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IODP Proposal Cover Sheet

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☑ **New** ☐ **Revised** ☐ **Addendum**

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Title:	A Gas Hydrate Thermal Perturbation Experiment		
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Keywords: *(5 or less)*	Cabled Borehole Observatory Experiments	Area:	Generic

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Permission to post abstract on IODP-MI Sapporo Web site: ☑ Yes ☐ No

Abstract: (*400 words or less*)

Several international projects are underway which will install submarine cables for scientific purposes. These cables will provide electric power and real time communications to seafloor experimental sites and will make it possible to conduct experiments that utilize modest amounts of electric power in ways that have been previously unimaginable. Many of these forward-looking experiments will require the combination of the capabilities of the IODP to install sub-seafloor infrastructure and the cabled observatory systems to power and monitor the experiments over time.

A generic thermal perturbation experiment is proposed which uses electric power from a submarine cable to thermally decompose naturally-occurring near-seafloor gas hydrates to observe the effect of gas hydrate decomposition on the structure of the sediments, to establish the efficiency of thermally-induced gas production from gas hydrates, and to learn about the fate of the released gas. A volume of sediment around an instrumented borehole drilled into near-seafloor gas hydrates will be heated to temperatures that are above those necessary for gas hydrate stability, thus decomposing gas hydrate immediately surrounding the borehole and releasing the gas into the sediments, the water column, and possibly into the surface mixed layer and atmosphere. A suit of sensors will allow the consequences of gas hydrate dissociation in the sediments surrounding the heated borehole to be assessed.

This perturbation experiment is envisioned as involving a field of five closely-spaced instrumented boreholes. This facility will comprise a central 30-m deep borehole with downhole heaters, sensors, and an acoustic source, and four surrounding boreholes configured to monitor conditions around the heated sections of the central borehole. These surrounding holes are planned to be approximately 10 m away from the heated borehole and about 30 m deep. Acoustic sensors and sources in the boreholes will be configured to allow high frequency acoustic sources to generate ray paths through the heated central volume into the surrounding boreholes. The reduction of gas hydrate content within the affected sediments and the changes in the thermal conditions within this well field will be tracked using an array of sensors in the boreholes and on the seafloor.

Hydrate Ridge is the area proposed for this experiment because we know there is a significant amount of gas hydrate-bearing sediment in the near-seafloor sediments based on the results of ODP Leg 204, in addition to substantial amounts of background scientific information about the area. However, this experiment could just as well be conducted at other sites as long as the requirements for shallow gas hydrates and a submarine cable are met.

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Scientific Objectives: (*250 words or less*)

Gas hydrates are believed to constitute a widespread geo-hazard on continental margins worldwide. Many of the slope failure events on continental margins have been attributed to a decrease in sediment strength associated with gas hydrate decomposition, and as seafloor hydrocarbon-producing infrastructure, such as well bores and pipelines, are placed in deep water where gas hydrates occur, thermal effects of warm hydrocarbon fluids may contribute to submarine slope failure. This is primarily because oil and gas extracted from the subsurface reservoirs are warm (~100 °C) relative to seafloor temperatures (~2-12 °C) and heat will inevitably be conducted into the sediments adjacent to well bores or pipelines through which these warm fluids pass. Thus, if the surrounding sediments contain gas hydrate, it should decompose with a progressively enlarging radius around a borehole in response to the passage of warm fluids. A dramatic change in the physical properties of the surrounding sediments may be the consequence of gas hydrate decomposition. A reduction in sediment strength may cause failures in the surrounding sediments, which in turn could produce substantial damage or destruction of the hydrocarbon-producing infrastructure. This scenario is analogous to the loss of load-supporting capabilities of thermally-decomposing permafrost-bound sediments in the Arctic. The objective of conducting a thermal peturbation experiment in gas-hydrate-bearing sediments is to learn how thermally-induced decomposition of gas hydrates alters sediment strength, and how and whether methane gas is lost from the sediment.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

Cable-to-borehole connections; instrumented boreholes; borehole heaters with sufficient capacity to decompose gas hydrate; and cross-hole acoustic tomography

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
GHPEX-1A	Hydrate Ridge (?)	780	~30 m	0	~30 m	perturbation of gas hydrates