

## Bathymetric survey and discovery of hydrothermal plume in the Daiichi-Amami Knoll using autonomous underwater vehicle

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Many submarine volcanoes exist along the volcanic front in the Ryuku Arc. The Daiichi-Amami Knoll, which is located about 70 km off Amami Oshima Island, is one of those submarine volcanoes. Detailed bathymetric survey of this knoll has not been done before, therefore its shape and size have not been known. Japan Coast Guard conducted a high resolution bathymetric mapping of the knoll using survey vessel and autonomous underwater vehicle (AUV) and discovered hydrothermal plumes which are rising from the seafloor, indicating that the presence of hydrothermal activities in the Daiichi-Amami Knoll.

### 1. Method

The survey was conducted in August and September, 2013 using survey vessel Takuyo and AUV Gondo. The knoll was surveyed with multibeam echo sounder (MBES) installed on S/V Takuyo. Then the detailed survey was done with MBES on AUV Gondo.

### 2. Bathymetry

The bathymetry of the Daiichi-Amami Knoll indicates that the knoll is a volcanic high. The knoll has flat areas, a caldera with a diameter of 1.6 km and some volcanic cones at its summit. The knoll also has two small depressions near to the volcanic cones and they are deeper about 40 m than the surrounding areas. The relative high of the knoll is about 500 to 700 m and the shallowest depth of the knoll is 245 m.

### 3. Hydrothermal plume

Water column data acquired by MBES on S/V Takuyo detected the clear hydrothermal plumes in the two depressions. The plumes were especially clear at the rim of the depression. Some plumes were observed to rise from the seafloor of 350 m depth to near sea surface (although no discolored water was visually observed on the sea surface). Plumes were also detected at the slope areas of the volcanic cones. AUV Gondo dived to the depressions at the altitude 40-50 m above seafloor and conducted a detailed survey. The high resolution bathymetric map shows a presence of a numerous small depressions near the plume points. The side scan image by AUV Gondo also shows the plumes acoustically at its nadir.

### 4. Water temperature

AUV Gondo observed the water temperature at the altitude 40-50 m in the depressions, but distinguished temperature increases were not observed. Temperature profile observation, which was conducted using expendable bathythermograph launched from S/V Takuyo, showed over 2 degrees temperature increase near the seafloor in the depression. This observation along with the presence of plumes indicate the presence of hydrothermal activity in the Daiichi-Amami Knoll.

### 5. Importance of this survey result

The detailed bathymetry and the presence of plumes in the Daiichi-Amami Knoll were revealed by the survey using survey vessel and AUV. The discovery of plumes suggests the presence of hydrothermal deposits and chemosynthetic community, therefore being important in terms of seafloor resources. The high resolution bathymetric map acquired by AUV is fundamental information which is useful for scientific research and mineral exploration. This result is a first step for further survey to understand the geological history of the knoll and to secure new seafloor resources.

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