CHAPTER TWENTY-TWO

RECENT XERORADIOGRAPHIC ANALYSIS OF KURA-ARAXES CERAMICS

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The Kura-Araxes horizon (3500–2500 BC) is the largest archaeological horizon for either the Near East or Europe, encompassing a large geographic region that includes portions of northern Iran, eastern Turkey and much of the Caucasus (Fig. 1). This horizon is predominantly defined by a single ceramic type that is based on morphological and decorative criteria. While morphological and decorative characteristics are no doubt important indicators of socially conditioned practices of production, so too are the forming processes for raising the walls of these vessels, though these processes have yet to be examined for Kura-Araxes type wares. The results of a small pilot project involving the xeroradiography of Kura-Araxes type wares and other contemporary ceramic types found together at sites in Daghestan and Azerbaijan indicate that there is greater variability and diversity in the production practices underlying these wares than previously was described. The observed contrasts in manufacturing techniques revealed in xeroradiographic images raise new sets of research questions with interesting implications for the development of ceramic technologies in the Caucasus as well as for social interactions related to ceramic production and consumption during the Kura-Araxes period.

Previous interpretations of Kura-Araxes horizon sites have frequently attempted to make sense of distinct regional variations in decoration and morphology within the Kura-Araxes ceramic type (Khanzadian 1967; Dzhaparidze 1980; Kushnareva and Chubinishvilli 1971). Many of these interpretations relied on competing migration theories for peoples to whom the manufacture of these wares was attributed. Less sophisticated variants of Kura-Araxes pottery were alternatively taken to indicate the earliest point of cultural origin (Kushnareva 1997; Burney 1977) or the degraded remnants of a pottery style that had migrated a great distance from its homeland (Sagona 1984).

More recently, both Bochkarev (1982) and Ismailov (1983) have indicated, based on these distinct regional stylistic and morphological variations, that the

