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DETAILED STUDY OF SPUR AND GULLY TOPOGRAPHY WITHIN EASTERN VALLES MARINERIS, MARS.
L. Vargas[1] <lv15vb@brocku.ca>, F. Fueten[1] <ffueten@brocku.ca>, R. Stesky[2], and E. Hauber[3]. [1]Department of Earth Sciences, Brock University, St. Catharines, Ontario, Canada L2S 3A1; [2]Pangaea Scientific, Brockville, Ontario, Canada K6V 5T5; [3]Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany.

Introduction: The Tharsis province is a large Noachian-Amazonian elevated volcanic and tectonic bulge that rises ~10 km above the datum and holds several giant shield volcanoes [1]. Radial extensional grabens and concentric compressional wrinkle ridges within it are evidence of significant deformation [2]. Valles Marineris, a 4000 km long system of troughs, is a prominent feature that provides a cross section through parts of the eastern Tharsis province. It formed in part through extensional tectonism involving vertical accommodation of subsiding fault blocks [3]. The walls of Valles Marineris were subsequently formed by erosion [4] creating the spur and gully (SG) texture within them. The slope of spur and gully topography is between 30° and 40°, corresponding to the strength properties of the relatively competent wallrock [5].

The plateaus surrounding Valles Marineris display tectonic features such as grabens and wrinkle ridges, which are largely not visible on the chasm floor due to late deposition of eroded material [6]. As with the dikes seen in chasma walls [7], we have observed other tectonic features that might have influenced the development of SG. This possibility implies structural control in the formation of spur and gully texture, as previously suggested [8]. Furthermore, faults within the walls of Valles Marineris are involved in progressive development of the spurs and gullies [9].

This study explores the possible relationships between spur and gully orientation and the large deformation structures present within the Tharsis bulge. The aim of this project is to get a better understanding of the deformation of the Tharsis bulge and the tectonism that led to the formation of Valles Marineris.

Methodology: Context Imager (CTX) data covering Coprates and East Candor Chasmata was used to compute 132 digital terrain models (DTM) at 20 m/px spacing using the NASA AMES Stereo pipeline [10, 11]. After eliminating sets deemed too noisy, 84 CTX DTMs were used. Gaps between CTX DTMs were bridged with nine High Resolution Stereo Camera (HRSC) digital terrain models at 50-200 m/px.

The selected DTMs were processed with the Surface Derivate tool within ArcGIS [12], used to determine planar features. The tool calculates the surface attitude for a 3x3 DTM pixel kernel over each pixel of the DTM. The attitude of the surface shows Augmented Visualization of Attitude (AVA) color scheme notation, which facilitates the 2D visualization of the planar features and their orientation. AVA imagery covers the floor and walls of Valles Marineris, HRSC nadir images (12-50 m/px) are used for imagery of the plateau.

Preliminary Results: Initial observations focus on two different structures: termination locations of late Hesperian grabens [13, 14] and wall structures near ridges. Grabens cross the walls at different attitudes with respect to the wall direction. SG orientation in the south wall of East Candor appears to trend along the grabens that crosses that wall (Fig. 1-B). These SG are longer, smoother and continue in the approximate direction of the grabens (Fig. 1-B) than those examined in the north wall of Coprates.

Grabens that cross the north wall of Coprates (Fig. 1-D) are oriented at a low angle to the wall orientation. Graben terminations appear to coincide with the uppermost end of SG. SG are oriented at a high angle to the graben and are disrupted by wall-parallel faults [9].

Several SG plunge at low angles to the wall (Note: large yellow planes within 1-A) in several locations (Fig 1-C, E). These appear to be anomalous planes as they dip into the walls. In Coprates, they appear to cut regular SG present at the same location within the wall (Fig. 1-E). In several locations, these occur below ridges visible within the plateau (Fig. 1-C, E).

Future work will examine these structures in more detail.

