STUDY OF A 15 KM CRATER WITH DIVERSE MORPHOLOGY, ELYSIUM PLANITIA, MARS.

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Introduction: The recent missions to Mars with diverse instruments have provided a new perspective for the study of Martian surface landforms. They have permitted the characterization of over 40,000 impact craters ≥ 5 km in diameter [1], showing a diverse cratering record with some quite unusual morphologies. Changes in crater morphology are thought to reflect the impact energy and target properties involved in the crater formation [2].

We examine the nature of the ~15 km diameter crater (28.3º N, 116.7º E), part of an assessment of rampart craters on northwestern Elysium Planitia (20-30º N, 110-120º E) (Figure 1). This crater is of particular interest due to the presence of a massive lobe in the southwestern side of the rim (Figure 2a). Significantly, the Elysium region has been found to contain evidence of widespread ground ice [3]. In addition, lobate ejecta morphology, like that here, has been shown to correlate with evidence of near-surface volatile reservoirs [4]. Perhaps, this feature formed as a result of interaction with ground ice during impact.

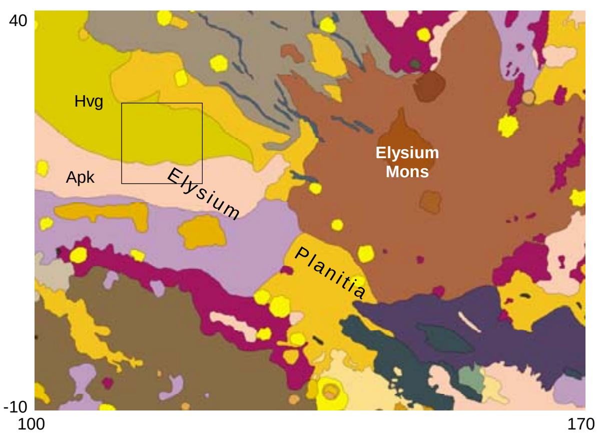

Figure 1. Geologic map of Elysium Planitia with crater area shown by box (From [5]).

Data: For our analysis, 5 data sets were integrated. Image data for this crater are available from the Viking Orbiter, the Mars Orbiter Camera (MOC), and the visible bands of the Thermal Emission Imaging System (THEMIS). In addition, there are topographic and thermal data from the Mars Orbiter Laser Altimeter (MOLA) and the infrared bands for THEMIS, respectively. As has been shown by previous studies [6,7,8], the combination of these data sets can provide great detail about this lobe.

We correlated MOLA topographic profiles with Viking Mars Digital Image Mosaics (MDIMs 1/256) and high resolution images. This correlation was used to construct a surficial geology map of the crater and its associated deposits. For the THEMIS IR images we concentrated our analysis on band 9, because of its availability in both day and night IR, calibration, and avoidance of major dust and CO_2 bands.

Discussion: Viking MDIM for the 14.9 km diameter crater reveals a complex crater with a double-layered radial ejecta blanket, central peak, and a massive lobe located on its southwestern rim (Figure 2a). MOLA has acquired 18 passes through this feature, with at least one at ~2 km from the center of the crater. Although the two high resolution MOC images do not cross the massive lobe, they give detailed view of the crater floor, central peak, and the ejecta material west of this layer. Analysis of day and night THEMIS-IR reveal a uniform, hummocky, and rayed ejecta blanket with no distinctive internal thermal inertia boundary. Surprisingly, the lobe only shows warm (bright) temperatures outlining its shape with no apparent fissures or internal structures (Figure 2b-c).

Conclusions: This unnamed crater with diverse morphology is one of 47 craters (≥ 5 km) with lobate ejecta morphology [1] located within the northwestern Elysium Region. Five origins for the unusal lobe are possible: (1) an pre-existing crater buried by the excavation of the 15 km crater, (2) an oblique impact, (3) shallow ground-ice, (4) pre-existing topography, and (5) an oblique impact on a ground-ice rich area.

We favor the combination of an oblique impact with ground-ice as the explanation for the origin of the lobe. This best fits the geometry of the ejecta pattern and accounts for the lack of a significant structural complexity as seen by IR data. Further work will include the analysis of 3 other craters in this area showing ejecta of diverse morphology, as well as 9 single lobe rampart craters located between 20-30º N, 110-120º E.

