

Book Reviews / Critiques

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Book Reviews / Critique

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Book Reviews

Fine-grained Sediments: Deep-Water Processes and Facies

Edited by D.A.V. Stow and D.J.W. Piper
Blackwell Scientific Publications, Palo Alto
659 p., 1984; \$99.00 US, cloth

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In *Fine-grained Sediments: Deep-Water Processes and Facies*, Special Publication No. 15 of The Geological Society (1984), the geological public now has access to a volume which provides as much information on most aspects of deep-water sediments as one is likely to find between two covers. D.A.V. Stow and D.J.W. Piper have collated a wide variety of subject material, some of which augments the contributions originally presented at the International Workshop on Fine-Grained Sediments (Halifax, Canada, August, 1982), into a well-organized treatment of recent and ancient fine-grained deposits. The book is divided into seven main sections dealing with: (i) processes of transport, deposition and erosion in deep water; (ii) siliciclastic turbidites; (iii) carbonate turbidites; (iv) contourites; (v) mainly hemipelagic, mixed deposits of slopes and slope basins; (vi) pelagites and organic-rich sediments; and (vii) internal sediment characteristics. Within sections (ii) to (vi), the studies include sequences of diverse ages recovered from a wide range of present marine environments, either via conventional gravity coring or through the Deep Sea Drilling Project; in addition each of these sections (excluding contourites) also contains at least one paper dealing with analogous on-land deposits ranging in age back to the late Precambrian.

Until the early 1970's, little detailed research had been carried out on fine-grained sediments, probably for the simple reason that they led to a lot of squinting, and normal sedimentological techniques could not be readily applied. However, the application of X-radiographic and microprobe studies, together with very detailed particle size,

microtextural and XRD analyses of fine-grained beds and laminations, revealed not only a considerable variety of internal structures, but sequential variations in sediment parameters which generally pointed to deposition through some type of turbidity current mechanism. As more and more fine-grained sediments were cored and subjected to detailed examination, it became apparent that even in the deep and distant ocean, a plethora of redeposited sediments existed, typically in alternation with other fine-grained beds representing the ambient "background" sedimentation. Since the former sediments often superficially resembled the latter, this recognition was important, particularly in research where unbroken original stratigraphy was necessary, e.g. paleomagnetic and micropaleontological studies. Studies of on-land fine-grained siliciclastic and biogenic sediments were leading to the same inferences, and hence, by the beginning of the 1980's, the importance of such deep-sea processes in shaping the sequence and appearance of the fine-grained sedimentary record had become not only appreciated, but to a significant degree, understood (although contourites remained rather enigmatic). The timing of the Halifax meeting, which was sponsored by the Geological Association of Canada and the Geological Society of London, was therefore judicious, as it brought together many recent studies by leading researchers in this field (as well as containing some useful reviews).

The breadth of topics covered by the 38 papers in the volume is impressive. Although too numerous to itemize, studies range in scope from fine-grained turbidites formed on deep-sea fans in the Paleozoic of Nova Scotia and the Quaternary of Zaire, through Holocene hemipelagic sediments in the California Continental Borderland and sapropels in the Mediterranean, to modern off-bank carbonate sediments in the Bahamas and contourites in the Gulf of Cadiz. The editors have done well in organizing these topics, given that fine-grained deep-sea deposits display a wide spectrum of facies associations and textural and compositional features, and are formed by a variety of oceanic circulation and mass transfer currents in a multitude of environments. Perhaps the only

weaknesses are the omission of metalliferous oceanic sediments of hydrothermal derivation, which are a notable component of the stratigraphic record in regions such as the eastern Pacific, and the paucity of geochemical data on fine-grained sediments in general. The penultimate section of the book presents data on the internal characteristics of fine-grained sediments (plasticity, compaction, mud and shale fabrics, and bioturbation), features important from both diagenetic and geotechnical viewpoints. Finally, editors Stow and Piper present a useful synthesis of facies models applicable to deep-water fine-grained sediments, outlining a total of nine different facies formed by the three main depositional processes: turbidity currents, contour currents, and pelagic settling.

This volume is notable not only for the wealth of subject material covered, but also for the very considerable amount of scientific detail it presents. The numerous illustrations and photographs are informative and of high-quality. It is also gratifying to see abstracts which actually concisely summarize the salient points and conclusions of the papers, rather than simply listing those features which the papers will address. Although the authors modestly claim that this volume focusses on a narrow class of sediments, such sediments actually constitute a significant proportion of the stratigraphic sequences present in the oceans (no small area), and in many orogenic belts (likewise). Hence, this book should be indispensable as a basic reference volume for researchers working within either of these broad domains, both in terms of comparative geological data and their corresponding interpretations. Unfortunately, at a cost of \$99.00 US (ca. \$130 CDN.), this book is unlikely to find its way onto the shelves of many graduate students although it should be in every geological library.

Other recent publications which deep-sea enthusiasts may wish to peruse are: *Modern and Ancient Deep Sea-Fan Sedimentation* (SEPM Short Course No. 14, 1984) and *Origins, Transport, and Deposition of Fine-Grained Sediments* (Proceedings of the 1984 SEPM Research Conference; Geo-Marine Letters, v. 4-5, 1984-85). These, to an extent, supplement and slightly update Stow and Piper's strongly recommended volume.

The Caribbean-South American Plate Boundary and Regional Tectonics

Edited by W.E. Bonini, R.B. Hargraves and R. Shagam

Geological Society of America Memoir 162, Boulder

432 p., 1984; \$47.50 US, cloth

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It's time for another memoir on the Caribbean, that enigmatic buffer zone between North and South America, which has endured multiple plate and microplate interactions since Early Mesozoic time. Memoir 162 brings together 28 papers authored by faculty and students from Princeton University and other eastern US colleges as well as earth scientists from the oil industry and southern Caribbean geological surveys. It is a compilation which features the analytical tools of the seventies and eighties, and contains regional plate kinematic syntheses together with detailed case histories of local areas.

All scenarios agree that the crust of the Caribbean plate was generated from a spreading oceanic ridge which divided North and South America prior to 125 million years ago and extended southwestward into the proto-Pacific Ocean (Burke *et al.*; Ghosh *et al.*; Duncan and Hargraves). Subsequently, a tongue of this Pacific oceanic crust was inserted between the North and South American plates which became, after Cretaceous and Tertiary jostling, the Caribbean plate of today. Ghosh *et al.* believe they can identify NE-SW trending magnetic anomalies in the Venezuelan Basin and recognize a fossil spreading ridge which became inactive 127 million years ago.

