Fe-Mg PARTITIONING BETWEEN OLIVINE AND MARTIAN MAGMAS: APPLICATION TO GENESIS OF OLIVINE-PHYRIC SHERGOTTITES AND CONDITIONS OF MELTING IN THE MARTIAN INTERIOR

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Fe-Mg partitioning between olivine and basaltic melt, expressed by the distribution coefficient, $KD_{ol-melt}^{Fe-Mg}$ is widely used to: check if a planetary composition may represent a mantle-derived magma, verify that experiments in mafic-ultramafic systems approach equilibrium; and constrain liquid line of descent where olivine is the dominant fractionating phase [e.g., 1-3]. However, $KD_{ol-melt}^{Fe-Mg}$ appropriate for terrestrial basalts (~0.30 [4]) may not apply for Martian basalts [e.g., 2, 3] as $KD_{ol-melt}^{Fe-Mg}$ is known to depend strongly on the melt composition [5-6] and Martian basalts are typically more iron rich than terrestrial basalts. Here we compiled experimental data on olivine-melt equilibria of Martian and terrestrial basalt compositions to parameterize the effect of magma composition on $KD_{ol-melt}^{Fe-Mg}$ and derive the $KD_{ol-melt}^{Fe-Mg}$ applicable for Martian magmatic systems. We find that $KD_{ol-melt}^{Fe-Mg}$ ~ 0.36 better describes the equilibrium relationship between olivine and melt in Martian systems.

We apply this new value of $KD_{ol-melt}^{Fe-Mg}$ to olivine-phyric shergottites to predict which samples may represent magma compositions and which contain excess cumulate olivine. These results confirm previous notions that the only Martian meteorites where the olivine cores and the bulk composition are in equilibrium and therefore could represent magma compositions are: Yamato 980459 [2] and NWA 5789 [7]. LAR 06319, which has been suggested to represent a near magma composition [8], however, contains ~10 wt% excess olivine. Further, assuming that the basalts analyzed by the Mars Exploration Rovers at Gusev crater [9] and the olivine-phyric shergottitess are mantle derived melts and lie on olivine control lines, we have used Fe-Mg partitioning to add or subtract equilibrium olivine to the bulk compositions until the resulting compositions are in equilibrium with the Martian mantle (with Fo_{75-80}). Application of melt silica-activity barometer and olivine-melt Mg-exchange thermometer [10] to the newly corrected magma compositions yield mantle-melt equilibration *P-T* higher than previous estimates.

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