GEOLOGICAL MAPPING OF INTERIOR LAYERED DEPOSITS WITHIN OPHIR, EAST CANDOR, AND WEST CANDOR CHASMATA, VALLES MARINERIS, MARS. Josh Labrie[1], Frank Fueten[1], Amanda Burden[1], Ariel van Patter[1], Jessica Flahaut[2], Robert Stesky[3], and Ernst Hauber[4], [1]Brock University, Earth Sciences, St. Catharines, Canada (jl17dx@brocku.ca), [2]CRPG, CNRS/UL, 54501 Vandoeuvre-lès -Nancy, France, [3]Pangaea Scientific, Brockville, Ontario, Canada K6V 5T5 [4]Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany

Background: Located in the Tharsis region of Mars, Valles Marineris is an approximately 4000 km long network of troughs known as chasmata. These chasmata reach depths >10 km through the Martian crust and provide an unparalleled look at the planet's crustal geology [1,2].

Situated on the northern edge of central Valles Marineris are three interconnected troughs believed to be ancestral basins [3]. Ophir, West Candor, and East Candor chasmata are linked depressions with a variety of shared morphologic features [4], as well as similar stratigraphic units and unit relationships, implying that they may share a common geological history [3].

These three chasmata host large, enigmatic sedimentary deposits called Interior Layered Deposits (ILD). ILD are widespread and geologically significant, but their origin and formational history remains uncertain, with lacustrine, eolian, and volcanic (subaerial and subglacial) processes proposed as potential formation mechanisms. It has also been hypothesized that ILD could correspond to spring deposits, or be composed of collapsed chasma wall material [5,6]. The signatures of hydrated sulfates in spectral imagery of these chasmata provide evidence for the presence of water in Valles Marineris prior to 3.5Ga ago, perhaps in the form of ancient lakes [6,7]. While many studies have concluded that ILD are early basin fill, it is still unclear whether they were deposited pre-, syn-, or post-tectonically [7,8]. The evolution of Valles Marineris and of its ILD are inextricably linked, meaning that a greater understanding of ILD can play a role in unravelling the geological history of Valles Marineris.

We present geological maps of ILD in Ophir, West Candor, and East Candor chasmata according to qualitative characteristics observed in orbital optical imagery. These maps are used in conjunction with elevation data to analyze the spatial and stratigraphic relationships between different units. These findings are presented alongside a proposed ILD stratigraphy for Ophir, West Candor, and East Candor, and are used to make several inferences about the shared geological history of the three chasmata. Based upon their stratigraphic similarities, we suggest that these chasmata likely share a common geologic history, and may have been structurally linked at the time the basal stratigraphic unit was deposited.

Methodology: Imagery from the Mars Reconnaissance Orbiter's Context Camera (CTX) [9] was used to create the base map for this study, as it is the highest quality imagery (up to ~5 m/pixel) to cover the entirety of the area of study. Where available, High Resolution Imaging Science Experiment (HiRISE) [10] imagery of up to ~0.5 m/pixel was used for a more detailed examination of the surface. Using ArcMap, this imagery was analyzed and polygons were manually drawn to delineate 6 different geological units that can be recognized in all 3 chasmata.

Thin Mesa [11]

A somewhat competent, late cover of ash and dust. Generally appears relatively featureless and is often darker than other units.

Thin Layering [11]

Packages of visible layering on a <10 m scale. Often appear to be smoothly eroded, suggesting there is little contrast in competency among individual layers.

Thick Layering [11]

Packages of visible layering on a larger, approximately decameter scale. Often exhibits a "stepped" appearance with erosional benches, suggesting a greater degree of contrast in layer competency than Thin Layering.

Deformed Layering

Packages of layered material that have been heavily deformed by possible slumping and local tectonism. Most layers appear to be irregular and/or discontinuous in nature. Most likely equivalent to the folded and faulted Layered Sedimentary Deposits described in [12].

Massive [11]

Large units of competent material that do not exhibit layering at the scale of CTX imagery. Generally have a higher albedo than other units, and often have a distinctive "fluted" or "herringbone" erosional pattern.

HiRISE-only Layering [3]

A subset of the Massive unit that exhibits layering when examined at the scale of HiRISE imagery. Massive units only exhibit layering in some HiRISE images.

These geological maps of the 3 chasmata were exported as georeferenced polygons and draped over a 50-150 m/pixel High Resolution Stereo Camera (HRSC) [13] DEM in Global Mapper. The maximum and minimum elevation was measured along each unit contact as a proxy for the elevation of each unit's stratigraphic contact. These data were used to analyze the spatial and stratigraphic relationships between different unit types.

