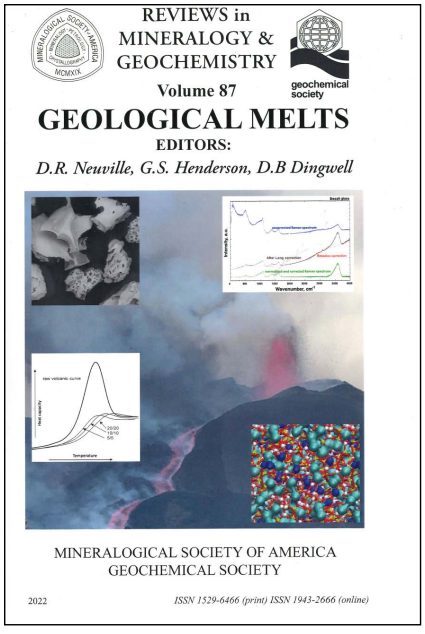
Book Review

Book Review: Geological Melts, Reviews in Mineralogy and Geochemistry, Volume 87 (2022) Daniel R. Neuville, Grant S. Henderson and Donald B. Dingwell, editors. i–xix + 1088 pages. ISBN 978-1-946850-08-9



Twenty-seven years after the pioneering volume on silicate melts (Vol. 32, Stebbins et al. 1995), a new volume on magmas and melts of geological relevance has been published. While the old volume focused on structural, chemical, and physical properties of melts and glasses—the material sensu-strictu—this volume provides a significantly larger topical range that includes the specific role of melts or magmas in geologically relevant processes. In addition, a few aspects of this volume consider properties of glasses, including their technical and cultural relevance.

Several chapters deal with structural properties and make links to bulk properties of melts and glasses. The collection of articles highlights the complex interplay of short-, medium-, and long-range order that all control macroscopic properties such as density and viscosity or transport on the microscopic scale. A notable weakness of this volume is its need for a more complete collection of new literature emphasizing short-range order. Not missing is a chapter wrapping up recent developments on diffusion, particularly on the treatment of multi-component diffusion as well as current knowledge on crystal nucleation and growth. Compared to the 1995 volume, the computational power has substantially evolved, so that the reader is offered insights into the latest results from numerical simulation studies as well as the added value that may be gained by combining lab experiments with computationally derived structural models. In the last decade, substantial experimental and computational progress has been made regarding glasses/melts at extreme pressures, relevant to the lower mantle. Unfortunately, this is only reflected in a limited manner in the given chapter, but relevant links are given to literature on this topic. No book on magmas and melts would be complete without a treatment of chemical thermodynamics. This volume focuses specifically on the treatment of equilibria in multi-component melts and equilibria in gas-melt systems. They provide fundamental basics, highlight the complexity of developing comprehensive models, and illustrate the current possibilities and limitations. The formation of melts at depth is only treated in light of the role of volatile components and how melts contribute to mobilizing these components during planetary evolution. This certainly reflects the scientific activities of the past decades regarding the deep volatile-cycles of the Earth.

The largest part of the volume deals with aspects that are related to transport properties of melts and magmas, with a strong emphasis on magma rheology. The added value of this compilation of articles is that it emphasizes various fundamental natural processes (i.e, magma fragmentation, magma mixing, magma sintering, strain-localized flow or suspension rheology) and their relation to magma properties. These chapters address phenomena that are ubiquitous in natural observations, but challenging to describe and analyze in a quantitative manner. The chapters provide a connection between the observation (e.g., natural evidence for magma mixing or strain localization on outcrop scale) and the responsible processes and their theoretical description. The observations are linked to various physical constraints and magma parameters and ways are indicated to quantify them. In the case of magma-mixing, the authors illustrate how lab experiments and theoretical fluid-dynamic descriptions lead to numerical simulations that allow for assessing magma-mixing scenarios and how these results can be used to decipher textures found in natural rocks. Pyroclastic rocks represent large parts of deposits produced in explosive volcanism. The authors show ways how to understand the parameters controlling magma fragmentation and how this gives way to deriving the dynamics of volcanic systems throughout their geological lifetime. There are a couple of more exotic topics that found their home in this volume, such as frictional melting, non-magmatic glasses or non-terrestrial melts, that may only be of interest to a limited readership at first sight. However, the neighborhood to the more classical topics in the same volume may foster cross-fertilization between different communities.

