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Ceramics at the Emergence of the Silk Road: A Case of Village Potters from Southeastern Kazakhstan during the Late Iron Age

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ABSTRACT

Between the fourth century B.C. and second century A.D., changes in climate, culture and commerce converged to extend networks of influence and intensify social stratification in communities situated along the Silk Road. The horse-riding nomads and agro-pastoralists of what is now Southeastern Kazakhstan were important actors in the unfolding of these events. The settlements and kurgan burials of the Saka and Wusun could be found dotting the alluvial fans north of the Tien Shan Mountains just a short time before Alexander the Great founded outposts in the Ferghana Valley and Chinese emissaries formalized relations with their periphery. In other words, the appearance of Iron Age Saka-Wusun sites anticipated the formation of the Silk Road's northern branch and subsequently helped mediate long-distance relationships connecting East and West. Historical accounts appear to confirm the presence of the Saka and Wusun in this role, but there is much that remains unknown regarding relationships both within and across their communities. Typological variability in their material culture has fed speculation concerning their position within trade networks, but there has been very little in the way of materials analysis to test the validity of these assumptions.

The ceramics recovered at Tuzusai near Almaty provide an excellent opportunity for examination of the impacts and implications of extended regional contacts throughout the region. Although no Persian or Chinese ceramic imports were identified, an extensive vocabulary of pot forms was locally produced. However, the pottery, particularly pitchers, drinking cups and bowls, and, especially with bright red surface decoration, is found in elaborate burial kurgans. The pottery is coarse, perhaps better called a "rock body" than a clay body, as very little clay is present. The frequency of sherds from the excavation (over 1000) and from surface survey is very low (e.g. 3 surface sherds for one-half days effort) compared with excavations in Southwest Asia or China. Rims are unusually worn. Thus, we suggest pottery was precious and high status, but difficult to make. A local survey of clay resources produced meager results. Tests showed that the finest sediments had perhaps 3% clay-sized particles. Among the adobe houses at Tuzusai is evidence of courtyard work areas for pottery production with fired remains of a possible firing pit or kiln and bone potting tools. Other courtyards were areas for dairying and spinning and some copper alloy and iron metal working. Our aim was to establish the life history, production sequences, status and uses of the pottery. Given our current understanding of local production resources and the technical difficulty associated with the production of thin

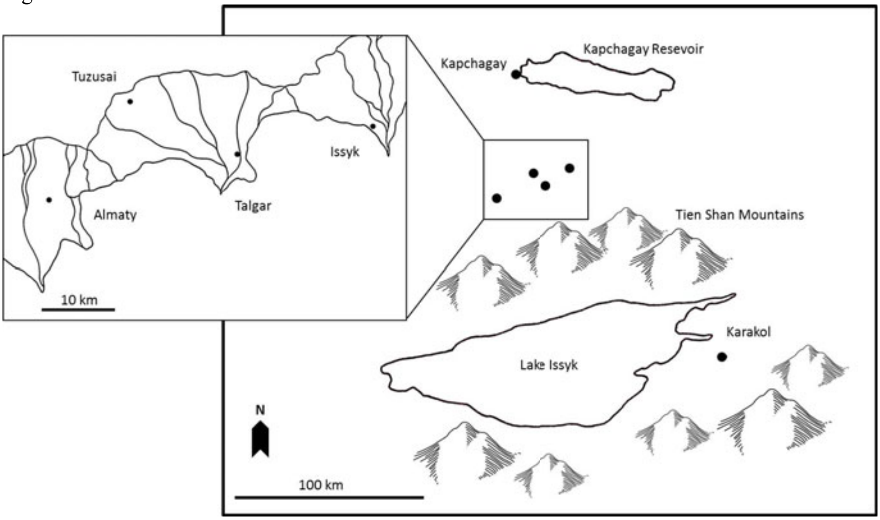
walled forms using these materials, we suggest that these ceramics were high-status goods, many used in feasting activities, and valued not solely for their function in feasting activities, but for the labor and skill required to produce them. Study of the ceramics, clay sources, production methods, and decoration suggests greater social permeability of Saka-Wusun communities than was previously proposed and allows us to understand the formative dynamics of village along the Silk Road.

INTRODUCTION

The conventional view of socio-cultural developments in the Iron Age of Southeastern Kazakhstan (8th century B.C.E. to 5th century C.E.) has been dominated by archaeological discoveries from burial kurgans supplemented by ancient historical documents. These attest to the presence of diverse and highly mobile communities throughout the region. Although a number of permanent settlements attributed to semi-nomadic Iron Age groups are widely known elsewhere [1, 2], the prevailing emphasis on mobility and nobility produced only modest enthusiasm for additional exploration of settlements along the margins of the steppe and northern foothills of the Tien Shan Mountains. Beginning in 1994, Claudia Chang and Perry Tourtellotte in collaboration with Feodor Grigoriev initiated the Kazakh American Archaeological Expedition (KAAE) produced some of the first systematic field surveys of settlement sites in this region [3]. A substantial portion of their work has focused on an area 20 km to the east of Almaty in the Talgar alluvial fan. The 525 km^2 area of the fan is dotted with over 700 kurgan burials, and, to date, at least 70 Iron Age settlements have been identified [4].

Recently, a handful of these settlements have been excavated, although the site of Tuzusai has so far received the most attention (Fig. 1). Archaeological and magnetometry surveys of the site indicate Tuzusai was a large site, perhaps as many as 11 hectares in extent [5].

Figure 1. The location of Tuzusai in relation to alluvial fans north of the Tien Shan Mountains



Well-excavated and carefully dated with a series of tree-ring and calibrated radiocarbon dates [6, 7], the initial occupation of this site spanned roughly four centuries from 400 B.C.E. to 1 C.E. These dates indicate that the settlement at Tuzusai was established after the Achaemenid annexation of Sogdiana (550 B.C.E.), and not quite a century before Alexander the Great established outposts in the Ferghana Valley (329 B.C.E). The opening of the Silk Road through the efforts of Han emissaries occurred as the site fell into abandonment, with the northern steppe route of the Silk Road tracing a path not far from the site. The community at Tuzusai was therefore witness to a series of events in which steppe empires of Central Asia coalesced and contacts between East and West intensified.

Because prior understanding of the Iron Age in this region derives mainly from kurgan finds, the material culture of Tuzusai provides an important opportunity to learn about the role of agrarian activities within regional subsistence patterns while also examining local production traditions at a pivotal time in the formation of long-distance economic and political relationships. Coordinated efforts to analyze material assemblages at Tuzusai are on-going and describe an agro-pastoralist community relying on irrigated cereal cultivation (including millet, rice and wheat) and mixed sheep, goat and cattle herding [8,9]. Excavations have so far yielded evidence of mudbrick structures and semi-subterranean domestic architecture. These were associated with hearths and activity areas producing paleobotanical and faunal remains, iron slag, spindle whorls and pottery [10, 11]. The ceramic finds were diverse, although the spatial density of individual sherds is considerably less than most Chinese or Southwest Asian sites of the same period.

These ceramics are not yet well understood. Owing to limitations in the pottery available for study from domestic contexts as well as difficulties in dating funerary finds, few attempts have been made to produce a periodization for Iron Age pottery in Southeastern Kazakhstan. This is the first technical study of the ceramics. While there has been some preliminary documentation of morphology and paste texture [12], this has yet to be evaluated in the context of available clay resources and evidence for production techniques. Because ceramic production traditions are shaped through the intersection of regional influences, local preferences and material constraints, describing these traditions for the Tuzusai ceramic assemblage is an important next step in elaborating our understanding of the position of this community within emerging networks of interaction.

PLAN OF RESEARCH AND METHODS

A catalog was made to document variability, including information on morphology, decoration, finish, and texture. Profile drawings, caliper measurements and Munsell designations were supplemented in the field with the use of both an Aven USB powered magnifier and Leica EZ4 microscope with internal camera to document surface wear, brushstrokes, surface indications of assembly technique and variations in both size and density of aplastic inclusions. Representative sherds were later Xeroradiographed Xerox Medical Systems Xeroradiobraph 125) to reconstruct sequences of manufacture, especially assembly and shaping. Relative Mohs hardness and open porosity estimates were also provided for these sherds. A selection of sherds was examined with scanning electron microscopy with energy dispersive spectroscopy (SEM/EDS, Hitachi S-340N Type II with ThermoNoran NSS-EDS) to estimate firing temperature and bulk chemical composition of clays. Information on mineralogy of inclusions, clays and porosity is provided by petrographic analysis. In addition to an examination of the ceramics themselves, micro-wear analysis of several bone tools from Tuzusai was conducted to match textures and inclusion sizes to show how they were used to form, burnish and scrape the pottery. Inclusions from the potters are embedded in the bone. Infrared spectroscopy (Bruker FTIR) was used to attempt identification of organic residues on white to tan interior pot residues, and blackened exterior ones, as well as on a red slip, but without results.

