Mapping Aristarchus Crater: Geology, Geomorphology, and Pre-Impact Stratigraphy. M. Zanetti[1,2], H. Hiesinger[2], B. L. Jolliff[1]. [1]Washington University in St. Louis, Earth and Planetary Science Dept., 1 Brookings Drive, Campus Box 1169, St Louis, MO 63130. [2] Westfälische Wilhelms-Universität Münster, Institut für Planetologie, Wilhelm-Klemm Str. 10, 48149 Münster, Germany. Michael.Zanetti@wustl.edu

Introduction: The lunar crater Aristarchus is a complex impact crater 40 km in diameter and ~3.5 km deep [1,2], and is located in northern Oceanus Procellarum, on the edge of the Aristarchus Plateau. The crater impacted into both the pyroclastic rich deposits of plateau material and the surrounding mare flood basalt deposits, and the region has been extensively studies for decades with many different datasets [1-11]. Recent remote sensing data sets have provided increased detail and sharper focus on the characteristics of these materials. Here we report on efforts to compositionally and geomorphologically map crater ejecta and interior deposits in order to investigate the distribution of ejecta and melt at the crater, and to attempt to reconstruct the pre-impact target stratigraphy.

Geologic Mapping and Pre-Impact Stratigraphy: During the formation of Aristarchus Crater an unusual suite of rocks were exhumed. In addition to basaltic components from the surrounding mare, the crater excavated very high albedo material, especially in areas of the proximal ejecta to the east and southwest, and the central peak. Olivine-rich rocks have been observed [5, 10] and are concentrated in ejecta along a narrow radial deposit east – southeast of the crater. Lunar Prospector Gamma Ray Spectrometer (LP-GRS) results show that Aristarchus Crater lies at the center of one of the strongest Th hot spots on the Moon [3,8,12,13]. Recently, using spectral bands that are sensitive to silicate mineralogy and bulk SiO2 content (i.e. the Christiansen feature at 7.8, 8.25, and 8.55 μm) LRO Diviner radiometer data suggest that bright ejecta rays in the southwest of the ejecta might indicate the presence of abundant quartz (or related phases) and alkali feldspar (i.e. granite or alkali feldspar) [8].

From the integration of various remote sensing data sets, we infer that the Aristarchus target section features a petrogenetically diverse suite of rocks including materials of the Aristarchus Plateau, young and relatively Th-rich basalts of Oceanus Procellarum, a differentiated, KREEP-rich igneous intrusive body, and diverse ejecta deposits from the Imbrium basin including olivine-rich materials [14,15] and KREEP-rich impact-melt deposits. This diversity of lithologic materials associated with the crater and located in the target area reflect the diversity of the target rock formations that exist in the upper few km in this region, and the specific target rocks may be highly localized. Furthermore, some of the components are not easily relatable to specific morphologic units [10,14] and cannot be explained by any simple petrogenetic scenario. For example, compositionally evolved KREEP-rich rocks and olivine-rich rocks [14] are not expected together petrologically, and we infer that these may simply reflect juxtaposition of Imbrium ejecta deposits with evolved intrusive rocks of the PKT. The high albedo materials, including those within the crater and the SW ejecta unit are most likely low-FeO, alkali-rich differentiates of a KREEP-rich, near-surface intrusive body and not primary anorthosite of the Moon's early primary crust. Given the extensive volcanic activity that occurred in this region of the Moon, basaltic underplating, as suggested by Hagerty et al. [23], of KREEP rich rocks, may have caused partial melting and intrusion of silicic magma (with a small degree of melting) or melting and injection of an evolved KREEP-rich magma such as quartz monzogabbro to a shallow level in the Aristarchus target section [15].

Geomorphologic Mapping: A detailed geomorphologic sketch map of the crater interior and proximal ejecta blanket has been created using high resolution Lunar Reconnaissance Orbiter Camera (LROC) Narrow Angle Camera (NAC) images [3]. Major units of focused mapping are impact melt ponds, flows, melt veneer deposits, crater floor deposits, and ejecta materials, which we attempt to correlate to distinct spectral units. Other interesting features such as stratified boulders of ejecta and enormous individual impact melt flows (up to ~16.5 km² in area) are well-characterized through mapping and subsequent analysis. Mapping of melt veneer has been aided by crater counting statistics and morphologically diagnostic crater morphologies on impact melts and allows for preliminary volume estimates of melt production.

References: [1] Guest (1973) GSA Bulletin 84. [2] Zisk et al. (1977) Moon 17. [3] Etchegaray-Ramirez et al. (1983). JGR 88 supplement p A529-A543 [4] Guest & Spudis (1985) Geol. Magazine 144. [5] Lucey et al. (1986) JGR 91. [6] McEwen et al. (1994) Science 266. [7] Le Mouélic et al. (1999) GRL 26. [8] Hagerty et al. (2009) JGR 114. [9] Chevrel et al. (2009) Icarus 199. [10] Mustard et al. (2011) JGR 116. [11] Glotch et al. (2010) Science 329. [12] Lawrence, D. et al. (2003) JGR 108. [13] Lawrence, D. et al. (2007) GRL 34. [14] Wiseman et al. (2012) LPSC 43, Abs #2515. [15] Zhang and Jolliff (2008) LPS 39, #2534. [16] Hagerty et al., 2006 JGR 111. [17] Robinson et al. (2010) Space Science Reviews, 150. [18] Zanetti et al. (2011) LPSC 42, Abs #2330.