Paleomagnetism is used to delineate local movements. Maze and Hargraves report results consistent with post-Jurassic net counterclockwise rotation of the Perija Range of Western Venezuela. In contrast, MacDonald and Opdyke report minimal post-Jurassic rotation of the Santa Marta block in northern Colombia, and Hargraves *et al.* document complex rotations which involve the Santander Massif. Muessig dates the magnetization of intrusions in the Falcon Basin as early Miocene, since it appears to predate Late Miocene folding. These and previous paleomagnetic studies show that the southern Caribbean area must contain a complexly overlapping collage of displaced terrains with individual emplacement histories. The effects of some of these active microplate boundaries are revealed by the classical petrologic and REE analyses which Beets *et*

al. have applied to volcanic and metamorphic Cretaceous island arc sequences exposed in the southern Caribbean area. Contemporary northward sub-sea overthrusting of the Curacao ridge is vividly portrayed by the multichannel seismic reflection lines described by Ladd *et al.* Further east, Vierbuchen has another look at the El Pilar Fault, long championed as the focus of a major transcurrent plate boundary. By re-interpreting Metz' field mapping and invoking gravity data, he shows that Tertiary right lateral offsets of 150-300 km can be entertained. Another major contemporary geofracture is the Urica fault zone, which is described and illustrated seismically by Munro and Smith. Other papers propose regional overthrusting of the Perija Range (Kellogg); describe varying orientations of Tertiary compression in the Tachira depression (Marcellari); report a Paleozoic orogenic belt beneath the Venezuelan llanos (Feo-Codecido *et al.*); describe Tertiary sedimentary diapirism in Columbia (Duque-Caro); discuss a late Tertiary fluvial deltaic complex in the southwestern Maracaibo Basin (Van Houten and James); explore the manifestations of Late Tertiary tectonics in the Venezuelan Andes (Giegentack) and use fission trace ages to unravel the timing of batholith unroofing and regional uplift (Kohn *et al.*). Meanwhile Mattson, in step with Bally, uses regional unconformities to identify times of major changes in Caribbean plate movements. Lest geography bewilder the readers, Case *et al.* have provided a most effective coloured map of geologic provinces of the Caribbean region. There is no index, nor a unified bibliography, but the volume is well produced and contains a variety of figures which benefit from the large page format.

In my opinion, it is essential reading for all geologists undertaking research in the area. The papers in it hint at an awesomely complex tectonic evolution, with probably much more overthrusting than can presently be documented. They reveal the need for more biostratigraphy of measured sections, more radiometric age determinations of well-mapped rock bodies and more controlled interpretation of deep reflection seismic profiles to augment our other geochemical and geophysical insights. Most areas need this, but few offer the degree of intellectual stimulation of the Caribbean jigsaw, which this Memoir reveals.

Elements of Micropalaeontology

By Gerard Bignot
IHRDC Press, Boston
217 p., 1985; \$20.00 US, paper

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Professor Gerard Bignot is a micropaleontologist at Pierre-et-Marie Curie University in Paris, France. He has published extensively on foraminifera, ostracodes, calcareous algae, calpionellids, diatoms and several other fossil groups. Had he confined his task to writing a simplified but accurate account of these fossil groups, Dr. Bignot might have come closer to the goal stated in his Preface: "...a synopsis of the current state of knowledge". Unfortunately, Professor Bignot has attempted to cover numerous other microfossil groups including the panoply of microfossils loosely grouped under palynology: spores and pollen, dinoflagellate cysts, acritarchs, chitinozoa, microscopic plant remains and, in some circles, the calcareous nanofossils. Each of these could merit exhaustive treatment; several full-length textbooks have appeared on the dinoflagellate cysts alone. Dr. Bignot has attempted also to cover the great variety of practical applications for which these microfossil groups can be put to use. Some notable gaps occur in this part of his endeavor, including the whole field of visual kerogen studies using microscopic plant remains and palynomorphs and the role of plant microfossils in support of the hypothesis of plate tectonics and as an aid in modern paleo-oceanographic studies. When such a distinguished worker does not meet his goal, the truth is clearly that no one person anymore can attempt such a lofty aim and expect to be successful.

The text itself is divided into two parts: "Microfossil Groups"; and "Geological and Palaeobiological Applications of Micropalaeontology". Part One attempts to treat work and preparation methods and to summarize, with inevitable "gaps and simplifications", essential morphological and systematic details about microfossil groups. These include foraminifera, ostracodes, calpionellids and related fossils, calcareous and siliceous nano- and microfossils, conodonts, palynological entities and other minor groups. In Part Two, Professor Bignot examines microfossils in their environment of preservation, as the key to biological problems, as sediment sources, chronometers and as paleoenvironmental and paleogeographic indicators. Part Two is probably more successful than Part One.

The text is illustrated by black-and-white line drawings and diagrams, many of which

are adapted from other publications. At the end of each chapter the author refers the reader to other more detailed treatments, often heavily weighted to French sources. The reader is wise to follow these leads, especially in the sections on palynology.

Despite F.T. Banner's assurances in his fulsome Foreword that Gerard Bignot can surmount the difficult task of being succinctly encyclopaedic and write from his singular experience about all major microfossil groups, my reluctant assessment is this. Dr. Bignot has written a text somewhat too detailed in places for the casual perusal of a non-paleontologist; but often he has simplified his treatment so as to be somewhat misleading especially in areas outside his direct experience. This places a dubious value on its use as a textbook. There are several other more satisfying treatments of the subject involving multiple authors that meet the purposes of casual readers and interested students.

The Significance of Trace Elements in Solving Petrogenetic Problems and Controversies

Edited by S.S. Augustithis
Theophrastus Publications S.A., Athens
 917 p., 1983; \$55.00 US, cloth

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Currently there is no text or collection of papers that deals with the significance of trace elements in solving a variety of geological and petrological problems. By its title, one might expect that this volume might at least go part way to filling this gap in the geological literature. Unfortunately, the old adage "you can't judge a book by its cover", or in this case, its title, still holds true. This book contains 39 papers covering a wide range of topics dealing with trace element geochemistry. Not all of these papers address the theme of the book; the significance of trace elements in solving petrogenetic problems and controversies. Some papers are simply detailed studies of local interest, which although they deal with trace elements, do not really address the theme of the book. However, as is generally true in collections of this sort, there are some grains of wheat amongst the chaff.

The 39 papers are grouped into ten subject areas, mainly on the basis of lithology: Processes-Analytical Methods, Igneous Rocks, Granites-Pegmatites, Metamorphics, Sediments, Coals-Fuels-Organic Matter, Weathering, Mineralization, Radioactive Substances, and Minerals. As might be expected, some papers fit into several categories, and consequently, are not always logically placed in the book. Given the title and contents of the book, a different grouping would have been preferable, for example: Statistical Methods, Theory, Analytical Methods, Crystal-Liquid Partitioning, and Case Studies. In addition to making the book more useful, it would make it easier for the reader to identify material of the greatest interest to them. For instance, the chapters by P.C. Rickwood on "The Use of Cluster Analysis" (Chapter 7), I.E.M. Smith on "Numerical Methods" (Chapter 8), and A. Hall on "Non-parametric Statistical Methods" (Chapter 9) all provide succinct reviews on the use of modern statistical methods adapted to geological situations, and all would be excellent for teaching purposes at the undergraduate or graduate level. As the book is presently organized, these three chapters are split between two sections of the book. Other examples exist of similar misgroupings. It is also unfortunate that most of the other papers in the book that use statistics provide examples of the abuse of statistical methods as discussed by Rickwood, Smith, and Hall.