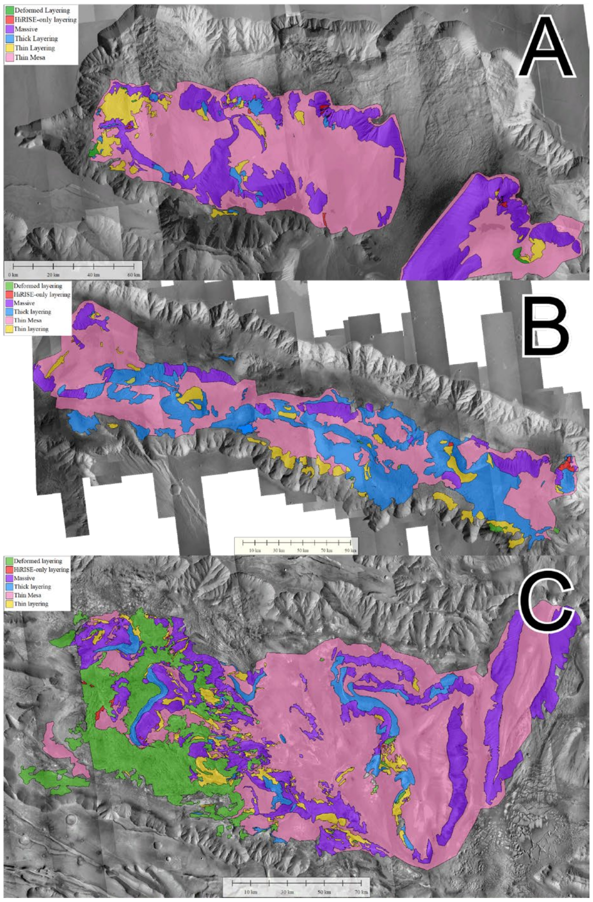

Figure 1: Geological maps of ***(A)*** *Ophir,* ***(B)*** *East Candor, and* ***(C)*** *West Candor chasmata.*

Results and Discussion: All 5 stratigraphic units were identified in each chasma (Fig. 1). The Massive unit comprises the stratigraphic bottom of each chasma, with its maximum elevation similar across all three chasmata (Fig. 2). These similarites suggest that all three chasmata were linked at the time of the Massive unit's deposition. West Candor has an anomalous Massive unit at a high elevation near the top of Ceti Mensa, which will require further study. Thick and Thin Layered units can be observed to drape unconformably over massive units, suggesting the deposition of these units was separated by an indeterminate period of time. The maximum elevation of the Massive unit nearly reaches the top of each chasma (Fig. 2), suggesting that if the Massive unit was deposited continuously in the three ancestral basins, the Layered units are a relatively thin veneer atop the Massive unit. Based upon the similarities in each chasma's stratigraphic sequence, we conclude that their ILD likely deposited synchronously.

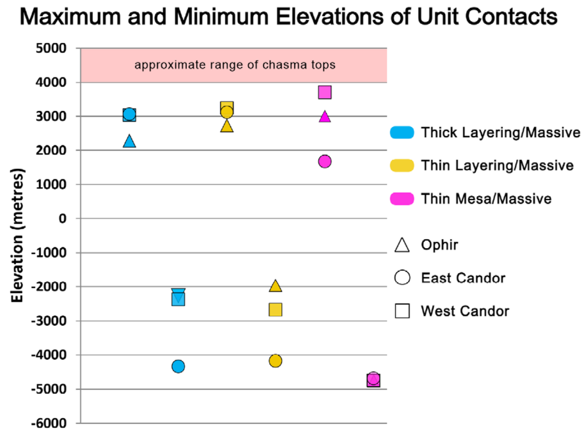

Figure 2: Plot showing maximum and minimum elevations of unit contacts in Ophir, East Candor, and West Candor chasmata.

A general stratigraphy for these chasmata, from bottom to top, is as follows: Massive, Thick Layering, Thin Layering, Thin Mesa (Fig. 3)

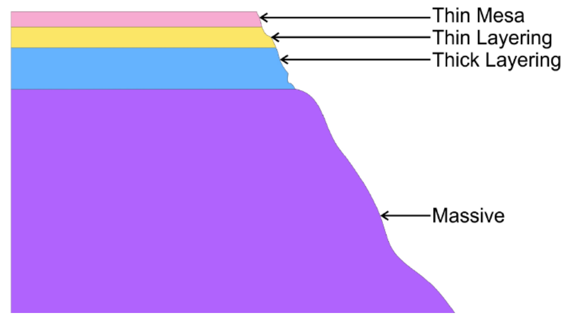

Figure 3: Generalized stratigraphy for Ophir, East Candor, and West Candor chasmata based on elevation measurements of unit contacts.

Future work will continue to study these chasmata in greater detail, such as the analysis of hyperspectral imagery (e.g. CRISM and CaSSIS) to find characteristic spectral signatures for each unit type.

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