Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

SCG058-P10 Room:Convention Hall Time:May 23 10:30-13:00

Long-period events observed by DONET

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Off the Kii-peninsula, Dense Observation Network for Earthquake and Tsunami (DONET) has been developed by Japan Agency for Marine-Earth Science and Technology (JAMSTEC). DONET is a network of ocean-bottom seismic stations, aiming at improving detection capability and earlier detection of earthquakes and tsunamis in this region. Each DONET station uses a broad-band seismometer (Guralp CMG-3T), a strong-motion seismometer (Metrozet TSA-100S), a hydrophone (High Tech inc. HTI-99-DY), a differential pressure gauge (product of Nichiyu-giken inc.), and a quartz pressure gauge (product of Proscientific inc.). A combination of these sensors realizes broad-band and wide-dynamic range observations in ground motion and pressure change. Data from these stations are transmitted in real-time to our laboratory through ocean-bottom optical cable. We have already installed 8stations by January, 2011.

Around the Kii peninsula and Kumano fore-arc basin, several kinds of characteristic seismic activities are known as the non-volcanic tremor (NVT) and very-low-frequency (VLF) earthquakes. Since DONET stations are deployed immediately above the source region of the VLF earthquakes, we expect that DONET data will contribute to clarify their mechanism, although any signals from these events have not yet been identified. On the other hand, we found long-period signals with dominant periods of several tens of seconds to ten minutes in the records. These signals are clearly different from the well-known signals from the NVT or the VLF earthquakes. In this study, we introduce the long-period signals observed by DONET.

One type of the long-period signals, which is most frequently observed, shows a harmonic oscillation that monotonously decays with a characteristic period of about 60 s. This signal is dominated by horizontal motion, and the particle motion is almost linear. The duration of this signal is typically between 5 and 10 minutes. Some exceptional events continued about one hour. Such a harmonic oscillation is widely observed below volcanoes. No magmatic volcano is known around Kumano fore-arc basin, although. We also found other types of signals: One is a spindle-shaped signal which oscillates with characteristic frequencies of about ten seconds. The other example shows a waveform similar to a cycloid-function, repeating at a period of about 5 to 10 minutes. Since these signals are clearly observed at single station, we could not quantitatively determine the source location or the mechanism. The fact that the signal is recorded at only one station may indicate that the source is located close to the station. A mud volcano is located in this region. We speculate these signals are originated from the mud volcano. Since only a little is known about a mud volcano, investigations of these signals may help to understand the dynamics of it.

We also can not rule out the possibility that these signals are originated from artificial sources at present. The seismometer package of DONET stations are finally buried under the ground covering with a pile of sand. The station which observed these peculiar signals is not yet completely buried. These signals might be oscillations of the sensor package caused by ocean-bottom current. This possibility can be checked after burying the sensor package. If this is the case, ocean-bottom broad-band seismic sensors should be completely buried under the ground in order to minimize artificial signals caused by ocean-bottom current.

Keywords: Mud volcano, low-frequency earthquakes