LITHOLOGY OF ROCK FRAGMENTS IN APOLLO 17 DOUBLE DRIVE TUBE CORE 73002 USING X-RAY COMPUTED TOMOGRAPHY AND COMPARISON TO LITHOLOGIC MAKEUP OF STATION 3 SOILS. B. L. Jolliff[1], C. J.-K. Yen[1], J. Gross[2,3,4], R. A. Zeigler[2], S. A. Eckley[2,5,6], and the ANGSA Science Team[7]. [1]Department of Earth & Planetary Sciences and the McDonnell Center for the Space Science, Washington University in St. Louis, MO 63130. [2]ARES, NASA Johnson Space Center (JSC), Houston, TX 77058. [3]Dept. of Earth & Planetary Sciences, Rutgers University, Piscataway, NJ. [4]Dept. of Earth & Planetary Sciences, American Museum of Natural History, New York, NY; [5]Jackson School of Geosciences, University of Texas at Austin, Austin TX. [6]Jacobs Technology, Johnson Space Center, Houston, TX. [7]www.lpi.usra.edu/ANGSA/teams/ (bjolliff@wustl.edu)

Introduction: The Apollo Next Generation Sample Analysis (ANGSA) program seeks to display state-of-the-art analytical tools that are available today to provide for the analysis of planetary materials returned by spacecraft missions in such a way as to optimize the curation, allocation, and analysis of precious and often limited samples to address key scientific questions [1]. One of the great advancements is in the area of petrographic analysis of materials made possible by X-ray Computed Tomography [2, 3]. This method is non-destructive and provides information that: (1) once required sectioning and polishing of rock materials for SEM imaging, or (2) may no longer be available once a sample such as a core has been dissected. By comparing the scans to Apollo samples and lunar meteorites of known lithologic type, this method can be used to locate, classify, and categorize materials as part of preliminary examination so that investigators know exactly what to request to address science questions. For complex rocks such as impact breccias, the XCT scans can be used to search for - and target - specific lithologic materials for extraction and further analysis (see [3]).

In this abstract, we highlight a variety of rock types observed in XCT images that are prominent lithologic components of Apollo 17 Station 3 soils, and that can readily be found in the core by XCT imaging and, once separated, further characterized by individual rock-particle imaging. In addition, new and unusual lithologies can be found using XCT technology.

Methods: Individual rock particles >4 mm are separated from the core as part of the dissection process and are individually bagged in Teflon under a nitrogen atmosphere. They are then scanned using the 180 kV nano-focus transmission source on the Nikon XTH 320 micro-XCT system at NASA Johnson Space Center [2]. The X-ray intensity is a function of mean atomic number.

Results: From the first pass dissection of drive tube 73002, the lithologic types and proportions (by numbers of rock fragments) have been estimated from the XCT images of the fragments. The most common lithologies are regolith breccias, impact melt breccias, basalts, agglutinates, and impact melt. Impact melt breccias and regolith breccias are the most abundant and approximately even in number, each composing about 40% of the rock particles. Basalts account for about 5% of the

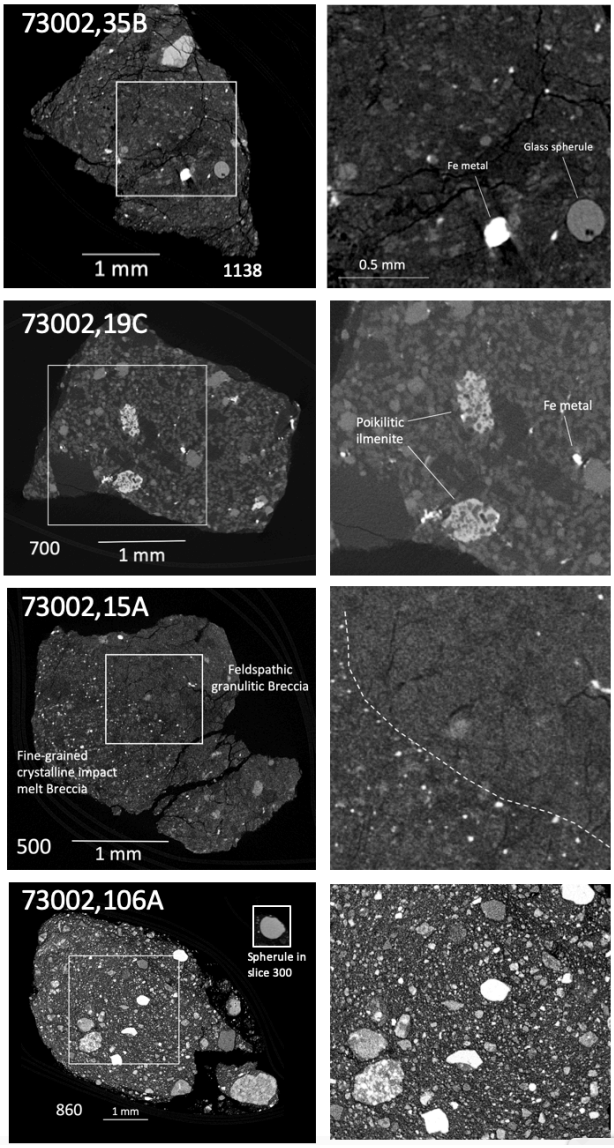

Figure 1. XCT image slices of a sampling of lithologies in the 73002 first pass dissection and enlargments of areas noted with white squares, on right. From top to bottom: 73002,35B regolith breccia; 73002,19C impact melt breccia with granulitic texture; 73002,15A dilithologic impact melt breccia, and 73002,106A Fe-metal-rich regolith breccia. With as many as 1000 slices or more, scans sometimes reveal multiple lithologies such as ,15A. Features such as glass spherules or agglutinitic clasts, which may not be visible in every slice, indicate a regolith breccia.

