MALEA PLANUM HESPERIAN VOLCANIC PROVINCE: CHARACTERIZATION USING MOLA DATA: J. W. Head and S. Pratt, Dept. Geological Sciences, Brown University, Providence RI, 02912 USA, james_head@brown.edu

Introduction and background: Malea Planum is an extensive flat plain over 1200 km in width situated at the southern margin of the Hellas Basin. It is unusual in terms of the almost complete obscuration of the rough topography characterizing the rim and inner walls of Hellas around the rest of the basin [1]. Geological mapping of the region [2-4] shows that it is characterized by several volcanic units of Hesperian age and three major volcanic structures, Peneus Patera, Amphitrites Patera, and a volcanic complex located at 68°S, 320°W. In this analysis, we report on the topographic characteristics of these major volcanic units and structures using MOLA data, and describe an additional ~350 km wide structure in central Malea Planum.

Stratigraphy: Malea Planum consists predominantly of three major units in ascending stratigraphic order: 1) Nplr, a plains unit of probable volcanic origin subsequently deformed by ridges (e.g., Dorsa Brevia) and wrinkle ridges, and forming an annulus at high topographic levels above the Hellas rim toward the south pole; 2) Hr, a less-cratered plains unit interpreted to be of volcanic origin and subsequently deformed by wrinkle ridges; distributed in a broad annulus northward from Nplr on the rim of Hellas; and 3) laterally equivalent to Hr, the Amphitrites Formation (Ha), consisting of two members. Hap, the patera member, which forms Peneus and Amphitrites Paterae and is interpreted to be materials of volcanic centers from which the ridged plains material was extruded; and Had, the dissected member, which consists of ridged plains material deeply furrowed by sinuous channels and gullies that trend downslope toward Hellas Planitia.

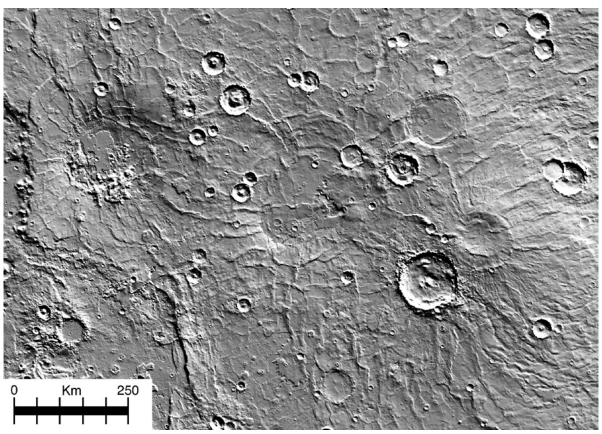

Figure 1. Gradient map of the topography of Malea Planum, on the southern rim of Hellas. North is to the right.

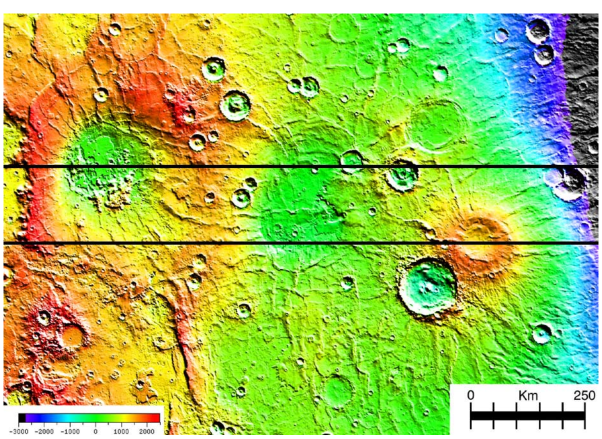

Figure 2. Topographic map of Malea Planum, on the southern rim of Hellas. North is to the right. Lines represent profile locations; top line is Figure 3, bottom Figure 4.

Topographic characteristics and relationships of units and structures: Regional topographic maps derived from MOLA data illustrate the relationship of these units to the basin rim (Figure 1-4). Nplr occupies a rough highland region toward the south pole, generally in excess of 1000 m elevation, and forming part of the outer topographically high annulus of Hellas [11]. Hr forms a very broad and distinctive plateau lying predominantly between 1000-1500 m. There is s striking lack of ancient impact craters in this region, supporting the interpretation that Hr flooded the rim, burying the underlying cratered terrain [3-4]. MOLA data reveal the presence of some flooded impact craters and confirms the distribution of wrinkle ridges into locally circular features that appear to reflect buried impact craters [3-4]. MOLA data also reveal evidence for large arcuate crater rims that may reflect craters in excess of several hundreds of km that have been superposed on the Hellas rim in this area, prior to the emplacement of Hr, smoothing the terrain. Had begins to occur as high as at about 1000 m at the edge of Amphitrites Patera and extends down to the floor of the basin (Figures 3-4).

