

area in its infancy. Each chapter is packed with observations and descriptions, with discussions on the better understood processes. An example of the details in the text is the section on the tooth formation in chitons. The chiton 'shell' consists of eight overlapping aragonitic plates associated with a fleshy girdle which has aragonite spicules or scales. Chitons generally live in the tidal and subtidal zones, and graze rocky surfaces. The grazing teeth become abraded or fractured at an average rate in a row of every 12–48 hours, and are then discarded. The teeth are a complex structure consisting of a magnetite capping to provide the necessary hardness, and a core comprised of a range of minerals including ferrihydrite, lepidocrocite, dahllite, francolite, amorphous hydrous ferric phosphate, and amorphous silica. After a discussion of the growth of the tooth, the authors comment on the relevant biomineralization principles and environmental factors.

In the chapter on non-skeletal functions involving biomineralization, the authors review four selected aspects. The first is the role of minerals in gravity perception; a technique applicable to plants, protocists, and animals. The minerals used include baryte, gypsum, calcite and aragonite. The second aspect is a discussion of magnetite, particularly its role in enabling organisms to detect the Earth's magnetic field (examples given are magnetotactic bacteria, euglenoid algae, and the sockeye salmon). Thirdly, the use of ferritin as an iron storage macromolecule is introduced, with an emphasis on the structure of ferritin. Finally, the means by which organisms control ice formation are reviewed. Certain plant bacteria deliberately induce ice formation, whereas fish living in polar waters inhibit ice crystals with glycoproteins.

In considering environmental influences on biomineralization, the problem the authors tackle is one in which organisms form minerals which are unstable in relation to their environment. For example, although sea-water is undersaturated with respect to celestite, a group of planktonic protocists (the *Acantharia*) form tests composed of celestite. In spite of this apparent isolation from the environment, the environment does affect certain aspects of the biomineral, including the phase nucleated, the minor and trace element distributions, the stable isotopic composition of the mineral, and its ultrastructure.

The last chapter is dedicated to the evolution of biomineralization in the fossil record. The earliest deduced records to date come from sulphur isotopic studies indicating bacteria could induce mineralization as far back as 2.7 Byr BP. The oldest actual fossils preserving evidence of bio-

mineralization occur at 1.6 Byr BP. Biomineralization evolution is reviewed in three sections: evolution of carbonate mineralization, phosphate mineralization, and silica (opal) mineralization.

It is believed that this book is one which will become a standard reference for some time. It is comprehensive, full of details, very well referenced, and filled with high-quality schematic diagrams, tables, and black-and-white photographs. Obviously a text written for a new field, of interest to several disciplines, is open to criticism of some details or views by those who are specialists. However, one strength of the text lies in its comprehensive review from several viewpoints. The text is considered essential for every university library, and unhesitatingly recommended for anyone with some interest in the subject. Within the geological sciences, there are sections of interest for mineralogists, geochemists and palaeontologists. Although generally aimed at the 'state of the art' level, undergraduates will benefit greatly from relevant sections and the clear separation by the authors of principles, observations, and speculations. Apart from the science, there is much in the style of writing which is commendable. For one of the authors, the book comes towards the end of his career, and yet the text expresses the curiosity and amazement of a child. A sense of wonder permeates the text as the reader is taken through an Aladdin's cave, shown a myriad of wonders, questions asked, and future areas of research indicated.

It is clear that biomineralization is a research area still in its infancy. The authors are to be congratulated on the hard work which has gone into a text which is highly informative, and does not get bogged down in details or dead-ends. The whole attitude of this book can be summarized by one comment on a problem of biomineralization processes: 'The solution is probably not super sophisticated or trivial, just elegant and simple!'

A. P. GIZE

Smith, D. G., ed. *Eclogites and Eclogite-Facies Rocks*. Amsterdam and New York (Elsevier Science Publishers), 1988. xxii + 534 pp. Price Dfl. 220.00 (\$115.75).

This book belatedly presents a limited selection of papers mostly presented at the First International Eclogite Conference in 1982, together with a 206 page review by Smith on the so-called 'Norwegian Coesite-Eclogite Province'. For most readers unfamiliar with controversies over the interpretation of Norwegian eclogites, the latter is likely to be both startling and fairly indigestible, as the style is rather verbose, at times confusing

and much of it regrettably presented as a rather personal crusade.

