Submarine volcanic activity in French Polynesia detected by broadband ocean bottom seismographs

Aki Ito1, Hiroko Sugioka1, Daisuke Suetsugu1, Hajime Shiobara2, Toshihiko Kanazawa2, Yoshio Fukao1
1 Institute for Research on Earth Evolution, Japan Agency for Marine-Earth Science and Technology 2 Earthquake Research Institute, University of Tokyo

Abstract
Ocean acoustic waves (T-waves) associated with volcanic activity is often observed as a swarm of wave-packets. There are many reports for the detection and locating using by the hydrophone array. Here we show the T-waves associated with submarine volcanic activities using by the broadband ocean bottom seismographs (BBOBSs) in the French Polynesia region.

Along with the Japan-France cooperative project we deployed 10 BBOBSs in the French Polynesia area in a period from 2003 to 2005. All the BBOBSs were installed on the seafloor at depths of 4000-5000 m with an average spacing of 500 km. Each BBOBS was equipped with the Guralp CMG-3T broadband sensor that could record ground motions at periods from 0.02 to 360 s.

Swarms of T-wave events from submarine volcanic activities, as well as T-waves associated with local and global seismic activities, were recorded. In the northern part of our study area, typical T-waves were recorded at a BBOBS station near the Marquesas hot spot. They are accompanied by no obvious P or S waves. They have shorter durations and higher prominent frequencies than those of tectonic earthquakes. All of these characteristics are similar to those of volcanic T-waves reported by previous studies. Each of the repeated T-wave events has duration of 20-30 s with an intermission of also 20-30 s. We examined the direction of the particle motions of T-waves to be related to the paths from the source.

Another type of T-wave events was also observed at several BBOBS stations in the southern part of the studied area. Each of the repeated T-wave events has duration of 60 s or longer with an irregular intermission. Using onset times observed by BBOBS network in the southern part, the source locations of the T-waves were determined to be around the Macdonald hot spot, which is located in Austral islands.

Table 1: Principal specification of Free-Fall Pop-Up BBOBS

In the northern area, typical T-waves were recorded at a BBOBS station near the Marquesas hot spot. They are accompanied by no obvious P or S waves. They have shorter durations and higher prominent frequencies than those of tectonic earthquakes. All of these characteristics are similar to those of volcanic T-waves reported by previous studies. Each of the repeated T-wave events has duration of 20-30 s with an intermission of also 20-30 s. We examined the direction of the particle motions of T-waves to be related to the paths from the source.

Another type of T-wave events was also observed at several BBOBS stations in the southern part of the studied area. Each of the repeated T-wave events has duration of 60 s or longer with an irregular intermission. Using onset times observed by BBOBS network in the southern part, the source locations of the T-waves were determined to be around the Macdonald hot spot, which is located in Austral islands.

Hypocenters of T-waves events in the southern area

* Using hyposat4 inversion program
* Water wave velocity was assumed to be 1.49 or 1.50 km/sec.
* 120 events were located.

Fig. 1 Location of BBOBS stations and hotspots.

Fig. 2 Broadband ocean bottom seismographs (BBOBS). BBOBS was equipped with the broadband sensor that can record ground motions at periods from 0.02 to 360s.

Fig. 3 Example of typical T-waves observed at FP2. A two-pole Butterworth filter (6-9Hz) is applied. Each trace was normalized by maximum amplitude.

Fig. 4 Horizontal components observed at FP2 and examples of the particle motion of T-waves event observed at FP2.

Fig. 5 Example of T-waves observed at FP6 first near the Macdonald hot spot.

Fig. 6 Hypocenters of T-waves events in the southern area.