

## **When did permafrost disappear in the area of Last Glaciation, northern Poland?**

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During the maximum Late Weichselian ice-sheet advance, very harsh climatic conditions prevailed. Most researchers assume that almost all Poland area, lying in the foreground of the LGM, was covered by continuous permafrost. A much larger discussion, however, is raised by the issue of the permafrost existence in the last glaciation area of Poland (Weichselian glaciation). What is discussed is both: the possibility of permafrost being preserved under the ice sheet from the anaglacial phase, and as well as encroachment of the "fresh" permafrost into the areas which were not covered by the ice sheet for a longer time. An important stage in the course of the study in the Weichselian glaciated areas was the model of RAMPTON (1988), with some reservations also accepted in Germany (LIEDTKE 1993) and Poland (KOZARSKI 1993), which takes into account the disappearance of permafrost under the ice sheet during its transgression, and its development in the areas subject to deglaciation. Recent studies of the areas covered by the Laurentian glaciation indicate that the disappearance of permafrost under the ice sheet was not complete, and even that it was limited only to the subglacial water circulation zones (LACELLE et al. 2004). More recently, in the Weichselian glaciated area of Poland the possibility of partial preservation of permafrost under the ice sheet originating from the transgression period has been considered. An important argument in this discussion is the important role of permafrost under the ice sheet in the formation of subglacial drainage and subglacial channels (PIOTROWSKI et al. 2009).

In the course of research in the Last Glaciation area of Poland some evidence pointing to encroachment of permafrost on the land released from the ice sheet were brought together. The most important include thermal contraction cracks, oriented kettle holes on outwash plains, permafrost-affected horizons in soil profiles, as well as the long-term preservation of buried dead ice blocks in depressions (VAN LOON et al. 2012). The biggest controversy in the literature, however, is raised by the issue of determining the time of the final disappearance of permafrost. Most authors lean toward the view it took place in the wider Bølling-Allerød complex, but some point to the possibility of discontinuous permafrost preservation until the beginning of the Holocene. The study, conducted by the author within lake basins in Eastern Pomerania (BŁASZKIEWICZ 2011), as well as the recent work carried out in the middle section of the valley of the Wda river where very distinct structures of the river developing in the existence of permafrost throughout the Late Glacial were documented, fully confirm and properly document this possibility (BŁASZKIEWICZ et al. 2015). From the point of view of the appearance of lake deposits, three main lake generations were distinguished: pre-Allerød lakes, lakes of the Bølling-Allerød complex and lakes of the Preboreal period. In the context of the time of the final permafrost decay, the lakes of the youngest generation during Preboreal are particularly important, since the lakes age differentiator was the varied duration of preservation of lake

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basins by buried dead ice blocks, which in turn was dependent primarily on the conditions of surface drainage network.

Documenting the fact that buried ice was preserved until the Preboreal period fully justifies the thesis about the preservation of permafrost patches until that period. Under the permafrost conditions, full preservation of dead ice blocks took place when the mineral cover reached the thickness corresponding to the depth of the active layer. In this way, buried dead ice blocks became an essential element of the permafrost. Blocks of dead ice modified the course of permafrost degradation in a manner similar to that observed in the case of the degradation of permafrost containing large amounts of ground ice on the modern-day periglacial areas. Under thermokarst, at the places where dead ice blocks existed, quickly spreading taliks formed, which greatly hastened the process of permafrost degradation. On the other hand, where the dead ice blocks were not subjected to the thermal interaction of water, they became a kind of permafrost refuges, thermally affecting their surroundings.

In conclusion of the above considerations, it can be said that the ultimate disappearance of permafrost in the Last Glaciation area of Poland occurred only at the end of the Preboreal period.

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