

# Cruise Summary

## 1. Cruise Information

Cruise ID:

KH-22-6

Name of vessel:

R/V HAKUHO MARU

Title of cruise:

Study of fluid flow and heat transport processes in the uppermost part of the Pacific plate on the seaward side of the Japan Trench

Chief scientist:

Makoto YAMANO      Earthquake Research Institute, The University of Tokyo

Cruise period:

April 6, 2022 – April 22, 2022

Ports of departure / arrival:

2022   April 6   Dept. from Tokyo

April 22   Arriv. at Tokyo

Research area:

Japan Trench and northwest Pacific areas

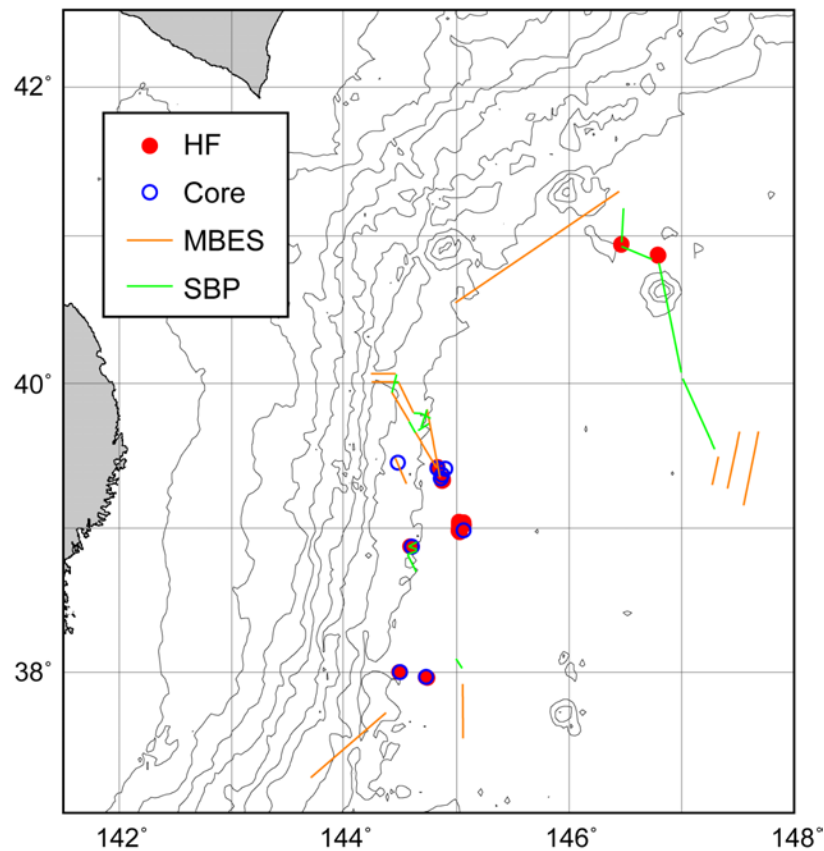
Title of proposal:

Study of fluid flow and heat transport processes in the uppermost part of the Pacific plate on the seaward side of the Japan Trench

Representative of science party:

Makoto YAMANO      Earthquake Research Institute, The University of Tokyo

Research map:



Locations of observation points and survey lines.

HF: heat flow measurement, Core: sediment core sampling, MBES: multi-beam echo-sounder survey, SBP: sub-bottom profiling survey

## 2. Overview of Research Activities

### [Background and objectives]

Recent surveys made on the seaward side of the Japan Trench revealed various features indicating flows of fluid, material and heat in the upper most part of the incoming Pacific plate: petit-spot volcanism, a broad high heat flow zone, and anomalies in the seismic velocity structure (e.g., Hirano et al., 2006; Yamano et al., 2014; Fujie et al., 2018). Such flows should change the physical/chemical conditions of the subducting plate, the input to the subduction zone, which is a very important factor in studies on subduction zones. We therefore planned comprehensive research of fluid and heat flow processes in the trench outer rise area in cooperation with wide fields of earth science and have been conducting it supported by a JSPS KAKENHI (Grant Number 18H03733).

This cruise (R/V HAKUHO MARU KH-22-6) was proposed as a major component of the above-mentioned research project. We 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. Heat flow measurements are made on the outer rise of the Japan and Kuril trenches as well to reveal characteristics of the heat flow distribution, which may reflect pore fluid circulation and heat transport processes resulting from fracturing of the oceanic crust. We also conduct multi-beam echo-sounder and sub-bottom profiler surveys for investigation of petit-spot volcanism and contourite drifts.

#### [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) 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.

##### (4) Geomagnetic field measurement

Measurement of the geomagnetic field using a shipboard three component magnetometer along the ship tracks for analysis of the structure of oceanic crust.

##### (5) Bathymetry and sub-bottom profiling surveys

Bathymetry and seabed image mapping with a multi-beam echo-sounder and surface sediment structure survey with a sub-bottom profiler for investigation of sedimentation process and volcanic edifices.

#### [Research results]

##### (1) Heat flow measurement

On the seaward slope of the Japan Trench, we conducted measurements in the vicinities of well-developed normal faults for investigation of influence of faults on fluid flow and heat transport processes in the incoming oceanic crust. On the Japan Trench outer rise around 39°N, measurements were made to examine heat flow variation at a scale of several km in the trench-parallel direction. We also made measurements on the Kuril Trench outer rise off the easternmost part of Hokkaido to reveal characteristics of heat flow distribution in the

Kuril Trench area.

We attempted probe penetrations at 93 points in total and 56 of them were successful.

(2) Sediment core sampling

Sediment sampling was conducted with piston corers and a multiple corer at eight sites in the vicinities of normal faults on the seaward slope of the Japan Trench. Piston core samples were split in half after removing whole-round samples for gas analysis, and then description of sedimentary structures, measurement of thermal conductivity and sampling for pore fluid analysis were made. Samples for pore fluid and gas analysis were taken from multiple core samples as well.

(3) Aerosol and surface water sampling

Aerosol sampling was made continuously along the cruise track. Chlorophyll-a, Cell Counting and Biomarker samples were collected from surface water at 69 sites.

(4) Geomagnetic field measurement

Three components of the geomagnetic field were measured with the shipboard three component magnetometer throughout the cruise.

(5) Bathymetry and sub-bottom profiling surveys

Multi-beam echo sounder survey was made for mapping detailed bathymetry and acoustic backscattering strength to find possible petit-spot volcanoes in areas off the Japan and Kuril trenches.

Sub-bottom profiler survey was made on specific bathymetric features to identify contourite drifts and to resolve their structures.