New applications of noble gases as environmental proxies in unusual aquatic environments

M.S. BRENNWALD[1*], Y. SCHEIDEGGER[1], Y. TOMONAGA[1], C.P. HOLZNER[1,2], R. WIELER[3], AND R. KIPFER[1,3]

[1] Water Resources and Drinking Water, Swiss Federal Institute of Aquatic Science and Technology (Eawag), CH-8600 Dübendorf, *matthias.brennwald@eawag.ch
[2] Environmental Physics, Swiss Federal Institute of Technology (ETH), CH-8092 Zürich
[3] Isotope Geochemistry and Mineral Resources (ETH Zürich)

The concentrations of atmospheric noble gases in water are determined by the physical conditions (air pressure, water temperature and salinity) prevailing during gas exchange with the atmosphere. After separation from the atmosphere, the atmospheric noble-gas concentrations in the water remain unchanged, and therefore provide a record of the physical conditions during the last contact of the water with the atmosphere. In addition, the accumulation of terrigenic or radiogenic noble-gas isotopes may reflect the dynamics of a water body. In the past, these principles were used for palaeoenvironment reconstruction and for dating using noble-gas records in groundwater.

We recently extended the use of noble gases to determine (palaeo)environmental conditions and processes in 'new' aquatic systems, e.g.: (i) The pore water of lacustrine or oceanic sediments can serve as a noble-gas archive for palaeoenvironmental conditions (e.g. the salinity and water level of closed lakes as indicators of humidity in the past). Furthermore, the accumulation of terrigenic He or tritiogenic ^{3}He in the pore water allows studying the transport rates of solutes and fluids in the sediment. (ii) In surface waters, the release of gas bubbles (e.g. CH_4 or CO_2) from the sediment affects the gas abundance in the water (e.g. at gas seeps in the Black Sea). Noble gases are sensitive tracers for the dynamics of the gas exchange processes involved. (iii) Speleothems (dripstones) contain microscopic fluid inclusions, which are (partially) filled with water originating from the air-saturated film of drip water covering the speleothem surface. These inclusions can therefore be expected to provide a high-resolution (~1 yr) noble-gas archive for continental palaeoclimate conditions. Preliminary data from a new method for noble-gas analysis in ~1 mg of water from fluid inclusions confirms that the noble-gas signature of this water resembles that of air-saturated water. This result encourages further research to fully assess the scientific potential of speleothems as noble-gas archives that, complementary to ice cores from polar regions, would allow quantitative reconstruction of palaeoenvironmental conditions (e.g. temperature) in non-polar regions.