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POTTERY TECHNOLOGY AND MANUFACTURE AT THE KORENOVO CULTURE (LBK) SITE OF MALO KORENOVO (BJELOVAR, CROATIA)

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Archaeologists believe that ceramics can reflect the culture of a people such that the main forces of cultural change that affect a society are reflected in their ceramics. (Grieder 1975: 850-51)

This article deals with the scientific analysis of twenty-nine potsherds attributable to the classic phase of the Malo Korenovo, Linear Pottery Culture, site near Bjelovar. The potsherd and one soil sample, collected from the proximity of the site, were analysed following three different methods: in thin section, with the XRD and the SEM-EDS. The results should indicate that their production was local. The fabrics are mainly composed of 1) alluvial silts that are typical of the terraces on which the site is located and by 2) granitic rocks that are characteristic of the geology of the region surrounding the site. The temper employed in the pottery manufacture might indicate a functional variability according to the different ceramic classes. The fine ware forms, including hemispheric and carinated bowls, show a fine, silty paste, with added mica, quartz and heavy minerals; the coarse, thicker-walled ceramics are characterised by a coarser fabric, with bimodal distribution, which mainly shows fragments of granitic rocks and thick lamellae of biotite.

*Key words: Neolithic, Korenovo Linear Pottery Culture, thin section, and XRD and SEM-**EDS** **a**nalysis of the ceramics*

1. Preface

Until a few years ago, the study of the Early Neolithic ceramics was mainly based on the analytical description of the typological-stylistical characteristics of the pottery assemblages. During the last decades many archaeologists tried to develop new scientific approaches to the study of ancient ceramics (Shepard 1952; 1956; Matson 1969).

Qualitative analysis, that is the identification of the clay/matrix and of the inclusion/temper characteristics, has been chosen also for this research. The analytical approach is based on the mineral phase identification by optical microscopy, while X-Ray diffraction (XRD) and Scanning Electron Microscopy (SEM-EDS) was applied to selected samples. Thin section helps answer questions concerning the provenance and the technological aspects of pottery making. The XRD and SEM-EDS were mainly used to test the groups classified according to the thin section. Twenty-nine sherds and one soil sample were analysed from Malo Korenovo. The results of these analyses will be discussed and addressed to establish the location of the raw material provenance source.

2. Site location and history of the research

The open-air settlement of Malo Korenovo is located in the vicinity of the village bearing the same name, 5 km south of Bjelovar, some 75 km northeast of Zagreb, in Croatia. It lies in an area of fluvial terraces covered with light silty soils, heavily incised by temporary stream courses (fig. 1) among which the Bjelovarska River which flows just to the west of the site. This geomorphologic and pedological location is very typical for most of the Linear Pottery Culture (LBK, Linear Bandkeramik) sites. 15 km to the south-west the geology of the region is characterised by granitic and granodiorites rocks (Bjelovar, L 33-82 Osnovna Geološka Karta SFRJ, 1:100000). The Česma River course presently flows some 2.5 km south of the Neolithic site.

The first excavations were carried out by S.Vuković in 1958 (Dimitrijević 1971: 108). They were resumed by S. Dimitrijević (1961) in 1961. He brought to light a number of postholes and pits, two of which, with side steps, yielded most of the finds. Despite the opening of many trail-trenches, no real evidence of permanent structures was ever found at Malo Korenovo. Furthermore the function of the pits is still uncertain, although many of them might have been utilised as rubbish pits. The trenches also revealed an archaeological layer, some 40 to 80 cm thick, in the central part of the terrace (Težak-Gregl 1993: 64). According to the field observations of the principal excavator (Dimitrijević 1961), it seems that the site was inhabited for rather brief (seasonal?) periods. The excavations did not yield any grave or human skeletal remains.

On the basis of the pottery characteristics, Dimitrijević (1979) subdivided the Korenovo Culture into three main periods of development: early, classic and late or final. Despite the absence of radiocarbon dates for Malo Korenovo, Chapman (1981: 18) suggested that the early phase of the Korenovo Culture should fit into the Vinča A phase, around 4300 cal BC.

3. The Korenovo Culture

The Korenovo Culture represents the south-westernmost aspect of the Linear Pottery Culture (LBK). It has been included in the western variant of this culture by J. Lichardus (1972). Its distribution is badly known although the results of the more recent research should indicate that the area covered by of this cultural aspect includes the Lonja-Ilova lowlands, the Sava of Sisak and the westernmost part of Slavonia, in Croatia, and the Zala, in southwestern Hungary. Contacts with the Dalmatian coast have been suggested by Batović (1979: 548) on the basis of the recovery of eight typical Korenovo potsherds from the Danilo horizon of the Neolithic site of Smilčić, located on the hills surrounding the Bay of Zadar.

4. The material culture assemblage

The shapes and decorations of both the fine and coarse Malo Korenovo wares are typical for an assemblage of an advanced stage in the development of

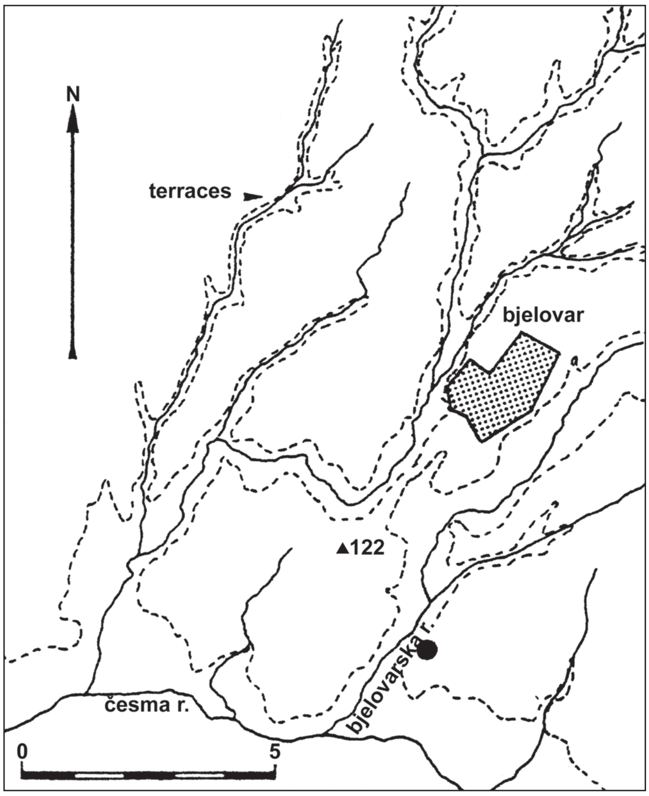

Fig. 1 Malo Korenovo: location of the Neolithic site (dot). Scale in kilometres.

the Linear Pottery Culture (Raczky, 1989: 250). The pottery can be simplistically subdivided into two main fabrics: coarse and fine.

The coarse pottery, which is characterised by rough (sometimes wet hand-smoothed), usually undecorated surfaces of reddish colour, is fired under oxidizing conditions; reducing conditions were used only at the end of the firing process. The decorations are represented by circular finger and fingertip impressions and short oblique knobs below the rim.

The fine ware has grey or dark grey burnished surfaces, with single or paired grooved decorations including bands of straight lines, meanders and "V"-shaped motifs as well as different varieties of spirals. The decorations are always located below the rim and on the body or, in the case of the high pedestal forms, on the lower part of the vessel. The wall sections are of ochre or red brick colour. The fine pottery is represented by hemispherical and carinated bowls with thick flat or, more commonly, rounded bottoms. High pedestal vessels and conical goblets are also attested. Lugs and knobs are present instead of handles, which are almost completely missing. Dimitrijević (1968) describes a typical Flomborn amphora found at Malo Korenovo.