Within the book there are five types of papers. Because of space, and the fact that most of the papers have lengthy titles, I will refer to them below only by chapter number. The first type of paper is relatively short contributions that address the theme of the book. These are Chapters 2, 4, 7-9, 28, and 30. These papers could be used in an introductory course on geochemistry. The second type are case studies, generally brief, that also relate to the theme of the book, and include Chapters 15, 18, 20-22, 25, 31-33, and 35. Many of these papers could also be used in the classroom. The third type are review papers. While they deal with trace elements, for example the "Minor Element Content of Coals", they are lengthy data collections, not a look at trace elements to solve problems. Chapters 19, 26, 27, and 29 are of this type. The fourth type are extremely local studies. They are of limited interest, and are Chapters 11-14, 17, 23, 24, and 34. The fifth type are curiosities (Chapters 1, 3, 5, 6, 10, 16, 36, and 37). They cover diverse subjects such as migration of radionuclides at the Oklo natural reactor in Gabon, a survey of geochemist's views on the use of semi-quantitative data (it should be avoided, although some chapters use this data), and a paper which considers borehole gamma-ray logs of K, U, and Th as a study of trace element behavior. The latter seems to be stretching the definition of trace element measurement a bit.

Only about half the papers in this book

really address the theme of the book, and could be used for teaching/reference purposes. Even many of these papers are limited by the absence of a summary or conclusion section. This is not the only sign of a lack of a firm hand by the editor. Many of the other papers could have been easily rewritten to address the theme of the book, or to make the local studies into case studies of broader interest. Since this book is not a symposium volume, not all of the 39 papers need have been accepted. Clearly the editor opted for quantity rather than quality.

In summary, there is still no adequate text or book that deals with the application of trace element geochemistry to geologic or petrologic problems. Nor can I recommend this book for inclusion in most geochemist's libraries. However, a number of papers are of sufficient interest (for example, the papers on statistics, several Japanese papers on trace element crystal-liquid partitioning, the papers in the metamorphic section, and Chapter 33) that this volume should be added to most geological libraries, especially as the cost of this book is reasonable given its size.

Evolution of Archean Supracrustal Sequences

Edited by L.D. Ayres, P.C. Thurston, K.D. Card and W. Weber
Geological Association of Canada
Special Paper 28
 380 p., 1985; Members \$35.00,
 Non-members \$42.00, cloth

Reviewed by P.W. Fralick
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The title of this volume overstates what is present between the covers. Areas such as Asia, Europe, South America and northern Africa are not discussed at all but three papers deal at least in part with the Canadian Shield. This reflects the volume's parentage, a symposium sponsored by the Precambrian and Volcanology Divisions of the GAC and held during the 1982 GAC-MAC meeting in Winnipeg. Twenty-two papers, most based on oral presentations given at the symposium, make up the book. These are organized into eight sections: "Overviews" (4 papers); "Greenstone-Granite Terranes of the Superior Province" (5 papers); "Greenstone-Granitoid Terranes of the Slave Province" (2 papers); "Gneisses and Granulites in the Superior Province" (2 papers); "Volcanism, Erosion, and Cu-Zn Deposits" (2 papers); "Reworking of Archean Terranes" (3 papers);

"Archean Terranes of South Africa and Australia" (3 papers); "Summary" (1 paper). Unfortunately, most of the contributions are on subjects so diverse that this type of categorization sometimes appears very arbitrary and artificial. The division of the book into sections gives it the semblance of containing papers devoted to separate themes when in fact closer examination reveals that it is simply a collection of papers. A better strategy would have consisted of listing the articles without attempting to classify them.

As in any collection of papers emanating from a symposium the quality is variable. The first section is particularly strong with good review articles by Ayres *et al.* (introduction to the book), Thurston *et al.* (bimodal volcanism) and, in particular, Ojakangas (sedimentation), though he is limited by the paucity of detailed sedimentological studies conducted on Archean terrains. Unfortunately, the themes developed in these papers (bimodal nature of many Archean volcanic belts, large volume of felsic material erupted, scarcity of shallow marine deposits, importance of reworked felsic volcanic material) are not recognized as important topics by some of the other authors. It appears that some authors when in the field spent all their time asking *what* instead of occasionally stopping to ponder the *why's*. There are, of course, marked exceptions to this complaint and bright spots in most papers: Easton provides an excellent comparison between the tectonic processes that formed the Basin and Range Province of the southwestern US and those that probably led to the development of Archean basins in the Slave Province; Dimroth *et al.* develop an interesting lithofacies model for mafic submarine flows; Lowe relates preservation potential of volcanogenic massive sulphide deposits to ideas he has previously developed on variations in water depth (somewhat of a rerun); Schwerdtner *et al.* and Bickle *et al.* put forward contrasting hypotheses on the generation of oval structures in gneiss terrains; Percival and Card discuss a possible cross-section through the Archean crust represented by the Kapuskasing Structure; plus discussion of the genesis of specific terrains in sections of papers by Glikson and Jahn, Jensen, Beakhouse, Padgham, and Blackburn *et al.* Those interested in Proterozoic tectonics should see papers by Lewry *et al.* plus Thomas and Gibb highlighting the growing evidence for the operation of modern day plate tectonic processes in that time interval.

An article by Ayres and Thurston concludes the volume. This purports to be an overview of the Archean supracrustal sequences in the Canadian Shield but in practice puts forward a single viewpoint which is in conflict with data presented by other authors in this volume. Its designation as a summary of the volume is further impaired by the emphasis it places on igneous successions with only minor discussion of other at-

tributes of Archean sequences. This paper deserves to be in the main body of the text, not presented as an overview.

The title of the book suggests that it may be useful as a text, but this is not the case as coverage of topics is erratic, as would be expected in a collection of papers. The book is directed toward geologists working in Archean terrains, and all those fitting this description should give it a perusal. The first three papers are particularly good, plus Archean oriented earth scientists in almost any subdiscipline will be able to find other articles of interest. Those working on the Canadian Shield and other Archean terrains should strongly consider recommending this volume for acquisition by their institution's library. However, because of its non-directed nature the book's appeal to any particular specialization is not sufficient for it to warrant a permanent place on most geologists' bookshelves.

