Geochronology, isotope geochemistry and tectonomagmatic setting of the Lalezar granitoids (Urumieh-Dokhtar Volcanic Belt, Iran)

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Abstract

The Lalezar granitoids crop out within the Urumieh-Dokhtar Volcanic Belt, which is the largest volcanic belt in Central Iran. These granitoids have intruded into the Eocene volcano-sedimentary rocks and range from gabbro-diorites to granites in composition, with dominance of diorites and tonalites.
Two of the least altered samples, 5-ln-7 and 23-ln-6, were selected for Rb–Sr geochronology. Biotite (Bt), hornblende (Hbl) and plagioclase (Pl) separates were obtained from both samples.
For sample 5-ln-7, using the data from the whole-rock and the three mineral separates, a $^{87}Sr/^{86}Sr$ vs. $^{87}Rb/^{86}Sr$ correlation corresponding to a 14.6±5.8 Ma age is obtained, with initial $^{87}Sr/^{86}Sr$=0.7055. However, the MSWD has a very large value (376). This is due to the fact that Hbl composition plots deviated from the alignement defined by WR, Pl and Bt, suggesting that some disturbance took place. Under the petrographic microscope, the amphibole grains in this sample show some low temperature alteration, as testified by chloritization and oxidation, which makes plausible that a late enrichement in radiogenic Sr could have affected hornblende. If Hbl is discarded, the result now is a 15.0±0.4 Ma Bt-Pl-WR isochron, with MSWD=2.4 and initial $^{87}Sr/^{86}Sr$=0.70517. Considering the errors, both results (with and without Hbl) overlap, which suggests that there was Sr isotope equilibrium at an age of ca. 15 Ma (most likely during igneous crystallization).
In the $^{87}Sr/^{86}Sr$ vs. $^{87}Rb/^{86}Sr$ diagram for sample 23-ln-6, the line obtained with Bt-Hbl-Pl-WR has a slope indicating an age of 15.8±1.6 Ma. The MSWD value is 18 and the initial $^{87}Sr/^{86}Sr$ ratio is 0.70533. The MSWD shows that the correlation is not perfect, and, as in the previous case, it probably reflects some minor alteration; once again, Hbl plots above the line that passes through WR, Pl and Bt. Taking the errors into account, the ages calculated for 23-ln-6 and 5-ln-7 overlap each other, suggesting that this set of data is geochronologically meaningful. Therefore, and considering that the studied rocks are shallow intrusives which should have not undergone a long cooling period, the obtained 15-16 Ma ages are probably dating the intrusive events.
For isotope geocchemistry, Sr and Nd isotopic compositions were determined for 14 whole-rock samples. Assuming an age of 15 Ma, initial $^{87}Sr/^{86}Sr$ and εNd values vary in restricted ranges from 0.70495 to 0.70565 and from +3.1 to +1.5, respectively. In the εNdi versus $(^{87}Sr/^{86}Sr)i$ diagram, this cluster plots to the right of the so-called mantle array and overlaps the field of island-arc basalts. The limited range of Sr and Nd isotopic compositions suggest that the Lalezar intrusions are co-genetic, deriving from the same parental magmas essentially by magmatic differentiation processes. Taking into account the IAB-like isotopic compositions of the studied rocks, the parental magmas may have been formed by partial melting in a supra-subduction mantle wedge. The occurrence of gabbrodioritic rocks in the Lalezar suite provides additional evidence in favour of an origin of the parental magmas by melting of mantle peridotites, rather than by melting of mafic crust.
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Keywords: Lalezar granitoids, Urumieh-Dokhtar Volcanic Belt , Rb-Sr geochronology, Sr-Nd isotope geochemistry.