



## The inter-ground massive ice sheet in the bottoms of Valyok Valley (Norilskaya River)

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Inter-ground massive ice sheet is a wide spread phenomena in many regions of permafrost zone and in Norilsk area (North of Middle Siberia) as well. Here they are located at the 2nd terrace of the Norilskaya River where in lateral piedmont parts of the valley buried glacier sheet ice occurs. High ice content and occurrence of ice sheets and ice wedges are the reasons of thermokarst, thermoerosion and cryogenic landslides development on coasts of rivers and lakes.

The Valyok Valley (lacustrine-alluvial terrace of the Norilskaya River) is located in the intermountain depression limited by the Putorana Plateau offshoots from the north, east, south and south-west. To the north-west it spreads towards the Pyasino Lake. In the Late Pleistocene and Early Holocene the valley was occupied by the cold fresh-water lake and ancient permafrost melted. After the water retreat 9000-8000 years B. P., epigenetic freezing began. The lower part of sediments of this epoch (al III34 vl – al-b IV vl) is represented by bandy clay covered by loam and loamy-sand deposits on the plain and by loamy-sand and gravel deposits in the piedmont part. The surface on many sites is composed of peat up to 2-3 m thick containing ice wedges. For epigenetically frozen sediments of the Valyok formation, high ice content (i up to 30-60% by volume) in upper layers is characteristic. In buildings construction, dangerous ground subsidence resulted from ice-rich deposits thawing may occur. At the same time, a contrary tendency was marked.

In engineering prospect in 1970, before construction of large building of a suburban ski base, ice-rich clay of lattice cryostructure (i = 25 – 40 %) was found near the surface and at the depth of 8-12 m, a massive ice sheet 3,2 m thick was discovered. Temperature measurements (5 November, 1970) detected that the permafrost here is in the degrading state and lattice cryostructure formed under colder thermal conditions of Holocene age. Besides, thawing and thawed ground below the depth of 9-11 m was disclosed.

Temperatures measured 5, November, 1970, were as follows: 1m - [U+F0B1] 0,0; 2 m - -0,2 ; 3 m - -0,2; 4 m-0,2; 5 - -0,1; 6 m - -0,1; 7 m - -0,2; 8 m - -0,2; 9 m - [U+F0B1] 0,0; 10 m - [U+F0B1] 0,0; 11 m - + 0,1; 12 m - [U+F0B1] 0,0; 13 m - + 0,1; 14 m - +0,1

Natural ventilating of cold cellar resulted in gradual ground cooling and after 24 yeas of the building operation the clay ground is in the stable frozen state and it's bearing capacity is secured. Temperatures measured 29, July, 2004, were as follows: 1 m - -0,8; 2 m- -1,2; 3 m -1,3; 4 m -1,5; 5 m - ,7; 6 m- -20; 7 m - -2,; 8 m - -2,2; 9 m - -2,1; 10 m - -2,1 Thus, in the Norilsk region, ice rich deposits frozen after the Holocene thermal optimum, are often in the state of degradation but the cold ventilated cellars construction may reduce risk of permafrost thawing and dangerous thermokarst processes development.

During the field works in 1999-2004 were explored exposures of inter-ground massive ice, which were found in cirques in the right river-bank of Norilskaya River and also in the coasts of inherited (Valyok Lake) and in modern thermokarst lakes. it has been established that thickness of inter-ground massive ice are from 0,5-1 m to 8-10 m, and maximum rates typically for buried glacier ice piedmont part of Norilsk. In the cirque with diameter 40 m. which situated in 3,2 km to the east from the bridge over the Norilskaya was found and described exposures of inter-ground massive ice with the length 60 m in diameter and with maximum thickness 1,7 m. For describing this exposure we used six pickets in a circumferential direction of this cirque.