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Plate-tectonic view of European mantle lithosphere assembled from rigid microplates with inherited seismic anisotropy

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We model three-dimensional seismic anisotropy of the mantle lithosphere from anisotropic parameters of teleseismic body waves. We invert jointly shear-wave splitting parameters and P residual spheres based on data of dense networks of temporary and permanent stations in four European regions ranging from the Variscan belt to the Baltic Shield. Changes in orientation of the large-scale anisotropy, caused by systematic preferred orientation of olivine, identify boundaries of domains of mantle lithosphere. Individual domains are characterized by a consistent large-scale orientation of anisotropy approximated by hexagonal or orthorhombic symmetry with generally inclined symmetry axes. The domains are separated by mapped tectonic boundaries (sutures), which cut the entire lithosphere. Besides the change of anisotropy orientation at domain boundaries, we often observe a change of the lithosphere and/or crust thicknesses. We do not detect any fabric of the mantle lithosphere, which could have been produced by a collision of microcontinents in a volume detectable by large-scale seismic anisotropy. The observations of consistent anisotropy within individual blocks of the mantle lithosphere reflect frozen-in olivine preferred orientation, most probably formed prior to the assembly of microcontinents that created the modern European landmass. Therefore, our findings support a plate-tectonic view of the continental lithosphere as a mosaic of rigid blocks of the mantle lithosphere with complicated but relatively sharp contact zones. These contacts are blurred by the easily deformed overlying crust terranes.