SPECTRAL UNMIXING MODELING OF THE ARISTARCHUS PYROCLASTIC DEPOSIT: ASSESSING ERUPTIVE HISTORY AND EXPLORATION POTENTIAL OF GLASS-RICH REGIONAL LUNAR PYROCLSTIC DEPOSITS. Erica R. Jawin[1], James W. Head[1], and Kevin M. Cannon[2], [1]Department of Earth, Environmental, and Planetary Sciences, Brown University, Providence, RI 02912 USA, (Erica_Jawin@brown.edu), [2]Planetary Sciences Group, University of Central Florida, Orlando, FL 32816.

Introduction: The Aristarchus Plateau in central Oceanus Procellarum is viewed as the most diverse volcanic complex on the Moon [*1*], containing the largest pyroclastic deposit [*2*] which is understood to be ~20 m thick and rich in volcanic glass [*1–5*]. Pyroclastic deposits are of interest for future exploration potential due to the concentrations of easily extractable in-situ resources such as O, Fe, Ti, H^3, and H_2O [*6–8*].

While many authors have reported the glass-rich nature of the Aristarchus pyroclastic deposit, the interpreted color (and therefore composition) of the glass varies between analyses, including orange (high-Ti) [*1*, *2*], green (low-Ti) [*9*], and yellow glass (intermediate-Ti) [*10*]. In addition, previous spectral analyses of the Aristarchus pyroclastic deposit have been performed using lower resolution data than are currently available. In this work, high-resolution spectral data from the Moon Mineralogy Mapper (M^3) [*11*] are applied to investigate the nature of the Aristarchus pyroclastic deposit, with four objectives: (1) What is the degree of mineralogic variability of the pyroclastic deposit? (2) What kind (color) of volcanic glass is present, and how does it vary in abundance across the deposit? (3) What can we determine about the eruption conditions on the Aristarchus Plateau from this analysis? (4) What is the exploration and in-situ resource utilization (ISRU) potential of the Aristarchus pyroclastic deposit?

Methods: We apply Hapke theory of radiative transfer modeling [*12*, *13*] to nonlinearly unmix M^3 data. The approach (modeled after [*14*, *15*]) models a spectrum as a five-component mixture where three components are laboratory mineral endmembers, the fourth component is a flat line approximating lunar space weathering effects, and the fifth is a laboratory spectrum of a returned Apollo volcanic glass or a synthetic lunar glass (modeled glasses include green, orange, yellow, red, and black) [*16*]. Reflectance between is converted to single-scattering albedo (SSA) and a spectrum is mathematically inverted to give relative abundances of each endmember.

Results: The Aristarchus pyroclastic deposit is very low albedo and the pyroclastic materials contain very shallow absorption bands centered at approximately 1000 nm and 1800 nm. Preliminary results of the M^3 unmixing suggest that spectra of the pyroclastic deposit can be modeled by a mixture composed predominantly of a featureless endmember (indicating a space weathered target) and a smaller component of glass. Various glasses were able to give relatively good fits, but the most accurate fit was generated by using a synthetic orange glass endmember.

Discussion: The results shown here confirm that there is a detectable component of glass in the Aristarchus pyroclastic deposit which may be similar to the high-Ti orange glass seen in other regional pyroclastic deposits [*17*], with minimal contributions of other crystalline mineral components, suggesting that soil is dominating the spectral fraction. These results are in agreement with several previous analyses [*1–5*].

The presence of volcanic glass in the pyroclastic deposit, with the low abundance of crystalline material, supports the model that the Aristarchus pyroclastic deposit formed in a long-duration, hawaiian-style fire fountain eruption [*18*, *19*]. Glass abundance did not vary significantly across the deposit, and there was no significant detection of devitrified black beads (as was observed at the Apollo 17 landing site in the Taurus-Littrow pyroclastic deposit [*17*]) in the modeling results. These observations suggest that the eruption optical density remained low throughout the eruption [*5*].

The confirmation of abundant glass that may be rich in titanium in the Aristarchus pyroclastic deposit has implications for the future exploration and in-situ resource potential of this region. Spectral analyses, combined with other data sets such as radar CPR (e.g., [*3*]) and mapped water content [*8*] can help to identify regions where the pyroclastic deposit is thickest and most abundant in useful resources. Regional pyroclastic deposits such as that on the Aristarchus plateau therefore represents a key region of scientific and exploration potential, and should be of high priority when considering future human exploration destinations.

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