Cult objects are extremely rare. They include one "altar" from the site of Tomašica and one square mouthed vessel with four goat heads on the spouts, from the site of Kaniška Iva (Težak-Gregl 1993: T. 18), as well as one pig figurine from Malo Korenovo. The "altar" is a four-legged cubic ceramic object with a pierced knob on its upper surface. It is almost

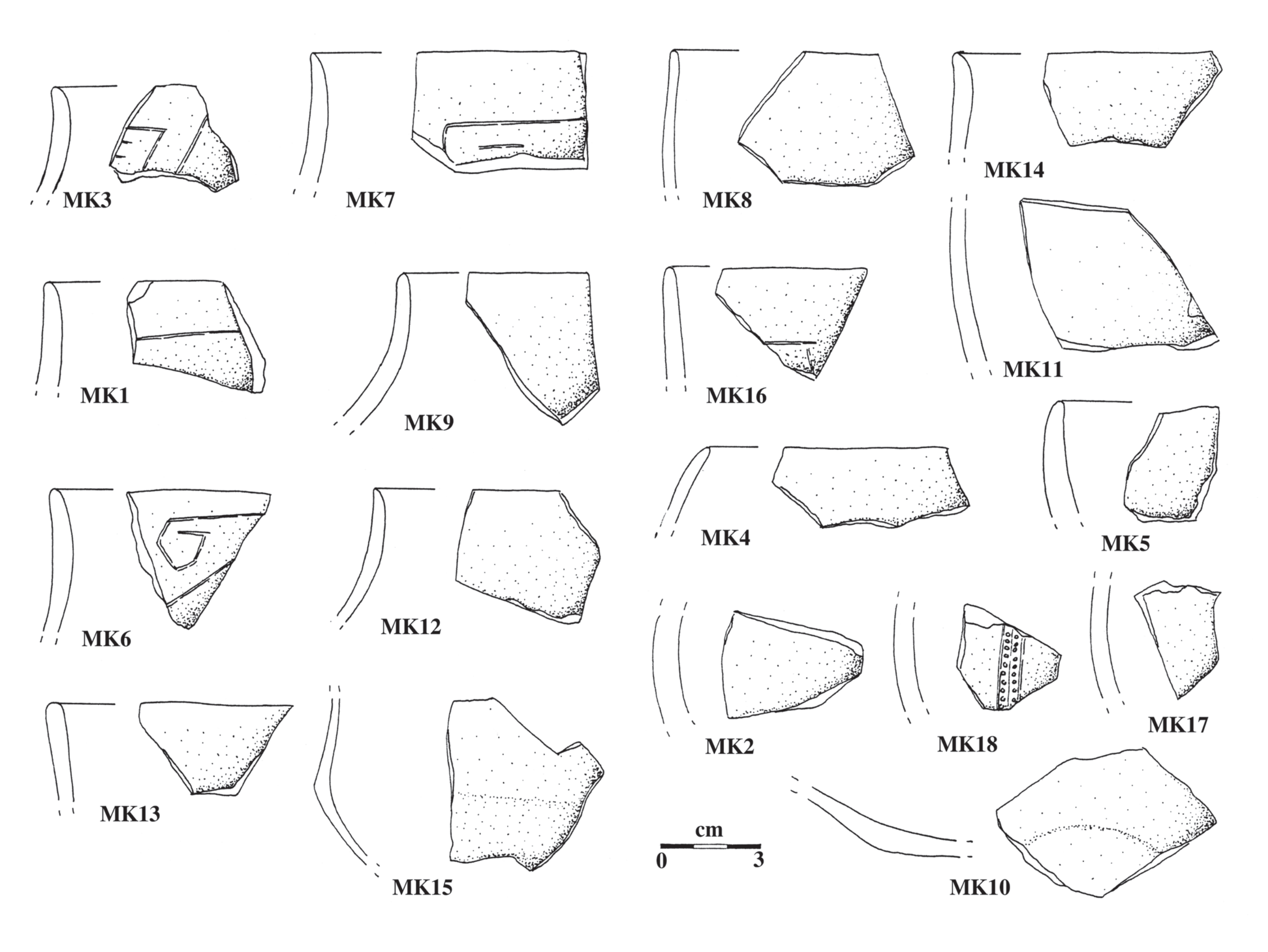

Fig. 2 Malo Korenovo: potsherds analysed.

entirely ornamented with groups of grooved spiral lines.

Polished stone tools are represented by shoe-last adzes obtained from grey stones, a few small, flat, trapezoidal axes, and one axe with a cylindrical perforation for the shaft of the handle (Težak-Gregl 1993: 70). The chipped stone assemblage is badly represented by flint artefacts of low-quality raw material. It is mainly composed of unretouched bladelets, side scrapers and perforators.

5. Pottery archaeometrical analyses

5.1. Thin section

For a better understanding of the pottery manufacture and technology, 29 sherds, belonging to the classical phase of the Malo Korenovo occupation at Malo Korenovo, have been analysed in thin section (fig. 2). Four different fabrics have been identified (table 1). They are:

G1 - (9 samples: MK 3, 4, 7, 9 [fig. 3 top], 11, 14, 17+ MKV 8, 11)

Brown fine, very well sorted matrix with abundant muscovite (15%; average length grain size 0.1 mm) and biotite micas (5%), epidote (2%), zircon (2%), opaques and iron oxides (3%), some hornblende, well-sorted abundant angular and subangular quartz (up to 30%; typical size 0.1 by 0.08 mm);

sub. a (10 samples: MK 1 [fig. 3, bottom], 6, 8, 12, 13, 15 + MKV 2, 7, 10, 17)

This subgroup shows a matrix very similar to that of G1. However some variations in the percentage of muscovite mica (up to 15%) can be noted. The angular and subangular quartz (up to 20%) is of the same size as that of G1.

sub. b (1 sample: MK 16)

Poorly sorted silt, of average coarser, angular and subangular quartz, compared to that of G1 (>30%; size range between 0.15 by 0.1 and 0.03 by 0.02 mm) and longer mica grains (up to 0.4 mm length), probable river sand (Y. Goren and I. Freestone, pers. comm. 2001).

G2 - (6 samples: MK 2, 10 [fig. 4, top]+ MKV 3, 4, 14, 16)

