Cruise Summary

1. Cruise Information

Cruise ID:

KH-20-8

Name of vessel:

R/V HAKUHO MARU

Title of cruise:

Study of pore fluid circulation and heat transport in the uppermost part of incoming plate on the seaward side of the trench

Study on fluctuation of cold seep through a source fault of great earthquakes along the Sagami Trough

Chief scientist:

Makoto YAMANO　Earthquake Research Institute, The University of Tokyo

Cruise period:

August 24, 2020 – September 2, 2020

Ports of departure / arrival:

2020　August 24　Dept. from Hachinohe

September 2　Arriv. at Tokyo

Research area:

Kuril Trench, Japan Trench and Sagami Bay areas

Title of proposal:

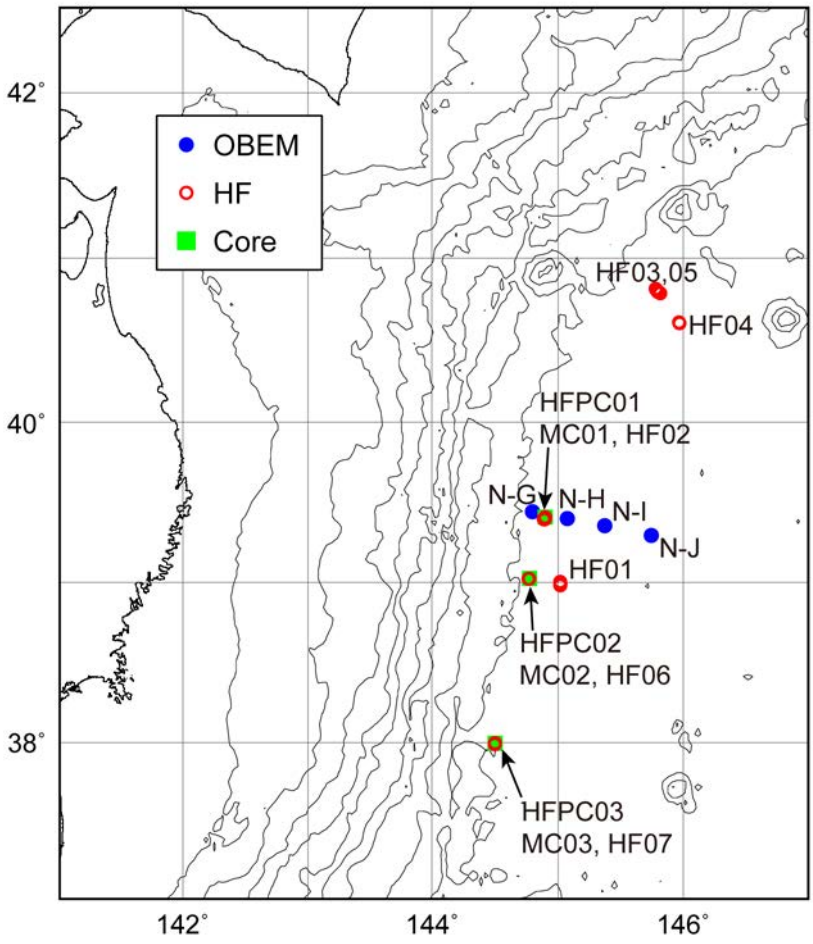
Study of pore fluid circulation and heat transport in the uppermost part of incoming plate on the seaward side of the trench

Study on fluctuation of cold seep through a source fault of great earthquakes along the Sagami Trough

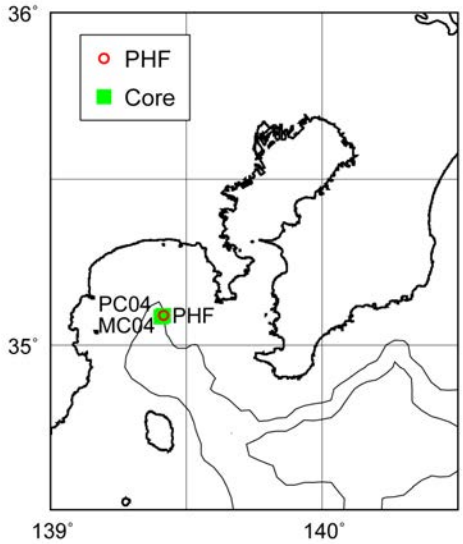
Representative of science party:

Makoto YAMANO　Earthquake Research Institute, The University of Tokyo

Research map:



Locations of observation points in the Kuril and Japan trench areas.
HF: heat flow measurement, Core: sediment sampling and heat flow measurement, OBEM: recovery of OBEM.



