

A cabled observatory on the Juan de Fuca Ridge:

A letter of intent for a conceptual science experiment proposal to the OOI

Scientific studies of mid-ocean ridges are motivated by two overarching goals: (1) understanding the geological processes that form and age the oceanic lithosphere; and (2) understanding the role of mid-ocean ridge volcanoes in fostering diverse and productive biological communities above and below the seafloor. Investigations that seek to address these goals are inherently multidisciplinary since they aim to unravel the complex interaction of numerous physical, chemical and biological processes. These types of studies are also critically dependent on long-term high-frequency observations because the volcanic and tectonic processes that form the oceanic crust and modulate biological communities are inherently episodic and short-lived.

The Juan de Fuca Ridge has been extensively studied for over 20 years. The entire ridge has been mapped at a basic level and several sites of particular interest are extremely well characterized and are visited by research cruises on an annual basis. In addition, the availability of real-time data from the US Navy's SOSUS system has facilitated rapid response cruises to several volcanic and tectonic events along the ridge. These studies have contributed substantially to our understanding of dike-eruptive events, but they also demonstrate that many of the processes of interest occur on timescales that are too short to capture with shore-based responses. There is a critical need to develop the capability to record these perturbation events with in situ instrumentation and to adapt experiments in real-time based on the observations. A high-power high-bandwidth observatory can also be used to conduct anthropogenic perturbation experiments in which environmental parameters are actively manipulated.

In this proposal we seek to use the regional cabled observatory to monitor the whole ridge and to conduct focused experiments to characterize and respond to events. During the initial phase of this program we have chosen four well-characterized and contrasting sites for focused, integrated efforts:

- (1) Middle Valley is a sediment covered ridge that has been the site of ODP drilling into an active hydrothermal system. It is a likely node on the NEPTUNE Canada cable network.
- (2) The central portion of the Endeavour Segment is one of the most vigorous magma-driven hydrothermal systems known on a mid-ocean ridge and it is extremely seismically active. It is one of three initial sites selected for integrated studies by the RIDGE2000 program, is the site of a proto-NEPTUNE experiment funded by the Keck foundation and it is also a likely node on the NEPTUNE Canada cable network.
- (3) Axial Seamount marks the intersection of the ridge with a small hotspot and it is the site of NOAA's NeMO observatory. It is the most magmatically robust site on the ridge and the volcano and its flanks spawned eruptions in 1993 and 1998.
- (4) The Cleft segment erupted in the late 1980's, has vigorous black smoker vents at several sites, and it can be viewed as a type example of an intermediate- to fast-spreading-rate ridge segment.

We envision developing comprehensive experiments on a 5-10 year time scale that will comprise:

- (1) Seismic and acoustic monitoring of the whole ridge with local seismic networks at the four sites of interest.
- (2) Geodetic observations of the continuous and episodic deformation associated with ridge extension.
- (3) The use of diverse sensor networks, time-series samplers, and visual observations to characterize temporal variations in the physical, chemical and biological characteristics of hydrothermal vents.
- (4) Water column observations to measure fluxes, monitor the chemical and microbial evolution of hydrothermal plumes and study the effect of water column hydrodynamics on seafloor biological communities.
- (5) In situ autonomous underwater vehicles to conduct periodic surveys and respond to geological events.

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**Additional co-PI's may be added to the final proposal.*

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