debts and payments were always engendered. The chromatic choices or preferences suggested by early metal ornaments in Northwest China clearly show the agency of material culture goods and the shift in value systems whenever the technology was transmitted to a different cultural context. This finding challenges the traditional unilineal evolutionary perceptions on the development of metallurgy from primitive pure copper to arsenic copper, and finally to more advanced bronze at the regional and micro-regional scale. More importantly, the developmental trajectory of metallurgy in Northwest China together with other Central Eurasian middle-range societies, once again, rejects the stereotype that the introduction of metallurgical production is always causally correlated to the growth in social complexity in a given society. Due to the low resolution of archaeological evidence, we are still unclear about the production organization at the early metallurgical centers in Northwest China. If Franklin's (1999) theory on the social consequences of technology are true, then a holistic production mode, as opposed to prescriptive production, may be observed in the context of metallurgy in Northwest China once better data become available in the future. This seems likely based on current available evidence: the relatively hig h homogeneity in the morphology of all emulated STP spearheads found in modern China, together with the rather simple metal repertoires of early metallurgical centers, suggests a holistic technique in which the craftsmen in one small group or guild controlled the process of their own work from beginning to end, as opposed to a prescriptive technology with a high degree of specialization, as represented by the unique bronze vessels which later appeared in the East Asian heartland from the Erlitou Era on (Franklin 1999:13). The reasons why a holistic technique scheme mainly developed in the Hexi corridor while a prescriptive scheme formed in the Central Plains could be manifold. The geographical characteristics of the Hexi corridor, as well as the relatively concentrated distribution of resources necessary for metallurgical production (including not only mineral ores and fuels, but also craftsmen and other necessary manpower) in a restricted cultural space, should be major factors. The technology as social representation is no more than a sort of developing liquid to make the latent negative image of one society visible through its material culture: technology itself cannot impose a decisive power to change social organization as alleged by the so-called "technological determinism".

The fact that most of the earliest metal objects with assured archaeological contexts found so far are concentrated in Northwest China has already proven the direct influence from the Eurasian Metallurgical Province on the local development of metallurgy. The study of the STP provides additonal important implications for the understanding of the development of early metallurgy in China. The spatial distribution of local emulations of the STP spearheads largely overlaps with the reconstructed Qijia trading networks, and thus suggests that the Qijia traders or trading diaspora communities were mainly responsible for the circulation of those exotic-style metal objects. Meanwhile, the spatial distribution of the two spearheads with original technical signatures (one recovered in Taiyuan, Shanxi; the other in Chaoyang, Liaoning) from the metallurgical centers in the middle Irtysh River makes one automatically connect them with the hypothesized “Crescent-shaped Communication Belt” first proposed by Tong Enzheng (1987). By contrast to Northwest China, the absence of local emulations in North China suggests the absence of local technological capability at the time when those exotic metal objects were first circulated in the local contexts. However, the idiosyncratic copper or alloyed copper items appearing at Taosi (2300-1900BC) and Shimao (2300-1800BC), dating to the early second millennium BC, suggested the possibility that local metalworking, if not metallurgy, may have emerged under the influence of the STP, in parallel to the emergence of metallurgy in the Hexi corridor. As for the possibility of an independent origin of metallurgy in those sites, current available evidence is too meager to support such a notion.

