GEOLOGY OF THE EASTERN FLANK OF THE OLYMPUS MONS VOLCANO AS SEEN IN MEX HRSC IMAGES OF MARS. A. T. Basilevsky[1,2], G. Neukum[2], S. Werner[2], S. van Gasselt[2], K. Gwinner[3], and B. A. Ivanov[4], [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Kosygin Str., 19, 119991, Moscow, Russia, atbas@geokhi.ru; [2]Institut fuer Geologische Wissenschaften, Freie Universitat Berlin, D-12249, Berlin, Germany; [3]DLR-Institut fuer Planetenforschung, D-12489, Berlin, Germany; [4]Institute of Dynamics of Geospheres, RAS, 119334, Moscow, Russia.

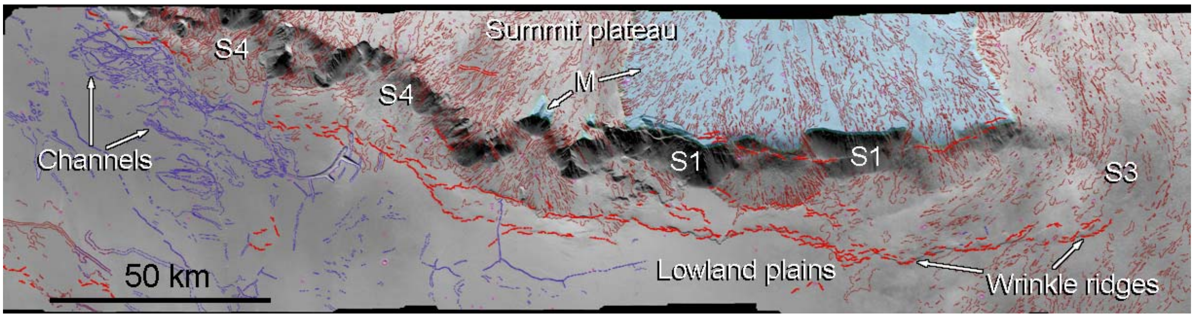

Figure 1. Geomorphic map of the Olympus eastern flank. Mesa material (M) indicated in blue and slope types S1, S3, S4.

Introduction: This work is based on the photogeologic analysis of the High Resolution Stereo Camera (HRSC) images of the eastern flank of Olympus Mons volcano and adjacent lowland plains taken at orbit 1089 (Fig. 1). The HRSC-derived DTM's and topomaps as well as MOC and MOLA data were also used. This study continues our analysis of the western flank of volcano, which has been published in [1-2]. Our initial results from the eastern flank have been presented in [3-5]. As in previous analysis we divide the study area into three domains: 1) the volcano summit plateau, 2) the volcano slopes, and 3) the lowland plains.

Observations: ***The summit plateau.*** The surface of the summit plateau's eastern flank shows ~200 Myr old [3, 5] lava flows almost everywhere. In comparison to several small mesas on the summit plateau in the west, only one relatively large mesa-like feature (covered by lavas, Fig. 2) and a few small steep-sloped hills (all marked M in Fig. 1) are observed here. Layers in their slopes are rarely seen most likely because of a dust mantle, the presence of which is suggested by down-slope trending dark streaks [e.g., 7].

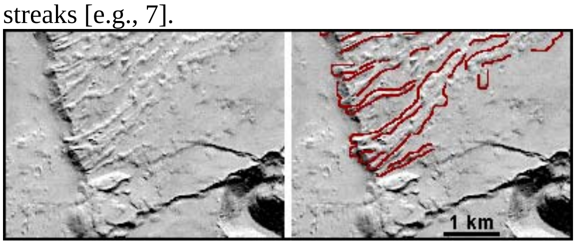

Figure 2. The SE edge of the mesa. Red shows lava flows.

The slopes. In the west, they were classified into three morphological types: S1, S2 and S3 [2]. The *S1 slopes* are the steepest and often have ravines. *The S2 slopes* are less steep. In their uppermost part there are several chaos-like depressions, from which the channel-like grooves trend downhill. *The S3 slopes* are typically the most gentle and covered by lava flows continuing from the summit plateau down to the lowland plains. In the east there are no the S2 slopes, but the S1 and S3 slopes are abundant. A new type is also present: *the S4 slopes*, which appear when lavas flow over the rims of the S1 slopes (Fig. 3).

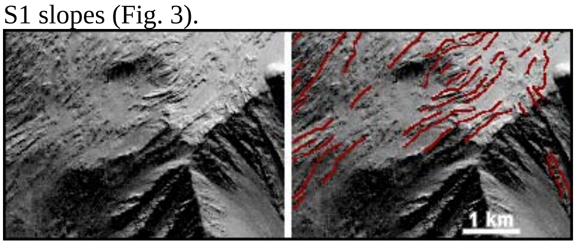

Figure 3. The S4 slope at the Olympus easten flank. Red shows lava flows.

In the west, at the foot of the S1 and S2 slopes, more than ten flow-like features, a few kilometers to several tens of kilometers across and interpreted as rock glaciers, have been described (see summary in [7]). At the foot of the eastern S1 and S4 slopes, only five features (1.5 x 2 km to 3 x 3 km) have similarities with terrestrial rock glaciers (Fig. 4).

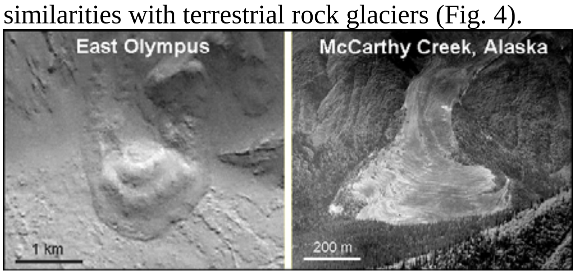

Figure 4. Possible rock glacier at easten flank of Olympus.

