Geophysical Research Abstracts
Vol. 13, EGU2011-151, 2011
EGU General Assembly 2011

Use of lipid biomarkers to reconstruct past hypoxia and past environmental conditions in two Swiss lakes

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Oxygen is crucial for the water quality of aquatic ecosystems. The oxygen concentration in the water affects organisms in all trophic levels. The number and duration of hypoxic events in lakes and oceans increase due to eutrophication and global warming (Keeling et al., 2010). To reconstruct past changes in the oxygenation of lakes and oceans and to assess future scenarios, we need to establish indicators and methods to determine oxygen levels qualitatively and quantitatively. We studied oxygen depletion using biomarkers in Lake Rotsee and Lake Zurich in Switzerland. Lake Rotsee is highly eutrophic and monomictic. The lake is stratified and anoxic in the hypolimnion most of the year. Because of the shallow water column of Lake Rotsee (maximum water depth 16m) and stratification, relatively little degradation of organic matter occurs. We used archaeal biomarkers such as archaeol, sn2-hydroxyarchaeol and GDGTs in order to understand processes of oxygen depletion and to reconstruct microbial communities that live under anoxic conditions within this lake.
In contrast, such biomarkers do not occur in the mesotrophic and monomictic Lake Zurich (Switzerland). Here, we tested the influence of bottom water oxygen concentrations on the degradation of organic material. We compared three cores from Lake Zurich that were recovered from 139m, 109m, and 45m water depths. Those sediments were deposited under different bottom water oxygen concentrations as proved by long-term oxygen monitoring data (1947-today) and are therefore well suited to investigate climate driven factors of hypoxia.
According to our preliminary result we expect to determine rates of biomarker degradation under different oxygen levels. We are going to calibrate biomarker concentrations with long-term oxygen monitoring data and compare these with iron and manganese deposits to test the applicability of biomarker use for oxygen reconstructions.

References

Keeling, R.F., Kortzinger, A., Gruber, N., (2010) Ocean Deoxygenation in a Warming World. Annual Review of Marine Science, 2, 199-229.