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PALEOTECTONIC ORIGINS OF THE BROOK STREET AND MURIHIKU TERRANES, NEW ZEALAND: EVIDENCE FROM GEOCHEMISTRY, PALEOMAGNETISM AND PALEOBIOLOGY

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The eastern half of the New Zealand continent is underlain by 10 terranes of Permian to Cretaceous age (fig. 1a & Bradshaw, 1989) that represent the arc, forearc, trench slope basin, and accretionary prism regimes of a complex convergent margin. In the past these have been interpreted as the autochthonous or parautochthonous products of plate convergence along the New Zealand segment of the Gondwana margin. During the last decade evidence from petrology, geochemistry and paleomagnetism has pointed to allochthonous origins, particularly for the Brook Street terrane. In contrast, studies of the flora and fauna of the Murihiku terrane which lies outboard of the Brook Street show to strong Gondwana links.

The early Paleozoic rocks that form the Gondwana crust of New Zealand are separated from the eastern group of terranes by a zone of Mesozoic plutonic rocks and two small terranes (Largs and Drumduan) of uncertain affinities, that make up what is best termed the "median tectonic zone" (fig. 1b). The Brook Street terrane lies immediately to the east and comprises an eastward younging, Lower and Middle Permian arc-flank sequence more than 10 km thick. The succession is mainly marine basaltic volcanic sediments with subsidiary flows. The Murihiku terrane is in tectonic (thrust) contact with the eastern margin of the Brook Street terrane and is composed of a similar thickness of Triassic and Jurassic volcanogenic sediments, with numerous vitric tuffs but no contemporaneous lavas. The sediments are predominantly marine with subsidiary non-marine intervals and minor unconformities, particularly towards the western (inboard) margin. The Murihiku terrane is interpreted as a forearc basin lying to the east of its parent arc.

Trace element and isotope geochemistry point strongly to a very primitive character for Brook Street magmas with almost direct derivation from the mantle. This, coupled with the absence of any continent derived detritus, suggests an intraoceanic arc setting (Frost & Coombs, 1990). Its current position adjacent to thick older continental crust is anomalous and suggest either truncation of the continental crust or significant tectonic telescoping or both. Paleomagnetic data suggest that the Brook Street rocks originated at a low to middle paleolatitude.