Smith's view of the supposed Norwegian coesite-eclogite province as a 'mineralogist's paradise and a petrologist's nightmare' seems to rather summarize his own state of thinking on this area. Inadequate consideration is given to how kinetic factors are likely to influence the extent of the stabilization and preservation of eclogite facies assemblages and can explain the close spatial associations of diverse metamorphic facies assemblages. For example, recent published work by Austrheim on the Bergen Arcs area has convincingly demonstrated kinetically controlled stabilization of eclogites within plagioclase-bearing granulite facies anorthosites.

Readers will find it surprising that such a lengthy review chapter on Norwegian eclogites does not include a single geological map. They have to rely entirely on a rather poor quality locality map (without any geological boundaries) for only part of the eclogite-bearing Western Gneiss Region. They are also likely to experience considerable difficulty in following the proposed multi-stage (Z,Y,X,I,A,S)  $P$ - $T$ - $t$  evolution of these eclogites from the summary figure (1.6) and caption provided.

Smith questionably relates geographically closely associated coesite (or low Al orthopyroxene) eclogites, other mineralogically non-specific eclogites, partly eclogitised metagabbros and garnetiferous ultrabasites to diverse interdigitated nappes with different  $P$ - $T$  histories in a supposed 'gigantic tectonic melange'. However, he lacks the confidence to indicate on Figure 1.1 even provisional outlines to these various nappes or even to the much trumpeted 'Coesite-Eclogite Province'. Even Smith seems uncertain as to whether this province comprises any more than just a few square metres (excluding the intervening gneisses between the eclogite pods) in the 'Selje' district, curiously considered to contain several 'peculiar' minerals within a 'privileged portion of the Earth's crust'.

Smith's admission that his new tectono-metamorphic model 'may still be a long way from the truth' and 'may seem to be inordinately complicated' are hardly likely to encourage wide acceptance. Recent Precambrian age determinations for eclogites in the Bergen Arcs and for eclogite facies garnet peridotites, as distinct from Caledonian ages for external (in gneiss) eclogites and recrystallized garnet peridotites, in the Western Gneiss Region do however support Smith's contention that not all West Norway eclogite facies rocks can be related to a single, *in situ* model for eclogite generation. Certainly there is now

compelling evidence that the Western Gneiss Region does contain some older mantle derived eclogite facies rocks tectonically intercalated into the thickened crustal nappe sequence during the Caledonian orogeny.

The seven other chapters, whilst dwarfed by the opening one, individually contain data and interpretation of much interest to petrologists engaged in the study of high-pressure rocks. With the obvious need to better characterize eclogite facies assemblages in lithologies other than basites and ultrabasites, the chapters on meta-acidites in New Caledonia (Black *et al.*) and in Sifnos, Greece (Schliestedt and Okrusch) are of particular value. The reviews of chemical zoning in eclogite garnets (Ghent) and clinopyroxene crystal-chemistry (Rossi) are of wide interest and likely to be much quoted, especially the latter which sadly as it has turned out effectively represents the closing 'chapter' to the work of a highly respected X-ray crystallographer. Also included are two chapters on eclogite and other high-pressure xenoliths (including granulites) from S.E. Australia and the Colorado Plateau, U.S.A. The chapter by Arculus *et al.* presents a large volume of mineralogical, trace element and isotopic data which point to the complex, heterogeneous character of the lower crust beneath these regions. That by Helmstaedt and Schulze proposes that eclogite facies xenoliths from Colorado Plateau diatremes may constitute an important link between low-temperature 'crustal' eclogites in ophiolitic melanges and high-temperature 'mantle' eclogites in kimberlites and be indicative of a subduction origin for at least some of the latter. The final chapter (Godard) presents detailed descriptions and analytical data on eclogites from the Champocéaux and Les Essarts complexes, South American Massif in France, together with a short and rather inconclusive review of the distribution and significance of Hercynian eclogites in a wider geotectonic context.

