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## Archaeometrical issues related to Transcaucasian pottery from Georgia

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**ABSTRACT.** — The ceramic fragments examined here come from the settlements of Kiketi, Medamgeis Gora, Kvatskhelebi and Satkhe; the first two are located in the region of Kvemo Kartli, south-eastern Georgia; Kvatskhelebi, in the Shida Kartli region, is one of the few stratified Bronze Age sites in Georgia, and is thus one of the most important points of reference for Caucasian Anatolian archaeology. Satkhe, recently discovered, lies near the present-day Turkish-Georgian border. The four sites have all been dated between the end of the fourth millennium and the first half of the third millennium B.C.

Samples were analysed by means of X-ray diffraction (XRD), scanning electron microscopy with microanalyses (SEM-EDS), and observation of thin sections at the mineralogical microscope for chemical, physical and mineralogical characterisation; Other research aims were also: to hypothesize firing temperature; for better understanding of the techniques used to create the colouring of the ceramic walls; and to verify possible regional differences in the use of materials and techniques within the Transcaucasus.

Results were preliminarily compared with data from the red-black pottery of Arslantepe, in south-eastern Turkey.

**RIASSUNTO.** — I reperti ceramici presi in considerazione nel presente lavoro provengono dagli insediamenti di Kiketi, Medamgreis Gora, Koda, Kvatskhelebi e Satkhe; i primi tre sono localizzati nella regione di Kvemo Kartli, nella Georgia sud-orientale; Kvatskhelebi si trova nella regione

denominata Shida Kartli e costituisce uno dei pochi siti stratificati del bronzo antico della Georgia e per questo uno dei principali punti di riferimento per la archeologia Caucasica e Anatolica; Satkhe, di recente scoperta, è localizzato nelle vicinanze del moderno confine turco-georgiano. I quattro siti sono tutti databili tra la fine del quarto millennio e la prima metà del terzo millennio.

Lo scopo di questa ricerca è approfondire alcuni degli aspetti riferiti alle tecnologie ed alle tradizioni manifatturiere delle ceramiche rosso - nere. I campioni sono stati analizzati mediante diffrazione a raggi X (XRD) microscopia elettronica a scansione con microanalisi (SEM-EDS) e sezioni sottili al microscopio mineralogico. I risultati ottenuti da queste analisi sono stati oggetto di un primo confronto con i dati provenienti dai campioni in ceramica rosso-nera del sito di Arslantepe, in Turchia sud-orientale.

**KEY WORDS:** *Georgia, Kuro-Araks, ceramics, analyses, red and black pottery*

### INTRODUCTION

The aim of this research was to go deeper into some aspects related to the technologies and manufacturing traditions of the red and black pottery (Fig. 1) from several Georgian communities going back to the Early Bronze Age (second half of the fourth millennium-first half of the third millennium B.C.) and belonging to the so-called Kuro-Araks cultural

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tradition. Petrographic and mineralogical analyses were carried out on a set of ceramic fragments from the settlements of Satkhe, Kvatskhelebi, Kiketi, Koda and Medamgreis Gora (Fig. 2). It is interesting to note that the inner and outer surfaces of pot rims are always red or pale brown, resulting from positioning the pots upside down in the kiln with their rims covered by ash or sand. It must be emphasized that the five settlements belong not only to different geographical and geological areas, but also to different phases of the Early Bronze Age. Satkhe is located in south-western Georgia and is dated to the first half of the third millennium, whereas Kvatskhelebi, which is one of the few stratified Early Bronze Age settlements (Dzhavakhishvili and Glonti, 1962), is in north-central Georgia (Shida Kartli) and goes back to the first quarter of the third millennium. The settlements of Kiketi (Pkhakadze, 1963), Koda and Medamgreis Gora are in south-eastern Georgia (Kvemo Kartli). However, although the necropolis of Kiketi and Koda probably go back to the last quarter of the fourth millennium, Medamgreis Gora belongs to the end of the Early Bronze Age.

