

Determining the controls on $\delta^{13}\text{C}$ of sedimentary organic matter in Lake Tiefer See (NE Germany) – an integration of sediment cores and monitoring data

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The carbon isotopic composition of sedimentary organic matter ($\delta^{13}\text{C}_{\text{Corg}}$) is widely used in paleoenvironmental studies and commonly considered as proxy for lake productivity. In order to better understand the $\delta^{13}\text{C}_{\text{Corg}}$ record of the partly annually laminated (varved) sediment profile of Lake Tiefer See, we complemented measurements from a long sediment core with analyses of short cores from different water depths and sediment trap data.

The $\delta^{13}\text{C}_{\text{Corg}}$ signature was determined (i) at 2 cm resolution from a 7.7 m-long continuous sediment record covering the last ~6100 years retrieved from the deepest part of the lake (62 m), (ii) at 1 cm resolution from four short cores (0.5 to 0.9 m long) located at different water depths (20 – 62 m) and covering at least the last 200 years and (iii) at bi-weekly to monthly resolution from sediment trap material collected at three water depths (5, 12 and 45 m) since March 2012.

We observed that $\delta^{13}\text{C}_{\text{Corg}}$ fluctuations are paralleled by changes in varve preservation, as well-varved sections show more negative $\delta^{13}\text{C}_{\text{Corg}}$ values compared to non-varved intervals (1 – 4‰ difference; analytical precision $\pm 0.2\text{‰}$). In short cores the negative shift of $\delta^{13}\text{C}_{\text{Corg}}$ always appears at the most recent transition from non-varved to well-varved sediments. Depending on the water depth the onset of varve preservation occurred at different times (e.g. AD 1924 in 62 m water depth; AD 1981 in 20 m water depth). Since sediment trap data exhibit similar $\delta^{13}\text{C}_{\text{Corg}}$ values of -30‰ to -31‰ in the entire water column and in the uppermost varved parts of the sediment cores, it is unlikely that the shift in $\delta^{13}\text{C}_{\text{Corg}}$ was caused by processes in the water column because this should be seen in all cores at the same time.

Therefore, we suggest that the $\delta^{13}\text{C}_{\text{Corg}}$ record of the long sediment core of Lake Tiefer See does not reflect processes in the water column (i.e. productivity), but different early diagenetic processes in varved and non-varved sediment. In this study, we discuss possible mechanisms influencing the $\delta^{13}\text{C}_{\text{Corg}}$ signature at Lake Tiefer See including the effects of plant detritus, organic matter contents and oxic bottom water conditions.

This study is a contribution to the Virtual Institute of Integrated Climate and Landscape Evolution Analysis –ICLEA– of the Helmholtz Association; grant number VH-VI-415.