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Patchwork structure of continental lithosphere captured in 3D body-wave images of its anisotropic fabrics

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Seismic anisotropy, modelled from propagation of teleseismic longitudinal (P) and shear (S/SKS) waves, provides unique constraints on tectonic fabrics and character of past and present-day deformations of the continental lithosphere in different tectonic environments (e.g., Babuška and Plomerová, Solid Earth Sci. 2020). We evaluate body-wave anisotropic parameters (directional variations of velocities or shear-wave splitting) in 3D and invert for three-dimensional structure of the upper mantle (Munzarová et al., GJI 2018) with no limitation imposed on the symmetry axis orientation into the horizontal or vertical directions. Resulting models of the continental lithosphere are based on data from several passive seismic experiments in Archean, Proterozoic and a variety of Phanerozoic provinces of Europe. We emphasize the importance of the three-dimensional approach of modelling anisotropy to be able to detect tilts of symmetry axes in individual domains of the mantle lithosphere. The extent of the domains is delimited by changes in orientation and strength of anisotropy. Assuming only azimuthal anisotropy, similarly to only isotropy, may create artefacts and lead to spurious interpretations (e.g., VanderBeek and Faccenda, GJI 2021). Prevailingly sub-horizontal preferred orientation of olivine, the most abundant mantle mineral, arises from mantle convection in newly formed oceanic lithosphere on both sides of the mid-oceanic ridges. Systematically oriented dipping fabrics in domains of the continental mantle lithosphere reflect series of successive subductions of ancient oceanic plates and their accretions enlarging primordial continent cores. Consequent continental break-ups and assemblages of wandering micro-plates preserve "frozen" anisotropic fabrics and create patchwork structures of the present-day continents.