MORPHOLOGY, MORPHOMETRY AND DISTRIBTUTION OF CRATERS IN NW HELLAS, MARS.
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Introduction: The circum-Hellas highlands provide important constraints on the age, distribution, and abundance of Martian volatiles, as well as evidence for changes in climatic conditions, due to prominent water- and ice-related landforms [1-5]. Highland terrains surrounding Hellas are of special interest given that recent MGS-, MO-, and MEX-based studies have suggested western Hellas Planitia [6], numerous craters, and highland intercrater plains show evidence for localized fluvial/lacustrine systems [3-5, 7-18], as well as the discovery of phyllosilicates around and within impact craters [19-26].

The current research focuses on the evolution of Hellas' NW rim, where Hellas basin floor deposits transition abruptly to cratered highland terrain. Within the highlands are impact craters that display pristine to degraded morphologies and which preserve a record of complex degradational processes. The geologic histories of impact craters are being used to constrain the geologic and volatile evolution of this part of the circum-Hellas highlands [12-14].

Approach: Impact craters (D>15 km) northwest of Hellas basin (22.5-32.5°S, 45-65°E; Figure 1) are being examined to better understand the degradational history and evolution of highland terrains. Specifically, the morphometric and morphologic characteristics of impact craters are being analyzed in order to 1) determine the geologic processes that modified this part of the highlands, 2) determine the sources (e.g. fluvial, lacustrine, eolian, mass wasting, volcanic, impact melt) of material composing crater interior deposits, and 3) determine the spatial and temporal relationships between degradational processes on local and regional scales.

Previous Work: 732 impact craters in Noachis Terra/Hellaspontes Montes (20-60°S, 20-50°E) were identified, their morphologies categorized, and many (238) were characterized in detail based on available image coverage [13,14]. Many craters in Noachis Terra exhibit abundant evidence for modification (erosion and infilling), especially by fluvial and eolian processes. Craters that exhibit irregular pits, interior plateaus, and (or) similar surface textures suggest either emplacement of similar materials/layered sequences and (or) that the processes of emplacement and subsequent modification were widespread. Strong correlations were also observed between crater interior deposits and latitude and crater type; specifically, modification by eolian processes is significant at higher latitudes (>40°S), flow-like textures are observed in fresh, mid-latitude (30-45°S) craters, and gully features are found in many craters at all latitudes (20-60°S) but are most abundant in morphologically fresh craters at lower latitudes [14].

Preliminary work by [27] suggests that the NW Hellas rim can be divided into four zones that have different surface characteristics and lie in specific elevation ranges: Terra Sabaea highlands (above 500 m), Terra Sabaea plains (-1800 m - 500 m), Hellas basin rim (-5800 m - -1800 m), and Hellas Planitia/basin floor deposits (below -5800 m). These zones show significant numbers of moderate to large impact craters most of which display a considerable amount of modification, suggesting that the basic geologic framework of the region was established early in Martian history. However, there are clear differences in densities of large impact craters and crater degradation states. A significant and complex sedimentary history can be inferred given that many craters contain interior layered deposits, as well as by a multitude of scarps and valleys within intercrater plains. Crater interior deposits, typically exposed by irregular scarps or within large irregular depressions, exhibit layering and clear differences in erosional morphology and thermophysical properties [14,27].

Crater Morphology: For 119 craters (D≥15 km) in NW Hellas, crater morphologies have been assessed using images (HiRISE, HRSC, MOC, THEMIS VIS and IR, and Viking Orbiter) and MOLA data [13,14]. These craters have been designated Type A (fresh, 4), Type B (degraded, 18), Type C (moderately degraded, 15), Type D (highly degraded, 51), and Type E (buried or exhumed, 31) [12,13].

Crater Morphometry: For the 119 craters, we have also compiled a database of morphometric parameters that include crater diameter (D), and maximum and minimum elevations of the crater floor (H_f), crater rim (H_r) and the terrain surrounding each crater (H_t; measurements taken within one crater diameter of the rim of each crater). Crater depth (d) has been approximated by the difference between $H_{r\text{-}max}$ and $H_{f\text{-}min}$. This maximum depth measurement allows assessment of the minimum infilling of a crater floor. These parameters allow an evaluation of crater topography that complements geomorphic analyses and a search for trends with respect to elevation and distance from Hellas basin.

Results: Preliminary results show that there is a lack of large (D>~25 km) fresh (Types A and B) craters below elevations of approximately -2000 m (Figure 2), and that below this elevation craters with diameters ≥40 km are very rare. This is consistent with observations made in Noachis Terra [14] and

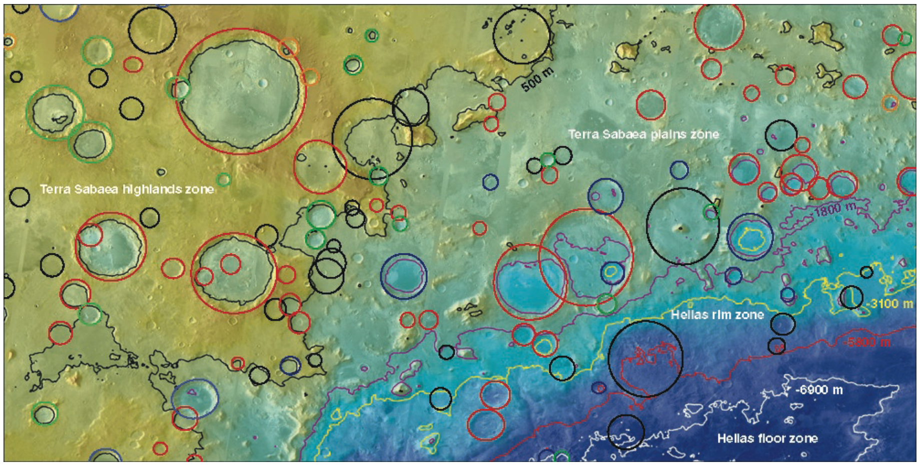

Figure 1. MOLA 128 pixel/degree DEM over Viking MDIM 2.1 showing impact craters (Type A = orange; Type B = green; Type C = blue; Type D = red; Type E = black) and the topographic 'zones' [27] in the NW Hellas region.

