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Book Reviews / Critique

Book Reviews

Economic Geology Seventy-Fifth Anniversary Volume, 1905-1980

Edited by Brian J. Skinner
Economic Geology Publishing Company
964 p., 1981
$37.00 USA, Canada, Mexico, Central America
$43.00 elsewhere

Reviewed by C. Jay Hodgson
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The journal *Economic Geology* has served the needs of the community of industrial and academic economic geologists since 1905, and during this time its pages have accurately reflected the concerns (and the fashions) of the discipline. There is no other journal published in the English language which comes even close to having its influence, scientific authority and wide readership among mineral deposits geologists. Therefore, the publication of this 75th Anniversary volume under the editorship of Brian Skinner, editor of the Journal, is a significant event. This is not just another in those legion of "special volumes" which emanate from certain well-known European publishing houses.

The volume is large, and covers a wide range of topics in twenty-eight articles, each averaging 35 pages. And there is no fat: diagrams are reduced to the minimum size necessary for legibility, there are several long tables densely packed with data and most of the articles are terse and to the point. The majority of the papers are reviews, but all of those I have looked at contain important new data, fresh perspectives and are right up to date (there are many references to papers "in press" and even "in preparation").

The topics covered are of four types. The most abundant of these (11 papers) is reviews of specific classes of ore deposits, i.e., epigenetic U deposits, Au-U conglomerates, sediment-hosted stratiform base metal deposits, sandstone-hosted lead deposits, porphyry coppers, Climax-type Mo deposits, skarns, volcanic massive sulfides, nickel laterites and ferromanganese nodules. Of these, I found the papers by Einaudi *et al.* on skarns; Nash *et al.* on epigenetic uranium; Naldrett on nickel sulfide and the section by Lydon on genetic models for volcanic massive sulfide deposits all to be of outstanding quality in terms of their clarity, the amount of new data presented and, most important, their wealth of fresh insights. The other articles on ore deposits also are excellent, with the exception of Titley and Beane's paper on porphyry copper deposits, which confuses more than it enlightens, especially in the second part dealing with alteration and mineralization. (Canadians will be interested to note the wide distribution of "Laramide" porphyry copper deposits in British Columbia on Figure 20, p. 233.)

The second major type of paper could be termed "miscellaneous topics of high current profile" in economic geology: active geothermal systems (yet another D.E. White review of this topic, but packed with useful data and references), fluid flow (mainly computer modelling perspective), the granitoid series (outstandingly clear, hands-on approach which emphasizes criteria for granitoid series identification and application to exploration and ore deposits research), Precambrian paleosurfaces in South Africa, ore-forming processes in geological history and the relation of mineral deposits to early crustal evolution.

The third type of paper consists of six articles which review the application of several specific geophysical techniques to mineral exploration and geochemical exploration techniques. Finally, there are five papers on the economic and social context of economic geology, including the problem of resource appraisal, and the social, political and economic environment of exploration specifically and the mineral industry in general.

The list of authors in all four areas reads like a "Who's Who" of economic geology. These papers are the best efforts of some of the best people who are involved in economic geology (*senso lato*) research.

I strongly recommend this book for those who think of themselves as economic geologists, or for those who are involved in research relevant to mineral deposits or who in the course of their work interface on a scientific level with economic geologists (e.g., provincial or federal survey geologists). And if you are one of these persons, it is the kind of book you will want to own, because it covers so much useful data (including references) in such an accessible and organized format that you will find you are referring to it all the time. If you don't buy it, you will probably end up stealing the copy belonging to the friend from whom you borrowed it (and so lose a friend), or paying in library fines what the book would have cost you in the first place.

Geomorphological Field Manual

By V. Gardiner and R. Dackombe
Allen and Unwin, Inc., 254 p., 1983
$30.00 US cloth; $15.95 US paper

Reviewed by D.G. Smith
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According to the authors, this field handbook (pocket-sized, 13 x 20 cm, about the same size as Lahee's *Field Geology*) is designed for the field scientist, and complements the volume *Geomorphological Technique*, published by the British Geomorphological Research Group (edited by A. Goudie). However, be warned that this manual assumes familiarity with the different kinds of field equipment and the essentials of their operation. To this end, the manual contains 13 chapters, a generous number of tables, equations (no photographs) and 5 pages of English and Metric unit conversion tables. Unfortunately, the list of figures is missing, a minor oversight of the publisher.