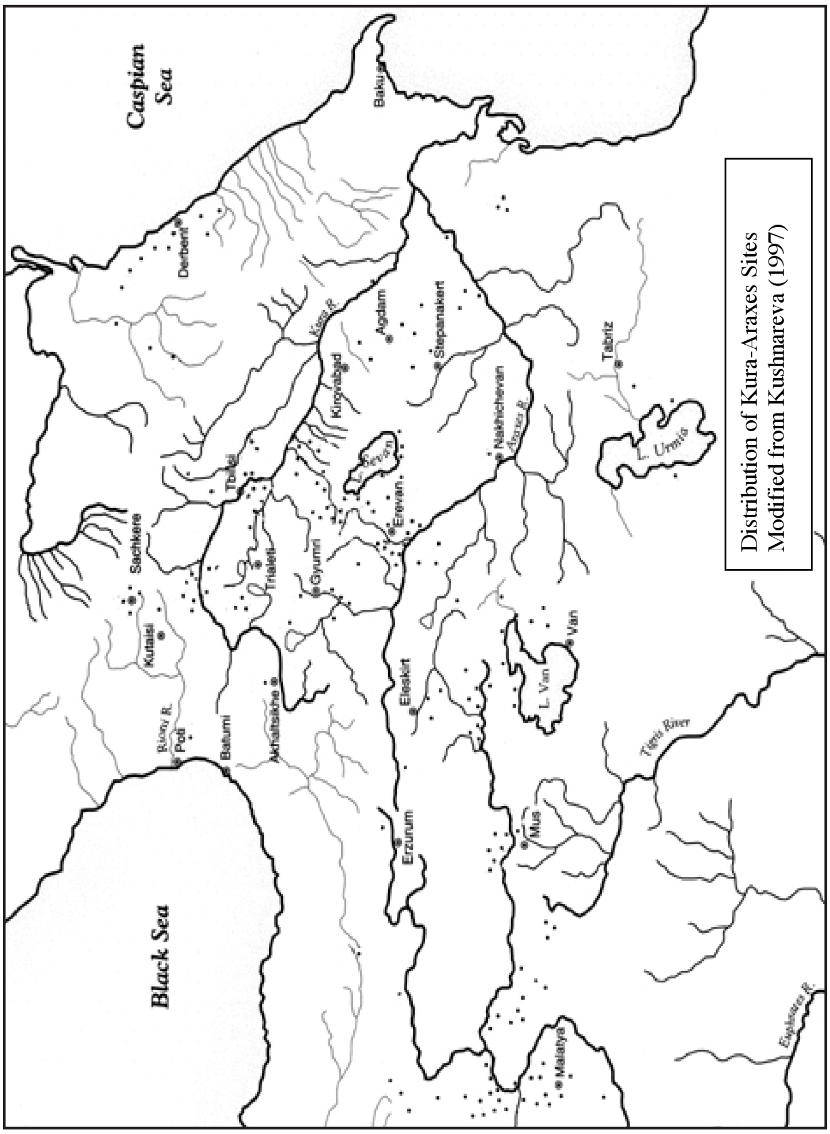

Fig. 1. Map of the Kura-Araxes horizon (modified after Kushnareva 1997).

Kura-Araxes horizon may best be described as a community of multiple cultures or, 'block of cultures' that are closely related in some unspecified manner. The organisation of these cultures and the relations between them is ambiguous. Further, the relationships between Kura-Araxes type wares and other contemporary wares at the same sites have not been investigated thoroughly and generally have not been taken into account when describing regional variation in ceramic assemblages. This interpretive perspective raises two questions. First, what is the nature and extent of the regional variation in Kura-Araxes horizon pottery technologies and how can this best be described? Second, how does this variation relate to patterns of social relationships within and between communities within this hypothesised 'block of cultures'? A useful framework for an investigation into these questions may be derived from perspectives within the anthropology of technology that are concerned with the implications of interaction between people and the objects they create (*cf*. Dobres 2000; Ingold 1993; Pfaffenberger 1992).

In particular, a socio-technical approach examines these objects in terms of the social practices that both produce them and are in part shaped by them. As such, this approach relies predominantly on *chaîne operatoire* (Leroi-Gourhan 1946; Cresswell 1976, 6; Lemonnier 1992, 6; 1986, 149) analysis in combination with theories of practice (see Ortner 1984) to describe changing patterns of technological activity within fluctuating social contexts (Dobres and Hoffman 1994). *Chaîne operatoire* analysis focuses on reconstructing sequences of techniques involved in both the production and consumption of objects. Each technique is examined as a 'total social fact' (Mauss 1979 [1936]), reflecting the integration of socially conditioned behaviours with material resources. The interpretation of this data through theories of practice (Bourdieu 1977; Giddens 1984) describe mechanisms for generating variation in techniques of ceramic production and consumption by situating individual agency within a broader scope of community practice. This combination provides a link between variability in Kura-Araxes material culture and variability in social context and organisation, though it requires a more detailed examination of social practices underlying, in this case, ceramic technologies, than previous analyses and interpretations have offered.

The first question regarding the nature and extent of variation in Kura-Araxes horizon ceramics may thus be addressed through an examination of their *chaînes operatoire* to identify variability in the techniques employed in their manufacture and consumption beyond the already apparent morphological and decorative divergences. The second question regarding the relationships between ceramic variability and social relationships may then be addressed through the articulation of techniques with theories of practice to describe patterns of social relationships relating to technological activity within and between communities. To begin with then, it is essential to describe as fully as possible, the techniques required in producing and using Kura-Araxes wares. This requires multiple forms of analysis, though one form of analysis, xeroradiography, offers a convenient starting point to address the production aspects of pottery.

Xeroradiography provides information regarding the assembly of vessel walls for most types of pottery. It involves the exposure of an electrostatically charged selenium plate to produce images that have far greater edge enhancement than those images produced by conventional radiography. This edge enhancement makes visible variations in the amount, shape and alignment of pores in the ceramic fabric that relate to specific differences in production techniques (Vandiver 1988, 145). The amount of these pores can indicate the extent of the forming pressure applied to the clay, a measure of which corresponds to forming technique (Vandiver 1988, 142). The shape and orientation of these pores further indicate the forming methods used. For instance, a coiling technique would produce horizontal rows of pores at varying intervals throughout the ceramic body (Vandiver 1988, 143). A pot thrown on a wheel would exhibit a pattern of elongated pores oriented at about a 30- to 45-degree angle as a result of upward pressure applied to clay moving across a horizontal centripetal axis (Vandiver 1988, 143) (Fig. 2). Xeroradiography also reveals variation in the relative size and amount of temper. Qualitative sorting and coding of these variations provides a method for selecting a smaller sample from large collections of sherds for more labour-intensive analyses such as petrography of inclusions, or instrumental neutron activation analysis, or determination of firing temperature ranges.

