STRATIGRAPHY OF THE MAWRTH VALLIS REGION THROUGH OMEGA, HRSC COLOR IMAGERY AND DTM. D. Loizeau[1], N. Mangold[1], F. Poulet[2], V. Ansan[1], E. Hauber[3], J.-P. Bibring[2], Y. Langevin[2], B. Gondet[2], P. Masson[1], G. Neukum[4]. [1]IDES, Bat. 509, Universite Paris XI, 91405 Orsay cedex, France, [2]Institut d'Astrophysique Spatiale, Bat. 121, Universite Paris XI, 91405 Orsay cedex, France, [3]Institute for Planetary Exploration, German Aerospace Center (DLR), 12489 Berlin, Germany, [4]Institut für Geologische Wissenschaften, Freie Universitaet Berlin, Germany. damien.loizeau@u-psud.fr.

Introduction: OMEGA/Mars Express has discovered large outcrops rich in phyllosilicates in the region of the outflow channel Mawrth Vallis, Mars, around 20°W, 25°N [1], through the detection of absorption bands at 1.4 and 1.9 µm, and at 2.2 or 2.3 µm. Comparison with laboratory spectra reveals similarities with clay minerals such as Al-OH smectites (with the presence of 2.2 µm band) and Mg- or Fe-OH smectites (with the 2.3 µm band) [2]. Moreover the abundances of clay minerals in the Mawrth Vallis region are the highest detected on Mars, reaching more than 65% in volume in some outcrops [3].

Those hydrated minerals are located exclusively on strongly eroded bright outcrops, exhumed from the Noachian plateaus, and cut by the outflow channel Mawrth Vallis, as seen on HRSC/MEx and MOC/MGS narrow angle images. Several MOC and HiRISE/MRO images also reveal that those bright Noachian terrains display meter-scale layers, over more than 150 meter depth as seen on some crater walls. The horizontal extension of more than 300 km x 400 km of this thick phyllosilicate-rich unit implies an important volume of altered rocks, formed during the "phyllosian era" [2,4].

The use of HRSC color imagery and the computation of HRSC Digital Terrain Models (DTM) provides helpful information to understand the geometry and stratigraphy of the phyllosilicate-rich unit. In the context of landing sites selection for the future rover mission, it is highly important to elect the most scientificaly relevant sites through the diversity of the exhumed terrains [5].

Correlation between OMEGA, HRSC color imagery and stratigraphy: The red, green and blue channels of the HRSC camera (High Resolution Stereo Camera) have been used to compose RGB images. No calibration has been applied, the aim is to detect easily different terrains by their different colors.

When looking at the bright exhumed outcrops of the phyllosilicate-rich unit on HRSC color imagery and comparing it to OMEGA detection of the 1.93 µm band, and the 2.20 or 2.30 µm absorption bands, it appears that, as in figure 1:

1. Al-bearing smectite-rich outcrops (2.2 µm band) always appear as white, grey or bluish outcrops;

2. Fe-bearing smectite-rich outcrops (2.3 µm band) display a yellow, red, pink or brown color.

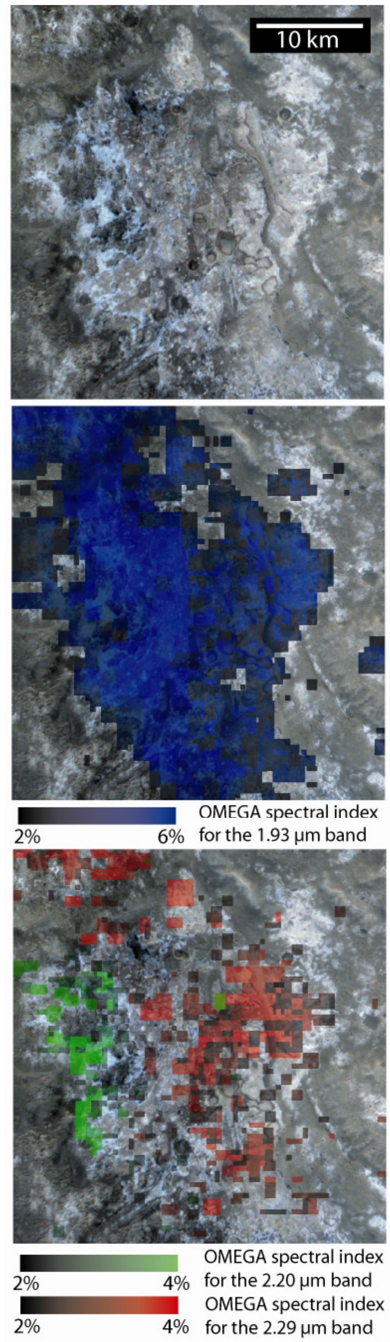

Fig. 1: Part of HRSC color image on Mawrth Vallis floor and OMEGA detection of Al-phyllosilicates (green) and Fe-/Mg-phyllosilicates (red)..

