AMPHITRITES-PENEUS PATERAE / MALEA PLANUM GEOLOGY. J. B. Plescia, U. S. Geological Survey (2255 N. Gemini Drive, Flagstaff AZ 86001 jplescia@usgs.gov).

Introduction: The Amphitrites – Peneus Paterae complex lies on the southern rim of Hellas in Malea Planum [1]. It is a low relief volcanic construct with two large calderas. A volcanic origin was proposed on the basis of Mariner 9 and Viking data [2, 3, 4]. MOLA altimetry and MOC images provide new insight into the volcanic, aeolian and polar processes that have occurred in the region. Fig. 1 illustrates the shaded MOLA-based topography.

Background: The Amphitrites-Peneus volcanic complex has two large calderas surrounded by ridged plains and cratered highland beyond. Wrinkle ridges, having several hundred meters of relief, are oriented in a strongly radial pattern around Amphitrites and less strongly around Peneus and Barnard crater.

[2] mapped the area as "furrowed shield material" and interpreted it to be old volcanic shields formed by low-viscosity lavas. He identified four calderas: Amphitrites Patera, Barnard, an unnamed one east of Amphitrites and a fourth north of Amphitrites. [3, 4] mapped the surface as "shield material" and defined two calderas: Peneus Patera and an unnamed feature immediately to the north. He also identified a volcanic dome, "Australis Tholus". [1] map only Amphitrites and Peneus Paterae as calderas.

MOLA Interpretation: Based on the MOLA altimetry (Fig. 1) Amphitrites and Peneus Paterae are well-defined calderas located on local topographic highs. Barnard (61.654°S, 298.586°W) is a 120 km complex impact crater, not a volcano. "Australis Tholus" (57.503°S, 322.196°W) is an 11.7 km impact crater.

The proposed caldera north of Peneus [2] (56.183°S, 307.511°W) is a circular ridge having a few hundred meters of relief 122 km in diameter. Its eastern side is a piece of older terrain; the western side is an arcuate wrinkle ridge. It is not a caldera and may simply be a buried crater. The other unnamed caldera adjacent to Amphitrites is not observed.

Peneus Patera (58.124°S, 307.455°W) is 125 x 136 km, has a relatively flat floor and is surrounded by arcuate faults that step down into the caldera; fault blocks have 100-200 m of offset. The surrounding plains ramp up toward the caldera edge over distances of 50 km. Elevations are highest on the southwest rim (1.1 km) and lowest on the northern rim (500 m). The floor lies at 325 m, 150-800 m below the rim. Amphitrites Patera (59.016°S, 298.901°W) is 121 km across. Elevations around its margin are ~1.7 km. The interior is bowl-shaped with a minimum elevation of 1.2 km, the lowest point is offset to the west of the center. From these highs, slopes into the Hellas basin are 1.2-1.5°.

Two additional closed depressions occur to the southwest at 63.329°S, 307.992°W ("1" in Fig. 1) and 67.266°S and 322.366°W ("2" in Fig. 1). Feature "1" is a flat floored depression 274 (NE) x 340 (NW) km lying 1-2 km below a regional high to the west and a few hundred meters below the plains to the east. The floor is deformed by wrinkle ridges. Feature "2" is 245 km across; surrounded by a well-defined sloping margin (1.6°) except on the east. The floor has a patch of smooth material 90 km across; elsewhere it is rough and there is a massif on the eastern side. These features appear to be simple sags; perhaps old impact craters filled with plains material that sagged due to loading. There does not appear to be any volcanic construct. However, there is no obvious protrusion of old crater rim material through the plains, suggesting either the rims were heavily eroded prior to burial or the burial is quite thick.

The regional morphology and topography suggest that Amphitrites and Peneus are volcanic calderas. However, extensive surface mantling obscures the diagnostic morphology (e.g., lava flows). Overall, the morphologic expression of Amphitrites-Peneus is similar to that of Syrtis Major (Meroe and Nili Patera calderas) [5, 6, 7].

The widespread thick mantling of the surface is clearly illustrated in MOC images (e.g., Fig. 2). The mantle is sufficiently thick that the topography of the underlying plains is hidden. Only toward the boundary with the heavily cratered terrain is the mantle thin enough such that craters on the ridged plains are visible, although still heavily mantled.

The mantle displays several small-scale surface morphologies: smooth, goose-bump, dune-like and chaotic. At large-scale there are mesas and troughs and a unique scalloped morphology. Scallops (Fig. 2) are depressions in the mantle having a characteristic morphology regardless of altitude, location, or regional slope. The northern margin is always defined by a steep-walled, fresh-appearing scarp. The southern margin is a gentle slope break rather than an abrupt boundary. The deepest part of the scallop appears to be at the base of the northern wall with elevations increasing to the south. Many scallops are elongate, the long axis always in a north-south direction. Scallops appear to be formed by a collapse phenomenon that begins as a small funnel-shaped pit a hundred or so meters across. It then expands into a larger feature growing in a southward direction, possibly due to enhanced solar heating on that side. The scallops can coalesce into broad jumbled regions.