A sample of 20 specimens from sites in Daghestan and Azerbaijan was xeroradiographed to refine future research methodology. The specimens selected represent two roughly coeval ceramic types that are represented at Kura-Araxes horizon sites in both regions. Relationships between these two types regarding their production and use have never been examined. Additionally, the Kura-Araxes type wares selected for this study represent two distinct regional variants of this type. Again, the possible relationships between these two variants have not been closely examined. By selecting specimens across types and typological variants we hoped to observe differences in their *chaîne*s operatoires that contribute to these distinctions.

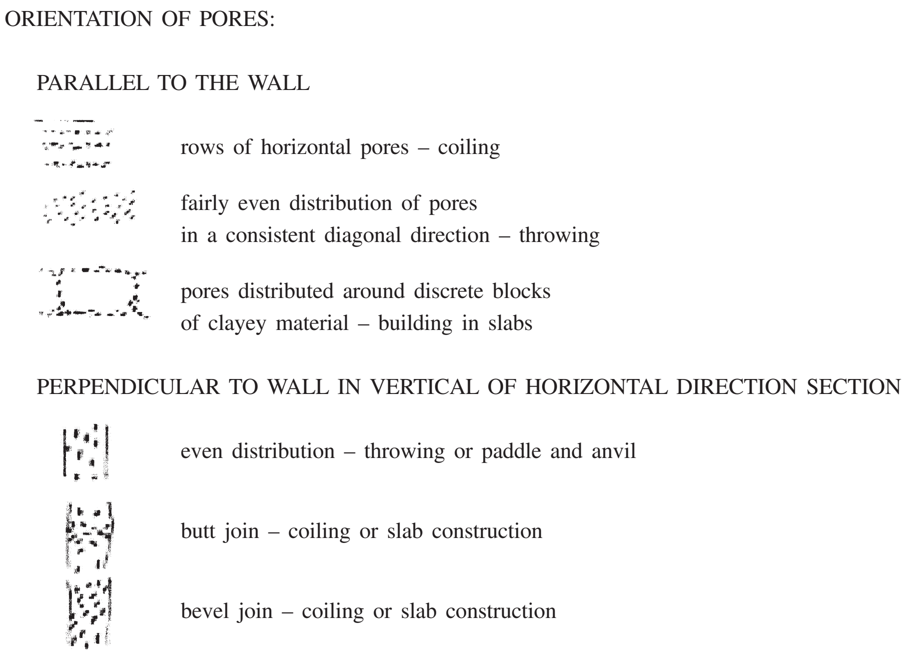

Fig. 2. Orientation of pores (modified after Vandiver 1988, fig. 3).

The 23 samples of Kura-Araxes type wares in the sample, like all Kura-Araxes type wares, are burnished and are hand made, as opposed to having been thrown on a wheel (Munchaev 1975). While the Kura-Araxes type includes specimens that are decorated with incised or modelled motifs (Munchaev 1975), those included in the sample lacked ornamentation. Also, while some Kura-Araxes wares are black or red in colour (Kushnareva 1997), those included in the sample ranged from grey to brown to orange. Evidence of a 'lug' handle often considered diagnostic of this ceramic type was present on two of the samples for this study.

The other ware type included in the sample is known as 'High Quality Ware' (HQW) (Gadzhiev *et al.* 2000). Like Kura-Araxes ware, HQW is similarly burnished, and typically displays patterns of tight rocker bar impressions or incised zigzags around the shoulder of the vessel body. HQW is found associated with Kura-Araxes type ceramics in domestic features at Velikent in Daghestan (Gadzhiev *et al*. 1998, 198). In contrast to the widespread distribution of Kura-Araxes type wares, the distribution of HQW appears limited to the Caspian littoral and adjacent foothills from Azerbaijan through Daghestan and into Chechnya (Munchaev 1975; Gadzhiev *et al.* 2000).

