EXPOSURE HISTORY OF APOLLO 17 DOUBLE-DRIVE TUBE 73001/73002. N. M. Curran[1,2,3], S. N. Valencia[2,4], C. M. Corrigan[5], E. S. Bullock[6]; B. A. Cohen[2] and The ANGSA team. (natalie.m.curran@nasa.gov) [1]The Catholic University of America, Washington, DC 20064, [2]NASA Goddard Space Flight Center, Planetary Geology, Geophysics, and Geochemistry Laboratory, Greenbelt, MD 20771. [3]CRESSTII, [4]Center for Space Sciences and Technology, University of Maryland, Baltimore County, Baltimore, MD 21250. [5]National Museum of Natural History, Smithsonian Institution, Washington D. C. 20560. [6]Earth & Planets, Carnegie Institution for Science, Washington D. C. 20015.

Introduction: The lunar regolith hosts a wealth of information regarding the processes that have modified and evolved the Moon and its surface over the last ~4.5 Gyr. Particles from the sun (solar wind, solar cosmic rays) and the wider galaxy (galactic cosmic rays, impacts from micrometeorite, comets and asteroids), as well as gases from the lunar interior (decay of radioactive elements) have directly interacted with and/or been implanted into regolith exposed at the lunar surface [1-2]. These processes have led to volatiles and organic compounds being added to the lunar surface, both exogenically and endogenically [3-13]. Furthermore, volatiles and organics may be produced or destroyed during the interaction of the solar wind and cosmic rays with surface exposed material [14-17].

Double-drive tubes, such as Apollo sample 73001/73002, present an opportunity to investigate the different processes and their affect at different depths. Noble gases can be used as a powerful tracer for measuring these inputs as well as their potential destruction via different surface processes (exposure to cosmic rays, impacts). Noble gas data of the regolith can be used to decipher how long a sample was exposed to the space environment (cosmic ray exposure (CRE) age), how much gardening and overturn was experienced (maturity), and the timing of breccia formation or soil appearance (antiquity age). These noble-gas derived quantities give crucial context to the geological history of the sample.

The Moon United Team: The Moon United team are a part of the Apollo Next Generation Sample Analysis (ANGSA) consortium and have analyzed a variety of particles (impact-melts, basalts and regolith breccias) and bulk soils from six depths from double-drive tube 73001/2 collected during the Apollo 17 mission (figure 1). In total there are 42 particles (5-7 particles from each depth) ranging from 1-4 mm, and 6 soils from each depth. These particles and soils provide the opportunity to assess the input budget from the solar wind and exogenous sources, understand exposure histories with depth, and explore how the local region has evolved over time. The petrology (scanning electron microscope), mineral and bulk rock chemistry (electron microprobe) (see [18]), and noble gas budget (mass spectrometry) will be measured for each particle and soil sample. These data will be used to determine parent lithology [18] and constrain the regolith history (e.g., cosmic ray exposure age, maturity, gardening history) of the samples and provide crucial context to the

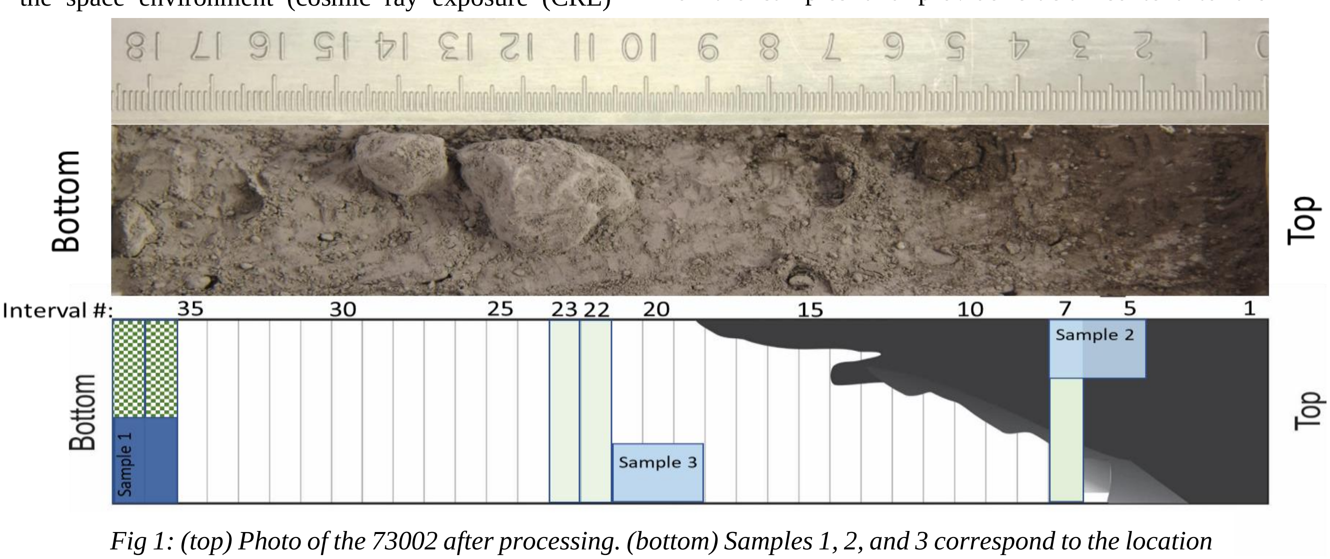

Fig 1: (top) Photo of the 73002 after processing. (bottom) Samples 1, 2, and 3 correspond to the location of the Moon United teams samples from 73002. Soils and particles were extracted from 3 additional depths from 73001 providing a samples from a range of depths.

