FORMATION AND EMPLACEMENT PROCESSES OF MARTIAN POIKILITIC SHERGOTTITE METEORITES. R. R. Rahib[1], A. Udry[1], L. C. Combs[1], G. H. Howarth[2] [1]University of Nevada Las Vegas, Las Vegas, NV 890154 (rahibr@unlv.nevada.edu), [2]University of Georgia, Athens, GA 30602

Introduction: Shergottites, the most prolific group of martian meteorites, have been subdivided based on their mineralogies and textures into three types: Olivine-phyric, basaltic, and poikilitic [1-3]. A further geochemical classification has been made for the shergottites on the basis of their light rare earth element (LREE) concentrations into: Enriched, intermediate, and depleted. The focus of this study are the poikilitic shergottites, which only include enriched and intermediate rocks to date (e.g., [3-9]). The poikilitic shergottites now make up >20% of the entire martian meteorite suite, with a total of 27 samples to date. Although the poikilitic shergottites may represent a dominant and important lithology on Mars as gabbroic intrusive rocks [10], the petrologic relationships between the enriched and intermediate poikilitic shergottites, as well as with other shergottites are not completely understood (e.g., [3-12]).

The poikilitic shergottites display a unique and characteristic bimodal texture (e.g., [3-12]) consisting of: 1) A poikilitic domain, which consists of early-crystallizing large pyroxene oikocrysts that have low-Ca cores and high-Ca rims, enclosing subhedral olivine and chromite chadacrysts, and 2) A non-poikilitic interstitial domain predominantly consisting of olivine, pyroxene, and maskelynite (shocked plagioclase), which crystallized after the poikilitic domain, at a shallower depth in the martian crust (i.e., [7-9]). The two textural domains record two stages of crystallization occurring at different depths in the martian interior, making them an excellent candidate for better understanding the evolution of martian magmas.

Here, we present quantitative textural analyses (crystal size distribution [CSD] and spatial distribution pattern [SDP] analyses), for the poikilitic and non-poikilitic olivine populations, within eight poikilitic shergottites. Quantitative textural analyses allow us to investigate the physical emplacement processes of igneous rocks, as well as to assess petrologic relationships amongst analyzed samples [13-18].

Samples and Methods: This study includes six enriched poikilitic shergottites (Northwest Africa - NWA - 4468, 10169, 7397, 10618, and 7755 and Roberts Mas sif - RBT - 04261) and two intermediate poikilitic shergottites (Lewis Cliffs - LEW - 88516 and Allan Hills - ALHA - 77005).

To construct CSDs and SDPs for the olivine populations within the analyzed enriched and intermediate poikilitic shergottites, olivine crystal boundaries were manually traced in *Adobe Illustrator* using digital photomicrographs, as well as X-ray elemental maps (obtained by use of a *JEOL JXA-8900* electron microprobe at UNLV). Crystal lengths, widths, XY coordinates, and areas were measured using *ImageJ* software. Crystal lengths and widths were then put into *CSDslice* software, which is a database that provides the best-fit 3D shape ratio for the 2D measured crystal population [13,14]. *CSDcorrections* software was then used to generate the CSD plots based off of the best-fit 3D shape ratio, and to obtain the R-value used for SDP analyses [15]. Olivine modal abundances were measured using pixel count in *ImageJ*.

Crystal Size Distribution Analyses: The olivine populations within the analyzed samples all have a rectangular prism shape, thus allowing for statistically sound results to be made with populations of 75 crystals or more [14].

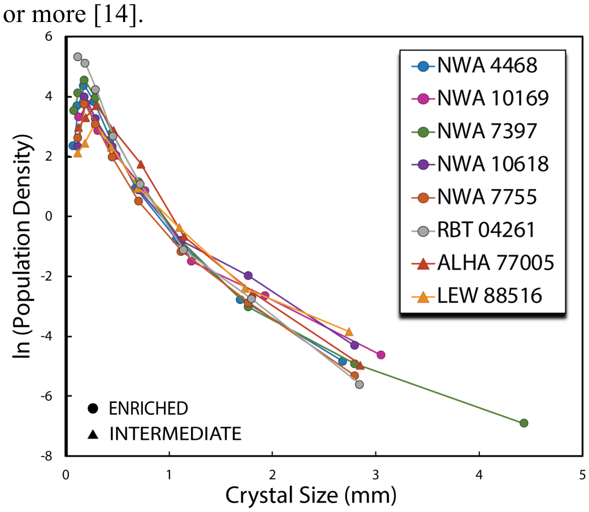

Figure 1. *CSD plot (population density versus crystal size in mm) comparing corrected length profiles of the olivine populations within six enriched and two intermediate poikilitic shergottites.*

Although the enriched and intermediate poikilitic shergottites have disparate LREE abundances (and likely different magmatic sources), they have similar CSD patterns (Fig. 1), suggesting similar olivine crystallization histories and similar magmatic processes responsible for their emplacement and formation (e.g., accumulation of olivine). Thus, a petrologic link between the two poikilitic subgroups may be deduced. In addition, a correlation between CSD slopes and y-axis intercepts is observed for the investigated samples (Fig. 2), implying that textural coarsening was an active process during their formation. Similar relationships have been observed in CSD studies of samples from comagmatic terrestrial igneous gabbro suites (e.g., [16,17]).

