Environmental Surfaces and Interfaces from the Nanoscale to the Global Scale


Donald L. Sparks*

Patricia A. Maurice has written a timely and comprehensive textbook that emphasizes the importance of environmental surfaces (minerals, humic substances, microbes, and plants) and interfacial processes in affecting reactivity and processes in the environment. One of the strengths of the book is the emphasis on both spatial (from the nanoscale to the global) and temporal scales and the need to integrate the scales if one is to accurately predict and model important environmental processes.

The first three chapters provide background information, including fundamental chemical and thermodynamic and kinetic concepts (Chapter 1), the hydrological cycle (Chapter 2), and minerals (Chapter 3) important in environmental surface chemistry. Chapter 1 provides information on activities and equilibrium constants. In this discussion, the emphasis on kinetics is brief and would be stronger if additional information were provided on time scales of environmental processes and more emphasis placed on models that are appropriate for heterogeneous natural materials. Chapter 3 discusses primary and secondary minerals with emphasis on metal oxides. The chapter could benefit by including discussions of not only kaolinite and montmorillonite but also descriptions of other important clay minerals such as vermiculite, mica, and intergrade minerals. Humic substances, which are also critical sorbents, are discussed in Chapter 8, which focuses on sorption of organic compounds. The discussion on humic substances is not extensive and seems to be out of place in the chapter.

Chapter 4 is a nice overview of various spectroscopic and microscopic tools that are useful in characterizing surfaces and elucidating reaction mechanisms. More emphasis is placed on microscopic techniques, particularly atomic force microscopy (AFM), which is one of the tools that Maurice is an expert in and has used extensively in her research. The section on synchrotron-based techniques is less comprehensive but adequate for an introductory chapter. Chapter 5 provides an excellent discussion of surfaces and interfaces. A case study on bacteria–mineral–gas interactions provides a nice application of the principles presented in the chapter. Chapter 6 is one of the best treatments of surface charge and sorption that I have seen. The chapter is comprehensive, and concepts are explained in a clear manner. Discussions on sources of surface charge, points of zero charge, sorption terminology, cation exchange capacity, adsorption isotherms, double layer theory, and surface complexation models are included.

Chapters 7 and 8 address inorganic ion and organic compound sorption processes, respectively. I was particularly impressed with the excellent coverage of organic chemical sorption in Chapter 8, a topic that is often neglected in many geochemical, soil chemistry, and environmental chemistry textbooks. Chapters 9 and 10 are first-rate chapters on mineral nucleation and growth and mineral weathering and dissolution, respectively. The author is commended for including chapters on the significance of plants and microbes as environmental surfaces. Too often, chemically oriented textbooks completely ignore the role that plants and microbes play in nutrient and contaminant reactivity, mobility, and bioavailability. These are two of the best chapters in the book. Chapter 13 is a very good overview of environmental nanoparticles, a specialty of the author. Discussions are included on unique properties of nanoparticles and impacts on various environmental processes. The final chapter shows the role that environmental particles and interfaces play in environmental challenges such as acid rain, acid mine drainage, and climate change.

Each chapter contains useful tables and figures, extensive questions and problem sets, and additional readings. Overall, the book is excellent and will be a very useful book for students and professionals in multiple disciplines. I highly recommend it and commend the author on a job well done.

*Corresponding author (dlsparks@udel.edu).

© ASA, CSSA, SSSA
5585 Guilford Rd., Madison, WI 53711 USA

Copyright © 2010 by the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America. All rights reserved. No part of this periodical may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher.

doi:10.2134/jeq2010.0007br
*Corresponding author (dlsparks@udel.edu).
© ASA, CSSA, SSSA
5585 Guilford Rd., Madison, WI 53711 USA

Book Review

Delaware Environmental Institute (DENIN), University of Delaware, Newark, DE.