TWO SUCCESSIVE MARTIAN YEARS ON THE ORBIT: SIMILARITIES AND DIFFERENCES OF CO_2 SEASONAL CYCLE 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], [1]Space Research Institute, RAS, Moscow, 117997, Russia, max@cgrsmx.iki.rssi.ru, [2]University of Arizona, Tucson, AZ 85721, USA, [3] NASA Headquarters, Washington, DC 20514, USA.

Introduction. The three years of Mars Odyssey successful work on the martian orbit provide a lot of new information about peculiarities of long term variations of CO_2 seasonal cycle. To start such analysis we have used observations of neutron albedo of Mars obtained by High Energy Neutron detector (HEND) mounted onboard Mars Odyssey spacecraft.

The high latitude northern and southern regions of Mars are affected by global redistribution of atmospheric CO_2 which resulted in 25% of atmospheric mass condensed on martian surface of these regions during winter period of time [1]. The seasonal deposit is formed starting from 60N/60S latitudes and achieve its maximal thickness about 1 m at latitudes close to martian poles [2]. Changes of CO_2 deposit thickness is the reason for significant variations of neutron flux above martian poles from summer to winter seasons because CO_2 frost effectively hides upper water rich surface layers from the orbit observations in neutrons and gamma-rays. This effect was used to estimate column density of CO_2 deposit at different latitudes [3-6] on North and South of Mars and reconstruct multidimensional model of CO_2 deposit showing how snow depth varies as function of latitude, longitude and time [6].

In this presentation we tried to make a next step in our study of martian seasonal CO_2 cycle and look for similarities and differences between two successive martian years.

Data Analysis. On fig 1 and fig 2 we have presented several seasonal curves of neutron flux created in different energy ranges for previous and current martian years. All curves present derived HEND data (background subtracted data with reduced solar events) normalized to the data observed at Solis Planum. Such data reduction gives us possibility to avoid variations of neutron flux caused by long term changes of CGR flux and possible instabilities in HEND detectors behavior.

It is easily seen that there are as local as global differences between observations made for successive martian years. The smallest discrepancy is observed in low energy epithermal neutrons which characterize the soil layer with thickness up to 1 m. Its seasonal curves (top graph on fig. 1 and fig. 2) created for different years have tendency to repeat each other.

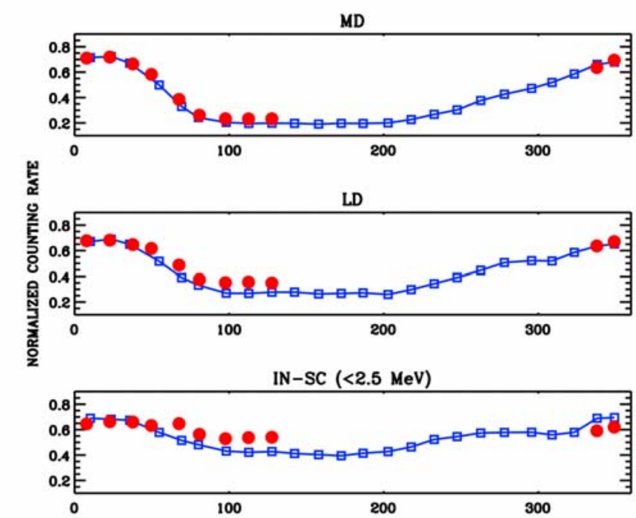

Fig. 1. Seasonal curves of neutron flux in different energy bands. The Y axis corresponds to the normalized counting rate in different HEND detectors and X axis describes the martian seasons measured by L_s. The top and middle graphs are created for MD and LD HEND detectors (epithermal neutrons) and the bottom graph corresponds to observations in soft channels of IN-SC detector (fast neutrons). The blue color was used for illustration of data points of the previous martian year and red color corresponds to observations performed during current martian year.

But the increasing of neutron energy (more thin soil layer of neutron production in comparison with low energy epithermal band) leads to more distinct discrepancies between different year's observations. For northern hemisphere it is mainly resulted (except several local differences in accumulation and sublimation of CO_2 deposit) in different level of neutron signal during summer period of time which may be discussed in terms of different water composition of regolith and martian atmosphere for similar seasons of different martian years (see middle and bottom graphs on Fig 1). In southern hemisphere the differences between two successive years of observations are smaller then at northern hemisphere and may be characterized as a larger (by 5-10%) thickness of CO_2 deposit (see middle and bottom graphs on Fig 2).

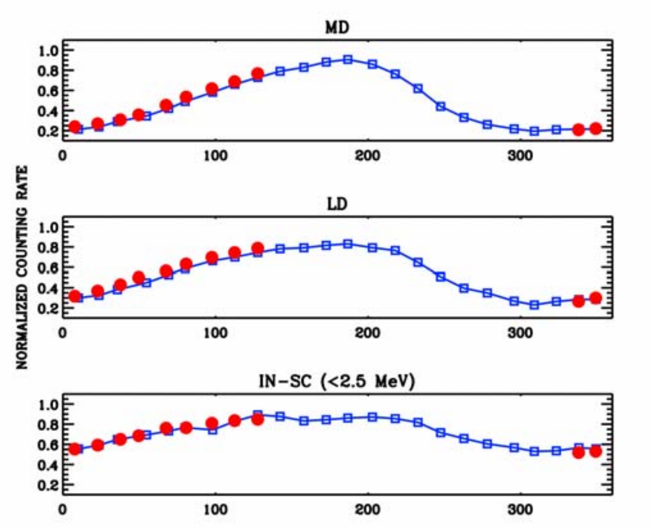

Fig. 2. Seasonal curves of neutron flux in different energy bands for southern polar region 80S-90S. The Y axis corresponds to the normalized counting rate in different HEND detectors and X axis describes the martian seasons measured by L_s. The top and middle graphs are created for MD and LD HEND detectors (epithermal neutrons) and the bottom graph corresponds to observations in soft channels of IN-SC detector (fast neutrons). The blue color was used for illustration of data points of the previous martian year and red color corresponds to observations performed during current martian year.

Conclusions. The presented comparison are only initial efforts directed to the understanding of long term stability of annual seasonal changes happened on Mars. But it has already revealed that neutron observations may be considered as a very sensitive technique for studying not only annual redistribution of atmospheric CO_2 mass between martian poles but also as additional instrument for analysis of long term variation of martian CO_2 and water cycles.

References:

[1] Forget, F. and Pollack, J. (1996) *J.Geophys. Res.*, 101**,** 16865-16879. [2] Smith D.E. et al (2001) *Science*, 294, 2141-2146. [3] Mitrofanov I.G. et al. (2003) *Science*, 300, 2081-2084. [4] Feldman, W. C., et al. (2003) *J. Geophys. Res*., 108. [5] Litvak M.L. et al. (2003) *Solar System Research*, 37, 5, 378-386. [6] Litvak M.L. et al. (2004) *Solar System Research*, 38, 3, 167-177.