The Amphitrites/Peneus Patera Complex is one of a series of highland paterae, low-relief, areally extensive central vent volcanoes representing the site of some of the most ancient recognizable volcanism on Mars [e.g., 5]. Originally, these were thought to represent low basaltic shield volcanoes formed from low-viscosity flows [2] because the extensive fine-grained deposits expected from pyroclastic eruptions were not observed. Additional details of many highland patera shown by Viking images led to the interpretation that phreatomagmatic activity caused by basaltic magma rising through a water-ice rich substrate was an important element of the eruptive style [6-10]. Examination of MOLA topography data for these structures shows the following: Profile 1 (Figure 3) extends through the middle of the volcanic complex located at 68°S, 320°W, and shows it to be about 400 km wide and at least 1.5 km deep. The rim and interior are characterized by a network of radial and concentric wrinkle ridges, part of a regional pattern that is highly modified in this area by the presence of the depression. Both rough (HNu) and smooth (Hpl_3) units occur on the floor of the depression [4]; the rough unit appears to be embayed by Hap and the smooth unit is clearly regionally smooth and superposed on the floor. A very similar feature occurs just to the north and is about 400 km in diameter and also about 1.5 km deep. Superposed Hpl_3 also occurs on the floor. In contrast to these features, Amphitrites Patera shows a distinctive positive profile (Figure 4), rising some 1.5 km from the surrounding plain and containing a central depression 300-600 m deep. In a manner similar to some other highland paterae, Amphitrites also has several radial channels emerging from it [6,8,9]. Peneus Patera, although similar in diameter to Amphitrites Patera, is much more similar in morphology and topography to the two larger depressions, and is also similar to several features just to the northwest and west that appear to be buried impact craters.

Summary: These new data provide important characterization of this phase of volcanism in the history of Mars [12] and further data on the mode of formation and eruption that characterizes this important class of features [6, 10]. Presently we are using these and related data to 1) model the volcanic flooding, loading and subsidence of large impact craters, 2) assess the subsidence of volatile-rich terrain embayed by regional volcanism, 3) determine the exact stratigraphic sequence implied by the high-resolution altimetry, and 4) complete a comparison of these features to others of their type on Mars.

References: 1) M. Kreslavsky and J. Head, *JGR*, 105, 26695, 2000; 2) J. Peterson, *PLPSC 9* , 3411, 1978; 3) R. Greeley and J. Guest, *USGS Map I-1802-B*, 1987; 4) K. Tanaka and D. Scott, *USGS Map I-1802-C*, 1987; 5) J. Plescia and R. Saunders, *PLPSC 10*, 2841, 1979; 6) R. Greeley and P. Spudis, *RG*, 19, 13, 1981; 7) P. Francis and C. Wood, *JGR*, 87, 9881, 1982; 8) R. Greeley and D. Crown, *JGR*, 95, 7133, 1990; 9) D. Crown and R. Greeley, *JGR*, 98, 3431, 1993; 10) R. Greeley et al., *Env. Effects on Vol. Erupt.*, 75. Kluwer, 2000; 11) D. Smith et al., *Science*, 284, 1495, 1999; 12) J. Head and A. Basilevsky, *LPSC 32*, #1114, 2001.

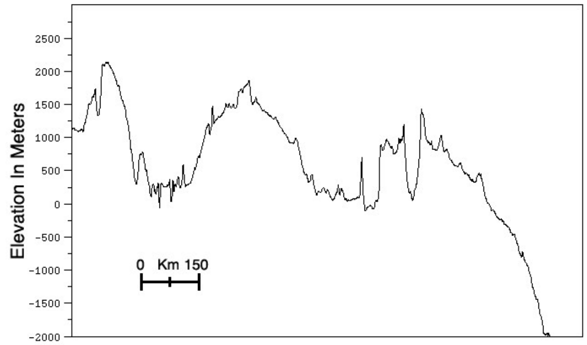

Figure 3. Topographic profile across Malea Planum (top line in Figure 2).

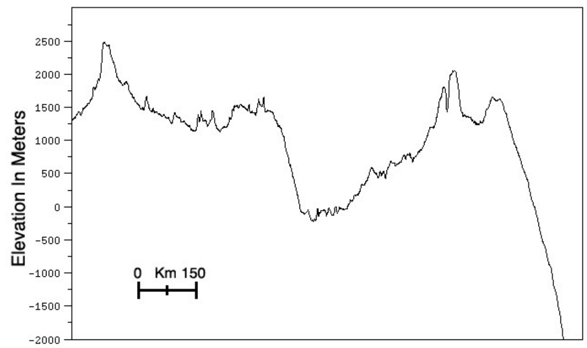

Figure 4. Topographic profile across Malea Planum (bottom line in Figure 2).