THE GEOLOGIC HISTORY OF TERBY CRATER: EVIDENCE FOR LACUSTRINE DEPOSITION AND DISSECTION BY ICE.

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Introduction: The geology of Terby Crater (28S, 287W), located on the northern rim of Hellas impact basin on Mars, is documented through geomorphic and stratigraphic analyses using all currently released visible and thermal infrared image data and topographic information. This large (D=164km), Noachian-aged [1] crater has a suite of geomorphic units [2] and landforms including massive troughs and ridges that trend north/northwest, sedimentary layered sequences, mantled ramps that extend across layered sequences, avalanche deposits as well as bowl-like depressions, sinuous channels, scoured-looking caprock, viscous flow features, fans, esker-like ridges, arcuate scarps and prominent linear ridges that may be indicative of past and present ice flow (Figure 1). The variety of the landforms within Terby and the surrounding area suggests that spatially and temporally varying geologic and geomorphic processes were responsible for the formation and modification of these features, perhaps as a response to changes in climate resulting from quasi-cyclical orbital variations [e.g. 3].

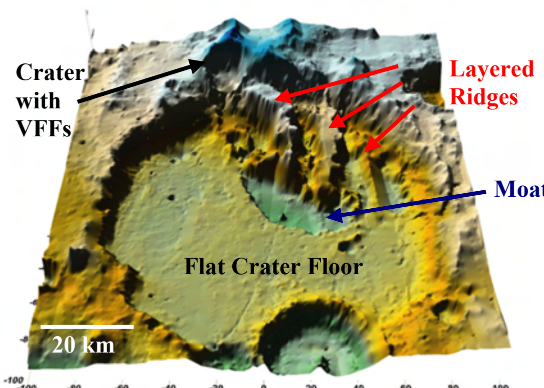

Figure 1. 3D view of Terby Crater highlighting layered ridges, moat deposit, flat crater floor and the crater with viscous flow features (VFFs).

Layered Deposits: The sedimentary layers in Terby Crater are exposed in the ridge scarps, as mounds between the ridges, and beneath the crater floor. The layers are indurated and fine-grained based on their appearance, preservation of faults, thermal signature and cliff-forming nature. The ~2 km-thick sedimentary sequence in main ridges has three apparent units that are separated by angular or stratigraphic unconformities along the northern edge of the crater. The basal and upper sequences contain sub-horizontal, laterally continuous layers that dip roughly 1.5º to the south and are regularly interbedded with somewhat massive, alternating light- and intermediate-toned layers. These units are separated by a light-toned, massive or poorly bedded unit that exhibits possible deformation structures. The physical and geological characteristics of the sedimentary layers and their original depositional geometry are indicative of a lacustrine origin with the sediment source from the northwest. The layered sequence appears to have been emplaced as an areally continuous deposit that was subsequently selectively dissected by ice and water.

Regional Setting: Topographic, morphologic and stratigraphic evidence in Hellas suggests that the interior fill was deposited in water [4], and that Hellas may have been the site of a basin-wide sea [5] or may have contained one or several ice-covered lakes [4] in the Noachian. A histogram of the elevation in the greater Hellas region identifies frequency peaks at elevations of -4500 m, -3100 m (previously identified by [4]), -2100 m, -700 m and +600 m. The -700 m and +600 m contours, which correspond to well-developed inward facing scarp boundaries around Hellas, suggest that Terby and the entire circum-Hellas region may have once been occupied by a lake that was up to 3.6 km deep (Figure 2). Most of the craters with pits and/or layers identified by Moore and Howard [6] in the circum-Hellas region are located at or below the +600 m contour, providing potential evidence for a lacustrine origin for the layers preserved in Terby and other highland craters around Hellas.

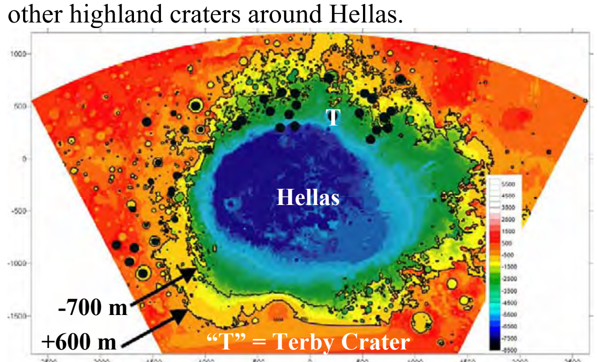

Figure 2. Most craters with pits and layers (black dots) in the Hellas region are located at or below the +600 m contour level. Scale in km, elevation in meters.