The lowland plains. Within the study area they typically have a smooth surface. In their southern part, a few *networks of channels* typically starting from the steep-sloped troughs are visible (blue lines in Fig.1). The channels intersect, anastomouse and form networks, the largest network is about 10 km wide and 60 km long. The mean surface age of the network bearing subarea is ~80 Myr [3, 5]. The morphology of these networks, including the presence of streamlined islands and terraces (Fig. 5), resembles that of the Martian outflow channels, which were previously interpreted as formed by the catastrophic release of subsurface water [e.g., 8].

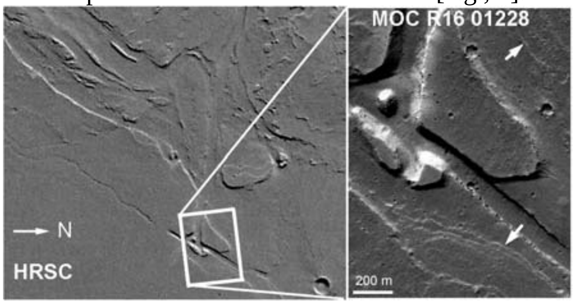

Figure 5. Fragment of the channel network at the plains. Arrows show terraces.

Recently, this interpretation has been challenged by the suggestion that highly fluid lavas could have cut the channels [e.g., 9]. Our observations do not support a particular hypothesis.

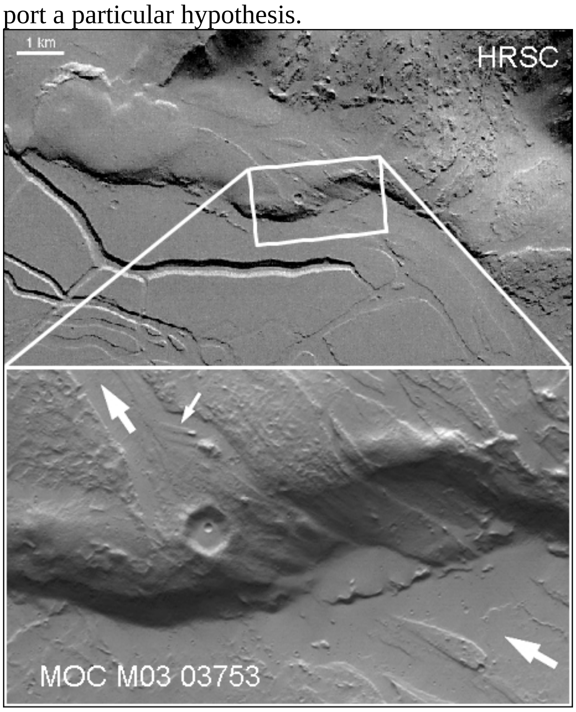

Figure 6. The channel appearing to climb the tectonic terrace. A streamlined island is indicated by the small arrow, and flow direction by the large arrows.

On the lowland plains, locally on the volcano slope and at the edge of the summit plateau, *wrinkle ridges* are observed (red lines in Fig. 1), which are interpreted as the result of compressional deformation [e.g., 10].

In some places, wrinkle ridges border the arch-like terraces at the foot of the volcano slope. In one of such places we see the channel crossing the terrace (Fig. 6). Here streamlined islands suggest that the channel forming flow direction was uphill. We interpret this as evidence that the wrinkle ridged terrace formed as the result of tectonic uplift subsequent to channel incision.

In the HRSC and MOC images of the lowland plains, ridges that are significantly more rectilinear than normal wrinkle ridges are observed. These sometimes merge into dome-like hills, while such hills occasionally form linear chains (Figure 7). Locally, these features are superposed on channels. We interpret these ridges and hills as extrusions of subsurface material, whose nature (lava, mud, ice?) we hope to
determine in future studies.

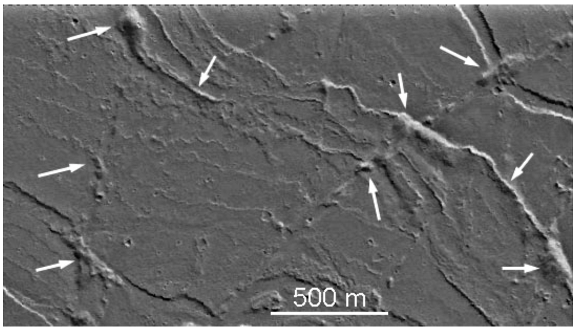

Figure 7. Extrusions of subsurface material (arrows) superposed on channels. Fragment of MOC M2201909.

Discussion and conclusion. The summit plateau morphoplogy of Olympus Mons' eastern flank shows remnants of layered sediments, supposedly airborne, which suggests a combination of volcanic and surficial deposition processes in the formation of the volcanic construct. In the west, similar sediments contained and probably still contain [13] water ice. This interpretation is supported by the S2 slope morphology as well as numerous glacial-type landforms [1, 2]. In the east, we did not find evidence for water ice in the past or present within summit plateau layered deposits. At the foot of some slopes in the east, we found a few landforms suggesting glacial-type activity, but on a significantly smaller scale than in the west. In the east, the plains have trough and channel networks, which could be cut either by water or by lava. Here, tectonic compressional landforms are seen, which are not present in the west. Therefore, geologic activity in the eastern flank of Olympus shows similarities with that of the western flank in lava emplacement style and differences in surficial water/ice processes and tectonism.

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