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Rare earth elements determination and distribution patterns in granite rock samples by using INAA absolute method

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Abstract This work determined elemental concentrations for rare earth elements (REE) in granite rock samples using the INAA absolute method. The accuracy of INAA absolute method was determined by analyzing two of USGS STM-1 and MAG-1 standards. The analytical results agreed reasonably well with certified values. In general, all analytical results had Z score less than 1.0 excepting Yb. The REE found in granite rock samples ranged from 116 to 325 mg kg^{-1}. The total content of REE in granite rock samples was 206 mg kg^{-1}. Patterns for REE were also studied in the present work.

Keywords Rare earth element (REE) · Instrumental neutron activation analysis (INAA) · Rotary rack (RR) · Pneumatic transfer system (PTS) · Chondrite-normalized

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Introduction

The REE is divided into two sub-groups: those from La to Sm (i.e. lower atomic numbers and masses) being referred to as the light rare earth elements (LREE) and those from Eu to Lu (higher atomic numbers and masses) referred to as heavy rare earth elements (HREE). The significant growth of interest in the geochemistry of the rare earth elements (REEs) is because of the realization that the measured degree of REE fractionation in a rock or mineral can be a pointer to its genesis [1].

In the Earth's crust, the estimated average concentration of the rare earth elements (REEs) is 150 to 220 mg kg^{-1} [2]. Ce is the most abundant element in the earth's crust at 60 mg $kg^{-1}$and the least abundant ones are Tm and Lu at 0.5 mg kg^{-1} [3]. The main source of REEs are found in rock contain carbonatites, igneous rocks comprising more than 50 % carbonate minerals. REE also are found in high concentration in some alkaline igneous rocks (characterized by their high content of alkali metal). Other potential concentrations of REE-bearing minerals are also found in placer deposits, residual deposits formed from deep weathering of igneous rocks, pegmatites, iron-oxide copper–gold deposits, and marine phosphates [2]. In addition, the carbonatites and alkaline igneous rocks are mainly found in the interiors of tectonic plates, which are away from the active plate margins where volcanic activity is at its greatest.

Rare earth elements play an important role in geochemical studies to elucidate evolutionary processes of geological cycles, providing information on derivation and dating of igneous rocks [1, 4]. Interest in REEs is growing due to their extensive utility in modern industry such as metallurgy, oil refinery, glass, ceramics, electronics, nuclear engineering as well as in high technology