Physics of the Earth and Planetary Interiors, 81 (1993) ix–x
Elsevier Science Publishers B.V., Amsterdam

Dedication

Dr. V.R.S. (Rosemary) Hutton retired in 1991 after a lifetime's dedication to, and contributions in, geophysical studies on the Earth's crust using electromagnetic methods. To honour her work, a symposium was organized at the 1992 European Geophysical Society meeting, held in Edinburgh, called 'The Hutton Symposium: Electromagnetic Studies of the Continents'. Some of the papers in this special issue of 'Physics of the Earth and Planetary Interiors' were presented at that symposium. The others were submitted by colleagues world-wide, both to honour Rosemary and to illustrate the contribution that can be made to studies of the continents by deep-probing electromagnetic methods.

After deciding that the physics of textiles was not sufficiently challenging, Rosemary moved to Africa and worked on theoretical aspects of the equatorial electrojet while she was based in Kenya, Nigeria and Ghana. In 1969, Professor Alan Cook lured Rosemary back to the UK to join him in building the fledgling Department of Geophysics at the University of Edinburgh, where Rosemary spent the rest of her career, eventually being promoted to Reader. Africa, and source-field problems, continued to attract, and the first field project undertaken by Rosemary, together with her first Ph.D. Student, Dennis Rooney, and the newly built, state-of-the-art (for 1972!) magnetotelluric equipment, was of a solar eclipse and the Kenyan Rift. The next project, a magnetometer array using borrowed (some eventually drowned) Gough–Reitzel variometers, began Rosemary's 20-year fascination with, and investigation of, the enigmatic 'Eskdalemuir anomaly'. This anomaly is now known to be a consequence of the closure of the Palaezoic Iapetus ocean and continent–continent suturing of Laurentia, ancestral North America, with Gondwana, but its discovery predated Wilson's epic 1966 paper by a few years. The Edinburgh group, under Rosemary's direction, undertook a number of field projects in the Southern Uplands of Scotland and neighbouring northern England, and also in Ireland, of this anomaly and the bounding Palaeozoic continental masses.

Electromagnetic investigations were also undertaken in other areas of Scotland, particularly the Great Glen Fault. During the 1980s, warm weather, fine food and funding enticed Rosemary to shoulder the burden of working in Italy and Greece, and beautiful scenery took her to the Canadian Rockies. Another study of the Kenyan Rift was also executed. During these many research programmes, Rosemary ensured that the Edinburgh group were always state of the art in instrumentation, processing, modelling and inversion; the paper by Parr and Hutton contrasts data from the early 1970s and the late 1980s. This was accomplished by having bright, energetic students (present editor excepted), and from knowing, through her vast international network, just what was 'new' in the theory and practice of magnetotelluric investigations. Many of us in the field have been invited to Edinburgh, only to be grilled mercilessly and have to reveal our secrets.

This present collection of papers, with its central theme of 'Electromagnetic Studies of the Continents', epitomizes the diversity of Rosemary's interests and the regard in which she is held by the community. The 20 contributions are grouped into Iapetus suture studies (five papers), crustal-scale studies (four papers), modelling studies (six papers), and other studies (five papers).

The first five papers describe magnetotelluric (MT) and magnetovariational (MV) studies of the Iapetus suture and Palaeozoic hinterlands undertaken during the 1980s. Sule et al. compare and contrast MT results with d.c. resistivity measurements, showing the potential of dense MT measurements for resolving near-surface structure, and also examine the resolution of their published 2D model of the Southern Uplands Fault

(SUF). Harinarayana et al. compare this model, and one for the same structure in Ireland, with one from a profile further to the southwest, after undertaking tensor decompositions of their data in the vicinity of the SUF. This paper also gives the first evidence for a two-sided, mid-crustal conductor centred in the middle of the Southern Uplands, rather than the previously interpreted one-sided, southward-dipping zone, to explain the Eskdalemuir anomaly. Parr and Hutton reprocess many of the available data, using a novel, constrained impedance tensor estimation technique, and undertake 1D and pseudo-2D inversions and 2D forward modelling of the MT and MV responses. Livelybrooks undertake 2D inversion of this dataset. The reader is encouraged to compare these approaches, and resulting models. Not surprisingly, one may conclude that the significant results are apparent early in the research, but that confidence in them increases with increasing sophistication of effort. Banks et al. describe an advance on the hypothetical event technique (HET), taking into account the contributions from the anomalous fields, and show its application to data from the region. They conclude that the Northumberland Trough and the Southern Uplands (Eskdalemuir) anomalies are strikingly linear and correlate closely with local geological features.

The next four papers show the results of MT and MV studies of tectonic problems. Adam and Steiner analyse data from the Pannonian basin, and conclude that the shielding effect of the sediments reduces resolution of the lithospheric conductivity variations. Stănică and Stănică discuss studies of the Carpathian orogen using data from 73 sites along a 150 km profile; such high station density permits excellent site-to-site correlation of features. Korja and Hjelt describe the conclusions from a decade of electromagnetic research on the Fennoscandian Shield using a variety of methods (audio MT, MT, dipole–dipole and very low frequency), detailing the main regions of enhanced conductivity and their correlation with local geology. Galanopoulos presents MT data from various Greek islands in his study of the currently active Aegea–African continent–continent collision, and describes the similarity of his models with other geophysical information.

The six modelling papers show advances and applications in this field. Agarwal et al. and Oldenburg and Ellis describe their new algorithms for inverting a set of data for 2D Earth conductivity structure. The former try to find the model with the least number of blocks of uniform conductivity that adequately fit the observations, whereas the latter employ approximations which reduce the computational time considerably. Arora et al., Bapat et al. and Heinson and Lilley use thin-sheet approximations to study the 3D induction effects in India, around Japan, and in the Tasman Sea, respectively. Chen et al. employ analogue modelling to interpret data from the South Island of New Zealand.

The final five papers deal with various topics in electromagnetic induction. Beamish and Travassos discuss the efficacy of MT for sedimentary basin evaluation by comparing data from two basins in Brazil. Zhamaletdinov et al. describe a novel application of the Kola Peninsula magnetohydrodynamic generator for mineral exploration in northern Norway, and Jones and Dumas use modern analysis and modelling methods to obtain high-resolution images of a volcanic front from MT data. Laštovičková et al. describe laboratory observations of electrical anisotropy on rocks from the German deep drillhole, and, last but not least, Hyndman et al. discuss the arguments for and against the current top two contenders for the title of 'cause of conductivity in the continental lower crust', namely fluids and carbon on grain boundaries.

It is our hope that this special volume will be read by others outside the field as an example of the potential that electromagnetic methods have for elucidating some of the problems associated with studies of the continents. As such, it would be a fitting tribute to Rosemary Hutton. What was the rag trade's loss, was certainly our gain!

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