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Moment Tensor Inversion of Earthquakes in the Sea of Marmara and Surroundings: Restraining Bend between the Ganos Fault and the Main Marmara Fault

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In this study, focal mechanism of small to moderate size earthquakes in the Sea of Marmara and surroundings are analyzed to determine the deformation and stress regime of the Marmara region. The records of the earthquakes are obtained from the broadband seismic stations operated by Boğaziçi University Kandilli Observatory and Earthquake Research Institute National Earthquake Monitoring Center. We determine source mechanisms of 90 earthquakes with magnitudes ranging between Mw 2.7 to Mw 6.5 in the Sea of Marmara and surroundings from 2003 to 2015. The source parameters are calculated using the CMT inversion method developed by Kuge (2003).
The North Anatolian Fault (NAF) is one of the largest currently active dextral strike-slip fault forming the plate boundary between Eurasia and Anatolia. Although NAF is a transform fault along its entire length, the fault zone is associated with uplifts and depressions related to segmentation and bending. The most prominent active depressions are the three basins, over 1000 m deep, which are forming along its main strand in the Sea of Marmara (Wong et al., 1995; Okay et al., 2000; Le Pichon et al., 2001; Armijo et al., 2002). The first remarkable finding of this study is related with the segmentation and bending between the Ganos Fault and Tekirdağ Basin. The transpression is reflected in the morphology as the Ganos Mountain, a major zone of uplift, 10 km wide and 35 km long, elongated parallel to the transpressional Ganos Fault segment west of this bend (Okay et al., 2000). In the west, between the Ganos Fault and Tekirdağ Basin, along with the strike-slip faulting mechanism, the CMT inversion results show significant number of events having reverse faulting mechanism with NW trending compressional stress, which is consistent with the fault plane solution on the Ganos Fault, that of the 27 April 1985 Mürefte earthquake (M=4.4) located in the Ganos Mountain, that gives a reverse fault mechanism with a NE striking fault plane (Kalafat, 1995).
As for the Çınarcık Basin, the results indicate various types of focal mechanisms. Although the basin is dominated by strike-slip and normal faulting regime, we obtain events having reverse faulting mechanism that may result from the presence of a segmented fault system where restraining local stresses are developed.
In our study, the CMT inversion is mainly carried out using broadband records; but, for the cases where the near-source broadband seismometers are clipped especially during large earthquakes the moment tensor inversion is determined by using acceleration data. As such, the May 24th, 2014 Mw6.5 Gökçeada Earthquake is a case study where the results very well coincided with the solution given for this event. Besides the aftershocks with strike-slip mechanisms, several events showing predominantly normal faulting mechanisms were determined in the source region of the 2014 Northern Aegean earthquake.