

STRATIGRAPHY AND ELEVATION DISTRIBUTION OF SULFATE DEPOSITS IN VALLES MARINERIS.

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Introduction: OMEGA is the VIS/NIR imaging spectrometer onboard Mars Express, the first ESA mission to Mars. After two years of observations, OMEGA has now observed the entire Valles Marineris area at kilometric resolution and many data have been acquired at middle to high resolution throughout the canyon (up to 600 m). Some areas have been observed up to four times.

This data set in Valles Marineris has revealed sulfate signatures [1,2]. OMEGA detects absorption bands typical of the monohydrated sulfate Kieserite at 1.6, 2.1 and 2.4 μm and of polyhydrated sulfates, with absorption bands at 1.4 and 1.9 μm and a drop at 2.4 μm [1]. As underlined in [1], other minerals such as anhydrous sulfates might also be present but not detected because they are spectrally flat.

A mapping of sulfate spectral signatures has been performed by [2], which takes into account the entire OMEGA data set. Although the different observations are of different quality (atmospheric conditions, observation time...) as detailed in [2], the current updated OMEGA mineralogical map gives us a good idea of the sulfate distribution throughout the canyon system. Here, we describe the relationship between mineralogy and geomorphology. We investigate stratigraphic relationships, and report on a large scale study of the sulfate distribution.

Data set and method: Our present work is based on multiple remote sensing data from MGS, Mars Odyssey and Mars Express missions. The different data sets have been imported and integrated into a Geographic Information System (GIS). Our GIS superimposes in Melas Chasma: (1) MOLA DEM, (2) the TES thermal inertia map, (3) a mosaic of day-time THEMIS infrared, (4) a mosaic of night-time THEMIS infrared images, (5) a mosaic of HRSC images covering Valles Marineris, (6) the available THEMIS visible images (7) All the available MOC images and (8) the mineralogy from OMEGA atmosphere-corrected dataset. Our work cross-correlates these data sets.

Global geological counterpart of sulfates detected by OMEGA in Valles Marineris: Sulfates have been detected in all the canyons of Valles Marineris. In each canyon of Valles Marineris, the sulfate signatures are correlated to layered deposits [1,2]. The sulfates are mainly located on the flanks of massive deposits and on several isolated ILDs. Most of the OMEGA sulfate signatures correspond to high thermal

inertia areas [3]. It is also confirmed when we study the morphology: the sulfates detected by OMEGA correspond to outcrops which are typically cliffs, with almost no impact craters suggesting that they are extremely fresh.

Morphologies and sulfate types: The observation of MOC or HRSC images corresponding to kieserite detections shows that the kieserite mineral is correlated to massive light toned material with yardang erosional features. These eolian features suggest highly eroded outcrops. It is the case, for instance, of kieserite signatures in Melas, Capri and Gangis Chasma (Fig. 1, B, C, D). On the other hand, polyhydrated sulfates are usually correlated to darker units (Fig. 1, E, F, G). Either these units are, from the lithological point of view, distinct from the kieserite ones or it is just a question of freshness of the outcrops. The spatial resolution of TES thermal inertia doesn't allow us to favor one or other hypothesis.

Stratigraphy : The sulfate signatures appear on the flanks of massive deposits. The flanks are made of exposed layers of varying thicknesses (a few meters to hundreds of meters). Sulfate signatures always correspond to groups of layers (over 1 km thick). When the layers are horizontal, the sulfate signatures can sometimes be followed around entire mounds. That is the case in Gangis Chasma for. It is more complicated in the case of deformed layered area like in some regions inside Candor Chasma or Melas Chasma.

Elevation distribution of sulfate signatures: A correlation between the sulfate signatures and the stratigraphy of Valles Marineris layered deposits is crucial to understand the origin of the sulfate mineralogy. That is the reason why we computed the elevation distribution of sulfate signatures for each canyon of Valles Marineris. The retrieved elevation diagrams show a non random distribution, which is rich of consequences in terms of the history of the canyon, and is currently under investigation.

References:

- [1] Gendrin et al., (2005), Science, 307, 1587-1591
- [2] Gendrin, A. et al., (2005) this issue [3] Mellon et al., Icarus, 148, 437-455 .