Optical Mineralogy, Second Edition

By D. Shelley
Elsevier Science Publisher, Amsterdam
321 p., 1985; \$37.50 US, paper

Reviewed by John Gittins
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This is a Second Edition of Shelley's *Manual of Optical Mineralogy*, that appeared in 1975, in slightly smaller format. The approach is similar and most of the figures from the earlier edition are used again. Chapter 1 is a brief introduction to morphological crystallography (10 pages) and stereographic projection (7 pages). Chapter 2 describes the polarizing microscope in 7 pages. Chapter 3 discusses the principles of optical mineralogy in 28 pages. Chapters 4 and 5 (52 pages) entitled "Flat-Stage Techniques" discuss the examination of thin sections and grain mounts, respectively. Chapter 6 (19 pages) discusses the Universal and Spindle Stages. Chapter 7 reviews, in 5 pages, the routine examination of thin sections and grain mounts. The remainder of the book consists of ten mineral determination tables (Chapter 8, 20 pages), individual mineral descriptions (Chapter 10, 153 pages) and 6 pages of references.

The treatment of interaction between plane-polarized light and crystals is fairly standard and follows the sensible modern tendency to reduce the amount of theory to the minimum necessary for an understanding of the purely determinative tests that are made on minerals. Gone is the wealth of theory that was once thought to purify the souls of all aspiring

petrologists and now to be found only in such books as the fifth edition of Wahlstrom. My own feeling, however, as a teacher is that it has been oversimplified and that the student might wish for a slightly more expanded treatment. The treatment of interference colours is a case in point and illustrates the problem faced by every teacher of mineral optics. It is usual to treat the subject entirely from the, admittedly over-simplified, perspective of plane polarization in which no interference occurs until the two out-of-phase waves are resolved by the analyzer into the same plane and can then interfere to generate interference colours. Shelley causes the waves to interfere in air immediately after leaving the crystal and before entering the analyzer, and he complicates the issue by mentioning, but not explaining, the roles of circular and elliptical polarization. This is guaranteed to confuse most geology students.

It is always difficult to know how much to include and leave out of an optics text. However, all students have been introduced to morphological crystallography before optical crystallography, and so Chapter One seems redundant with the possible exception of stereographic projection, often not taught today, but required for the Universal Stage section. I am a trifle surprised that the illustration of an aged Swift microscope would not have given way to one of the new "square" design instruments.

What we have is a book that gives a rather abbreviated treatment of mineral optics, but then devotes more than half the pages to a description of minerals in thin section which contains nothing that is not treated more fully in Deer, Howie and Zussman. Similarly, an attempt has been made to emulate the MacKenzie *Atlas of Minerals and Rocks in Thin Section* by including 40 colour plates, each a mere 4.5 cm × 6 cm. They are too small and many of the colours are inaccurate. An undergraduate today needs a straightforward treatment of optical principles and applications, the MacKenzie *Atlas of Minerals and Rocks in Thin Section*, and a DHZ. Shelley, unfortunately, has tried to produce a book for all seasons. Many will find it useful, but I could not recommend it as a text. It invites comparison with five other optics texts to be found in general use today and scores well down the list.

Sedimentology of Coal and Coal-Bearing Sequences

Edited by R.A. Rahmani and R.M. Flores
Blackwell Scientific Publications, Palo Alto
International Association of Sedimentologists Special Publication 7
 412 p., 1984; \$56.00 US (\$42.00 US for IAS members)
 £28.00 (£21 for IAS members), paper

Reviewed by Emlyn H. Koster
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This latest IAS Special Publication arose from a symposium of the same title during the 11th International Sedimentological Congress held at McMaster University in August 1982. Although the pace of coal exploration has slowed markedly since the symposium was planned, this collection of papers advances the data base in readiness for improved market conditions and is topical to several other types of process-response study in fluvial, deltaic, wave- and tide-dominated coastal environments.

The co-editors' prefatory paper places the contributions in the context of more detailed, "post-cyclothem era" work on coal-bearing sequences. The background review paper by P.J. McCabe cautions that sedimentological views on the origin of peat, which have evolved over this period, require some modification. One of McCabe's points is that thick, low-ash, unsplit seams may signify an inactive phase of the clastic depositional system responsible for inter-seam sediments. This suggests that the clastic and organic facies in a coal-bearing sequence require separate assessment in paleoenvironmental interpretation, rather than seams being viewed simply as an integral part of the host depositional system.

The main group of 21 papers relate to Holocene coastal environments in Georgia and British Columbia; Paleogene of Japan; Paleocene of the Wyoming-Montana-North Dakota region; Cretaceous of the North American Western Interior and Eastern China; Permian of Eastern Australia, India and China; and Pennsylvanian of the Appalachian region, England and China. Authors are divided almost equally between university and government survey affiliations, with a few mining companies also represented. Their raw data mainly derive from outcrop, geophysical logs and cores; only five of the papers use actual mine-site data. Interpreted paleoenvironments are mostly alluvial (meandering, anastomosed, delta distributary) in foreland molasse settings.

Papers are organized into five themes, with the opening trio evoking most interest. These

investigate "depositional models" from the standpoints of the ancient record (11 papers), modern peat-producing environments (2 papers) and mining problems (4 papers). Given the recent shift in thinking away from a limited variety of facies models for fluvial sediments, the interpreted nature of channel patterns between peat-forming wetlands in several papers is perhaps equivocal. The examples of application of sedimentological data to mine planning are satisfying testimonial for the practical role of sedimentology in coal resource development. One anticipates a similar situation with future *in situ* extraction technology. The fourth theme (3 papers by non-sedimentologists) looks at examples of depositional influence on coal composition: information presented here might be viewed as an ancient analog to the two earlier papers on modern peat-forming environments. The concluding two papers, under the theme "sedimentary tectonics of coal basins", relate specifically to China.

The reader of this volume should not lose sight of the fact that any sequence containing economic coal reserves ultimately requires a comprehensive evaluation of data on tectonic structure, seam geometry (areal extent, thickness, splits), seam quality (ash, sulphur, calorific value, etc.), zone character (e.g. cumulative thickness of superimposed seams) and the geotechnical aspects of intervening sediments. It is also desirable that a predictive capability of coal occurrence be developed within- or between-basins based on depositional "models" (i.e. origin of peat and enclosing sediments) and basin-scale analysis (i.e. tectonic setting, paleoclimate, sea-level movements). Given the multi-disciplinary nature of modern coal geology in which the field sedimentologist, coal petrographer, paleobotanist and basin analyst all play key roles, this proceedings' volume certainly has added value by virtue of its alphabetical subject index.

The volume contains a wealth of new data and thoughts; papers are well illustrated and the editorial function has been effectively carried out. It deserves a place in the personal libraries of clastic sedimentologists, and consultation by other specialties concerned with reserve estimation or mine planning. Sedimentologists doing contract work for coal companies should bring this book to the attention of their clients! Although it sells for the same price as the preceding issue in the series (reviewed for *Geoscience Canada*, v. 12, p. 80-81), the latter contained 40% more pages. However most purchasers are likely to be IAS members and therefore entitled to a 25% discount.

