Journal of Asian Earth Sciences 75 (2013) 36–45

Contents lists available at SciVerse ScienceDirect

Journal of Asian Earth Sciences

journal homepage: www.elsevier.com/locate/jseaes

# Crustal thickness of Turkey determined by receiver function

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## ARTICLE INFO

*Article history:*
Received 24 July 2012
Received in revised form 14 June 2013
Accepted 27 June 2013
Available online 11 July 2013

*Keywords:*
Receiver function
Moho discontinuity
Crustal thickness
Turkey

## ABSTRACT

Two-hundred and sixty-seven teleseismic events with a moment magnitude greater than 5.5 which occurred between January 2005 and October 2010 were analyzed to determine the Moho depth variation beneath Turkey by using the Receiver Function (RF) technique. The RF technique was applied to 120 broadband seismic stations, which were already deployed in the area permanently by the Kandilli Observatory and Earthquake Research Institute (KOERI) and the Disaster and Emergency Management Presidency (AFAD). The RFs were stacked considering back-azimuth, slowness and waveform similarities to enhance the signal/noise ratio. The genetic algorithm (GA) was used to obtain both 1-D shear-wave speed model and the Moho depth beneath each seismic station. A data set consisting of 112 shear-speed models derived from RFs revealed the crustal structure of Turkey. For imaging, several 2-D profiles of depth-migrated RFs were constructed to delineate the fine crustal structure. The Moho discontinuity is clearly seen on all profiles and the mid-crustal velocity discontinuity within the crust is observed in some profiles. The depth of the Moho varies between 24 and 48 km. The thinnest crustal thickness is located on the coast of Western Turkey, and the deepest Moho boundary is observed in Eastern Turkey. The shear wave velocities vary between 4.0 km/s and 4.5 km/s in the uppermost mantle beneath Turkey.

## 1. Introduction

The teleseismic RF technique is an efficient seismic tool for imaging discontinuities at crustal and upper mantle depths beneath broadband seismic stations (Langston, 1979; Owens and Zandt, 1985; Ammon, 1991). The RF technique was used to obtain the shear-wave speed structure and the Moho discontinuity depth beneath Turkey. In this technique, teleseismic events are used and teleseismic signals include information about source time functions, local structures beneath seismic stations and path effects. The information about the local structure beneath a seismic station is determined by removing the source and path effects.

Turkey is one of the most seismically active areas located in the Alpine–Himalayan belt. The tectonic state of the region is explained by continental collision and subduction. In the Early Miocene–Late Oligocene, the collision of Arabia with Eurasia occurred along the Bitlis–Pontide belt resulting in the closure of the Bitlis Ocean, a part of the southern Tethys (Faccenna et al., 2006). Fig. 1 shows that the northward motion of Arabia and collision with Eurasia caused westward movement of Anatolia that produced the North Anatolian Fault Zone (NAFZ) and the East Anatolian Fault Zone (EAFZ) (Şengör and Yılmaz, 1981). Kinematic studies show that the Arabian Plate moves N-NW at about 20 mm/a and the African Plate at about 10 mm/a (Reilinger et al., 1997). The NAFZ that forms the northern boundary of the Anatolian plate is a right lateral strike-slip fault and runs for about 1500 km from eastern Anatolia to the Aegean Sea where it splits into several branches (Barka and Kadinsky-Cade, 1988). Geodetic data indicate that the present-day motion of Anatolia with respect to Eurasia is almost totally accommodated by the NAFZ (Reilinger et al., 1997; McClusky et al., 2000). It is commonly agreed that the NAFZ follows the Neotethyan suture along the northern margin of the Anatolian Plate (Biryol et al., 2011). The left lateral movement along the Dead Sea Fault Zone accommodates the motion between the Arabian and African plates (Westaway, 1994). The Dead Sea Fault Zone (DSFZ) connects the sea floor spreading in the Red Sea with the north border of the Arabian Plate and it is important for the Cyprus Arc tectonics. The Central Anatolian region (CA) is a region that is bounded by the NAFZ to the north and EAFZ to the southeast, and that extrudes westward along these structures (Bozkurt, 2001). Western Anatolia is characterized by N–S extension and related formation of grabens bounded by roughly E–W striking normal faults (Taymaz et al., 1991). These tectonic processes are associated with high seismicity and a complex crustal structure in Turkey showing significant variation from west to east.

