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The origin of branched GDGTs in lake environments: Tracing allochthonous and autochthonous sources using compound-specific carbon isotope analysis

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Branched glycerol dialkyl glycerol tetraethers (brGDGTs) are bacterial membrane lipids that are ubiquitous in soils and peat, as well as in sediments and suspended particulate matter (SPM) of lakes, rivers and coastal marine environments. It has been found that the relative distribution of brGDGTs changes systematically with ambient temperature and pH, making them promising proxy indicators for paleoclimatic reconstructions in sedimentary archives. In lacustrine deposits, it was initially assumed that brGDGTs mainly originate from allochthonous soil organic matter, thus reflecting the integrated mean annual air temperature (MAAT) within the watershed. Most recent research, however, strongly suggest that the brGDGTs used for paleo-thermometry can also be produced in situ within the lake system, offsetting the temperature-brGDGT relationships commonly known from soils. Until now, disentangling the relative contribution of allochthonous versus autochthonous brGDGT sources in lacustrine sediments was impossible, complicating the use of brGDGTs for quantitative paleotemperature reconstructions. We recently discovered a novel brGDGT isomer with a strongly ^{13}C-depleted carbon isotope composition of about 46.6 ‰ in sediments of a small eutrophic Alpine lake (Lake Hinterburg, Switzerland), which was not present in soils collected from the catchment. Furthermore, all other major brGDGTs in the sediment uniformly displayed δ^{13}C values of about 43 ‰ strongly contrasting the C-isotopic composition of brGDGTs from catchment soils (ca. 27 ‰). These findings raise two prime questions: (1) Are lake-derived brGDGTs generally more depleted in ^{13}C with respect to their allochthonous counterparts? (2) Does the δ^{13}C of sedimentary brGDGTs serve as a reliable indicator for lacustrine in situ production of brGDGTs? To address these questions, we determined the ^{13}C content of brGDGTs in surface sediments from various lakes across the Swiss Alps by CG-IRMS analysis of their alkyl chains after chemical degradation. Our data set provides valuable and unique insight into the stable carbon isotope composition of brGDGTs in lake environments, and will aid in our efforts to test and establish brGDGT-based proxies in aquatic sedimentary archives.