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DONET 地震計により観測されたエアガン記録および雑振動記録を用いた南海トラフにおける S 波異方性構造の推定
Estimation of S-wave anisotropy in the Nankai Trough using active and passive seismic dataset observed by DONET

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In The Nankai Trough seismogenic zone, which is formed by the subducting Philippine Sea plate beneath the Eurasian plate with rate of 4-6 cm/year, mega-thrust earthquake occurred repeatedly every 100-150 years. In this area, cabled real-time observation system, DONET (Dense Oceanfloor Network Systems for Earthquakes and Tsunamis) and IODP C0002G borehole observatory, have been operated to monitor seismic activity, crustal deformation and tsunami propagation since August 2011 and January 2013, respectively.

For elucidating preparation and generation process of mega-thrust earthquake, which occurs repeatedly in subduction zones, it is important to observe and monitor the stress state, a key parameter governing its fault dynamics in the vicinity of seismogenic fault. In-situ stress analysis such as borehole breakout analysis may provide the orientation and the order of differential stress around the borehole, but it is still challenging to drill seismogenic fault, and is even more difficult to monitor temporal change of stress state, especially in wide area. Therefore, we have to consider another method to estimate stress state. In this study, we performed active and passive seismic data processing to obtain seismic anisotropy using dataset acquired by three-component seismometers installed in the DONET and IODP C0002G observatories. Seismic anisotropy can be a proxy of stress state, and by observing its temporal change is expected to identify change of stress around the seismogenic fault.

As active seismic dataset, we used airgun records observed by DONET and IODP C0002G seismometers during KR13-17 cruise conducted on November 2013. In this study, we used airgun records of eight circular shooting lines around these seismometers with radius of 3 km. In radial and transverse components computed from original horizontal records acquired by these circular shooting lines, P-S converted waves from bottom of shallow sediment were clearly visible. Fast symmetry axis of S-wave was estimated by fitting simple sine curve to amplitude fluctuation with shot-receiver azimuth in radial component, and then we obtained S-wave anisotropy in shallow sediment in the Nankai Trough wide area.

As passive data processing, we apply seismic interferometry method to ambient noise records acquired by horizontal components of each DONET and IODP C0002G seismometer. We computed zero offset 4-C ACF and CCFs (Auto-correlation function and Cross-correlation function) comprising V11, V12, V21, and V22 from ambient noise record observed by horizontal i- and j-direction components. Vij represents impulse response which has i-direction source and j-direction receiver of each seismometer. In the ACF and CCFs calculate from long-term records for two years, several coherent events are visible. These events may be reflected S-wave from each layer, and S-wave splitting affected by seismic anisotropy. We then applied the Alford rotation and layer stripping method to the obtained 4-C ACF and CCFs. Then S-wave anisotropy direction and amplitude beneath each seismometer in each layer above the plate boundary were obtained.

We finally compared the obtained S-wave anisotropy from the active and passive methods. There are some differences between the obtained results from these methods. It may result from some reasons. Airgun records have been affected by 3-D structure around the observatory including seafloor topography and effect of undergoing P-wave anisotropy. Results from passive ambient noise components also have causes of error. The obtained 4-C ACF and CCFs might be contaminated by surface wave component. We now evaluate above mentioned effects to obtained results. Also, we intend to obtain S-wave anisotropy in deeper part from active airgun dataset using weak converted waves from deeper boundaries. We now plan to conduct next airgun survey in March 2015 by R/V Kairei with same settings as KR13-17 cruise to detect temporal change of S-wave anisotropy.

Keywords: S-wave anistropy, Nankai Trough, DONET