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# Outline of the GONAF: A deep geophysical observatory at the NAFZ

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We will start drilling under the GONAF (Geophysical Observatory at the North Anatolian Fault) project in 2012, which is partly supported by ICDP.

The North Anatolian Fault Zone (NAFZ) is the most active plate-bounding strike-slip fault in Europe that follows an EW trend offshore through the Sea of Marmara within less than 20 km south of Istanbul. The fault has produced a series of large and devastating earthquakes during the 20th century starting in 1939 in eastern Anatolia and then systematically propagating westwards. The most recent M>7 earthquakes occurred in 1999 near Izmit and Duzce and temporarily produced accelerated seismic activity along the NAFZ south of the greater Istanbul area below the Sea of Marmara now representing a seismic gap of up to 150 km length. This part of the NAFZ is the only segment that has not been activated in the present series and may have accumulated a slip deficit of up to 4-5 m since the last event in 1766. Recent estimates indicate a 35-70% probability for the occurrence of a M>7 earthquake close to the population center of Istanbul by 2034. Owing to post-seismic stress redistribution after the 1999 Izmit earthquake the eastern part of the seismic gap along the Princes Islands segment is likely subjected to enhanced stresses.

The principal scientific objective is to study physical processes acting before, during and after the expected M>7 earthquake along the Princes Islands segment of the NAFZ by monitoring microseismic activity at significantly reduced magnitude detection threshold and improved hypocentral resolution. It is also intended to study wave propagation characteristics of a large earthquake using downhole seismic recordings at two different spots along the expected rupture and potentially close to its initiation point.

GONAF is focused on the installation of a deep borehole seismological observatory. Combining GONAF recordings with existing nearby surface arrays and regional permanent stations will allow to substantially improve monitoring conditions along the entire Princes Islands segment by lowering the magnitude-detection threshold by at least one order of magnitude thus allowing to study the spatial and temporal evolution of microseismic activity prior to the expected Marmara earthquake with unprecedented detail. GONAF will involve two vertical chains of downhole short-period and broadband seismometers allowing to record the entire frequency band of the seismic wavefield close to the fault from two different azimuths. Prior to the long-term installation of the seismological observatory we will use the GONAF boreholes to also measure heat and gas/fluid flow and to determine orientation and magnitude of local stresses for the first time in the entire Marmara region. This will in turn allow to test and calibrate existing stress models.

GONAF will give new insight into physical processes acting prior and potentially also during and after a large (M>7) earthquake at a major transform fault zone during the seismic cycle. Moreover, GONAF is expected to address fundamental questions related to rupture dynamics, temporal changes of material properties and to refine and calibrate ground shaking models and near-real time hazard assessment for the mega-city of Istanbul with its >13 million inhabitants.