Geoscience Canada

Book Reviews / Critiques

Volume 11, Number 2, June 1984

URI: https://id.erudit.org/iderudit/geocan11_2br01

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Publisher(s)

The Geological Association of Canada

ISSN

0315-0941 (print)
1911-4850 (digital)

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Cite this review

(1984). Review of [Book Reviews / Critiques]. *Geoscience Canada*, *11*(2), 93–98.

Book Reviews / Critique

Book Reviews

Basic Well Log Analysis for Geologists

By George Asquith with Charles Gibson
American Association of Petroleum Geologists
Methods in Exploration Series
216 p., 1982, $22.00 US; cloth

Reviewed by J.B. Currie
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This book is expressly intended to serve as a practical introductory text for geologists and other earth scientists who want to undertake log interpretation; specifically it is an introduction to open-hole logging. Its introductory chapter deals briefly with important properties of rocks, e.g., porosity, permeability and water saturation, then treats essential parameters used in logging and the basic relations and fundamental equations employed in log interpretation. While a great deal of technical ground is covered in this chapter, its format, clear illustrations and concise summary help to convey its content easily to a reader who has a degree of prior familiarity with the use of logs.

In four chapters the authors describe successively the character and derivation of information from SP logs, the several resistivity logs, porosity logs (sonic, density, neutron and combined neutron-density) and the gamma ray log. Reference in these chapters to theoretical aspects of each of these logging tools is brief; attention is focused on formation properties which the tool is designed to measure and on demonstrating how one determines properties such as true resistivity of a rock unit or its water saturation. Figures in each chapter are of prime importance since they constitute practice exercises by which one can become familiar at first hand with log calculations.

One chapter is devoted to quantitative log interpretation and in it emphasis is placed on step-by-step procedures for determining porosity, permeability, water saturation and other values. Use of crossplot methods in log analysis is examined in this chapter. As in previous chapters, the full-page figures serve both to illustrate the text and constitute working examples of log interpretation. This emphasis on practice is enhanced by inclusion of a detailed flow chart of steps in log evaluation.

In a chapter on the use of logs to identify and map lithology, six methods are presented which apply information from various logs. The authors employ crossplotting of data from different logs to their application in correlating log response to characteristic lithologies.

The final chapter describes six case studies of log interpretation applied to sandstone and to carbonate reservoirs in basins within the United States. Each study explains the geologic setting, details the log information and cites the problems faced by an explorationist. There follows a comprehensive answer in which the authors explain the procedures followed in analysing the logs and the difficulties presented to a log analyst. The case studies convey to the reader an appreciation of the type and degree of experience that is needed to evaluate logs with a measure of confidence. They complement the intent of this book to serve as a practical guide.

Carbonate Depositional Environments

Edited by P.A. Scholle, D.G. Bébout and C.H. Moore
Memoir 33, American Association of Petroleum Geologists
708 p., 1983, $58.00 U.S., ($48.00 U.S. AAPG, SEPM Members); cloth

Reviewed by R.W. Macqueen
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Newcomers to carbonates sometimes lament the absence of any single synthesis of all the exciting work on carbonate depositional settings accomplished over the past thirty years. Not so any longer. In this handsome, lavishly illustrated, stout volume some thirty carbonate specialists draw together a wealth of data on twelve nonmarine to deep water carbonate depositional environments. Each environment is examined along generally similar lines: an introductory section defines the particular environment and summarizes criteria for recognition; a second section examines the dimensions or form of the depositional setting and nearby related settings; the third section provides data on sedimentary structures along with a profusion of colour illustrations; a fourth section treats economic considerations—reservoirs, source rocks, hosts for mineralization. Selected references to 1980 are included with each section. Emphasis is very much on sedimentary environments and how to recognize them and, accordingly, with minor exceptions (e.g., shelf margin sands) we are given only fleeting glimpses of hydrodynamics or diagenetic fabrics including the development of carbonate cements.

