Anisotropy and Mantle Kinematics in the Eastern Mediterranean Region based on Shear Wave Splitting Measurements, Numerical Models and P-wave Tomography

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Upper mantle dynamics (e.g. subduction processes, slab roll-back, slab tearing and mantle upwelling) impact eastern Mediterranean region tectonics but a detailed understanding of the acting forces has remained elusive. Further progress requires more accurate measurements not just of the surface kinematics (from GPS) but also of indirect indicators of kinematics throughout the lithosphere and convecting upper mantle from seismology. A robust quantification of the magnitude, location and orientation of seismic anisotropy is a primary source of information to provide constraints on tectonic processes of the formation and evolution of the Anatolian Peninsula and the surrounding regions. Direct shear-wave splitting measurements in the Aegean to revealed mostly NNE-SSW oriented fast polarization directions, perpendicular to the trench and parallel to the mantle flow induced by the roll-back and large time delays (1.15-1.62 s) in the upper mantle. In southwestern Turkey the FPDs are more confusing and probably related to the tearing of the slab in the upper mantle underneath this region. With complex non-steady state 3D geodynamic modelling, the plate movement, mantle flow, anisotropy and SKS splitting parameters for the last 20-30 Ma in the regional subduction system of the eastern Mediterranean and Anatolia were calculated. The model shows that tearing underneath southwestern Turkey, a break-off in the collitional regime of eastern Anatolia as well as the retreat of the slab in the Aegean influence on the strength and direction of the mantle flow and anisotropy. At last a P-wave tomography study of the Eastern Mediterranean region, focusing on the upper mantle with a large data set was done. Since anisotropy is present in the region especially due to the active subduction system, travel times were corrected by including anisotropy as an aprori constraint, from the numerical model and SKS splitting parameters. In isotropic inversions as well as the ones corrected for anisotropy, tears in the northern Hellenic slab, underneath southwestern Turkey and in the Cyprian slab can be seen. Spatially large first order velocity perturbations are stable and similar in isotropic and anisotropy corrected models. But differences up to 2% and small geometrical discrepancies between the models show the importance of including anisotropy to P-wave