Noble gases to study sediment transport processes around deep-sea vents

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Black smokers are deep sea hydrothermal vents, releasing hot water from great depths through chimney-like structures into the ocean. Noble gas (NG) analysis, especially the determination of helium isotope ratios, is a useful tool to identify the origin of discharge, as mantle-derived fluids show a significantly higher $^{3}He/^{4}He$ ratio than those originating from the earth’ s crust or air saturated water (ASW).
Fluid samples from the water column above a black smoker in the Guaymas Basin (Gulf of California) prove to be supersaturated in helium and are strongly enriched in ^{3}He by a factor of 8 with respect to ASW [1]. A sediment core collected in the vicinity of the black smoker shows a high temperature gradient with depth (3-68˚C from 0-5m depth). Pore water extracted from the core was analysed for its NG composition to identify the process being responsible for the observed heating of the sediment column.
The NG concentrations were found to be equal to ASW at in-situ water temperature (3˚C), indicating that advective transport of fluids is virtually absent and that the sediment is heated almost exclusively by thermal conduction. However, the $^{3}He/^{4}He$ ratio is about twice as high as in ASW, which indicates diffusive transport from the smoker into the sediment.
Similar analysis was done to identify deep-sea vent structures and seeps to determine transport processes within the sediment column in the Atlantic in the tectonically active region around the Azores. With this contribution we would like to compare the physical transport processes in the sediment at two different set-ups.

[1] Berndt et al. (2016), *Geology*, **44**, 767-77

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