Sanpling Tools and Downhole Measurements for ODP Leg 204.

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Abstract

The Ocean Drilling Program (ODP), which is funded by the U.S. National Science Foundation (NSF) and 21 international partners, is an international marine geoscience research program that has been a leader in studying marine methane hydrate deposits for many years. The flagship of the ODP is the D/V JOIDES *Resolution*, which is a 471 foot-long, dynamically positioned drillship equipped with a seven-story laboratory complex that serves as a floating university . The vessel has been contracted by ODP since 1985 to conduct worldwide scientific coring operations. In 1999, the vessel underwent significant modifications and upgrades to various shipboard systems, such as the installation of an active heave compensation (AHC) system to reduce the effects of vertical heave on the drillstring, the installation of a rig instrumentation system (RIS) to capture information about drilling parameters with changes in downhole conditions, and an advanced station keeping (ASK) system to allow more efficient positioning of the ship over a spot on the seafloor. The field activities conducted onboard the D/V JOIDES *Resolution* allow teams of scientists to perform interdisciplinary basic research studies while at sea on two-month long voyages of discovery, which are known as legs . ODP Leg 204 will drill, core and log through the gas hydrate stability zone along a transect of sites across the southern part of Hydrate Ridge, offshore Oregon from July to September, 2002, and will recover samples of massive methane hydrate at near in situ pressures.

The prime contractor for the ODP is Joint Oceanographic Institutions (JOI), which is a non-profit corporation representing 16 U.S. academic research institutions (www.joiscience.org). Texas A&M University, the ODP science operator, manages the operations of the D/V JOIDES *Resolution*, as well as shipboard staffing, data collection, core curation, publications and other activities related to the ODP (www.odp-tamu.edu). ODP Logging Services are provided by Lamont-Doherty Earth Observatory (LDEO) of Columbia University, which collects, processes, and provides downhole measurements and logging data to the scientific community (www.ldeo.columbia.edu/BRG/ODP). The Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES)/ODP Site Survey Data Bank at LDEO, serves as the repository of site survey data to support ODP planning and operations for drilling legs (www.ldeo.columbia.edu/databank/Databank.html). The scientific advisory structure for the ODP is coordinated by the staff of the JOIDES Office (www.joides.rsmas.miami.edu), which coordinates the activities of volunteers from international academic institutions, industry, and federal agencies who serve on JOIDES panels. The operational phase of the ODP will end on September 30, 2003, but a new program, known as the Integrated Ocean Drilling Program (IODP), is now being planned (www.iodp.org), with a estimated start date of October 1, 2003.

A proposal entitled In-Situ Sampling and Characterization of Naturally Occurring Marine Methane Hydrate Using the D/V JOIDES *Resolution* resulted in a

cooperative agreement between DOE s National Energy Technology Laboratory (NETL) and JOI/ODP which has provided funding to develop specialized in situ and laboratory tools to characterize methane gas hydrates during ODP Leg 204.

The first part of Leg 204 will be dedicated to logging while drilling (LWD) operations to identify regions of rapid change in physical properties prior to coring. Resistivity-at-bit (RAB) and azimuthal density neutron (ADN) LWD tools will be used to provide rapid data about subsurface lithologies. This data will be used to optimize use of specialized coring tools to retrieve core samples at near in situ pressure, and to characterize their properties in the subsurface. A RAB-coring tool will be be deployed to attempt to recover samples while conducting LWD operations in a first-time deployment of this prototype system in collaboration with Schlumberger/Anadrill and the LDEO Borehole Research Group. The FUGRO piezoprobe will be used to measure pore pressure dissipation by inserting a probe into the formation and measuring the decay of the pressure pulse. Additional measurements will be made using the Davis-Villinger Temperature Probe with pressure (DVTP-P), a wireline tool that provides similar measurements to the piezoprobe tool. The leg also includes a two-ship seismic program with the R/V *Maurice Ewing*, to acquire offset vertical seismic profiles and other geophysical data in conjunction with wireline logging activities onboard the drillship.

ODP s standard suite of coring tools, which include the Advance Piston Corer (APC), Extended Core Barrel (XCB), and Rotary Core Barrel (RCB), will be used in concert with the ODP Pressure Core Sampler (PCS) to recover core samples from the subseafloor (see tool descriptions at: www-odp.tamu.edu/publications/tnotes/tn31). Three pressure-coring tools will be extensively used to attempt to recover hydrate samples at near in situ pressures and temperatures. These include the ODP PCS, and two prototype tools developed under the EU-sponsored HYACINTH program, e.g., the FUGRO Pressure Corer (FPC) and the HYACE Rotary Corer (HRC). The goal of these tools deployments are to acquire core samples under pressure and to be able to transfer them to a portable chamber for geophysical logging of gamma density and sonic velocity in the laboratory. The use of these tools will provide the opportunity to conduct a wide variety of measurements on natural hydrates and to assist with new tool development.

Downhole memory tools will provide in situ measurements of formation temperature (APC-Temperature tool) and time series of temperature, pressure, and conductivity in the head-space of the core (APC-Methane tool) during recovery of the core to the deck. Physical (fluorescent microbeads) and chemical (perfluorocarbon) tracers are routinely used to quantify the level of possible sample contamination (QA/QC) and to assist with microbiological sampling, using techniques developed at Brookhaven National Laboratory. Cores recovered on the deck of the vessel will be immediately scanned with an infrared thermal imaging device to detect cold anomalies along the core which are indicative of dissociating hydrate, so that they can be sampled as quickly as possible following recovery.

The objectives of Leg 204 include (1) comparing the source region for gas and the physical and chemical mechanisms of hydrate formation between accretionary ridge and slope basin settings; (2) calibrating estimates of hydrate and underlying free gas concentrations determined with geophysical techniques; (3) determining the porosity and shear strength of hydrate-bearing and underlying sediments in order to evaluate the relationship between hydrates, fluid flow, and slope stability; among other objectives.