RELATIVE TIMING OF PHYLLOSILICATE AND HYDRATED SULFATE DEPOSITION IN EASTERN SINUS MERIDIANI. S. M. Wiseman[1] and R. A. Beyer[2], [1]Department of Geological Sciences, Brown University, Providence, RI,[2]Carl Sagan Center at the SETI Institute, NASA Ames Research Center, Moffet Field, CA, USA.

Introduction: The Sinus Meridiani region of Mars is located near the southwestern margin of Arabia Terra and is centered at 5°S, 0°E. Heavily cratered Noachian-aged terrain that has an ancient regional slope to the northwest [1] is exposed at the base of the stratigraphic section in Sinus Meridiani. The Noachian cratered terrain is unconformably overlain by light-toned indurated sedimentary rock referred to as etched terrain (Figure 1) [2,3]. Low albedo, sulfate- and hematite-bearing plains overlie the etched unit and dominate the surface of Meridiani Planum (Figure 1) [2-4].

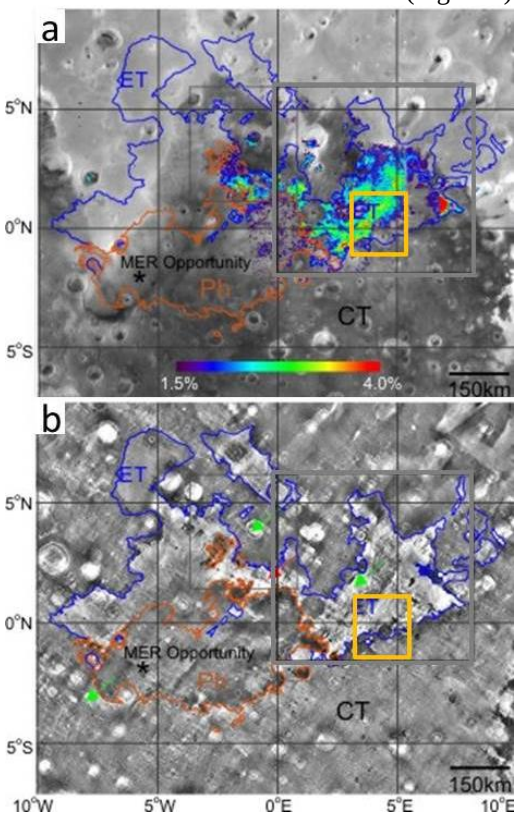


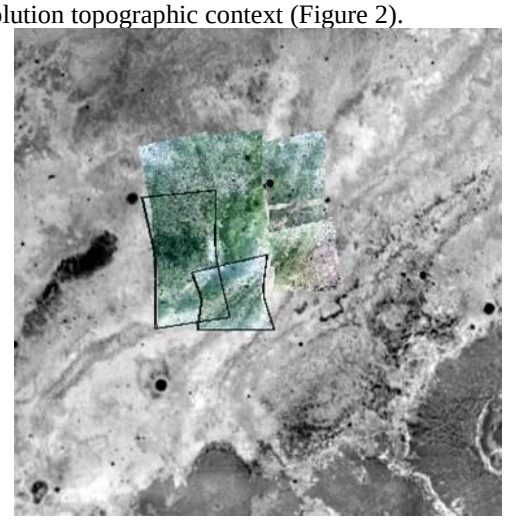
Figure 1. Units map (4ºS to 8ºN, 10ºW to 10ºE) on (a) MOC with colorized OMEGA hydration index and (b) THEMIS NIR.

Etched terrain is outlined in blue and the hematite bearing plains in orange. The sulfate- and hematite-bearing unit, which occurs near the top of the stratigraphic section, has a crater retention age of late Noachian/early Hesperian based on crater counts [5]. In situ investigations made of this unit by the MER Opportunity rover (landing site indicated in Figure 1) revealed that the bedrock in the vicinity of the landing site is ~20 wt% SO_3, contains jarosite at the ~10 wt% level [6,7], and contains hematitic concretions.

Etched terrain is composed of relatively high thermal inertia indurated material [2,3,8-11] that is at least 300 m thick in some areas. This unit is laterally extensive across Sinus Meridiani and is characterized by intermediate albedos and relatively high thermal inertias [3,12]. Etched terrain exposures are typically sub horizontal and dip between ~0.05° to 1.0° in the direction of regional slope, to the northwest [12]. Layering at multiple scales [9] and the presence of erosional mesas and grooves indicates variable material properties among layers [3].

The central and eastern portions of etched terrain are well exposed and have higher thermal inertias [e.g., 12]. Hydrous materials were detected in OMEGA spectral reflectance observations of higher thermal inertia areas within the etched terrain [14]. Some areas within etched terrain exhibit distinctive hydrated sulfate (red arrow) and Fe/Mg phyllosilicate (green arrows) spectral signatures [14-18]. Higher resolution CRISM analyses reveal small deposits of phyllosilicates and hydrated sulfates throughout the eastern etched terrain. *The goal of this study is to determine the relative timing of the deposition of Fe/Mg phyllosilicates and hydrated sulfate in eastern etched terrain.*

Initial Results: Initial analyses focus on hydrated sulfate and phyllosilicates exposed in the southeast etched terrain (yellow box, Figure 1). This area was chosen because well exposed layers (Figure 2) allow for mineralogic observations to be put into a stratigraphic context. Several high resolution CRISM [19] images (18 to 36 m/pixel) cover these layers. CTX DTMs (6 m/pixel) that were generated from stereo pairs using the Ames Stereo Pipeline [20] provide high resolution topographic context (Figure 2).



