MRO OBSERVATIONS OF FLUVIAL FEATURES, SULFATES, AND OTHER LANDFORMS IN THE MELAS CHASMA BASIN.
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Introduction: We have used new data acquired from the Mars Reconnaissance Orbiter (MRO), including HiRISE, CTX, and CRISM, to analyze fluvial features, sulfates, and other landforms in the Melas Chasma basin (Fig. 1). The Melas basin, located along the wallrock in southwestern Melas Chasma, contains layered beds in a postulated paleolake [1,2]. In the western portion of the basin are extensive Hesperian-aged valley networks. Alluvial fans, folded beds, sulfate deposits, and depositional fans [3] are also found within the basin. Together, these features define a complete erosional-to-depositional fluvial system [3].

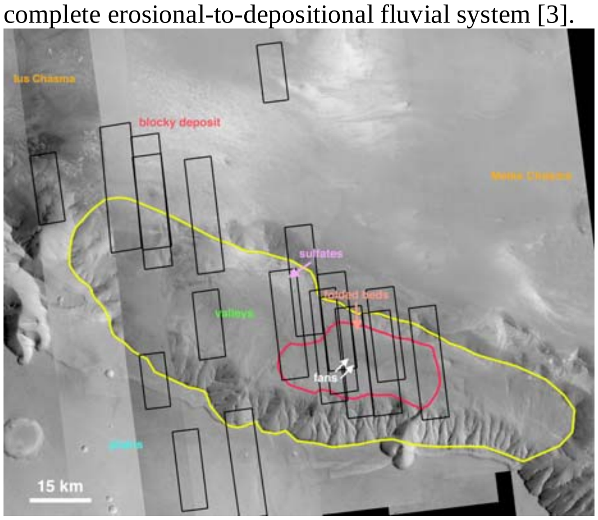

Figure 1. CTX mosaic of the Melas basin (yellow line) and features analyzed in this study. The location of the postulated paleolake is shown by the red outline. Locations of HiRISE images are shown by black rectangles.

Just to the south of the Melas basin along the floor of the chasma is an unusual blocky deposit composed of light-toned layered deposits (LLDs) [4]. Outside Melas chasma to the south along the plains are additional fluvial landforms and LLDs that appear to be coeval to water activity within the Melas basin [5]. Consequently, analyses of this region can address the geologic history of Valles Marineris, particularly features that have a possible lacustrine origin, and the possibility that this region could have been a habitable location in the geologic past.

Observations: The Melas basin contains a record of fluvial incision along the wallrock from precipitation during the Hesperian that resulted in extensive valley networks [1,2]. An erosional depression in the basin located downstream of the valleys reveals a depositional fan (Fig. 2). [3] has interpreted these fans to be sublacustrine in origin with a morphology similar to those seen in the Mississippi submarine fan complex. Just upstream of the submarine fans are steeply inclined beds bounded by geometric discontinuities that have been interpreted as clinoforms, fan delta deposits, and a channel-levee system similar to terrestrial deposits [6]. These fluvial features indicate that water carved the valleys and then transported sediments downhill to the east where both subaerial and sublacustrine deposition occurred.

In the northern portion of the basin are folded light-toned beds (Fig. 2). We interpret the folded beds to be material that mass wasted down a steep breach along the wallrock in a similar manner that has been proposed for the origin of the blocky deposit seen along the Melas floor [4]. Strata composed of fine beds that were deposited within a postulated paleolake dominate the eastern portion of the basin. Neither the color HiRISE images nor CRISM spectra reveal any compositional differences between the layers, but this could be due to dust and eolian material mantling the beds. Brightness variations in the HiRISE images could result from different materials being deposited from distinct episodes of fluvial discharge, such as darker beds representing material derived from dark-toned units upstream and lighter beds composed of evaporates or light-toned sediments eroded upslope. The valleys do not incise the wallrock but instead erode units deposited on the wallrock.

Sulfates: OMEGA found sulfates in the vicinity of the valley networks of the Melas basin [7]. We have explored these sulfates in more detail using CRISM data. CRISM I/F data were atmospherically-corrected as in [8], cleaned for column-dependent effects [9], and finally the entire scene was ratioed to a 10 pix x 10 pix homogeneous, spectrally bland region to remove systematic artifacts. Analysis of the CRISM observations over the sulfate unit reveals a strong spatial diversity in mineralogy. Spectra presenting absorptions consistent with oxidized Fe-sulfates (*e.g.*, rozenite), jarosite, monohydrated sulfates (*e.g.*, kieserite), and polyhydrated sulfates (*e.g.*, epsomite) were identified throughout the scene in spatially coherent units spanning many 10's of pixels. In nearly all cases, the spectra present absorptions consistent with assemblages of sulfate-minerals, suggesting that these minerals are mixed at the sub-pixel level. The formation of the sulfates identified in this scene requires relatively low humidity and in some cases low-pH conditions.

