

## PREFACE

J. T. WEAVER<sup>1</sup> and B. R. ARORA<sup>2</sup>

<sup>1</sup>*Department of Physics and Astronomy, University of Victoria, P.O. Box 3055, STN CSC, Victoria, BC, V8W 3P6, Canada E-mail: weaver@phys.uvic.ca;*

<sup>2</sup>*Wadia Institute of Himalayan Geology, 33 Gen. Mahadeo Singh Road, Dehradun, 248001, Uttaranchal, India E-mail: arorabur@wihg.res.in*

Since 1978, the review papers presented at the biennial workshops of Working Group I-2 of the International Association of Geomagnetism and Aeronomy on ‘Electromagnetic Induction in the Earth’, have been published in Special Issues of *Surveys in Geophysics*, and its forerunner *Geophysical Surveys*. These issues are not only a useful reference source for researchers, graduate students, and readers in other disciplines seeking a condensed but comprehensive review of the latest practical, instrumental and theoretical advances in the field, but also collectively form an important historical record of the development of the subject.

The 17th Workshop was held from the 18th to the 23rd October 2004, at the National Geophysical Research Institute (NGRI) in Hyderabad, India. This was only the second time that the venue for the Workshop had been located in Asia (the other occasion was in 1996 when it was held in Onuma, Japan). India has a strong tradition in geo-electromagnetic induction and the presence of the 17th Workshop in that country enabled the participation of many Indian researchers and graduate students, who would not otherwise have had the opportunity to attend. Altogether there were 243 registered attendees representing every continent and 32 different countries. A full day excursion to the northern part of Andhra Pradesh on the 20th October afforded participants the opportunity to observe the Precambrian geology of the eastern Dharwar craton, to enjoy a boat trip on the Nagarjuna Sagar reservoir and to experience the archeological and cultural heritage of the region.

The Scientific Programme was divided into the following sessions: Session 1, Local and Regional Seismic and Volcanic Studies; Session 2, Three-Dimensional Modelling and Inversion; Session 3, Oil, Geothermal and Environmental Exploration Studies; Session 4, Anisotropy from Laboratory to *in situ* Studies; Session 5, Deep Structure of the Lithosphere and Asthenosphere; Session 6, Multi Parametric Techniques; Session 7, Continent–Continent Collision; Session 8, Response Functions; Session 9, Oceanic and Other Studies. Session 10, held on the 24th and 25th October,

was a special post-workshop meeting on Multidisciplinary Studies in Himalaya, which provided an opportunity for Indian researchers to interact with international scientists who have worked in the Himalayan region. All sessions included a mixture of oral and poster presentations, while Sessions 2, 3, 4 and 9 began with longer review papers presented by invited speakers. The papers published in this Special Issue are expanded versions of those reviews.

Marine electromagnetics is presently enjoying something of a renaissance in the commercial world because of its recent successes in supplementing seismic methods in the search for off-shore hydrocarbons. Thus the first paper that follows, 'Marine controlled source electromagnetics: principles, methodologies, future commercial applications' by Nigel Edwards (Toronto, Canada), is both a timely and commercially-relevant account of recent developments in those controlled-source electromagnetic techniques and their applications that are in the public domain. After a brief summary of DC and AC methods, Professor Edwards describes actual case histories taken from the Norwegian shelf, Angola, the Cascadia margin off Vancouver Island and off-shore New Jersey. Because Professor Edwards was unable to attend the Workshop in person, the oral version of this paper was presented in Hyderabad by Dr Katrin Schwalenberg.

Still in the marine environment, but from a more purely geophysical perspective, Dr Kiyoshi Baba (Kanagawa, Japan) reviews recent investigations of the electrical conductivity structure in marine tectonic settings. After reviewing the latest technical advances, both in instrumentation and in the development of computer codes for modelling and inverting marine data, he describes recent electromagnetic experiments performed on mid-ocean ridges and other mantle upwellings, and in subduction zones. In particular he discusses the physical processes, such as melt generation and migration, crustal accretion and hydrothermal circulation, that can be better understood with the aid of electromagnetic measurements of conductivity.

One of the recurring themes pervading the 17th Workshop was the realisation that electrical anisotropy appears to play a far more important role in influencing geo-electromagnetic observations than has been previously recognised. The third paper, a review of anisotropy in continental regions by Dr Philip Wannamaker (Salt Lake City, USA), is therefore highly relevant to general scientific discussions that took place at the Workshop. Dr Wannamaker first describes the various physical causes of anisotropy in the crust and upper mantle and then summarises several regional field surveys over continental regions in which the importance of bulk anisotropy is evident. Examples from active transpressional, active transtensional and fossil transpressional regimes are discussed along with the implications of the observed anisotropy for geochemical and structural processes in the region.

In the final paper of this Special Issue, Dr Dmitry Avdeev (Dublin, Ireland and Troitsk, Russia) tackles the difficult and highly mathematical topic of

three-dimensional electromagnetic modelling and inversion. This is a rapidly developing subject that is too vast to be reviewed in its entirety. Accordingly, Dr Avdeev limits his review to a selection of recent developments in the finite difference, finite element and integral equation methods of forward modelling. He then presents an overview of certain optimisation procedures, which incorporate these forward solvers, for obtaining the extremely sensitive solutions of the non-linear and ill-posed inversion problem. The paper concludes with a series of appendices summarising some of the basic mathematical methods used in three-dimensional inversion.

All attendees at the 17th Workshop are indebted to the Workshop Co-ordinators representing the Indian Institute of Geomagnetism and NGRI, the members of the Local Organising Committee, and the staff at NGRI for providing the excellent facilities and efficient organisation that ensured that this well-attended meeting was both enjoyable and scientifically successful. Generous support from the International Union of Geodesy and Geophysics, the International Association of Geomagnetism and Aeronomy, the National Science Foundation (USA), the Department of Science and Technology (India), the Council of Scientific & Industrial Research (India), the Department of Ocean Development (India), the Indian National Science Academy, the Oil and Natural Gas Corporation Ltd., Oil India Ltd., the National Geophysical Research Institute, the Indian Institute of Geomagnetism and the Wadia Institute of Himalayan Geology is also gratefully acknowledged.

The 18th Workshop will take place near Barcelona in 2006. Three excellent proposals for the venue of the 2008 Workshop were presented in Hyderabad. After consultation and discussion the Working Group Committee decided that it would be held in Beijing, China.

Finally, the Guest Editors thank the eight referees of these papers for their thorough and promptly submitted reviews, and the publishers Springer for their guidance and cooperation.