Sources and transformations of organic biomarkers in a varved lake with a new approach using sub-milligram sample size

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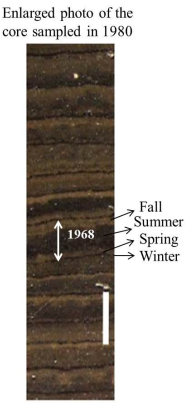
Nylandssjön in northern Sweden is a small (0.28 km2) dimictic lake where cultural eutrophication induced the formation of varves with distinct seasonal layers dating back to the past ~100 years (Figure below). Freeze cores have been taken in late winter and stored since 1979. Sediment trap samples with 5-25 days' resolution have been collected since 2002 and a limnological monitoring has been carried out since 2001. This unique sample collection permits us to investigate the incorporation and preservation of water column inputs to these varved sediments over several decades. One analytical challenge lies in the low sample masses and high numbers of samples. Existing methods to characterize organic matter and its related biomarkers require several hundreds of mg up to one g of sample and are associated to time-consuming extraction and/or data treatment procedures.



We thus develop a new approach for characterizing organic matter using (1) Pyrolysis-Gas Chromatography-Mass Spectrometry and (2) Thermal Programmed Desorption-Fourier Transformed Infra-Red Spectroscopy-Mass Spectrometry analyses on 200 μg of sample. Chemometric analyses are employed for high-throughput characterization of OM and commonly used biomarkers. We will also show how monitoring the evolution of a single varve over time can provide clues to the effects of diagenesis during burial on biomarkers by analysing a single varve (e.g., year 1989) over time (i.e., analysis of the varve year 1989 in following cores). These efforts will help us achieve our overarching aim at determining how environmental annual and seasonnal information from the lake is transferred down to recent sediments and preserved over time.