

TWO YEARS OF SULFATE MAPPING IN VALLES MARINERIS AND TERRA MERIDIANI AS SEEN BY OMEGA/MARS EXPRESS. Aline Gendrin^{1,2}, Jean-Pierre Bibring¹, Cathy Quantin³, Nicolas Mangold⁴, Stéphane LeMouélic⁵, Ernst Hauber⁶, Brigitte Gondet¹, Yves Langevin¹, François Poulet¹, R. Arvidson⁷ and the OMEGA team, ¹Institut d'Astrophysique Spatiale, Bâtiment 121, 91405 Orsay Campus, France, ²Geological Sciences, Brown University, Providence, RI 02912, ³LST, 69100 Villeurbanne, France, USA, ⁴IDES, Bâtiment 509, 91405 Orsay Campus, France, ⁵Planétologie, Université de Nantes, France, ⁶Institute of Planetary Research, German Aerospace Center (DLR), Berlin, Germany. ⁷Earth and Planetary Sciences, Washington University, St Louis, Missouri 63130, USA

Introduction: We present here an updated view of the location of sulfate and associated ferric oxide deposits, identified through the OMEGA data in Valles Marineris, Margaritifer Terra, and Terra Meridiani [1, 2]. We briefly summarize the factors influencing spectral detections, which are spatial resolution, water ice clouds, suspended dust in the atmosphere, and luminosity. We assess the mineralogy identified by OMEGA and comment on the possibility of refining this identification in the future. Some new sulfate deposits are then presented, which have been identified in the more recent observations.

OMEGA observes at the global scale sulfate minerals similar to those observed by the MER at a local scale [3].

Data: OMEGA is the imaging spectrometer onboard Mars Express [3]. It acquires spectra in the 0.3-2.5 μm wavelength range with 3 distinct detectors: Visible and Near InfraRed (VNIR, 0.3-1.0 μm), Short Wavelength InfraRed (SWIR, 0.95-2.6 μm) and Long Wavelength InfraRed (LWIR, 2.5-5.1 μm). It has now covered almost the entire planet at kilometeric scale, and ~5% at ~300 m/pixel [3,4,5].

Factors influencing the mineral detection: In areas observed several times, band depths are found to vary from one observation to another. We identify 4 factors influencing spectral detections:

- the spatial resolution: higher resolution observations show deeper absorption bands.
- Water ice clouds can make difficult the identification of shallow bands corresponding to hydrated minerals.
- Dust in the atmosphere can attenuate or even mask absorption bands
- Luminosity affects the strength of the signatures identified.

These quite simple factors have explained so far all the variability observed from one observation to another.

Three distinct sulfate types were identified in [1], and ferric oxides were reported in [2]. We looked for subtle signature variations indicative of a higher mineralogical diversity. We identified band shifts for the 1.9 μm feature, in polyhydrated sulfate rich areas, but in the examples that we observed, these shifts were explainable by a mixture with kieserite. Within the

polyhydrated sulfates, our near-infrared detection is really poorly sensitive to the cation (e.g. Al, Mg, Ca, Fe polyhydrated sulfates are equally good candidates).

Results: The new observations allow us to confirm and refine previous observations [1]. We identify sulfates and ferric oxides in all the major chasmata of Valles Marineris (Ophir, Candor West and East, Melas, Hebes, Ius, Tithonium, Coprates, Juventae, Capri/Eos), as well as in Aureum, Aram, Iani chaos. As previously noticed in [2], ferric oxides and sulfates are spatially close, and most of the times ferric oxides are located topographically on top and below sulfate deposits. Some craters in Arabia Terra also present sulfate signatures (for example Becquerel crater). The mapping of sulfates in Terra Meridiani is confirmed, ferric oxides are identified both in the etched terrain and Ph units of [6].

Figure 1 shows the mineralogical mapping obtained in Juventae Chasma, which was refined thanks to new observations. The main difference with [1] consists in the identification of kieserite associated to three of the four deposits present in the canyon. The 2.1 μm band strength, which allows the identification of kieserite, is much weaker for deposit 3 than for deposits 1 and 2. As shown in [1,4], gypsum is identified in association to the topmost layers of deposit number 2. It is of interest to mention that a very shallow 2.1 μm absorption band was identified associated to deposit number 4 in 2 distinct observations. However, a close observation of the spectra does not provide convincing evidence to support the identification of kieserite. Ferric oxides are also identified in association to the sulfate signatures of deposit 2.

Figure 2 shows our results in Aureum Chaos. One deposit of polyhydrated sulfates is identified, which is associated with a strong ferric oxide signature. It is of interest to note that a signature of grey hematite was identified in the same location by the spectrometer TES [7].

Figure 3 illustrates the effect of a higher spatial sampling, which results in deeper bands and a more accurate mapping of the sulfate location. This is of specific interest for the imaging spectrometer CRISM onboard MRO, which will start acquiring observations in September 2006.

References: [1] Gendrin et al. (2005), *Science* 307, 1587-1591. [2] Gendrin et al. (2005), *LPSC* #1378. [3] Bibring et al., J.-P. Bibring et al. (2004), *ESA-SP* 1240, 37. [4] Bibring et al. (2004), *Nature* 428, 627-

630. [5] Bibring et al. (2005), *Science* 307, 1576-1581. [6] Arvidson et al. (2003), *JGR* 108, ROV 14. [7] Glotch et al. (2005), *AGU*, #P21C-0160.

