STRUCTURAL ATTITUDES OF LARGE SCALE LAYERING WITHIN COPRATES CHASMA IN VALLES MARINERIS, MARS, USING HIGH RESOLUTION STEREO CAMERA DATA FROM MARS EXPRESS. F. Fueten[1], P. MacKinnon[1],R. Stesky[2], E. Hauber[3], K. Gwinner[3], F. Scholten[3], T. Zegers[4], G. Neukum[5], and the HRSC Co-Investigator Team [1]Department of Earth Sciences, Brock University, St. Catharines, Ontario, Canada L2S 3A1, ffueten@brocku.ca, [2]Pangaea Scientific, Brockville, Ontario, Canada, [3]Institute of Planetary Research, German Aerospace Centre (DLR), Berlin, Germany, [4]ESTEC, ESA, Noordwijk, The Netherlands, [5]Institute of Geological Sciences, Free University, Berlin, Germany.

Introduction: The almost 4000 km-long, E-W trending trough system of Valles Marineris, located on the flank of the Tharsis Ridge uplift on Mars has been interpreted as an extensional feature and studies have compared its geometry to terrestrial grabens and continental rifts [1]. The origin of the Valles Marineris troughs and basins remains a subject of debate, but numerous studies point to a complex tectonic, volcanic and geomorphic history [2], [3], [4].

Layering within the canyon walls has been revealed in great detail in images produced by the Mars Orbiter Camera (MOC) and interpreted as mainly volcanic flood lavas or sediments derived from volcanic material based on morphological and compositional data [5], [6]. Using the assumption that these layers were initially deposited nearly horizontally, two recent studies [6], [7] have attempted to quantify the present layer attitudes. Fueten et al. [7] used MOC wide angle images and the MOLA 1/128° x 1/128° topographic grid file to measure large scale layering within the canyon walls and found that that most layers dip gently into the adjacent canyon. Beyer and McEwen [6] use the elevation offsets within a topmost strong layer as evidence for substantial subsidence of a massif within Coprates Chasma. Both studies are somewhat limited by the relative coarseness of the MOLA data in the equatorial regions.

This project examines the attitudes of layering within central Coprates Chasma (Fig. 1) using data from the High Resolution Stereo Camera of the Mars Express mission using our Orion structural analysis software to compute the attitude of the large scale layering.

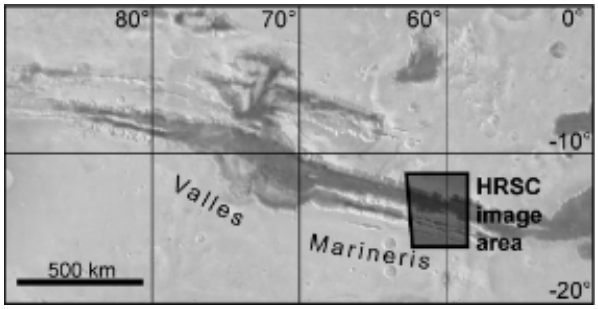

Fig. 1 Valles Marineris and location of HRSC image

Data Sets and Methodology: Primary data are the stereo and multispectral images by the High Resolution Stereo Camera (HRSC) of the Mars Express mission which enable the derivation of digital terrain models (DTM) and orthoimages [8]. Data for this study are from orbit 449 (Fig. 2); with a maximum ground resolution of 40 m/pixel it is among the lower resolution HRSC datasets. High-resolution stereo processing [9] allowed derivation of a 200 m DTM grid, a significant improvement over the MOLA grid within this region. Layers with trace lengths on the order of several kilometres were measured using the DTM, the orthoimage, and the software Orion, following the method outlined by Fueten et al. [7]. Orion uses the 3D coordinates of manually selected points, deemed to be on the same layer to compute a best-fit plane using multi-linear regression.

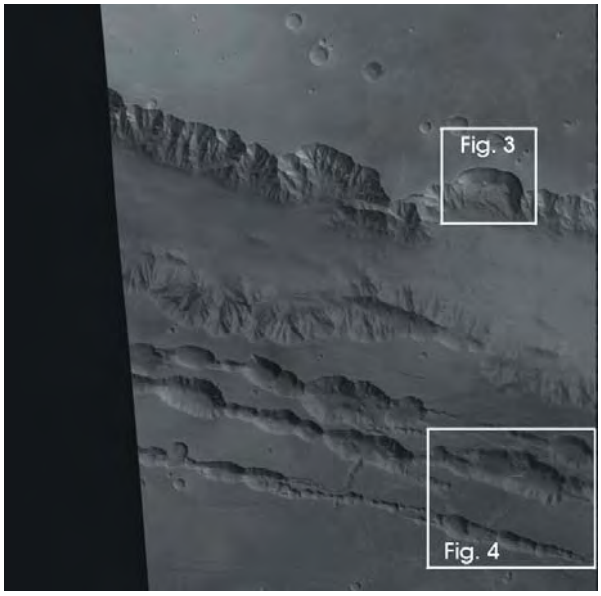

Fig. 2 HRSC image. Location of Figure 2 and 3 as indicated

Results and Discussion: l5 layer attitudes have been measured from both the relatively simple northern chasm wall and the more complex southern portion of the image. As expected, layer attitudes can be measured with good accuracy.

