Long-term seismic monitoring around Nishinoshima, Izu-Ogasawara by using ocean bottom seismometers

*Masanao Shinohara[1], Mie Ichihara[1], Shin'ichi Sakai[1], Tomoaki Yamada[1], Minoru Takeo[1], Hiroko Sugioka[2], Yutaka Nagaoka[3], Akimichi Takagi[3], Taisei Morishita[4], tomozo Ono[4], Azusa Nishizawa[4]

1. Earthquake Research Institute, University of Tokyo, 2. Faculty of Science, Kobe University, 3. Meteorological Research Institute, Japan Meteorological Agency, 4. Hydrographic and Oceanographic Department, Japan Coast Guard

Nishinoshima in Izu-Ogasawara erupted in 1973 and island was newly created. In November 2013, eruption of Nishinoshima volcano was confirmed again and a size of the island increased. It is difficult to make continuous observation on an uninhabited island such as Nishinoshima. Therefore we started seismic observation using Long-Term Ocean Bottom Seismometers (LT-OBSs) from February 2015 when the eruption occurred continuously. Our LT-OBS equips three-component 1Hz seismometer, and has a recording period of one year. The first deployment was carried out by the R/V Kairei, JAMSTEC. We deployed 4 LT-OBSs at a distance of about 8 km from a central crater of Nishinoshima where water depths are about 1,400 m and a LT-OBS at a distance of about 13 km. In October 2015, the deployed LT-OBSs were recovered by the R/V Keifu-maru, JMA, and 5 LT-OBSs were installed to continue the observation. Five LT-OBSs were had a distance of 5 km from the crater and water depth is about 1,000 m. In May 2016, the the R/V Shoyo, JCG retrieved the 5 LT-OBSs and deployed 5 LT-OBSs at positions closer to the island. In October 2016, 5 LT-OBSs were recovered by the R/V Shinsei-maru, JAMSTEC and 3 LT-OBSs were installed again to continue the observation. We will report temporal variation of activities of Nishinoshima volcano from the records of LT-OBSs.

LT-OBSs frequently recorded characteristic events from a start of the observation. The first part of the events has high frequency of a few Hz and large amplitude waves with a period of a few seconds follows. This characteristic waves have good S/N ratio at frequencies from 4 Hz to 8 Hz. Duration of the events are less than 1 minutes (usually 20-30 s) at frequency band of 4-8 Hz. Therefore we applied the band pass filter of 4-8 Hz to all records from OBSs for analyses. For the first period, four LT-OBSs had the same distance from the crater and the waves arrived at the same time with the same amplitude. We located hypocenters of these events using the first arrival times, and epicenters were located close to the crater. In February 2015, infrasound and picture observations were performed on the R/V Kairei, and infrasound was observed during release of plume from the crater. Compared the events recorded by a LT-OBS deployed during the infrasound observation with infrasound data (1-7 Hz) and picture of the crater, the events on the LT-OBS records seem to correlate with release of plumes.

We estimated the number of the events which are related to plume release by using the STA/LTA method. The method is applied to the records of more than three LT-OBSs. First, a bandpass filter of 4-8 Hz was applied to all the records and we adopted parameters of the STA/LTA method as follows, STA window: 2 s, LTA window: 40 s, STA/LTA ratio: 1.5, duration of trigger: 3 s, time for re-trigger: 4 s. The events are recognized by more than three triggers at the same time, and continuous trigger is interpreted as one event. We detected 363,367 events from 2015 February 28 10:00 to 2015 October 3 13:00 (the first observation period). In the second observation period (from 2015 October 4 01:00 to 2016 May 5 08:00), 27,544 events were picked up. For the second period, we changed the parameter of STA/LTA ratio to 2.0 due to a change of configuration of the LT-OBS network. From the start of the OBS observation (2015 February) to June, the number of detected events is constant of approximately 1,800 per day. From middle of July 2015, the detected number rapidly decreased, and duration time of the events became longer. In the end of October 2015, the number was reduced to less than 300 per day.

Although the number temporarily increased at the beginning of November, the number of the detected events reached less than 100 per day after the end of November. It is estimated that the surface activity of Nishinoshima volcano declined from the end of July 2015, and there was little activity from the middle of November 2015 to at least May 2016.

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