

sandstones of the North Sea and adjacent areas of the Netherlands and Germany, in which she deals comprehensively with factors controlling their mineralogy, morphology and regional distribution.

D. A. Spears describes the variety of different clay-bearing sediments in the onshore UK, which range from shales (marine and non-marine) and turbidites, through fireclays and seat-earths, to K-bentonites and tonsteins. H. F. Shaw deals with the relationship between clay mineralogy and porosity in Carboniferous on- and offshore reservoir sandstones, highlighting questions such as the preservation of smectite in sediments that have been buried to >2 km at temperatures >100°C.

Clay assemblages in the marine Devonian sediments of SW England and in continental red bed facies cropping out from South Wales to the extreme north of Scotland are described by S. Hillier, M. J. Wilson and R. J. Merriman. This review highlights the widespread occurrence of dioctahedral chlorite and dioctahedral chlorite-smectite (tosudite), especially in the Lower Old Red Sandstone, attributing their origin to prograde diagenetic alteration of kaolinite. Overall, the present clay mineral assemblage of the ORS is interpreted in terms of an original smectite-dominated precursor assemblage subsequently modified by diagenesis/low-grade metamorphism. Provenance and retrograde diagenesis appear to have had a role, but the authors are clearly divided as to the extent. This divergence only serves to illustrate the value of reviews of this type. Interpretations that appear perfectly reasonable based on evidence from suites of samples from a restricted geographical area or stratigraphic sequence are often called into question when a wider synthesis is undertaken. By documenting their differences of opinion in this way, the authors have provided a valuable service to a continuing debate.

Finally, Merriman summarizes the mineralogy of Lower Palaeozoic mudstones, shales and slates, referring extensively to the Kübler index of illite 'crystallinity'. He recognizes two regional clay mineral assemblages linked to geotectonic settings of the original depositional basins. Mudrocks that evolved in extensional settings developed both K-rich and Na-rich representatives of the 2:1 dioctahedral reaction series together with sporadic pyrophyllite, whereas the assemblages found in plate-convergent settings contain only K-rich phengitic micas and chlorite, negligible Na-micas and no pyrophyllite. He concludes that the tectono-thermal history of these basins rather than inherited compositional differences is the controlling factor determining final clay mineral assemblage.

This book is packed full of data on the clay mineralogy of British sediments, so why should it be of interest to clay mineralogists outside the UK? The short answer is that it addresses many generic questions of clay mineral evolution during varied geological events at a regional scale. It doesn't necessarily come up with the answers, but it assembles the evidence for

others to judge and compare. From the UK perspective, it has placed clay mineralogy firmly back as an important tool for interpreting geological processes, and I sincerely hope that it will inspire a new cohort of clay mineralogists to supplement the existing, but rapidly diminishing, band of geologically-oriented clay scientists currently active in the UK.

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Handbook of Clay Science. F. Bergaya, B.K.G. Theng and G. Lagaly (editors). *Developments in Clay Science*, Volume 1, Elsevier Science, Amsterdam, 1246 pp., 2006, ISBN-13: 978-0-08-044183-2; ISBN-10: 0-08-044183-1. Price: GBP £105, US \$165, EUR €150.

The 'Handbook' is a monumental undertaking edited by three prominent scientists. On a five-star basis it ranks 4.5 and deserves to be on the bookshelf of every clay (materials) scientist. Hopefully, a paperback edition will soon follow that will make the book more affordable for students.

According to the publisher's information, the book "assembles the vast literature on the diverse aspects that make up the discipline of clay science. The topics covered range from the fundamental structures and properties of clays and clay minerals, through environmental, health and industrial applications, to analysis and characterization by modern instrumental techniques. There are also chapters on clays and microorganisms, layered double hydroxides, zeolites, cement hydrates, and the genesis of clay minerals, as well as the history and teaching of clay science." It contains "contributions from 66 authors from 18 different countries,...provides up-to-date concepts, properties, and reactivity of clays and clay minerals,...covers classical and new environmental, industrial, and health applications of clays, as well as the instrumental techniques for clay mineral analysis,...combines geology, mineralogy, crystallography with physics, geotechnology, and soil mechanics together with inorganic, organic, physical, and colloid chemistry for a truly multidisciplinary approach."