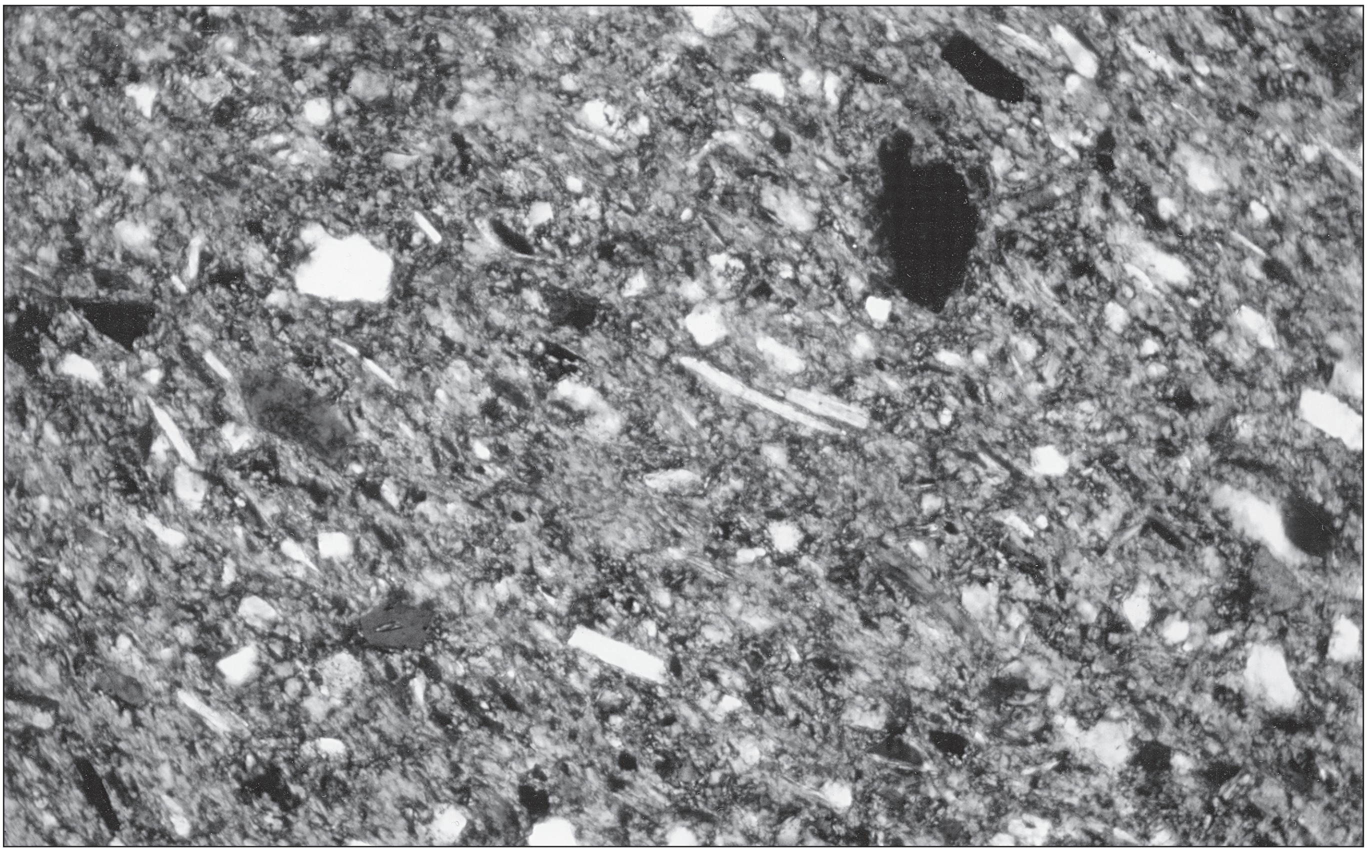

Fig. 3 MK 9

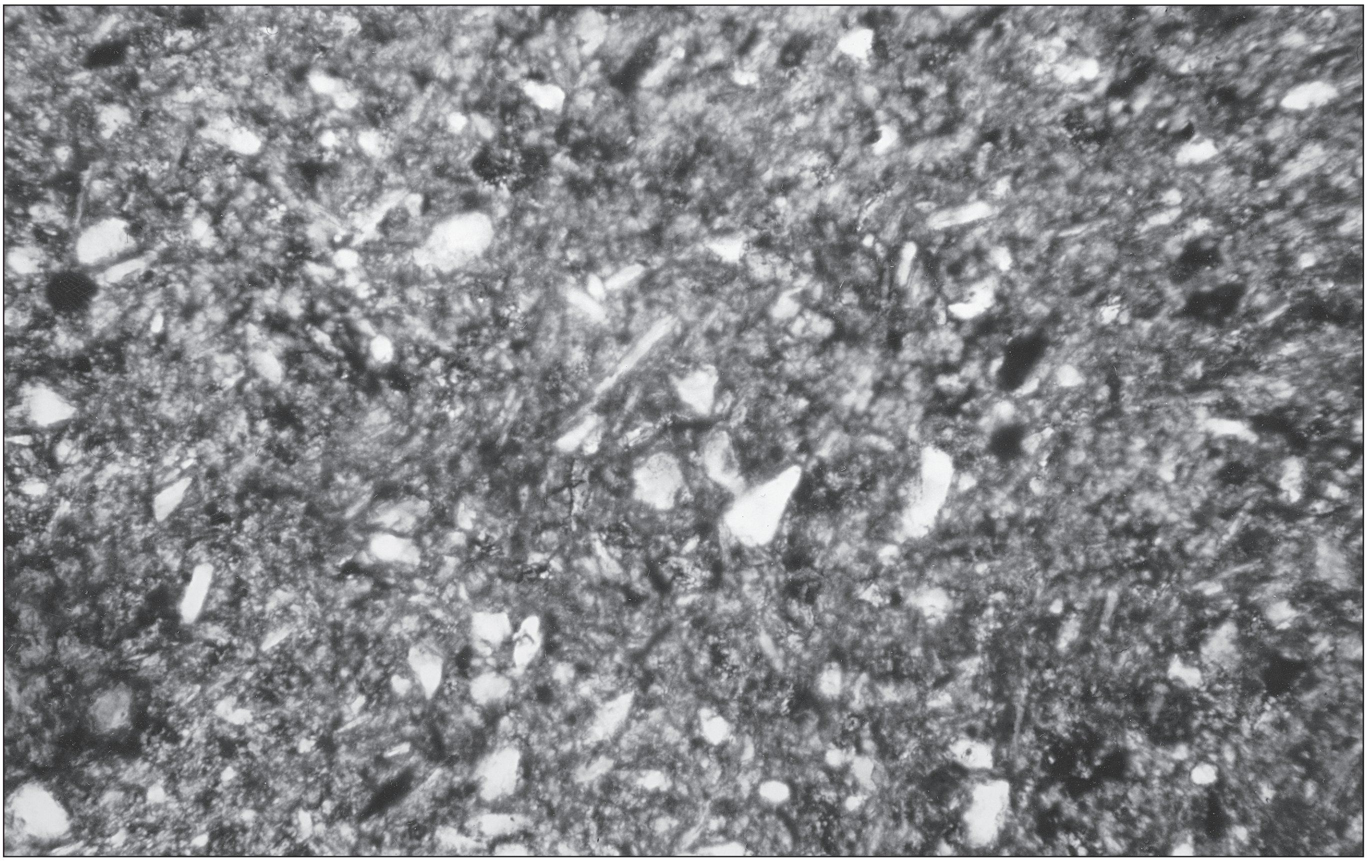

Fig. 3 Malo Korenovo: photomicrographs of thin section samples MK 9 (top) showing a brown, very fine alluvial fabric with abundant and fine quartz, muscovite and biotite micas, and MK1 (bottom) showing a fine fabric similar to the preceding one but poorer in quartz and micas (N+ 40X) (photographs by M. Spataro).

Red-brownish matrix, containing lower quantity of muscovite mica than that of G1 (15%) with longer diameter of base grains (size range between 0.2 by 0.1 and 0.1 by 0.05 mm), very abundant and coarser angular and subangular quartz (<40%; size range between 0.2 by 0.1 and 0.1 by 0.05 mm), opaques and iron oxides (5%), and few clay pellets. It contains coarse angular granitic rock fragments that have been probably added as temper. The rock fragments (15%; size range between 1.05 by 1.0 and 0.6 by 0.5 mm) are of granite composed of quartz, plagioclase, K-feldspar, microcline, muscovite and biotite micas. They show a bimodal distribution.

G3 - (1 sample: MK18 [fig. 4, bottom])

It shows a brown, very different fabric compared to those of G1 and G2. It is much coarser, characterised by a great quantity of muscovite (20%; typical size 0.4 by 0.05 mm) and biotite (10%; typical size 0.4 by 0.06 mm) micas. It contains very well sorted, abundant angular and mainly subangular quartz (20%; typical size 0.15 by 0.1 mm), opaques (3%) and some heavy minerals like epidote and titanite.

G4 - (2 samples: MK 5 [fig. 5, top]+ MKV 1)

Reddish matrix characterised by angular and subangular quartz (30%; typical size 0.2 by 0.1 mm), muscovite micas of wide size range (15%; typical size 0.03 by 0.02 mm) and biotite mica (15%; size range between 0.8 by 0.15 and 0.5 by 0.1 mm). The temper contains abundant angular and subangular granitic rock fragments (10%; size range between 1.1 by 0.7 and 0.8 by 0.3 mm) characterised by quartz, feldspar, tourmaline, muscovite and biotite micas.

One soil sample was collected from the proximity of the site and later examined in thin section (fig. 5, bottom). Its matrix shows alluvial sediment (R. Macphail, pers. comm. 2001) characterised by a brown, very silty fabric with fine mainly subangular quartz (10%; typical size 0.02 by 0.01 mm), fine muscovite mica (10%), iron oxides and some heavy minerals (mainly epidote).

