APOLLO SAMPLE 64455: PETROLOGIC AND GEOCHEMICAL CHARACTERIZATION OF A GLASS-COATED IMPACT MELT ROCK.

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Introduction and Background: Impact melts are a key product of the impact cratering process. Impact melts can turbulently entrain pre-existing rock fragments, and melt part of those entrained materials until thermal equilibrium is achieved [1–3]. Lunar impact melt rocks are valuable for determining the precise ages of basin-forming and cratering events, which anchor the cratering chronology and dynamics of the entire solar system [4, and references therein]. Additionally, entrained clasts can inform on the petrology and age of crustal materials that predate the melt-forming impact. In lithologies where no pristine samples are available, entrained materials may hold the record of endogenous lunar volatiles, provided we can untangle their impact histories as high temperature impact melt can heat the clasts and may alter their native volatiles or isotopic signatures [5–6]. Here, we characterize an Apollo 16 sample, 64455,70B, in an effort to understand the physical, microstructural, and geochemical consequences of impact melt contact metamorphism. We acquired optical light and x-ray maps of the sample, as well as quantitative analyses via electron probe microanalysis (EPMA). These tasks allow us to better understand the interaction between impact melts and entrained clasts, ultimately closing knowledge gaps in high-temperature impact processing on planetary surfaces.

Sample Description: Sample 64455 is an oblong crystalline rock encased in glass to form an egg-like shape [7–8]. The impact melt coating has altered the outer (1 to 2 mm) rind of the crystalline rock and has preserved schlieren. The interior crystalline rock is likely a crystalline impact melt rock based on its bulk Ir content of 2.25 parts per billion [9]. The composition of the impact melt glass rind cannot be solely derived from the crystalline interior, the glassy rind is more aluminous and less magnesian [10]. Neither the crystalline interior nor the glassy rind were radiometrically age dated, although several studies investigated its cosmogenic isotopes and exposure ages, which reveal the sample was exposed on the lunar surface for ~1–2 Ma [11–13].

Preliminary Results: The interior crystalline rock consists primarily of plagioclase with interstitial pyroxene and olivine. Plagioclase grains are zoned and compositions range from An_{97-89}, while pyroxene compositions generally range from $En_{68}Fs_{19}Wo_{13}$ to $En_{82}Fs_{15}Wo_{3}$ and olivine are Fo_{77} to Fo_{85}. Minor phases include Fe-Ni metal, Ca-phosphates, a K- and Si-rich phase, sulfides, and Fe-phosphides. The glass rind contains approximately 44 wt.% SiO_2, 25 wt.% Al_2O_3, 6 wt.% FeO, 8 wt.% MgO, and 14 wt.% CaO, with other oxides at <1 wt.% each, although the composition of the glass becomes more variable closest to the crystalline rock. The rind consists of rounded plagioclase, pyroxene, and olivine crystals with interstitial melt. In some locations, the rounded crystals are surrounded by closely-packed, blade-like crystals, <5 µm in width. These results indicate that the crystalline interior has partially melted where in contact with the high-temperature impact melt and while further investigation is needed, pyroxene may have preferentially melted relative to olivine and plagioclase.

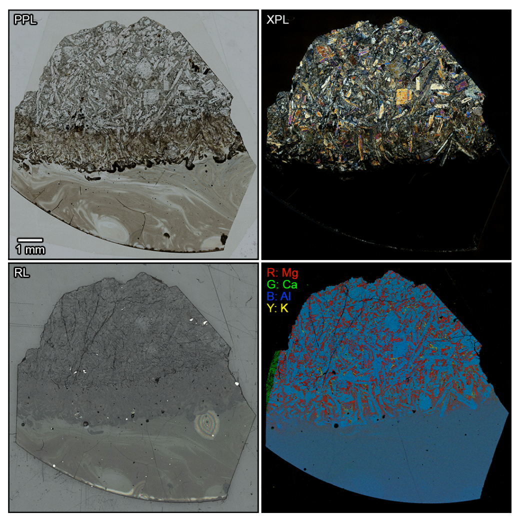

***Figure 1**. Sample 64455,70B shown in plane-polarized (PPL), cross-polarized (XPL), reflected (RL) light, and a false-color X-ray composite with Mg in red, Ca green, Al blue, and K yellow.*

Future Work: We plan to conduct electron backscatter diffraction (EBSD) mapping in order to determine crystallinity and crystal orientation. Next using transmission electron microscopy (TEM) data in conjunction with EBSD and EPMA information, we will model the diffusion of moderately volatile elements between the melt and remnant crystals.

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