

Preface

Pilar Queralt · John T. Weaver

Received: 26 May 2007 / Accepted: 4 June 2007 / Published online: 28 June 2007
© Springer Science+Business Media B.V. 2007

This Special Issue contains four review papers presented at the 18th Workshop on Electromagnetic Induction in the Earth, held in Spain by Working Group I-2 of the International Association of Geomagnetism and Aeronomy. The workshop took place during the week 17–23 September, 2006, in the Catalonian town of El Vendrell, situated on the Mediterranean coast some 70 km southwest of Barcelona and renowned as the birthplace of the celebrated cellist and humanist Pau Casals. It proved to be an ideal location for the presentation and discussion of the latest experimental and theoretical progress in the field of geo-electromagnetic induction and attracted over 270 participants, representing 43 different countries, from universities, government institutions and the industrial sector, as well as a sprinkling of ‘retired scientists’.

Following a well-established tradition, four invited review papers were presented on selected topics to complement the large number of contributed oral and poster papers. Since 1978, the full printed versions of the workshop review papers have been published in Special Issues of *Surveys in Geophysics* and its forerunner *Geophysical Surveys*. Together these Special Issues form a valuable record of how the subject has developed over the past decades. At the 18th Workshop, the reviews focused on (i) the integration of magnetotelluric (MT) data with other information to determine Earth’s physical properties, (ii) the role of electromagnetic methods in the investigation of aquifer systems, (iii) electromagnetic monitoring in regions of seismic and volcanic activity using the ‘Network-MT method’, and (iv) imaging the European lithosphere. It is these themes which the authors have developed further in the four papers appearing in this Special Issue.

P. Queralt
Departament de Geodinàmica i Geofísica, Universitat de Barcelona, c/Martí i Franquès s/n,
08028 Barcelona, Spain
e-mail: pilar.queralt@ub.edu

J. T. Weaver (✉)
Department of Physics & Astronomy, University of Victoria, P.O. Box 3055 STN CSC,
Victoria, BC, Canada V8W 3P6
e-mail: jtweaver@uvic.ca

As a technique for determining the electrical conductivity structure in the crust and upper mantle, the MT method suffers from well-known limitations associated with the non-uniqueness of its inverse problem. In the first paper, Paul A. Bedrosian (US Geological Survey, Denver) succinctly explains the principles of the MT method, including inversion of MT data, and reviews different mechanisms that account for the wide range of electrical conductivity values in the crust and upper mantle. He then introduces his main theme by discussing how MT data can be combined with other geological or geophysical information (MT+) to provide an integrated approach to the inversion of MT data, which helps to overcome some of the usual limitations in the method. He selects a number of case studies involving such multi-property inversion, to demonstrate that MT+ can play a vital role in determining important information about the geometric structure of the Earth as well as such geophysical properties as lithospheric temperature, the presence of partial melt, and the composition of oceanic crust.

In the next paper, Lee Slater (Rutgers University, USA), presents a comprehensive discussion of the estimation of hydraulic conductivity from static and low frequency measurements of geoelectric properties, specifically electrical resistivity, induced polarization (IP), and spectral induced polarization (SIP). In the first part of his paper, Dr. Slater reviews different petrophysical models that link geophysics and hydrogeology and summarises the findings of laboratory studies. He then presents different strategies for the geoelectrical estimation of spatial patterns of hydraulic conductivity at field-scale including, in particular, joint/constrained inversion techniques of geophysical and hydrological data. The paper concludes with a discussion of some of the future challenges within this domain of hydro-geophysics.

Recent developments in the topical subject of electromagnetic monitoring in regions of seismic and volcanic activity are covered in the third paper by Makoto Uyeshima (University of Tokyo, Japan). After reviewing the various mechanical, thermal and chemical mechanisms, which are believed to be the sources of the magnetic, electric or electromagnetic signals recorded in such active regions, he describes the ‘network-MT method’ which employs existing telephone networks to improve the quality of MT data by increasing the baseline lengths for the electric field measurements. Dr. Uyeshima then refers to results obtained by the network-MT method in seismic and volcanic regions of Japan as well as to other field observations made with long telluric baselines in the French Alps.

Finally, Toivo Korja (University of Oulu, Finland) reviews the results obtained from extensive electromagnetic investigations of the European lithosphere and asthenosphere. His review is mainly focused on MT studies, but other electromagnetic methods (e.g. magnetovariational profilings and geomagnetic depth soundings) have also been included when they provided important additional information. Dr. Korja reviews an enormous number of papers, and has extracted from them critical and robust information from which one can draw reasonably confident geological or tectonic inferences. His contribution brings the database of depths to the lithosphere–asthenosphere boundary in Europe fully up to date.

Working Group I-2 is indebted to many institutions and companies for their generous financial support, which not only covered some administrative and other costs of the workshop, but also enabled the attendance of students, post-doctoral fellows and scientists from developing countries who would otherwise have had little or no funding. Many thanks are also due to the Local Organising Committee from the University of Barcelona for arranging an excellent meeting in a delightful setting and also for organising, on the day of the mid-workshop break, an interesting and enjoyable tour of the architectural and

historic sights of Barcelona, concluding with a splendid gala dinner at “Sala Maremagnum” on the harbourside of the port of Barcelona. Future workshops are planned for Beijing, China, in 2008 and Cairo, Egypt, in 2010.

In closing, we would like to thank the referees of these papers for their thoughtful and constructive reviews, as well as Michael Rycroft, Editor in Chief, and Miranda Dijkstra in the Springer Editorial Office, for their help and advice, especially in guiding us through the mysteries of the computerised Editorial Manager system.