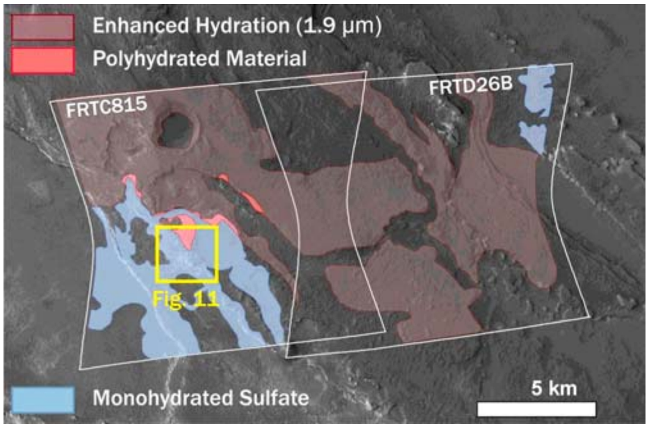

Figure 10. Detections of monohydrated sulfate, polyhydrated material, and enhanced hydration in CRISM observations FRTC815 and FRTD26B showing the transition from the monohydrated state at the base to a polyhydrated state in the upper section. The location of Figure 11 is indicated by a yellow box.

Massé et al. [2008b] suggest that their continued existence can be explained by very slow transformation kinetics. The strongest ferric oxide and enhanced hydration detections occur on the slightly raised plateau in the northeast part of the deposit (Figures 2a and 2b), although hematite is detected in lower concentrations at slightly lower elevations due to erosion and transport onto lower-lying regions [*Glotch and Christensen*, 2005].

[22] In contrast to previous work, the analysis of high-resolution MRO data shows that this unit is unconformably superimposed on the monohydrated sulfate-bearing sedimentary section described in section 4.1. We see no evidence for polyhydrated signatures in these older deposits and we see no morphologic evidence that the polyhydrated deposits are beneath or included in the older deposits. For example, CRISM observations that cover parts of the older cliff-forming deposits (FRTC14E, FRTBE2D, and FRT7FA4) do not show spectral indications of polyhydrated sulfates in the wall exposures (Figure 9). In addition, examination of the cliff walls in CTX and HiRISE images show no indications of a low-albedo layer which might indicate the presence of polyhydrated/hematite/iron oxide material (Figure 11). Thus, even though this material is topographically below the cliff-forming unit (monohydrated sulfates and nanophase ferric oxides), we conclude the monohydrated sulfate-bearing unit was already emplaced and differentially eroded by the time the polyhydrated deposits formed. This inference is also consistent with mapping the spatial distribution of these materials using OMEGA data, morphology, and albedo [*Gendrin et al.*, 2005; *Noe Dobrea et al.*, 2008]. We infer that the polyhydrated deposits formed in local topographic lows after formation and differential erosion of the older, monohydrated sulfate-bearing sedimentary unit.

5. Summary and Implications

[23] Our work shows that the sedimentary deposits in Aram Chaos first formed with intercalated ferric hydroxysulfate ($Fe(OH)SO_4$) and monohydrated sulfates (likely, szomolnokite) at the base of the section, followed by monohydrated sulfates, followed by a mix of monohydrated sulfates and nanophase ferric oxides. The data show that these deposits were then differentially eroded by wind, after which polyhydrated materials (e.g., polyhydrated sulfates) with hematite and other ferric oxides were deposited in low-lying areas during a second depositional event. Work by *Wang and Freemen* [2009] shows that relative humidity is a critical factor in determining hydration/dehydration states of forming Mg sulfates. In conjunction with their work, our work indicates a possible change in environmental humidity between depositional events in Aram Chaos, beginning with the formation of ferric hydroxysulfate and monohydrated sulfate under relatively dry conditions and ending with the formation of polyhydrated materials under relatively wet conditions.

[24] We favor a formation mechanism involving groundwater recharge/evaporation and multiple wetting events to explain the stratigraphic section observed in the sedimentary deposits in Aram Chaos. Regional-scale groundwater distribution modeling by *Andrews-Hanna et al.* [2007] predicts Aram Chaos to have one of the thickest evaporite deposits in the region. A regional-scale groundwater system would link the deposits in Aram Chaos to those in Meridiani Planum to

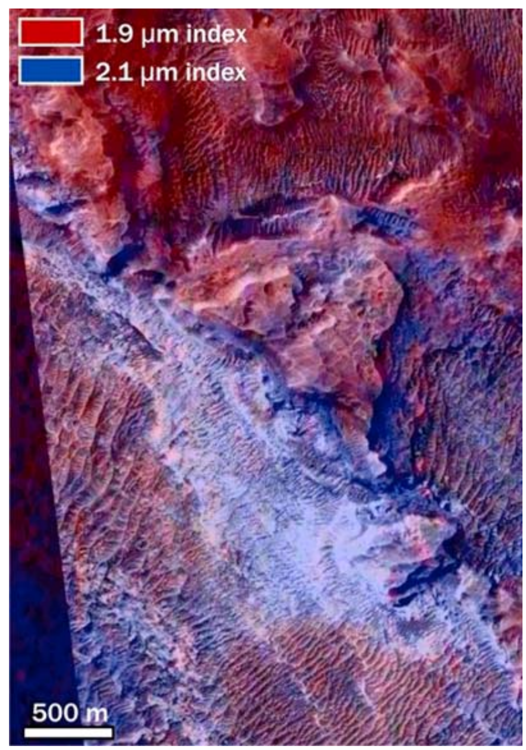

Figure 11. Subset of HiRISE image PSP_010025_1835 (center is at 3.39°N, 339.42°E). The monohydrated sulfate-bearing material is in layers at the base of the polyhydrated/hematite/ferric oxide unit. Aeolian ripples lying on top of the monohydrated material show an absorption at 1.9 μm, suggesting that it is material that has been eroded off the polyhydrated/hematite/ferric oxide unit. The ripples visible at the bottom of the image are trending SW-NE and are indicative of winds blowing predominantly from the northwest.