Locking Behavior of Main Marmara Fault in Western Turkey During Interseismic Period

Zeynep Yılmaz¹, Ali Özgün Konca², and Semih Ergintav³
¹Kandilli Observatory and Earthquake Research Institute, Boğaziçi University, Istanbul, Turkey (zeynep.yilmaz6@boun.edu.tr)
²Kandilli Observatory and Earthquake Research Institute, Boğaziçi University, Istanbul, Turkey (ozgun.konca@boun.edu.tr)
³Kandilli Observatory and Earthquake Research Institute, Boğaziçi University, Istanbul, Turkey (semih.ergintav@boun.edu.tr)

The North Anatolian Fault (NAF) produced multiple earthquakes of M>7 throughout the 20th century, while the part of NAF beneath Sea of Marmara did not rupture during this period. Analysis of the Main Marmara Fault's interseismic behavior, the most active branch of the North Anatolian Fault in this region, in terms of locking depth and fault slip rate is critical for evaluating the region's seismic risk with a population of more than 20 million, as it provides information about the seismic moment deficit that may release in a potential future earthquake.

In this study, we modeled the Main Marmara Fault's interseismic locking with realistic geometry and 3D structure including sedimentary basins, by implementing a 3D finite element approach and using interseismic GPS velocities. We have optimized the fits with GPS data by evaluating cases where each fault segment is constrained by a fault slip rate below a predefined locking depth ranging from 0 to 20 km. Preliminary models reveal that a difference in locking depth is required between the Western Marmara and the eastern end of the Ganos Segment entering the Sea of Marmara. This result, which is consistent with seismicity studies and other previous studies using 1D profiles shows that the strain accumulation under Western Marmara is less and that the locking depths or couplings are not similar in these two segments. For the Princes' Islands Segment, further analysis is required due to complexity in the GPS data. Recent earthquakes along Silivri also indicate that the strain accumulation is complex with most mechanisms showing significant thrust component. We have also calculated various possible strain accumulation patterns and compared the strain rate field around the Main Marmara Fault. Our results show that in most cases the change in the seismicity of each segment is consistent with the interseismic behavior associated with its fault locking.

(This research has been supported by Boğaziçi University Scientific Research Projects Coordination Unit. Project Number: 15022, 2019)