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Book Reviews

Landolt-Börnstein. Numerical Data and Functional Relationships in Science and Technology. New Series, Group V, Volume 1, Physical Properties of Rocks (Subvolume a), 373 p. Editor: Angenheister, G., Springer, Berlin, Heidelberg, New York 1982

This is the first volume on geophysical data within the new series of the Landolt-Börnstein table work, which has appeared on the market. Together with Subvolume b it contains laboratory data on physical properties of minerals and rocks, while geophysical "in situ" data of the solid earth are treated in Volume V.2. Compared with the previous edition of 1952 in which Astronomy and Geophysics were sharing one volume the expansion reflects the increasing demand of these data for geophysical data inversion and interpretation.

In contrast to other table works individual chapters begin usually with a rather comprehensive characterization and definition of the respective physical properties and the methods of their measurement. This almost encyclopedic character is, in some chapters, unterlined by key words in bold letters. All text pages are set up as double columns in English and German language simultaneously. This is not only convenient for German speaking users but may also be helpful for transcribing geophysical terms in both directions.

The first chapter, written by a competent petrographer (H.G. Huckenholz) gives an overview, especially for geophysicists, on nomenclature, genesis, composition, and structure of the rocks of the earth. Tables on densities of minerals and rocks at atmospheric pressure (J. Wohlenberg) are followed by an extensive list of high pressure shock wave data (D. Stöffler). A broad and profound section is devoted to quantities such as porosity, permeability, internal surface, and capillarity (J.R. Schopper), which have an important influence on many physical properties of sedimentary rocks. A rather lengthy list of individual porosity data, however, seems to be of limited value only for general use. Thermal properties of rocks under room- and elevated temperature conditions, and radioactive heat production, are thoroughly treated by V. Čermák, L. Rybach, M. Schuch, and supplemented by a short section on melting temperatures of rocks (R. Schmid).

Of course, a full appreciation of the content and completeness of the geophysical table work can only be given after the other volumes have been published. The weight of certain chapters and the preference of the physical units used is somewhat biased by the individual authors. Concerning the data sources used there appears to be a fair balance between European and Anglo-American references which is often not the case. In this respect, but also in stile and content, this book seems to be complementary to other modern table works on physical rock properties.

The arrangement and printing of text, tables and figures are of traditional Springer quality. This, in every respect very "valuable" table work should be available in central scientific libraries, in libraries of geoscience institutes where pure or applied research is carried out but may also be found useful for research in material sciences and civil engineering. A broader distribution, hower, will probably be prevented by its exorbitant price. **H. Berckhemer**

Yuen, C.K., Fraser, D.: Digital Spectral Analysis. CSIRO, Pitman Advanced Publishing Program, San Francisco, London, 1979

This book is a publication of a course of lectures on spectral analysis. It differs from currently available texts on spectral analysis and digital signal processing as it does not require a background in advanced mathematics and communication theory. This volume gives in the early chapters an introduction to mathematical and computational properties of Fourier Transform and Fast Fourier Transform applied to discrete values. Beside the potentials of these methods the limits are also pointed out. The following chapters discribe statistical treatments of discrete time series, e.g. autocorrelation, autoregression, power spectrum etc. Finally the very important technics of windowing, digital filtering and spectrum interpretation which are necessary when applying spectral analysis to real data are introduced. The appendix contains five Fortran computer programs for various transformations.

Since the matter is clearly arranged this book is a rather helpful guide for teaching this subject. Besides that it is a good introduction for students who intend to work in this area. It clearly points out the shortcomings of the various methods. This is of special relevance nowadays, since these functions are available at many computers and nobody should use them blindly. Every one who wants to apply these algorithms to real data needs, however, additional information about the spectral properties of the special data set. **Hermann Lühr**

Swinney, H.L. and Gollub, J.P. (eds.): Hydrodynamic Instabilities and the Transition to Turbulence. Springer, Berlin, Heidelberg, New York, 1981

"Hydrodynamic Instabilities and the Transition to Turbulence" is a collection of eight review articles written by hydrodynamicists and mathematicians for this book. In geophysics and other fields the interest in instabilities and turbulence is rising. A break-through seems to be pending. Freely quoted from the Preface by H.L. Swinney and J.P. Gollub: The transition from laminar flow to turbulent flow has until recently been beyond the reach of theory and experiment. The situation has been changed dramatically by the use of computers in laboratory experiments and in numerical analysis of nonlinear systems. Numerical studies of nonlinear models have also revealed unexpected results, such as chaotic behaviour in a system with only three variables. Another development is the application of new mathematical concepts from the qualitative theory of differential equations. More traditional methods such as bifurcation theory and stability analysis also continue to contribute new insights.

