INHOMOGENEITIES IN THE UPPER LEVELS OF THE MARTIAN CRYOLITHOSPHERE; R.O. Kuzmin, N.N. Bobina, E.V. Zabalueva, and V.P. Shashkina, Vernadsky Inst., U.S.S.R. Acad. Sci., 19 Kosygin St., Moscow, 117975.

By studying the nature of Mars during the past decade it has become clearly known that most of the free water on the planet is present in the form of ice (and possibly brine) in the permafrost zone of the planet's crust (1–3). For that reason, studies of the structural characteristics of the cryolithosphere are essential for understanding the character of water ice distribution and it's abundance in upper layers of the martian crust.

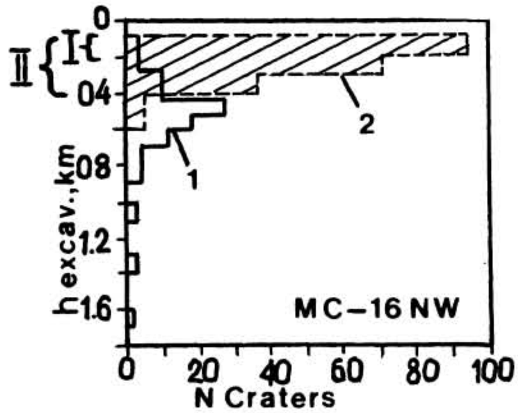
The aim of our investigation was to distinguish inhomogeneities of the cryolithosphere formed by different amounts of ice present in sub-surface rocks during the geological history of Mars. For this work we used the crater method proposed earlier and the morphological study of craters with fluidized ejecta (4). In our investigations only fresh craters with fluidized ejecta were looked upon as basic morphological indicators of excavation into ice masses in sub-surface rock. On the basis of analysis of 127 photomaps at 1:2,000,000 scale, morphological and morphometrical parameters of all fresh craters larger than 1 km in diameter both with fluidized ejecta (9089 craters with D = 1 to 60 km) and without fluidized ejecta (14630 craters with D = 1 to 10 km) were investigated. The crater excavation depths were estimated using empirical formulas based on measurements of crater shadows and the sun angle (5).

Using these crater parameters, the roof depths of ice-bearing rocks were estimated (Fig. 1) and data on the relative ice content in the excavated permafrost layers (6) was obtained. These data were used to compile maps of the boundary depth (minimal and mean) between the ice-free near-surface layer and ice-bearing rocks. One can deduce from these maps (Fig. 2) that the zone of the most desiccated near-surface rocks on Mars is in the latitudinal belt of +30°, where maximum roof depths to the ice-bearing rocks varies from more than 300 to more than 400 meters. At 30° latitude the roof depth decreases to 200 meters and at 50° latitude it decreases to 50 to 100 meters. As a rule, the maximum roof depths in the 30° latitudinal belt are localized in either the highest areas (e.g. Syria Planum, Noctis Labyrinthus, Elysium Planum) or in the oldest and highest areas of the cratered terrain within the southern highlands.

It was found that the thickness of ice-free rocks in the southern hemisphere is greater than in the northern hemisphere (20% and 38% at 15°S and 60°S respectively). As seen from Figs. 3 and 4, the axis of the zone with the maximum roof depths is not at the equator, but is shifted to 10°–15°S. The tendency towards latitudinal zonality observed on both the maps of the minimal and mean roof depths may be considered an indicator of the structural stability of upper horizons of the martian cryolithosphere down to depths of 300 to 400 meters. The latitudinal dependence of the roof depth to ice-bearing rocks reflects a general planetary trend since the the excavation depths of the craters under study were averaged within a 15° latitudinal range. In the regional aspect, the upper levels of the cryolithosphere have a more complex structure. A great variety of factors such as local geological conditions, terrain level, and the difference in rock lithology may affect observed structure in the upper levels of the cryolithosphere.

The data obtained may be useful for selection of landing sites for Mars sample return missions and for future radar sounding of the martian permafrost layer.

References: 1. R.O. Kuzmin, (1983) Nauka, Moscow (in Russian). 2. F.P. Fanale et al., (1986), Icarus, 67, 1-18. 3. M.H. Carr, (1986), Icarus, 68, 187-216. 4. R.O. Kuzmin, (1980), LPSC XI, 585-586. 5. R.J. Pike, (1981), LPSC XII, 839-841. 6. R.O. Kuzmin et al., (1988), LPSC XIX (this volume).