	Inclusion size range	**Pore size Range**	**Ceramic body thickness range**
Kura-Araxes Textile-Formed	N/A	<1 – 2.3 mm	9.75 – 10.5 mm
Kura-Araxes Straw-Tempered	N/A	7.3– 20.2 mm (length of void)	9.3 – 14.75 mm
HQW Straw-Tempered	N/A	4.1 – 7.2 mm (length of void)	9.0 – 12.1 mm
HQW Coarse Grit-Tempered	1 – 6.8 mm	1.1 – 6.5 mm	8.1 – 11.2 mm
HQW Fine-Tempered	N/A	< 1mm	9.6 – 10.1 mm – Serker-tepe 4.2– 6.1 mm – Velikent

Fig. 3. Table of comparison of subtypes recovered from domestic contexts. N = 43.

Comparing existing typologies based on morphological and decorative characteristics and the xeroradiographs that suggest variations in clay body textures, five production subtypes can be established to describe specimens for both Kura-Araxes and HQW ceramics. These include two production subtypes of Kura-Araxes type wares, 'Textile-formed' and 'Straw-tempered', and three production subtypes of HQW, 'Straw-tempered', 'Coarse grit-tempered' and 'Fine-tempered'. The accompanying table lists comparisons in grit particle size and straw pore size for each of the subtypes as well as ranges in the thickness of the clay body for each subtype (Fig. 3).

The first production subtype, 'Textile-formed Kura-Araxes wares', is represented by three specimens (Fig. 4). One of the specimens may belong to a flat ceramic form (Fig. 4b), though this is difficult to determine as it is a small fragment. The other two specimens with textile impressions represent a rim and a body sherd from bowl forms (Fig. 4a and 4c). This subtype appears to contain no added temper as is indicated by the uniformity of pore size range and even pore distribution (Fig. 5). The textile impressions on these three specimens became visible when layers in the wall of the ceramic body separated from one another due to variable, probably seasonal, moisture and expansion of the clay body in their depositional contexts. If not for this exposure, identifying the use of textiles in the forming process would be difficult, if not impossible. A few possibilities for finding evidence of textile use through xeroradiography include

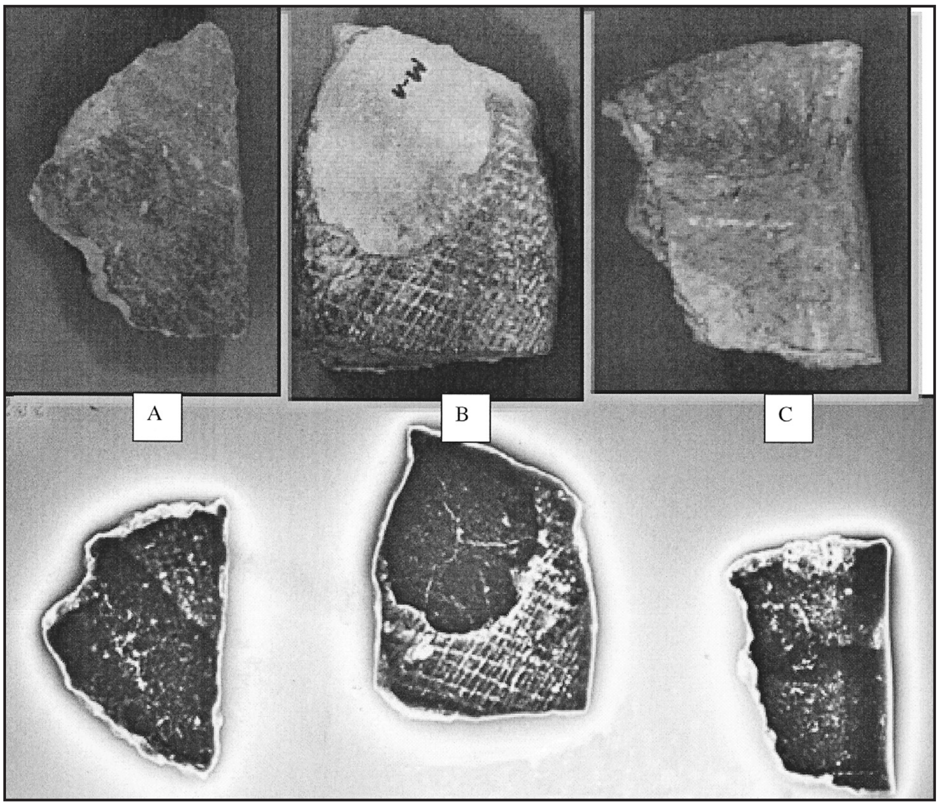

Fig. 4. Photographs and corresponding radiographic images of textile impressions imbedded in the clay fabric.

imaging thick sections of potsherd in profile, or perhaps sampling larger specimens in the hope that an occasional air or water pocket formed between clay layers during manufacture. This would produce a void through which the textile impressions could be seen on the xeroradiograph.

