



## A-type granite of the Hasan Robot area (NW of Isfahan, Iran) and its tectonic significance

M. Mansouri Esfahani<sup>a,\*</sup>, M. Khalili<sup>b</sup>, N. Kochhar<sup>c</sup>, L.N. Gupta<sup>c</sup>

<sup>a</sup> Department of Mining Engineering, Isfahan University of Technology, Isfahan, Iran

<sup>b</sup> Department of Geology, The University of Isfahan, Isfahan, Iran

<sup>c</sup> CAS in Geology, Punjab University, Chandigarh 160 014, India

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### ABSTRACT

The Late Precambrian Hasan Robot Granite occurs in the northwestern part of the Sanandaj–Sirjan Zone NW of Iran. The granitoid rocks are composed of biotite-bearing syenogranite, alkali-feldspar granite and minor amount of monzogranite. The main minerals are quartz, microcline, plagioclase (albite–oligoclase), green biotite, and amphibole (ferrohornblende) with subsolvus to subordinate hypersolvus affinities.

Chemically, the rock suite is characterized by high SiO<sub>2</sub>, Fe/Mg, total alkali (K<sub>2</sub>O, Na<sub>2</sub>O), Zr, Nb, Y, Hf, Ta, Ga/Al, and REE (except for Eu), and low contents of MgO, CaO, P<sub>2</sub>O<sub>5</sub>, and Sr. They display A-type characteristics, being ferroan, alkali–calcic to calc–alkalic and metaluminous to peraluminous with minor of peralkaline nature. Crystallization of such magmas has produced the iron-enrichment and alkali composition of the Hasan Robot Granite which likely occurred in an extensional environment. Low abundances of Ba, Sr, P, Ti, Eu, the positive correlation between Ba and Eu anomalies, and the negative correlation between Rb and K/Rb reveal fractional crystallization of alkali feldspar produced at the final compositions of these granites. The low ratios of Y/Nb (<1.2) as well as the ferroan composition of these rocks suggest that they are fractionation from mantle derived magma related to Within Plate Granite (WPG) field.

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### 1. Introduction

The Sanandaj–Sirjan Zone (SSZ) with a NW–SE orientation, is a part of Zagros orogen (Alavi, 1994), and is considered as an aborted rift (Rashidnejad-Omran et al., 2002). The belt with 1500 km length, and a width of approximately 200 km, consists of metamorphic complexes of deformed rocks in association with widespread deformed and undeformed plutonic as well as Mesozoic volcanic rocks (Shabanian et al., 2009) (Fig. 1). For the past 40 years, the occurrence of numerous granitic plutons in the SSZ has been under extensive geological investigations.

Thiele et al. (1968) identified three different magmatic events in the Golpayegan area (about 50 km west of the study area) (Fig. 1). The first event which is the oldest one (Late Precambrian) is characterized by three plutonic bodies viz. (i) The Muteh Granite, (ii) the Hasan Robot Granite, and (iii) the granites occurring in the northern area of Golpayegan city. The second event, consisting predominantly of biotite granodiorite to granite, is located near Aligudarz city (about 80 km west of Hasan Robot Granite). These rocks intruded into a Jurassic shale–sandstone sequence displaying either crustal origin (e.g. Muteh, Azna and Kolah-Ghazi Granites) (Othroy, 1988; Tabatabaei-Manesh, 1994; Noghreian and Tabata-

baei-Manesh, 1995; Khalili and Khalili, 2002; Moazzen et al., 2004), or crustal–mantle origin (e.g. Aligudarz Granites) (Bagherian and Khakzad, 2001) and are genetically linked to syn-collisional and post-orogenic tectonic settings. The third episode which is predominantly diorites and gabbro–diorites intruded into the marl–shale sequence of upper Cretaceous. According to some authors (Turkian, 2008; Tahmasebi, 2009) the granitoid rocks exposed in the south of Qorveh and Astaneh are most commonly classified as volcanic arc granite (VAG) related likely to active continental margin. Recently, a number of workers (Mansouri Esfahani, 2003; Sepahi and Athari, 2006; Davoudian et al., 2007; Shabanian et al., 2009) reported the anorogenic and/or post-orogenic alkaline granites (A-type) from several localities (Hasan Robot, Saqqez, Golpayegan and Ghaleh-Dezh) in the Sanandaj–Sirjan structural zone.

For the purposes of the present study we use field relationships, petrography as well as major and trace element chemistry to constrain the petrogenesis and tectonic setting of the Hasan Robot Granitic magma. The area under investigation is situated about 140 km northwest of Esfahan (Fig. 2).

### 2. Field relations

The Hasan Robot Granite lies between 50°45′–51°00′ longitude and 33°15′–33°30′ latitude and is located in the central part of the

\* Corresponding author.

E-mail address: [mmansouri\\_2001@yahoo.com](mailto:mmansouri_2001@yahoo.com) (M.M. Esfahani).