



Geology and seismotectonics of the North-Anatolian Fault in the Sea of Marmara: implications for seismic hazards

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Based on high-resolution multibeam and seismic reflection data recently collected and analysed in the frame of Marsite (New Directions in Seismic Hazard Assessment through Focused Earth Observation in the Marmara Supersite) EC FP7 Project, in conjunction with a large set of geophysical and geological data collected starting from 1999, we compiled a new morphotectonic map of the submerged part of the North-Anatolian Fault system (NAF) in the Sea of Marmara. Data analysis allowed us to recognize active fault segments and their activity at the scale of 10 ka, taking as stratigraphic reference the base of the latest marine ingression, which constitutes a clear marker in the sedimentary sequence of the Sea of Marmara. This is mainly due to the fact the Sea of Marmara was a fresh water lake during the Last Glacial Maximum, and switched to a marine environment when the global sea level reached to the -85 m relative to present day and crossed the Dardanelles sill during the transgression. The passage from lacustrine to marine environment is marked by a typical unconformity in high-resolution seismic profiles, which can be correlated over the entire Marmara basin.

According to the average recurrence time for major earthquake along the NAF, the time interval of 10 ka should include several earthquake cycle and is representative of the seismotectonic behavior of the fault at geological time scales. Given the relatively high deformation rates relative to in relative to sediment supply, most active tectonic structures have a morphological expression at the seafloor. This allowed us to correlate deformations from a seismic section to the adjacent. Fault strands not affecting the Holocene sequence were considered inactive. Three types of deformation patterns were observed and classified: almost purely E-W oriented strike-slip segments; NE-SW oriented trans-pressure structures; NW-SE trending trans-tensional features. Segmentation of the so-called Main Marmara Fault in the Sea of Marmara occurs along three main right-lateral oversteps, which delimit three major fault branches from east to west: the transtensive segment of Cinarcik; the Istanbul (East and West) segments; and the westernmost Tekirdag segment. For each segment, a quantitative morphometric analysis was carried out, in order to define prevailing deformation style and cumulative length. These data were used as inputs in empirical relationships to calculate the maximum expected Moment Magnitude for each NAF segment, obtaining values in a range from 6.82 to 7.14 for the Istanbul segment, and 6.85 and 7.08 for the Cinarcik and the Tekirdag segments, respectively. Such estimates are in agreement with earthquake historical record of the Sea of Marmara region.