Determination of Hellenistic pottery and wall plaster mineral composition

Zh. Uzunov[1], B. Dumanov[1], B. Kostova[2], V. Stoyanov[3], R. Berberova[2], B. Zlateva[4]

[1]New Bulgarian University, Department of Archaeology
[2]New Bulgarian University, Department of Natural Sciences
[3]University of Structural Engineering and Architecture (VSU) „Lyuben Karavelov”
[4]Sofia University “St. Kl. Ohridski”; Faculty of Chemistry and Pharmacy

Aim

The work aims to investigate: (i) the chemical composition of pottery fragments and clay plaster from the Hellenistic settlement and compare it with the potential raw material (clay), and (ii) mineral composition to define the pottery's firing temperature and clay plaster's burning temperature. The investigation was made by X-ray fluorescence analysis and powder X-ray diffraction measurements.

Materials and Methods

Materials

Archaeological site for sampling: Hellenistic settlement located on a prominent summit named Harmanlaka, by the village of Orizare (Fig. 1)

Studied archaeological samples: ? 1 clay plaster; ? 2 wheel made monochrome pottery; ? 3 Fragment from the jug, ? 3 handmade pottery; ? 4 Lopas, plain pottery; ? 5 Cup, plain pottery; and ? 6 Bowl, red-gloss ware.

Studied raw material samples: two clay samples (A and B), sampling – two different levels of modern clay quarry (out of operation at the moment) with location Orizare village.

Methods

The X-ray fluorescence (XRF) analysis - Micro-XRF Spectrometer M1 MISTRAL, Bruker - for clay samples investigations.

The powder X-ray diffraction (PXRD) - Empyrean Powder X-ray diffractometer (Malvern Panalytical, Netherlands).

Figure 1. Settlement site by the Orizare village, Bulgaria

Results

Table 1. Results from the XRF analysis of clay samples (A and B).

№	wt %																
	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	Ti	V	Mn	Fe	Cu	Zn	Rb	Sr	Y	Zr	S
A	1.56	14.98	33.72	0.07	2.11	8.69	0.48	0.01	0.05	4.14	0.01	0.01	0.01	0.04	0.0014	0.01	0.15
B	2.73	25.68	48.26	0.12	2.39	8.33	0.38	0.01	0.04	3.65	0.01	0.01	0.01	0.03	0.0016	0.01	-

Table 2. Results from the PXRD analysis

Sample	Mineral composition		References
raw clay – sample A and sample B	montmorillonite, clinochlore, quartz, muscovite, albite, microcline, calcite		montmorillonite [5] clinochlore [6] quartz, PDF # 06-1757 [7] muscovite [8] microcline - PDF #19-0926 [7] albite - PDF #89-6426 [7] calcite - PDF#06-6528 [7] gehlenite [9] diopside [10] hematite PDF# 33-0664 [7]
pottery	**raw minerals**	**newly-formed minerals**	
№1 clay plaster	quartz, muscovite, albite, microcline, calcite	-	
№2 Wheel made monochrome pottery	quartz, muscovite, albite, microcline, calcite	-	
№3 Jug, handmade pottery	quartz, muscovite, albite, microcline	-	
№4 Lopas, plain pottery	quartz, muscovite, albite, microcline	-	
№5 Cup, plain pottery	quartz, muscovite, albite, microcline, calcite	-	
№6 Bowl, red-gloss ware	quartz, microcline	gehlenite, diopside, hematite	

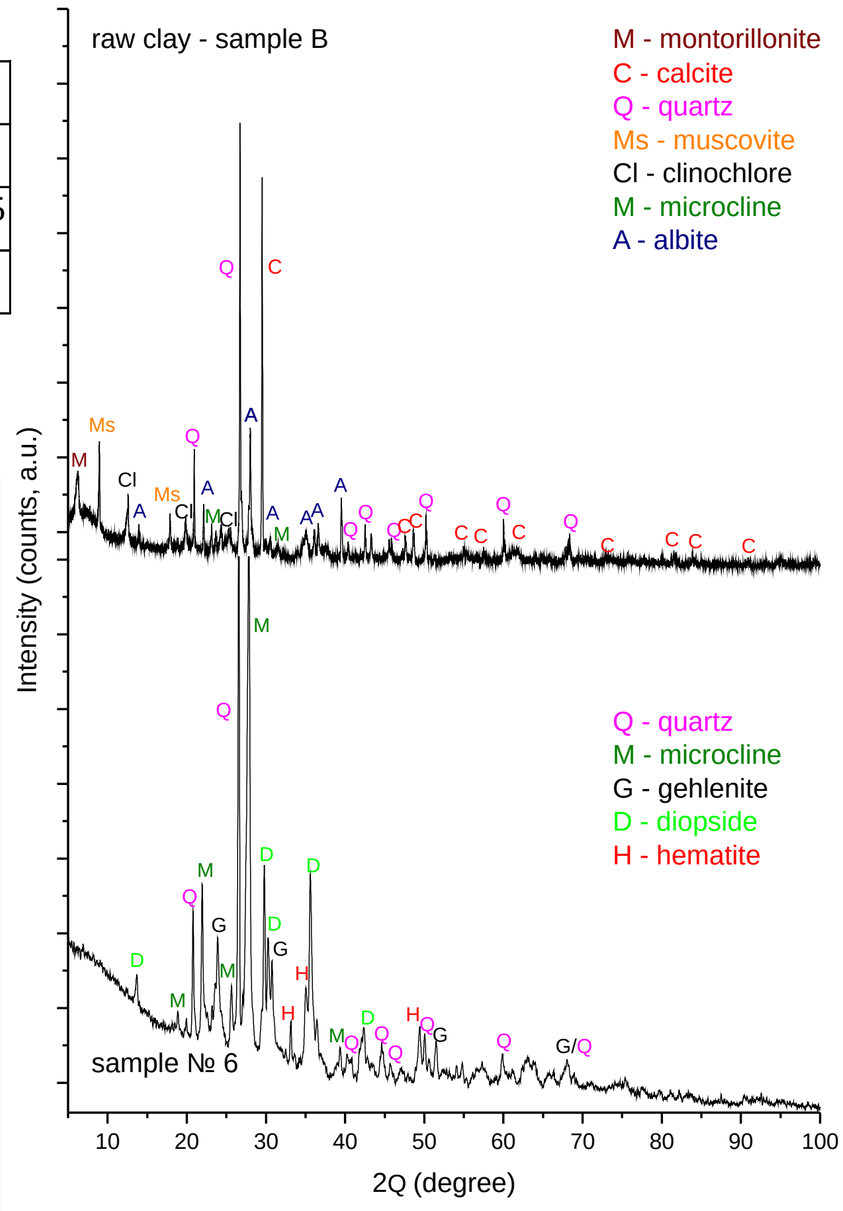

Figure 2. PXRD patterns of raw clay (sample B) and pottery (Sample № 6).

Conclusion

The chemical and phase composition study of clay samples from the area of the village of Orizare and the comparison with the phase composition of the studied Hellenistic pottery and clay plaster samples determined the studied clay as raw material and their local production, respectively.

The determined mineral composition of the raw clay, pottery samples, and clay plaster show:

- three different firing temperatures of the ceramics: 600 - 660°C, 600 - 800°C and 950 - 1000°C, proving three manufacturing technologies used;
- temperature of wall clay plaster burning and building burning at the fire, respectively - 600 - 660°C.

The obtained results are of importance for other archaeological sites from the region of Nessebar municipality.

Acknowledgments

This work was funded by the Bulgarian Science Research Found under grant KP-06-N40/6 (Zh. U., B. D., B. K).