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GONAF - A deep Geophysical Observatory at the North Anatolian Fault: Permanent downhole monitoring of a pending major earthquake

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The North Anatolian Fault Zone (NAFZ hereafter) is a right-lateral transform plate boundary between the Anatolian plate and Eurasia accommodating a relative plate motion of ∼25 mm/yr. Almost the entire fault zone has failed during the last century as a westward migrating sequence of destructive earthquakes leaving a very high probability of a forthcoming large event to the Sea of Marmara segments. This area did not host any M>7 earthquake since 1766. Therefore, listening to the Sea of Marmara segments at a very low detection threshold is required to address how the brittle deformation develops along a critically-stressed fault segment prior to a potential failure. GONAF-ICDP project has been developed to design a downhole seismic network surrounding the Sea of Marmara segments of the NAFZ deploying 300 m deep boreholes equipped with a chain of sensitive seismographs. Natural and city-induced noise is attenuated through the unconsolidated subsurface formation and therefore provides ideal boundary conditions for seismic monitoring within the intact rocks at greater depths. A typical GONAF borehole consists of 1 Hz vertical sensor at every 75 m depth increment and a combination of 1Hz, 2Hz and 15 Hz 3C sensors at 300 m depth. By now, three boreholes were successfully implemented in the Tuzla and Yalova-Çınarcık regions. The plan is to complete four more GONAF boreholes in 2014. Our preliminary results show that GONAF waveform recordings will broaden the magnitude range down to ∼M -1 in the target area providing a better characterization of seismically active features in time and space.