It is disappointing that in a book on 'Eclogites and Eclogite-Facies Rocks' Smith is not prepared as editor to make really firm and positive recommendations on the definitions of these fundamental lithologic terms. Just to signal that petrologists have to await the prolonged deliberations of the I.U.G.S. Subcommittee on 'The Systematics of Metamorphic Rocks' will seem unsatisfactory and frustrating to active geoscientists. Whereas most petrologists will accept restriction of the lithotype name eclogite as plagioclase free rocks, Smith's insistence that plagioclase must also be absent in *all* cofacial eclogite facies lithotypes perpetuates the types of interpretative problems highlighted in his chapter on Norwegian eclogites. He fails

to take account of experimental data which indicates that the pressures required for plagioclase elimination in different lithologies vary by as much as 16 kilobars or of the crucial influence of water activity on the stability of eclogite relative to amphibolite and blueschist. Whilst Smith validly criticizes the much favoured Groups A, B and C eclogite classification scheme of Coleman *et al.*, his proposed alternative classification scheme is scarcely adhered to in this book and certainly does not adequately define the geological environment for the formation of most eclogites.

Overall this book falls well short of presenting a balanced and comprehensive account of 'Eclogites and Eclogite Facies Rocks'. However, this reviewer must confess to being not unbiased in reaching this conclusion having just completed the editing of a separate review text on such rocks.

D. A. CARSWELL

Latter, J. H., ed. *Volcanic Hazards: Assessment and Monitoring*. Berlin, Heidelberg and New York (Springer-Verlag), 1988. viii + 625 pp., 284 figs. Price DM 178.00.

During the last decade or so, there has developed within the volcanological community a heightened awareness of the social implications associated with volcanic studies. The need for this awareness was probably first highlighted by the eruption of Soufriere in Guadeloupe during 1976 when controversies between scientists were utilized by the media in a way that did not enhance scientific credibility, and lines of communication between scientists and governmental authorities were not clearly established. More extensive monitoring of active volcanoes was an urgent requirement, as well as the development of better predictive ability, procedures for the interface between volcanologists and civil defence authorities, and a code of conduct for scientists working on volcanoes. Considerable endeavours on all these fronts have been and are being made.

It is thus appropriate that the first volume in the IAVCEI Proceedings in Volcanology should be devoted to the assessment and monitoring of volcanic hazards. This volume is the outcome of a symposium held at the International Volcanological Congress in New Zealand during February 1986. The book contains thirty-five of the papers that were presented orally or as posters as part of the Symposium, including two that were given in a symposium on pyroclastic flow deposits.

The Editor has divided the book into two parts, the first covering hazard assessment and the second monitoring. Within each of these sections

he has attempted to order the papers logically, keeping works on particular regions or volcanoes grouped together. Inevitably with a book of this type, the contributions are variable in quality and interest. The topics covered are wide-ranging and the geographical coverage of volcanoes good; but, as the editor regrets in his preface, there are no sections dealing with volcanoes of Africa, the Atlantic Islands (except Iceland), Hawaii, Central America (except Mexico), or South America. [All the papers have been abstracted in *Mineralogical Abstracts* M. A. 90M/1048-1082].

Although this publication is presented as typed camera-ready copy, there is at least uniformity, all the papers being typed to a standard style. There is also a measure of uniformity in the written English, presumably as a result of a heavy editorial pen. The result is a good record of the presentations given at this symposium. As such it will be a useful reference in Earth Science libraries.

Having said that, there is a feeling that something is missing. An important aspect of any meeting such as the one represented here is the cross-fertilization of ideas. The book could have been so much better if there had been one or two stimulating chapters by authors invited to present ideas developed by discussion as the conference progressed. The Editor's Preface goes some way towards this especially in pointing out that only a few Quaternary volcanoes are known well enough for estimates to be made of mean intervals between eruptions of a given magnitude. Thus emphasis is often given to those volcanoes known to have had large eruptions in the recent past, whereas real danger may be present at centres that have been long dormant. He argues that a future thrust of research should be detailed chronological studies of potentially destructive volcanoes including those currently dormant. While this is not entirely a new idea it is one that is certainly worthy of emphasis.

Perhaps for future volumes in this series the publishers will consider a format that will record these symposia not just as a collection of papers presented, but adding contributions that reflect the intellectually stimulating outcome of a group of scientists coming together to discuss their subject.

J. E. GUEST

Young, T. P. and Taylor, W. E. G. (Editors) *Phanerozoic Ironstones*. (Geological Society: Special Publication No. 46), 1989. xxv + 251 pp. Price £66.00.

An International Symposium on Phanerozoic