Compound-specific radiocarbon analysis with a gas ion-source as a tool for the reconstruction of soil organic carbon build-up

Axel Birkholz, Rienk H. Smittenberg, Irka Hajdas, Stefano M. Bernasoni

ETH Zurich, Geological Institute
ETH Zurich, Laboratory of Ion Beam Physics

With ~1500 Gt, Soil Organic Carbon (SOC) is the second largest active carbon pool in the world and plays as such an important part in the global carbon cycle. However, there are still many uncertainties about the reactivity of the SOC pool in response to climatic and environmental changes, especially the role of a refractory pool, which is stored on longer time scales and thus could act as a CO2 sink. It is, for instance, still uncertain how fast the large amount of terrigenous carbon at the higher latitudes was accumulated after deglaciation, and even if this build-up is still ongoing or not. To understand the longer-term dynamics of this large carbon pool, one needs to resort to sedimentary records, as experiments are not possible at the time scales involved. In order to gain more insight on soil organic carbon dynamics, we expand on the successful approach of Smittenberg et al. (2006) [1] to analyze terrestrial- and soil-derived molecular compounds and organic matter fractions preserved in well-dated and well-constrained sedimentary records. When compared to the depositional age of the sediment, the age of the terrestrial lipids and organic carbon fractions, gives insight in the recalcitrance of these lipids and fractions. Changes in the age differential between sediment and organic compounds over time, in addition, provide indication on how fast the terrestrial refractory SOC pool has evolved. For the isolation and purification of the specific compounds, High Performance Liquid Chromatography - Mass Spectrometry combined with fraction collection, and preparative capillary Gas Chromatography are used. Radiocarbon dating is performed using an Accelerator Mass Spectrometry interfaced with a gas source, allowing the analysis of small samples. Targeted compounds are higher plant waxes (long chain n-alkanes and fatty acids), pentacyclic triterpenoids, certain sterols, lignin oxidation products, the digestion products of black carbon (BPCA's), and soil bacterial-derived branched GDGTs. We will present the methods and results for radiocarbon analysis of procedural blanks and AMS gas-source blanks.

References [1] Smittenberg, R.H., Eglinton, T.I., Schouten, S., Damste, J.SProxy-Connection: keep-alive Cache-Control: max-age=0 . (2006) Science 314, 1283-1286.