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The Active Stress Structures in the Marmara Region

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Stress tensors with the aid of a large number of fault plane solutions provide important contributions for the evaluation of the seismotectonic setting of a region. In this study, earthquake activity between the dates of 02.09.2006 and 31.03.2011 at Eastern Ganos Offshore, Eastern Tekirdag Basin, Cinarcik Basin, Yalova Region and Gemlik Region, which are all located on the western branches of the North Anatolian Fault Zone, were analyzed using a current data set of fault plane solutions derived from a very dense seismic network. The earthquakes were selected with the following criteria; minimum local magnitude of 2.0, number of minimum P-wave first motion polarity of 10 and toleration of maximum misfit of 1. During the study 85, 75, 73, 102, and 63 source mechanisms were determined in the Eastern Ganos Offshore, Eastern Tekirdag Basin, Cinarcik Basin, Yalova Region and Gemlik Region, respectively. Through the determination of 9226 high quality P-wave first motion polarities for the selected 398 earthquakes, the number of average polarity per earthquake was 23. Average error depth, latitude, longitude, and GAP values were also obtained as 2.75 km, 0.98 km, 1.25 km and 63°, respectively. Furthermore, using the algorithm of Horiuchi et al. (1995), simultaneous focal mechanism solutions of individual earthquakes and recent stress regimes have been determined for the five clusters. As a result, it was found out that NW-SE trending transtensional stress structures leading mostly normal and oblique faulting systems are predominant in Eastern Tekirdag Basin, Cinarcik Basin, Yalova and Gemlik clusters. Nevertheless, Eastern Ganos Offshore Cluster was presented as a dextral strike-slip deformation system through the transition from normal to reverse faulting system.
Furthermore, 27.11.2013 (ML4.7), 07.06.2012 (ML5.1), 25.07.2011 (ML5.2) Marmara Sea and 16.08.2011 Gemlik Gulf (4.0) earthquakes were also analyzed. It was stated that the stress tensor solutions obtained using mostly small size earthquakes fit the source mechanisms of these three moderate size earthquakes. Consequently, in this research, a new and comprehensive approach to the fault geometries, present stress state, and seismotectonic structures of the Marmara Region have been proposed by a detailed analysis of the results of the large number of fault plane solutions of earthquakes using the densest seismic network of Turkey.