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Modeling differentiation of Karaj Dam basement igneous rocks (northern Iran)

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The Karaj Dam basement igneous body (KDB) is located in the north of city of Karaj, 30 km from city of Tehran, which lies between 35° 50Ń to 36° 05Ń and between 50° 50É to 51° 15É. It is one of the several plutonic bodies within the E-W trending Alborz zone in northern Iran. Following the late Cretaceous orogenic movements, vast volumes of dacite, andesites and basaltic lavas with tuffaceous and other clastic sediments were deposited during Eocene time, forming Karaj Formation in central Iran and Albourz. The KDB is penetrated thorough middle and upper tuff units from Karaj Formation which is underlain by late Jurassic depositions (Shemshak Formation) and overlain by the Neogene red Conglomerates in regard to stratographic consideration. It is mainly composed of a layered series dominated by gabbro, diorite and monzonite, which is a rock sequence formed upward from the lower to upper chilled margins, respectively. The chilled margins, which have gabbroic in composition, show porphyritic texture with euhedral to subhedral plagioclase (andesine & labradorite) and pyroxene (augite) megacrysts up to 5 mm long. These rocks become coarse-grained inward and transform to equigranular texture gradually.In addition, a small fine-grained doleritic stock as well as some doleritic dykes is intrusive into the pyroclastic volcanic rocks of Karaj Formation. It is possible to observe doleritic enclaves included in the KDB, indicating that the KDB are slightly younger than the dolerites. Whole rock geochemistry and mineral chemistry of the plagioclase and pyroxene in various rock samples, suggest differentiation processes. The Mg# of the pyroxene and An% of plagioclase of the contact chilled samples can be used as an indication of the original magma and plotted between the gabbro and monzonitic samples. In addition, increasing of the Mg# within the whole rock samples from the upper of contact chilled, in comparison to the lower one, demonstrates elemental differentiation by the gravity diffusion. Moreover, Na2O, K2O and incompatible elements increase and MgO, Fe2O3, CaO and compatible elements decrease with the progress of the magma differentiation.
Indeed, after Eocene volcanic activities filled magma chamber, under the volcanic-subsiding basin of Karaj formation, penetrate magma in the form of doleritic stock. Then during evolvement of above mentioned layers folding, magma intrudes between middle and upper tuff unit in Asara shale altitude. These intrusion show chilled margins which are obvious by porphyritic texture. This chilled margin caused magma cool slowly and have sufficient time to produce different differentiated sequence by in-situ crystallization mechanism from Gabbro to Diorite and Monzonite. Thus mass transfer by convective induced thermal diffusion has occurred during formation of chilled margins and caused such concentration gradient. But the major mechanism for differentiation of layered series had been crystal fractionation and in-situ growth of crystals.