

# iSAS/IODP Proposal Cover Sheet

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**547-Full4**

New

Revised

Addendum

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Title:	Proposal 547 Full Revised. Oceanic Subsurface Biosphere: Life in Subseafloor Volcanic Rock		
Proponent(s):	Martin Fisk, Carol Di Meo, Stephen Giovannoni, Stefan Sievert, Ruth Blake, Kenneth Neelson, Radu Popa, Everett Shock, Jack Istok, Ingunn Thorseth, Rolf Pedersen, Karsten Pedersen		
Keywords: (5 or less)	microorganisms, ocean crust, microbial biomass, microbial diversity, lithotroph	Area:	Juan de Fuca Ridge and Plate

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Permission to post abstract on iSAS Web site:  Yes  No

Abstract: (400 words or less)

Microorganisms are present in subsurface volcanic environments, and water emanating from oceanic crust contains microorganisms adapted to life in the subsurface. The oceanic volcanic crust may host a significant fraction of the Earth's biomass, yet little is known about subsurface microbial communities. This proposal is a multidisciplinary effort to understanding the nature and extent of subsurface biosphere in volcanic ocean crust.

Our six goals are: (1) to demonstrate that the ocean crust is capable of sustaining microbial life, (2) to identify organisms in the crust, (3) to obtain pure cultures of subsurface organisms, (4) to stimulate microbial growth and measure microbial activity in the crust, (5) to identify microbial interactions with minerals and microbial impact on chemical, mineralogical, and physical conditions of the igneous crust, and (6) to determine the influence of temperature on microbe physiology, microbial activity, and microbe-mineral interactions.

Experiments designed to achieve these goals are best carried out in a well-characterized and accessible region with a range of basement temperatures. Our efforts focuses on four sites, three on the east flank of the Juan de Fuca Ridge, and one in Middle Valley of Juan de Fuca Ridge (Fig. 1) where the basement temperatures are known (15°, 35°, 60°, and 90° C).

To achieve the six goals, the primary activities are: (1) deploy *in situ* sample chambers that can be recovered and examined for microbial growth, (2) extract and amplify DNA and RNA, analyze lipids, and conduct direct counts on rocks, formation water and drill water, batch cultures, and *in situ* sample chambers, (3) culture microorganisms from rocks and thermal waters, (4) conduct push-pull tests to stimulate and evaluate *in situ* microbial growth, (5) deploy and recover mineral substrates in boreholes and examine microbial alteration of natural samples, and (6) to conduct these tests in holes where temperatures of 15° to 90° C. These primary activities are linked to shipboard and shorebased chemical and physical measurements, analyses, and experiments.

The revisions resulted from a U.S. and European sponsored workshop held in Bergen, Norway, September 5 and 6, 2002. The proposal now focuses on life in igneous crust. Three sites have been eliminated from the original proposal. Sites OSB01C, D are relocated. OSB05A and OSB06A are unchanged. One site, OSB07A, has been added.

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Scientific Objectives: (250 words or less)

We wish to answer key questions that are repeatedly asked about the subsurface biosphere. These questions reflect the six goals outlined above. The most intriguing questions for which we like answers are:

- Is the ocean crust is capable of sustaining microbial life?
- What microorganisms are present in the ocean crust?
- What substrates support microbial life?
- Can microbial activity be stimulated and quantified by introducing substrates?
- What microbial-mineral interactions occur in the crust?
- What effects do microorganisms have on the chemical, mineralogical, and physical conditions of the igneous crust?
- What are the effects of microorganisms on element distribution in the ocean crust and the composition of sea water?
- What is the influence of temperature on microbe physiology, microbial activity, and microbe-mineral interactions.

## Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
OSB01C	48° 24.0'N 128° 40.0'W	2455	120	150	270	High-temperature (90°C) subsurface microbial observatory.
OSB01D	48° 23.2'N 128° 38.2'W	2400	80	150	230	High-temperature (90°C) subsurface microbial observatory.
OSB05A	47° 55.0'N 128° 47.5'W	2593	192	150	342	Low-temperature (15°C) subsurface microbial observatory.
OSB06A	47° 53.2'N 128° 38.9'W	2606	97	150	247	Mesophilic (35°C) microbial observatory.
OSB07A	47° 45.8'N 127° 45.6'W	2658	225	150	375	Thermophilic (60°C) microbial observatory.