An in-depth look into martian magmatism and shergottite formation through olivine-hosted melt inclusions in a poikilitic shergottite suite

E. W. O'Neal[1], A. Udry[1], G. H. Howarth[2], J. Gross[3], and A. Ostwald[1]

[1]Department of Geoscience, University of Nevada Las Vegas, 4505 S. Maryland Pkwy, Las Vegas, NV 89154-4010, oneale1@unlv.nevada.edu; [2]Department of Geological Sciences, University of Cape Town, Rondebosch 7701, South Africa; [3]Department of Earth and Planetary Sciences, Rutgers University, Piscataway, NJ 08854, USA; Department of Earth and Planetary Sciences, American Museum of Natural History, New York, NY 10024, USA

Martian poikilitic shergottite meteorites are igneous rocks that can be used to understand magma evolution on Mars from the crust-mantle boundary up to shallow depths. The abundance of poikilitic shergottites allows for comprehensive geochemical studies. Since most poikilitic shergottites have not yet had their parental magma compositions constrained, we do not fully understand these characteristics of this major group of martian meteorites. Through comprehensive melt inclusion (small pockets of trapped melt) analyses, we will be able to create petrological relationships throughout the poikilitic shergottite suite and further our understanding of the martian interior. Through completion of this study, we are furthering the goals of objective 1.1 outlined in NASA's 2018 Strategic Plan lead by the Science Mission Directorate (SMD). This study is also important for preliminary data collection before martian samples are returned to Earth as part of the Mars sample-return mission.

In our study, we have examined a suite of five meteorites including: Allan Hills (ALHA) 77005, northwest Africa (NWA) 11065, NWA 7755, NWA 10618, and NWA 11043 by conducting melt inclusion analyses in both poikilitic (early-stage mineral assemblages) and non-poikilitic (late-stage mineral assemblages) textures. Our results show that, although not as primitive, the parental melt compositions of the poikilitic shergottites overlap with the range of parental melt compositions of olivine-phyric shergottites (another shergottite subgroup) suggesting similar petrogenesis and magmatic history for the two types. Additionally, we observed K-enrichment more commonly in melt inclusions located in the non-poikilitic texture, implying the addition of K-rich crustal material is a common process during poikilitic shergottite formation, which may be a result of assimilation or alteration.