

emphasise that the rate of melting is poorly understood and discuss the merits of equilibrium and disequilibrium melting. During metamorphism important mineralogical changes take place which will exert an influence upon the final results. Progressive reactions leading to melting are described by Schumacher, J., Hollocher, Robinson and Tracy (Ch. 9). The paper describes relationships of P - T - t paths, isograds and isotherms in the extensively studied central Massachusetts metamorphic belt. In such an extensively studied area the database is sufficient to allow a study of the interactions of P , T , time, chemical composition of rock and associated fluids and reaction kinetics. It clarifies the difference between metamorphic field gradients and P - T - t paths and introduces the possibility that some P - T - t paths may have no meaning because they are not the result of one continuous metamorphic episode. The formation and compositions of water-undersaturated granitic melts are discussed by Johannes and Holtz (Ch. 4). There has been long debate over the possibility of forming granitic melt whilst at the same time forming granulite-facies assemblages. This paper suggests lines of evidence that persuade the reader that this can happen. The mineralogy of leucosomes may tell us much about the conditions under which melting and/or crystallisation took place and something about the composition of the parent material. In chapter 5, Powell and Downes describe garnet-bearing leucosomes in aluminous meta-pelites from Broken Hill. On the basis of the modal mineralogy the compositions of the leucosomes are at odds with them representing partial melts. Their conclusion is that the appearance of garnet is controlled by an incongruent melting reaction. Once melt has aggregated and moved it may be difficult to establish what its origins were because magmatic processes such as fractionation as well as contamination by material derived from the crust through which the melt moves will modify its composition. Wickham (Ch. 6) considers the use of both stable and radiogenic isotopes as tracers to examine the relationship between granites and their source rocks. The possible crustal versus deep-seated origin of the fluids is also discussed, another theme that runs through several of the contributions. Following on from this there is a discussion of fluid-rock interactions from the Adirondack Mountains (Ch. 8 Cartwright and Valley) where attempts are also made to establish the origins of some of the fluids. The results of this study show that fluid movements may be very complex, occurring in a number of distinct episodes. Together with strong local control of the fluid

composition the result is heterogeneous fluid-rock interaction.

Amphibolite-granulite facies rocks from central Australia with rather exotic textures and assemblages which formed at low pressures (2.5–4 kbar) and which have undergone partial melting are described by Vernon, Clarke and Collins (Ch. 11). These most unusual rocks are well-illustrated and, because of the abundance of important mineral assemblages, have allowed the P - T conditions to be tightly constrained. This has permitted a special case to be convincingly argued involving a local, abnormally high geotherm of 75 °C per km. The poly-metamorphic granulites from the Enderby Land region of Antarctica have demonstrated some equally exotic mineral assemblages that preserve evidence of extremely high temperatures associated with moderate to high pressures. Chapter 12, by Harley and Hensen, provides a well-written summary of a considerable volume of field, mineralogical and chemical data on these rocks. Further, there is a demonstration of the integration of theoretical and natural systems as FMAS grid data are taken from Ch. 2 and are calibrated so that interpretations may be applied. The last contribution (Cartwright) is a discussion of the relationships between anatexis, melt extraction and crystallisation associated with retrogression in the Scourian of north-west Scotland.

Each paper has an individual reference list and the volume has a fairly comprehensive index. It is well-illustrated and both the printing and binding are of a high standard. Considering the current cost of similar books this 407-page edition at £55 represents good value that will not become outdated too rapidly. It should be available to researchers in all Earth Science libraries though sadly it may not, I suspect, be purchased by many individuals.

C. R. L. FRIEND

Kear, D. (Ed.). *Mineral Deposits of New Zealand*, Monograph 13, Australasian Institute of Mining and Metallurgy, Parkville, Victoria, Australia, 1989. xiv + 225 pp. Price \$A73.50.

This volume, sub-titled *The Gordon J. Williams Memorial Volume*, consists of a collection of papers summarizing the results of mineral exploration in New Zealand from 1974 to 1987; it effectively supplements the second edition of *Economic Geology of New Zealand* by the late Professor Williams published in 1974 as Monograph 4 of the Australasian Institute of Mining and Metallurgy.

