A STUDY OF CRYSTAL SIZE DISTRIBUTION OF ILMENITE IN APOLLO 17 DRIVE TUBE 73001. J. L. Valenciano[1], C. R. Neal[1], C. K. Shearer[2], and the ANGSA Science Team, [1]Department of Civil and Environmental Engineering and Earth Sciences, University of Notre Dame, Notre Dame, IN 46556, USA [2]Institute of Meteoritics, University of New Mexico, Albuquerque, NM, USA

Introduction: Station 3 of Apollo 17 was located on the light mantle landslide deposit approximately 50m east of Lara Crater (**Fig. 1**) [1,2]. Among the samples collected at this location is two vacuum-sealed drive tubes, forming samples 73002 above 73001. These samples are part of the Apollo Next Generation Sample Analysis (ANGSA) project and represent new samples from the Moon that will be used as part of educating the next generation of lunar scientists and potentially unveiling new lunar lithologies.

As with 73002, drive tube 73001 was imaged using x-ray computerized tomography (XCT). These images enable ilmenite to be easily identified in basaltic clasts, which allowed this study to be conducted without physical samples. From the clasts imaged throughout the core, ten basalts (**Fig. 2**) were analyzed for this study and used to construct ilmenite crystal size distributions (CSD) and investigate their crystallization history.

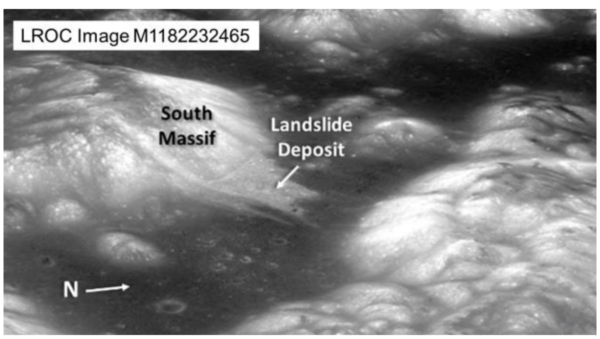

Figure 1: Location of the "light mantle" landslide deposit at the base of South Massif

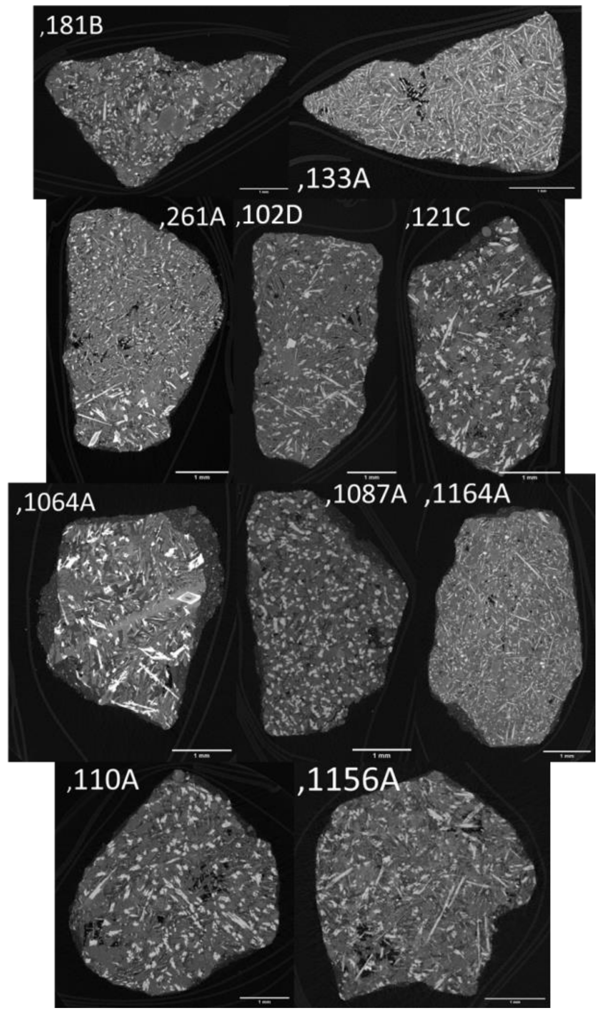

Figure 2: XCT scans of the ten basalt clasts that were analyzed in this study. Phases in white represent ilmenite. Each white scale bar represents 1 mm.

Methods: Crystal size distributions (CSDs) are a quantitative, non-destructive method of analyzing the crystallization histories of a chosen mineral phase in igneous samples. This is based on the principle that the crystal size and the natural log of the number of crystals in each size interval have a linear and negative correlation, and that the slope can be used to calculate the residence times (if a growth rate is known or assumed), as well as the relationship between nucleation and the growth rate [3,4]. The data for this study were collected using a method similar to [5]. Ilmenite crystals are easily distinguishable in XCT and were used in lieu of traditional thin sections (**Fig. 2**). User-selected "slices", the amount of which being dependent on the number of crystals available in each slice, were taken from the CT videos of each clast and imported into *Corel Paintshop Pro 2020*. Ilmenite crystals were traced using a touchscreen laptop computer and active stylus pen, with any crystals that overlapped traced on separate layers. Crystals touching the edges of the clast, or were otherwise incomplete, were traced on their own layer to achieve a more accurate value for the percentage of ilmenite in the clast and were not included in the CSD profiles.

