Letters of Intent: Lau Basin
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LAUB-FLEX: Deep Circulation and Dispersal in the Lau Basin using Floats

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Collaborative Proposal: Sampling and Initial Characterization of Hydrothermal Fluids, Deposits, Microfauna, and Megafauna at Vent Fields along the Eastern Lau Spreading Center

Intellectual merit:

We propose an interdisciplinary study to identify

1) the range in vent fluid chemistry, vent deposit composition, and biota at major vent fields along the Eastern Lau Spreading Center (ELSC) and

2) the key processes and variables that influence fluid chemistry, sulfide deposit formation, and the range of habitats available for biological communities.

The molecular and physiological diversity of associated microbes, the distribution and reproductive status of dominant megafaunal organisms present in the vicinity of hot-springs, and the distribution of plankton and larvae in the overlying water column will be related to the environmental conditions present at each vent site. Our choice to work at the ELSC is largely based on the substantial and systematic along-strike variations exhibited from south to north. The variations in spreading rate (40-95 mm/yr, full rate), axial depth and morphology (1600 to 3000 mbsl), magma source and lava chemistry (andesitic lavas to typical tholeiitic basalts), melt lens characteristics, crustal structure, and proximity to arc magma sources and the subducting slab provide an excellent opportunity for examining the influence of key variables on hydrothermal venting and associated megafauna and microfauna. It is already known that within the Lau Basin there is a representative variety of venting styles, and along the ELSC there are three known areas of low temperature diffuse venting, and one known area of high temperature venting. Thus, the ELSC is an excellent location for addressing a number of important questions, including:

1) Does the regional morphology and source rock affect styles of venting?

2) Do differences in substrate compositions (dacite vs andesite vs basalt) affect compositions of vent fluids and their deposits?

3) Is there evidence for subsurface mixing of fluids, deposition and metal remobilization (e.g., low pH, low H2S, low Cu, high Zn)?

4) Is there evidence for input of magmatic volatiles (e.g, as at Desmos Caldera (Gamo et al., 1997))?

5) Is there evidence for recent magmatic or tectonic events?

6) How do differences in fluid compositions affect the diversity of microbes and megafaunal community structure?

7) Does microbial biomineralization and bioleaching contribute significantly to the mineralogies?

8) Do megafaunal communities associated with hydrothermal venting in Lau Basin share synecological characteristics with other vent faunas (e.g. endemicity, zonation)?

9) Are megafaunal communities taxonomically and autecologically distinct from other vent-endemic faunas?

We will address these questions through mapping of vent fields coupled with systematic sampling of vent fluids, deposits, and biological communities using an ROV (e.g., JASON II), establishing the interdependence among deposits, fluids from which they form, and biological communities.

We will characterize, for each of ~3 to 6 vent fields,

1) distributions of types of venting, vent structures and morphologies, and their relations to substrate and the range and distribution of megafauna,

2) fluid chemistry (e.g., range and variation of Cl, H_2S, H_2, CO_2, pH, Fe, Mn, and a suite of other aqueous species, some stable isotope compositions, volatiles, and organics at each site),

3) vent deposit mineralogy and bulk geochemistry,

4) molecular and physiological diversity of microbes associated with diffuse and high temperature fluids and active chimneys, and

5) range, abundance, distribution, and reproductive status of dominant megafaunal organisms present in vent fields and distribution of larvae/plankton in water column above vents.

In addition, addressing the questions above will provide critical information about ELSC vent sites that can be used by the RIDGE 2000 community, in conjunction with data collected on other cruises, to identify the bull's-eye of the Lau Integrated Study Site.

Broader Impact:
This work will increase our understanding of the genesis of potentially economic massive sulfide deposits, and of microorganisms that thrive in the extreme seafloor vent environment. Mechanisms used by organisms to withstand these extreme conditions may well spur development of new technology by the biomedical community and provide sources of thermophiles suitable for industrial bioleaching of mine tailings or resistant to heavy metals. Educational component: Several graduate students will be involved in the cruise and in on-shore research. We will solicit students and educators from Tonga and Fiji to be active participants in the expedition, and use results from this project in other outreach and educational venues.