

Research Project

A GC-MS/GC-IRMS for the molecular-level analyses of organic matter and the isotopic characterization of inorganic and organic compounds in aquatic and terrestrial ecosystems (2008)

Third-party funded project

Project title A GC-MS/GC-IRMS for the molecular-level analyses of organic matter and the isotopic characterization of inorganic and organic compounds in aquatic and terrestrial ecosystems (2008)

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Stable isotopes represent a valuable means to constrain specific biogeochemical processes in natural environments. The main objective of the project is to develop an Environmental Laboratory for Aquatic and Terrestrial Biogeochemistry, which will support research that will make use of molecular-level characterization and (compound-specific) isotope ratio determination methods to assess a wide spectrum of biogeochemical transformations in the natural environment and in the laboratory, and to study sources and the fate of organic compounds in marine, freshwater, and soil systems. The requested infrastructure includes the following instruments:

- Gas Chromatograph coupled to a quadrupole mass spectrometer (MS) with two detectors (FID and MS) for organic compound recognition. Through the GC-C III interface, the GC will be coupled to the IRMS for isotope measurements on single target molecules.
- Gas source stable isotope ratio mass spectrometer (IRMS), Gasbench-II Interface, accessories for ^{18}O and H/D analysis in GC eluates, and autosampler for high-precision isotope ratio determination.

One of the major goals of the projects that make use of the new instrumental capacities is to understand the interactions of the bio- with the geo- and atmosphere with respect to the transport of organic materials and the transformation of inorganic and organic compounds by plants and microorganisms, which is of ultimate importance for the reduction of green house gases and the cycling of elements in aquatic and terrestrial ecosystems. A prime objective will be to use stable isotope measurements to constrain specific biogeochemical and metabolic processes, as well as sources, transport and degradation of organic matter in aquatic and terrestrial environments, and, in turn, to use these constraints to obtain improved estimates on global and regional C and N fluxes, in modern environments as well as in the past.

Planned research themes include: I) using lipid biomarker approaches to study microbial communities in various marine and freshwater environments, II) characterizing organic matter components in lacustrine sediments as well as in soils, and identifying the mechanisms responsible for the longer-term sequestration and degradation of organic C and the emission of greenhouse gases, III) understanding the metabolic pathways of C and N during the symbiosis between microorganisms and plants, and IV) generating data sets for the isotopic composition of nitrate and other N species in various aquatic

systems in order to characterize the controls on isotope fractionation of specific N cycle reactions. The spectrum of investigated ecosystems will range from Swiss soil and groundwater systems and small lakes to hydrothermal vent systems in the deep ocean, and the spatial scale of the planned research extends from enzyme biogeochemistry to ocean-scale circulation.

Planned projects address a diverse range of topics, yet they share the common goal of using biomarker and isotope analyses to address important and innovative questions regarding a) the cycling of C and N in terrestrial and aquatic systems on the organism-level, regional and global scales, b) the role of microbes for greenhouse gas emissions and c) the use of C and N stable isotope ratios as environmental tracers, in modern environments and in the past.

Keywords isotopes, organic molecules, compound-specific isotope measurements, nitrogen cycle, carbon cycle

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Add publication

Published results

86940, Alewell, C.; Schaub, M.; Conen, F., A method to detect soil carbon degradation during soil erosion, Biogeosciences, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

86879, Conen, F.; Zimmermann, M.; Leifeld, J.; Seth, B.; Alewell, C., Relative stability of soil carbon revealed by shifts in delta N-15 and C:N ratio, 1726-4170, Biogeosciences, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

86870, Schaub, Monika; Alewell, Christine, Stable carbon isotopes as an indicator for soil degradation in an alpine environment (Urseren Valley, Switzerland), 1097-0231, Rapid communications in mass spectrometry, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

86880, Conen, F.; Karhu, K.; Leifeld, J.; Seth, B.; Vanhala, P.; Liski, J.; Alewell, C., Temperature sensitivity of young and old soil carbon - Same soil, slight differences in C-13 natural abundance method, inconsistent results, 0038-0717, Soil Biology & Biochemistry, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

