GEOLOGY OF EAST CANDOR CHASMA, MARS INFERRED FROM ANALYSIS OF OMEGA AND HRSC DATA. L. Le Deit[1], S. Le Mouélic[1], J.-Ph. Combe[1], E. Hauber[2], A. Gendrin[3], C. Sotin[1], D. Mège[1], O. Bourgeois[1], J.-P. Bibring[3], and the OMEGA Science Team, [1]Laboratoire de Planétologie et Géodynamique UMR-CNRS 6112, Université de Nantes, Faculté des Sciences et Techniques, 2 chemin de la Houssinière BP 92208, 44322 Nantes Cedex 3, France (laetitia.ledeit@univ-nantes.fr), [2]DLR-Institute of Space Sensor Technology and Planetary Exploration, Rudower Chaussee 5, D-12489 Berlin-Adlershof, Germany, [3]Institut d'Astrophysique Spatiale, Université Paris 11, Bâtiment 121, 91405 Orsay Campus, France.

Introduction: The characterisation of mineralogy and geomorphology of geological structures in Valles Marineris is fundamental to understand their mechanism of formation. The analysis of OMEGA / Mars Express data using band ratios has already revealed ferric signatures in Valles Marineris, Margaritifer Terra and Terra Meridiani [1]. We report here on the analysis of OMEGA data with two complementary methods indicating the presence of minerals with spectral signatures of ferric oxides in East Candor Chasma. The results that we obtain are in good agreement with [1]. We then study the HRSC (High Resolution Stereo Camera / Mars Express) images of these deposits in order to characterise the geomorphological context of the detected signatures.

Dataset: OMEGA is the visible and near infrared imaging spectrometer onboard Mars Express [2]. A reflectance spectrum between 0.38 µm and 5.2 µm is acquired for each pixel of an image with a spatial resolution ranging from 300 m to 4.8 km per pixel. The instrument is composed of three detectors: VNIR (Visible Near Infrared) between 0.38 µm and 1.05 µm, SWIR (Short Wavelength InfraRed) between 0.93 µm and 2.73 µm and LWIR (Long Wavelength InfraRed) between 2.55 µm and 5.2 µm. The contribution of the atmosphere in the spectra is removed using an empirical atmospheric transmission derived from the ratio between two spectra acquired at the top and the bottom of Olympus Mons.

In this study, we focus on the SWIR channel data to avoid any problem of spatial registration between VNIR and SWIR channels. This tactic was already adopted in other studies for sulfate identification [3,4]. Although the specific ferric iron absorption band is centered at 0.9 µm, the typical sharp rise between 0.9 µm and 1.3 µm of this band is a good clue to detect ferric oxide.

The HRSC camera provides high resolution images (from less than 15 m per pixel covering more than 50 % of the surface to less than 30 m per pixel covering more than 70 % of the planet), colour images and 3D DTM with an unprecedented lateral resolution. In this study, we focus on the nadir images which have the best spatial resolution.

Methodology: Figure 1 shows a mosaic of OMEGA albedo images covering Eastern Candor Chasma in Valles Marineris. We have classified this mosaic using endmembers (the most extreme spectra of the global image) derived from the data. They have been identified using the algorithms implemented in ENVI software called Minimum Noise Fraction (MNF) and Pixel Purity Index (PPI) [5]. The similarity between each spectrum of the mosaic and the endmembers has then been evaluated by Spectral Angle Mapper (SAM) [6].

We also used a complementary method based on a linear unmixing model [7]. This method provides a distribution map for each component of the input library, which contains 27 minerals from the main mineralogical families. An example of the kind of map obtained is shown figure 2.

Results: Red spots in figure 1 correspond to areas whose spectra present a high similarity with the red endmember in figure 3. This spectrum shows a steep positive slope ranging from 1.0 µm to 1.3 µm, and a drop at 2.4 µm. These spectral features can be due to ferric oxides. The small absorption band at 1.95 µm and the drop at 2.4 µm suggest the presence of polyhydrated sulfates associated to these ferric oxides [8].

Figure 2 shows the distribution of the ferric oxide (in colour) detected by the linear unmixing model. The results obtained using that method are in good agreement with the classification performed in figure 1. Figure 3 shows an OMEGA spectrum of the region compared with the modelled spectrum. The contribution of the ferric oxide spectrum appears to be strong in the linear mixing which gives a high level of confidence in this detection of ferric oxide by the linear unmixing model.

The analysis of HRSC images of East Candor Chasma shows the location of these isolated ferric oxide deposits (figure 4). They appear to be located in topographic lows that are adjacent to light-toned interior layered deposits (ILDs) [1,9,10,11,12]. Spectral signatures of sulfate have been identified on the same light-toned deposits [4,8]. HRSC and MOC imagery suggest that the largest ferric oxide-rich deposits (7°S, 67.7°W) may correspond to a piedmont glacier whose rocky material has been eroded from the ILDs.

The distribution of oxides identified here corresponds to the distribution of hematite identified by TES in East Candor Chasma [9].

Perspectives: We will combine HRSC, OMEGA, THEMIS, MOC and MOLA data to constrain the detailed geological and geomorphological history of East Candor Chasma.

