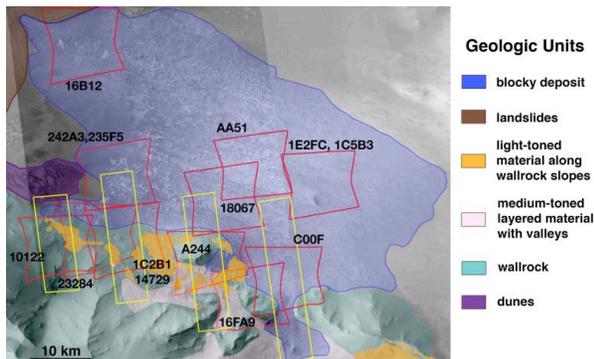


**GYPSUM, JAROSITE, AND OTHER MINERALS ASSOCIATED WITH A BLOCKY DEPOSIT IN WESTERN MELAS CHASMA.** C. M. Weitz<sup>1</sup>, E. Noe Dobrea<sup>1</sup>, and J. J. Wray<sup>2</sup>, <sup>1</sup>Planetary Science Institute, 1700 E Fort Lowell, Suite 106, Tucson, AZ 85719 ([weitz@psi.edu](mailto:weitz@psi.edu)); <sup>2</sup>School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, Georgia.

**Introduction:** We are producing a geologic map of the Melas basin region (8.4-10.3°S, 281.5-284.5°E), which encompasses a blocky deposit along the western Melas Chasma floor (Fig. 1). Previous studies of the blocky deposit have interpreted it as detached slabs sourced from the southern wallrock that defines the Melas basin [1,2]. Using CRISM data, we have identified several minerals associated with this blocky deposit. Complementary HiRISE and CTX images allowed us to infer physical properties about the materials within the deposit. HiRISE Digital Terrain Models (DTMs) were also produced in select locations to establish stratigraphic relationships, especially where distinct minerals were identified.



**Figure 1.** Geologic map of the Melas blocky deposit and region. Red outlines and labels indicate CRISM images analyzed in this study, while yellow rectangles are locations of HiRISE DTMs produced for this study.

**Observations:** The blocky deposit generally consists of brighter rounded blocks that are contained within a darker matrix (Fig. 2). Light-toned, irregular shaped blocks have spectral features at 2.21, 2.27  $\mu\text{m}$ , and sometimes at 2.62, consistent with jarosite (Fig. 3). The presence of an absorption at 1.92  $\mu\text{m}$  indicates that another hydrated mineral may be present or the jarosite formed at low temperatures [3]. In HiRISE images, these bright blocks appear heavily fractured with no observable loose rocks in HiRISE images.

The morphology of the medium-toned blocks is similar, albeit with lower reflectances. CRISM spectra for most of the medium-toned blocks show either no features or a very weak 1.92  $\mu\text{m}$  absorption. Some of these medium-toned blocks exhibit additional features at 2.4  $\mu\text{m}$  or a weak absorption at 2.28  $\mu\text{m}$ , while others exhibit a doublet absorption at  $\sim 2.21$  and  $\sim 2.27$

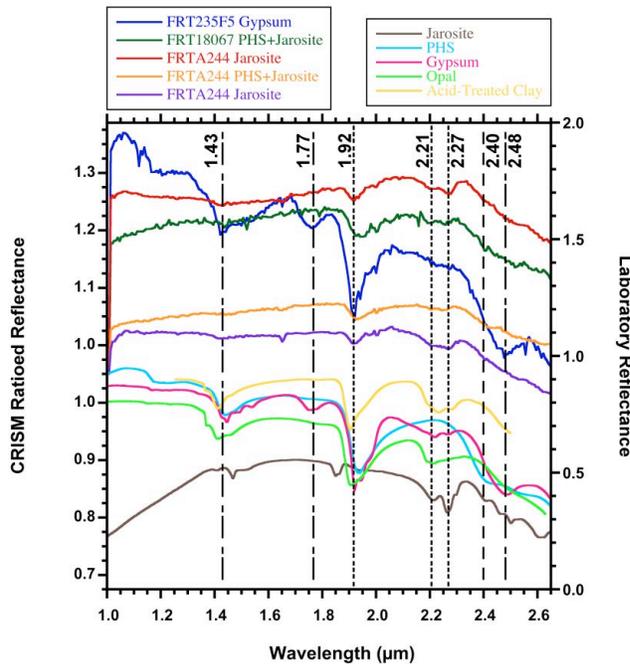
$\mu\text{m}$ . We interpret these medium-toned blocks to represent mixtures of polyhydrated sulfates (PHS) and jarosite, although an acid-leached clay produced in the laboratory also exhibits the doublet absorption between 2.21-2.27  $\mu\text{m}$  (Fig. 3) seen elsewhere in Valles Marineris [4-6] and Mawrth Vallis [7]. These blocks generally have rounded edges and oval shapes.



**Figure 2.** Portion of HiRISE enhanced color image showing the blocky deposit along the Melas Chasma floor. Brighter irregular blocks of jarosite-bearing (J) material are interspersed with darker oval-shaped blocks consisting of mixtures of PHS and jarosite (PHS). High-standing, very bright, and fractured outcrops (green arrows) contain gypsum.

