Submission date 2016/03/20

Cruise Summary

1. Cruise Information

Cruise ID: KR16-04

Name of vessel: KAIREI

Title of the cruise: <u>Detection of magmatism beneath the Ontong Java Plateau last for ~100 million years</u>

Chief Scientist (Representative of Science Party): Takashi Sano (National Museum of Nature and Science, Tokyo)"

Cruise period: March 7, 2016 ~ March 20, 2016

Ports of call: Pohnpei (Federal States of Micronesia) ~ Brisbane (Australia)

Research area: North of Eastern Salient, Ontong Java Plateau

(an area at S2°00'~4°30', E164°00'~166°30')

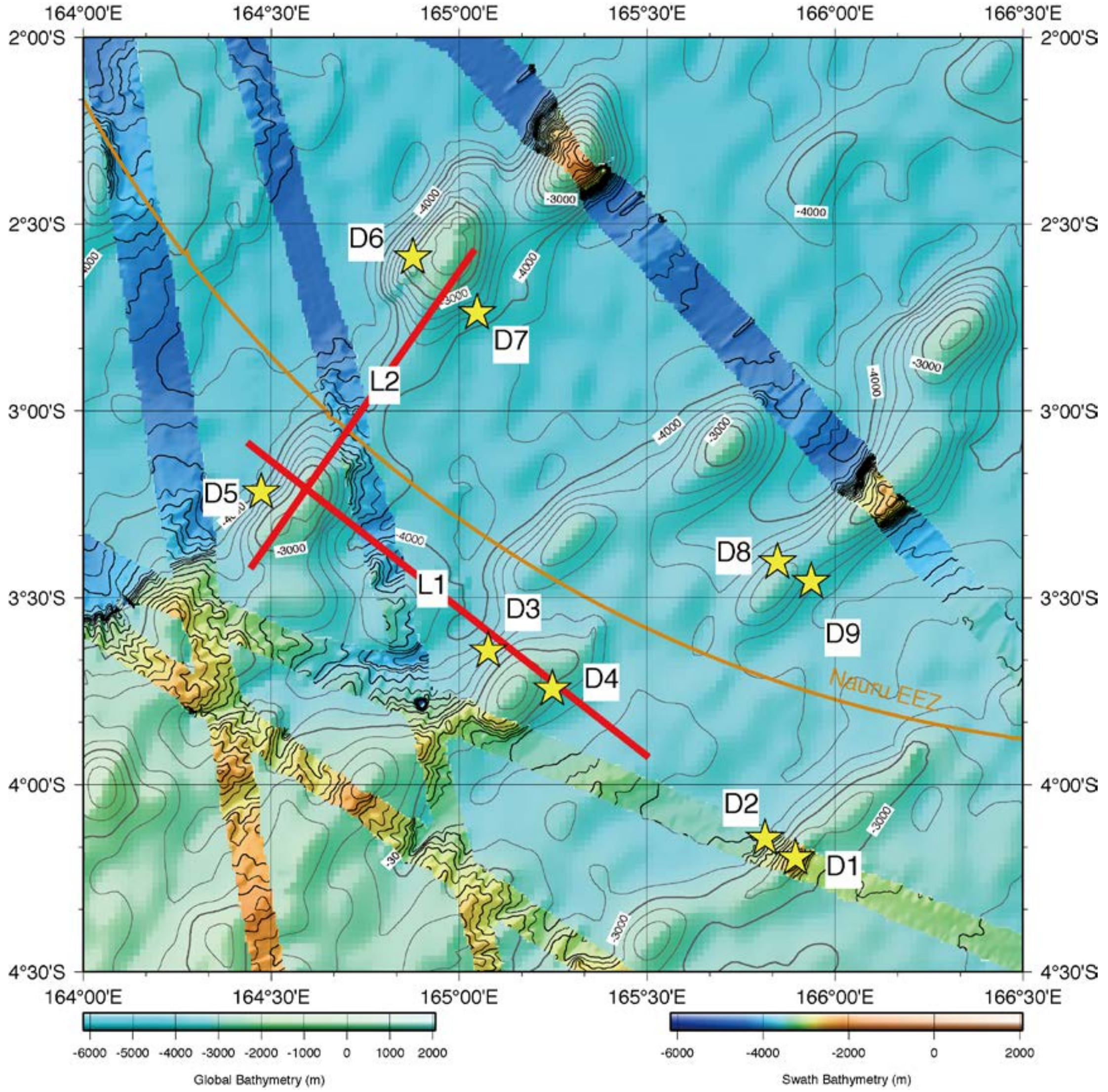

Figure 1. Bathymetry map of the survey area (Smith and Sandwell, 1997; MR14–06). Dredge sites (D1 to D9) are indicated by yellow stars and single channel seismic lines (L1 and L2) are shown by red lines.

