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Trying to distinguish aquatic from terrestrial organic matter in lake sediments using various methods/biomarkers

CARSTEN J. SCHUBERT[1,2], PATRICK STUECHELI[3] AND BERNHARD WEHRLI[3]

[1]Swiss Federal Institute of Aquatic Science and Technology (EAWAG)
[2]ETH Zürich, Institute of Institute of Biogeochemistry and Pollutant Dynamics
[3]Eawag

Organic matter (OM) preservation and degradation is mainly determined by its composition, however, other factors like sedimentation rate and redox conditions of water column and sediments play a role. The molecular characterisation of the OM in sediments can help understanding its diagenetic state. Marine studies have shown that the fraction of molecular uncharacterised component (MUC) of organic matter increases with water and sediment depth and that the acid insoluble (AI) fraction, defined as the remaining organic matter after the removal of lipids and after hydrolysis, is a good proxy for MUC. In the ocean, the AI fraction mainly originates from allochthonous sources namely terrestrial OM. Since inland waters including lakes are influenced more strongly by terrestrial sources it is an important question, how the contribution of terrestrial OM in lake sediments contributes to the bulk, the residual OM after hydrolyses (AI), the OM extracted by hydrolysis (AS) fractions, and lipid (LI) and how it affects the reactivity of sedimentary OM. Here we examine sediments from three different lakes in Switzerland (Lake Zug, northern Basin, LZN; Lake Zug southern basin, LZS, Lake Biel, LB, and Lake Thun, LT) with contrasting productivity and contribution of allochthonous organic material. In Figure 1 we show the different fractions (AI, AS, LI) of the four basins. The nitrogen fractions were separated into total nitrogen (TN), organic nitrogen (ON), and bound nitrogen (included in clay minerals, bound IN). Additionally, we used a whole suite of proxies including C/N ratios, $d^{13}C$ isotopic composition, carbohydrate, amino acid, and lignin content. Furthermore, we investigated the OM by pyrolysis and estimated the terrestrial contribution using the carbon isotope composition of terrestrial and lacustrine endmembers. The oligotrophic to mesotrophic lakes had a much higher content of terrestrial organic material whereas the eutrophic lake had a much higher proportion of aquatic organic material. We calculated different reactivities of the sedimentary organic compounds and revealed that the fastest degradation could be observed for chlorins whereas lignin was not degraded but accumulated in the sediments.

Fig.1

