Geophysical Research Abstracts
Vol. 12, EGU2010-177-1, 2010
EGU General Assembly 2010

The origin of Karaj dam basement sill marginal reversal by Soret fractionation

Reza Maghdour-Mashhour and Dariush Esmaeily
Faculty of Geology, College of Science, University of Tehran, Iran (samer.mashour@gmail.com)

The Karaj dam basement sill (KDBS), located North West of Tehran, northern Iran, is one of the several E–W-trending plutons in the Albourz Mountains. The KDBS consists of a layered series between upper and lower chilled margins. The rocks of the chilled margins are gabbroic in composition and porphyritic, with euhedral to subhedral plagioclase and clinopyroxene megacrysts up to 5 mm long. The rocks become coarse-grained toward the center of the sill and show a gradual transition from porphyritic to equigranular texture. Field and petrographic observations reveal a reverse trend in marginal units crystallization from the eutectic point to the main magma composition; i.e., the olivine-bearing gabbro (porphyritic chilled margin), which has a eutectic composition, crystallized prior to the marginal gabbros, which have a cotectic or near-cotectic composition, as plagioclase laths in the gabbroic unit are embedded in large crystals of clinopyroxene and this phenomenon is believed to result from the cotectic crystallization of plagioclase and clinopyroxene. Four major mechanisms are proposed and discussed in order to find the exact mechanism responsible for marginal reversal formation as following: 1) Crystal settling is a gravity-dependent mechanism and phenocrysts must have settled to form a layer at the bottom of the sill, showing sharp upper boundary which is not observable in KDBS. Besides, the reverse fractionation of inwardly-dipping sequence of mentioned sill occurs in layers with primary dips up to 55°. Consequently capability of marginal reversals to develop along steeply inclined chamber margins, by this mechanism is implausible. 2) Multiple injections of successive magma pulses fails to explain the origin of marginal reversal since the transition along the entire length of marginal reversal is gradual also there is no compositional break or chilled contact between two mentioned units of KDBS margin (Olivine-gabbro and marginal gabbro). 3) The idea of supercooling could not be applied to the marginal series as well. Because the high degree of supercooling would make the marginal series with a fine-grained chilled margins which is far from being observed in KDBS. 4) Soret fractionation is the most probable mechanism among the others which has recently taken into account by researchers (e.g. Latypov, 2003). As shown by Worster et al. (1990), vigorous convection can be logically assumed to be a major process responsible for the generation of smooth trends in the distribution of cumulate minerals in the accumulation zone and the gradual transition between different layers, which are characteristic features of the KDBS confirm the occurrence of vigorous convection in the main magma reservoir. Vigorous magma convection in the KDBS chamber leads to the formation of a thin thermal boundary layer along the chamber margins, thereby maintaining the temperature contrast from fading and ensuring the continuous exchange of HMPCs (e.g., MgO) across the liquid boundary layer from the margins toward the main magma chamber and for LMPCs in opposite direction, by Soret diffusion. Consequently further decrease in the magnitude of the thermal gradient within the boundary layer would have caused a gradual change in the composition of the liquids in the boundary layer, becoming progressively depleted in LMPCs, shifting away from the eutectic point Ol + Pl + Cpx + L along the cotectic line Cpx + Pl + L. In this way, crystallization of the developing cumulus front in the liquid boundary layer produced the compositional sequence in reverse order, from the eutectic point to the initial parental magma, resulting in the occurrence of olivine-bearing gabbro in the chilled margins and gabbros toward the center of chamber.