The layering along the northern chasm wall consists of a topmost strong layer on the order of 50 m below the plateau surface followed by a competent sequence of darker-toned layers on the order of 100-200 m below the plateau surface. The topmost strong layer appears similar to the topmost strong layer identified by Beyer and McEwen [6] in Coprates further to the east. It can be seen outcropping along the entire north chasm wall of Coprates in this area and can be seen continuously outcropping for a distance of 100 km supporting the hypothesis that it underlies much of the Ophir Planum along Coprates. The 200m resolution of the DTM makes measurements of this topmost layer difficult but where it can be successfully measured, it dips 1 to 3 degrees to the south into Coprates Chasma (Figure 3). The competent sequence of layers below the topmost layer also dip to the south into Coprates Chasma (Fig. 3). The northern rim in this area is disrupted by faulting and some slumping and rotation of fault blocks can be seen along the canyon margin here.

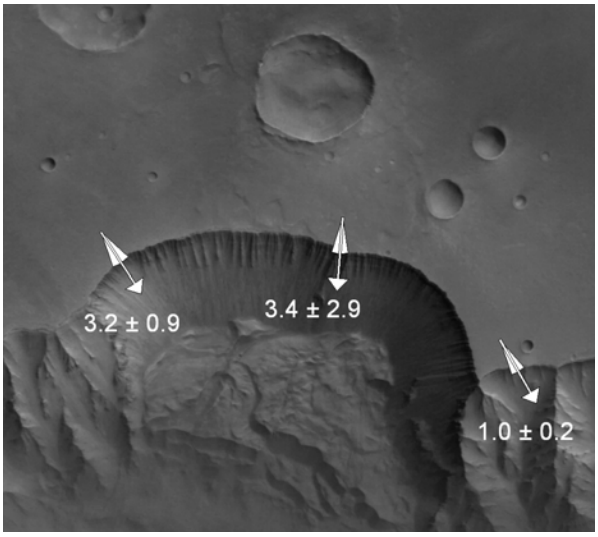

Fig. 3 Layering along northern Chasma wall. Symbol indicates dip direction and strike error. Values indicate dip and dip error.

As may be expected, layer attitudes are more variable in the southern portion of the image which is dissected by an extensive network of east-west trending pit chains. The topmost strong layer is not well-exposed here. In this area layer measurements are made of a competent sequence which outcrops 100 to 300 m below the plateau surface. Individual layers are disrupted by faults of presumably SW to NE trends. While layers are still generally very shallow, dip reversals are evident (Fig. 4).

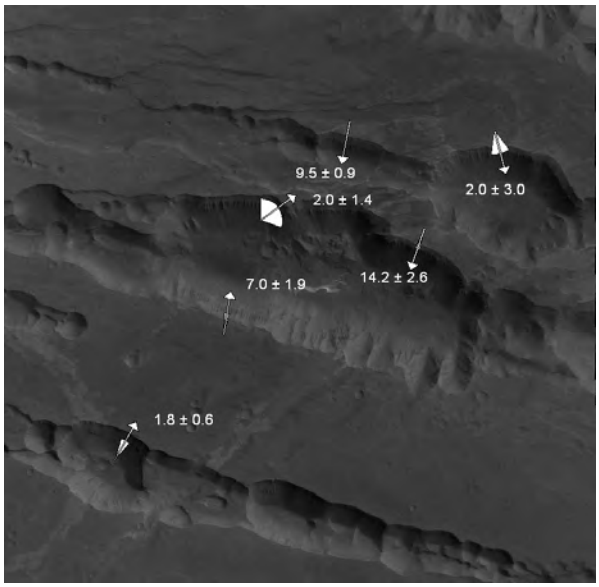

Fig. 4 Layering in pit chain walls

Conclusions: Measurements of attitudes of layering within the northern canyon wall of Coprates Chasma indicate gentle dips into the chasma, supporting the earlier conclusions [7]. The higher resolution of the HRSC DTM enables the detection of many small structural features, undetectable with the MOLA grid. The northern margin of Coprates chasma exhibits a fairly uniform and shallowly dipping stratigraphy that appears consistent with the stratigraphy observed to the east. The southern margin is more structurally complex and the stratigraphy is less well defined. Higher resolution HRSC data with DTM grids on the order of 50 m, which will be available in the future, will allow for a greater understanding of the structural complexity within Valles Marineris.

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