A probable fluid lava flow in the Hebes Mensa (Mars) studied by HRSC images. G. G. Ori[1], A.Pacifici[1], G. Komatsu, G. Neukum[2] and the HRSC science team, [1]International Research School of Planetary Sciences, Univ. d'Annunzio, Viale Pindaro 42, 65127 Pescara, Italy, ggori@irsps.unich.it, [2]Institut fuer Geologische Wissenschaften, Freie Universitaet Berlin, Malteserstr. 74100, Bldg. D, 12249 Berlin, Germany.

Introduction: The nature of lava flows on Mars and in other planetary bodies is still controversial. Several lines of evidence suggest that different composition, flow behaviors, and erosional capabilities of the Martian and planetary lava are different from those of terrestrial lava flows and fields. On the other hand, several other processes and related deposits not linked to volcanic activity may provide similar morphologies, facies, and depositional patterns. The problem is clear when exotic lava flows with low viscosity and with probable turbulent behavior are observed. In this case, lava flows are quite similar to water flows in term of processes and deposits. The High Resolution Stereo Camera on board of Mars Express has imagined a dark flow features that appear to be deposited by a flow descending over a slop of an Interior Layered Deposits (ILD) Hebes Mensa in Hebes Chasma (Figures 1 and 2).

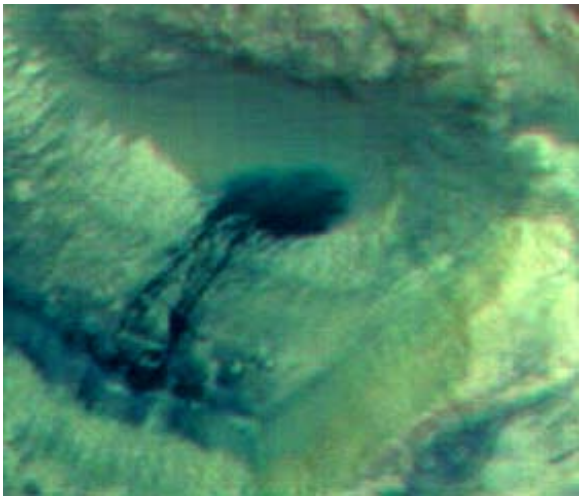

Figure 1. Plan view image of dark deposits on the slope of the ILD within the Hebes Chasma. The quasi-circular area of the dark deposits is about 4.5 km wide.

The ILD of Hebes Mensa: The origin of ILDs has been a matter of debate. Several origins have been proposed in order to interpret these relieves situated on the floors of Valles Marineris and related chasmata. They have been interpreted as volcanic features emplaced within thick ice cover [1][2]. In this interpretation the ILDs are volcanic edifices resembling tuyas such as the ones occurring in Iceland and in the Azas Plateau in central Asia. The lacustrine origin has been reviewed by [3][4] and compared with other genetic processes. It is quite probable that there is not a single origin for the ILDs [4] and that some of them may be the product of lacustrine sedimentation and others of volcanic sub-ice activity. The Hebes Mensa can be probably volcanic in origin as suggested by its stratification pattern and its high elevation compared to the rim of the chasma [1][2][5].

The dark feature: The feature that is the object of this abstract is located on the northern slope (14 degrees) of the Hebes Mensa. It consists of a dark material that forms several anastomosing rills along the slope. The rills in the upper part are linked to a poorly defined dark layer that follow the stratification of the ILD of the mensa.

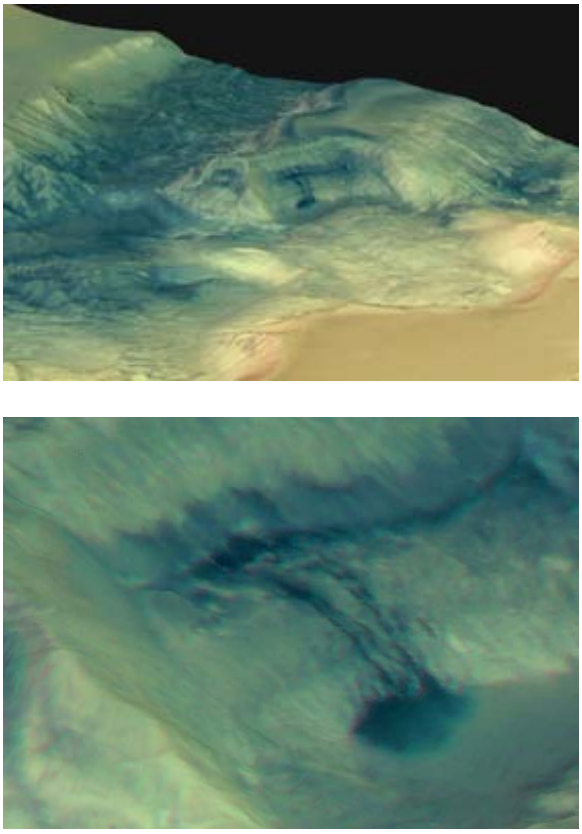

Figure 2. Three-dimensional view of the dark feature. Above: the Hebes Mensa within the chasma with the dark feature at the centre in the northern slope. Below: close-up.