A preliminary survey was also made of available ceramic raw materials within three kilometers of the excavation at Tuzusai. Samples of potential mineral tempers and argillaceous or fine-grained soils that may be similar to materials used in ceramic production at Tuzusai were collected. These materials were evaluated in the field with an HCl test to judge relative calcium content and with Stokes' Law sedimentation tests to estimate particle size distributions with results that only 3% of the finest sediments consisted of clay. These poor quality raw materials were used to attempt a reconstruction of the bowls and cups that occur at high frequency within the assemblage. The replicate pottery made on-site using local resources proved how woefully inadequate those resources are. The environment is very active being at the foot of glaciated mountains that are moving in a northerly direction making extensive sedimentary weathering impossible. The overwhelming majority of forms appear to have been molded using assembly strategies that responded to shortcomings in available raw materials. A survey of a wider area to search for clay resources along the mountains and further north in the desert was planned, as well as visits to the two pottery workshops and one brick yard in Kapchaygay (Fig. 1).

The pottery corpus of over 1000 excavated pottery sherds and pot profiles, studied in the field by optical microscopy, were compared to contemporaneous museum collections, for instance from the nearby mound burial of the so-called Golden Warrior at Issyk. The intent was to establish the range of uses for the ceramics based on whole vessels from burials that presumably were the best that were produced. No Persian or Chinese imported vessels or sherds were found in these museum collections.

INVENTORY OF FINDS AND FIELD ANALYSIS

Ceramics Classification: A total of 992 accessioned ceramics with point provenience information and 649 level bags consisting of small, non-diagnostic fragments were excavated from two adjacent 8 meter by 8 meter trenches in the 2012 and 2013 field seasons. Most sherds were found thickly encrusted with caliche which often obstructed observation of surface features. Despite this, a wide variety of pottery shapes and finishes could be identified. Of the 902 accessioned finds, at least 141 distinct rim profiles and 22 different handles were recorded with drawings and photos. Two different base shapes were also identified and photographed. Repair holes, usually 0.5 cm in diameter, were observed on at least 7% of the collection. The ratio of unique elements relative to the total number of sherds speaks to the morphological diversity and idiosyncrasy of the finds. Some aesthetic parallels can be observed between Tuzusai pottery and that recovered from Iron Age burials within both the Talgar and neighboring Issyk alluvial fans. The Tuzusai assemblage is greater than that in the available mortuary assemblages. Table 1 shows the wares and their characteristics.

The Fine Orange Ware category describes a range of smaller vessels, generally cups and small bowls without handles (Fig. 2). These well oxidized ceramics are lightly burnished and profiles typically reveal a fine grained fabric with only a few small pores. Fine Orange pottery

Category	Percent of Accessioned Inventory	Wall Thickness	Color	Morphology
High Frequency Ceramics				
Fine Orange Wares	9.8% (n = 87)	≤ .7 cm	Light red to red. - 10R 4/8 10R 6/8 2.5YR 5/8 2.5YR 7/6	- Small cups and bowls no larger than 13 cm in diameter and 9 cm deep. - No handles. Round bases only.
Red Washed Wares	84.9% (n = 753)	.7 cm ≥ 4 cm	Reddish yellow, light red and red. – 10R 6/6 2.5YR 6/6 5YR 6/6 7.5YR 8/6	- Extensive range of forms including mugs, bowls, pitchers, beakers, cooking pots (garshok), small and large storage vessels (homcha). - Wide array of handles. Both rounded and flat bases.
Low Frequency Ceramics				
Corrugated Ware	2.3% (n = 20)	.6 cm ≥ 1.2 cm	Weak red to reddish brown 10R 5/3, 4/3 2.5YR 5/4, 4/3	- Globular bodies with or without a tall neck. - Coil handle joined to exterior near neck. Rounded bases.
Reduced Red Ware	0.1% (n = 1)		Gray and black with a thick bright red wash or slip	- Only one example. - Possibly a small cup no larger than 8 cm in diameter.
Punctate Ware	1.5% (n = 13)	.3 cm ≥ .6 cm	Light red 2.5YR 6/6	- All fragments belong to one vessel. - Small, nearly complete jar with round bottom, roughly 9cm in diameter.
Transitional – Red Washed	1.5% (n = 13)		Pink 7.5YR 8/4, 7/4	- All fragments belong to one vessel. - Globular shape with small lugs and perhaps asymmetrical opening.
Transitional – Gray Ware	2.3% (n =20)		Gray and Black	- All fragments belong to one vessel. - Globular shape with lug handles.

Table 1. Preliminary categories of diverse ceramics in the Tuzusai assemblage.

may have sharply carinated profiles, or they may have either raised parallel bands or narrow circumferential incised lines on their exteriors. Those displaying carinated rims or shoulders are found more frequently in the earliest levels of the site. These have the appearance of metal skeurmorphs. More common are Fine Orange wares with either raised bands or incised lines. Unlike carinated forms, these have only a thinly tapered lip with no distinct rim. Variations with incised lines are more fragmentary and less well represented in the assemblage. Some incised bowls have traces of a red wash carefully applied within the incised grooves that circle both the lip of the vessel and the base.

This same red wash is found in greater abundance on a variety of thick-walled forms (0.7-0.4 cm), here classified as Red Washed Wares (Fig. 3). This category is the largest and most abundant at Tuzusai. It includes some smaller objects such as mugs and bowls, but more frequently describes larger vessels in a wide variety of shapes and sizes including pitchers, beakers, cooking pots (garshok), and storage jars (homcha). The storage vessels can be quite large. At least one homcha excavated at Tuzusai stands nearly a meter tall with walls just over 4 cm thick near the base. While round bases can still be observed for Red Washed mugs and bowls, some forms appear with uneven, flattened bases. Shallow circumferential ridges on interiors and "wipe-marks" on the exterior are widely observed on these wares. All Red Washed wares are oxidized with significant amounts of surface spalling and in many cases, smoke clouds or soot. Large portions of the exterior and the lips of rims are often heavily eroded, exposing a coarse and sandy fabric that sometimes contains very large lime grains.

Where the surface has not eroded or spalled, as many as three different finishes can be seen. The use of a false slip or re-wetted exterior predominates. Less commonly, a thin cream colored slip may have been applied. This treatment appears reserved for a small number of bowls or basins and has not been observed on beakers and storage jars. Red wash was then applied to the dry surface, frequently restricted to accents at the lips of rims and the margins of handles. This red wash was thinner than most slips and in some instances, the red wash is applied in a design or pattern. A cross-hatched design was applied with dry strokes on the body of a deep basin. The largest homcha was covered in an overlapping scroll pattern using a heavily loaded brush or rag (3.5-7 cm) that produced long drips. In addition, there are a few examples of pieces that are thickly and completely covered with red wash. These include a pitcher or tankard shape with a strap handle and a simple bowl with inverted rim.

Ceramics tentatively designated as Corrugated Ware are markedly different in appearance from either Fine Orange Wares or Red Washed Wares and comprise a small minority of the entire assemblage (2.3%) (Fig. 4). Wide, regular, circumferential ridges cover all or part of the exterior. Fabrics are coarse with fairly uniform sized inclusions and appear low-oxidized and unburnished. Vessels are either decorated or coated with a thick white slip. One example has a globular body with a restricted neck and angular everted rim. The neck of this pot is corrugated and covered in white slip while the body is decorated with white slip painted in diagonal lines to form triangles.

There are only isolated examples of the remaining five wares listed in Table 1. The only accessioned piece of Reduced Red ware is very thin-walled and dark gray in color. This carinated rim fragment displays a thick and smoothly applied red wash that is flaking off a well-burnished exterior (Fig. 5a). One small, but nearly complete Punctate Ware jar is light red in color with very thin, grainy walls and uneven walls (Fig. 5b). An open punctate decoration diagonally and imprecisely radiates from the rim. Traces of red wash were visible under a microscope at x20 suggesting that it may have been either decorated or covered in red wash on its exterior. Both Transitional Red Washed and Transitional Gray wares are so named because, while they are similar in many respects to the Red Washed ceramics that predominate at Tuzusai, they display features often associated with regional Early Medieval ceramics (5^{th} century C.E. – 8^{th} Century C.E.). The one example of Transitional Red Washed ware displays a single row of closed punctates near the shoulder, above which is found a single row of stamped impressions (Fig. 5c). A similar cross-in-field or wheel stamp can be found on medieval period ceramics at other nearby sites including Talgar and Charyn [13]. There are ample traces of soot which cloud the exterior below the shoulder and partially obscure faint indications of red wash that haphazardly cover the entire body. The only example of Transitional Gray ware was a nearly complete, heavily reduced, lightly burnished pot with a globular shape, narrow rim, and a series of 5 small evenly spaced nodes or lugs at the shoulder (Fig. 5d). This vessel was found in situ near the Transitional Red Washed ware in relatively late deposits at Tuzusai, and is one of only two clearly reduction-fired ceramics in the Tuzusai assemblage.

