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Development of high quality seafloor earthquake and Tsunami observation in DONET project

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We developed seafloor cabled observatory network called Dense Ocean-floor Network for Earthquake and Tsunamis (DONET) in the rupture zone of Tonankai earthquake and around to monitor earthquakes and tsunamis as well as crustal activity in the seafloor. Observation targets of DONET are earthquakes from micro-earthquakes to large earthquake of magnitude 8 such as the last Tonankai earthquake in 1944, episodic slow slip events such known as very low frequency earthquakes, tsunami generation process in the epicenter area and so on. In DONET project, 20 seafloor observatories are planned to connect to 5 seafloor observation node with 10 km extension cables. The seafloor observation nodes are connected to a backbone submarine cable of both ends landed to supply power and communicate with each observatory. With this system of backbone cable, observation node, and extension cables, we are able to establish an observatory network much denser (10-30 km separations) than the past cabled observatories.

Each seafloor DONET observatory consists of a set of seismometers observing earthquakes and a set of pressure gauges observing earthquakes, tsunamis and slow crustal motion, as well as seafloor water thermometer intended for seafloor turbidity current monitoring. The seismometers are a set of broadband seismometer (Guralp CMG3T) and strong motion accelerometer (Metrozet TSA100-S), which support ground motion monitoring from the smallest to 4 G ground acceleration. The pressure gauges are a set of quartz pressure gauge (Paroscientific 8B7000-2), deep sea differential pressure gauge and hydrophone, which support seafloor pressure observation of much less than 1 Pa, very slow seafloor vertical movement as well as pressure wave of over a few MPa during a large earthquake in the vicinity. With the DONET seawater thermometer, seafloor water temperature can be monitored with an accuracy of 5 mK and 1 mK resolution which will be necessary to detect seafloor turbidity current.

In the DONET project, we also developed a technique to install a seismometer to avoid influences of seafloor current flowing in the seafloor. With the developed technique, the seismometers are completely buried beneath the seabed. As a result of complete burial, low frequency noise of seafloor broadband seismometer was lowered by more than 40 dB for horizontal components. With this noise reduction, we were able to clearly observe the effect of long period ocean gravity wave deforming the seabed in the period longer than 50 seconds. This ground deformation due to the long period ocean gravity wave is regarded as a noise for earthquake monitoring, but this effect may also be reduced by monitoring seafloor pressure at the same place of ground motion monitoring by the broadband seismometer. This is possible with differential pressure gauge in the DONET seafloor observatory. This is an example showing the importance of measuring both ground motion and pressure in the seafloor.