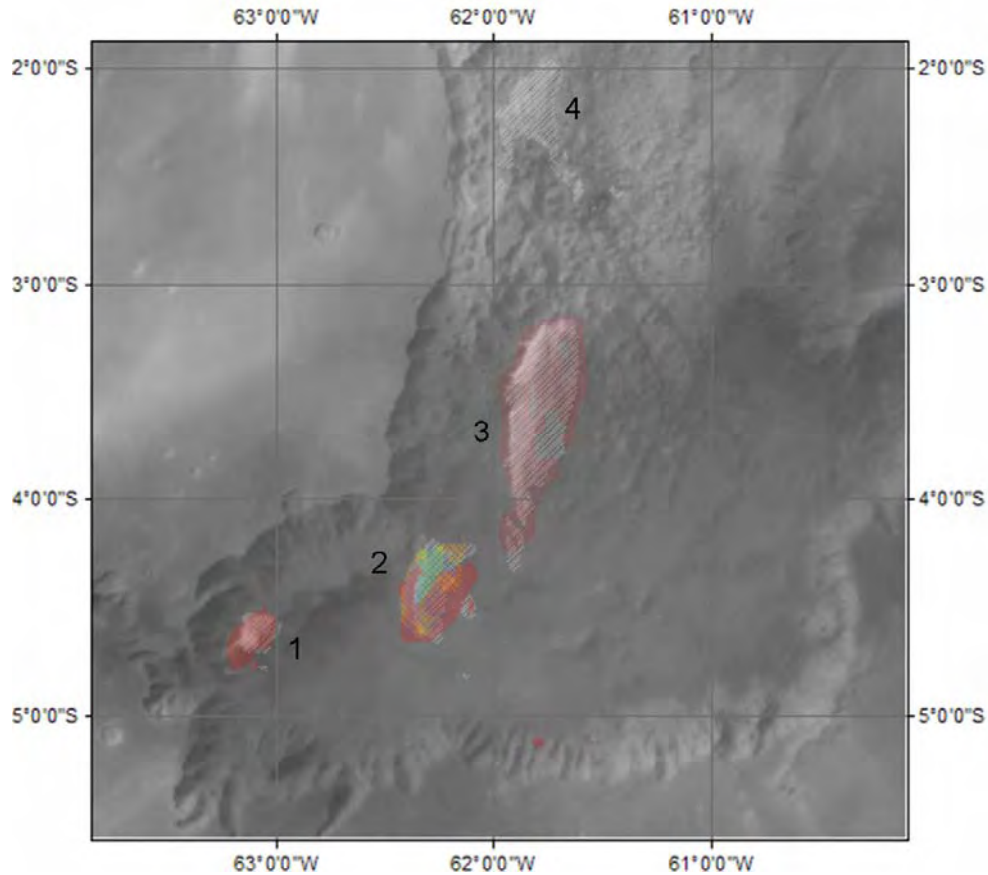


Fig. 1: Sulfate location obtained in Juventae Chasma. White Hatched area: interior layered deposits (ILDs). Red: kieserite. Green: polyhydrated sulfates. Blue: gypsum. The numbers are used in text to refer to each of the ILDs.

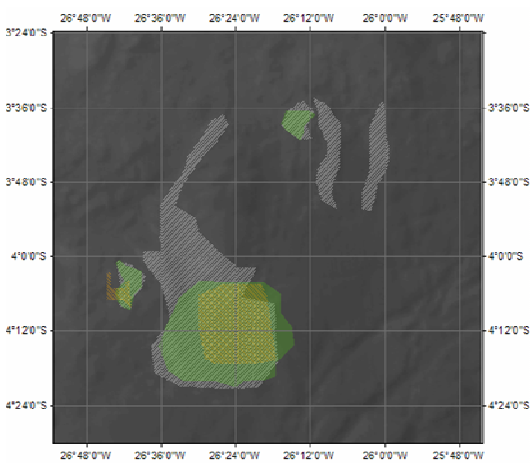


Fig 2: sulfate location in Aureum Chaos. Same legend as for fig. 1, plus hatched orange: ferric oxides.

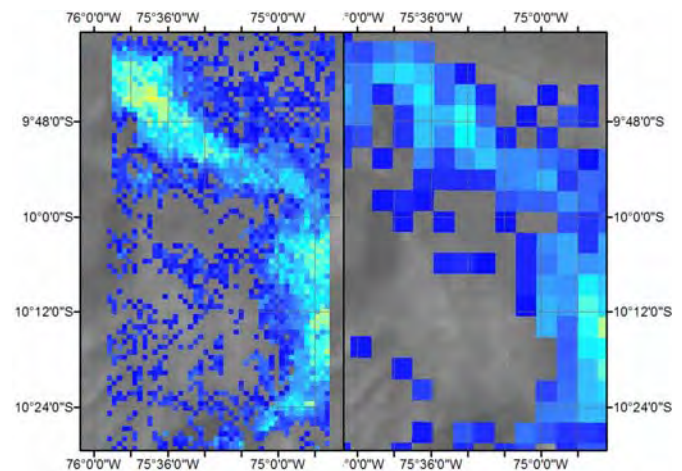


Fig. 3: Band depth at 2.1 μm in a region of Melas chasma. Right and left picture correspond to the same area, observed twice by OMEGA (dark blue: 1%, yellow: 6%). The higher resolution observation shows stronger bands with a better defined location.