5.1.1. Summary of group characteristics

Group 1 is very homogeneous. It is characterised by a well-sorted, very fine fabric rich in heavy minerals (mainly epidote), muscovite and biotite micas, iron oxides, quartz and some zircon. G1 *sub. a* has a very similar fabric, with a lower percentage of quartz and micas. G1 *sub. b* has a fabric similar to that of G1, although much coarser, because of the larger size of the quartz and muscovite mica grains. Group 2 shows a fabric very different from that of G1. It is characterised by a much lower percentage of muscovite mica, more abundant and coarser quartz, iron oxides and opaques, and added temper composed of granitic rock fragments (indicated by bimodal distribution and angular shape of the grains), which are absent in the preceding group. Group 3 has a brown fabric, much coarser than those of the preceding groups, with larger size angular and subangular quartz, very long and thick lamellae of biotite and many heavy minerals (mainly zircon and epidote). Group 4 shows a reddish fabric coarser than that of G2, with the same added inclusions (granitic rock fragments). Also it has more abundant and longer grains of biotite and muscovite micas.

The thin section of the soil sample shows a fabric rich in muscovite mica (but with a lower percentage, if compared to that of the potsherds), finer quartz and more rounded-shape grains than those of the potsherds.

5.2. SEM-EDS analyses

Most of the potsherds analysed in thin section were also studied with the SEM-EDS (Scanning Electron Microscopy - Energy Dispersive Spectrometry)[1]. Some were omitted because the samples were too small and consequently utilised only for the thin sections. Five bulk analyses were made on each sample at a magnification of 86X.

The results of the analysis of the Malo Korenovo samples are almost homogeneous (table 2). They show rather high contents of aluminia, magnesia, soda, iron oxide, potash, and phosphorus oxide (probably due to post-depositional factors), while the percentage of calcium oxide is very low.

G1 shows homogeneous data. Also the percentages of G1 *sub. a* are similar to those of G1, whereas G1 *sub. b* is similar to G1 although with a percentage of iron oxide higher than those of the preceding two groups. G2 shows slightly higher percentages of aluminia and silica while potash is lower than that of G1. Group 3 is similar to the previous two, but the content of phosphorus oxide is lower, whereas potash is much higher. G4, that in thin section is similar to G2, contains a higher percentage of soda and potash, and less silica.

To conclude, these results show that the groups and their subgroups are very homogeneous and that noticeable differences among the groups cannot be observed. In particular, from a minero-petrographic point of view, the results of MK 18 (G3) seem to indicate a fabric rather different from those of the other groups. The results are rather peculiar since, according to the thin section analysis, G1, G2 and 4 are absolutely different from each other.

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[1] SEM is used in combination with LINK ISIS - Oxford instruments. The machine I employed is a JEOL JSM-35 CF with a standard peak resolution of 138 eV, and Window ATW2. The results are normalised semi-quantitative.