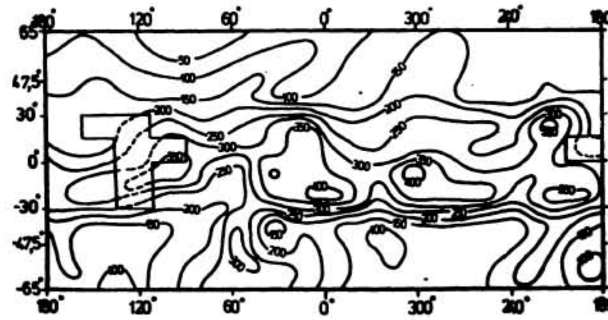


Fig.2a

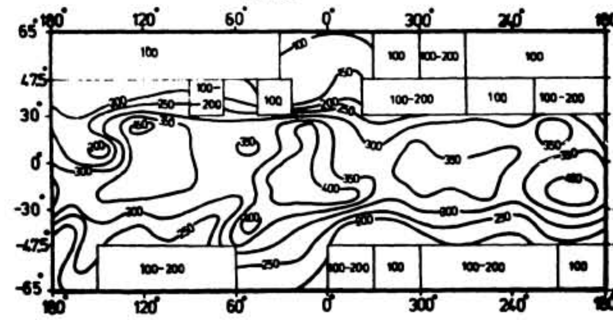
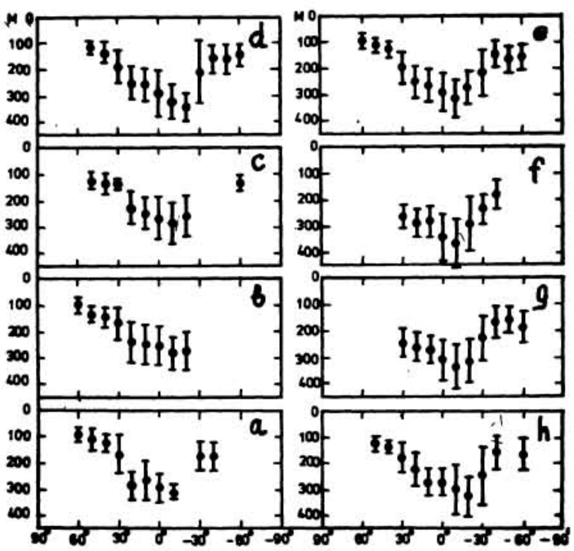


Fig.2b

Fig.1. Estimation of te minimal (I) and mean (II) roof depth of ice-bearing rock; 1 and 2 – distribution histograms of the craters with fluidized ejectas and without it, respectively.

Fig.2. Maps of the minimal (a) and the mean (b) roof depth (meters) of ice-bearing rock.



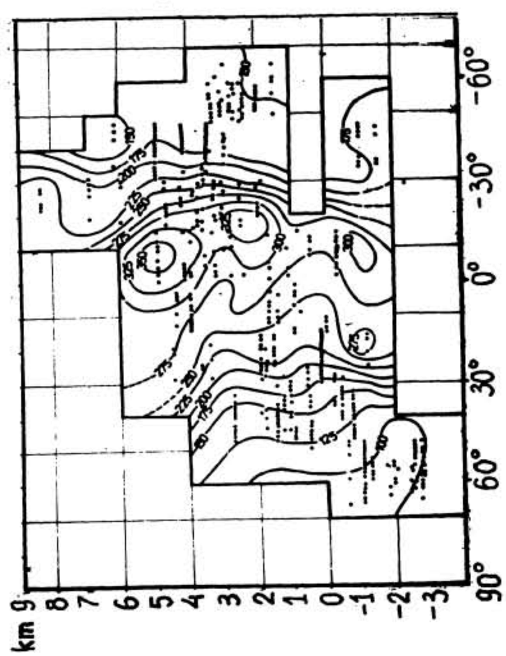


Fig.3. Minimal roof depth of ice-bearing rock as a function of the latitude on different elevations: a – -1 km; b – 0 km; c – 1 km; d – 2 km; e – 3 km; f – 4 km; g – 5 km; h – planet's mean.

Fig.4. Mean values of the minimal roof depth of ice-bearing rock as a function of the latitude and the elevation. Dots are the real values of the minimal roof depth.