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Seismic structure at the Kairei Hydrothermal vent field near the Rodriguez Triple Junction in the Indian Ocean

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1. Introduction

The Central Indian Ridge is located at the north of the Rodriguez Triple Junction and shows slow˜intermediate spreading rate. The Kairei Hydrothermal Field (KHF) was discovered in the first segment of the Central Indian Ridge. The vent fluid has higher H_2 content compared to other hydrothermal vent fluids in the world.

Although the KHF itself exists above a basaltic rock massif named the Hakuho Knoll, gabbro and peridotites were discovered on the seafloor around the KHF. The Yokoniwa Rise is located at the north of the KHF and shows peridotites exposure on the seafloor. The Uraniwa Hills are small core complexes which exist just east of the KHF and olivine-rich gabbroic rocks are exposed on the seafloor. The serpentinization of these deep-seated rocks exposed around the KHF may contribute to the high H_2 concentration of the vent fluid. To understand the sub-seafloor of the KHF, we conducted a seismic reflection/refraction survey with ocean bottom seismometers (OBSs).

2. Observation and Analysis

We conducted a seismic reflection/refraction survey from January 27 to January 29 in 2013 and from March 5 to March 6 in 2013 using S/V Yokosuka of JAMSTEC. In the experiment, we used 19 OBSs, an air gun (G.I.gun) and a single channel steamer cable. We obtained 5 survey lines NNW-SSE direction parallel to the ridge axis, 5 lines E-W direction and 5 lines NE-SW direction. In addition to these lines, we acquired other 5 lines passing through the point above the KHF or the Yokoniwa Rise.

In analysis of refraction data, we estimated 2-D velocity model under survey lines using the progressive model development method (Sato and Kennett, 2000). Then, we constructed a 3-D initial model and conducted 3-D inversion using FAST (Zelt and Barton, 1998).

3. Results

Seismic velocities under the Yokoniwa Rise and the Hakuho Knoll exceed about 6 km/s at depth of 1-2 km below seafloor. The high velocity area extends horizontally beneath the Yokoniwa Rise, suggesting that deep-seated rocks are uplifted when the Yokoniwa Rise was formed. The high velocity area beneath the Hakuho Knoll extends vertically, indicating that the knoll is a volcanic seamount.

A 1-D velocity profile of this study area generally seems to be similar to that of mid ocean ridges such as Mid-Atlantic Ridge, East Pacific Rise until depth of 3 km below the seafloor. However, the velocity of this study area at the seafloor shows about 1 km/s faster than that of other ridges except Juan de Fuca Ridge and the Southern Ridge. The Southern Ridge is the south part of the Atlantis Massif core complex on the Mid-Atlantic Ridge, and serpentines were sampled on the seafloor. The 1-D velocity structure of this study area is similar with that of the Southern Ridge, suggesting that deep-seated rocks are uplifted and serpentinized at shallow depth in this study area.

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