INVESTIGATING THE PETROGENESIS AND ERUPTION HISTORIES OF APOLLO 15 AND APOLLO 17 BASALTS

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Introduction: Lunar missions led by NASA have discovered water on the Moon's surface [1-3], revolutionizing views of the abundance, distribution, and potential sources of H_2O and other volatiles to the Moon. Amidst the developing field of lunar volatiles, there are debates regarding the amount of H_2O in the bulk silicate Moon (BSM), the timing of volatile accretion to the Moon, and the origins of these volatiles. Volatile elements and halogens (e.g., H, H_2O, CO_2, S, Cl, F) affect the physicochemical properties of melts or magmas in which they are dissolved, and as such influence eruption conditions. Previous studies show that despite being volatile depleted, lunar basalts contain measurable amounts of magmatic volatiles [e.g., 1,2]. To determine the indigenous volatile inventory of the Moon, it is vital to identify the magmatic and secondary processes that may have affected the volatile records now present in lunar minerals, such as apatite [e.g., 4]. We investigate the histories of a group of lunar basalts to decipher the magmatic, volcanic, alteration, and terrestrial processes they experienced. Many lunar basaltic samples contain vesicles and vugs, which are important testaments to the gas-rich volcanic activity that occurred on the Moon. The combination of in-situ quantification of volatile chemistry with textural analyses, including the 3D abundances and fabric of voids via X-ray computed tomography (XCT), can yield powerful insights into the petrogenetic history of lunar basalts [5]. Moreover, when such data is coupled with eruption ages, a comprehensive picture of their magmatic origin and post-magmatic evolution can be revealed.

Samples: We investigate two Apollo 15 Terrace basalts, two Apollo 17 Central Valley basalts, and two Apollo 17 Camelot Crater basalts. The Apollo 15 Terrace (the basaltic plain adjacent to Hadley Rille) samples are low-Ti, olivine normative and vesicular, while the Apollo 17 Camelot Crater and Central Valley samples are high-Ti and span a range of compositional types. Sample 70215 represents a Type B basalt, 70035 is a Type U (unclassified), and 75035 and 75055 are Type A [6].

Methods: To date, X-ray elemental and backscattered electron maps of thin sections were acquired at the University of Arizona using the Cameca SX100 electron microprobe. Mineral modal abundances were determined using the threshold method and quantified using ImageJ. These 2D phase abundances will be compared to 3D X-ray computed tomography scans. Areas of interest have been identified for future electron microprobe spot analyses (Fig.1). For 3D analysis, a XCT dataset of 15556 [Astromaterials 3D] was studied for modal mineralogy and vesiculation textures. This scan has been visualized using Dragonfly™ and Blob3D software. At the meeting we will present our initial chemical characterization and discuss our comparison of 2D and 3D data.

References: [1] Clark R.N. (2009) *Science,* 326, 562-564 [2] Pieters C.M. et al. (2009) *Science*, 326, 5952, 568-572 [3] Sunshine J.M. et al. (2009) *Science*, 326 (5952), 565-568 [4] McCubbin F.M. et al (2015) *Am. Min.,* 100, 1668-1707 [5] Berg S.E. et al (2016) *Bull. Volcanol.* 78, 85 [6] Hallis L.J (2014) *GCA*, 134, 289-316.

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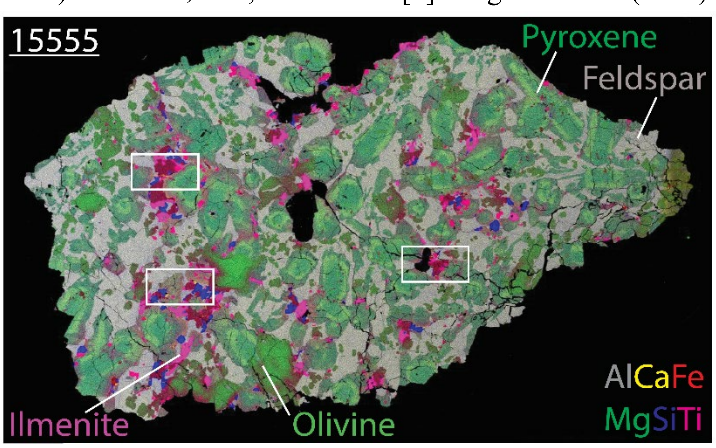

Figure 1. *Elemental composite map of 15555. Areas within the rectangles contain phosphates and are targets for future chemical analysis.*