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# Mesozoic alkaline plutonism: Evidence for extensional phase in Alpine-Himalayan orogenic belt in Central Alborz, north Iran

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**Abstract**

The Kamarbon Jurassic alkaline basic intrusion crops out in Central Alborz, north Iran, along the northern margin of the Alpine-Himalayan belt. The intrusion includes foid gabbros at the margins and foid monzodiorites towards the center. The foid monzodiorites are considered as the evolved melts after the fractional crystallization mostly of olivine and clinopyroxene from a foid gabbro parental magma. Based on mass balance calculation the evolution of the Kamarbon alkaline gabbro could be explained by 19.2% fractionation of clinopyroxene, 13.8% of olivine, 3% of plagioclase and 1.0% Ti-Magnetite, with 63% of residual liquid. REE inversion modeling indicates that the Kamarbon intrusion magma was generated by low degrees (<3%) of partial melting from a garnet-bearing mantle source. In primitive mantle-normalized incompatible element diagrams, the Kamarbon rocks show enrichment in LILE elements (Ba, Rb, Sr and Th), HFSE elements (Nb, Ta, Ti, Zr and Hf) and P and depletion in K, Y and HREE (Yb, Lu) which are similar to patterns of HIMU-OIBs or intraplate alkaline magmas. According to the existence of extensional phases and occurrence of different rifting during late Triassic to middle Jurassic in Central Alborz, the formation of Kamarbon intrusion could be related to an intracontinental rifting.


*Keywords:* Kamarbon; Foid gabbro; Foid monzodiorite; Central Alborz; Iran

## 1. Introduction

Defining the characteristics of alkaline magmatism is a key to figure out the nature of its mantle origin, although its abundance at the earth's surface is small (Gast, 1968; Green and Ringwood, 1967; Kushiro, 1968). Alkaline mafic rocks are typically associated with continental rifting or intraplate continental and oceanic settings, usually generated by the partial melting of asthenospheric mantle (Ernst et al., 2005; Ganguly, 2005; Lustrino and Carminati, 2007; McKenzie and Bickle, 1988; White and McKenzie, 1989; Wilson and Downes, 1991). The study of alkaline rocks are useful to investigate the mantle characteristics and processes like fractional crystallization, magma mixing and crustal contamination that play important roles in the evolution of magmas (Wilson, 1989; Rollinson, 1993; Best, 2002; McBirney, 2006; Pilet, 2015). Investigating the geochemistry and petrology of alkaline rocks clarify the efficacy of these processes in magmatism of orogenic belts.

Kamarbon intrusion in the northern part of central Alborz is a part of the Alpine-Himalayan orogeny that formed in late Triassic to upper Jurassic and associated with Mesozoic shales and silts of Shemshak Formation (Saidi and Ghassemi, 1993) (Fig. 1).

In Central Alborz, the outcrops of plutonic rocks allow for an investigation of the Mesozoic intrusive magmatism of the Alpine Himalayan orogeny. Little is known on the Paleozoic and Mesozoic igneous activity in the Central Alborz, and only few aspects are known for the Cenozoic activity. No

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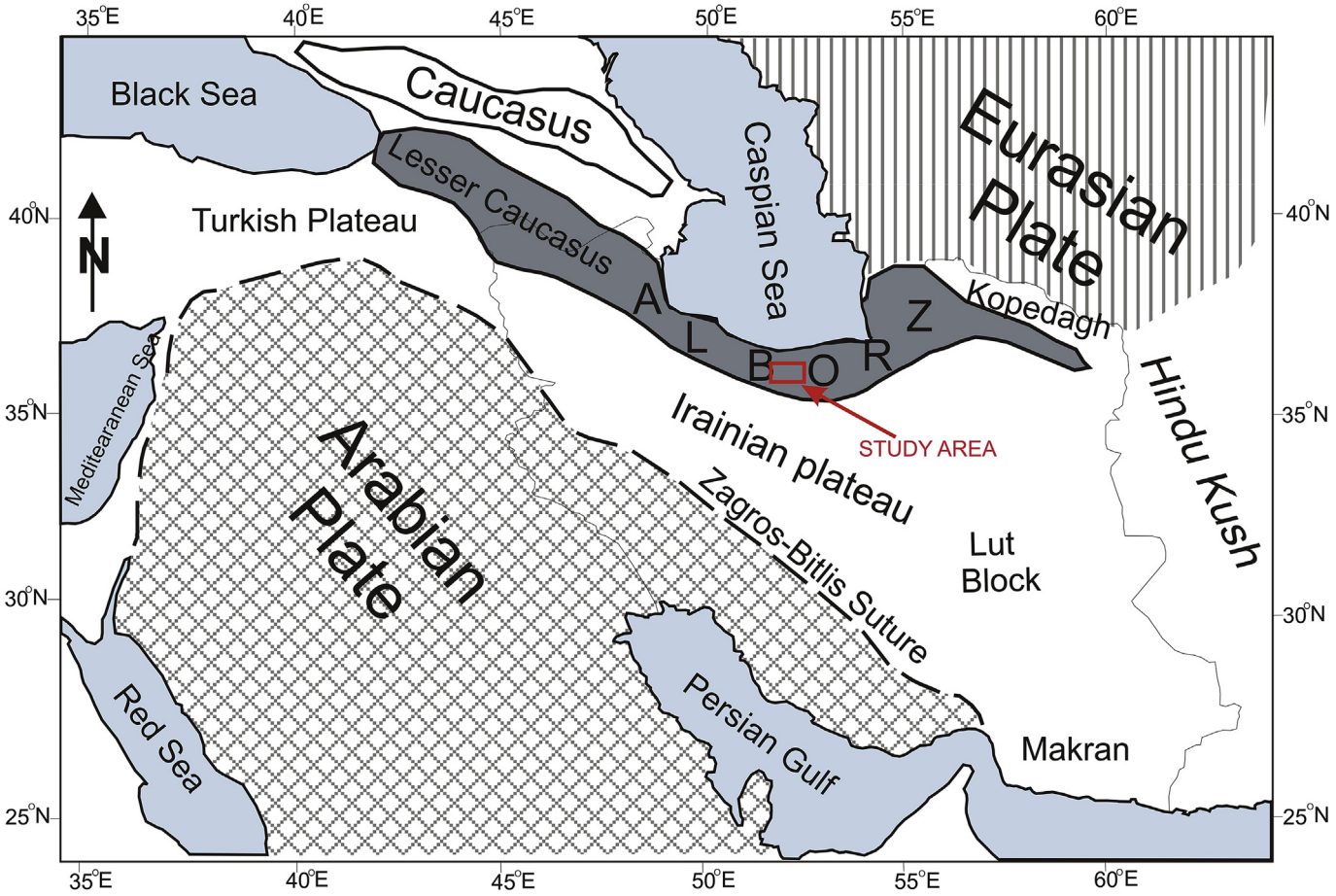


