Cruise summary of YK09-06

1. Cruise Name and ship: YK09-06: R/V Yokosuka

2. Title: Magmatic processes at the initiation of Izu-Bonin oceanic island arc & A role of forearc tectonics on the formation of Mariana arc-trench system with special reference to serpentinite seamounts

3. Chief Scientist: Osamu Ishizuka (Geological Survey of Japan/AIST)

4. Representative of Scientific Party: 1) Osamu Ishizuka (Geological Survey of Japan/AIST), 2) Hirokazu Maekawa (Osaka Prefecture University)

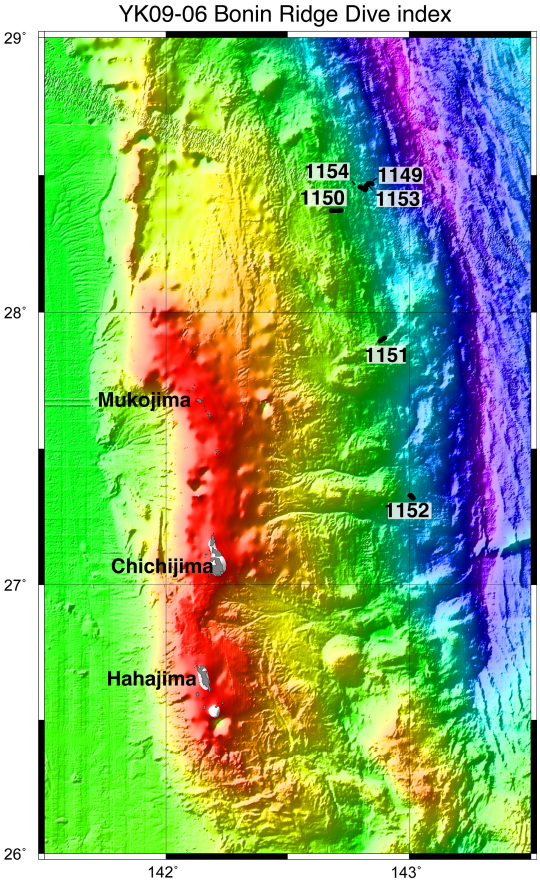
5. Title of Proposal: 1)Revealing long-distance lateral magma transport within oceanic island arc crust by investigating magma plumbing system of Izu Oshima volcano, 2) A role of forearc tectonics on the formation of Mariana arc-trench system with special reference to serpentinite seamounts

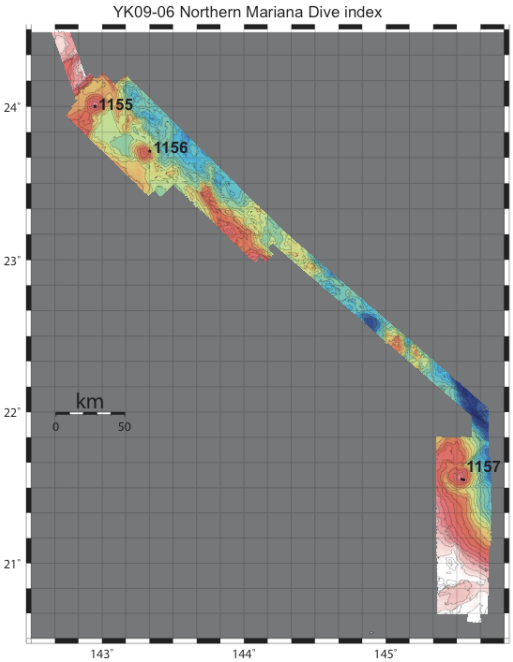
6. Cruise period: May 24, 2009 - June 10, 2009.

7. Port call: Chichijima to JAMSTEC

8. Research area: Izu-Bonin-Mariana forearc area

9. Research area map:





10. Summary of cruise results:

(1) Bonin Ridge area

This part of the cruise investigated eastern slope of the Bonin Ridge (i.e., landward slope of Izu-Ogasawara trench). We accomplished 6 Shinkai 6500 dives and bathymetric and geomagnetic surveys in this area.

The major objectives of the YK09-06 cruise were:

1) To more clearly define the nature of "pre-boninite" volcanism in the Izu-Bonin arc and to test our hypotheses for how mantle convection and magma generation changes during the initiation and maturation of an oceanic island arc.

2) To establish the spatial distribution of all igneous rocks along the Bonin Ridge forearc,

3) To precisely determine the chronology of events after initiation of subduction in the Bonin Ridge region,

4) To better understand the constitution of the of arc crust including that produced during the earliest stages of subduction, and

5) To use this better understanding the lithologic make-up of the Bonin Ridge fore-arc to understand the gravity anomaly associated with the Bonin Ridge, which is the Earth's largest.