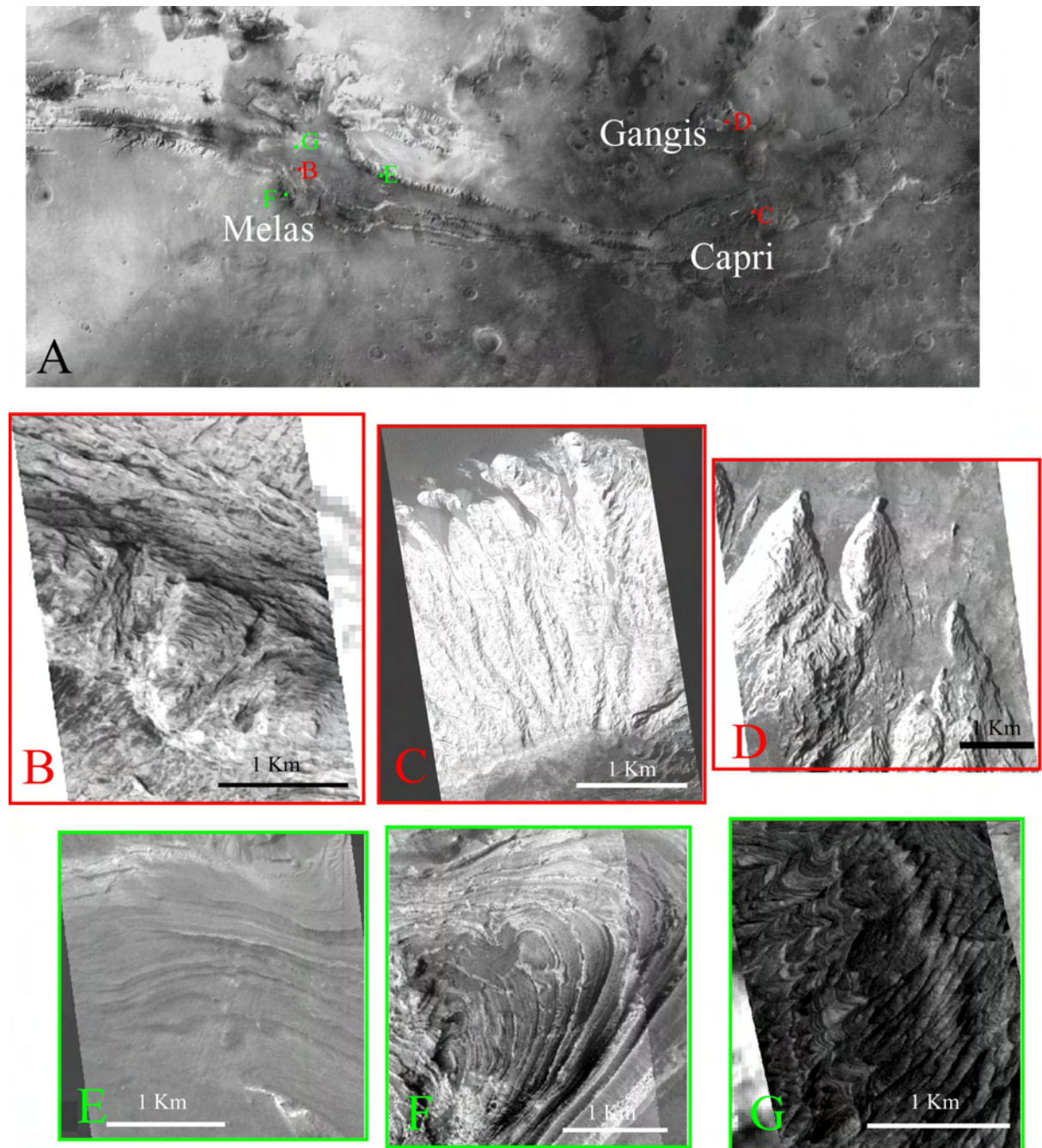


Fig.1 : MOC images of the geological context of sulfate signatures detected in Valles Marineris by OMEGA : A) context, B) Kieserite outcrop in Melas Chasma, C) Kieserite outcrop in Capri Chasma, D) Kieserite outcrop in Gangis Chasma, E, F, G) Polyhydrated sulfate outcrops in Melas Chasma. The color of the edge of the MOC images are related to the type of sulfates (red/kieserite, Green/polyhydrated).