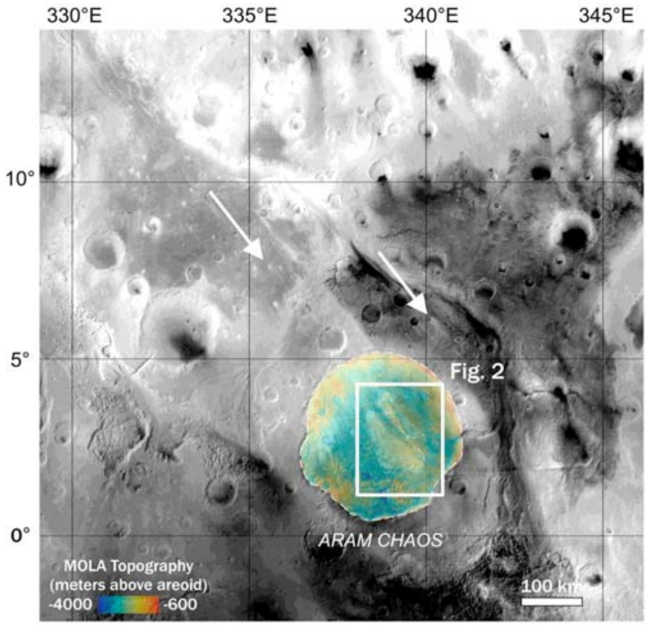

Figure 1. MOC-based mosaic of northern Xanthe Terra (231.55 m/pixel). White arrows indicate small craters with wind streaks trending to the southeast, showing the dominant wind direction in this area. The sedimentary unit within Aram Chaos is located in the white box; this is also the area shown in Figure 2. Other chaos regions can be seen to the west and south of Aram Chaos.

Express High Resolution Stereo Camera (HRSC) topographic data at 75 m/pixel [*Neukum et al.*, 2004] and (2) retrieval of mineral compositions for the stratigraphic units using CRISM hyperspectral targeted mode observations at ~20 and 40 m/pixel [*Murchie et al.*, 2007]. For reference, Figure 1 presents a regional-scale view of Aram Chaos, Figure 2a shows results from mapping mineralogy from OMEGA and TES data, and Figure 2b shows detailed mapping that we have done using the high-resolution CRISM observations. Figure 3 summarizes the key stratigraphic and mineralogic relationships developed in this paper, including the first identification on Mars of the ferric hydroxysulfate-$Fe(OH)SO_4$-located at and near the contact between the sedimentary deposits and the underlying chaos bedrock surface.

2. Geologic Setting

[4] Aram Chaos (~3°N, 339°E), contained within a 280 km wide crater of Noachian age, is one of a number of chaotic regions located in Xanthe Terra. Chaos terrain is characterized by a series of plateaus and mesas separated by valleys that form a mosaic pattern (Figure 1) [*Rodriguez et al.*, 2005]. The likely chaos formation mechanism involved catastrophic outflow of pressurized groundwater, either through melting of subsurface ice or liquefaction [*Carr*, 1979; *Nummedal and Prior*, 1981; *Rodriguez et al.*, 2005]. The outflow of water that created the sunken chaos blocks also carved the channel on the east side of the crater and then joined other material flowing north in Ares Vallis [*Nummedal and Prior*, 1981]. After the initial chaos-forming event(s), subsequent aqueous activity in the area changed from erosion to deposition, producing the layered sedimentary materials that unconformably overlie the chaos bedrock materials [*Glotch and Christensen*, 2005; *Oosthoek et al.*, 2007]. At some point postdeposition the area experienced an uplift, creating a domical structure within Aram Crater [*Glotch and Christensen*, 2005; *Oosthoek et al.*, 2007; *Massé et al.*, 2008b]. The layered deposits have experienced significant differential wind erosion, revealing stratigraphic layers of differing morphology, thermal inertia, and mineral composition (including gray crystalline hematite, nanophase ferric oxides (npOx), and hydrated sulfates materials) [*Gendrin et al.*, 2005; *Glotch and Christensen*, 2005; *Glotch and Rogers*, 2007; *Massé et al.*, 2008b; *Noe Dobrea et al.*, 2008]. The erosion was driven by winds trending from the northwest which formed elongated plateaus of partially eroded sedimentary materials running NW-SE (Figures 1 and 2) [*Oosthoek et al.*, 2007]. As noted by *Fenton and Richardson* [2001], wind directions have been to first-order invariant as Mars has moved through its orbital oscillations. Thus, these northwesterly winds have been active for a large fraction of geologic time.

3. Methodology

3.1. Orbital Data Sets

[5] We use an integrated data processing and geographic information system (GIS) approach using both ENVI and ArcMap commercial software packages. MOLA and HRSC topographic data, CTX images, and HiRISE images over the study area were map projected to an equidistant cylindrical (equirectangular) projection using a Mars radius of 3396.0 km (scales for each data set were commensurate with their intrinsic spatial resolution). The data sets were then incorporated into an ArcMap pyramid-structured database, which allowed covisualization of the all data sets with user-selected transparency values. CRISM data (observation footprints, false-color images, and mineral detections) were added to the GIS system, and the combination of the spectral processing capability of ENVI and the map capabilities of ArcMap was used to map superposition and embayment relationships, morphologic characteristics, and mineral

Figure 2. The extent of the layered sedimentary deposits in Aram Chaos is illustrated in these CTX-based mosaics. (a) Locations of OMEGA and morphologically identified extents of monohydrated and polyhydrated sulfates. CRISM targeted observations are indicated with white outlines; locations of Figures 6a, 6b, and 10 are indicated with yellow boxes. (b) Same area as Figure 2a but with CRISM-based mineral detections. Key is as follows: 1.9 and 2.4 μm absorptions indicative of polyhydrated sulfates (red), 1.9 μm absorption indicating enhanced hydration but without a corresponding 2.4 μm absorption indicating hydrated sulfate (light red), 2.1 and 2.4 μm absorptions indicative of monohydrated sulfates (blue), 2.23 μm absorption indicative of ferric hydroxysulfates (green). The cross section in Figure 3 is indicated by the white line (A to A′).