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FaultLab: Results on the crustal structure of the North Anatolian Fault from a dense seismic network

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The North Anatolian Fault Zone (NAFZ) is a major continental strike-slip fault system, similar in size and scale to the San Andreas system, that extends ∼1200 km across Turkey from the Aegean coast on the west to the Lake Van region in the east. FaultLab is a multidisciplinary project that aims to better understand deformation throughout the entire crust in the NAFZ, in particular the expected transition from narrow zones of brittle deformation in the upper crust to broad shear zones in the lower crust/upper mantle and how these features contribute to the earthquake loading cycle. The project incorporates broadband seismology, satellite geodesy, structural geology and numerical modelling in order to give an unprecedented view of the dynamic state of the NAFZ in the vicinity of the devastating 1999 Izmit and Düzce earthquakes. This contribution will discuss the first results from the seismic component of the project, a 73 station network encompassing the northern and southern branches of the NAFZ in the Sakarya region. Deployed in May 2012, the Dense Array for North Anatolia (DANA) is arranged as a 6×11 grid with a nominal station spacing of 7 km, with a further 7 stations located outside of the grid. Receiver function analysis will provide estimates of bulk crustal properties, along with information regarding heterogeneity at depth (dipping interfaces/anisotropy). With the excellent resolution afforded by the DANA network, we will present results using the technique of teleseismic scattering tomography. The method uses a full waveform inversion of teleseismic signals coupled with array processing techniques to infer the properties and location of small-scale heterogeneities (with scales on the order of the seismic wavelength) within the crust. Images obtained using these methods will provide evidence for how the deformation is distributed within the fault zone at depth, providing constraints that can be used in conjunction with structural analyses of exhumed fault segments elsewhere, and models of geodetic strain-rate across the fault system. By linking together results from the complementary techniques being employed in the FaultLab project, we aim to produce a comprehensive picture of fault structure and dynamics throughout the crust and shallow upper mantle of this major active fault zone.