How mini-Ruedi Ruessel sniffs the world - towards real-time in-situ gas determination in the field

UI GROUP[1,2], MATTHIAS S. BRENNWALD[1], YAMA TOMONAGA[1], RUEDI RÜSSEL[1], ROLF KIPFER[1,2]

[1] Environmental Isotopes Group, Dept. of Water Resources and Drinking Water, Swiss Federal Institute of Aquatic Science and Technology (Eawag), 8600 Dübendorf, Switzerland, kipfer@eawag.ch
[2]Institute for Geochemistry and Petrology, ETH Zürich, 8092 Zürich, Switzerland

Available techniques for (noble) gas determiantion in terrestrial fluids are in most cases laboratory-based and expensive. As a result, this allows for only few samples to be analysed. Thus, these methods are inadequate

- to resolve the spatial distribution pattern of (noble) gases, e.g. gas mapping at contaminated sites or gas fields
- to determine (noble) gas / liquid partitioning in the short time scales being charateristic of many environmental processes, e.g. aeration of groundwater,
- to track long-term gas evolution, e.g. gas monitoring in response to seimicity.

These experimental limitations hamper the more widely used application of terrestrial (noble) gas geochemistry in environmental sciences.

In an attempt to get around these experimental restrictions, we developed a membrane inlet mass spectrometric system operating at gas / water equilibrium, wich allows (noble) gas analysis in all kind of fluids in the field [1, 2]. The second-generation of the system ('Mini-Ruedi-Rüssel': MRR) [2, see Eawag spin-off: www. gasometrix.com] is self-contained and 'hand'-held (i.e., battery operated, < 40 kg) enabling He, Ar, Kr, N_2, O_2, CH_4, CO_2 and H_2 concentrations to be simultaneously and quasi-continuously determined (< 15 min.)

Recently, MRR-systems were applied to analyse hydrothermal activity and fluid emission from ocean sediments, to quantify air/water partitioning at low wind stress [4], and to study the gas evolution in a proof-of-concept experiment for nuclear waste disposal [5].

This presentation will describe the simple and robust technology of the MMR system, and discuss some of the most recent field applications.

[1] ES&T 2013, 47, 7060-7066. [2] ES&T 2013 13455-13463. [3] Geology 2016, 44, 767-770. [4] ES&T 2019, 53, 1463-1470. [5] Appl. Geochem. 2019, 234-243.