**Letters of Intent: Endeavour**
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**Collaborative Research: Toward a model that integrates geochemistry with microbial processes and diversity in submarine hydrothermal systems**

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There are a multitude of microbial habitats associated with hydrothermal systems. Each contributes to the overall chemoautotrophic and heterotrophic microbial productivity. Aside from microbial symbionts associated with some vent macrofauna, the subseafloor habitats may account for a significant amount of the microbial productivity at vents. Information about the microbial communities and their metabolic activity in these subseafloor habitats can be accessed by sampling diffuse flow fluids. Some previous work on diffuse flow fluids from Axial Volcano, where effects of microbial activity on fluid chemistry are apparent, show the presence of complex microbial communities that include a high diversity of anaerobes and hyperthermophilies with diverse physiologies. No studies of this kind have been done at other vent sites or in multiple diffuse flow vents from different locations within a vent field. Moreover, virtually nothing is known about the growth and metabolic rates of microorganisms in subseafloor environments and how these rates impact the geochemistry. In addition to conducting coordinated chemical and microbiological sampling of diffuse flow vents, we propose to make extensive microbial and mineralogical analyses of a sulfide structure. A common feature of both the subseafloor and active sulfide structures is the thermal and redox gradients that control the diversity and activity of microbial communities. We propose to core into sulfides so as to map the distribution and diversity of microbes and mineralogy through the redox and temperature gradients.

The Endeavour segment is characterized by geochemical gradients at every spatial scale, providing excellent opportunities to recognize and delineate specific relationships between parameters. The proposed 3-year program involves extensive fieldwork, instrument development, laboratory studies, genomics, geochemical modeling, and education/outreach activities. We intend to coordinate activities in this proposal with the chemical and biological work proposed by R. Lee and D. Butterfield, which concentrates on macrofaunal communities.

A long-term field program combining geochemical and microbiological methods in a well-characterized geologic environment on the Endeavour Segment of the Juan de Fuca ridge will enable the interdisciplinary observations, experimentation and modeling required to establish not only the spatial dimensions of the subsurface biosphere, but also the physical and chemical factors that control the diversity and productivity of these microbial communities. Five key questions to be addressed in this proposal include:

What is the incidence and phylogenetic diversity of microorganisms in diffuse-flow fluids of different temperature and chemical compositions and in vigorously active high-temperature sulfide structures?

What are the kinds and sources of nutrients supporting the microbial communities?
How do the subseafloor microbial communities change over time with variations in chemical properties, temperature, tidal perturbations and other temporal cycles?

What is the diversity of microbes that harbor and express genes involved in key geochemical reactions including methane production and consumption, iron and sulfur oxidation and reduction, and denitrification?

What temperatures, redox conditions, salinities and heavy metal concentrations permit growth and survival of microorganisms in diffuse and high temperature environments?