N94-16350

HELLAS BASIN, MARS: FORMATION BY OBLIQUE IMPACT;

Gregory J. Leonard and **Kenneth L. Tanaka**, U.S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ, 86001.

Hellas, a 2,000-km-diameter, roughly circular multiring impact basin in the southern highlands of Mars [1-3], has a pronounced southeastern lobe of rim material that extends for some 1,500 km [4]. This lobe and a system of ridges concentric to the southern part of the basin (including part of the lobe) have been interpreted to be formed by an oblique impact that was inclined in the direction of the lobe [5]. Our preliminary geologic mapping of the Hellas region (lat -20° to -65°, long 250° to 320°) at 1:5,000,000 scale gives this hypothesis additional supporting evidence, including a symmetric distribution of basin ejecta and volcanic centers across the inferred trend of the impact. Furthermore, measurements of relief indicate that the downrange ejecta may be about twice as thick as they are elsewhere around the rim.

The generalized geologic map of Hellas (Fig. 1) shows that the basin rim (interpreted to be made up of ejecta [6]) not only varies in width but also is notably discontinuous; basin-ring structures are also discontinuous [1]. We note that major structural and geologic features associated with Hellas, both contemporaneous with and postdating the impact event, appear bilaterally symmetric around a line passing through the center of the basin (at lat -43°, long 291°) and trending about N60°W. The northwest half of the rim is relatively narrow, having an average width of 300 km (in comparison, Argyre basin has about half the diameter and a uniform rim 500 to 600 km wide). The topographic map of Mars [7] and shadow measurements of massif heights (at *1* and *2* in Fig. 1) indicate that the northwestern part of the rim generally does not exceed a kilometer in elevation above surrounding terrain. A few massifs have 2 km of relief, and one has 4 km. Large sections of the rim are buried on the northeast side by volcanic materials of Hadriaca and Tyrrhena Paterae and on the opposite side by degraded volcanic rocks of Amphitrites and Peneus Paterae; these volcanic centers (except Tyrrhena) are approximately equidistant (about 1,350 km) from the basin center. Also, two sets of scarps near the proximal edges of the southeastern lobe of basin-rim material are symmetrically located on either side of the proposed line of impact (Fig. 1). If these scarps formed by normal faulting or ejecta emplacement as a result of the impact event or by excavation due to later impacts, then the adjacent areas of missing rim material may simply have been lower lying and readily buried by the volcanic deposits. Alternatively but perhaps less likely (if we consider the high elevations of the rim massifs), the rim massifs were largely eroded away by fluvial or glacial erosion [8, 9]. Also shown in Fig. 1 are parts of a circumferential ridge system developed on the south side of the basin; these ridges formed sometime after the impact, perhaps controlled by more subtle basin structure. On the Moon, basin-rim and ring-height variations have been interpreted to be caused by pre-impact surface morphology, oblique impact, and post-impact modification [10].

Figure 2 shows a cross section of Hellas basin along the inferred trend of the impact, which suggests that ejecta on the southeast rim rises more than a kilometer above surrounding highlands in some areas and consists of an order of magnitude more cross-sectional area than ejecta on the northwest rim. Experiments have shown that oblique impacts produce bilaterally symmetric ejecta deposits [11], as seen at Hellas. (For trajectories of 45°-60° above the horizon, impacts produce ejecta relatively evenly around their craters, with a preferential concentration downrange [11].) We intend to improve our analysis of Hellas basin structure through further mapping and photoclinometric measurements of massifs.

References cited. [1] Wilhelms, D.E., 1973, *JGR 78*, 4084. [2] Peterson, J.E., 1977, *USGS Map I-910*. [3] Schultz, R.A. and Frey, H.V., 1990, *JGR 95*, 14,175. [4] Greeley, R. and Guest, J.E., 1987, *USGS Map I-1802-B*. [5] Tanaka, K.L. and Scott, D.H., 1987, *USGS Map I-1802-C*. [6] Potter, D.B., 1976, *USGS Map I-941*. [7] U.S. Geological Survey, 1991, *USGS Map I-2160*. [8] Crown, D.A., et al., 1992, *Icarus 100*, 1. [9] Kargel, J.S. and Strom, R.G., 1992, *Geology 20*, 3. [10] Whitford-Stark, J.L., 1981, *in Multi-ring Basins, PLPS 12A*, p. 113. [11] Gault, D.E. and Wedekind, J.A., 1978, *PLPSC 9*, 3843.

