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Compound-specific Radiocarbon dating - a tool for dating lake sediments?

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Worldwide lake sediments provide information about environmental changes that took place in the past. Chronologies of these natural archives are often based on radiocarbon ages of recognizable terrestrial macrofossils that are deposited soon after their biosynthesis. However, in many instances reliable dating is not possible due to a lack of macrofossils that can be dated using radiocarbon (14C). On the other hand technical development in AMS 14C dating allows measurements of very small amounts of Carbon (micrograms) allowing to date biomarkers. Since the introduction of compound-specific radiocarbon analysis (CSRA) by Eglinton et al. (1996) this method has been used for an increasing number of studies. Nevertheless, there are only few examples of using CSRA to date sedimentary records of lakes (e.g. Uchikawa et al. 2008).
Our project of CSRA on lake sediments was designed to study: (1) the build-up and reactivity of the soil organic carbon (SOC) pool and its response to climatic and environmental changes and (2) the possibility of using biomarkers as material suitable for dating lake deposits.

As the lake sedimentary organic matter consists of a mixture between aquatic and terrigenous matter, compounds with an unequivocal terrigenous source need to be isolated. In this study we are targeting higher plant waxes (long chain n-alkanes and fatty acids) and branched GDGTs produced by soil bacteria. Moreover soil-derived molecular compounds found in a well-dated lake sedimentary record were analysed in order to access the role of refractory SOC, which is an important pool responsible for long-term carbon storage. When compared to the depositional age of the sediment, the age of the terrestrial lipids and organic carbon fractions provides an average residence time of these lipids and fractions in the SOC pool. Changes in the age-difference between sediment and soil-derived organic compounds over time can give an estimate of SOC build-up and evolution.

We will present results of CSRA obtained for sediments of three different records: Lake Soppensee is situated on the Swiss Central Plateau, Lake Lusvatnet lies on Andoya in Northern Norway and Lake Ioannina in the Greek Epirus region. We will compare these results with corresponding age-depth models of each record that are based on 14C-dated macrofossils. The three study sites are located in different climatic regions with different environmental and topographic settings. They show different patterns in the 14C content of biomarker in comparison to their sediment age. We will discuss the influence of topography, climate and land use as causes for the different patterns.

References

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