The above evidence is taken to indicate a compressive regime for the central as well as for the better known northern part of the Macquarie Ridge Complex. That subduction in the central region of the Complex is not well developed is indicated by the lack of earthquake activity at intermediate and greater depths and the lack of island arc volcanics in the region.

It is not immediately clear whether the Pacific or Indian plate is being subducted in the central part of the Complex. The structure of the Macquarie Ridge Complex is similar to that observed in the western part of the Bowers Ridge Complex described by Kienle (1971). This structure, however, grades into what appears to be a typical island arc structure along the Bowers Ridge and this is apparently due to loading by island arc volcanics landwards from the previously existing morphological ridge. This would suggest that the morphological ridges associated with subduction zones include the effect of initial uplift and crusted thickening under compressive forces. The evolution of a mature subduction zone from a structure similar to that of the Macquarie Ridge complex could then be as depicted in Figure 1. This suggests that in the case of an incipient plate-plate subduction zone, that plate on the opposite side of the trench to morphological ridge will be subducted. It would follow then that, for example, the Emerald Basin rocks will be subducted at the Macquarie Trench if the present structural regime continues for a long period.

The above model further suggests that sea-floor lavas are more likely to be found closer to the trench than island arc volcanics in continent building by orogeny and this may add a further criterion for ascertaining the polarity of fossil subduction zones.

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MOTION ALONG THE NEW ZEALAND ALPINE FAULT AND A MODEL FOR THE FORMATION OF THE SOUTHERN ALPS

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Analysis of marine geophysical data by Falconer, Geddes and Christoffel shows that the present position of the pole of rotation for motion between the Pacific and Indian Plates differs from the average pole for the past 10 million years.

The pattern of volcanic activity for the North Island and geochemical data for the Alpine Fault indicate that a more or less abrupt change occurred about 3 million years ago. A significant thrust component should now exist along the line of the Alpine Fault.

A model, assuming that the lithosphere beneath the Southern Alps deforms by plastic flow has been developed. It can account for the formation of the Southern Alps and appears to be compatible with current geological and geodynamic observations.

NEW ZEALAND 60 M.Y. AGO

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Rigid plate theory has been highly successful in explaining the origin of the oceans, but far less so in explaining the twisted rock belts of the continents. The New Zealand region is the smallest of the continents, and its rocks have a fairly simple twist, which is well mapped and has been termed a recurved arc. Can New Zealand be straightened out while keeping the ocean floor rigid? The following is a preliminary attempt.

The reconstruction is for 60 m.y. ago, and is based on oceanic magnetic anomaly 24 (A24), and the Stokes Magnetic Anomaly (SMA). A24 is now in two well separated parts: the central anomaly for the Tasman Sea; and to the south of Campbell Plateau. In the reconstruction it is assumed that the two parts were originally parallel, but not necessarily collinear, and that SMA had the form of a circular arc with unknown radius. It is further assumed that the length of SMA has been conserved. SMA is well defined within the New Zealand land area, and magnetic anomalies in the eastern part of the Campbell Plateau are assumed to represent its south-eastern off-shore extension. Within the New Zealand land area SMA is parallel to the belts of pre-upper Cretaceous rocks.

SMA is dextrally displaced by 500 km by the Alpine Fault, and is here assumed to be dextrally displaced by about 200 km by an inferred fault here named the AC Fault (Auckland Island – Chatham Island Fault). The recurved arc of New Zealand is defined by the bend in the anomaly, the bend increasing towards the Alpine Fault, and being in the direction expected for dextral drag.

Fig. 1 shows the present position of SMA, and its inferred position relative to the northern part of the New Zealand region 60 m.y. ago. The amount of rotation is about 75°, and the shiftpole is shown by a star. If the two parts of A24 had been collinear the shiftpole would lie on the bisector of the angle between the two parts of the anomaly. The difference is less than the errors of construction, and a collinear relation is probable.

In the reconstruction first the dextral displacement of SMA at the Alpine and AC faults was taken out; second the recurved arc was straightened. In Fig. 2 the parallel rock belts, and the 3 km bathymetric contour have been bent in conformity with the straightening. Also shown on Fig. 2 is the 60 m.y. coastline determined from the boundary between marine and freshwater strata; the position of the 100 m.y. old basic intrusives and volcanics; and the position of the