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Petrological constraints on the origin of the plutonic massif of the Ghaleh Yaghmesh area, Urumieh–Dokhtar magmatic arc, Iran

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ABSTRACT

The Oligocene Ghaleh Yaghmesh plutonic massif (GYPM) consists of diorite, quartz-diorite, tonalite and granodiorite and evolving from metaluminous nature. All the samples are predominantly medium-K calc-alkaline series, having typical characteristics of I-type granitoids. A significant geochemical criteria of the GYPM is the impoverishment of high-field-strength elements (HFSE) (e.i. Zr, Nb, Ti and Hf) and the overabundance of large-ion-lithophile elements (LILE) (e.i. K, Sr, U, Ba and Cs), with respect to the light rare elements (LREE) as compared to chondritic concentration. These geochemical criteria suggest the involvement of sedimentary components in the generation of rocks studied. Furthermore, variable Pb/Ce amounts, linear trend of all rocks studied on Ti/Zr vs. Yb/Hf diagram, as well as some characteristics petrographic features (e.i. acicular apatite, corroded margin of the plagioclases, the amphiboles and some of the pyroxenes, oscillatory zoning of plagioclases) and the presence of mafic microgranular enclave (MME) indicate that the Ghaleh Yaghmesh parental magma was likely generated by the partial melting of a mixed source dominantly composed of amphibolite and possibly meta-sedimentary source. The overall geochemical and petrographic features are consistent with the interpretation of the Urumieh–Dokhtar Magmatic Arc as an active continental margin during subduction of the Neo-Tethyan oceanic crust underneath the Central Iranian microcontinent.

1. Introduction

Granitoids are the major components of the continental crust and are of prime importance in understanding the geodynamic evolution of the Earth's crust. The diversity of the origin of these rocks stressed by Read (1957) had led different authors to propose that granitoids are not simple in their origin and might be produced in more ways than one. On this account, for the past several years, many petrologists used a variety of characteristics to subdivide the granitoid rocks. Such proposals have been put forward by Chappell and White (1974) for the granitoids of southeastern Australia. They divided these rocks into two distinct types, S- type granites which are interpreted as being derived from partial melting of meta-sedimentary source rocks and are always of peraluminous nature and contain excess Aluminum hosted in Al-rich biotite, cordierite, or muscovite. I-type granites are produced either directly by fractional crystallization of mantle-derived liquids, direct partial melting of mantle-derived source rocks in the crust, or melting of mantle modified by silicic melts. Therefore, basaltic to andesitic rocks are invoked as the source materials for I-type granites (Chappell and White, 1992; Pitcher, 1993). These granitic rocks are classified into low-and high-temperature I-type granites (Chappell and White, 1984, 1992; Chappell et al., 1998). The "low temperature" (Caledonian I-type granites) generated by partial melting of quartzo-feldspathic crust at temperatures of ~700–800 °C. These rocks are characterized by the presence of inherited zircons and are commonly associated with S-type granites (Pitcher, 1993).

The "high-temperature" I-type granites are the most primitive and originated by partial melting of mafic rocks in the deep crust, or possibly in subduction-modified mantle at magmatic temperatures higher than 1000 °C (Chappell et al., 1998) These granites, called

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