The encyclopedic nature of the text is evident in the titles of the 16 major chapters and subchapters: 1. General Introduction, Clays, Clay Minerals, and Clay Science; 2. Structures and Mineralogy of Clay Minerals; 3. Surface and Interface Chemistry of Clay Minerals; 4. Synthetic Clay Minerals and Purification of Natural Clays; 5. Colloid Clay Science; 6. Mechanical Properties of Clays and Clay Minerals; 7. Modified Clays and Clay Minerals with subchapters on Activation, Thermal Modification, Organic Interactions, the Origin of Life, and Pillaring; 8. Properties and Behavior of Iron in Clay Minerals;

9. Clays, Microorganisms and Biomineralization; 10. Clays in Industry containing expanded discussions of Conventional Applications, Catalysis, and Organoclay-Polymer Nanocomposites; 11. Clays, Environment and Health with discussions of Pollution Control, Pesticides, Clay Liners and Waste Disposal, Nuclear Waste Management, Human Health, and Clays as Drugs. A long chapter (12) on a critical assessment of some analytical techniques focuses on Mössbauer Spectroscopy, X-ray diffractometry, X-ray Absorption Spectroscopy, X-ray Photoelectron Spectroscopy, Small Angle Scattering Techniques, Fourier Transform Infrared Spectroscopy, Nuclear Magnetic Resonance Spectroscopy, Electron Microscopy, Surface Area and Porosity, Cation and Anion Exchange, and Thermal Analysis. The methods chapter is followed by: 13. Some Other Materials Related to Clays, including subsections on Layered Double Hydroxides, Parallels and Distinctions between Clay Minerals, and also Cement Hydrates; 14. Genesis of Clay Minerals; 15. History of Clay Science: A Young Discipline; and, 16. Teaching Clay Science: A Great Perspective. A long list of references, some with 2005 publication dates, follows most chapters and the book contains an all-important Subject Index. One is hard-pressed to find a topic in clay science that is omitted.

In most chapters, the authors present a brief review of pertinent references and reviews followed by their own summaries of recent discoveries and examples of the general relationship of physical, chemical and mineralogical properties of clays and clay minerals to the topic being presented. The longest chapter on the colloidal nature of clays is one that best exemplifies the goals of the text. It illustrates how the colloidal chemist views clay properties that underpin many of the applications described in other chapters such as waste management or the fabrication of organo-clay nanocomposites. The publicity statement that “the Handbook is an excellent point of entry for students and scientists

seeking information on clays and clay minerals” is confirmed by the content.

The Handbook lost half of a star in this reviewer’s rating because of inconsistencies that are no doubt a consequence of trying to compile contributions from 66 authors. An important chapter such as that devoted to nuclear waste isolation is very myopic. One could get the impression that Sweden was the only country where investigations related to clay minerals and nuclear waste isolation had been performed. Other chapters were noticeably short considering the amount of information available. The discussion of transmission electron microscopy, an image-intensive characterization technique, without a single micrograph does not do justice to the fantastic work that has been done by the author and others in TEM and other electron microbeam techniques. X-ray diffraction patterns were noticeably absent from the chapter on qualitative and quantitative XRD methods. From one point of view, the last two chapters on history and education appear to be unrelated to the major goals of the book. Recounting the chronology of international conferences while ignoring the history and contributions of the various national clay groups and failing to note the contributions of such notable clay scientists as Georges Millot and George Brindley and others make the historical narrative incomplete. One could also take exception to the correctness of the opinions expressed in the summary of educational activities.

So, the book is not perfect! It is, however, an important contribution to the advancement of clay science at the beginning of the 21st century. It will serve as a benchmark in this field of scientific endeavor equivalent to the mid-20th century *Applied Clay Mineralogy* text of Ralph Grim.

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