

The Evolution of the Crystalline Rocks; edited by D. K. BAILEY and R. MACDONALD. P. ix, 484, 182 figs. London, 1976 (Academic Press, \$35.00).—In the half century since N. L. Bowen wrote *The Evolution of the Igneous Rocks* there has been a great deal of progress in experimental igneous petrology, while experimental metamorphic petrology has begun and grown into a science of its own. *The Evolution of the Crystalline Rocks* is an attempt to provide a basic text in applied experimental petrology and acquaint the reader with the modern literature in that field. This is undertaken with a minimum of thermodynamic terminology in order to make the book usable by all hard rock geologists and students of the earth sciences.

Part I is a discussion of experimental methods and uses of phase diagrams by D. K. Bailey. Part II is experimental petrology, divided into

several chapters: high pressure metamorphism by R. C. Newton and W. S. Fyfe, moderate temperature and pressure metamorphism by H. J. Greenwood, high temperature metamorphism by W. Schreyer, granitic rocks by W. C. Luth, and alkaline rocks by D. K. Bailey. Basic and intermediate igneous rocks are not dealt with. In each system, the authors attempt to relate experiments with natural observations.

As is to be expected with a book of this type, there are differences of opinion and approach between authors. Greenwood and Schreyer accept different aluminum silicate diagrams; Newton and Fyfe spend more time than the other authors in trying to understand the differences between various experimentalists on the same system. In my opinion, most of the authors are a little soft on experimentalists who have used, and in some cases still use, experimental methods that do not demonstrate equilibrium and accurately show the nature of the reaction. In a few cases, important references have been omitted either as an oversight or due to the writer's prejudices.

Bailey's initial discussion of experimental methods and phase diagrams serves as an introduction to the other parts of the book. This section is especially good for igneous experimental work. The metamorphic part could use a little more discussion of the pitfalls of metamorphic experiments and the importance of careful analysis of experimental data.

Newton and Fyfe give an excellent analysis of the various experimental studies applicable to glaucophane schists and eclogites. They arrive at tentative conclusions as to where the "true" equilibria lie. Much of the discussion centers on the nature of reactions that produce index minerals and on the effects of solid solution. The reader has a rather clear picture of what is not yet understood and what kinds of experiments should be attempted.

Greenwood's analysis of greenschist- and amphibolite-grade rocks includes theoretical discussions concerning facies and the nature of the fluid phase in addition to oxide equilibria, reactions in pelitic rocks, and $\text{H}_2\text{O}-\text{CO}_2$ reactions in carbonate-bearing rocks. Unfortunately, study is progressing so rapidly in impure carbonate systems that parts of the chapter are already out of date. However, it is invaluable as a guide to the work published before 1974.

Schreyer discusses mainly magnesian, pelitic, and carbonate systems applicable to upper amphibolite- and granulite-facies conditions and contact metamorphism. For pelitic rocks, emphasis is placed on reactions involving cordierite, because this mineral is especially indicative of high temperature, low pressure metamorphism. The discussion of equilibria is very complete, but perhaps more emphasis on the effects of $P_{\text{H}_2\text{O}} < P_{\text{load}}$ for such rocks is warranted.

Luth gives an excellent treatise on the melting relations of granitic rocks. He emphasizes the importance of more studies on melting relations at $P_{\text{H}_2\text{O}} < P_{\text{load}}$. Luth attempts to combine all valid data on a given reaction to produce the best possible equilibrium curve.

Bailey brings together numerous studies dealing with the origin and evolution of alkaline igneous magmas. From his discussion it is obvious that despite the large volume of research on the subject, there are many unsolved problems. The alkaline rocks remain enigmatic.

The Evolution of the Crystalline Rocks should be required reading for all igneous or metamorphic petrologists and graduate students interested in petrology. The material is perhaps too detailed for most undergraduate students. In the areas covered, the book provides an excellent background in experimental petrology and its application. I believe that the continued use of the metamorphic facies classification in the book provides a useful framework for discussion of metamorphism. My only general criticism is that I wish the authors had spent more time on detailed discussion of the application of idealized experimental equilibria to real rocks by considering solid solution calculations and the probable dilution of H₂O in the fluid of pelitic rocks as well as carbonates. This book should certainly provoke new ideas on the part of any thoughtful reader.

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