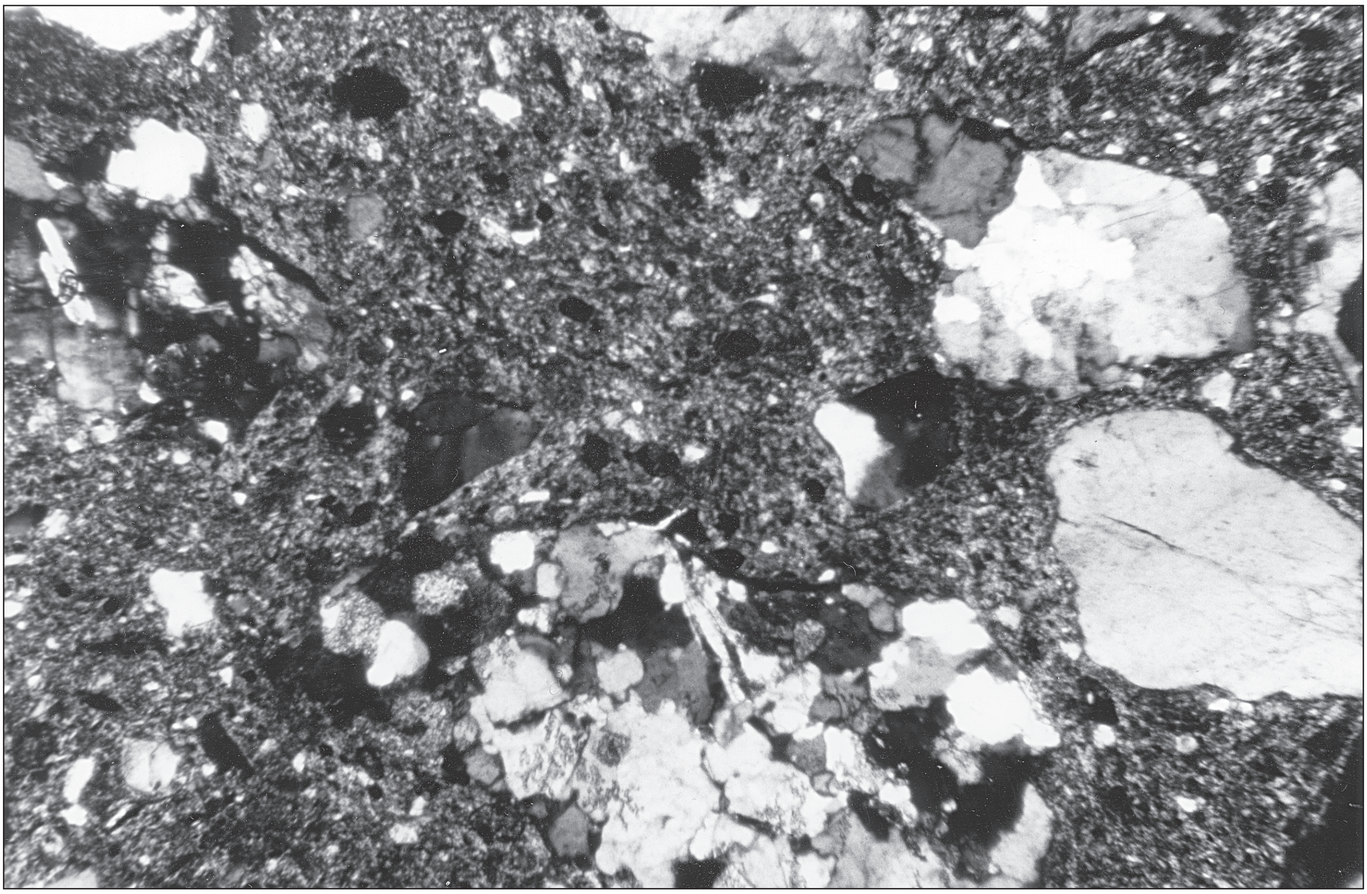

Fig. 4 MK 10

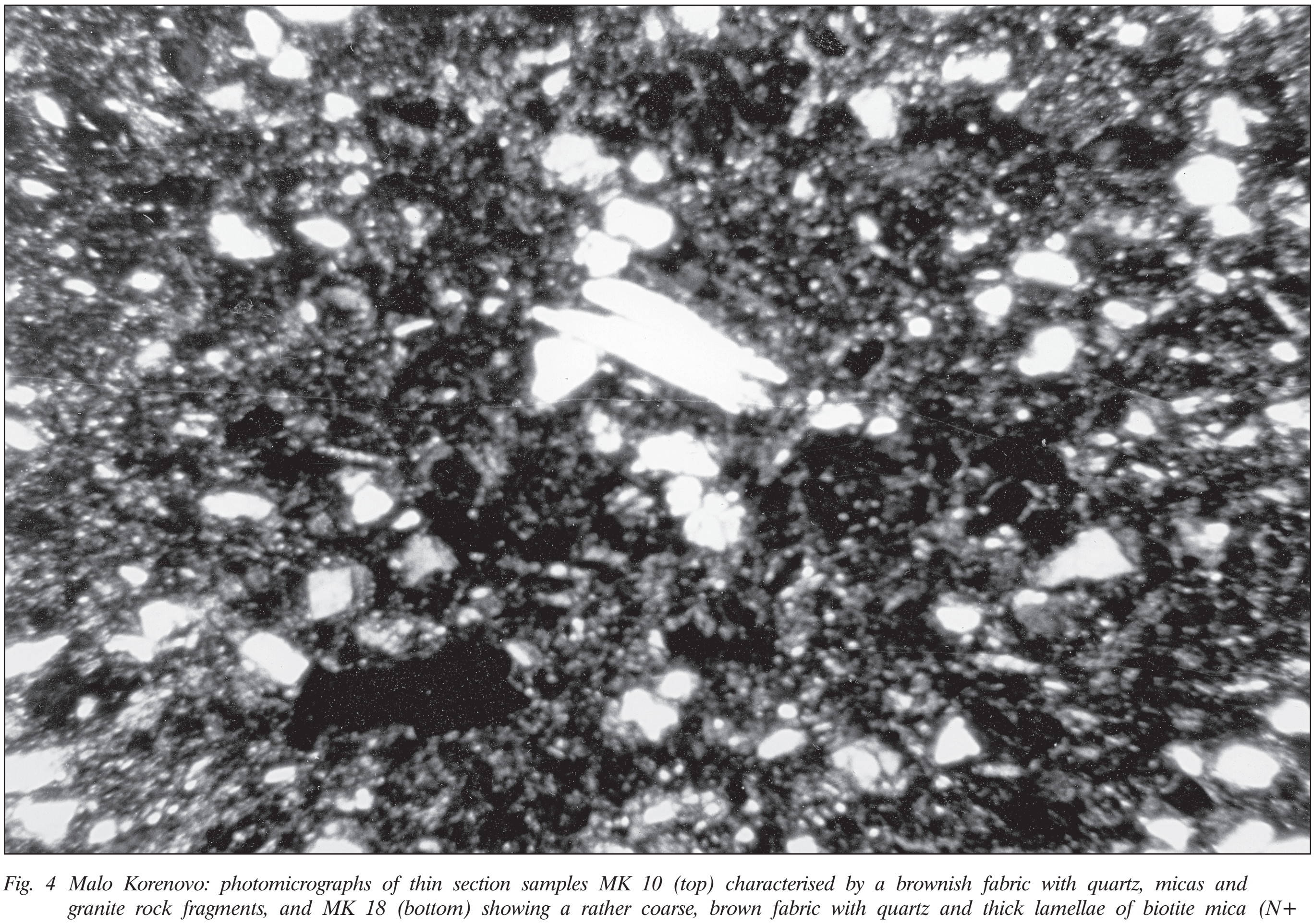

Fig. 4 Malo Korenovo: photomicrographs of thin section samples MK 10 (top) characterised by a brownish fabric with quartz, micas and granite rock fragments, and MK 18 (bottom) showing a rather coarse, brown fabric with quartz and thick lamellae of biotite mica (N+ 40X) (photographs by M. Spataro).

