Seismic and geothermal observation in the buried seafloor observatory of the Sagami Bay

Eiichiro Araki[1]; Sho Kaneko[1]; Yoshiyuki Kaneda[2]; Masataka Kinoshita[1]

[1] JAMSTEC; [2] JAMSTEC,IFREE

In December 2005, we made a shallow seafloor borehole called a 'seafloor benchmark borehole' in the Sagami Bay using a piston coring system. The location of the borehole is at 1250 m water depth approximately 1 km east of the Hatsushima submarine cable observatory. The area is known for active tectonics such as east of Izu peninsula earthquake swarm and seafloor eruption of Teishi knoll in 1989. The 4-m seafloor benchmark borehole can be used to install various scientific instruments such as thermometer string for geothermal observation and seismometer for monitoring broadband seismic activity which may be related to volcanisms. The benchmark borehole can also be used as a reference basement for seafloor geodetic measurement.

We have installed a thermometer string in the seafloor benchmark borehole from December 2005 until December 2006. The thermometer string was replaced by a broadband seismometer when we recovered the thermometer data logger. Almost a year data from seven thermometers was recovered from the seafloor benchmark borehole. Inside borehole was hydraulically isolated from the water above seafloor by a rubber seal so that we can associate the temperature inside the borehole with thermal structure below the seafloor. Of seven thermometers, two thermometers were outside the borehole measuring seawater temperature. Temperature variation inside the seafloor benchmark borehole over a year period was less than 100mK in most of the sensors. Seawater temperature in the seafloor showed much higher (˜400mK) variation indicating the borehole was appropriately isolated from the water above the seafloor.

After recovery of the thermometer string, we installed a broadband seismometer in the seafloor benchmark borehole. When a seismometer is installed in the seafloor benchmark borehole, the seismometer can avoid influence from seafloor current flow that pushes and moves the seismometer. The effect of seafloor current flow is severe problem for seafloor broadband seismic observation especially for low frequency below 0.1 Hz.

The broadband seismometer (Guralp CMG-1T) is housed in a 1.2m length cylinder of 5 inch diameter with a coupler and bow springs to couple to the borehole tubing when inserted in the borehole. The seismic signal is digitized and transmitted to a seafloor recorder via a cable. The seafloor seismic recorder can be disconnected from the borehole seismometer by an underwater mating connector. The seismic recorder houses batteries and precision clock necessary for a year continuous observation. All of these instruments were successfully installed by a ROV Hyper Dolphin of JAMSTEC on December 9th, 2006. Upon installation of the borehole seismometer, we monitored the seismic data from the seismometer by the ROV to check the seismic noise level obtained from the sensor. Approximately 2 hours continuous record by the ROV operation showed excellent long period performance over existing seafloor installed broadband seismometer. Long period seismic noise level at 100 second period was -140dB m**2/s**3 for horizontal components and -165 dB m**2/s**3 for vertical component. This shows effect of seafloor current to tilt seismometer was properly reduced by installation in the seafloor benchmark borehole. We continue broadband seismic observation in the seafloor borehole, and we plan to recover seismic data in early 2008 after a year of long-term observation.