The various chapters include: introductions to the relationships between dynamical systems theory and turbulence (O.E. Lanford: 'Strange attractors and turbulence'; J.A. Yorke and E.D. Yorke: 'Chaotic behaviour and fluid dynamics); a review of hydrodynamic stability and bifurcation theory (by D.D. Joseph); three case studies – convection, rotating fluids, and shear flows (F.H. Busse: Transition to turbulence in Rayleigh-Benard convection; R.C. DiPrima and H.L. Swinney: Instabilities and transition in flow between concentric rotating cylinders; S.A. Maslowe: Shear flow instabilities and transition); a review of geophysical fluid instabilities (by D.J. Tritton and P.A. Davies); and a discussion of instabilities and chaotic behaviour in nonhydrodynamic systems (J.M. Guckenheimer).

The articles are not strictly introductory, but the authors have tried to make their chapters accessible to physicists, mathematicians, geophysicists, and engineers, who may not be specialists in fluid dynamics. Certainly the book provides an introduction to the literature of this rapidly growing field.

The book covers the spectrum from abstract mathematics to empirical observation, but the emphasis is on theory. It does not make easy reading, but it seems important in providing an insight into a complex subject. Up to recently turbulence was thought to be accessible only by statistics. We begin to understand now that turbulence is a property of systems that are sensitive to initial conditions. Such systems are sometimes described by only few parameters and by simple differential equations. The study of such 'simple' systems is an important step toward a deeper insight into nature.

I repeat: a break-through may be pending in understanding turbulence and chaos. It seems to require more sophisticated and

more abstract mathematics than many of us are used to. The book seems to be a good document of the state of the endeavors in that direction and of the developments to come. For everybody interested in the problems of geophysical fluid dynamics I consider the book highly recommendable and for libraries of institutions with any kind of interest in fluid dynamics I consider it a must.

W.R. Jacoby

D.H. Griffiths and R.F. King: Applied Geophysics for Geologists and Engineers (Second edition of "Applied Geophysics for Engineers and Geologists"), Pergamon Press, Oxford, 230 pp., 1981

"Applied Geophysics for geologists and engineers, the elements of geophysical prospecting" is exactly what the title promises. It is (the second revised edition of) a text which originally had been aimed at civil engineers but now gives more attention to the interests of geology students. "The scope of the book has therefore been broadened to include some discussion of geophysical methods used in prospecting for oil and other minerals, even though these methods will be of little or no interest to the civil engineer" "...this being reflected in considerable strengthening of the sections dealing with electromagnetic and induced polarization techniques. However, the bias of the book remains... toward the seismic and resistivity methods which dominate the field of engineering geophysics, and it does not pretend to be a comprehensive textbook...". There are also chapters "Gravity surveying" and "Magnetic surveying", "Geophysical borehole logging" and "Radiometric surveys and remote sensing".

Judging from my experience in teaching geophysics to geology students, I think the book is an excellent compromise between physical explanation, practical application, and theory using mathematical formulation. It describes the geophysical methods very accurately, though so much abbreviated (necessarily so) that only someone with considerable knowledge will realize how much is behind what is actually said. This is, of course, so much better than a description that has become inaccurate by its brevity. The authors generally try to make the problems intuitively understandable with only a minimum of abstract back-up. The book is well illustrated. A brief bibliography is added for those who want to learn more about the various methods; again I find the selection is appropriate for the readership of this book. Finally the book is completed by 12 quesions (followed by brief answers) for the student to work out.

I find this book a highly recommendable text of introcudtory applied geophysics for geologists and engineers, so much that I shall use my next opportunity of teaching such a course to test it in practice.

W.R. Jacoby

Krefelder und Lippstädter Gewölbe – die großen Querstrukturen am Rande des Ruhrkohlenbeckens. 439 Seiten, 83 Abbildungen, 31 Tabellen, 28 Tafeln. Krefeld, Geologisches Landesamt Nordrhein-Westfalen 1982. Fortschritte in der Geologie von Rheinland und Westfalen, Band 30.

