VOLCANIC CONTRIBUTION OF WATER AT LUNAR SILICIC DOMES. M. Barta, L. Dyjach, E. Erickson, E. Lindley, N. Lizdas, K. Guenther, P. Penne, and S. Richards

Introduction: Water has been detected on the Moon's surface; however, the abundance of water is extremely sparse in comparison to the Earth. The majority of water observed on the lunar surface is concentrated around the lunar poles. The primary theory explaining the origin of this water and its distribution pattern is solar wind interaction with compounds in the lunar regolith. However, there are volcanic formations across the lunar surface that have anomalously high water concentrations relative to the surrounding area. Select silicic domes exhibit localized enrichments of water, and these features are suggestive of a volcanic contribution wherein the water observable may have originated from the dome-forming magma. By comparing the amount of water theoretically erupted and the amount of water detected presently, it was determined that the origins of these localized water enrichments could be attributed entirely to lunar volcanism and do not require additional origin explanations to account for the amount of water present.

Methods: Calculations were conducted for three silicic domes. Two of the domes studied exhibit relatively high concentrations of water: the Mairan domes (Figure 1) and the Compton-Belkovich Volcanic Complex. The third dome studied, Hansteen Alpha, shows significantly lower hydration.

The mass of water theoretically erupted during dome formation was calculated using estimates of magma composition and volume. The volume of each dome was calculated using QuickMap [1] and then multiplied by theoretical magma water contents in order to yield the mass of water erupted. The precise water content of siliceous lunar magma has yet to be determined; however, estimated values range between 0 to 1 wt% H_2O. As such, calculations were performed for water contents in the range 10 parts per million (ppm) to 1 wt.%, which yielded a range of outputs for the mass of water erupted. This range of possible hydration is the range of water masses that can be accounted for by volcanic eruption.

Water currently observable at these sites was quantified using spectral data collected by the Moon Mineralogy Mapper [2-3]. Distribution maps illustrating the detection of H_2O and OH^- species were used to calculate the mass of water represented spectrally on the lunar surface at each dome.

Results: Results of our calculations show that the water present spectrally can be accounted for by the eruption of hydrous magma during dome formation. For every Hansteen Alpha calculation, as well as the 0.1-1.0 wt.% H_2O compositions at Compton-Belkovich and the Mairan Domes, the theoretically erupted water is greater than the water observed on the surface. Volcanic degassing of water may explain why the observed water is less than predicted. For the Compton-Belkovich Volcanic Complex and Mairan domes, calculations using magma with 100 ppm H_2O produce the spectrally-observed water contents of the domes; however, magmas with less than 100 ppm H_2O would require an additional non-volcanic water contribution. These results validate the theory that lunar volcanism may have played a primary role in the formation and presence of water at the lunar silicic domes.

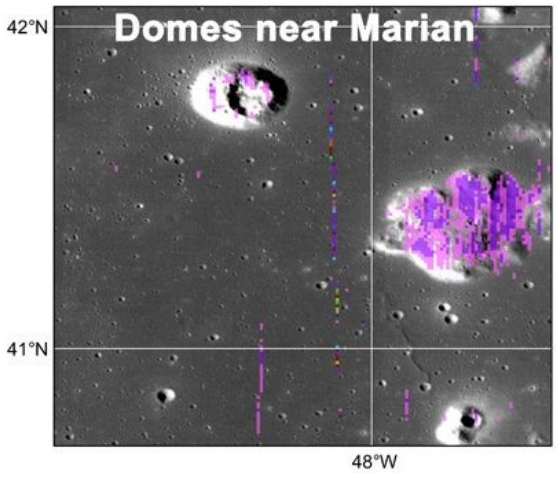

Figure 1. Spectral observation of water enrichment (pink) at Mairan domes [3]

References: [1] quickmap.lroc.asu.edu, [2] Pieters et al. (2009) *Science*, 326(5952), 568-572, [3] Li and Milliken (2017) *Science Advances*, 3(9), 1-11.