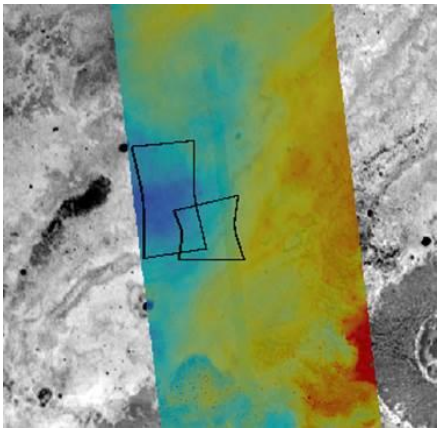


Figure 2. CRISM (upper) and CTX (lower) on THEMIS NIR for yellow box shown in Figure 1. CRISM FRT0000550C and HRL00005B20 overlain.

Layers exposed in Figure 2 exhibit various amounts of hydration (blue in Figure 3) with Fe/Mg smectites occurring in greenish layers (Figure 3, magenta). Polyhydrated sulfates are shown in cyan in Figure 3.

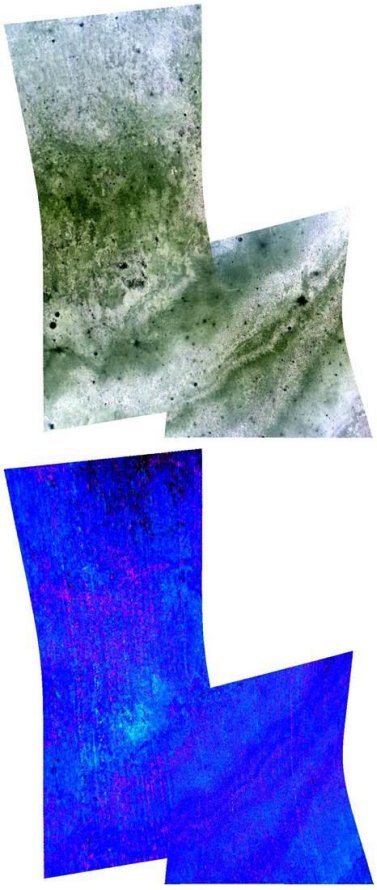


Figure 3. CRISM FRT0000550C and HRL00005B20. (upper) false color composite. (lower) Parameter composite, R=D2300, G=D2400, B=D1900 [17].

The stratigraphic context of the hydrated sulfates and Fe/Mg smectites is shown in Figure 4. The phyllosilicate-bearing layers are exposed on slopes whereas the hydrated sulfates occur in a topographic low.

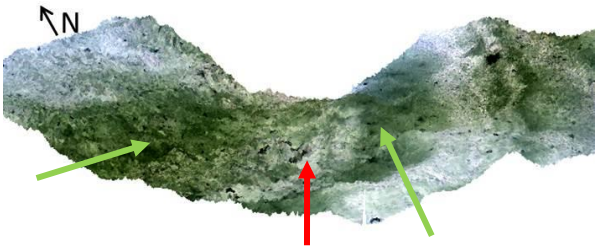


Figure 4. CRISM FRT0000550C and HRL00005B20 color composite draped on CTX DTM P06_003326_1795_XI_00S356W.IMG - P07_003748_1801_XI_00N356W.IMG (vertical exaggeration 20x). Green arrows indicate Fe/Mg smectites and red arrow indicates polyhydrated sulfates.

Discussion: Fe/Mg smectites exposed in the southeast etched terrain correlate with a specific horizon within the outcrop (Figure 4) whereas the hydrated sulfates occur in a topographic low. The hydrated sulfates may represent a lower, older unit or a younger unit that was deposited after erosion of the etched terrain. Based on analyses of other hydrated sulfate exposures in the area, which commonly occur in topographic lows and at different stratigraphic levels, it is likely that the hydrated sulfates are younger.

The phyllosilicate unit may have been laterally continuous prior to its erosion because the same phyllosilicate-bearing unit appears to be exposed on both the north and south slopes surrounding the depression (Figure 4). Further work will focus on mapping the Fe/Mg smectite exposures to determine if the south eastern exposures are in the same stratigraphic horizon as the larger phyllosilicate exposure to the north (Figure 1, green arrow).

References: [1] R. Phillips et al. (2001), Science, [2] B. Hynek et al. (2002), JGR [3] R. Arvidson et al. (2003), JGR [4] P. Christensen et al. (2001) JGR [5] R. Arvidson et al (2006), JGR [6] G. Klingelhöfer et al. (2004), Science [7] R. Morris et al. (2006), JGR [8] M. Mellon et al. [2001] JGR, [9] M. Malin and K. Edgett (2000), Science [10] K. Edgett and M. Malin, (2002), GRL [11] M. Putzig and M. Mellon (2007), Icarus [12] B. Hynek (2004), Nature [13] B. Hynek and R. Phillips (2008), EPSL [14] F. Poulet et al. (2008), JGR [15] A. Gendrin et al. (2005), Science [16] J. Griffes et al. (2007), JGR [17] S. Wiseman et al. (2010), JGR [18] J. Wray et al., (2009), GRL [19] S. Murchie et al. (2007), JGR [20] Z. Moratto et al. (2010), LPSC.