EVIDENCE OF THE SEASONAL REDISTRIBUTION OF WATER IN THE SURFICIAL MARTIAN REGOLITH BASED ON ANALYSIS OF THE HEND MAPPING DATA.

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Introduction. The global mapping of the neutrons emission from the Mars, conducted recently by HEND instrument from "Mars Odyssey" spacecraft, have shown that the surface layer (1-2 m) on the high latitudes of the planet (up to 50°) is very reached by water ice with abundance more 50% by mass [1,2,3]. It was also shown that water ice distribution in surficial layer of the northern and the southern sub-polar regions is notably different [4]. Until today the existing HEND data already covers the period more then one the Martian year. This let to study the seasonal effects of volatiles redistribution associated with processes of sublimation and condensation of the seasonal polar caps and water exchange between the surface regolith and atmosphere. The goal of our work was to analyse the dynamic of the globally mapped neutrons flux as key to understanding of the seasonal redistribution of the water ice in the surface layer. For this we analyzed the globally mapped flux of the neutrons with different energy and corresponding effective layer of their emission.

Observations. The global mapping of the neutrons emission from Mars has been realized at different energy ranges of the neutrons: by two ranges for both epithermal (100eV-10keV and 10keV-1MeV) and fast neutrons (1Mev-2.5Mev and 2.5MeV-10MeV). The corresponding effective layers from where the neutrons emitted are equal to ~1.5-2 m, ~1m, 20-30 cm and ~10 cm respectively for indicated energy ranges. We analyzed the data as function of areocentric longitudes (Ls) and the latitude. The data were averaged in 10° range of latitude and in 15° range of Ls and have been normalized to the neutrons flux emitted from Solis Planum as the driest region on Mars. Using the data, the maps of the normalized neutrons flux dynamic (for different energy ranges) as function of Ls and the latitude were created (fig.1). Analyses of the maps has shown that the dynamic of the most low-energy epithermal neutrons flux (100eV-10keV with effective layer 1.5-2 m) on the high latitudes

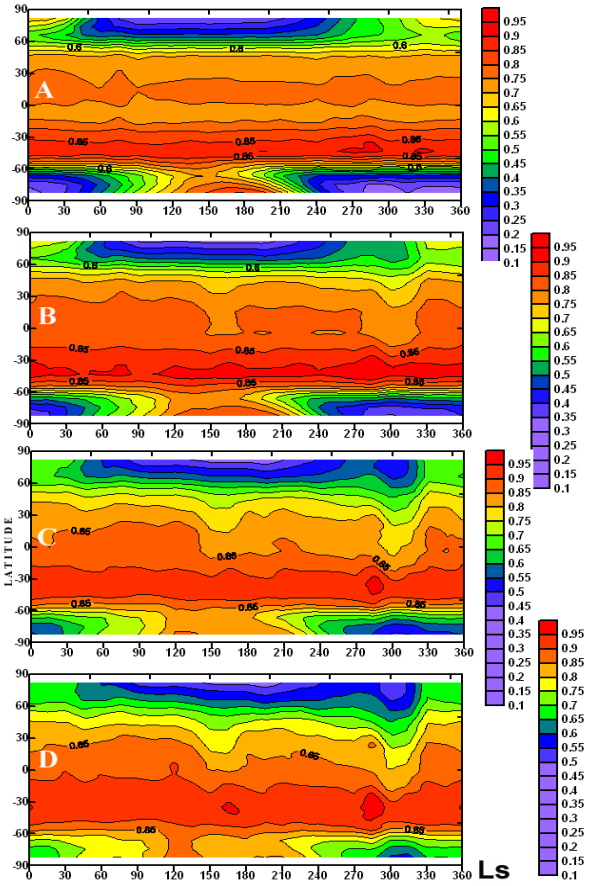

***Figure 1.** The maps of the normalized neutrons flux dynamic during one the Martian year for different neutrons energy ranges. For epithermal neutrons (100eV-10keV (a) and 10 keV-1MeV (b)) and fast neutrons (1Mev-2.5Me (c) and 2.5MeV-10MeV(d)).*

of both sub-polar regions of Mars is well consistent with sequence of sublimation and condensation processes in the seasonal polar caps (fig.1a). The flux of the epithermal neutrons consequently increases during condensation of the seasonal polar caps (CO_2 –ice cover) and approach the most minimal value during complete

