Martian Magma Evolution from Olivine-hosted Melt Inclusions in Shergottites using MELTS models

J. FERDOUS[1]*, A.D. BRANDON[1], A.H. PESLIER[2]

[1] Department of Earth and Atmospheric Sciences, University of Houston, Houston, TX 77204 (* jferdous@uh.edu)
[2] Jacobs, NASA-Johnson Space Center, Mail Code XI3, Houston, TX 77058, USA

Shergottites, the largest martian meteorite group, come from at least two geochemically different source reservoirs i.e. incompatible trace element (ITE)-depleted and enriched [1]. The depleted shergottites are thought to be derived from an ITE-depleted mantle reservoir, while enriched shergottites are thought to be derived from an ITE-enriched mantle reservoir that represents late stage residual melt from a magma ocean [2] or interaction with martian crust [3]. Moreover, the martian crust is distinct from shergottites, by being highly oxidized, distinctly ITE-enriched, and older [4]. The link between the crust and shergottite compositions is poorly understood. Here we model shergottite differentiation to resolve the origin of enriched shergottites and why the bulk martian crust is compositionally distinct from shergottites. Early formed olivine-hosted melt inclusions can provide primary melt composition from which the parental magma had crystallized and also information at different stages of crystallization during parent magma differentiation [5] that leads to shergottite magma evolution as well as crustal contribution assessment.

We analyzed olivine-hosted melt inclusions of two enriched poikilitic shergottites (i.e. Northwest Africa 7397, Roberts Massif 04262) for their major, minor and trace element concentrations using electron microprobe and laser ablation ICP-MS. We corrected the melt inclusion compositions for post-entrapment re-equilibration with their host olivine. To comprehend the crystallization sequence of these rocks and whether the melt entrapment is consistent with the crystallization, we use MELTS models for equilibrium and fractional crystallization [6]. The results of these models suggest that all the melts were trapped in a closed system progressive crystallization at 1150-1210 ºC within 1 kbar to 1 bar pressure that is equivalent to <8.5 km, implying melt entrapment without any additional exogenous materials.

[1] Borg & Draper (2003) *MAPS,* 38, 1713-1731. [2] Ferdous et al. (2017) *GCA,* 211, 280-306. [3] Humayun et al. (2013) *Nature,* 503, 513-516. [4] Filiberto (2017) *CG,* 466, 1-14. [5] Danyushevsky et al. (2002) *JP,* 43, 1651-1671. [6] Ghiorso & Sack (1995*) CMP,* 119, 197-212.