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Sand and Sandstone

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Canadians of the Mackenzie delta, Manitoba, and Quebec being displaced and plundered in the search for loot. In the process, claims Sykes, we are losing or have lost our independence, and the Mackenzie Valley pipeline decision, which he keeps coming back to throughout the book, represents Canada's "last chance" to retain some control over our resources.

Well, Sykes states openly that his book is not a "neutral effort", and the reviewer has little trouble agreeing with that statement. Loaded words and phrases abound: blunder and plunder, ripoff and rape, destruction and fire sales.

The geologist concerned with energy will be dissatisfied with the approach to that field. Most of the statements and quotes are qualitative, and some of the quantitative ones are simply wrong. On the important issue of oil reserves, Sykes states that the Canadian Society of Petroleum Geologists estimates oil reserves to be 85 billion barrels, *including* the tar sands, which is not true. His concern with the further destruction of Canada's rivers by hydro projects may well be eliminated by the growing use of CANDU reactors, yet the growth of nuclear fuel technology is scarcely mentioned in the book.

In the epilogue, Sykes is critical of the recently published "An Energy Policy for Canada", which he claims was "effectively neutered by the Trudeau Cabinet". Most geologists would, I believe, prefer that statement as a much more balanced one of the problems of finding, developing, and estimating our energy resources. Decisions and policies to govern further exports are still open national choices, and it is quite possible that the energy picture and our options will change so drastically within the next few years that statements like Sykes', and reviews like this one, will be rendered quite meaningless.

MS received, March 14, 1974.

Sand and Sandstone

by F. J. Pettijohn, P. E. Potter, and Raymond Siever
Springer-Verlag, New York, 618 p., 1972.
$31.10 for hard cover,
$14.50 for soft cover.

Reviewed by Jean Lajoie
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As we learn from the preface, the book is an updated edition of the 200-page syllabus, Geology of Sand and Sandstone, published in 1965 by the Indiana Geological Survey for a conference on sandstone. It is intended as a text or supplementary text for advanced undergraduate and graduate courses.

The book is divided into 12 chapters grouped into four parts plus an introduction. Part I (124 p.) consists of three chapters on mineral and chemical composition, texture, and sedimentary structures. Part II (144 p.), The Petrography of Sandstone is divided into three chapters: the petrographic classification, petrography of common sands and sandstones, and the volcaniclastics. Part III (145 p.), Processes that Form Sand and Sandstone, includes three chapters on production and provenance, on transport, deposition and deformation, and on diagenesis. Part IV (146 p.) discusses the broader aspects of sand deposition regrouped into two chapters: sand bodies and environment, and sandstones, sedimentary basins and continental evolution. The 12 chapters are followed by an appendix on the petrographic analysis of sandstones (17 p.), and indexes by author and subject. The book also contains three glossaries of the used terms on sand and sandstone, volcaniclastic sediments, and hydrodynamics and bedforms.

The text has many references, more than half are post-1960, and are annotated. Most references are to the English literature, but there are also quite a few to the French, German and Russian literature, and a few to the Italian. The annotated references are well chosen, and will be useful to students and teachers not familiar with particular aspects of sandstone geology.

I have found quite a few interesting chapters in the book. The chapters on the volcaniclastics, on transport, deposition and deformation, and on sand bodies and environment are all well written, informative, well documented, and with pertinent diagrams. However, I have had some problems with the nomenclature and classification proposed by the authors (Chapters 5 and 6). The classification may be considered new: it tries to combine Gilbert's and Pettijohn's. The authors use "arenite" and "wacke" with a limit for the matrix content at 15 per cent. The amount of quartz in quartz arenite (or wacke) is 95 per cent. Chert is placed with the rock fragments. These choices are not discussed in the text. The descriptions of a few sandstones are ambiguous. It may be that I failed to get the logic behind the nomenclature proposed by the authors, but the observable differences between a lithic graywacke and a lithic wacke or between a feldspathic graywacke and a "dirty" arkosic arenite are not too clear to me. I know that there must be some differences since the authors tell us that graywackes do not seem to occur outside Alpine-type orogenic belts, and that lithic wackes (and arenites) are typical of alluvial sandstones, but these observable differences are not expressed to my satisfaction.