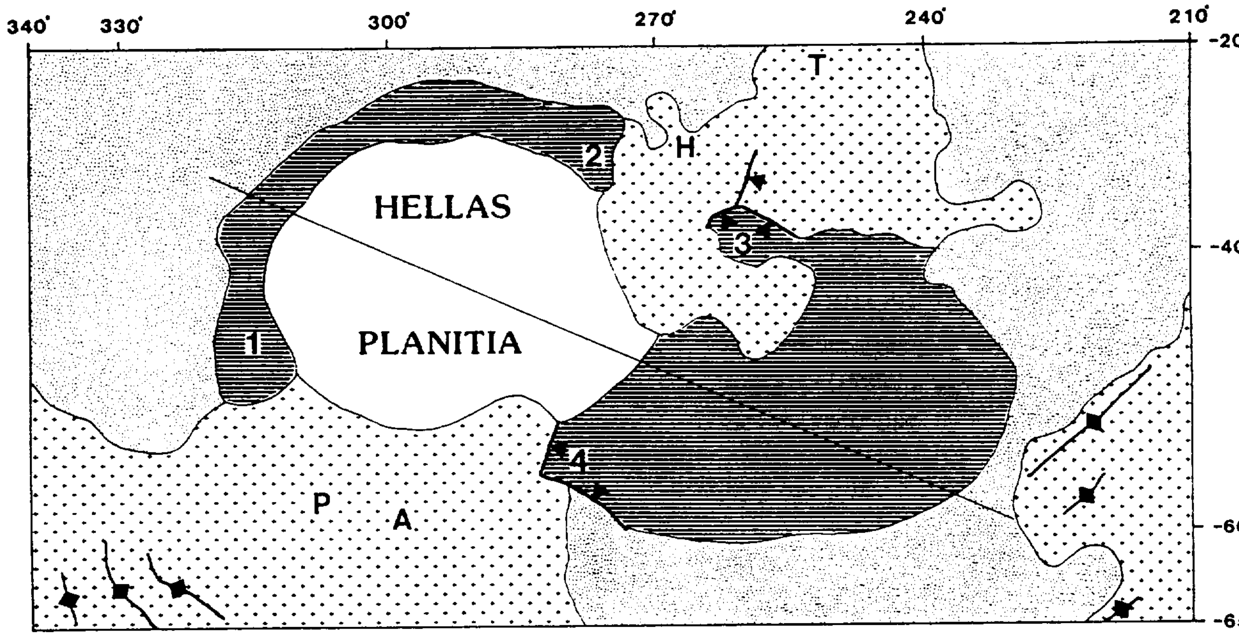

Figure 1. Generalized geologic map of the Hellas region of Mars. Line pattern, basin-rim material (largely made up of ejecta; see text); dotted stipple, highland material; cross stipple, volcanic material; blank, interior basin sedimentary rocks. H=Hadriaca Patera, T=Tyrrhena Patera, P=Peneus Patera, A=Amphitrites Patera; numbers show areas where shadow measurements of rim massifs were obtained. Thin line, line of cross section in Fig. 2, which coincides with inferred trend of impact. Lines with barbs, scarps; lines with diamonds, ridges.

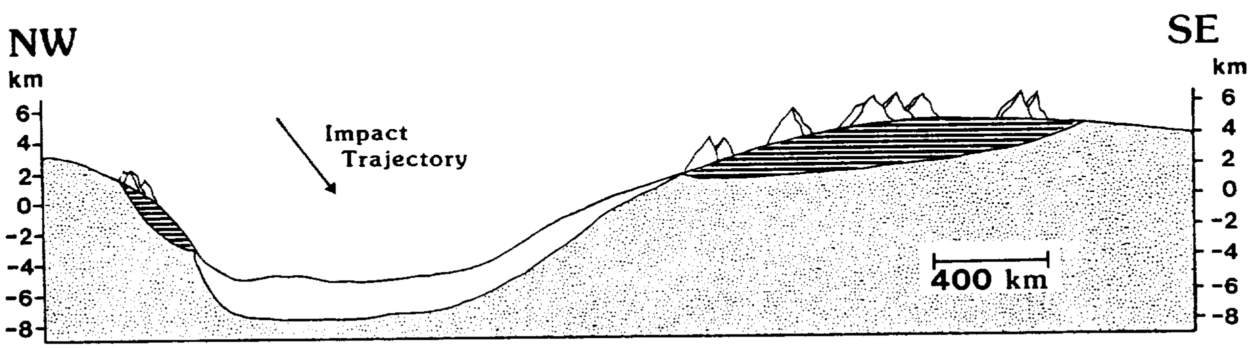

Figure 2. Cross section of Hellas basin along inferred trend of impact (topography from [7]; vertical exaggeration about 55X). Symbols as in Figure 1. Note that uprange (northwest) part of rim is relatively narrow and low, whereas downrange part of rim is broad and high and has larger massifs; much more ejecta were emplaced on downrange side.