STRUCTURAL ANALYSIS OF AN INTERIOR LAYERED DEPOSIT IN NORTHERN COPRATES CHASMA, MARS.

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Introduction: Interior Layered Deposits (ILD) occur widely throughout the canyon system of Valles Marineris, although their origin and mechanisms of formation remain uncertain. Proposed mechanisms for their formation include fluvial [1], aeolian [2], volcanism [3,4,5,6] or may even be ancient deposits exhumed from below the material forming the trough walls [7]. Diverse characteristics of layered deposits indicate several mechanisms are likely involved in their formation. Recently [8,9,10,11,12], measurements of the attitudes of layering within the deposits have indicated that layering primarily dips less than 20 degrees and in the direction of the topographical slope, suggestive of a draping morphology.

This study presents observations and measurements from a single ILD within northern Coprates Chasma, a small canyon, 100 kilometers long and 8 kilometers deep, located in the Valles Marineris (Fig. 1A). The ILD is approximately 12 kilometers long and 8 kilometers wide.

Methodology: An High Resolution Stereo Camera (HRSC) panchromatic orthoimage, obtained during orbit 2039, with a resolution of 12.5 meters per pixel and its corresponding DTM with a grid spacing of 13 meters is used to obtain attitude measurements of layered deposits using the software ORION. High Resolution Imaging Science Experiment (HiRISE) image PSP 001456195 is used to confirm the trace of the layering in the HRSC image where the two images overlap. The HiRISE image is further examined for evidence of structural deformation.

Measurements and Observations: The majority of the layering that can be measured is located within the lower stratigraphic section of the ILD and along the southern margin (Fig. 1B). Here the layering can be traced for distances from 800m to approximately 3km.

Layering along the eastern margin of the ILD dips consistently to the south with dip values ranging between 8 and 13 degrees. Along the western edge of the ILD layering dips consistently to the southwest with dip values between 17 and 22 degrees. The calculated trace of the western layers diverges from the observed layering along a distinct boundary. Because this boundary is outside the extent of the HiRISE image, it is not possible to determine if this divergence is the result of faulting or folding. Although layering is visible along the central portion of the ILD, measurements are difficult to obtain. Both HRSC and HiRISE images show disruption of layering along a zone that can be traced through the central portion of the ILD (Fig. 1D,E). A series of topographic ridges on either side of the long axis of the ILD and parallel to the zone of disrupted layers (Fig. 1B) do not coincide with measurable layering.

Also visible primarily in the eastern portion of the ILD are two nearly perpendicular fracture sets with SW-NE and NW-SE orientations. The SW-NE trending fracture set appears to be dominant with longer fractures. Where both fracture sets are visible (Fig. 1C) no offsets are observed. The fractures appear similar to those attributed to fluid alteration of finely layered deposits [13].

Discussion: The disrupted layering, topographic ridges and fracture sets, suggest that a significant fault trending SW-NE dissects the ILD along its long axis (Fig. 1B). If deposition of layers occurred by draping, the differences in layer attitudes on either side of the proposed fault may suggest that the fault had been active prior to deposition. The observed disruption of layering certainly indicates that some fault movement continued after deposition. However, the scale of the observed disruption and the fact that layering can be traced across the central axis of the ILD makes it unlikely that post-deposition faulting can account for the differences in layering attitude.

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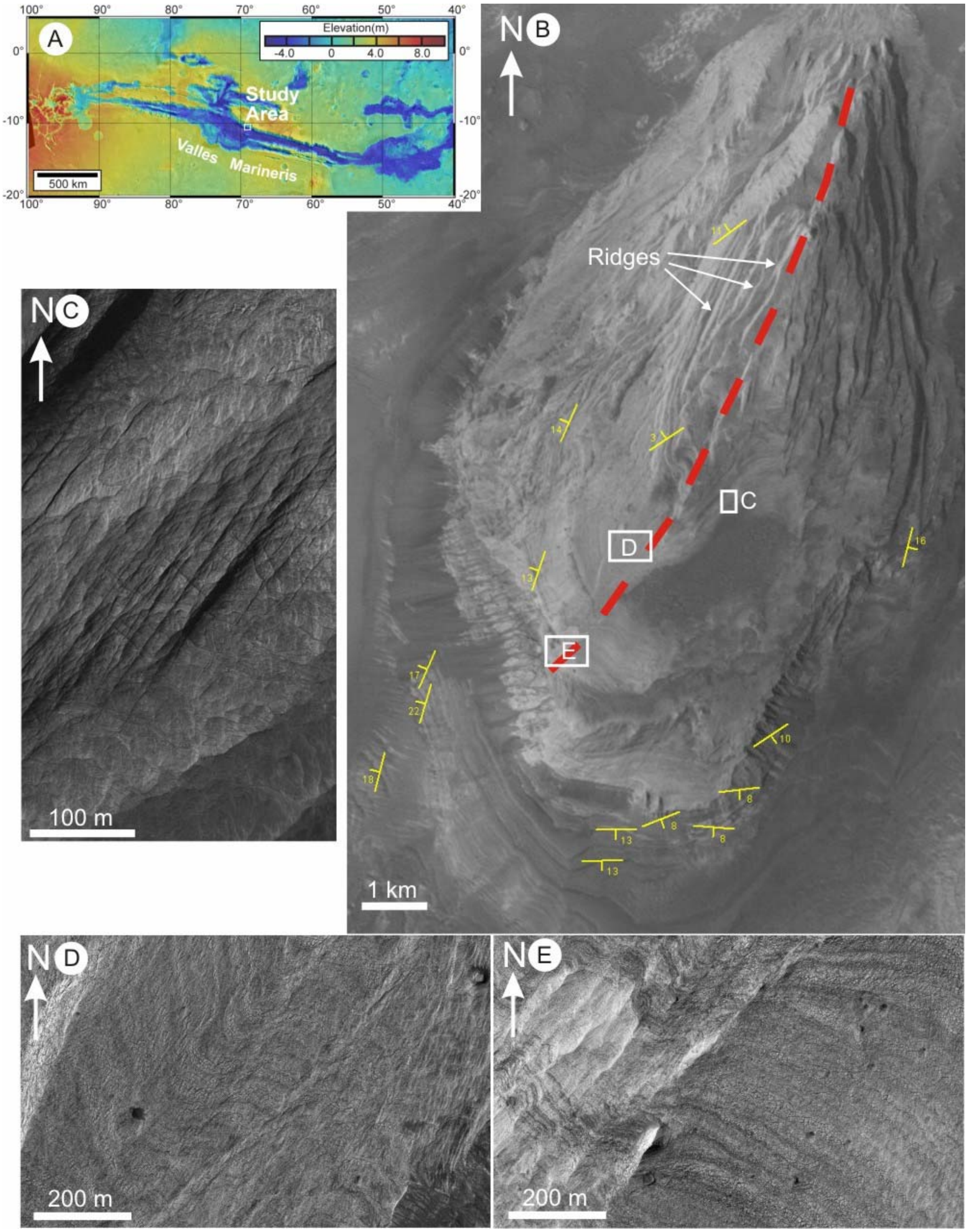

Figure 1: A. Location of ILD. B. HRSC image of ILD with layer attitudes as indicated. Boxes C, D, E indicate locations of Fig 1 C, D, E. Topographic ridges as indicated. Red dashed line shows the approximate location of a proposed fault. C. Fracture sets observed in HiRISE image PSP 001456195. D. Layer disruption observed in HiRISE image PSP 001456195. E. Layer disruption observed in HiRISE image PSP 001456195.