Petrology and geochemistry of Natanz plutonic rocks, central Iran

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The study area is located in the central province of Iran (north of Esfahan). The Neogene igneous rocks in this area are situated in Urumieh Dokhtar volcanic arc which is part of Zagros orogenic belt and consequently part of Alpian Himalyan orogenic belt.

The Oligo-Miocene Natanz complex intrudes Eocene volcanics of this area. The contacts of the intrusions with the volcanic rocks are sharp, epidotized and include volcanic xenoliths.

This complex consists mainly of coarse to medium grained gabbro, diorite, quartz diorite, quartz monzonite, granodiorite and granite, which acidic ones contain a number of mafic microgranular enclaves and are intruded by aplite dikes. The Natanz rocks are characterized by enrichment in large ion lithophile elements (LILE) such as Rb, Ba, Th and slightly depletion in high field strength elements (HFSE) such as Yb, Y, Nb and Zr (except for granites). The chondrite normalized REE patterns are characterized by moderate LREE enrichment [(La/Yb) N = 2.15.22] and unfractionated HREE [(Gd/Yb) N = 1.15 to 1.38]. Gabbro and diorite with the least fractionated HREE and a general absence of Eu anomalies suggest the involvement of plagioclase and absence of garnet during the melting processes. Granites with the highest (La/Yb) N values and pronounced negative Eu anomalies are more differentiated products. These geochemical data suggest that the Natanz granitoid stock has the characteristics of metaluminous, calc-alkaline, I-type granite formed in a volcanic arc setting. The subduction of the Neotethys oceanic crust beneath the central Iranian microcontinent in Neogene time could have accounted for the continental arc volcanism in this area. The major and trace element signatures of gabbros indicate they were crystallized from high aluminium basaltic magmas, which were generated from metasomatised upper mantle. Dehydration of subducted oceanic crust and partial melting of mantle wedge caused partial melting of subcontinental lithosphere, which resulted in the formation of metasomatised and enriched mafic arc magmas, at variable water fugacity and led to the formation of the Natanz granitoid rocks as well as distinct enrichment peaks of fluid-sensitive trace elements such as Pb in N-MORB normalization, clearly indicating that all studied granitoids are derived from refertilised mantle above subduction zones.

Whole-rock compositional data indicate that differentiation occurred via fractional crystallization with magma mixing, in this complex.

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