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Chronology and evolution of glacio-nival systems of Mongun-Taiga mountain massif in Late Pleistocene and Holocene

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The main glacial complex of western Tuva – Mongun-Taiga mountain massif (3970.5 m) is situated in the center of Altai-Sayan mountain system. Modern glaciation of the massif has area about 20 km2, average firn line altitude is about 3400 m. Average summer temperatures at the firn line is 0.5°C, precipitation about 270 mm. We studied glacial fluctuations of the past on base of geomorphologic methods and radiocarbon dating of peat, soils and wood samples.

Moraines of the Early Stage of the Last Glaciation (MIS 4) extend from cirques and troughs to the flat piedmonts forming lobes reaching the level of 1830 m in the south of the massif and 2200 in the north. There are traces of 4 glacial advances, during the maximal the area of glaciation reached 513 km2 with 800 m of depression of firn line. We reconstructed that average summer temperatures were 2.5°C below present with precipitation 2.3 times more than now. During MIS 3 the area of glaciation reduced to less than 0.5 km2 with 450-490 m of elevation of firn line. Samples of moraine-buried wood with with radiocarbon age about 58-39 and 27-25 kBP found 600 m higher than present upper limit of growth of trees give evidence of climatic conditions at least 1.5°C warmer than present (with a correction for tectonics). In the Late Stage of the Last Glaciation glaciers mostly remained inside troughs reaching during the maximum the level of 2200 m in the south and 2400 m in the north, the area of glaciation about 320 km2, firn line depression about 690 m. We estimate cooling in the maximum -3.6 °C with precipitation 65% of present. There are moraine complexes of 4 postglacial advances, in the latest of them, presumably Younger Drias, firn line depression reached 500 m. In the Early Holocene glaciers reduced rapidly, evidence of this reduction are samples of wood with age 9120±110 cal. B.P. that were found about 350 m over the present forest line. According to our reconstruction in the Boreal Holocene optimum (about 9000. B.P.) summer temperature was at least 2.3°C higher than now, minimal elevation of firn line was 270 m relative to present. Corresponding values reconstructed for the Atlantic optimum warming in the interval about 6000-3600 years B.P. are 0.35°C and 50 m. Late Holocene moraines are complexes of 3-4 terminal moraines adjacent or thrust one another. They are thick, bare, with steep foreslopes and contain buried ice. The glacial advance of the historical (subatlantic) stage took part between 3600 and 1200 years B.P., reconstructed depression of firn line is 155 m, probable cooling was 1.5 °C relative to present. Climatic conditions of the interstadial 1200-1130 years B.P. were not colder than present. Glacial advance of the LIA probably had 2 phases, the culmination of the last of them took place in the middle of the XIX century. Reconstructed depression of firn line is 120 m, cooling 0.9 °C relative to present.