Overall, this volume provides a huge range of topics largely related to geological melts and thus, provides a timely compendium on magma properties and their role in magmatic/volcanic processes. It may not fully replace the former volume, but rather extends it by linking the perspective on the material itself to the one on the geological processes observed in nature and geological archives.

Max Wilke
Institut für Geowissenschaften
Universität Potsdam
Germany

0003-004X/23/0004–786$05.00/DOI: https://doi.org/10.2138/am-2023-B10843

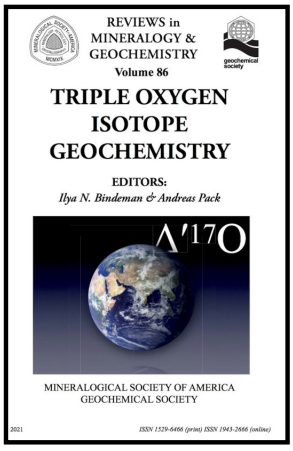
Reviews in Mineralogy and *Reviews in Mineralogy and Geochemistry*

Reviews in Mineralogy and, later, *Reviews in Mineralogy and Geochemistry* are two series of multi-authored, soft-bound volumes containing concise reviews of the literature and advances in theoretical and/or applied mineralogy, crystallography, petrology, and geochemistry. The content of each volume consists of fully developed text which can be used for self-study, research, or as a text-book for graduate-level courses. *Reviews* volumes are typically produced in conjunction with a short course, but can also be published without a short course. The series is jointly published by the Mineralogical Society of America (MSA) and the Geochemical Society.

Reviews volumes are available in hard copy from the MSA Bookstore, by subscription for online access, and electronically, as pdfs, at this link: www.minpubs.org.

Reviews Titles

Volume 86 Triple Oxygen Isotope Geochemistry
Volume 85 Reactive Transport in Natural and Engineered Systems
Volume 84 High Temperature Gas–Solid Reactions in Earth and Planetary Processes
Volume 83 Petrochronology: Methods and Applications
Volume 82 Non-Traditional Stable Isotopes
Volume 81 Highly Siderophile and Strongly Chalcophile Elements in High-Temperature Geochemistry and Cosmochemistry
Volume 80 Pore-Scale Geochemical Processes
Volume 79 Arsenic, Environmental Geochemistry, Mineralogy, and Microbiology
Volume 78 Spectroscopic Methods in Mineralogy and Materials Sciences
Volume 77 Geochemistry of Geologic CO2 Sequestration
Volume 76 Thermodynamics of Geothermal Fluids
Volume 75 Carbon in Earth
Volume 74 Applied Mineralogy of Cement & Concrete
Volume 73 Sulfur in Magmas and Melts: Its Importance for Natural and Technical Processes
Volume 72 Diffusion in Minerals and Melts
Volume 71 Theoretical and Computational Methods in Mineral Physics: Geophysical Applications
Volume 70 Thermodynamics and Kinetics of Water-Rock Interaction
Volume 69 Minerals, Inclusions and Volcanic Processes
Volume 68 Oxygen in the Solar System
Volume 67 Amphiboles: Crystal Chemistry, occurrences, and Health Issues
Volume 66 Paleoaltimetry: Geochemical and Thermodynamic Approaches
Volume 65 Fluid-Fluid Interactions
Volume 64 Medical Mineralogy and Geochemistry
Volume 63 Neutron Scattering in Earth Sciences
Volume 62 Water in Nominally Anhydrous Minerals
Volume 61 Sulfide Mineralogy and Geochemistry
Volume 60 New Views of the Moon
Volume 59 Molecular Geomicrobiology
Volume 58 Low-Temperature Thermochronology: Techniques, Interpretations, and Applications
Volume 57 Micro- and Mesoporous Mineral Phases
Volume 56 Epidotes
Volume 55 Geochemistry of Non-Traditional Stable Isotopes
Volume 54 Biomineralization
Volume 53 Zircon
Volume 52 Uranium-Series Geochemistry
Volume 51 Plastic Deformation of Minerals and Rocks
Volume 50 Beryllium Mineralogy, Petrology, and Geochemistry
Volume 49 Applications of Synchrotron Radiation in Low-Temperature Geochemistry and Environmental Science
Volume 48 Phosphates Geochemical, Geobiological, and Materials Importance
Volume 47 Noble Gases in Geochemistry and Cosmochemistry
Volume 46 Micas: Crystal Chemistry & Metamorphic Petrology
Volume 45 Naturnal Zeolites: Occurrence, Properties, Applications
Volume 44 Nanoparticles and the Environment
Volume 43 Stable Isotope Geochemistry
Volume 42 Molecular Modeling Theory: Applications in the Geosciences
Volume 41 High-Temperature and High-Pressure Crystal Chemistry
Volume 40 Sulfate Minerals - Crystallography, Geochemistry, and Environmental Significance
Volume 39 Transformation Proceses in Minerals
Volume 38 Uranium: Mineralogy, Geochemistry and the Environment
Volume 37 Ultrahigh-Pressure Mineralogy: Physics and Chemistry of the Earth's Deep Interior
Volume 36 Planetary Materials

