Letters of Intent: Endeavour
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Gradient-Driven Microbial Processes and Diversity in Submarine Hydrothermal Systems

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Studies of fluids emerging on the seafloor after volcanic eruptions and at stable hydrothermal vent fields indicate the existence of a subsurface microbial biosphere associated with ridge-crest systems. Among several compelling lines of evidence pointing to subseafloor biotopes is the presence of variable, but commonly high numbers of anaerobic hyperthermophiles in diffuse-flow fluids emitted from the crust following seafloor diking-eruptive events that are too cold at the seafloor to support the growth or metabolism of these organisms: their native habitats must lie deeper, in high temperature zones within the extrusive layers of the crust.

Very little is known about the abundance, diversity, or growth and metabolic rates of microorganisms in subsurface environments that may be stable for decades. A long-term field program, using the Endeavour Segment of the Juan de Fuca Ridge as a natural laboratory, 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 microbial communities. The four key scientific questions to be addressed in this proposal include:

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

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

The Endeavour has been chosen because this ridge segment is characterized by geochemical gradients at every spatial scale and thus, maximizes the opportunities to recognize and delineate specific relationships between parameters. The proposed 3-year program involves extensive fieldwork, instrument development, laboratory studies, and educational/outreach activities. The fieldwork will focus on characterizing the microbiology and chemistry of contrasting diffuse and high temperature sites of venting.