

Letters of Intent: Lau Basin
Target Date: August 15, 2002

Biogeography and Community Structure in Mussel Beds at Pacific Hydrothermal Vents

Summary of a proposal to be submitted by C.L. Van Dover to NSF Biological Oceanography and Ridge 2000 for the 15 August 2002 deadline.

The proposed research builds on biogeographic and ecological studies of mussel bed communities begun in 1996 sample of the mussel bed community at Lucky Strike on the Mid-Atlantic Ridge and continuing through sampling of a number of EPR, MAR and seep mussel bed communities. The proposal includes 5 components:

1. Biogeographic differentiation of faunas within mussel bed communities at vents
2. Seafloor spreading rate, degree of isolation of vent fields, and diversity
3. Competition for resources in mussel-bed communities
4. Community differentiation along gradients of fluid flux and species' habitat preferences
5. Continuation of time-series studies at 9°50'N

The biogeographic field component (1) will focus on quantitative collection of mussel bed faunas from Lau, Fiji, and 32°S on the East Pacific Rise. These faunas will be compared to each other and to data already collected from mussel beds on the EPR (17°S, 9°N, 11°N), the MAR (Logatchev, Snake Pit, Lucky Strike) and seeps (Florida Escarpment, Blake Ridge). These same data sets will be used to consider issues relating to spreading rate, degree of geographic isolation, and diversity (2).

Competition for resources in mussel beds (3) will use an experimental approach at Train Station and Mussel Bed at the 9°50'N bulls eye site on the EPR to examine the effect of competition for resources by symbiont and free-living microorganisms on community structure within mussel beds.

Quantitative analysis of community structure (species composition, abundance, etc.) in mussel bed samples will be related to temperature and mussel condition in all samples collected (at Lau, Fiji, EPR mussel beds) to examine community differentiation along gradients of fluid flux and species' habitat preferences (4).

Biovent and East Wall mussel beds will be resampled in late 2005/early 2006 to continue the time-series characterization of these communities for which 1999 and 2002 samples have already been collected. (Analysis of 2002 samples from East Wall shows that there has been no change in community structure as assessed using multivariate statistics on species-abundance matrices, hence the desire to delay resampling until more than 2 years have gone by.)

Either Alvin or Jason II can be used to accomplish the field objectives. In Alvin dive-day equivalents, I plan to request the following:

2004: Lau 7 dives
Fiji 5 dives
32°S, EPR 3 dives
2005: 9°50N, EPR 10 dives
2006: 9°50N, EPR 12 dives

I will suggest that Lau, Fiji, and 32°S dives be undertaken on 2 back-to-back cruises to save on transportation and shipping costs. The science party for all dive series will require 8-10 individuals since the sampling methods and processing are labor-intensive.

Relevance to the Ridge 2000 program

This proposal was written to address important issues in vent biogeography and ecology rather than to respond to the specific agendas specified by the Integrated Studies component of Ridge 2000. Nevertheless, there are several research themes in this proposal that contribute to Integrated Studies objectives for both the Lau and East Pacific Rise sites. For individuals not familiar with the Ridge 2000 goals, the relevant portions of the Implementation Plans for each site are excerpted here.

Lau Basin:

The Implementation Plan for Lau Basin calls for a cruise in 2004 with 3 objectives:

1. location and description of active hydrothermal vents
2. preliminary evaluations of hydrothermal mineral deposits and megafaunal communities
3. collection of a basic sample suite that includes igneous rocks, vent fluids, vent deposits, microbes, and megafauna

Objectives 2 and 3 will obviously be met for the specific example of the mussel bed megafaunal communities at Lau. These are important communities, since they have dominated the biomass at the known sites. Quantitative data obtained from the mussel beds will serve as baseline data for time-series studies of community structure. A Lau “bulls-eye” has yet to be designated, but the sites proposed for study here are best candidates. The PI will ensure that mussel beds from the most likely “bulls-eye” site will be included in the mussel-bed sampling program.

Over-all site-specific objectives for Lau Basin include understanding the structure and function of biological communities, hydrothermal flow, and chemistry at a “bulls-eye” site. Key components of this objective include

1. examination of the functional relationships of the biota to vent conditions and each other
 2. understanding the relative importance of geological setting and biogeographic provincialism
- Biogeographic and species' preferences components of the proposed research contribute substantively to objectives 1 and 2. The only way to understand Lau biogeographic provincialism is by comparison to other sites, as is proposed here.

East Pacific Rise:

The East Pacific Rise Implementation Plan identifies the 9°50'N site as the “bulls-eye”. Fundamental questions and goals to be addressed at this site include:

1. What are the interactions between biological activity, vent chemistry, physical processes, and hydrothermal features?
2. How and to what extent does hydrothermal flux influence the physical, chemical and biological characteristics of the vent ecosystem?

Experimental study of bottom-up control on invertebrate biomass, species density, and other aspects of community structure in mussel beds contributes to an understanding of the interaction between biological activity and inorganic resources supplied by the vent fluid. The species' preferences component of this proposal address issues relating to how hydrothermal flux influences biological characteristics (community structure) in vent ecosystems.

The EPR Implementation Plan also identified 9 5-yr goals, one of which is to obtain quantitative information about microbes and their link to macrofauna. The resource competition experiment, which explicitly considers the influence of symbiont vs free-living microorganisms, will contribute substantively to this goal. A second goal is to understand linkages between spatial and temporal variation in biological, geological, and chemical parameters at the site. The continuation of quantitative, time-series study of community structure in two mussel bed communities (East Wall and Biovent) contributes to this goal.

