Geochemistry, petrogenesis, and tectonic setting of the Almogholagh batholith in the Sanandaj–Sirjan zone, western Iran

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A B S T R A C T
The Almogholagh batholith in the northern Sanandaj-Sirjan magmatic–metamorphic zone comprises three intrusive bodies (gabbroic diorite, quartz syenite, and quartz monzonite) that were generated during the northeastward subduction of Neo-Tethys beneath the Iranian sector of the Eurasian plate. These bodies intruded at different time phases and are related to post-collision magmatism. The quartz syenite and quartz monzonite rocks with specifications of metaluminous, generally ferroan, alkalic to alkali-calcic types, high content of Na2O + K2O, Zr, Ce, Ga, Y, Nb, Ta, and rare earth elements, and depletions in Eu, Sr, and Ti show borderline characteristics between A2 and A3 types granitoids but with more affinity to A2 type. The gabbroic dioritic rocks show borderline specifications between A2 and I types rocks but with more affinity to I type. Distinctive spiked peak patterns in spider diagrams accompanied by (La/Yb)CN values equal to 2.44 to 6.11 and a Ba/La ratio >3 indicate the magmatism activity in the volcanic arc environment. The characteristics (Ba/Rb)PN < 1, (Ba/Th)PN < 1, and Th/Ta ratio from 3.18 to 8.42 suggest the magmatism activity of the continental margin setting. The specifications of post-collision magmatic activities, 43Nd/144Nd > 0.512638 in some samples, εNd > 0, εSr > 0, and high content of Nb, Ta, and Zr (589 ppm) demonstrate the involvement of the mantle source, subducted slab fluids, high flux of mantle-derived halogen-rich volatiles, and contamination within the crust during the petrogenesis of intrusions. After the initial collision, the operation of minor subduction (with slab break-off) or foundering of the lithospheric mantle (delamination) occurred because of asthenospheric upwelling and heat flows in the mantle in the Sanandaj-Sirjan zone. Stretch and local disruptions were created by these heat flows; simultaneously, magma was formed and ascended upward.

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1. Introduction

The southwestern part of Iran was divided into three parallel NW–SE trending tectonic zones (Alavi, 1994), namely, the Zagros thrust and fold belt, the Sanandaj-Sirjan zone (SSZ), and the tertiary–quaternary Urumieh-Dokhtar magmatic arc (UDMA) (Fig. 1), which is an integral part of the Alpine–Himalayan orogenic system that resulted from the Arabian-Central Iranian microplate continental collision after the subduction of the Neo-Tethys oceanic crust beneath Central Iran (Sengor, 1984). SSZ was geographically subdivided into southern (S-SSZ) and northern (N-SSZ) parts by Eftekharnejad (1981) (Fig. 1). During the Paleozoic period, SSZ was a part of northeast Gondwanaland and separated from the Eurasian plate by the Paleo-Tethys Ocean (Golonka, 2004). During the Middle to Late Triassic, coeval with the closure of the Paleo-Tethys in the north and a rifting episode along the Zagros belt resulted in the opening of a new ocean called Neo-Tethys. SSZ was separated from the Arabian plate (Gondwanaland) as a part of Eurasia. The in inception of the subduction of Neo-Tethys is inferred to have occurred during the Late Triassic-Early Jurassic (Berberian and Berberian, 1981). This phenomenon deformed rocks and several intrusive bodies in S-SSN (Late Triassic) and emplaced numerous intrusive bodies ranging from gabbro to granite in N-SSZ (Fig. 1). The ages of zircon U-Pb imply that many SSZ granitoids were emplaced during the Middle Jurassic (e.g., Shahbazi et al., 2010; Mahmoudi et al., 2011; Esna-Ashari et al., 2012; Ahmadi Khalaj et al., 2007), Middle to Late Cretaceous (e.g., Ghalamghash et al., 2009), and Early Eocene (Mazhari et al., 2009). The closure of the