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Discriminating between crustal anisotropy and inhomogeneity based on seismic wide-angle data from SE Poland (CELEBRATION 2000 Experiment)

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Determinations of seismic anisotropy in the crust and mantle based on azimuthal variations of traveltimes in wide-angle data have usually to be taken with caution as similar effect can be produced by an isotropic medium with velocity inhomogeneities of specific, elongated geometry, e.g ridge-like structures. These two cases are especially hard to distinguish in case of uneven or inhomogeneous ray coverage. Analysis of data from CELEBRATION'2000 experiment in SE Poland revealed azimuthal variation of the Vp velocity, unlikely to be explained by a common model with a local velocity anomaly. The axis of the fast velocity, trending roughly NW-SE, is consistent with the strike of the main tectonic lineaments in MB and LB. This phenomenon is explained by seismic anisotropy of the upper crustal material in the MB area. The azimuthal dependence of the traveltimes of the Pg phase was analysed in order to prove this hypothesis. Assuming TI approximation, an inversion of available traveltimes was performed in order to determine the amount of anisotropy, using 1-D and 2-D delay-time method. Obtained results indicate that the Vp anisotropy amounts to about 10%, with fast axis trending at azimuth of approx.110 deg. Such explanation is consistent with the known geological structure of the area, where tightly folded (dip 40-80 deg) metapelites of Neoproterozoic and younger age were reported at depths of few km and deeper. Fast axis direction coincides very well with azimuth of outcropping folds axes and other deformational structures. In order to assess the credibility of obtained anisotropy parameters, synthetic tests have been performed. The tests consisted of generating synthetic traveltimes for several variants of isotropic models and subsequent inversion using anisotropic delay-time method to check if artificial anisotropy can be obtained by inverting data generated by isotropic medium. The tests indicate that realistic velocity inhomogeneities can account only for small part of observed

azimuthal traveltime variations. Therefore, the anisotropy modelled in the study area cannot be an artifact resulting from inhomogeneous upper crust.