Preserving and Curating the Moon: Adventures in Lunar Core Processing

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The lunar crust is the most easily accessible part of the Moon to both remote sensing and sample analyses and provides an archive of information about planetary formation, crustal evolution, and contains a wealth of information about the origin of the Earth-Moon system [e.g., 1-5]. The Apollo mission returned 382 kg of rocks, soil and core samples. Studies of these lunar samples are crucial for our understanding of the Moon's formation and geological evolution, and for the past 50 years these returned samples have provided the foundation for lunar science [5].

The returned samples are stored and cared for in the lunar curation facility at NASA's Johnson Space Center. This facility is comprised of a large suite of clean rooms, sample vaults for pristine and return samples, thin section labs, core and saw rooms, storage and working areas, and ancillary labs all designed to minimize contamination from the environment and other samples. Some of the returned samples were intentionally set aside and left unopened. Recently, the Apollo Next Generation Sample Analysis (ANGSA) initiative was designed to examine these pristine samples so the next generation of lunar scientists can further our insight into the Moon's history. Here, we present the meticulous process that involves preparing for, and ultimately opening, one of the unopened core samples: Apollo 17 drive tube 73002,0, which was collected on the Moon from a landslide deposit near Lara Crater by astronauts Gene Cernan and Jack Schmitt.

In order to open, examine, and curate 73002,0 with minimal potential contamination, great care had to be taken prior to opening its container. Beginning 18 months before extrusion of the sample, all core processing equipment was pulled out of storage, identified, sorted, cleaned, and purged with nitrogen gas. However, limited institutional memory has made this step challenging as most of the former core processors from the Apollo area have retired or passed away. Twelve months prior to extrusion, table-top rehearsals were initiated to identify equipment and learn how it fits together and operates. Five months before extruding the real core, preparations further evolved to include the extrusion and dissection of a lunar core simulant. In addition, a mock-up glovebox was designed and built to allow for a more realistic practice environment. One month prior to extrusion, the actual core cabinet was prepared for use, which included fitting it with lights, a webcam, and power. The tool and equipment cleaning procedure was also modified to include increased cleanliness and sterility requirements. While still sealed, the core was CT scanned at the University of Texas at Austin to maximize its scientific return. Days before the extrusion, witness plates and foil were deployed inside the core cabinet to monitor potential particle and organic contamination within the cabinet. On Nov. 5th, 2019, core sample 73002,0 was successfully opened and extruded (Fig.1). Dissection of 73002,0 began immediately afterwards and is still under way. Processing this sample will help us prepare for future sampling missions and core extrusions and will enable new scientific discoveries about the Moon.

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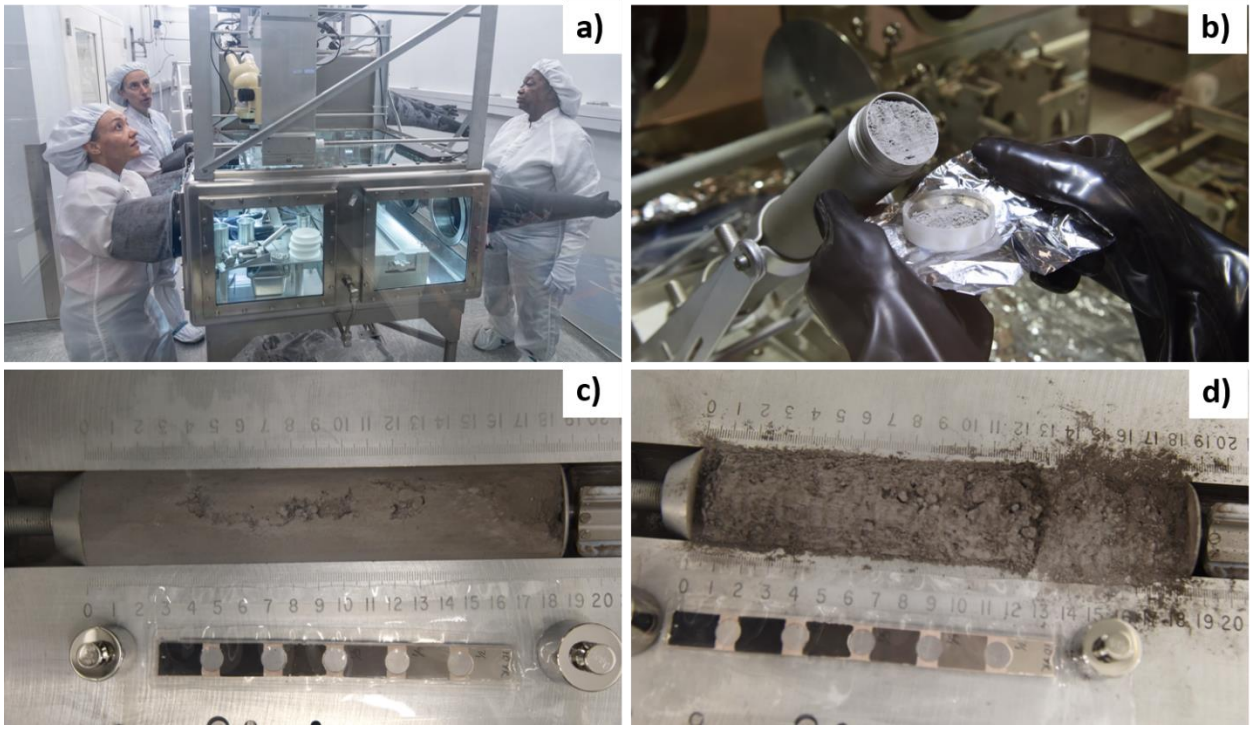

Fig. 1: *Process of opening 73002. (a) extrusion of the core inside the core cabinet; (b) opened drive tube; (c) extruded core; (d) first few intervals dissected.*