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# Book Review

***Book Review: Geochemical Rate Models: An Introduction to Geochemical Kinetics.*** By J. Donald Rimstidt (2013) Cambridge University Press, 232 p. $84.99 Hardback, ISBN: 9781107029972.

The book *Geochemical Rate Models: An Introduction to Geochemical Kinetics* by Don Rimstidt is a delight to read and fills an urgent need for students of geochemistry. Over the last two decades, there has been a tremendous increase in the literature on the topic of reaction kinetics. For example, a search on the Web of Science database using the keyword "kinetics" shows that over the last 25 years, there has been an increased number of articles in the leading journal *Geochimica et Cosmochimica Acta* (GCA), totaling 1193 publications (Fig. 1). In contrast, only a total of 176 articles published in GCA used keyword "thermodynamics" between 1990 and 2015. As evidenced, a book on the topic of geochemical kinetics is timely and relevant.

The surge in kinetics studies reflects the fact that many reactions in near Earth surface environment are regulated by kinetics, as the author eloquently made the case in the Preface. Some of society's mega-environmental projects, such as geological carbon sequestration and nuclear waste disposal, need to consider reactions in the time frame from 10 000 to hundreds of thousands of years. Research regarding the safety for the geological repositories has already incorporated kinetics into many performance models, but the underlying science's concepts and models are not necessarily fully understood. Most geochemistry textbooks have five to six chapters to cover thermodynamics, but only one to chapter for some basic introduction to kinetics. Rimstidt's book helps to fill this lacuna in our understanding.

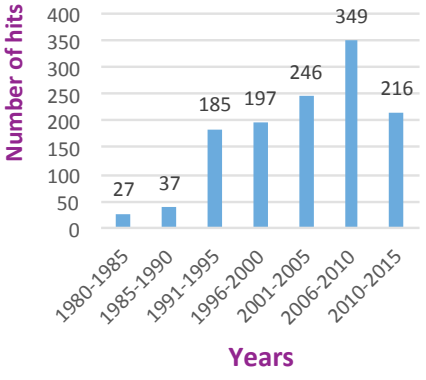
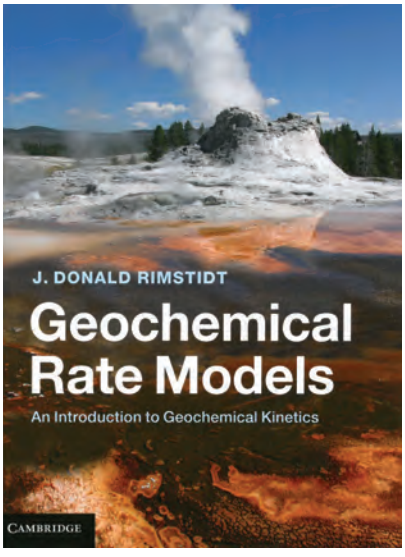



**Figure 1.** Search statistic of articles published in *Geochimica et Cosmochimica Acta* that used the key word "kinetics." Data are arranged in five year intervals. Search was made in August 2015. (Color online.)

Therefore, the book *Geochemical Rate Models: An Introduction to Geochemical Kinetics* published by Cambridge University Press will no doubt play a significant role in educating our next generation of geologists and will contribute to many solutions for environmental problems. The word "model" in the title and the emphasis on models throughout the book is also unique and useful. To quote Einstein: "*A theory is something nobody believes, except the person who made it. An experiment is something everybody believes, except the person who made it*." We might substitute the word "theory" with "model" here. If anyone who can bridge the gap between kinetics experiments and models, Rimstidt is one of the few in the world who qualify for it.




The author has carried out some of the pioneering and most seminal experiments on quartz dissolution and precipitation (e.g., Rimstidt and Barnes 1980). His 1980 publication was the introduction to geochemical kinetics for me as a graduate student 30 years ago, and this paper has been cited over 700 times, testifying to its importance. In this book, one can understand how the author describes kinetics models using his own experiments and look for his insights that were gained from years of experience.

The book is divided into 10 chapters. The first two chapters introduce the various concepts of model and modeling and provide necessary background information with essential knowledge of chemistry. This prepares the reader for the following chapters. Chapter 3 is on rate equation. The phrase "rate equation" is a better choice than another commonly used phrase in geochemistry, which is "rate law." The latter gives the connotation of a more fundamental nature and rigor while in reality most "rate laws" in geochemistry are empirical. The term "rate laws" could

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confuse the reader, as he or she may draw parallels to laws in thermodynamics. Furthermore, the examples used in the chapter are great choices. Chapter 4 introduces chemical reactors. The author has used most types of reactors in his experiments, and the chapter draws upon his intimate knowledge of their advantages and pitfalls.

Chapters 5–7 introduce theories and applications of molecular kinetics, surface chemistry, and transport processes, respectively. These chapters first cover the basic theoretical background and then explain with specific models. The author's careful choice of examples, and many of these examples draw from the author's own experiments and publications. Again, because of these choices, the concepts easier to understand, making this book especially appropriate for students.

The last three chapters are on the applications of rate models to various geological and engineering situations. The structure of the chapters maintains a good balance on background, mathematical derivations, and specific examples.

In summary, this is an excellent textbook for upper class undergraduate and graduate student courses. It is also a great reference book for someone who works in government agencies and oil industries and encounters the topic of kinetics in environmental or production projects. Additionally, I would also recommend this book to any serious researcher who works on kinetics problems. The insights in this book on how to interpret experimental data using geochemical rate models are so valuable, and nobody has more authority than the author in providing these insights.

**Reference cited**

Rimstidt, J.D., and Barnes, H.L. (1980) The kinetics of silica-water reactions. Geochimica et Cosmochimica Acta, 44, 1683–1699.

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