EVIDENCE FOR SHORELINE-CONTROLLED CHANGES IN BASELEVEL FROM FLUVIAL DEPOSITS AT AEOLIS DORSA, MARS. B. T. Cardenas1 and D. Mohrig1, 1Jackson School of Geosciences, University of Texas, Austin, TX, 78758. Email: benjamin.cardenas@utexas.edu

Introduction: Sinuous ridges at Aeolis Dorsa have been interpreted by several researchers as inverted sedimentary deposits filling paleochannels [1]. Using imagery and stereo pair DEMs from HiRISE and CTX, we have mapped a downstream reach of the inverted paleochannels known as Aeolis Serpens, which meander asymmetry [2] preserved in the ancient channel deposits records a southeasterly paleo-flow direction. In the study area, several generations of stacked paleochannels are confined within the fills of ancient incised valleys. The stratigraphy is well enough exposed that changes in channel planform and valley configuration can be identified. The study area has two discrete and cross-cutting valley fills, and a similar stratigraphic succession of fluvial deposits is seen within each valley. Taken together, the valley and channel stratigraphy are interpreted to preserve a record of variations in baselevel that includes at least two episodes of fall and rise of greater than fifteen meters.

Mapping: In the study area, Aeolis Serpens branches into three corridors which we have interpreted as incised valleys, each with its own set of stacked paleochannels (Fig. 1). Textural differences in the visible imagery and thermal inertia differences in TIR imagery between the valley fills and the surrounding terrain were used to map the valley walls. The paleochannels within each valley were mapped with an emphasis on identifying continuous individual channels.

High resolution DEMs helped to confirm the stacking pattern of paleochannels. Cross cutting relationships were used to establish the relative timing of valley formation and filling.

Stratigraphy: An abundance of scroll-bar deposits in the lowermost paleochannels of each valley records evidence for considerable meandering of the oldest channels (Fig. 2). At several locations the valley walls are defined by the extent of the scroll bars, indicating erosion at the outer banks of channel bends was linked to valley cutting. Preserved scroll bars are absent from the subsequent generations of paleochannels, which instead take on a sinuous ridge morphology (Fig. 2). The sinuosity of these inverted paleochannels is primarily inherited, due to the reoccupation of the underfilled channels left by the previously meandering system. The tendency of younger channels to reoccupy the positions of older channels decreases with each generation of channel, indicating that over time enough sediment accumulated within a valley to remove any topographic expression of the older channel forms. As a result, the youngest paleochannels are least sinuous.

Figure 1 - Study area with incised valleys mapped in red, green, and purple. Features mapped in each valley are topographically inverted paleochannel deposits.

Figure 2 - HiRISE image of a sinuous paleochannel deposit positioned above older scroll-bar deposits.
exist beyond the boundaries created by the earliest, erosional meandering channels, supporting the hypothesis that these channels remained confined to a valley incised by either its basal meandering channel or older, unpreserved channels.

Estimates for thickness of valley deposits was measured as the difference between the minimum and maximum elevations within the valley at cross-sections with exposures of the basal meandering channel. The thickest deposit measured twenty meters, with more common values in the range of ten to fifteen meters.

**Relative Timing:** Cross-cutting relationships have been used to identify the relative timing of valley incision and subsequent filling by channelized flows. In Figure 1, the channels confined by the red valley are cut out by the green valley, suggesting that upstream deposits of the red valley have been reworked by activity in the younger green valley. The green and purple valleys are interpreted as coeval branches of the same larger valley; the blue channel mapped in the purple valley is continuous upstream into the green valley. Red channel deposits define the latest stage of sedimentation within the valley complex. These observations can be explained by the following sequence of events:

1. Incision of the red valley, which once extended upstream into the position of the green valley.
2. Fluvial deposition within the red valley.
3. Coeval incision of the green and purple valleys and erosion of the upstream portion of the red valley deposits.
4. Channelized deposition in the green and purple valleys, ending with deposition in the green valley only.

**Fluvial Response to Baselevel Changes:** Changes in elevation of the water surface for a large standing body of water are used to explain similar successions of fluvial deposits on Earth [3]. Valley incision is due to a relative baselevel drop tied to a low water-surface elevation. These intervals are represented by deposits of net-erosional meandering channels and valley formation at Aeolis Dorsa. Rising baselevel and water-surface elevation drive fluvial sedimentation within the valleys. These intervals are connected with sedimentation by sinuous, but not meandering rivers fully contained within the incised valleys. The red and green+purple valleys implies two complete episodes of baselevel fall and rise.

At locations where the positive relief of the valley wall is still preserved, a minimum value for baselevel drop can be estimated as the change in elevation from the top of the valley wall to the surface of the basal meandering deposits. We have measured this to be roughly ten to fifteen meters.

**Figure 3 – Location map and topographic profile showing valley-fill deposits reaching the same height as the valley walls.**

Thicknesses of the valley-filling deposits approximate values for subsequent baselevel rise. In several locations, the upper deposit surface is as high as the valley wall, indicating a baselevel rise of ten to fifteen meters and a complete filling of the valley (Fig. 3).

**Implications:** Aeolis Dorsa sits on the crustal dichotomy and is at least presently, open to the northern lowlands where ancient oceans have been hypothesized to have existed [4]. The observations presented here and by others [5] suggest that Aeolis Dorsa channels were deposited near the shoreline of an ancient body of water, although the aerial extent of this body of water remains unknown. This study provides evidence that these channelized systems underwent multiple episodes of cutting and aggradation driven by base-level changes; changes that were most likely the product of change in the water-surface elevation of an ancient lake or sea.

**References:**