

Indeed, Gilmore's relaxed style will not be to everyone's taste; for example, after a page or two describing a standard treatment of some phenomenon, he concludes with the acerbic aside "In short, an intractable problem is replaced by an intractable problem". It is a style he handles well; it could so easily be overdone, but in my view it is not, and greatly enhances readability and thence understanding. The most formal section, also the shortest, is Part 4, in which he presents in some detail the mathematics underlying ECT. In contrast with Part 1, this is (necessarily) couched in sophisticated mathematical language. It would have been easy to have included this material in Part 1, and many readers would not then get beyond it: it is greatly to the benefit of the book that this mistake was avoided. Coincidentally, Part 4 is the least

satisfactory part of the book, when judged against the standard work in the field, the classic text of Poston and Stewart (*Catastrophe Theory and its Applications*; Pitman, 1978) whose treatment of Thom's theorem, transversality, determinacy and unfoldings stands head and shoulders above Gilmore's. That criticism is more than offset by the fact that, particularly for the reader not well versed in the language of modern pure mathematics, the first nine-tenths of Gilmore's text is excellent.

In his epilogue, Gilmore asks the question "Is catastrophe theory useful and important?" and concludes by asserting his belief that it is. I share that view, and both his and Thompson's books are convincing evidence in support of it. □

Colin Upstill is at the H.H. Wills Physics Laboratory of the University of Bristol.

Islands or East Africa. The problem is made more difficult by the way in which Gill attempts to distinguish tholeiitic and calc-alkaline andesites. While he recognizes the importance of iron content, he ignores the more reliable compositional criteria of Irvine and Baragar and makes no mention of the high alumina and normative plagioclase contents that many petrologists consider compositionally diagnostic and crucial to any petrogenetic interpretation of calc-alkaline andesites.

Because much of the evidence bearing on these rocks comes from geochemical relations, any book of this kind must deal with complex trace-element patterns and isotopic ratios, and with how these may be related to the processes of magmatic evolution. Gill uses these data to weigh the relative importance of melting subducted oceanic lithosphere, assimilating crustal material and differentiating basaltic magma. In this way he systematically assesses essentially all the current ideas on the origin of andesitic magmas. While he does not hesitate to give his own judgement on these questions, he does so in the context of an overall appraisal of the evidence, so that readers can accept or reject Gill's conclusions according to their own view of the facts.

No two persons would agree as to how much weight should be given to various types of evidence bearing on the origins of these rocks. I would personally have preferred more data on geologic relations and less on trace-element geochemistry. It astonishes me that anyone can write an entire book about andesites and never present a single geologic map or structural section of an andesitic volcano. The book, like most modern work which covers orogenic igneous rocks, deals almost exclusively with the structural relations observed today around the Circum-Pacific and gives much less attention to the geologic past. If it is important to note that all active andesitic volcanoes are in well-defined belts close to convergent plate boundaries, is it not equally important to stress that the same has not always been true in the past? Many rules of thumb based on modern relations fail when we look beyond the Quaternary, and I suspect that one can learn more about andesites from the anomalous cases that violate our conventional models than from all the examples that neatly fit them.

These, of course, are petty differences of view, and they detract in no way from my unreserved recommendation of this book as a timely, scholarly survey of a very complex subject. The sincerest praise I can offer any book is to say, as I can of this one, that I have adopted it as a text in my graduate-level petrology course. No student of orogenic igneous rocks should neglect adding it to his professional library.

Alexander R. McBirney is a Professor in the Department of Geology at the University of Oregon, Eugene.

## All around andesites, and beyond

Alexander R. McBirney

*Orogenic Andesites and Plate Tectonics.* By J.B. Gill. Pp.390. ISBN 3-540-10666-9. (Springer-Verlag: 1981.) DM 98, \$44.60.

A THOROUGH, up-to-date review of orogenic andesites has long been needed and is especially welcome at this time, when many petrologists are taking stock of this group of rocks and their interpretation in terms of accepted concepts of plate tectonics. In undertaking this formidable task, James Gill has performed a notable service to petrology. His book is certainly the most comprehensive compilation of data and ideas that has yet been attempted.

The book summarizes almost every aspect of the occurrence, composition and genetic relations of andesites. It reviews their structural and tectonic setting, rheological properties, eruptive behaviour, geochemical and mineralogical features, compositional variations in time and space, and all the major petrogenetic theories proposed to explain their relations to plate tectonics. This mass of data is presented in a concise, well-organized fashion. In his evaluation of the various schemes which have been proposed to account for orogenic igneous rocks, Gill turns much of his attention to their relationship to subduction, and a large part of the book is an attempt to reconcile the occurrence and unusual features of the rocks with a party-line view of plate tectonics. In doing so, he has made a conscientious effort to mention all observed relationships, together with every known exception; the result is a text which tends towards the encyclopaedic, with awkward sentences that one must read two or three times to sort out an elusive trivial point. The style improves, however, when

Gill comes to a question of interpretation that clearly interests him. The text then blossoms and becomes quite readable.

The book is burdened by the long-standing difficulty of defining what rocks should be included under the name andesite. The reader encounters this problem in the very first sentence, which tells him that "active volcanoes on Earth erupt andesite more than any other rock type". Before recovering from this, he reads, further down the same page, that these andesitic volcanoes include Kilimanjaro and Hekla! The explanation for these startling assertions soon becomes apparent when Gill gives his definition of andesite as any hypersthene-normative rock with a silica content between 53 and 65 weight per cent. Although this definition is offered in the interests of "simplicity" the resulting confusion in the mind of the reader persists throughout the book, for one is often in doubt as to whether, in referring to "andesites", Gill means calc-alkaline andesites or some other intermediate sub-alkaline rock. Much needless discussion is devoted to rocks that have no relevance to andesitic volcanism as most geologists perceive it.

There is a certain logic in including among andesites the important group of intermediate tholeiitic rocks of island arcs that are clearly related to subduction and share many genetic features in common with the "true" calc-alkaline andesites with which they are closely associated, sometimes even in the same volcano. It seems illogical not to refer to these rocks as tholeiitic andesites, but most petrologists would certainly agree that they are quite distinct from rocks of similar composition in settings such as Iceland, the Galapagos