In addition to these potsherds, a significant number of ceramic spindle whorls were included in the site's ceramic inventory. A representative collection of 32 of these were accessioned. The spindle whorls were undoubtedly formed from discarded Red Washed body sherds, with the edges of the pot fragments abraded to give them their rounded shape. Each varied in size from 5.2 mm to 15.8 mm in thickness and between 25.2 mm and 57.6 mm in diameter. A few were incomplete, that is, they did not have a hole drilled in their center. Because most of the ceramics were heavily covered with caliche, the exposed surfaces and edges of the spindle whorls were useful in helping to describe the range of paste textures and fired color in much of the assemblage. Together with the available evidence from the potsherds, as many as six variants of paste textures could be identified while in the field (Table 2 and Fig. 6).

A representative sample of sherds was selected on the basis of these paste texture categories, the preliminary ware categories outlined above, as well as sherd thickness and shape. The sample was weighted to reflect the greatest range of technical and stylistic variation possible, and included at least one representative sherd of each of the low frequency ware categories. This strategy yielded a collection of 120 potsherds, a little more than 13% of the accessioned inventory. These are being subjected to more intensive analysis including additional microscopy, petrography, xeroradiography and SEM-EDS. In addition to these sherds, a selection of bone tools and locally available raw materials were also collected for analysis.

Figure 2. Fine Orange Ware

Figure 3. Red Washed Ware

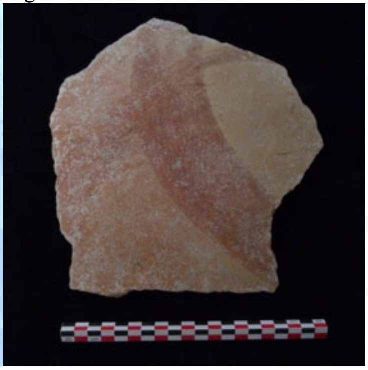


Figure 4. Corrugated Ware

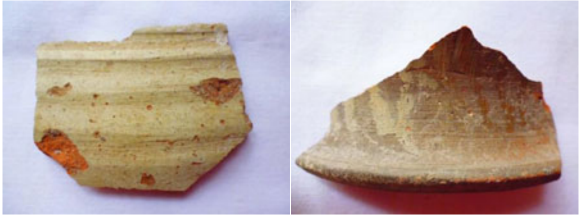


Figure 5. Other low frequency ceramics

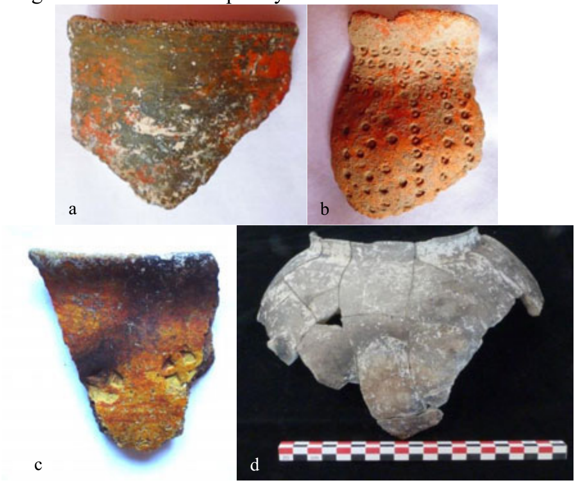


Figure 6. Paste texture categories

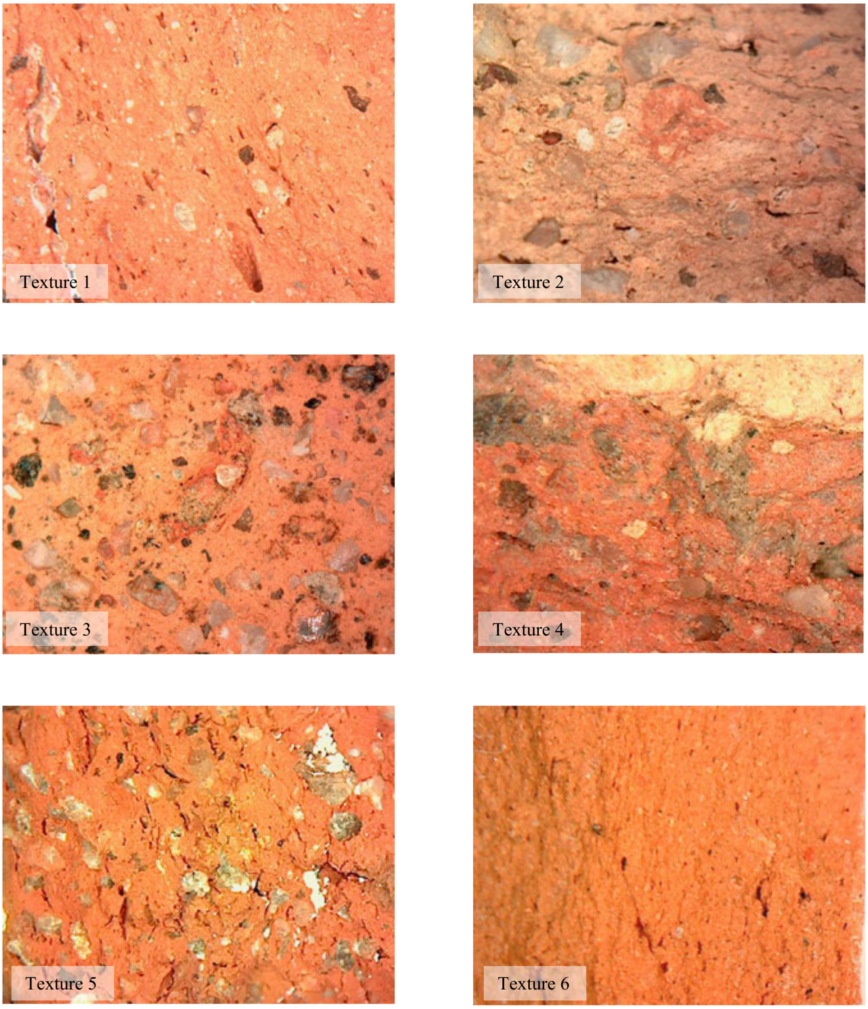


Table 2. Description of texture categories

Texture Category	Color	Description
1	Reddish Yellow and Light Red	Straw impressions and a wide variety of small grains including quartz, mica, dark black inclusions, white particles (lime). Low density of larger quartz inclusions
2	Reddish Yellow	High density of angular inclusions in a wider range of grain sizes, including quartz, granite and a red-brown mineral not yet identified. Little or no mica present.
3	Reddish Yellow, Light Red and Red	Similar to category 2 but with a wider variety of mineral inclusions containing mica, cherts, and olivine or serpentine.
4	Light Red and Red	Similar to category 1, but slightly more variety in mineral inclusions and the occasional appearance of very large grains of lime (in one instance as wide as 1.7 cm.).
5	Light Red	Similar in density of inclusions to categories 2 and 3 but with high concentrations of mica and quartz.
6	Red	Very fine and silty matrix. Very few, small inclusions.

Bone Tools: A small number of sheep bones from the Tuzusai faunal assemblage were identified as possible tools for ceramic manufacture. These were remarkable for their rounded and abraded surfaces. Ten potential bone tools were accessioned and included in the sample for analysis (Fig. 7).

Figure 7: Possible bone tools for ceramic manufacture.

Argillaceous Soils and Sand: A total of 23 samples of potential ceramic raw materials were included for analysis. These samples were collected during brief prospecting surveys during both 2012 and 2013 field seasons within 3 kilometers of Tuzusai. Fine soils were sampled from multiple locations along the Big Almaty Canal, the nearby site of Tsegonka, as well as from the site of Tuzusai itself. Fine soils were collected from multiple points below the layer of the topsoil from eroded embankments alongside both active and dry streambeds as well as from the sterile soil layer beneath the oldest excavated cultural horizon at Tuzusai itself. Samples of mud brick from excavated architectural features were also included as were hardened reddish orange lumps adhering to iron slag. These latter samples were associated with a fired structure that may have served as a small kiln or metal-working site and will be analyzed to estimate the firing temperatures for this as well as for the pottery. Three of the 23 samples were of alluvial sands near active streams that bore similarities to inclusions already noted in the ceramics.