If the first quarter of the second millennium BC, or earlier, can be seen as a period of incipient cultural contact between Northwest China and its westerly neighbors, then the second quarter witnessed the climax of this cultural contact, which resulted in an economic network of unprecedented extent, operating at a truely continental scale, as represented by the expansion of the Andronovo horizon in Central Eurasia. Under this influence, the metallurgical centers in the western part of the Hexi corridor also reached a peak in metallurgical production, as shown by the Siba metal objects unearthed from the Huoshaogou and Tianshanbeilu cemeteries. Different from the last wave of cultural contact initiated by the STP in the forest/forest-steppe, the rise of metallurgical communities in the steppe and their self-motivated (gold-rush model) expansion to Central and Eastern Kazakhstan, where rich mineral ores (i.e. copper, gold, silver, tin, lead etc.) are deposited, formed a great driving force to the local economic system and accelerated the interaction across natural borders as well as social borders defined by sex, age, and social status. The exploration of new territory for copper and tin ores by experienced miners, prospectors and the following craftsmen probably was one major social scenario in which cultural contact and interaction happened. The spatial distribution of early Andronovo bronze and pottery repertoires and mining sites along the major mountains in Xinjiang endorses that hypothesis. It cannot be better explained by the high homogenous metal repertoires found at the Huoshaogou cemetery in the western part of the Hexi corridor. The Huoshaogou community was probably one of major gateway communities that formed a link in the exchange of technology, goods, personnel, and even ideology between the Andronovo in the west and the Qijia (Late Phase) in the east. The latter then played the same intermediary role between the Hexi corridor in the west and the Central Plains in the east, as represented by the rise of the Erlitou metallurgical production. By means of this sort of relay-station mode, the two pre-existing economic networks connected with each other for the first time as a whole. Metal, no doubt, was one major category of goods flowing through this economic network. It could be exchanged in multiple forms varying from mineral ores, ingots, rough preforms, and finished products, and thus left myriad and almost indecipherable fingerprints in the archaeological record. Metallurgy could disperse in an unbelievably swift way, as shown by the abovementioned STP across Central Eurasia. However, due to the great imbalance in the distribution of mineral resources, metallurgy can only take root in a very limited array of loci providing ideal economic niches. In addition, ideological factors (e.g., social taboos developed towards metallurgy and metallurgists) can also condition the distribution pattern of metallurgical production and organization. The negotiation of such factors complicated the pre-existing social, economic, technological, and even ritual tensions at the regional and micro-regional scale, and hence provided further dynamics to the socio-economic development.

Focusing on the formation of economic networks at a continental scale also offers us an alternative perspective for perceiving the change of cultural momentum over a long term; the outcome is different from the traditional interpretation dominated by exogenous climate change, which, at its best, just provided an impetus. The displacement of the center of gravity of the economic complexity well explains the synchronic declines of the cultural communities along the interconnected networks around the middle of the second millennium BC: the Andronovo cultural-historical community disintegrated into multiple regional variants around 1500BC following the transformation of its subsistence economy to nomadic pastoralism that marked the onset of the Final Bronze Age in Central Eurasia (1500-1000BC). Concomitantly, the once predominating Siba communities along the whole Hexi corridor suddenly collapsed and left the desert oases unsettled for hundreds years until the early first millennium BC; the Qijia communities totally withdrew from the Hexi corridor and disintegrated into several regional cultural entities, such as Xindian, Siwa and Kayue, that were scattered over Central and Eastern Gansu and Eastern Qinghai; and finally, around 1500 BC, the Erlitou cultural regime in Central Plains was the last domino to fall.

Appendix 1. Results of residue analysis* by GC/MS on selected pottery samples from Huoshaogou cemetery

***** This analysis was conducted by Dr. Kym F. Faull (Lab Director) and Dr. Hans Barnard (Cotsen Institute of Archaeology) in the Pasarow Mass Spectrometry Laboratory at UCLA in March-May, 2017. The instrument used is Thermo Q Exactive Hybrid Quadrupole-Orbitrap Gas Chromatography-Mass Spectrometer (GC-MS) (scan rates up to 12 Hz, 140,000 at m/z 200 in resolution and 50-6,000 m/z in mass range).

Sample	RT(retention time, minute)	Detected molecule/compound	Probability	Notes
76YHM115:5	15.26	Propylene glycol, 2TMS derivative	17%	
	24.87	Decane, 1-bromo-	36.50%	
	25.02	1-Tridecanol, TMS derivative	41.20%	fatty alcohols
	27.35	4-tert-Amylphenol, TMS derivative	58.10%	
	28.85	Myristic acid, TMS derivative	83.40%	common saturated fatty acid
	30.85	Dibutyl phthalate	12.30%	plasticizer
	32.67	Palmitic acid, TMS derivative	89.40%	common saturated fatty acids
	33.21	Oleanitrile	92.90%	nitrile formally derived from oleic acid
	34.69	Silane, dimethyl(octadecyloxy)propyl-	66.80%	organic compound
	35.65	11-Octadecenoic acid, (E)-, TMS derivative	18.90%	a naturally occurring trans-fatty acid found in the fat of ruminants and in dairy products

