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Partial creep revealed by seafloor geodetic observation along the North Anatolian Fault, beneath the Sea of Marmara

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The North Anatolian Fault (NAF) is a right-lateral strike-slip fault ranging 1200 km across the northern Turkey. Since the past century, rupture zones of major earthquakes (M >$\sim$ 7) are moving from east to west. The latest events were Izmit and Duzce Eqs. in 1999, close to Istanbul (100 km and 200 km distance, respectively). However, locking state of NAF in the Sea of Marmara, south of Istanbul, is little known because there are no on-land geodetic data such as GNSS and InSAR. In this study, we used "Direct-Path acoustic Ranging (DPR)" to measure creep state across NAF. DPR can directly measure roundtrip time between a pair of stations. Sound speed for time-distance conversion depends on ambient temperature, pressure, and salinity. Furthermore, the position of phase center of acoustic transducer slightly drifts due to the transient effect of coupling between instrument and sediment, which can be monitored with tiltmeter. After applying corrections for sound speed and transducer position, we obtain change in the baseline length between the pair of instruments. The instruments were installed at the Western High, which is located in the western part of the Sea of Marmara because no prominent branching fault exists. We installed five DPRs and kept repeated ranging for $\sim$2.5 years. At this site, about 10 +/- 5 mm/yr creeping of NAF was detected, which corresponds to roughly a half of the regional block motion of 25 mm/yr. In addition to direct measurement of NAF, we investigated the locking state of the fault together with on-shore GNSS data along the NAF surrounding the Western High. We found that the fault model incorporating DPR result can explain the GNSS data properly. Further interpretation on the locking state must be done with seismicity distribution revealed by concurrent OBS observation. These results may contribute to assessment of seismic hazard in the Marmara region, including Istanbul.

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