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Investigation of Mantle Kinematics beneath Hellenic-Subduction Zone by using Teleseismic Direct Shear Waves

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Direct shear-wave splitting measurements based on the Reference Station Technique in the southern Aegean Sea revealed significant seismic anisotropy. The technique overcomes possible contamination from the source–side anisotropy on direct S-wave signals recorded at a station pair by maximizing the correlation between the seismic traces at reference and target stations after correcting the reference stations for known receiver-side anisotropy and the target stations for arbitrary splitting parameters probed via a grid search. We initially determined receiver-side anisotropy derived from SKS splitting measurements performed at four broadband stations. Following the bootstrap approach, in which only these four stations with well-constrained SKS splitting parameters are used as seeds to determine the splitting parameters of seismic stations of the EGELADOS temporary network in an iterative manner, we obtained splitting parameters at 35 stations with good-quality S-wave signals extracted from 82 teleseismic events. The fast polarization directions (φ) show a general trend of NNE-SSW orientation that ranges from 5.8° to 51.8°. Two stations in the west close to the Hellenic Trench and one in the east show N-S oriented fast polarizations. In the back-arc region three stations exhibit NE-SW orientation. Split time delays (δt) vary between 1.0s and 1.6s. Employing direct S-waves enabled more stable and reliable splitting measurements, with an average of 46 individual measurements. The overall fast polarization variations tend to be similar to those obtained from previous SKS splitting studies in the region but indicate a more consistent pattern. Splitting analyses on direct shear waves resulted in larger split time delays compared to the previous studies, possibly because they travel along a longer path in the same anisotropic structure. Observed differences between direct shear waves-derived (this study) and previous SKS splitting measurements could be due to the fact that S-waves propagate by sampling a broader zone in the upper mantle as well as anisotropy measurements based on insufficient number of individual SKS splitting measurements reported in earlier studies. Very consistent NNE-SSW directed anisotropic directions imply a dominant asthenospheric source due to the mantle flow exerted by the retreat of the African lithosphere along the Hellenic Trench.