Krefelder und Lippstädter Gewölbe sind zwei große Querstrukturen, die das Ruhrkohlenbecken im Westen und Osten begrenzen. Beide Gewölbe stellen Aufragungen älterer Schichten im Karbon der subvariscischen Vortiefe dar, die unter einem Deckgebirge aus Kreide- und jüngeren Schichten verborgen sind. Das Geologische Landesamt Nordrhein-Westfalen hat in Zusammenarbeit mit der Erdölindustrie die Forschungsbohrungen Schwarzbachtal 1 am Südostrand des Krefelder Gewölbes und Soest-Erwitte 1/1a im Lippstädter Gewölbe abgeteuft. Mit diesen Bohrungen wurde beabsichtigt, in den Gewölben einen Einblick in den devonischen und altpaläozoischen Unterbau des Ruhrkohlenbeckens zu erhalten.

Die Ergebnisse dieser Bohrungen regten umfangreiche interdisziplinäre Forschungsarbeiten an, über deren Ergebnisse in dem vorliegenden Band berichtet wird. In 19 Arbeiten ist von 26 Autoren ein umfangreiches Material über das Krefelder und Lippstädter Gewölbe zusammengetragen worden, das auch für die Erforschung der angrenzenden Gebiete von großem Wert ist. Neben regionalgeologischen, tektonischen, petrographischen und geochemischen Arbeiten stehen Forschungsergebnisse von Seismik, Magnetik, Geothermik, Gravimetrie, Magnetotellurik und Geoelektrik. Daß bei der Fülle des Materials der Überblick nicht verloren geht, dafür sorgen eine Einleitung und eine zusammenfassende Arbeit über „geklärte und ungeklärte Probleme" am Ende des Bandes. In einigen Arbeiten wäre es wünschenswert, wenn deutlicher zwischen Modellen, Hypothesen und gesicherten Erkenntnissen unterschieden würde. Das trifft besonders dann zu, wenn Ergebnisse jeweils anderer Fachbereiche als Beweismittel herangezogen werden.

Dieses Buch ist allen Geophysikern, die im Bereich der genannten Strukturen und in den angrenzenden Gebieten arbeiten, als Nachschlagewerk zu empfehlen.

Als Schulbeispiel interdisziplinärer geowissenschaftlicher Forschung dürfte dieser Band aber auch für Studenten von Interesse sein.

K. Knödel

Charles C. Bates, Thomas F. Gaskell, and Robert B. Rice: Geophysics in the Affairs of Man. A Personalized History of Exploration Geophysics and its Allied Sciences of Seismology and Oceanography. XX + 492 pp., Pergamon Press, Oxford, New York, Toronto, Sydney, Paris, Frankfurt, 1982.

The authors present an intriguing review of the history of applied geophysics and allied sciences. Main emphasis is attributed to the role and interaction of men and human organisations as governmental institutions and agencies, scientific organisations (universities and societies) and private (mainly commercial) enterprise. The authors restrict their report, but not exclusively, to Canada, Great Britain and the United States of America with emphasis on the latter. Though it must be admitted that the U.S. have a leading role in applied geophysics, especially seismics, the restriction to the above mentioned countries might have been mentioned already in the title or subtitle.

The book is divided into 9 chapters. Each chapter refers to genuine exploration geophysics for private enterprise, mainly the oil industry, but also to civil and military governmental applications of geophysical methods. Furthermore classical seismology and physical oceanography are two additional topics of most chapters. As to the geophysical methods most attention has been paid to the history of seismics.

After a short glance in Chapt. 1 on what happened before world war I, the authors devote Chapt. 2 to the "roaring twenties" and "the depressing thirties". They describe in detail how the first geophysical contractors developed in the U.S., partly flourished, and partly disappeared. The strong impetus to this development by Mintrop and his Seismos Ltd. company by 1924 is only shortly mentioned*), but more emphasis has been given to the technical progress achieved by the daring first geophysical companies of the U.S., especially to the advent of the reflection seismograph.

Non-seismic methods are also dealt with as Schlumberger's well logging, the torsion balance and the gravimeter, however, not mentioning the Thyssen gravimeter of Seismos Ltd., Germany, one of the first such field proven instruments (1934) of which about 100 pieces were constructed and sold all over the world before world war II.

In Chapt. 3 the development and application of geophysical methods for warfare in world war II is reported on. Detection of enemy artillery, influence mines, e.g. magnetic mines, and geophysical aspects of undersea warfare are the main topics.

Chapters 4 to 6 deal with the time from 1945 to 1970. Tremendous development is going on in exploration seismics. The introduction of magnetic recording, digital recording and processing,

* By the way, Mintrop did obviously not spoil the prices for the arising industry of exploration geophysics in the U.S., if footnote 9 of p. 25 is interpreted in favour of Mintrop

the common reflection point (CRP) method etc. are represented in an intriguing manner, giving due credit to the persons and companies involved.

