

Investigate the capability of INAA absolute method to determine the concentrations of ^{238}U and ^{232}Th in rock samples

I. A. Alnour · H. Wagiran · N. Ibrahim ·
S. Hamzah · B. S. Wee · M. S. Elias

Received: 19 May 2013 / Published online: 20 November 2013
© Akadémiai Kiadó, Budapest, Hungary 2013

Abstract This work aimed to study the capability of INAA absolute method in determining the elemental concentration of ^{238}U and ^{232}Th in the rock samples. The INAA absolute method was implemented in PUSPATI TRIGA Mark II research reactor, Malaysian Nuclear Agency (NM). The accuracy of INAA absolute method was performed by analyzing the IAEA certified reference material (CRM) Soil-7. The analytical results showed the deviations between experimental and certified values were mostly less than 10 % with Z-score in most cases less than 1. In general, the results of analysed CRM Soil-7 show a good agreement between certified and experimental results which mean that the INAA absolute method can be used accurately for elemental analysis of uranium and thorium in various types of samples. The concentration of ^{238}U and ^{232}Th ranged from 1.77 to 24.25 and 0.88 to 95.50 ppm respectively. The highest value of ^{238}U and ^{232}Th was recorded for granite rock sample G17 of ^{238}U and sample G9 of ^{232}Th , whereas the lower value was 1.77 ppm of ^{238}U recorded in sandstone

rock and 0.88 ppm of ^{232}Th for gabbro. Moreover, a comparison of the ^{238}U and ^{232}Th results obtained by the INAA absolute method shows an acceptable level of consistency with those obtained by the INAA relative method.

Keywords Instrumental neutron activation analysis (INAA) · Rotary rack (RR) · Pneumatic transfer system (PTS) · INAA Absolute method · PUSPATI TRIGA Mark II research reactor

Introduction

Analyses of ^{238}U and ^{232}Th in different samples using neutron activation analysis are in high demand in NAA laboratory. Generally, there are three approaches in doing INAA: relative method, k_0 -standardization method (single comparator), and absolute method. INAA relative and k_0 methods are a major methods used for determining ^{238}U and ^{232}Th . The main drawbacks of the relative method is the requirement to prepare standards for each element to be determined. Estimation of errors may occur during the manipulation of the standard that are cumbersome and tedious to analyze. Compared to the relative method, the technique of k_0 -INAA is experimentally simpler but more complex in the formulation and calculations as well as computational programming. This technique requires experts to interpret the spectrum of selected elements in the sample, which are difficult to do [1, 2]. On the other hand, INAA based on absolute method is a more direct analysis of the irradiated samples without using any standard as in the case of INAA relative method or comparator as in k_0 -INAA [3]. Therefore, This study aimed to determine the concentration of ^{238}U and ^{232}Th in different rock types by using the instrumental neutron activation analysis absolute

I. A. Alnour (✉) · H. Wagiran
Department of Physics, Faculty of Science, Universiti Teknologi
Malaysia, UTM, 81310 Skudai, Johor, Malaysia
e-mail: aaibrahim3@live.utm.my; ibrahim.elnour@yahoo.com

I. A. Alnour
Department of Physics, Faculty of Pure and Applied Science,
International University of Africa, 12223 Khartoum, Sudan

N. Ibrahim
Faculty of Defence Science and Technology, National Defence
University of Malaysia, Kem Sungai Besi, 57000 Kuala Lumpur,
Malaysia

S. Hamzah · B. S. Wee · M. S. Elias
Malaysian Nuclear Agency (NM), Bangi, 43000 Kajang,
Selangor, Malaysia