Tracing N_2O transformation pathways in a lake ecosystem by N_2O isotopomer analysis

C.B. WENK[1]*, H.J.R. BLEES[1], K. KOBA[2], K.L. CASCIOTTI[3], C.J. SCHUBERT[4], M. VERONESI[5], C.V. FREYMOND[1], H. NIEMANN[1], J. ZOPFI[6] AND M.F. LEHMANN[1]

[1]Insitute of Environmental Geosciences, University of Basel, Switzerland (*correspondence: christine.wenk@unibas.ch)
[2] Faculty of Agriculture, Tokyo University of Agriculture and Technology, Japan
[3]Department of Environmental Earth System Science, Stanford University, USA
[4]Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland
[5]Institute of Earth Sciences, University of Applied Sciences of Southern Switzerland, Switzerland
[6]Laboratory of Microbiology, University of Neuchâtel, Switzerland

In terrestrial and aquatic ecosystems, N_2O can be produced through two pathways: nitrification and incomplete denitrification. The measurement of the stable isotopic and isotopomeric composition of N_2O can help determine the relative importance of these processes in net N_2O production. To date, relatively little is known about the role of lakes as N_2O source to the atmosphere, and N_2O isotopomer dynamics in lakes have barely been studied.

Lake Lugano (South Basin) is a monomictic, eutrophic lake, where high bottom water N_2O concentrations are observed (900nM; 100x equilibrium saturation). Sediment core incubations with ^{15}N-labeled substrates suggest that sedimentary denitrification is the main N_2O source. These incubation data, however, appear to conflict with water column observations. A N_2O concentration maximum at the aerobic/anaerobic interface, together with the intramolecular distribution of ^{15}N (SP of ~33‰) in N_2O suggests that N_2O in the water column is mainly produced by nitrification. The investigated redox-transition zone is a net sink for NO_x, and N_2O gradients suggest N_2O reduction just below this zone. Yet, isotopomeric signatures that were previously assumed to be characteristic for N_2O production by denitrifying organisms were not observed. Our results raise doubts about the general validity of previously reported N_2O isotopomer effects from laboratory experiments for lake ecosystems.

Spins deep in the Earth

RE NATA WENTZCOVITCH

Department of Chemical Engineering and Materials Science, Minnesota Supercomputing Institute, University of Minnesota, MN, USA, 55403

There has been much interest in spin crossovers found in 2003 and 2004 in the most abundant minerals of Earth's lower mantle ((MgFe)O and (MgFe)(Si,Fe)O_3-perovskite) under pressure. Spin crossovers depend on thermodynamic conditions and a full understanding of this problem requires its investigation as function of pressure and temperature. There are several controversies, especially in the perovskite systems, and surprises are revealed by electronic structure calculations. The geophysical consequences of these crossovers are yet to be fully understood. I will review recent progress in the study of spin crossovers and give an overview of this phenomenon and its potential implications for the Earth.

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