AMPHITRITES AND PENEUS PATERAE, MARS:CHARACTERISTICS AND POSSIBLE ORIGINS. J.R Somerville[1] and T.K.P. Gregg[1]. [1]Department of Geology, 876 Natural Scienced Complex, University at Buffalo, NY 14260-3050; jrs49@buffalo.edu.

Introduction: Highland paterae are considered to be the oldest volcanoes on Mars [1-3]. Peneus and Amphitrites Paterae are located to the south of the Hellas impact basin (Figure 1), and have not yet been studied in detail [4-5]. Peneus Patera (56° S, 307° W) is the smaller of the two features (~120 km in diameter) and its central depression is surrounded by a concentric ridge arcs [4]. Amphitries Patera (59° S, 288° W) is characterized by a central depression surrounded concentric ridge arcs that have the same relief as the caldera rim [4]. Both paterae have minimal topographic expression (Figure 1). Although the term "patera" implies a volcanic origin, no evidence for volcanic flows have yet been observed using either Viking Orbiter (VO), Thermal Emission Imagind Spectrometer (THEMIS) or Mars Orbiter Camera (MOC) data near these paterae to indicate that they have a volcanic origin. Here, we present preliminary results of our topographic investigations to constrain the origin of these paterae.

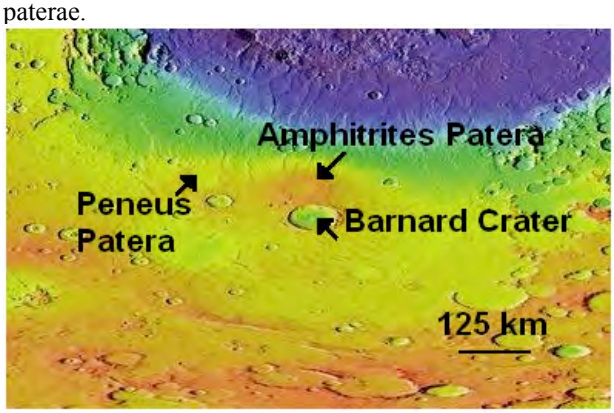

Figure 1: MOLA composite image of Peneus and Amphitrites Paterae, southern Martian highlands [6]

Approach: We use the freeware program Gridview (http://denali.gsfc.nasa.gov/mola_pub/gridview/gridview.html) to measure the dimensions of Amphitrites and Peneus Paterae, as well as the other major volcanoes on Mars, and impact craters in Malea Planum [7]. We hope to identify commonalities and differences between Amphitrites and Peneus Paterae and other, more clearly identified, features on Earth and Mars.

Impact craters in Malea Planum show a linear trend (Figure 2): as the diameter of the crater increases, so does the depth. The two paterae plot well below the crater trend, suggesting that they are not impact craters. Inspection of THEMIS and MOC images suggest that much of Malea Planum is covered with a mantle of

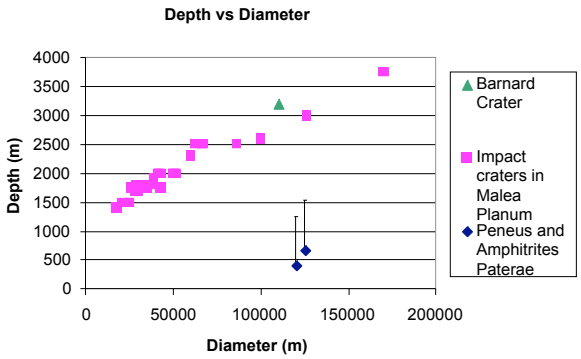

Figure 2: Impact crater depth and diameter measured in Malea Planum, with Amphitrites and Peneus Paterae (blue diamonds) plotted for comparison. Notice that the impact craters show a linear trend; increasing the diameter increases the depth of the craters. Peneus and Amphitrites Paterae lie well below the linear trend of the craters, even when the average infill of the area is removed (error bars show how deep they would be if the average fill was removed).

dust, possibly ice-rich. We can use the amount of crater infill to determine the thickness of the mantle in Malea Planum, and therefore within Amphitrites and Peneus Paterae. The amount of dust cover can be used to determine what the original depth of Amphitrites and Peneus Paterae may have been. Using Pike's [8] work that provides a general depth/diameter relation for martian craters, we can determine what the depth of impact craters should be for a measured crater diameter. This calculated depth, compared to the measured depth, provides an estimated fill thickness within Malea Planum. When the average fill of Malea Planum is removed from the measured depths of Peneus and Amphitrites, they don't plot within the impact crater trend seen in Malea Planum, suggesting that they are not infilled impact craters.

