



REVIEWS in MINERALOGY

Volume 5
SECOND EDITION

ORTHO- SILICATES

PAUL H. RIBBE, Editor

C O N T E N T S

CLASSIFICATION of SILICATES

SILICATE GARNETS

ZIRCON

The ACTINIDE ORTHOSILICATES

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STAUROLITE

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Gordon E. Brown, Jr.

J. Alexander Speer & Paul H. Ribbe

MINERALOGICAL SOCIETY OF AMERICA

Reviews In Mineralogy Vol 5 Second Edition 1982
Orthosilicates

S.W. Bailey



Reviews In Mineralogy Vol 5 Second Edition 1982 Orthosilicates:

Orthosilicates Roger G. Burns, 2018-12-17 Volume 5 of Reviews in Mineralogy emphasizes the crystal chemistry and related physical properties of the major rock forming orthosilicates. Though in some chapters more attention is given to phase equilibria and paragenesis than in others, these are for the most part cursorily treated with references to the more important papers and to review articles. Also see Deer, Howie and Zussman 1962 *Rock forming Minerals Vol 1 Ortho and Ring Silicates*.

Characterization of Metamorphism through Mineral Equilibria John M. Ferry, 2018-12-17 Volume 10 of Reviews in Mineralogy reviews the use of a powerful probe into metamorphic process: mineral assemblages and the composition of minerals. Put very simply, this volume attempts to answer the question: What can we learn about metamorphism through the study of minerals in metamorphic rocks? It is not an encyclopedic summary of metamorphic mineral assemblages; instead, it attempts to present basic research strategies and examples of their application. Moreover, in order to limit and unify the subject matter, it concentrates on the chemical aspects of metamorphism and regrettably ignores other important kinds of studies of metamorphic rocks and minerals conducted by structural geologists, structural petrologists and geophysicists.

Spectroscopic Methods in Mineralogy and Geology Frank C. Hawthorne, 2018-12-17 Volume 18 of Reviews in Mineralogy provides a general introduction to the use of spectroscopic techniques in Earth Sciences. It gives an Introduction To Spectroscopic Methods and covers Symmetry Group Theory And Quantum Mechanics, Spectrum Fitting Methods, Infrared And Raman Spectroscopy, Inelastic Neutron Scattering, Vibrational Spectroscopy Of Hydrous Components, Optical Spectroscopy, Mossbauer Spectroscopy, MAS NMR Spectroscopy Of Minerals And Glasses, NMR Spectroscopy And Dynamic Processes In Mineralogy And Geochemistry, X Ray Absorption Spectroscopy Applications In Mineralogy and Geochemistry, Electron Paramagnetic Resonance, Auger Electron And X Ray Photoelectron Spectroscopies and Luminescence, X Ray Emission and New Spectroscopies. The authors of this volume presented a short course entitled *Spectroscopic Methods in Mineralogy and Geology* May 13-15 1988 in Hunt Valley, Maryland. *An Introduction to Mineral Sciences* A. Putnis, 1992-10-22. The subject of mineralogy is moving away from the traditional systematic treatment of mineral groups toward the study of the behaviour of minerals in relation to geological processes. A knowledge of how minerals respond to a changing geological environment is fundamental to our understanding of many dynamic earth processes. By adopting a materials science approach, *An Introduction to Mineral Sciences* explains the principles underlying the modern study of minerals, discussing the behaviour of crystalline materials with changes in temperature, pressure and chemical environment. The concepts required to understand mineral behaviour are often complex but are presented here in simple, non-mathematical terms for undergraduate mineralogy students. After introductory chapters describing the principles of diffraction, imaging and the spectroscopic methods used to study minerals, the structure and behaviour of the main groups of rock-forming minerals are covered and the role of defects in the deformation and transformation of a mineral are explained. The energy changes and the

rate of transformation processes are introduced using a descriptive approach rather than attempting a complete and rigorous treatment of the thermodynamics and kinetics. Examples and case histories from a range of mineral groups are set in an earth science context such that the emphasis of this book is to allow the student to develop an intuitive understanding of the structural principles controlling the behaviour of minerals.

