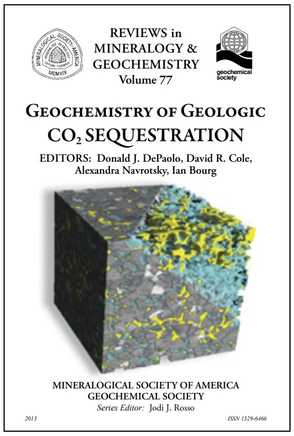
GEOCHEMISTRY OF GEOLOGIC CO_2 SEQUESTRATION[3]

Geochemistry of Geologic CO_2 Sequestration, RiMG volume 77 published by the Mineralogical Society of America and the Geochemical Society, is mainly an outgrowth of research conducted by members of the U.S. Department of Energy–funded Energy Frontier Research Center, known as the Center for Nanoscale Control of Geologic CO_2 (NCGC), but it contains a few contributions from experts outside this program.



Finding technologies to mitigate CO_2 emissions into the atmosphere is one of the great challenges we face given the ever-increasing demand for fossil fuels. Implementation of large-scale carbon capture and storage, where carbon dioxide is captured from stationary sources as well as directly from the atmosphere and injected underground for storage in porous rock formations, could result in a significant reduction of CO_2 emissions. However, the effectiveness of geologic CO_2 storage will depend on finding suitable reservoirs in which CO_2 will remain for thousands of years with only minimal leakage back to the surface. To predict the transport and ultimate fate of the injected CO_2, we have to understand the chemical interactions occurring in a CO_2–H_2O–mineral/rock system. Aqueous-dominated systems containing CO_2 and water-bearing supercritical CO_2 systems are equally important in terms of chemical reactions, but the latter have not received enough attention from the research community so far. In both systems, chemical reactions can have a significant impact on the reservoir rocks as well as on the flow and transport of CO_2 and reservoir brine. Thus, long-term CO_2 trapping within rocks will be determined by geochemistry.

Geochemistry of Geologic CO_2 Sequestration comprehensively addresses many of the geochemical aspects related to geologic CO_2 storage. The 15 chapters are written by an international group of well-known and accomplished experts. Various topics on different scales, from molecular simulations of CO_2–brine–mineral systems to pore, wellbore, and reservoir processes, are addressed. In addition, topics such as natural analogues of CO_2 storage, carbon mineralization, caprock stability, acid gas co-injection, and geochemical monitoring for potential environmental impacts of CO_2 storage are discussed. Even though the purpose of this book is not to provide detailed instructions in fundamentals and present various laboratory and modeling techniques, some chapters do discuss fundamentals and technical issues related to experiments and modeling. Examples are the thermodynamics of carbonates, *P–V–T–X* properties of H_2O–CO_2–brine systems at relevant conditions, contact angles and wettability of supercritical CO_2, reactor experiments for mineral dissolution and precipitation studies, multiscale imaging techniques for studying pore-scale properties, and modeling approaches for simulating pore-scale processes.

Although the volume is already expansive, there are no single chapters dedicated specifically to the questions of upscaling, the coupling between chemical and mechanical processes, and the role of biogeochemistry in CO_2 sequestration. The issue of upscaling pore-scale processes to the larger continuum scale is briefly mentioned in chapter 8 by Steefel and others. However, a more integrated discussion of how processes on the molecular/pore scale are upscaled to the continuum scale of porous media would be valuable for the reader. In addition, there is a large body of recently published work that discusses geomechanical responses to the injection of CO_2 into underground reservoirs and the coupling between chemical and mechanical processes, but these topics are not represented in this volume. Similarly, the book does not cover research conducted to understand the role of microbes in mineral dissolution and precipitation reactions, although Power and others discuss some of the relevant microbial processes in chapter 9. Personally, I would have appreciated separate chapters on these important topics. Regardless of these shortcomings, the breadth of the contributions in this volume is remarkable. Especially useful for the reader is an account, at the end of each chapter, of what remains to be discovered and possible directions for future research. *Geochemistry of Geologic CO_2 Sequestration* will be a valuable resource for students and researchers involved in geologic carbon sequestration research. I highly recommend it.

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3 DePaolo DJ, Cole DR, Navrotsky A, Bourg I (eds) (2013) Geochemistry of Geologic CO_2 Sequestrations. Mineralogical Society of America, Review in Mineralogy & Geochemistry 77, i-xiv + 539 pages, ISBN 978-0-939950-92-8, US$40 (25% discount for MSA, CMS and GS members)