Lithospheric structure across Ireland inferred from magnetotelluric studies

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SUMMARY

The Iapetus suture is a major Caledonian feature that dominates the geology of Ireland, and is a tectonic boundary caused by the collision of three plates Laurentia, Balatic and Avolonia, during the closure of the Iapetus Ocean ca. 400 my ago (Late Silurian to early Devonian). A 39 station magnetotelluric study was conducted in SW Ireland across the suture along five NW-SE profiles to study the electrical properties of this suture zone to lithospheric depths. Broadband and long period magnetotelluric data were collected at 32 stations with a station spacing of approximately 10-25 km and a period range of 0.03-10000 sec. Additionally, 7 broadband only stations were deployed between the existing sites. The time series were processed using robust, multi-site remote-reference codes. Even though the quality of the estimated MT responses improved compared to single site processing, the effects of electric fences on the data in the 1.0-10 Hz frequency band could not be completely eliminated. The uncontaminated parts of the responses were analyzed for local galvanic distortions using the multi-site and multi-frequency distortion code *strike*. For the eastern profiles (III, IV and V) we observe a geolectric strike of 75 ± 5^{o} whereas for the two western profiles (I and II) a strike of 52 ± 5^{o} is observed. These geoelectrically-defined strike directions are consistent with the local geological strike of Caledonian structures. The distortion corrected responses were inverted using RLM2D, as implemented in the WinGLink package.

The major features of all resistivity models from east to west are: (i) A prominent conductor at upper to middle crustal depths with decreasing conductivity from east to west. (ii) A high anomalous conductor at upper mantle depths across the two eastern most profiles. (iii) The depth cross sections of all profiles show a prominent demarcation that the western part is resistive and the eastern part is more conductive. (iv) The prominent conductor in the upper-middle crust is correlated with the inferred Iapetus suture zone with different causative factors for the change in conductivity from east to west of the profiles. (v) The high anomalous zone at depth of 60 km across the eastern profile is associated with the Iceland plume magmatic intrusion.