UMEÅ UNIVERSITET

CARVED MOUNTAINS AND MOVING STONES

Applications of Near Infrared Spectroscopy for Mineral Characterisation in Provenance Studies

Claudia Sciuto

Akademisk avhandling

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Fakultetsopponent: Dr. Rachel Opitz,
School of Humanities, University of Glasgow, United Kingdom.

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Author
Claudia Sciuto

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Abstract

The study of stone artefacts is a combination of anthropological archaeology and geology, rooted in analytical techniques for determining the materials' composition, typological stylistic classification and interpretation of cultural patterns. In this thesis, the archaeology of materials is considered in the context of sites- and landscape transformation, economic history and development of techniques. Focus has been on applications of near infrared spectroscopy (NIR) for characterising minerals in different case studies. Interdisciplinary protocols are implemented in order to account for the various aspects of stone artefacts, merging geochemical investigation and digital documentation.

This thesis consists of two parts: an introductory text and five research publications. In the first paper, a NIR portable probe is tested to measure iron oxide-based pigments in rock paintings in Flatruet (Sweden). The study demonstrates that the probe is useful for characterising different sections of paint in-situ and pinpointing similarities and dissimilarities in the pigments used for the figures. The second and third papers are aimed at studying the use of raw materials for tool production in a Mesolithic settlement in Northern Sweden. In the second paper is shown that hyperspectral imaging helps characterise the mineral composition of a selected group of tools and the spectral signature of quartz, quartzite, and flint are examined. In the third paper, hyperspectral imaging-based classification is applied to the entire dataset of lithic tools and flakes collected during excavation of the site. The objects are divided into categories of raw materials according to their spectral features and the distribution is visualised on a 3D GIS platform. The fourth paper deals with the application of hyperspectral imaging, a field probe (MicroNIR) and portable Energy-Dispersive X-Ray Fluorescence (ED-XRF), for in-situ characterisation of building materials on the inner wall of the fortified citadel of Carcassonne (France). The research shows how the combination of these analytical methods in conjunction with a stratigraphic study of the architecture helps to understand the use and re-use of materials in different construction phases. The last paper shows how an in-field NIR-probe may be used in landscape surveys for instant characterisations of different stone types. This study was carried out in the district of Montescaglioso, Southern Italy, to highlight patterns of use and distribution of artefacts made of local calcarenite (limestone) in the period between the 6th and 3rd century BC.

Keywords
Raw materials, mineral characterization, material agency, Near Infrared spectroscopy, hyperspectral imaging, Energy-Dispersive X-ray Fluorescence, multivariate statistics.

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