

## BOOK REVIEWS

**Natural Zeolites: Occurrence, Properties, Use**, edited by L. B. Sand and F. A. Mumpton. Pergamon Press, Elmsford, New York and Oxford, 1978. 546 + xii pp. \$75.00.

This book consists of "A Selection of Papers Presented At Zeolite, 76, An International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites, Tucson, Arizona, June 1976" as described by the editors on the title page. It is divided into 5 sections: Introduction, Crystal Structure and Mineralogy, Geology and Occurrences, Physical and Chemical Properties, and Applications. This unique publication brings together under one cover the latest studies of most of the world's leading authorities on the many aspects of naturally occurring zeolites as distinct from synthetic zeolites. While there are 10 to 15 excellent books devoted largely to synthetics, the present publication is devoted solely to natural zeolites and stands alone in this respect.

This reviewer is overwhelmed at the prospect of attempting a detailed critique of this work. As the divisions listed above suggest, the best reviewer would be a crystallographer, mineralogist, geologist, geochemist, geophysicist, physical chemist, organic catalytic chemist, inorganic chemist, colloid and detergent chemist, mining engineer, civil engineer, rolled into one. This listing simply indicates the almost universal interest in the naturally occurring zeolites described in this volume and the impossibility of one reviewer (of less than genius caliber) to do justice to the entire work.

The perspective of the book is set in the Introduction by one of the editors, F. A. Mumpton who reviews such topics as history, occurrence, pollution-control applications, energy-conservation uses, agricultural significance, aquacultural uses, mining and metallurgy uses, and even medical applications. The Introduction prepares the reader for the broad horizon embraced by the forty-four technical papers that follow.

Several articles have a breadth of scope which deserves special attention. G. Gottardi's paper "Mineralogy and Crystal Chemistry of Zeolites" is a wide-ranging review covering mineralogical aspects of nearly every known natural zeolite. R. L. Hay, author of "Geologic Occurrence of Zeolites," and R. A. Sheppard, who coauthored with R. C. Surdam the paper "Zeolites in Saline, Alkaline-Lake Deposits," are prominent among those who first recognized that zeolites constitute some of the most common authigenic silicate minerals in sedimentary rocks. Their papers review the geology and geochemistry of zeolites. Also the paper "Zeolites in Pelagic Sediments of the Atlantic, Pacific, and Indian Oceans" by M. Kastner and S. A. Stonecipher should be of special interest to the geology-oceanography community. D. E. W. Vaughan in "Properties of Natural Zeolites" details the chemistry and sorptive and

ion-exchange properties of the seven naturally occurring zeolites which he states "occur in sufficient quantity and purity to be considered as exploitable natural resources"—mordenite, clinoptilolite, chabazite, erionite, ferrierite, phillipsite, and analcime.

"Cation-Exchange Equilibria in Zeolites and Feldspathoids" by R. M. Barrer is a review paper of broad scope which includes studies as early as 1953. A fascinating application of zeolite minerals is presented in D. I. Tchernev's paper "Solar Energy Application of Natural Zeolites." In view of the great interest and use of synthetic zeolites in detergents, the paper by H. G. Smolka and M. J. Schwuger, "Cleansing Action of Natural Zeolites in Detergents," is timely. Beneficiation of many zeolite minerals will undoubtedly be required prior to commercial application, and a paper by K. D. Mondale, F. A. Mumpton, and F. F. Aplan entitled "Beneficiation of Natural Zeolites from Bowie, Arizona: A Preliminary Report" contributes significantly to this important aspect of zeolite mineral exploitation.

The fact that natural zeolites have not played as large a role as the synthetics as hydrocarbon-conversion catalysts is evidenced by the fact that only one paper in the volume is devoted to this subject. This paper, "A Survey of Catalytic Properties of North American Clinoptilolites" by N. Y. Chen, W. J. Reagan, G. T. Kokotailo, and L. P. Childs, is novel in that catalytic properties are used to distinguish heulandite, which they propose as an end-member of the clinoptilolite group, from other members of this closely related group of zeolites.

The book is not without flaws. The photographic reproductions are of relatively poor quality which is particularly unfortunate in the case of the scanning electron micrographs of a variety of zeolite crystals which in the original form (as seen by this reviewer) were generally excellent. Also, for example, the notation on the title page quoted above is in error: The Conference in Tucson was entitled "Zeolite '76" not ". . . Zeolite, 76 . . ." However, flaws in this publication are minor compared with the wealth of information included. Anyone interested in zeolites, synthetic or natural, should possess this work to complete his store of zeolite knowledge. There remain about a dozen known natural zeolites which man has yet to duplicate synthetically. We hope that more zeolite minerals will be discovered in the future to extend the challenge to us zeolite synthesizers.