Whether sales of IAS Special Publication 7 decline sharply over the next couple of years will largely depend on the amount of progress captured in the proceedings' volume to the International Symposium on Coal and Coal-bearing Strata, organized for April 1986 by the Geological Society of London.

Invertebrate Fossils Chart

Compiled by P. Lof
Elsevier Science Publishers, Amsterdam
 95 × 135 cm chart, 1985;
 10 copies \$81.00 US, paper

Reviewed by Alan Logan
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This illustrated chart, the latest in Elsevier's wall chart series, features all the major fossil invertebrates on a single large sheet. At first glance students might be bewildered by the sheer mass of information, but a few moments of study should reveal order in apparent chaos. The chart is read vertically in a series of columns from the top left-hand corner. Following a brief introduction and references, heavy horizontal black lines demarcate the major phyla into a series of large boxes. Within each box are smaller boxes representing taxonomic categories down to the level of order. Each large box has a short description of the main morphological characteristics of the phylum, together with line drawings taken directly from the excellent little book *The Elements of Palaeontology* by Rhona Black. The diagnostic features of taxa below the phylum level are described in smaller boxes and illustrated by high-quality colour photographs of representative species. There are 156 of these photographs in all, each with its binomial name, author, geological age, location and size. The Protista are not included in the chart and groups are arranged in the usual manner of increasing complexity, from Porifera to Hemichordata, by way of Coelenterata, Mollusca, Brachiopoda, Bryozoa, Arthropoda and Echinodermata. In each phylum box is a multi-coloured time-range chart for all groups above the level of order, to emphasize the biostratigraphic value of fossils to students.

The excellent photographs are the strong point of this chart and I recommend it for a place in the wall of all paleontology laboratories (if room can be found). One small criticism is the rather faint reproduction of the line drawings in one or two cases. Also, due to its large size, the chart tears easily and it should have been produced with a cloth back.

The question now remains, who will use this chart? The advertising blurb maintains that the chart is designed for fossil collectors, students and professional paleontologists and will assist students in "placing reasonably well-preserved fossil specimens into their correct taxonomic categories". I hope to put this to the test in my next invertebrate paleontology class.

Taxonomy, Ecology and Identity of Conodonts. Proceedings of the Third European Conodont Symposium (ECOS III) in Lund, 30th August to 1st September, 1982.

Edited by A. Martinsson (deceased) and S. Bengtson

Fossils and Strata, No. 15, Oslo
192 p., 1983; \$38.00 US, paper

Reviewed by Alexander D. McCracken
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The volume of 16 articles and 2 notes is well produced, with numerous line drawings and photographs. Most of the latter are electron-micrographs that will be of interest to conodont taxonomists.

Two papers explore the early history and affinities of conodonts. Bengtson suggests that true conodonts (euconodonts) evolved from paraconodonts during Late Cambrian. His discussion covers several Cambrian conodont-like fossils, and adds to the suggested relationship between conodonts and chaetognaths. Szaniawski notes a great histological similarity between Late Cambrian protoconodonts and the grasping spines of Recent chaetognaths. This study supplies arguments in favour, and none against a relationship between these organisms.

Authors of biostratigraphic studies include Jeppsson (Silurian, Gotland), Lin (Silurian, China), Mannik (Silurian, Severnaya Zemlya), Nowlan (Ordovician-Silurian, eastern Canada), Repetski and Henry (Late Mississippian, West Virginia) and Wang and Wang (Cambrian-Triassic, China). Assemblage zones are proposed by Moskalenko for the Ordovician Siberian Platform, where some taxa are endemic although there was periodic correspondence with Mid-continent and North Atlantic faunal provinces, possibly reflecting transgressive events.

Dzik identifies three centres of diversification of family-related groups in the Early and Middle Ordovician. The diversification probably depended on local ecologic factors and bathymetry rather than climate. Faunas of Laurentia evolved gradually, with periodic additions of taxa from the Iapetus Ocean. The stable faunas of Baltica changed considerably in late Caradoc with the influx of taxa previously confined to Iapetus. Bergström also discusses Ordovician biogeography, biostratigraphy and evolution. He describes five lineages of platform conodonts, two new genera and three new species.

Ontogenetic development of platform elements is used by Bultynck to trace the evolution of *Ancyrodella* from Devonian *Ozarkodina* and to make a three-fold subdivision of a Devonian biozone. Changes in taxa correspond to a dispersal of *Ancyrodella* from nearshore to offshore. Clark and Hatleberg use similarity coefficients to compare Early Triassic conodont biofacies of Svalbard (Arctic) and Nepal (Tethyan) with those from Australia, United States and USSR. Differences between conodont faunas from Svalbard and Nepal are due to lithofacies factors: the Svalbard biofacies represents the inner part of the outer shelf, while that of Nepal, the outer shelf to basin.

Orchard presents a study of conodonts associated with Upper Triassic ammonoid zones. Each of his *Epigondolella* population from British Columbia shows a range of ontogenetic morphological variability that may cause identification problems because early growth stages of some species resemble later stages of others. Neoteny is also suggested by Broadhead and McComb to be responsible for the rapid evolution from *Pedavis* to *Icriodus* in the Lower Devonian.

Serpagli's study shows that the basic number of morphologically distinct elements in *Icriodus* is six rather than two as previously thought. Contrary to the observation that a decrease in number of morphotypes is typical of younger Icriodontidae, at least some species of *Pedavis* and *Petekysgnathus* may also have similar apparatus. Serpagli's data support previous observations that an apparatus of six morphotypes is a common plan in Ordovician to Triassic taxa.

The volume is of interest to all conodont paleontologists. But, it is also a diverse source of conodont studies that will be useful to other paleontologists, and to students of senior micropaleontology courses — it is more than simply a collection of papers on "classical" systematic paleontology. Science libraries should have this book, and for that matter, a standing order for the *Fossils and Strata* series.

The Catskill Delta

Edited by D.L. Woodrow and W.D. Sevon
Geological Society of America Special Paper 201, Boulder
246 p., 1985; \$32.00 US, paper

Reviewed by J. Ross McLean
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Catskill Delta! The name rings across the fading years from the pages of my first geology textbook. The name is familiar to most geologists. It has a captivating ring to it. But, what exactly is it? This 246-page compendium addresses that surprisingly-complex question. The editors were quick to point out that the term "delta" is inappropriate, but were at a loss for a better all-encompassing, or more widely-recognizable, title for this sequence of Devonian sediments to which scores of stratigraphic names have been applied over the past 150 years. The Catskill Delta is not the deposit of a single delta, nor even a delta complex, but rather a montage of depositional environments — nonmarine and marine — in a major clastic wedge generated by a prolonged tectonic event — the Acadian Orogeny. The volume aims to synthesize present knowledge of the Delta to serve as a starting point for future research and discussion. Unfortunately, this sort of publication is invariably a patchwork, with many gaps, inevitable repetition, and a general lack of continuity. The success of the volume in achieving its aim will have to be judged by those who work in the area, but I came away feeling that I had learned quite a lot about what is known, as well as what is not well known, about the Delta.

