Geoscience Canada

# Annual Review of Energy, Vol. 1, 1976

H. MacKay

Volume 4, Number 2, June 1977

URI: https://id.erudit.org/iderudit/geocan4_2br04

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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

MacKay, H. (1977). Review of [Annual Review of Energy, Vol. 1, 1976]. *Geoscience Canada*, *4*(2), 104–105.

## Petrological Study of the Sambagawa Metamorphic Rocks

By Mitsuhiro Toriumi
*University of Tokyo Press, 99 p., 1975*
$19.50
*U.S. and Canadian Distributor: ISBS, Inc., P.O. Box 555, Forest Grove, Oregon 97116.*

*Reviewed by E. Froese*
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This book is based on a thesis presented to the University of Tokyo. It deals with the petrology of rocks from a small area (northwestern Kanto Mountains) within the Sanbagawa metamorphic belt, one of the classic examples of high-pressure metamorphism. Although the book is concerned with a very fascinating and rewarding topic, it is disappointing on two accounts. First of all, there is neither a clear statement of problem which directed the investigation nor an assessment of new contributions to an understanding of petrogenesis. The treatment loses itself in detail and there is no guiding theme to help the reader in picking his way through a maze of assembled observations. The petrological picture never comes into focus. The second major difficulty in reading the book is inadequate English editing. Many sentences are incorrect or awkward to the extent of obscuring the meaning. Reading is a chore and expositions of ideas and arguments in particular are most difficult to follow.

The strong point of the book is a wealth of information on mineral assemblages and mineral compositions. This will be a valuable source for metamorphic petrologists. It is gratifying to note that mineral assemblages of rocks with analyzed minerals are listed in detail in an appendix.

The area has been divided into four metamorphic zones: zone 1 (prehnite-pumpellyite facies), zones 2a and 2b (glaucophane schist facies), and zone 3 (greenschist facies). The following mineral assemblages are characteristic:
1. prehnite-pumpellyite-chlorite
2a pumpellyite-chlorite-actinolite-sodic amphibole-sodic pyroxene
2b. chlorite-actinolite-epidote-sodic amphibole-sodic pyroxene
3. chlorite-actinolite-epidote-barroisitic amphibole (calcic amphibole rich in Al and Na)

The zones are separated by isograds based on specific chemical reactions, a commendable practice:
A. prehnite + chlorite + $H_2O$ = actinolite + pumpellyite + quartz
B. pumpellyite + chlorite + quartz = actinolite + epidote + $H_2O$
C epidote + albite + quartz + chlorite barroisite + $H_2O$

Apparently it is difficult to establish which reactions lead to the appearance and disappearance of sodic amphiboles and sodic pyroxene. These minerals do not appear in the defining reactions of isograds, although their occurrence is restricted to zones 2a and 2b. It is interesting to note that in this area the glaucophane schist facies does not mark the beginning of metamorphism; instead it occupies a range of metamorphic conditions between the prehnite-pumpellyite facies and greenschist facies.

MS received December 2, 1976

## Annual Review of Energy, Vol. 1, 1976

Edited by Jack M. Hollander and Melvin K. Simmons
*Annual Reviews, Inc., 793 p., 1976.*
$17.00 in US; $17.50 elsewhere.

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This book is not the precinct of the casual student of energy. Twenty-seven papers are presented covering every aspect and concern on exploitation and financing of energy systems. It would be presumptuous to review each subject in the space allotted since the papers cover 793 pages of relatively fine print thus allowing somewhat less than one word per page in this review.

The *Annual Review on Energy* falls under the general subsections of Energy Supply and Distribution: Resources and Technologies, with papers covering Coal, Nuclear, Solar, Potential for Energy Conservation in Industry, and Social and Institutional Factors in Energy Conservation. Under the sub-section Impacts of Energy on Environment, Health and Safety, the papers are entitled Social and Environmental Costs of Energy Systems; Health Effects of Energy Production and Conversion; Economic Costs of Energy-Related Environmental Pollution; Philosophical Basis for Risk Analysis; and Safety of Nuclear Power. Some authors have been bold enough to pursue the subject Energy Policy and Politics in three papers entitled Energy Self-Sufficiency; Energy Regulation: a Quagmire for Energy Policy, and Federal Land and Resource Utilization Policy. The book concludes with a sub-section entitled International Aspects of Energy, with a paper entitled International Energy Issues and Options.

After twice reading the volume and referring back to many margin notes, one can only conclude it is impossible to summarize the vast amounts of information contained between the two covers. Some lasting impressions do, nevertheless, result.

I found, in the sections on Coal, that an often overlooked correlation of low sulphur, low BTU coal is, in fact, as polluting as higher sulphur and high BTU coal when burned to generate the same amount of heat. The low sulphur coals of the mid-continent area are, therefore, of questionable advantage. It was also somewhat of a revelation in the examination of future nuclear potential that most of us have overlooked the health and death statistics in the non-nuclear energy supply areas. This does not imply, nor did the authors intend, that the hazards in the nuclear field or in the mining of uranium should be regarded lightly. More correctly, the accepted health hazards, deaths, and risks, in the petroleum and coal industries have become commonplace and accepted by society.

