

## Cruise Summary

### 1. Cruise Information

Cruise number	KR15-03
Ship name	KAIREI
Title of the cruise	Monitoring of tsunamis by long-term seafloor EM observation
Chief Scientist	Hiroaki Toh [Graduate School of Science, Kyoto Univ.]
Representatives of Science Party	Hiroaki Toh [Graduate School of Science, Kyoto Univ.]
Title of proposal	Monitoring of tsunamis by long-term seafloor EM observation
Cruise period	20, February – 1, March 2015
Port call	Jamstec, Yokosuka – Port of Kochi
Research Area	West Philippine Basin and near the Nishino-shima
Research Map	Refer to Figure

### 2. Overview of Observation

#### -Purpose and background

Electric and magnetic (EM) fields are generated within ocean currents moving through the earth's magnetic field, and tsunami flows are also considered to generate EM fields in the ocean, what so called tsunami dynamo effect. A long-term SeaFloor EM Station (SFEMS) in the northwestern pacific (NWP) co-developed and co-operated by Kyoto University and JAMSTEC successfully enabled to measure the EM perturbations by the tsunami associated with the 2006 Kurile earthquake on 15 November in 2006 for the first time due to recent advances in high precision measurements of EM fields. Moreover, we have equipped the differential pressure gauge (DPG) with the SFEMS to simultaneously observe not only the EM perturbation but also the sea level change by tsunami since February of 2011, which is more enhanced performance than general tsunami measurement in that the observed data extracted tsunami characteristic including the direction and velocity of tsunami propagation as well as sea level change. We actually verified the effectiveness by the EM data detected from the 2011 Tohoku-oki earthquake tsunami. In this cruise we start the observation at the SFEMS for the tsunami associated with the collapse event by volcanic activities near the Nishino-shima volcano.

Nishino-shima volcano of the Bonin Islands has been continued eruptive

activity since 20 November in 2013. The purpose of this research cruise is to make scientific observation for the activity of the volcano. We install long-term ocean bottom seismometers (LTOBS) developed by Earthquake Research Institute, University of Tokyo around the Nishino-shima, and collect infrasonic and visual data during the cruise. In addition, we make some preliminary experiments for development of a new monitoring system for the island volcano and/or the submarine volcano using an unmanned automated sea vehicle (Wave Glider by Liquid Robotics Inc.).

#### -Research result

We retrieved the SFEMS deployed at the western Philippine basin (WPB) on 15 November in 2012. The retrieved operation was done by KAIKO Mk-IV (Dive #648), which is the celebratory first dive of the Mk-IV. The SFEMS was found to have successfully recorded continuous electromagnetic time-series in addition to associated attitude data for about 2 years (from 15 November 2012 to 6 November 2014) with an interval of two minutes. The DPG attached to SFEMS recorded variations of ocean bottom pressure for 2 years and 2 months (from 14 November 2012 to 23 January 2015) by 100 Hz sampling.

We deployed the SFEMS at around 10-km east to the Nishino-shima. The location was determined by the acoustic range measurement at three points. We confirmed the condition of the SFEMS in the observation by KAIKO Mk-IV (Dive #649). We also sampled several volcanic rocks around the station by KAIKO Mk-IV. We installed five LTOBSs around the Nishino-shima volcano, which are going to store data for 6 to 10 months. The locations were confirmed by the acoustic range measurements. We mapped the bathymetry and the subsurface structure by onboard multi-narrow echo sounding (MBES) and the sub-bottom profiler, respectively. Surface tow of a proton precession magnetometer was also conducted around the Nishino-shima whenever it was possible.

Four infrasonic microphones were set at the funnel deck of the KAIREI. The best installation to reduce wind and electric noises was explored and finally the infrasonic measurement for Nishino-shima volcano was done with three microphones. While KAIREI were close to Nishino-shima, the volcanic activity was taken by a video camera to be compared with the infrasonic data.

As the experiments for the development of the Wave Glider observation system, which has been co-developing by Earthquake Research Institute, University of Tokyo and JAMSTEC, we tried data transfer via 'Thuraya' satellite phone, and conducted tests of two types of hydrophone.