The text does contain a few contradictions which may be more apparent then factual in that they may result from the necessary simplifications of complex problems. However, I would have liked some of these discussed for the benefit of the students (the users). The definition of sand is an example: in Chapter 1, the reader is presented with two alternatives, sands may contain 50 per cent or 40 per cent sand-size material but in Chapter 5, the wackes may have as much as 75 per cent of material finer than 30 . Is it that some wackes are not sands? One more example: it may very well be as stated

by authors that proof of a diagenetic origin for the matrix in graywackes is that "Recent" and Tertiary turbidites are free of detrital matrix, but then what about the Miocene graywackes in Table 6-5 which contain 45 per cent matrix?

There were few chapters in the book that I found poor. The chapter on diagenesis is however not at par with the other sections of the book. It contains many distracting trivial statements and equations.

The quality of both printing and binding is excellent, with my personal choice going to the less expensive paper edition. The editors have done a remarkable job, and there are few printing errors. However no book is immune from such errors and this one is no exception. The French references suffer most. A few authors have their names altered and a few references are not listed. There are many very good photographs in the book, many of thin sections. I do agree with the authors that "under crossed nicols one has great difficulty in distinguishing between somewhat altered rock fragments and recrystallized sericitic and chloritic matrix", which probably explains why they decided to have eight out of nine of the graywacke photographs in crossed nicols.

In summary, the book is not perfect, it has many good things and some bad ones. I do believe that geologists will find that the good is well worth the $14 investment.

MS received, February 6, 1974.

Stable Isotope Geochemistry

by J. Hoefs
Springer-Verlag, New York, 140p, 1973.
$14.50.

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The publication of an introductory text for geologists and other scientists interested in the geochemistry of stable isotopes was long overdue. This publication is thus a very welcome edition, especially as it fulfills most of the requirements expected from such a text. It is easy to read and the summary discussions are in general well presented and documented.

The book is divided into three parts: Section A deals with the theory of isotope effects and gives technical information about stable isotope analyses with mass-spectrometers. In Section B isotope abundances and isotope effects controlling the distribution of elements important for geological investigations are discussed, and C is intended as a survey of the most important results from a geologists point of view.

The introduction to the subject and the technical information given in Section A are very clear and amply satisfy the requirements such a text should meet. However some of the topics covered have been discussed in more detail. For example, a more complete discussion of the equilibrium and kinetic fractionation processes such as the Rayleigh process would have been desirable. Also missing is all reference to standards and interlaboratory comparisons of standards available from the Atomic Energy Agency in Vienna.

In Section B geologically important elements are treated individually. Fairly detailed data are presented for the isotopes of hydrogen, carbon, oxygen and sulphur and whatever information was available to the author is given for the isotopes of selenium, boron, nitrogen, silicon, chlorine, bromine, lithium, potassium, magnesium and calcium. The chapters on D, C^{13}, O^{18} and S^{34} include general remarks on the relative and absolute abundances of the various isotopes, preparation techniques for stable isotope analyses, standards used, and some remarks on fractionation mechanisms.

Unfortunately much of the isotope fractionation data available in the published literature has been omitted and the author often limits himself to a descriptive discussion. This applies for example to the deuterium exchange in the $H_2S - H_2O$ system, the distribution of carbon-13 in the H_2O, $CO_2 - CO_3$ system and the O^{18}-fractionations between minerals and water and minerals – minerals. It is not clear why these data were not presented since they are the basis for many of the interpretations of stable isotope data. However, a fairly complete reference list is provided and the interested reader can easily obtain more detailed information about this subject.

Section C begins with a discussion of the distribution of stable isotopes in meteorites, and lunar rocks. This is followed by a good presentation of stable isotope abundances in igneous rocks and high temperature fluids. Some remarks on mineral – mineral fractionations are made in this chapter. The chapter on volcanic gases and geothermal waters is also fairly complete.

In the discussions of stable isotope abundances in ore deposits (Section B, Chapter 4) one misses a detailed presentation of the geochemical processes and their significance with respect to the distribution of carbon and sulphur isotopes in hydrothermal systems. As a consequence some of the statements made by the author are not readily understood if the reader is not familiar with the literature cited. However, the reader is provided with a good coverage of many recent studies and the references given indicate the more significant publications.

This cannot be said for Chapter 5 in Section B: the Water Cycle. Here the author limits himself to a rather superficial description of the fractionation processes and their control over the distribution of stable isotopes in the hydrosphere. For