Molecular characteristics of water column and sedimentary dissolved organic matter in boreal Swedish lakes (DOM)

JULIANA VALLE[1], MICHAEL GONSIOR[2], MOURAD HARIR[1], ALEX ENRICH-PRAST[3,4], PHILIPPE SCHMITT-KOPPLIN[1], DAVID BASTVIKEN[3], RALF CONRAD[5] AND NORBERT HERTKORN[1*]

[1] Helmholtz Zentrum Munich, German Research Center for Environmental Health, Neuherberg, Germany (correspondence: hertkorn@helmholtz-muenchen.de)

[2] University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, Solomons, USA

[3] Linköping University, Department of Thematic Studies – Environmental Change, Linköping, Sweden

[4] Federal University of Rio de Janeiro, Department of Botany, Rio de Janeiro, Brazil

[5] Max Planck Institute for Terrestrial Microbiology, Marburg, Germany

Processing of freshwater dissolved organic matter (DOM) affects the global carbon budget: microbial processing alters DOM molecular structures and greenhouse gases CH_4 and CO_2 are being produced as well. High field NMR and FTICR mass spectrometry of solid-phase (PPL) extracted organic matter (SPE-DOM) of Swedish arctic and boreal lake waters and sediments revealed a fundamental distinction of water column and sedimentary organic matter. While the former showed a near continuum of compounds, sedimentary pore water was composed of molecularly heterogeneous and polydisperse DOM and a suite of recognizable, more abundant smaller molecules. During anaerobic incubation of pore water SPE-DOM, CO_2 production was near ten-fold compared with that of CH_4. However, large scale general DOM processing was much more extensive than mineralization: both highly oxidized and reduced CHO compounds decreased during incubation, while rather non-labile fulvic acid-type CHO molecules and CHNO compounds were enriched. These molecular alterations of DOM were in the percent range, exceeding greenhouse gas production by several orders of magnitude [1]. Lake water SPE-DOM was more distinctive in NMR than in FTICR mass spectra, revealing the significance of aliphatic compounds. SPE-DOM after incubation may represent freshly synthesized compounds, intrinsically refractory leftover DOM and/or microbial metabolites which were also not consumed in our experimental incubation. Lake size and water residence time appeared to affect DOM processing. Diagenetic modification of organic matter can be substantial compared to complete mineralization, despite the low fraction of the total DOM being mineralized to CO_2 and CH_4.

[1] Valle *et al* (2018) *Water Research* **129**, 252-263.