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DETERMINATION OF THE NEUTRON CAPTURE CROSS-SECTION OF ^{232}Th INDUCED BY D-D/D-T NEUTRONS USING THE NEUTRON ACTIVATION METHOD*Lan Chang-lin, Xie Bao-lin, Zhang Yi, Peng Meng, Yao Ze-en, Kong Xiang-zhong*

School of Nuclear Science and Technology, Lanzhou University, Gansu Province 730000, China, e-mail: lanchl@lzu.edu.cn

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Abstract: The $^{232}\text{Th}(n, \gamma)^{233}\text{Th}$ neutron capture reaction cross-sections at average neutron energies of 2.5 ± 0.3 MeV and 14.8 ± 0.2 MeV from the D-D/D-T neutron generator have been measurement using the activation method. The neutron flux was determined using the monitor reaction $^{58}\text{Ni}(n,p)^{58}\text{Co}$ or $^{27}\text{Al}(n,\alpha)^{24}\text{Na}$. Induced gamma-ray activities were measured using a low background gamma ray spectrometer equipped with a high resolution HPGe detec-

tor. The experimentally determined cross-sections were compared with the literature data, evaluated data of ENDF/B-VII, JENDL-4.0, CENDL-3.1 and JEFF-3.1. The Excitation functions of $^{232}\text{Th}(n,\gamma)$ reaction were also calculated theoretically using the TALYS 1.6 computer code. The new results measured in this work are useful for verifying the accuracy of nuclear models used in the data evaluations and practical applications.

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BOX-COX TRANSFORMATION ON DATASET FROM COMPOSITIONAL STUDIES OF ARCHAEOLOGICAL POTTERIES*José Osman dos Santos^{1*}, Casimiro Sepulveda Munita², José Espinola da Silva¹, Michel Santana Reis³*¹Coordenação de Física, Instituto Federal de Sergipe – Campus Lagarto, CEP 49055-660, Sergipe, Brazil, *e-mail: osmansantos@ig.com.br²Instituto de Pesquisas Energéticas e Nucleares, IPEN-CNEN/SP. C.P. 11049 CEP 05422-970, São Paulo, SP, Brasil, e-mail: camunita@ipen.br³Aluno Bolsista do PFRH 127B, Instituto Federal de Sergipe – Campus Lagarto, CEP 49055-660, Sergipe, Brazil, e-mail: joseespinoladasilvajr@uol.com.br**Keywords:** INAA, archaeometry, multivariate statistics

In many archaeometric studies to determine the provenance of potteries by means of the elemental composition the normality is assumed to be desirable. The non-normality and non-normality features of geochemical variables provide a challenge for parametric statistical analyses since normality of datasets is required by many multivariate statistical methods such as principal components, canonical correlation, discriminant analyses and MANOVA. In many published examples of the use of multivariate methods to archaeometry studies, it is neglected that geochemical data almost never follow a multivariate normal distribution. Here, a geochemical dataset was obtained by means of Instrumental Neutron Activation Analysis (INAA) of archaeological potteries from Xingó, Sergipe State – Brazil which was used to demonstrate that in provenance studies, data as rule, shows neither a multivariate normal nor multivariate lognormal distribution. In this work, 50 ceramic fragments and 1 clay sample from Justino site were analyzed by means of INAA: Cemetery B (25), Cemetery C (25) and one clay sample collected near to Justino site. Eleven elements (Na,

Lu, Yb, La, Th, Cr, Cs, Sc, Fe, Eu and Hf) were used for the interpretation of the results. A logarithmic transformation did not produce a multivariate normal distribution and it was necessary an optimal method of transformation for the raw data, which is a powerful method of Box-Cox transformation to dataset closer to multivariate normality. To statistical interpretation, this paper presents the MNV package from R Software, which can be used to test multivariate normality by using of measures of multivariate skewness and kurtosis of Mardia. When the multivariate normality test was disapproved, then the data was nearly normalized by means of Box-Cox or logarithmic transformation both marginally and jointly on the variables. In this paper, we have selected the parameter of the Box-Cox transformation by using of Akaike's information Criterion (AIC). Find transformation to normalize data by means of Box-Cox transformation, the significance between compositional groups of pottery specimens from Justino archaeological site could be tested by Hotelling's T^2 statistics (at 5% significance), which is the multivariate equivalent of the Student's t-statistics.