

Historical Earthquake Scenarios and Effects on the Ancient City of İstanbul (A.D. 478 - 1999)

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Active fault mapping is one of the most important subject in the active tectonic studies. The consistency of the active fault maps with the reality is curial for the settlements and socio-economic conditions. The Marmara region is one of the precious area where the longest duration settlement and civilization are observed along a fault system. The Marmara Sea and its surrounding area are unique on the earth which has the remarkable history of 1500 years in non-instrumental period. Because, İstanbul was the capital city of both Byzantium and Ottoman Empire and the historical records of İstanbul are reliable for this environment such as A.D. 1509 earthquake known as 'little apocalypse'. Although the active faults of the Marmara Sea have studied and mapped by many researchers, there are only three different main fault model suggested for the Marmara Sea. These are single fault model (Le Pichon et al., 2001), pull-apart model (Armijo et al., 2005) and horsetail model (Yaltrak, 2002; 2015). Yaltrak (2015) grouped the 38 destructive historical earthquakes according to their felt area for these three fault models in the Marmara region. In this study we have modelled the Modified Mercalli Intensities (MMI) of historical buildings and cross checked with damages on the related structure in order to investigate the consistency of fault pattern with historical earthquakes.

In this study three-stage evaluation has been made. In the first stage, three models that differ from each other were prepared on a database in commercial ArcGIS software. Mw values were calculated for each segment according to their lengths, seismogenic depths and 18 mm/yr accumulation by using the equation of Kanamori (1977). In the second stage, the 1:25000-scale geological map of the ancient city of İstanbul was revised according to Vs30 data of the İstanbul Metropolitan Municipality. The exact location of the historical constructions in the İstanbul have been plotted by using non-commercial high-resolution satellite images and archaeological maps. The third stage is the calculation of g-acceleration by using attenuation relation of Boore et al. (1993 and 1997). In order to calculate the MMI values for this study, we used the PGA-MMI equation of Bilal and Askan (2010). The MMI data sets produced in ArcGIS 10.2 utilized to generate the images by using the Generic Mapping Tool (GMT). In conclusion, one of the fault patterns (Le Pichon et al., 2001) has major contradictions with historical earthquake records and the other (Armijo et al., 2005) has incompatibilities with records as much as the first one. The remarkable correlation between the active faults and the damages of historical earthquakes on the constructions in ancient city of İstanbul is observed in the third model (Yaltrak, 2002; 2015).