

# **Trace element behavior at natural marine hydrocarbon seeps – Preliminary results and new insights from oil seepage-derived authigenic pyrite**

**DANIEL SMRZKA<sup>1</sup>, ZHIYONG LIN<sup>2</sup>, PATRICK MONIEN<sup>1</sup>, WOLFGANG BACH<sup>3</sup>, JÖRN PECKMANN<sup>2</sup> AND GERHARD BOHRMANN<sup>4</sup>**

<sup>1</sup>University of Bremen

<sup>2</sup>Universität Hamburg

<sup>3</sup>MARUM, University of Bremen

<sup>4</sup>MARUM – Center for Marine Environmental Sciences and Department of Geosciences, University of Bremen

Presenting Author: [smrzka@uni-bremen.de](mailto:smrzka@uni-bremen.de)

At marine hydrocarbon seeps, a large variety of compounds are expelled from seafloor sediments to bottom waters. The key biogeochemical process at seeps is the sulfate-driven anaerobic oxidation of methane (AOM), mediated by a consortium of sulfate-reducing bacteria and methanotrophic archaea. This metabolic process triggers the formation of minerals, which are excellent archives of the biological and geochemical processes operating through geologic time. Aside from authigenic carbonate, pyrite is a main mineral product of AOM at seeps, and represents a yet understudied archive of early diagenetic processes. Distinguishing natural oil- from methane-dominated seep systems in particular has gained traction in recent years in the search of proxies that enable the identification of endmember systems. The element inventory of authigenic pyrite reveals new insights into potential sources and sinks of trace elements during early diagenesis. Preliminary results from oil seepage-derived authigenic pyrites reveal strong enrichment in Mn, Cu, U, and Mo, moderate enrichment in Zn, Cd, V and Ni, as well as distinct relative depletion in Se and As compared to their methane seepage-derived counterparts. Trace elements within the Co – Ni – As or the Fe – As – S system that usually show some degree of correlation in pyrite lack such a covariation at oil seeps. This suggests that the presence of heavy hydrocarbons compounds in concert with increased organic matter content appear to override typical crystal lattice substitution mechanisms and mineral-specific trace element affinities in pyrite. Strong enrichment in Mn, which appears to substitute for Fe in the oil seepage-derived pyrite, may argue for higher concentrations of dissolved sulfide in parent fluids, or for longer lasting, more stable reducing conditions overcoming the sluggish kinetics of manganese reduction. Likewise, the high degree of Mo enrichment in oil seepage-derived pyrite points to intense sulfate reduction at oil seeps. These results shed new light on the mobility and distribution of trace elements related to oil seeps that may well constitute an underestimated source of trace elements to marine sedimentary pore and bottom waters.