In general, the authors have done a good literature review in preparing this manual, as indicated by 11 pages with 222 references covering methods from surveying to geophysics, from surficial deposit mapping to geomorphic process measurements.

Information on laboratory analysis and advice on the choice and purchase of equipment have been deliberately excluded. Fortunately, both topics are discussed in Goudie (1981). Mathematical and statistical tables also have been excluded.

A quick skim of the manual will impress the reader; it seems to contain the expected standard figures and tables. However, a closer inspection reveals that the manual is little more than a collection of numerical and classification tables, charts and equations. While such information is very useful, it means that the title and introduction are somewhat misleading in terms of stated content, description and objectives. The manual would be better entitled "Numerical tables and classification systems in field geomorphology."

To me, a field manual implies a compilation of information necessary to conduct field work, covering subjects such as equipment, techniques, methods, limitations and accuracy, and including tables of numerical data and classification schemes. However, Chapter One of this manual, which focusses on topographic surveys, contains little more than two tables on calculating horizontal and vertical distance from stadia intercepts and three additional tables on correcting temperature for barometric readings of elevation. Chapters two and four contain only symbols for mapping.

Chapter Seven, which deals with fluvial processes (a specialty of both the authors and myself), is a mixed bag. It begins with an outline of procedures for selecting a channel reach for measuring discharge using velocity-area methods (current metre, floats and formulae). Formulae include Manning, Chezy and Darcy-Weisback equations (surprisingly, the authors forgot to include the Moody diagram, Chow, 1959, p. 7-17) and procedure for estimating velocity using the latter equation. The authors then discuss dilution gaging methods which, though a complex procedure, is dealt with in only 15 lines and 3 equations. Weir methods fare a little better, but no mention is made of the superb *Stevens Water Resources Data Book*, a wealth of tables and charts for differently shaped wiers.

Finally, I was particularly disturbed by the authors' total avoidance of sediment load measurement methods; no mention is made of the Helley-Smith bed load sampler, a major development of the 1970s.

In summary, its misleading title is my major criticism of the book. In reality, the manual is a collection of charts, tables and formulae. As a reference item the manual is worth the paperback price. However, by itself it has limited utility as a field manual. Perhaps if it were used together with Goudie's book it would have considerably more value.

Introduction to Small-Scale Structures

By Gilbert Wilson
(in collaboration with J.W. Cosgrove)
Allen & Unwin, Inc., 128 p., 1982
$20.00 cloth; $9.95 paper

Reviewed by W.M. Schwerdtner
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Modern analysis of large tectonic structures relies heavily on small structural features and their spatial variation in character, orientation, size and shape. As defined by Gilbert Wilson, small-scale structures can be observed in the field with the naked eye, and they range in size from that of hand specimens to that of single exposures as large as mountain sides. While the distinction between large-scale structures and small-scale structures follows time-honoured geological practice, the proposed size range of small-scale structures seems to be excessive. Moreover, some modern specialists avoid the term *small-scale structure* in view of the prevalence of multi-order folds and boudins, developed pene-contemporaneously on three or more scales, within rythmically layered rocks.

Wilson notes in his introduction that structural geology has become too involved, and that modern textbooks are presented "in a form which frightens the non-specialist to such an extent that he either leaves the subject entirely alone or loses himself in a maze of detail and jargon." To remedy the situation and educate the field geologist, Wilson has expanded and modernized his summary paper on the tectonic significance of small-scale structures (Ann. Soc. Geol. Belg. Bull., v. 84, p. 423-548, 1961). John Cosgrove, a man well acquainted with modern publications, assisted the principal author in writing a highly readable and interesting little book.

A brief introductory chapter is followed by two general chapters on (i) stress and strain and (ii) structural symmetry and kinematics. These chapters are pivotal, as they provide the theoretical framework for the subsequent discussion of the small-scale structures. The treatment of stress, strain and kinematics is similar to that found in classical textbooks of structural geology. This treatment should help us to comprehend the papers of the 1930-65 period, but it is no longer adequate in 1983. For example, little attention is paid to the concepts of heterogeneous stress and heterogeneous strain, which are invaluable to the student of regional folds.

