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## Book Reviews

**Gill, J.: Orogenic Andesites and Plate Tectonics, Minerals and Rocks.** Springer, Berlin Heidelberg New York, 390 pp., 1981.

Almost all volcanic activity on Earth is confined to plate margins. The largest volume of volcanic rock is produced at accreting margins at ocean ridges. Most volcanoes are located at convergent plate margins where lithosphere is subducted into the mantle. These volcanoes are arranged in long narrow chains that parallel the ocean trenches which mark the downward bending of the lithosphere. A major constituent rock type erupted from these volcanoes is Andesite which is chemically and petrologically different from basalts, the major rock extruded at ocean ridges. Conversely, Andesites are primarily associated with convergent plate boundaries. According to Gill, the term Andesite was introduced by the German geologist Leopold von Buch to distinguish from the European trachytes the rocks brought to Germany from the Andes by Alexander von Humboldt. Gill defines Andesites as hypersthene – normative volcanic rocks with 53–63% silica. Orogenic Andesites are defined as a subset characterized by low titanium and potassium. Ironically, von Buch's rock (which is no longer available) would stand a good chance to fail Gill's criteria of being Andesite.

Interpretation of data with the help of plate tectonic theory led to the suggestion that the production of Andesites (and other rocks that erupt at convergent plate margins) is linked to the subduction process. A major problem is how enough heat could be generated to melt the source rock. The descending lithosphere is more of a heat sink rather than a heat source. A heat source frequently cited is frictional heating on the fault zone between the subducting lithosphere and the overriding mantle. A detailed understanding of the peculiarities of Andesites is vital to any assessment of geophysical models of its magma generation. Moreover, Andesites are similar in composition to the continental crust and may be important agents of continental growth. Also, andesitic magma are likely sources of ore deposits.

Gill compiled and critically synthesized an overwhelming amount of chemical, petrographical, and geophysical data on Andesites in chapters 1–7 which he calls the core of his book. These chapters (annotating more than 1100 references) provide an enormous source of information for everybody interested in the subject. Chapter 1 deals with the difficulties of defining Andesites and arrives at the above cited definition. Chapter 2 discusses the occurrence of Andesites in different plate tectonic environments. Chapter 3 reviews the geophysical characteristics of subduction zones, while chapter 4 summarizes the physical characteristics of Andesite magma. Chapter 5 gives a detailed discussion of major and trace element chemistry, chapter 6 a description of the mineralogy of Andesites, while chapter 7 discusses the variations in magma composition in time and along and across volcanic arcs. Chapters 8–12 are more interpretive (and also more speculative). They discuss the role of the subducted crust, the overlying mantle wedge, the crust underlying Andesite volcanoes, and the process of basalt differentiation in Andesite genesis. These chapters pave the way to

Gill's conclusion that "differentiation of basalt by crystal fractionation of anhydrous minerals at low pressure is the most frequent and most fundamental process of orogenic Andesite genesis". The link to subduction is not direct but occurs through the formation of the primary melt. Whether one is willing or not to agree to all the conclusions (this reviewer is not quite satisfied with Gill's evaluation of the shear heating process and magma ascent theories), this book is an outstanding source of information and provides a stimulating discussion. The book is highly recommended for all geoscience libraries.

**T. Spohn**

*National Research Council. Geophysics Study Committee:*

Continental Tectonics ser.: Studies in Geophysics. National Academy of Sciences, Washington, D.C., 197 pp., 1980 (Off. Publ. Nat. Acad. Sci., 2101 Constitution Ave., N.W. Washington, D.C. 20418 USA)

'Continental Tectonics' is something between an internal study group report to a science decision making agency and a book for the scientific public or it is both things in one. It was written in 16 individual papers by the members of a Panel on Continental Tectonics chaired by B.C. Burchfield (MIT), J.E. Oliver (Cornell), and L.T. Silver (Caltech), "to provide assessments from the scientific community to aid policymakers in decisions on societal problems that involve geophysics. An important part of such an assessment is an evaluation of the adequacy of present ... knowledge ...". "This study ... was motivated by ... problems ... involving natural hazards .... The thesis of this report is that more reliable scientific input to the decisions ... can be provided only with a much improved basic understanding of continental tectonics". "The study was developed through meetings ... and presentation of papers in preliminary form at the American Geophysical Union meeting in Miami in April 1978 ... the authors had the benefit of discussion ... as well as the comments of several scientific referees". "They provide examples of our current basic geophysical knowledge of the architecture and processes on the continents. They also pose many of the fundamental questions and uncertainties that require additional research. The essays allude to several practical applications ...".

These quotations from the Preface give a good impression of the character and intention of the report. It begins with an "Overview and Recommendations", followed by a "Summary" of "Plate Tectonics and the Continents: A Review" by B.C. Burchfield and "Problems of Pre-Mesozoic Continental Evolution" by L.T. Silver. The second chapter is on "Plate Boundary Tectonics" covering "Complexities of Modern and Ancient Subduction Systems" (W.B. Hamilton); "Intracontinental Rifts and Aulacogens" (K. Burke), and "Evolution of Outer Highs on Divergent Continental Margins" (M.A. Schuepbach and P.R. Vail). Chapter III

on "Intraplate Tectonics" contains four papers: "Tectonics of Noncollisional Regimes – The Modern Andes and the Mesozoic Cordilleran Orogeny..." (B.C. Burchfield); "Models for Midcontinent Tectonics" (W.J. Hinze, L.W. Braile, G.R. Keller, E.G. Lidiak); "Problems of Intraplate Extensional Tectonics, Western U.S." (G.A. Davis); "Geophysical and Geological Characteristics of the Crust of the Basin and Range Province" (G.P. Eaton). Chapter IV on "Characterization of Continental Crust": "Seismic Exploration of the Continental Basement" (J.E. Oliver); "Exploration of the Continental Crust Using Aeromagnetic Data" (I. Zietz); "Chemistry of the Lower Crust: Inferences from Magmas and Xenoliths" (R.W. Kay, S. Mahlburg Kay); and "Geochemical Evolution of the Continental Crust" (G.N. Hanson). Finally the fifth chapter concentrates on "Continental Evolution": "Cenozoic Volcanism in the Western United States: Implications for Continental Tectonics" (P.W. Lipman); "The Shape of North America during the Precambrian" (W.R. Muehlberger); and "An Outline

of the Tectonic Characteristics of China" (T.K. Huang: essentially a reprint from *Eclogae Geol. Helv.*, **71**, 611–635, 1978).

The above demonstrates the broad spectrum of the earth sciences covered in the report. This series of "Studies in Geophysics" covers geophysics in the widest possible sense, it is a good example of a truly interdisciplinary approach, not a mere profession of interdisciplinarity.

The papers represent the state of the art and define topical questions. Much is to be learned from them, particularly about North American geology.

I feel every report to an administrative body should be written in a similar fashion as this one was, i.e. publishable to the scientific public, clearly written, somewhat tutorial, stimulating. Other kinds of reports should not be written at all. I recommend "Continental Tectonics" to those who are interested in doing research on continental tectonics and to those who request earth scientists to write reports.

**W.R. Jacoby**