High-Pressure Research: Applications in Geophysics

Edited by Murli H. Manghnani and Syun-iti Akimoto
Academic Press, Inc., 642 p., 1977.
$29.50

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Over 160 years ago, Sir James Hall published the results of his experiments on basalts which struck a decisive blow to the Neptunist's view and supported James Hutton's Plutonists. As this book illustrates, high-pressure experiments contributing to our understanding of the earth have come a long way since Hall's experiments at about 270 bars and 1000°C. Using a variety of ingenious techniques, many of which are described in this book, earth scientists can now experiment at pressures in excess of 1 Mbar (equivalent to depths well over one-half of the distance to the earth's centre) and temperatures greater than 2000°C. The results of such high-pressure experiments should be of fundamental interest to a wide spectrum of earth scientists particularly geophysicists, geochemists and petrologists.

High-Pressure Research: Applications in Geophysics is a collection of 42 papers and abstracts mainly by American and Japanese scientists presented at a seminar held in Honolulu in 1976. The book is divided into four sections. Geophysics and geochemistry of the Crust and Upper Mantle; Phase transitions related to the Earth's deep interior; Equations of state and shock wave experiments; and Instrumentation, pressure calibration, and standardization. The majority of papers present new data or new techniques; the remainder are valuable review papers which will be of interest both to scientists involved in high-pressure research as well as to those not directly involved in this field. This reviewer was impressed by the techniques involved in generating extremely high pressures and high temperatures, particularly the diamond anvil pressure cell and laser heating system, and by the use of holographic interferometry to determine deformation in granite under high pressures.

Unfortunately Manghnani and Akimoto's book has a number of faults that potential buyers should be aware of. One is its misleading title – "Applications in Geophysics". Since approximately one-third of the book (the first section) is directly applicable to igneous petrology and plate tectonic processes the potential buyer in petrology and geochemistry should not be put off by the title. Another fault is the lack of cohesion in the book. Although this is a common failing in books consisting of a series of papers by authors of diverse specialities, it could have been avoided by a rearrangement of papers within each section and by a brief "overview-type" chapter at the beginning of each section which would have given readers, unfamiliar with the problems dealt with in the sections, an idea of their significance as well as providing them with a connecting link between the sections.

Although typographical errors and omissions in this book are minimal, they are annoying since they tend to occur frequently in certain papers. The book is well illustrated by line drawings and photographs, and the text, reproduced by a rapid manuscript reproduction process, is clear. References are given at the end of each chapter and range from papers published in 1977 to a reference to William Shakespeare's "Othello" published in 1622! An author index would have been valuable.

In this reviewer's opinion, this book is unsuitable as a textbook for anything but advanced graduate courses in earth sciences and because of this will probably have a limited sale, confined to specialists in high-pressure research. This is a pity since it contains many contributions which should influence earth scientists both now and in the immediate future.

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A Structural Stratigraphic and Petrologic Study of Anorthosites, Eclogites and Ultramafic Rocks and Their Country Rocks, Tafjord Area, Western Norway

By H.K. Brueckner
Norges Geologiske Undersokelse, 53 p., 1977.
U.S. $10.00

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This monograph, which is the published version of an unpublished Ph.D. Thesis dated 1968, is based on a field study which covers an area of about 300 km² in the central gneiss of south-western Norway. The report consists of two parts: the first part is devoted to gneisses and metasediments, the second part contains an account of stratigraphy, structure and petrology of the various lithologies.

The stratigraphy, based on careful mapping leads to a two-fold subdivision of Precambrian gneisses and metasediments into the Fetvatn gneisses and the Vikvatn sequence. The Vitvatn sequence has been subdivided into three groups which clearly outline major structures on the geological map. The basal group (Oyen Group) is subdivided into three formations. Unfortunately these formations do not appear on the map and one wonders whether this is due to a scale problem or to the questionable status of these formations.

The most striking feature of the Oyen Group (and also the overlying Ovtse Rodal Group) is the occurrence of eclogites and ultramafic boudins and of stratiform anorthosites that are mapped as thin bands several km in length. These two groups are overlain by the quartzitic Svartega Group tentatively attributed to the Eo-Cambrian.