Chapters 5-11 provide a lucid description and interpretation of small-scale structures such as tension gashes, shear zones, cleavage, schistosity, lineations, boudins, folds and mullions. Chapter 12 deals with overprinted structures and introduces geometric criteria through which the field geologist can recognize repeated deformation. Much attention is paid to the origin and history of various structural terms. The detailed description of macroscopic deformation features is based on Wilson's long experience in the use of small-scale structures. I found the chapters on cleavage and mullions particularly informative.

Chapter 13 (Minor Structures and Large Scale Tectonics) is of crucial importance to the practical geologist engaged in regional tectonic studies. Regrettably, the chapter is far too short, and offers little more than a brief description plus schematic diagrams of large-scale structures in selected regions with diverse tectonic style.

After reading this publication written for the field geologist, one is left with the question of whether the book will serve its original purpose, or whether it will be chiefly regarded as a lucid summary of classical structural geology (>85% of the cited papers were published before 1965). As the structural subdiscipline is rapidly regaining its rightful place in economic and field geology, we will soon have an answer to this question.

Nares Strait and the Drift of Greenland: A Conflict in Plate Tectonics

Edited by P.R. Dawes and J.W. Kerr
Meddelelser om Grønland
Geoscience 8, 392 p., 1982
$55.00 Cdn. cloth

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This book is the outcome of a symposium held at the annual meeting of the Geological Association of Canada in Halifax, 1980. The eighteen papers presented at that time are included here, with some changes in titles and authorship, and an additional twelve papers were solicited by the editors to complete the coverage.

Anyone who is interested in Arctic Islands geology will be familiar with the "Nares Strait problem." Geophysical evidence from Labrador Sea and Baffin Bay indicates that these small ocean basins were generated by sea floor spreading, and that Greenland was formerly part of the North American plate. However, reconstructions of the original position of Greenland leave a gap hundreds of kilometres wide between Greenland and the Canadian Arctic Islands. There is no evidence that this gap was closed by subduction. Part of the gap can be explained by rotation, stretching and compression of the Arctic Islands, but these processes cannot account for a remaining 200-300 km of left-lateral displacement that must have occurred between Greenland and Ellesmere Island during the Cenozoic, if the geophysical models are correct. The seaway between the two islands, Nares Strait, has been named Wegener Fault in recognition of the first great proponent of continental drift, who recognized the need for such displacement. However, the onshore geological evidence from either side of the strait does not appear to permit more than 25 to 50 km of movement. Many geological markers can be matched across the strait and none of them actually require any strike-slip displacement in order to resolve problems of correlation. The problem seems unresolvable.

Bill Kerr was one of the first to recognize the geological problems associated with large scale strike-slip displacement. He summarized the evidence in 1967 at a time when knowledge of the onshore geology was at little more than a reconaissance level. One of the main strengths of this book is that it brings together a great deal of widely scattered and previously unpublished data, collected mainly by members of the Greenland and Canadian geological surveys during the last fifteen years, that bears on the cross-strait correlation problem. There is no question that the case against displacement has been considerably strengthened by this work. At the same time, the geophysicists have not changed their minds either. All attempts to generate alternative crustal models for Baffin Bay and Labrador Sea or different geometrical reconstructions of the continental pieces have failed. The geophysical case for major displacement seems particularly convincing when viewed on a regional, North Atlantic scale. Closure of this ocean basin without significant movement of Greenland results in impossible overlaps of Greenland with Scandinavia and Svalbard.

Most of this book consists of statements of the evidence by the appropriate specialists. Two opening chapters, by Dawes and Christie and by Kerr, summarize the history of exploration of the region and the nature of the "plate tectonic conflict." Kerr concludes that "the debate should concentrate only on determining into which of the two ranges the displacement along Nares Strait falls, less than 25 km or more than 220 km" as though the debate was some kind of contest (it is described in exactly this way in another of his papers). One of the lessons of scientific progress in the twentieth century is that in any debate the protagonists are rarely entirely right or entirely wrong. Certainly, almost all geological arguments are resolved by compromise, but this spirit seems to be sadly lacking in the book.