sublimation of the caps. At that, on the latitudes less of 60° the neutrons flux is mostly constant during all year. Other situation is found for the dynamic of higher energy epithermal and fast neutrons flux (with thinner effective layers of the neutrons emission): in the northern hemisphere it remarkably different than in southern hemisphere. As it well seen from fig.1b,c,d, two distinctive "hollows" of neutrons flux reduction have been appeared in the northern hemisphere during northern summer at Ls=130°-170° and in first half of northern winter at Ls=270°-330°, being extended from high to low latitudes. At that, later "hollow" (Ls=270°-330°) is characterized by much stronger reduction of the neutrons flux and it traces from northern polar region up to low latitudes in the southern hemisphere. The first "hollow" is related with periods of the northern middle summer, while the second one – with of the southern middle summer. In both case the residual polar caps serve as main source of the water in the Martian atmosphere. It is remarkable that during period with Ls=270°-330°, when the seasonal cover of CO_2- ice must be formed on the latitudes >60°N, the noticeable decreasing of the neutron flux is observing in both the sub-polar and middle-latitude regions. Observing reduction of the neutrons flux in the northern sub-polar region represents the sagging on background of monotonic increasing of the neutrons flux in the autumn/winter period (Ls 200°-360°) associated with growing of seasonal cover from CO_2-ice. At that, there is the next distinct tendency: the higher energy of the neutron (or thinner the effective layer), the much stronger reduction of the neutrons flux is observing (fig.2). As it seen from fig.2, the percentage of the neutrons flux reduction (in each energy range) increases very slowly in the latitude range 90°N-70°N and much intensively in 70°N-60°N, being constantly higher on the higher latitude and in most shallow effective layer.

Discussion. Because the value of the neutrons flux are sensitive to water abundance in the surface layer [5], the observing effect of the neutrons flux reduction may to be considered as indicator of some temporal increasing of the water content in the surface layer in the time range of the year. It is known [5] that even increasing of the water abundance in the surface material on 1% of mass may result to reduction of the emitted fast neutrons approximately on 10%. The observing maximum

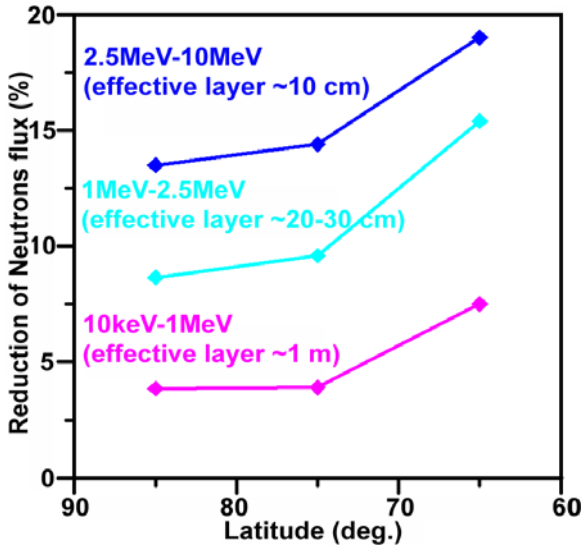

Figure 2. ***Reduction of the neutrons flux value (in %) in the northern sub-polar region during period Ls = 270°-330° for different energy ranges.***

value of the reduction of the higher energy fast neutrons flux (in the period with Ls=270°-330°) approaches ~ 20%.That is the abundance of the water (in form of water ice or clathrate $CO_2 \cdot 6H_2O$) in ~ 10 cm thickness surface layer could be increased notably in the period on. As water source for this apparently serves the water vapor mass transferred meridionally to here from residual southern polar cap due to the significantly lower partial pressure of H_2O over the cold surface of the northern seasonal cap and its surrounding region. We suggest that the visible reduction of the neutrons flux outside of the seasonal cover of the CO_2-ice (up to the equatorial regions), may to be associated with both condensation of the H_2O frost on the surface and hydration of a salts minerals (mostly sulfates and chlorides) contained in the surface layer of the regolith. The neutrons flux reduction observing in the period Ls=130°-170° is rather associated with hydration process in the surface regolith due to high atmospheric humidity in the period.

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