REVISITING THE MINERALOGY OF THE ARISTARCHUS REGIONAL PYROCLASTIC DEPOSIT WITH NEW M^3 ANALYSIS TECHNIQUES. M. J. McBride[1], B. H. N. Horgan[1], and L. R. Gaddis[2]. [1]Purdue University, 610 Purdue Mall, West Lafayette, IN 47907 (mjmcbride@purdue.edu). [2]Astrogeology Science Center, U.S. Geological Survey, Flagstaff, AZ 86001.

Introduction: Copernican-aged crater Aristarchus has a diameter of 45 km and is located on the western near side of the Moon (23.7°N, 47.5°W). The crater lies on the southeast corner of the Aristarchus plateau, which is raised about 1-1.5 km above Oceanus Procellarum. Known for the distinctive brightness compared to other craters of similar ages, the region is a scientific point of interest. The Aristarchus region is also home to the largest pyroclastic deposit on the Moon [1]. Using a new method to map glass and other ferrous minerals [2], we are revisiting this large regional pyroclastic deposit to evaluate the full extent of the glass and to search for compositional diversity that could help to constrain the locations of source vents and eruption mechanisms. Pyroclastics were previously thought to be generally highly homogeneous in composition, but our recent work has shown clear heterogeneity within local pyroclastic deposits that we used to constrain eruption processes [3]. However, it is unknown if that same type of diversity exists in the larger regional deposits. Here we present our preliminary maps of compositional variability in the Aristarchus region.

Background: Aristarchus crater and the surrounding region are known for its spectral diversity as well as mixtures of volcanic and impact minerals. Previously, other analysis methods found olivine and glass-rich impact melts and orthopyroxene-rich (OPX) impact ejecta [4]. Surrounding mare basalts contain clinopyroxene (CPX) and the glass-rich pyroclastic deposits are present on the Aristarchus Plateau [5]. The central peak of Aristarchus crater was also shown to contain anorthosite [6]. Aristarchus crater was spectrally analyzed using some of the new methods used in this work in Horgan et al 2014, but here we expand the analysis to include the full extent of the pyroclastic deposit.

Methods: The Moon Mineralogy Mapper (M^3) was an imaging spectrometer on the Chandrayaan-1 lunar orbiter operating in the visible to near-infrared (0.42µm-3.0µm). M^3 has a resolution of 140 m/pixel in 86 spectral channels [8]. Data from the M^3 instrument is publically available through the Planetary Data System. M^3 collected data during two operational periods defined by changes in temperature and viewing orientation. Data in this project was collected from operational periods 1B, 2A, 2B, and 2C. A M^3 map of the region was constructed (Figure 1) with bounds 304-312ºE and 20-31ºN. Using the methods described in [2,3], the continuum of each spectrum was removed using a linear convex hull with two segments between 0.6-2.6 µm. Spectral noise was reduced using a median filter and a boxcar smoothing algorithm, both with widths of 5 channels. An albedo map was created using the 2.98 µm channel, which is more sensitive to thermal effects on slopes (Figure 1d).

Two new spectral parameters were applied to our M^3 map. Our OPX spectral parameter detects the presence of the broad OPX iron absorption band centered near 0.9 µm based on the average band depth below the continuum at 0.88, 0.9, and 0.92 µm. Our glass spectral parameter detects the wings of the glass iron absorption band, which is centered at much longer wavelengths than other Fe-bearing minerals, based on the average band depth below the continuum at 1.15, 1.18, and 1.20 µm. These maps are shown along with topography from LOLA, Clementine Optical Maturity (which is a proxy for surface exposure), and Clementine TiO_2 abundance (which is elevated in many glassy pyroclastic deposits [8]) in Figure 1.

Preliminary Results: Some of the horizontal variability across the deposit shown in albedo and the M^3 spectral parameter maps is due to changes in resolution and sensitivity between individual observations, but in general, the variability in these maps correlates well with the boundary of the plateau and the inferred extent of the mantling pyroclastic deposit.

There are strong OPX signatures in Aristarchus crater ejecta, small plateau craters, as well as in the Vallis Schroteri rille (Figure 1f). In contrast, stronger glass signatures are present over the remaining portion of the pleatau and in the southeast portion of Aristarchus crater. (Figure 1e). The glass index map (Figure 1e) shows that the pyroclastic deposit appears to extend well beyond the bounds of the topographic plateau (Figure 1a), as well as beyond the bounds of our preliminary maps. At this scale TiO_2 abundance does appear to be correlated with the areas of stronger glass signatures, and expanding the map will help us verify this trend in the larger region. There are also similarities between the optical maturity map (Figure 1b) and the OPX map (Figure 1f) in that abundances are seen in the craters, ejecta, Vallis Schroteri, suggesting that OPX has been exhumed from subsurface sources

Future Work: Since the pyroclastic deposit extends beyond the bounds of the map, we intend to extend the map to evaluate the deposit's full extent. We will also search for a possible pyroclastic source vent by comparing the glass spectral parameter map to the topographic map. We are also currently working on

producing more detailed mineral maps based on 1 and 2 micron band centers, in the manner of [2,3] to search for compositional variations and trends within the mantling deposit. These compositional data will help us to constrain the source and possibly the eruption mechanism of the Aristarchus pyroclastic deposits.