At least 250 crystal traces are necessary to create a statistically relevant population density value [6] and between 300 – 1150 ilmenite crystals were traced for each clast. These crystal traces are then filled with a solid color and are processed through *Fiji*, where the known scale of each sample is used to calculate the area, best-fit ellipse, and major and minor axis. These major and minor axes are then exported to *CSDSlice*, where it is compared to a database of >700 crystals to determine the best shape of each 2-D tracing [6]. *CSDCorrections* was then used to group crystal sizes into bins and plot the natural log of the population density against the corrected length of each crystal (**Fig. 3**) [7].

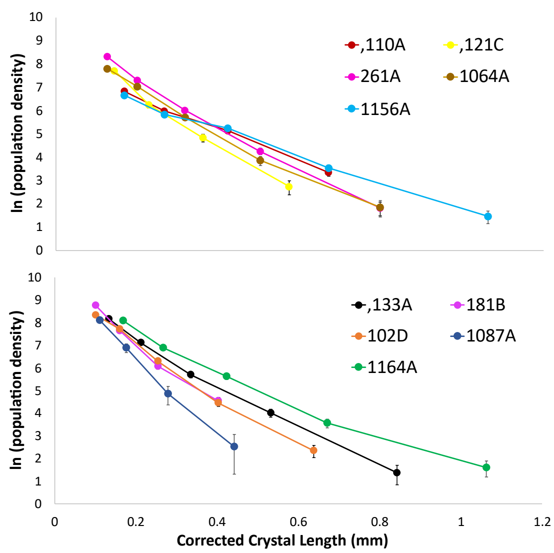

Figure 3: CSD profiles for the clasts in this study. Any error bars that are not visible are within the symbol.

Results & Discussion: CSD profiles for these samples yielded mostly linear slopes, indicating a constant cooling rate. The steepest and therefore relatively faster cooling sample is shown to be ,1087A, while sample ,1156A shows the shallowest slope and represents the slowest cooled sample in this study. Samples ,110A and ,1156A have a mixture of larger ilmenite crystals and very fine needles of ilmenite and show would be a minor kink at ~0.25 mm, suggesting that there may have been a shift in cooling regime or other change in crystal nucleation. When comparing ilmenite CSDs of samples from 73002 with those completed for 73001 they follow a similar trend, plot in similar locations, and define three distinct groupings that are common to both drive tubes (**Fig. 4**). The Slope-Intercept plot of different mare basalt ilmenite CSDs defines an upper faster (shallower) and a lower slower (steeper) cooling trends [8]. Two of the ANGSA basalt groups fall on the slower cooling trend with on at the intersection of the two trends. Preliminary interpretation: samples are from various positions from thick (inflated?) pahoehoe flows (cf. [9]) Future work: geochemical analyses, performing ilmenite CSDs on the other 17 high-Ti basalt clasts from drive tube 73001.

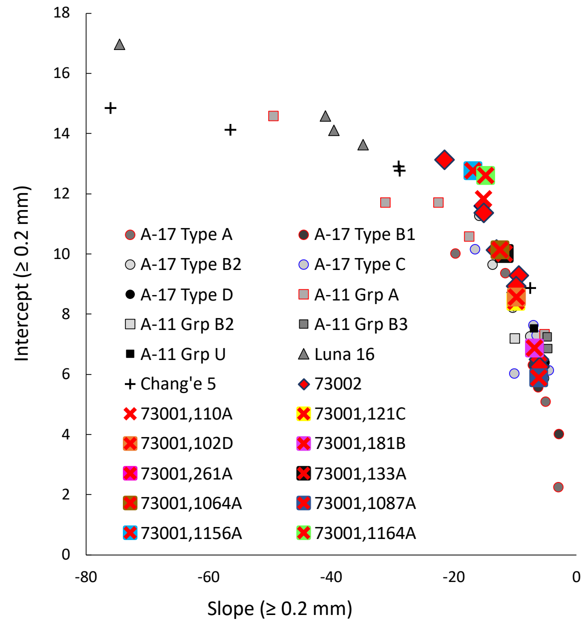

Figure 4: 73001 samples put into context with other ilmenite CSDs, including those from drive tube 73001.

Acknowledgments: We thank the ANGSA Preliminary Examination Team and the curatorial staff at JSC for their work and for allocating the samples, and NASA for supporting ANGSA. This was supported by NASA Grant 80NSSC19K1099 to CKS and the subcontract to the University of Notre Dame.

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