Letters of Intent: Endeavour
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Fluxes of Heat and Salt from Endeavour Segment Vent Fields: Discrete Measurements as a Test of the Sea Breeze Flux Meter Hypothesis

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Measurement of the heat and material fluxes that link geological forcing to biological response is central to addressing the questions posed for the Endeavour Integrated Study Site. Taking advantage of the topographic constraints of the Endeavour Segment, we propose to make direct observations of fluxes of fluid, heat and salt both emanating from vent fields and transported laterally at each end of the axial valley. We will use these observations to evaluate whether the lateral fluid flux into the valley balances upward fluid flux from the fields--the "sea breeze" hypothesis (Thomson et al., ms.), thereby providing a means of making continuous proxy measurements, through the entrainment coefficient, of fluxes from these same vent fields. The key elements of the program include:

We would make discrete measurements of fluxes of heat and salt emanating from the five major vent fields along Endeavour Segment. We will use the observational strategy developed during the Flow Mow 2000 program (Stahr et al., ms.) utilizing the autonomous vehicle ABE to measure fluxes in rising hydrothermal plumes. The products of this portion of the experiment will be the first direct determination of the relative strengths of these five sources, a salt budget for the segment, and the first meaningful assessment of the stability of fluid flow and transport of heat and salt from the Main Endeavour Field.

We would establish two or more continuous, long-term current meter arrays (fences) across the axial valley to determine the horizontal flux of fluid due to entrainment, continuously over long periods of time. An analysis of current meter deployments in 2000-2001 in the vicinity of Main Endeavour Field (Thomson et al., ms., Veirs et al., ms.) reveals a persistent northward flow deep within the axial valley. A mass balance suggests that this flow is comparable to entrainment into rising hydrothermal plumes. We hypothesize that this "sea breeze" could be exploited as flux meters for the vent fields of the Endeavour Segment. Integrating these data with the discrete flux measurements will allow us to test this hypothesis. The success of this effort would represent a major advance in our ability to determine fluxes from these vent systems continuously and over long intervals.

This same suite of current meters would represent an important community resource. The southern mooring would provide one boundary of Cowen's proposed program concerning regional export of biomass and reducing power. The central meters in the suite would provide key information for interpretation of time series data within the vent fields. Overall, the array would provide a rich data set for considering the role of currents in dispersal of larvae. Finally it would enable some very exciting physical oceanographic experiments comparing topographically modified flows in the axial rift valley, with its buoyancy driven upwelling, to its neighbor to the west in which topographic effects are similar but where buoyancy sources are expected to be substantially smaller.

The success of Flow Mow 2000 relied on a careful analysis of synthetic data to verify the observational strategy. Before initial deployment of the current meter array, we will complete work with an adaptation of the Princeton Ocean Model to the local environment. One application of this model will be for optimizing the deployment strategy. We already know that the relative source strength of the major vent fields is a key variable, so that the field work will be done in a sequence allowing constant improvement in the deployment strategy as additional observational and modeling results become available.

To accomplish these objectives, we would conduct a series of four cruises:

Summer 2003, CCGS John P. Tully, ~10 days, deploy fences.

Early Summer 2004, RV Thomas G. Thompson, ~30 days, ABE and CTD work at five major vent fields, service fences.

Late Summer 2004, CCGS John P. Tully, ~10 days, reconfigure fences reflecting analysis of these two data sets.

Summer 2005, CCGS John P. Tully, ~10 days, service or recover array, depending on success of/reaction to a February 2005 proposal based on results from first year of data.