MODAL PETROLOGY OF THE 1mm to 150µm FRACTION OF APOLLO 17 DRIVE TUBE SECTION 73002. S. B. Simon[1,2,3], C. K. Shearer[1,2,4], M. J. Cato[2], and the ANGSA Science Team[5]. [1]Institute of Meteoritics, Univ. of New Mexico, Albuquerque, NM 87131,[2]Dept. Earth and Planetary Sci., Univ. of New Mexico, [3]Field Museum of Natural History, Chicago, IL,[4]Lunar and Planetary Institute, Houston, TX, [5]all members of the ANGSA Science Team listed in https://www.lpi.usra.edu/ANGSA/teams/. (sbs8@unm.edu)

Introduction: As part of the Apollo Next Generation Sample Analysis (ANGSA) program, samples from previously unopened Apollo 17 double drive tube 73001/73002 have been made available for study. The upper section, 73002, was extruded in late 2019, and 73001 in March, 2022. Dissection and sampling have been completed. This process includes sieving of the material into multiple size fractions. Here we report results from petrologic investigations of three size fractions (1000-500, 500-250, 250-150 µm) from ten 0.5-cm depth intervals in 73002: 1.0-1.5 cm; 2.0-2.5; 3.0-3.5; 4.5-5.0; 5.0-5.5; 9.5-10.0; 12.0-12.5; 15.0-15.5; 16.0-16.5; and 17.5 cm to bottom of the column. Importantly, to previously reported results [1] we add data for three intervals from the upper 5 cm. Upon extrusion, the upper several cm of 73002 was observed to be darker in color than the rest of the column, with a sharp, steeply inclined contact between the units. Data for additional sampling intervals will be presented at the Workshop.

The double drive tube was collected at Station 3, within the "light mantle" deposit at the base of South Massif. Exploring and sampling this deposit were among the major scientific goals of the Apollo 17 mission. Orbital data suggest that this deposit represents multiple landslide events that were triggered by movement along the Lee-Lincoln scarp [e.g., 2] or impact events [e.g., 3]. Thus, 73001/73002 allows investigation of landslide dynamics and effects, such as mobilization of volatiles, on the lunar regolith, and the soil column can be expected to contain samples of highland lithologies from the South Massif that would otherwise be inaccessible.

Methods: Bulk <1 mm soils were received at the University of New Mexico (UNM) and sieved into six size fractions, then mounted in epoxy and polished. Particles were identified and classified through backscattered electron imaging and energy-dispersive analysis (both qualitative and quantitative) with a TESCAN Lyra3 scanning electron microscope at UNM equipped with an IXRF silicon drift energy-dispersive X-ray detector running Iridium Ultra software.

Results: Petrographic observations and modal petrologies are summarized here.

Grain size systematics. The average modal petrology of each size fraction is illustrated in Fig. 1, showing several trends with decreasing grain size: contents of impact melt rocks and regolith breccias decrease; agglutinates, monomineralics, and glass increase; and highland igneous and mare basalt lithic fragments are nearly constant, as is the total fused soil component (agglutinate + regolith breccia). There is a hint of an increase in mare lithics at the bottom of 73002 (Fig. 2, 3), but highland lithics are more abundant than mare basalt fragments in every sample; a "surprising paucity" of mare lithics in the 150-90 µm fraction of A-17 light mantle soils, including the four Station 3 trench samples, was noted by [4].

1000-500 µm fraction. Percentages of fragment types are illustrated in Fig. 1. Most abundant (at 39.5%) are crystalline melt breccias (CMBs) - rocks crystallized from impact melts, typically with coarse plagioclase clasts in a fine-grained matrix. The second most common fragment type is regolith breccia (26.9%). The most abundant of the remaining particle types are 12.6% highland igneous rocks (plutonic except for one feldspathic basalt), monomineralic fragments (7%) and mare basalt fragments (4.2%).

500-250 µm fraction. Here too CMBs and regolith breccias are the most abundant in most cases. The upper 4 cm of the section are much richer in agglutinates and poorer in mare basalt fragments than the bottom 4 cm (Fig. 2).

250-150 µm fraction. CMBs are most abundant in this size fraction as well, followed by monomineralics (more abundant than in coarser size fractions), igneous highland rock fragments, and regolith breccias (less abundant than coarser fractions). Agglutinate contents generally decrease with increasing depth (Fig. 3).

To first order, the modal data indicate that the upper ~4 cm of 73002, with higher agglutinate contents (Fig. 2, 3), are more mature than the lower material, consistent with the observation, prior to sampling, that the upper material is darker in appearance than the lower material, the only easily visible transition in the column. Our results are also consistent with I_s/FeO values (≥60, (in the "mature" range) reported for this material [5].

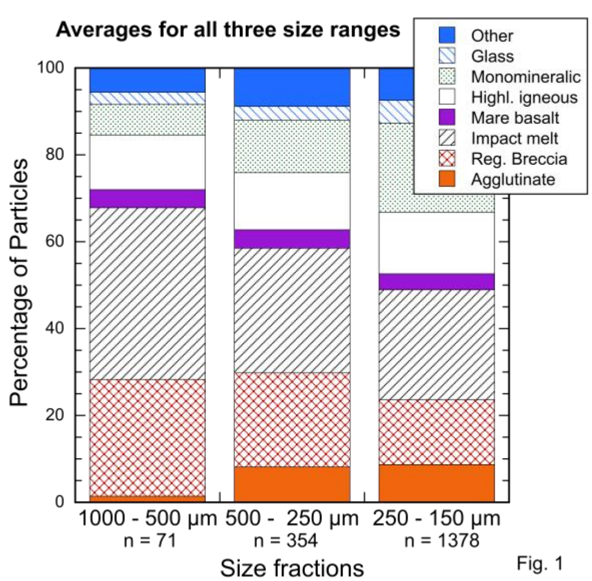
Discussion: Despite the wide variety of mare basalts found in <1mm fines [6] as well as the 4-10mm fraction, the lithic fragment population in 73002 is dominated by highland lithologies, mainly Mg-suite members and impact melt rocks, probably derived from multiple horizons of the South Massif. Soils from the base of North Massif (Stations 6 and 7) and Sculptured Hills