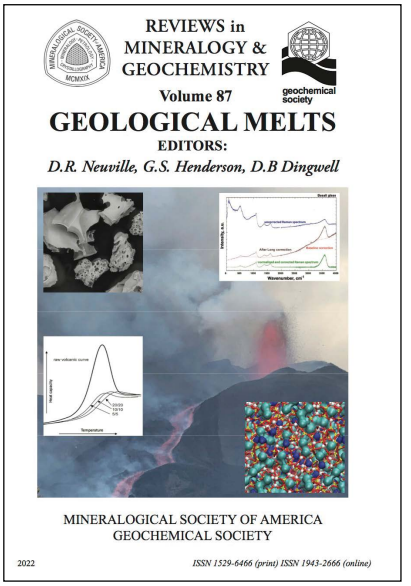


Volume 35 Geomicrobiology: Interaction Between Microbes and Minerals
Volume 34 Reactive Transport in Porous Media
Volume 33 Boron Mineralogy, Petrology and Geochemistry
Volume 32 Structure, Dynamics and Properties of Silicate Melts
Volume 31 Chemical Weathering Rates of Silicate Minerals
Volume 30 Volatiles in Magmas
Volume 29 Silica: Physical Behavior, Geochemistry and Materials Applications
Volume 28 Health Effects of Mineral Dusts
Volume 27 Minerals and Reactions at the Atomic Scale: Transmission Electron Microscopy
Volume 26 Contact Metamorphism
Volume 25 Oxide Minerals:Petrologic and Magnetic Significance
Volume 24 Modern Methods of Igneous Petrology: Understanding Magmatic Processes
Volume 23 Mineral-Water Interface Geochemistry
Volume 22 The Al2SiO5 Polymorphs
Volume 21 Geochemistry and Mineralogy of Rare Earth Elements
Volume 20 Modern Powder Diffraction
Volume 19 Hydrous Phyllosilicates (exclusive of micas)
Volume 18 Spectroscopic Methods in Mineralogy and Geology
Volume 17 Thermodynamic Modeling of Geological Materials: Minerals, Fluids and Melts
Volume 16 Stable Isotopes in High Temperature Geological Processes
Volume 15 Mathematical Crystallography
Volume 14 Microscopic to Macroscopic
Volume 13 Micas
Volume 12 Fluid Inclusions
Volume 11 Carbonates: Mineralogy and Chemistry
Volume 10 Characterization of Metamorphism through Mineral Equilibria
Volume 9 Amphiboles and Other Hydrous Pyriboles - Mineralogy
Volume 9 Amphiboles: Petrology and Experimental Phase Relations
Volume 8 Kinetics of Geochemical Processes
Volume 7 Pyroxenes
Volume 6 Marine Minerals
Volume 5 Orthosilicates, Second Edition
Volume 4 Mineralogy and Geology of Natural Zeolites
Volume 3 Oxide Minerals
Volume 2 Feldspar Mineralogy
Volume 1 Sufide Mineralogy