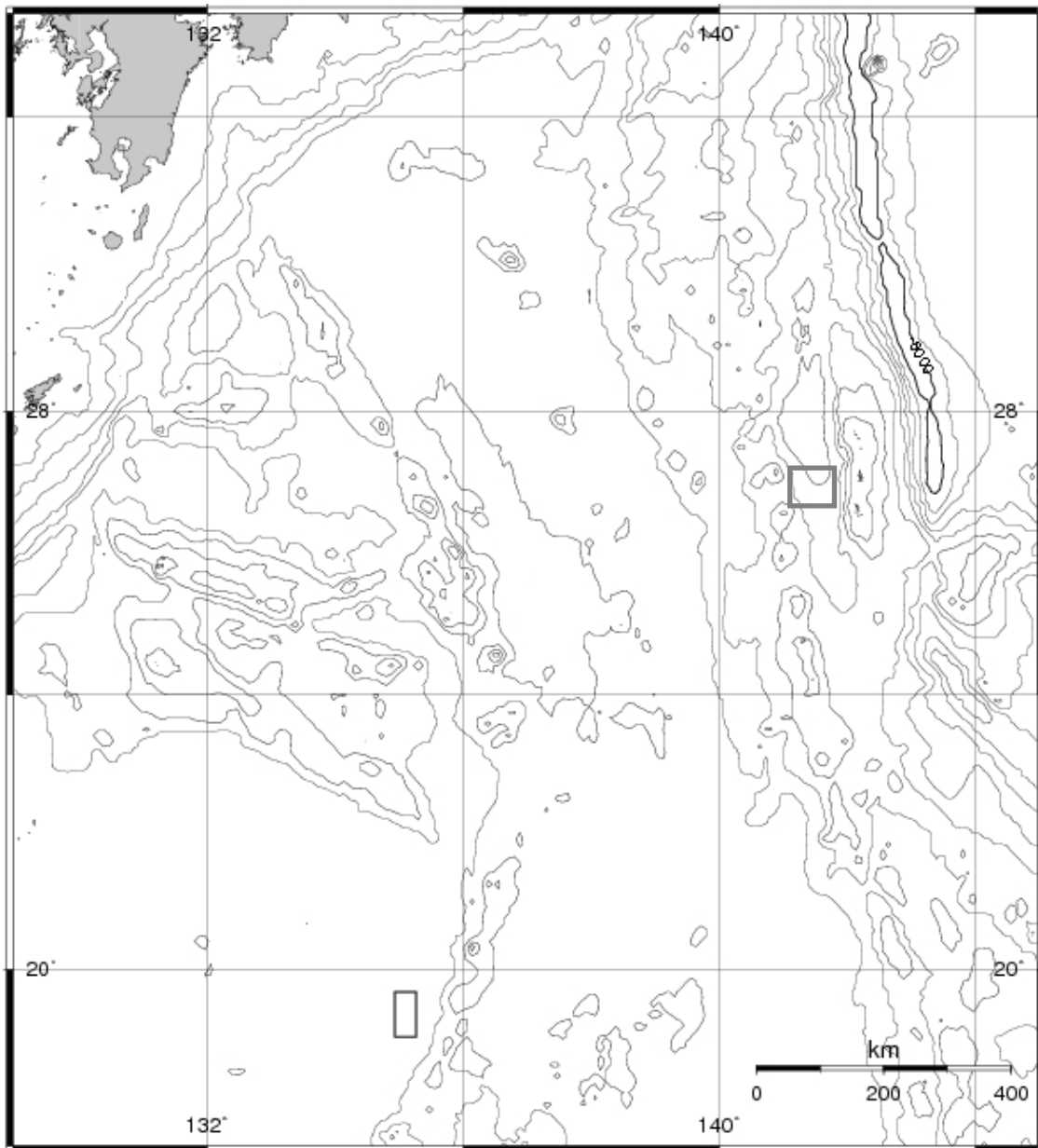


Figure: Observation site location. The sites of WPB and near the Nishino-shima are within the small rectangular area in the lower left and in the upper right, respectively.