SEARCH FOR CHEMICALLY BOUND WATER IN THE SURFACE LAYER OF MARS BASED ON HEND/MARS ODYSSEY DATA. A. T. Basilevsky[1], M. L. Litvak[2], I. G. Mitrofanov[2], W. Boynton[3], R. S. Saunders[4]. [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Moscow, 119991, Russia atbas@geokhi.ru; [2]Institute for Space Research, RAS, Moscow, 117997, Russia; [3]University of Arizona, Tucson, AZ 85721, USA. [4]Jet Propulsion Laboratory, Pasadena, CA 91109, USA.

Introduction. This study is emphasized on search for signatures of chemically bound water in surface layer of Mars based on data acquired by High Energy Neutron Detector (HEND) which is part of the Mars Odyssey Gamma Ray Spectrometer (GRS). Fluxes of epithermal (probe the upper 1-2 m) and fast (the upper 20-30 cm) neutrons, considered in this work, were measured since mid February till mid June 2002. First analysis of this data set with emphasis of chemically bound water was made by (1). Early publications of the GRS results (2,3,4) reported low neutron flux at high latitudes, interpreted as signature of ground water ice, and in two low latitude areas: Arabia and SW of Olympus Mons (SWOM), interpreted as "geographic variations in the amount of chemically and/or physically bound H_2O and or OH…" (3). It is clear that surface materials of Mars do contain chemically bound water (5,6). but its amounts are poorly known and its geographic distribution was not analyzed.

The approach. Because HEND data can not distinguish free water from chemically or physically bound water we search for chemically bound water in the areas where presence of water ice is unlikely. This is why we analyze areal distribution of the epithermal and fast neutron fluxes for the ±60° latitude zone that is ±40° belt, where ground ice is expected to be absent (7,8), plus additional 20° poleward belts, where signatures of chemically bound water may potentially be seen. The Figure on the following page shows maps (top to bottom) of epithermal and fast neutrons fluxes, MOLA topography, thermal inertia (9) and bedrock geology (10,11,12) for this zone as well as maps of epithermal and fast neutron fluxes for smaller areas of specific interest (at the Figure right).

Flux of epithermal neutrons. It is prominently low (0.04-0.10 count/s) at 180-280°E at the northern margin of the ±60° zone and at 30-180°E at its southern margin and rather low (0.10-0.15 count/s) within Arabia Terra and geographically antipodal to it SWOM area. Very large area from 50°S to 50°N and from 250° to 330°E shows relatively high thermal neutron flux (0.20-0.26 count/s). The rest of the territory in the zone shows intermediate flux (0.15-0.19 count/s) with sporadic lower and higher values. As a rule, this flux distribution correlates neither with surface elevation, nor with thermal inertia, nor with bedrock geology. Only for Arabia and SWOM there is correlation with geology (see below). For Arabia, correlation with thermal inertia is also seen (Figure).

Flux of fast neutrons. Its geographic distribution differs from that for epithermal ones. In the northern part of the ±60° zone there is vast area of relatively low flux (0.10-0.15 counts/s) with values gradually increasing to the south. Its southern boundary follows not a specific latitude but rather to –1 km contour line (thin pink lines on the fast neutron map). At the south of the ±60° zone, the area of low (0.06-0.14 counts/s) flux is observed mostly at 40-150°E longitude range, also showing the latitude-altitude control of its equatorward boundary while at other longitudes of the south the altitude control seems not to work (Argyre). Terra Arabia and partly SWOM, so different from their surrounding in low epithermal neutron flux, show no noticeable difference of that sort in fast neutrons. The region with high epithermal neutron flux (50°S-50°N, 250°-330°E) shows mostly intermediate flux of fast neutrons (except Solis Planum where the flux is high). For the rest of the ±60° zone, typical values of fast neutron flux are 0.15-0.17 with sporadic higher and lower values.

Neutron flux at Viking 1,2 and Pathfinder sites, in the area of Sinus Meridiani hematite deposit and in "Stealth" area. Flux of epithermal neutrons at the Viking 1 site, western Chryse Planitia (V1 in the Figure), is rather high (0.18-0.20 counts/s) while fast neutron flux is rather low (0.12-0.14 counts/s), the latter is obvious seasonal effect. Mars Pathfinder site, SE Chryse Planitia (Pf in the Figure), also shows high (0.18-0.20 counts/s) epithermal neutron flux and low (0.13-0.15 counts/s) flux of fast neutrons, also seasonal effect. More poleward Viking 2 site at Utopia Planitia (V2 in the Figure) shows low flux both for epithermal (0.12-0.14 counts/s) and fast (0.10-0.13 counts/s) neutrons, both obviously due to seasonal effect. The area of hematite deposit in Sinus Merediani (13) (SM in the Figure) shows no specific signature both in epithermal (E) and fast (F) neutrons (Figure lower right). "Stealth" area (thick pink boundary south of Olympus Mons) shows no specific signature both in epithermal and fast neutrons too.

Discussion and conclusions. Low flux of *epithermal* neutrons along the poleward margins of the ±60° zone is obviously due to ground ice (2,3,4). Terra Arabia and SWOM areas have easily eroded by wind deposits considered by (14) as remnants of ancient polar layered deposits. *Here low epithermal neutron flux is probably due to relatively high contents of chemically bound water* (clays? hydroxides? hydrated salts?). The alternative explanation considered as possibility by (1): stability of ground ice at low latitudes in low thermal inertia material (15), seems to be rejected by relatively high neutron fluxes in Stealth area (see Figure), which has rather thick low thermal inertia surface mantle (16). Except Arabia and SWOM, no correlation of epithermal neutron flux with bedrock geology was found. Chryse Planitia (Viking 1 and Pathfinder sites), which was believed to be the ocean bay (16), instead of expected low epithermal neutron flux, shows rather high flux. Similarly, the area of Sinus Meridiani hematite deposit, supposedly formed in water-rich environment (13) does not show low neutron flux. All this means that *the 1-2 m thick surface layer, where the the epithermal neutron flux forms, is not compositionally linked (at least, in chemically bound water contents) to the underlying bedrock being part of a surface mantle, well mixed laterally*. To study this mantle, an analy sis of high-resolution MOC images is required (18). The HEND data show also that *the contents of chemically bound water in the majority of ice-free areas are higher than at the Viking and Pathfinder sites*. The *fast* neutron flux shows no correlation with the bedrock geology even in Arabia and SWOM. This implies that *the 20-30 cm thick surface layer is even less compositionally linked to the bedrock and better laterally mixed than the lower part of the surface mantle.*

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