Available Resources: The Talgar fan, in which lies the site of Tuzusai, is notable for its fertile chernozem soils, though not particularly for its clay resources. The northern fringe of the fan is characterized by thick layers of loess loam overlying heterogeneous gravels within a matrix of silt and sand [14]. This loess loam is formed through the alluvial redeposition of loess deposits much further upstream. During hot and dry summer months silt particles from the margins of the fan and desert are blown southward by seasonal cyclonic winds. This aeolian material is trapped by the mountains and is quickly redeposited at altitudes between 1000 and 1300 above sea level [15]. The rivers supplying the Talgar, Almaty, and Issyk fans are each characterized by large sediment charge rates, particularly during periods of glacial melting in the spring and summer [16]. At these times, montane loess may become turbated with other fine particles including eroded granite sediments, mica and perhaps two-layer clays before being deposited in the fan.

The samples of potential ceramic raw material extracted from these sediments were not expected to be particularly rich in clay suitable for pottery-making. Any glacial clays that may have washed downstream along with the loess are known to be refractory, stripped of fluxes, salts and fine particulates. In addition, clay deposits with good sintering qualities have been said to be nearly non-existent in the greater part of Kazakhstan, with many of the available clays sintering near temperatures of 1300°C [17].

Of the 23 samples of potential ceramics raw materials collected, 15 argillaceous and silty soil specimens, including the architectural mud brick fragments, were examined for clay content. None of these appeared to be suitable for pottery production. The samples were tested in the field with 1 N HCl solution for lime with positive results, but pH paper indicated the samples were nearly neutral, contraindicating the presence of clays. The salt content of these samples was poor, amounting to a minor amount of 1 to 5% calcium oxide in various hydration states. Ten centimeter shrinkage bars indicated very little linear drying shrinkage in these materials (1-2%), yet coil tests indicated low plasticity and dried samples were extremely friable, breaking apart when picked up. A Stokes law sedimentation test indicated that these samples contained between 20 and 50% fine sands (ISO criteria $0.063 \geq 0.2$ mm in size) and a wide range of silt sized particles (ISO $0.02 \geq 0.0063$ mm), but very little or no clay sized particles. The clay should have formed a colloid suspension that required nearly a week to settle. Only the specimens from Tsegonka, 1 km to the east of Tuzusai produced as much as 2% clay by volume. The water for the other specimens was essentially clear within 48 hours. Given the possibility that calcium bentonite may have been present in these samples, this test was repeated with the addition of a sodium carbonate (soda ash) solution. The results of the sedimentation test in this case were in every way the same, confirming that clay was not present in the form of flocked particles of a bentonite.

While proper clays could not be located within the vicinity of Tuzusai, alluvial sands did appear to closely match the range of observable aplastic inclusions in the ceramics themselves. Sands from Tsegonka and the Big Almaty Canal proximal to Tuzusai contained similar mineralogical heterogeneity and range of grain size (Fig. 9).

PRELIMINARY THIN-SECTION PETROGRAPHY

A small selection of 13 sherds was examined by thin-section petrography. These were mainly Red Washed wares, including three transitional sherds, along with single examples of Fine Orange and Punctate wares. All of the samples examined are very similar petrographically, with very weathered granitic inclusions, although there are differences in the amount of inclusions and in the presence or absence of some accessory minerals. Amount of inclusions sand-sized or larger (≤ .063 mm) ranges from 10 – 30%, with maximum size ranging from 1 to just over 2 mm in length. Regardless of size or percentage of abundance, the shape of these larger inclusions remains very similar, ranging from an aspect ratio of 1.8 – 2.1 (relatively elongated) and roundness of 1.6 – 2.3 (rounded rather than angular). The size and shape of macropores varies more than do the granitic inclusions. These can range in maximum size from 1- 5 mm in length, and are much more elongated than the mineral inclusions, with aspect ratio ranging from 2.2 – 3.9. In some samples these pores are rounded (roundness of 2.1) but can range up to 3.7 (angular).

The ubiquitous granitic inclusions consist primarily of quartz plus feldspars (more plagioclase than alkali feldspars), with total feldspars being greater than total quartz (and hence likely to have derived from the breakdown of granodiorite). Feldspars are heavily weathered (with surfaces altered to clay and/or sericite), and sometimes have a perthitic texture. There is a mix of some rock fragments and many separated polymineralic components. Other common minerals include hematite, biotite, and hornblende, with muscovite, orthopyroxenes, clinopyroxenes, calcite, polycrystalline quartz, microcrystalline quartz, magnetite, sphene, leucoxene, epidote, chlorite, zircon, and charred organic material also seen.

With a dearth of good clay resources in the vicinity of the site, and many of the ceramic samples found to be low in clay content, it is possible that plasticity was improved by the presence in the hematite-rich matrix of abundant fine micas (tiny shreds of fine sericite, with some fine biotite) and sometimes very small, rounded chunks of glauconite. Examples with the appearance of a wash-type coating seem in thin section to have a layer that is simply bleached out rather than being an actual wash or slip; though lighter in color these layers contain the same large-grained granitic inclusions as found on the interior of the sherds.

FORMING PROCESSES AND SEQUENCES

The Clay Body: Prior to the thin section analysis that isolated glauconite and sericite as sources of plasticity, we attempted in the field to make some bowls by a variety of methods using the separated silt constituent with about 25% by volume of sand-size particles, after some experimentation, as the best clay body we could produce that resembled the paste textures observed in the Tuzusai ceramic assemblage (Fig. 10).

Regardless of similarities in texture however, it quickly became clear that this blend of materials would be insufficient to produce the wide range of vessel forms observed at Tuzusai. Efforts to reconstruct five vessel shapes including a mug, two bowls, and two small garshok, revealed that even the clay body was not plastic and instead was thixotropic, such that the pots slumped and the clay body would not stay in place to allow additions. Reconstructed vessels cracked at contact points when touched or shifted. Similar cracks, and repairs to such cracks by smearing clay on the interior, can be seen throughout much of the Tuzusai assembly, but especially on thick-walled Red Washed wares.

Figure 9. Sampled alluvial sands

Figure 10. Left: Tuzusai sherds (1 and 3 from left), Our replica sherds from broken bowl (2 and 4)

Vessel Assembly and Shaping: While the dearth of good clay resources in and around Tuzusai raises suspicions that pottery could have been transported to the site from elsewhere, this remains only a remote possibility. Not only do ethnographic parallels suggest that this was unlikely, but the finding of bone fragments with ceramic microwear at Tuzusai recommends that in fact, pottery was being made at this site. Microscopy of the bone implements revealed abraded surfaces with fine troughs or ridges consistent in size with the range of sand sized particles prevalent in most of the observed paste textures. (Fig. 11). All ten of the bones yielded similar results.

The use of these bones as modelling or shaping ribs is also supported by similarities in the size of ridges on the scraped interior surfaces seen on nearly all of the Tuzusai pottery, particularly Fine Orange, Red-Washed, and Corrugated Wares (Fig. 12). A similar bone implement of problematic provenience was used to achieve a similar pattern of scraping and shaping marks by using the rounded edge on each of the five attempted pottery reconstructions. The flat surfaces were used to smooth the exterior surface. The most successful bowls were made inverted over a male mold, with the exterior tooled, then when dry enough to handle the interior was smoothed and scraped. Strip forming worked for larger pots.

Evidence for the shape and size of individual clay elements was examined in the field with a grazing light, loop and probe. Xeroradiography was later carried out on a sub-sample of sherds to compare their internal structure with surface and profile observations and suggest a range of assembly strategies. Flattened coils or strips were among the most frequently identified clay elements from the surface and profile features (Fig. 13a). These were particularly apparent on a large fragment of corrugated ware which showed thin circumferential linear pores. Wide overlaps between these strips are visible in step fractures, particularly in larger, thicker vessels (Fig. 13b). Coils or strips are also seen near rims and these tightly overlap in thicknesses of 2 to 3 layers. Additional coils are observed in profile which served to thicken and reinforce the wall at joints between strips.

