Geophysical Research Abstracts
Vol. 12, EGU2010-730-5, 2010
EGU General Assembly 2010

Surface Wave Phase Speed Models of the Crustal and Upper Mantle Beneath Turkey

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We investigated the crustal and upper mantle structure beneath Turkey using phase speed of the fundamental-mode Rayleigh waves. To determine the Rayleigh wave phase dispersion, the two-station method is employed to analyze vertical-component seismograms of 165 broad-band seismic stations in Turkey and surrounding areas. We used 289 teleseismic events with moment magnitude 5.5 and greater, and with focal depth shallower than 100 km occurred in the world between January, 2006 and December, 2008. The data is obtained from two national seismic networks operated by Boğaziçi University Kandilli Observatory and Earthquake Research Institute (KOERI), and General Directorate of Disaster Affairs Earthquake Research Department (ERI).

In the first step of the study, the path-average dispersion curves along the great circle for each event are determined using the conventional two-station technique. In the second step, Rayleigh-wave phase speed maps of the entire region of Turkey are obtained as a function of frequency using the LSQR algorithm.

The phase speed models are constructed in a period range from 30 to 160 sec. The fast phase speed anomalies are found in the western and southern parts of Turkey (particularly conspicuous in the north-western part; i.e., the Marmara Region) and the phase speed becomes slow in the eastern part in almost all phase speed models. In the eastern region, prominent slow anomalies are found in the short period range below 40 seconds, which corresponds to the depth of the crust and the uppermost mantle, while the faster phase speed anomaly becomes dominant in the longer periods, which sample the deeper part of the mantle.

We may explain the observed fast phase speed anomaly in the northwestern part of Turkey by the cooling of the upper mantle, which can affect the immersion of oceanic lithosphere of the Black Sea beneath southward margin of the Marmara region. The slow anomalies of phase speed in the eastern Turkey, may represent the presence of the conjugate strike slip fault system (EAFZ) and Bitlis thrust zone as well as partially molten litospheric mantle which can be inferred from the wide spread of young volcanism (< 2Ma). The previous local geological (i.e., heat flow, volcanism and tectonics) and seismological (i.e., Pn waves speed distribution, Sn waves attenuation) studies strongly support our results.

In order to make more detailed investigations of the crustal and mantle structure of Turkey, three-dimensional tomographic inversion will be performed to construct a 3-D shear wave speed model of Turkey using the same or extended data set in the future.