Moreover, when looking at very high resolution datasets (HiRISE or MOC narrow angle images), and relating them to HRSC or HiRISE color imagery, we see that the different colors correspond locally to different groups of layers deposited on top of each other, thus contructing different color sub-units indicating different compositions.

Hence, we used the color properties in the visible to map at high resolution the different smectites over the whole Mawrth Vallis region. This is complementary to the use of the CRISM dataset [5,6].

The stratigraphy of the phyllosilicate-rich unit: We apply the color mapping in addition to the use of the HRSC high resolution DTM to map constrained cross-sections of the phyllosilicate-rich outcrops across the plateau and the Mawth Vallis channel (example Fig. 2). When the same color sub-unit crops out at different levels along the cross-section, by linking the limits between the different sub-units, it is possible to retrieve a value of the apparent dip of the sub-unit –and hence of the layers– in the direction of the cross-section, with an error <0.5°. It was possible to count up to five color sub-units on top of each other in the region, but other sub-units may be present. The mapping method applied to other large outcrops of the region reveals generally sub-horizontal sub-units, or with < 3° dips.

Layers cannot be tracked from the top to the bottom of the Mawrth Vallis channel due to local mantling, but layered terrains can be seen in some outcrops on the sides and floor of the channel, implying that the phyllosilicate-rich unit extend down to below Mawrth Vallis floor. This possibility is even reinforced by the presence of large deposits of clay minerals in other parts of the channel floor.

We also identified in numerous locations, outcrops of a paleo-surface. This surface is also phyllosilicate-rich, and appears brown in HRSC and HiRISE color images.

Implications for the formation: We observed a paleo-surface on top of which the layered unit was deposited and later impacted and eroded, enabling today to see large sections of the unit.

The link between the deposition and alteration of the rocks is still a fundamental issue: 1) the alteration could have happened during the accumulation of the material, building different sub-units depending of changing conditions of formation; 2) the alteration could have happened by groundwater/pedogenic processes after depositionof a thick layered unit..

Moreover, the presence of layers outcropping at the dichotomy boundary in the western part of the region (Fig. 2), and in the sides of Mawrth Vallis channel, imply a deposition prior to the Mawrth Vallis present channel and the dichotomy boundary erosion, for at least part of the sediments.

References: [1] Poulet F. et al. (2005), *Nature, 438*, 623-627. [2] Loizeau D. et al. (2007), *JGR, 112*. [3] Poulet et al., submitted to *Science*. [4] Michalski J. R. and E. Z. Noe Dobrea (2007), *Geology 35*, 951-954. [5] Mustard et al. (2008), *Nature 454,* 305-309. [6] Wray et al. (2008), *GeoRL 35*.

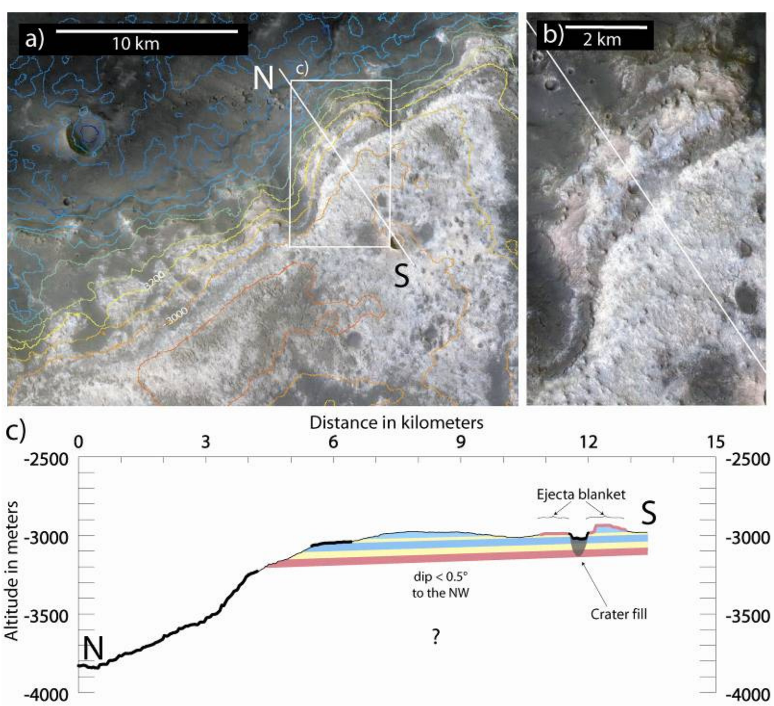

Fig. 2: a) Close-up on a scarp at the dichotomy boundary. CTX images, and HRSC color images are displayed. HRSC DTM height contours are displayed with an interval of 100 m.
b) Close-up on the cross-section of the scarp presented in (c).
c) Constrained cross-section of the upper-figure derived from the HRSC DTM and the color imagery.