

PREFACE

(THE COLLECTIVE REVIEW PAPERS PRESENTED AT THE 9th IAGA WORKSHOP ON ELECTROMAGNETIC INDUCTION IN THE EARTH AND MOON)

Working Group WG I-3 of IAGA held its Ninth Workshop on Electromagnetic Induction in the Earth and Moon in the Black Sea resort of Sochi in the U.S.S.R., from October 24 to 31, 1988. The first of the biennial Workshops took place in Edinburgh in 1972, followed by Ottawa (Canada), Sopron (Hungary), Murnau (F.R.G.), Istanbul (Turkey), Victoria (Canada), Ile-Ife (Nigeria) and Neuchâtel (Switzerland). The Sochi Workshop was sponsored by the Academy of Sciences of the U.S.S.R., by the Soviet Geophysical Committee, by the Institute of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation (IZMIRAN), by the IUGG and by IAGA itself.

Traditionally the Workshop meetings focus on a selection of topics and the more important of these are usually introduced by an invited review. Tradition also has it that these reviews are published together in a special issue of *Surveys in Geophysics*. Of the seven reviews presented in Sochi six are printed in this issue.

The special issues with review papers must be regarded as successive landmarks in the science of electromagnetic induction sounding of the Earth. They are equally useful for the specialist who must keep abreast of his field, and for those in adjacent research areas with whom the specialist should endeavour to establish fruitful contacts. The strengthening of the interactions between the so-called 'induction community' and other avenues of geophysical sounding is at present one of the major goals of our Working Group. In Sochi a large effort was devoted to problems of data interpretation and in a sense the six reviews which follow all touch on this theme.

The first paper by Schwarz "Electrical Conductivity of the Earth's Crust and Upper Mantle" is perhaps the most traditional, essentially compiling and reviewing recent field work and some interpretational problems which were raised. Wherever possible the data are discussed in relation to other geophysical information, especially of a petrological or physical nature. The effects caused by the possible inclusions of fluids or volatiles, or increases in temperature are given special attention. As is to be expected, this type of paper includes a very rich bibliography.

Jiracek's contribution "Near-Surface and Topographic Distortions in Electromagnetic Induction" is a carefully written review of an important topic in magnetotelluric (MT) studies: the correction for unwanted distortions, such as static shift. A very topical subject, where a great deal of research is still going on at present, is also considered: the decomposition of the impedance tensor, under the assumption of a 3-D near surface distortion superposed on a 1-D or 2-D regional setting, with the aim of recovering the regional structure. Conceptually many of these problems

appear simple, but are in fact poorly understood and the subject of controversy; the careful introduction presented by the author is therefore a most welcome contribution.

Cerv and Pek's review "Modelling and Analysis of Electromagnetic Fields in 3-D Inhomogeneous Media" is remarkable in its clarity and completeness, despite the difficulty of the subject. The paper comprises two distinct parts: the first deals with various 3-D modelling techniques and their comparison; the second considers the analysis of field data where new and more sophisticated methods, especially regarding the interpretation and decomposition of the MT tensor, are ever more frequently implemented.

Oldenburg has tackled the subject "Inversion of Electromagnetic Data: An Overview of New Techniques" and has concentrated especially on the 2-D MT problem. The basis and workings of the EMAP (Electromagnetic Array Processing), AIM (Approximate Inverse Mapping), and RRI (Rapid Relaxation Inverse) inversion methods are presented. The overview also deals with the practical aspects which must be considered in carrying out an inversion, such as model parameterization, methods of calculating first order sensitivities and linearizing the problem. This is a very timely contribution which makes the rather complex mathematics of MT inversion reasonably accessible to the non-specialist, but nevertheless covers most aspects of the question.

Spichak makes a survey of "EM-Field Transformations and their Use in Interpretation" in which he gives special attention to the work of Eastern colleagues. The subject is wide and many different techniques are in use. The first group of methods concerns the relations between field components measured either at a single site or at an array of sites. This leads to the concepts of impedance transformations and inductive operators. The second group of methods deals with the integral transformation of the data sets, particularly with a view to separating the data into either internal and external parts, or normal and anomalous parts, or into surficial and deep parts. The author has assembled and exhaustively collated a wide range of material published over the last five or six years. While it was not possible to treat every method in great detail, the reader will find this review an extremely useful guide in his own searches.

Constable discusses the status of "Marine Electromagnetic Studies" in an unusually narrative paper which is a pleasure to read. He succeeds in conveying his view without recourse to any mathematics and with very few illustrations. Sea floor induction studies are progressively abandoning single-site MT soundings for large, often multinational, experiments, combining simultaneous land and oceanographic recordings, as well as MT and geomagnetic depth soundings. Great advances have recently been made in controlled source experiments on the sea floor. The characteristics of the sea floor environment allow much larger source-receiver spacings than on land, indicating that the oceanic upper mantle is apparently very resistive, with resistivities of the order of $10^5 \Omega\text{m}$. This finding is apparently confirmed by sounding on land in coastal areas.

On Thursday October 27 a sightseeing excursion took all Workshop participants to Ritsa Lake, also known as the "Pearl of the Caucasus". Unfortunately the weather did not cooperate and the pearl could not be admired under the best of conditions, but shop-talk was thus encouraged.

Close to 200 participants from more than 25 countries attended the Sochi Workshop. Beside the review papers published here, 175 contributed papers were read or posted, the abstracts of which have been published by IZMIRAN as a separate booklet.

The Sochi Workshop was a great success, for which the induction community expresses its thanks to their organizing colleagues from the U.S.S.R. The next Workshop will be held in Ensenada (Mexico: Baja California) between August 22 and 29, 1990.

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