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1984/40. A Palaeozoic suspect terrane in south-eastern Australia and Antarctica

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Abstract

A new tectonic interpretation of south-eastern Australia, Tasmania and North Victoria Land, Antarctica is given, in which a major N-S trending lineament is recognised separating essentially shallow-water shelf and continental deposits of latest Cambrian or Early Ordovician age from deeper-water Ordovician flysch deposits. Lateral offset of this lineament, which is interpreted as a major strike-slip fault, adequately explains the present distribution of major rock types in the three areas and also removes a number of problems previously encountered in correlation.

INTRODUCTION

A number of attempts have been made to correlate pre-Late Carboniferous folded sequences in Tasmania with similar sequences in south-east Australia and North Victoria Land, Antarctica (for summary see Cooper and Grindley, 1982; Crawford and Keays, 1978; Burrett and Findlay, 1983). Many different interpretations of the relationship of the rocks in these three areas have appeared in the literature, none of which fully explain the known geological characteristics of the region.

The following recent papers provide a summary of previous work in various parts of the region and give a background to the overall geology and major relationships; Cooper and Grindley, 1982; Crawford and Keays, 1978; Powell, 1983*a*, 1983*b*; Richards and Singleton, 1981; Tessensohn *et al*., 1981; Vandenberg, 1978; Webby *et al*., 1981; Williams, 1978.

A new interpretation is given here, in which a major N-S trending lineament is recognised separating essentially shallow-water shelf deposits of latest Cambrian or Early Ordovician age from deeper-water Ordovician flysch deposits. Lateral offset of this lineament along two major faults adequately explains the present distribution of major rock types in the three areas and also removes a number of problems previously encountered in correlation.

TASMANIA

In Tasmania the line of the River Tamar sharply differentiates two areas of contrasting rock sequences and structural style (Williams, 1978). In western Tasmania deposits ranging in age from ?Eocambrian to Early Devonian occur in zones between and within areas of Late Proterozoic rocks (Tyennan, Rocky Cape, Badger Head regions) (fig. 1). These regions acted as relatively competent blocks while the younger rocks were folded in a number of directions in Middle Devonian times (Williams, 1978).

The latest Cambrian and Ordovician sedimentary sequences of western Tasmania consist of a shallow-water siliciclastic sequence (Denison Subgroup) overlain by a peritidal carbonate sequence (Gordon Subgroup) which in turn is overlain by Silurian and Early Devonian shallow-water siliciclastic deposits of marine origin (Eldon Group and correlates). In its type area, the Denison Subgroup consists of a flysch sequence grading up into a shallow marine-deltaic-fluvial sequence, above which is a conglomerate-sandstone sequence probably deposited on alluvial fans, and an uppermost shallow-marine sequence of Early Ordovician age (Corbett, 1975;

Brown *et al.*, 1983). The Gordon Subgroup ranges in age from Early to Late Ordovician (Banks and Burrett, 1980) and is predominantly a peritidal carbonate sequence, although a deeper-water equivalent has been recognised at Surprise Bay on the south coast (Burrett *et al.*, 1983).

These sedimentary sequences are extensively deformed into flattened parallel folds. Deformation occurred before the accumulation of Givetian cavern deposits at Eugenana (Williams, 1978). As a result of this deformation, the main folds on the west bank of the River Tamar are of a north-westerly trend, resulting from a tectonic transportation from the north-east (Gee and Legge, 1974; Williams, 1978).

East of the River Tamar the pre-Carboniferous folded rocks are known as the Mathinna Beds and are quartzwacke-mudstone sequences of turbiditic origin (Williams, 1978). The age of the Mathinna Beds ranges from Early Ordovician in the west (Banks and Smith, 1968) to Early Devonian in the east (Rickards and Banks, 1979).

The Mathinna Beds were deformed at about the same time as the rocks in western Tasmania, with the main folds having a north-westerly trend, resulting from tectonic transport from the south-west (Williams, 1978).

