Cruise summary

1. Cruise information

Cruise number & Ship name:

YK08-09 R/V YOKOSUKA

Title of the cruise:

2008 Deep Sea Research YOKOSUKA solo cruise

Chief Scientist:

Kiyoshi Baba (Earthquake Research Institute, University of Tokyo)

Representatives of the science party:

Kiyoshi Baba (Earthquake Research Institute, University of Tokyo)

Proposal: Interdisciplinary survey on a new type volcanism "petit-spot" in northwestern Pacific: Investigation for the distribution of the melt generation and magma extrusion fields (S08-38)

Masao Nakanishi (Graduate School of Science, Chiba University)

Proposal: Tectonic evolution of the Shatsky Rise (S08-35)

Cruise period & Port call:

Jul. 28 2008 (Yokosuka) – Aug. 19 2008 (JAMSTEC)

Research Area:

Northwestern Pacific

30°~40°N

143°~161°E

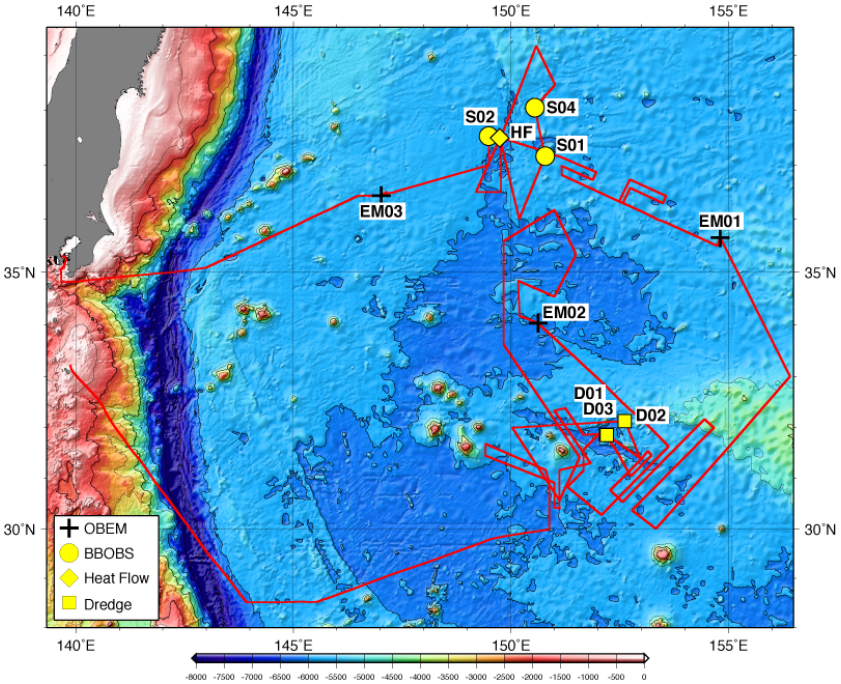

Figure 1. Bathymetry map of the survey area. Observation sites are plotted by symbols and the ship track is plotted by red line.

2. Overview of Observations

2-1. Proposal S08-38: Interdisciplinary survey on a new type volcanism "petit-spot" in northwestern Pacific: Investigation for the distribution of the melt generation and magma extrusion fields

Background and objectives

A petit-spot is a newly recognized type of volcanic activity that is characterized by a cluster of young small knolls not associated with mid-ocean ridges, island arc volcanism, or hot spots (Hirano *et al.*, 2001; 2006). The origin of young volcanisms on old, cold, and thick oceanic plates is enigmatic, and should be elucidated. Through analyses of the distribution of the petit-spot fields and geochemical signatures of rock samples, Hirano *et al.* (2006) proposed a hypothesis that the asthenosphere is partially molten layer and the melt leaks through fractures due to plate bending before subduction. This hypothesis implies that, unlike other major types of volcanism on Earth, the melt generation and magma extrusion processes may be considered separately for the formation of petit-spots. Interdisciplinary research is essential to elucidate the processes and to understand the nature of petit-spot. Several cruises for the interdisciplinary research have been implemented since 2005 (KR03-07, KR04-08, YK05-06, and KR05-10). This cruise is also a part of the interdisciplinary research, focusing the investigation for the distributions of melt generation and magma extrusion fields.

Observations

Following research subjects were proposed for a couple of cruises with one-year interval.

