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S-wave velocity structure and anisotropic properties of the Arctic upper mantle

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S-wave velocity structure and anisotropic properties of the upper mantle of the poorly investigated Arctic region (>60° N) are studied from surface wave data. A representative dataset of Rayleigh (1555 seismic paths) and Love (1265 seismic paths) wave group velocity dispersion curves in the period range from 10 to 250 s is collected using a frequency-time analysis procedure. A 2D tomography technique developed for spherical surface without the sphere-to-plane transformation is implemented to image the distributions of the group velocities at different periods. Totally, 18 maps for each wave type are obtained and their lateral resolution is estimated. Locally averaged dispersion curves are calculated using the obtained group velocity maps, with reference to the resolution, and then inverted to SV- and SH-wave velocity-depth profiles. Finally, the radial anisotropy coefficient is estimated as the ratio of the difference between SH- and SV-wave velocities to the average S-wave velocity. The model shows lateral and vertical velocity variations over the whole depth range within the study area. The most prominent velocity heterogeneities are localized in the uppermost mantle up to the 200 km depth. In this depth range, the velocity anomalies are strongly correlated with the main tectonic structures. The calculated S-wave velocity distribution demonstrates that the upper mantle of the continental shields is characterized by high S-wave velocities and contains regional velocity anomalies associated with small-scale blocks. Low mantle velocities are attributed to the areas with high level of tectonic and seismic activity. Significant difference in the deep velocity structure of the marginal seas and deep-water oceanic basins of various ages is revealed. Radial anisotropy is observed in the upper mantle up to the depth of about 250 km which is approximately coincides with the bottom of the asthenosphere. It is the most prominent in the depth interval from the Moho up to 150 km. The regions with maximum values of the radial anisotropy coefficient are also characterized by low S-wave velocities. The obtained model suggests some insights into the geodynamical evolution of the lithosphere of the Arctic region.
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