Geophysical Research Abstracts
Vol. 19, EGU2017-6743, 2017
EGU General Assembly 2017


# GONAF – A borehole Geophysical Observatory around the North Anatolian Fault in the Eastern Sea of Marmara

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The Marmara section of the North Anatolian Fault Zone (NAFZ) runs under water and is located less than 20 km from the 15-million-person population center of Istanbul at its eastern portion. Based on historical seismicity data, recurrence times forecast an impending magnitude M>7 earthquake for this region. The permanent GONAF Geophysical Observatory at the North Anatolian Fault has been installed around this section to help capture the seismic and strain activity preceding, during, and after such an anticipated event.
The GONAF observatory is currently comprised of seven 300 m deep vertical seismic profiling stations and four collocated 100 m deep borehole strainmeters. Five of the stations are located on the land surrounding the Princes Islands segment below the eastern Sea of Marmara and two are on the near-fault Princes Islands south of Istanbul. The 300 m boreholes have 1, 2, and 15 Hz 3-C seismometers near their bottoms. Above this are vertical, 1 Hz, seismometers at ∼210, 140, and 70 m depths. The strainmeter boreholes are located within a few meters of the seismometer boreholes and contain horizontal strain tensor sensors and 2 Hz 3-C seismometers at their bottoms. This selection of instruments and depths was done so as to ensure high-precision and broad-frequency earthquake monitoring and vertical profiling, all under low-noise conditions.
GONAF is the first ICDP-driven project with a primarily focus on long-term monitoring of fault-zone dynamics. It has already contributed to earthquake hazard studies in the Istanbul area in several ways. Combining GONAF recordings with existing regional seismic stations now allows monitoring of the NAFZ offshore Istanbul down to magnitudes M<0. GONAF also improves the resolution of earthquake hypocenters and source parameters, better defining local fault branches, their seismicity, and earthquake potential. Using its vertical distribution of sensors, it has directly measured depth-dependent seismic site-effects for ground shaking studies. GONAF is starting to address fundamental questions related to earthquake nucleation, rupture dynamics, temporal changes of material properties and strain.