

Development of seafloor realtime observation network for crustal deformation in the Nankai Trough: tiltmeter installation

*Eiichiro Araki¹, Takashi Yokobiki¹, Toshinori Kimura¹, Shuhei Nishida¹, Yuya Machida¹, Shuichi Kodaira¹

1. Japan Agency for Marine-Earth Science and Technology

Dense ocean-floor network for earthquake and tsunami in the Nankai Trough has been operational since 2010 monitoring earthquake and Tsunami activity in real-time in the seismogenic zone of Tonankai and Nankai earthquakes off Kii peninsula and off Shikoku Island of Japan.

The DONET observation system was designed so that new sensors may be added after deployment of the system, which is first utilized to connect deep borehole observatories deployed by IODP D/V Chikyu. The connection to the DONET enabled us to obtain continuous observation data and this led to discovery of repeating slow slip in the shallow part of the subducting plate (Araki et al., 2017). Currently, three such deep borehole observatories (C0002, C0010, C0006) are operational and providing borehole geodetic data in real-time. The sensitivity of the borehole to such slow slip events is significantly high and only these borehole can detect such repeating small slow slip events in the Nankai Trough. The distribution of the borehole observatories are not very suitable, though, to model area of observed slow slip, due to linear array of these three observatories. Wide spread of observatories sensitive enough to these slow slip events is crucial for such more detailed analysis of slow slip events.

Therefore, in addition to the deep borehole observatories, we plan to establish seafloor observatories that are sensitive to observe slow slip events, which can also be deployed and connected to DONET with lower cost. In our plan, the seafloor observatory (called seafloor observatory for crustal deformation) consists of tiltmeter deployed in shallow hole, fiber optic strainmeter, and seafloor pressure gauge.

We started construction of such seafloor observatories for crustal deformation in 2018. The first observatory is located east of the deep borehole observatory array (C0002, C0010, and C0006) near B-Node of DONET-1. We drilled 8.6 m borehole in October 2018 by R/V Kaimei and seafloor drill called BMS. We installed a Lily tiltmeter in February 2019 and connected the shallow hole tiltmeter to DONET via an interface box which will also be used to connect other sensors (seafloor fiber optic strainmeter and pressure gauge) in the future. The tiltmeter in the shallow hole was packed with sand to the top of the borehole to enhance stability of the tiltmeter in the hole. The initial data from the tiltmeter showed significant drift over 50 microradians a day, but appears to get stable gradually over a week period after the deployment. We analyze initial stabilization history of the shallow hole borehole tiltmeter to improve our installation technique in the future installation of tiltmeters in the seafloor.

We plan to complete installation of the observatory by adding fiber optic strainmeter and pressure gauge this year. Also, another observatory installation is planned in 2019 in DONET-2 area where JHD reported crustal deformation over a year in 2017-2018.

Keywords: the Nankai Trough, slow slip event, seafloor cable observatory