

BOOK REVIEW

Applied Clay Mineralogy. Occurrences, processing and application of kaolins, bentonite, palygorskite-sepiolite, and common clays. Haydn H. Murray. *Developments in Clay Science*, volume 2, Elsevier Science, Amsterdam, 2007, 180 + viii pp. ISBN-13: 978-0-444-51701-2, ISBN-10: 0-444-51701-4. Price: USD \$145, EUR €120, GBP £83.

Any article or book written by Professor Haydn Murray is to be welcomed, as he is one of the leading figures in the Industrial Minerals field, particularly with respect to various types of clays. Following a distinguished career in industry he became Professor in the Department of Geological Science in Indiana University in the USA and in his retirement continues to work actively in the field as a consultant. Many of his former PhD students are now in senior positions in industry with some of the major kaolin and clay companies both in the USA and overseas.

His book covers a wide range of topics and is just 145 pages of text and figures with 45 pages of Appendices and an Index.

The book is clearly aimed as an introduction to clay mineralogy and the occurrences, processing and applications of various clay minerals. For specialists in the field it will be a useful reference point for looking up locations of clay minerals they are not so familiar with. Specialists in particular clay minerals, *e.g.* kaolin, will view the book as a general summary of world occurrences but for more detail on particular deposits will need to carry out further reading and research.

Generally the book is well laid out though the standard of some of the scanning electron micrographs is not very good, but this could reflect the type of paper used in the publication. Other figures are generally clear and supportive of the text. Each chapter in the book concludes with a reference list for the particular section which is useful rather than having all references at the end of the book. However, the index is fairly limited.

Chapters 1 and 2 cover the introduction to clays and the structure and compositions of various clay minerals and their physical and chemical properties. The information is general but is clearly stated and useful.

Chapter 3 on the Geology and Location of Major Industrial Clay Deposits is the part that will probably be referred to most. Only the major deposits of the world are covered and it is remarkable how much information has been crammed into just 34 pages. Kaolins from deposits in the USA are well covered with a good description of the soft and hard varieties. For southwest England the primary kaolinized granite deposits are discussed briefly with the major types of kaolin outlined

– platy and vermiform types. Figure 22, showing the distribution of kaolin deposits in southwest England, is difficult to read and the Carnmenellis granite is labelled as Blackpool (presumably the Imerys Blackpool clay pit in the St. Austell granite). Again, it is impossible in such a small book to do justice to all of the major deposits though the importance of Brazil with major resources of kaolin (estimated at 500 Mt) and as a leading producer of coating kaolin is emphasized. Deposits in the Czech Republic, Indonesia, China and New Zealand (a high-quality halloysite deposit used mainly for ceramics) are covered. There is no mention of the growing kaolin business based on high-quality kaolinized granite products from the Ukraine (but, as mentioned, only current major deposits are considered).

For ball clays the major producing areas are covered well. However, section 2.4, on the Ukraine, reports >1 Mt of production for 1998. Recent figures for ball clay production (2006) from the Ukraine are estimated at >5 Mt which is an incredible jump in output in just 8 years. The Ukrainian ball clay is exported in large amounts to Italy (>2 Mt per year) and Spain (1.2 Mt per year) in 2006 and elsewhere in the world. It is an important constituent of *gres porcellinata* tiles (mainly a mix of Ukrainian ball clay and Turkish feldspar) which are fired in just 30 min.

The USA bentonites are well covered with very brief summaries of deposits elsewhere in the world.

Chapter 4 covers the exploration, mining and processing of clays. Here the main emphasis is on wet processing of kaolin with the importance of flocculation and deflocculation described. The importance of delamination in producing a new range of platy materials is also highlighted.

Chapter 5 covers the applications of kaolin with emphasis of its use in paper, paint and ceramics with some information on use in rubber, plastics, ink, catalysts and fibreglass. Table 14 is useful in describing the particle size and brightness of some USA coating kaolin clays. Many other minor uses are described briefly.

Bentonite applications are dealt with in Chapter 6 and cover a wide range of smectite clay minerals including Na-montmorillonite, saponite, hectorite and sauconite. The major use of Na-montmorillonite (Na-bentonite) is in drilling muds. The importance of bentonites in cat litter and absorbents clays is covered along with a host of miscellaneous applications.

Palygorskite and sepiolite applications are covered in Chapter 7, and Table 27 lists the main properties of the two minerals, with the main applications in Table 28. The mineral assemblage is mainly used as a thixotropic

gelling viscosity builder and suspending agent in the drilling of oil and gas wells. Because of their elongate shape these minerals are excellent suspension aids in systems with a high electrolyte content, which causes smectite particles to flocculate. In the current climate where there is a suggestion that elongate particles may pose a potential health hazard, there is a helpful comment (page 139) confirming that sepiolite is not a health hazard, this based on studies carried out on the Vallecas-Vacalvaro (Madrid) deposit in Spain.

Appendices A–D describe the test procedures for identifying and evaluating various clay minerals. Whilst the information presented is useful, it is probably not appropriate to have so many pages taken up on test procedures where the level of information presented on

important world deposits of the various clay minerals is limited.

Overall this is a most useful reference book on clay minerals for the non-specialist. It gives a good background to many clay minerals and their main uses in the market place. Professor Haydn Murray is to be congratulated on cramming so much information into such a small book – a good example perhaps of a nano-book!

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