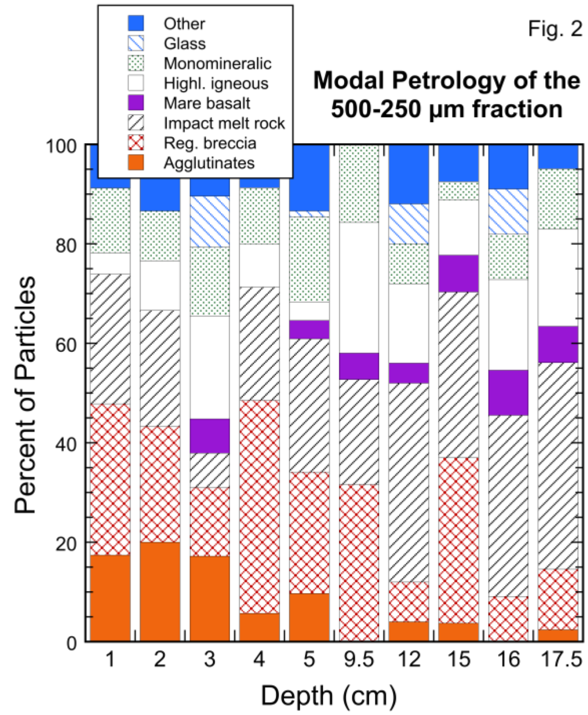
(Station 8) are also enriched in highland lithologies relative to mare basalts compared to soils from the valley floor [4].

Among the present samples and in the 150-90 and 90-20 µm size fractions [7], the upper 4 cm of 73002 are more agglutinate-rich than the lower soils, but overall, 73002 appears to be less mature than most of the A-17 surface soils and three of the four Station 3 trench soils [4]. The upper unit of 73002 has ≤~20% agglutinates in all size fractions, including 150-90 µm [7], whereas that size fraction of most surface soils has >30% agglutinates [4]. Like 73002, most of the A-17 deep drill is agglutinate-poor compared to the surface soils, with most of the column having 20-30 (volume) % [8].

Prior to the opening of 73002, the only soils from Station 3 of the Apollo 17 site that had been studied were surface and trench (~10-15 cm) soils. Drive tube 73001/2 penetrated the landslide deposit (the "light mantle") to previously unsampled depths; this soil column has great potential to contain previously unsampled rock types, and some evidence of that is seen in the wide varieties of Mg-suite rocks [9], mare basalts [7], and a suite of unusual felsites [10] already found in preliminary studies of a relatively small sample.

References: [1] Simon S. et al. (2022) LPSC 53, abst. #2211. [2] Schmitt H. (2017) *Icarus 298*, 2-33. [3] Lucchitta B. et al. (1977) I*carus 30*, 80-96. [4] Heiken G. and McKay D. (1974) *Proc. 5th LSC*, 843-860. [5] Morris R. et al. LPSC 53, abst. #1849. [6] Simon S. et al. (2022) NESF abst. [7] Cato M. et al. (2022) This mtg. [8] Vaniman D. et al. (1979) *Proc. 10th LPSC*, 1185-1227. [9] Shearer C. et al. (2022) LPSC 53, abst. #2546. [10] Shearer C. et al. (2022) NESF abst.





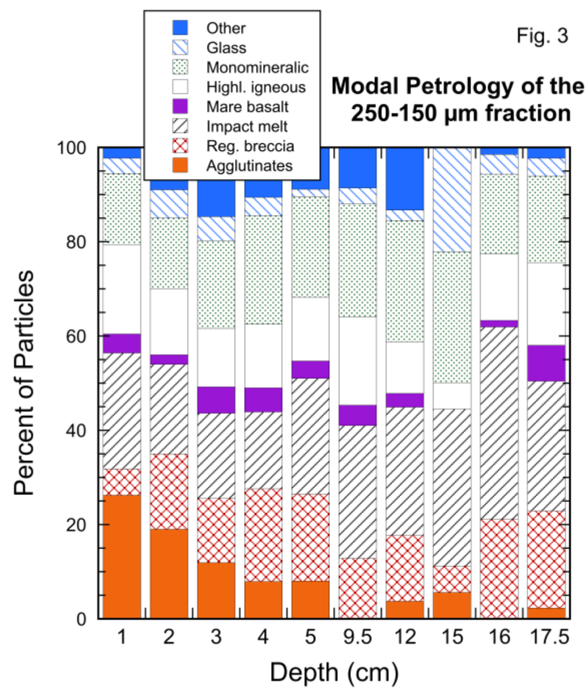


Fig. 1 (left)**.** Modal petrology of the 1000-500, 500-250, and 250-150 µm size fractions, determined by SEM/EDS, in 73002. Impact melt rocks are a significant component of all size fractions throughout the soil column.

Figs. 2, 3 (above). Modal petrology of 500-250 µm (Fig. 2) and 250-150 µm (Fig. 3) size fractions of 10 depth intervals of 73002. Numbers at bottoms of columns show the upper depth of the corresponding 0.5 cm depth interval (e.g., "1" represents the 1.0 – 1.5 cm interval).