Stratigraphy and Attitude Measurements of Interior Layer Deposits in East Candor Chasma, Valles Marineris, Mars.

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Introduction: Interior Layered Deposits (ILDs) occur throughout Valles Marineris (VM). Their origin is still widely debated with several potential formation mechanisms proposed [refs in 1]. The presence of sulfates within the ILDs indicates that they formed in the presence of liquid water [2]. Examining layer attitude, structure and overall appearance will help interpret their formation and history. This study focuses on the central ILD mounds of East Candor Chasma.

East Candor Chasma: East Candor Chasma (Fig. 1A) is 475 km long, 145 km wide and ranges in elevation from -5.5 km to 3.5 km at the highest point within the ILD. Previous mapping suggests that the geological history of the chasm is complex [3]. East Candor Chasma contains four separate mounds of ILD which are examined here.

Methodology: A CTX image mosaic formed the basemap for this study. 27 CTX DEMs (~20 m/pixel) were calculated with the NASA Ames Stereo Pipeline [4,5]. Layer attitudes were measured using Orion software (Pangaea Scientific) and CTX DEMs. Measurements where verified with HiRISE DEMs where available. The ILD material in the mounds has been grouped into three distinct varities of bedding based on their appearance in CTX imagery: massive, layered and thin mesa. Massive deposits have no visible layering. Layered units has visible layering/benches. More competent layers are visible within the units and they generally fine upwards. Thin mesa is a low albedo, late cover unit that appears to be preserved as erosional remnants [6]. The mounds in East Candor have been labelled A, B, C, D from east to west.

Results: Massive units generally form the lowest part of the visible stratigraphy. They display distinctive erosional morphology characterized by parallel linear depressions. Multiple layered units were identified by the existence of angular unconformities. Attitude measurements of layered units primarily indicate dips towards the north. The uppermost layers appear to drape over pre-existing geology and have varying dip directions.

The easternmost mound, mound A, displays a high degree of complexity; showing a prominent angular unconformity with two opposing dips below the unconformity (Fig. 1 C). Layering in the southern half of the mound dips towards the southeast at a relatively steep angle of 18°-19°, while layering in the northern half of the HiRISE image dips towards the northeast 16-19˚. Layers above the unconformity are parallel to it, dipping ~11° to the northeast (Fig. 1 C). On the west side of the mound, the lower unit displays the erosional characteristics of being massive. The contact relationship between the western massive unit and the eastern layered unit is uncertain.

Mound B (Fig. 1 D&E) displays layer attitudes that primarily dip towards the north. The upper portion of the mound displays thin layering with dips of 4°-10˚ varying in direction, while ~1.5-2.0 km lower in elevation, thicker layering displays dips of 14°-19˚ northwest. An uncomformity separates the layering in this mound from the massive unit below it.

At mound C, several additional unconformities are observed between thinner layered units drape over thicker layered units, while a massive unit forms the base of the visible stratigraphy (Fig. 1 F).

Mound D displays a significant unconformity between the massive and layered units (Fig. 1 G). The layered unit dips 6˚ northeast sits unconformably above a massive unit. The upper portion of the layered unit appears to drape over the underlying massive unit (Fig. 1 G) as layering mimics the upper boundary of the massive unit.

Discussion: While dips vary throughout the mounds they can be separated into two main types, shallow and steeply dipping. Evidence presented above, such as differences in layered unit attitudes, thickness, draping lithologies and massive beds, suggest that East Candor Chasm has been subjected to a series of depositional and erosional events similar to those described by Kite et al. [9]. Other significant unconformities have been documented within ILDs, suggesting that ILD formation in VM is a multi-stage process [7].