What environments were chosen for review? The highly informative and well organized initial section deals with *Subaerial Exposure* (hardly a depositional environment, but important) in five chapters, including general features, paleokarst, travertine and two chapters on carbonate-hosted lead-zinc deposits. *Lacustrine* deposits are examined in the second section. Emphasis is on Cenozoic lake deposits of North America: there is little on modern carbonate lacustrine settings. The seaward march continues with *Eolian* (dune sand) environments, mostly Pleistocene and younger, but from many global settings. Not until section four on the *Tidal Flat* environment do we reach the sea. This important environment is presented with abundant documentation of the major Persian Gulf and Caribbean settings and lots of ancient examples. *Beach* environments follow: here there is an emphasis on ancient beach deposits rather than modern ones, which is a departure from other sections in which the reverse tends to be true (much Holocene, little ancient). The next section, although labelled *Shelf*, is really about restricted shelf environments and largely the modern restricted environments of the Bahama and Florida Bay lagoons. More widespread aspects of the shelf environment are dealt with in a section titled *Middle Shelf*. Here there is an admirable balance between modern and ancient

settings, with lots of insights into what the vertical record of modern settings will look like over time. Late Precambrian to Holocene *Reefs* are the subject of the longest single section of the volume, with detailed examples from the south Texas Lower Cretaceous, the Alberta Upper Devonian and the Paradox Basin, Pennsylvanian, southwestern U.S.A. Again there is an excellent marriage of spectacular (and photogenic) modern environments and products, and ancient examples.

The final four sections deal with deeper water carbonate environments, including *Bank Margins* (mostly about shelf margin sands and very informative), and *Forereef slopes* and *Basin Margins*, with emphasis on debris flows, slides and truncation surfaces characteristic of these settings. The *Pelagic Environment* section emphasizes the Mesozoic and Cenozoic record now becoming well known from the many studies by the Deep Sea Drilling Project and is an elegant account of the evolution and importance of pelagic carbonate contributors in the Phanerozoic.

What's wrong with this volume? Very little: in places the emphasis might have been broader or slightly different, as noted above. Diagenesis, so important to carbonate suites, is little treated, but that was not the mandate as clearly stated. The use of colour is excellent for field photographs of modern and ancient examples, but is unnecessarily overdone on some of the diagrams, and particularly so in some tables which have a dark blue background. There are remarkably few trivial errors: two I enjoyed were the 200-metre Holocene pisoliths on page 125, and the upside-down cap reef on page 365. This isn't fair: the good points vastly outweigh these very minor deficiencies.

What's right with this volume? It is easily the most significant and complete reference to the depositional world of carbonate sediments and rocks existing, and it will remain a landmark publication indefinitely. It is of lasting value to anyone with any interest whatever in carbonates. Editors and authors have earned a large measure of admiration and respect from the earth science community for their achievements. Why not a companion volume on carbonate diagenesis? Are you listening, A.A.P.G.?

Exercises in Sedimentology

By G.M. Friedman and K.G. Johnson
John Wiley and Sons
208 p., 1982, $18.05 Cdn.; paper

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This book is intended to be a practical laboratory complement to the Friedman and Sanders textbook "Principles of Sedimentology". It contains ten exercises, but only one of these deals with what I would call sedimentology. Eight of the exercises are in basic sedimentary petrology, and one is strictly an exercise in elementary structural geology. The book is, therefore, badly named.

Exercise One provides an introduction to sedimentary petrography by suggesting routines for the examination of crushed igneous and metamorphic rocks, as artificially generated first-cycle sediments. The student is then intended to move on to the examination of unconsolidated sand, silt and mud under the binocular microscope. Procedures for staining are described, as an aid to identifying feldspars and carbonate minerals.

Exercises 2 and 3 deal with the textural analysis of sand, silt and clay, using sieving, pipette techniques and other methods. Exercise 4 shows how to plot the textural data in graphic form and provides an introduction to the interpretation of these plots (the subject is dealt with at length in the Friedman and Sanders textbook).

