Noble gas analysis of sediment pore fluids near black smoker

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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 $^3He/^4He$ 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 Gulf of California prove to be supersaturated in helium and are strongly enriched in ^3He 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 0-5 m depth). Pore water extracted from the core was analyzed for its NG composition to identify the process being responsible for the observed geothermal heating. The NG concentrations were found to be equal to ASW at in-situ water temperature (3 °C), indicating advective transport of fluids is virtually absent and that the sediment is heated by thermal conduction almost exclusively. However, the $^3He/^4He$ ratio is increased by a factor of ~2 w.r.t. AEW, which might suggest diffusive transport.

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