In the capital financing area the quantities, even to a banker, are staggering. It has been the reviewer's experience in the high energy cost industries of the future that an economist will give comfort the systems will pay out, an engineer is certain they can be built, although none are now accepting cost constraints and, finally, bankers are more than certain the funds will be available. It is the reviewer's impression

the Zapp Theory has not yet been put in its grave and that any given amount of investments will result in a predictable quantity of energy. This certainly must be subject to question.

One of the frequently referred to authors, whose material does not appear in the text, is Dr. M. King Hubbert. Some authors have utilized Dr. Hubbert's curves as an estimate for future reserves and refer to the curve indicating world potential of $2100 \times 10^9$ barrels. It was the writer's own impression the $1350 \times 10^9$ barrels, is a more realistic possibility and Dr. Hubbert's thesis is that the 80 per cent consumption time span only covers from 58 to 64 years in the two cases. This, indicating that consumption would expand to utilize whatever world crude oil resources may exist in essentially the same time frame. The serious student of Dr. Hubbert is referred to the paper entitled "Researcher Defends Reserve Estimate" appearing in *The Oil and Gas Journal*, October 11, 1976.

The Annual Review on Energy is a "must" reading for any serious student of the subject. The one criticism which might be raised for future reference is that many of the papers spend much of the text setting out the argument that an energy problem does, in fact, exist. With this frequently restated by many of the authors, it tends to make the book unnecessarily lengthy.

MS received November 25, 1976

## Oil Under the Ice

By Douglas Pimlott, Dougald Brown and Kenneth Sam
*Canadian Arctic Resources Committee, 178 Pages, 1976.*
$6 95

Reviewed by C J. Yorath
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As a potential libretto for a turgid four act opera, *Oil Under the Ice* presents a scenario of collusion, deception and potential tragedy. The villains of the piece are the petroleum companies and the Department of Indian Affairs and Northern Development (DIAND), together in an orchestrated conspiracy to defraud and destroy our heros, the environment and native peoples of the Canadian Arctic. The frustrated and emasculated fool is the Department of the Environment (DOE). Three of the acts take place in the Beaufort Sea, the offshore regions of the Arctic Archipelago and the Hudsons Bay where petroleum companies are greedily hunting for liquid gold. The music creates an aura of a mysterious, cold, dark and hostile environment within which the "savage innocents" live and die in a timeless pageant of survival and unity with nature.

Enter the men from the "South", their mouths salivating in anticipation of wealth and power. The tools they bring, designed to rape the land and thus wrench the souls from the natives, are inadequate to cope with a vengeful earth which will vomit forth black oil upon and beneath the pristine and ever shifting Arctic ice pack. Meanwhile, in the Nation's capital, a power struggle continues between two jealous government departments. One is DIAND, the sinister Mafiosi partner of the oil companies; the other is DOE, vainly trying to establish its protective mandate while being led by men who are weak and powerless. Although the fourth act is excluded from the libretto, the climax is certain and to be awaited with sorrow. The two villains will be successful in their rape and slink silently away, the fool will vanish in whimpering despair and the once proud native peoples, driven from a new Tower of Babel, will vanish into history, victims of the Tragedy of the Commons. Such is what the authors of *Oil Under the Ice* would have us believe.

The book is about offshore drilling in the Arctic. On the positive side it is well written and researched, given the limited official sources of information available to the authors. They describe in considerable detail the degree of infighting between DIAND and DOE, the prize being the ultimate authority in matters affecting the Arctic offshore. DIAND is a regulatory agency, charged with the responsibility to ensure that marine drilling systems are adequately engineered and operated so as to reduce the risk of an oilspill to an "acceptable minimum", whatever that is. DOE, through its mandate under the Arctic Waters Pollution Prevention Act, must ensure that adequate (whatever that means) environmental assessment and impact studies are undertaken prior to the granting of drilling licences. The authors describe how DOE has been relegated to an advisory role and how DIAND achieved its prominent position with regard to all development issues affecting the Arctic. The characteristics of proposed drilling systems are discussed to the extent of the limited engineering and geological knowledge of the authors. They illustrate the dangers to the environment of potential blowouts, for which they claim adequate preventative measures for all anticipated circumstances have not been taken. The authors provide a reasonably realistic assessment of what the dangers are and how industry plans to cope with them.

On the negative side, if the reader is looking for a balanced treatment of a complex issue, he will be disappointed. Although they make no apology for the biased perspective of the book, and state as much, this does not excuse their apparent lack of interest in the reasons for which such great risks are being taken. The kind of emotionalism and bogie-man-under-every-bed attitude expressed in parts of the book lends a certain lack of credibility to their efforts.

In an era threatened with global energy shortages and during a time when petroleum diplomacy will alter the structure of international economics, much will be said and written on the value of risk taking. Books such as *Oil Under the Ice* may encourage people to search collectively for realistic solutions, but as the authors say in their opening statement of the Preface: "it has been said that where men are involved there is no absolute truth".

MS received November 3, 1976