exposure history experienced by volatile and organic compounds within them. These measurements will offer significant value to the ANGSA consortium efforts to understand the complete geologic history of the samples, the Apollo 17 landing site, and lunar processes. In this project, we will use a combination of noble-gas isotopic ratios ($^{3}He/^{4}He$, $^{20}Ne/^{22}Ne$, $^{21}Ne/^{22}Ne$, $^{36}Ar/^{38}Ar$, $^{40}Ar/^{36}Ar$) and abundances ($^{3}He_{cosmogenc(c)}$, $^{20}Ne_{trapped(tr)}$, $^{21}Ne_{c}$, $^{36}A_{tr}$, $^{38}Ar_{c}$) to decipher the importance of each input source and understand what is the variation in exposure ages and maturity with depth?

As lunar soil matures at the surface by micrometeorite comminution and agglutination, it can be overturned or buried by larger processes of movement and turnover collectively known as gardening. The movement of material by large impacts is the dominant mode but slumping and landslides can also be locally important as seen at the Apollo 17 landing site. The formation of layers can aid preservation of molecules by removing them from direct surface interaction, but organic molecules may continue to degrade as cosmogenic effects are still felt meters into the regolith. Determining the exposure age, antiquity, maturity, and abundance of noble gases in these horizons will allow us to address how long organic molecules have been exposed to potentially damaging cosmic rays, and when volatiles and organics were gardened back into the soil column and protected from escape.

Current and Pending Work: Samples allocated from 73001/2 (figure 1) to the Moon United team range from lithic fragments of basalt and noritic nature to breccias including impact melts and regolith breccia. These have all been characterized by X-ray computed tomography (XCT), Scanning electron microscopy (Fig 2), and electron microprobe analysis [18] to determine the petrologic, mineralogic, and chemical makeup of the particles and soil samples before noble gas work is conducted. Work has begun on the noble gas content of the soils and particles and will be presented here.

Acknowledgments: This work was funded through the NASA Apollo Next Generation Sample Analysis program. We thank the NASA JSC curation team for the xCT data and Tim Gooding for making thick sections. Portions of this work were supported by NASA ISFM FLARE.

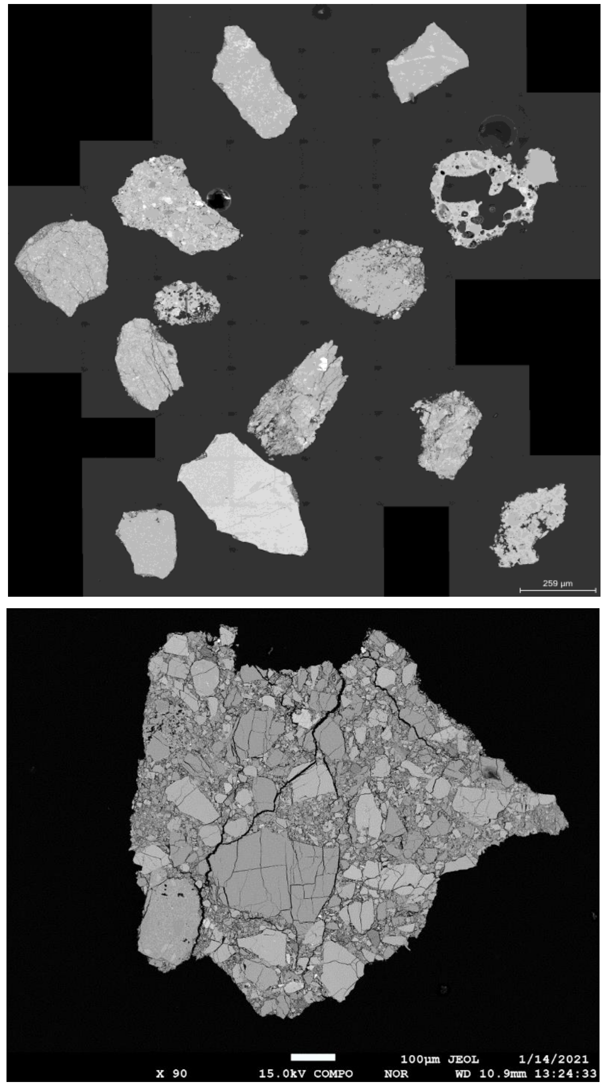

Fig 2: (top) Back scattered electron image of soil from sample 1 (figure 1) and (bottom) particle 73002,184C from sample 2 (figure 1).

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