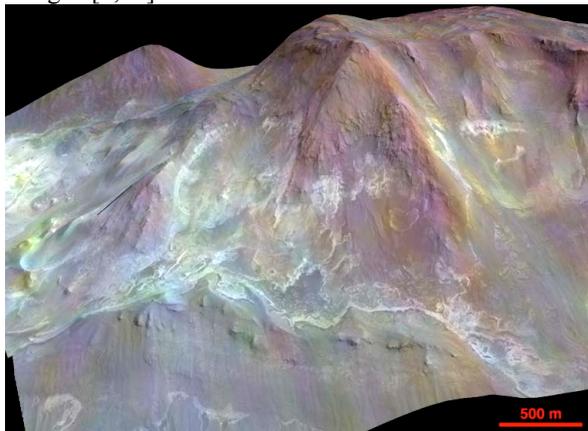
To the south along the slopes that define the Melas basin (Fig. 4), there are additional mixtures of jarosite and PHS, along with possible hydrated silica (opal) in spectra with an overall rounded 2.2  $\mu\text{m}$  absorption with no features at 2.21 or 2.27. The underlying medium-toned rocks are blocky and layered, but exhibit no spectral features. They have been dissected by Hesperian-aged valleys [8] and are draped by both the jarosite- and the PHS-bearing rocks. The contact between the jarosite-bearing and PHS-bearing rocks can be either sharp or subtle, with the PHS-bearing rocks sometimes seen embaying jarosite-bearing rocks.

Near the center of the blocky deposit, very bright and irregular mounds have features at 1.43, 1.77, 1.92, 2.23, and 2.28  $\mu\text{m}$ , suggesting the presence of a Ca-sulfate such as gypsum (Fig. 3). Based upon superposition relationships from stereo HiRISE images, the gypsum mounds appear to represent older floor materials rather than blocks within the blocky deposit (Fig. 2). Fracturing of the gypsum-bearing materials has produced meter-size blocks seen adjacent to outcrops.



**Figure 3.** Plot showing CRISM spectra compared to laboratory spectra of selected minerals. Generally, spectra that exhibit stronger 2.21 and 2.27  $\mu\text{m}$  features characteristic of jarosite also have shorter wavelength 1.9  $\mu\text{m}$  absorptions relative to rocks that have a greater proportion of PHS. The acid treated clay spectrum, which was taken from a laboratory sample of acid-leached Fe-smectite [5], has been proposed for doublet absorptions between 2.20–2.28  $\mu\text{m}$  seen in CRISM spectra taken elsewhere in Valles Marineris and Mawrth Vallis [3,4,6] but does not seem to fit as well as jarosite in the Melas spectra. Gypsum appears to be a good match to our CRISM spectrum, although bassanite is another possibility.

**Interpretations:** The presence of jarosite indicates an acidic and oxidizing environment. At Meridiani Planum where jarosite has been identified *in situ* from rover measurements [9,10], the jarosite is interpreted to have formed in acid-saline shallow waters. Jarosite and bassanite have been detected at Mawrth Vallis [7,11,12] while both gypsum and jarosite have been identified from CRISM data in Noctis Labyrinthus troughs [5,13].



**Figure 4.** CRISM spectral parameters in color (R=Olivine Index, G=BD1900R, B=Doublet 2200) merged with HiRISE DTM image showing light-toned material (jarosite-PHS-hydrated silica mixture) draped along wallrock slopes. CRISM spectra that best match jarosite correspond to the brightest materials in the HiRISE image. Vertical exaggeration is 3x, view is looking southward.

Origins of the jarosite-PHS-hydrated silica mixtures on the wallrock slopes include: (1) in association with precipitation that created the valleys [8]; (2) alteration of younger volcanic ash; (3) ice or snow along the wallrock slopes that trapped dust and volcanic aerosols [14]; and (4) the rocks originally formed on the Melas floor and were subsequently uplifted during enlargement of Melas Chasma. The jarosite formed initially, followed by magnesium-rich polyhydrated sulfates after all the iron had been used up to make jarosite. Gravity or an earthquake or other triggering event [2] subsequently caused much of the sulfate mixtures to slide down the Melas basin slopes and flow onto the Melas floor. The Ca-sulfate identified near the center of the blocky deposit may have been deposited during an earlier episode of water infiltration into Melas Chasma.

**References:** [1] Weitz C.M. et al. (2003) *JGR* 108, 8082. [2] Metz J. et al. (2010) *JGR* 115, E11004. [3] Wray J.J. et al. (2011) *JGR* 116, E01001. [4] Roach L. et al. (2010) *Icarus* 206, 253-268. [5] Weitz C.M. et al. (2011) *Geology* 39(10) 899-902. [6] Madejova J. et al. (2009) *Vib. Spectroscopy* 49, 211-218. [7] Noe Dobrea E. et al. (2011) *Mars* 6, 32-46. [8] Quantin C. et al. (2005) *JGR* 110, E12S19. [9] Squyres S.W. et al. (2004) *Science* 306, 1709-1714. [10] Klingelhofer G. et al. (2004) *Science* 306, 1740-1745. [11] Farrand W.H. et al. (2009) *Icarus* 204, 478-488. [12] Wray J.J. et al. (2010) *Icarus* 209, 416-421. [13] Weitz C.M. et al. (2013) *in preparation*. [14] Michalski J.R. and P.B. Niles (2012) *Geology* 40, 419-422.