There is no transition between the shallow-water shelf deposits of western Tasmania and the flysch deposits of north-eastern Tasmania. This abrupt change in sedimentary rock types and the contrast in tectonic transport directions across the River Tamar led to the postulation of a fracture zone along which lateral movements brought the contrasting regions into juxtaposition (Williams, 1978). This postulated movement zone was termed the Tamar Fracture System (TFS) (fig. 1).

Seismic refraction data (Richardson, 1980) indicates that the Tamar lineament is only the surface expression of a structure extending through the crust and the TFS is the site of zone of crustal thickening, suggesting that the TFS may represent a collision zone between crustal blocks.

A similar contrast in wide-scale distribution of rock-types can be recognised in south-eastern Australia and eastern Antarctica.

SOUTH-EASTERN AUSTRALIA

In western New South Wales the deposits of the Gnalta Shelf (fig. 1) consist of shallow-water siliciclastic conglomerate, sandstone, and siltstone, with minor limestone, ranging in age from latest Cambrian to Middle Ordovician (Webby *et al.*, 1981). The sediments were deposited in zones between Proterozoic basement areas. Rocks of the Lachlan Fold Belt (LFB) crop out some 300 km to the east. The nature of the contact between the two sequences is concealed beneath Devonian-Early Carboniferous sediments of the Cobar Basin (Webby, *in* Cooper and Grindley, 1982).

In western Victoria, the Grampians Trough (fig. 1) is considered to form the transition between the Kanmantoo (Late Proterozoic) and Lachlan Fold Belts (Vandenberg *et al.*, 1983). The sedimentary infill of the Grampians Trough overlies an undated rhyolite which in turn overlies the amphibolite-grade Glenelg Metamorphic Complex, probably correlative with the Kanmantoo Group (Vandenberg *et al.*, 1983). The boundary between the fold belts appears to be sharply marked by the Stawell Fault. Between the Stawell Fault and the richly fossiliferous Lower to Middle Ordovician rocks of the Bendigo Trough is an unfossiliferous turbidite succession of earliest Ordovician or Cambrian age (Vandenberg and Wilkinson, *in* Cooper and Grindley, 1982).

West of the Stawell Fault is a zone of structural complexity within which occur the Mt Ararat and Mt Stavely Greenstone Belts of probable Early Cambrian age (Vandenberg and Wilkinson, *in* Cooper and Grindley, 1982). The greenstones consist of meta-andesites and meta-dacites with intermediate and acid pyroclastic rocks, postulated to have been erupted on to thin continental crust (Crawford and Keays, 1978). These rocks are quite unlike the greenstones of the eastern Victorian Mt Wellington Greenstone Belt and the central Victorian Heathcote Greenstone Belt, which are interpreted as being disrupted ophiolites (Crawford and Keays, 1978).

ANTARCTICA

In North Victoria Land, Antarctica, the rocks show a similar E-W contrast. Shallow-water shelf deposits of Ordovician age occur in close juxtaposition to Ordovician flysch sequences. The Bowers Super-Group of this area ranges in age from Middle Cambrian to Early Ordovician, and the sediments are preserved in a fault-bounded strip 20-25 km wide (Bowers Trough) extending northwards from the Ross Sea for a distance of 350 km (Laird and Grindley, *in* Cooper and Grindley, 1982). At the top of the Bowers Super-Group, the Leap Year Group, of latest Cambrian to Ordovician age, consists mainly of fluvial siliciclastic conglomerate sequences and lies unconformably on older sequences (Laird and Grindley, *op.cit.)*. To the west of the Bowers Trough is Precambrian basement, the Wilson Group, which consists of metasediments cut by granitic bodies, sometimes grading into migmatites (Tessensohn *et al.*, 1981).