Fig. 1. General tectonic map of Iran with Arabian and Eurasian plates and the location of the study area in Central Alborz.

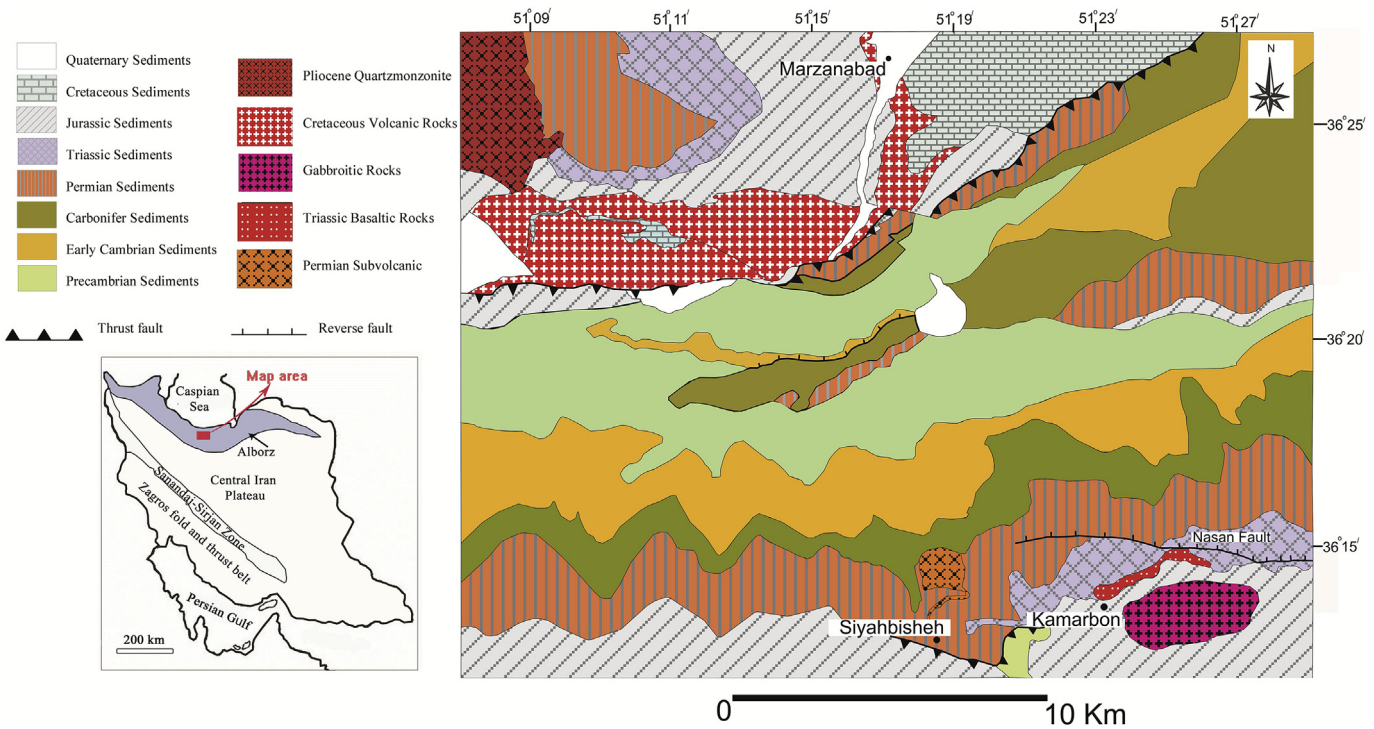


Fig. 2. Geological map of the study area. Modified from the geological map of 1/100000 Marzanabad, Iran.

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