Salt Lakes of Western Australia – Emissions of natural volatile organic compounds

T. SATTLER[1], T. KRAUSE[1], H. F. SCHÖLER[1], K. KAMILLI[2], A. HELD[2], C. ZETZSCH[2], J. OFNER[3], W. JUNKERMANN[4] AND E. ATLAS[5]

[1]Inst. of Earth Science, University of Heidelberg, Germany;
[2]Bayreuth Centre of Ecology and Environmental Research, University of Bayreuth, Germany;
[3]Vienna University of Technology, Austria;
[4]Inst. for Meteorology and Climate Research, Karlsruhe Inst. of Technology, Garmisch-Partenkirchen, Germany
[5]Rosenstiel School of Marine and Atmos. Sci., Miami, USA

Western Australia is a semi-/arid region that is heavily influenced by global climate change and agricultural land use. The area is known for its many saline lakes with a wide range of hydrogeochemical parameters. This area has been repeatedly investigated since 2006 and consists of ephemeral saline and saline groundwater sourced lakes with a pH reaching from 2.5 to 7.1. The semi-/arid region was originally covered by natural eucalyptus forests, but land-use has changed considerably after large scale deforestation from 1950 to 1970. Today the region is mostly used for growing wheat and live stock. The deforestation led to a rising groundwater table, bringing dissolved salts and minerals to the surface.

In the last decades, a concurrent alteration of rain periods has been observed. A reason could be the regional formation of ultra-fine particles that were measured with car-based and airborne instruments around the salt lakes in several campaigns between 2006 and 2011. These ultra-fine particles emitted from the lakes and acting as cloud condensation nuclei can modify cloud microphysics and thus suppress rain events [1]. New data from a campaign in 2012 accentuates the importance of these hyper saline environments for the local climate.

Ground-based particle measurements around the salt lakes in 2012 were accompanied by novel chamber experiments directly on the lakes. The 1.5 m^3 cubic chamber was constructed from transparent PTFE foil permitting photochemistry within while preventing dilution of the air due to lateral wind transport. This experimental setup allows linking the measured data directly to the chemistry of and above the salt lakes. Another advantage of the PTFE chamber is the enrichment of volatile organic compounds (VOC) that are emitted from salt lakes as possible precursors for the ultra-fine particles.

Chamber air was sampled using stainless steel canisters. Sediment, crust and water samples were taken for investigation of potential VOC emissions in the laboratory using GC-MS technique.

Different VOC and halogenated volatile compounds (VOX), exceeding atmospheric background concentrations, where identified from the sampled chamber air. Their enrichment or depletion over the time in the chamber allows for postulated reaction pathways leading to the formation of ultra-fine particles.

Geochemical and acoustic investigations of hydrocarbon seepage on the continental shelf off northern Norway

S. SAUER[1]*, J. KNIES[1], C. SCHUBERT[2], A. LEPLAND[1] AND S. CHAND[1]

[1]Geological Survey of Norway, Trondheim, Norway (*correspondence: simone.sauer@ngu.no)
[2]Swiss Federal Institute of Aquatic Science and Technology (EAWAG), Kastanienbaum, Switzerland

Active natural hydrocarbon seepage in the Hola area along the continental shelf off northern Norway has recently been found by Chand *et al*. 2008 [1]. We conducted acoustic and geochemical investigations to gain a better understanding of the extent and history of this gas seepage. Seismics and water column acoustic data were used to reveal potential hydrocarbon pathways to the seafloor and to locate active gas seepage. Methane concentrations are determined in the water column and in sediment pore waters and geomicrobiological analyses of the sediments from the seepage sites are used to assess microbial processes involved in the methane cycle.

We use sulfate and methane sediment pore water profiles to estimate the anaerobic oxidation of methane and stable isotopic analyses of methane are applied to identify biogenic or thermogenic methane sources. Concentration profiles of dissolved iron, ammonium and phosphate provide information on biogeochemical activity in the sediments.

The results of the geochemical investigations of seawater and sediment pore waters will ultimately be combined with the investigation of methane-derived carbonate crusts whose presence has recently been documented in the Hola area with an AUV based on photo and synthetic aperture sonar images. U-Th dating of these carbonate crusts will provide insights into past methane release and possible links with climate variations.

[1] Chand, S., Rise, L., Bellec, V., Dolan, M., Bøe, R., Thorsnes, T., Buhl-Mortensen, P., 2008. Active Venting System Offshore Northern Norway. Eos, Transactions American Geophysical Union 89, 261-262.

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