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Electrical conductivity of the Fennoscandian Shield margin from recent magnetotelluric profiles

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During the last decade several magnetotelluric profiles extending from Proterozoic East European Craton into younger domains have been measured.

Magnetotelluric TOR profile crosses the Sorgenfrei-Tornquist-Zone (STZ) in the southwestern part of the Fennoscandian Shield. The STZ marks the border between the intact shield in Sweden to the north and the reactivated Danish basin and the Ringkobing-Fyn High (RFH) to the south. The STZ manifests itself electrically very clearly in the lower crust and upper lithospheric mantle as a narrow zone of high conductivity. The thickness of the electric lithosphere decreases across the STZ from about 300 km in the Fennoscandian Shield to about 100 km in the Danish basin.

Jämtland-Trondelag magnetotelluric profile crosses the Central Scandinavian Caledonides from Baltic to Norwegian Sea. The results of the data analysis reveal the following main features: (1) An electrically highly conducting layer beneath the Caledonides images alum shales, the autochthonous Cambrian carbon-bearing black shales on top of the Precambrian basement. (2) Beneath the eastern part of the profile in the Fennoscandian Shield, proper, the first upper mantle conductor is detected at the depth of more than 250-300 km. A region of enhanced conductivity is identified at the depth of c.100- 150 km under the Caledonides in the central part of the profile. Further to the west, however, the lithosphere seems to thicken to 150-200 km.

A large-scale international electromagnetic experiment has been carried out in northwest Poland and north-east Germany across the Trans European Suture Zone (TESZ), which is the most prominent tectonic boundary in Europe and which constitutes a complex transition between the European Paleozoic Platform towards the southeast and the Precambrian Craton towards the northeast. The results show the presence of highly conductive Cenozoic-Mesozoic sedimentary cover reaching depths up to 3 km. The significant conductivity anomaly in the central part of the TESZ in the Polish Trough at mid-crustal depths is well resolved. The upper mantle of the Precambrian Craton is more resistive than the younger Paleozoic lithosphere by at least one order of magnitude.

We can summarize the results from these profiles in the following conclusions. Magnetotelluric data revealed remarkable features at the crustal level along each profile. Some of them were not clearly identified before by other geophysical methods. Conductors like alum shales are very well indicated in the final models. Electrical lithosphere is thick beneath the Fennoscandian Shield and significantly thinner beneath younger domains. The resulting models shows the conductivity contrast at a depth of about 150 km across the cratonic margin to be at least one order of magnitude.