AREAS WITH ENHANCED WATER CONTENT OBSERVED IN EQUATORIAL AREAS OF MARS THROUGH TGO'S FREND NEUTRON TELESCOPE. A. V. Malakhov, I. G. Mitrofanov, M. L. Litvak, A. B. Sanin, D. V. Golovin, M. V. Djachkova, S. Yu. Nikiforov, A. A. Anikin, D. I. Lisov, N. V. Lukyanov, M. I. Mokrousov, Space Research Institute, 84/32 Profsoyuznaya st., 117997, Moscow, Russia, malakhov@np.cosmos.ru.

Introduction: Fine Resolution Epithermal Neutron Detector, FREND [1], is an instrument onboard ExoMars' Trace Gas Orbiter (TGO) [2]. It measures neutron flux on orbit, which is a good characteristic of hydrogen content in the Martian subsurface up to 1-meter in depth. Similar spectrometers already flew onboard Mars Odyssey (HEND, NS and GS instruments all part of GRS suite [3]), but FREND's major characteristic is its neutron collimator. It narrows the instrument's field of view down to 60-200 km [1], allowing for mapping with higher spatial resolution.

Indeed, water content maps generated by previous instruments (HEND [4], NS [5] and GRS [6]) have characteristic spatial resolution of hundreds of kilometers [4]. Data obtained by FREND during its measurements between May 2018 and January 2021 allow to characterize water content on a scale of local relief features. This allows to estimate the water content for particular relief features on the surface, and also to analyze prospective landing sites.

Methodology:

Previous studies [4-6] generated global water content maps from which it is obvious that the largest water content on Mars is located on its poles, and equatorial areas are mostly dry. There were two extended equatorial areas, such as Arabia and Memnonia, which were clearly visible on these maps with water content around 10 wt%. Such values are most probably associated with adsorbed water or hydrated minerals, but not water ice.

A study performed on FREND data in equatorial areas identified several local areas, with characteristic size of hundreds of kilometers, showing water content of tens of wt% with high statistical significance relative to its immediate surroundings. We performed a global search within the ±40° latitude equatorial band for neutron flux suppressions content and identified local spots with enhanced hydrogen content. Next, a thorough analysis of such local areas was performed to assess water content and significance of these values [7].

Results:

Figure 1 shows an example of analysis performed for one of such locations, near the Ascraeus Mons. First, dry reference region is selected in the immediate surrounding of a local wet area identified in global search. Next, pixels between the two reference areas are grouped together ordered by decrease (e.g. from highest to lowest) of water content one by one until a 3σ confidence level relative to dry reference area is reached. This procedure is repeated until all pixels are processed. In case of the example on Figure 1, two concentric groups were identified in magenta and blue on Figure 1 with 20-100 wt% and 7-26 wt% water content, respectively.

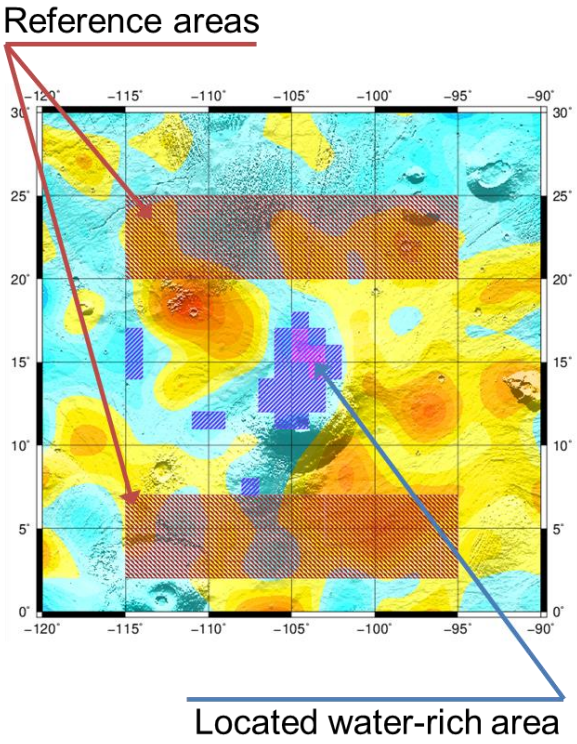

Figure 1. Water-rich area near Ascraeus Mons. Magenta and blue shading show the water-rich area pixels. Red shading shows areas used as local dry reference pixels used for statistical certainty estimation.

Conclusions:

Data presented in this report is based on the latest hydrogen measurements on Mars from orbit, although FREND's maps will improve with time as statistical certainties will grow. Search for new local water-rich areas will continue as new data is obtained. However, it is already possible to conclude that Martian equatorial regions contain a number of wet "oases" with tens of wt% water content accessible in the vicinity of surface for future exploration missions.

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