Exercise 5 is concerned with the techniques for separating heavy minerals using heavy liquids, and includes an identification chart and a brief discussion of the provenance of the common heavy minerals.

Exercise 6 deals with carbonate staining and the procedure for preparing peels. Exercises 7 and 8 discuss the description and classification of "intrabasinal" (chemical) sediments and "extrabasinal" (clastic) sediments. Curiously, however, the authors chose not to emphasize any of the well known sandstone classification schemes, and this section seems weak.

Up to this point in the book the emphasis has been on laboratory techniques. I have doubts about the practicality of teaching these techniques to large introductory classes (though presumably the authors themselves manage to do it) and even greater doubts about the necessity. By spending so much time on preparatory procedures surely much time is lost that could be better spent looking at the rocks themselves, and learning to understand them. Few practicing sedimentologists in industry are required to perform these techniques, as they are technical chores unrelated to the business of trying to understand basin evolution. I have long felt that the great emphasis placed by some sedimentologists on grain size analysis is largely misplaced. As the authors themselves state (p. 74): "although quantitative studies of size and sorting and various statistical parameters have become a part of modern sedimentological practice it is worth noting that one need not depend entirely on them. Observations with the hand lens can go a long way in relating size fractions to depositional processes". Yes indeed! Such use of the hand lens is part of the art of facies analysis, which is only touched on here in Exercise 9.

This exercise discusses the facies analysis of a fluvial-tidal-offshore complex. The student is provided with descriptions of facies characteristics for seven sections, and is asked to reconstruct the depositional systems. It is noteworthy that no grain size analyses are used here, only such semi-quantitative data as the presence of "fine to medium grained sandstone".

Exercise 10 is a version of the popular exploration game, in which students buy or bid for data in an attempt to find the oil and gas pools within a hypothetical map area. However, the traps are entirely structural and no use is made of sedimentology, so the exercise is not appropriate to this book.

Exercise 9 is a good example of facies analysis, but it is the only one to live up to the title of the book. Where are the exercises in the identification and interpretation of sedimentary structures? Paleocurrent analysis? Lithofacies mapping (e.g., sand: mud ratios)? Interpretation of geophysical logs? In the absence of such material it is doubtful that many instructors will want to use this book in their sedimentology courses.

International Minerals—A National Perspective

Edited by Allen F. Agnew
AAAS Symposium #90
Westview Press Inc.
164 p., 1983, $20.00 US; cloth

Reviewed by Duncan R. Derry
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The American Association for the Advancement of Science sponsors the exchange of up-to-date information between members of the various sciences and those non-professionals who are interested in following science. It is, therefore, a particularly suitable organization to undertake a discussion of the distribution and supply of minerals crucial to the economic and military well-being of the U.S. and, incidentally, other friendly nations including Canada. Such discussion took place at the AAAS Annual Meeting in Washington, D.C. in January, 1982. The book includes papers given at this symposium and an introductory chapter by the editor, Allen F. Agnew, written subsequent to the meeting.

In this initial chapter, *International Minerals—Problems and Opportunities*, Agnew notes that whereas the need for *fuel* minerals is understood by the public, the critical position of *non-fuel* minerals is less well appreciated. It is pointed out that the average annual per capita requirements in the U.S. is quite high, for example, aluminum 55 lbs. (24.75 kg.), copper 23 lbs. (10.35 kg.), manganese 14 lbs (6.3 kg.). In some cases these requirements cannot be supplied from within the 49 states and the nation is consequently vulnerable. Reduction of vulnerability may be achieved by substitution, conservation, recycling and stockpiling (a policy instituted by President Eisenhower). A comparison with the situation and policy in the U.S.S.R. is included, and some useful tables summarize the net import reliance for selected minerals and metals for the U.S., EEC countries, Japan and the U.S.S.R.