In these Transcaucasian regions, since the second quarter of the fourth millennium, a new cultural phenomenon, the so-called Kuro-Araks culture, replaced the local Chalcolithic material tradition. One of the most distinctive and characteristic hallmarks of the Kuro-Araks culture is its red and black pottery, the production of which underwent specific development. During the early phases of the Kuro-Araks culture (3500-3000 B.C.) the production of pottery was organized according to two different classes: 1) red and black ware characterized by alternating colours between the outer and inner surfaces of the same pot. The former are usually black and carefully burnished; the latter are red, light brown or orange; 2) monochrome pottery, varying in colour between dark and light brown. According to macroscopic analyses, no difference can be detected between them as regards quality of paste and inclusions. However, from the early third millennium until the end of the Bronze Age, red and black production became the most popular and widespread in all the Georgian communities. A similar process (starting from the last quarter of the fourth millennium) may also be

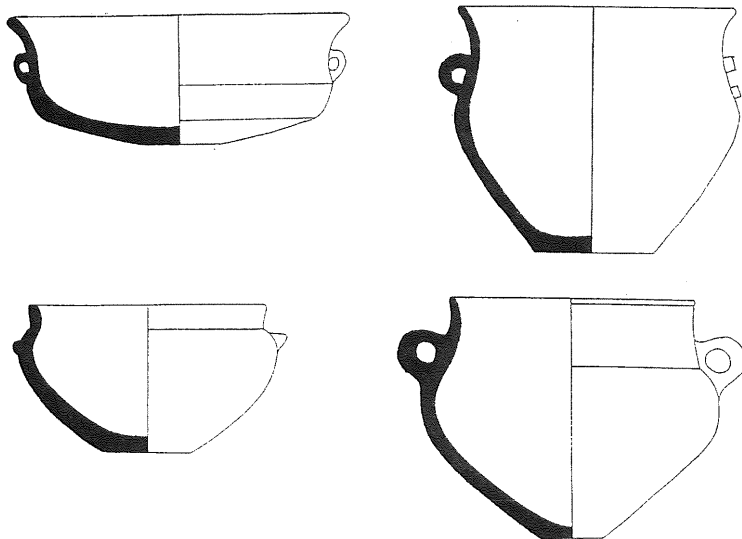


Fig. 1 – Typical examples of red and black pottery production

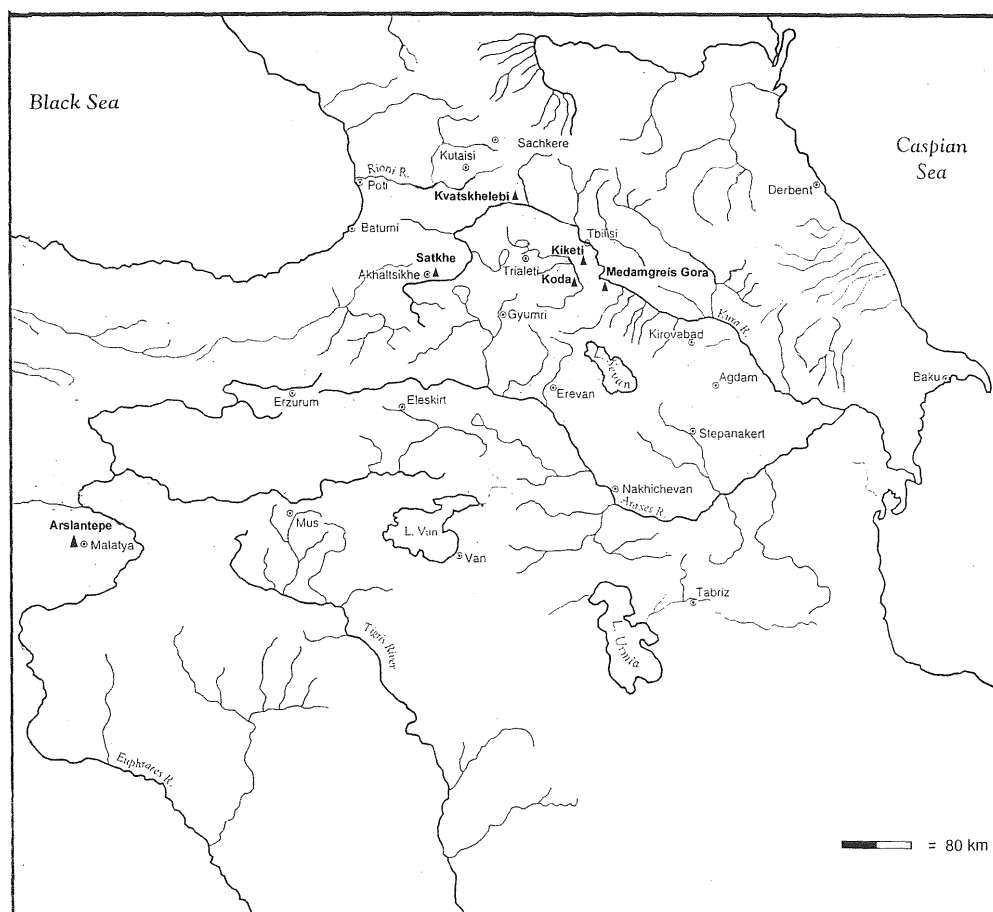


Fig. 2 – Map of area from which finds originate

observed in the productive contexts of the Eastern Anatolian communities, consisting of the progressive spread and quantitative increase in red and black pottery. What happened in Anatolia was the beginning of a process of contextualization of new elements, linked not only to material culture but also with models of land use and exploitation of the land and with forms of social organization which were very similar to those of the Transcaucasian communities (Georgia, Armenia, Azerbaidjan).

This process may be explained partly both by the high level of territorial mobility

probably typical of the Transcaucasian communities of transhumant pastoralists, and by intensified links between the two regions, probably due to increased demand for metal minerals, which are very common in the the Transcaucasus, and which the south-eastern Anatolian communities needed in order to supply their own local and the Syro-Anatolian metallurgical market.

Results from the Georgian red and black pottery and comparisons with that from Arslantepe (Malatya, eastern Turkey) may be used to verify and better understand how and to which extent aspects related to the

manufacture and meaning of the local red and black pottery were the outcome of a single transfer of techniques and knowledge from Transcaucasian communities to Anatolian ones, or whether they were the outcome of local, partial adoption of foreign technologies. In the latter case, they should be interpreted in the more specific ecological, cultural and social contexts of those Anatolian communities which, starting from the last quarter of the fourth millennium, were actively involved in the production of red and black pottery.

