Sill Intrusion, sediment alteration, and hydrothermal activity in off- and on-axis environments of Guaymas Basin, Gulf of California

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Guaymas Basin, Gulf of California is a an early rift environment where crustal accretion involves the intrusion of mafic sills into unconsolidated organic-rich sediments. In October, 2017, 78°C seawater-derived hydrothermal fluids were collected at Ring Vent, an area of hydrothermal activity above a shallow sill located ~30 km northwest of the northern graben of Guaymas Basin. High and low-temperature fluids (64 to 331°C) were also collected from areas of venting at the top of the southeast wall bounding the axial graben, ~1.5 km from the spreading axis. The chemical and isotopic composition of the fluids were used to constrain subsurface conditions and processes during the evolution of vent fluid chemistry.

All of the fluids were highly enriched in low molecular weight hydrocarbons relative to seawater with endmember CH_4 concentrations varying from 12 to 60 mmol/kg. Although the relative abundance of C_{2+} hydrocarbons and isotopic composition of CH_4 indicate that both thermogenic and microbial processes contribute to the inventory of CH_4 at both locations, the abundance of microbial CH_4 is substantially greater at the lower temperature Ring Vent relative to on axis high temperature fluids. Significant differences were also observed in the inorganic major element composition. Ring vent fluids were characterized by partial removal of K and Mg relative to the seawater source fluid. In contrast, the high temperature fluids were highly enriched in K relative to seawater and contained near-zero concentrations of Mg. Collectively, the organic and inorganic fluid compositions point to lower temperature conditions during fluid-sediment interaction in subsurface environments below Ring Vent relative to on-axis hydrothermal activity. The results demonstrate that off-axis magmatic activity in rift basins may play an important role in the sequestration and cycling of carbon over geologic time.