A chapter entitled "Two Centuries of Mineral Policy in Wisconsin", by M.E. Ostrom, reviews the changes over this period in policy affecting mineral resources in a state that was not, until the last few years, endowed with many mineral deposits. Starting with a policy favouring rapid development of minerals, it changed to one of environmental protection and social responsibility, and later back to one encouraging mineral treatment and use.

T.K. Bundtzen's review of Alaska's strategic minerals is in contrast to the last chapter in that Alaska has a greater mineral potential than any other state. After reviewing the definition of "strategic" and "critical" minerals, and listing the most vulnerable (chromium with a vulnerability index of 34 is just ahead of the platinum group metals with 32), the author discusses, with an excellent table, the production and reserves of selected strategic minerals in Alaska.

The "Mineral Resource Analysis in Canada", by John H. de Young, compliments Canada on its assemblage and distribution of mineral resource data due especially to the efforts of the Energy, Mines and Resources' Mineral Policy Sector and Economic Geology Section of the Geological Survey and the Centre for Resource Studies in Kingston, Ontario. The part played by the respective Provincial Departments of Mines is rather lightly touched on.

In the chapter "South African Minerals and World Demand" the remarkable endowment of that country in many minerals on which the western world is dependent is backed by well presented data.

In the report entitled "The USSR and Afghanistan Mineral Resources" John F. Shroder, Jr. shows the relatively good mineral endowment of the latter country which has a complex geological history and composition. Although the mineral studies of Afghanistan commenced under British control in the last century, it was the realization of important mineral potentiality by the Soviets that probably had a bearing on the 1979 invasion.

The book ends with the review by A.E. Eckes, Jr. "The Global Struggle for Minerals", which includes a warning to avoid past mistakes in mineral strategy. This is a thoughtful conclusion to a book that should be read by anyone concerned with and interested in mineral endowment and availability.

The Mediterranean Was a Desert: A Voyage of the Glomar Challenger

By K.J. Hsü
Princeton University Press
197 p., 1983, $17.90 U.S.; cloth

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Ken Hsü is one of those very clever people who not only manage to be in the right place at the right time to make important geological discoveries, but also know how to make the most of them. This book is about one of his most famous pieces of work, but he is known for many others, including theoretical contributions to evaporite and turbidite sedimentology and, more recently, the debate about meteorite impacts and their geological effects.

The story of the desiccated Mediterranean is one of the most extraordinary discoveries of the Deep Sea Drilling Project. This book describes the development of the idea, as the first holes were drilled on the floor of the Mediterranean, penetrating the mysterious "M" seismic reflector long known to geophysicists. The book is not intended as a scientific treatise, although enough detail is given to show how the idea took shape and why it was eventually accepted. The purpose of the book is to describe, day by day, the excitements and frustrations of Leg 13, as the scientific work proceeded in the face of navigation problems and equipment failure. Hsü was co-chief scientist on this cruise, along with W.B.F. Ryan, and the remainder of the party consisted of seven other scientists from Britain, France, Italy, Austria and Romania. Hsü describes how the team began to work together, the tensions between them and the ship's crew, the endless sleepless nights as drilling, decision-making and discovery went on around the clock, and the exhilaration of exploring totally unknown terrain.

Those, like me, who have never been on a scientific cruise of this type, will be fascinated by this book. The complexities of "very big" science will be familiar to many—I was reminded of the problems of trying to run a large field party in the Arctic, with all the difficulties of limited aircraft time, mechanical failures, and so on. Those who are old hands at this type of work may want to give copies to their families and friends, as a way of providing some insights into their own jobs. The writing style is light and excellent, and the book is short enough to be read in one evening. Recommended without hesitation!