References: [1] Gaddis, L.R. et al. (2003) *Icarus*, 161:2, 262-280. [2] Horgan et al., 2014, *Icarus*, *234*(C), 132–154, doi:10.1016/j.icarus.2014.02.031 [3] Bennett et al., in review, Icarus. [4] Mustard et al., 2011, *J. Geophys. Res. Planets*, *116*(E6), E00G12, doi:10.1029/2010JE003726 [5] Gaddis, L.R. et al. (1985) *Icarus*, 61:3, 461-489 doi:10.1016/0019-1035(85)90136-8 [6] McEwen, A.S. et al. (1994) *Science*, 266:5192, 1858-1862 doi: 10.1126/ science.266.5192.1858 [7] Pieters, C. M. et al. (2009) *Curr. Sci*, 96:4, 500-505 [8] Lucey, P.G. et al (1995) *J. Geophys. Res. Planets*, *102*(16), 16,319-16,325.

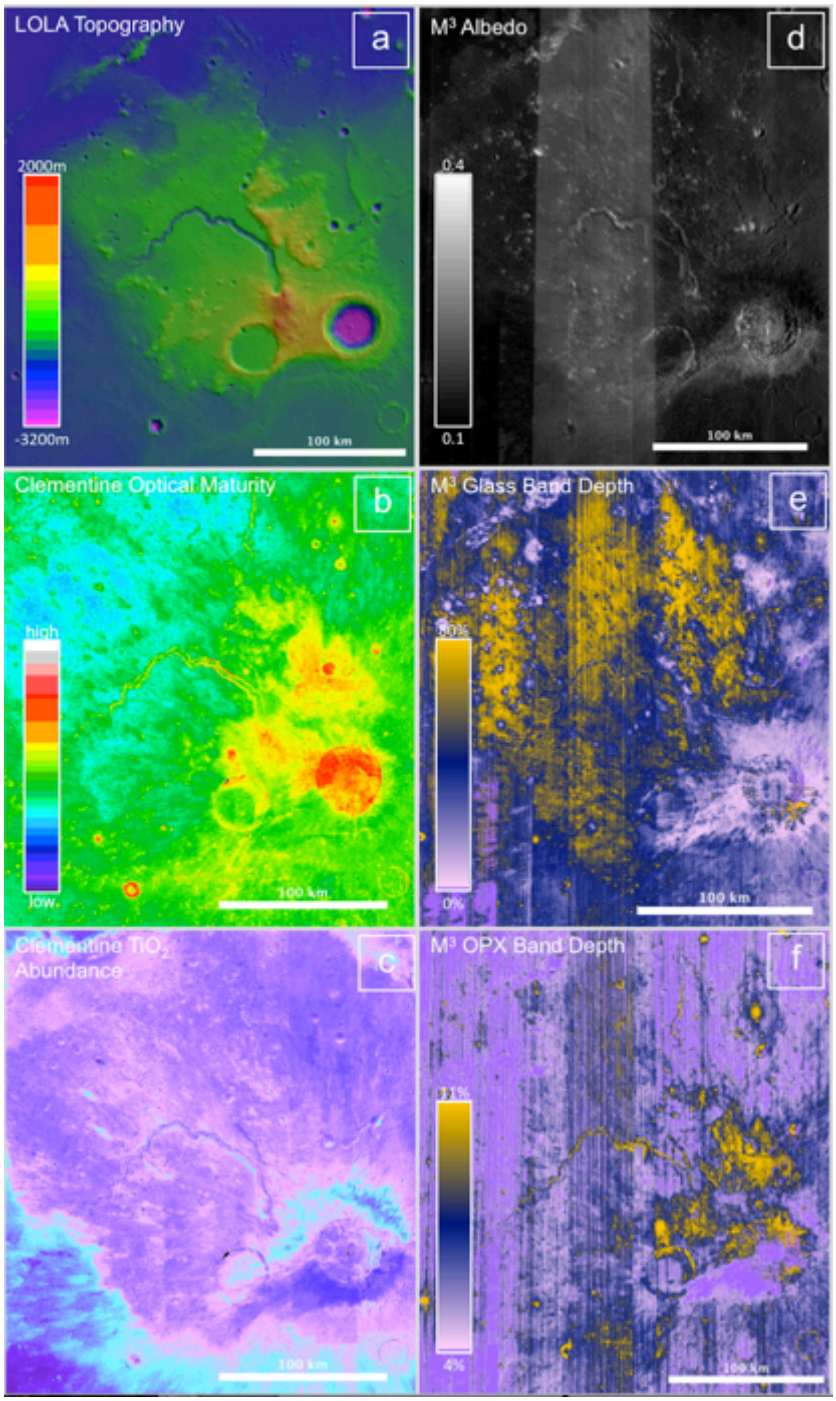

Figure 1: (a) LOLA Topography showing Aristarchus Plateau and Crater. (b) Clementine Optical Maturity, a proxy for surface exposure age. (c) Clementine TiO_2 Abundance, where blue indicates high and purple indicates low. (d) M^3 albedo from 2.98µm channel. (e) M^3 Glass Band Depth showing pyroclastic deposit. (f) M^3 OPX Band Depth showing OPX exhumed from depth.