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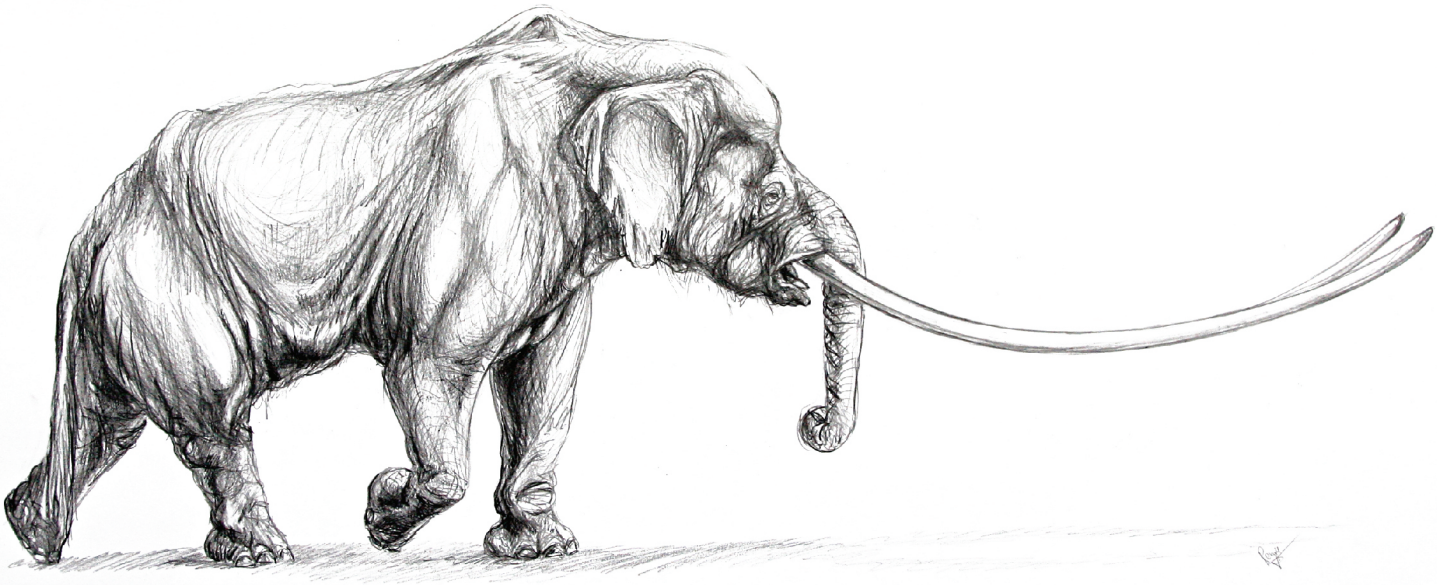

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ABSTRACT BOOK

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Influence of cryogenic processes on the Late Pleistocene vegetation reconstruction

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Although the study of the Late Pleistocene landscapes that were capable to maintain the megafauna in cold climates has a long history, paleontologists still do not have a consensus on the dominant vegetation type of that period.

Adopted at the end of the 60s of the 20th century the definition of the Late Pleistocene landscape as a "tundra-steppe" was based on analysis of the floristic component of pollen spectra, where pollen relating to either steppe or tundra associations occurred at the same horizon.

The plant community reconstructions based strictly on paleo-entomological studies of highly stenobiontic beetle, *Morychus viridis* yielded unexpected result: there were vast plains with extremely low amounts of grasses in the Pleistocene contradicting the presence of the flourishing mammoth fauna (Berman, Alfimov, 2010). The paradox results reflected the beetle habitat preference rather than revealing natural mosaic distribution of different flora biotopes. The thermophylic steppe phytocenoces were occupying southern slopes, cryosteppe groups with the *Morychus viridis* inhabited drained areas, while mesophytic meadows (with tundra plants) were spread in flooded lowlands serving as pastures for mammoths and other grazers.

In this paper, we would like to point out one important environmental factor that has not been taken into account by many paleobotanists while reconstructing paleolandscapes of the Late Pleistocene. This factor is the presence of a cryolithozone. Formed and developed in the north of Eurasia in the Early Pleistocene, permafrost still has an enormous impact on modern vegetation.

In contrast to the past, the cryolithozone's influence on the modern vegetation is well studied. It has not only a direct effect of low temperatures on the plant root systems, but also on accumulation of moisture in the soil, supporting the survival of modern taiga vegetation in the central regions of Yakutia. If it were not permafrost, there would be widespread desert or arid steppes.

Another important feature of the permafrost in respect of vegetation is distribution of moisture. Influence of cryogenic processes leads to the formation of negative landforms due to subsidence - frost cracks, alases, landfills and others, which develop bog vegetation and, at low latitudes, tundra-marsh vegetation. Due to cryogenic processes, soil heave occurs, resulting in the formation of rollers, hydrolaccolith (pingo) and migration mounds. Alases, thermokarst subsidence of oval form with diameters from hundreds of meters to several kilometers, occur during thermochrons. Wedge ice develops and engrosses during cryochrons, when the most typical form of landscape, the roller polygonal and heaving mounds are formed at the same time.

Processes associated with the formation of heaving hillocks, including hydrolaccolith (pingo or bulgunnyakhi) and polygons, are actively taking place in modern time. Alases, common in the central part of Yakutia, which are often located in modern hydrolaccolith mainly formed in the Early Holocene. The current process of alases formation also takes place, though not at a pace as was recorded for the Holocene optimum.

Similar processes associated with the dynamics of the cryolithozone occurred in the Late Pleistocene, when alases and heaving mounds formed (Kaplina, 2011). At the same time, various forms of permafrost terrain of different times of origin coexist with each other for thousands of years.

The golden age of the mammoth fauna is associated with chryochron, when heaving mounds and polygons with rollers and hollows occupied alases that were formed during preceding thermochrons. Cold and dry climate of the Late Pleistocene contributed to the fact that xerophytic plants typical to steppe phytocenosises, predominantly grew on the swelling hills. At the same time, studies have shown that vegetation of hydrolaccolith in Central Yakutia and vegetation on the top knolls where soil surface is strongly eroded are represented by sagebrush associations of *Artemisia jakutica, A. commutata, A. sieversiana*, as well as xerophytes plants, *Carex duriuscula* and *Festuca ovina*.

During cryochron periods, hollows in poligons, alas lake coasts were overgrown mostly by hygrophilic vegetation such as *Calamagrostia langsdorfii, Beckmannia syzigachne, Carex rhynchophysa, C. aquatilis*, and *C. wiluica*. Analysis of pollen spectra gives xerophilic-hygrophilous script. All of them grow on a few hundred square meters area. The reason for this is the permafrost origin of landforms.

Thickness of loess deposits in the Arctic, filled through with ice cores, serve as evidence that the late Pleistocene cryogenic process was more extensive than in modern times, directly affecting landforms, which in turn more directly affected the distribution of vegetation according to moisture gradients.

Thus, the Pleistocene vegetation reconstructions must consider that permafrost has been one of the key factors affecting the flora composition for hundreds of thousands of years. It is possible that the Late Pleistocene tundra-steppe scenario is directly linked to cryogenic processes of that time.

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