We compared summit caldera depth and diameter measure measurements for the four major Tharsis volcanoes (Olympus, Arsia, Pavonia and Ascraeus), three Elysium volcanoes (Elysium Mons, Hector Tholus and Albor Tholus) and the Circum-Hellas volcanoes (Tyrrhena, Hadriaca, Peneus and Amphitrites Paterae) with those of Amphitrites and Peneus Paterae (Figure 3). The two paterae plot closest to Arsia Mons on the graph, and are larger than their respective ci-

rum-Hellas counterparts (Tyrrhena and Hadriaca). For each caldera/crater measured using Gridview, the maximum depth and diameter were found. The maximum depth is the depth from the caldera rim to the lowest point on the caldera floor. The maxium diameter of the feature was determined using the highest points on a topographic profile of the caldera.

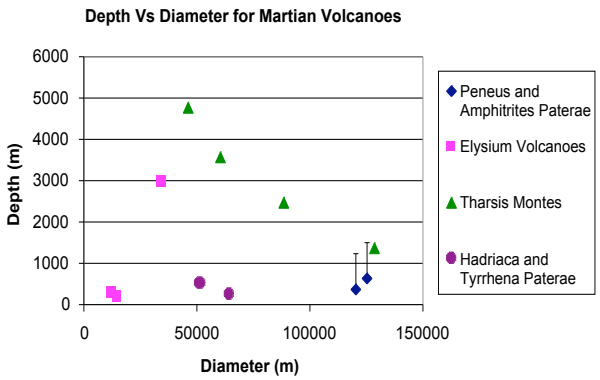

Figure 3: Maximum depth and diameter for summit calderas on Mars, measured using Gridview. The other paterae, represented by the purple dots, are much smaller than Peneus and Amphitrites Paterae.

We also compared the dimensions of Amphitrites and Peneus Paterae with those of terrestrial volcanic calderas. For Earth volcanoes, caldera depth and diameter was found for the three major Hawaiian volcanoes (Kilauea, Mauna Loa and Mauna Kea), three of the large evolved calderas (Yellowstone, Valles and Long Valley) and volcanoes in the Galapagos (Fernandina, Alcedo, Darwin, Wolf, Sierra Negra, and Cerro Azul) (Figure 4). There are trends seen in both the shield volcanoes on Earth and the evolved calderas. However, Peneus and Amphitrites Paterae do not fall within any of these trends, indicating that they are not like anything seen on Earth.

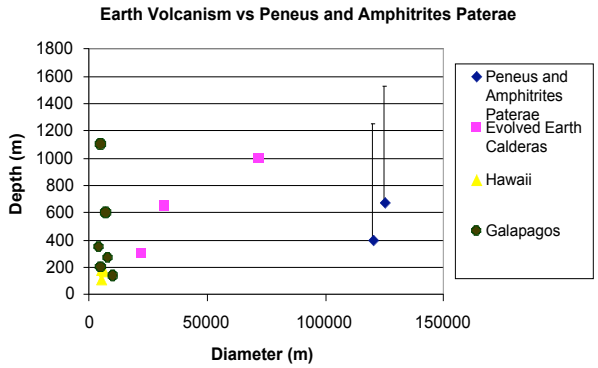

Figure 4: Caldera dimensions on Earth and Mars. Earth calderas form a slight trend, and all other shield volcanoes are concentrated in one area of the graph. Peneus and Amphitrites are not located near any of the Earth volcanoes.

Discussion: Analysis of the data strongly suggest that Amphitrites and Peneus Paterae are unlike any features currently seen on Earth and Mars. They fall well below the impact crater trends seen in Malea Planum, supporting the interpretation that they are not impact craters. Comparison of these paterae to other volcanic features has shown that they are unlike terrestrial volcanic features as well. In comparison with Martian features, Amphitrites and Peneus Paterae are most similar to the caldera at Arsia Mons, one of the large Tharsis region volcanoes. They are larger than their fellow circum-Hellas counterparts, Tyrrhena and Hadriaca paterae. Interpretation of the data suggestes that Amphitrites and Peneus Paterae are not typical volcanic calderas, instead they maybe some form of collapsed laccolith.

Conclusions: Analysis of the different plots discussed above have lead to the conclusion that Peneus and Amphitrites Paterae are not Martian Paterae. Instead, they maybe some form of drained or partially erupted laccolith. We plan to continue our investigation of these paterae using MOLA, MOC and THEMIS data.

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