BURIAL DEPTH OF WATER ICE IN MARS PERMAFROST SUBSURFACE. I.G.Mitrofanov[1], M.T. Zuber[2], M.L.Litvak[1], N.E.Demidov[3], A.B.Sanin[1], W.V.Boynton[4] , D.A.Gilichinsky[3], D.Hamara[4], A.S.Kozyrev[1], R.S.Saunders[5], D.E. Smith[6] , and V.I.Tretyakov[1], [1]Institute for Space Research, Moscow 117997, Profsojuznaya st. 84/32, Russia, imitrofa@space.ru, [2]Massachusetts Institute of Technology, Cambridge, MA 02139-4307, USA, [3]Institute of Physical-Chemical and Biological Problems of Soil Science, Pushchino, Russia, [4]University of Arizona, Tucson, AZ 85721, USA, [5]NASA Headquarters, Washington DC 20514, USA, [6]NASA/Goddard Space Flight Center, Greenbelt, MD 20771, USA

Introduction: Neutron and gamma-ray data from GRS suite of Mars Odyssey has provided the evidence of high content of water ice of Mars permafrost everywhere above the latitude bands of 50° – 60° at North and South [1–3]. These data has also manifested the presence of dry layer on top of water ice table, which was much clear at Southern permafrost than in the Northern one [4,5]. To make more conclusive studies of the burial depth of water ice of permafrost on Mars, we have performed the joint analysis of HEND neutron data from Mars Odyssey and near-IR radiometry data of MOLA from Mars Global Surveyor.

Results: HEND data for epithermal neutrons and MOLA radiometry data at 1064 nm [6 – 8] were co-registered along 5° latitude bends (72 surface elements in each band). Data for summer seasons only were used for each band. Figure 1 shows cross-correlation coefficients between these two data sets. The levels of statistical significance ±0.325 are shown by dashed line. There is no correlation in the broad l latitude belt *I* between 40°S and 40°S. Significant negative cross correlation is found in two belts *II* and *III* at latitudes 40° - 80°N and 40° - 60°S, respectively, and there is no correlation in the belt *IV* poleward of 60°S.

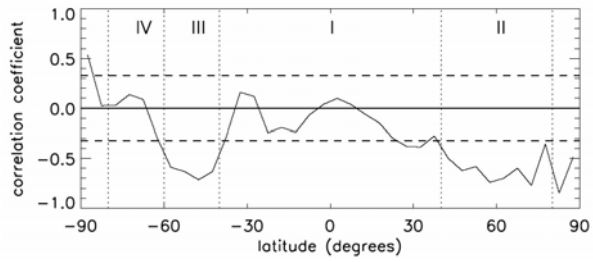

Figure 1. Coefficient of cross-correlation for latitude bands.

Interpretation: We interpret the observed cross-correlation for latitude belts *II* and *III*, as indication that burial depth of water ice table in these regions depends on heating of soil by absorbed sunlight. HEND neutron data allows to estimate the best fitting parameter $h^{(*)}$ for the burial depth of each surface element in belts *II* and *III* (e.g. see [4]). MOLA data for radiometry allows to estimate the heating fluxes *W* of sunlight at noon of summer for the same surface elements taking into account variable distance to the Sun and local solar elevation. Figure 2 presents the scatter plot of these two parameters for selected latitude bands of belts *II* and *III*. Simple linear approximation of these points (Figure 2) corresponds to the empirical relationship for the burial depth of water ice in the subsurface $h = k\,(W - W_o)$, where k=0.95 cm/(%) and W_o = 20%.

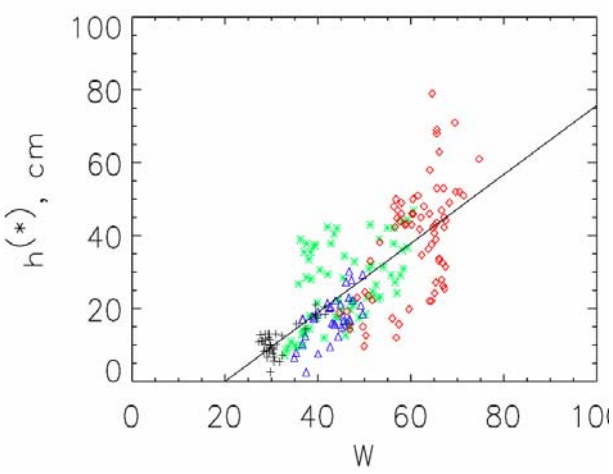

Figure 2. Scatterplot of estimated burial depth based on HEND neutron data and heating from sunlight according to near-IR albedo from MOLA (red, green, blue and black points corerspond to latitude bands (55°S – 60°S), (50°N – 55°N), (60° – 65°N) and (70° – 75°N), respectively)

Conclusions: One may conclude that burial depth of water ice in the latitude belts II and III corresponds to the condition of equilibrium between the condensation of water vapor from the atmosphere and sublimation of water ice due to heating from sunlight, as it was suggested in [9].

Moreover, correlation at latitudes >40° at belts *II* and *III* is thought to indicate on the presence of stable water ice in the subsurface, while neutron data displaces it at the higher latitudes.

Lastly, the absence of correlation in the belt *IV* points out that burial depth of water ice at the pole-

ward southern permafrost is not regulated by the equilibrium interaction with the atmosphere.

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