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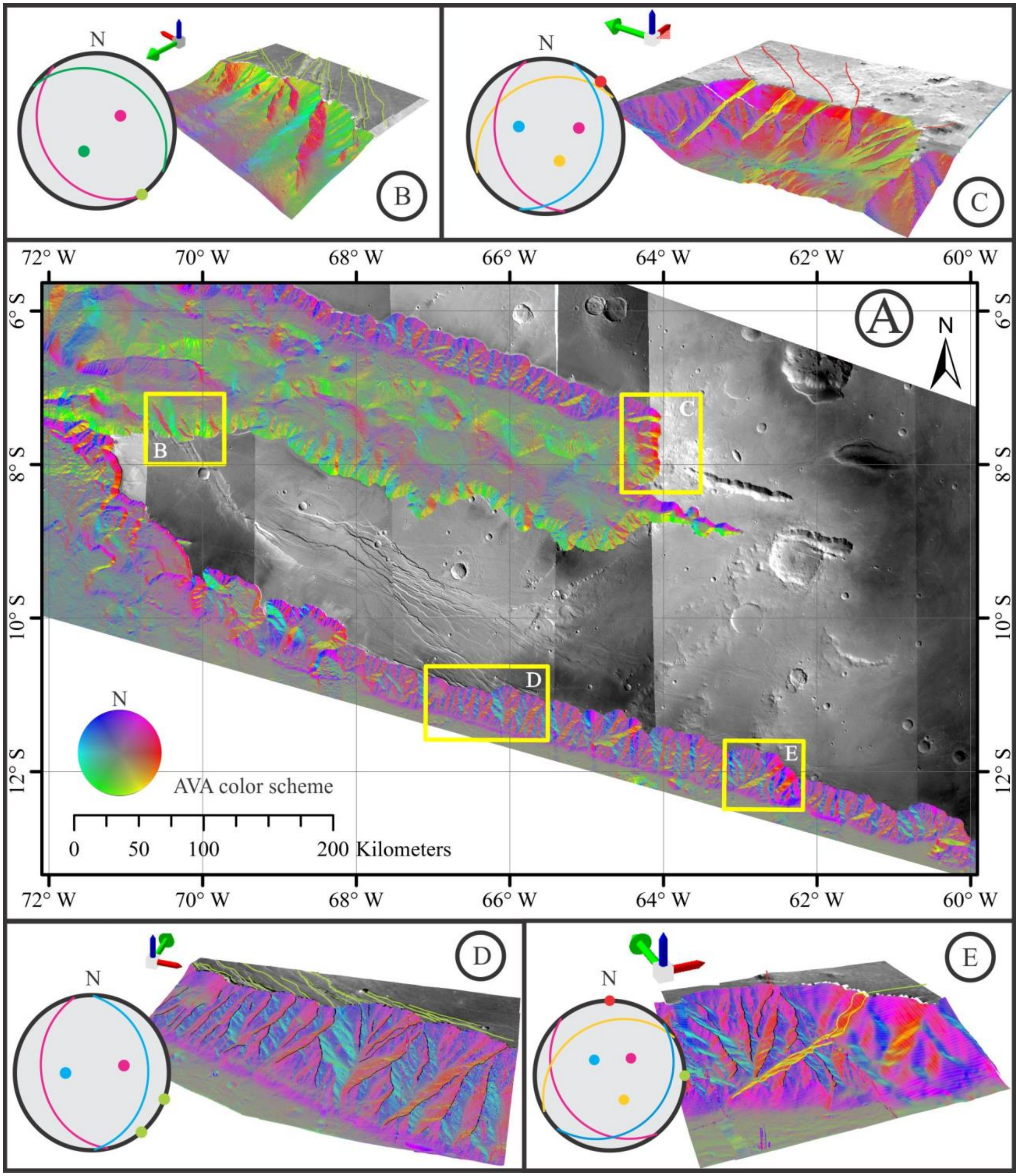

Figure 1: A) Study location using HRSC imagery for the plateau and primarily CTX data for walls and interior of chasms. Wall and interior depicted with AVA color scheme; B) Grabens cross at a high angle to the south wall of East Candor Chasma; C) Ridges crossing the east wall of East Candor Chasma, and anomalous planes (yellow) across the north wall of East Candor Chasma; D) Grabens crossing with a low intersection angle the north wall of Coprates Chasma; E) Ridge crossing nearly perpendicular, graben crossing with a low intersection angle, and an anomalous plane across the north wall of Coprates Chasma. Each section projects a 3D-DTM and measurements of the main features presented in stereonet with a color code corresponding to the feature.