Locations of observation points in the Sagami Bay area.
PHF: recovery of pop-up heat flow instrument (failed), Core: sediment sampling.

2. Overview of Research Activities

[Research objectives]

Research activities on the KH-20-8 cruise are based on two independent proposals: (1) study of pore fluid circulation and heat transport in the uppermost part of incoming plate on the seaward side of the trench, (2) study on fluctuation of cold seep through a source fault of great earthquakes along the Sagami Trough.

In the first proposal, we aim to compare characteristics of heat flow distribution on the trench outer rise between the Kuril and Japan trenches, which may reflect pore fluid circulation and heat transport processes resulting from fracturing of the oceanic crust due to bending of the Pacific plate. We also investigate fluid flow along normal faults developed on the seaward slope of the Japan Trench through concentrated heat flow measurements and analysis of pore water and gas extracted from sediment samples. We recover ocean bottom electromagnetometers (OBEMs) deployed on the Japan Trench outer rise in 2019 and the obtained data will be used for estimation of the electrical resistivity structure related to pore fluid distribution.

The target of the second proposal is cold seep along faults on the landward slope of the Sagami Trough. We attempt to retrieve a long-term temperature recording instrument deployed in 2019 for monitoring fluid flow through sediment and take sediment core samples for study of depositional history.

[Research items]

(1) Heat flow measurement

Measurement of temperature profiles in surface sediment with an ordinary deep-sea heat flow probe and a piston corer for determination of terrestrial heat flow.

(2) Sediment core sampling

Sampling of surface sediments with a piston corer and a multiple corer for measurement of physical properties and analysis of sedimentary structure and pore water/gas compositions.

(3) Marine magnetotelluric (MT) survey

Measurement of natural variations of electromagnetic fields on the seafloor with OBEMs for about a year.

(4) Long-term temperature monitoring

Long-term monitoring of temperature distribution in surface sediment for estimation of vertical flux of pore fluid.

(5) Aerosol and surface water sampling

Aerosol sampling with air samplers and surface water sampling with the ship’s pumping

system for observation of atmospheric dry deposition.

(6) Bathymetry and sub-bottom profiling surveys

Bathymetry mapping with a multi-beam echo-sounder and surface sediment structure survey with a sub-bottom profiler.

[Research results]

(1) Heat flow measurement

In the Kuril Trench area, we conducted measurements along a line perpendicular to the trench to reveal characteristics of heat flow distribution on the outer rise. In the Japan Trench area, most of the measurements were made in the vicinities of normal faults on the seaward trench slope to examine influence of faults on fluid flow regimen in the oceanic crust. Some measurements were made on the outer rise along a line parallel to the trench. We attempted measurements at 43 points in total and 31 of them were successful.

(2) Sediment core sampling

In the Japan Trench area, sediment sampling was conducted at three sites in the vicinities of normal faults on the seaward trench slope. After pore water and gas samples were extracted from the core samples, description of sedimentary structures and measurement of thermal conductivity were made. In the Sagami Bay area, sampling was made at two sites on the landward slope of the Sagami Trough.

(3) Marine magnetotelluric (MT) survey

We successfully recovered four OBEMs, which were deployed during KS-19-13 cruise of the R/V SHINSEI MARU in July 2019. They were located on the incoming Pacific plate, along a line perpendicular to the trench around 39.5°N.

(4) Long-term temperature monitoring

We failed to recover a temperature recording instrument because the acoustic release system did not operate properly. The instrument was deployed at a seep site on the landward side of the Sagami Trough during KH-19-5 cruise of the R/V HAKUHO MARU in August 2019.

(5) Aerosol and surface water sampling

Aerosol sampling was made continuously along the cruise track. Chlorophyll-a, Cell Counting, Biomarker, and REEs samples were collected from surface water at 36 sites.

(6) Bathymetry and sub-bottom profiling survey

In the Japan Trench area, bathymetry survey was made to select heat flow measurement and sediment sampling sites. In the Sagami Bay area, we conducted bathymetry and sub-bottom profiling survey along closely-spaced parallel lines around the sediment sampling sites.