Vegetation at the northern pole of cold during the climate extremes of the late Pleistocene: fossil records from the Batagay mega thaw slump, Yakutia

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The Batagay mega slump is the largest active thaw slump on the planet. Enormously rapid thermal erosion gave access to permafrost sediments that deposited since the Middle Pleistocene. Permafrost is an excellent medium for the preservation of ancient organic matter. The Batagay exposure is well known for some spectacular findings of Pleistocene megaherbivore carcasses including the youngest steppe bison found in Eurasia so far, dated to 8.2 ka BP. The extraordinarily long sequence of Pleistocene deposits in Batagay is therefore an excellent archive of the palaeoenvironmental history in the Yana highlands - a region with uniquely stable cold-continental climate known as the pole of cold in the northern hemisphere. This region is regarded as refugial area for extrazonal steppe plants and now extinct large grazers together constituting the Pleistocene mammoth steppe, which covered vast areas in high and mid latitudes of the northern hemisphere during cold stages. Modern vegetation around the study site consists of light taiga mainly composed of larch, shrub alder, shrub birches and stone pine. To understand the processes that resulted in the demise of Pleistocene megafauna and in the biological turnover during the late Quaternary, we reconstructed vegetation and environmental conditions during the two climate extremes of the late Pleistocene, the onset of the last glacial maximum and the last interglacial using remains of plants and insects preserved in organic-rich material. The results from studies of plant material gathered in a fossil ground squirrel nest suggest that grassland vegetation corresponding to modern meadow steppes in Central Yakutia and northern Mongolia existed in the study area during the last cold stage. During the last interglacial, open coniferous woodland similar to modern larch taiga was the primary vegetation at the site. Abundant charcoal indicates wildfire events during the last interglacial. Zoogenic disturbances of the local vegetation were indicated by the presence of ruderal plants, especially by the abundant nitrophytic Urtica dioica, suggesting that the area was an interglacial refugium for large herbivores. Meadow steppes, which formed the primary vegetation during cold stages and provided potentially suitable pastures for herbivores, were a significant constituent of the plant cover in the Yana Highlands.
also under the full warm stage conditions of the last interglacial. Consequently, meadow steppes occurred in the Yana Highlands during the entire investigated timespan of the Pleistocene documenting a remarkable environmental stability. The documented fossil record also proves that modern steppe occurrences in the Yana Highlands did not establish as late as in the Holocene, as suggested by some scholars, but instead are relicts of a formerly continuous steppe belt extending from Central Siberia to Northeast Yakutia during the Pleistocene.