Both round and flattened bases can be seen on vessels with this type of strip assembly (Fig. 14). In both kinds of base, clay strips forming the base of the walls abut a flattened slab at roughly a 45° angle. Based on information about the quality of the clay body and the raw

Figure 11. Examples of ceramic microwear on bone implements

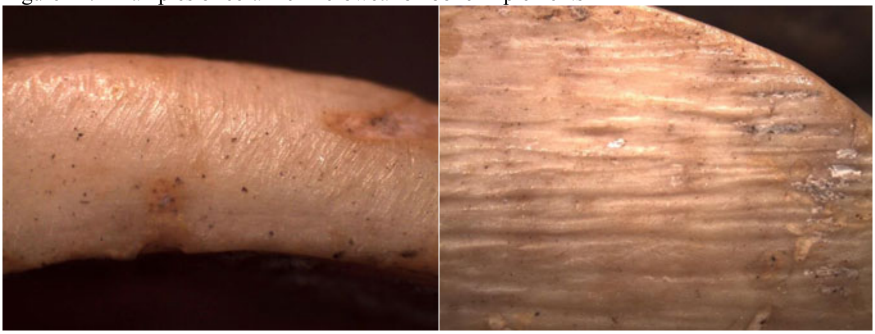


Figure 12. Surface wear of consistent size and texture on ceramics

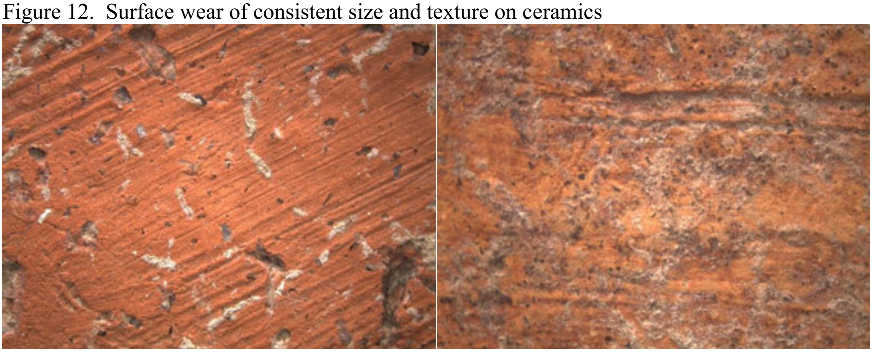
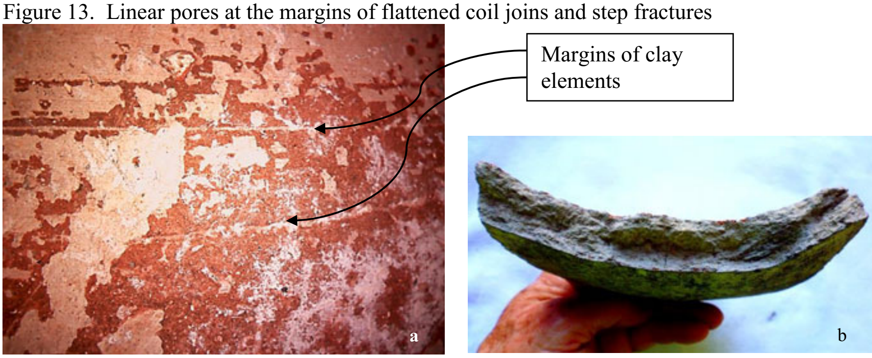


Figure 13. Linear pores at the margins of flattened coil joins and step fractures



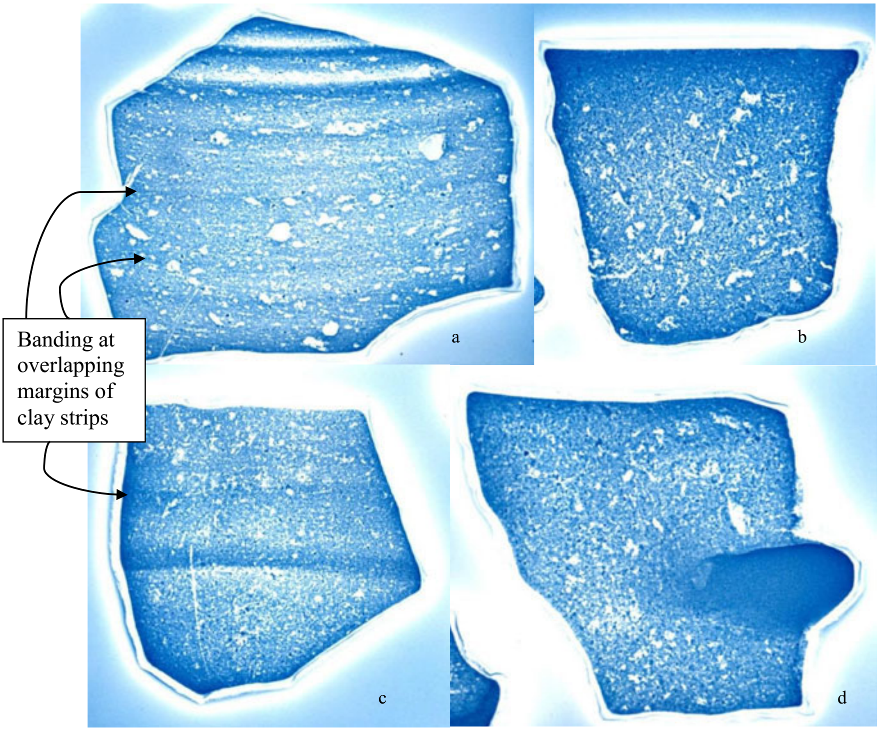
materials, molds, both male and female shapes, were used as a support during assembly. Differences in the ways these molds were used likely correspond to differences in base shape. A number of vessels had profile thicknesses that were continuous and curvilinear with the thickest part of the wall at maximum diameter. This feature is especially consistent with the use of an male mold in the construction of a round-bottom pot. Limited evidence for textile impressions (Fig. 15) supports the use of molds, since these impressions were found on the interior of the vessel and may indicate the use of fabric to separate the pot from the mold.

Figure 14. Comparison of rounded and flattened bases

Figure 15. Textile impressions on the interior of vessels, especially bowls

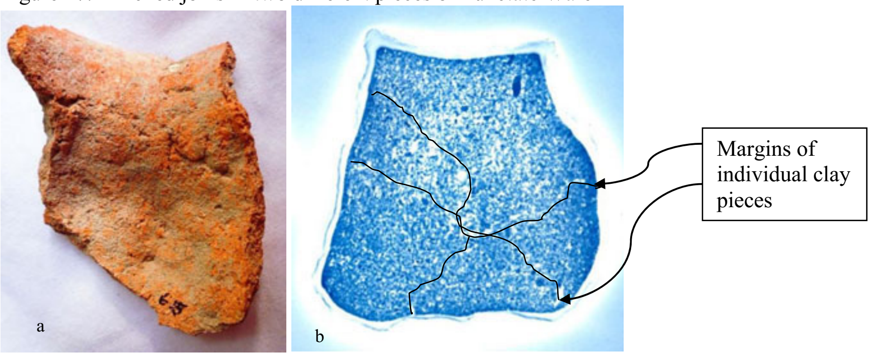
Xeroradiographs of this pottery also argue for the use of molds, even if only for the lack of positive evidence for an alternate assembly technique (Fig. 16a, b, c, and d). At first look, the porosity is distributed throughout these sherds and is not directional as would be expected of coiling, strips, or slab joints. The pores themselves are not only formed around aplastic mineral inclusions but also result from some fine fibrous vegetal material that included other small rounded organic material, similar in size to millet and sorghum seeds. Additional pores are associated with fine cracks at the margins of clay strips or coils. Internal vertical cracking that likely resulted from handling of leather-hard pots, and short fine cracks that are consistent with surface friction during the removal of partially dried pottery from a mold also contributed to the porosity observed in the xeroradiographs. Evidence of strips to build up these vessels is most clearly shown near the rims, although banding patterns in the thickness and density of the sherds also attests to this (Fig. 16a and c). That these strips were joined against a mold is suggested in the high frequency of small rounded pores observed on the interior where insufficient scraping occurred.

Figure 16. Xeroradiographs



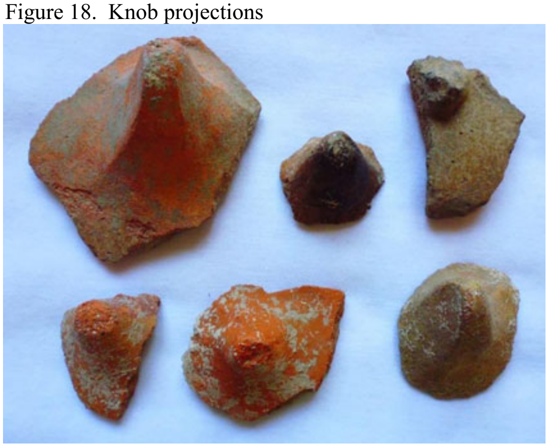
Evidence for other forms of wall assembly was lacking; for example, no variations in thickness or faceting as from the use of paddle and anvil or diagonal elongation of porosity as found in throwing on a wheel. There were no radiating patterns of fine fracture lines characteristic of paddling that occurred when we undertook this process. Likewise, no elongated pores were found with a 30 to 45 degree incline from horizontal which would have indicated a wheel thrown pot. There were also no repeated circular or near-circular indentations or areas of thinning. Only one other assembly technique was represented in these data. The Punctate Ware in our sample provides indications of small disks or lumps of clay pinched together. The rounded base and exterior walls of this vessel are fairly smooth, but the interior walls reveal numerous finger impressions (Fig. 17a). Overlapping pieces of clay are likely in the radiograph in Fig. 17b. This mode of assembly was not observed for any of the other ceramics at Tuzusai.

