GEOLOGIC INVESTIGATIONS OF BARNARD CRATER, SOUTHERN HELLAS REGION, MARS. D. C. Berman[1], D. A. Crown[1], and H. Bernhardt[2], [1]Planetary Science Institute, 1700 E Ft Lowell Rd, Suite 106 Tucson, AZ 85719 (bermandc@psi.edu). [2]School of Earth & Space Exploration, Arizona State University, Tempe, AZ.

Introduction: The ~2000 km-across Hellas basin exhibits diverse rim terrains that preserve a complex record of Martian geologic history, including both emplacement of ancient units and multiple cycles of modification [e.g., 1-3]. The volcanic plains of Malea Planum extend across the southern rim of Hellas basin and contain a series of degraded volcano-tectonic centers (including Amphitrites, Malea, Peneus, and Pityusa Paterae) [4-6]. Recent studies describe geologically young, ice-rich mantling deposits that cover the region and partially obscure the underlying geology [7-10]. As part of a new study focused on understanding the evolution of southern Hellas landscapes and the formation and degradation of volcanic landforms, we present initial results regarding the geology of Barnard Crater, whose interior rim and floor morphologies provide important insights into recent degradational processes in the region.

Data sets: This investigation utilizes image and topographic data sets from the THEMIS, MOLA, CTX, HiRISE, and HRSC instruments.

Geomorphology of Barnard Crater: Barnard (Fig. 1; 61.06°S, 61.59°E) is a 121.1 km diameter impact crater with a central peak and terraced inner rim located adjacent to the summit of Amphitrites Patera. Hummocky deposits in the plains surrounding Barnard appear to be remnants of its degraded ejecta blanket. Recent studies by Bernhardt and Williams [11] map Barnard ejecta out to 300 km from its rim, and determine a 3.7 Ga age, making Barnard an important regional stratigraphic marker. Barnard is also important because it impacted into Amphitrites Patera and exposes volcanic materials within its rim materials (i.e., mafic signatures are present in CRISM data of a fan along the northern wall; FRT00007EFC_07_IF163L_MAF1). The crater floor is a confined depositional sink and its inner rim slopes are the steepest local topography in the region. The geologic characteristics of Barnard may thus provide important information to help constrain regional degradational processes including the deposition, preservation, and mobilization of ice-rich materials.

Preliminary observations show the presence of a partly buried central peak and an adjacent irregular depression with significant infill. The inner rim displays an annulus of material that appears to result from the coalescence of numerous flow lobes extending toward the crater floor. CTX images show that Barnard's inner rim and floor are highly irregular, with widespread mantling deposits in various states of preservation, arcuate ridges, lobate flows with ridged upper surfaces, pedestal craters, and numerous dust devil tracks. In addition, numerous sinuous ridges extend down the inner rim slopes of Barnard crater (Fig. 2). In some cases, these appear to occur in sets of individual features and in others ridges appear to form immature parallel "networks." Potential formation mechanisms for these ridges include glacial (moraines, eskers) and fluvial or volcanic, as inverted landforms. HiRISE images show well-developed polygons on surface materials within floor materials (Fig. 3).

Geomorphic Mapping and Topographic Analyses: We are conducting geomorphic mapping and analyses of Barnard crater with a focus on mantling and crater infill deposits, pedestal craters, arcuate ridges, lobate flows, and sinuous ridges. Integrated with geomorphic mapping of Barnard crater and its interior deposits and features will be a series of topographic analyses (e.g., Fig. 4). We will use HRSC and CTX topography to assess the gross morphology of Barnard crater (e.g., diameter, depth, variability of rim height and floor depth, inner and outer rim slopes) and to estimate the thickness of the crater interior deposits. We will use topographic profiles across the Barnard crater rim to evaluate suites of features identified and make comparisons to those found in southern hemisphere mid-latitude regions (e.g., sequences from top to bottom include gullies, lobate flows, arcuate ridges on rims covered with mantling deposits [12,13]). We will examine correlations between both individual features and suites of features to elevation/elevation range and rim slopes.

Studies of the morphology, evidence of infilling, and modification/degradation processes at Barnard crater will provide important information for assessing environmental conditions in the mid to high latitudes in the southern hemisphere. Detailed morphologic and topographic studies of Barnard crater will help assess the distribution, preservation, and mobilization of ice-rich surface materials.

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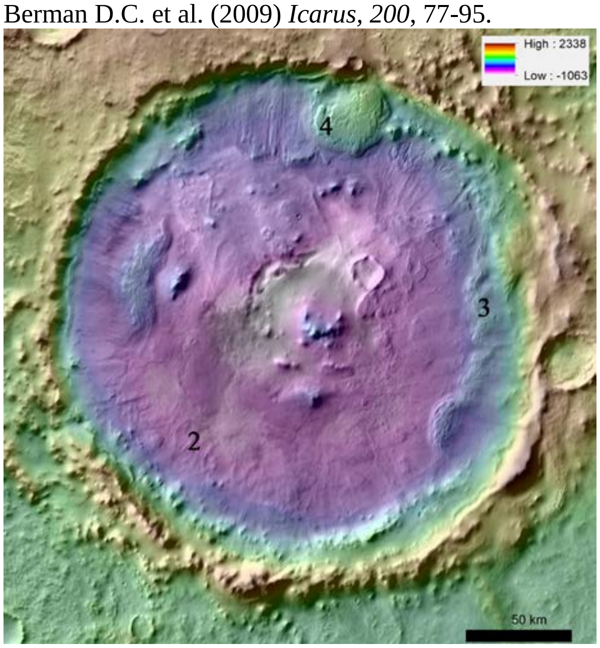

Figure 1. THEMIS IR daytime view of Barnard crater merged with MOLA color elevation data (m). Note lobate flow features extending from walls onto crater floor with figure locations indicated.