This subtype of Kura-Araxes wares presents some difficulty in their interpretation. There is a striking lack of ethnographic analogies to suggest production techniques that rely on textile in the manufacturing process. While there appears to be at least one archaeological example of woven mat impressions in slab-constructed vessels (Jarrige 1995), evidence of textile impressions are considerably more difficult to locate. Recent communications with both Miriam Stark and Carol Kramer (August 2002) have yielded no additional leads on relevant ethnographic analogies. We suggest that the textile in the case of Kura-

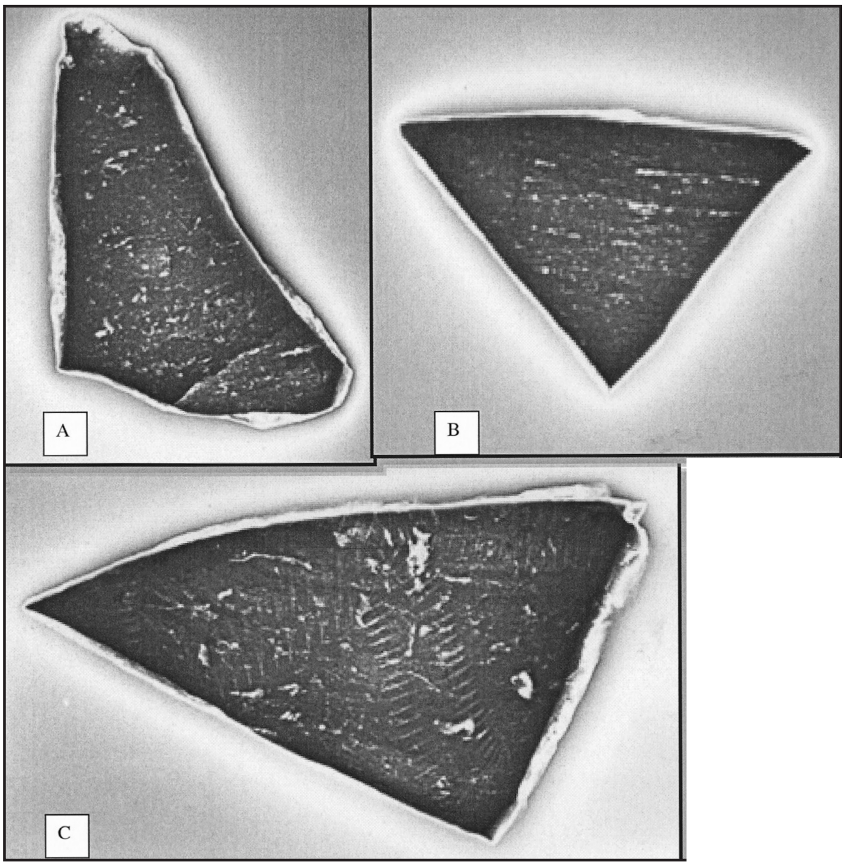

Fig. 5. Xeroradiographic images of select straw-tempered subtypes.

Araxes wares was a sort of canvas or support, perhaps placed over or inside a mould for forming the vessel. The textile could then be peeled off, and a coating of clay could be applied to make the surface smooth. Speculation aside, what is known from both materials science and ethnographic data on textiles in plate formation is that the textile is probably being used to support highly plastic, sticky clay, the sort of clay that would ordinarily benefit from the incorporation of temper to make the clay a little leaner and provide strength. The apparent lack of inclusions in textile impressed Kura-Araxes wares supports this. It is possible that mineral inclusions in this case may have been intentionally removed from the clay by elutriation prior to forming. Future INAA will be important in describing the differences in regional clay composition with and without natural inclusions. Additionally, images of larger vessel fragments may reveal cuts or folds in the fabric. Perhaps strips of textiles were used, or perhaps a single piece of material was fitted or folded.

