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Fluid geochemistry of cold seeps and hydrothermal vents in the Guaymas Basin, Gulf of California

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In this study, we present geochemical data from pore fluids and gases that were sampled at cold seeps and hydrothermal vents in the Guaymas Basin during Sonne cruise 241. The Guaymas Basin is a unique environment where magma intrudes into thick sequences of organic-rich sediments, thereby maturing host rocks and releasing large amounts of hydrocarbons. Geochemical measurements performed on samples from a recently discovered high-temperature vent field (Berndt et al., 2016) clearly support this paradigm. 3He/4He ratios agree with that of excess He from the southern part of the Guaymas Basin (Lupton, 1979) and suggest the same general MORB source, while isotopic data of hydrocarbon gases largely indicate a thermogenic, sedimentary source. Heat flow measurements performed in the vicinity of the smoker site are extremely high, exceeding 10 W/m2, indicating that hydrocarbon gas production (mainly CH4) is related to contact heating due to magmatic activity near the hydrothermal vents.

Cold seeps are located up to some tens of kilometres off the rift axis and are typically characterized by chemosynthetic fauna assemblages at the seafloor. The occurrence of the seeps has also been related to sill intrusions. Seismic records typically show evidence for sediment mobilization in the deeper subsurface and blanked zones due to gas accumulations directly beneath the seeps. Despite these visual and geophysical indications for deep-sourced heat-driven fluid flow, pore water data are not indicative for geochemical reactions taking place at elevated temperatures. Major dissolved constituents do not show strong deviations from seawater and dissolved methane is typically of biogenic origin. In addition, heat flow values do not deviate from regional averages, and hence, these findings contradict the existing hypothesis of a sill-driven mechanism responsible for the formation of seafloor seepage sites. A preliminary interpretation is that fluid and gas mobilisation from sill activity has ceased and biogenically formed methane migrates upward along pre-existing fluid pathways.

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