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Monitoring of the Marmara Sea Seismicity (2014-2017) with Ocean Bottom Seismometers (OBS)

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The North Anatolian Fault (NAF) that defines the boundary between Anatolia and Eurasia, which is most important active strike-slip fault, not only because of its remarkable seismic activity between 1939 and 1999. Last earthquakes occurred in the Marmara region, western Turkey. The August 17, 1999 İzmit (Mw=7.4) and November 12, 1999 Düzce (Mw=7.2) earthquakes are the latest of a sequence of eight large earthquakes that progressively ruptured the North Anatolian Fault Zone in the 20th century, which broke almost the entire length of the NAF, excluding the segment in the Sea of Marmara.
The Marmara Sea region is one of the most seismic active regions in Turkey. The NAF is divided in two main branches in the Marmara Region. Northern branch is passing to the Gulf of İzmit and through to the northern part into the sea. On May 24, 2014 North Aegean Sea (Mw = 6.9) earthquake occurred took place at the westernmost point of the NAF.
The investigation of the seismicity of this region is very important because three major plates (Aegean, Anatolia, Eurasia) have boundaries in the Marmara Sea area. As a result, the seismic gap only part of the 1600-km-long NAF that has not ruptured for over 300 years according to trenching studies and it is located off Istanbul area in the Marmara Sea.
To consider the earthquake hazard and disaster mitigation, the detailed information about fault geometry and its stick-slip behavior beneath the Western Marmara Sea is very important. Therefore, towards the end of 2013 we started to operate a series of ocean bottom seismometer (OBS) observations to estimate the fault geometry from micro earthquake distribution. Totally, 15 OBSs were deployed on the seafloor starting from the Western Marmara. Approximately 3 years of data was collected from the three campaigns.
Western part of Marmara Sea showed that most of the micro-earthquakes we identified occurred along the main Marmara fault (MMF), although one of them could not be explained by the characteristic right-lateral strike-slip motion of the MMF. Our data indicate that the fault plane of the MMF is almost vertical. We identified a seismogenic zone that extends from 13 to 25 km depth through the upper and lower crust beneath the Western Marmara Sea.
The hypocenters showed distinct lateral changes along the MMF. Both the upper and lower crust beneath the Western High are seismically active. At the same time, beneath the Western High there is no micro-earthquake activity from the seafloor to 8 km depth, but under the eastern Central Basin the upper limit is at only about 5 km depth. The distribution of the upper limit of the seismogenic zone is consistent with the depth variation of the acoustic basement.
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Keywords: North Anatolian Fault; Marmara Sea; Ocean bottom seismometer; micro-earthquake; Central Basin