

3D STRUCTURAL ANALYSIS OF OPHIR CHASMA BASED ON HRSC IMAGE DATA AND STEREO-DERIVED DTM

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Introduction: Interior Layered Deposits (ILD) in the Valles Marineris Chasmata are some of the most enigmatic features of the Martian geology. These mounds, rising up to 6 km above the canyon floor, preferentially occur in the irregularly shaped central part of Valles Marineris. Here we study the structural and stratigraphic relationships in Ophir Chasma, using HRSC image data, and digital terrain models (DTM) derived from HRSC (High Resolution Stereo Camera, on Mars Express) stereo data. A better understanding of the structural elements of both the ILD and the wall rock of Ophir Chasma provide insights in the processes of formation of both the chasma and the ILD.

Geological setting of Ophir Chasma: Ophir Chasma is situated at the northwestern part of central Valles Marineris. The northern part is formed by wall rock with landslide scarps. A ridge of faulted wall rock material separates Ophir Chasma from Candor Chasma to the south. ILD form a mound that abuts against the wall rock ridge and covers the part of the Valley that connects Ophir Chasma with Candor Chasma. The geology of the area was mapped by Lucchitta (1999) [1].

Structural analysis using HRSC data: In this study we use HRSC data covering the central part of Ophir Chasma. We use a combination of multispectral ortho images and DTM data derived from stereo images [2]. A high-resolution DTM was generated by the method of Gwinner et al. [3]. The attitudes of visible layers were measured using Pangaea Scientific's ORION software [4].

Figure 1 shows the resulting layer measurements for layering visible in the mounds of ILD and the northern wall rock. Dips are typically moderate on the flat upper part the mounds, but steepen towards the edge of the mounds up to 20 degrees. On the basis of layering measurements it is possible to detect angular unconformities. The mounds can be subdivided into at least three subunits, separated by unconformities. Layer attitude

measurements performed on the wall rock units show that layering is sub horizontal.

Discussion: The layer measurements provide insight into the surface and subsurface geometry of interior layered deposits in Ophir Chasma and the wall rock units. The sub horizontal wall rock units indicate that structural tilting due to faulting or structural collapse did not play a major role in the formation of the northern escarpment. Erosion and landslides are a likely process for the formation of the northern wall of Ophir. The interior layered deposits of the upper unit clearly show variable dips up to 20 degrees, whereas the underlying ILD unit shows subhorizontal dips. The dipping layering may be the result of deformational processes, but this is unlikely in view of the underlying subhorizontal layers. Alternatively, the dipping layering may be the result of inclined deposition from for example airfall deposits. Since there are no features to suggest tectonically induced deformation in the ILD, such as faulting, we find the inclined deposition more plausible.

Recent studies in Hebes Chasma [4] and Candor Chasma [5] show that a subhorizontal lower ILD unit, overlain by an upper ILD unit that is draped over the existing topography, is a feature that is consistent over several parts of Valles Marineris.

References:

- [1] Lucchitta, B.K., 1999, Geologic map of Ophir and Central Candor Chasmata (MTM-05072) of Mars: *United States Geological Map*, p. I-2568. [2] Scholten, F., Gwinner, K., Roatsch, et al., 2005, *Photogrammetric Engineering & Remote Sensing*, v. 71, p. 1143-1152. [3] Gwinner, K., Scholten, F., Spiegel, et al., 2005, *Photogrammetrie Fernerkundung Geoinformation*, v. 5, p. 387-394. [4] Fueten, F., Stesky, R., and MacKinnon, P., 2005, *Icarus*, v. 175, p. 68-77. [5] Hauber, E. et al., *LPSC 2006*. [5] Stesky et al., *LPSC 2006*