86869, Schaub, Monika; Seth, Barbara; Alewell, Christine, Determination of delta O-18 in soils : measuring conditions and a potential application, 1097-0231, Rapid communications in mass spectrometry, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

57317, Bourbonnais, Annie; Lehmann, Moritz F.; Waniek, Joanna J.; Schulz-Bull, Detlef E., Nitrate isotope anomalies reflect N-2 fixation in the Azores Front region (subtropical NE Atlantic), 2169-9275, Journal of Geophysical Research. C, Oceans, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

1469102, Bourbonnais, Annie; Lehmann, Moritz F.; Butterfield, David A.; Juniper, S. Kim, Subseafloor nitrogen transformations in diffuse hydrothermal vent fluids of the Juan de Fuca Ridge evidenced by the isotopic composition of nitrate and ammonium, 1525-2027, Geochemistry, geophysics, geosystems, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

1469107, Walder, Florian; Niemann, Helge; Natarajan, Mathimaran; Lehmann, Moritz F.; Boller, Thomas; Wiemken, Andres, Mycorrhizal Networks : Common Goods of Plants Shared under Unequal Terms of

Trade, 0032-0889, Plant physiology, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

1469216, Niemann, H.; Stadnitskaia, A.; Wirth, S. B.; Gilli, A.; Anselmetti, F. S.; Sinninghe Damsté, J. S.; Schouten, S.; Hoppmans, E. C.; Lehmann, M. F., Bacterial GDGTs in Holocene sediments and catchment soils of a high Alpine lake: application of the MBT/CBT-paleothermometer, 1814-9324 ; 1814-9332, Climate of the Past, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

1742243, Wenk, Christine B.; Blee, Jan; Zopfi, Jakob; Veronesi, Mauro; Bourbonnais, Annie; Schubert, Carsten J.; Niemann, Helge; Lehmann, Moritz F., Anaerobic ammonium oxidation (anammox) bacteria and sulfide-dependent denitrifiers coexist in the water column of a meromictic south-alpine lake, 0024-3590, Limnology and Oceanography, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

2270311, Wirth, Stefanie B.; Gilli, Adrian; Niemann, Helge; Dahl, Tais W.; Ravasi, Damiana; Sax, Nadja; Hamann, Yvonne; Peduzzi, Raffaele; Peduzzi, Sandro; Tonolla, Mauro; Lehmann, Moritz F.; Anselmetti, Flavio S., Combining sedimentological, trace metal (Mn, Mo) and molecular evidence for reconstructing past water-column redox conditions : the example of meromictic Lake Cadagno (Swiss Alps), 0016-7037, Geochimica et cosmochimica acta, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

2270313, Walder, Florian; Niemann, Helge; Lehmann, Moritz F.; Boller, Thomas; Wiemken, Andres; Courty, Pierre-Emmanuel, Tracking the carbon source of arbuscular mycorrhizal fungi colonizing C-3 and C-4 plants using carbon isotope ratios ($\delta^{13}\text{C}$), 0038-0717, Soil biology & biochemistry, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

2270320, Brunner, Benjamin; Contreras, Sergio; Lehmann, Moritz F.; Matantseva, Olga; Rollog, Mark; Kalvelage, Tim; Klockgether, Gabriele; Lavik, Gaute; Jetten, Mike S M; Kartal, Boran; Kuypers, Marcel M M, Nitrogen isotope effects induced by anammox bacteria, 0027-8424, Proceedings of the National Academy of Sciences of the United States of America, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

2392731, Wenk, Christine B.; Zopfi, Jakob; Blee, Jan; Veronesi, Mauro; Niemann, Helge; Lehmann, Moritz F., Community N and O isotope fractionation by sulfide-dependent denitrification and anammox in a stratified lacustrine water column, 0016-7037, Geochimica et cosmochimica acta, Publication: JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)

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