Noble gases dissolved in porewater of lacustrine sediments

MATTHIAS S. BRENNWALD[1,2,*], R. KIPFER[1,3], F. PEETERS[1], M. HOFER[1], W. AESCHBACH-HERTIG[1,2], D.M. IMBODEN[2]

[1] Water Resources & Drinking Water, EAWAG, CH-8600 Dübendorf, Switzerland, brennmat@eawag.ch
[2] Environmental Physics, ETH, CH-8092 Zürich, Switzerland
[3] Isotope Geology, ETH, CH-8092 Zürich

Atmospheric noble gases dissolved in environmental aquatic systems are tracers for the environmental conditions prevailing when the respective waters were last in contact with the atmosphere (temperature, salinity, atmospheric pressure). Paleoclimatic conditions have been successfully reconstructed from noble gas concentrations in groundwaters. This study discusses the use of lacustrine sediments as a new noble gas archive.

In lakes noble gas concentrations closely correspond to the temperature and salinity of the water at sampling depth[1,2]. Hence, if the noble gas concentrations are preserved in the porewater of sediments, they contain information on past water temperature and salinity at the specific water depth. This would enable reconstruction of the temperature and the salinity distribution in lakes over time scales of several thousand years.

Numerical modeling of noble gas transport in lake sediments indicates that signals in the noble gas concentrations are smoothed by diffusive transport. However, diffusivities in the sediment porewater are not well known. Vertical ^{4}He gradients in the sediment resulting from the combined effect of in-situ production and transport may allow quantification of the relevant transport parameters.

The analysis of noble gases dissolved in groundwater or lakes is a routine procedure, whereas sampling and extraction of noble gases dissolved in sediment porewater is a new challenging task. Contact of the sample with air or any other gas reservoir must be avoided to prevent contamination or degassing of the sample. Our new approach is to collect the sediment by directly connecting the sample container to the liner holding the sediment core. By squeezing the bulk sediment in the liner the sediment is transferred into the sample container (copper tube). To extract the noble gases from the sediment porewater which is trapped in the sediment matrix, the sample container is first connected to an evacuated extraction vessel, and is opened. Then the sample is heated to increase the vapour pressure in the copper tube which causes the sediment to be sprayed into the extraction vessel, releasing the porewater and the dissolved noble gases.

[1]Aeschbach-Hertig, W., F. Peeters, U. Beyerle, and R. Kipfer, Water Resour. Res. 35 (9), 2779-2792, 1999.

[2]Peeters, F., R. Kipfer, D. Achermann, M. Hofer, W. Aeschbach-Hertig, U. Beyerle, D.M. Imboden, K. Rozanski, and K. Fröhlich, Deep-Sea Res. I, 47 (4), 621-654, 2000.

$CaCO_3$ preservation and dissolution events: What are they trying to tell us?

W.S. BROECKER, E. CLARK, AND A. PIOTROWSKI

Lamont-Doherty Earth Observatory of Columbia University, 61 Route 9W/P.O. Box 1000, Palisades, New York 10964-8000, USA (broecker@ldeo.columbia.edu, eliza@ldeo.columbia.edu, arcturus@ldeo.columbia.edu)

$CaCO_3$ size fraction and shell weight data clearly document the existence of dissolution events at the onset of times of glaciation and of preservation events at the onset times of interglaciation. While the most likely explanation is that these events were driven respectively by the reduction and regrowth of terrestrial biomass, two drawbacks exist. First the magnitude of the events appears to be larger than expected from the glacial to interglacial $\Delta\delta^{13}C$ for benthic foraminifera and second their distribution in the deep ocean does not appear to be as uniform as would be expected. In an attempt to account for this uneven distribution, Wally Broecker proposed an insolation-driven change in the interface between deep waters formed in the northern Atlantic and those formed in the Southern Ocean. However this idea is not supported by new Nd isotope data (Alex Piotrowski). Elizabeth Clark is currently exploring cores from the LDEO collection for pteropod (i.e., aragonite) preservation events in hopes of extending our evidence to shallower water depths.