The stratigraphic position of this layers can be followed laterally all around the mensa. It corresponds to a change in lithology (underlined also by a slope break). Downslope, the rills end in a quasi-circular dark area that covers part of a smoothed surface. Even at first sight, it is clear that the dark feature represents flowing of material from the upper source area down to the plain where it slightly expanded and stopped. The source of the dark material is not a point, but it is a linear zone along the stratification and it extends laterally for about 5 km. There are two main emission sites along the linear source from which the anastomosing rills are derived. The rills are 8 km long and are 10s of meters wide. Clearly the rills follow channels or depressions along the slope, but it is not clear if they have been eroded by the flows or if they are pre-existing depressions. The material of the rills debouches into a smoothed inclined surface (Figures 2 and 3).

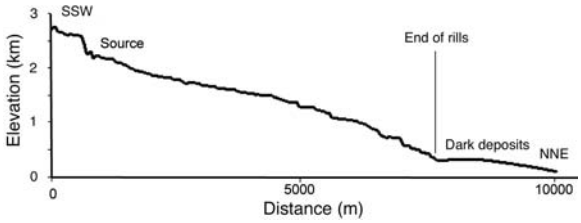

Figure 3. Topographic profile derived the HRSC stereo data.

Clearly the material expanded, but it accumulated on a slope of about 7 degrees. The same area has been imaged during the Viking mission nearly 25 years before (Figure 4). The dark feature appears not to have undergone any noticeable changes from the Viking era in term of both albedo and morphology.

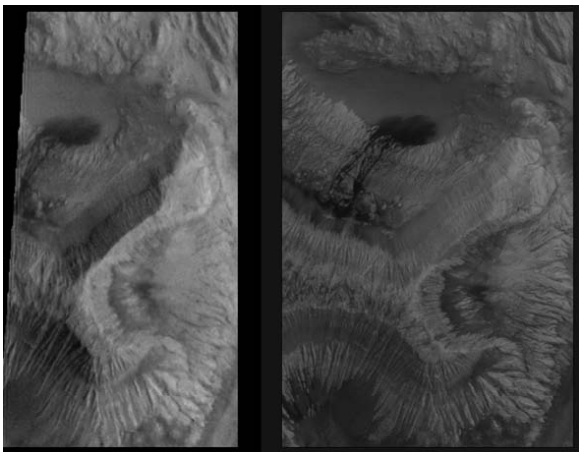

Figure 4. Comparison between the Viking image (left) taken on December 21st 1978 and the HRSC image (right) taken on May 2nd 2004.

Interpretation: The overall morphology of the dark feature clearly indicates that some material has been removed from the area upslope, carried along the slope and deposited on an inclined bottom. However, the morphology also suggests that the despositional process was a near viscous flow: (i) the rills are contained in channels and braid as in a turbulent flow, (ii) the basal quasi-circular spot is well-defined with a clear border as the terminus of a viscous flow, (iii) the spot is on an inclined surface that do not allow sedimentation from a turbulent fluid flow. Therefore, a turbulent water flow with bed load and sediment in suspension can be discarded. A creep of dry sediment is also quite improbable due to the shape of the basal spot and the length of the rills. It dose not seem that this structure is analogues to the dark streak that have been extensively found on the slopes in MOC images. The morphology is different and, mainly, this is a long lasting (at least 25 year) feature. Among the rheological or quasi-rheological flows we can consider sediment-carrying diluted (fluidized?) debris or mud flows and lava flows with relatively a low viscosity range. The dark flow does not show any modification during the last 25 years, and it seems quite pristine. This stability should be produced by a competent and hard material that is not eroded or modified by wind action and weathering over even a short geological time span. A debris flow should contain at least 10% of mud plus other sediments that, once dried out are easily removed by wind action. Moreover, loose sediment is prone to modification, weathering and erosion. Lava is more stable both in mechanical and chemical terms. Possibly, this lava flow was related to a late, mostly hydrothermal phase due to its peculiar appearance. On the other hand, the situation with the Hebes Mensa dark feature is similar to the accessory carbonate flows associated with Oldoyno Lengai in Tanzania.

Conclusions: Based on the morphology of the dark feature, its location on a slope, and its resistance to exogenic modification we think it is more probable that it has been emplaced by a low-viscosity lava flow. Other Newtonian to non-Newtonian sedimentary flows can be taken into account even if they are less probable.

References: [1] Chapman M. G. and Tanaka K. L. (2001) *JGR*, 106, 10,087-10,100. [2] Komatsu G. et al. (2004) *PSS*, 52, 167-187. [3] Nedell S. S. (1987) *Icarus*, 70, 409-441. [4] Komatsu G. et al. (1993) *JGR*, 98, 11,105-11,121. [5] Hauber E. et al. (2005) *LPS XXXVI* (this volume).