The structural framework on which map interpretation and stratigraphy are based follows the techniques of

E.C. Hansen (Strain Facies, Springer Verlag, 1971).

The description of folds and related structures is fairly exhaustive but there is no attempt to give a quantitative estimate of strain magnitude.

Although major structures are clearly underlined on the map, the superposition of fabric symbols on the lithology tends to blur the details of the picture. A separate structural map would have allowed a more complete representation of fabric elements. Nevertheless the reader can see from the text that large folds are correlated with minor structures and an attempt is even made to correlate deformations in the Tafjord area with those described further east by other authors.

The folding mechanism invoked to explain the two main folds generations (F_1 and F_2) is slip parallel to the axial plane. One may question the appropriateness of discussing the folding mechanisms of Precambrian folds strongly reoriented during a Caledonian event.

Basic petrographic data have not been included in the printed memoir, but the reader can refer to the thesis. All metamorphic assemblages presented are convincingly related to the various deformation episodes but no attempt is made to give an estimate of PT conditions during the main metamorphism (related to F_1 folds). Given evidence tends to show that an intermediate pressure type amphibolite facies metamorphism was superposed on a pre-existing granulite facies metamorphism.

The stratigraphic position of anorthosites, eclogites and ultramafic rocks in the metasediments is clearly established and convincing arguments are presented to show that these rocks have been involved in the same metamorphic and tectonic events as the country rocks.

In spite of the various metamorphic episodes and considerable strain they have suffered, these rocks still retain part of their original mineralogy and the author clearly correlates various metamorphic assemblages to corresponding deformation episodes, or as is the case for coronitic assemblages to postkinematic metamorphism.

Unfortunately, relict pyrope, enstatite and forsterite in mafic and ultramafic rocks are attributed to a pre-F_1 metamorphic history, whereas they could well belong to the original igneous assemblage.

The puzzling problem of relic Svecofennian K-Ar ages of hornblendes in contradiction with Caledonian U-Pb ages on nearby eclogites is tentively attributed to excess argon in Tafjord hornblende, although one should not discard the possibility that Hareidland eclogites are younger than those of Tafjord. This point is not clearly documented in the text.

In the final discussion, the author favors a common origin for eclogites, ultramafics and anorthosites which show compositional variations resembling those found in layered complexes. Strain analysis might help to reconstruct the dimension and shape of an hypothetical mafic-ultra mafic complex. This will solve the main question as to whether this kind of anorthosite results from a particular type of intrusion (sills?) or belongs to an extremely flattened stratiform complex.

To summarize these comments, the good structural and stratigraphic framework given by this study constitutes a valuable basis for further petrologic studies on polycyclic mafic, ultramafic and anorthositic rocks.

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Marine Manganese Deposits

Edited by G.P. Glasby
Elsevier Scientific Publishing Company, 523 p., 1977.
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G.P. Glasby and 23 other eminent authorities on manganese nodules have collaborated in the preparation of an exceptionally useful reference volume for resource, marine and environmental geologists, and for all in industry and government who are concerned with future mineral supply and development. In 14 well organized chapters the authors have succeeded in presenting a considerable amount of good data, timely evaluation and interpretation of relevant scientific research and knowledge, and an appreciation of the status and level of understanding of manganese nodule occurrences throughout the world. Data and interpretation are dealt with concisely and objectively in the volume for subject material ranging from an historical introduction to manganese-iron nodule investigations; the distribution and geochemistry of deep-sea, shallow-water, continental, lacustrine, and fossil nodules; the morphology, internal characteristics, mineralogy, rates of accretion of the nodules; the form of manganese and iron in marine sediments and the mechanisms of removal of manganese, iron and other trace metals from sea water; extractive metallurgy; to environmental, legal and economic aspects of nodule mining.

To have attempted comprehensive treatment of such an expansive subject over the years 1972 to 1977 when research and publication "mushroomed" in this field was a bold undertaking, yet the authors have succeeded in presenting an understanding in depth of genetic problems and the scope of working knowledge, and point out critical aspects and the direction which future investigations should follow. Because of thorough