Geochemical interpretation of origin of Garr Mountain in northeast Iran by select chemical signature

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The intrusive tonalite and associated sodic subvolcanic dacitic rock masses of Pliocene-Quaternary age of Garr mountain are located in northeast Iran within the ophiolotic suite of Sabzevar region. The origin of rocks of this mountain has similar composition to typical tonalite-trondhjemite-granodiorite. These rocks are results of partial melting of basaltic material which were formed with mineral assemblage of amphibole ± pyroxene ± garnet. They mostly contain Al_2O_3 > 15% and Y < 18 ppm. The light rare earth elements are enriched and have characteristic ratio of 2 < La / Yb < 30 , and distinct anomalous values of Eu^{2+}.

The studied rocks show a wide range values of $\mathcal{E}\ Nd_{(t)}$ (+4.5 to -6.8), and $\mathcal{E}(Sr_{(t)}$ (-3.7 to +293.4). Investigations of isotopic Pb data reveals that the main components of original magma is granitic and variations of Nd and Sr isotopes gives an age of Pliocene-Quaternary. Trace element studies along with the isotopic data confirms that this rock mass has originated from basltic-andesitic magmatic mixing along with partial melting of lower crustal basalts in Pliocene time.

Low amounts of heavy rare earth elements with presence of Y proves garnet has acted as an important residual phase in partial melting of thick continental crust. In early stages of magma formation amounts of $\mathcal{E}\ Nd_{(t)}$ has increased, while $\mathcal{E}Sr_{(t)}$ decreased indicating formation of new continental crust. Deeper mantle processes of post Eocene subduction has caused enrichment of large ion lithophile elements with respect to large rare earth elements in the rock mass which is conclusive evidence of their formation in a compressive phase.