Geochemistry of a shallow-water hydrothermal vent system within a tropical coral reef (D'Entrecasteaux Islands, PNG)

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Hydrothermal vents are recognized as important contributors to global biogeochemical cycles, supplying metals and other substances to the ocean. Although they are found worldwide, little is known about the impacts of shallow water hydrothermal vents on their surrounding. To understand the influence of the chemistry of hydrothermal fluids on the well-being of shallow-water marine environments, we investigated a sediment-hosted vent system (0.5-6 m water depth) that is located within a fringed coral reef at Normanby Islands (D'Entrecasteaux Islands, Papua New Guinea). Seawater, porewaters and surface sediments of serval sediment patches were analysed for their chemical composition and fluid flow rates were calculated from high-resolution temperature profiles measured in situ in the sediment.

We found that the porewaters in sediment patches with active venting were depleted in Cl, Br, SO_4, Na, K, Ca, Mg, Sr and were enriched in Si, Li, Mn, Fe, Rb, Cs, As, dissolved inorganic carbon and total alkalinity relative to seawater. From the Mg and SO_4 concentrations we calculated the original hydrothermal fluid endmember concentration and found that the porewaters have a hydrothermal component of 15-35 volume%. Mixing of hydrothermal fluids with seawater will lead to the precipitation of redox-reactive substances in the sediments, hence metals such as Fe, As, Cr and Ni have accumulated to concentrations 10-times the background levels and likely contribute to the observed reduction in the abundance and diversity of benthic fauna in the sediments. For other elements our flux estimates indicate that hydrothermal vents can be a significant source of dissolved inorganic carbon and nutrients (Si, NH_4) to the local reef ecosystem. However, releases are in the same order as nutrient cycling, so potentially not affecting the reef biota.