MAPPING OF ADSORBED AND BOUND WATER IN MARS REGOLITH BASED ON MARS EXPRESS/OMEGA DATA. N.A. Evdokimova,[1,2], R.O.Kuzmin[3], A.V.Rodin[1,2], A.A. Fedorova[1], J.-P.Bibring[4] and OMEGA team, [1]Institute for Space Research, RAS, Moscow, 117997, Russia, nadca@mail.ru [2]Moscow Institute of Physics and Technology, Dolgoprudny, 141700, Russia, [3]Vernadsky Institute of Gepchemistry and Analytical Chemistry, 119991Moscow, Russia, [4]Institut d'Astrophysique Spatiale, Batiment 121, 91405 Orsay Campus, France.

Introduction: OMEGA is a mapping spectrometer operating in visible and NIR spectral range (0.38-5.1μm). The instrument, inherited from the unsuccessful Mars-96 mission, is dedicated to the identification of molecular and mineral composition of Martian surface and atmosphere by means of spectral analysis of the outgoing reflected solar radiation[1]. The instrument acquires spectra in 352 spectral channels, provided by three detectors: visible (0.38-1.05 μm) and two infrared ones (0.93-2.73 μm and 2.55-5.11 μm). Imaging capability is reached by combination of spacecraft orbital motion and transversal sweeping of the Field Of View (FOV) by means of special scanning device. OMEGA provides surface coverage at mean spatial resolution of 0.3-5 km from the orbit of 300-4000 km elevation, which allows mapping of minerals and volatiles on the Martian surface. The latter includes ice, as well as bound and adsorbed water, as the working spectral range involves important bands of CO_2, H_2O (including adsorbed and bound phases), oxides, hydrates, and other minerals[1,2].

Correction on the atmosphere: Since spectral features of interest (1.41μm, 1.46 μm, 1.5 μm, 1.91 μm etc.) overlap molecular CO_2 absorption bands at 1.4 μm and 1.9 μm, their analysis requires accurate subtraction of the atmospheric contribution to the observed spectral radiances. To correct OMEGA spectra on atmospheric absorption, we have chosen *ab ibitio* approach and calculated several atmospheric transmittance spectra for mean temperature profile and pressures derived from the European Mars Climate Database [3] for the seasons, local time and geometry corresponding to OMEGA observations.

An approximate estimate of the atmospheric contribution to the observed radiance is a convolution of the monochromatic transmittance with instrumental function. According OMEGA calibrations, a symmetric trapezoid with top width and both wings each equal to one pixel has been adopted.

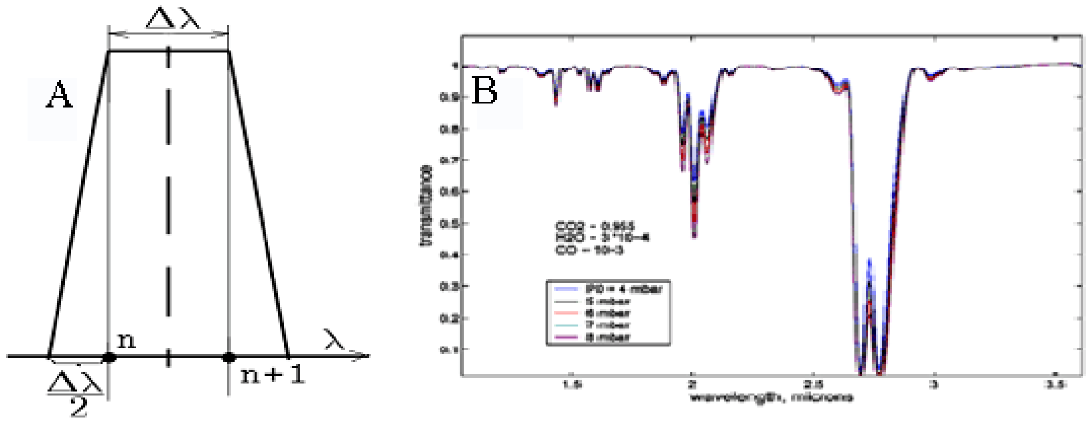

Figure 1. ***Instrumental function (a) and simulated transmittance (b) used to correct OMEGA spectra on atmospheric absorption. n is pixel number, Δλ - distance between pixels in spectral scale.***

An example of simulated transmittances in OMEGA spectral range is shown in Fig.1. This algorithm has resulted in very clean subtraction of the atmospheric absorption at 1.5 μm; however, the correction of 1.9-μm band was incomplete yet, precluding for the moment the analysis of bound water absorption features overlapping with this band.