2. Overview of the Observation

2–1. Background and Purpose

The Ontong Java Plateau (OJP) is the largest of the Earth's large igneous provinces (Figure 2). This plateau covers an area of ~1.9×10^6 km and has a total volume of $4.4–5.7 \times 10^7$ km (e.g., Coffin and Eldholm, 1994), with a maximum crustal thickness that exceeds 30 km (e.g., Miura et al., 2004). ^{40}Ar–^{39}Ar dating of OJP basalts indicates that most volcanic activities ended in relatively short periods (within a few million years) around 122 Ma, but post-emplacement volcanoes are evident on Solomon Islands that could have been formed by obduction of a part of the OJP in this subduction zone. Previous studies have reported that several post-emplacement volcanoes formed at ~90, 60, and 30 Ma on the OJP (e.g., Tejada et al., 2002). One idea to explain the post-emplacement volcanism is underplating of magma that resided for a very long time beneath the plateau (e.g., Ito and Clift, 1998), but geological information to support the idea is poor.

Geological information (eruption style, vent and lava flow distributions, etc.) of the post-emplacement volcanism may be similar to rejuvenated volcanism of hotspots. The rejuvenated volcanism is the final stage in volcanic evolution of a hotspot volcano and is characterized by a multi-stage, but infrequent, eruption sequence following an eruptive hiatus of variable duration (0.5–2 Myr) after the main shield construction stage. Many oceanic island groups show evidence for rejuvenated volcanism (e.g., Koppers et al., 2008; Garcia et al., 2010). The best-known Hawaiian rejuvenated volcanism is characterized by a number of monogenetic volcanoes that are arranged in NE–SW direction that intersects at a right angle to the direction of the Hawaiian chain. Similar to the Hawaiian rejuvenated volcanism, seamounts north of the Eastern Salient of the OJP are arranged in NE–SW directions that also are perpendicular to the plateau extension (Figures 1 and 2). We therefore proposed the working hypothesis that the seamounts on North of Eastern Salient represent rejuvenated volcanism on the OJP.

In order to research eruption style of the seamount, we planned to carry out topographical and geological survey as well as rock sample collection by dredge. We also planned to conduct the single-channel seismic survey to reveal the structure of the upper oceanic crust and seamounts.

References

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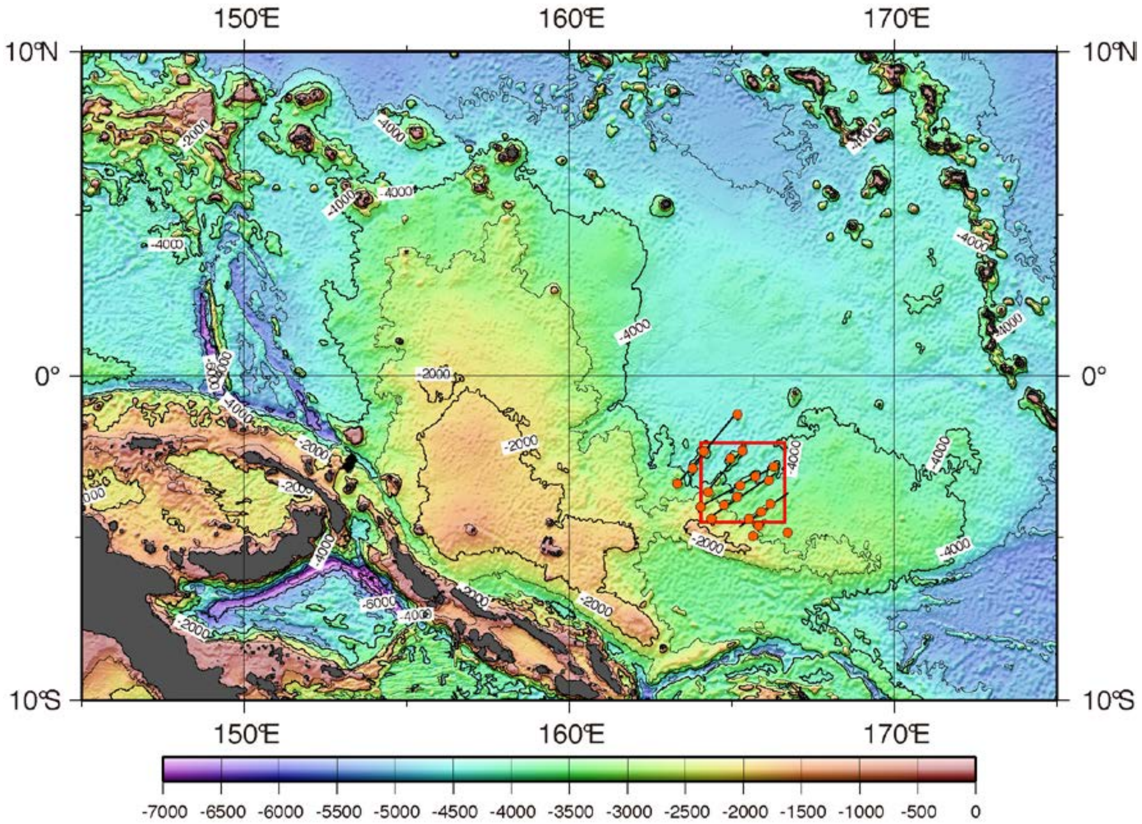