GEORGE T. KERR

**The Chemistry of Soil Constituents**, edited by D. J. Greenland and M. H. B. Hayes. John Wiley & Sons, Chichester, New York, Brisbane, Toronto, 1978. 469 + xii pp. \$65.00.

This book, comprising 469 pages, covers the chemistry of soil components, and is the companion volume to a second book (in press) dealing with the chemistry of soil processes. The subject areas follow a logical sequence, with the first chapter by D. J. Greenland and M. H. B. Hayes placing soil chemistry in perspective relative to the other disciplinary fields of soil science. The history of the scientific study of soils is presented, demonstrating the progress that has been made using the principles of chemistry, physics, biology, and mineralogy. The next two chapters represent the bulk of the book's content, covering the structural and chemical descrip-

tions of clay minerals and soil organic colloids. The structural aspects of clay minerals are presented by G. Brown, A. C. D. Newman, J. H. Raynor, and A. H. Weir. Very detailed structural information on the more common clay minerals is included, with some discussion of less crystalline minerals such as allophane and imogolite. Less common soil minerals, such as the fibrous (sepiolite, palygorskite) and plumbogummite types, are also given some attention. The importance of interstratification in soil mineralogy is emphasized in a detailed discussion of the phenomenon. Many of the structural data presented in this chapter are quite recent, and this up-to-date

review provides an insight into certain clay structures (e.g., imogolite) that has not previously been possible. Although crystalline oxides of iron and aluminum are briefly discussed, the lack of information on the amorphous or microcrystalline hydrous oxides is evident from the very brief mention that they receive.

The second major chapter, by M. H. B. Hayes and R. S. Swift, presents a highly detailed and complete review of the various techniques that have been applied to the arduous task of identifying constituent molecular structures of soil organic matter. Much of the discussion relates to the degradative processes used to identify humic acid components. The difficulties encountered are noted, and conclusions derived from these procedures are compared with results from other techniques such as spectroscopy. A section on soil polysaccharides emphasizes that nonhumic organic substances are present in substantial amounts in soils. The chapter provides a detailed critical review of research and summary of our present understanding of soil organics. Results from the many approaches to the measurement of physical and chemical properties of organics indicate clear gaps in knowledge, an inevitable result of the complexity and heterogeneity of soil organic matter.

The remainder of the book is devoted to surface properties as they relate to adsorption. A chapter by D. J. Greenland and C. J. B. Mott discusses the chemical nature of soil surfaces and the importance of surface area in ionic and molecular adsorption on clays. A clear, concise description of various

methods of surface area measurement in soils and clays is given. The classical electrochemical description of diffuse double layer theory with application to oxides and permanent charge clay minerals appears in a separate chapter on surface-electrolyte interactions by P. W. Arnold. It is unfortunate that alternate approaches to surface-ion interactions are not mentioned, since many colloidal phenomena are not predicted by double layer theory. To some extent, the separation of soil components from soil processes weakens the presentation in this chapter, since ion exchange would logically build upon the description of ions electrostatically bound to surfaces.

Finally, a short review of the present state of understanding of water on layer silicate clays, oxides, and organics is given by V. C. Farmer. The surface properties of clays that most affect water bonding are clearly summarized, based largely on data from X-ray diffraction and infrared spectroscopy.

As an advanced account of soil chemistry, this book should be welcomed by students and scientists. Despite being written by a number of authors, a degree of coherence and order is maintained, the level of presentation is consistent, and overlap of material is avoided. A complete subject index and author index facilitate use as a reference. The main problem in its use as a textbook of advanced soil chemistry and mineralogy is the price (\$65.00). However, the book contains a tremendous amount of detailed information, and demonstrates the influence that recent research has had in shaping the basic concepts of soil chemistry.

MURRAY B. MCBRIDE

## ANNOUNCEMENTS

### THE CLAY MINERALS SOCIETY

16th Annual Meeting

27th Annual Clay Minerals Conference

*Place:* Macon, Georgia—Macon Hilton Hotel

*Time:* August 26 to August 31, 1979

*General*

*Chairman:* W. E. MOODY  
Ceramic Engineering  
Georgia Institute of Technology  
Atlanta, Georgia 30332

*Program*

*Chairman:* C. E. WEAVER  
Geophysical Sciences  
Georgia Institute of Technology  
Atlanta, Georgia 30332

*Symposium:* Kaolinite Clay Processing

*Field*

*Trips:* Kaolinite Deposits of Southern Georgia (August 30)  
Attapulgite Deposits of Georgia and Florida (August 31)