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Geomorphological studies on western Valles Marineris, Mars – landforms and processes

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1. Introduction

Context Camera (CTX) images obtained by the Mars Reconnaissance Orbiter (MRO) covered ~85% of the Martian surface to February 2013 [1], including almost 100% coverage of the Valles Marineris trough system. The images of resolution 6 m/pixel play an important role as a background for detailed landform mapping of Mars. We present: (*i*) a detailed geomorphologic mapping procedure of western Valles Marineris based on USGS ISIS processing, ArcGIS mapping, and incorporation of additional data sets, (*ii*) observations of chasma floor and wall features.

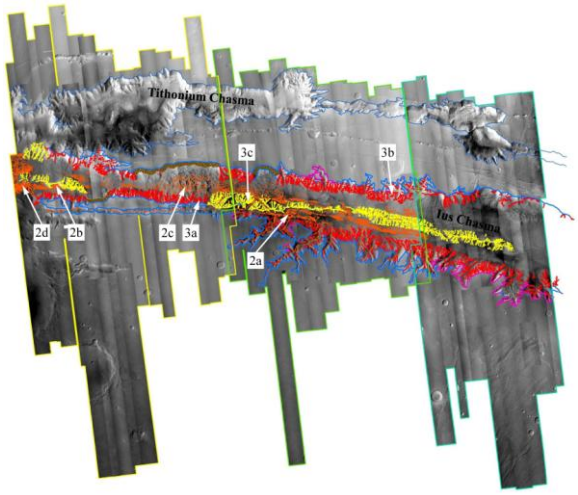

Figure 1: Study area of western Valles Marineris with indicated 3 separate mosaics and mapped features (*blue* – chasma contour without plateau sand cover; *pink* – chasma contour with plateau sand cover; *yellow*, *red* – ridge crest of spur; *orange* – dune area; *brown* – landslide scarp).

2. Procedure and datasets

100 CTX images were selected to cover the interior of western Valles Marineris chasmata and the adjacent areas. Each CTX image file was processed separately in sequence by 5 ISIS subprogrammes: *mroctx2isis*, *spiceinit*, *ctxcal*, *ctxevenodd*, and *cam2map*. The image resolution was decreased to 12 m/pixel. In order to enable ISIS software to match file size limitations (*indicated in brackets*), the image collection was divided into three smaller sets (Figure 1). Each set was adjusted by tone matching *equalizer* and mosaic creating *automos* (*12 GB*), and eventually converted to PNG file in *isis2std* (*2 GB*).

MRO HiRISE images and Mars Global Surveyor MOLA altimeter datasets were used for interpretation. The resultant map will consist of description and interpretation layers characterizing for the first time in details the area of western Valles Marineris.

3. Observations

3.1 Study area

Valles Marineris trough system extends over 650 km x 2000 km in the equatorial part of Mars. Internal trough landforms inform on 4 Gy of Mars' history, recording a broad range of magmatic, tectonic, fluvial, lacustrine, glacial, eolian, and gravitational processes [2, 3]. The investigated area includes Ius, Tithonium and western Melas chasmata, where trough contours, landslide scarps and main geomorphological bodies, ILDs, dune areas, sapping channels, spur and gullies, and different wall types were mapped.

3.2 Dune areas

Dune areas cover a significant part of chasma floor, but they are not a homogeneous unit. Valles Marineris dunes are characterized by different: type (barchans, transverse dunes, longitudinal dunes), lithology (bright and dark dunes), exposure size of single dune area (from ~100 m^2 to ~100 km^2), and sand source [4].

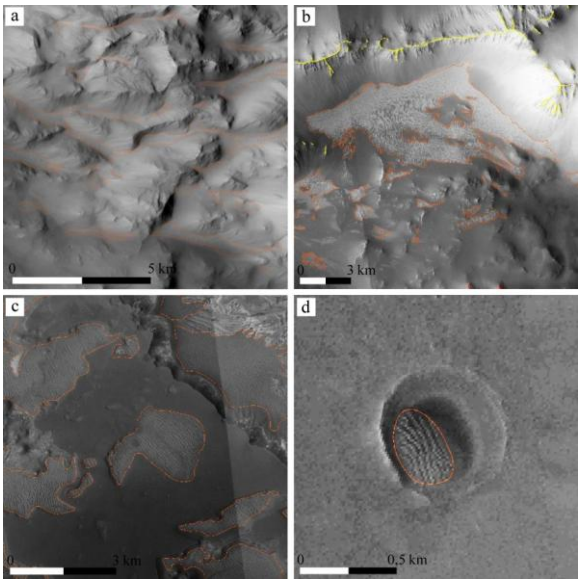

Figure 2: Examples of dune fields related to: (*a*) landslide, (*b*) wall, (*c*) floor and (*d*) crater.

Among 20 largest dune fields on the Ius Chasma floor, the average dune spacing (measured between crests) is 50 m and the predominant facing direction of dune slopes is W-E. These transverse and longitudinal dunes are built of sand from intra-chasma main sources (landslides, walls) and secondary sources (interior layered deposits (ILDs), floors and craters) (Figure 2). Dunes originated in landslides dominate in the northern trough, whereas wall-related dunes are widespread in the entire chasma. Floor source is a stratigraphically homogeneous unit observed in the southern Ius trough, probably of detrital origin, in which dunes occupy erosional hollows. Crater dune fields are rare.

3.3 Wall types

Analysis of spur and gully morphology has revealed three chasma wall types (Figure 3): active (with a visible evidence of modern sediment transport; common), inactive (with a lack of transport; rare) and grooved (displaying up to 100-meter wide shallow flat-floored linear grooves parallel or oblique to the local slope; common on the central Ius inner ridge). The grooves might result from a creeping process of viscous surface material.

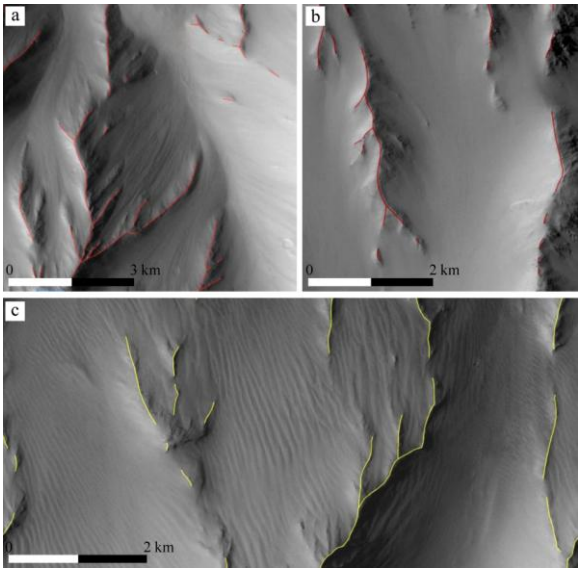

Figure 3: Wall types: (*a*) active, (*b*) inactive and (*c*) grooved.

4. Summary

Systematic high-resolution mapping in Valles Marineris is revealing geomorphologic features and processes that had not been recognized before. Full mapping results will be presented in 2015.

References

[1] Harrison T. et al., Present-Day Gully Activity Observed by the Mars Reconnaissance Orbiter (MRO) Context Camera (CTX), BAAS, Vol. 41, 1113, 2009.

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[4] Chojnacki M. et al., Valles Marineris dune field provenance and pathways, Icarus, Vol. 232, pp. 187-219, 2014.