

## WATER CONTENT IN THE ARABIA SOIL

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**Introduction.** Analysis of neutron and gamma-ray data from NASA's Mars Odyssey mission has proved the presence of water in the soil poleward of about 60° latitude and also in the soil of two diametrically opposite equatorial regions in Arabia and Memnonia [1-3]. Content of water in the poleward regions varies from 20 – 30 wt% up to about 50 wt%, which clearly indicates that water is solid ice, as the surface-forming substance in these regions. For equatorial Arabia and Memnonia the form of water in the soil is not clear: it hardly can be water ice (see however [4]), and more likely is either adsorbed water or chemically bound water in the regolith (see discussion in [5]). The choice between these options is a clue to the origin of these two water-rich regions on the equator.

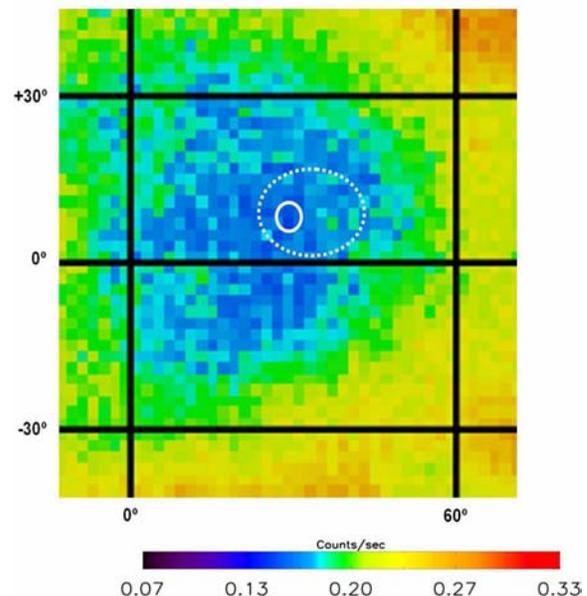
**Data Analysis.** Neutron data are known to be very sensitive for detection of hydrogen within heavy soil-forming elements: the addition of as little as 100 ppm into a "standard" soil leads to decrease of flux of epithermal neutrons by about 5%. However, these data should be subject to very careful analysis because there are many physical factors, other than the content of hydrogen, which influence the neutron flux and which should be taken into account (changes of galactic cosmic rays, changes of thickness of atmosphere, etc.). Also, these model estimates depend on a layered structure of the irradiated subsurface. Therefore, the accuracy of neutron mapping data corresponds to the accuracy and reliability of the neutron data deconvolution.

In this paper we will apply these methods to two locations in the Arabia region (Figure 1): the spot at (30°E, 10°N), which corresponds to the absolute minimum of epithermal neutrons within the equatorial belt (solid circle), and to the larger region to the east, which corresponds to the maximum flux of hydrogen line emission at moderate latitudes (dashed circle).

We use HEND mapping data for four years in 2002-06 for this analysis, which correspond to about 5000 detected neutrons from each individual pixel 2°x2° at the equator. The HEND instrument on NASA's Mars Odyssey provides 3 independent measurements of epithermal neutrons with different energy ranges and 16 measurements of high energy neutrons of about 600 KeV [5]. These data will be analyzed separately for season intervals  $\Delta L_s = 15^\circ$ ,

which allows us to take into account long-term variations of cosmic rays and seasonal variations of the thickness of atmosphere.

**Expected Results.** Three models of soil composition will be examined for estimation of water content: the Depth-Homogeneous (DH) model, Double Layer (DL) model and Gradient Layer (GL) model. The estimation based on DH model corresponds to lowest limit of the content of water in the layer of neutron production.



**Figure 1:** HEND map of epithermal neutrons from Arabia. White circle and dotted circle represent minimum of neutron flux and maximum of gamma-ray flux at 2.2 MeV, respectively

However, the rich statistics of HEND data allows us as well to test the models with layered structure DL and GL. These two models assume drier soil in the top layer, and therefore, they correspond to some higher content of water in the deeper layer in comparison with the prediction based on DH.

The HEND data analysis will allow us to determine the best model of soil in Arabia among DH, DL and GL, and using this model to provide the most reliable estimation of content of water  $\zeta^{(s)}$  in the Arabia soil.

The identification of the state of the water in Arabia could be based on accurate quantitative

estimation of the content  $\zeta$  of detected water: there are definite limits for each physico-chemical model of regolith for each state. In general (e.g. see [6]), a small content of a few wt% corresponds to physically adsorbed water, some larger values of  $\zeta$  up to 10 – 15 wt% indicates to the chemically bound water, and for  $\zeta$  larger than 15 – 20 wt% the only possibility is water ice.

**References:**

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