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Numerical simulation of 3D mantle flow in subduction systems in relation to seismic anisotropy beneath eastern Mediterranean and Anatolia

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Seismic anisotropy is a key parameter in understanding plate movements in relation to the past/present deformation styles, and it is usually controlled by the mantle flow patterns as a consequence of dynamic interactions between a relatively buoyant and dense subducting oceanic plate and the surrounding mantle. A proper modelling of mantle flow in subduction systems will help our understanding of its source, strength, and evolution in time. This study examines the evolution of splitting parameters as one of the most well established measure of seismic anisotropy and their source for the last 30Ma based on a 3D dynamic model, performed for the eastern Mediterranean and Anatolia. Our model setting is chosen to be as much similar to reality as possible as it consists of an active and fast moving Anatolian micro-plate, slow moving African and Arabian plates and an oceanic plate in between. The retreat of the slab in the Aegean, the alleged tear in the subducting slab close to the Cyprian trench and the break off in the slab in Eastern Anatolia are considered in our modelling study in order to see their influence on mantle flow and the splitting parameters. The synthetically calculated fast polarization directions (FPDs) mostly showed a decent matching with those inferred from previous seismological observations that mainly depend on SKS splitting measurements. Regions of similarities between FPDs measured from synthetic and observed shear waves mostly indicate N-S to NE-SW orientations of fast shear waves, which are parallel to the extension and in general perpendicular to the trench. Pattern of FPDs seems to be more complex nearby the trench. Our modelling results suggest that the development of tear in the African slab and the detachment of Arabian plate (break-off) appear to have a significant influence on the FPDs. The mantle flow through the tear close to Cyprus and the break off in the east can be identified clearly, despite their recent appearances. A circular pattern around the edges of the slab can be observed as well as disruptions of the overall general fast polarization direction due to the flow through the tear in the slab.