

MINERALOGICAL, PETROGRAPHIC AND GEOLOGICAL STUDIES ON ROMAN BRICKS AND TILES FROM *ALBURNUS MAIOR* AND *APULUM* (DACIA PROVINCE): POSSIBLE RAW MATERIALS SOURCES

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A high number of Roman ceramic tegular material *i.e.* bricks and tiles, from the beginning of the IInd century AD were found at Roşia Montană (*Alburnus Maior*) and Alba Iulia (*Apulum*), in Romania. A large part of these are marked with the stamp of the famous Legion XIII Gemina, which played an important role in defending the Apuseni Mts. gold-mining area.

Twelve samples from the Roşia Montană archaeological site have been compared, from a mineralogical-petrographical-geological point of view, with ten samples of tegular material belonging to same legion and found at *Apulum*. For comparison, material belonging to the same chronological segment only, was studied. Consequently, *Apulum* samples marked with similar types of stamps as those from the *Alburnus Maior* were selected. The main aim of the investigation was the search for the provenance area for both, the raw clays and the temper sources. The ceramics consists mainly of a matrix with crystalline and/or amorphous fabric, showing different degrees of sintering and vitrification. In the matrix variable amounts of magmatic, metamorphic and sedimentary lithoclasts, various crystalloclasts (quartz, feldspar, mica), and rare ceramoclasts and bioclasts are present. Regarding the grain size, the ceramics is mainly lutitic-siltic-arenitic, with a contribution of arenaceous-sized grains exceeding 15% and reflecting the coarse category for all samples. Quartzites, granites-granodiorites, basalts, andesites/basaltic andesites, gneisses and limestones are ubiquitous lithoclasts.

Microscopical observations on the matrix as well as the X-ray diffraction indicate the use of polymictic clays, consisting mainly of illite, kaolinite ± smectite ± calcite ± micas as raw materials. The clays seem to be similar for both, the Rosia Montana and the Alba Iulia, artefacts.

The thermal changes of primary minerals as noticed in thin sections are represented mainly by the fissuring of quartz, the decomposition of calcite, the occurrence of contraction holes around some lithoclasts, the change of the anisotropy of clay minerals, the forming of glass, gehlenite, wollastonite and hematite. Additionally, the XRD show the disappearance of some lines belonging to clay minerals and the modification of calcite lines. Based on the above-mentioned thermal alterations, compared with our experimental data and references (RICCARDI *et al.*, 1999;

CULTRONE *et al.*, 2001; ANTONELLI *et al.*, 2002; *etc.*), the firing temperatures were inferred and the ceramic artefacts were classified in three categories: a) type I ceramics, fired at lowest temperature (800-850°C); b) type II ceramics, fired at 850-900°C and c) type III ceramics, fired at 900-950°C. In the Alba Iulia site the ceramics of type III is prevalent, followed by type II ceramics. The Rosia Montana ceramics is mainly of type II and subordinately of type I. Nevertheless, from mineralogical-petrographical point of view, both ceramics (*Apulum* and *Alburnus Maior*) are very similar.

Based on the mineral composition of the matrix (illite, kaolinite ± smectite ± calcite + micas), we presume that clays with an according composition, outcropping west and north-west of Alba Iulia were used as raw materials.

The mineralogical and petrographical composition of the crystalloclasts and lithoclasts respectively, in the ceramics from both Rosia Montana and Alba Iulia sites is similar. Granites and granodiorites are like those crossed by the Aries river, north of Alba Iulia, basalts, basaltic andesites, radiolarites are surely originated from the Mesozoic ophiolitic zone outcropping westwards of Alba Iulia, while limestones outcrop also westwards of Alba Iulia, together with the ophiolites. These lithoclasts are also found in the alluvial sediments of the Mures River downstream the confluence with the Ampoiu River. Thus, we presume that the temper was most likely mined from the right bank of the Mures River, south-east of Alba Iulia. Even today this location provides quartz sands, used for bricks and tiles manufacture.

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