**D/H RATIOS OF HIGHLY EVOLVED LUNAR ROCKS.**

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**Introduction:** The felsites are highly evolved lunar rocks, typically containing ~70wt%$SiO_2$. Most have igneous textures that feature graphic intergrowths of K-feldspar and quartz [1]. Sampled felsites occur as clasts in breccias, sometimes coexisting with Fe-rich, low-Si clasts. This pairing of Fe-rich and Si-rich compositions suggests that the felsites could have formed through silicate liquid immiscibility from a magma with KREEP basalt composition in small intrusive bodies [1].

Recently, water has been detected in lunar pyroclastic glasses [2] and apatites [3,4]. Apatite [$Ca_5(PO_4)_3(F,Cl,OH)$] incorporates water as OH into its crystal structure. At low abundances, water acts like an incompatible element and will become enriched in the melt. Thus, KREEP-rich magmas should be enriched in water when apatite begins to crystallize. Apatites in felsites could contain water sufficient to allow the D/H isotopic composition of the water to be determined, which is important for determining the source of the Moon's water and the extent of water loss during magmatic processing [e.g., 4,5].

We identified four apatite grains large enough (>20μm) for SIMS analysis in two lunar rocks. Sample 14321,1047 is a quartz-K-feldspar felsite, while sample 77538,16 consists of felsite and associated Fe-rich phases; the apatite was within the Fe-rich phase.

**Methods:** Apatites were analyzed for P, Ca, Si, Na, Fe, Ce, F, Cl, Y, and La with the UH JXA-8500F electron microprobe. Hydrogen isotopic composition and water content were analyzed *in situ* with the UH ims 1280 ion microprobe with a $Cs^+$ primary beam. $H_2O$ content of apatite samples was estimated from a calibration curve on $H_2O$ (wt%) vs. $^1H/^{18}O$ determined using 4 apatite standards with different $H_2O$ contents (provided by F. McCubbin). The detection limit for $H_2O$ was ~100 ppm. Uncertainties on δD and water content are ~75‰ and ~30% (2σ), respectively.

**Results:** We analyzed a total of five points among four apatite grains in two samples. The single large apatite in 14321,1047 had $H_2O$ below our detection limit in both points analyzed. Two apatite grains were measured in 77538,16. They have $H_2O$ contents of ~180 ppm. δD values for these points are +300–+400‰ .

**Discussion:** We found very little water in the apatites measured. Apatites in both samples contain significant (wt% level) amounts of REEs, indicating that these highly-evolved, KREEP-rich magmas contained little water. In turn, this suggests that the lunar magma ocean (and the bulk Moon) had a low initial water content, as argued by [5]. The δD values in apatite in 77538 with detectable water are elevated, which agrees with findings in [4]. However, since the measured $H_2O$ is barely above detection limit, we cannot say with absolute certainty that the δD of lunar water in this magmatically evolved lunar rock is elevated with respect to Earth.

**References:** [1] Robinson K.L. and Taylor G.J. 2011. Abstract #1257, 42nd Lunar & Planetary Science Conference. [2] Saal A.E. et al. 2008. *Nature* 454:192-195. [3] McCubbin F.M. et al. 2010. *PNAS* 27:11223-11228. [4] Greenwood J.P. et al. 2011. *Nature Geoscience* 4:79-82. [5] Elkins-Tanton, L. et al. 2011. *Earth & Planet. Science Letters*, in press.