Black Shales

*by **P.B. Wignall**, published in 1994 by Oxford Science Publications, ISBN 0-19-854038-8, 127 pages at $68.*

Review by **Christopher G. Kendall**

This book is aimed at a diverse audience of earth scientists who include higher level undergraduates, shale specialists and those who are interested in black shale. The book is essentially is a compendium of the current understanding of black shales. It discusses the proposed origins of black shales; their sedimentology; paleoecology, inorganic and organic geochemistry; the role of anoxic conditions in their formation; modern and ancient analogues; and the role of shales with respect to the Exxon sequence stratigraphic model in terms of transgressive system tracts and condensed sequences. The book is tightly written and most complete. It is illustrated with maps, diagrams, photographs and tables which relate the occurrence of black shales to their depositional setting, forming a coherent narrative. Line drawings and photographs are extremely clear and the author has gone to some trouble to make sure diagrams explain the evolution of the various concepts associated with black shales.

The book is deceptively simple in its presentation but contains a wealth of detail. It emphasizes the various models which are proposed to explain the occurrence of black shales in terms of water depth, oxygen content and sedimentation rate; and the production and preservation of organic matter and its relationship to bottom water oxygenation. The depositional processes involved in the formation of black shales are discussed, including those associated with hemipalegic settling, turbidity currents, bottom currents, storm currents, internal waves, bacterial mats, varves, black shale substrates, the fissility of shales and syn-depositional deformation. The chapter on the paleoecology of shales includes discussions of anaerobic, dysaerobic and aerobic conditions and is illustrated by cross-sectional diagrams showing the various sedimentary structures and the bioturbated facies associated with each of the zones and the role of relief versus the vertical migration of the oxygenated waters in the water column within a particular setting. There is discussion of various types of faunas associated with the level of oxygen in the water column and how the presence of fauna changes and effects the sedimentary structures. There are illustrations of oxygen restricted biofacies and explanations of various types of sedimentary relationships and how these have traditionally been explained and how these may be explained by less conventional mechanisms. These are extensive discussions on inorganic geochemistry dealing with such things as diagenesis within the oxic bottom waters, beneath anoxic bottom waters, the use of sulphur/carbon plots, degree of pyritization, occurrence of trace metals including molybdenum, nickel, rare earth elements, uranium, etc. This is a chapter on the organic geochemistry of sediments including uses of Van Krevelen diagrams, the distribution of macerals and the use of palynomorph analysis; the occurrence of carbon isotopes and biomarkers, etc. There is a chapter on productivity versus preservation within black shales which investigates the influence of sedimentation rate, anoxia versus organic matter, preservation-cause or consequences, and paleo productivity. The chapter on modern analogues for shale formation focuses on the Black Sea and includes the Deuser and Strakhov models. It also discusses the occurrence of temperate shelf seas and their relationship to flat shales, oxygen minimum and upwelling zones. Finally, there is a section on the association of lagoons and lakes with organic rich sediments. There follows a chapter on ancient examples of black shale deposition ranging from the Cenomanian event, the Kimmeridge Clay, and the Green River formation. Finally there is a chapter on "transgressive black shales - a stratigraphic enigma", which discusses how these black shales can be associated with either

the transgressive surfaces and/or also maximum flooding surfaces. It uses examples from the Late Carboniferous of northern England, the Pleinsbachian, and Toarcian stages of upper Jurassic of England, and the Callovian Lower Oxford Clay. The various models are discussed in terms of their association with maximum flooding and basal transgressions.
The text is up to date, with numerous references which are extremely modern. This book will be a great help to sequence stratigraphers who are puzzled by the creation and accumulation of black shales. It provides a good understanding of the causes for the various characteristics that we find associated with these sediments. Geologists from the USA may be dismayed by a lack of information on the Devonian black shales of the United States but the book has numerous examples from the United Kingdom and Western Europe. This shouldn't put off the US reader since the examples are clearly described and can be used as analogues to similar geological sections in other parts of the world. This is a very professional book and I would suspect that if you are practicing sedimentology and sequence stratigraphy, whether from an economic or academic viewpoint, this book will be a useful volume to have on your shelves and of course I am glad to have it on mine.

Black shales are dark, thinly bedded sedimentary rocks deposited under anaerobic conditions. They are rich in carbon, sulfides and organic matter, and potentially can serve as hydrocarbon source rocks. Black shales may also contain significant enrichments of gas or oil (gas shales, oil shales). Because of the continuous distribution of the natural gas or oil, they are considered to be unconventional reservoir types (Law and Curtis, 2002). Black shale Uraniferous alum shale in Sweden, the Chatanooga shale in the USA, the deposit of Gera-Ronneburg in the eastern part of Germany. [Pg.73]. U3Og). The concentration during the period 400-300 M years occurs in marine black shales, while that in the 300 M years to recent period is accounted for by sedimentary-type deposits, an important example being the Colorado Plateau deposits of USA. [Pg.75]. Fig. Black shales have been of increasing interest in recent years due to their oil and gas potential, but also because many are enriched in nonfuel "unconventional" critical elements such as cobalt, chromium, molybdenum, nickel, platinum group elements, rhenium, and vanadium. Critical metals residing in shales presented a challenge to economic recovery, and thus, development of deposits was "shelved" because metals could not be recovered by traditional methods.