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Radioactivity and geochemical characteristics of post collision granites, west Wadi Murrah area, South Eastern Desert, Egypt

A.H. El Afandy, Kh, M. Fawzy*, H.M. Assran, E.K. Abu Zeid, J.B. El Shayip

Nuclear Materials Authority, Cairo, P. O. Box. 530, El Maadi, Egypt

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ABSTRACT

Wadi Murrah area is located in the southern Eastern Desert of Egypt comprising four distinct lithological groups: Ophiolitic assemblage (dismembered ophiolitic rocks and ophiolitic mélange), arc assemblage (metavolcanics, metagabbros and older granites), post-collision granites (monzogranite, syenogranite and alkali feldspar granite), dykes and quartz veins. The post collision granites are originated from metaluminous, subalkaline magma in extensional suite. They were developed in within plate tectonic setting and have A_2-type character which means that these granites were generated from apparent crustal source via fractional crystallization. The similar chondrite-normalized REEs distribution patterns of these granites reveal that they may be derived from the same source magma. Uranium and thorium were mainly controlled by primary magmatic processes. They are mainly present in accessory minerals such as allanite, zircon, sphene and apatite.

1. Introduction

Wadi Murrah area is located in the southern part of the Eastern Desert at about 250 km southeast Aswan city. It is situated north to Wadi Allaqi covering about 530 km^2 and delineated by longitudes 33° 43′ to 33° 52′ E and latitudes 22° 24′ to 22° 30′ N (Fig. 1a).

A-type granitic rocks have drawn the attention of many workers in the last decades, but their origin is still subject of debate. There are three main models to explain the source of A-type granite magma: (1) melting of felsic crust (e.g., Clemens et al., 1986; Creaser et al., 1991); (2) derivation from a mantle-derived mafic magma (e.g., Turner et al., 1992; Litvinovsky et al., 2002; Vander Auwera et al., 2003), and (3) mixing of crustal and mantle sources (e.g., Foland and Allen, 1991; Frost and Frost, 1997).

The Arabian-Nubian Shield consists of Neoproterozoic juvenile crust evolved by accretion and assembly of island-arc terrains between 850 and 550 Ma in the framework of the Gondwana supercontinent (Stern, 1994, 2002, 2008; Nehlig et al., 2002; Stern and Johnson, 2010). The evolution of the ANS records three main tectonic stages of intra-oceanic subduction (850-700 Ma), collision and terrain amalgamation (700–635 Ma), and tectonic escape, strike-slip faulting and extension (635–550 Ma) of the newly formed continental crust (Genna et al., 2002; Johnson and Woldehaimanot, 2003; Be'eri-Shlevin et al., 2009a; Eyal et al., 2010; Stern and Johnson, 2010; Johnson et al., 2011). Post-collisional calc-alkaline to alkaline A-type granites (e.g., Be'eri-Shlevin et al., 2009b; Eyal et al., 2010; Ali et al., 2009, 2012; Moreno et al., 2012; Moghazi et al., 2012) intrude older K-rich calc-alkaline I-type granitic rocks (Johnson, 2003; Eyal et al., 2010).

Different models have been proposed for the sources of the post-collisional A-type granites of the Arabian-Nubian Shield which invoke contrasting continental crust and mantle reservoirs (e.g., Katzir et al., 2007; Be'eri-Shlevin et al., 2009a, 2010; Ali et al., 2009, 2014; Eyal et al., 2010; Farahat and Azer, 2011; Moghazi et al., 2011, 2012; El-Bialy and Hassen, 2012). These models are not conclusive, because none of them could assess the crustal versus mantle contributions to explain the radiogenic isotopes and the juvenile character of the A-type magmatism (e.g., Eyal et al., 2010; Moreno et al., 2014). Some of the post-collisional A-type granite plutons in the ANS are characterized by a marked enrichment in granitophile trace elements and valuable metals of economic interest, e.g. Nb, Ta, Zr, Th, U, Y, Sn and rare earth elements (REE).

Three different processes have been suggested to explain the rare metals endowments in the granitic rocks: (1) enrichment controlled by magmatic processes (i.e. fractional crystallization) (Lehmann, 1982, 1987; Pollard et al., 1987; Raimbault et al., 1991;

* Corresponding author. Geology Department, Faculty of Science, Aswan University, Egypt.
E-mail address: fawzik20@gmail.com (K.M. Fawzy).

