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Integrated geophysical-petrological modelling of the Trans-European Suture Zone along the TOR-profile

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We apply the integrated geophysical-petrological software package LitMod3D to study the effect of changes in thickness and composition associated with the Sorgenfrei-Tornquist-Zone as part of the Transeuropean Suture Zone (TESZ).
Results of the TOR-project (Teleseismic Tomography TORnquist) show a P wave velocity anomaly that indicates an abrupt step in the base lithosphere between southern Sweden and Northern Germany. From a depth of ∼300 km beneath the proto-Proterozoic Baltic shield the base lithosphere increases to less than 100 km beneath the Phanerozoic terranes in the southwest. However, this significant change in lithospheric thickness is not expressed by significant changes in the gravity field or topography. Hence, some form of isostatic compensation must be achieved by changes in the composition or thermal structure of the crust or upper mantle.
First sensitivity tests were performed to show that the most important parameters to explain seismic upper mantle velocities, gravity and topography. These are, in addition to lithospheric thickness, the densities and thermal conductivity in the crust and the amount of depletion of the subcontinental lithospheric mantle (SCLM).
When applying a simple geometry with steps at the Moho and base lithosphere, the TOR results could be reproduced to a large degree when applying different compositions for the SCLM beneath the Proterozoic and Phanerozoic domains. To address the gravity field and topography as well, we present two alternative models for the TOR-profile. In the first model, the gravity field and topography is explained by dividing the Phanerozoic SCLM in a refertilized upper and more depleted lower part. This model leads to a deeper base lithosphere (130 km), but does not provide a very good fit to the P wave velocities. In the second alternative, the thermal conductivity of the Phanerozoic crust and for the sediments has been increased within reasonable parameters. This leads to a shallower LAB ∼100 km and a better correlation to the observed P wave velocity structure.