
Petrological Study of the Sambagawa Metamorphic Rocks

By Mitsuhiro Toriumi
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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 Sambagawa 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 (glaucofan 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 + H₂O = actinolite + pumpellyite + quartz

B. pumpellyite + chlorite + quartz = actinolite + epidote + H₂O

C. epidote + albite + quartz + chlorite = barroisite + H₂O

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.

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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