Results: The corrected spectra were analyzed in order to derive features corresponding to condensed phases of water [4]. As a first step, qualitative spectral index have been adopted as a measure of band depths and accordingly – the amount of absorbed in the Martian soil. For narrow bands at 1.41 μm and 1.46 μm, the spectral index are equal to band depths normalized by corresponding continua, so that the maximal band depths corresponds to the maximal index; for broader 1.5-μm water ice band, the index equals to the integral reflectance within the band normalized by integral reflectance in the band region with the spectral continuum approximated by linear function. In the latter case, maximal value of absorption corresponds to minimal index value. The examples of mapping these indices on the orbit 941 are presented in Figure 2. The orbit is suitable for testing mapping techniques because the frame contain such

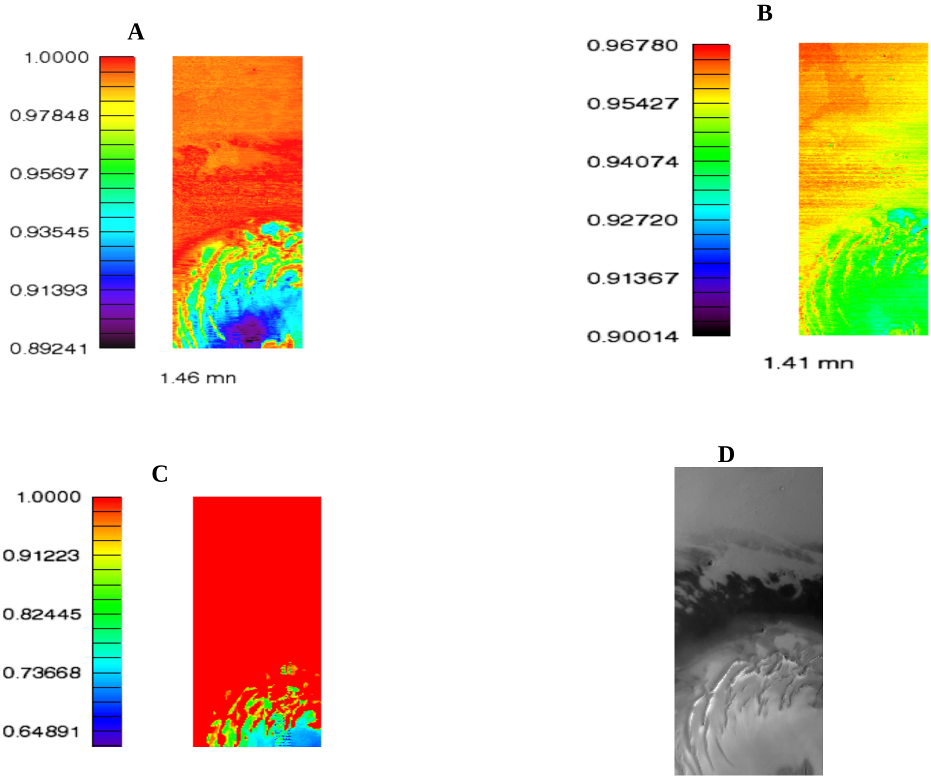

Figure 2. ***Maps of condensed phases of water derived from OMEGA data. Orbit 941, latitude range 67°-84°N, L_s=100.2°. Shown are spectral index based on relative depths of related spectral features. (a) 1.46 μm adsorbed water feature; (b) 1.41 μm bound water feature; (c) water ice absorption at 1.5 μm (inverted); (d) reference plot: albedo at 1 μm. (a) and (b) contain spatial structure not related to local topography; they may be indicative to the mineral composition of the Martian surface.***

different morphological features as ice deposits of the Northern polar cap, near-cap aeolian dusty deposits, and seasonal inventories of ground water outside the cap. Upper maps (a,b) shows adsorbed and bound water spectral index. The area of maximal index of the adsorbed water (a) coincides with the belt of dust deposits around the polar cap and may reflect the extended adsorbing capacity of dusty surface, as well as a result of intensification of the nighttime water deposition onto dusty areas due to lower thermal inertia. The map of index reflecting distribution of hydrated minerals (b) shows little correlation with that of adsorbed water; instead, a new feature is the upper-left corner appears, most probably, corresponding to the minerals hydration in this area. Lower map shows water ice (c) which is present in the polar cap area only, since at Ls=100 no seasonal ice cover is expected. Finally, the 1-μm albedo map (d) gives a general picture of the morphological context of the area of interest. A systematic mapping of the indices discussed above, combined with the 1.9-μm features after cleaning of the atmospheric CO_2 contribution, will provide insights into important aspects of Martian mineralogy and connection of the polar processes with the global water cycle on Mars.

References: [1] Bibring, J.-P., *et al.* 2005. *Science* 307, 1576-1581.[2] Bibring, J.-P., *et al.* 2004. *Nature*, 428, 627-630. [3]. Lewis, S.R., *et al*. 1999. *J. Geophys. Res.*, 104, 24177-24194. [4] Clark, R.N., Swayze G.A. 2003. *J. Geophys. Res.*, 108, E12, 5-1, CiteID 5131, DOI 10.1029/2002JE001847.