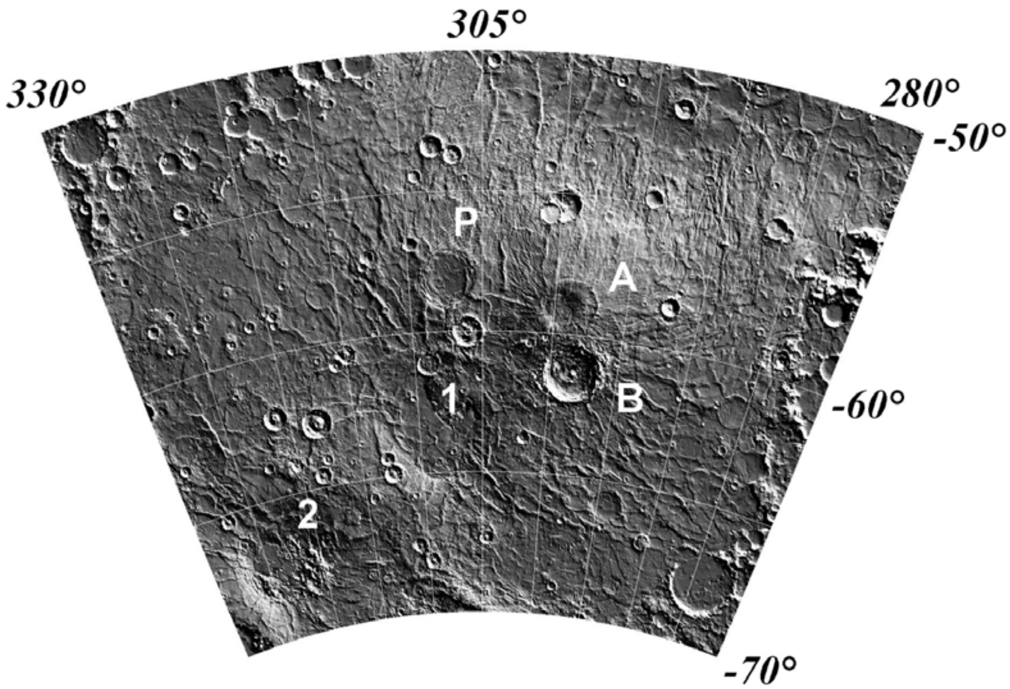

Fig. 1. Shaded topography of the Amphitrites-Peneus-Malea Planum region. A: Amphitrites Patera; P: Peneus Patera; B: Barnard; "1" and "2" denote features discussed in text. Illumination is from the upper left (northeast).

Age: The mantle and scalloping process must be active. None of the craters that are observed in Viking images (hundred of meters to kilometers) overlie the mantle. MOC images show the surface to be virtually devoid of craters in the tens to hundreds of meter size. The surface does not appear to be an old surface that is being deflated but rather one that is aggradational. Erosion of an old surface would retain some signature of earlier impacts.

References: [1] Leonard, G. and Tanaka, K. (2001) *USGS Misc. Inv. Ser. I-2694.* [2] Potter, D. (1976) *USGS Misc. Inv. Ser. I-941*. [3] Peterson, J. (1977) *USGS Misc. Inv. Ser. I-910*. [4] Peterson, J. (1978) *LPSC. 9th*, 3411-3432. [5] Meyer, J., and M. Grolier (1977) *USGS Misc. Inv. Ser. I-1995*. [6] Schaber, G. (1982) *JGR, 87*, 9852-9866. [7] Hiesinger, H. and J. Head (2002) LPSC *XXXIII*, Abstract 1063.

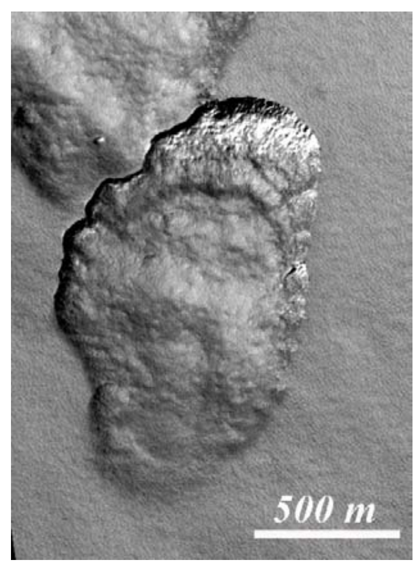

Fig. 2. Scallop feature in mantle. Note the asymmetric morphology. Portion of M03-02636.