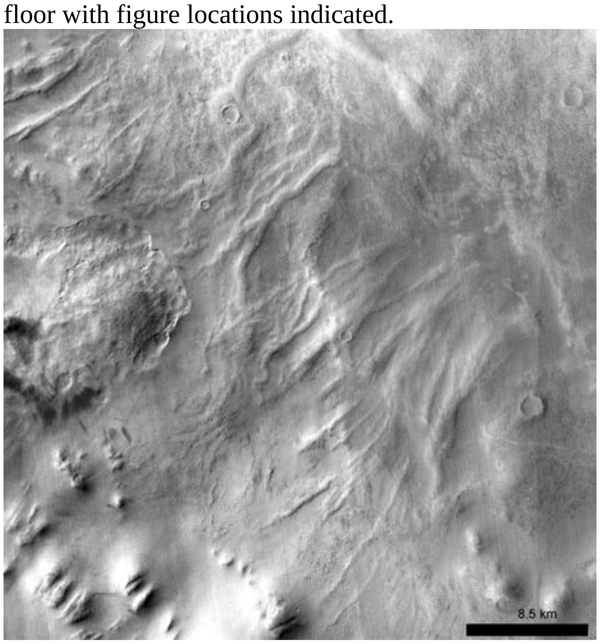

Figure 2. CTX mosaic of sets of raised ridges on SW floor of Barnard crater.

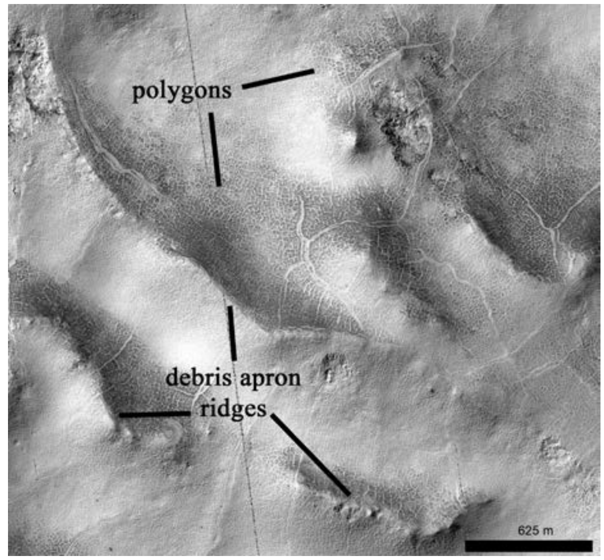

Figure 3. HiRISE image ESP_055502_1185 showing small polygons and ridges on the surface of the lobate debris apron extending from the eastern crater wall.

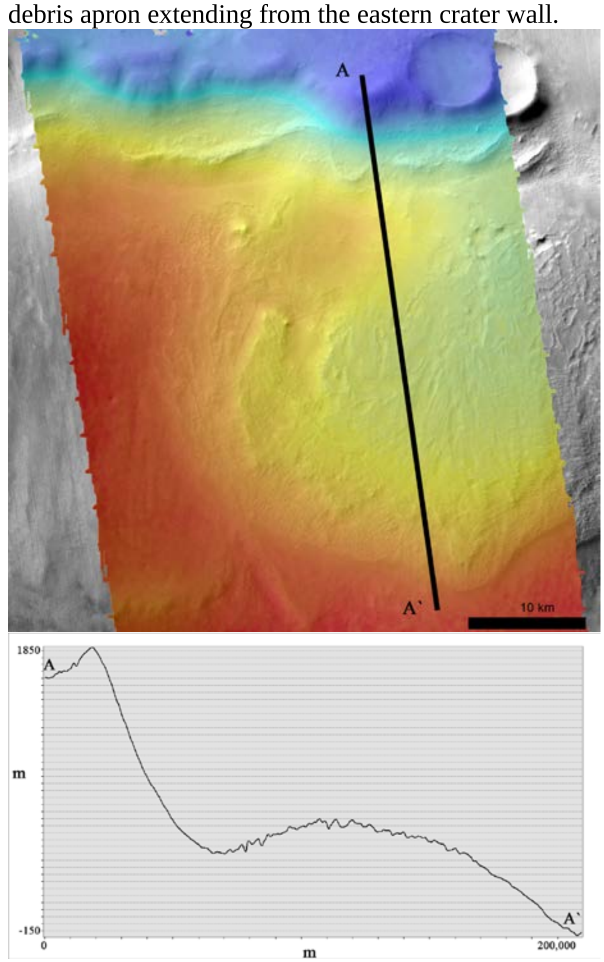

Figure 4. DTM made using Ames Stereo Pipeline from CTX images P11_005500_1187 and P13_006212_1202 over the north rim of Barnard crater, with elevation profile extending across lobate debris apron.