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Heat and Volume Fluxes at the Turtle Pits Vent Site, southern Mid Atlantic Ridge

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The Turtle Pits vent site consists of eight known high temperature vents and several diffuse vent sites which are distributed over three hydrothermal fields: Turtle Pits, Comfortless Cove, and Red Lion. These vent fields are located in a north-south orientated rift valley at the Mid-Atlantic Ridge (MAR) near 5°S. The total volume and heat emissions of the entire Turtle Pits site have been calculated with three different approaches using data collected during a Meteor cruise in May 2006 and a L′Atalante cruise in January 2008. The data sets consist of vertical profiles and towed transects of temperature, salinity, and turbidity, as well as direct velocity measurements with a lowered acoustic Doppler current profiler (LADCP) and water samples for Helium isotope analysis. Vent fluid samples for noble gas analysis where taken with ROVs.

Since the vent fluid is highly enriched in primordial ^{3}He this noble gas can be used as a conservative tracer for vent fluid. The geographical setting of the vent site confines the particle plume to the rift valley since the depth of the valley exceeds the rise height of the plume. Therefore the fluxes of heat and volume can be estimated from the horizontal helium transport in the valley in combination with a mean ^{3}He endmember concentration determined from the water samples taken with the ROVs. The comparison of the ^{3}He concentrations measured south of the hydrothermal vents with the ^{3}He signal north of the hydrothermal vents suggests a rather strong northward flow. This is confirmed by the tide corrected velocities observed with the LADCP during the Meteor cruise. The northward volume transport has been calculated using the local bathymetry and tide corrected velocities from the Meteor cruise. In combination with the ^{3}He concentrations and the average ^{3}He endmember concentration a flux of 1000 l/s is estimated, which corresponds to a heat flux of 1400 MW.

The measured temperature anomalies within the plume combined with the known background stratification and the mean flow velocity within the valley yield an estimate of the total flux of the hydrothermal vents which is significantly lower.

Similar results have been calculated using the rise height of the particle plume estimated from the measured temperature anomalies in combination with the background stratification.

In contrast to the flux calculated from the ^{3}He concentrations the fluxes calculated from the temperature anomaly and the plume rise height only take the emissions from hot vents into account and exclude emissions from diffuse vent sites.