Introduction: This abstract summarizes current results and planned activities from an ongoing initiative to construct a series of high-resolution structural and geologic maps in the east Candor Chasma region of Valles Marineris, Mars.

The goal of this work is to advance current understanding of the coupled structural evolution of eastern Candor Chasma and the sedimentary deposits within it through a campaign of geologic unit and structural mapping at spatial resolutions that are at least an order of magnitude finer than has been achieved by previous studies in this part of Valles Marineris. This will be accomplished by characterizing the structure of the sedimentary deposits using digital elevation models (DEMs) derived from publicly released, stereo image pairs acquired by the High Resolution Imaging Science Experiment (HiRISE) camera.

Work is progressing in two map areas and adjacent to Nia Mensa (Fig. 1). Mapping is most mature in the northern Nia Mensa map area, and an initial structural reconnaissance has been completed in southeastern Nia Mensa.

Current results from the north Nia Mensa map: Mapping in this area initially focused on two HiRISE stereo pairs (ESP_014154_1730/ESP_014431_1730 and ESP_031916_1730/ESP_031982_1730), which were used to create one merged digital elevation model and to orthorectify the associated HiRISE images. This initial map area encompasses the contact between the massive sedimentary rocks that comprise most of Nia Mensa and the stratified sedimentary and mass-wasting deposits exposed between Nia Mensa and the northern wall of eastern Candor Chasma (Figs. 1 & 2). The area also contains a terraced fan-shaped landform that appears to superpose and post-date the sediments that constitute, Nia Mensa.

Early results in this map area [1] were intriguing. Three geologic units were interpreted to have been affected by soft sediment deformation in the form of subsurface sediment mobilization (contorted bedding and injectites). Additionally, a trough network in the northern part of the map area was interpreted to be the vent area for erupted mobilized sediments (mud flows). Further, the structure of the fan-shaped landform indicated a constructional origin for the fan shape rather than alternate erosional origins; that is, this landform is a depositional fan instead of being a remnant of an originally more extensive deposit that was pervasively eroded after deposition.

An important scientific obstacle encountered during mapping was that evidence supporting key interpretations of the area’s geologic history is not contained within the initial map area. Most notably, this includes evidence in support of the idea that the trough network in the northern part of the map area formed due to subsurface sediment mobilization, as well as facies that could be used to distinguish between a subaerial and submarine origin for the depositional fan in the southwest part of the map area. Fortunately, additional regions of the trough network and depositional fan are covered by existing HiRISE stereo images, and these data were used to expand the initial map area.

Using two HiRISE stereo pairs (ESP_044773_1735/ESP_045406_1735 and ESP_034685_1730/ESP_034751_1730), two separate DTMs were constructed following the methodology of [2] and added to the mapping project (Fig. 2). Subsequently, mapping was undertaken and completed within the new DTM over the trough network, and mapping is
about to begin within the DTM of the depositional fan.

Mapping within the region of the trough network yields results that further support and help refine findings made in the initial map area. Interpreted mud flows are found to be extensive, forming smooth top surfaces of the mesas between the troughs (brown-colored unit in Fig. 2). This mud flow unit is thickest along the trough (at the edges of the mesas) and tapers away from the trough, terminating in lobate contacts with underlying units. The lobate termini of the mud flows extend into topographic lows within the topography of the underlying units. Further, the topography of underlying units can be traced ‘under’ the mud flows and in some areas, topographic highs comprising the underlying unit is exposed as kipuka surrounded by the mud flow unit. These findings strongly support the interpreted mud flow origin for this unit.

Mapping around the trough network has also revealed an additional unit affected by soft sediment deformation. This new unit has a striated, or ridged, texture. The ridges are generally subparallel, and are either linear, curved or (rarely) sinuous. In some outcrops, these ridges converge, forming v-shaped patterns in map view. The striated unit underlies a unit affected by contorted bedding, and the contact between the two is broadly-undulating at the 100-m scale. Based on these observations, this striated unit is interpreted as tightly-folded stratified material in which the folding occurred contemporaneous with other soft-sediment deformation features in the map area.

In summary, soft-sediment deformation is found to have been an important process within this region of eastern Candor Chasma. The occurrence of soft-sediment deformation indicates that the local sediments were poorly indurated and water saturated at the time of deformation. However, a trigger for this deformation has not yet been identified. Work will now concentrate on mapping the depositional fan and then focus on reconstructing the geologic history of the map area.

Current results from the southeast Nia Mensa map: An initial structural reconnaissance has been completed for both DTMs in this map area. This effort involved measuring layer orientations using Layer Tools [4] and tracing unconformities. Work will now focus on identifying the regional structural trends and delineating preliminary geologic units.


Figure 2. Thumbnail view of the northern Nia Mensa map area. Footprints of newly-incorporated DTMs are shown in red. Individual DTMs are ~6 km in width. Description of map units given in the column to the right; provisional unit names in bold, description in plain text, and interpretation in italics.