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Seismic anisotropy of the upper mantle beneath Fennoscandia - Preliminary results of anisotropic tomography with novel code AniTomo

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Seismological investigations of the continental mantle lithosphere, particularly its anisotropic structure, advance our understanding of plate tectonics and formation of continents. Orientation of the anisotropic fabrics reflect stress field during the lithosphere origin and its later deformations. We process teleseismic body waves recorded during passive seismic experiments SVEKALAPKO (1998-1999) and LAPNET (2007-2009), deployed in the south-central and northern Fennoscandia, around the contact of the Archean and Proterozoic parts of the shield, to retrieve both anisotropic and isotropic velocity images of the upper mantle.

Standard isotropic teleseismic P-wave tomography distinguishes two major regions of the mantle lithosphere in the northern part of Fennoscandia, boundary of which follows the surface trace of the Baltic-Bothnia Megashear Zone (BBZ). Apart from that, joint interpretation of lateral variations of anisotropic P- and SKS-wave pattern detected domains of mantle lithosphere with differently oriented anisotropic fabrics within those two regions (Vecsey et al., Tectonophysics, 2007; Plomerova et al., Solid Earth, 2011). The retrieved anisotropy reflects fossil fabrics of the mantle lithosphere (Babuska and Plomerova, Phys. Earth Planet. Int., 2006). The contact of the Proterozoic and Archean Fennoscandia appears as a broad transition in the south-central Fennoscandia (Vecsey et al., Tectonophysics, 2007), while the contact seems to be more distinct towards the north.

We have developed a novel code (AniTomo) that allows us to invert relative P-wave travel time residuals for coupled isotropic-anisotropic P-wave velocity models assuming weak hexagonal anisotropy with symmetry axis oriented generally in 3D. The code was successfully tested on synthetic data and here we present results of its first application to real data. The region of Fennoscandia seems to be a right choice for the first calculation of anisotropic tomography with the new code as this Precambrian region is tectonicly stable and it has thick anisotropic mantle lithosphere (Plomerova and Babuska, Lithos, 2010) without significant thermal heterogeneities.