RADIOANALYTICAL MULTI-ELEMENTAL ANALYSIS: NEW METHODOLOGY AND ARCHAEOMETRIC APPLICATIONS

Magen E. Coleman
J. David Robertson, Dissertation Advisor

Abstract

Several projects are covered in this dissertation: the application of instrumental neutron activation analysis (INAA) and rigorous statistical analyses to the sourcing of Egyptian limestone and Kenyan obsidian, and the development of a method to determine titanium, barium, and arsenic concentrations in obsidian using epithermal neutron activation.

INAA, when coupled with rigorous statistical methods, including principal component analysis and clustering techniques, can provide the precision and confidence needed to accurately determine the source of material. However, this technique has not been fully explored for the provenancing of Egyptian limestone sculpture. A combination of the elemental concentration data and rigorous statistical methods is used to study the compositional differences between known ancient quarries.

Obsidian is an important component of East African artifacts. Although compositional studies of obsidian from East Africa conducted in the 1980s showed great potential, a comprehensive database has not been developed. Here, samples from Kenya were examined via INAA. The results indicate that there is a clear correlation between geographic proximity and chemical composition.

Titanium and barium are often used for characterizing obsidian, especially in areas in Africa. A method has been developed to analyze for these elements using epithermal neutron activation analysis, which takes advantage of larger natural abundances of parent nuclides and a higher probability for epithermal neutron reactions. It produces results with improved accuracy and precision for titanium and barium analyses in obsidian. It is also now possible to analyze for arsenic, which has not previously been reported in obsidian studies.