



## Thaw /thermokarst lakes of the Last Glacial and Early Holocene

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Thaw (thermokarst) lakes have attracted attention as major sources of CH<sub>4</sub>, amplifying climate change. Also during the Last Glacial thaw lake sedimentary successions have been deposited; several lacustrine units in sedimentary successions in Western Europe have been attributed to permafrost thaw. Likewise, rapid expansion of thaw lakes has occurred during the last glacial termination, in particular in high northern areas of the Eurasian continent. This suggests that also during the Last Glacial, thaw lake formation and associated methane emission from permafrost may have been a positive feedback to climate warming.

In this paper, the sedimentological evidence for past thaw lake formation is assessed and compared with thaw lakes and thaw depressions observed in Eastern Siberia. Several of the Western European successions that are interpreted as thaw lakes may have been rather shallow permafrost thaw features instead of lakes, although larger thaw lakes did exist. In several successions, lake and thaw depression formation could be associated with climate warming during interstadials.

The sedimentological evidence is also compared with present-day thaw lake dynamics. The evidence on present-day thaw lake expansion is mixed despite pronounced climate warming in the Arctic, and shows stability, net contraction or expansion of lake area in various regions. The evidence may also differ with lake size: net expansion for smaller lakes and ponds, while the area of larger lakes contracts due to drainage of larger lakes.

The assumed existence of a thaw lake cycle, that consists of a repeating cycle of lake formation by permafrost thaw, drainage of lakes and re-establishment of ice-rich permafrost, is crucial in the interpretation of lake area changes as an effect of climate change. The thaw lake cycle implies that expansion or contraction of thaw lake area may not necessarily relate to climate change. However, the existence of a thaw lake cycle is inconclusive, although modeling of thaw lake expansion suggests that cyclic behaviour may occur.