Journal of Economic Geology
Vol. 10, No. 1 (2018)
ISSN 2008-7306

زمین‌شناسی اقتصادی
جلد ۱۰، شماره ۱ (سال ۱۳۹۷)
صفحات ۱۱ و ۱۲

# Geochemistry and petrogenesis of the Kolah-Ghazi granitoid assemblage, south of Esfahan

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Submitted: May 2, 2016
Accepted: Feb. 11, 2017

**Keywords**: *Calc-alkaline, S-type granite, Jurassic, Kolah-Ghazi, Sanandaj-Sirjan*

## Introduction

The Kolah-Ghazi granitoid assemblage is located in the south of Esfahan and in the Sanandaj-Sirjan magmatic-metamorphic zone. The Sanandaj-Sirjan zone is extended for 1500 km from Sirjan in the southeast to Sanandaj in the northwest of Iran and is situated in the west of Central Iranian terrane.

The Sanandaj-Sirjan zone represents the metamorphic belt of the Zagros orogeny which is part of the Alpine- Himalayan orogenic belt. The Kolah-Ghazi granitoid assemblage consists of granodiorite, granites, quartz-rich granitoid and minor tonalite. The aim of this paper is to represent the mineralogy, geochemistry, petrogenesis and tectonic setting of this plutonic assemblage.

## Materials and methods

More than 60 samples representing all of the rock units in the study area were chosen for microscopic studies. Then, 22 samples were selected for geochemical studies. The major elements were determined with XRF in the Naruto University, Japan. The trace and rare earth elements were analyzed by ICP-MS in the Acmelab, Canada. The geochemical results are presented in Table 1.

## Results and Discussion

The Kolah-Ghazi granitoid assemblage intruded into the Jurassic sedimentary units and overlaid by lower Cretaceous sandstone and conglomerate which suggest Upper Jurassic as the possible age of the Kolah-Ghazi intrusion. Based on the modal studies, this granitoid assemblage is comprised of granite, granodiorite, quartz-rock granitoid and tonalite with different igneous textures including symplectic, myrmekitic, rapakivi, poikilitic and porphyroid. There are some xenoliths, microgranular enclaves and sur micaceous enclaves in the Kolah-Ghazi granitoid assemblage. Xenoliths are mostly derived from Jurassic shale and sandstones which have been trapped in the magma. The sur micaceousenclaves have tonalite composition. The sur micaceous enclaves are biotite-rich rock fragments which display metamorphic texture. The sur micaceous enclaves are classified as restite since they are poor in quartz. The essential minerals in this magmatic assemblage are quartz, plagioclase, alkali-feldspar and biotite as the only ferromagnesian mineral. There was no hornblende in the studied samples. The presence of andalusite, sillimanite and garnet in these rocks point to the sedimentary source of these granitoid melts. Zircon, apatite and opaque minerals occurred as accessory minerals. The secondary minerals included sphene, tourmaline, clay minerals, chlorite and opaque minerals. The Kolah-Ghazi rock samples plot on the granite and granodiorite fields on the geochemical classification diagrams. The geochemistry of these

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DOI: 10.22067/econg.v10i1.55622

plutonic rocks show peralunimous, high K-calc alkaline features. On the Harker variation diagrams, it can be observed that the $Al_2O_3$, FeO, MgO, $TiO_2$ and CaO contents decrease with the increase in $SiO_2$, whereas $K_2O$ and $Na_2O$ show an ascending trend with increasing $SiO_2$. Moreover, the fractionation of plagioclase and the crystallization of alkali-feldspar caused the observed trends of Rb and Sr in the Harker diagrams. Ba contents decrease with increasing $SiO_2$ which is relevant to the biotite fractionation. All of the analyzed samples show similar patterns in the chondrite-normalized trace elements and the REE diagrams. All samples show LILE and LREE enrichment and HFSE and HREE depletion. The negative anomaly of Sr may be related to the lack of calcic-plagioclase in these samples or suggest the plagioclase rich restite during partial melting of the parental rock. The latter is in agreement with the Eu anomaly that appeared in the REE diagram. All of the Kolah-Ghazi samples show linear trends in the major and trace elements versus $SiO_2$ diagrams and display similar REE patterns suggesting close relationship in the source and magmatic history.

The field, petrography and geochemical evidences such as pegmatit veins in the pluton, biotite rich enclaves, lack of hornblende and titanite, occurrence of metamorphic minerals (e.g., garnet, andalusite and sillimanite), the predominance of ilmenite, A/CNK values (A/CNK >1), and crondom contents (more than 3% in norm) suggest that the Kolah-Ghazi plutonic assemblage can be classified as S-type granitoids. Moreover, all of the Kolah-Ghazi samples plot on the S-type field of the granite classification diagrams (Whalen et al., 1987; Chappell and White, 1992) which is in good agreement with mineralogical evidences.

The sedimentary source, mostly shale and greywacke, can be suggested for Kolah-Ghazi melts according to the Rb/Sr vs. Rb/Ba diagram (Sylvester, 1998). Several discrimination diagrams such as Rb vs. Ta+Yb (Pearce et al., 1984) and R1-R2 (Batchelor and Bowden, 1985) were used to determine the tectonic setting of the Kolah-Ghazi granitoids. The Kolah-Ghazi samples lied between the fields of magmatic arc and syn-collisional granitoids in the discrimination diagrams.

The geochemistry of the studied samples suggest a syntectonic environment for the Kolah-Ghazi granitoids which may be related to the late Cimmerian orogenic phase.

## References


Batchelor, R.A. and Bowden, P., 1985. Petrogenetic interpretation of granitoid rock series using multicationic parameters. Chemical Geology, 48(1): 43–55.

Chappell, B.W. and White, A.J.R., 1992. I- and S-type granites in the Lachlan Fold Belt. Transactions of the Royal Society of Edinburgh, Earth Sciences, 83: 1–2.

Pearce, J.A., Harris, N.B.W. and Tindle, A.G., 1984. Trace Element Discrimination Diagrams for the Tectonic Interpretation of Granitic Rocks. Journal of Petrology, 25(4): 956–983.

Sylvester, P.J., 1998. Post-collisional strongly peraluminous granites. Lithos, 45(1-4): 29–44.

Whalen, J.B., Currie, K.L. and Chappell, B.W., 1987. A-type granites: geochemical characteristics, discrimination and petrogenesis. Contributions to Mineralogy and Petrology, 95(4): 407–419.