MINERALOGY OF THE NORTHERN HIGH LATITUDE REGIONS OF MARS. F. Poulet[1], Y. Langevin[1], J.-P. Bibring[1], B. Gondet[1], R. Arvidson[2] and the OMEGA team. [1]IAS, Université Paris 11, 91405 Orsay Cedex, France francois.poulet@ias.fr, [2]Washington university, St Louis, USA

Introduction: The northern high latitude regions of Mars have had a complex geologic history. Although they are some of the youngest units on Mars little is known about their composition, formation and deposition [1]. Neutron data acquired using the Neutron Spectrometer aboard 2001 Mars Odyssey indicates hydrogen-rich layers (<1 meter) ranging up to 100% water-equivalent by mass are found at latitudes higher than 50-60°N latitude [2]. Recently, sedimentary minerals have been detected by OMEGA-MEx in some parts of the circumpolar dunes [3,4]. We have used OMEGA data to analyze the surface composition of the regions located between 50°N and the permanent polar cap. The surface properties of the northern terrains are discussed.

Observations: The orbital evolution of Mars-Express, when combined with the largest fields of view of OMEGA (4.4° or 8.8°) made it possible to obtain a comprehensive coverage of the northern regions at a km scale. The analyzed data were acquired between October and December 2004 corresponding to Ls=95° to 120° (northern summer). At this time, the seasonal frost is totally sublimated. Local time of the analyzed observations at 70°N is between 2:30 and 3:30 pm.

Results: Figure 1 shows the averaged spectra of the different geologic units defined by [5]. All terrains exhibit an 1.9 µm band. The Am unit (darker area) spectrum shows an absorption feature in the 1-1.4 µm range. In other spots, this feature is more pronounced, consistent with the presence of Fe^{3+}-bearing minerals typical of oxyhydroxides. The presence of oxide (possibly hematite) is also confirmed by a shallow 0.86 µm band, identified only in this geologic unit. Some very small areas also present pyroxene band. The bright Hvk unit spectrum has no significant features apart the 1.9 µm band. The small unit Adc spectrum presents subtle features in the 2.2-2.4 µm which can be linked to metal-OH bound, while this detection needs to be confirmed with higher spatial resolution data. The Apl unit spectrum shows distinct water ice features. It is important to note that some subtle water ice features are also detected in small areas of Am and Hvk units. By comparing different orbits, we can infer that these features likely come from the surface features and not the atmosphere. This means that very small concentrations of water ice on the top of the surface is still present in some areas in the middle of the summer after the complete recession of the water ice seasonal frost.

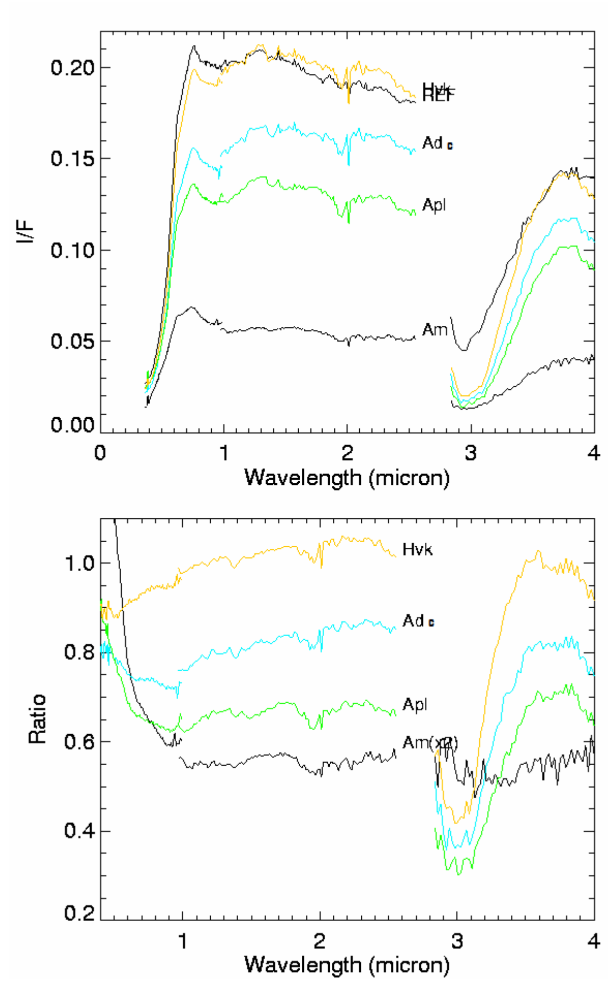

Figure 1: Averaged spectra of different geologic units of the polar regions defined by [5]: Am: mantle material, Hvk: Knobby member, Adc: crescentic dunes, Apl: Polar layered deposits. Top: spectra compared to a reference spectrum (REF) taken at 50°N. Bottom: ratioed spectra. Note that the 1.38 µm band is due to the water vapor with large column density at these high latitudes.

The hydration at 1.9 µm starts at ~ 60° N and increases with latitude (Fig. 2). The 3 µm absorption band depth also increases with latitude. The strength of the 1.9- and 3-µm bands is an indication of the water content. As compared to the other hydrated regions (Terra Meridiani, Syrtis Major,...) identified by OMEGA [6,7,8,9], the polar region are the most hydrated terrains on Mars. However, the surface material does not exhibit clear evidence of metal-OH (1.4 µm, 2.2-2.4

μm) or sulfate features present in all other hydrated minerals found on Mars. This could be explained in terms of water molecule adsorbed on the grains rather than bounded to the crystal structure.

