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Lithospheric structure of the Eastern Mediterranean

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The eastern Mediterranean basin is tectonically complex. The present day stress field is controlled by the Africa-Eurasia convergence, the collision between the Arabia and Eurasia and the displacement of the Anatolian-Aegean microplate. The Ionian Sea represents a foreland to the Mediterranean Ridge, its evolution is consequently mainly related the active subduction along the Hellenic arc. The early evolution of the Levantine Basin in the easternmost Mediterranean is closely related to the history of the Neo-Tethys. Plenty of studies have attempted to characterize the evolution of the lithospheric structure of these regions, however, nature and thickness of the crust and the mantle lithosphere is still debated. In this project, we calculated new high resolution Rayleigh wave phase velocity maps using surface wave tomography using an unprecedentedly large number (200.000) of fundamental mode dispersion curves. For the first time, broad band waveform data, from the Egyptian National Seismological Network (ENSN) have been combined with the available data from IRIS and WebDC in order to ensure a good path coverage especially for the southern part of the eastern Mediterranean. We aim to determine what type of crust (oceanic or deformed continental) underlies the individual basins of the eastern Mediterranean, how shear wave velocities vary in the lower crust and upper mantle through the region, and whether the Vp/Vs ratio is indicative of lithospheric deformation. In order to examine the variability of the crust and the mantle lithospheric structure of the eastern Mediterranean, we constructed broad band local phase-velocity dispersion curves for the Levant Basin (deformed continental) and the Ionian Sea (oceanic). Each local dispersion curve is inverted individually for 1D shear wave velocity model using a newly implemented Particle Swarm Optimization (PSO) algorithm. In order to minimize the trade-off between the crustal velocities, mantle velocities and the crustal thickness, we constrained our inversion with an accurate local P-wave initial model. The P-wave velocity models have been calculated from two seismic refraction profiles recently recorded at Levant Basin and the Ionian Sea. The results indicate a Moho depth of about 22 km and 13.5 km beneath the Levant and the Ionian Basin, respectively. A shallow asthenosphere is highly pronounced beneath the Levant Basin, whereas the higher shear-velocity beneath the Ionian Sea indicates a thick oceanic lithosphere. The Vp/Vs ratio for the crust and upper mantle is then calculated for both locations. The issue about the continental or oceanic nature of the crust beneath the Levant basin is still a matter of discussion. In the Ionian Sea a thin oceanic crust is mapped.

Key words: phase velocity, seismic refraction, surface waves inversion, particle swarm optimization, Ionian Sea, Levant Basin