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Development of anoxia during the last 90 years in Lake Tiefer See, NE Germany

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The sediments from the deepest part of the lake basin (62 m) of Lake Tiefer See, an elongated lake formed in a sub-glacial channel during the last glaciation in NE Germany, have been proven to be annually laminated (calcite varves) since AD 1924 (KIENEL ET AL. 2013). Possible explanations for the onset of varve formation are either eutrophication caused by increased nutrient influx through the use of fertilizers in agriculture and/or the modern climatic warming. Since varves can only form under predominantly anoxic conditions it is hypothesized that the development of the anoxic water body in Lake Tiefer See can be reconstructed by determining the onset of varve formation in different parts and at different water depths of the lake basin.

Therefore, we investigated: eleven short cores (length from 49 cm (TSK 14 S 2) to 121 cm (TSK 13 QP5)) from a depth of 19, 4 m up to 62 m water depth, mainly along a N-S and a W-E transect. The onset of varve preservation was investigated on all cores by varve counting. Counting and characterization of varves has been obtained by micro-facies analyses of large-scale thin sections μXRF-element scanning.

In result we found a good correlation between the onset of varve formation/preservation and water depth. Whereas varves at the deepest point of Lake Tiefer See are developed since 1924 the onset of varve formation began successively later at more shallow water depths. The latest development of varves since 1981 occurs in the northern part of the basin at a water depth of 30 meters and in the East in a depth of 19 meters. In addition to the onset of varve formation, further differences between deep and shallow water cores have been observed. (1) The number of sub-layers per year: two or three layers in the shallow areas in the east, up to seven layers in the deeper part. (2) Better preservation of varves in the northern than in the eastern part of the basin. (3) Different diatom assemblages related to the water depth: Stephanodiscus medius in all water depths detectable; Asterionella, Fragilaria, Navicula, Stephanodiscus parvus, Synedra, Tabellaria in larger abundances only in the deeper parts; Aulacoseira mainly in the shallow areas. (4) Missing single varves have been only traced in the eastern part of the basin.

Possible reasons for the observed differences including wind and wave activity near the shore-line and in shallow water, water circulation and lake bathymetry are discussed in this paper.

The varves of Lake Tiefer See are part of an integrated multi-proxy study including high-resolution sediment analyses and monitoring of modern deposition processes within the Virtual Institute of Integrated Climate and Landscape Evolution Analysis –ICLEA– of the Helmholtz Association, grant number VH-VI-415.

Reference

KIENEL, U.; DULSKI, P.; OTT, F.; LORENZ, S.; BRAUER, A. (2013): Recently induced anoxia leading to the preservation of seasonal laminae in two NE-Germany lakes. Journal of Paleolimnology 50:535 – 544