Diversity of hydrothermal fluids from four vent sites at the Kermadec Island Arc and its relevance for elemental fluxes

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During SONNE cruise SO253 in 2016/2017, four active hydrothermal vent sites at submarine arc volcanoes (Macauley, Haungaroa, Brothers and Rumble III), located at water depths ranging between 220m and 1600m, were sampled. Fluid samples were taken from diffuse-flow sites as well as from white and black smokers discharging fluids, rich in metals and gases that are dispelled at temperatures as high as 312°C. Their composition is very variable but basically groups into two end members: one that reflects strong magmatic input and another that shows evidence for intense water-rock interaction under hot acidic conditions. A new vent field was discovered at Haungaroa.

Samples from the shallowest sampling site, where fluids discharge directly into the photic zone of high bioproductivity (Macauley, 220m water depth), had Fe concentrations as high as 1.8 mM and H_2S up to 10 mM at a very acidic pH of 1.5. At the deepest sampling site (Brothers), we identified two fluid types: A magmatically influenced type at the cone with 80 mM Mg, which is clearly enriched compared to seawater, high H_2S (6 mM) and Fe concentration of only 30 µM in contrast to the fluid displaying water-rock interaction at the NW caldera wall with low Mg (4 mM), low H_2S (1-2 mM) and highest Fe contents (11 mM). Chloride concentrations in all fluids were similar or highly enriched compared to seawater (up to 820 mM), indicating phase separation of some fluids and emission of brine phases; however, only one low chlorinity vapour phase fluid was recovered at Brothers.

Our data display the diversity of hydrothermalism at the Kermadec Island Arc and its importance for elemental fluxes into the ocean as well as on the biogeochemical cycle of metals, since e.g. Fe concentrations in the plumes could be traced over long distances and hydrothermal fluxes in some cases, are reaching into the photic zone.