Precambrian Sulphide Deposits

H.S. Robinson Memorial Volume
Edited by R.W. Hutchinson, C.D. Spence and J.M. Franklin
Geological Association of Canada Special Paper 25
791 p., 1982, $47.00 members, $57.00 non-members; cloth

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The title of this volume suggests a good deal more than the text provides. It is not a general discussion of Precambrian massive sulphide deposits of the world but rather a treatment of North American and predominately Canadian examples of the type. A more appropriate title would be *Precambrian Sulphide Deposits of Canada and the U.S.: Selected Examples.* This caveat aside, the quality of the papers assembled is uniformly good and those interested in Precambrian Metallogeny will find the volume well worthwhile.

The format has been logically arranged, starting with four review papers covering major subdivisions of the Canadian Precambrian. This is followed by eighteen case histories describing typical deposits. A final review chapter synthesizes the data presented and gives a good overall summary of present thinking about these types of deposits.

The deposits described cover a spectrum of deposit types but naturally include a majority of volcanogenic massive sulphide ones for which the Precambrian is noted. The case histories used are as follows:

Cu—Zn
Millenbach, Corbet, Detour, Opemiska—Quebec
Bathurst Norsemines—Northwest Territories
Crandon—Wisconsin
Anderson Lake, Ruttan, Sherrit Gordon—Manitoba
Geco—Ontario
Ni
Thompson—Manitoba
Redstone—Ontario
Au
Agnico Eagle—Quebec
Cu
Redstone Copper—Northwest Territories
Zn—Pb
Balmat—New York
Sullivan—British Columbia
Gayna River—Northwest Territories
Nanisivik—Baffin Island

Of the eighteen deposits described, ten are clearly of volcanogenic origin and fit the established volcanogenic massive sulphide model very well. Others, such as Sherrit Gordon and Geco, with a strong metamorphic overprint, are less clear but still show definite volcanogenic characteristics. Less clear still are deposits like Opemiska and Redstone. At Opemiska the ore occurs as veins in gabbro and while a volcanic precurser is suggested other alternatives are still feasible. Redstone is a nickel sulphide deposit spatially and genetically related to komatiitic flows, and while of probable volcanogenic origin is clearly different from the other examples.

The other deposits described comprise a variety of ore and genetic types. The Thompson Nickel belt deposits are ultrabasic cumulates modified by metamorphism. The Gayna River and Nanisivik Pb Zn deposits in carbonate rocks are representatives of the Mississippi Valley type. The Balmat deposit may be of this type as well, but folding and metamorphism have so modified it that the connection is obscure. Redstone copper is a representative of the redbed copper type and Sullivan an excellent example of the clastic-hosted Pb Zn deposit type.

There are many Precambrian sulphide deposits not described in this volume, e.g., in Australia, southern Africa, Scandinavia and the U.S.S.R. On the other hand, there are few deposit types that are not covered. Exceptions are the Sudbury camp, the Bushveldt, certain uranium deposits and perhaps others, but these are for the most part special cases and not a large part of current exploration efforts.

The editors are to be commended for assembling a good selection of case histories and ensuring consistency in the way they are presented. The regional metallogenic summaries are very helpful in providing a framework for the case histories and the concluding synthesis, while biased to syngenetic theory, is a lucid exposition of that point of view.

I would recommend the volume to anyone interested in sulphide deposits Precambrian or later, for there is a wealth of information useful in the understanding of sulphide deposits of any age.

Seismic Exploration Methods

By R.L. Sengbush
International Human Resources Development Corp.
296 p., 1983, $44.00; cloth

Reviewed by A. Easton Wren
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Even in a rapidly evolving scientific discipline such as geophysics (applied seismology) there are periods of consolidation and reinforcement when the growth curve tends to flatten. This often coincides with a harvest of textbooks on the subject by a crop of established and aspiring authors. A disappointing outcome is that most recent texts have followed the well-trodden acquisition—processing—interpretation routine and the result is frequent overlap in both material and illustrations.