Special Paper 201 contains 17 papers and 1 abstract, arranged with 8 syntheses on broad, integrating aspects of the delta at the beginning, followed by 9 papers of more local and detailed character. The initial paper by Sevon and Woodrow consists mainly of stratigraphic charts which illustrate the proliferation of lithostratigraphic nomenclature, but did little to clarify it. Some lithological designation to convey broad facies changes would have been valuable in orienting the uninitiated. The paper by Kent looks at the paleogeography of the Catskill Delta as revealed by paleomagnetic data. The one illustration is reminiscent of Russian publications where a poorly-annotated map commonly is followed by a long explanatory caption in small print. Although not crystal-clear to this Catskillian tyro, the paper did set the broad plate tectonic and paleogeographic stage. Papers by Fail and Ettensohn deal with the relationship of the Acadian Orogeny to the Catskill Delta and provide a good understanding of the spatial context of the Delta and the

problems in interpreting associated tectonic events. The paper by Woodrow briefly covers a realm of topics discussed more fully in other papers. Ettensohn's second paper deals with controls on basin facies. It focusses on the black shales in the distal part of the Delta, and touches on the fascinating paleogeography of the Old Red Sandstone Continent, on rain shadows and on paleocirculation patterns. Some repetition of his earlier paper could have been avoided but, on the whole, a useful, thought-provoking and well-illustrated paper. Sevon's paper on nonmarine facies attempts to generalize for the whole of the nonmarine Delta. It contains a few useful diagrams, but discussion of depositional environments is elementary and presents little evidence for interpretations. Dennison's paper on shallow marine strata focusses mainly on interpreted strandline positions. There is little discussion of facies, none of processes, and the paper is rife with supposition and unsubstantiated references. It suggests a profound need for detailed sedimentological study of the shelf and shoreline environments.

In answer to this need, three sedimentological gems are to be found in the central part of the volume in papers by Lundegard, Samuels and Pryor, Bridge and Droser, and Bridge and Gordon. The first deals with Upper Devonian turbidite sequences in part of the basin. It is a concise, well-documented study of the type I have come to expect from Pryor and his co-workers. It presents evidence of distinct differences between these turbidites associated with small, quixotic delta systems, and submarine fan turbidite sequences. The Bridge and Droser contribution addresses the question of tidal influence in the Catskill Delta, and that of Bridge and Gordon, documents the anatomy of some Devonian river systems. Both are admirably presented, with excellent illustrations, well-marshalled evidence, and convincing interpretations. These three papers are indicative of the relatively sophisticated level of interpretation now possible in sedimentological studies.

The flora of the Catskill Delta and its impact on sedimentation is a fascinating paper by Banks, Grierson and Bonamo. It provides interesting insights into plant anatomy, diversity and distribution during the Devonian, a time which I tend to think of as being largely devoid of land plants. Papers by McGhee and Sutton, Sutton and McGhee, and Sass and Condrate have some interesting paleoecological insights, but all would benefit greatly by collaboration with a good sedimentologist. Their assessments of depositional environments are vague and unconvincing. The paper by Kirchgasser on ammonites suggests that much work needs to be done on biostratigraphy and that long-standing miscorrelations need to be ferreted out in order to clarify stratigraphy nomenclature.

The only paper which addresses economic

aspects of the Delta is that by Smith and Rose on uneconomic copper and uranium deposits. The editors indicate that thousands of wells have been drilled in the search for hydrocarbons in the Delta, and the lack of any discussion of this important economic aspect, seems to me to be a serious omission.

Who should read Special Paper 201? Anyone not familiar with the Catskill Delta, who wants to know its principal features, will find it informative. The three sedimentological papers will be enjoyed by any clastic sedimentologist. Some of the paleontology is interesting, but, I suspect, mainly to the novice. The price of \$32.00 US (\$45 + CDN) is excessive for what the publication offers.

Reservoir Sandstones

By Robert R. Berg
Prentice-Hall Inc., Englewood Cliffs, NJ
481 p., 1986; \$50.35, cloth

Reviewed by Andrew D. Miall
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This book is offered as "the basis for a one-semester course on the origin of sandstones for upper-level undergraduates and graduate students in geology, geophysics and petroleum engineering. Basic knowledge is presented on sandstone properties, transport mechanisms, and modern depositional environments so that this book alone provides the necessary background for advanced study." (from the Preface).

In my opinion the use of this book for the purpose stated would be a serious disservice to any group of students. It represents a level of knowledge prevalent at around 1970. A few more recent references are included (especially those of the author), but they do not appear to have influenced the presentation except in a superficial way. So many modern concepts about clastic depositional environments are missing that it is hard to know where to begin a critical evaluation. The book obviously represents a body of experience entirely restricted to the subsurface, and is directed at those working with core and log data. Many illustrated examples of each environment are provided, together with appropriate geophysical logs, but these cannot properly represent the full range of depositional environments that we now know to exist. The sections describing our general knowledge of each environment are extremely thin. The focus of the work is on interpretation of vertical profiles. These are obviously important in the subsurface — they are about the only kind of data available, but

it is surely important to go beyond the half dozen or so basic profiles purporting to cover all clastic environments, that form the core of this book.

Chapter 1, entitled "Sandstone Properties", deals briefly with composition, grain size, sorting, bed geometry, porosity, permeability, and the study of these various properties in cores and in geophysical logs. The best sections are those which deal, in a quantitative way, with porosity and permeability. The description of geophysical logs is thorough, but does not contain nearly enough illustrations. The sections on grain size and composition are extremely weak; for example, there are no illustrations of the principal components of sandstones (if this subject is going to be discussed, it must be illustrated), and the treatment of grain size data makes no mention of the fact that nowadays grain size statistics are reported almost entirely in terms of the phi scale.

Chapter 2 provides a basic mathematical treatment of the major "sedimentary processes", including channel flow, erosion, transportation and deposition, an introduction to the flow regime concept and density flow, wave motion and the resultant bedforms. This is all standard stuff, basic hydraulics is considered a necessary part of any sedimentology course, although, personally, I have never found that much of it really helps students understand how sandstone facies are actually formed. A qualitative examination of the flow regime concept is the most useful background to the formation of hydrodynamic sedimentary structures, and this is provided here, albeit in a somewhat dated form. The contributions of Southard, in the early seventies, are barely mentioned, and the application of the concept to an understanding of wave-formed structures, the Bouma sequence and hummocky cross-stratification are not dealt with. The section on density flow makes no mention of the various types of sediment gravity flow that have been identified by Middleton, Hampton, Lowe and others, but deals only with turbidity currents.

