Publication

Abundance and delta C-13 values of fatty acids in lacustrine surface sediments: Relationships with in-lake methane concentrations

JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

ID 4488100
Author(s) Stoetter, Tabea; Bastviken, David; Bodelier, Paul L. E.; van Hardenbroek, Maarten; Rinta, Paeivi; Schilder, Jos; Schubert, Carsten J.; Heiri, Oliver
Author(s) at UniBasel Heiri, Oliver ;
Year 2018
Title Abundance and delta C-13 values of fatty acids in lacustrine surface sediments: Relationships with in-lake methane concentrations
Journal QUATERNARY SCIENCE REVIEWS
Volume 191
Pages / **Article-Number** 337-347
Keywords Methane; Fatty acids; Methane oxidizing bacteria; Stable carbon isotopes; Aquatic invertebrates; Lakes; Sediment
Proxy-indicators in lake sediments provide the only approach by which the dynamics of in-lake methane cycling can be examined on multi-decadal to centennial time scales. This information is necessary to constrain how lacustrine methane production, oxidation and emissions are expected to respond to global change drivers. Several of the available proxies for reconstructing methane cycle changes of lakes rely on interpreting past changes in the abundance or relevance of methane oxidizing bacteria (MOB), either directly (e.g. via analysis of bacterial lipids) or indirectly (e.g. via reconstructions of the past relevance of MOB in invertebrate diet). However, only limited information is available about the extent to which, at the ecosystem scale, variations in abundance and availability of MOB reflect past changes in in-lake methane concentrations. We present a study examining the abundances of fatty acids (FAs), particularly of C-13-depleted FM known to be produced by MOB, relative to methane concentrations in 29 small European lakes. 39 surface sediment samples were obtained from these lakes and FA abundances were compared with methane concentrations measured at the lake surface, 10 cm above the sediments and 10 cm within the sediments. Three of the FAs in the surface sediment samples, C-16(:1 omega 7c), C-16(:1 omega 5c/t), and C-18(:1 omega 7c) were characterized by lower delta C-13 values than the remaining FAs. We show that abundances of these FM, relative to other short-chain FAs produced in lake ecosystems, are related with sedimentary MOB concentrations assessed by quantitative polymerase chain reaction (qPCR). We observed positive relationships between methane concentrations and relative abundances of C-16:1 omega 7c, C-16:1 omega 5c/t, and C-18:1 omega 7c and the sum of these FAs. For the full dataset these relationships were relatively weak (Spearman's rank correlation (r(s)) of 0.34-0.43) and not significant if corrected for multiple testing. However, noticeably stronger and statistically significant relationships were observed when sediments from near-shore and deep-water oxic environments (r(s) = 0.57 to 0.62) and those from anoxic deep-water environment (r(s)= 0.55 to 0.65) were examined separately. Our results confirm that robust relationships exist between in-lake CH 4 concentrations and 13 C-depleted groups of FAs in the examined sediments, agreeing with earlier suggestions that the availability of MOB-derived, C-13-depleted organic matter for aquatic invertebrates increases with increasing methane concentrations. However, we also show that these relationships are complex, with different relationships observed for oxic and anoxic sediments and highest values measured in sediments deposited in oxic environments overlain with relatively methane-rich water. Furthermore, although all three C-13-depleted FA groups identified in our survey are known to be produced

by MOB, they also receive contributions by other organism groups, and this will have influenced their distribution in our dataset.
Publisher PERGAMON-ELSEVIER SCIENCE LTD
ISSN/ISBN 0277-3791
edoc-URL https://edoc.unibas.ch/67683/
Full Text on edoc No;
Digital Object Identifier DOI 10.1016/j.quascirev.2018.04.029
ISI-Number 000437363000021
Document type (ISI) Article