rock fragments. These numbers are similar to what may be inferred from the chemical composition of subsamples of <1 mm material from the first pass dissection [4]. From the chemistry, noritic impact melt breccia composes about 40 wt.% and basalt ranges from 3% near the bottom of 73002 to 10% near the top.

Discussion: Rock particle contents of other Station 3 soils have been investigated to determine their geochemistry and lithology. In a study of lithologic components among the 2-4 mm sieve fraction of Station 3 trench soil 73240, [5] tabulated the main represented rock types including impact melt breccias, regolith breccias and agglutinates, miscellaneous feldspathic lithologies, mare basalts, and meteoritic contaminants. In 73243, impact-melt breccia particles by number make up 39%, mare basalt fragments make up 10%, and the remaining assortment of lithologies, mostly regolith and fragmental breccias, make up 50%. The numbers are very similar to what we find for the XCT-classified rock particles in 73002.

As has been pointed out previously [2, 3], the XCT images of individual rock particles are very useful for detailed lithologic characterization. We highlight an example of 73002,51A, which is a high-Ti mare basalt (Fig. 2). This basalt is composed of pyroxene and olivine (difficult to distinguish olivine from pyroxene) grains with interstitial splays of plagioclase and abundant, mostly acicular ilmenite. Some ilmenite grains appear to have armalcolite cores. The texture resembles that of a number of Apollo 17 ilmenite basalts, most notably 70215 (Fig. 2), 72155, 71556, 71595, and 75035 [6]. The type is likely close to Type 1A of [7]. In the XCT images, we find olivine and pyroxene can be difficult to distinguish in this sample, but this would not be an issue where olivine forms euhedral phenocrysts. Nevertheless, the textural similarity with specific Apollo 17 basalts makes the lithologic determination robust and would enable a researcher to know exactly what to expect in requesting one of these rock particles or a portion thereof for analysis.

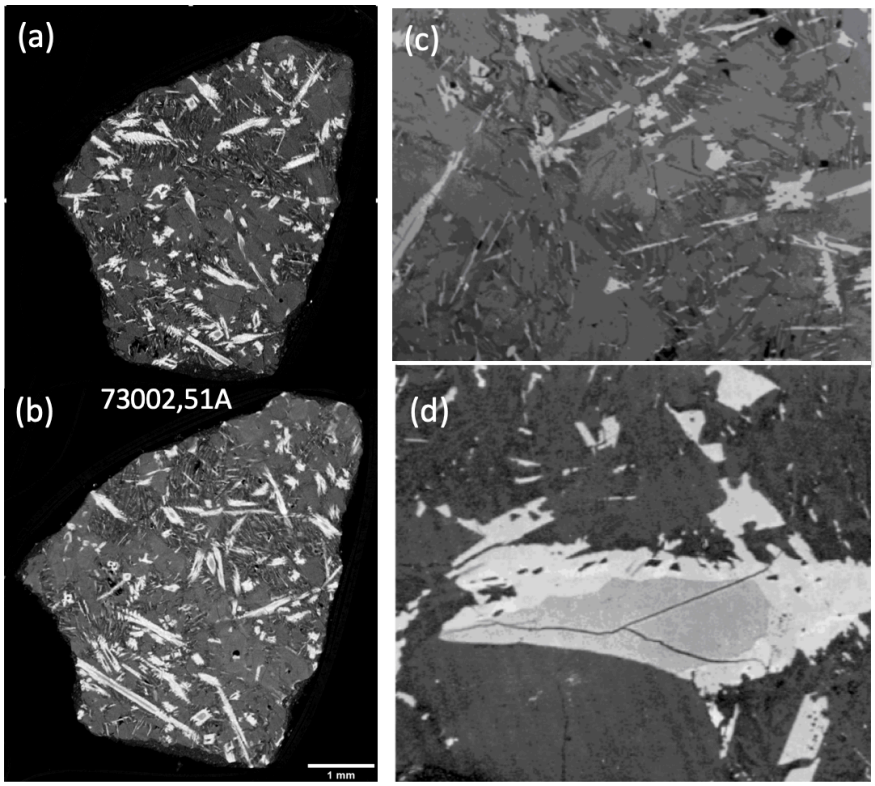

Figure 2. (a,b) two different XCT slices of 73002,51 high-Ti basalt rock fragment. (c) Reflected light photomicrograph of 70215,89 (field of view 1.3 mm). Olivine is clear, surrounded by colored pyroxene. Ilmenite is opaque with high reflectivity. Plagioclase is interstitial, with low reflectivity. NASA # S79-26738-26740. (from [6]). (d) Armalcolite grain adjacent to olivine in 70215,159, showing the reaction relationship of armalcolite with melt, forming ilmenite with rutile exsolution. Grain is about 100 µm across (from [8] in [6])

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