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Non-double-couple mechanisms of deep earthquakes caused by intra-slab seismic anisotropy

V. Vavrycuk

Geophysical Institute, Academy of Sciences of the Czech Republic, Prague (Email: vv@ig.cas.cz)

The paper contributes to a long-lasting debate about the nature of non-double-couple (non-DC) mechanisms of deep-focus earthquakes. So far the non-DC mechanisms have been mainly attributed to complex shear faulting at non-planar faults and to the errors of the moment tensor inversion due to unmodelled path effects. The paper brings evidence that a substantial part of the non-spurious non-DC mechanisms originates in seismic anisotropy in slabs. This origin has so far been overlooked and not fully recognized. From the moment tensors of deep earthquakes in the Tonga subduction zone, the intra-slab anisotropy has been estimated to have a strength of 5-7% for P waves and 9-12% for S waves. The anisotropy is oriented according to the orientation of the slab and is probably caused by an alignment of anisotropic minerals such as wadsleyite, ringwoodite or others under the stress acting in the slab. In accordance with observations, anisotropy generates no or very small ISO components. The correlation between the observed CLVD and the CLVD predicted by anisotropy increases with increasing accuracy of the moment tensors and attains a value of 0.77 for the best-determined moment tensors reported in the Harvard centroid moment tensor catalogue.