AN EXAMINATION OF OLYMPUS MONS AUREOLES. J. Griswold [1], M. H. Bulmer[2], D. Beller [3], and P. J. McGovern[4], [1]Case Western Reserve, 10900 Euclid Avenue, Cleveland, OH 44106, [2]Geophyiscal Flow Observatory, JCET/UMBC 1000 Hilltop Circle, Baltimore, MD 21250, [3]Brandeis University, 415 South St., Waltham, MA 02454, [3] [4]LPI, 3600 Bay Area Blvd, Houston TX 77058-1113.

Introduction: Olympus Mons and the surrounding aureoles were first examined in detail in 1976 using images returned from the Viking Orbiter mission. Based on the observations made from these images, three emplacement models were proposed: pyroclastic flow [1, 2], mass movement hypothesis [2, 3, 4], and local emplacement [5]. However, because of the limited resolution of the Viking data, no models could be conclusively validated. New image (MOC, THEMIS, HRSC and HiRISE) and topography (MOLA) data now available allow for a re-examination of the aureoles.

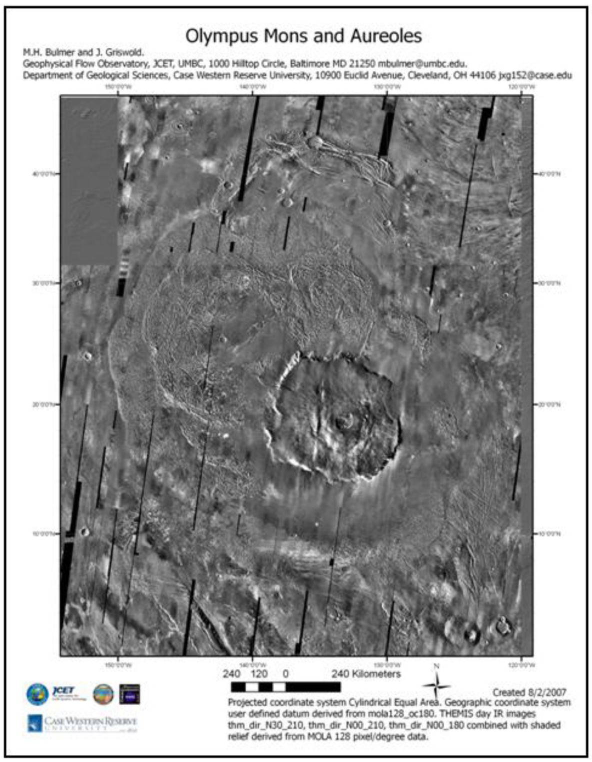

Figure 1. Georectified maps of Olympus Mons. A. Mosaic of THEMIS Visible IR and a MOLA shaded relief.

Approach: In order to relate these differing datasets, they were imported into a GIS environment where they were assigned a common projection and geographic coordinate system. Once this was achieved, image data were georeferenced to the MOLA 128 degree/pixel digital elevation model. This allowed spatial, geographic and topographic relations to be examined. Derivative products such as shaded relief models, contours and color coded elevation as well as slope maps were created. These products formed the base data for geomorphologic mapping of the aureoles (Figure 1).

Mapping: By relating topography and image data, a re-evaluation of published maps and interpretations of aureole units has begun. There appear to be six deposits that share characteristic blocky morphologies, and these are most pronounced on the north and northwest flanks of Olympus Mons (Figure 2).

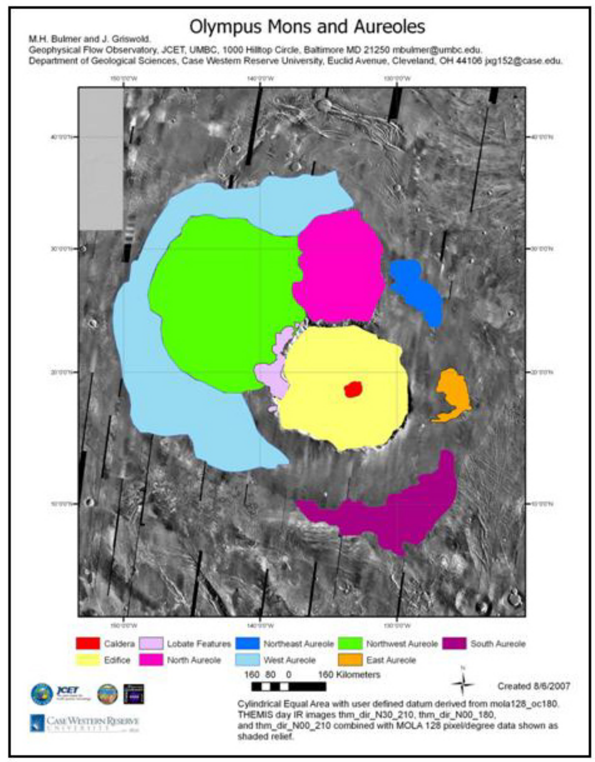

Figure 2. Preliminary geomorphologic map showing the major aureole units.