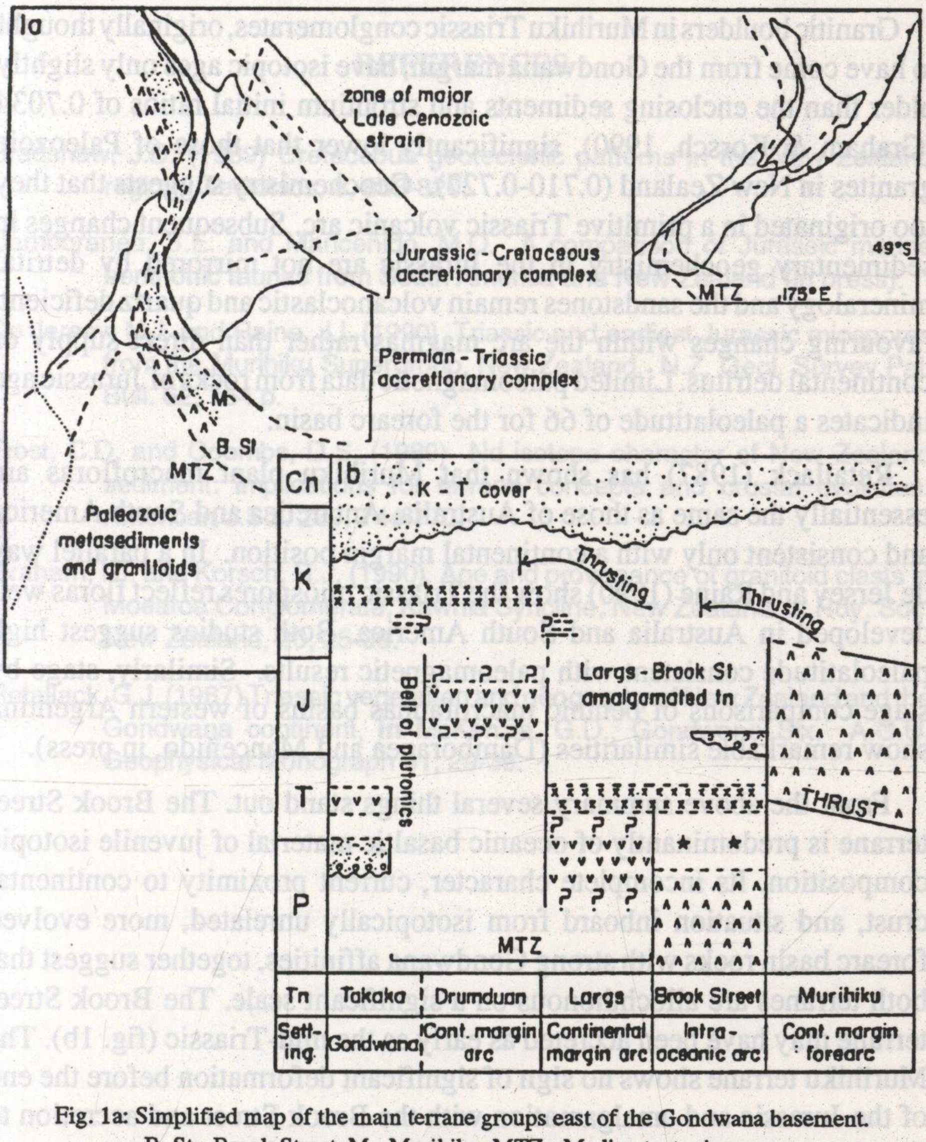

Fig. 1a: Simplified map of the main terrane groups east of the Gondwana basement. B. St= Brook Street, M= Murihiku, MTZ= Median tectonic zone.

Fig. 1b: Synoptic time-rock relationship diagram for terranes near the median tectonic zone. vvv, non-marine volcanics and volcanogenic sediments. ^^^, Marine volcanics and volcanogenic sediments. xxx, acid to intermediate plutonics. ≡≡≡, basic plutonics. ::::, siliciclastics.

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Clasts of characteristic Brook Street rocks and minerals do not occur in the Murihiku terrane and the abundance of tuffs indicate an active arc source rather than the extinct Brook Street arc. Isotope geochemistry is more diverse than in the Brook Street, showing primitive island arc patterns in the Early to Middle Triassic but strong continental influence in the late Triassic and Jurassic (Frost and Coombs, 1990).

Granitic boulders in Murihiku Triassic conglomerates, originally thought to have come from the Gondwana margin, have isotopic ages only slightly older than the enclosing sediments and strontium initial ratios of 0.7034 (Graham & Korsch, 1990), significantly lower that those of Paleozoic granites in New Zealand (0.710-0.727). Geochemistry suggests that they too originated in a primitive Triassic volcanic arc. Subsequent changes in sedimentary geochemistry in the Jurassic are not mirrored by detrital mineralogy and the sandstones remain volcanoclastic and quartz deficient, favouring changes within the arc magmas rather than direct supply of continental detritus. Limited paleomagnetic data from rocks of Jurassic age indicates a paleolatitude of 66 for the forearc basin.

Retallack (1987) has shown that Murihiku plant macrofloras are essentially the same as those of Australia, Antarctica and South America and consistent only with a continental margin position. In a parallel way de Jersey and Raine (1990) show the Triassic miospores reflect floras well developed in Australia and South America. Both studies suggest high paleolatitude consistent with paleomagnetic results. Similarly, stage by stage comparisons of benthic macrofaunas basins of western Argentina show remarkable similarities (Damboranea and Manceñido, in press).

From the above summary several things stand out. The Brook Street terrane is predominantly of oceanic basaltic material of juvenile isotopic composition. Its incomplete character, current proximity to continental crust, and situation inboard from isotopically unrelated, more evolved forearc basin rocks with strong Gondwana affinities, together suggest that both terranes are allochthonous on a significant scale. The Brook Street terrane may have been accreted as early as the mid-Triassic (fig. 1b). The Murihiku terrane shows no sign of significant deformation before the end of the Jurassic and amalgamation with the Brook Street and accretion to Gondwana probably took place in the Early Cretaceous.

A number of model can be generated to explain these events. They are constrained by the need to be consistent with the existence of other terranes outboard of the Murihiku, and should also relate in some way the large input of magmatic arc derived material into the epicontinental foreland basins of Antarctica and Australia.

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