We investigated 3 areas of the Bonin Ridge. In the northernmost survey area (Area A) near 28^{o}25'N, we used 4 dives (Dive 1149, 1150, 1153, 1154) to look at the lower to upper crustal section formed in the earliest stage of oceanic island arc formation. The deepest dive of Dive 1149 observed both gabbro and basalt/dolerite, and appears to have passed over the boundary between the two. Lower slope is composed of fractured gabbro, whereas pillow lava was observed in the uppermost part of this dive track. Dives 1153 and 1154 surveyed up-slope of D1149. These two dives found outcrop of numerous doleritic basalt dykes and fractured basaltic lava cut by dykes between water depth of 6000 and 5500m. The shallowest dive of Dive1150 recovered volcanic breccia and conglomerate with boninitic and basaltic clasts.

Area B near 27^{o}54'N, down slope of small knoll (probably a remnant edifice of boninite) was surveyed by Dive 1151 with a goal of observing the transitional section between the lower basaltic section and the upper boninitic section. Dive 1151 surveyed between water depths of 4760 and 4300m. This slope was covered with blocks of volcanic breccia containing boninitic and basaltic clast. The expected transition of basaltic and boninitic magmatism might exist somewhere between 5500 and 4760m, or it simply may be covered with the observed volcaniclastics.

Area C at around 27°19'N was surveyed by Dive1152 because of the uniqueness of its stratigraphic sequence inferred from dredging results. Beneath the upper basaltic and gabbroic sequences, pillow lava blocks were recovered during the dredging and this basaltic lava was dated to be >130Ma. The Dive 1152 surveyed a slope between water depths of 6000 and 5600 m. Outcrops of mudstone were frequently observed during the course of this dive. Sub-angular basaltic blocks were found only at 5766m as talus deposit. These were basaltic pillow lavas with partially preserved glassy rinds.

In summary, the first six dives of this cruise established stratigraphy of lower to upper crust formed at the initial stage of Izu-Bonin arc. Collected samples will provide information about the evolution of magmatic system in association with subduction initiation and subsequent arc maturation.

(2) Northern Mariana area

The second half of the YK09-06 cruise investigated dome-shaped seamounts in the northern Mariana forearc region during June 1 to June 7, 2009. We accomplished three Shinkai 6500 dives and bathymetric survey in this area. During the period, we successfully conducted prearranged three dives at three forearc seamounts, that is, "Hujin Seamount" (Dive #1155), Raijin Seamount (Dive #1156), and Babel Seamount (Dive #1157). Until now, no researches have been carried out in these seamounts. Dive #1155 intended to confirm distribution of serpentinite seamounts along the Mariana forearc region, to describe characteristics of the highly viscous serpentinite flows indicated in the bathymetric map; and to collect samples for petrographic investigations. The dive was planned to land on the edge of dome shaped summit region of Hujin Seamount at 3600 m in depth and move to summit at 3259 to find chimneys. Many outcrops are covered by mantle bedded sediments. Some outcrops of serpentinite flow under the sediment were observed during the early half of the dive. We didn't find any chimney, but confirmed that Hujin Seamount is a diapiric serpentinite seamount which is situated at the northernmost end in the Mariana forearc.

Dive #1156 aimed to take rock samples to know constituent materials inside the seamount and confirm whether Rijin Seamount is diapiric serpentinite seamount. Dive #1156 was investigated on the eastern hillside of Raijin Seamount from 4313 to 4097 m. Most part of the flank are covered by bedded mudstone of tens centimeter to more than fifty centimeter thick. Characteristic joints are commonly developed in the mudstone in the direction normal to bedding surfaces, and the mudstone are often fragmented to

box-like blocks and peridotite blocks probably of underlying serpentinite flow are exposed. During this dive, 17 serpentinized peridotites and 6 mudstones were recovered. Some serpentinized peridotites well retain primary olivine, spinel, and pyroxenes.

The objects of Dive #1157 are (1) to confirm geology of the highly acoustic reflection area on Babel Seamount, (2) to describe the outcrops of a highly viscous serpentinite flow lobe, and (3) to collect rock samples for petrographic investigations. The dive survey was carried out in the summit region of Babel Seamount from 3516 m to 3282 m in depth. The outcrops are exclusively occupied by serpentinite breccia. They were appeared cyclically as a steep wall during the dive. We collected 22 samples including 5 soft sediment and two push cores. We revealed a crater, approximately 200 m in diameter, on the summit. Based on the thickness of both sediments on the seafloor and iron–manganese oxide crust of the outcrops and floats, the latest serpentinite flow of Babel Seamount might be very young.