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Regional tomography reveals mantle traces of tectonic processes in the Circum-Arctic region

I. Koulakov, N.L. Dobretsov, A. Jakovlev, and N. Bushenkova
IPGG SB RAS, Novosibirsk, Russian Federation (KoulakovIY@ipgg.nsc.ru)

Studying the deep seismic structure beneath the Circum-Arctic region is important to understand the mechanisms of recent tectonic evolution. However, poor coverage of the region with seismic networks makes it difficult applying common tomography schemes. We propose using the travel time data from global seismological catalogues which correspond to seismicity located in the study region and recorded by worldwide stations at any epicentral distances. Another possibility to study "blank" areas is using travel times of PP rays having reflection points in the study area. Using more than 50 years of the ISC catalogue data, we have computed a seismic model in the upper mantle down to 700 km depth beneath the Arctic region. Based on this model, we confirm the existence of thick lithosphere (up to 300 km) beneath Greenland, Canadian and Baltic shield and the Siberian craton. The orogenic areas of Alaska, Chukotka and Yakutia coincide with low-velocity seismic anomalies which indicate the existence of relatively thin lithosphere that can be easily deformed due to tectonic displacements. In the oceanic segments corresponding to the Northern part of the Atlantic ocean and beneath Bering and Baffin seas we observe strong low-velocity anomalies indicating to the anomalously hot mantle. At the same time, beneath central basins of Arctic, the tomographic model does not reveal any significant perturbations. We propose that opening of the oceanic basins in Central Arctic is caused by passive rifting due to relative displacement of Eurasia and America. Beneath Chukotka, below 300 km depth we observe high-velocity anomaly whose origin is actively debated. It might be the trace of an old subduction zone which took place close to the Arctic coast of Chukotka. On the other hand, this positive anomaly might be a continuation of the Aleutian slab which moves horizontally along the transition zone between 410 km and 670 km depth. Besides the Arctic features we clearly observe well known structures, such as Iceland plume and subduction zones beneath Northern Pacific which were studied in many previous works.