Aeromagnetics, an offspring of the techniques of world war II's warfare, and other aerogeophysical methods are also duely dealt with.

Considerable attention is paid to the problem of detecting nuclear tests and the Vela Uniform project. Increased oceanographic activity gives rise to the conceptions of ocean spreading and plate tectonics and ensues the deep sea drilling program.

Chapter 7 comprises the 1970s and early 1980s. It deals especially with the problems caused by environmentalists and Opec. During this period the reflection seismic exploration of the crust and upper mantle was initiated by the COCORP effort.

The rest of the book is devoted to "geophysics as a business" (Chapt. 8) and to "personal achievements" of a selection of important geophysicists (Chapt. 9). In Chapt. 8 the history and achievements of 8 most important geophysical contractors are presented. Moreover, an Appendix was devoted to a broader version of the history of GSI and Texas Instruments. Prakla-Seismos GmbH was excluded from this list because it is government-owned as announced in a Note (Table 8.2, p. 301). I myself cannot understand this exclusion since some of the other major companies are owned by large holdings or the majority of shares is owned by government. By the way, it is not quite logical either, to mention Prakla-Seismos GmbH on the table of the eight largest geophysical contractors (p. 301) and to mention Prakla-Seismos GmbH once more on Table 8.7 where smaller seismic acquisition firms are dealt with (p. 343).

If I disregard these and some previous minor objections this book is an excellent presentation of the history of a rather young science, focussing on the human aspects of those persons who were active in promoting their sciences. It was a pleasure for me to read the book and let pass in review all the years when I was active in geophysics (since 1936), and all the persons mentioned, many of whom I know or knew.

Many figures, tables and photos enrich the book. Proper references, a name index and a subject index facilitate to follow up special problems. An index of abbreviations might have been an additional help, though each abbreviation is generally explained when it appears for the first time. **Th. Krey**

Kaufman, Alexander A. and Keller, George V.: The Magnetotelluric Sounding Method, Methods in Geochemistry and Geophysics, Vol. 15, 596 pp., Elsevier Scientific Publishing Company, Amsterdam 1981.

Das große Interesse an geothermischer Energie war Anlaß eines vom U.S. Geological Survey an der Colorado School of Mines geförderten Projektes zur Sicherung des gegenwärtigen Wissensstandes elektromagnetischer Prospektionsmethoden großer Eindringtiefe; speziell solchen zum Explorieren auf geothermische Energie. Einen Teil der Ergebnisse dieser Studie dokumentiert das vorliegende Buch. Nur einen Teil deshalb, weil neben der hierin ausschließlich behandelten Magnetotellurik (MT) auch andere Sondierungsmethoden: Controlled-Source (Time Domain, aktive Audio Magnetotellurik) und Gleichstromverfahren untersucht wurden.

Erklärtes Ziel dieses Buches ist es, eine möglichst umfassende Darstellung des physikalischen und mathematischen Apparates der MT in einem Bande zu geben. Dabei beschränken sich die Autoren auf die ‚klassische MT'; nicht zuletzt deshalb, weil diese Methode auch in fernab gelegenen Gebieten ohne künstliche Anregung auskommt und sie deshalb eine sehr große Verbreitung gefunden hat.

Ausgehend von den Quellen der natürlichen elektromagnetischen Felder wird in didaktisch hervorragender Weise die ganze Theorie der MT entwickelt. Für das Verständnis, besonders des Lernenden, sehr hilfreich sind die durchgängig zahlreichen Graphen für unterschiedliche Horizontalschichtmodelle. Hier wird das Einwirken der verschiedenen Parameter auf den scheinbaren spez. Widerstand und die Phasenbeziehungen besonders anschaulich.

Neben den Fragen nach den Gültigkeitsgrenzen des Modelles ebener Wellen, gerade auch unter dem Aspekt der Kugelgestalt der Erde, werden auf breitem Raum die Probleme der nicht horizontalen Schichtung und die eingelagerter Inhomogenitäten (Zylinder in E- und H-Polarisation) abgehandelt. Hier fehlt auch nicht die Diskussion magnetotellurischer Sondierungskurven über vertikalen Stufen, schräg einfallenden Leitfähigkeitsanomalien, Aufwölbungen oder Grabenstrukturen.