Herein an attempt is made to determine the crustal thickness (Moho depth) beneath Turkey and shear-wave velocities of the

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1367-9120/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jseaes.2013.06.016

**Fig. 1.** Simplified tectonic map of Turkey and surrounding area. Lines show major faults and black arrows indicate plate motion relative to Eurasia. EAFZ; East Anatolian Fault Zone and NAFZ; North Anatolian Fault Zone. The fault data are from Şaroğlu et al. (1992).

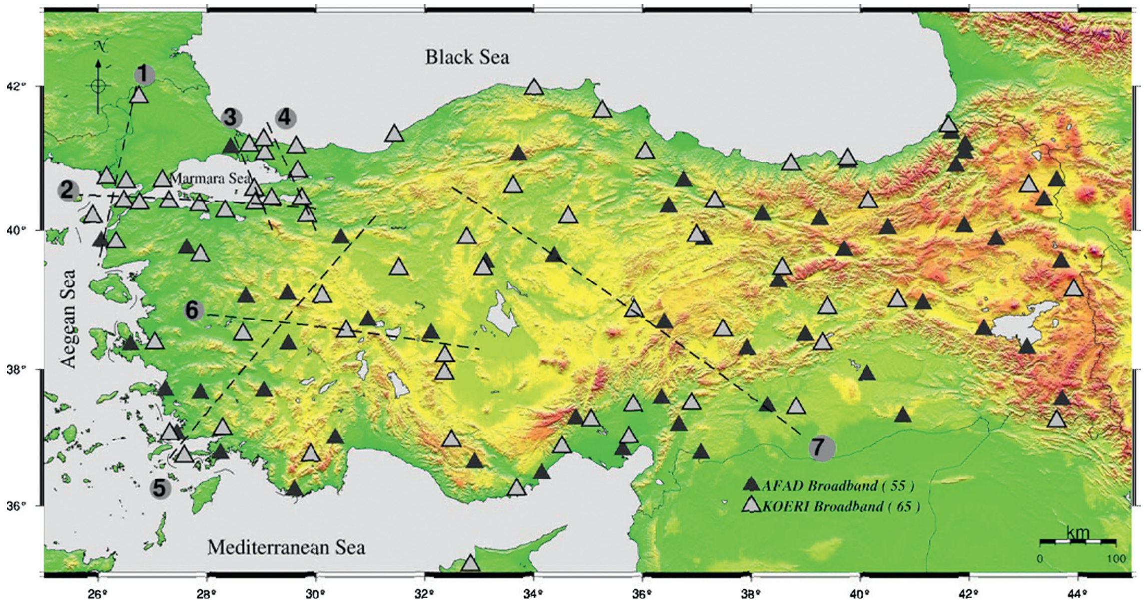

**Fig. 2.** Map of seismic stations used in this study. Black and gray filled triangles show the locations of broadband stations operated by AFAD and KOERI respectively. Numbered lines indicate the profiles for the 2-D receiver function images.

crust and uppermost mantle. Determination of the detailed structure of the crust and uppermost mantle is one of the most important issues in geophysics; and Turkey and surrounding area deserves attention due to a complex tectonic structure. There are some previous RF studies that determined the Moho and 1-D crustal velocity structure for Turkey (e.g. Saunders et al., 1998; Çakır et al., 2000; Zor et al., 2003; Çakır and Erduran, 2004; Angus et al., 2006; Zhu et al., 2006; Zor et al., 2006; Özaçar et al., 2008; Erduran, 2009; Tezel et al., 2010; Çakır and Erduran, 2011). The widespread and well-equipped seismic network and newly