Surface composition of Terra Meridiani and Western Arabia Terra from OMEGA. F. Poulet[1], R. Arvidson[2], C. Gomez[1], J.-P. Bibring[1], R.V. Morris[3], Y. Langevin[1], and B. Gondet[1], [1]Institut d'Astrophysique spatiale, CNRS/Université Paris-Sud, Orsay, France (francois.poulet@ias.u-psud.fr), [2]Washington University, St. Louis, MO 63130, [3]1ARES, NASA Johnson Space Center, Houston, TX 77058.

Introduction: We use OMEGA hyperspectral data to provide mineralogical inferences for the surface of Terra Meridiani and Arabia Terra. The study area straddles the Martian Prime Meridian from 10°W to 10°E longitude, 5°S to 15°N latitude (Fig. 1). Its boundaries were defined to include the classical low-albedo Sinus Meridiani and the southern part of Arabia Terra, where large exposures of layered sediments exhibiting the physical characteristics of rock occur in numerous locations [1]. Although numerous ground and orbital data sets over the study area have been analyzed, several key questions relevant to better constraining the origin of these sedimentary rocks in Sinus Meridiani and Arabia Terra and to placing the rocks at the Opportunity site into regional context were not yet described in detail.

Terra Meridiani: Mineral distributions mapped from OMEGA data correlate well with the geology and even better with the thermophysical properties.

Unit DCT: The dominant minerals identified in the unit Dissected Cratered Terrains are low-calcium and high-calcium pyroxenes, and typical spectra are well reproduced by a mixture of pyroxenes and feldspar. The best picture of the surface is thus soil of basaltic composition with sand-sized particles (in the 10s to 100s µm). We interpret the nature of this soil as a result of the erosion resulting from meteoritic impacts and eolian erosion of these Noachian Terrains.

Unit MCT: The unit Mantled Cratered terrains is a mantle of dust whose spectral signatures are dominated by nanophase ferric oxides. Such a composition is consistent with other parts of Arabia Terra [2], supporting the interpretation that the unit MCT has the same origin that the overall Arabia Terra deposits.

Unit E: The exposures of the etched terrains with high thermal inertia only are composed of hydrated minerals (Fig. 1). We confirm the presence of Mg-sulfates in the west-northern part [3, 4]. Small occurrences of phyllosilicate-rich terrains are detected in the etched terrains, although no geomorphologic characteristics distinct of the surrounding terrains have been identified. Poorly crystalline ferric components identified by a strong Fe^{3+} band in the 0.7-1.35 µm cover the entire unit E. Both ferric hydroxides (ferrihydrite, lepidocrocite) and some ferric sulfates (amarantite, schwertmannite) are good candidates to explain the unique spectral properties (Fig. 2). Surprisingly, no jarosite-rich deposit was detected. The use of CRISM data will be able to address the question of whether these deposits are too small to be identified by OMEGA [5].

Unit Ph: This unit lacks of strong mineral signatures. However, careful analysis and comparison with other spectral units indicate the presence of olivine and a small amount of pyroxene in some areas. Moreover, one of the flattest slopes in the VNIR wavelength range seen on Mars strongly suggests the presence of coarse grains of oxide (likely spectrally featureless gray hematite as reported by [6] and confirmed by Opportunity).

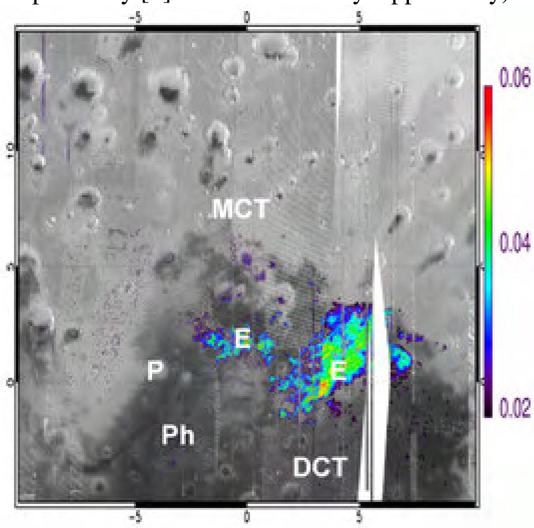

Fig.1: Map of the 1.9 µm band depth (from 2% to 6%) indicator of the presence of water-bearing minerals over most of the unit E of Terra Meridiani.

Western Arabia Terra:

Dark streaks: Numerous dark streaks in the MCT unit are enriched in pyroxene and show a lower oxidation state that the surrounding bright terrains similar to those of the unit MCT. The low albedo deposits (dunes in most cases [7]) inside the craters from which the dark streaks emanate are enriched in pyroxene. This similar composition indicates that the dark dunes directly supply sediment to create the streaks that are dark material on top of bright material. Moreover, the decrease of the band depth from the interiors to the dark streaks can be interpreted as a grain size effect, with the streaks consisting of grain finer than those that comprise the dunes.