Im Gegensatz zum Vorangegangenen, sind die Themenkreise: Elliptische Polarisation und Impedanztensoren knapp dargestellt. Ebenso wird auch die Signalverarbeitung nur kurz angerissen. Hier findet man Ausführungen zum Dynamikbereich, den erforderlichen Abtastraten und der Meßdauer einer MT-Apparatur. Auch wird eine Übersicht gängiger Filter gegeben. Das aktuelle ‚Remote-Reference'-Verfahren, zur Verbesserung des Signal- zu Rauschverhältnisses, wird, wie auch der sehr große, komplexe Themenbereich der Inversion in nur einem sparsamen Unterabschnitt abgehandelt.

Das Kapitel Meßtechnik stellt unter anderem inzwischen ungebräuchliche E-Feld-Sonden wie auch Magnetometertypen vor. So findet sich neben der Beschreibung des SQUIDs die eines Torsionsmagnetometers mit Vacuumphotozelle und Röhrenverstärker. Ob letzteres noch zum ‚State of the Art' gezählt werden darf?

Ganz entsprechend der Herkunft beider Autoren schließen sich im letzten Abschnitt des Buches einige MT-Fallstudien aus der UdSSR bzw. den USA an: Kamchatka, Moskauer Becken, Kaukasus – The Geysers, Utah Thermal Belt .... Ganz entsprechend zitieren sie in der Literaturliste zur Hauptsache Autoren dieser beiden Lager; wobei die jüngsten Zitate auf 1979 datieren.

Zusammenfassend darf man sagen: Es handelt sich um ein Buch, gleichermaßen geeignet für denjenigen, der sich in die Theorie der MT einarbeiten oder es als Nachschlagewerk benutzen möchte. Da die Autoren das Schwergewicht auf den physikalisch-mathematischen Apparat gelegt haben, läßt das Buch für den Praktiker viele Wünsche offen. Bleibt aber zu hoffen, daß sie sich mit eben solcher Gründlichkeit in einem weiteren Bande der Theorie der hier ausgesparten Themen der Controlled-Source annehmen mögen. **Falko Kuhnke**

Kanasewich, E.R.: Time Sequence Analysis in Geophysics. University of Alberta Press, Edmonton, Canada, 3rd ed., 1981.

The third edition of this excellent textbook has been revised and appreciably extended to 480 pages. Five new chapters have been added as indicated below on subjects which were at most touched very briefly in the earlier editions. A few useful computer subroutines (FORTRAN) have been imbedded in the text. The book costs 30 Dollars (Canadian, I suppose) and for that price it is a real bargain. The quality of the make-up leaves nothing to be desired.

The sequence of subjects treated by the author is as follows: introduction, convolution, Fast Fourier transforms, Laplace transform, transfer function of linear systems, correlation and covariance, power spectrum and periodogram, aliasing, power spectral estimation, joint spectral analysis on two data sets, maximum entropy methods, maximum likelihood methods, properties of filters and minimum delay concept, deconvolution, band pass filters, wave propagation in layered media and filter theory, velocity filters, velocity spectra, polarization analysis, homomorphic deconvolution and cepstral analysis (new), Hilbert transforms (new), digital data acquisition and conversion (new), Walsh transform and data compression (new), and a chapter on generalized linear inverse theory (new). Seven useful appendices on subjects like Fourier transforms, delta functions, Wiener-Hopf equation, stationary time series and white noise, windows, filter stability and the Cooley-Tukey algorithm extend the information contained in the main text appreciably and could as well have been chapters in the book.

The list above looks complete to the scientist or student interested in time series analysis not only in geophysics. But it seems that longperiod seismology in a wide sense is excluded from geo-

physics by the author and this hurts a little. There is not even a single reference to the tricky methods for the analysis of dispersed wave-trains (surface wave seismology), namely time-frequency spectra and the more generally interesting implications of causality of linear systems on the relation between attenuation and dispersion. The modern methods of analysis of a sum of decaying cosinusoids (free oscillations) are not mentioned, although this very field is used as one of the prime examples of the importance of time series analysis in geophysics in the introductory chapter. The book does not contain a single reference to the analysis of tides. This shortcoming is especially sad, because these missing items comprise very interesting types of time series, a treatment of which could make the book very interesting to the nonseismologist. At least there should be references to these methods in the introduction or somewhere else. Of course, the addition of the chapter on generalized linear inverses could be said to contain implicitly some of the not discussed subjects (tides are usually analyzed by least squares).

Besides this obviously biassed look at geophysics from the point of view of an applied or short-period seismologist the book must be highly recommended to the student, the teacher and researcher in time series analysis including geophysics. **Walter Zürn**