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Seafloor geodetic survey revealed partial creep of North Anatolian Fault at the western part of the Sea of Marmara, Turkey

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The North Anatolian Fault (NAF) is known to sequentially ruptured from the east to the west crossing the Turkish mainland in the past century, which periodically wreaked severe destruction. The latest failures are Izmit and Duzce Earthquakes (1999) just at the east bound of the Sea of Marmara. Thus, the Marmara region remains un-ruptured and is expected high seismic risk. The coupling condition of the fault plane controls the rate of stress accumulation and is critical for the risk assessment. Therefore, we applied seafloor geodetic technique to relevel the coupling condition of NAF beneath the Sea of Marmara, where space geodetic technique, such as GNSS or InSAR, cannot be applicable. Seafloor acoustic extensometers were employed to directly measure changes in a baseline length between a pair of instruments as roundtrip time. Applying appropriate correction for temperature of sea water on sound speed and for instrumental attitude on exact position of the acoustic element, the technique has a potential to resolve sub-centimeter movement.

The Western High is selected as a target area for the reasons that: no major branch fault is found to avoid dispersion of creep partitioning; fault trace on the seafloor is well identified to minimize the baseline length for installation; developed topographic trough suited for clearance of acoustic paths across NAF. We deployed five instruments, which alternately locate northern and southern side of NAF, just like a figure 'W'. Baseline lengths of the neighboring paths are roughly 1 km. Currently, ranging data of four baselines for 20 months since Sept. 2014 were recovered through acoustic data transfer and the measurement still continues. Although the depth of the Western High is only $\sim$700 m, temperature change is quite modest because of the dichotomy of density stratification in the water column. Temperature change among the instruments were nearly coherent and showed slight increase throughout the period. Attitude changes showed exponential decay, but is still visible even after 20 months. Taken together all of these information, we obtained change rate of each baselines and their projections or direction cosines to the fault strike were 9-14 mm/yr indicating right-lateral movement. There still remain a few mm/yr uncertainty in the slip rate, it is obvious that coupling rate of NAF at this site is roughly a half at least near the surface compared to the regional rate of 22-25 mm/year.

Looking at onshore GNSS data along a perpendicular line to NAF including the Western High, slight decay of displacement rate at northern and southern innermost sites compared to the regional rate gives some information on the depth extent of the partial coupling. We have extended two additional GNSS site along the line closer to NAF than above sites for more strong constraint on the depth extent in the future, which can be discussed with seismicity distribution obtained by repeated OBS survey.