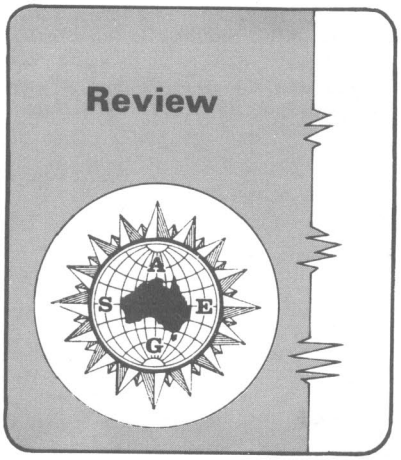

Plate Tectonics and Modern Regional Geophysics

David Falvey
Department of Geology & Geophysics, University of Sydney

Plate tectonic theory, with the passage of time, may prove to be as important to geology as the theory of relativity has been to modern physics. The development of this theory, and its acceptance by the various academic and industrial communities in Australia is characteristic of our provincialism. Research in this field commenced in Australian Universities in about 1966-7, and the subject has been included in undergraduate courses at most Universities since the early 1970's. I believe that most academics and students now have at least a superficial understanding of the basic concepts and corollaries of the theory, although, I must add, frequently *not* of the geometrical and geophysical core principles of plate-plate motion, nor of the full power of its mathematical and geological predictors.

The Australian mining and oil industry could not be said to have demonstrated "uncontrollable enthusiasm" for the theory, to say the least. Based on recent conference titles it appears that the mining industry has, even now, little interest in the theory or its ramifications. Yet this is despite the fact that, even in the mid to late 1960's, a relationship, with predictive value, had been realized connecting porphyry copper deposits in the S.W. United States with plate tectonics. Since then we have had publications on the Red Sea brines and on ophiolite belt obduction and nickel deposits like New Caledonia, to give but two examples. Ore genesis and plate tectonics has been recently summarized by Mitchell and Bell (1973) but such concepts have had little apparent influence in Australia.

The oil exploration industry has shown significantly more interest, however, as demonstrated by the Australian Petroleum Exploration Association Symposium on Continental Drift in 1972. But even the lofty title betrayed a general misconception – in plate tectonic theory continents don't drift! The continent is a geologically special part of a *composite plate* whose motion is integral with that plate. The papers themselves illustrated how mere corollaries, such as marine transgressions, had been taken as much more convincing evidence of the timing of seafloor spreading than the oceanic magnetic anomalies that had been, and still are, the cornerstone of the theory. Lack of *in depth* understanding still limits many brave attempts at using plate tectonics where its power really lies – a geotectonic tool which provides large scale boundary conditions and generalized geological models in the analysis of regional geophysical data.

There are now many good text books which treat plate tectonics appropriately and which discuss the possible exploration corollaries. The S.W. Pacific Workshop Symposium was not intended to be a review conference, nor to have specific economic implications. However, most papers do have relevance to regional aspects of oil and mineral exploration. Indeed, we were most disappointed that the exploration industry was represented by only one contributor in spite of the increasing interest by oil industry majors in the last year or so in aspects covered by this symposium. We hope that they will be able to contribute to, and profit from the next workshop-symposium planned for 1977.

As its name implies the S.W. Pacific workshop symposium covered the tectonics of the S.W. Pacific region – the evolution of the convergent plate boundary from the late Mesozoic to the Recent. The Symposium was held in the University of Sydney and limited to forty contributing participants. Section 1 of the papers and abstracts published in this volume is concerned with the continental margin of E and SE Australia – its tectonic development and relationships at active ocean-continent plate boundaries. Various contributors discussed Atlantic rifted margin models and their use and limitations in recognizing tectonic elements and in predicting facies (Taylor, Mutter, Terrill, Brown). The Tasman margin raised various problems concerning limited subduction and the prediction of igneous masses and continental structure associated with oceanic transform offsets (Ringis, Roots).

Section 2 covered, in part, the perennial problem of the origin of the marginal basins which lie behind island arcs. Watts and Weissel presented probable seafloor spreading anomalies from the Shikoku Basin in the N.W. Pacific, but could not conclusively resolve the problem of whether they imply uniaxial or biaxial spreading. The present writer discussed a new biaxial model for the North Fiji Basin involving growth offset transforms. As pointed out by Mitchell and Bell (1973) and others, the genesis of these basins and their involvement in orogenesis is of major importance in ore province prediction.

Papers devoted to the New Zealand region (Section 3, and others) dealt mainly with evolution of plate boundaries in late Mesozoic to Recent times. A variety of approaches were taken: analysis of the distribution of igneous rocks (Ballance, Leitch, Middlemost), interpretation of marine geophysical

data (Williamson, Packham), and quantitative inversion of inferred plate movements (Christoffel, Wellman). Some disparities arose between accounts; Packham could find no evidence for the Lower Miocene trench required by Ballance and Leitch, and the latter two differed in their interpretation of the Lower Miocene arc in northern New Zealand. Christoffel's "Bulldozer" model for the Alpine Fault suggested that the Helwig-Hall concepts of deformation at plate boundaries as outlined by Rod were not exclusive, although Falvey's India-Pacific pole, based on the Fiji Fracture Zone, suggests mostly transform motion on the Alpine Fault.

The more general papers on petrology and island arcs, such as Nicholls and Whitford (Section 6) provided background to many of the studies of the Papua-New Guinea region (Section 5; Smith, and others). It is clear from the various attempts at kinematic solutions (Ripper, Tilbury, Mackenzie, Coleman) that we have barely reached "first base" in our understanding of the region. These studies are of clear importance in outlining ore provinces in the region, as are the papers on the Solomon Islands region (Section 4).

I believe that a consensus of the view of the participants at the end of the workshop-symposium was full support for this kind of activity. Gordon Packham and myself (the convenors) have been criticized for insisting that contribution be a condition of attendance. However, I believe that in such a relatively small scientific community as ours there should be a greater willingness to contribute, particularly from our colleages in the oil and mineral exploration industry.

Reference

MITCHELL, A.H., and BELL, J.D., 1973: Island arc evolution and related mineral deposits. *Jnl. Geol.* 81:381-405.