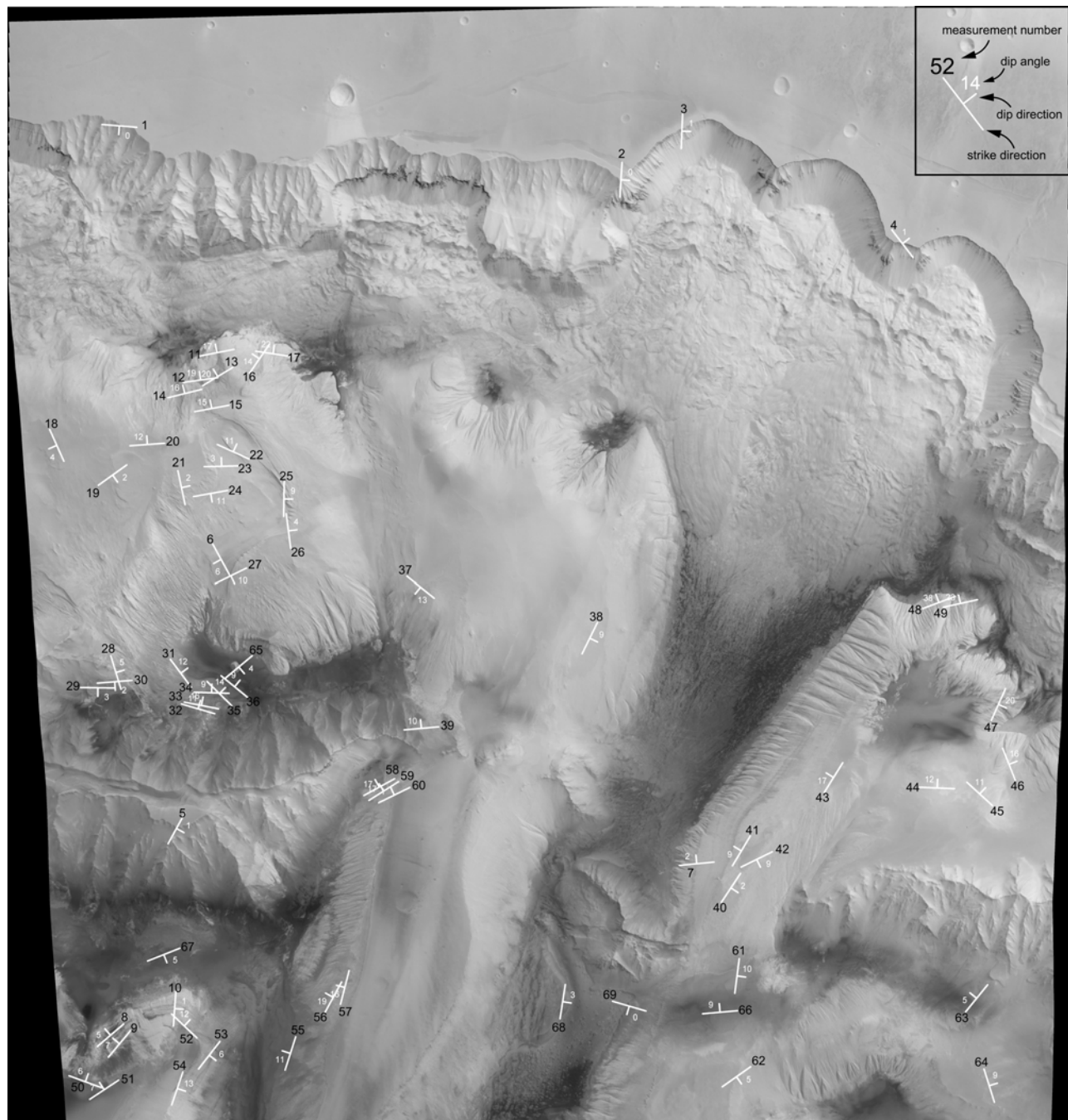


Figure 1. Structural attitude measurements in the Interior Layered Deposits of Ophir Chasma. Angular unconformities in the ILD are visible at the measurements numbered 50/51, 56/57, and 22/25