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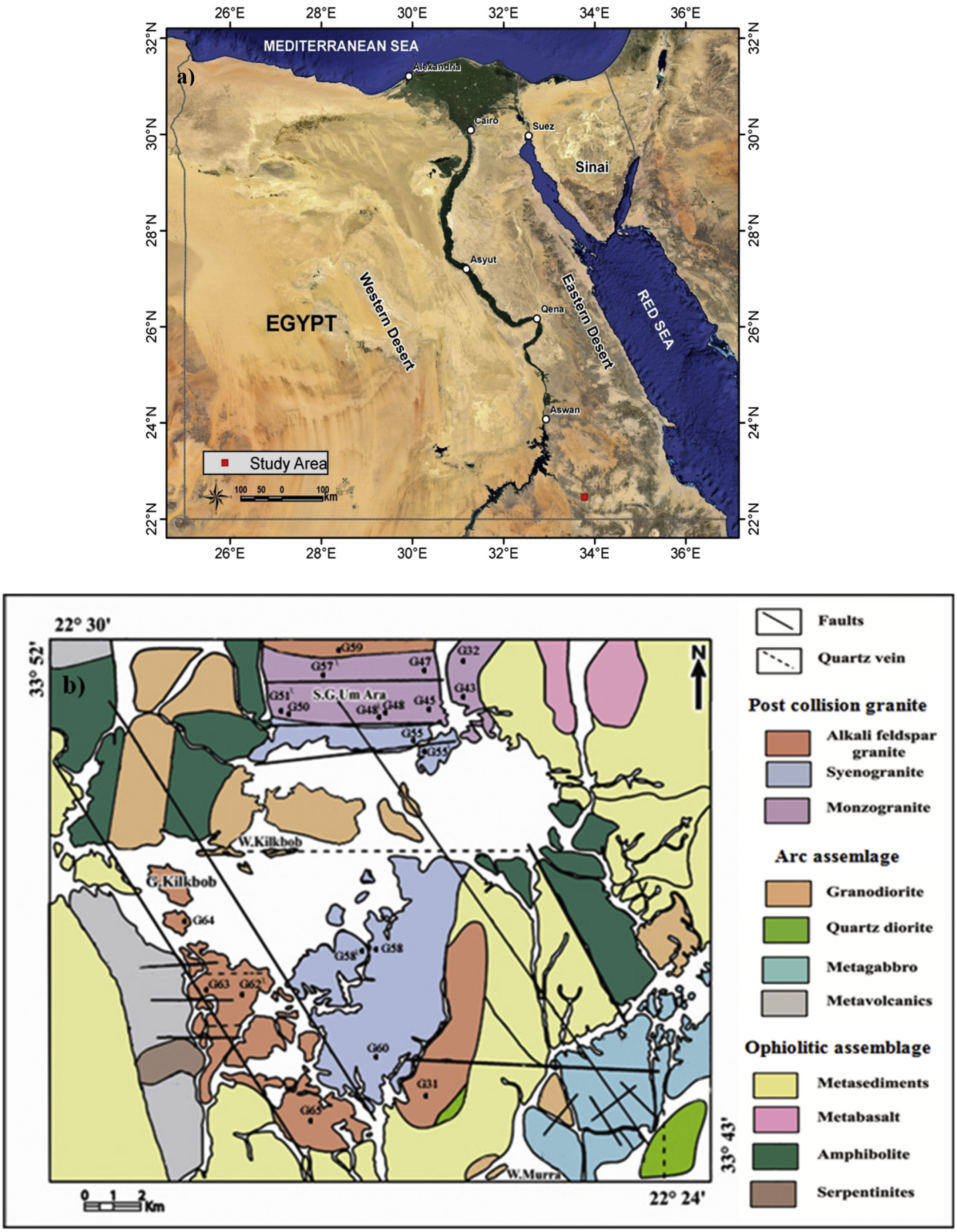

Fig. 1. a) Location map of west Wadi Murrah area, South Eastern Desert, Egypt. b) Geologic Map of west Wadi Murrah area (after Nasr and El sherbeni, 2001).

Cuney et al., 1992), (2) volatile-phase transfer and complexation of rare metal elements and REE with F, Cl, CO2 (Webster and Holloway, 1988; Audétat et al., 2000; Webster et al., 2004; Salvi and Williams-Jones, 2005; Schönenberger et al., 2008; Agangi