The available image and topography evidence supports the aureoles as originating from flank failure of Olympus Mons [6] and not from the current edifice but from earlier in the evolution of the volcano. This agrees with the evolution of the edifice determined from flexure models [7]. Lava flows from Olympus Mons embay and are superimposed on all aureole units, indicating that lava flows continued to originate from the volcano after aureole emplacement (Figure 3). Using direction and superposition, these flows provide a way to relate the various aureoles. To the south and southeast, many flows may have originated from monogenetic point-source shields, cones, rifts and pit chains only tens of kilometer in diameter (Figure 3). Fields of shields and cones occur in the region that are similar to those observed on Venus and on Earth seafloor [8]. How the subsurface plumbing of these is related to Olympus Mons or the Tharsis province in general, has yet to be determined.

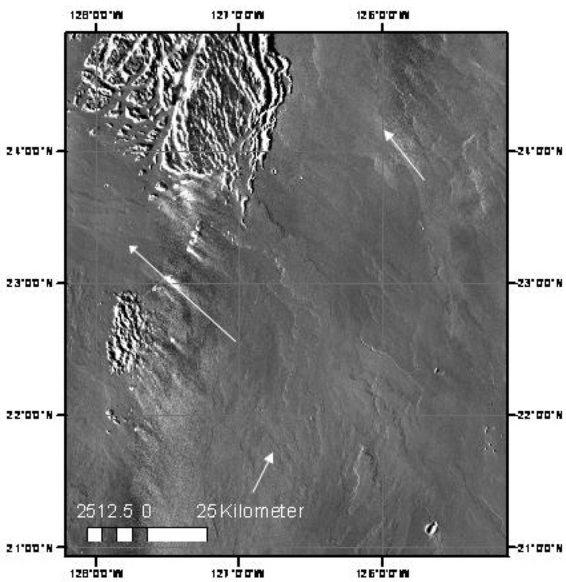

Figure 3. Lava flows originating from Olympus Mons at the bottom of the image flowed north and then northwest to embay the northeast aureole. Arrows denotes flow direction.

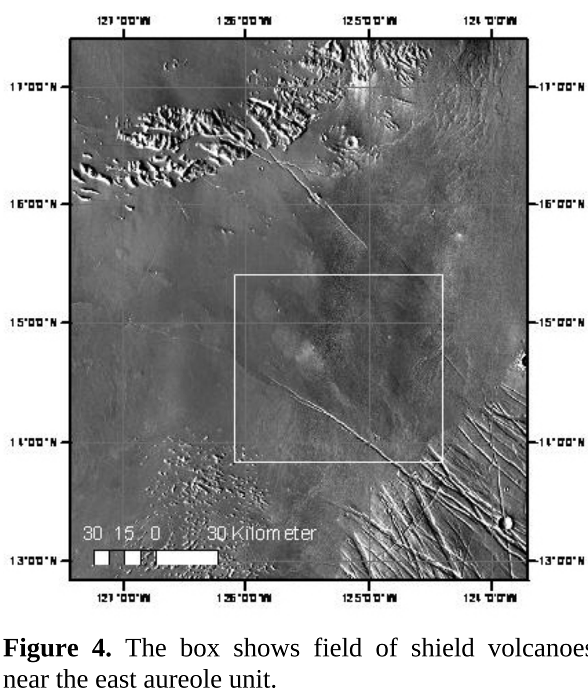

Figure 4. The box shows field of shield volcanoes near the east aureole unit.

Dimensions: The MOLA data provides a moderate resolution DEM of the aureole units. The MEGDR gridded 128 pixels/degree data was assigned the same projection and coordinate system as for the mapping data and used to examine the dimensional characteristics of the aureoles. Using Gridview, topographic profiles were selected across aureole units whose boundaries had been defined by the mapping effort (Figure 1). For each profile the length, height, and slope was obtained, and used to compile a table of dimensions for each aureole. Table 1 shows that the areas and volumes derived from MOLA and Viking are notably different and reflect the improved delineations of the aureoles using MOLA topography. It has been suggested that the aureoles are too big to be slope failures but comparison of the areas and volumes to terrestrial aprons on the sea floor show comparable dimensions.

Name	A	V	Lopes A	Lopes V
N Aureole	112.5	144.6	-	77
NE Aureole	20.7	25.5	12	33
E Aureole	21.5	17.8	10	33
SE Aureole	74.8	84.8	17	-
W Aureole	39.3	54.8	-	75
NW Aureole	379.8	558.5	-	197
Agulhas	20.3	79.5	-	-
Chamais	68.8	17.4	-	-
Cape Town	47.9	9.9	-	-

Table 1. Area (A) and volume (V) of aureoles and terrestrial analogs. The table compares the data from the MOLA 128 pix/degree data set, the estimates of Lopes [4], and data from terrestrial submarine landslides Dingle (1977), Summerhayes, et al. (1979), and Jacobi (1976)].

Conclusions: Combining image and topographic data into a GIS environment has allowed a new mapping effort to begin. Topographic data derived from the gridded 128 pix/degree MOLA data set, are allowing new super-positional relationships between the aureoles to be deduced. Comparisons of areas and volumes between aureole units and terrestrial landslides provides further constrains on emplacement models. Analysis to date continues to support the aureole units as being of mass movement origin; most likely originating from a volcanic structure centered around the current Olympus Mons. This, in turn, suggests that the volcanic history of this region is long and has undergone significant transitions in style.

References: [1] Carr, 1973. [2] Morris, 1982. [3] Francis and Wadge, 1983. [4] Lopes et al., 1980. [5] Morris and Tanaka, 1994. [6] McGovern et al., 2004. [7] Morgan and McGovern, 2005. [8] Bulmer and Wilson, 1999.