Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24208

Preparing for Artemis Sample Return: Lessons from the Analysis of Volatile-Rich and Specially Curated Apollo Samples

MICHELLE S. THOMPSON

Purdue University

Presenting Author: mthompson@purdue.edu

The NASA Artemis missions will return samples from volatile-rich regions of the Moon that have never before been explored by humans. The collection of volatile-rich samples from the lunar surface is a new opportunity to advance our understanding of the Moon, but these samples will present unique challenges for their curation and analysis. In order to prepare for sample return from Artemis, the community must employ new techniques for sample handling, storage, and examination. In particular, the next frontier will require the nanoscale detection and quantification of volatiles in these lunar materials, potentially under cryogenic or cold-curated conditions. To prepare for this new analytical regime, we can draw from our experience in the analysis of volatile-rich and specially curated samples from the Apollo missions.

Recent advances have been made by applying existing techniques in new ways to lunar sample analysis. In particular, volatile characterization has taken a leap forward with the correlated use of electron energy loss spectroscopy in the transmission electron microscope and atom probe tomography. In addition, the application of cryogenic sample analysis capabilities will provide an opportunity to ensure these samples maintain the volatile species that were present on the Moon even after their return to Earth. These analytical tools have begun to reveal the volatile histories of samples from Apollo and will ultimately be critical for the characterization of Artemis samples. Here we will discuss lessons learned from those analyses, as well as the next steps to take towards identifying and quantifying volatiles in the lunar regolith, such as solar wind species (e.g., H, He, Ne, etc.) and products derived from solar wind irradiation (e.g., OH and H_2O). We will also explore how the analysis of specially curated samples, like the double drive tube core sample from Apollo 17 made available during the Apollo Next Generation Sample Analysis Program, could guide our curation and preliminary examination of Artemis samples. Finally, we will explore how the planetary science community is preparing for sample return from Artemis, and what work needs to be done to maximize the science return from a new lunar sample collection.