Subsurface Geology – Petroleum, Mining, Construction

Compiled by L.W. LeRoy and D.O. LeRoy
Colorado School of Mines, 941 p., 1977
U.S. $28.50

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With the price of technical books escalating it is a welcome relief to see a high-standard geological book (encyclopedia?) come to your desk at such a low price (3.5¢ per page or $6.30 per pound). LeRoy and LeRoy have produced a major compilation on subsurface data and the geological techniques necessary to procure them.

Seventy-six contributors treat the fundamentals of subsurface geology relating to petroleum, mining and construction. The text is superbly illustrated with high quality black-and-white photographs (823 illustrations including the photographs) followed by a modest list of references and an index. The book is divided into eight parts: Introduction (24 p.), Laboratory Methods (114 p.), Petroleum Geology (340 p.), Mining Geology (110 p.), Construction Geology (166 p.), Other Subsurface Investigations (36 p.), Geologic Report (11 p.), and Applied Problems (76 p.).

The standard of treatment is uneven varying from the purely introductory to the overly technical. On the whole, the Petroleum part is the most impressive: it could be used as a text in an undergraduate course. The part on Mining pales in comparison. Besides an informative chapter on borehole television (why here?), there is little that would be new to someone who left school twenty years ago. New advances in strata control, rock burst mechanics and pit slope stability are not reflected in the treatment of these topics. This disappointment carries on to the part on Construction. Although the illustrations are superb, the material presented is too elementary to be of much use. There are however a few good chapters on groundwater, grouting and on legal implications of the construction business. On the other hand, such bread-and-butter subjects as slope stability and tunnel geology could have benefitted from reliance on the milestone works by Hoek and Bray *(Rock Slope Engineering)* and by Barton, Lien and Lunde *(Engineering Classification of Rock Masses for The Design of Tunnel Support)*.

A few very good chapters are found at the end of the book. In particular, chapters on remote sensing, land use, geothermal systems and wastewater injection introduce the reader to relatively new areas of geological investigation. The part on Applied Problems will be found most useful in the classroom.

All in all, *Subsurface Geology* deserves to be on your library shelf.

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Trends and Opportunities in Seismology

By The Committee on Seismology, Assembly of Mathematical and Physical Sciences, National Research Council (U.S.A.)
National Academy of Sciences, Washington, D.C., 158 p., 1977.
$6.95

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Seismology is a relatively new science which emerged at the turn of the century as a separate scientific discipline. At first it was concerned mainly with the study of earthquakes and earth structure but after World War I its potential as an applied science for the exploration of energy resources was soon realized. The nuclear detection problem stimulated a several-fold increase in financial support from various agencies such that during the past 20 years the development of the subject was greatly accelerated.

The book *Trends and Opportunities in Seismology* is a report by the Committee of Seismology, The National Research Council U.S.A., based on a workshop held in January 1976 in which 35 experts in the fields of geology, geophysics, and engineering, from academic, government and industry were invited to participate. In the words of D.L. Anderson, the Chairman, the workshop was held "to address the many problems of national and global concern that require seismological expertise for their solutions. This report reviews the history, accomplishments and status of seismology, assesses changing trends in seismological research and applications; and recommends future directions in the light of these changes and of the growing needs of society in areas in which seismology can make significant contributions".

This report achieves the goal set by its terms of reference in an excellent manner. In the first eight pages the 24 specific recommendations for future action taken from the later portion of the report are listed. Among these recommendations, a great emphasis is placed on long term stable and adequate funding for many important programs such as earthquake prediction, earthquake hazards with emphasis on the location of nuclear power plants, fundamental research, nuclear detection and the exploration of energy resources. The remainder of the report is divided into two parts.

In Part I entitled "Opportunities and Benefits" each of 13 major areas of concern, for example earthquake prediction or oil and gas to name two areas, are discussed in much more detail. In each discussion, arguments are presented as to why research in each area is important, what has already been accomplished and what the major unsolved problems are, and then gives its recommendations for future action. The roles of the federal government, state governments, industry and the university are presented separately. Each of these sections is well-written and not too technical so that anyone not familiar with the field can understand the significance of what is presented. As one reads these sections, one cannot

help but be impressed with the progress made so far in a number of areas such as earth structure and dynamics, plate tectonics, instrumentation, data analysis and the exploration for oil and gas.

In Part II entitled "Background and Progress", 14 background papers which were prepared by different experts for the workshop are presented. These papers summarize a number of important areas of the subject such as background and history, nuclear test monitoring, instrumentation, data processing, geodynamics, plate tectonics, theoretical seismology, structure and composition of the earth, earthquake source mechanism studies, engineering, seismology, strong ground motion and earthquake hazards, volcanoes, tsunamis, planetary seismology and the international aspects of seismology. Each section is three or four pages long and complements the material that was presented in Part I.

Although the report was written primarily for the national, state and local decision-makers and educators of the U.S.A., scientists working in related fields and other countries will find the report interesting and useful. In Appendix A, data on manpower, education and funding are presented and show that the employment picture for graduates with seismological backgrounds is particularly bright. The report as a whole is of great value to students contemplating a career in geoscience and may help graduate students in geophysics search for a thesis topic or area of research.

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Thermodynamics in Geology

Edited by Donald G. Fraser
D. Reidel Publishing Company, Dodrecht-Holland, 1977, 403 p.
$U.S. 11.95 (soft cover)

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This book is a collection of 19 invited chapters which were presented at a NATO Advanced Study Institute at Oxford in 1976. The editor states in the preface that each lecturer was asked to write a chapter suitable for use as a teaching text. Study problems to illustrate the principles are included at the end of most chapters. Unfortunately, solutions to these problems are not always presented.

The topics covered represent a reasonably comprehensive coverage of the state of the science. The contributors represent many of the outstanding experts in the field. Because of the interests of the contributors, the emphasis is on igneous and metamorphic applications. The chapters include calorimetry, mixing properties of garnets and clinopyroxenes, general principles of activity-composition relations using multi-site models and Margules parameters, methods of determination of atomic occupancies, evaluation of the accuracy and precision of calculated phase equilibria, extraction of thermodynamic properties from experimental phase equilibria, mixing properties of different species in fluids at high pressures and temperatures, fluid inclusions in metamorphic rocks, the stability of phlogopite, oxygen barometry and geothermometry using coexisting oxides from lunar basalts, thermodynamics of molten salt solutions and silicate melts, thermodynamics of trace element distribution, the solubility of calcite in sea water and non-equilibrium thermodynamics in metamorphism.

Although there is some overlap of the topics treated in the chapters, I feel that this is not a serious problem. Exposure to different viewpoints and styles of presentation of concepts is advantageous to the student of thermodynamics.

The chapters are rarely cross-referenced, which makes the book more of a collection of papers and less of a comprehensive text. Different notations are used in some chapters, e.g., $X\,CaAl_2Si0_6$, px; X^{fd}_{Ab}, for the mole fraction of a species in a phase, but this should not lead to difficulties. SI units are used in only one chapter.

The references cited at the end of chapters are presented in abbreviated form, including only the first page of the reference. While this feature was undoubtedly introduced as an economy move, it makes these lists of references far less useful to the student. Grover's chapter includes an annotated list of geological publications utilizing Margules parameters for excess functions.

The level of treatment and the brevity of the chapters suggests to me that the collection will be of use to advanced students and research workers. I would find this collection most useful in graduate seminars as a starting point for more extensive reading and discussion. The practicing geological thermodynamicist will want a copy of this book and the cost of the paper-cover edition is not excessive.

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