X-RAY COMPUTED TOMOGRAPHY FOR THE ANALYSIS OF MATERIALS COLLECTED AT THE LUNAR SOUTH POLE. A. J. Gawronska[1], C. L. McLeod[1], C. M. Gilmour[2], [1]Department of Geology and Environmental Earth Science, Miami University, Oxford, Ohio, USA, 45056 (gawronaj@miamioh.edu). [2]Centre for Research in Earth and Space Science, York University, Toronto, Ontario, Canada, M3J 1P3.

Introduction: Studies of materials from rocky bodies across the Solar System have worked to inform and refine our understanding of processes occurring in the universe around us. The future Artemis program will provide new materials from a region of the lunar surface that has never been investigated in-situ. Specifically, the Artemis 3 mission will land at the lunar south pole, which lies on the flank of Shackleton Crater. There, a number of lithologies have been found (Figure 1), and materials associated with these lithologies could potentially be collected by crew during extravehicular activity (EVA) [1]. The most novel materials that could be collected at the lunar south pole are water and other volatile species [2]. However, volatiles are concentrated in permanently shadowed regions (PSRs) which are not easily accessible for direct sampling during EVA [1]. Instead, the crew may focus on rocky materials found on the rim or ejecta blanket of Shackleton. These materials will likely include: 1) crystalline crust (specifically norite, and/or purest anorthosite with >98% feldspar) [3-4], 2) layered materials from nearby ejecta deposits (Figure 1, [1]), 3) impact melt [5], 4) regolith, and 5) core or dredge samples that will include any mixture of the above. It is important to note here that regolith and core/dredge samples in particular will also likely include a mixture of regolith-ice [6].

Analytical Methods: Once new samples are returned from the lunar surface, it will be critical to take advantage of all available analytical methods, and to properly curate and preserve samples. Both can be addressed by utilizing X-ray computed tomography (XCT; e.g., [7-8]), where scans of a sample are gathered by passing X-rays through a sample. The resulting scans may be used to recreate a 3D model of the sample, preserving it for posterity and permitting investigations of sample characteristics at the µm to cm scale (e.g., morphology, mineralogy, textures) [7]. The application of XCT has been demonstrated to be of particular use to extraterrestrial sample preservation and analysis [7-10], and will therefore be integral to the characterization of returned Artemis materials.

Resulting Data and Future Work: Scans returned via XCT are monochromatic and feature different grayscale values for different phases existing in a given sample. These can be used to easily and decisively evaluate the modal proportion of components within sampled materials. With regards to materials gathered at the lunar south pole, this approach will support the characterization of crustal material gathered, and assess whether sampled material appears to contain any layering or mixing features consistent with ejecta deposits. In preparation for the Artemis missions, it will be crucial to utilize XCT in identifying lunar sample characteristics by analyzing already-gathered samples. One way in which this is being accomplished is the Apollo Next Generation Sample Analysis program's investigation of Apollo 17 drive tubes (e.g., [10]). Future preparation should include further investigation of feldspathic samples, impact melts, and regolith.

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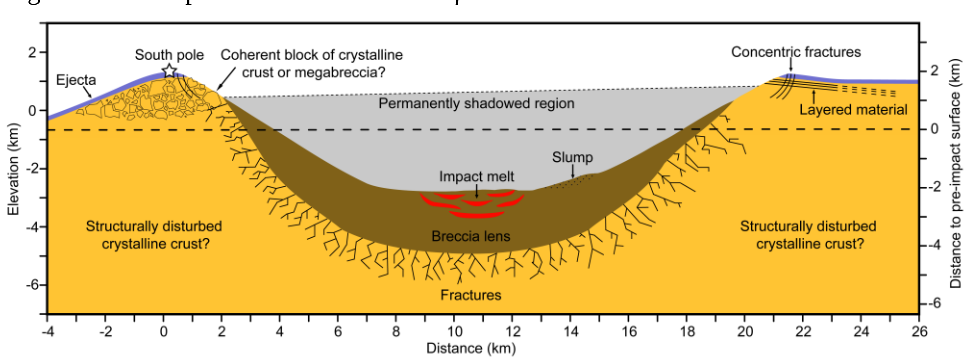

Figure 1: Cross-section of Shackleton crater, outlining the major lithologies existing near Shackleton that may be sampled during extravehicular activity at the lunar south pole (south pole delineated by white star). Figure from [2].