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Geoelectrical structure of Sorgenfrei-Tornquist Zone in southern Sweden and Denmark

M.Yu. Smirnov and L.B. Pedersen

Uppsala University, Sweden (maxim.smirnov@geo.uu.se / Fax: +46 18 50 11 10 / Phone: +46 18 47 1 2385)

We report on the first results of Magnetotelluric measurements across the southwestern part of the Baltic Shield including the Sorgenfrei-Tornquist-zone that marks the border between an older intact part of the shield in Sweden to the north and a reactivated part forming the Danish basin and the Ringköbing-Fyn High (RFH) to the south.

Earlier geophysical studies include teleseismic tomography producing models of P-wave velocity perturbations that were interpreted to show increase in lithosphere thickness from 100 km below RFH to more than 200 km below Sweden.

In this study we deployed about 50 MT sites along two profiles. High quality data were collected in the period range of 0.001 to 30000 sec. In Denmark both long period and short period measurements were included in most of the sites. Due to the highly resistive exposed basement in Sweden most of the sites were measured only with short period instruments, covering the period range of 0.001 to 1000 sec.

Strike and dimensionality analysis as well as induction vectors support the general 2D character of the area. However, there are many 3D features in the observed data that prevent us from satisfactorily inverting the data with simultaneous use of E- and B-polarization data. We prefer to invert the determinant average of the impedance together with the vertical magnetic field whereby we can reach an rms datafit of about 3 using impedance error floors of 5% and 90% for the phase and apparent resistivity, respectively.

The crustal part of the model compares well with models derived by Thybo from seismic, gravity and magnetic data. In the Danish basin we resolve a peculiar vertical, resistive feature that coincides with a large basement fault and at the northern border of the Sorgenfrei-Tornquist Zone in Sweden we resolve a near vertical conductor that might represent a deep fault zone with increased porosity.

Because of the very thick sediments in the Danish basin with conductance in excess of 1000 S the resolution at mantle depths is worse than in the shield proper. We have conducted extensive resolution studies using synthetic models with various hypotheses about mantle conductivity and using the same station geometry and periods as the real data. Only when data are fitted to an rms level of about 2.5 the mantle conductivity in the depth interval 100-200 km can be resolved. With a real data fit of about 3 we conclude that the modeled increase in conductivity under The Danish Basin by an order of magnitude is real and can be taken to represent the variation in lithospheric thickness derived from teleseismic tomography models.