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CHAPTER 2

CIRCUM-PACIFIC OROGENIC PROCESSES: A VIEW FROM THE ANDES AND THE ANTARCTANDES

I. W. D. Dalziel
Institute for Geophysics
University of Texas
Austin, Texas, U.S.A.

ABSTRACT

Tectonic accretion along the Pacific margin of Gondwana was a widespread and important process prior to initiation of breakup in the Late Jurassic to Early Cretaceous. Since that time, there apparently have been no major additions to the South American and Antarctic continental margins. Rather, the Andes and Antarctandes owe their existence to basin formation and inversion, magmatism, and small-block rotation and migration along a relatively simple ocean-continent convergent boundary.

Several different types of tectonic activity characterize the circum-Pacific mountain ranges. No one model explains them all. Study of cordilleran orogenic processes would be greatly enhanced by acquisition of deep seismic-reflection profiles from several carefully selected transects.

INTRODUCTION

This contribution is a brief overview of work in progress on the evolution of the Andes and the Antarctandes in the context of Gondwana fragmentation. Most of the recent work cited is part of collaborative efforts currently in press. In recent years much attention has been paid in the literature to the identification of so-called “suspect terranes” in mountain belts (Coney, Jones, and Monger, 1980; Jones et al., 1982; Howell, 1985). The importance to orogenesis of collision (“docking”) of allochthonous terranes, such as island arcs and oceanic plateaus, with a major continent at a continent-ocean convergent boundary has been emphasized (Nur and Ben Avraham, 1982). Indeed, it has been maintained that high mountain chains such as the Andes can only be formed by collisional processes (Nur and Ben Avraham, 1983).

Yet despite abundant evidence of accretion to the South American part of the Gondwana supercontinent during the Paleozoic and early Mesozoic (Dalziel and Forsythe, 1985; Ramos et al., 1986), there is no evidence of such accretion during the late Mesozoic and Cenozoic building of the Andean Cordillera (Dalziel, 1985). Rotation and migration of small crustal blocks along the Pacific margin probably were more important than accretion (Dalziel and Forsythe, 1985; Beck, in press). Major “suspect terranes” such as the Arequipa massif of southern Perú and the metamorphic complexes of the Chilean coastal cordillera were clearly part of South America

before the initiation of Andean orogenesis in the late Mesozoic.

What processes, then, have been most active in the building of the Andes? Classically, subduction-related magmatism has been recognized as playing a major role. Undoubtedly this is correct. More recently, however, it has become apparent that the Late Triassic to Early Cretaceous formation and mid-Cretaceous inversion of a composite backarc basin extending along most of the length of the Cordillera was probably critical in the initiation of tectonic uplift. Similar processes continued on a more local scale during the latest Cretaceous and Cenozoic (Bussell, 1983), controlled by such factors as segmentation of the downgoing lithospheric slab, differences in dip of the segments, and convergence rate (Jordan et al., 1983; Suarez, Molnar, and Burchfiel, 1983; Dalziel, 1985). Overall, tectonic shortening and thickening of the continental lithosphere along the western margin of the South American continent is now believed to have played a major role in Andean orogenesis (Suarez, Molnar, and Burchfiel, 1983; Dalziel, 1985; Molnar, 1986). The relative importance of deformation in relation to magmatism in this regard remains uncertain.

Examination of the Antarctic Peninsula Cordillera to the south of Drake Passage, originally known as the Antarctandes, provides further insights into the processes of cordilleran orogenesis. The peninsula was a magmatic arc during the entire Mesozoic and Cenozoic, displaying virtually no signs of compressional deformation during that time (Thomson et al.,