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Collaborative Research: The North Anatolian Fault System in the Marmara Sea, Turkey - Insights from the Quaternary evolution of a multi-stranded transform

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The North Anatolian Fault (NAF), a major continental transform boundary, splays westward into three branches in the Sea of Marmara region of NW Turkey. The main northern branch passes only ∼20 km from Istanbul and has been the subject of intense investigation, The central branch enters the sea of Marmara in Gemlik Bay and extends westward along the southern shelf of the Sea of Marmara. However, its detailed offshore geometry as well as its level of seismic activity have remained controversial. Under the SoMAR, bilateral TUBITAK-NSF Project, two geophysical cruises were carried out in 2013 and 2014 to map the major sedimentary basins and shallow fault patterns of the southern shelf of the Marmara Sea. Including our 2008 and 2010 acquisition, we acquired 4,430 km of high-resolution multichannel seismic, sparker, multibeam bathymetric and CHIRP data. We used the new data to correlate our published late Quaternary stratigraphic age model across the outer shelf, and a ∼1/4 Ma horizon across the Inner Shelf, thus providing a chronology that can be applied to the tectonic history of the central branch. As it exits Gemlik Bay, the central branch itself diverges westward into strands in a fan pattern. A half dozen southern strands strike WSW and W, with one continuing onland near the Kocasu River delta between Bandırma and Mudanya, and others dying out offshore. The northern strand strikes WNW and splays again into the İmrali Ridge Fault and the Imrali Fault across respectively the mid-shelf and the shelf break. A middle fault, the Kapidag fault, is present between Kapidag Peninsula and Marmara Island.
Most of the faults increase their vertical component with depth, suggesting activity during Pliocene through Holocene time. The Kapidag fault and Imrali Ridge fault each exhibit between 1 and 2 km of vertical separation of acoustic basement. Late Quaternary rates of vertical separation on these faults can accumulate the total vertical component after Miocene time. Thus, steady-state activity is possible. Alternatively, the late Quaternary activity could represent reactivation. High-resolution CHIRP seismic profiles confirm that tilting is ongoing and that most of the faults offset the Last Glacial Maximum unconformity.

Keywords: Marmara Sea, North Anatolian Fault; central branch; strike slip fault; erosional unconformity, seismic hazard; transform fault;