Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.35135

Fatty acid hydrogen isotope ratios record large millenial-scale trophic changes on the southwest Greenland coast and their influence on carbon burial

PETER M J DOUGLAS[1], ESTELLE ALLAN[2], YUNFENG WANG[1], ANNE DE VERNAL[3], YVES GELINAS[4], MARIT-SOLVEIG SEIDENKRANTZ[5] AND ALFONSO O. MUCCI[1]

[1]McGill University
[2]EPS, McGill University
[3]Geotop - Université du Québec à Montréal
[4]Concordia University
[5]Aarhus University

Short-chain fatty acid hydrogen isotope signatures are strongly influenced by microbial metabolism, with large differences between phototrophic and heterotrophic organisms. Hence, their isotopic composition could be used as a paleo-proxy to identify the prevalence of heterotrophic microbes in aquatic ecosystems. We used the hydrogen isotope composition of short-chain fatty acids, extracted from a sediment core recovered on the southwest Greenland shelf, to reconstruct the prevalence of heterotrophy and the history of OC biodegradation over the past 12,000 years in this area. Over this period, the southwest Greenland shelf experienced major environmental change related to the Holocene thermal maximum (HTM) as well as ice sheet retreat and advance. Elevated hydrogen isotope ratios of the saturated C_{16} fatty acid during the HTM implies increased heterotrophic OC biodegradation in response to increases in temperature and nutrient availability, which is corroborated by the stable carbon isotope composition and relative abundance of bacteria-specific fatty acids. This period of high heterotrophic biodegredation resulted in low sedimentary OC burial despite concurrently elevated primary productivity. Our results point to enhanced OC biodegradation and reduced OC burial efficiency in warmer high-latitude oceans as a positive climate feedback. The hydrogen isotope composition of fatty acids could be a useful tracer of microbial trophic ecology in other sedimentary ecosystems, and a valuable complement to studies of past aquatic carbon cycling.