References: [1] Barlow N.G. et al. (2000) *JGR, 105,* 26733-26738. [2] Melosh H.J. (1989) Impact Cratering: A geologic process, Oxford University Press, 245 pp. [3] Cave J.A. (1993) *JGR, 98,* 11079-11097. [4] Barlow N.G. and Perez C.B. (2003) *JGR., 108,* doi:10.1029/2002JE002036. [5] Greeley R. and Guest J.E. (1987), USGS 1:15,000 MAP I-1802-B. [6] Christensen, P.R. et al. (2003) *Science, 300*, 2056-2061. [7] Barlow N.G. and Dohm J.M. (2004) *35th LPSC*, Abstract #1122. [8] Pelkey S.M. et al. (2004) *Icarus*, *167*, 244-270.

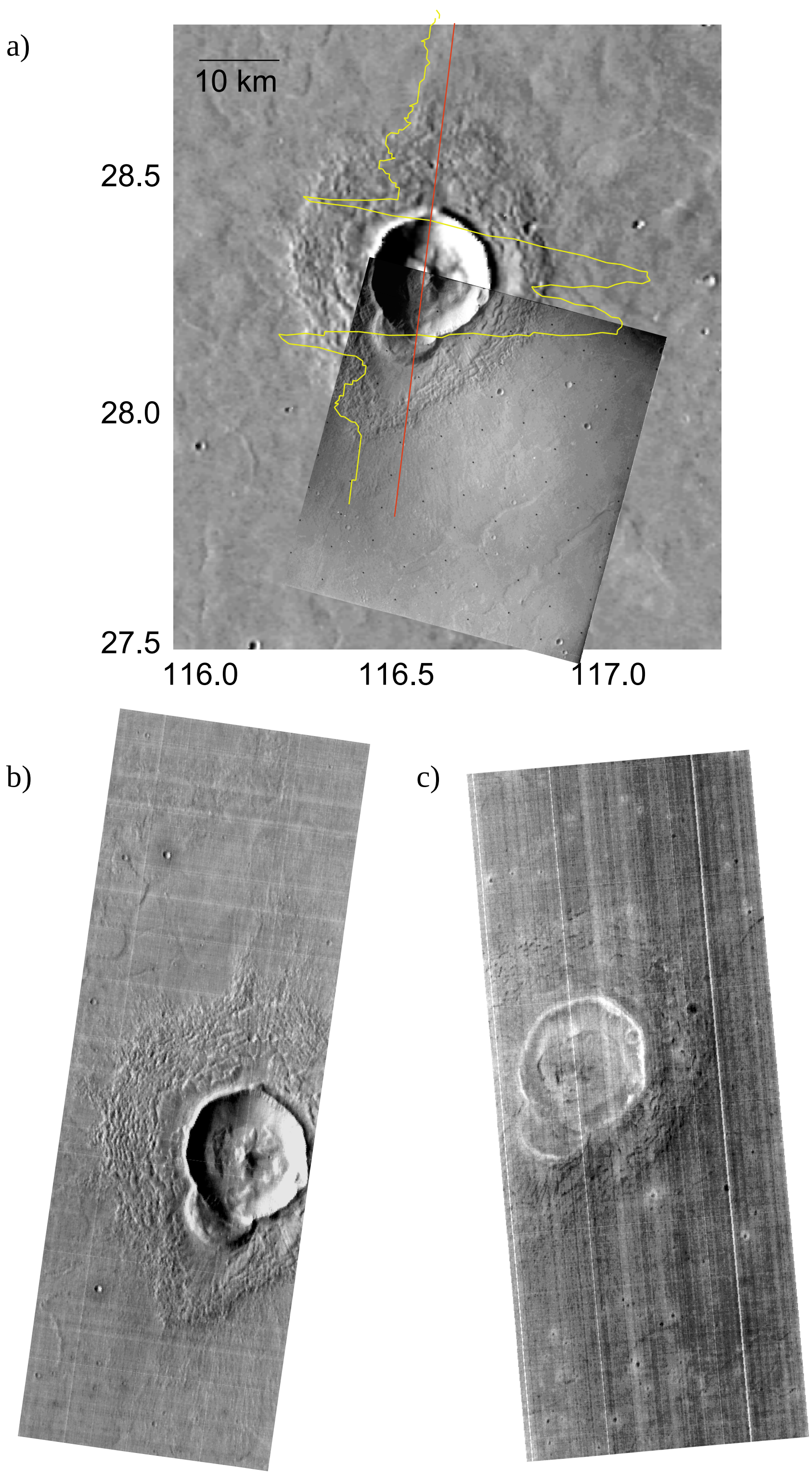

Figure 2. (a) Viking low- and high-resolution (F647A21-37 m/pixel) images of the ~15 km crater at 28.3 N, 116.7 E, showing in yellow MOLA topography for transect 12057 (red) on top.
(b) THEMIS Day IR image (I04365002-band 9). (c) THEMIS Night IR image (I05108005-band 9).