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Temporal Variations in Hydrothermal Fluid Chemistry at 9-10°N East Pacific Rise: Elucidating Ties to Crustal and Biological Processes

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The high temperature vent fluids at 9°50'N EPR, especially from Bio9, Bio9' and P vents have shown unprecedented temporal variation between 1991 and 2002. Although results from our January-February 2002 cruise are still being analyzed, it is clear that the fluid chemistries now are most similar to those observed within a year following the volcanic eruptions at this site in 1992. Our temperature measurements of vent fluids from these three vents are all now 386C, hotter than has been measured since 1992. Based on the chemical and temperature characteristics of the fluids, our hypothesis is that the heat source driving the hydrothermal circulation is now shallower than it has been in a decade. Our interpretation is that another eruption and/or dike intrusion is 'imminent,' however we do not know the time scale that 'imminent' implies. We therefore propose to sample and analyze the vent fluids at this site, and to measure their temperatures on three cruises to this site over the next three years. Chloride and silica are the most critical indicators of this process, in conjunction with temperature, and as instruments for the in situ measurement of Cl and Si in high temperature fluids do not yet exist, this time series must be accomplished by point sampling.

Our data from 1991-2002 for these vent fluids show that the trends in increasing Cl and Si and decreasing temperature (indicative of a deepening reaction zone within the hydrothermal circulation cell) which began between the March 1992 and December 1993 samplings, started to reverse between December 1995 and April 1996. This is approximately a year after the seismic swarm and temperature spikes observed in March/April 1995 (Sohn et al., 1998; Fornari et al., 1998) , and a month before the AHA arrays began monitoring this site. There is no pronounced signal in the temperature records for this interval, and no seismic arrays were deployed at this time. Hence, we do not know what the pivotal event was in this hydrothermal system. It is therefore clear that while we can use the changes in fluid chemistries as indicators of changes in the heat distribution within the crust, until we have contemporaneous data, we cannot determine cause and effect. While we cannot guarantee another similar event will occur within the proposed study period, as there are pronounced changes between every fluid sampling that occurred on the scale of months, we are likely to catch several events. Until we can rigorously link fundamental changes in fluid compositions and temperatures to known changes in the nature of the heat source, we will not be rigorously able to link the hydrothermal heat removal to the formation of new crust.

As the changes in fluid compositions involve reduced chemical species, as well as species we can use as more direct indicators of pressure and temperature conditions of reaction (such as Cl and Si), and it is these reduced chemical species that provide the energy source for the biological communities at these sites, the same processes which cause change in the fluids will therefore have an effect on the biological communities. Our goal is therefore to work with geophysicists/seismologists who can constrain changes in the heat source, and/or the depth to which the crust surrounding it is brittle and therefore able to support fluid flow, and also to work with biologists to see how changes in fluid composition may or may not be reflected in theabundance and nature of the adjacent biological communities. We see our focus being primarily at 9°50'N, where our time series to date suggests the most temporal variation has occurred, but are also potentially interested in working as far south as 9°46.3'N, where the temporal variation that is occurring is more uni-directional, if other investigators are proposing to work in these areas.

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