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Lithosphere-asthenosphere velocity structure along the Transmed VII section (Moesian platform – Aegean Sea)

Скоростна структура на литосферата и астеносферата по профила Трансмед VII (Мизийска платформа – Егейско море)

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Introduction

Geodynamics of the Balkan Peninsula is very complex and there is no single hypothesis about the evolution and the deep structure of the region. Several studies of the crustal and upper-mantle structure of Europe have been performed in the last decades (P- and surface waves tomography, tomography of cross-correlation of seismic noise, receiver function, thermal or gravity modeling) but the results about the Balkan Peninsula are not so detailed and some of the obtained features in the region are not interpreted. Different studies for parts of Balkan Peninsula are too limited in space to explain undergoing large scale processes in the whole area. Additional difficulties in the interpretation of the results are connected to the discrepancy in different features outlined by various authors.

This study supplies the lithosphere-asthenosphere S-wave velocity structure along the European part of Transmed VII section – Fig. 1 (Cavazza et al., 2004) adding new details to the geological section and extending the section to the depth of 320 km. The lithosphere-asthenosphere system along the African part of the section is given by ElGabry et al. (2013).

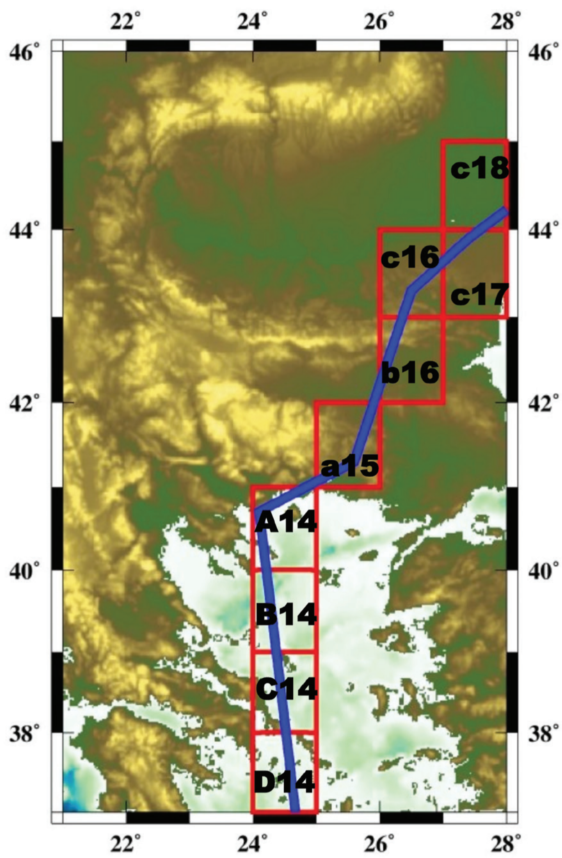

Fig. 1. Map of the study region. Thick blue line delineates Transmed VII. Cells along Transmed VII are evidenced by red rectangles, labeled in black, delineating the cellular structures taken from Raykova and Panza (2015).

Methods

The S-wave velocity structure along Transmed VII is derived from Raykova and Panza (2015) and Raykova et al. (2018). The location of the profile is shown in Fig. 1. Velocity models for cells sized 1 degree per 1 degree were obtained using the non-linear inversion of local dispersion curves for each cell. The location and the label of the cells are shown in Fig. 1. Multiple cellular solutions are analyzed by local smooth optimization LSO (Boyadzhiev et al., 2008) to select a single cellular solution, considered, as a rule, the representative one. Additionally representative solutions are revised according with published geophysical information about seismicity distribution, crust thickness and heat flow.

Results

LSO gives a mathematical selection of the representative cellular model. For cells a15, B14, and D14 the representative models are replaced with models that have similar mantle structure but fit bet-

Fig. 2. Structure model along the Transmed VII section: *a*) geological section (modified after Papanikolaou et al., 2004); *b*) S-wave velocity section (segments along Transmed VII are labeled as the cells in Raykova and Panza, 2015); velocities values of crustal layers are in black and velocity ranges are omitted to avoid crowding of numbers; velocity values of mantle layers are in white; grey rectangles indicate the uncertainties in layers definition marking layers transition; red circles denote the hypocenters according to ISC (2005); dashed green lines delineate the Moho boundary depth range according to published data; *c*) interpretative section combining geological and geophysical models.

ter the depth range of the Moho boundary, as given by Grad et al. (2009) and Tesauro et al. (2008). The obtained Moho depth in each representative cellular model along the Transmed VII agrees with regional studies (Boykova, 1999; Tirel et al., 2004). The major geological features along Transmed VII are shown in Fig. 2(a); juxtaposed cellular velocity models along the profile are shown in Fig. 2(b). Fig. 2(c) shows the overlapping of geological and geophysical structures. The low velocity layer (4.0–4.3 km/s) at depths of about 80–120 km, common to all models obtained by non-linear inversion for cell b15, may be interpreted as the deep magma reservoir for the abundant magmatism in the Srednogorie, Strandzha and Sakar mountains. Velocity models of cells d17, c17, c16, b16 and b15 have well-defined lithosphere and asthenosphere layers as lithosphere thins from ~130 km in cell d17 to ~70 km in cell b15. The lithosphere in South Rhodopes and in North Aegean Sea it seems to be fragmented or delaminated. The deep high velocity body in cell A14 below depths of ~170 km may be interpreted as a remnant of old subduction according to the results reported by Shanov et al. (1992). This hypothesis is supported by the negative values of Bouguer anomaly (Trifonova et al., 2012) in the whole cell. The high velocity mantle layer (4.6–4.8 km/s) in cell B14 at depths between 80 and 140 km is bounded by layers with relatively low velocities up to 4.6 km/s and can be also interpreted as non-assimilated lithospheric remnant from a paleosubduction (Papadopoulos, 1997). Magmatism in South Rhodopes and North Aegean Sea has a relatively shallow reservoir with depth between ~25 km and ~75 km and S-wave velocity in the range 4.0–4.3 km/s. In cell D14 is visible a part of the present-day subduction of the high velocity African plate (4.5–4.8 km/s) at depths below ~100 km, marked by intermediate-depth hypocenters.

Conclusions

S-wave velocity models reaching depth of ~320 km along the section Transmed VII, from Moesian platform to the south Aegean Sea supply new details about the lithosphere-asthenosphere structure in support of the geological profile by Papanikolaou et al. (2004).

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