Branched GDGTs in Arctic Lake Sediments: Sources and Implications for Paleothermometry at High Latitudes

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One of the newest methods to reconstruct absolute continental paleotemperatures is by analyzing subtle changes in the distribution of branched tetraether membrane lipids (so-called "brGDGTs"), throughout a sedimentary archive. Although brGDGTs were initially considered to be exclusively derived from soil bacteria, recent studies have shown that they may also be produced in lacustrine environments. The aquatic contribution causes an underestimation of reconstructed temperatures when using the initial soil-calibrated transfer functions. In the lake-specific calibrations that were developed to account for this offset, Arctic lakes are generally underrepresented. Thus, the source of brGDGTs and their suitability as paleothermometer in high latitude lakes has so far remained uncertain.

Here we show that brGDGTs in Arctic lakes are primarily soil-derived based on the comparison of brGDGT signatures in lakes, riverine suspended material, riverbank sediments, and permafrost material from the Canadian (Mackenzie River delta) and Siberian (Kolyma River basin) Arctic. A subsequent assessment of the available brGDGT-temperature transfer functions indicates that the most reliable continental air temperatures are returned by the original 'MBT-CBT paleothermometer' calibrated on soils. Thus, analyzing brGDGT signals down-core Arctic lake sediments is likely to reveal the timing, rate, and magnitude of past climate change, improving our understanding of the implications of the current and future climatic changes in this vulnerable area.