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High-resolution tomographic models of the upper mantle in various tectonic provinces - the standard isotropic approach and a novel anisotropic advancement

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Teleseismic body waves recorded during passive seismic experiments allow us to investigate isotropic velocities of the Earth's upper mantle in a great detail, on scales of tens of kilometres, by means of the standard high-resolution travel-time tomography. Nowadays, tomographic exploration of anisotropic properties of the mantle becomes realistic as well. Novel code AniTomo enables a simultaneous inversion of travel-time residuals of teleseismic P waves for 3D distribution of isotropic-velocity perturbations and anisotropy in the upper mantle (Munzarová et al., in preparation), assuming a weak hexagonal anisotropy with symmetry axes oriented generally in 3D. The code represents a step further from modelling the upper mantle either under the assumption of purely isotropic seismic-wave velocities (e.g., Sandoval et al., Geophys. J. Int. 2004; Karousová et al., Geophys. J. Int. 2013; Silvennoinen et al., Solid Earth 2016) or from modelling the mantle lithosphere as homogeneously anisotropic blocks (e.g., Babuška et al., Phys. Earth Planet. Int. 1993; Šílený and Plomerová, Phys. Earth Planet. Int. 1996; Vecsey et al., Tectonophysics 2007).

We compare tomographic models of anisotropic velocities of the upper mantle with results from independent studies, particularly SKS-wave splitting and directional analysis of P-wave travel-time residuals, as well as with models of purely isotropic-velocity perturbations in different tectonic provinces. First, in Precambrian northern Fennoscandia, based on data from passive seismic experiment LAPNET (2007 - 2009), and second, in the Variscan Bohemian Massif in the Phanerozoic part of Europe, exploiting data from series of passive experiments in the region. The isotropic-velocity components from the anisotropic tomography are close to the results from the purely isotropic inversion. The anisotropic parts of the models are compatible with inferences from independent modelling of seismic anisotropy in the mantle lithosphere.