Figure 2. Map of Ontong Java Plateau showing research area (red box) and seamounts (orange circles). The seamounts are arranged in NE–SW directions. The edge of plateau is defined by the –4000 m depth contour, except in the SE part where part of the OJP has been uplifted through collision in the subduction zone at the Solomon Arc.

2–2. Observations and Activities

To achieve the scientific objectives, we have conducted the following activities within the research area in Figure 1.

(1) Surface geophysical measurement (gravity and geomagnetics) and multibeam mapping to reveal the tectonic structure and the morphology of the seamounts north of the Eastern Salient of the Ontong Java Plateau.

(2) Basement rock sampling by dredging to determine the source and type of volcanism that formed the seamounts.

(3) Single-channel seismic (SCS) survey to elucidate the structures of the volcanic layers of the seamounts and in the adjacent basins.

2-3. Instruments and Methods

(1) Surface geophysical measurement

Bathymetry, geomagnetic and gravity data were recorded during the cruise. We used a proton magnetometer, a shipboard three components magnetometer for the geomagnetic measurement, multi-narrow beam echo sounder with a sub-bottom profiler with Bathy-2010P and SeaBeam 3012 system for the bathymetric measurement, and a shipboard gravimeter for the gravity measurement. The degree of survey area was about 120° (auto system) and the ship speed was 8 knot at the dredge sites and 12 knot in other areas.

(2) Dredge

The dredge system consisted of the winch wire, lead wire, chain, weight, pipe dredge, fuse linker, life wire, and chain-bag dredge (Satsuki-type box-shape or cylinder-type). The dredge assemblages were connected with the ship-board winch wire.

(3) SCS survey

The SCS system consisted of two GI guns, firing controller, streamer, recording system, and post-processing system. The air compressor system installed in R/V KAIREI was used during KR16-04.

2-4. Preliminary results

(1) Surface geophysical measurement

The survey lines for the surface geophysical mapping were designed mainly to see the detailed topography of each seamount and to identify both the direction and morphological arrangement of the seamounts. The result shows that all seamounts are elongated linear features having ridge-like shape on tops (up to 50 km in length and 20 km in width, and typically ~2000 m high) and, therefore, we call them ridge-type seamounts. The elongated directions of all seamounts studied are NE–SW and several small mounds (~2 km in diameter and ~300 m high) are present along the ridge-like tops. In addition, an obvious NE–SW arrangement of the studied seamounts is apparent.

The gravity measurements are useful for examining the deeper structure of each seamount and the geomagnetic measurements would be utilized to identify magnetic anomaly lineations in the adjacent basins next to the seamounts and to expose the tectonic fabrics in the survey area. The acquired data were good and will contribute to the understanding of the origin of the seamounts.

The sub-bottom profilers were deployed within the areas of the two dredge sites (D8 and D9) right before the dredging, and the data were used to determine the dredge points.

(2) Dredge

Nine dredge hauls were conducted on the flanks of five seamounts during the 6-day survey period from March 10 to 15, 2016. Each seamount has an elongated shape trending NE–SW, referred to as a ridge-like seamount. The seamounts generally have steep slopes at the edges and gentle slopes in the center. There also exist small mounds, likely late stage volcanic cones, on the seamounts. The dredge targets were typically placed on the steeper side slopes and the small mounds on top of the seamounts. The dredge points are shown in Figure 1. The position and depth of the dredge sites are summarized in Table 2. Total weight of the recovered rocks was 521 kg.

(3) SCS survey

The SCS reflection data were acquired along two lines (L1 and L2) with a total length of approximately 259 km (Figure 1). In both tracks, reflection from the seafloor was clearly recorded. Igneous basement structures were confirmed except beneath steep slope of the ridge-like seamounts. In some places beneath the seamounts, upper volcanic breccia layer and lower lava flow layer are likely identified. In the basin area with near flat topography, some clear reflections were recognized within both sediments and basements. Although the SCS reflection data along the seamounts and basins are complex, possible slump structures and normal faulting are omnipresent. Along the L1 line in particular, several offsets, including possible normal faults in a parallel SW–NE configuration of likely several horsts and grabens, are confirmed in sediment (and basement) layers. On the other hand, obvious offset and other structure cannot be seen in L2 line, which was oriented parallel to the extensional features observed in the L1 line. Further descriptions and investigations will be reported later.