Announcement: Two *New* *Reviews in Mineralogy & Geochemistry* Volumes

The Mineralogical Society of America is delighted to announce the availability of two exciting new volumes in the *Reviews in Mineralogy & Geochemistry* series.

Volume 87: *Geological Melts*
Daniel R. Neuville, Grant S. Henderson, and Donald B. Dingwell, editors



From the preface to the volume:

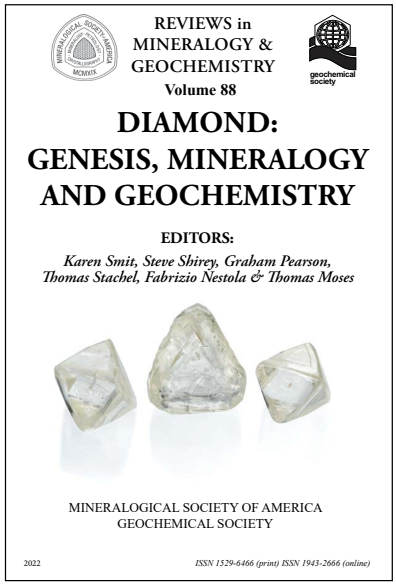
Collected in this volume are a compact set of chapters covering fundamental aspects of the nature of silicate melts and the implications for the systems in which they participate, both technological and natural. The contents of this volume may perhaps best be summarized as structure – properties – dynamics. The volume contains syntheses of short and medium range order, structure-property relationships, and computation-based simulations of melt structure. It continues with analyses of the properties (mechanical, diffusive, thermochemical, redox, nucleation, rheological) of melts. The dynamic behavior of melts in magmatic and volcanic systems, is then treated in the context of their behavior in magma mixing, strain localization, frictional melting, magmatic fragmentation, and hot sintering. Finally, the non-magmatic, extraterrestrial and prehistoric roles of melt and glass are presented in their respective contexts.

Volume 88: *Diamond: Genesis, Mineralogy and Geochemistry*
Karen Smit, Steven Shirey, Graham Pearson, Thomas Stachel, Fabrizio Nestola, and Thomas Moses, editors

This is an open access volume sponsored by the Gemological Institute of America, the Deep Carbon Observatory, and the Geological Survey of Canada.

From the preface to the volume:

The purpose and goal of this new volume is to assemble all the chief current knowledge about natural diamond in one body for the use of the Earth Science community. The contents of this volume are wide-ranging, with the goal to leave little out so that any scientist could reach for this volume to obtain as much basic diamond knowledge as necessary. RiMG volumes have always served this role. An important feature of Diamond: Genesis, Mineralogy and Geochemistry is that the authors of several chapters used new and up-to-date databases that were expressly compiled for the purposes of accuracy in writing their chapters. These databases are available for community use at: https://dataverse.scholarsportal.info/dataverse/diamond.



MSA wishes to extend its thanks to the volumes' editors, authors, and sponsors, as well as Ian Swainson, Series Editor, and Rachel Russell, Managing Editor of *American Mineralogist.* Both volumes are available to purchase in hard copy from the MSA Bookstore: https://msa.minsocam.org/publications.html. For any questions, please contact the MSA Business office at business@minsocam.org.