Contribution ID: **214** Type: **Poster**

Analysis of large and non-standard geometry samples of ancient potteries and bricks by internal monostandard NAA using insitu detection efficiency

Tuesday, 20 April 2010 11:45 (20 minutes)

Studies of archaeological artifacts constitute an important area of research that might provide clues to unravel the past human activities, art, trade etc. Archaeologists are mainly interested in the provenance studies of the artifacts. Archaeological artifacts like potteries, bricks, coins and paintings are mainly studied for their provenance and one of the valid, and accepted methods is through their chemical composition analysis in conjunction with statistical methods. Among the archaeological artifacts, potteries are most widely studied and occasionally bricks are also analyzed. Since they have a strong correlation with the clay/soil source from which they are prepared, elemental concentrations could be used for arriving at correlations. Elements, which are mainly present at trace levels in the artifacts, give authentic clue to their origin compared to the major elements. Elemental concentration ratios of Al and Sc, due to their non–volatile nature and La and Ce, due to their similar geochemical properties are used for preliminary grouping. The confirmation of grouping is done from statistical analysis like principal component analysis (PCA) and cluster analysis (CA). The present paper describes application of large sample instrumental neutron activation analysis (LS-INAA) method for provenance study of potteries and bricks using scandium as internal monostandard.
In the present study, samples of ancient potteries and bricks belonging to 4th-5th century BC to 4th century AD were excavated from 15 different Buddhist sites in Andhra Pradesh, India. Samples in the larger mass range of 10-50 g were taken for the experiment, irrespective of their geometry. Samples were irradiated for 7 hours in Apsara reactor, BARC. Radioactivity assay was carried out using a 40% relative efficiency HPGe detector coupled to 8k MCA. Peak areas were determined using peak-fit software PHAST. The k0-based internal monostandard INAA (IM-INAA) was used for arriving at the elemental concentration ratios with respect to Sc. Since the method uses insitu detection efficiency, it is geometry independent and non-standard geometry samples could be analyzed. Concentrations of about 18 elements such as Na, K, Sc, Cr, Fe, Co, Ga, As, Br, La, Ce, Nd, Sm, Yb, Hf and Th were determined in both potteries and bricks. The results of elemental concentration ratios with respect to Sc show that the both potteries and bricks fall into four major groups. It was observed that in some samples of potteries and bricks, collected from same location, correlations exist indicating the source of clay/soil may be the same. We would like to highlight that the provenance / grouping study of archaeological samples could reliably be carried out through their elemental concentration ratios than the absolute concentration values and thus the present method is a suitable one for this study.

Acknowledgement

Authors from GITAM University acknowledge UGC-DAE Council of Scientific Research, Mumbai for the financial assistance. This work is also a part of the IAEA Coordinated Research Project (CRP Code : F2.30.27).

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Session Classification: Poster Session - Nuclear Analytical Methods

Track Classification: Nuclear Analytical Methods