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:

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.

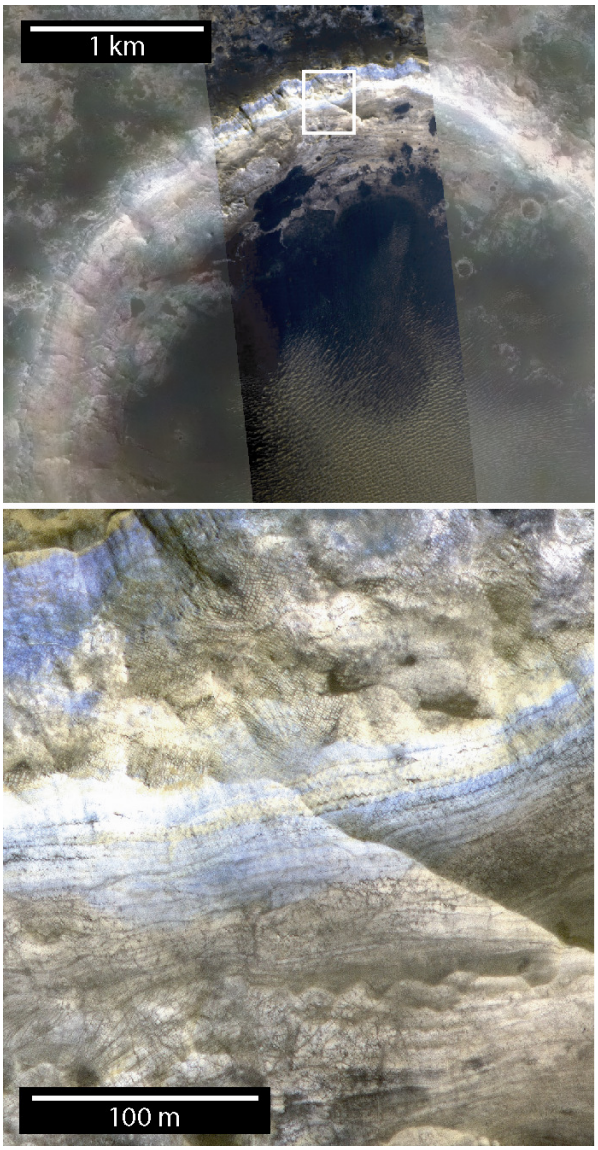

Figure 1: *top:* mosaic of HiRISE image (PSP_004052_2045), HRSC RGB composite image and HiRISE color image in the middle, situated on the plateau, near Mawrth Vallis mouth. The white box indicates the close-up location; *down:* close-up of the upper image. The layers of the crater wall (more than 100 m thick) build color sub-units indicating a variation in composition as follow: Al-clays in white, grey or bluish colors, Fe-clays in yellow, reddish, brown colors.

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 to different groups of layers deposited on top of each other (as seen in Fig. 1), thus contructing different color sub-units indicating different compositions. This observation demonstrates that the color properties in the visible can be used to map at high resolution the different smectites over the whole Mawrth Vallis region. This is complementary to the use of the CRISM dataset [6,7]. The complex stratigraphy shown in Figure 1 also indicates a sequence of episodes of deposition of phyllosilicate-rich material, or an in-situ alteration by groundwater of layers of different materials.

The stratigraphy of the phyllosilicate-rich unit: We apply this method 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. 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 dip of the sub-unit –and hence of the layers– in the direction of the cross-section. Figure 2 shows a simplified constrained cross-section of the southern part of Mawrth Vallis. On the available datasets for this area, it was possible to count at least five color sub-units on the 100 km long line, and to link them between the two sides of the channel. Other smaller intermediate sub-units may be present. A small stratigraphic bend appears at the present place of the outflow channel. Layers cannot be tracked from the top to the bottom of the channel due to local mantling, but layered terrains can be seen in some outcrops on the floor of the channel, implying that the phyllosilicate-rich unit extend down to below the valley floor. This possibility is even reinforced by the presence of large deposits of clay minerals in other parts of the channel floor. The mapping method applied to other large outcrops of the region reveals generally sub-horizontal sub-units, or with < 3° dips.

Implications for the formation: About ten sub-units of different composition have been identified over the Mawrth Vallis region, on the different plateaus. The sub-units could be tracked over tens of kilometer. Such a uniform organization over the region is in favor of a deposition of clay-rich material in a basin.

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] Michalski J.R. et al. (2008), this conference. [6] Mustard et al. (2008), submitted to *Nature*. [7] Bishop et al. (2008), this conference.

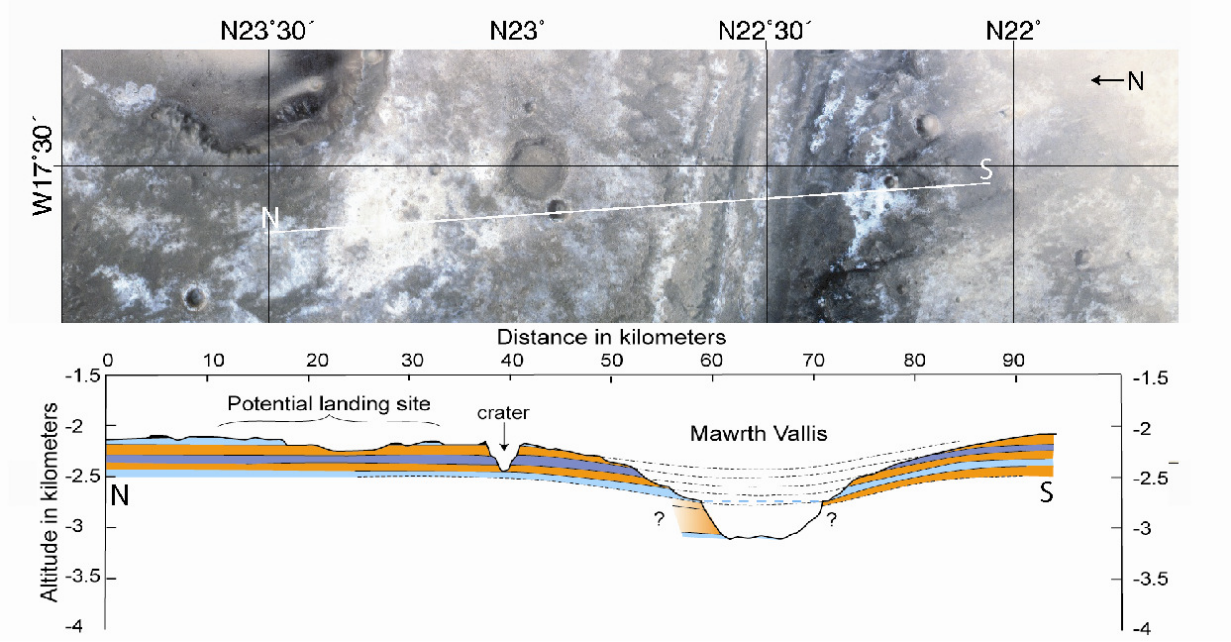

Figure 2: *top:* context of the lower cross-section, crossing the Mawrth Vallis main channel, north is to the left; *down:* constrained cross-section. At least five different color sub-units can be distinguished and linked from one side to the other of the Mawrth Vallis channel. The supposed upper level of the outflow is indicated by a blue dashed line.