	36.17	Stearic acid, TMS derivative	92.10%	a common fatty acid
	38.07	9-Octadecenamide, (Z)-	93.90%	derived from the fatty acid oleic acid
	38.93	Oleamide, TMS derivative	95.50%	derived from the fatty acid oleic acid
	40.12	Oleanitrile	74.60%	nitrile formally derived from oleic acid
	40.7	Phthalic acid, di(oct-3-yl) ester	9.63%	plasticizer
	40.95	Pyridine-3-carbonitrile	14%	nicotinic acid nitrile
	44.36	13-Docosenamide, (Z)-	81.90%	the amide of docosenoic acid, or erucic acid
76YHM116:12	15.18	Octanoic acid, TMS derivative	69.40%	also known as caprylic acid, is found naturally in the milk of various mammals
	15.53	Glycerol, 3TMS derivative	40.20%	generally obtained from plant and animal sources
	17.73	Nonanoic acid, TMS derivative	65.40%	a fatty acid which occurs naturally as esters in the oil of pelargonium
	20.18	Decanoic acid, TMS derivative	60.20%	a saturated fatty acid, is also known as capric acid
	22.51	Undecanoic acid, TMS derivative	40.10%	carboxylic acid
	24.91	Decane, 1-bromo-	27.20%	

	29.04	Phthalic acid, 6-ethyl-3-octyl butyl ester	6.37%	plasticizer
	31.11	Dibutyl phthalate	15.50%	plasticizer
	32.74	Palmitic acid, TMS derivative	88.20%	common saturated fatty acids
	33.29	Oleanitrile	92.30%	nitrile formally derived from oleic acid
	34.74	Silane, dimethyl(octadecyloxy)propyl-	60.30%	organic compound
	35.72	11-Octadecenoic acid, (E)-, TMS derivative	21%	a naturally occurring trans-fatty acid found in the fat of ruminants and in dairy products
	38.35	9-Octadecenamide, (Z)-	94.10%	derived from the fatty acid oleic acid
	38.96	Oleamide, TMS derivative	94.70%	derived from the fatty acid oleic acid
	40.17	Oleanitrile	74%	nitrile formally derived from oleic acid
	40.76	Phthalic acid, bis(2-pentyl) ester	6.20%	plasticizer
	44.44	13-Docosenamide, (Z)-	83.30%	the amide of docosenoic acid, or erucic acid
76YHM216:4	15.19	Octanoic acid, TMS derivative	66.80%	also known as caprylic acid, is found naturally in the milk of various mammals
	17.74	Nonanoic acid, TMS derivative	25.30%	a fatty acid which occurs

				naturally as esters in the oil of pelargonium
	21.14	4-Nitrophenol, TMS derivative	81%	a phenolic compound
	24.91	Decane, 1-bromo-	35.90%	
	26.41	4-tert-Amylphenol, TMS derivative	51.90%	
	29.05	Phthalic acid, 6-ethyl-3-octyl butyl ester	6.32%	plasticizer
	30.98	Dibutyl phthalate	8.28%	plasticizer
	32.76	Gibb-3-ene-1,10-dicarboxylic acid	19%	
	34.81	Silane, dimethyl(octadecyloxy)propyl-	64.10%	organic compound
	36.25	Stearic acid, TMS derivative	86.50%	obtained from fats and oils by the saponification of the triglycerides using hot water
	38.41	9-Octadecenamide, (Z)-	93.90%	derived from the fatty acid oleic acid
	40.21	Oleanitrile	73.60%	nitrile formally derived from oleic acid
	40.77	Phthalic acid, bis(2-pentyl) ester	5.99%	plasticizer
	44.52	13-Docosenamide, (Z)-	78.80%	the amide of docosenoic acid, or erucic acid
Gansu 8	15.28	Propylene glycol, 2TMS derivative	20.80%	
	24.88	Decane, 1-bromo-	42.90%	
	30.86	Dibutyl phthalate	8.95%	plasticizer

	32.67	Palmitic acid, TMS derivative	90%	common saturated fatty acids
	35.64	11-Octadecenoic acid, (E)-, TMS derivative	20.50%	a naturally occurring trans-fatty acid found in the fat of ruminants and in dairy products
	36.16	Stearic acid, TMS derivative	87.40%	obtained from fats and oils by the saponification of the triglycerides using hot water
	38.02	9-Octadecenamide, (Z)-	91.90%	derived from the fatty acid oleic acid
	40.83	Phthalic acid, di(oct-3-yl) ester	9.28%	plasticizer
	45.62	Cholest-5-en-3-ol (3β)-, propanoate	13.60%	the principal sterol of all higher animals, distributed in body tissues, especially the brain and spinal cord, and in animal fats and oils

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