Thermodynamic Modeling of Geologic Materials Ian S. E. Carmichael, Hans Eugster, 2018-12-17 Volume 17 of Reviews in Mineralogy is based on a short course entitled Thermodynamic Modeling of Geological Materials: Minerals, Fluids and Melts, October 22-25, 1987, at the Wickenburg Inn near Phoenix, Arizona. Contents: Thermodynamic Analysis of Phase Equilibria in Simple Mineral Systems; Models of Crystalline solutions; Thermodynamics of Multicomponent Systems Containing Several Solid Solutions; Thermodynamic Model for Aqueous Solutions of Liquid-like Density; Models of Mineral Solubility in Concentrated Brines with Application to Field Observations; Calculation of the Thermodynamic Properties of Aqueous Species and the Solubilities of Minerals in Supercritical Electrolyte Solutions; Igneous Fluids: Ore Fluids; Magmatic to Supergene; Thermodynamic Models of Molecular Fluids at the Elevated Pressures and Temperatures of Crustal Metamorphism; Mineral Solubilities and Speciation in Supercritical Metamorphic Fluids; Development of Models for Multicomponent Melts; Analysis of Synthetic Systems; Modeling Magmatic Systems; Thermodynamic Relations; Modeling Magmatic Systems; Petrologic Applications.

Stable Isotopes in High Temperature Geological Processes John W. Valley, Hugh P. Taylor, James R. O'Neil, 2018-12-17 Volume 16 of Reviews in Mineralogy introduces to high temperature stable isotope geochemistry and should provide an entry into the pertinent literature as well as some understanding of the basic concepts and potential applications. The first three chapters focus on the theory and experimental data base for equilibrium, disequilibrium and kinetics of stable isotope exchange reactions among geologically important minerals and fluids. The fourth chapter discusses the primordial oxygen isotope variations in the solar system prior to formation of the Earth along with a discussion of isotopic anomalies in meteorites. The fifth chapter discusses isotopic variations in the Earth's mantle and the sixth chapter reviews the variations in the isotopic compositions of natural waters on our planet. In Chapters 7, 8, 9 and 10 these isotopic constraints and concepts are applied to various facets of the origin and evolution of igneous rocks, bringing in much material on radiogenic isotopes as well because these problems require a multi-dimensional attack for their solution. In Chapters 11 and 12 the problems of hydrothermal alteration by meteoric waters and ocean water are considered together with discussions of the physics and chemistry of hydrothermal systems and the ^{18}O - ^{16}O history of ocean water. Finally in Chapters 13 and 14 these concepts are applied to problems of metamorphic petrology and ore deposits, particularly with respect to the origins of the fluids involved in those processes.

Mathematical Crystallography Monte B. Boisen, Gerald V. Gibbs, 2018-12-17 Volume 15 of Reviews in Mineralogy is written with two goals in mind. The first is to derive the 32 crystallographic point groups, the 14 Bravais lattice types and the 230 crystallographic space group types. The second is to develop the mathematical tools necessary for these derivations in

such a manner as to lay the mathematical foundation needed to solve numerous basic problems in crystallography and to avoid extraneous discourses To demonstrate how these tools can be employed a large number of examples are solved and problems are given The book is by and large self contained In particular topics usually omitted from the traditional courses in mathematics that are essential to the study of crystallography are discussed For example the techniques needed to work in vector spaces with noncartesian bases are developed Unlike the traditional group theoretical approach isomorphism is not the essential ingredient in crystallographic classification schemes Because alternative classification schemes must be used the notions of equivalence relations and classes which are fundamental to such schemes are defined discussed and illustrated For example we will find that the classification of the crystallographic space groups into the traditional 230 types is defined in terms of their matrix representations Therefore the derivation of these groups from the point groups will be conducted using the 37 distinct matrix groups rather than the 32 point groups they represent

Antarctic Journal of the United States, 1989 **The Al₂SiO₅ Polymorphs** Derrill M. Kerrick, 2018-12-17 Volume 22 of Reviews in Mineralogy is a book exclusively devoted to three minerals the Al₂SiO₅ polymorphs andalusite sillimanite and kyanite It covers a wide variety of topics that must be considered in the analysis of metamorphic systems and illustrates the fact that modern metamorphic petrology demands an awareness of a wide spectrum of geologic variables and processes This volume is intended to provide a comprehensive review summarizing the methods theories and pitfalls of the various contributions on the aluminum silicates Several sections of this book present the chronological development of research on various topics giving readers historical perspectives on the development of theories models and biases on various problems regarding the aluminum silicates