Discussion: The correlation between the latitude dependence of the 1.9 μm band and the distribution of Hydrogen obtained by GRS is not fortuitous and may indicate that the hydration of the terrains at latitude > 60°N could result from a water transport between the permafrost and the overlying soil. Given the strong absorptions at 1.9 μm and 3 μm, the lack of obvious hydroxyl features is also in favor of an hydration resulting from a surface weathering implying the permafrost rather than alteration during the formation of the minerals or diffusive exchange of water between the pore space of the regolith and the atmosphere. Regarding to the Apl unit, the detection of water ice bands in this unit could be explained by a deposition of a mixture of ice and dust.

References: [1] Fischbaugh K. and Head J.W., JGR, 105,22455-22486. [2] Feldman W.C. et al. *J.G.R.* 109, *EO9006,*(2004). [3] Langevin Y. et al. (2005) submitted. [4] Langevin Y. et al. (2005) this meeting. [5] Tanaka K. and Scott D. USGC Map I-1802-C. [6] Bibring J.-P. et al. (2005) submitted. [7] Poulet F. el al. (2005) *this meeting*. [8] Mustard J. et al. (2005) *this meeting.* [9] Gendrin et al. (2005) *this meeting.*

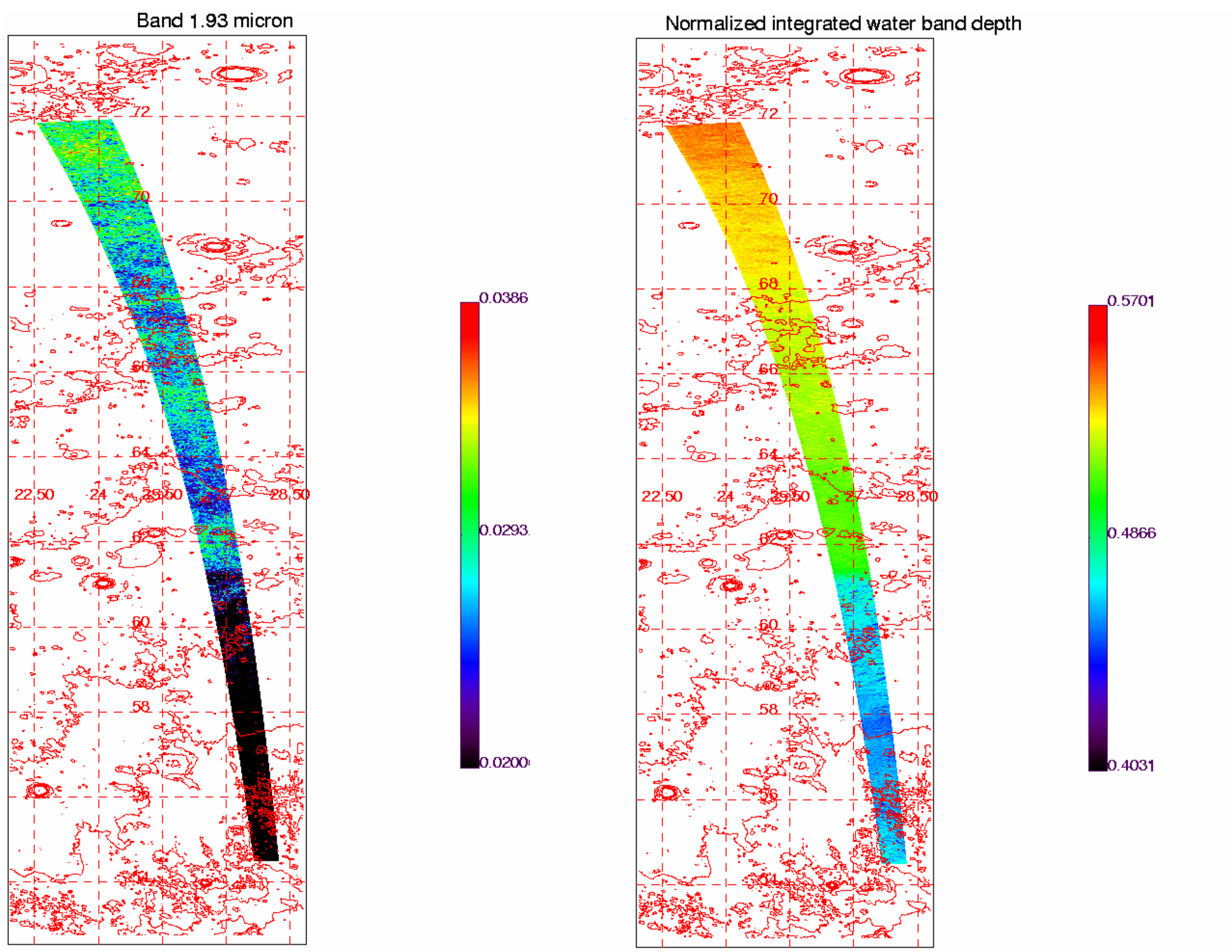

Figure 2: Maps of the 1.93 μm (left) and 3 μm (right) band depth of an OMEGA track. The 1.9 μm is clearly identified from 60°N (band depth larger than 2%) and increases with latitude. The 3 μm band depth shows the same latitude dependence.