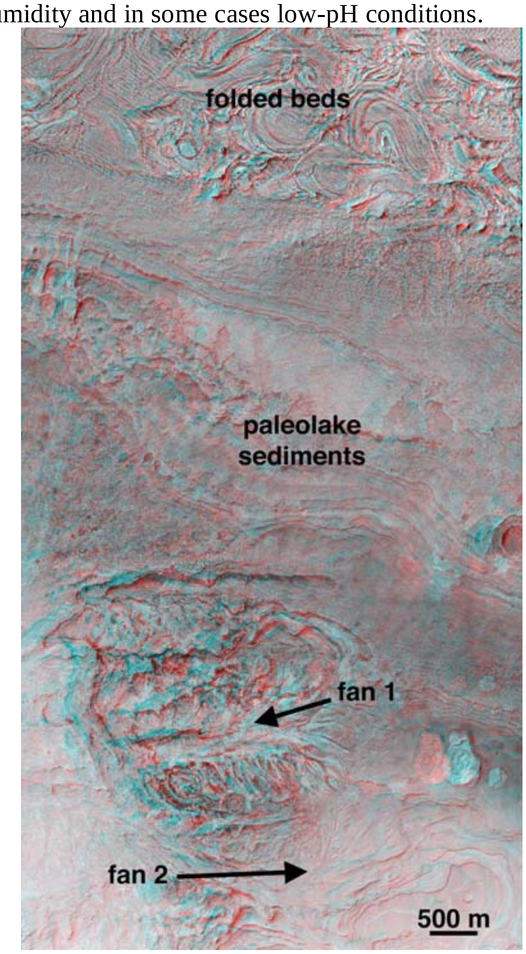

Figure 2. HiRISE stereo anaglyph.

The sulfates correspond to a light-toned unit upslope along the northern wallrock that defines the basin, although the unit could have been more extensive but subsequent erosion has removed it elsewhere. The sulfate unit appears higher in albedo and smoother in meter-scale roughness than adjacent non-sulfate units (Fig. 3a). The unit appears to be ~10 m thick with limited, if any, layering seen in the HiRISE images. Its surface appearance is similar to that of the blocky deposit (Fig. 3b), which could have formed by mass wasting of the sulfate unit under subaqueous conditions [4]. HiRISE stereo pairs reveal that the sulfate unit drapes over the topography and fills in preexisting valleys, indicating it is a younger deposit relative to the fluvial landforms. Sulfates require the presence of liquid water to form so their identification indicates that water reached upslope of the paleolake. In order to explain the sulfates at high elevations above the paleolake, either a larger lake once existed in the Melas basin, or the sulfates formed during precipitation and ground water flow.

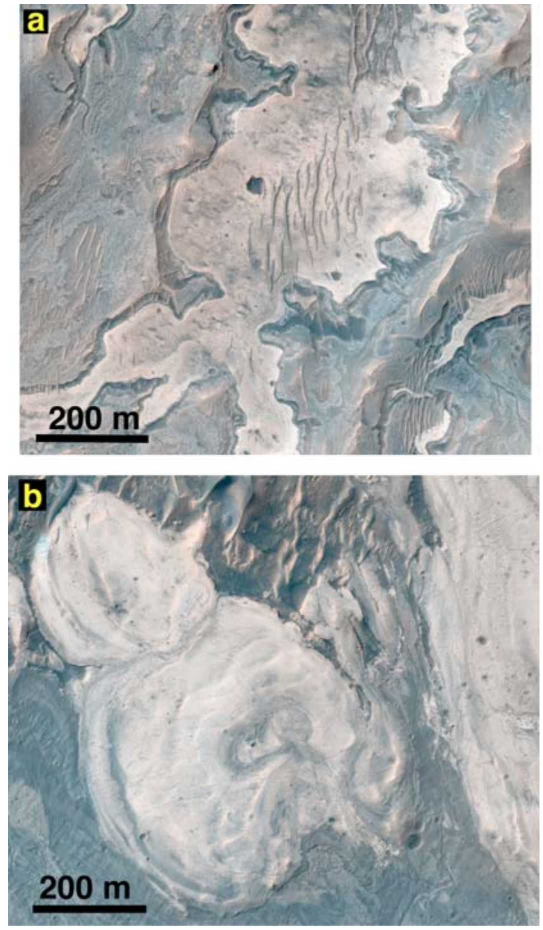

Figure 3. (a) HiRISE blowup showing false-color of the sulfate unit that drapes over topography along the northern edge of the Melas basin. (b) False-color HiRISE image of the blocky deposit along the Melas floor.

References: [1] Mangold et al. (2004) *Science*, *305*, 78-81. [2] Quantin et al. (2005) *JGR*, *110*, E12S19. [3] Metz et al. (2009) *AAPG abstract*. [4] Weitz et al. (2003) *JGR*, *108*, E12, 8082. [5] Weitz et al. (2008) *Icarus*, accepted. [6] Dromart et al. (2007) *Geology*, *35*, 363-366. [7] Gendrin et al., (2005) *Science*, *307*, 1587-1591. [8] Mustard et al. (2008) Nature, 454, 305-309. [9] Parente et al. (2008) *LPSC XXXIX*, Abstract 2528.