Hydrated deposits: Of special interest is the detection of hydrated terrains located inside craters of this region (Fig. 3). They are located in the area from 1° to 6°N latitude, 1°W and 10°E. The spectral characteristics are the same than those found over most of the etched terrains: a 1.9 µm band associated to a significant red slope between 1 and 1.35 µm. In general, the hydrated deposits are spatially well separated of the pyroxene-rich regions (Fig. 3). Both the morphology and the thermophysical properties are in favor of a close relationship with the hydrated etched terrains. MOC images when available reveal that the hydrated deposits are strongly eroded, exposed, light-toned and etched similar to the unit ET and/or layered mounds. The rocky character is also confirmed by THEMIS observations, which reveal a remarkable spatial correlation between the hydrated deposits and the largest values of the nighttime temperature as it was found for the etched terrains (Fig. 4).

Implications for formation: The mineralogy deduced from the analysis of the MER-B experiment indicates that the rover studied a specific zone where the acidic conditions have been preserved, best explained by a "dirty" evaporite [8]. Based on the OMEGA observations, there are several indications (the lack of observable Mg-Ca-bearing sulfates and jarosite deposits, the lack of siliclastic residual plains over most of the unit E and the presence of the Fe-bearing minerals under the form of ferric sulfate complexes associated to hydroxides over most of the etched terrains) that the solutions from which most of the etched terrains were formed had a larger pH. We propose that the oxidative weathering of iron sulfide-bearing rocks through successive rises of groundwater table occurred [9] is the leading candidate process for formation of the outcrops.

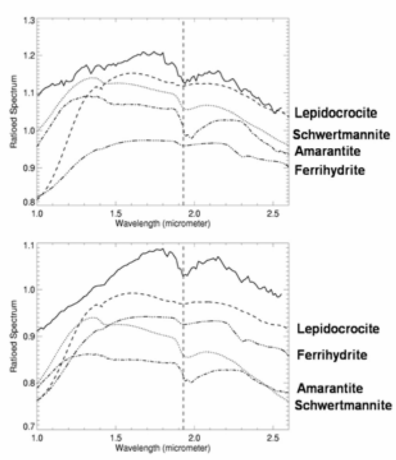

Fig. 2: Examples of OMEGA spectra extracted from the unit E and compared to different laboratory spectra of hydroxides and ferric sulfates. The spectra (solid lines) are ratioed to a reference taken in the same OMEGA cube. The lack of the spectral features except for a 1.9 µm band is typical of the spectra of the unit E.

References: [1] Arvidson R. E. et al. (2003) *JGR, 108,* 8073/2002JE0011982. [2] Poulet F. et al. *Submitted to JGR*. [3] Gendrin A. et al. (2005) *Science, 307*, 1587-1591. [4] Griffes J. et al., *JGR,* in press. [5] Wiseman et al. *this conf.* [6] Christensen P.R. et al. (2001) *JGR, 106*, 23873-23886. [7] Edgett K.S. (2002) *JGR, 107,* 10.1029/2001JE001587. [8] Tosca et al. (2005) *EPSL, 240,* 122-148. [9] Arvidson et al. (2006) *JGR, 111,* 10.1029/2006JE002728.

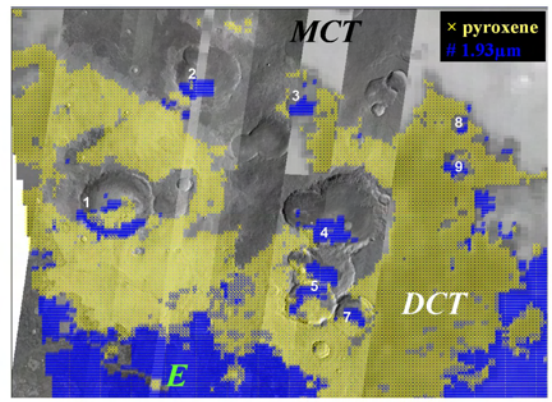

Fig 3: OMEGA distribution of the pyroxene and hydrated minerals showing the identification of hydrated deposits in craters. Base map is a mosaic of THEMIS images.

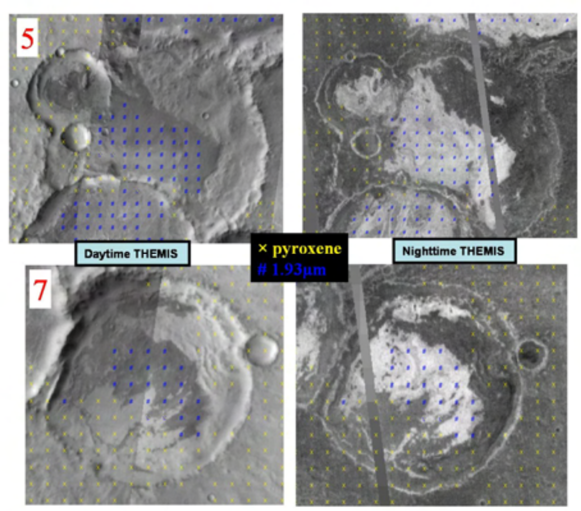

Fig. 4: Close-up of the distributions of the pyroxene and the hydrated minerals for two craters numeroted 5 and 7 (see Fig. 3). Base maps are daytime THEMIS (left) and nighttime THEMIS mosaics. MOC images reveal that these terrains are strongly eroded, layered and light-toned mounds.