New insights into the Lunar Magma Ocean crystallization hypothesis

Katie M. O'Sullivan,[1] and Clive R. Neal[1]

[1]*Department of Civil Engineering and Geological Sciences, University of Notre Dame, Notre Dame, IN 46556*
kosulli4@nd.edu

Abstract. In this study we chose 2 samples from the highlands region of the Moon to test the Lunar Magma Ocean crystallization hypothesis as proposed by Snyder et al.[1]; ferroan anorthosite (FAN) 15415, and Mg-suite troctolite 76535. Ferroan anorthosites are considered to be flotation cumulates of a lunar magma ocean (LMO)[1]. It is proposed that troctolites are formed either from partial melts generated from the mantle[2, 3], or from mechanical mixing of plagioclase and olivine during impact events[4]. We investigate the origin of 15415 and 76535 using crystal stratigraphy to calculate equilibrium liquids and determine parental melt compositions using published and calculated partition coefficients. We then compare those with the liquids of the LMO to determine at what stage 15415 could have formed. We use the equilibrium liquids calculated for 76535 to determine a source composition, then using estimated mineralogy we model at what stage these cumulates could have formed during LMO crystallization.

Initial findings indicate that parental melt compositions of 15415 are too depleted to have formed from direct crystallization from the LMO (Figure 1), suggesting that perhaps initial bulk Moon estimates are too depleted, or more detailed experiments to determine lunar-relevant partition coefficients are needed. Detailed modeling of the petrogenesis of 76535 and source region cumulates will be presented at the conference.

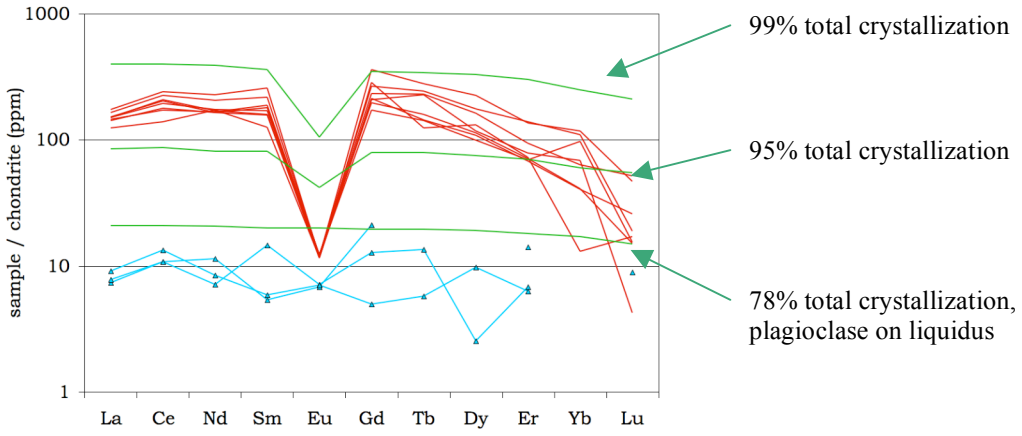

Figure 1. Calculated equilibrium liquids of 15415 (blue) and 76535 (red) compared to LMO liquids[1](green) at various stages of crystallization.

[1]G.A. Snyder, L.A. Taylor, and C.R. Neal, *GCA* 100, 9365 (1992). [2]O.B. James, *LPSC 11th*, 365 (1980). [3]M.D. Norman and G. Ryder, *LPSC 10th*, 531 (1979). [4]P.C. Hess, *J.Geo.Res.* 99, 19083 (1994).