The geological evidence is presented in a series of seven papers by Dawes, Hurst, Frisch, Kerr, Christie, Peel and others, who examine cross-strait correlations ranging in age from early Precambrian to Silurian. Structural evidence for limited displacement is given in two separate papers by Higgins and Mayr and their coworkers. Dawes, Hurst and Kerr discuss other interesting structural features in Greenland that have a less immediate relevance to the debate. Soper, Dawes and Higgins present new data on volcanic rocks and tectonic activity on the north Greenland coast and attempt to relate these data to plate movements in the Arctic Ocean. This paper, and one by Peirce, are amongst the best in the book in their attempts to reconcile conflicting evidence and generate new ideas. Both, however, fail to account for all the facts and are thus ultimately unsuccessful. For example, Soper *et al.* do not directly address the problem of the rotation of Greenland about a pole in North Africa, as deduced by Srivastava. This crucial, mainly Eocene, phase of spreading is the one that requires most of the strike-slip displacement between Greenland and the Arctic Islands. Two remaining papers in the structural section are an attempt by Newman to reconcile the onshore geological data to a 250 km displacement along Nares Strait, and an analysis by Sobczak of lineaments and potential fracture patterns in the Arctic. This reviewer was not impressed by either of these papers. Newman's work is based on a 1977 thesis and does not take into account any more recent work, including any of the new material in this book. The resultant synthesis is thus entirely unconvincing. Sobczak's discussion is typical of all lineament analyses that correlate miscellaneous features on the basis of supposed similarity of orientation: it ignores the fact that there are numerous deep-seated causes for geological lineaments, many of which are totally unrelated to the problem in hand.

The last major section in the book contains papers dealing with the geophysical evidence. The gravity, seismic and magnetic data that form the basis of what Kerr likes to call the conventional plate tectonic model for Baffin Bay and Labrador Sea are summarized by Menzies, Keen, Peirce, Srivastava and Falconer. Problems with these models are discussed by Grant, but most of these seem to be of secondary importance, as, for instance, the departures of subsidence curves in some offshore wells from the trends predicted by the accepted thermal subsidence model. Papers by Newman and by Wetmiller and Forsyth present puzzling contrasts on Nares Strait itself, the crucial region about which very little is actually known. Bathymetric, gravity and seismic evidence show that the southern part of the strait has a rugged topography and is underlain by deformed sediments and basement highs, suggesting an active history. Yet the seismicity of the strait is virtually nil, even in contrast to far more ancient lines of weakness such as Boothia Uplift. Kovacs discusses aeromagnetic anomalies in the Lincoln Sea and erects a complex spreading chronology for that area unconstrained by any onshore geology. Finally, (though not in this order) Langel and Thorning present a largely irrelevant report on a satellite survey of the magnetic field in the region.

The third from last paper offers some speculations by McMillan about the petroleum potential of the Lincoln Sea, and the book concludes with two summary papers. That by Johnson and Srivastava is a brief discussion of the evidence, mainly geophysical, in favour of major displacement along Nares Strait. None of this evidence derives from the strait itself, a point that is seized upon by Dawes and Kerr who, as editors, give themselves the

last word on the subject in a closely argued summary of the case against major displacment. They list twenty lines of evidence, mostly based on onshore geology, that severely constrain any proposed fault movement.

In one respect, this book is highly successful in that it brings together all the relevant evidence on the Nares Strait problem. The editors are to be congratulated for their thoroughness. Nearly all the material is new, and the papers are well written, clearly illustrated and produced almost entirely free of typographical error. It is indeed useful to have these data collected into a single book, although for those not immediately involved in the problem the wealth of information and bedlam of conflicting ideas are liable to prove rather overwhelming.

