WATER CHANNELS NEAR OLYMPUS MONS, MARS.  A. Ambard and P. J. Mouginis-Mark, 1Hawaii Space Grant College, University of Hawaii, Honolulu, HI 96822 (ambard@hawaii.edu), 2Hawaii Institute Geophysics and Planetaology, University of Hawaii, Honolulu, HI 96822 (pmm@hawaii.edu)

Introduction: Images obtained by the THEMIS instrument on the Mars Odyssey spacecraft permit the identification and analysis of many fluvial features on Mars. In this study, we focus on the distribution and morphology of numerous channels >50 km long that are believed to be of fluvial origin surrounding the basal escarpment and aureole materials of Olympus Mons. THEMIS VIS images show that parts of the aureole have been modified by water discharged to the east of Olympus Mons [1]. While fractures on the plains to the east of Olympus Mons have been previously identified as the source for recent water release [2] the observations presented here provide better insight into the diversity of locations of the water channels, including the first identification of water flow within the aureole materials.

Distribution and Morphology of Channels: We have identified three characteristics of channel systems surrounding Olympus Mons. (1) A single channel to the west of the aureole (at 22.1°N, 208.7°E) that appears to have been a sink of water rather than a source; (2) a single channel system within a lobe of the western aureole deposit (at 25.6°N, 211.6°E); and (3) numerous channels to the SE of the basal escarpment of the volcano that originated from fractures in the young lava plains. The fractures from which these channels originate can either be confined sources or linear fractures. A second attribute of some of these channels is that they are not aligned with the current maximum topographic gradient, despite recent data from detailed crater counts [3] that suggest that the lava flows within which the channels are carved may be very young (<25 – 40 Myr). This implies that the ground has either been tilted, or that topographic obstacles (such as glaciers) existed at the time that the channels formed. Figure 1 shows an example of these channels.

In contrast to the single example of a channel that was discussed by Mouginis-Mark [2], we have identified numerous long (>50 km long) channels complexes to the SE of the basal escarpment of Olympus Mons (Figure 1). Frequently, these channels are braided, with stream-lined islands along their length. Multiple levels within the channel floor can also be seen in some instances. Several of the source areas show signs of the accumulation of materials along the sides of the fractures so that the source areas have raised rims. The lack of lava flow lobes, or hills with summit pits, allows us to exclude a volcanic origin for these channels and source areas.

Figure 1: Example of a channel complex to the SE of the Olympus Mons escarpment. “C” indicates each channel, and “F” marks the fracture originally studied by Mouginis-Mark [2]. See Fig. 2 for location.

Figure 2: Distribution of the seven large channel systems identified to the east of Olympus Mons. Blue arrows show observed flow-paths, and red lines indicate maximum down-slope gradient from the source. Note the mis-match in directions for four of these channels. Outlines of Figs. 1 and 3 also shown.
**Channel Slopes:** Before the availability of MOLA topographic data, Mouginis-Mark et al. [4] used Earth-based radar data to identify several lava flows in this part of the Tharsis region that appear to have experience tilting following their emplacement. The same situation appears to be true for some of the water channels that we have studied. We have explored the apparent mis-match between the current topography and the flow path of the water and have found a mis-match between the flow paths of four out of the seven most prominent channels to the east of Olympus Mons (Fig. 2). Using the 128th-degree MOLA digital elevation model, we have calculated the maximum downslope direction from the source area of these channels, and then compared these flow paths with the observed channel.

![Image](image1.png)

**Figure 3:** The source of the channel (located at 16.4°N, 232.6°E) is at the top left of the image, and the channel morphology indicates that the direction of water flow was towards the bottom right. Contours are in red at 10-meter intervals relative to the MOLA datum. THEMIS image V17029009.

One of the most striking examples of this mis-match in topography and channel flow-direction is illustrated in Figure 3. This channel originates close to the western margin of a partially buried segment of the aureole material. The fracture system comprises two elongate collapse pits ~3 km in length that are surrounded by a slight depression that then merges with the outflow channel. As can be seen from Fig. 3, the local topographic gradient runs from the east (highest ground) to the west. In contrast, the flow path of the channel is almost north-south, with the floor of the channel parallel to the 1,070 m elevation contour. Because it seems unlikely that this part of the lava plains could have been tilted, we are exploring alternative mechanism by which the water flow could have been forced to go in a direction that was not directly downhill. Two possibilities appear to be plausible at this time: (1) there may recently have been transient glaciers on some of the Martian volcanoes [5, 6] that acted as a barrier to water flow, or (2) eolian materials may have been on the surface at the time of channel formation and that these materials have subsequently been eroded away. Extensive eolian materials associated with explosive volcanism have been postulated for parts of Tharsis [7], so that this material could have acted as a barrier during the formation of the water channels.

![Image](image2.png)

**Figure 4:** Channel (arrowed) between blocks of the Olympus Mons aureole material, located at 25.6°N, 211.67°E. Direction of flow is towards the top of the image. The black area at top right is where data have been lost. THEMIS image V19975008.
Water Release within the Olympus Mons Aureole:
Almost all of the channels that we have identified lie within the lava plains surrounding Olympus Mons volcano. One channel (Fig. 4) has, however, been found within the aureole materials to the west of the volcano summit. No source can be found for this channel, but there are several stream-lined islands within the channel floor.

Fractures as water sinks: In addition to the examples of fractures that served as sources for water release, we have also found one example close to Tooting impact crater that appears to have been a sink for water (Fig. 5). We have used raw MOLA data to identify a local slope that runs into the fracture. Interestingly, no clear source for the water that carved this channel has been found. Instead, there is a diffuse “collecting area” where several shallow depressions merge as they approach the sink hole.

Conclusions: The young age of the basement materials [3], and the mis-match between the regional topographic gradients and the flow direction of the channels, indicates that significant topographic change has taken place in the last few tens of millions of years. The occurrence of release water release is particularly important as we try to better understand the near-surface distribution of volatiles in the Amazonian. At the present time, however, we are unable to determine if this change involved a tilting of the surface, as suggested by [4] or that there was once surface materials (e.g., glaciers or eolian deposits) that diverted the water flow and have subsequently been removed. In either case, there are a number of observations that could be made to help resolve the cause. As higher resolution data, such as HiRISE images, become available it will be possible to search for deformation features (had they formed due to local tilting), or remnants of deposits from glaciers and dunes had they once existed. Recognizing the flow direction, through analysis of the shapes of stream-lined islands, will also become easier, as will the interpretation of the constructional features around the source areas of the channels.

Reference: