RADIOCARBON ANALYSIS OF ISOPRENOID AND BRANCHED GLYCEROL DIALKYL GLYCEROL TETRAETHERS IN SOILS AND FLUVIAL SEDIMENTS

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Glycerol dialkyl glycerol tetraethers (GDGTs), membrane lipids synthesized by archaea (isoprenoid GDGTs) and bacteria (branched GDGTs), form the basis of a suite of molecular proxies used in terrestrial as well as marine environments. Compound-specific radiocarbon analysis has provided valuable insights into the sources and yielded constraints on transport dynamics of different biomarkers in the context of carbon cycle processes. To complement the existing biomarker radiocarbon toolbox, and to shed new light on the sources and fate of GDGTs, we developed a new method to measure GDGT radiocarbon compositions in natural samples.

Isoprenoid and branched GDGTs are isolated using two UHPLC silica columns in series coupled to a fraction collector set to eluent recovery at different time intervals. The accuracy of the method was tested using a modern and a radiocarbon-dead reference material. Procedural blanks show that the separation procedure adds less than 0.8 µg carbon. The isolated GDGT compounds are measured using a gas source MICADAS AMS system at ETH Zürich [2].

The method is first applied to determine the $\Delta^{14}C$ composition of isoprenoid and branched GDGTs in two soil core profiles from a temperate and subalpine forest ecosystem in order to explore the range of typical values encountered in natural systems. The cores, which reach a depth of 80 cm and 40 cm respectively, have previously been analyzed with respect to radiocarbon characteristics of long-chain n-alkanes and fatty acids as well as bulk particulate and dissolved organic carbon (OC) [1]. For each core, GDGTs were separated and analyzed from 3 different depth intervals. While alkane and fatty acid $\Delta^{14}C$ values show an increasing divergence from those of the bulk OC $\Delta^{14}C$ with depth [1], which is attributed to slower cycling of the former through close mineral association, the radiocarbon signatures of both isoprenoid and branched GDGTs closely track bulk $\Delta^{14}C$ values measured over the whole extent of the respective core. These findings imply that GDGT precursor organisms utilize a more labile pool as a carbon source,

Similar measurements are underway on a suite of fluvial sediments in order to examine GDGT dynamics associated with soil mobilization and to place temporal constraints on proxy signal transfer to sedimentary archives.

References

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