A model for recent magmatism on Mars

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On Mars young-aged lava flows have been identified in several locations such as Central Elysium Planitia and Amazonis Planitia. This raised strong curiosity whether the present Mars is still active like the Earth or not. At the same time another significant question has been raised, whether this magmatism is essentially different from those which had been active for long time because the surface morphology is so different.The young lava flows are characterized by extremely smooth plane, which indicates flooding of low viscosity lava(for example, Voucher et al 2009 about Central Elysium Planitia and Fuller and Head 2002 about Amazonis Planitia). The activity seems short and persistent repeated discharges of lava flow are not recognized. On the other hand long-lived magmatism is characterized by formation of huge volcanic edifice such as Olympus Mons.To build such a huge edifice continual supply of magma at the same locality fro long time is necessary, which reminds us terrestrial hot spot magmatism by deep-rooted thermochemical plumes. We would like to discuss existence of two contrasting styles of magmatism, huge edifice building magmatism and lava-flooding magmatism and their origins. Particularly we present a working hypothesis of delamination-induced magmatism as an origin of lava-flooding magma.

The martian crust is significantly heavy compared with the terrestrial lower crust.Crustal density of 2900 to 3100 kg/m3 is estimated by analysis of gravity anomaly and admittance analysis(Wieczorek and Zuber 2004).This is consistent with the chemical composition of the martian meteorites. Basaltic shergotite contains twice amount of FeO than terrestrial MORB. In such iron-rich system Ohmori 2013 estimate phase boundary of basalt-eclogite transition based on the thermodynamical calculation and obtained lower transition pressure such as the depth range of 60-80km in Mars. If the crust thickens gradually by accumulation of lava the lower-most part of the martian crust possibly transforms to eclogite. Since the iron-rich eclogite is heavier than iron-rich mantle peridotite transformed lower crust is expected to delaminate and sink in the mantle. Associated with this delamination mantle compensating flow should be induced. During the adiabatic rise melting should occur if the mantle temperature below the lithosphere is close to the solidus. In this situation the locations of magmatism are expected at near the dichotomy boundary, where the crustal thickness largely changes. This seems consistent with the localities of young lava flooding (Noguchi and Kurita 2013 in this meeting).

At last part we would like to discuss probable sites of terrestrial analog for the lava-flooding magmatism. We propose Garrotxa volcanic zone at the periphery of Pyrenees Mountains as a such analog.