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Micromineralogy for raw material determination of ancient ceramics – Case study on Roman amphorae, Istria, Croatia

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Amphora is a special type of vessel that was used in the wholesale trade for transporting food (e.g. olive oil or wine) in the Roman Empire. The study of amphorae provides an insight into trade routes and ancient manufacturing technology. One of the best documented amphora workshops was located in Fažana (south Istria, Croatia). The workshop was owned for a long time by the Roman Laecanius family. The olive oil produced between 45-40 B.C. and 78 A.D. was shipped in amphorae to northern Italy and the provinces beyond the Alps. In the golden age of the workshop 10-12,000 Dressel 6B type amphorae were manufactured annually. The nearly 0.90 m high amphorae had scarcely 1cm thin wall. During the long-distance land and water transportation they were full of valuable products, so they had to be perfectly shock resistant and pressure-tight but also cheap enough because of their disposable use. The amphorae required high quality raw material, but the exact composition and origin of the raw material used in Fažana is still unclear.

Dr. 6B type amphorae of investigated time period were analysed by both archaeological and geological methods. Thin section petrography and fabric analysis show the raw material and the manufacturing technology. XRD can specify the plastic components and the firing temperature. Micromineralogy and heavy mineral analysis provide information about the nonplastic components of the paste and temper of the amphorae.

According to former thin section petrography and comparative heavy mineral analysis, terra rossa (the red soil of the Mediterranean, common in south Istria) was thought to be the only major source of the paste of Laecanius amphorae. Later new style petrographic studies suggested that the paste was a mixture of terra rossa and flysch (limestone, sandstone, siltstone and claystone bearing rock assemblage, common in north Istria), but their exact place of exploitation and proportion of use for the final paste is still unknown.

In this work the heavy mineral analysis occurred with a new, reverse approach, which starts with precise mapping of the heavy

minerals of possible raw materials. For heavy mineral analysis terra rossa and flysch samples were collected from the Istrian Peninsula. After dissolution in HCl and wet sieving, heavy minerals were separated (two fractions: 63-125 µm and 125-250 µm) in bromoform. From the obtained heavy minerals we made 26 different preparations. Stereomicroscopy, polarizing microscopy and scanning electron microscopy were used in quantitative and qualitative analysis of heavy minerals.

On the base of recent heavy mineral study of terra rossa and flysch samples, significant differences could be established. The coarse grained fraction consists mainly of authigenetic opaque mineral grains in both formations. The fine fraction is more varied: terra rossa samples consist mainly of minerals of the epidote-group, garnets and blue-green amphiboles, while in the flysch rocks epidote and amphibole are absent, however Cr-spinel is significant. Both terra rossa and the flysch rocks contain zircon, rutile, tourmaline and staurolite in small quantities, but their shapes and colours are basically different. Several flysch samples also contain foraminifers filled with opaque minerals (mainly pyrite) and elongated ferrous particles. Minerals in terra rossa samples are typically idiomorphic- hypidiomorphic, while in flysch samples are hypidiomorphic-xenomorphic.

In our study we have gained important qualitative and quantitative information on the heavy mineral composition of the Istrian terra rossa and flysch - as the two presumptive raw materials for Istrian amphorae. Thus by the heavy mineral analysis of Laecanian amphorae we will have better chance to determine more precisely, what kind of raw materials were used and in what proportion were they mixed for the paste of the amphorae in the Fažana workshop. Moreover, our results should help in raw material research of other amphora-producing workshops in Istria. Application of presented new style heavy mineral study can help to get more reliable knowledge about preparation of paste for different fired pottery products in wider range of space and time.