#### GEOLOGICAL BACKGROUND

The geomorphological composition of the territory surrounding the settlements is quite homogeneous. These areas are mainly composed of tuff, tuffaceous sand and limestone (all of Pleistocene age), andesite, dolerite and basalt (of Pliocene and Pleistocene age), revealing the volcanic formation of the central and southern regions of Georgia.

#### METHODS AND TECHNIQUES

– X-ray diffraction: powdered samples were analysed on a Philips PW 3710 diffractometer, equipped with a PW 3020 goniometer, from 5° to 70° 2 $\theta$ , in step-scan mode, 0.02°/step and 2 sec/step, using CuK $\alpha$  radiation, tube condition 40kV and 40mA. Powders were pressed on amorphous silicon sample holders.

– Scanning Electron Microscopy (SEM): a Cambridge model 250 MK3 equipped with a Link-Isis energy-dispersive system (EDS) Observations were carried out on polished cross-sections.

– Thin sections were observed under a Leitz microscope.

#### STUDIED MATERIALS

The fragments examined consist of walls of jars with a symmetrical pair of looped handles on the neck, and single or double-handed

carinated bowls with outflaring rims. Both jars and bowls have black outer surfaces and red or pale brown inner ones, and are part of the characteristic repertoire of the Early Bronze Age in Georgia (Sagona 1984).

#### RESULTS

##### *Kiketi*

X-ray diffraction revealed quartz and plagioclase (albite and anorthite in one case) as major minerals; hematite, K-feldspars, pyroxenes (diopside) in two samples, and micas as minor minerals; amphibole in traces (Table 1). SEM-EDS analyses (Fig. 3) confirmed these identifications.

*Thin sections.* The paste matrix is anisotropic with iatal granulometry, primarily of iron-yielding nature, and presents a wide range of colours, from the brown to deep red.

Crystals of silic minerals including quartz, plagioclase and K-feldspars and sporadic crystals of biotite form the siliceous temper. Among the coarsest crystals, especially at the edges of the thin sections, the occurrence of «Bohnerz» (nuclei with high iron content) is remarkable. They may indicate incomplete purification of the clay, and often contain quartz, feldspars and biotite micro-crystals. Small, always extinct, crystals of magnetite are visible. Sample Ki2 contains some small calcite crystals.

##### *Koda*

Samples from Koda are very homogeneous. X-ray diffraction showed the presence of quartz and plagioclase (mostly albite) as major minerals, with hematite, pyroxenes (augite), micas and K-feldspars in smaller amounts (Table 1).