1) Imaging electrical conductivity of the upper mantle using ocean bottom

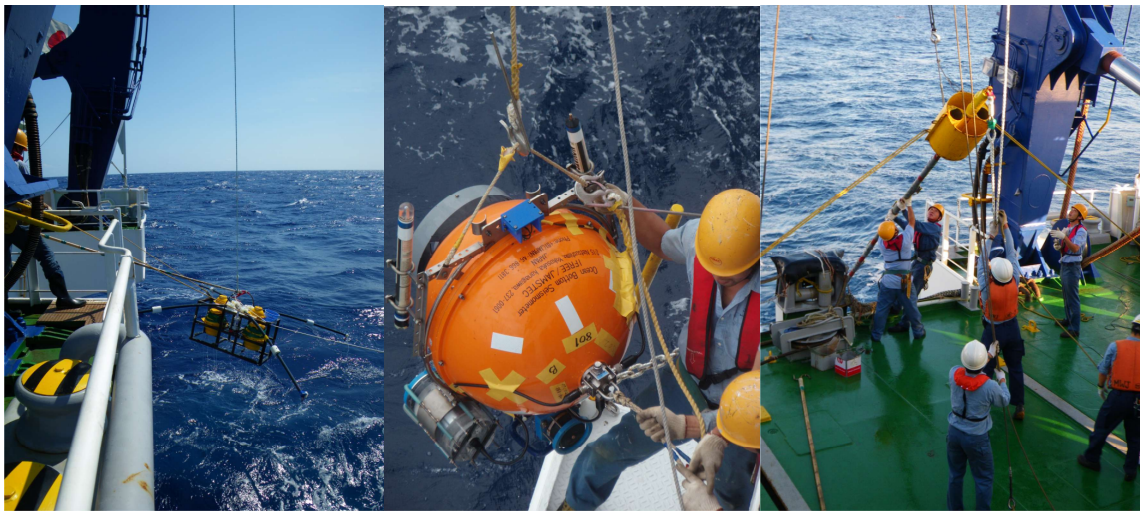

Photo 1. OBEM recovery, BBOBS recovery, and heat flow measurement from the left to the right.

electromagnetometers (OBEMs).

2) Investigation of seismicity near petit-spot and seismic velocity structure of the upper mantle using broad-band ocean bottom seismometers (BBOBSs).
3) Research on heat transfer process associated with the petit-spot using crustal heat flow observation
4) Surface geophysical mapping using multi-narrow beam sounding system, proton magnetometer, shipboard three-component magnetometer, and shipboard gravity meters.
5) Rock sampling using ROV KAIKO 7000II.

For 1) and 2), we deployed three OBEMs and three BBOBSs during KAIREI KR07-06 cruises in May, 2007 and attempted to recover in this cruise. The rock sampling was carried out only in KR07-06 cruise.

Preliminary results

The OBEMs were successfully recovered for two (at sites EM01 and EM02) of the three. The OBEM at site EM03 was failed to recover because of the trouble acoustic system. The recovered two OBEMs recorded the variations of electromagnetic field on the seafloor for about 15 months. These data will be analyzed together with the data obtained in the area in previous studies. Then, an image of electrical conductivity structure will be imaged and the distribution of melt generation field will be discussed.

The BBOBSs were successfully recovered for all the three sites (S01, S02, and S04). They recorded local seismic events near the petit-spot area (Yukawa knolls) and teleseismic events. The seismicity near the area and seismic velocity structure will be investigated through the future analysis.

The heat flow measurement was conducted in the lines crossing Yukawa knoll in N-S and E-W directions. Total 14 measurements were succeeded and some trend of heat flow was appeared. Further analysis will elucidate the heat transfer process around the knoll.

Surface geophysical mapping covered a part of the data blank area. Compiling the data previously obtained in the area and public data, the relation between the petit-spot activity and the tectonics in the area will be discussed in the future.

2-2. Proposal S08-35: Tectonic evolution of the Shatsky Rise

Background and objectives

Shatsky Rise is an oceanic plateau located about 1600 km east of Japan. The rise is elongated southwest to northeast and has an area of 4.8×10^5 km^2, about 25 % more than islands of Japan. It has been shown that Shatsky Rise formed at the Pacific-Izanagi-Farallon triple junction during the Late Jurassic and Early Cretaceous (e.g., Nakanishi *et al.*, 1999). On the other hand,

Sager (2005) proposed that Shatsky volcanism occurred because the triple junction jumped to a location underlain by a large volume of anomalously fusible shallow mantle. To test plume head versus ridge tectonics models of Shatsky Rise formation, it is necessary to expose detailed configuration of the plate boundaries among Pacific, Izanagi, and Farallon plates. This is the reason why we proposed geophysical measurement and dredging around the Shatsky Rise.

Observations

6) Surface geophysical mapping using multi-narrow beam sounding system, proton magnetometer, shipboard three-component magnetometer, and shipboard gravity meters.
7) Rock sampling by dredge.

Preliminary results

The survey line for the surface geophysical mapping was designed mainly to identify magnetic anomaly lineations and to expose tectonic fabrics around the Shatsky Rise. The obtained data were good and will contribute to reconstruct the plate forming history near the Shatsky Rise.

The dredges were carried out at three sites (D01, D02, and D03). Only manganese nodules, manganese crusts and some allochthonous pumices were sampled. These rocks are not the target samples of our research. However, several manganese nodules possibly include highly altered basic rocks as their cores. They may be able to use some geochemical study.

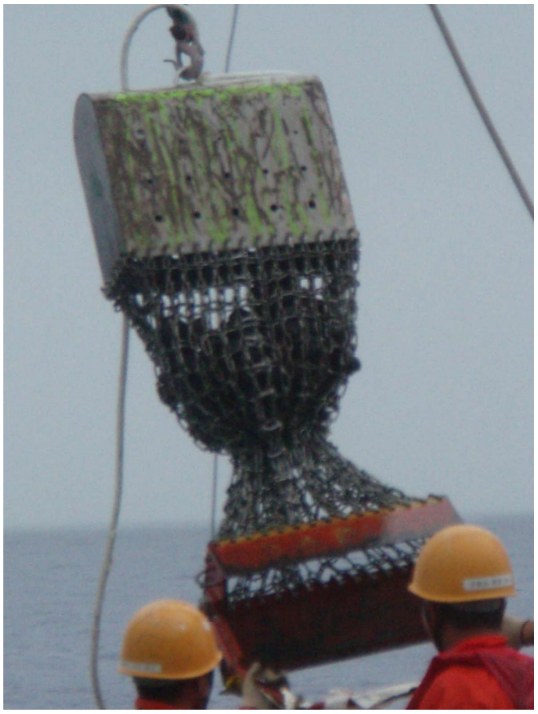

Photo 2. Rock sampling by dredge.