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Models of the seismic crustal anisotropy beneath the East European Craton and adjacent Palaeozoic terranes in Southern Poland – results of 3-D tomographic inversion

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The seismic experiments CELEBRATION 2000 and SUDETES 2003, due to a 3-D recording scheme, provided the data for a systematic analysis of azimuthal dependence of crustal P-wave velocity. The wide-angle seismic data form Southern Poland show directional variations of Pg traveltimes, suggesting anisotropy of the upper crust. This effect is the most pronounced in the area of the Malopolska Block and Lysogory Block. In this study, inversion of the traveltime data was performed using two methods: the anisotropic delay-time method and the three-dimensional tomography using more precise ray tracing and regularized inversion algorithm. The model of a transversally isotropic medium was assumed. To evaluate the reliability of the models, several subsets of the data were modeled, and synthetic tests were carried out in order to estimate the spatial resolution of the result. The results prove the existence of upper crustal anisotropy and provide an image of horizontal variability of the anisotropy magnitude and of the fast velocity direction in the study area. The anisotropy of the upper crust varies for the studied tectonic units: from 2-4% in the area of the East European Craton and Fore-Sudetic Monocline, to about 10% in the area of Malopolska and Lysogory Blocks. In the latter region, the axis of the fast velocity, trending roughly NW-SE, is consistent with the strike of the main tectonic lineaments: faults, outcropping folds axes and other deformational structures. In MB and LB, tightly folded metapelitic rocks of Neoproterozoic and younger age occur at depths of few km and deeper, and are likely to cause the observed anisotropy. Beneath the EEC, observed anisotropy may be attributed to metamorphic rocks of Proterozoic age (gneisses, schists), present in the crystalline basement of the craton. Beneath the TESZ and FSM, it is thought to be an effect of compressional/transpressional deformation of upper crustal rocks during Palaeozoic accretion.