APOLLO NEXT GENERATION SAMPLE ANALYSIS (ANGSA). THE IMPORTANCE OF LUNAR SAMPLE RETURN AND PREPARING FOR ARTEMIS. C. K. Shearer[1,2], F. M. McCubbinr[3], R. Zeigler[3] , J. Gross[3,4], the ANGSA Science Team, and the Johnson Space Center ANGSA Curation Team.[1] Institute of Meteoritics, Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, New Mexico; [2]Lunar and Planetary Institute, Houston TX 77058 (cshearer@unm.edu); [3] ARES, NASA Johnson Space Center, Houston (JSC) TX 77058-3696, [4] Depart. of Earth and Planetary Sciences, Rutgers University, Piscataway NJ 08854.

Introduction: Although the Apollo Program to explore the surface of the Moon ended in 1972 with the success of Apollo 17 (A17), the legacy of the program has continued with the samples that were returned. The analyses of these samples provided fundamental insights into the origin and history of the Earth-Moon system and how planets and even solar systems work. The samples have provided ground truth for every post-Apollo mission to the Moon for the interpretation of remotely sensed data. Over this time, our sophistication for handling, examining and analyzing samples has greatly increased. During Apollo special samples were collected or preserved in unique containers and environments and remained unexamined by standard or advanced analytical approaches. In many cases, the purpose of samples placed in sealed containers was to protect characteristics that could be modified by interactions with spacecraft cabin conditions, the Earth's environment, or agitation of regolith samples. The Apollo Next Generation Sample Analysis (ANGSA) initiative was designed to examine a subset of these special samples (e.g., Core Sample Vacuum Container (CSVC), Special Environmental Sample Containers (SESC), frozen samples). The ANGSA consortium consists of 9 original teams funded by NASA plus international partners (e.g., ESA). The initiative was purposely designed to functions as a "new sample return mission" with processing, preliminary examination, and analyses utilizing new and improved technologies and recent mission observations. The ANGSA initiative links the first generation of lunar explorers who participated in the Apollo Program with future explorers of the Moon during the Artemis Program. Therefore, ANGSA is preparing a new generation of scientists and engineers for human lunar sample return and analysis activities.

Opening Lunar Treasures: Thus far, Johnson Space Center curation and ANGSA preliminary examination (PE) teams have extracted and are dissecting-examining the upper core sample from the double drive tube (73002). The core was extracted from the drive tube on November 5, 2019 in a dry nitrogen core processing glove box by a curation team consisting of Charis Krysher, Andrea Mosie, and Juliane Gross. Following extrusion, the core was derinded (outer surface removed) and subsamples were collected and analyzed for organics and hydrogen isotopes. Following the derinding step the core is being dissected in 0.5 cm sections on three different passes (horizontal levels parallel to the length of the core). Following pass three the remaining core will be encased in epoxy and used to make continuous thin sections of the core stratigraphy. During the core dissection of pass 1, ANGSA Preliminary Examination Team (PET) members described and photograph both the core and the greater than 1mm lithic fragments. During each pass the core will be imaged using a multi-spectral analyzer that examines wavelengths comparable to those collected by orbital instruments on orbital missions Lunar Reconnaissance Orbiter, Kaguya, and Chandrayaan-1. As of March 1, 2020, the first pass of the core had been processed. The overall timeline following this point will be dictated by health measures taken to combat COVID-19. The gas phase in the A17 CSVC (73001) will be documented, extracted and analyzed in late-Fall 2020. The CSVC core will be imaged and extruded in Winter 2020-21.

Initial Results: Some of the first data derived from 73002 were from X-Ray computed microtomography (XCT) imaging of the core (through its aluminum drive tube container prior to extraction and processing) and lithic fragments, ANGSA PET descriptions of the core and lithic fragments, multi-spectral imaging of the core, and sample measurements that could potentially be disturbed by sample processing over a period of time (volatile organics, hydrogen, chlorine, oxygen and their isotopic composition). The mineralogy and maturity of these initial analyzed samples have also been examined. The core sample site (73001-73002; A17 Station 3) has been placed within a local and regional geological context using human surface observation, orbital data, surface samples, and empirical modeling. The results of these initial observations and analyses will be reported by the science team members.

Links to Artemis: Ultimately, these measurements and observations are linked to the Artemis program and the future of human activity on the Moon. How are samples selected, handled, stored, curated, and released to the science-engineering community to maximize lunar science? Are there resources that can support human science, exploration, and economic activities between the Earth and Moon, on the lunar surface, and beyond the Moon? How are these resources identified, sampled, and processed?