Mineral-Water Interface Geochemistry Michael F. Hochella, Art F. White, 2018-12-17 Volume 23 of Reviews in Mineralogy and accompanying MSA short course covers chemical reactions that take place at mineral water interfaces We believe that this book describes most of the important concepts and contributions that have driven mineral water interface geochemistry to its present state We begin in Chapter 1 with examples of the global importance of mineral water interface reactions and a brief review of the contents of the entire book Thereafter we have divided the book into four sections including atomistic approaches Chapters 2 3 adsorption Chapters 4 8 precipitation and dissolution Chapters 9 11 and oxidation reduction reactions Chapters 11 14 *Geochemistry and Mineralogy of Rare Earth Elements* Bruce R. Lipin, G.A. McKay, 2018-12-17 Volume 21 of Reviews in Mineralogy treats a short course on the rare earth elements to about 80 participants in San Francisco California December 1 3 1989 just prior to the fall meeting of the American Geophysical Union Contents Cosmochemistry of the Rare Earth Elements Condensation and Evaporation Processes Radiogenic Isotope Geochemistry of Rare Earth Elements Partitioning of Rare Earth Elements between Major Silicate Minerals and Basaltic Melts An Approach to Trace Element Modeling Using a Simple Igneous System as an Example Rare Earth Elements in Upper Mantle Rocks Rare Earth Elements in Metamorphic Rocks Rare Earth Elements in Sedimentary Rocks Influence of Provenance and Sedimentary

Processes Aqueous Geochemistry of Rare Earth Elements Rare Earth Elements in Lunar Materials Compositional and Phase Relations among Rare Earth Element Minerals Economic Geology of Rare Earth Minerals Cathodoluminescence Emission Spectra of Rare Earth Element Activators in Minerals **Hydrous Phyllosilicates** S. W. Bailey, 2018-12-17 Volume 13 of Reviews in Mineralogy presents much of our present day knowledge of micas Since 1984 was too much material available to attempt to cover all of the hydrous phyllosilicates in one volume the micas were treated first because of their abundance in nature and the fact that many detailed studies had been carried out on them The serpentines kaolins smectites chlorites etc would have to wait their turn Now four years later that turn has come Hence the peculiar nature of the title of this volume We know less about the rest of the phyllosilicates than we do about the micas primarily because many of them are of finer grain sizes and lower crystallinities than most of the micas As a result we have been unable to determine as much detail regarding their structures crystal chemistries and origins One compensating factor that has helped greatly in the accumulation of knowledge about these minerals is that some of them occur in large deposits that are of great economic value and thus stimulate interest For this reason considerable emphasis in this volume will be related to the occurrence origin and petrology of the minerals *Micas* S.W. Bailey, 2018-12-17 Volume 13 of Reviews in Mineralogy attempts to gather together much of our knowledge of micas the most abundant phyllosilicate and to indicate promising areas of future research Chapters 1 3 lay the foundations of the classification structures and crystal chemistry of micas Chapter 4 treats bonding and electrostatic modeling of micas Chapters 5 and 6 cover spectroscopic and optical properties Chapters 7 13 the bulk of the volume are devoted to geochemistry and petrology These include phase equilibria and the occurrences chemistry and petrology of micas in igneous metamorphic and sedimentary rocks pegmatites and certain ore deposits Some treatments are exhaustive All are at the forefront of our present knowledge and indicate clearly the practical applications of the study of micas to ascertaining various parameters of origin and crystallization history as well as the many problems that still exist The aim of this type of treatment is to provide a reference volume for teachers and students and to enable researchers to pick more easily those directions and problems for which future research is most needed or is apt to be most productive or most challenging

Minerals and Reactions at the Atomic Scale Peter R. Buseck, 2018-12-17 Volume 27 of Reviews in Mineralogy provides a background to the TEM as a mineralogical tool to give an introduction to the principles underlying its operation and to explore mineralogical applications and ways in which electron microscopy can augment our knowledge of mineral structures chemistry and origin Much time will be devoted to mineralogical applications It provides sufficient information to allow mineralogists and petrologists to have an informed understanding of the data produced by transmission electron microscopy and to have enough knowledge and experience to undertake initial studies on their own The opening chapters cover the principles of electron microscopy and chemical analysis using the TEM while the following chapters consider mineralogical petrological and geochemical applications and their implications for both low and high temperature geological environments

