SPINEL-RICH LITHOLOGIES ON THE MOON: LINKING SAMPLES, EXPERIMENTS, AND REMOTE SENSING.

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Introduction: The discovery of areas rich in (Mg,Fe)-Al spinel on the rims and central peaks of lunar impact basins (by the M^3 mapping spectrometer on Chandrayaan-1) [1,2] has revived the old puzzle of the origin of lunar spinel. (Mg,Fe)-Al spinel is rare but found in a variety of lunar highlands rocks, and thus might be an important component of the lunar crust [e.g., 1-4]. The only spinel-rich sample described to this day is a rock fragment rich in Mg-Al spinel from lunar meteorite ALHA 81005 that seems to be related to the lithology detected by M^3 [5]. To better understand the origin and formation history(s) of spinel-rich rocks, we (1) perform liquidus/crystallization (L/C) experiments at low-pressure as analogues for impact melt crystallization and assimilation processes, respectively and (2) get reflectance analysis of our experiments to compare to the M^3 spectra of the spinel-rich lithologies.

Sample and Methods: Antarctic meteorite Allan Hills (ALH) A81005, is a polymict, anorthositic regolith breccia from the lunar highlands [e.g., 6]. Thin section ALHA 81005,9 contains a single rock fragment, 350 x 150 µm, with ~30 vol% $(Mg,Fe)Al_2O_4$ spinel – enough that an outcrop of it would be easily detected by M^3 [5]. L/C experiments are performed at 1 atm under lunar fO_2 (IW-1). We explore different starting compositions: Apollo troctolite 65785; spinel-rich clast in ALHA81005; Fe-poor spinel-bearing troctolite. This will distinguish whether spinel-rich rocks crystallize directly from a melt or whether a concentration mechanism (such as accumulation) is needed.

Results and Discussion: A likely origin for its bulk composition is assimilation of anorthosite by a picritic magma [5]. The L/C experiments on Apollo 65785 show that a maximum proportion of 9 vol% spinel can be crystallized from that bulk composition. However, our preliminary Vis/NIR spectral reflectance analyses of the experiments indicate that the spinel composition not only appears to be similar to the composition of the spinel lithology detected by M^3, but also that the modal abundances of coexisting phases influence the spectral reflectance properties. For example, the experiment at 1250°C crystallized only 3 vol% spinel; however, the absorption feature (depth and position) of the spinel in this run product is almost identical to the absorption feature of the spinel-rich lithology on the lunar surface. This could indicate that the spinel-rich lithology detected by M^3 is not as spinel rich as previously thought. However, we will explore different bulk composition to place further constraints on effects that could influence the absorption strength of the M^3 spectra.

References: [1] Pieter C.M. et al., 2011. *Journal of Geophysical Research,* 116, E00G08. [2] Lal D. et al. 2011. Lunar Planetary Science 42, Abstr. #1339. [3] Demidova S.I. et al., 2007. *Petrology,* 15, 386-407. [3] Isaacson P. et al., 2011. *Journal of Geophysical Research,* 116, E00G11. [5] Gross J. and Treiman A.H. 2011. *Journal of Geophysical Research,* 116, E10009. [6] Goodrich C.A. et al., 1984. *Journal of Geophysical Research,* 89, C87-C94.