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Geochemistry of mylonitic tourmaline-bearing granite- gneiss pluton in the northeast of June mine

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Introduction

Studied mylonitic granite-gneiss body is located in the Northwest of the Azna region in the Lorestan province close to the June dimension stone mine. It is a part of the metamorphic-magmatic complex including granite-gneiss, amphibolite, marble and schist. The crystalline basement is attributed to late-Neoproterozoic and it indicates a Panafrican basement, which yields a laser-ablation ICP–MS U–Pb zircon ages of 608 ± 18 Ma and 588 ± 41 Ma (Shakerardakani et al., 2015). There are two granite-gneiss plutons in the complex that are Galeh– Dezh (Shabanian et al., 2009), and June plutons. The Galeh-Doz pluton are previously proposed as syn-deformation pluton with a major S-shaped bend which has been imparted during dextral shearing with a Late Cretaceous (Mohajjel and Fergusson, 2000). However, new age dating on the pluton using U–Pb in the magmatic zircon produced the late-Neoproterozoic dates (Nutman et al., 2014; Shakerardakani et al., 2015). The granite-gneiss plutons show mylonitic fabrics and microstructures (Shabanian et al., 2010). The geochemical characteristics of mylonitic granite-gneiss body near June mine in NW Azna, is in the focus of our research.

Materials and methods

Petrographic investigations of 30 thin sections were made. Then eight samples were selected and analyzed for whole rock major, trace and REE compositions by ICP-emission spectrometry and ICP-mass spectrometry using natural rock standards as reference samples for calibration at the ACME Analytical Laboratories in Vancouver, British Columbia, Canada.

Results

The studied gneiss- granitic body has lepido-granoblastic texture as its major texture. It variably shows evidence of dynamic deformation from ultramylonite to protomylonite. The gneiss-granite consists of quartz, alkali feldspar (mostly as perthite), plagioclase, biotite, white mica (muscovite and phengitic muscovite). Accessory phases in the granitoid include, tourmaline, zircon, magmatic epidote, allanite, apatite, and magnetite. The mylonitic gneiss-granite has a mantled porphyroclast texture that may be characterized by large asymmetrical porphyroclasts of K-feldspar and plagioclase with a mantle which includes white-mica, biotite, quartz and feldspar aggregates. Some of the petrographic evidence show dynamic deformation during the crystallization such as grain boundary migration (GBM) or sub-grain rotation (SGR), patchy perthite. Evidence of strain, such as deformation twins, bent or curved twins, undulatory extinction occur characteristically in plagioclase and display dynamic deformation in solid state. The rocks exhibit identical compositional ranges with 71.24–78.35 wt.% SiO2; high levels of alkalies (Na_2O ranges from 3.07 to 4.02 %, K_2O varies from 4.18 to 5.53 %); low levels of $Fe_2O_3^{tot}$ (0.80 to 2.60 %). Also, the trace element compositions display significant variations, such as Zr (157.7-330.5 ppm), Eu (0.07-0.28 ppm), Nb (40.9-77.3 ppm), Ga (19.7-25.97 ppm). The studied rocks are strongly enriched in LREE and HFSE and show a strong

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depletion in Ba, Sr, Eu and Ti and enrichment in Rb and Zr. The element contents are also similar to typical A-type granite (Whalen et al., 1987). The rocks are alkali to alkali-calcic, metaluminous to mildly peraluminous granite and ferroan in new geochemical classification scheme for granitoids (proposed by Frost et al., 2001).

Discussion

The chondrite-normalized rare-earth element patterns of the mylonitic gneiss- granitic rocks indicate the LREE over HREE fractionation with significant negative Eu anomalies. Primitive-mantle-normalized spidergrams (Sun and McDonough, 1989) normalized trace element patterns with negative Ba and Nb anomalies, and positive Rb, Th and Ce anomalies, simulate the collisional and post-collisional granitoids of Pearce et al (Pearce et al., 1984). All of the samples fall in the A2 group in Eby classification (Eby, 1992). On the tectonic discrimination plots, the granites show a within-plate granite (WPG) character (Pearce et al., 1984).

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