The formation and fate of minerals in a buoyant rising plume

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A Significant Chemical Reservoir

As they emerge from the crust, hydrothermally influenced fluids are rich in dissolved metals and depleted with respect to oxygen. As the fluid mixes with the cold and oxic deep-sea water rapid formation of metal sulfides and oxides occurs.

Most hydrothermal systems are significantly enriched in dissolved metals with respect to seawater and it is common for dissolved iron, zinc, and copper concentration to be orders of magnitude above that of other metals[1]. The minerals that they form are known to incorporate other elements, both within the structure of the mineral and via adsorbtion to the mineral surface, as they form[2,3].

The deposition and burial of these minerals represents a major sink for the dissolved metals and phosphorous in hydrothermally influenced fluids[4]. By studying the dynamics of mineral formation, we seek to identify the locations within the plume where the loss processes occur and the rates at which they occur within a rising hydrothermal plume.

Methods and Results

Particles were collected from multiple heights within the rising plumes of three Lau Basin venting sites: Kilo Moana, ABE, and Mariner using in-situ filtration. By combining bulk geochemical measurements with synchrotron X-ray spectroscopy and diffraction techniques it is possible to determine the speciation and quantity of the minerals that are formed.

Our work thus far has shown that chemical differences in the hydrothermal fluids from different venting sites significantly affects the speciation of the iron, zinc, and copper minerals formed in the rising plume.

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