COMPARISON BETWEEN NORTH AND SOUTH NEAR POLAR REGIONS OF MARS FROM HEND/ODYSSEY DATA. M.L. Litvak[1], I.G. Mitrofanov[1], A.S. Kozyrev[1], A.B. Sanin[1], V. Tretyakov[1], W.V. Boynton[2], D.K. Hamara[2], C. Shinohara[2], R. S. Saunders[3], D. Drake[4], [1]Space Research Institute, RAS, Moscow, 117997, Russia, max@cgrsmx.iki.rssi.ru, , [2]University of Arizona, Tucson, AZ 85721, USA, [3]Jet Propulsion Laboratory, Pasadena, CA 91109, USA, [4]Lansce 3, Los Alamos Nat'l Lab. Los Alamos, NM and TechSource Inc, Santa Fe, NM 87594, USA.

Introduction: The two years of neutron mapping measurements onboard Mars Odyssey spacecraft are presented based on High Energy Neutron Detector (HEND) observations. HEND instrument is a part of GRS suite responsible for registration of epithermal and fast neutrons originating in Mars subsurface layer [1,2]. The scattering of fast neutrons in Mars surface caused by primary cosmic rays is strongly sensitive to presence of hydrogen atoms. Even several percents of subsurface water significantly depress epithermal and fast neutron flux [3,4]. It turns orbit neutron spectroscopy into one of most efficient methods for finding distribution of subsurface water.

There is direct correspondence between energy of registered neutron and depth where it was produced. The production rate of fast neutrons has maximum at depths less than tens of centimeters while the epithermal neutrons originate in layer placed 1-3 m below the surface. Combining measurements in epithermal energy range with measurements above 1 MeV one may reconstruct the water abundance distribution at different depths starting from thin subsurface layer and going down to several meters depths. It allows to check simple model describing layered structure of regilith.

It is known that North and South near polar regions are affected by global redistribution of atmospheric CO_2. The maximal thickness of CO_2 snow depth may be as high as 1 m at latitudes close to martian poles[5]. It explains why neutron flux above martian poles significantly varies from summer to winter seasons. It occurs because CO_2 frost hides upper surface layer from the orbit observations. This fact was used to estimate thickness of CO_2 deposit at different latitudes[6,7]. Here we suggest to make comparison between martian near polar regions in both ways as in terms of subsurface regolith structure as in terms of distribution of CO_2 deposits.

Data Analysis. To realize this approach we split our study in two steps. On first one the summer data were processed when surface was free from seasonal CO_2 frost. It helps us to find best fit parameters describing regolith structure in given region. To do it two layers model was applied to the data. It consists of relative dry (~2% of water) upper soil layer covering the bottom water ice rich layer. The thickness of upper layer and content of water in bottom layer were used as free parameters. To convert orbital measurements to real values of neutron flux near Mars surface we should to take into account atmosphere thickness above observed region. The orbital measurements are accumulated each ~ 20 sec and gathered from large surface area. The sizes of this footprint area may be as large as 600 km x 600 km. To avoid complicated model-dependent analysis how neutron flux is distributed inside footprint area we split Mars near polar regions into large areas with sizes which are more than HEND footprint. The thickness of martian atmosphere was taken from Ames Global Climate Model.

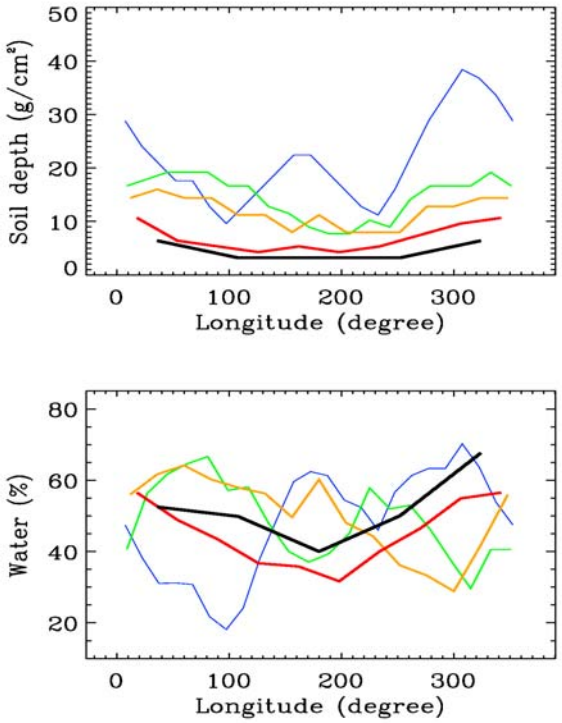

Fig 1. The content of water ice and thickness of soil deposit above it are shown for North region. Black color corresponds to 80°-90° latitude belt. The red, yellow, green and blue colors correspond to 75°-85°, 70°-80°, 65°-75°, 60° -70° latitude belts.