Figure 17. Pinched joins in two different pieces of Punctate Ware



The Tuzusai potters became flamboyant in their design of handles and winged or horned attachments. Whereas wall assembly and shaping strategies were homogeneous, more diversity and design variation occurred in the crafting of handles. These may be characterized separately as knobs, lugs, and coils. Knobs are here meant to describe the small projections typically found at the shoulder of globular shaped vessels. Some are more pyramidal while others are more rounded. None are very large, less than 2cm deep (Fig. 18). Small elongated pores between knobs and the vessel wall suggest that the knob was added as a small lump of clay and then shaped and smoothed into the wall surface. They are not very strong and often contain porosity at the joint.

Figure 18. Knob projections

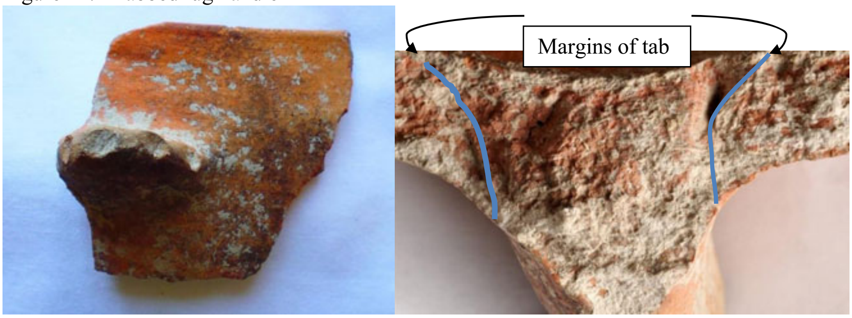


The lug handles have a wider range of shapes and sizes. Flat round disks with a very small center opening are observed, as are elongated narrow ledges (Fig. 19 a and b). There are thick lobes that extend at a wide range of angles, some of which are vaguely zoomorphic in character (Fig. 20). The largest lug handles are more than 10 cm deep and look like horns (Fig. 20b). Many of these lug handles were bonded flush to the wall surface, the joints healed with additional clay and slipped over in much the same way that the knob projections may have been added. Other lug handles, however, were inserted into an incision in the wall surface (Fig. 21). The clay elements comprising the lug are much thicker at the interior edge, yielding the impression that they may have been inserted as tapered coils or cones from inside the pot and then given their shape as they were worked into the vessel wall (Fig. 21b). This tabbed lug uses a metal construction technique to handle attachments.

Figure 19. Disc and ledge lug handles

Figure 20. Lobe and horn or wing lug handles that were inserted through the wall as in metal construction and joining of a handle to a vessel.

Figure 21. Tabbed lug handle



The coil handles also include a wide range of shapes and methods of assembly. These handles may accommodate only a finger's width or the entire palm and are attached at varying angles between 45 degrees and perpendicular to the vessel wall (figure 22). Forming the coils for the largest of these handles may have required near constant attention to maintain their shape since the silt-sand pastes were highly susceptible to slumping and cracking. Butt joins between handle and wall surface can be observed, particularly on one example of corrugated ware where the seam between handle and neck was not over-slipped and smoothed into the wall (figure 23). Vertically attached coil handles are ovoid in profile, attached to both the wall surface and the lip of the rim and well joined to the vessel wall with no obvious separation between the wall and handle (figure 24). In addition to these, several examples of horizontal coil handles were attached to the vessel either by inserting them through an incision in the wall or using a smaller coil inserted into the wall as an anchor for attaching the handle (figure 25). Like the tabbed lug handles, this riveted type of attachment is again reminiscent of metal crafting techniques.

Figure 22. Coil handles of varying sizes

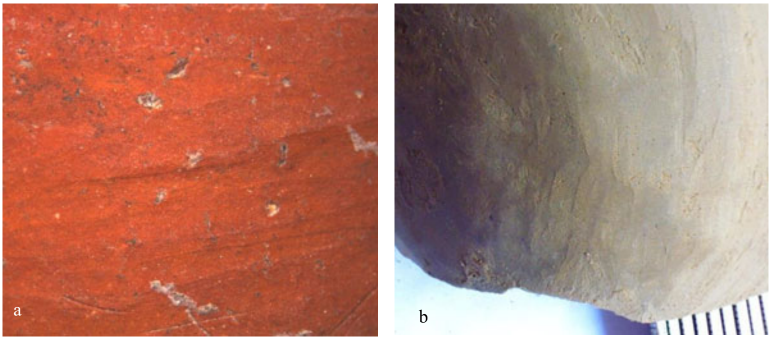
Figure 23. Butt join for coil handle through the wall   Figure 24. Vertical handles

Figure 25a. Horizontal riveted coil handle, similar to that used for metal work; b, pot reassembled

Figure 26. Unique two-fingered handle shape (top to the right)

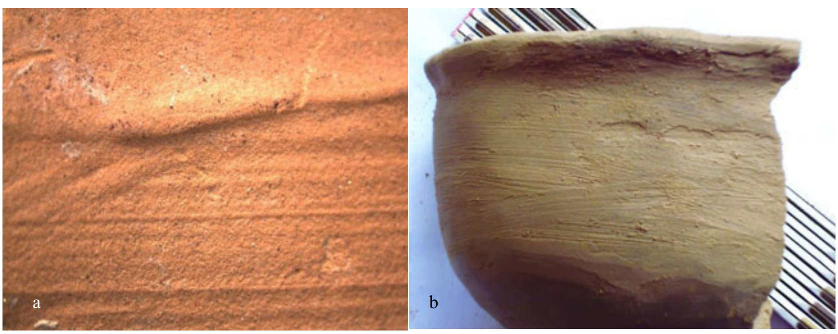
Surface Treatments: Many surface treatments are observed in the Tuzusai ceramic assemblage. These include the use of burnishing/shaping, false slip, cream slip, red wash, incisions, stamps and punctate impressions. Fine Orange, Reduced Red and Transitional Gray wares all bear characteristic marks of burnished exteriors. This finish was produced with a narrow, rounded tipped implement that shaped the exteriors of these pots as it also aligned clay or silt particles (Fig. 27a). A similar surface texture was achieved using a bone tool as a rib to smooth and shape the leather hard surface of one of the reconstructed vessels (Fig. 27b).

Figure 27. Burnishing and shaping indentations



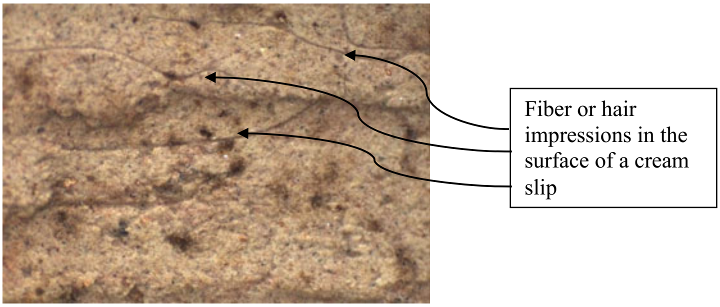
None of the Red Washed Ware displayed any burnishing or shaping of this kind. Instead, a false slip is seen on a large majority of these ceramics. Whether this effect was created simply by rewetting the surface or by applying a slip made of the same materials as the silt matrix, the use of a cloth or rag appears to be probable. The fine, multidirectional slip trails that result are favorably comparable between artifacts (Fig. 28a) and reconstructed vessel (Fig. 28b).

Figure 28. False slip with multidirectional drip lines on artifact and on reconstruction



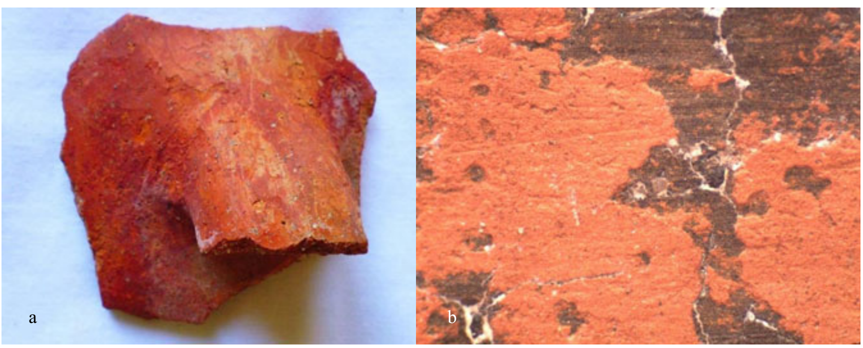
The use of a cloth in the application of cream slips is even more likely. These slips have been identified on both Corrugated Ware and select basins and small bowls of Red Washed Ware. In one example, impressions from fine fibers or hairs were seen embedded in the surface (Fig. 29).

