Detailed spatial distribution of microearthquakes beneath the Sea of Marmara, Turkey, deduced from long-term ocean bottom observation

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The North Anatolian Fault (NAF) crosses the Sea of Marmara in E-W direction, accommodating about 25 mm/yr of right-lateral motion between Anatolia and the Eurasian plate. There are many large earthquakes along the 1500 km long NAF repeatedly occurred and interacted each other. The recent large northern Aegean earthquake with Mw=6.9 filled one of the last two seismic gaps along NAF that experienced extraordinary seismic moment release cycle during the last century and confirmed a remained blank zone in the Sea of Marmara. However, this segment keeps its mystery due to its underwater location. Earthquake hazard and disaster mitigation studies in Marmara region are sensitive to detailed information on fault geometry and its stick-slip behavior beneath the western Sea of Marmara. We have started ocean bottom seismographic observations to obtain the detailed information about fault geometry and its stick-slip behavior beneath the western Sea of Marmara, as a part of the SATREPS collaborative project between Japan and Turkey namely MarDiM project “Earthquake and Tsunami Disaster Mitigation in the Marmara Region and Disaster Education in Turkey”. The target area spans from western Sea of Marmara to offshore Istanbul along the NAF. In the beginning of the project, we deployed ten short period Ocean Bottom Seismographs (OBSs) between the Tekirdag Basin and the Central Basin (CB) in September 2014. Then, we added five short period OBSs and deployed them in the western end of the Sea of Marmara and in the eastern CB to extend the observed area in March 2015. We retrieved all 15 OBSs in July 2015 and deployed them again in the same locations after data retrieve and battery maintenance.
From continuous OBS records, we could detect more than 700 events near the seafloor trace of NAF during 10 months observation period whereas land-seismic network could detect less than 200 events. We estimated the micro-earthquake locations using manual-picking arrival times incorporating station corrections. The tentative results show heterogeneous seismicity. The Western High (WH) and CB have relative high seismicity and the seismogenic zone was found to be thicker than the previous estimations done by other researchers. Our result clearly shows that the maximum depth of seismogenic zone is about 24 km beneath the WH and the western half of CB, and this depth suddenly decreases to about 15 km in the eastern half of CB. Our results also suggested that the dip angle of NAF is almost vertical or northward beneath WH, whereas it is about 80 degrees southward beneath the eastern CB and perhaps further decreases to 60 degrees towards the Kumburgaz Basin. These results suggest that some structural or frictional segment boundary is located around 28°E in the middle of CB.

Keywords: Ocean bottom seismographic observation, Sea of Marmara, Seismicity distribution

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