There has been considerable activity by mining

and mineral prospecting companies in New Zealand since Williams went to press, and the scientific community will be only too aware how the results of such work are commonly lost to science. Dr. D. Kear, the editor of the present volume and a former Director of the New Zealand Geological Survey and Director General of the New Zealand Department of Scientific and Industrial Research, has successfully solicited papers by company geologists recording activities in a wide variety of mineral prospects. Previous work and geological backgrounds are briefly reviewed together with prospecting methods, results, and actual or potential processing methods where applicable. Included are papers on various gold and gold-silver prospects, sulphur and halloysite deposits, titanomagnetite and ilmenite iron sands, scheelite, copper, nickel, and molybdenum mineralization, bismuth sulphosalts, and platinum group minerals. These papers are complemented by some more general reviews by DSIR scientists on the geological setting of mineralization in New Zealand, the Hauraki goldfield, placer gold mining, and non-metallic minerals, including a particularly interesting account of the submarine phosphorite deposits of the Chatham Rise.

Work in the period under review led to the reopening of a major gold-silver (electrum-acanthite) mine in the Hauraki epithermal goldfield, which is associated with Miocene volcanism. This is the Martha Hill pit at Waihi, and another large mine is planned for the Golden Cross prospect in the same field. Both alluvial and underground reef mining for gold and scheelite have taken place intermittently near Macraes in the province of Otago since 1862. Here gold- and scheelite-bearing quartz lodes are hosted in a shear zone in schist, and following investigations summarized in the volume a new large open-cut mine at Round Hill went into production in November, 1990. One important enterprise, the mining for export of the Waipipi iron sands, has ceased during the 1974-87 period, and in this case an epitaph is provided in the form of an account of the production history, mining and concentration processes, slurry-loading onto ore carriers, and land rehabilitation.

Perhaps more important than the accounts of the successful enterprises, are those documenting less well known activities, knowledge of which could so easily have been lost for most readers. The quality of the papers is inevitably uneven, specialists may sometimes wince at statements that are made, and proof-reading leaves something to be desired ('schistocity' appears so frequently in one paper that it can hardly be

ascribed to a mere typographic error). Nevertheless, workers who do not usually do so have recorded data of interest and have sometimes included further references to otherwise inaccessible reports. Dr. Kear himself has provided an extended bibliography. Past production figures are summarized in many cases, and some fascinating snippets are revealed, for example official gold production in New Zealand in 1986 was 1265 kg with a value of \$27.2 million, whereas one Auckland bullion exchange company alone is said to have handled around 2500 kg of West Coast placer gold in about the same year.

While not intended for professional mineralogists as such, the volume should prove a valuable source book for future workers involved in mineral exploration in New Zealand, and Dr. Kear is to be congratulated on bringing it together [M.A. 90M/3998-4034].

DOUGLAS S. COOMBS

Railton, C. T. and Watters, W. A. *Minerals of New Zealand*. Lower Hutt, New Zealand (N.Z. Geological Survey Bulletin 104), 1990. 89 pp., 38 photos., 3 maps. Price \$NZ 60.00 (\$US 60.00), including overseas airmail postage.

This publication is a welcome supplement to the widely used N.Z. Geological Survey Bulletin 32 (1927) by P. G. Morgan: *Minerals and Mineral Substances of New Zealand*. The main part is an alphabetical listing of minerals recorded in published form up to 1990 from New Zealand and its outlying islands. For each mineral the chemical formula, locality details, geological setting, availability of analytical data (with references), and associated minerals are listed. There is a bibliography of some 500 items, photographs of 38 representative minerals including photomicrographs in colour and SEM photographs. Appendices include an explanation of chemical formulae, a list of chemical elements and symbols, minerals arranged according to metallic elements they contain and Maori names for minerals.

The bulletin is intended for the professional geologist and mineralogist, but will also be of much interest to collectors and lapidarists.

R. A. HOWIE

Rothwell, R. G. *Minerals and Mineraloids in Marine Sediments: an optical identification guide*. Elsevier Science Publishers, 1989, 279 pp., 148 figs. Price £47.00.

The subtitle of the book accurately describes its purpose: it is an aid to the rapid identification of