Figure 29. Fine gauge fiber impressions in cream slip



Red washes could also have been applied with a cloth in many cases. This may be particularly true for pieces that are thickly covered in red wash, a Red Washed Ware tankard handle for instance (Fig. 30a), or the piece of Reduced Red Ware (Fig. 30b). Results were consistent with a reconstructed pot in which a red wash was made using the finest sifted fraction of the available sand and silt materials and daubed onto the exterior with a cloth rag (Fig. 31). In rare instances, however, there is some evidence to support use of a brush. The margins of individual application strokes consistent with the use of a brush are visible under a microscope at x25 (Fig. 32).

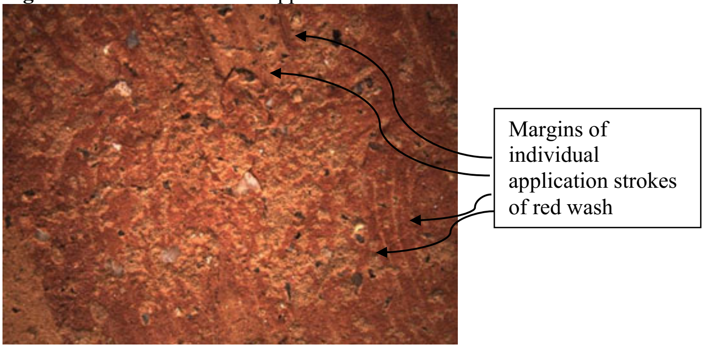
Figure 30. Daubed applications of red wash



The red washes likely include pigment quality hematite. These were applied to a leather hard or wet silt body resulting in the expansion of the surface and the formation of fine cracks. The 200 to 500 micron thick red paint found on the Reduced Red Ware was also applied prefire. It does not fluoresce in short- and long-wave infrared illumination, a test that indicates the presence of some organic compounds. Furthermore, although the red paint on this specimen was flaking off at the margins, it survived gentle boiling in water and subsequent soaking during the

Figure 31. Reconstructed red wash with a daubed application

Figure 32. Red wash - brush application



ASTM test for open porosity. In almost every example, the original pattern for both Reduced Red and Red Washed Wares cannot be determined in sufficient detail due to past wear.

Decoration in the form of incised or modelled patterns was rarely observed, and only a few late period potsherds that demonstrate their use. Two vessels had a punctate design, but even in this, the punctates were technically different from one another. The Transitional Red Wash Ware had a single row of closed punctates created with a solid object such as a bone or stick (Fig. 33a), whereas the Punctate Ware was clearly decorated with a hollow reed or other tube to produce an erratic constellation of open punctates (Fig. 33b). Circumferential incised lines were typically restricted to a small number of Fine Orange Ware bowls (Fig. 34); however, one rare example of coarse Red Washed Ware has a row of teardrop shaped incised motifs across the shoulder of the vessel (Fig. 35). Unlike the incised Fine Orange Ware, the incisions in the teardrop motif were not filled with red wash. With stamped designs, a wheel or cross-in-field pattern was filled first with cream slip and then the relief portion of the pattern was painted with red wash (Fig. 36).

Figure 33. Closed and open punctate design

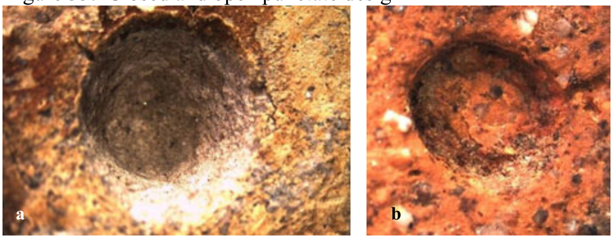


Figure 34. Incised lines

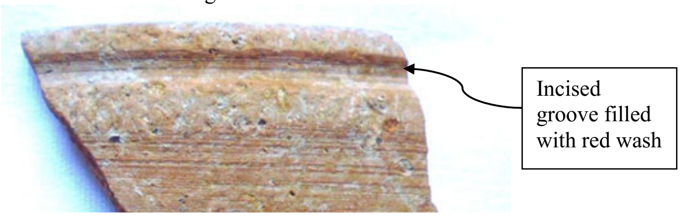
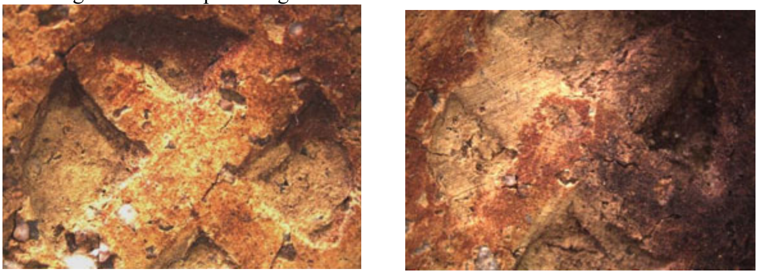


Figure 35. Teardrop incised lines

Figure 36. Stamped designs



Firing Conditions: Firing conditions were estimated from measurements of open porosity, hardness, oxidized fired color of locally available raw materials, and refiring of sherd fragments. SEM analysis of refired samples is forthcoming. The temperature range is 900 to 1000°C.

The spalling around mica and lime particles frequently observed for Tuzusai pottery, offers the first indication that firing temperatures exceeded 800°C. The high degree of porosity indicated in xeroradiographs of the Tuzusai pottery is consistent with estimates of open porosity using a simple ASTM test. This involved gently boiling the sherds for 2 hours and then allowing them to remain in water for 24 hours. The weight of each sherd was recorded before and after this process, taking note of the percentage increase in weight. A representative subsample of 27 potsherds was tested. Some potsherds were more weathered than others, admitting more water, and thus yielding an artificially high value. With only a few exceptions open porosity was in the range typical of most earthenware (Fig. 37). The mean open porosity for all the Tuzusai potsherds tested was 12.5%, while the range of open porosity varied between different categories of wares (Table 3). A sample of reconstructed pottery was also tested for open porosity after a sequence of trial firings. A replicate pot fired to 950°C was a light red color similar to the bodies of Red Washed and Fine Orange Wares and was more porous than 22 of the 27 potsherds in the subsample. Because lower percentages of open porosity usually correspond to higher firing temperatures, the higher porosity of the reconstructed pottery compared to the Tuzusai potsherds suggests firing temperatures were likely to meet or exceed 950°C.

Despite having porosity consistent with earthenware, nearly all of the pottery in the Tuzusai assemblage made a clinking sound when struck unless significant internal cracking or corrosion was present. This clinky quality of pottery usually corresponds to higher firing temperatures or longer soaking times producing a harder ceramic. The Mohs hardness for many earthenwares ranges between 2.0 and 3.0, while the Tuzsai subsample ranged between 2.5 and 4.0 (Table 3). The majority of the subsample, 23 of 27 in all, could be assigned a Mohs score of 3 or more (Figure 38), but the mean hardness of the sherds varied with category of wares (Table 3).

Reconstructed pots ranged in hardness with firing temperature. Each sample was fired in increments of 50° C between 800°C and 1200°C, with a soaking time of 12 hours. A replicate pot fired to 900°C, while light red in color, was still somewhat chalky and soft, thudding when struck. At 950°C, the replicate pot was more clinky, maintained a light red color and rated a 3.0 on the Mohs scale. At 1050°C the body color become brown in color, changing from light red to

