10th international conference on nuclear reaction mechanisms
Varenna, Villa Monastero-Italy; *June 7 - 11, 2006*

Neutron method for Amerindian Archaeological Provenance Study and Etruscan Art Authentication

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Abstract. In this study two main problems related to archaeology and art authenticity will be addressed. The first is related to the provenance of figurines to shed light on the nature and dynamics of the intersociety relationships within the *Valencioid Sphere of Interaction (Venezuela)* specifically between the societies from the core area (Lake Valencia Basin) and the periphery (the coast and the Caribbean islands). The other study related to art and museum objects, deals with the determination of the authenticity. Among the different analytical techniques available today, the interdisciplinary group selected the neutron related one to determine the elemental and isotopic composition of Amerindian figurines and Etruscan artefact. We present our results of elemental and isotopic concentrations, obtained with k_0-Instrumental Neutron Activation Analysis (k_0-NAA at SCK•CEN, Mol-Belgium), Prompt Gamma Activation Analysis (PGAA – Budapest Neutron Centre BNC, Hungary) and Neutron Resonance Capture Analysis (NRCA – EC-JRC, IRMM Geel Belgium). These techniques present advantages depending on the boundary conditions related mainly to the material availability and the non destructive aspects. Some technical restrictions exist: e.g. the NAA requires a thermal neutron flux and Gamma detector with high energy resolution i.e. HPGe-detectors. PGNAA, besides a relatively intense neutron beam, (e.g. guided cold neutron beam installed at BNC) requires a costly Gamma Spectrometer often coupled with Compton suppressor. The NRCA has an accelerator driven pulsed white neutron beam (LINAC) and requires only a good time resolution that can be obtained with a less expensive scintillators detectors. The results, from ceramology features of studied samples grouped by their style as *Standardised*, *Imitative* and *Heterogeneous,* could not be positively confirmed to establish a common origin for island and continental samples. We have to state that our results suggest that the origin of the majority of the island figurines have similar composition to the continental samples connecting them to the Valencia lake culture from where probably they originated. In the case of authenticity of the Etruscan artefact, the results of the elemental and isotopic composition suggested clearly that it is not original. Further more this study evidenced that, by comparison, the PGAA is the best method for light elements (H, S, P, K and other major components) and the NRCA is the best for heavy elements such as As, Ag, Sb, Au and Pb. But the most limiting factor in selecting a technique is that in these cases bulk material goes under analysis (non destructive analytical method) and that intrinsically excludes the isotope (e.g. Californium-252 at the university USB) or fission neutrons NAA.-technique. However k_0-NAA has several advantages over the others mentioned and it is a fact that very small amounts (mg -- microg) are required and, as we experienced, a short irradiation time gives information on a large number of elements (70) making it *de facto* one of the most sensitive method particularly useful to analyse powders and small amounts of soil samples that undoubtedly would characterize e.g. a clay or mineral mining site. The IAEA financial support is acknowledged under the RC-1228 as well as the USB-DID and FONACIT-Venezuela, participation.

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