

## PREFACE

*(The Collective Review Papers Presented at the 10th IAGA Workshop  
on Electromagnetic Induction in the Earth)*

Working Group WG I-2 of the International Association of Geomagnetism and Aeronomy (IAGA), held its 10th Workshop on Electromagnetic Induction in the Earth in the city of Ensenada, Baja California, Mexico, from August 22 to 29, 1990. The first of the biennial Workshops took place in Edinburgh (U.K.) in 1972, followed by Ottawa (Canada), Sopron (Hungary), Murnau (Germany), Istanbul (Turkey), Victoria (Canada), Ile-Ife (Nigeria), Neuchâtel (Switzerland) and Sochi (U.S.S.R.). The Ensenada Workshop was sponsored by CICESE, UGM, Government of Baja California and CONACyT, all Mexican institutions; by the USA National Science Foundation and Department of Energy; and by the IUGG and IAGA itself.

The Workshop programme was divided into nine scientific sessions, four of which were introduced by invited reviews and one by an additional tutorial paper. Traditionally, the reviews and tutorials are published together in a special issue of *Surveys in Geophysics*. These special issues are regarded as successive landmarks in the science of electromagnetic induction sounding of the Earth. They are equally useful for the specialist and those in related fields, and for graduate students in search of relevant problems for their theses. The topics of the reviews are not the same at every Workshop. They are carefully selected according to recent advances, and may also reflect the interest of the community to stimulate a neglected but critical area of research. The present issue includes the four reviews, the tutorial paper and a special report of semantics.

Singer's contribution 'Correction for Distortions of Magnetotelluric Fields: Limits of Validity of the Static Approach' is a well balanced discussion of the many extraneous effects that distort magnetotelluric sounding curves. The author classifies the effects according to their origin into geological noise, and local and regional inhomogeneities. Correcting for these distortions has become a most important step since new instrumentation and data processing techniques guarantee the collection of highly accurate data. The induction community has responded with a series of correction techniques which are reviewed in the paper considering their applicability as well as their limitations. Special attention is given to alternatives to spatial filtering techniques, in an attempt to exploit one of the most attractive features of magnetotellurics. Namely, its capability of making inferences from single site observations.

Experienced geophysicists know that it is very rare to see a "clean" magnetotelluric data set, free of the distorting effects of small-scale or near-surface conductivity inhomogeneities. Most field data require further processing prior to any interpretation. The paper by Groom and Bahr 'Corrections for Near Surface

Effects: Decomposition of the Magnetotelluric Impedance Tensor and Scaling Corrections for Regional Resistivities: A Tutorial' explores the application of methods that the authors have used. There is a strong emphasis on decomposition of the magnetotelluric impedance tensor, and on methods that can be used in conjunction with this. All concepts are theoretically justified, taking into account the relationships between specific decomposition methods. The techniques are first illustrated using synthetic examples, and then they are applied to experimental data so that the performance of each method is fully appreciated. The available techniques for correcting the "static shift" of the impedance tensor after decomposition are briefly discussed for completeness.

Properly conceived electromagnetic induction studies are only the means to obtain conductivity models that must in turn be interpreted in geological terms. The geological inferences are the main end product of our science. In this context, we seek explanations for the origin of the highly conducting layers that have been detected worldwide in the middle and lower crust of the Earth. The existence of these conductivity anomalies is well-established through the analysis of many magnetotelluric and deep geomagnetic soundings collected in tectonically active regions as well as in stable shield areas. The paper by Jödicke 'Water and Graphite in the Earth's Crust – An Approach to Interpretation of Conductivity Models' addresses this problem not just as a summary of the possible candidates that have been proposed to explain the anomalies. The author focuses on the possibilities of water and/or graphite in the crust, emphasizing the petrophysical and petrological evidences of each. Surprises from deep research wells in Russia and Germany are noted. All in all, the paper makes it very clear that we are facing a fundamental problem, one that may have profound implications on the deformation of continentals.

The paper by Martínez-García 'Electromagnetic Induction in Geothermal Fields and Volcanic Belts' is an extensive review of one of the most important applications of electromagnetic induction methods in geophysics. The paper details the usage of the magnetotelluric method in geothermal fields and volcanic belts in North and South America, Europe, Asia and Oceania. The critical discussion of a very rich bibliography includes the classical topics of instrumentation, data processing techniques and interpretation, all of which have seen important developments over the past decade. Many of these improvements are now standard practice in geothermal exploration, resulting in better data quality and better estimations of the underground distribution of electrical resistivity. Although there are grounds to be optimistic, there are still problems that defy our science. One of them, included in the conclusions, is that magma chambers remain an elusive target to electromagnetic induction.

Boemer's review 'Controlled Source Electromagnetic Deep Sounding: Theory, Results and Correlation with Natural Source Results' is a clear account of the most significant advances in controlled source electromagnetic methods, particularly in

relation to deep probing of the crust. The paper covers controlled source theory, particular electromagnetic methods and practical applications which have produced reliable and useful results. The effort to integrate all the aspects of the subject is commendable, given the plethora of possible variations on basic electromagnetic sounding techniques. The author rightly considers that it is only with an appreciation of the theory of electromagnetic sources that the similarities, capabilities and limitations of the different deep sounding methods can be judged. Using some basic concepts derived from theory, the discussion of several important deep sounding experiments follows. There is little doubt that as modelling capabilities improve, controlled source methods will gradually become more and more appealing for deep sounding, either as an attractive compliment to natural source soundings, or as the only viable alternative in special circumstances.

Close to 200 scientists from 29 countries attended the Ensenada meeting. Beside the review and tutorial papers published here, 180 contributed papers were read or presented on posters. A few copies of the book of abstracts are still available from the local committee. It is worth mentioning that the programme was organized differently than in previous Workshops. All oral presentations were given in the morning, reserving the afternoon for the poster presentations only. Each session ended with a panel discussion and comments from the participants.

Among the general comments, there seems to be a concern that the future of our scientific community depends very much on our own capabilities of communication with other earth scientists, particularly geologists. We must present our results not so much to each other but more and more to our geophysical and geological colleagues. Another main concern is that of semantics in the induction community, particularly the proliferation of terms for the same technique or concept, and the many different ways of presenting the same graphical information. This can only confuse our colleagues about our methods and results, and it certainly does nothing to clarify an already complicated subject. This problem of semantics is being addressed by IAGA Working Group I-2, first by soliciting views from all induction workers so that the community is involved in the decision-making process. B. A. Hobbs prepared a questionnaire that was sent to all members of the Group previous to the Ensenada meeting. The results were presented at the Workshop and are included in the present issue as a special report by B. A. Hobbs.

Traditionally, one day in the middle of the Workshop is reserved for a visit to a nearby tourist site. On Sunday, August 26, all workshop participants took the sightseeing excursion to the tallest blowhole in the world, La Bufadora, by the Pacific Ocean a few miles from the city of Ensenada. The excursion ended on the beach with a number of teams composed of players from all countries and of all ages competing in volleyball, softball, and other sports. A picnic meal featured fish tacos, a Baja California speciality.

The Ensenada Workshop was a great success, for which the induction com-

munity expresses its thanks to the organizing committees. The next workshop will be held at Victoria University of Wellington, New Zealand, from August 26 to September 2, 1992.

E. GÓMEZ-TREVIÑO AND GEORGE R. JIRACEK