Seismic structure of the crust in Eurasia

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Seismic structure of the crust in Eurasia

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We present a compilation of Moho topography and crustal structure in the area encompassing most of Europe, Greenland, Siberia, the North Atlantic Ocean and the Arctic shelves (EUNAseis and SibCrust models, Tectonophysics 2013). Our new, high resolution, continent-scale crustal model is based solely on seismic profiles and RF models published since 1960, which makes it applicable to potential field modelling. The database represents a major improvement in coverage and resolution with a sample interval of 50 km or less. It includes information on the depth to Moho, thickness and average P-wave velocity of five crustal layers (sediments, and upper, middle, lower, and lowermost crust) and Pn velocity. For each of the crustal parameters included in the compilation, we discuss uncertainties associated with theoretical limitations, regional data quality, and arising from interpolation.

We provide an extensive summary of the tectonic and geodynamic evolution of the region and discuss the origin of crustal heterogeneity and processes of crustal evolution in the Precambrian cratons of Europe and Siberia, and major Phanerozoic basins, orogens, and rift zones. We conclude that for all tectonic settings there are significant variations in depth to Moho and crustal structure, essentially controlled by the age of the last major tectono-thermal event. We demonstrate that generally-adopted global averages of crustal parameters are incorrect for any particular tectonic setting in Europe and in Siberia, and conclude that we cannot define a “typical cratonic” crust. We show that relative thickness of the upper-middle crystalline crust (Vp<6.8 km/s) and the lower (Vp>6.8 km/s) crust is indicative of the crustal origin, i.e. oceanic, transitional, platform, or extended crust. Continental rifting generally thins the upper-middle crust without changing the average Vp. Thinning of the lower crust during rifting is less significant and generally occurs without significant change in lower crustal average Vp, suggesting a complex interplay of magmatic underplating, gabbro-eclogite phase transition and delamination. The Barents Sea shelf differs from rifted continental crust in structure of the crystalline crust and average Vp velocities, indicating that processes other than rifting have also been involved in its evolution.

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