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An Integrated Study for the Seismotectonics of Eastern Mediterranean Region

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Eastern Mediterranean is a unique setting where crust-mantle interractions can be studied, especially along the Hellenic and Cyprus subduction zones. Two subduction fronts are separated by N – S oriented tear from the west of Cyprus up to the Antalya Bay. The discontinuous nature of Cyprus and Hellenic subduction zones is an important question to be addressed. Furthermore, the response of the overriding crust to this complex tectonic setting has not been studied. In this study we aim to answer these questions using available seismological data.

We discuss the mechanics of this transition between two subduction zones by studying the seismic velocity structure from teleseismic tomography, seismicity and the earthquake focal mechanisms in the region. There are observations that the geometry, kinematics and dynamics of the subducting plates with overlying mantle structure are correlated with the surface topography, GPS, volcanism and heat flow measurements in the region.

In that regard, we computed the focal mechanism solutions of ∼60 earthquakes M>4.4 between the depths of 10 and 140 km using regional waveforms. We attempt to interpret these mechanisms and seismicity distribution with an improved 3-D teleseismic P-tomographic model. The high resolution tomographic model shows the details of discontinuity between the Hellenic and Cyprus subductions. Earthquake mechanisms and the tomographic model show that in the transition zone between Hellenic and Cyprus slabs, along the Antalya Bay, a piece of the slab subducts toward northeast consistent with the prior kinematic models based on GPS velocities. In addition, some of the reverse mechanisms show intra-slab deformation and fragmentation while strike-slip earthquakes show a transitional character of the zone between two subduction fronts. In the west of Isparta Angle, we observe significant number earthquakes with normal mechanisms. The strike directions of these events are oriented E-W in the west, near Gökova Bay terminating with events with N-S directions in the east. This zone of extension sits on top of a 100 km deep low velocity zone in a tear zone of the Hellenic slab. This extensional zone and the low velocity mantle structure beneath are likely related to upwelling of astenospheric material along a slab tear. The correlation between tomographic images and geomorphology in the Isparta Angle also indicate that the active tectonics is significantly influenced by the mantle dynamics. Our study shows that the seismic structure and earthquake mechanisms reveal information about the relation between the subduction and the deformation of the Anatolian Plate.