**GEOLOGIC MAPPING OF THE NW RIM OF HELLAS BASIN, MARS.** David A. Crown[1], Leslie F. Bleamaster III[1], Scott C. Mest[1], and John F. Mustard[2], [1]Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719; crown@psi.edu, [2]Dept. of Geological Sciences, Brown University, Providence, RI 02912.

**Introduction:** Hellas basin, spanning 2000+ km in the southern cratered highlands, is the largest well-preserved impact structure and deepest depositional sink on the Martian surface. The Hellas region is significant for evaluating Mars' hydrogeologic and climate histories, given the nature, diversity, and range in ages of potential water- and ice-related landforms [e.g., 1-2], including possible paleolakes on the basin floor [2-4]. The circum-Hellas highlands are of special interest given recent studies of potential localized fluvial/lacustrine systems [2, 5-17] and evidence for phyllosilicates around and within impact craters north of the basin [18-26]. Our current research focuses on the evolution of Hellas' NW rim where basin floor deposits transition abruptly to the cratered highlands. Production of a geologic map of the NW Hellas rim is providing new constraints on the magnitudes, extents, and history of volatile-driven processes as well as a geologic context for mineralogic identifications.

**Study Area and Mapping Objectives:** We are producing a 1:1.5M-scale geologic map of eight MTM quadrangles (-25312, -25307, -25302, -25297, -30312, -30307, -30302, -30297) along Hellas' NW rim. The map region (22.5-32.5°S, 45-65°E) includes a transect across the cratered highlands of Terra Sabaea, the degraded NW rim of Hellas, and basin interior deposits of northwestern Hellas Planitia. No previous mapping studies have focused on this region, but it has been included in earlier global and regional maps [27-29].

Specific objectives for our new mapping include: 1) evaluation and comparisons of geologic history and surface degradation styles in topographic zones along Hellas' rim, 2) detailed characterization of crater degradation and crater interior deposits within large craters on the NW rim, 3) analysis of intercrater plains and their associated fluvial valley systems, and 4) assessment of the nature and stratigraphic position of spectroscopically interesting outcrops, including phyllosilicate deposits.

**Geologic Mapping and Related Investigations:** Analysis of the map region to-date has included general terrain characterization and comparison to other circum-Hellas regions, preliminary evaluation of geomorphology and stratigraphic relationships, preliminary exploration of compositional signatures using CRISM, and investigation of impact crater distribution, morphometry, and interior deposits.

*Hellas Rim Morphology*. The Hellas basin rim exhibits significant morphologic diversity. To the east, the rim is poorly defined and modified by a shallowly sloping sediment/volatile accumulation zone [2]. To the west and north, it is well-defined and the transition from basin floor to adjacent highlands occurs over relatively short distances. The NW rim exhibits the most abrupt transition from basin floor to circum-Hellas highlands.

*Hellas NW Rim Geology*. Preliminary observations suggest that the NW Hellas rim can be divided into four physiographic zones: 1) Terra Sabaea highlands (above 500m), 2) Terra Sabaea plains (-1800m - 500m), 3) Hellas rim (-5800m - -1800m), and 4) Hellas floor (below -5800m). All of these zones show significant numbers of moderate to large impact craters, suggesting that the basic geologic framework of the region was established early in Martian history. However, there are clear differences in the types of landforms and materials exposed as well as differences in crater degradation states. A significant and complex sedimentary history can be inferred given that many large craters have been infilled, and expose to different degrees, layered interior deposits, as well as by numerous scarps and valleys within intercrater plains.

The densely cratered highlands of Terra Sabaea contain impact craters of a wide range in size and that display a variety of degradation styles and states. Some craters exhibit well preserved ejecta deposits and others are almost completely buried or barely exhumed. Many of the larger craters contain smooth interior deposits exposed by scarps. Local, low-lying regions of the intercrater plains may be more recent depositional sites for aeolian, fluvial, and/or lacustrine sediments, given brightness variations evident in THEMIS IR images. Minor highland fluvial dissection is apparent given the presence of small valleys. Many impact craters show gullied interior rims.

Between the rugged highlands of Terra Sabaea and the Hellas rim is a zone of plains at elevations between -1800m and 500m. This zone has abundant moderate to large impact craters, though fewer than in Terra Sabaea proper, but is mostly a large expanse of smooth, low-relief plains. Within this zone, obvious remnants of highland terrains are observed in the form of highland massifs and the rims of large impact craters. These characteristics suggest lowering of the highland surface and creation of a younger shelf separating Terra Sabaea proper from the steeper basin rim zone. In THEMIS images, the plains in this zone show abundant scarps, a variety of subunits, and a multitude of surface variations. The plains contain numerous fluvial valleys; valley networks are apparent but they are less well integrated than typical highland valley networks and exhibit straight segments and high-angle junctions indicative of structural control. The zone, or shelf, appears to be part of a larger shelf along Hellas' northern rim and is located at elevations similar to those that exhibit smooth and channeled plains along Hellas' east rim [i.e., 2]. The east rim is interpreted to be a large depositional shelf potentially associated with flooding from Reull Vallis, large paleolakes within Hellas, and/or accumulation of atmospheric volatiles due to circulation patterns off of the south pole [e.g., 2, 4, 30-31].

The Hellas rim and floor zones exhibit buried and softened landforms as well as small valleys. In several locations, valleys segments appear to form disconnected downslope patterns. Small lobate debris aprons are observed extending from local topographic highs. Layered surficial deposits are also evident.

*Multispectral mapping with CRISM*. Central to our investigation of NW Hellas is integration of compositional characterizations with geologic mapping using MRO CRISM data. CRISM multispectral data acquired for parts of the NW Hellas study area show the presence of phyllosilicate minerals; the most common mineral indicated is an Fe/Mg smectite clay (e.g. nontronite). Similar signatures are typically found associated with crater rims and massifs in the Terra Tyrrhena region, but also are evident in some crater ejecta and floor deposits [26].

*Impact Crater Morphology and Morphometry*. Each of the 120 craters with diameters ≥ 15 km identified in the map region has been characterized as well-preserved, moderately-degraded, or highly-degraded on the basis of its rim and ejecta morphology, and the resulting spatial distribution of craters analyzed [32-33]. Well-preserved craters are found further from Hellas basin at lower latitudes and higher elevations (most above 500 m and all above 1800 m). Moderately-degraded and highly-degraded craters are scattered throughout the map region and occur at all elevations above -6900 m. Most large craters (≥ 50 km in diameter) are not well-preserved and occur at elevations above -1800 m. The lack of large and well-preserved craters below -1800 m suggests that either young geologic materials have been emplaced within Hellas basin or that significant erosion has occurred preferentially at low elevations.

We have also compiled a database of morphometric parameters for craters with diameters ≥ 15 km in NW Hellas by measuring: 1) crater diameter, 2) maximum and minimum elevations of the crater floor, crater rim, and terrain surrounding each crater, and 3) crater depth. Depth/diameter ratios suggest significant infilling of craters, consistent with observations of exposed layered deposits on crater floors.

*Impact Crater Size-Frequency Distribution*. Our preliminary analysis [32-33] of the population of impact craters ≥ 15 km in diameter and their distribution with respect to elevation suggests that the Noachian basement is exposed down to elevations of -5800 m. Any regional degradation processes would therefore have either been very old or was ineffective at eroding craters with diameters > 15 km. This suggests that any Hellas paleolakes not confined to the basin floor would have been no younger than Early Noachian or that larger, younger lakes did not erase the population of ancient highland impact craters.

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