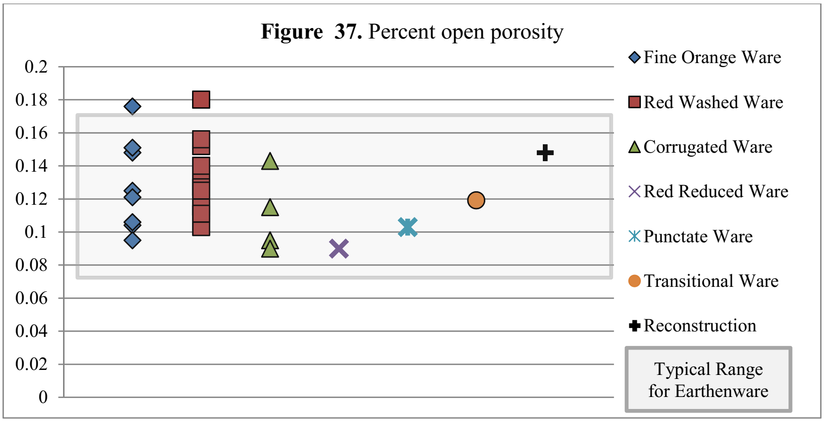
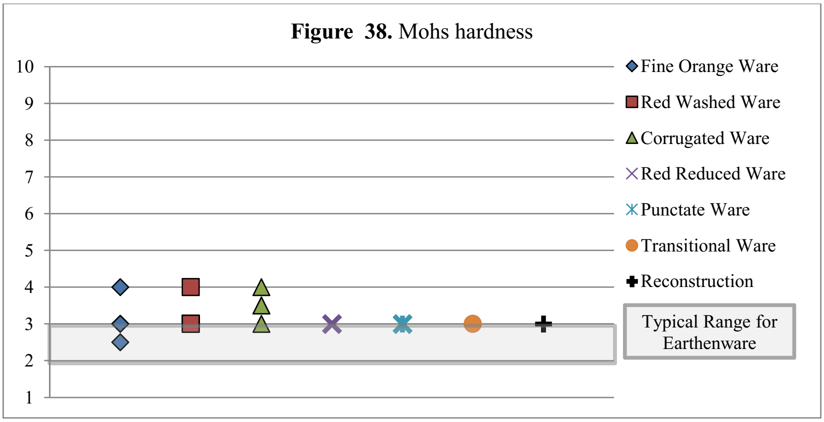


Table 3. Comparison of open porosity and hardness

Ware Category	Open Porosity		Mohs Hardness	
	Range	Mean	Range	Mean
Fine Orange	9.5% - 17.6%	12.8%	2.5 – 4.0	2.9
Red Washed	10.3% - 18.0%	13.3%	3.0 – 4.0	3.1
Corrugated	9.0% - 14.3%	11.1%	3.0 – 4.0	3.5
Reduced Red	9.0%		3.0	
Punctate	10.3%		3.0	
Transitional	11.9%		3.0	
Reconstruction	14.8%		3.0	



weak red, and the hardness increases from a 3.0 to a 4.0. These samples are consistent with the weak red color, lower porosity, and higher mean Mohs scores found for Corrugated Ware potsherds. The combined results of these preliminary descriptive analyses suggest that the Tuzusai pottery was fired either in the upper range for earthenwares, or else at a somewhat lower temperature but for a relatively long time. The Corrugated Ware and Reduced Red Ware were fired at higher temperatures than the Fine Orange or Red Washed wares. One suggestion has been that the Fine Orange may be an import from the Syr Daria region [24], but similarity paste forming, texture and inclusions, and shapes of the Fine Orange with the Red Washed ware that dominate the assemblage mean that importation is not likely, but more study is required.

One of the fired amorphous lumps from the pottery-making courtyard was determined to have been fired to 1000oC, the same range as the pottery and unlike the adobe used to construct the homes that disaggregates when put in water. This is one lump of almost 26 lbs. of similar pieces that were excavated from only the one pottery-making courtyard.

In Summary: Nothing about the manufacture of appearance of these pots is standardized. The amount of variability of manufacturing is excessive even for a group of village potters working in courtyards near their homes. Even though the raw materials are certainly not optimal, the potters were able to overcome raw material constraints with inventive solutions. Pottery making is not an established tradition, but quite experimental and even fun and risky. Many of the handles imitate horn or wings, and some use solutions from metalworking, such as rivets and through-wall joints. The firing is quite high for earthenware and consistent throughout the corpus. Lesser firing temperatures for this clay body lead to pots that break easily as the clay body is quite and little glass is formed to hold the sand and rocks in the body together. The firing temperature range is consistent, and the fired pots represent otters with experienced practices.

CONCLUSIONS

Between the fourth century B.C. and second century A.D., changes in climate, culture and commerce converged to extend networks of influence and intensify social stratification in communities situated along the Silk Road. The horse-riding nomads and agro-pastoralists of what is now Southeastern Kazakhstan were important actors in the unfolding of these events. The settlements and kurgan burials of the Saka and Wusun could be found dotting the alluvial fans north of the Tien Shan Mountains just a short time before Alexander the Great founded outposts in the Ferghana Valley and Chinese emissaries formalized relations with their periphery. In other words, the appearance of Iron Age Saka-Wusun sites anticipated the formation of the Silk Road's northern branch and subsequently helped mediate long-distance relationships connecting East and West. Historical accounts appear to confirm the presence of the Saka and Wusun in this role, but there is much that remains unknown regarding relationships both within and across their communities. Typolgical variability in their material culture has fed speculation concerning their position within trade networks, but there has been very little in the way of materials analysis to test these assumptions.

Difficult for pottery production at this site is the scarcity of adequate clay resources. Reconstruction efforts using a variety of materials both collected at the site and nearby produced pots with some practice (Fig. 39). The very small percentage (about 3%) of clay-sized particles in local soils makes it unlikely that elutriation techniques would have yielded sufficient clay.

Preparation of the ceramic paste must have required careful selection and collection of fine sediments. The clay fraction was identified by petrographic microscopy as glauconite and micaceous sericite with feldspar and other inclusions more numerous than quartz. Better clays are neither available in alpine meadows or lakes, nor in the red lakebed sediments in the nearby foothills. Most lowland areas with active water accumulation contain calcium salts that bleach the pottery surfaces to a white color during firing, and these are common in medieval pottery, but not at Tudusai. Near Kapchaygay lake are some sediments currently used for bricks and tourist pottery, but these deposits are quite distant, over 100 km. and beyond the range expected to be collected and transported by such village potters who wished to make pottery but who lived outside centers with a pottery tradition.

Figure 39. Reconstruction and molded bowl fragment (left) compared with similar sherd

The sequence of manufacture and the details of manufacture make investigating each pot a new experience. A wide variety of handforming methods were used, including slab building, moulding and coiling of rims. Handles and decorative surfaces are special, both in their diversity of form and the many ways in which joints were made. Obvious is the inventiveness and variation in strategies to produce pottery. The uses of round and flat bases relates to differences in the use of molds during construction and support during drying. In contrast, other Iron Age ceramics found in Southeastern Kazakhstan outside the Semirechye region, beyond the Talgar fan have predominantly flat bases [22]. Given the technical problems associated with the raw materials in this area, the difficulties in forming a pot from a flat base are considerable. The sophisticated use of molds and supports in pottery production suggests forming of metal in molds (repousse and raising), and some pots may be metal skeuomorphs. The thin walls and sharply carinated profiles of many Fine Orange Ware cups and bowls, emulate metal forms. Similarly, riveted coil handles and tabbed lugs found on many of the Red Washed wares rely on production techniques more commonly seen in metalwork. In this way, handles were joined to a molded vessel when fairly dry, making them less likely to slump out of place after being set into the wall. These production strategies probably provided useful means for working with difficult earthen materials.

The extensive use of a red wash in this assemblage is consistent with most Iron Age pottery across this region and throughout the neighboring Xinjiang province [23]. Often, only trace amounts of this wash remains on many of these potsherds. This is because when the red wash was applied to the unfired pottery, it made surfaces more susceptible to cracking. The combination of flying wing or horns handles and lugs, red surface washes that are presumably more prestigious than the tan to orange plain pottery color (at least in view of burial ceramics), and the presence of small medium and large versions of pottery with these characteristics, all together indicates that aesthetic concerns for the provision of sets of pottery was a production goal. One suggestion has been that this pottery was the equivalent of china patterns repeated throughout discrete sets used as feasting regalia (Fig. 40). Ethnographic evidence and museum collections of tableware from southeastern Kazakhstan have wooden or ceramic sets used for serving koumiss to guests and present in household assemblages (pitcher and cups).

Figure 40. Similarities in handles of different sizes of vessel

Our current understanding of poor quality resources, the considerable difficulty of achieving thin-walled forms and complex rim and body profiles, the rarity of pottery at the site, the presence of extremely worn rims leads to the conclusion that these ceramics are high-status goods valued not solely for their roles in feasting activites, but for the labor and skill required to produce them. The wooden tableware historically used by agro-pastoralists throughout the Semirechye region, including the Talgar, Issyk and Almaty alluvial fans, is probably a more sensible and lightweight option than the gritty, fragile and heavy ceramics that characterize the Tuzusai assemblage. They had to really desire pottery as the appropriate material. Another line of evidence consisting of repair holes reinforces this view. Repair holes are found in many of these ceramics can be interpreted in a new light. Whereas these repairs were once viewed as a necessity due to the short length of stay and limited scale of ceramic production among highly mobile communities, in reality, they may have been the result of efforts to conserve important or valuable objects that were difficult to make. In this respect, the pattern of ceramic repairs bears closer resemblance to those observed in collectors pieces in which either rare or expensive objects are preserved. Despite their sometimes ordinary appearance, the pottery at Tuzusai seems not intended for the mundane uses of everyday cooking and consumption, but rather reserved for serving food and beverage from pitchers into bowls and cups.

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