*Thin sections.* Two different colours may be distinguished: more intense and brown in the central part, thinner and reddish at the edges of thin sections. The paste matrix is anisotropic, mostly with iatal granulometry, altered by iron oxides which give the reddish-brown colour.

TABLE 1  
Results of X-ray diffraction analyses.

Kiketi											
	<i>Qz</i>	<i>Cal</i>	<i>Al</i>	<i>An</i>	<i>Mic</i>	<i>Dio</i>	<i>Aug</i>	<i>Amp</i>	<i>Hem</i>	<i>Geh</i>	<i>K-F</i>
Ki1	+++		++	+	±			±	±		+
Ki2	+++		++		+	+			+		+
Ki3	+++		++		+			±			±
Ki4	+++		+++		+	+			+		
Koda											
	<i>Qz</i>	<i>Cal</i>	<i>Al</i>	<i>An</i>	<i>Mic</i>	<i>Dio</i>	<i>Aug</i>	<i>Amp</i>	<i>Hem</i>	<i>Geh</i>	<i>K-F</i>
Ko1	+++		++	+	±		+		+		+
Ko2	+++		++		±		±		±		+
Ko3	+++		++		+		+		±		
Kvatskhelebi											
	<i>Qz</i>	<i>Cal</i>	<i>Al</i>	<i>An</i>	<i>Mic</i>	<i>Dio</i>	<i>Aug</i>	<i>Amp</i>	<i>Hem</i>	<i>Geh</i>	<i>K-F</i>
Kv1	+++	+	+++	++		++		+	+	+	
Kv2	+++	+	++	+	+	+		±	+		+
Kv3	+++	+	+++	++		++		±	+	+	+
Medamgreis Gora											
	<i>Qz</i>	<i>Cal</i>	<i>Al</i>	<i>An</i>	<i>Mic</i>	<i>Dio</i>	<i>Aug</i>	<i>Amp</i>	<i>Hem</i>	<i>Geh</i>	<i>K-F</i>
Mg1	+++		+++	++	+	+			+		+
Mg2	+++		+++	++		+	+		+		+
Mg3	+++		++	+	+			±	+		
Mg4	+++		+++	+	+		+	+	+	+	+
Mg5	+++		+++	++		+			+		+
Satkhe											
	<i>Qz</i>	<i>Cal</i>	<i>Al</i>	<i>An</i>	<i>Mic</i>	<i>Dio</i>	<i>Aug</i>	<i>Amp</i>	<i>Hem</i>	<i>Geh</i>	<i>K-F</i>
Sat1	+++		+++	+++	+	+			±		+

Qz: quartz; Cal: calcite; Al: albite; An: anorthite; Mic: micas; Dio: diopside; Au: augite; Amp: amphibole; Hem: hematite; Geh: gehlenite, K-F: K-feldspars

Only Ko2 shows serial granulometry. The siliceous temper has homogeneous granulometry. In the detrital reservoir, silic minerals, such as quartz, subordinately K-

feldspars and plagioclase prevail, with rare pyroxene. Abundant crystals of hematite, which often incorporate the silic crystals, occur, especially at the edges of the sections.