On the other hand, the book records a complete failure to resolve the Nares Strait problem. It is depressing to see so many authors push the problem away to somewhere beyond the bounds of their own speciality. Many of the contributors do not seem to be aware of data presented in other papers in the book – this could be the fault of the editors in not circulating preprints adequately. The result is that some conclusions incorporating earlier work are out of date. This is particularly apparent in Newman's first paper. Kerr persists with his "oceanization" model, in the face of a carefully executed demolition by the geophysicists; yet the latter are no better, arguing vaguely for a "fault zone" in the Nares Strait region to explain away the onshore evidence against displacement. Must we import a brilliant generalist such as John Dewey to solve this one for us? (Tuzo Wilson, who was invited to contribute a foreword, stayed away from the mess and wrote in general terms about the multidisciplinary nature of plate tectonics research.) Perhaps we could hire Camp David and sequester the main protagonists there for a week. I would be happy to volunteer myself for Presidential services as moderator and keeper of the liquor cabinet key . . .

Upper Cambrian and Lower Ordovician Trilobite Biostratigraphy of the Rabbitkettle Formation, Western District of Mackenzie

By Rolf Ludvigsen
Royal Ontario Museum, 188 p., 1982
$11.50 paper

Reviewed by James H. Stitt
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Rolf Ludvigsen has made an important contribution to the rapidly growing body of knowledge about the faunal and lithologic changes that occur at the Cambrian-Ordovician boundary in North America. This horizon is being critically re-examined in detail on a world-wide basis, in the hope that greater knowledge of the boundary interval will lead to a uniform placement of this boundary on all continents, which is not the situation at present.

Ludvigsen sampled the Rabbitkettle Formation near the western edge of the Mackenzie carbonate platform, interpreted to be an open marine, moderately deep-water shelf environment. A continuous sequence across the Cambrian-Ordovician boundary in this environmental setting has not been studied in this detail before in North America, and Ludvigsen describes a number of new taxa not previously encountered in other areas. An added bonus is that these trilobites are silicified and abundant, occurring in thirty-one closely spaced samples that span the boundary twice, thanks to a thrust fault in the upper Rabbitkettle that repeats the critical interval.

Forty-six species of trilobites are described in this paper, and they are well illustrated by a large number of photographed specimens. Many of the photographed specimens are slightly distorted as a result of structural deformation of the area, and Ludvigsen has provided excellent drawings of many of the taxa which remove the distortion and serve to clarify some of the finer morphologic details of these trilobites.

The trilobite fauna is divided into a succession of zones, and the problems of correlation from this area to others in North America and in the rest of the world is discussed in detail. A new subzone based on *Missisquoia mackenziensis* n. sp. and two species of Parabolinella is recognized at the base of the Ordovician, and it is argued that this horizon is very close to the base of the Tremadocian.

A major lithologic change in the upper Rabbitkettle Formation from light to medium grey, burrowed fine-grained limestones to dark grey to black, non-burrowed fine-grained limestones coincides with a major trilobite zonal boundary (just below the Cambrian-Ordovician boundary) and a major change in the conodont fauna (described in another paper). Ludvigsen equates the lithologic change with the top of a Grand Cycle, one of eight major carbonate cycles that can be recognized in Middle Cambrian to Middle Ordovician strata in the Rocky Mountains. The coincident trilobite zone boundary marks a major extinction horizon at the top of the Ptychaspid Biomere (as revised by Palmer), a thick, extinction-bounded regional trilobite biostratigraphic unit. Ludvigsen then describes a detailed scenario whereby the successive trilobite faunas from the western Mackenzie district and other areas in North America are grouped into trilobite biofacies, with contemporaneous biofacies tied to particular lithofacies that range from nearshore detrital rocks to middle shelf carbonates to outer shelf detrital rocks. As the wide carbonate belt abruptly narrows at the end of the Grand Cycle, the associated trilobite biofacies is essentially eliminated, with only a few survivors temporarily mingling with a new and ultimately successful replacement trilobite biofacies. As the carbonate belt begins to widen again, a third trilobite facies begins to dominate. Thus Ludvigsen suggests that the sudden extinctions that characterize trilobite biomere boundaries are related to major shifts in sedimentary facies (at least near the outer shelf margin), an idea that has already provoked much discussion among trilobite specialists.

In summary, this is an extremely interesting paper that is full of thought-provoking ideas, both taxonomic and environmental. It should be read carefully by anyone interested in the phenomena that occur at and near the Cambrian-Ordovician boundary.