

BOOK REVIEW

Organo-Clay Complexes and Interactions, edited by S. Yariv and H. Cross. Marcel Dekker New York, 2002, viii + 688 pages. [ISBN 0 8247 0586 6]. Price \$195.

This book contains 11 chapters, four of which are written or co-written by Shmuel Yariv. Despite the number of pages, it does not offer a comprehensive review and the editors acknowledge this in the preface before expressing the intention to remedy this in a second volume. From my own perspective the major omissions are in the areas of kaolin-organic interactions and the use of organoclays as adsorbents and barrier materials. However, given the enormous number of publications that have emerged in recent years in both these areas, it is perhaps understandable. Moreover, given the amount of (sometimes repetitious) attention to alkylammonium-exchanged clays in this volume it is surprising that little mention is made of their importance in clay-based nanocomposites.

The book opens with a chapter devoted to the 'Structure and Surface Acidity of Clay Minerals' by S. Yariv and K.H. Michaelian (35 pages, 44 references). Twenty pages are devoted to the structure of 1:1 and 2:1 layer silicates and are used as a prelude to a well-structured discussion of the water present in the gallery and how it is influenced by the type of exchangeable cation and the locus of isomorphous substitution. There is also a discussion of the surface acidity/basicity of clays and how it is affected by the occupancy of the octahedral sheet. The second chapter 'Introduction to Organo-Clay Complexes and Interactions' by S. Yariv (72 pages, 188 references) positions clay-organic interactions with respect to their role in fixation and/or transport of organic matter in the environment, industry and the laboratory. There is some repetition of chapter 1 when he describes adsorption sites on the clay but this is overshadowed by the extensive consideration given to the interaction of organic ions, amines and fatty acids with clays. The author provides structures for all the possible interactions including their variation with pH, which may be particularly useful for non-chemistry majors. Interactions with the broken bond (edge) surfaces are also covered. The majority of the chapter focuses on smectites although kaolin, sepiolite and palygorskite are considered in the final 12 pages of text. The third chapter, 'Interactions of Vermiculites with Organic Compounds' by J.L. Pérez-Rodríguez and C. Maqueda (60 pages, 224 references), begins on a cautionary note emphasizing that the level and type of impurities present in many vermiculites, together with the differences in charge, CEC, composition and particle size, makes direct comparisons between organo-vermi-

culites difficult. Subsequently, the authors provide a comprehensive and detailed account of the interaction of vermiculite with alkyl- and aromatic ammonium cations, dyes and molecules of biological significance including pesticides and amino acids. In chapter 4, 'Organophilicity and Hydrophobicity of Organo-Clays' (16 pages, 31 references), R.F. Giese and C.J. van Oss provide the reader with a succinct summary of how contact-angle measurements and thin-layer wicking experiments can be used to determine the nature of natural and organo-modified clay surfaces. Chapter 5, 'Adsorption of Organic Cations on Clays: Experimental Results and Modelling' by S. Nir, G. Rwyto, T. Polubesova, T. Undabeytia and C. Serban (30 pages, 44 references), is another focused account which reviews the development of Nir's model for the adsorption of ions on artificial membranes to a stage where it can deal with issues including the adsorption/aggregation of dyes on clay surfaces in the absence and presence of added electrolyte. Examples from the authors' work on competitive adsorption suggests that the model can predict the preferred component from adsorption isotherms of the individual components.

The next section of the book is devoted to use of advanced investigative methods in the study of clay-organic interactions. Chapter 6, 'Nuclear Magnetic Resonance Spectroscopy of Organo-Clay Complexes' by J. Sanz and J.M. Serratosa (50 pages, 98 references), begins with a rapid overview of the important principles of the technique and continues with the landmark papers of the last 25 years. This latter aspect covers Al in tetrahedral and octahedral sites, the distribution/ordering of Al within the tetrahedral sheet, how the TOT angle affects the chemical shift of the ^{29}Si peak and NMR of the exchangeable cations and adsorbed water. Pertinent results on clay-organic systems using ^1H and ^{13}C NMR are also presented. Chapter 7, 'Thermal Analysis of Organo-Clay Complexes' by A. Langier-Kuźniarowa (71 pages, 189 references), concentrates mainly on DTA results listing the peak temperatures from a wide range of investigations. The author rightly states that the quality of the information obtained from any thermoanalytical technique can be significantly enhanced using evolved-gas analysis but overlooks many of the fine papers that have appeared since 1998. Chapter 8, 'IR Spectroscopy and Thermo-IR Spectroscopy in the Study of the Fine Structure of Organo-Clay Complexes' by S. Yariv (117 pages, 214 references), does not cover Raman or photoacoustic spectroscopy and concentrates on complexes of expanding clays because these provide appreciable IR signals. Nevertheless, it does represent a comprehensive,

although occasionally over-detailed, review of the subject matter and offers a section on sample preparation and specialist IR cells. The tables of band assignments for adsorbed amines and fatty acids are a useful complement to the structures given in chapter 1.

Chapter 9, 'Staining of Clay Minerals and Visible Absorption Spectroscopy of Dye-Clay Complexes' by S. Yariv (103 pages, 201 references), is another comprehensive, well-referenced review which deals mainly with the interaction of dyes with expanding clays, although the first 15 pages are devoted to colored complexes arising from radical formation or complexation with transition metal exchange cations. The understanding of clay-dye spectra is continually improving, and the different interpretations, with their supporting evidence, are presented in this useful chapter. The author has done well to navigate the sometimes controversial issues with diplomacy, arriving at his preferred destination. In Chapter 10, 'Clay Catalysis in Reactions of Organic Matter' (46 pages, 141 references), L. Heller-Kallai does an excellent job of pulling together a rational set of examples and carefully selected references to illustrate the important interplay of properties which determine whether a clay, pretreated in a particular way, will make an effective catalyst. The approach raises a number of questions which those with an interest in catalysis using clays may find enlightening to answer. In the final chapter, 'Organo-Minerals and

Organo-Clay Interactions and the Origin of Life' (24 pages, 61 references), N. Lahav introduces the early hypotheses and identifies the fundamental features in the study of life's origins before providing a concise summary of the way in which mineral systems mimic biological systems.

Overall, I felt that the volume was a useful resource that covered the selected areas well. It contains a mineral, organic compound and author index and, to my delight, the references are supplied complete with titles which is far too uncommon, except in clay journals. The quality of a number of the figures is disappointing and I felt that occasionally some authors paid too much attention to well-established studies with which they were familiar, rather than presenting new and emerging work. However, I would not want these critical observations to deter the prospective buyer because I believe that the volume represents a very useful resource that covers the selected areas very well. It would be of particular value to research students (and others new to the clay-organic area) provided that they were able to form a balanced view of the information presented. For my part, it has already proved a very useful addition to my bookshelves and I know that I will be referring to it on an almost daily basis for the foreseeable future – provided I can remember which of my group I have passed it to because it is relevant to all of them.

CHRIS BREEN