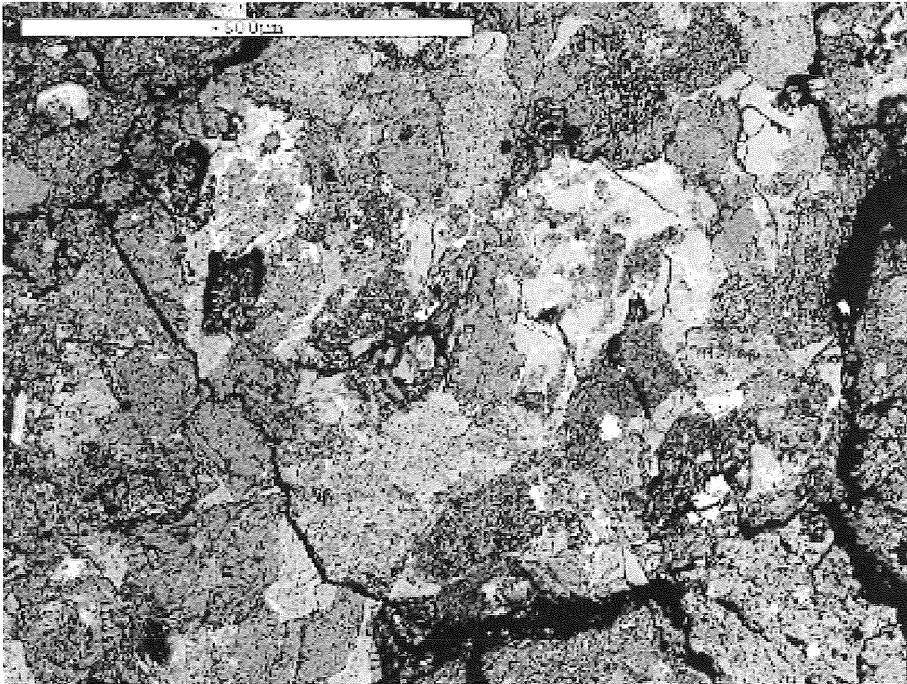


Fig. 3 – SEM micrograph of sample Ki1

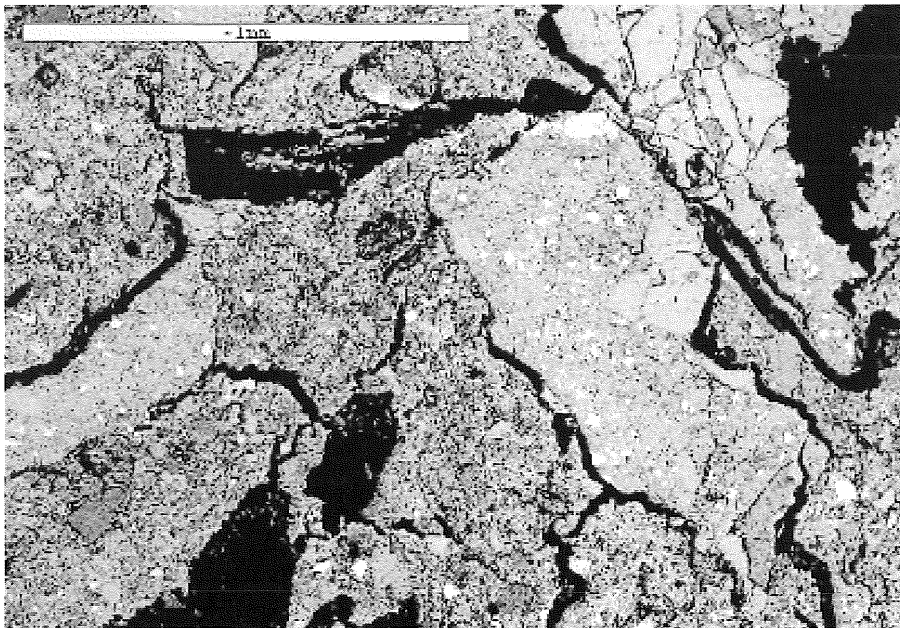


Fig. 4 – SEM micrograph of sample Kv1

### *Kvatskhelebi*

X-ray diffraction analyses highlighted the presence of quartz as major mineral, followed by plagioclase (albite and anorthite), calcite, K-feldspars, hematite, micas (muscovite), amphibole, pyroxenes (diopside) and gehlenite (in two samples), (Table 1). SEM-EDS analyses (Fig. 4) also identified titanomagnetite.

*Thin sections.* The matrix is amorphous and brown in colour, from light to dark. The temper is siliceous and contains abundant crystals of silicic minerals, such as quartz and plagioclase as major minerals and less abundant K-feldspars. Carbonatic crystals, primary calcite of different granulometry, and «Bohnerz» nuclei, which imply poor purification of the raw material, are noticeable. Among the micas thin, acicular crystals of biotite and muscovite show strong birefringence and are easily recognisable. Small iron-magnesian crystals, of pyroxenic and amphibolitic nature (mostly in sample Kv3) are present. Among the secondary minerals, hematite alterations and magnetite in small crystals, always extinct, were observed.

### *Medamgreis Gora*

XRD analyses revealed quartz and plagioclase (albite, anorthite) as major minerals, with K-feldspar, hematite, micas (muscovite), amphibole, pyroxenes (augite and/or diopside) and gehlenite (sample Mg4) (Table 1).

