



Provenance determination of white marble used in antiquity: from quarry to artefact

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Determining the source area of white marbles used in antiquity for sculptures and buildings is still an important problem in archaeology and art history. Deciphering the source of an artefact is a multidisciplinary–multi-method approach whereby disciplines like art history and archaeology have to supply from stylistic characteristics and the original location the most likely time frame and place of fabrication, but also locations of quarries in use at this time period. Natural science disciplines such as physics, chemistry or earth sciences, on the other hand, have to apply physical, chemical, mineralogical and petrographical analysis techniques which unequivocally assign the artefact's marble to comparable material from a unique quarry. Simply based on individual parameters, however, reliable determinations are questionable and only a multi-method approach may reach a high confidence level. Moreover, all techniques applied to date are destructive for the artefact, i.e., they consume material. Thus, the size extractable from an archaeological artefact sets limits on the quantitative use of certain techniques. Therefore, it is important to apply a set of techniques which encompass the whole characteristics of the extracted material, i.e., not only the bulk chemical fingerprint, but also chemical, mineralogical and petrological heterogeneities as well as preferred orientations/accumulations. From this viewpoint a combination of cathodoluminescence texture, fabric analysis and geochemical parameters such as stable isotopes, is an ideal, low cost multi-method approach which satisfy the demand for 2D characterization of the material.

Still, large uncertainties exist on the assignment to a source as (1) not all ancient quarries are known, (2) certain quarries used in antiquity were reopened later or are still in

use and thus the exact location of the ancient quarry is unclear, (3) often only small, randomly oriented chips from ancient dumps are available which are not necessarily representative for the quarry, and (4) the marble in the quarry is heterogeneous. Thus, the knowledge at quarry level is limited and depends on the quality of the sampling method, i.e., random extraction/collection or well defined location and orientation.

Therefore, any substantial improvement in the determination reliability of the source area of white marble used for a specific artefact needs detailed studies of the 3D-variability at each ancient quarry site. Furthermore, a search for still unknown sites is required.