Geophysical Research Abstracts
Vol. 13, EGU2011-1260, 2011
EGU General Assembly 2011

Hydrothermal Fluxes at the Mid-Atlantic Ridge, 5°S

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The growing number of known hydrothermal vent sites has lead to an increasing recognition of the quantitative importance of hydrothermally derived materials in the large scale ocean circulation due to their possible impact on the ocean carbon cycle. The basin wide spreading of primordial helium measured during the WOCE era revealed intense hydrothermal venting in the South Atlantic, but it was not until 2005 that the first vent fields were located after intense surveys along the Mid-Atlantic Ridge. Before these surveys no hydrothermal fields were known in the Atlantic between 12° N and the Southern Ocean, thus leaving a large gap in the biogeography of hydrothermal vent fauna.

One of the newly discovered sites is located in a relatively short segment of the rift valley at 5° S. It consists of three known high temperature fields: Turtle Pits, Comfortless Cove, and Red Lion, as well as several areas were diffuse venting was found. Hydrographic measurements were carried out at the Turtle Pits vent site during three cruises: Meteor cruise 68/1 in May 2006, a cruise with the french vessel L'Atalante in January 2008, and Meteor cruise 78/2 in April/May 2009. The data collected during these cruises are vertical profiles and towed sections of temperature, salinity, and turbidity, direct velocity measurements with lowered ADCP, as well as water samples for Helium isotope analysis.

The hydrography at the vent sites is largely determined by the location of the sites in relation to the surrounding rift valley. The vents are situated in the center of the valley at a topographic sill. The water column plumes of the vent fields are clearly visible by strong signals in turbidity and temperature anomalies, and show a maximum rise height of more than 200 m, which does not exceed the height of the side walls of the graben. The currents in the rift valley are predominantly northward; the difference in stratification between upstream and downstream conditions and observed Froude Numbers around one indicate a hydraulically controlled flow across the sill. Turbulent mixing as evident in the frequent occurrence of overturns causes a vertical transport of hydrothermal material downstream of the sill. Analysis of mixing from finescale measurements indicates the possible importance of the mixing for the transport of hydrothermal material into the upper water column above the ridge crest.

Combining the observed throughflow with the helium distribution in the rift valley leads to estimates of the power emission about 10 times larger than estimates using the rise height of the plume. This may indicate an underestimation because of plume bending by the background current. On the other hand the large emissions of helium may indicate a considerable contribution of diffuse venting.