Cruise Summary

1. Cruise Information

Cruise number:

KR09-16

Ship name:

R/V KAIREI (with ROV KAIKO 7000II)

Title of the cruise:

2009 Deep Sea Research

Research cruise with KAIREI and research dives with KAIKO 7000II

Chief Scientist:

Makoto YAMANO Earthquake Research Institute, University of Tokyo

Representative of Science Party:

Makoto YAMANO Earthquake Research Institute, University of Tokyo

Title of proposal:

S09-64

Studies on the thermal structure and the water distribution in the upper part of the Pacific plate subducting along the Japan Trench

Cruise period:

October 30, 2009 – November 12, 2009

Port call:

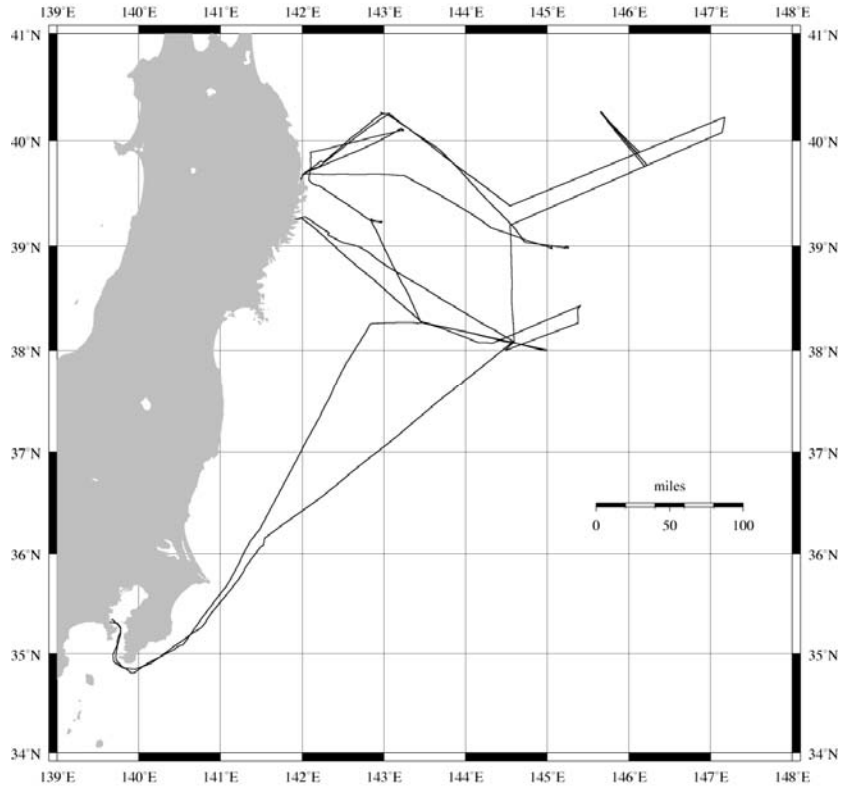
2009 Oct. 30 Dept. from Yokosuka (JAMSTEC)

Nov. 12 Arriv. at Yokosuka (JAMSTEC)

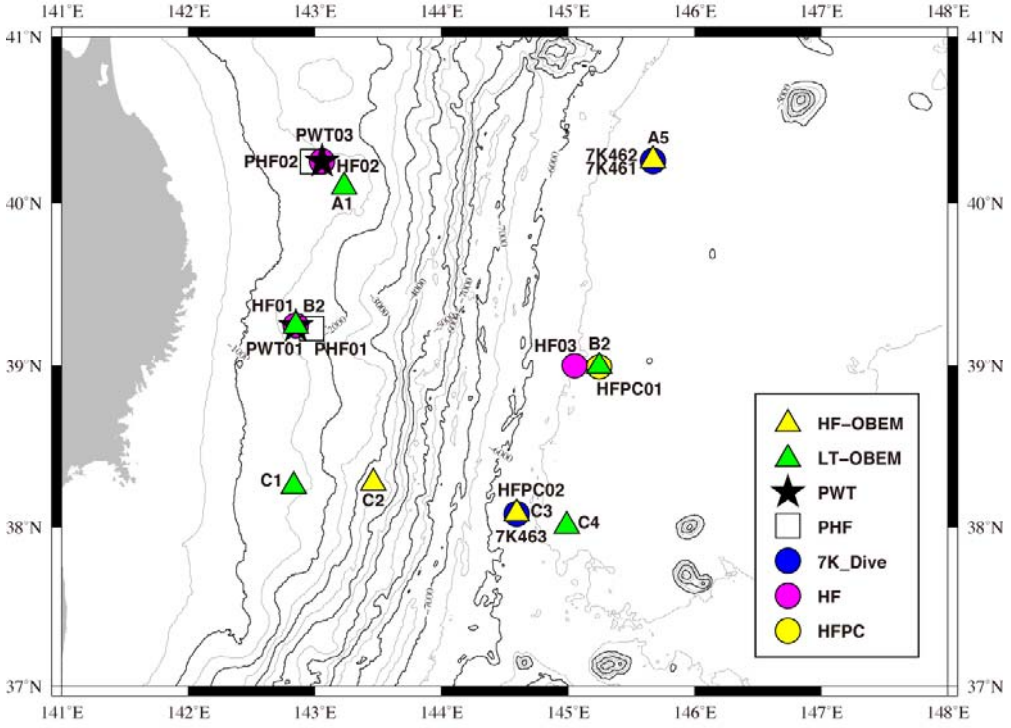
Research area:

