Lithosphere response to intracratonic rifting: examples from Europe and Siberia

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TITLE: LITHOSPHERE RESPONSE TO INTRACRATONIC RIFTING: EXAMPLES FROM EUROPE AND SIBERIA

ABSTRACT BODY: Several cratons have experienced a significant modification of their crustal and mantle lithosphere structure during Phanerozoic large-scale lithosphere-mantle interactions. In Eurasia, the most prominent examples include the Dniepre-Donets rift in the East European craton, the Oslo graben in the Baltic shield, the Viluy rift and the Baikal rift in Siberia. Despite some similarities, mostly in the crustal structure, there are also significant differences in the lithospheric structure of these rifts. Besides, a large lithosphere-scale Riphean suture/rift runs across the East European craton. While this suture can be recognized in the crustal structure, it is not clearly seen in the structure of the lithospheric mantle. In contrast, Phanerozoic processes associated with emplacement of large magma volumes had a strong effect on modification of the lithosphere structure, primarily by infiltration of basaltic magmas and consequently in a change in mantle density and seismic velocities. Although kimberlite magmatism is commonly not considered as a rifting events, its deep causes may be similar to the mantle-driven rifting and, as a consequence, modification of mantle density and velocity structure may also be expected.
We present a new model for the structure of the crust in an area that encompasses the East European craton, the West Siberian basin, and the Siberian cratons. The region includes a nearly continuous age record for lithosphere evolution over ca. 3.6-3.8 billion years. The crustal model is based on critically assessed results from various seismic studies, including reflection and refraction profiles and receiver function studies. We also use global shear-wave tomography models, gravity constraints based on GOCE data, and thermal models for the lithosphere to speculate on thermo-chemical heterogeneity of the mantle. An analysis of the lithosphere structural heterogeneity is presented in relation to geotectonic setting and mantle geodynamics based on interpretations of geophysical models. The results indicate that there is no simple rule for lithosphere modification by intracontinental rifting. The pattern of is controlled by the pre-existing tectonic setting and the intensity of lithosphere-mantle interaction. The results are summarized in a series of maps of lateral variations in lithosphere structure, including the depth to the LAB and compositional heterogeneity of the lithosphere as reflected in it seismic wave velocity and density structure.

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