MAGMA EMPLACEMENT ON MARS INFERRED FROM A COMPREHENSIVE SUITE OF NAKHLITES AND CHASSIGNITES. A. Udry[1], J. M. D. Day[2], and F. Moynier[3] [1]University of Nevada Las Vegas, Las Vegas NV 80154 (arya.udry@unlv.edu); [2]Scripps Institution of Oceanography, La Jolla, CA 92093 (jmdday@ucsd.edu); [3]Institut de Physique du Globe de Paris, 75005, Paris, France (moynier@ipgp.fr).

The nakhlite and chassignite magmatic system: Cumulate martian nakhlites (clinopyroxenites) and chassignites (dunites), which now include 20 individually classified meteorites, likely originated from a similar magmatic system. This interpretation is based on their common crystallization (1.3 Ga) and ejection (11 Ma) ages [1], as well as their geochemical and textural similarities [2,3]. However, these meteorites show different cooling equilibration histories and variation in cumulus and intercumulus material modal abundances. Most nakhlite and chassignite samples have been studied individually and few studies included comprehensive nakhlite and chassignite suites, except [2] and [4]. According to volatile content in hydrous minerals, [2] has shown that nakhlites and chassignites are petrologically linked. Conducting a systematic study of these meteorites, which likely originate from the same location on Mars, is critical as the lack of a complete dataset hampers our understanding of their emplacement. Investigating nakhlites and chassignites as a suite will help to determine more complete emplacement models, constrain their parental magma and source compositions, and better link them together to understand martian magmatic evolution. Here, we combine quantitative textural and bulk rock geochemical observations on 15 nakhlites and chassignites to ultimately evaluate emplacement models and source compositions of these rocks.

Methods: Bulk rock major and trace element concentrations were obtained at the *Scripps Isotope Geochemistry Laboratory* using a *ThermoScientific* iCAP Qc quadrupole ICP-MS. Analyses were standardized versus reference material BHVO-2. In addition, reference materials were analyzed as “unknowns” (AGV-1, BHVO-2, and BCR-2) to assess external reproducibility and accuracy. For major and trace elements, reproducibility of the reference materials was generally better than 6% (RSD), except for Se, Sn and Mo (<12% RSD). For quantitative textural analyses, pyroxene and olivine grain boundaries were traced using transmitted and reflected light image mosaics and converted to length and width measurements using the software *ImageJ*. Measurements were inputted into CSD*slice* software [5] for a true three-dimensional crystal size distribution. Best matching habit ratios (long-, intermediate-, and short-axis ratio) were calculated with CSD*slice* and entered in the CSD*corrections* software [6] to generate Crystal Size Distribution (CSD) results. The R-value, used in Spatial Size Distribution (SDP) analyses, was obtained using Big-R available in CSD*corrections* for the pyroxene population [7]. Modal abundances were measured using pixel count in *ImageJ*.

Quantitative textural analyses: CSD and SDP analyses have been conducted on 9 nakhlites in order to better understand emplacement in the martian crust/surface. Our data show that nakhlites underwent textural coarsening, which confirms the model of crystal mush emplacement suggested by [4]. In addition, the newly classified Northwest Africa (NWA) 11013 and NWA 5790 (also studied by [8,9]) nakhlite textural analyses combined with mineralogy, and isotopic composition [10] suggest emplacement of nakhlites as several lava flows at the martian surface.

Bulk rock analyses: The 15 analyzed nakhlites and chassignites have MgO ranging from 7.3 to 35.8 wt.% (up to 12.3 wt.% for nakhlites, exclusively) and Mg#s from 35.6 to 76.2. These ranges are similar to cumulate basaltic intrusions on Earth. All the samples show light rare earth elements (LREE) enrichments with small $[La/Yb]_{CI}$ variations between 3.2 and 5.9 that do not correlate with Mg#, likely indicating progressive fractional crystallization or infiltration of Cl-rich, LREE-rich fluids. The trace element and REE patterns in all of the investigated nakhlites and chassignites are similar. We also observe consistent trace element ratios, such as Zr/Hf and Th/U, between nakhlites and chassignites. This indicates that these rocks likely originated from a similar parental magma, and thus the same mantle source, which is distinct from shergottite mantle sources.

Summary: We investigated nakhlites and chassignites as a suite to examine existing models. Textural analyses reveal mineralogical coarsening consistent with crystal mush emplacement [4]. The nakhlite and chassignite magmatic body likely includes several magma pulses/lava flows. In addition, trace elements confirm a chassignite and nakhlite linkage. Further studies of isotopic compositions of these meteorites will allow us to better constrain their source composition.

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