# PROVENANCE STUDY OF MARAJOARA POTTERY BY MÖSSBAUER SPECTROSCOPY, XRD AND INAA

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The Marajoara culture, located in Marajó Island, was one of the most complex societies in South America. The Marajoara society developed an intensive survival system maintaining large population centers for almost 1000 years (A.D. 400 to 1400). heir beautiful pottery is characterized mainly for its multicolored, modeled and incisive ceramics made for feasts and for burials.

$^{57}$Fe Mössbauer spectroscopy is an excellent microscopic method in the investigation of clay-based ceramics since practically all pottery clays contain iron, usually in concentrations between 1 and 10 wt%, enough to easily obtain $^{57}$Fe Mössbauer spectra. The changes which pottery clays undergo during firing are reflected in the Mössbauer spectra of the fired ceramics and hence can be used, even after millennia of burial, to obtain information on the original firing conditions and on techniques and abilities of the ancient potters. Mössbauer spectroscopy can also be applied in the classification of pottery finds into groups on the basis of their Mössbauer patterns. The combination of such groupings with information from methods like trace element analysis obtained by instrumental neutron activation analysis (INAA), allow to assign individual sherds to certain production sites or workshops.

Here we report on a preliminary study on samples from fragments of Marajoara ceramics using $^{57}$Fe Mössbauer spectroscopy, DRX and INAA.

The Mössbauer spectra were measured at room temperature (RT) and at liquid helium temperature (4,2K). Despite a certain variability of the Mössbauer spectra, dominant features could be established, which allowed the samples to be classified into characteristic types (Möss-groups) according to their Mössbauer patterns. The different groups were defined on account of the presence and intensity or the absence of certain components, mainly in the RT spectra. The Mössbauer data of the archaeological samples will be compared with those of appropriate clay samples fired under controlled conditions in the laboratory and will be complemented by data obtained with X-ray diffraction.

The small differences in sample trace elements concentrations were determined by INAA. The data set were analysed by several multivariate statistical methods, such as cluster analysis, principal component analysis and discriminant analysis, allowing for the differentiation of samples from different groups.