Dynamic Processes of Fluids and Gas Hydrates on the Continental Margin

Research Proposal for Community Experiments at Natural Gas Hydrates in the northern Cascadia Margin.

Objectives:

The presence of gas hydrates at depth in the sediment and at the sea floor is well established from previous research off shore Vancouver Island over the past ten years. NEPTUNE provides the opportunity to investigate two fundamental research hypothesis about the formation of hydrates in this region:

- Hydrates form at the seafloor in areas of high fluid flux which implies local conduits of high permeability.
- In regions of low fluid and methane flux, hydrate is concentrated near the BSR and decreases toward the seafloor.

These hypotheses are expanded into science questions:

- What factors control the formation and dissociation of hydrate at depth in the sediment, and at the sea floor?
- What is the response of the hydrate system to time variations in the bottom environment, and to episodic events caused by tectonic forces?
- What is the flux of methane at the sea floor?
- What are the relationships with microbial processes in the sediment and in the water column?

This proposal outlines a set of experiments at the Barkley Canyon hydrate site. This site is of great interest because hydrates of thermogenic origin are formed at the sea floor, and there is evidence of hydrocarbon seepage from the sea floor. The experiments are designed:

(1) to determine the environmental factors that control the formation and dissociation of the hydrates and monitor the response to changes of these factors over time; and,

(2) to measure the flux of gas seepage at vent sites.

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Experiments:

Experiment A

1. Measurement of temperature versus time in the water at the sea floor, in the hydrate at the sea floor, and at shallow depths in the sediment. The temperature probes are co-located at one of the hydrate mounds where there is evidence of gas seepage.
2. Measurement of pH and salinity in the water within a few cm of the sea floor.
3. Measurement of the salinity in the water.
4. Digital still photos of the sea floor environment at specific hydrate mounds. The cameras are designed to take digital photos at specific bearings during a 360° sweep of the hydrate environment.

Experiment B

1. Measure the flux of seep gas at a natural vent site. The measurement is made using a multi-frequency active sonar that is directed at the venting gas stream. The sonar frequencies are in the range 20 – 100 kHz, and at least four frequencies are used. The gas flux is inferred from an analysis of the backscattered signal from the sonar.