This text has a topic selection and sequence that sets it apart. The author's long career with Mobil Oil and as a consultant and course instructor with Pexcon has focused his ideas and understanding of the subject and he has provided a text that is interesting and educational. In the Preface he underlines the practical point he wishes to make: it is of the utmost importance to look beyond the seismic section and understand how the section came to be with the impact of acquisition and processing methods. Hear, hear!

In general, the book is well written and easy to follow, with numerous illustrations of good quality. In this regard a neophyte geophysicist would find several sections of the text extremely clear.

The author wastes no time in getting to the salient aspects of the subject. Wiener Deconvolution makes its entry on page 6. The summary at the close of each chapter is appropriate and the Reference List is comprehensive. From this reviewer's point of view, the highlights of the book include the section on Seismic Signatures (Chapter 3), Analysis and Suppression of Seismic Noise (Chapter 4), which runs to 57 pages and is obviously a subject of avid interest for the author, Distortion Operators and Deconvolution (Chapter 7) and Migration Techniques (Chapter 9).

On the negative side, it is hard to decide who the author had in mind as the intended reader of this textbook. It tends to flip from elegant and contemporary treatment of some topics to a contrasting superficial and inadequate treatment of others. Most geophysicists might encounter

this inconsistency in the section on Multiple Reflections (Chapter 6) which might almost be redundant. The section on Direct Detection of Hydrocarbons on Seismic Data (Chapter 10) obviously benefits from the author's pioneering involvement with the topic but falls short in not including some later developments, such as the amplitude analysis below tuning (GeoQuest), and does not include any discussion on temporal resolution beyond Widess (1957); reference should have been made to Kalweit and Wood (1982) and some mention should have been made of Fresnel zones in the context of lateral resolution and migration. The Appendices are well written and well illustrated but occupy almost 20 percent of the book, and it is difficult to relate them to the main text in the context of the intended reader. They appear here almost as afterthoughts.

These negative impressions are outweighed by the positive attributes of the book, which justify it reaching a wide audience of geophysicists for whom it should prove to be the "mind-stretcher" the author intended. The author deserves commendation for a well written and original contribution, and I.H.R.D.C. (publisher) merits acknowledgement for continuing its long line of fine, contemporary texts in seismic exploration.

Silicon Geochemistry and Biogeochemistry

Edited by S.R. Aston
Academic Press
248 p., 1983, $42.50; cloth

Reviewed by Dale E. Buckley
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More than a quarter of the earth's lithosphere consists of silicon. The vast majority of rock-forming minerals are silicates, and dissolved silicon is one of the essential nutrients in the oceans; these characteristics have challenged geologists, physicists, chemists and biologists who have devoted their lives to the study of this fascinating element. However, in spite of the extensive study, or perhaps because of it, there are many controversies and enigmas remaining in the knowledge of silicon and its many forms. Even the terms used to identify this fourteenth element in the periodic table are confusing to the uninitiated. The element *silicon* is referred to as silica in both the dissolved and solid form. Mineralogists use the term *silicate* to describe various solid minerals, while limnologists and oceanographers use the same term to describe the dissolved form of Si in natural waters. Chemists often prefer the term *silicic acid* to identify the dissolved complex ion.

An impressive list of seven highly qualified authors have contributed six chapters to this book. All of these authors are well known for their research contributions and their abundant citations in the literature on silicon and silicates. Each of the chapters is intended to be a review of certain aspects of the subject but there are some areas of overlap and of conflict between chapters.

The first chapter, by R. Macdonald, on silicon in igneous and metamorphic rocks and the processes responsible for transferring silicon from the mantle to the crust appears to be a good, brief review, but the relevance of this chapter to the remainder of the book is not obvious. However, there is a case for understanding these processes when one wishes to address the problems of mass transfer of silicon in the total global cycle.

R. Wollast and F.T. Mackenzie have contributed an excellent chapter on the exogenic global cycle of silica and, yes, they have included several examples of schematic models to illustrate fluxes between component systems and to help the reader to understand the mass balance calculations. Actually, this chapter contains examples of fluxes and compositional data for other elements in addition to silicon, and I found it to be an elegant example of clear, concise writing and presentation of complex ideas.