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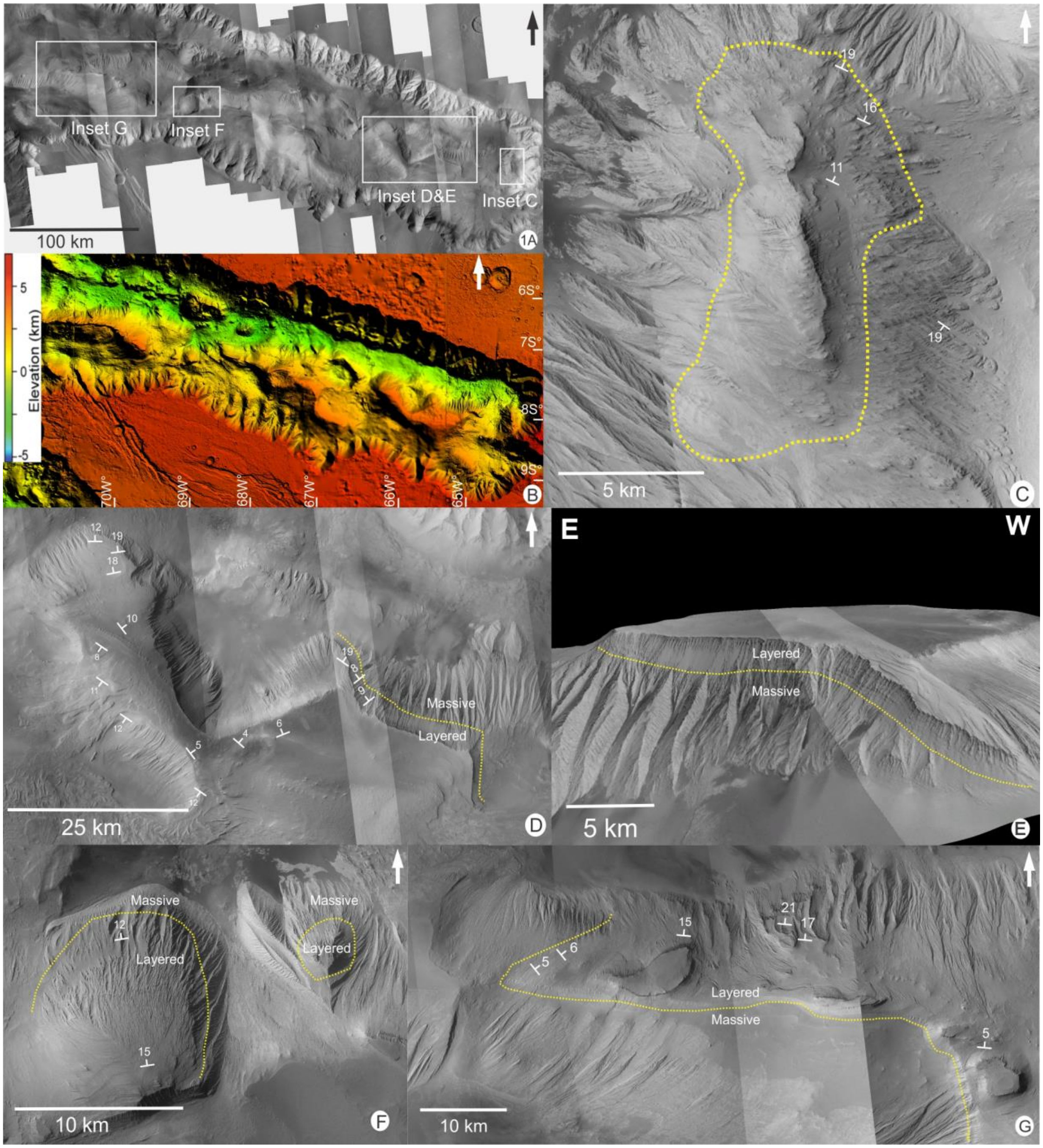

Figure 1A: Study area, East Candor Chasm, Valles Marineris, with insets. B: Elevation map with location coordinates. C: Mound A with angular unconformity outlined in yellow, attitude measurements in white. D: Mound B, with unconformity between layered and massive units outlined in yellow and CTX attitude measurements. Distinctive erosional style described as parallel linear depressions observed in the massive unit below unconformity. E: 3D view of figure D showing unconformity separating lower massive and upper layered units. Notice draping of upper layers in right side of image. F: Mound area C where two smaller mounds display an unconformity separating massive and layered units. G: Mound D with unconformity separating massive units. Layered units on the north side of the mound display draping over pre-existing massive unit. Attitudes steepen towards the northeast of the image.