IDENTIFICATION OF PREDOMINANT FERRIC SIGNATURES IN ASSOCIATION TO THE MARTIAN SULFATE DEPOSITS. A. Gendrin1,2, J.-P. Bibring1, J. Mustard2, N. Mangold3, C. Quantin4, B. Gondet1, Y. Langevin1, F. Poulet1, C. Sotin5, S. Le Mouelic5, J.-P. Combe5, L. Hutchison2 and the OMEGA team, 1Institut d’Astrophysique Spatiale, CNRS, Université Paris 11, bâtiment 121, 91405 Orsay Campus, France (aline.gendrin@ias.fr), 2Department of Geological Science, Box 1846, Brown University, Providence RI, 02912, 3IDES-Osray, UMR 8148, CNRS and Université Paris-Sud, Bat. 509, 91405 ORSAY Cedex, France, 4LST, UCB and ENS Lyon, Villeurbanne, France 5Laboratoire de Planétologie et géodynamique, Nantes, France.

Introduction: OMEGA, the imaging spectrometer onboard Mars Express has identified sulfates in association to layered deposits in Valles Marineris and Terra Meridiani [1,2]. Here, we report the identification of a strong ferric band in association with these sulfate deposits, sometimes overlapping the sulfate deposits, sometimes closeby. This band is much stronger than the ferric band previously identified in bright Martian terrains [3,4].

Enhanced ferric signatures were identified in the ISM/Phobos2 dataset, the father of OMEGA, inside Candor Chasma [5]. These enhanced ferric signatures were then attributed to red hematite. A comparison with the areas mapped as crystalline grey hematite rich by the Thermal Emission Spectrometer (TES) onboard Mars Global Surveyor [6,7] is also of interest. TES data indicate the presence of crystalline grey hematite in Terra Meridiani, Aram Chaos, and Valles Marineris [6,7]. Some of the areas identified with TES data interestingly match areas that we identify here.

We will also address the question of the possible mineralogy corresponding to these areas, and propose possible constituting minerals.

Dataset: OMEGA, the imaging spectrometer onboard Mars Express covers the 0.35-5.1 µm wavelength range in 352 contiguous channels. Three detectors cover respectively the 0.35-1.0 µm (Visible and Near InfraRed, VNIR), the 0.9-2.7 µm (Short Wavelengths InfraRed, SWIR) and the 2.5-5.1 µm (Long Wavelengths InfraRed, LWIR) wavelength ranges. The spatial resolution of the instrument varies from 300 m/pixel to 4 km/pixel, due to the elliptical orbit adopted by the spacecraft. After almost one year of observations, which represents half of the nominal mission, ~50 % of the surface have been observed by the instrument.

Here, we focus on the 0.35-1.4 µm wavelength, which is the wavelength range of the electronic absorption bands, characteristic of ferric mineralogy [8]. We correct the data from the atmospheric contribution using a scaled atmospheric transmission spectrum, with the methodology exposed in [9]. It must be noticed that some slight discrepancies remain between the VNIR and SWIR detectors, because the calibration and spatial registration processes are still ongoing, that have to be taken into account before an accurate mineralogical identification can be performed in this wavelength range.

Method: We searched the entire OMEGA dataset using a band ratio characteristic of ferric and ferrous mineralogy, looking for a raise in reflectance between 1.0 and 1.3 µm. We kept only pixels with band depths greater than 15 % in this criterium. Because this spectral property can also originate from the presence of a pyroxene or olivine absorptions [1,11], we filtered out pixels with a deep pyroxene signature at 2 µm, obtained as described in [9], or an olivine signature [1,10]. We look at the areas isolated by this methodology, and keep only the areas with an extended spatial grouping.

Results: We explored the entire OMEGA dataset, and we noted that such a band is identified only in the close vicinity of sulfate deposits. No other area on Mars in the current OMEGA dataset shows a similarly strong ferric signature. The strength of the band varies from 15 to 30 %.

Several areas of ferric rich material are identified inside Valles Marineris. Specifically, we find deposits inside Candor, Melas, Hebes, Eos and Capri Chasmata. These deposits either overlap the sulfate deposits [1,2] or are located in their close vicinity. Two examples are shown which correspond to Capri and Candor Chasma (fig 2).

The case of Capri Chasma is further discussed in [13]. The areas of enhanced ferric mineralogy either coincide with a deposit mapped as polyhydrated sulfate rich or correspond to an area of similar geomor-
phology, where the sulfate bands are more shallow or absent. Another area corresponding to kieserite rich material is present inside the OMEGA observation, which does not show an enhanced ferric signature.

The case of Candor Chasma (fig. 2) is interesting since the deepest ferric absorptions do not overlap the layered terrains where sulfate signatures are identified. Instead, it is located at the base of the slope containing the sulfate signatures.

We also identify an enhanced absorption band inside Aram Chaos (fig. 2), whose location matches the location of TES crystalline hematite [6]. This deposit is discussed more in detail in [14].

Some deep absorption bands also appear in Iani Chaos, again in association with identified sulfate deposits. Finally, we identify a ferric absorption band in Terra Meridiani, inside the etched terrains [12], where we also identified sulfates, and in a small area located inside the region of crystalline grey hematite identified by TES [6,7].

Discussion: In the case of Aram Chaos, we noted that the distribution of the absorption that we mapped, and the distribution of crystalline hematite identified by TES matched perfectly. For Terra Meridiani, only a small region inside TES hematite area presents a deep ferric feature, while it is identified over an extended region inside the etched terrains. Finally, for Valles Marineris, we identify several occurrences of a deep ferric feature, which are mostly located in areas different from TES crystalline hematite.

The deep ferric feature that we identify could be due to red hematite, as was suggested by [5,15]. The band center at 0.86-0.88 µm is most consistent with this interpretation. It is also interesting to note the common occurrence of this feature in Terra Meridiani and other areas on Mars. In Terra Meridiani, the ferric signature identified by TES is due to spherules of hematite [16]. The erosion of spherules of grey hematite would result in the formation of red hematite. In this case, it would suggest that the processes of formation of sulfates and oxides could have been very similar in very different areas on Mars.