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Mapping of Mars neutron emission after seven years of observations by HEND instrument onboard NASA's Mars Odyssey

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Since February 2002, HEND instrument is performing orbital measurements of neutron emission from the Mars surface during seven years of orbital flight of NASA's Mars Odyssey. Very large statistics of counts is accumulated at each elementary surface element for very broad neutrons energy range from 0.4 eV up to 15 MeV, which allow to measure both surface variations and temporal changes of neutron emission of Mars with very high accuracy.

This data is used for mapping of surface distribution of hydrogen over the entire surface of the planet. The hydrogen map is transformed into the maps of water ice distribution at high latitudes of Mars, and it is also used for estimation of abundance of phylosilicates and another water-rich minerals in the selected regions at moderate latitudes of the planet. A spectrometric capability of HEND also provides the opportunity to study the layering structure of water-rich permafrost at high latitudes and to estimate the thickness of dry layer above the water-rich layer at these permafrost provinces. It is shown that different layering structure is the main distinction between southern and northern permafrost provinces of Mars.

Seasonal phenomenon of deposition of carbon dioxide was also studied using the HEND data for three successive martian years of orbital observations from Mars Odyssey. Time profiles of deposited mass of atmospheric carbon dioxide are presented for different latitude belts of seasonal caps at north and at south of the planet, and winter-to-winter variations of seasonal coverage at different latitudes are tested using this data. The orbital data from Mars Odyssey also allows to compare the process of CO2 deposition and sublimation for day and night time with different temperatures on the surface.

Finally, the data from HEND is used to characterize the neutron component of radiation environment over the Martian surface for different phases of solar activity and for episodes of powerful solar particle events. It is known that flux of galactic cosmic rays is modulated by variable condition in the outer heliosphera during the solar cycle, and measurements from Mars Odyssey have permitted to describe quantitatively the radiation environment on the Martian surface from the peak of last solar cycle to the current minimum before the next one.