

Protocol for lapis lazuli provenance determination: evidence for an Afghan origin of the stones used for ancient carved artefacts kept at the Egyptian Museum of Florence (Italy)

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Abstract Despite that the Badakhshan Province (Afghanistan) remains the most plausible hypothesis for the lapis lazuli used in antiquity, alternatives proposed in literature are worth to study to confirm or disprove their historical reliability. In this work, a protocol for determining the provenance of lapis lazuli rocks used for carved artefacts is described. Markers for the univocal attribution of the raw material to a source were identified analysing 45 rocks of known provenance (among which 15 georeferenced) from 4 quarry districts. To the best of our knowledge, this reference database is the widest in provenance studies on lapis lazuli. All the markers are recognisable by means of Ion Beam Analysis (IBA) techniques, in particular micro-proton-induced x-ray emission (PIXE) and micro-ionoluminescence (IL). These techniques are non-invasive and applicable in air, allowing to analyse artworks and rocks of practically any shape and dimension without sample preparation.

The protocol was applied to determine the provenance of raw material used for carved lapis lazuli artefacts kept at the Egyptian Museum of Florence, the second most important

Egyptian museum in Italy, second only to the museum of Turin. The collection in Florence has a great historical value and includes several lapis lazuli pendants, scarabs, small statuettes and amulets ascribable mainly to the first millennium BC. Following the protocol, 11 of these artefacts were analysed by means of IBA techniques. Results ascribe the raw material to the Afghan quarry district.

Keywords Lapis lazuli · Provenance · Ancient Egypt · Archaeometry · μ -PIXE · Ionoluminescence

Introduction and Background

Historical context

Lapis lazuli is a very attractive semi-precious stone. Due to its peculiar blue colour and its rareness, lapis lazuli has been used since the Neolithic Era for the manufacturing of

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