In this study we restrict ourselves by studying regions near Mars poles above 60 degrees for each hemisphere. It was done by two reasons. At first, observation of these regions demonstrates presence of enormous amount of water in subsurface layer [1,2,8,9]. At

second, The south and north regions are highly affected by seasonal CO_2 global circulation process. The CO_2 snow depth varied from tens of cm up to ~1m at the selected latitudes.

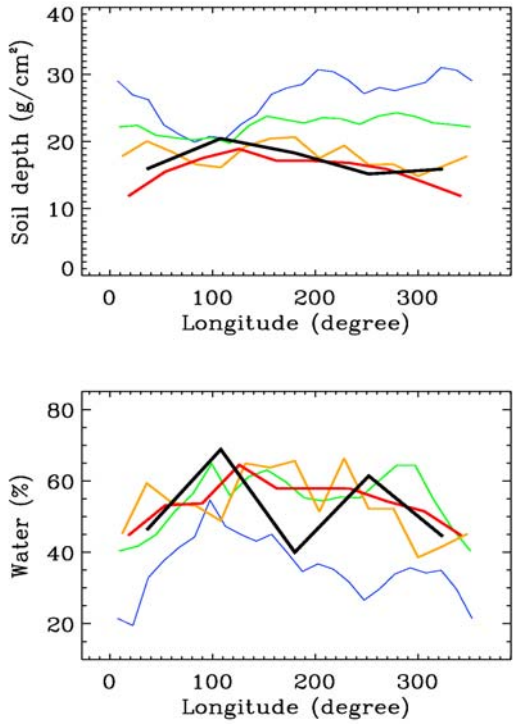

Fig 2. The content of water ice and thickness of soil deposit above it are shown for South region. Black color corresponds to 80°-90° latitude belt. The red, yellow, green and blue colors correspond to 75° -85°, 70° -80°, 65° -75°, 60° -70° latitude belts .

On second step of our study we fixed best fit parameters for each selected area and implemented additional layer of neutron production which should simulate CO_2 deposit. Fitting the HEND data for different winter seasons we tried to find the best fit thickness of this layer.

Conclusions: Comparison between north and south regolith structures show that south and north near polar regions contain comparable content of subsurface water ice. But on south the ice rich layer is placed significantly deeper in comparison with north areas (see fig 1 and fig 2). The minimal depth of bedding of water ice for North was founded equal ~ 3 g/cm^2. For south region this value was estimated more then 10 g/cm^2.

Model estimations of winter CO_2 deposit shows that thickness of snow layer may achieve up to 1 meter on South while snow depth on North do not exceed 80-85 cm. The distribution of south CO_2 deposit also shows more complicated and irregular behavior then on north.

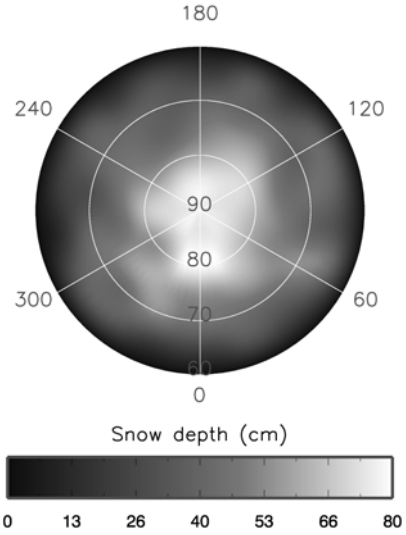

Fig 3. The Map of CO_2 deposit are shown for north region of Mars.

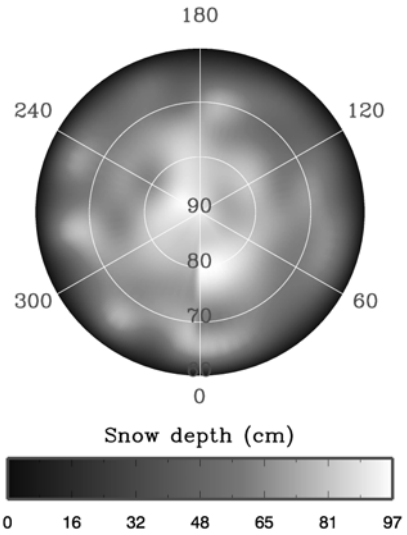

Fig 4. The Map of CO_2 deposit are shown for south region of Mars.

References:

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