441 GRADUATE STUDIES IN RADIOCHEMISTRY AT COLORADO STATE UNIVERSITY. S.A. Ibrahim. Department of Environmental and Radiological Health Sciences, Colorado State University, Fort Collins, CO, 80523, USA

The Department of Environmental and Radiological Health Sciences (ERHS) at Colorado State University (CSU) has recently established a specific area of specialization in radiochemistry within its existing graduate program. The program main objective is to increase the pool of appropriately educated and trained radiochemists in the USA. This undertaking is supported in part, through the sponsorship of the U.S. Department of Energy (DOE), Office of Nuclear Energy, Science and Technology, Radiochemistry Education Award Program, administered by South Carolina University Research and Education Foundation. The programs core curriculum is designed to provide in-depth integrated coverage of radiochemistry and related areas, linked with a summer internship at selected DOE-supported laboratories. The internship component is intended to provide students with hands-on experience with various laboratory activities and interaction with radiochemistry personnel. Laboratory facilities participating in the internship program include: the Carlsbad Environmental Monitoring & Research Center, The Savannah River Ecology Laboratory, Los Alamos National Laboratory and Argonne National Laboratory. Three (3) highly qualified students were recruited and admitted into the program with full financial support (stipends and tuition) for the current academic year 2002-03, and all are making good progress toward their M.S. degree. Program details are featured at the following web site: http://www.cvmbs.colostate.edu/erhs/academic_programs/graduate/radiochem/erhs_radiochem.htm . The ERHS department and CSU are committed to the success and long-term viability of this program and is providing all instructional facilities and equipment needed.

442 THE LIVING TEXTBOOK OF NUCLEAR CHEMISTRY. W. Loveland*, A. Gallant, and C. Joiner, Dept. of Chemistry, Oregon State University, Corvallis, OR 97331, USA.

The Living Textbook of Nuclear Chemistry (http://livingtextbook.orst.edu) is a website, which is a collection of supplemental materials for the teaching of nuclear and radiochemistry. It contains audio-video presentations of the history of nuclear chemistry, tutorial lectures by recognized experts on advanced topics in nuclear and radiochemistry, links to data compilations, articles, and monographs, an audio course on radiochemistry, on-line editions of textbooks, training videos, etc. All content has been refereed.

443 AN ATTEMPT TO IDENTIFY SOURCE OF RAW MATERIALS OF ARCHAEOLOGICAL CERAMICS FROM THE CENTRAL AMAZON. C.S. Munita*[1], E.G. Neves[2], E. Soares[3], J.B. Petersen[4], R.P. Paiva[1], C. Zoppe[1], S. Schreiber[1], P.M.S. Oliveira[5]. [1]Instituto de Pesquisas Energéticas e Nucleares – IPEN-CNEN/SP, C.P. 11049, 05422-970, São Paulo, SP, Brazil. [2]Museu de Arqueologia e Etnologia – USP, Av. Prof. Almeida Prado, 1466, 05508-900, São Paulo, SP, Brazil. [3]Departamento de Geociências, Universidade Federal do Amazonas, Campus Universitário, 69077-000, Manaus, AM, Brasil. [4]Department of Anthropology, University of Vermont, Burlington VT, USA. [5]Instituto de Matemática e Estatística – USP, C.P. 66281, 05315-970, São Paulo, SP, BRAZIL

Studies on the provenance of archaeological artifacts and the sources of raw materials provide insight into the interpretation of archaeological data. It is assumed that the chemical composition of the fired ceramic is indicative of chemical composition of the principal material - clay. Such studies can lead to the formulation of appropriate criteria by which to classify ceramic artifacts within a specific regional perspective, but also can provide hard evidence for material and cultural exchange among different farther-flung populations in the past. Paste analyses provide important information about the organization of ceramic production and distribution, revealing the emergence and demise of source communities and the movement of their ceramic products. In this work 37 ceramic and clay samples from two archaeological sites, were analyzed. Arsenic, Ba, Ce, Co, Cr, Cs, Eu, Fe, Hf, K, La, Lu, Na, Nd, Rb, Sb, Sc, Sm, Ta, Tb, Th, U, Yb and Zn by INAA, were determined. The geographical provenience of the clay samples was confined to a relatively small region, for

those samples were collected near the sites. Consequently the clays in the different sampling loci may not differ greatly in their composition and the method of analysis must be sensitive enough to cope with this problem. Values derived from concentrations data first were converted to base 10 log values and submitted to three multivariate statistical methods: cluster analysis, principal components analysis and canonical discriminant analysis including the calculation of Mahalanobis distance. Bivariate plots were employed to display the structure groups in a reduced dimensional space. .

444 THE IMPACT OF MEASUREMENT UNCERTAINTY ON THE PHYSICAL MEANING OF EPITHERMAL NEUTRON FLUX CHARACTERIZATION BY BARE MULTI-MONITOR METHOD. P. Bode[*1], M. A. Bacchi[2] ,E. A. De Nadai Fernandes[2], M. J. J. Koster-Ammerlaan[1]. [1]Interfaculty Reactor Institute, Delft University of Technology, THE NETHERLANDS. [2]CENA, University of São Paulo, Piracicaba, BRAZIL.

The ratio of the thermal and epithermal neutron flux, f, and the epithermal flux parameter, α, vary with space (i.e. position inside the irradiation container) and with time, elapsed after start-up of the reactor operation. Routine application of the bare multi-monitor method has given evidence that uncertainties in the physical parameters, in the monitor composition and in the measurement process itself can have a dramatic effect on f and α thus determined. Results have been observed which are highly questionable as a physical reflection of the actual shape of the neutron spectrum in the irradiation position. As such, this seems to violate the hitherto usurped statement that the physical process in activation analysis is fully understood, a cornerstone of having INAA accepted as method with high metrological value. This work demonstrates the impact of measurement uncertainty on the determination of the neutron flux parameters and its consequences to the selection of monitor elements. Results obtained for different sets of elements, irradiated at two light water research reactors, are presented and evaluated according to the uncertainty budget established for each measurement condition.

445 RADIOTRACER STUDY OF EUROPIUM INTERACTION WITH HUMIC ACID USING ELECTROPHORESIS, ULTRAFILTRATION, AND DIALYSIS. J. Mizera[*1,2], G. Masnerová[2], and P. Beneš[2]. [1] Nuclear Physics Institute, Academy of Sciences of the Czech Republic, CZ-250 68 Řež near Prague, Czech Republic[2]. Department of Nuclear Chemistry, Czech Technical University, Břehová 7, CZ-115 19 Prague 1, CZECH REPUBLIC .

Three independent speciation techniques – the free liquid / moving boundary electrophoresis, ultrafiltration, and equilibrium dialysis - combined with the radiotracer method (using ^{152}Eu) have been compared at the study of Eu interaction with humic acid (HA). The degree of complexation of Eu in 10 mg/L Aldrich HA solutions was determined within a broad range of metal loading (Eu total concentration $10^{-8} – 10^{-4}$ mol L^{-1}), at pH 4 and 6, ionic strength 0.01 and 0.1 ($NaClO_4$). Uncertainty of the determination given by sorption losses of Eu on the walls and membranes of the experimental devices, and the effect of kinetic lability of the Eu-HA complexes are discussed. From the anodic electrophoretic mobilities determined, additional information on the charge of the Eu-HA complexes was obtained. The dependencies of the degree of complexation and the Eu-HA charge on Eu loading, pH and ionic strength have been interpreted with a simple model of HA as a mixture of two types of binding sites: less acidic - strongly binding - slowly dissociating, and more acidic - weakly binding - rapidly dissociating.

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