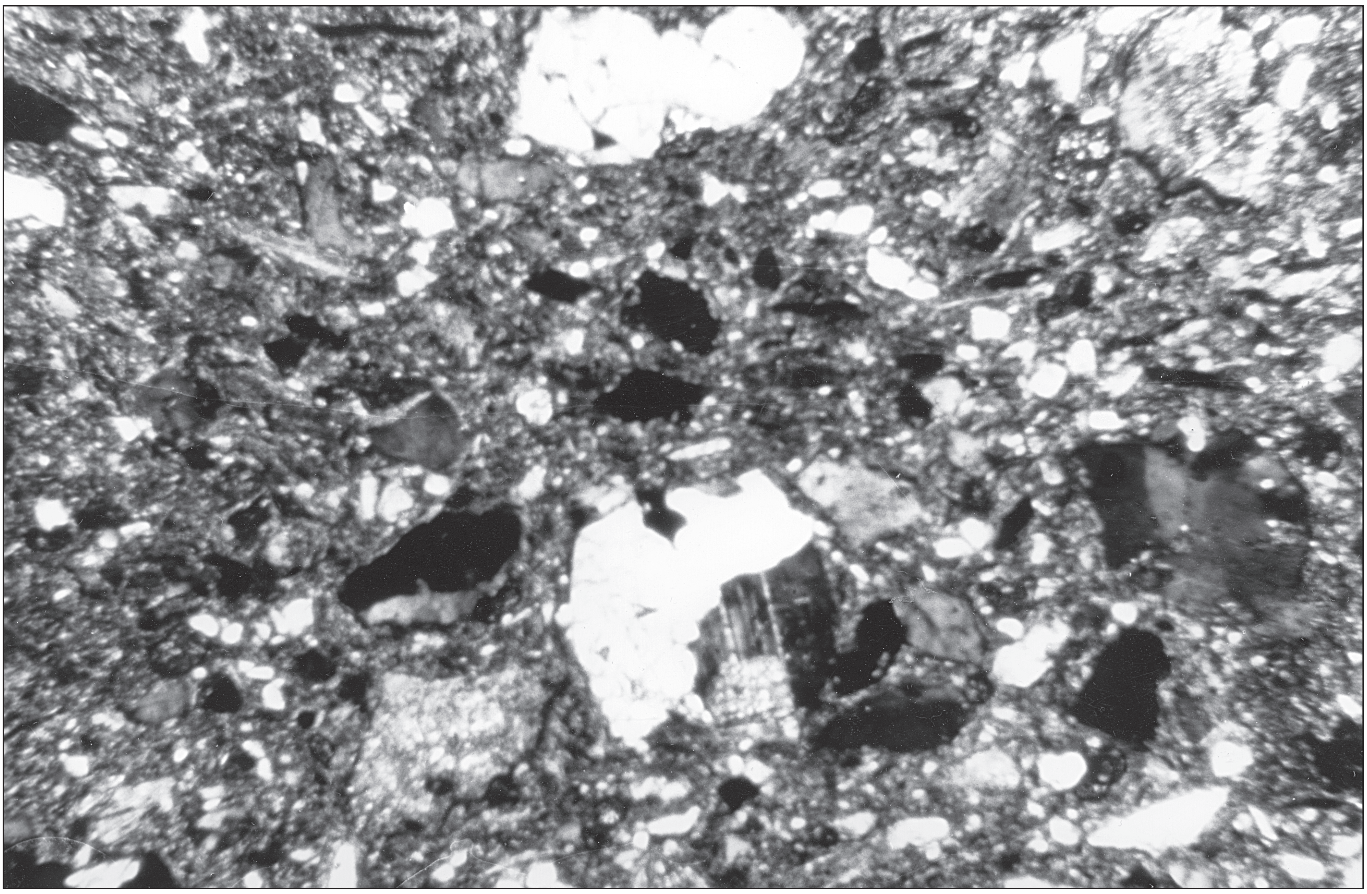

Fig. 5 MK 5

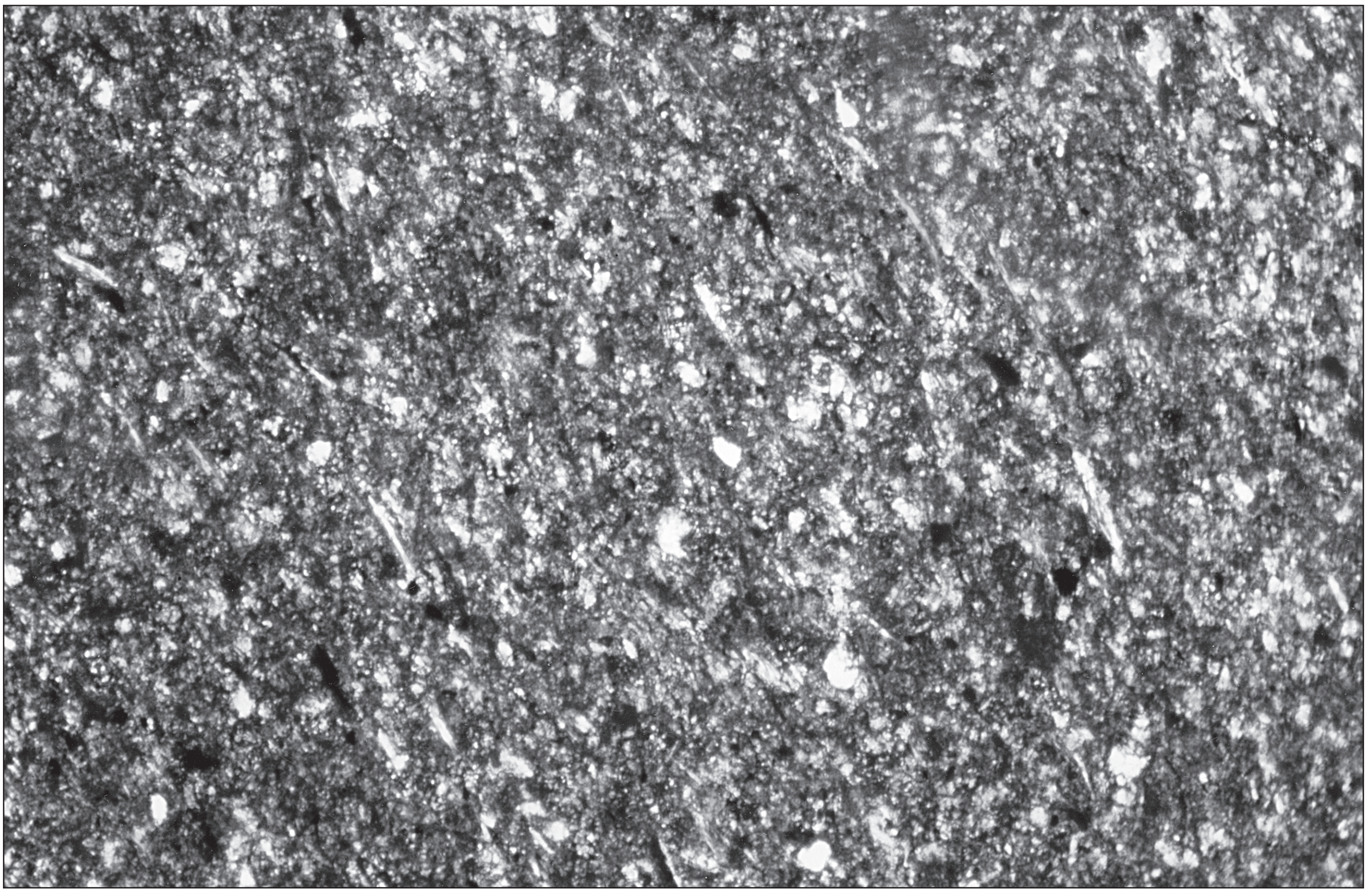

Fig. 5 Malo Korenovo: photomicrographs of thin section sample MK 5 (top) characterised by a reddish fabric with quartz, micas and granite rock fragments, and of the soil from Bjelovar (bottom), showing alluvial sediment characterised by fine and abundant quartz, muscovite mica and iron oxides (bottom) (N+ 40X) (photographs by M. Spataro).

5.3. XRD analyses

Two potsherds and one soil sample were analysed by X-Ray Diffraction (XRD)[2]. The soil sample collected in the neighbourhood of Bjelovar was analysed both in thin section (see above) and by XRD. The XRD pattern (fig. 6, top) shows the presence of kaolinite, muscovite mica, quartz, chlorite and microcline. The chlorite is frequently associated with micas and microcline (that also occurs in group 2). It is a widespread mineral, characteristic of granitic sediments.

Also two potsherds belonging to G1 and G2 (samples MK 7 and 10) were analysed by XRD. The patterns of MK 7 (G1; fig 6, middle) and MK 10 (G2; fig. 6, bottom) show quartz and muscovite (both these minerals also occur in the soil sample) but also albite, which occurs in many igneous rocks, such as granite, diorite, syenite, etc. (Ford 1949: 546). It is often associated with microcline. The pattern of MK 10 also shows some hematite.

To sum up: clear relationships exist between the XRD patterns of the soil sample and the two sherds analysed. The pattern of MK 7 shows some hornblende, visible also in the microscopic fabric. The minerals observed in the patterns suggest a granitic source. However, the relationships between the different groups are more evident from the thin sections. The relationship between the soil sample and the specimens of the two ceramic groups (1 and 2) is much clearer in thin section. Group 2 looks very similar to group 1 in the XRD analysis, although, in thin section, they undoubtedly show two different fabrics and two different provenances.

5.4. Discussion

Group 1 is very homogeneous. Its very well sorted matrix derives from alluvial sediments that might have been collected from a river course or from the proximity of a river. Group 2 shows added inclusions. They might derive from an igneous source, because of the presence of microcline, sericite (indicator of K-feldspar orthoclase), and granite fragments. Group 3 is characterised by very well sorted abundant quartz, coarser muscovite and biotite micas, as compared to those of the previous groups. The temper was most probably collected from an alluvial source. The same size/shape quartz grains might indicate fluvial transport. This variety of fabric is common to the alluvium in a river system that flows from an area with granitic rocks or metamorphic schist. The matrix of G4 is very similar to group 2 but the temper is coarser than that of G2.

The raw material sources employed in the manufacture of the potsherds of groups 2 and 4 are to be sought in areas close to each other. They include the same rock fragments, coarse muscovite and biotite micas, and heavy minerals. The clay source exploited for the manufacture of group 4 was probably closer to a granitic outcrop (because of the coarser and longer mica lamellae). Given that we are dealing with pottery made from alluvial sediments, the clay employed in the manufacture of group 1 vessels might have been collected from a deposit close to a fluvial course or from a riverbed. The materials utilised for the production of groups 2 and 4 are to be sought very close to a local granite outcrop. While the source for the manufacture of the vessels of group 3, might derive from a river, which flowed through a granitic outcrop. It is reasonable to think of a local source.

6. Conclusions

The potsherds analysed from the site of Malo Korenovo have most probably been produced with raw materials collected from the proximity of the site. The inhabitants of the Neolithic settlement mainly exploited three different (local) clay/soil sources. From a stylistic and typological point of view, the potsherds of group 1 are typical and characteristic of the fine ware shapes of this Linear Pottery Culture aspect. They consist mainly of carinated and hemispherical bowls with thin walls, decorated with typical, paired grooves in geometrical patterns (fig. 2). Their fabrics are very homogenous. Groups 2 and 4 are characterised by coarser pottery with thicker walls (MK 2, 5 [fig. 5, top] and 10 [fig. 4, top]). In particular, MK 10 is a bottom fragment of an open vessel or of a hemispherical (?) bowl.

It is possible to suggest that the Malo Korenovo villagers exploited local silt to produce fine pottery vessels and a source rich in granite rock fragments, located some 15 km from the site, for the manufacture of the coarse wares. It is likely that the coarser vases were utilised as cooking pots, because volcanic rock or calcite is often used as temper for this type of vessels (Rye 1976; Woods 1986). Given the absence of these materials at their disposal, the coarser possible temper has been added, that is granite. This suggestion is based on the observation that cooking pots, which represent the coarser ware vessels in the typological record, always have coarse temper.

From a typological point of view, the group 3 (fig. 2, MK 18 and fig. 4, bottom) potsherd is very different from all the other ceramics both for its

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[2] The XRD machine utilised is a Philips Pc APD version 3.6. The diffractometer type is a PW1710 based. The generator tension is 40 kV, and the generator current is 30 mA. Characteristic of the model: start angle (20°) 2.010; end angle (20°) 69.970; step size (20°) 0.020; maximum intensity 4186.090; time per step 2.000 s; continuous type of scan.