The Mineralogical Society of America sponsored a short courses in conjunction with their annual meetings with the Geological Society of America and this volume represents the proceedings of the eighteenth in the sequence This TEM course was convened October 23 25 1992 at Hueston Woods State Park College Comer Ohio XAFS for Everyone Scott Calvin, 2013-05-20 XAFS for Everyone provides a practical thorough guide to x ray absorption fine structure XAFS spectroscopy for both novices and seasoned practitioners from a range of disciplines The text is enhanced with more than 200 figures as well as cartoon characters who offer informative commentary on the different approaches used in XAFS spectroscopy The book covers sample preparation data reduction tips and tricks for data collection fingerprinting linear combination analysis principal component analysis and modeling using theoretical standards It describes both near edge XANES and extended EXAFS applications in detail Examples throughout the text are drawn from diverse areas including materials science environmental science structural biology catalysis nanoscience chemistry art and archaeology In addition five case studies from the literature demonstrate the use of XAFS principles and analysis in practice The text includes derivations and sample calculations to foster a deeper comprehension of the results Whether you are encountering this technique for the first time or looking to hone your craft this innovative and engaging book gives you insight on implementing XAFS spectroscopy and interpreting XAFS experiments and results It helps you understand real world trade offs and the reasons behind common rules of thumb *Modern Powder Diffraction* David L. Bish, Jeffrey E. Post, 2018-12-17 Volume 20 of Reviews in Mineralogy attempted to 1 provide examples illustrating the state of the art in powder diffraction with emphasis on applications to geological materials 2 describe how to obtain high quality powder diffraction data and 3 show how to extract maximum information from available data In particular the nonambient experiments are examples of some of the new and exciting areas of study using powder diffraction and the interested reader is directed to the rapidly growing number of published papers on these subjects Powder diffraction has evolved to a point where considerable information can be obtained from μg sized samples where detection limits are in the hundreds of ppm range and where useful data can be obtained in milliseconds to microseconds We hope that the information in this volume will increase the reader's access to the considerable amount of information contained in typical diffraction data **Kinetics of Geochemical Processes** Anthonio C. Lasaga, James Kirkpatrick, 2018-12-17 Volume 8 of Reviews in Mineralogy treats a Short Course in Kinetics which brings together the fundamentals needed to explain field observations using kinetic data It is hoped that this book may serve not only as a reference for researchers dealing with the rates of geochemical processes but also as a text in courses on geochemical kinetics The book is organized with a rough temperature gradient in mind i e low temperature kinetics at the beginning and igneous kinetics at the end However the topics in each chapter are general enough that they can be applied often to any geochemical domain sedimentary metamorphic or igneous The theory of kinetics operates at two complementary levels the phenomenological and the atomistic The former relies on macroscopic variables e g temperature or

concentrations to describe the rates of reactions or the rates of transport the latter relates the rates to the basic forces operating between the particular atomic or molecular species of any system This book deals with both descriptions of the kinetics of geochemical processes **Neues Jahrbuch für Mineralogie** ,1985 Contact Metamorphism Derrill M. Kerrick,2018-12-17 Volume 26 of Reviews in Mineralogy provides a multidisciplinary review of our current knowledge of contact metamorphism As in any field of endeavor we are provided with new questions thereby dictating future directions of study Hopefully this volume will provide inspiration and direction for future research on contact metamorphism The Mineralogical Society of America sponsored the short course on Contact Metamorphism October 17 19 1991 at the Pala Mesa Resort Fallbrook California prior to its annual meeting with the Geological Society of America **Handbook of Soil Sciences** Pan Ming Huang,Yuncong Li,Malcolm E. Sumner,2011-11-17 An evolving living organic inorganic covering soil is in dynamic equilibrium with the atmosphere above the biosphere within and the geology below It acts as an anchor for roots a purveyor of water and nutrients a residence for a vast community of microorganisms and animals a sanitizer of the environment and a source of raw materials for co

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