Composition and microstructure of Late Roman-Early Byzantine pottery from (L)Ibida (Dobrudja, Romania)

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The town of (L)Ibida in Moesia Inferior (Scythia Minor) province (present day Slava Rusă, in Dobrudja, Romania) begun at the end of the 1st century AD as a Roman military camp, along the actual Slava River. The city was located along the right bank of the actual Slava River, on the trade route connecting Noviodunum (in north-west, on the Danube River) and Constantinopolis. The archaeological excavations revealed a high amount of pottery, tile and glass fragments, as well as various metal artefacts. In this study, twenty pottery sherds dated to the Late Roman (4^{th} century AD) to Early Byzantine (6^{th} century AD) period were investigated by several analytical methods in order to obtain a snapshot of the technology and production in a remote province of the Late Roman Empire. Optical microscopy (OM) and X-ray powder diffraction (XRPD) helped to identify the main mineral components and the thermal changes due to firing. The fresh surface of small chips broken from nine selected sherds were subject of cold field emission scanning electron microscopy coupled with energy dispersive X-ray spectrometry analysis provided compositional and microstructural information at small scale (~10 nm).

Most of the sherds have a mixed matrix, with both low birefringent and isotropic parts. The semifine to coarse aplastic inclusions consist of mostly angular fragments of quartz, plagioclase, potassic feldspar, amphibole, biotite and various lithoclasts. The latter are fragments of rhyolite, basalt, granite, sandstone, chert, limestone, greywacke, quartzite and micaschist. Most of samples contain Fe-rich concretions. Part of the samples contains discrete grains of carbonate, sometimes grouped in small clusters. Muscovite in significant amount was found in only two samples. The limestone clasts show partial thermal transformation. Only hematite, melilite, clinopyroxene and most likely part of feldspar were identified as firing phases by XRPD. The secondary electron images show also a mixed groundmass, with both sintered and vitreous areas. Chemically, the have mainly SiO_2, Al_2O_3, FeO_{TOT} and K_2O, with variable but low CaO. As firing phases, silica glass, Fe aluminosilicates, rare CaSiAl compounds (melilite), and clinopyroxene are characteristic.

In the studied ceramic shreds, the partial decomposition of the carbonates, the formation of the CaSiAl compounds and the diminishing of illite-muscovite XRPD peaks points to at least 850 °C temperature. On the other hand, the transitional character of the matrix, with a mix of sintered and vitreous parts, indicates a temperature below 900 °C.

In the areas there are no clays suitable for pottery. The Pleistocene loess is silt containing too much quartz to make a workable paste. The geological formation fitting to the matrix and clasts composition i.e. the Quaternary alluvial mud of the Slava River (collecting material from Proterozoic greywacke, micaschists and amphibolites, Paleozoic granites, Mesozoic rhyolites, basalts, limestones and cherts, and Pleistocene loess) supports the assumption of a local production of the pottery.

Acknowledgements. The study was financed by the Romanian Ministry of Research and Innovation through the UEFISCDI/CNCS project PN-III-P4-ID-PCE-2016-0229. C.I. acknowledges support by the Russian Government Program of Competitive Growth of Kazan Federal University.