Geophysical Research Abstracts, Vol. 7, 03846, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03846

Methane bubble streams in the Black Sea traced by dissolved noble gases

C.P. Holzner (1), H. Amaral (1), M.S. Brennwald (1), M. Hofer (1), S. Klump (1) and R. Kipfer (1,2)

(1) Water Resources and Drinking Water, Swiss Federal Institute for Environmental Science and Technology (EAWAG), CH-8600 Duebendorf (christian.holzner@eawag.ch), (2) Isotope Geology, Swiss Federal Institute of Technology (ETH), CH-8902 Zurich

In the NW Black Sea, numerous high-intensity methane (CH_4) seeps have been detected using hydro-acoustic methods. We apply noble gas (^{3}He, ^{4}He, Ne, Ar, Kr and Xe) measurements in the seawater to study bubble streams from gas seeps and trace secondary gas/water partitioning between the rising bubbles and the surrounding water. As CH_4 bubbles rise through the water column, gas exchange with the surrounding water takes place (dissolution and stripping) which affects the local noble gas concentrations. Therefore, the observed noble gas anomaly is related to the amount of gas released from the seeps.

Water samples from the CRIMEA cruise 2003 [1] revealed characteristic depletion of noble gas concentrations for samples taken out of a bubble stream compared to reference sites unaffected by bubble streams. The investigated bubble stream originates from a high-intensity gas seep on the abyssal plain of the Black Sea (approx. 2000 m depth) SE of the Crimea peninsula. On the second CRIMEA cruise in 2004, additional samples were taken to reinvesitgate the same bubble stream in more detail and to extend the survey to other seep sites. Special attention was paid to the top of the bubble stream, where the hydro-acoustic signal disapperars, indicating complete dissolution of the ascending gas bubbles. Also, to further characterise the gas release from the CH_4 seep, sediment samples were taken to analyse the noble gas signature of the sediment pore water.

The reinvestigation of the deep seep confirmed the depletion pattens in the deep water observed in 2003. In contrast to the first survey, however, a distinct maximum of the

noble gas depletion at the top of the hydro-acoustic image of the bubble stream was found. These anomalies are evidences of the spatial dimension and temporal evolution of the bubble stream.

The isotopic He signature (^{3}He/^{4}He ratio) of the water samples from the deep seep site, and also of those from several shallow seep sites (100 m to 250 m depth), is nearly the same as for the reference sites. The measured isotopic ratios indicate, that the gases released from all these seeps are of shallow (probably sedimentary) origin. On the other hand, water samples from one seep site at approx. 600 m depth have clearly different characteristics. Their He concentrations and ^{3}He/^{4}He ratios are higher than at the other sites, which indicates the influence of a deeper gas/fluid source (probably in the earth's mantle). This result is supported by seismic observations of a deep reaching fault zone at that site.

The above-mentioned examples illustrate the potential of noble gas measurements as a tool to study effects of bubble streams in the water column and to trace secondary gas partitioning phenomena in lakes and oceans. In addition, the isotopic noble gas signature of the water allows the geochemical origin of the seeping gas to be constrained.

[1] CRIMEA project: Contribution of high-intensity gas seeps in the Black Sea to methane emission to the atmosphere, see www.crimea-info.org.