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Fault Characterization in the Sea of Marmara (Turkey) Using OBS and Land Seismic Stations

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The fault segments of the North Anatolian fault (NAF) occurring between Tekirdag basin and Kumburgaz basin are investigated using 15 Ocean Bottom Seismic (OBS) stations. The OBS stations were deployed closely around the fault trace of NAF. During the observation period from September, 2014 until July, 2015 more than one thousand microearthquakes were determined. No uniform seismicity pattern was observed along strike and along dip of the fault segments in an area spanning 100 km from East to West of Marmara Sea. The western fault segments exhibit relatively higher and deeper seismic activity while the eastern segment show shallower and relatively lower seismic activity.

Integrating the first motion polarity data from the land based stations of Kandilli Observatory and Earthquake Research Institute (KOERI) with the polarity data acquired from the OBS stations the focal mechanisms of 173 micro-earthquakes were determined. Most of the fault plane solutions indicate predominantly strike-slip mechanism. Several clusters of events are identified along the E-W extending NAF. We derive a focal mechanism for the individual events whenever the number of the polarities are sufficient. In addition, simultaneous inversion of the polarities in a cluster are done to retrieve a stress tensor along with focal mechanisms of the individual events in a cluster.

A unique cluster of focal mechanisms was obtained from the events taking place in Western High (WH) region located between Tekirdag Basin (TB) and Central Basin (CB). Several features of this cluster are noticeable; 1) the site is the most seismically active part in Marmara Sea, 2) the site is the locus of the deepest events in the Sea of Marmara, 3) the shallower part of this segment is seismically less active, 4) two subgroups of P-axes of focal mechanisms exist; one oriented NW-SE and other oriented in N-S direction despite the proximity of the location of the events giving clues on the faulting dynamics. The N-S oriented P-axes which are close to vertical to the main trace of NAF are observed from the predominantly reverse faulting mechanism . Moreover, E-W oriented extensional features are observed from the normal faulting mechanisms with T-axes parallel to the main trace of NAF. Besides the high micro-earthquake activity, this site also generates relatively larger events for which CMT solutions are retrieved. The CMT inversion results point out fault parallel extension in the deeper part of the segment and predominantly strike-slip mechanism with a nodal plane parallel to the main trace of NAF in the shallower part of the fault segment.The locations of the strike-slip events along with the azimtuhs of their nodal planes implies that the ENE-WSW oriented Ganos fault segment extend towards WH and there meets with the E-W striking NAF segment extending between CB and WH.