

# Thermodynamics in Geology

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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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Edited by Donald G. Fraser  
*D. Reidel Publishing Company,*  
*Dodrecht-Holland, 1977, 403 p.*  
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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.,  $X_{CaAl_2SiO_6}$ ,  $p_x$ ;  $X_{Ab}^{fd}$  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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