Geophysical Research Abstracts
Vol. 16, EGU2014-9077-1, 2014
EGU General Assembly 2014

3D Tomographic Imaging of the Crustal Velocity Structure beneath the Marmara Sea using Air-gun and Earthquake Data

Adil Tarancioglu (1,2), Argun H. Kocaoglu (3), and Serdar Ozalaybey (4)

(1) PhD Student, Department of Geophysics, Istanbul Technical University, Istanbul, Turkey (adil.tarancioglu@tubitak.gov.tr), (2) TUBITAK, Marmara Research Center, Earth and Marine Sciences Institude, Kocaeli, Turkey, (3) Department of Geophysics, Istanbul Technical University, Istanbul, Turkey (argun@itu.edu.tr), (4) TUBITAK, Marmara Research Center, Earth and Marine Sciences Institude, Kocaeli, Turkey (serdar.ozalaybey@tubitak.gov.tr)

The objective of this study is to investigate the local seismicity and obtain a detailed three-dimensional crustal velocity structure beneath the Marmara Sea in an area surrounding the North Anatolian Fault Zone (NAFZ) by tomographic inversion using both controlled-source (air-gun) and earthquake data. The tomographic inversion is carried out by using the local earthquake tomography code SIMUL2000. Two sets of seismological data, collected in 2006 (EOSMARMARA experiment) and 2001 (SEISMARMARA experiment), are re-processed and used in this study. A total of 441 high quality earthquakes and 452 air-gun shots recorded by a total of 53 Ocean Bottom Seismometers (OBS) are selected for the simultaneous inversion for velocity and hypocentral parameters. The OBS location and time-drift errors are identified from air-gun shot records by a grid search method and required corrections are made on the travel time data.

The initial (reference) velocity model and earthquake locations required for the three dimensional tomographic inversion are derived from the one-dimensional velocity model obtained by using the VELEST algorithm in which a subset of earthquakes are selected such that phase readings were made by at least five stations and maximum azimuthal gap was 180^o. The inversion results are checked for initial model dependence and the effect of damping factor. The reliability of the results is also evaluated in terms of derivative-weighted-sum, resolution-diagonal-elements values and checkerboard tests.

The hypocenter locations of the local earthquakes have been remarkably improved by the three-dimensional velocity model obtained from the tomographic inversion. The three-dimensional velocity model shows that the Tekirdag, Central and Cinarcik Basins are characterized generally by lower Vp (3.0 - 3.5 km/s) values and most of the earthquakes across these regions are located at the depths of 10 to 17 km, about 5 km deeper than those obtained from the one-dimensional reference velocity model. Also, the epicenters of these earthquakes are observed to coincide with the mapped surface trace of the NAFZ for this area. A few earthquakes with a hypocenter depth of about 15 km are identified in the west of Kumburgaz Basin where Vp values are higher (5.5 km/s). In contrast, the eastern part of Kumburgaz Basin is characterized by lower Vp (5.0 km/s) values and shows almost no apparent seismicity. Generally, low Vp values are obtained in the western part of Cinarcik Basin where the seismicity is predominantly located between the depths of 10 to 15 km. The highest Vp values (up to 6.5 km/s) are found to be near the northern coastline of the Armutlu Peninsula at a depth of 10 km.

Finally, the comparison of our tomographic cross-sections with the interpreted seismic reflection sections from previous studies shows a high correlation down to a depth of 12 km. Future work will involve further investigation of deep structures with the wave propagation modeling using the finite-difference method.