Geologic Evolution of Terby Crater: The following scenario is proposed based on the synthesis of the geologic, geomorphic and stratigraphic evidence from Terby Crater (Figure 3):

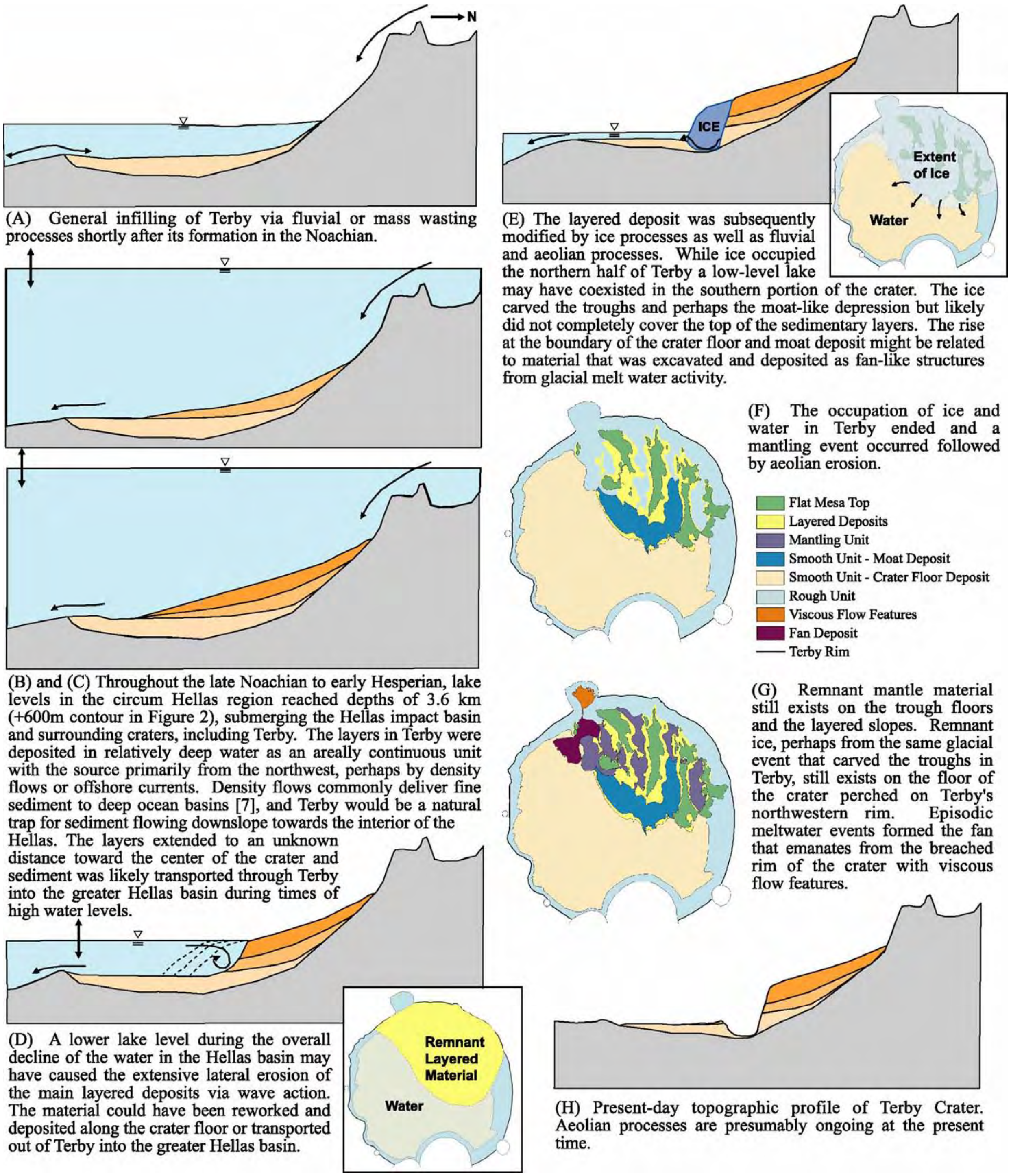

Figure 3. Possible geologic evolution of Terby Crater based on geologic, geomorphic and stratigraphic evidence.

References: [1] Wilson S. A. and Howard A. D. (2005) *LPSC XXXVI* Abstract #2060. [2] Leonard G. J. and Tanaka K. L. (2001) *USGS Geol. Ser., Map I-264.* [3] Laskar J. et al. (2004) *Icarus, 170*, 343-364. [4] Moore J. M. and Wilhelms D. E. (2001) *Icarus, 154*, 258-276. [5] Malin M. C. and Edgett K. S. (2000) *Science, 290*. [6] Moore J. M. and Howard A. D. (2005) LPSC XXXVI, Abstract #1512. [7] Milliman J. D. and Shuh-Ji Kao (2005) *Geology*, *113(5)*, 50-516.