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U. of Hawaii at Manoa

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East Pacific Rise hydrothermal results

The continuation of the Polar work originally proposed to the ONR in 1990 for this proposal had to be curtailed after the cancellation of the Barents Sea cruise in 1990 and after the P.I. was denied space on the trans-Polar expedition during the summer of 1991. Instead, after consultation with the ONR program manager the P.I. participated in a cruise designed to use trace elements to survey the hydrothermal plumes generated by sea-floor hydrothermal activity between 9° and 11° N on the East Pacific Rise. The P.I.'s participation in this cruise was designed to determine the magnitude and variability of dissolved Al enrichment in the hydrothermal plumes which result from the mixing of hydrothermal vent fluids with the overlying sea water. A goal of the work was to determine whether the magnitude of that enrichment can be used to elucidate the variations of Al in the hydrothermal vent end-members thus providing a remote means of assessing the variations in the circulation schemes along ridge axes. The preliminary results of this work were presented at the AGU Fall meeting in December of 1992. Until all the shore-based analyses of the samples collected are available the interpretation of the data set will be necessarily incomplete. However, preliminary results do allow certain interim conclusions to be reached and indicate the general thrust that future data interpretations are expected to take. The preliminary findings of this work are summarised below:

Bottom water (non-plume) values of dissolved Al are considerably higher than have previously been observed at these depths (~2500 m) in other regions of the Pacific. The pervasive nature of the enhanced bottom water (non-hydrothermal plume) signal suggests that the 2-3 nM Al enrichment seen is produced by the low temperature weathering of the new ocean floor. The absence of sediments at this local topographic high eliminates any other diagenetic source.

The elevated Al concentrations measured in the neutrally buoyant hydrothermal plume indicate that the flux of hydrothermal Al is detectable in the hydrothermal plumes and that the signal is above that which can be generated by entrainment of the elevated bottom waters. Therefore, the plume signal must in some way be related to the hydrothermal end-member. While the enriched layers are both well defined and numerous, they do not appear to correlate simply or uniformly with either the light attenuation-

based measurement of particulate load, or the concentration of dissolved methane or manganese. This lack of simple correlation may be related to the considerably longer residence time of dissolved Al relative to either the methane or Mn, resulting in integration of the hydrothermal signal over a longer time period than the other tracers. This hypothesis will be tested when the shore-based ^3He data from the cruise become available. An alternative explanation might be that the relative variation of the Al signal strength to that displayed by the other parameters reflects differences in the end-member Al content of the hydrothermal fluids. The Al content of the end-member fluids is believed to be controlled by the composition of the mineral assemblage deep within the hydrothermal system that reacts with the hydrothermal fluid. Samples of hydrothermal vent fluids have been collected by other workers over part of this study area. As soon as the results of the analyses of these fluids become available, the plume data set will be examined to see if there are any correlations between the Al content of the vent end-members and the enrichment seen in the plumes. If end-member chemistry were detectable by such plume measurements as these then Al could play a significant role in enabling ship-board plume surveys to become an efficient mechanism for establishing first order assessments of both the magnitude and nature of hydrothermal activity in regions, prior to more intensive submersible-based sampling.

The off-axis casts, undertaken to provide a background by which the plume chemistry could be assessed, showed elevated values for many of the parameters determined, including Al. The unexpectedly high values lead to the belief that there must be a considerable amount of off-axis hydrothermal activity from sea mounts, etc.

The results of this work have been submitted to the Geophysical Research Letters and will be published in the December 1993 issue.