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Insights into Lunar Volcanism through a Unique Olivine Porphyritic Very Low-Ti Basalt, 73002,1017C, and an Accompanying High-Mg-Al Volcanic Glass

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The Apollo 17 double drive tube 73001/73002 was unsealed for the Apollo Next Generation Sample Analysis (ANGSA) initiative. 73001/73002 collected subsurface soil from the South Massif of the Taurus-Littrow Valley. We present here a previously unknown lunar lithology from the upper portion of the drive tube: 73002,1017C, an olivine porphyritic very low-Ti basalt that exhibits unique texture and perhaps has an affinity with the Mg-suite.

73002,1017C was in the 2-2.5 cm depth interval beneath the surface, and weighs 0.050 g. We began by studying µXCT data of the whole clast and estimated the phase proportions of ,1017C. Initially, we hypothesized that the coarser phenocrysts were olivine and the finer ones were pyroxene. However, after we received thick section 73002,455 from ,1017C and studied it with EPMA, we discovered that the phenocrysts in 73002,455 are exclusively highly magnesian olivine (Fo_{86-96}) (Fig.1). Higher spatial resolution images and chemistry show that the groundmass comprises plagioclase laths and interstitial olivine, pigeonite, augite, phosphate, sulfide, spinel, Mg-ilmenite, and loveringite. ,455 is roughly 50:50 phenocryst to groundmass, which differs slightly from the whole-sample µXCT estimate, likely a 2D slice vs. 3D volume issue. We calculated a bulk composition for ,455 using quantitative EPMA mapping and ENVI, an image processing and analysis software (Fig.2).

We also searched the continuous thin sections of 73002 for picritic, volcanic glass beads. We found an outlier among almost 600 beads that is a highly magnesian and aluminous volcanic glass bead with Mg/Al of 1.86 located ~5.5 cm beneath the surface. Simple ~20% olivine subtraction from the ,455 bulk composition results in a composition that is close to that of the Mg-Al glass bead. We used the glass composition as the input to the crystallization modeling program Perple_X. As we cool a melt of this composition, it first produces olivine then plagioclase. If this composition represents a mantle source region, it is among the most aluminous. 73002,455 and its parent clast ,1017C could represent a sample that initially underwent near-equilibrium, closed-system cooling and crystallization in an olivine accumulation zone in the parent magma, represented by the Mg-Al glass, resulting in excess olivine.