*Thin sections.* The amorphous matrix is anisotropic, with serial granulometry, and altered by iron oxides. The temper is siliceous and formed primarily of quartz, plagioclase and K-feldspars; the granulometry is homogeneous. Rare femic minerals are represented by small crystals with high birefringence of pyroxenic and amphibolitic nature. Among the micas, biotite is scarce and muscovite appears in tiny lengthened crystals. Iron oxides such as magnetite are common.

### *Satkhe*

X-ray diffraction analyses identified quartz, plagioclase (albite, anorthite, andesine) and K-

feldspars as major minerals, with small quantities of micas, hematite and pyroxenes (diopside) (Table 1).

*Thin sections.* The matrix is amorphous, anisotropic with iatal granulometry, altered by iron oxides. The temper is predominantly siliceous and marked by iatal granulometry. Two different granulometric classes may be distinguished: 1) small crystals constituting the detrital component of the clay; 2) minerals of larger dimensions, clearly belonging to the artificially added temper. The granulometry of the detrital fraction is homogeneous and is mainly composed of quartz, plagioclase and K-feldspars.

The most evident mineralogical structure, not often observed in comparison with the smaller fraction, is composed of feldspars and plagioclase with intersertal structure. Femic (pyroxene) minerals and micas (muscovite) are scarce.

## DISCUSSION AND CONCLUSIONS

It must be recalled that the above analyses only represent preliminary results of a project which will be developed further. The present work may be regarded as highly innovative, since the topic in question has always been studied in Soviet and Near Eastern archaeology according to criteria based exclusively on form and type analyses. This is the first time that the red and black pottery of the Early Bronze Age in Georgia and questions related to its production have been analysed and worked out from an archeometric perspective. Mineralogical and petrographic data obtained by means of thin sections and chemical-physical analyses has been compared with geological maps of the Georgian territory, in order to understand the dynamics linked to the production of this specific class of pottery.

The results of archeometrical analyses on the red and black pottery allow two important considerations: The first is that, although similar in type, the samples analysed here are not homogeneous in mineralogical

composition, as may be deduced from the X-ray diffraction tables. Nevertheless, looking at the geological maps, it is reasonable to assume the local provenance of the raw materials needed for this kind of pottery. The area surrounding the settlement for a distance of 30 Km is considered to be the source of supply of raw materials. First, the results of our analyses confirm that the clay composition very closely reflects the geological composition of the area around the settlements. As it is not yet possible to sample the local clays, any kind of comparison is still premature.

A second point is related to firing temperatures. These were probably around 850°C for samples from Kvatskhelebi, according to the contemporaneous presence of gehlenite (secondary mineral) and primary calcite observed in thin-section, and around 900°C for samples from Kiketi, Medagreis Gora and Satkhe, as the formation of diopside and anorthite suggest. For the samples from Koda, no significant firing temperature can be hypothesized at the present state of the study, although the absence of calcite and the appearance of anorthite in some specimens suggest a temperature above 750°C.

According to our preliminary results, it may be stated that the composition of the red and black pottery of the early Bronze Age settlements in Georgia is the result of local materials, altogether with traditions related to firing techniques. The latter, overcoming the specificity of the ecological context, created a single tradition of production, linking different geographical and geological areas over a time-span ranging from the last quarter of the fourth millennium until the first quarter of the third millennium B.C.

Correlations with data on the red and black pottery from the Arslantepe settlement highlight not only differences in the mineralogical composition of the pottery, reflecting regional geomorphology, but also differences linked to firing temperatures which, in Arslantepe, were around 700°C (Amadori *et al.*, 1994; Trojsi *et al.*, 2000). The difference of 200°C between the firing temperatures of the

Georgian red and black pottery and those of Arslantepe suggest divergences in applying production technologies, perhaps due to different kinds of kilns which were used or to the quality and quantity of fuel. All these factors may be linked to the cultural «filter» of the technical traditions which the Arslantepe community applied to the manufacture of the same class of pottery.

Despite differences in technologies and production traditions, the typical contrasting colour effects between outer and inner surfaces, and the close analogies between the formal ceramic repertoire of Arslantepe VIB1 and Georgia, confirm determination, precision and will-power in the creation of common visual codes of reference which must have linked the Georgian and Anatolian communities from a cultural perspective since the second half of the fourth millennium B.C.

#### ACKNOWLEDGMENTS

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