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The Kimberlite PNE seismic data profile: modelling and resolution tests.

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The Kimberlite profile was acquired with peaceful nuclear explosions (PNEs) as sources in the late ‘70s, when an extensive program of deep seismic soundings (DSS) was carried out in northern Eurasia of Russia. In order to constrain the mantle structure of the Eastern Siberian platform, we perform two-dimensional P-wave velocity modelling by application of seismic traveltime inversion along this high-resolution PNE seismic data profile. Due to the very large offsets of more than 3000 km we take into consideration the Earth’s sphericity. Reflections from discontinuities at average depths of 230, 300 and 410 km and refractions from the discontinuities at about 530 and 650 km depth have been identified. A travel time delay and scattered arrivals are observed at $\sim$800-1400 km offset. The preliminary 2D structure of this profile shows the presence of a low-velocity layer (LVL) at the average depth range of 60-80 km and a second and deeper LVL with its top at about 110 km depth. The presence of the LVL in cratonic areas has already been demonstrated from seismic tomographic, full-waveform modelling, petrological studies and seismological studies performed with surface waves: both the LVLs of the Kimberlite PNE profile lie within the depth range previously detected for this layer. We test the uniqueness and resolution of the preferred model for the most representative velocity and depth parameters (nodes) of the model. We use (1) a single-parameter resolution test to estimate the spatial resolution of the final model centred about a specific node and (2) a single-parameter uncertainty test to obtain an estimate of the node’s absolute uncertainty.

The future goals of this study are: 1) to interpret the seismic velocity structure along two other Russian PNE-profiles, Meteorite and Craton, 2) to compare the 2D structures of these three crossing profiles in order to detect possible anisotropy in the LVL, and 3) to model the physical parameters of seismic scatterers in this layer.