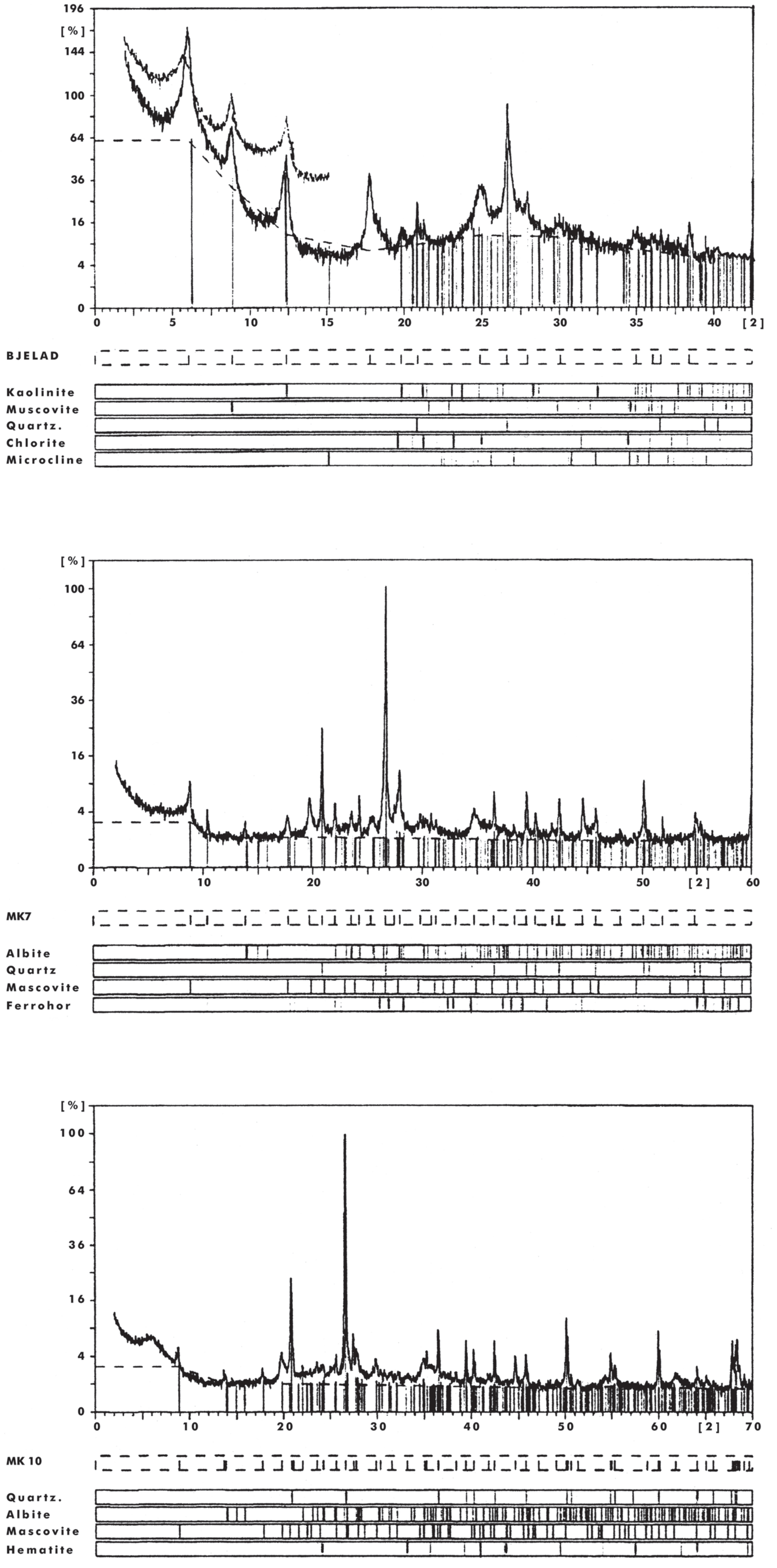

Fig. 6 Malo Korenovo: XRD patterns of the soil sample from Bjelovar (top) and of the potsherds MK 7 (middle) and MK 10 (bottom) (40 kV, 30 mA).

shape and for the unique decorative patterns that does not find parallels with other Malo Korenovo assemblages. The fabric of MK 18 (G3) is different from that of G1 and consequently from that of G4, because is coarser, with a higher percentage of biotite mica and quartz grains larger than those of G1. It has nothing in common to the specimens of groups 2 and 4. Furthermore it is possible to suggest that the sherds of these latter groups were not fired at high temperature (about 700-750 °C) because of the presence of mica and because the matrices are non-vitrified.

In conclusion, the results obtained by the three different analyses employed, show two important points/data. First that the pottery manufacture at Malo Korenovo during the classical phase of development of the LBK settlement was local; second that, the temper (i.e., granite rock fragments) utilised in the ceramic production, might indicate a functional variability of the different classes of pottery.

In order to provide a better contribution to the understanding of the Neolithic of the region, and in particular of the Korenovo Culture, it would be important to analyse a number of ceramic samples from a few more sites neighbouring and contemporary to that of Malo Korenovo.

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Microscopic analysis of the ceramic inclusions																										
		Quantity			Size			Quartz																		
Sample	Description of the matrix and notes	Abundant	Medium	Scarce	Very fine	Fine	Medium	Angular	Subangular	Polycrystailine	Flint	Aeolic	Feldspar	Plagioclase	Muscovite	Biotite	Calcite	Pyroxene	Amphibole	Opaques	Rock fragm.	Clay pellets	Iron oxides	Limestone	Radiol. Chert	Microfossil
MK1	red-brownish, very well-sorted; hornblende	X				X		A	A						VA	P				R			P			
MK2	red-brownish; granite; sericite	X					X	VA	A				P		A	P				A	A	P	A			
MK3	brown, very well-sorted; hornblende; epidote	X				X		VA	A						VA	A				P		R	P			
MK4	brown, very well-sorted; hornblende; epidote	X				X		VA	A						VA	A				P		R	R			
MK5	brown, poorly-sorted; zircon; tourmaline	X					X	A	A				P		A	A				P	A	R				
MK6	brown, very well-sorted; hornblende	X				X		A	A						A	P				P			P			
MK7	brown, very well-sorted; epidote	X				X		VA	A						VA	A				P		R	P			
MK8	brown, very well-sorted; epidote	X				X		A	A						A	P				P			P			
MK9	brown-reddish, well-sorted; epidote; hornblende	X				X		VA	A						VA	P				P			P			
MK10	red-brownish; granite	X					X	VA	A	P			P	P	A	A				P	A	P	A			
MK11	brown, well-sorted; hornblende	X				X		VA	A						VA	A				A		P	P			
MK12	brown, well-sorted; hornblende; epidote	X				X		A	A						A	P				A			P			
MK13	brown, well-sorted	X				X		A	A						A	P				P		P	P			
MK14	brown, well-sorted	X				X		VA	A						A	P				P		P	P			
MK15	brown, well-sorted	X				X		A	A						VA	A				P		R	P			
MK16	dark brown, well-sorted; long mica	X					X	VA	A						A	P				P			P			
MK17	brown, well-sorted	X				X		VA	A						A	P				P			P			
MK18	brown; epidote and titanite	X					X	A	A						VA	A				P			P			
MKV1	reddish	X					X	VA	A						A	A				P	P		P			
MKV2	brown, well-sorted; hornblende	X				X		A	A						A	P				P			P			
MKV3	red-brownish; granite	X					X	A	A						P	P				P	P		P			
MKV4	red-brownish; granite	X					X	A	P						A	P				P	A	R	P			
MKV7	brown, well-sorted; hornblende	X				X		A	A						VA	A				A			P			
MKV8	brown, well-sorted	X				X		VA	A						VA	A				P			P			
MKV10	brown, well-sorted; epidote	X				X		A	P						A	A				A			P			
MKV11	brown, well-sorted; epidote	X				X		VA	A						VA	A				P			P			
MKV14	red-brownish; granite	X					X	A	P						A	P				P	A		P			
MKV16	red-brownish; granite	X					X	A	P						P	P				P	A		P			
MKV17	brown, well-sorted	X				X		A	P						A	P				P			P			

Table 1 Malo Korenovo: results of the thin section analysis of the potsherds. Legend: VA= very abundant, A=abundant, P=present, R=rare, n/d=not detected.