The editor, S.R. Aston, has contributed a chapter on the atmospheric and aqueous chemistry of silicon. Some of the material here overlaps with the second chapter, but it does elaborate on the important aspects of particulate and dissolved transport of silicon through the atmosphere and estuaries. Especially useful is the review of problems related to field and laboratory observations of conservative/non-conservative behaviour of silicon during estuarine mixing.

C.P. Spencer's chapter on marine biogeochemistry of silicon provides an introduction to the last half of the book, which deals almost exclusively with marine (biogenous) cycles of silicon. Much of this chapter is devoted to an examination of spatial variations of silicon concentrations in the water column and how this may be related to marine biological productivity. Although diatoms and radiolarians appear to dominate the biogenic cycles of silicon, Spencer devotes most of this review to the role of diatoms alone. At the end of this section a global flux model is presented to highlight the annual biogeneous silica fluxes. Unfortunately, Spencer chose to modify, without sufficient justification, earlier global models already discussed in this book, and used different units for expressing the fluxes, so the reader must do considerable detective work to compare this model with others.

In S.E. Calvert's chapter on sedimentary geochemistry of silicon there is yet another presentation of an annual marine budget for silicon, and yet another unit was selected for expressing the fluxes, so that once again the reader must rationalize the various models. Calvert reviews much of the same information on biogenic silicon precipitation and dissolution as was discussed by Spencer, but adds some perspective with respect to the reactivity of the 10 percent of the annual production of biogenic silica that becomes buried in marine sediments. In calculating the flux of dissolved silicon across the sediment/water interface, Calvert concludes that the amount of recycled, dissolved silicon from the pore waters of marine sediments is of the same magnitude as that supplied by runoff, and that the second largest flux of silicon to the ocean is from submarine hydrothermal discharge.

The last chapter in this book focuses on points of detail concerning the physical and chemical properties of siliceous skeletons. There could hardly be a more appropriate author than D.C. Hurd to review this aspect. However, the review is filled

with more tedious detail than most readers will care to know. Perhaps some specialists may appreciate the series of questions Hurd has posed to focus attention on the need for additional research on the solubility and dissolution of amorphous silica.

Some of the persistent controversies and enigmas of silicon, ranging from the global to the microscopic scale of geochemistry and biogeochemistry, have been highlighted through the reviews contained in this book. These reviews emphasize the need for further research on a number of fronts. Improvements in the mass balance calculations may be obtained as current research advances on hydrothermal fluxes and pore water diffusion. The suggestion of the effective buffering capacity of reactive silicate minerals in the oceans, as made by Silen in 1961, is still a problem about which there is disagreement. For a number of years arguments have been made that reactive, dissolved silicon in natural waters consists of the monomeric form of silicic acid, and that natural polymeric forms exist but were not detected. The question of the stable existence of non-reactive natural polymeric sols is still unanswered. Although there is general agreement that biogenous silica (opal), is the most important phase in controlling the fluxes of silicon within the oceans, there is still a great deal of mystery as to how the planktonic skeletons are precipitated and dissolved.

This book is a collection of contributed review papers and the reader should not expect to find consistent style in its presentation. It is, nevertheless, unfortunate that the editor did not try to achieve less overlap between his contributors' chapters. It is even more regrettable that the editor did not insist on uniformity in units for expressing silicon concentrations and fluxes.

Most of the reviewers have included a good list of references at the end of their chapters, but it is unfortunate that a book published in 1983 should contain less than 3 percent of cited references dated after 1979.

It is difficult to identify a specific readership that would most benefit from having this book in its collection. The advanced student in marine sciences would certainly find the reviews useful in gaining perspective on the problems of silicon geochemistry and biogeochemistry. The researcher may find that some chapters are too superficial while others are too concerned with highly specialized topics which might be more appropriately reviewed in specialized journals.