LITHOSPHERIC ELECTRICAL CONDUCTIVITY STRUCTURE ACROSS SOUTHERN SCOTLAND AND NORTHERN ENGLAND

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ABSTRACT

Magnetotelluric soundings in the range (100-0.01Hz.) have been carried out along a 140 km. profile across S.Scotland and N.England. Following discussion of the steps taken to reduce cultural noise in the response functions, the results for 13 stations along the traverse are presented. Since the study of dimensionality parameters supports 1-D modelling, rotationally invariant resistivity-depth data have been subjected to two 1-D inversion schemes and the different parameters of the model derived have been examined using the Most squares approach. Two dimensional numerical modelling has also been carried out considering both the present data and those of earlier induction studies along the profile.

The resulting geoelectrical model confirms the existence of a crustal conducting layer (10-50 Ohm.m.) as found in earlier induction studies. Results of this study show additionally that- a) the conductor rises to a depth of nearly 3.5 km. about 20km. south of the SUF i.e., near the axis of the Eskdalemuir magnetic variation anomaly b) the conductor is at a depth of about 8-10 km. in region of the Weardale granite in N. England, c) there is a marked resistivity-depth variation below S.Scotland and d) the surface resistivity along the profile decreases from NW to SE and corresponds well to the Ordovician, the Silurian and the Carboniferous sediments. The geophysical interpretation of the model has been discussed in association with the results of earlier induction studies, seismic and gravity studies and the various tectonic models of the Iapetus suture zone. Based on the present study and comparison with electric structures of other tectonic regions, a hypothetical tectonic model has been proposed for this study region. It comprises a resistive triangular wedge surrounded by a conducting layer which is incorporated as a signature for the presence of a subducting plate in an island arc environment.

In addition to these field investigations, several computational analyses have also been undertaken. The main studies were - a) procedures to reduce noise from the recorded data using digital filtering techniques and b) determination of the distortion of telluric field measurements due to a conducting hill using a conformal mapping method. Digital filters have been discussed with special reference to persistent noise signals, eg. power lines, electrical fences etc. Delay line filtering, notch filtering and the maximum entropy method have been applied to both synthetic and field data and the results are discussed. The effect of a two-dimensional conducting hill on the telluric fields measured on a horizontal surface has been studied using the Schwartz-Christoffel conformal transformation technique. The

results indicated that the distortion depends strongly on the inclination, height of the hill and depth to the basement. The distortion of apparent resistivity values computed from MT field measurements has also been discussed.

In addition, some consideration has been given to - a) the processing of the data in the time domain using adaptive filters, b) the application of joint inversion of DC-AMT data to resolve shallow structures in N.England and c) the distortion effects of near surface inhomogeneities in N.England.

These various studies are presented in 7 chapters with 3 Appendices and the results are discussed in chapter-8, where the conclusions and suggestions for further work are also presented.

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