A second production subtype, 'Straw-tempered Kura-Araxes ware', is indicated by the presence of elongated irregular voids in the xeroradiographs (Fig. 5a). These voids, exhibiting flat, angled ends indicate that the vegetal temper was prepared by cutting. There is some variation in the amounts of temper used but also in the length of the straw. While mechanical requirements to produce a suitable clay body contribute to this variation, so do socially conditioned and transmitted technological decisions. In future work, a larger sample size will, we hope, provide sufficient detail to investigate these differences. What was interesting in the pilot study was that it was possible to distinguish, based on radiographic imaging of texture a difference between wares that authentically belong to the Kura-Araxes horizon and other, non-diagnostic sherds that may appear to be Kura-Araxes ware, but that really represent intrusions from later phases of occupation. An intrusive specimen, while burnished and orange in colour like many other Kura-Araxes fragments found at the same site, exhibits voids from straw temper that are parallel to each other (Fig. 5b). Vandiver has suggested that this sherd was produced using a coiling technique. Additional excavation and imaging can verify the extent of applicability of this interpretation, though it seems probable given the fact that this sherd was collected during a ground survey and identified as Kura-Araxes on the basis of its colour and burnished surface alone.

Sharing considerable similarities with this subtype is the third production subtype, 'Straw-tempered HQW' (Fig. 5c). Like the 'Straw-tempered Kura-Araxes wares', straw-tempered HQW is burnished and orange in colour. Examples of HQW with straw temper do not appear to substantially deviate from straw-tempered Kura-Araxes wares as regards the basic texture of the clay for both subtypes. Larger and more numerous specimens will be required to test the extent of this similarity, as will additional characterisation through INAA which may allow us to determine if both Kura-Araxes types and HQW were produced using the same clay sources. Gadzhiev *et al*. (2000) suggest that this is a strong possibility for wares recovered at Velikent in Daghestan.

Other production subtypes of HQW include 'Coarse grit-tempered' (Fig. 6a) and 'Fine-tempered' (Fig. 6b). Coarse grit temper in this ware is visible as dark spots ranging in size between 1.0 and 6.8 mm (Fig. 6) against a relatively uniform background. Fine-tempered HQW has no measurable inclusions, though inspection of the ceramic fabric indicates that sand may have been employed

