Landing (noble) gas analytics in the field: Towards real time in-situ gas determination

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Current available techniques to determine (noble) gases in terrestrial fluids, soil air or water are laboratory-based, expensive and allow only a very limited number of samples to be analysed. These methods are not adequate to resolve air / gas-water partitioning on the short time scales (min. - hours) being relevant for many environmental processes, e.g., gas transfer during bank infiltration. These facts prevent the powerful concepts of terrestrial noble gas geochemistry to be applied more wildly in environmental science and (tracer) hydrology.

To overcome these technical limitations we recently developed a membrane inlet mass spectrometric system operating at gas / water equilibrium (GE-MIMS) which enables the concentrations of dissolved He, Ar, Kr, N_2, O_2, CH_4 and CO_2 to be measured quasi-continuously (3 min.) in natural waters under field conditions on site [1] [2].

Initial dissolved O_2 concentrations at (ground) water recharge cannot be determined by the prevailing temperature (and salinity) of the water as all atmospheric gases are delivered to (ground) water not only by atmosphere / water equilibration, but also by excess air formation, i.e. at recharge the concentrations of atmospheric gases in (ground) water commonly exceed saturation equilibrium.

As Ar and O_2 have nearly the same physical properties with regard to gas/air-water partitioning, Ar concentrations allow the initial dissolved O_2 concentrations at (ground) water recharge to be determined. The GE-MIMS therefore enables, for instance, the quantification of O_2 turnover rates on the small time scales being typical for aquatic systems.

We present recent GE-MIMS applications to analyse (ground) water aeration during bank infiltration and to assess the contribution of excess air formation on the oxygenation of (ground) water. If feasible we demonstrate our portable GE-MIMS on site and in real-time at Goldschmidt conference.

[1] Mächler et. al, *Environ. Sci. Technol.*, **46**, 8288-8296. [2] Mächler et. al, *Chimia*, **68**, 155-159.