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Iron content of the Martian mantle

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High pressure experiments [1] reveal that the CaO/Al_2O_3 of Martian basalt (shergottites) parent magmas can be derived by partial melting at 5 GPa of Homestead L5 chondrite, whose bulk composition is very similar to that of the Dreibus and Wänke [2] model Martian mantle. However, the experimental melts are much richer in FeO than are calculated Martian parent magmas. We conclude that Homestead L5 and the Dreibus and Wänke [2] composition may be too FeO-rich (Mg#, molar Fe/Fe+Mg, ~75) to be considered good candidates for the mantle source region of shergottite parent magmas. This mismatch is well illustrated by comparing the FeO/MnO trends of basaltic shergottites, chondrites, and high pressure partial melts of L-chondrite. From these comparisons we propose that the Martian mantle may be closer in composition to the average value of H-chondrites with Mg#~80 (Fig.1). In order to test this hypothesis we are currently carrying out a series of high pressure partial melting experiments on the Farmville H4 chondrite to determine if they can produce shergottite parent magmas.

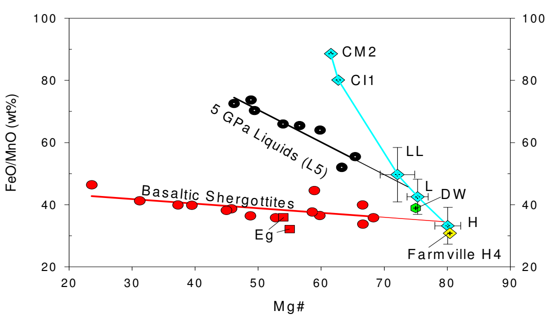

Figure 1. FeO-MnO-Mg# values for basaltic shergottites, shergottite parent magma (Eg), partial melts of Homestead (L5) at 5 GPa, average chondrites with sd-error bars, Farmville (H4), and DW-Mars.

Our experimental approach is independent of geophysical and mineral physics constraints considered by other studies [e.g. 3,4] that similarly estimate lower iron contents for the Martian mantle, in general agreement with our conclusion, suggesting a Martian mantle with a lower FeO-content and higher Mg# than DW-Mars.

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Source material of naklite magmas: Implications from Y000749

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SNC meteorites are widely considered to be derived from Mars [1]. Therefore, these meteorites have been studied intensively to understand the magmatism on Mars. Although the parent magma compositions and crystallization histories of Martian magmas have been well examined [e.g., 2, 3], the source materials of Martian magmas are not yet fully understood. Consequently, the nature and the origin of the source materials are still ambiguous. Recently, Shimoda et al. [4] have proposed a model which constrains the geochemical characters of source materials of Martian magmas. According to their model, Martian magmas were produced by two-stage melting of a plume uprising from the deepest mantle. In addition, the nakhlite magmas were inferred to be produced by the first-stage melting of the uprising plume. Thus it is important to reveal the geochemical characteristics of source material of nakhlite magmas for the better understanding of Martian magmatism. In this study, we determine REE composition of pyroxene cores in Y000749 nakhlite, which has been found in Antarctica desert recently. The REE pattern of Y000749 pyroxene cores shows middle REE enrichment which is similar to those of Nakhla, Lafayette and Governador Valadares [5]. It is therefore suggested that all of these nakhlites derived from the source materials of which geochemical characters are similar. Furthermore, this REE patterns of nakhlites indicate that these magmas were not produced by melting of peridotite or material with chondritic composition. Instead, nakhlite magmas could be produced by melting of a pyroxene-rich material. If this is the case, depleted isotopic characters and enriched middle-REE patterns of nakhlites [6, 7] can be easily understood. The higher REE concentrations of Y000749 would suggest that Y000749 is more evolved magma or produced by relatively small degree of partial melting compared to other nakhlites.

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