



Debris-covered glacial forms and dynamics of glaciers of the Mongun-Taiga mountain massif (Altai-Sayan mountain system).

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Mongun-Taiga mountain massif (3970 m) is situated in the intersection of Altai and Sayan mountain ridges. Average annual temperature within the massif is below -2.6°C , annual precipitation 145-300 mm. Glaciation of the massif has total area of 20 km². Geographers of Saint-Petersburg University study the glaciers and periglacial zone since 1990.

Since the maximum of the LIA the glaciers retreat, short stabilizations took place in early 1920-s, mid-1960-s and mid-1980-s. In 1995-2008 glaciation lost 19% of area. Irregular rate of glacial retreat after the LIA lead to formation of 3 groups of debris covered objects.

The first group is connected with moraines of LIA (altitude 2650-3000 m). They consist of ice core and debris cover of different thickness. The mechanism of their formation is the following: stabilization of the edges of the glaciers causes accumulation of the debris, they armor the ice, preventing it from melting. When warming starts the exposed part of the glacier grows thinner, the ice under the moraine loses contact with the main body of the glacier.

Increased flow of glacial melt water in the last 10 years led to exposure of moraine ice. Some glaciers which supported LIA moraines on the internal side, retreated abruptly in the period of 1995-2008. Moraines lost their stability, they collapse intensely and ice core melts out. This is observed at Seliverstova glacier (2.8 km²).

The second group (altitude 2850-2950 m) is situated between LIA moraines and glaciers. It is represented by layers of ice covered by thin (several dozen cm) moraine. Streams along the edges of the layers expose ice to the depth of 2-3 meters in many places. Edges of glaciers on aerial photos of 1965 coincide with the edges of these layers. It proves their glacial origin.

Objects of the third group are parts of glaciers that lost their connection with the main glacial masses and turned into dead ice and small cirque glaciers that lost their accumulation area and activity in 1995-2008. The process of armoring of these ice masses is now very active.

Rock glaciers of the massif also have glacial genesis but they don't belong to any group because they integrate buried ice of different generations at least from the maximum of the LIA. Periodic cutoff of new masses of buried ice from the glaciers provides continuous alimentation of rock glaciers. We mapped 17 rock glaciers with total area of 5.5 km². 2 active rock glaciers under valley glaciers Left Mugur and Right Mugur have the shape of tongues cutting through moraines of LIA and extending 350-500 m further down the slope. Activity of these rock glaciers is proved by transverse crevasses, steepness, instability and bareness of frontal ledges, abundance of boulders fallen from these ledges. We estimate the average rate of their advance from the beginning of LIA 0.5-0.7 m/year.