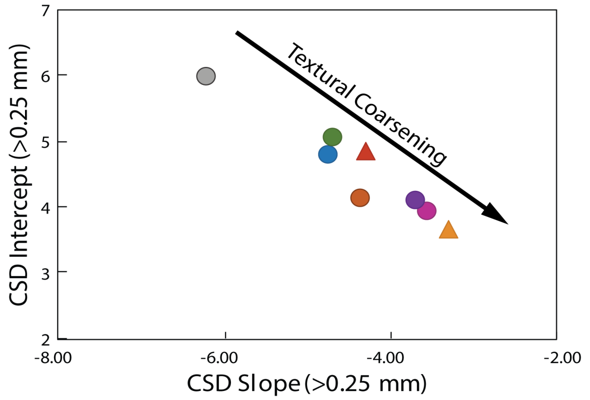

Figure 2. *CSD slope versus CSD intercept plot for same meteorites as figure 1.*

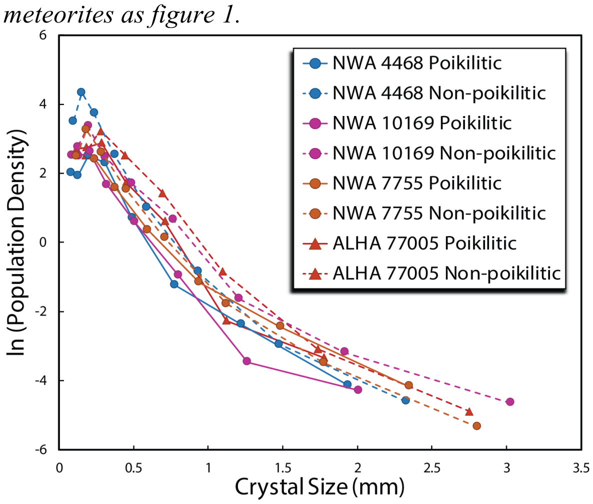

Figure 3. *CSD plot comparing corrected length profiles of the poikilitic and non-poikilitic olivine populations within NWA 4468, NWA 10169, NWA 7755, and ALHA 77005.*

CSD plots comparing poikilitic versus non-poikilitic olivine crystallization histories were only conducted for NWA 4468, NWA 10169, NWA 7755, and ALHA 77005, as they were the only samples that had 75 or more olivine crystals within both textural domains. The poikilitic CSD profiles share similarities, and are much different than the non-poikilitic CSD profiles that all resemble each other, supporting the concept that the two domains crystallized at different stages of poikilitic shergottite formation. The y-intercept of a CSD plot is related to the nucleation density of the population, and the analyzed non-poikilitic olivine populations showed greater y-intercepts than the poikilitic populations, meaning the nucleation density increased from the poikilitic to non-poikilitic population, which might represent that resorption of poikilitic olivines occurred.

Spatial Pattern Distribution Analyses: The analyzed enriched and intermediate poikilitic shergottites all fall within the "clustered" touching framework field on the SDP plot (Fig. 4), indicating that the olivine crystals grew as clusters during accumulation similarly to terrestrial cumulate rocks [18]. This is dissimilar to the SDP results for enriched (LAR 06319 [19]) and depleted (DaG 476 and Dho 019 [20]) olivine-phyric shergottites, which fall within the "clustered" non-touching framework field. However, LAR 06319, plots relatively close to NWA 4468, NWA 10169, and NWA 7755, which may suggest a possible enriched shergottite affinity.

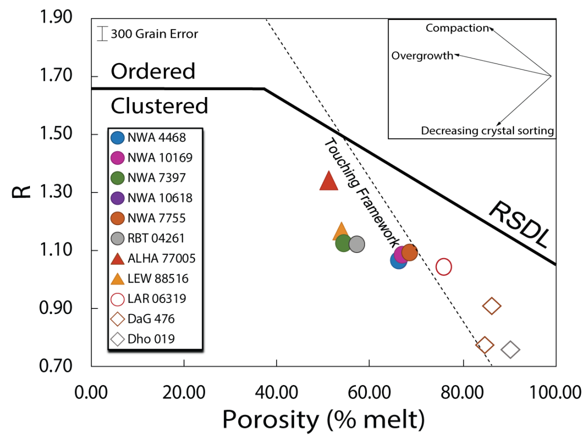

Figure 4. *SDP analyses for the same meteorites from figures 2 and 3 compared to enriched olivine-phyric shergottite – LAR 06319 [19] and depleted olivine-phyric shergottites – DaG 476 and Dho 019 [20].*

Future Work: Future work will include quantitative textural analyses for more poikilitic shergottites, as well as comparisons with other shergottites and terrestrial rocks. In addition, electron microprobe work will be conducted for all investigated samples.

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