Japan Trench area

Research map:



Ship track of KR09-16 cruise.



Measurement and sampling stations on KR09-16 cruise.

2. Overview of Observation

Overview of observation

[Research objectives]

We intend to clarify the temperature structure and the water distribution in the upper part of the Pacific plate subducting beneath the northeast Japan arc through heat flow measurements and electromagnetic surveys in the Japan Trench area. Based on the obtained results, we will investigate intra-plate volcanism on the Pacific plate, heat transfer and water movement in the oceanic crust associated with development of normal faults on the seaward slope of the Japan Trench. We also intend to examine relation between the temperature structure and water distribution along the subducting plate boundary and mechanical properties of the seismogenic zone.

[Research items]

(1) Heat flow measurement

Heat flow measurement with ordinary deep-sea heat flow probes.

(2) Long-term temperature monitoring on the seafloor

Long-term monitoring of the bottom water temperature and temperature profile in surface sediment using pop-up type instruments for determination of heat flow in areas with relatively shallow water depths.

(3) Piston core sampling with heat flow measurement (HFPC)

Sampling of surface sediments with a piston corer and heat flow measurement at the same site using temperature sensors mounted on the core barrel.

(4) Ocean-bottom electromagnetic survey

Controlled-source electromagnetic (CSEM) survey with KAIKO 7000II system and magnetotelluric survey with high-frequency ocean-bottom electromagnetometers (HF-OBEMs) and long-term OBEMs (LT-OBEMs).

(5) Bathymetry and geophysical survey

Bathymetry mapping with a multi narrow beam system, gravity measurement, and measurements of total magnetic field and geomagnetic vector.

[Research results]

(1) Heat flow measurement

We carried out heat flow measurements at five sites, three with the deep-sea heat flow

probe and two with the HFPC. In measurements with the deep-sea heat flow probe, multiple penetrations were made for examining local variability of heat flow. Two of the five sites are located in areas with water depths shallower than 2000 m, where temperature profiles in surface sediments must have been disturbed by bottom water temperature variation. The measured temperature profiles need to be analyzed with long-term bottom water temperature records obtained at nearby stations. Heat flow data of good quality were obtained at the other three sites located on the seaward side of the Japan Trench.

(2) Long-term temperature monitoring on the seafloor

We recovered pop-up heat flow instruments (PHFs), which can record temperatures in surface sediment for more than one year, at two stations. We also recovered one pop-up water temperature measurement systems (PWT), which monitor variation of the bottom water temperature, but another PWT did not respond to acoustic commands from the ship and could not be recovered. The three recovered instruments all provided long-term temperature records of good quality.

(3) Piston core sampling

Sediment core samples were collected at two stations using the heat flow piston coring system (HFPC), along the core barrel of which seven temperature data loggers were mounted. The lengths of the obtained core samples are 274.5 and 287.5 cm. Thermal conductivity measurement was made on board, while visual description, photographing and shear strength measurement were conducted on shore. 7-cc-cube samples were taken from the working half for further analyses.

(4) Ocean-bottom electromagnetic survey

We recovered five LT-OBEMs at three stations on the landward side of the trench and at two stations on the seaward side. Data for about 14 months were obtained at two stations and for about five months at the other three stations. Three HF-OBEMs were deployed and recovered during the cruise at one station on the landward side and at two stations on the seaward side. The observation period was 8 to 9 days for two instruments and for 1.5 days for the other one.

We conducted CSEM survey using the ROV KAIKO 7000II on three dives #461, #462 and #463 in the vicinity of two HF-OBEMs on the seaward side of the Japan Trench. The KAIKO vehicle transmitted artificial electric current signals through a 20-m dipole cable laid down on the seafloor. The signals were successfully received by OBEMs at distances up to about 400 m.