BOOK REVIEW

MINERAL SURFACES. Edited by D.J. Vaughan and R.A.D. Pattrick. Chapman and Hall, London, 1995. viii + 370 pages. $44.00.

The study of mineral surfaces is a rapidly growing subdiscipline within the earth sciences. This is largely because of the continued development of theoretical and experimental techniques for studying surfaces and surface-related phenomena. Additionally, there is growing recognition that mineral surfaces have unique properties that help to control a variety of processes, ranging from mineral growth and dissolution to sorption of radionuclides in contaminated aquifers to the global geochemical cycling of the elements. Although research on mineral surfaces is rapidly expanding, there are relatively few good texts on the subject. This poses a problem, especially for educators wishing to teach upper-level courses. Thus, Vaughan and Pattrick's *Mineral Surfaces* is an excellent and much needed addition to the few texts currently available in this field. As a collection of ten chapters, each written by an acknowledged expert, *Mineral Surfaces* provides a broad perspective, packed with up-to-date and practical information on many of the key topics of mineral surface studies.

This text grew out of a Mineralogical Society short course on "Mineral Surfaces" held at the University of Manchester (U.K.) Geoscience Research Institute in December 1992. Considering that the study of mineral surfaces is constantly changing, the text contains mostly state-of-the-art material. It is logically organized, well written, and well edited.

The first chapter, by D.J. Vaughan, gives a brief overview of mineral surfaces, including useful appendices on publications in mineral surface science and on surface science techniques. This chapter also states the purpose of the book: "It is hoped that this text will prove of value to those engaged in teaching advanced undergraduate and graduate courses in the mineral sciences, that those actively involved in research on mineral surfaces will find it a useful summary of much current work, and that it will stimulate interest in this rapidly developing field within the earth sciences." The text should, indeed, fulfill these goals.

The second chapter, by M.F. Hochella Jr., is titled "Mineral Surfaces: Their Characterization and their Chemical, Physical and Reactive Nature." This is one of the stand-out chapters, providing a practical guide for translating surface science into geologic usefulness. Sections of the chapter describe some of the most important methods in surface analysis, including how each method works, pros and cons, examples of applications in the geosciences, and a good list of references to more extensive reviews. The theme of the chapter is surface heterogeneity, and this theme is nicely illustrated throughout.

J.A. Tossell, author of the third chapter, "Mineral Surfaces: Theoretical Approaches," was given the difficult task of summarizing several complex theories in a very short section. The chapter contains a fair amount of jargon, and the equations are not always described in full for the layperson geoscientist. On the other hand, the chapter is well written and contains practical information on what the various methods offer, how they work, and some of their pros and cons. The chapter left me eager to learn more about the various theoretical approaches to mineral surfaces.

Chapters 4 (by G.N. Greaves) and 5 (by G.E. Brown, G.A. Parks, and P.A. O'Day) are closely linked in that they both describe new X-ray techniques and other approaches to surface mineralogy. Chapter 4 provides a review of several methodologies with excellent examples from a range of subdisciplines. Chapter 5 deals primarily with applications to sorption phenomena but also contains an excellent introduction to sorption phenomena and reviews of IR and EPR methods. Overall, Chapters 4 and 5 help to clear up some of the confusion regarding these complex methods by making their theory and applications more readily accessible.

The following chapter, by W.H. Casey, on the dissolution of oxide and silicate minerals, is a succinct but thorough review of dissolution. This chapter covers many of the fundamental theories and approaches currently used by the geoscience community to study mineral dissolution. It is up-to-date and nicely integrates a broad range of difficult concepts in a clear manner.

Chapters 7 (by G.H. Kelsall) and 8 (by P.E. Richardson) cover the electrochemistry and surface chemistry of sulfide minerals and the surface chemistry of sulfide flotation, respectively. These important topics in surface mineralogy are often overlooked in texts, and their inclusion thus represents an important contribution. Consistent with the rest of the text, these chapters provide detailed descriptions of methods and excellent examples of applications in the geosciences.

Finally, Chapters 9 (by R.A. Schoonheydt) and 10 (by A. Dyer) discuss clay mineral surfaces, zeolite surfaces, and their reactivity. These chapters form a nice conclusion to the text by summarizing research on some of the most important mineral surfaces. They contain excellent illustrations and should inspire students to seek out additional publications on these important topics.

In conclusion, *Mineral Surfaces* is a well-written text on an important subject of interest in the mineralogical sciences. Considering the length and number of the chapters and the fact that it is well written, this book could be a good textbook for a graduate-level reading- or seminar-style course. Following a series of introductory lectures, students could be assigned one chapter per week, supplemented by additional readings. These readings could then serve as backdrop for discussion, perhaps led by an appointed student discussion leader. Whether or not one plans to use *Mineral Surfaces* as a textbook, mineralogists, geochemists, and other interested researchers should find the book to be a valuable addition to their small but growing libraries on the topic.

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