Chapter 3, "Interpretation of Reservoir Morphology", introduces the various depositional environments. Berg introduces the concept of the vertical profile, though without mentioning Walther's Law, and provides a summary of the six "common sequences" most likely to be encountered in petroleum exploration. These are fluvial channel, delta front, coastal barrier, transgressive marine, submarine current and turbidity current profiles. To my amazement, two and one-half pages are devoted to "interpretation of composition", in terms of depositional environment. Berg acknowledges the strong influence of source on composition, but then offers generalizations such as "alluvial valley sands commonly have low to moderate amounts of monocristalline quartz in the range of 40-70%, and the balance of grain composi-

tion is largely feldspar or rock fragments". The chapter concludes with a discussion of the use of geophysical logs and microfossil data, and a description of the types of core normally available for study. No mention is made of the techniques of subsurface basin mapping, such as the construction of detailed stratigraphic cross-sections and the use of isolith maps.

The remaining six chapters each deal with individual depositional environments. The first of these is devoted to "eolian sandstones". The descriptions are mainly based on McKee's work, dating back to the sixties and earlier, and no mention at all is made of the recent papers by Brookfield, Hunter and Rubin, which have, for the first time, given us a thorough understanding of the dynamics of eolian bedforms, complete with facies criteria for recognizing various eolian transport mechanisms that can readily be used in core.

The chapter on "fluvial sandstones" confuses the terms braided and anastomosed, and provides an extremely sketchy treatment of braided facies. Nothing is said about the important anastomosed fluvial model. Point bars are treated in a superficial way. They are said to "prograde" as a result of channel migration, whereas this process is now described as lateral accretion, and the term progradation has acquired a distinctly different meaning. No use is made of the extensive literature that has been published on fluvial facies models as a result of the three international fluvial conferences, beginning in 1978.

The chapter entitled "deltaic sandstones" is marginally better, because it focusses on the Mississippi Delta, on which the most important work was completed by about 1970. The other important types of delta (wave- and tide-dominated types), however, are dismissed in four lines and one small illustration! Galloway's very useful delta classification is not mentioned.

Chapter 7, "Coastal sandstones", provides a competent description of low-energy microtidal barrier systems, based on the early work on Padre Island and Galveston Island. However, no mention is made of the importance of tide range, the effects of storms, or the sedimentology of tidal inlets and washover fans, all of which have been well known for ten years (e.g. the work of Hayes). Tidal flats are briefly described, but without any discussion of wavy, flaser and lenticular bedding.

The next chapter, on "shelf sandstones", gives an elementary description of the various processes that affect the shelf environment, including storms and tides. Hayes' Hurricane Carla turbidity current story is told although, unfortunately, this has now been shown to be incorrect. Sand ridges on the US Atlantic margin and in the North Sea are described. Once again, though, all the modern concepts that have improved our understanding of the shelf environment are missing — no mention is made of hummocky cross-stratification, or tidal sand waves, or the dis-

tinctive structure of wave ripples. How could Berg have missed the hullabaloo over HCS? This structure is mentioned only twice in the whole book, and its significance for shelf sedimentation (the work of Harms, Walker, Dott, Bourgeois, Tillman, Swift, Duke and many others) has been entirely missed. This is particularly unfortunate because all these sedimentary structures are readily recognizable in core, and are therefore of considerable relevance to any study of sandstone reservoirs.

The final chapter, on "basin sandstones", is consistent with the others in the absence of any real discussion of concepts that have been developed since 1966. A few of the more important recent references are mentioned, but they have clearly had no impact at all on how the book was written. For example, "Other systems of fan terminology have been proposed (Multi and Ricci-Lucchi, 1972; Normark, 1978; Walker, 1978), but the scheme proposed by Haner (1971) appears to be best suited for ancient submarine-fan deposits". Who, one might ask, is Haner? By now the litany of omissions is becoming wearisome: no mention of any type of sediment gravity flows except turbidity currents, no mention of the conglomeratic facies that are so common in fan channels, no mention of the well-known cyclic sequences that commonly result from lobe progradation and channel aggradation, and no mention of other environments and processes such as contour currents, olistostromes, submarine canyons, continental slopes and basin plains.

Each of the six chapters on specific environments is accompanied by a discussion of several examples of producing oil and gas fields. For each example the following information is given: geologic setting, drilling history, description of sandstones, morphology, porosity and permeability interpretation. Much of the information does not seem very useful or relevant, for example drilling history; and much seems misguided, for example the focus on a confirmation of interpreted environment from detrital petrography. Numerous core photographs are provided, but these are much less useful than they could be because they are interpreted from a perspective fifteen years out-of-date.

About the only recent references that the author seems to have used are his own; these include a set of course notes he prepared for AAPG in 1978. Berg seems to be one of those experienced petroleum geologists who go on consulting and giving courses long after they have stopped learning anything new themselves. There are several others on the lecture circuit. All one can say is *caveat emptor*.

The Story of the Earth

By Peter Cattermole and Patrick Moore
Cambridge University Press
224 p., 1985; \$24.95 US, cloth

Reviewed by Colin W. Stearn
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This book appears to be addressed to the amateur scientist or senior school student who wants to know something about Earth history but has little background in geology. It is profusely illustrated with colour photographs and simple colour diagrams, maps, and cross-sections that will attract the student and non-scientist. It is a relatively short book for a history of the whole earth. The writing style is conversational and informal as is appropriate to such a readership. Continents "stand by imperiously", mountains "stood proud for millions of years", orogenic belts are "rucked up", and represent "vast chunks of earth history".

The book is divided into four parts: "Beginnings", "The Planetary Engine", "Patterns of Earth History", and "Gondwanaland and More Recent Events". The first two parts (62 pages) are interesting accounts of recent research on the formation of the Earth, the physical properties of its core, its magnetic field, and the nature of the continents and oceans. These are the sections that are closest to the authors' fields of interest. In condensing the main features of the history of the Earth into the remaining 146 pages, the authors touch on many concepts very lightly and some that cannot be developed more fully would be better left unmentioned than alluded to in a single sentence (for instance, onlap and offlap). In general, the Phanerozoic geology of the cratonic areas is treated as if it were of minor significance and emphasis is placed on the marginal mobile belts. Approximately a page of text is devoted to the "American Interior" and this includes such puzzling statements as "... during the Proterozoic hardly any marine sediments appear to have been laid down at all". However, the treatment given to the North American Cordillera is extremely short (1½ pages) and makes no mention of important recent developments in the recognition of allochthonous terrains. The Appalachians receive about the same attention. From a North American perspective, a disproportionate emphasis is placed on the geology of the southern continents and the breakup of Gondwanaland.

