Si isotopes in sedimentary pore fluids trace early diagenetic reactions in the Guaymas Basin, Gulf of California

GEILERT, S.; HENSEN, C.; LIEBETRAU, V.; SCHOLZ, F.; FRANK, M.[1]; EHLERT, C.[2]

[1]GEOMAR Helmholtz Centre for Ocean Research Kiel, Wischhofstr. 1-3, 24148 Kiel, Germany
[2]Max Planck Research Group for Marine Isotope Geochemistry, ICBM, University of Oldenburg, Germany

Silicon (Si) isotopes in pore fluids from hot vents and cold seeps in the Guaymas Basin (Gulf of California, Eastern Pacific) have been sampled during the SO241 cruise in summer 2015. The Guaymas Basin is an early-opening continental rifting environment with vigorous hydrothermal activity. High sedimentation rates result in a thick siliceous, organic-rich sediment layer, composed mainly of diatoms. Hydrothermal activity in the Guaymas Basin is driven by magmatic sills, which have intruded into the sedimentary package thus giving rise to a high heat flow and accelerated early diagenetic processes. Sampling included the recovery of short and long sediment cores close to a newly discovered hydrothermal vent field and at cold seeps in varying distances to the rift axis. The aim was to investigate fluid sources and fluid-sediment interactions during the rise of deep pore fluids with the help of Si isotopes.

Dissolved silica concentrations (dSi) in pore fluids of short sediment cores (<30cm) increase with depth and range from 0.04 to 0.86 mM. Si isotope compositions ($\delta^{30}Si$) vary between 0.5 and 2.1 ‰. Pore fluid dSi of long sediment cores (up to 5m) range from 0.37 to 1.3 mM and $\delta^{30}Si$ signatures span an extreme range from -0.3 to 2.5 ‰. The isotopic values are the highest and lowest observed so far in pore fluids. They reflect a mixing system of hydrothermal fluids and seawater ($\delta^{30}Si$ = 1.8 ± 0.3 ‰ (2σ)) and are further affected by dissolution and precipitation reactions in the sediment. Silica concentrations and Si isotopes in the Guaymas Basin are strongly influenced by the local temperature regime. Highest dSi and $\delta^{30}Si$ signatures are found close to the hydrothermal vent sites where early diagenetic processes are accelerated, including Si release from diatoms and incorporation of light Si isotopes into authigenic phases. Close to the hydrothermal vent field mixing with isotopically light hydrothermal fluids likely occurs. Our data demonstrate that Si isotopes can be used to characterize early diagenetic processes and to determine sources and sinks of the present and past silica cycle.