Group	Sample	Mean/s.d.	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	K_2O	CaO	TiO_2	MnO	Fe_2O_3	ZnO
1	MK3	mean	2,74	2,32	19,80	47,60	4,96	0,56	4,88	2,14	1,18	0,10	13,24	0,06
1	MK3	s.d.	0,21	0,26	0,84	2,41	0,89	0,05	0,43	0,33	0,36	0,14	2,52	0,13
1	MK4	mean	3,03	2,93	19,25	51,00	5,30	0,50	4,33	2,15	0,78	n/d	10,28	n/d
1	MK4	s.d.	0,25	0,19	0,50	1,63	0,50	0,08	0,41	0,19	0,52		0,54	
1	MK7	mean	3,28	2,28	21,80	50,40	5,16	0,66	4,22	1,58	1,12	n/d	9,42	n/d
1	MK7	s.d.	0,24	0,18	1,30	2,61	1,45	0,05	0,24	0,13	0,23		0,44	
1	MK9	mean	2,36	1,58	20,20	50,80	4,70	0,56	4,60	1,82	1,46	n/d	11,62	n/d
1	MK9	s.d.	0,09	0,11	0,84	2,28	0,38	0,05	0,70	0,19	0,36		1,34	
1	MK11	mean	3,22	2,48	21,40	46,80	8,20	0,76	3,50	1,80	1,22	n/d	10,24	n/d
1	MK11	s.d.	0,11	0,25	1,14	2,28	0,50	0,15	0,25	0,29	0,15		0,81	
1	MK14	mean	3,38	3,28	19,40	51,60	3,00	0,78	4,40	2,10	0,96	0,02	10,90	0,04
1	MK14	s.d.	0,26	0,15	1,14	0,89	0,12	0,08	0,38	0,23	0,13	0,04	0,65	0,09
1	MK17	mean	3,60	2,78	20,80	47,60	6,04	0,74	4,16	2,12	1,08	0,02	11,10	0,04
1	MK17	s.d.	0,12	0,08	0,84	1,67	0,53	0,09	0,30	0,13	0,18	0,04	1,99	0,09
1a	MK1	mean	3,06	2,18	19,80	54,20	1,98	0,68	4,34	2,00	1,10	0,06	10,14	0,18
1a	MK1	s.d.	0,62	0,16	1,10	1,30	0,13	0,04	0,30	0,37	0,12	0,05	1,19	0,18
1a	MK6	mean	3,96	3,16	22,00	49,40	4,38	0,86	3,88	1,66	0,96	0,00	9,18	0,10
1a	MK6	s.d.	0,21	0,17	0,71	1,14	0,35	0,05	0,08	0,11	0,09	0,00	0,98	0,14
1a	MK8	mean	3,26	1,98	19,20	53,20	5,44	0,68	3,32	2,04	1,06	0,00	9,52	0,44
1a	MK8	s.d.	0,26	0,16	1,48	3,27	0,40	0,04	0,59	0,67	0,18	0,00	1,00	0,09
1a	MK12	mean	2,92	1,86	19,20	50,80	6,70	1,44	3,70	1,78	1,54	n/d	9,78	n/d
1a	MK12	s.d.	0,74	0,27	0,84	2,17	0,19	1,71	0,87	0,13	0,93		1,17	
1a	MK13	mean	3,32	3,02	19,00	53,40	2,38	0,90	3,78	2,38	0,90	0,02	10,40	0,18
1a	MK13	s.d.	0,13	0,08	0,71	2,70	0,26	0,07	0,25	0,52	0,19	0,04	1,30	0,16
1a	MK15	mean	3,10	2,05	20,75	52,50	4,00	0,63	3,98	1,55	0,93	0,00	9,85	0,25
1a	MK15	s.d.	0,39	0,13	0,96	1,29	0,56	0,05	0,25	0,06	0,13	0,00	0,60	0,06
1b	MK16	mean	3,12	2,58	20,20	48,00	4,12	0,64	4,66	1,06	0,98	0,14	14,46	n/d
1b	MK16	s.d.	0,15	0,64	0,84	1,58	0,31	0,05	0,39	0,15	0,28	0,11	1,82	
2	MK2	mean	2,48	2,12	20,60	55,40	4,02	0,68	2,70	1,58	1,22	n/d	9,04	n/d
2	MK2	s.d.	0,19	0,11	1,14	2,30	0,25	0,04	0,17	0,24	0,16		0,50	
2	MK10	mean	3,32	2,24	23,00	55,80	2,80	0,92	1,88	0,80	1,12	0,00	7,86	0,20
2	MK10	s.d.	0,57	0,36	4,74	7,85	0,77	0,11	0,61	0,10	0,33	0,00	0,55	0,12
3	MK18	mean	2,70	2,68	23,20	53,00	1,48	0,68	5,72	1,42	0,84	0,02	8,24	n/d
3	MK18	s.d.	0,10	0,20	1,30	2,45	0,40	0,04	0,45	0,18	0,09	0,04	0,55	
4	MK5	mean	3,84	2,50	23,20	48,40	6,04	0,44	5,12	1,06	1,18	0,04	8,52	n/d
4	MK5	s.d.	0,63	0,47	1,79	4,93	0,62	0,11	2,24	0,38	0,34	0,09	2,30	

Table 2 Malo Korenovo: results of the SEM-EDS analysis of the potsherds.

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SAŽETAK

TEHNOLOGIJA I PROIZVODNJA KERAMIKE NA LOKALITETU KORENOVSKE KULTURE MALO KORENOVO KRAJ BJELOVARA

Ključne riječi: neolitik, korenovska kultura linearnotrakaste keramike, mikroskopski preparat, analiza rengenskom difrakcijom i skenirajućim elektronskim mikroskopom

U radu je analizirano 29 ulomaka keramike s neolitičkog lokaliteta Malo Korenovo koji se pripisuju klasičnoj fazi korenovske kulture. Potonja predstavlja jugozapadnu varijantu linearnotrakaste keramike. Ulomci keramike i jedan uzorak tla, uzet u blizini lokaliteta, analizirani su pomoću tri metode: analizom mikroskopskog preparata, skenirajućim elektronskim mikroskopom i rengenskom difrakcijom. Rezultati ukazuju na lokalnu proizvodnju keramike - glina sadrži primjese 1) siltita aluvijalnog podrijetla, tipičnih za fluvijalne terase na kojima se smjestilo Malo Korenovo, 2) granitnih stijena karakterističnih za geologiju područja (15 km jugoistočno od neolitičkog sela vidljiva su ležišta granita i granodiorita). Drugim riječima, smjesa upotrebljena za izradu posuda mogla bi pokazati promjenjivost s obzirom na funkciju različitih vrsta keramike. Dok keramika, koju karakteriziraju posude tipične za linearnotrakastu keramiku - uglavnom polukuglaste i bikonične zdjele - pokazuje smjesu siltoznog tipa, s pljevom, kvarcom i teškim mineralima, dotle grubu keramiku, debelih stijenki obilježava gruba faktura s bimodalnom podjelom, koja pokazuje kvarc ne finih dimenzija, micu bijelu i crnu (muskovit i biotit) i zrna granitnih stijena.

Osobito je zanimljiva analiza ulomka MK 18 koji se i stilski razlikuje od ostatka keramike po ukrasu urezane okomite vrpce ispunjene ubodima, smještenom na unutarnjoj strani. Mikroskopski je utvrđena znatno grublja faktura, bogata kvarcom i krupnim česticama crne mice (biotita).