The authors are unfamiliar with the geology of North America. The age of rocks in the Canadian Shield is said to be 2800 to 4000 million years (although a map on page 85 shows much younger ages) and the text states that the Shield has been a stable area

since 2000 million years. The Caledonian belts around North America "... are called the Appalachian — the major ones being the Ouachita, Cordilleran, Franklinian and East Greenland". The Carlsbad caverns are "hewn out of carbonate rocks".

The small part of the book on paleontological material reveals that the authors are not at home in this field. The Isua Group microfossils that have been discredited are accepted as the oldest evidence of life. The sections on the fossil record are largely a history of paleontology and contain little about the use of fossils in correlation (one unexplained diagram), dating, or environmental reconstruction. On page 160 the authors imply that the dinosaur *Brontosaurus* was carnivorous (without clearly stating it) and that some of the ornithischian dinosaurs were not herbivorous. A table showing the range of mammals and labelled "Cenozoic Life" is not referred to at all in the text.

In fact, none of the figures are specifically referred to and they are not numbered. The source of a figure can be traced only with great difficulty because the figure credits in an appendix are not listed by the pages on which the figures occur. The book is printed in one column format leaving a wide margin on the inside of the page on which tiny pictures are inserted. Apart from these, most of the illustrations are attractive and well chosen.

This book could be stimulating to the young, or amateur scientist interested in learning about modern developments in tectonics and volcanism and their impact on historical geology. It is written with enthusiasm and printed in an attractive format. From the viewpoint of the stratigrapher and paleontologist, it is disappointing but a volcanologist, or geophysicist, might have written a more enthusiastic review.

Field Geologist's Training Guide

By EXLOG Staff, edited by Alun Whittaker
IHRDC Press, Boston
291 p., 1985; \$39.00 US, cloth

Reviewed by James R. Taylor
Canadian Superior Oil Ltd
Three Calgary Place
355-4th Avenue S.W.
Calgary, Alberta T2P 0J1

A better title for this book would be "Wellsite Geologist's Training Guide". It's not about "field geology" within the usual meaning of the term. There are no references to rock outcrops in the entire volume! It is specifically designed for beginning petroleum geologists as an instructional guide to drilling fluid and well cutting (mud) analyses during drilling operations.

This guide is a published version of EXLOG's (Exploration Logging Inc.) internal training manual. Therein lies the reasons for the book's considerable strengths and few weaknesses.

A basic overview and introduction is presented of petroleum geology, drilling rig types and their components and drilling operations. This is accomplished in a systematic manner utilizing many clear and concise line drawings and photographs. Emphasis is on the nuts and bolts of rotary drilling technology, while the chapter on petroleum geology is brief and sketchy in places. This is as it should be — most of the high-powered geological and geophysical interpretation will have been made in deciding on the location of the well in the first place.

A full one-third of the text, along with several appendices, deals with the main geological wellsite duties — formation evaluation procedures performed during drilling operations. This is one of the specialized services offered by EXLOG and this is where valuable hints and information based on the practical experience of the authors are imparted in detail. Mud logging techniques and equipment, lag determination, gas detection, cuttings examination, oil evaluation and mud measurements are all addressed. Methods of recording data and observations are emphasized and standardized in the EXLOG format. Again, easy to understand line drawings supplement the text. Test procedures and logging examples are given in the appendices and a glossary of oilfield terms is also included.

An aspect of this book which can be criticized is that several important sections refer the reader to unpublished EXLOG memoranda and even references to published papers are untraceable — no list of references is supplied. EXLOG is so conscious of drilling rig safety that it has entire internal manuals on the subject. In the text these are referred to for "more detailed information", however they are not available to the reader.

This is a useful volume for the oil company library and a good training aid for both wellsite and office geologists.

Petroleum Geology of the North European Margin

Proceedings of the symposium held by the Norwegian Petroleum Society
IHRDC Press, Boston

Reviewed by Glynn N. Wright
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This is a compilation of 31 out of 34 papers presented at the North European Margin Symposium held at Trondheim in 1983 and organized by the Norwegian Petroleum Society (Norsk Petroleumsforening). Full of new data, ideas, and interpretations, this synthesis comes from an international group of university, oil company, and Norwegian government authors. This collection of papers serves as an up-to-date reference for those interested in the petroleum potential of Northern Europe or the plate tectonics of the Atlantic and Arctic regions.

The area under discussion is similar in area to NWT, extending from 62°N to 80°N (Faroes to Spitzbergen) and from 40°E to 30°W. More than half of the papers deal with the details of specific geographic areas while the remainder are concerned with tectonics. Each paper has a list of references, varying from one item to three pages in length. There is a similar variation in the scope and depth of the papers, but all are worth reading and some are excellent. There is an extensive reference list after the papers.

A stranger to the topic has to be very selective in terms of which papers to read first; I found Chapters 13, 17 and 31 useful as an introduction. The understanding and exploration of the area has accelerated tremendously in the last 15 years, more specifically since the offshore drilling began in the 1980's, and the book gives a state-of-the-art record of this.

Terms are being coined for the structures offshore and one paper is in the form of a lexicon, reflecting the work of a nomenclature committee formed in 1982. However, because of the newness of the offshore exploration, or perhaps the variety of translators, some confusion arises. The geographical terms used in connection with the Svalbard Archipelago (which the Norwegians took control of in 1925) typifies this problem: the main island is Spitsbergen (formerly Vestspitsbergen); and sometimes one of the southern islands is referred to as Bjørnøya, and at other times as Bear Island. Text and maps do not always use the same place names, which I found irritating.

"Geoseismic" sections are used to advantage to illustrate seismic-stratigraphy. The seismic sections used vary in quality from superb to (occasionally) illegible and there is

a similar variation in the clarity of the maps and diagrams, but on the whole they are good. Some of the plates are coloured. The tectonic papers examine all sections of the Phanerozoic, and those on petrology delve mainly into the Jurassic. Photographs, including SEM, are used effectively throughout the papers.

The lone theoretical paper, on thermo-mechanical models of rifted continental margins, comes from Dalhousie University and the Atlantic Geoscience Centre. Several papers deal with the hydrocarbons discovered recently, and the potential for such areas as Haltenbanken, Trænabanken and Troms 1. As some papers deal with very similar topics, comparison can be made between the philosophies of the authors (or their companies). The papers offered by the Norwegian Petroleum Directorate and Shell on similar topics allow this, and presumably generated lots of discussion at the symposium. Equally intriguing are two Statoil papers on Troms 1 written by different groups within that company.

All the papers are in English. The lexicon of structural features and terms does a good job of providing the preferred Norwegian translation (presumably vice versa, originally), unfortunately the terms are not listed alphabetically.

Typically, the authors for many of the papers synthesize their data from both geophysical sources (aeromagnetic, refraction, reflection, gravity, etc.), and geological sources such as DSDP cores, well logs and surface outcrops. The integration makes this report of current exploration in this remote area of the Northeast Atlantic enjoyable and worth reading.

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