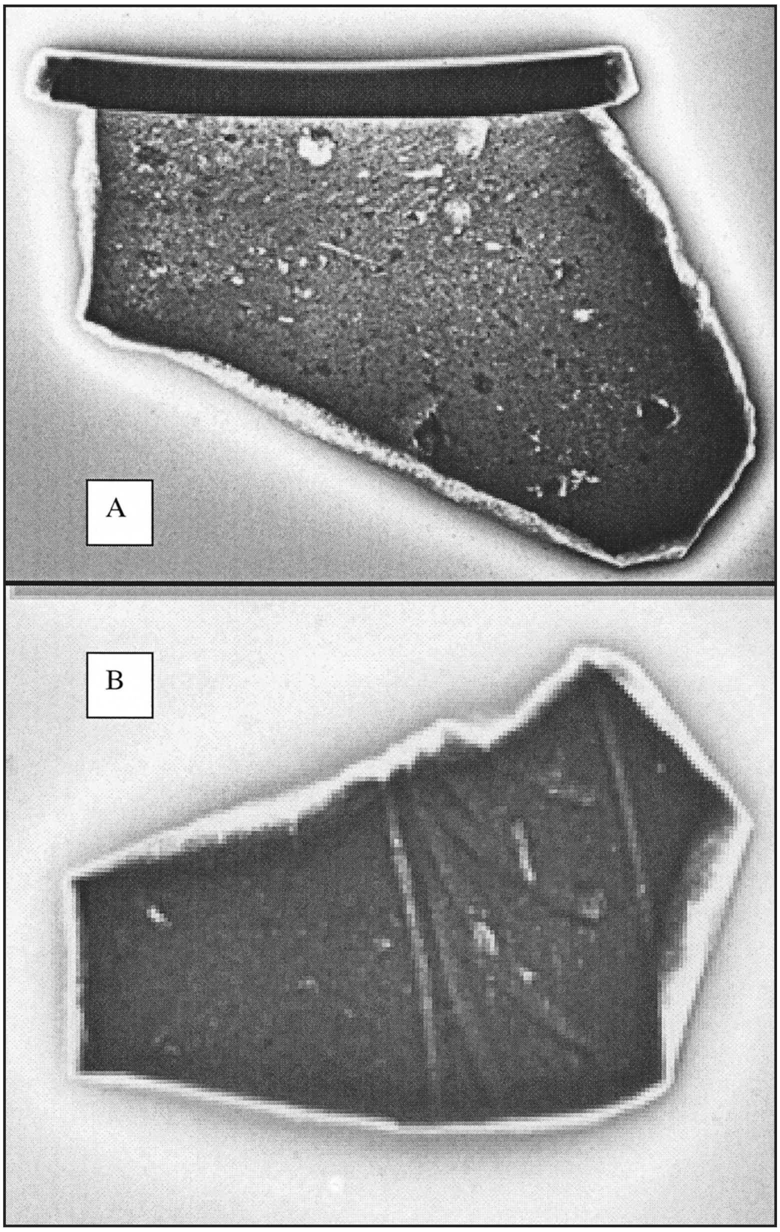

Fig. 6. Xeroradiographic images of select grit-tempered subtypes.

as temper. Those specimens with coarse temper seem to defy the appellation 'high quality ware'. Unlike either straw-tempered or fine grit-tempered HQW, coarse grit-temper HQW is only very lightly burnished and is very dark in colour indicating a reducing firing atmosphere. This subtype also exhibits a slight degree of spalling along the interior of the vessels corresponding to the location of the inclusions. Conversely, 'Fine-temper HQW' is highly burnished and red-orange in colour indicating an oxidising firing atmosphere. This subtype has the thinnest walls of all the specimens in the study ranging from 4.2 to 6.1 mm (Fig. 6).

As most of the samples for this study were retrieved from either Velikent, in Daghestan, and Serkertepe in Azerbaijan, it is possible to compare distributions of these five production subtypes between these two sites. While there are some overlaps of forming techniques between these sites, there are also divergences. At both sites there is evidence of textile-impressed and straw-tempered Kura-Araxes wares. Firing conditions for straw-tempered Kura-Araxes appear to differ between sites. Oxidised orange ceramic bodies indicate the broader application of a more oxidising atmosphere to the south at Serkertepe. Conversely, grey-black ceramic bodies indicate the general application of a more reducing atmosphere to the north at Velikent. At Serkertepe, similarity in clay texture is found between straw-tempered HQW and straw-tempered Kura-Araxes ware, indicating similarities in forming and clay preparation techniques. Representatives of all three subtypes of HQW are present at Serker-tepe. Contrariwise, at Velikent, only fine-tempered HQW is found in combination with straw-tempered and textile-formed Kura-Araxes wares.

The results of this study provide the basis for future work. We intend to continue studying how these five subtypes of wares were produced and used. Several questions are preliminarily generated by this brief study. For instance, to what extent does straw-tempered High Quality Ware reflect an extension of Kura-Araxes ware production strategies? Did HQW subtypes constitute a special-use category within a broader local ceramic repertoire that included textile-impressed and straw-tempered Kura-Araxes wares? Likewise, does textile-formed Kura-Araxes ware represent a special-use category within a broader local ceramic repertoire? Further, to what extent do these distinctions in forming processes reflect distinctions in crafting practices and the social co-ordination of labour? For example, is the locus for production of straw-tempered wares within the household or extended family compound, while there are specialists that only produce textile formed wares, or fine grit-tempered wares? Finally, can similarities in forming techniques for one or more subtypes of wares reflect routes of communication between potting communities and individual craftsmen?

These are clearly preliminary questions from the early stages of an investigation into the diversity of production techniques within conventionally defined ceramic types. The expanded analysis and comparison of these production subtypes will pose further challenges to existing interpretations of Kura-Araxes horizon sites, and will serve to identify patterns of distinct technological activities that describe not only diversity in material culture but the diversity in the social contexts and organisation that underlie them.

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