morphologic analyses of topographic zones along the NW Hellas rim [27]. At higher elevations, a remnant population of highland craters is evident, with diameters ranging from 15-160 km, but predominantly between 15 and 60 km.

Impact crater depths are found to range from 113 to almost 4000 m with the most variation (over 3300 m between the shallowest and deepest craters) occurring among Type D craters. The wide variation in depth observed at a given crater diameter suggests significant infilling of craters in the region.

Ongoing Work: 119 impact craters NW of Hellas basin with diameters ≥15 km have been identified, their morphologies categorized, and some have been characterized in detail based on image coverage. We are continuing to look at the geology of the NW Hellas region, as well as to assess the morphology, morphometry, and distribution of craters within this area.

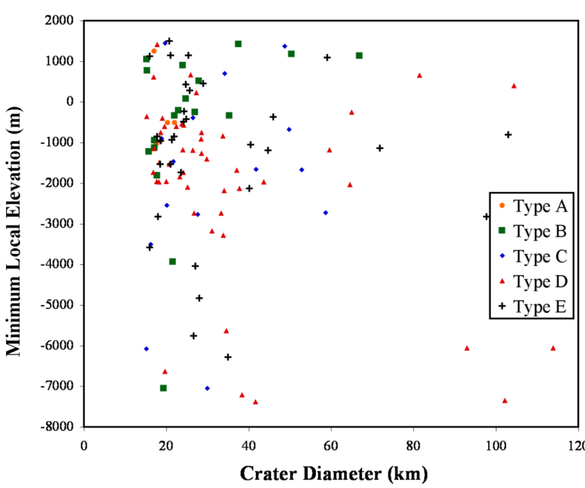

Fig 2. Plot of the topographic distribution of craters in NW Hellas region as a function of their diameter.

References: [1] Tanaka, K.L. and G.J. Leonard (1995) *JGR*, **100**, 5407-5432. [2] Mest S.C. and D.A. Crown (2001) *Icarus*, **153**, 89-110. [3] Crown D.A. et al. (2005) *JGR*, **110**, E12S22, doi:10.1029/2005JE002496. [4] Korteniemi J. et al. (2005) *JGR* **110**, doi:10.1029/2005JE002427. [5] Mest, S.C. and D.A. Crown (2005) *Icarus*, 175(2), 335-359. [6] Moore, J.M. and D.E. Wilhelms (2001) *Icarus*, **154**, 258-276. [7] Lahtela, H. et al. (2003) Vernadsky Institute-Brown University Microsymposium 38, MS057. [8] Lahtela, H. et al. (2005), LPSC XXXVI, Abs. **#1683**. [9] Ansan, V. and N. Mangold (2004) 2nd Conf. on Early Mars, Abs. **#8006**. [10] Ivanov, M.A. et al. (2005) *JGR*, **110**, E12S21, doi:10.1029/2005JE002420. [11] Kraal, E.R. et al. (2005) Role of Volatiles on Martian Impact Craters, Abs. **#3008**. [12] Mest S.C. (2005) Role of Volatiles on Martian Impact Craters, Abs. **#3014**. [13] Mest S.C. (2006) LPSC XXXVII, Abs. **#2236**. [14] Mest, S.C. (2007) LPSC XXXVIII, Abs. **#1841**. [15] Moore, J.M. and A.D. Howard (2005a) *JGR*, **110**, E04005, doi:10.1029/2004JE002352. [16] Moore, J.M. and A.D. Howard (2005b) LPSC XXXVI, Abs. **#1512**. [17] Wilson, S.A. and A.D. Howard (2005) LPSC XXXVI, Abs. **#2060**. [18] Wilson, S.A. et al. (2007) *JGR*, **112**, E08009, doi:10.1029/2006JE002830. [19] Poulet, F. et al. (2005) *Nature*, **438**, 623-627. [20] Bibring, J.-P. et al. (2006) *Science*, **312**, 400-404. [21] Costard, F. et al. (2006) LPSC XXXVII, Abs. **#1288**. [22] Murchie, S. et al. (2006) Eos Trans. AGU, Fall Meet. Suppl., Abstract P33A-04. [23] Mustard, J.F. et al. (2007a) LPSC XXXVIII, Abs. **#2071**. [24] Mustard, J.F. et al. (2007b) Seventh International Conference on Mars, LPI. [25] Pelkey, S.M. et al. (2007a) LPSC XXXVIII, abstract 1994. [26] Pelkey, S.M. et al. (2007b) *JGR*, **112**, E08S14, doi:10.1029/2006JE002831. [27] Crown, D.A. et al. (2007) Eos Trans. AGU, 88(52), Fall Meet. Suppl., Abs. #P41A-0189.