References: [1] Gendrin A. et al. (2005) *LPS XXXVI,* Abstract #1378. [2] Bibring J.-P. et al. (2004) *ESA-SP 1240*. [3] Langevin Y. et al. (2005) *Science, 307,* 1587-1591. [4] Gendrin A. et al. (2005) *Science, 307,* 1584-1586. [5] Boardman J.W. et al. (1995) *Summaries, Fifth JPL Airborne Earth Science Workshop*, *JPL Publication 95-1, 1*, 23-26. [6] Kruse F. A. et al. (1993) *Remote Sensing of Environment, 44,* 145-163. [7] Combe J.-Ph. et al., this issue. [8] Gendrin A. et al., this issue. [9] Christensen P. R. (2001) *JGR, 106,* 23,873-23,885. [10] McCauley J.F. (1978) *USGS Map, I-897*. [11] Lucchitta B.K. (1982) *NASA-TM 85127*, 233-234. [12] Nedell S.S. et al. (1987) *Icarus, 70,* 409-441.

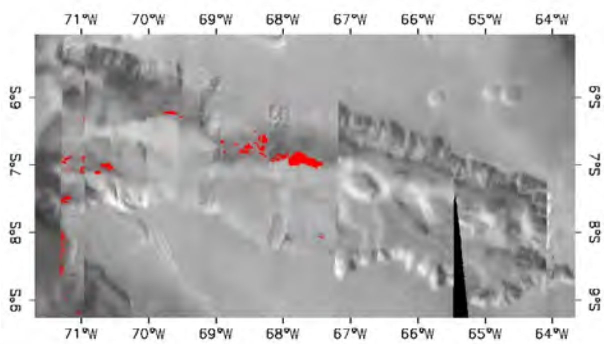

Figure 1: mosaic of OMEGA images at 1.08 µm of East Candor Chasma. The spatial resolution is 600 m / pixel. Red spots represent areas whose spectra are classified with the red endmember represented figure 3.

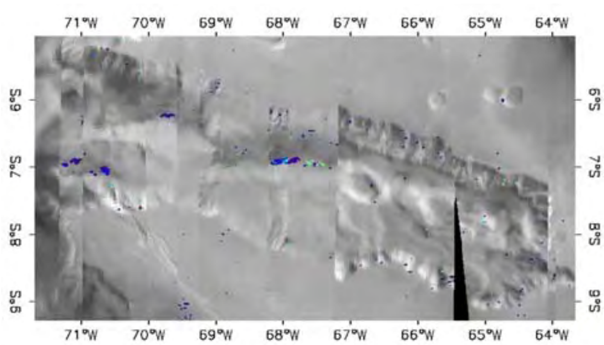

Figure 2: distribution map of ferric oxide endmembers of the linear unmixing model (in colour) on the albedo map.

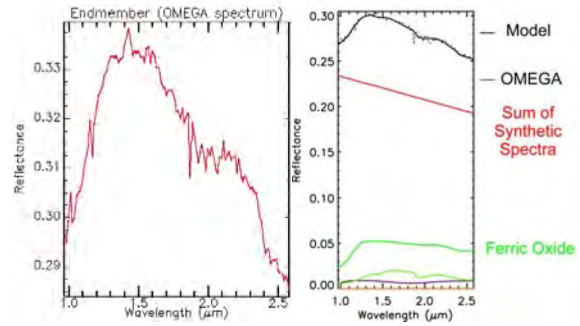

Figure 3: Left: OMEGA spectrum corresponding to the endmember provided by PPI tool with spectral characteristics of ferric oxides. Pixels of the OMEGA mosaic whose spectra are classified with regard to this endmember appear in red on figure 1.
Right: An OMEGA spectrum of a red area of figure 1 and the corresponding modelled spectra by the linear unmixing model. Synthetic spectra are three straight lines, a positive slope, a negative slope, and a flat spectrum. They permit to fit the spectral shapes independently of slope and albedo variations due to photometric effects.

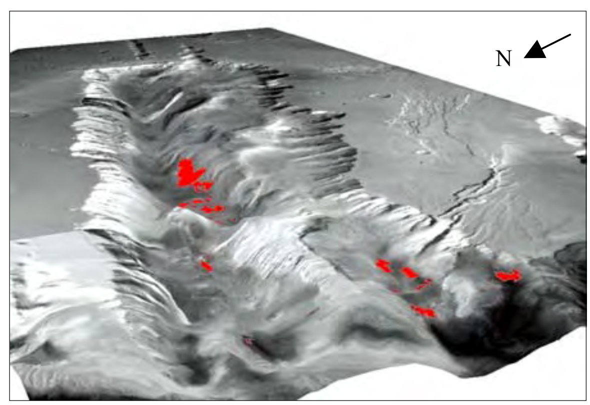

Figure 4 : mosaic of HRSC images of East Candor Chasma. The spatial resolution is 100 m / pixel. The vertical exaggeration is 20.0. Red spots correspond to areas associated to the endmember of figure 3 characterised by spectral signatures of ferric oxides. They appear to be associated with the interior layered deposits.