Andes has been advanced far less.

This volume is a collection of 20 papers contributed by 60 authors of 10 nationalities and represents the fruit of the International Geologic Correlation Program (IGCP) Project 249, from which the book gets its title. The editors suggest that it serve as an introduction for earth scientists interested in Andean magmatism and tectonism. Although the book will adequately serve this purpose for the next few years, the papers, which touch on many aspects of Paleozoic, Mesozoic, and Cenozoic magmatism and tectonism, vary dramatically in content and quality. Papers concerning the pre-Tertiary record are largely descriptive and break little new ground toward advancing the understanding of igneous or tectonic mechanisms and processes. They do, however, offer a view of the distribution of various suites of igneous rocks of different ages and highlight how much of the older geology remains very poorly constrained. Interestingly, not a single paper in this book focuses on modern or ancient igneous rocks from the northern Andean volcanic zone in Ecuador and Columbia, and only one paper discusses the Andes of Peru.

One of the most lively current debates in earth-science concerns the relative importance of several components of subduction-zone magmas that have erupted from Andean arc volcanoes. Determining accurately how much material is contributed to these magmas from subcrustal mantle melting, from crustally derived sediment transported into this mantle source region (either carried down recently on the Nazca plate or as long-lived, chemically distinct mantle domains), and from the 35- to 70-kilometer-thick continental crust through which the magmas ascend is critical if we are to understand how crust forms and evolves and how crustal material transported to deeper levels in the mantle controls the chemical heterogeneity of this large and important volume within the earth.

The controversial question of sources for magma erupted from recent Andean volcanoes surfaces in the three most lucid and provocative papers in the book, adding some new data and considerable fuel to the debate. Specifically, the paper by Tormey *et al.* suggests that the chemical signature of varying degrees of partial melting of the subcrustal mantle from south to north beneath modern Andean volcanoes in Chile can be discerned despite the evidence that crustal rocks through which the magmas pass also significantly affect the composition of these same magmas. The paper by Kay *et al.* on temporal changes in lava composition at mid- to late Tertiary volcanoes in northern Chile and Argentina, where the crust has thickened with time, suggests that crustal contributions to the magmas increased as the crust became thicker. Like Tormey *et al.*, Kay *et al.* also suggest a role for erosion of the continental margin and the subduction of spatially and temporally variable amounts of this crust into the mantle source regions. In my judgment, however, the chemical and isotopic variations of these lavas do not provide compelling evidence for recognizing differences in mantle contributions to Andean magmas. In this light, Davidson *et al.*'s paper succinctly clarifies the ambiguities inherent in using chemical and isotopic data from the lavas themselves as the sole criteria for getting at source composition. Their discussion focuses on recent volcanism in northern Chile and southern Bolivia and, in opposition to Tormey *et al.* and Kay *et al.*, Davidson *et al.* contend that although some variability of mantle sources beneath the Andes may exist, melting and assimilation of deep crustal rocks into ascending magmas thoroughly obscure any chemical signatures from the mantle. These papers not only expand the dimensions of the controversy but also lay some of the groundwork for future studies.

Earth scientists interested in the basic geologic framework of the southern Andes (Bolivia, Chile, and Argentina) or arc magmatism in general will find this book a useful resource, and volcanologists and petrologists will appreciate the more provocative chapters.

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Books Received

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