To the east of the Bowers Super-Group, and separated from it by the Leap Year Fault (Stump *et al.*, 1983), is the Robertson Bay Group which consists of simply-deformed quartzose and quartzo-feldspathic turbidite units (Tessensohn *et al.*, 1981). Recently discovered microfossils indicate that the Robertson Bay Group may be at least in part of Ordovician age (Burrett and Findlay, 1983), similar to the Ordovician flysch of the LFB and north-eastern Tasmania.

RECONSTRUCTION

The contrast in rock types that was originally recognised between the rocks lying to the west and to the east of the River Tamar in Tasmania can now be recognised over a significant part of Gondwanaland. Using a recent reconstruction of the south-west Pacific sector of Gondwanaland (Grindley and Davey, 1982) (fig. 1), movement along two postulated faults brings an alignment of western areas consisting of Precambrian/Cambrian basement with shallow-water Ordovician rocks separated from eastern areas of Ordovician turbidite sequences with no Precambrian basement (fig. 2). These postulated faults were to have marked geological significance in much later geological times. The more northerly of the faults was the line of weakness upon which the Otway, Bass, and Gippsland Basins initially developed during the Jurassic. The more southerly of the two was a line of weakness along which separation of part of the Antarctic and Australian plates occurred during the final break-up of Gondwanaland.

The reconstruction brings into alignment granitoids dated as Ordovician in western Victoria (443-484 Ma; Richards and Singleton, 1982) with the Tasmanian Mersey River Granite (469-487 Ma) which has a similar cooling history (Richards and Singleton, 1982) and the Granite Harbour Intrusives(467-490 Ma; Kreuzer *et al.*, 1981) which intrudes the Wilson Group in North Victoria Land. It should be stressed that granites which are dated as Ordovician are unknown from east of the N-S lineament described in this paper.

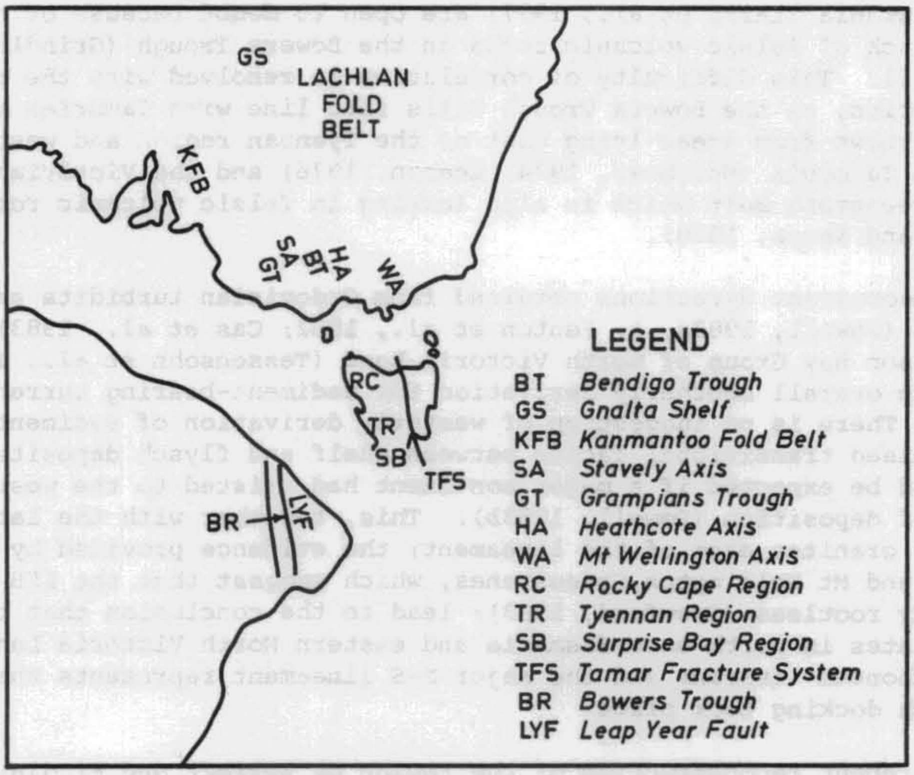

Figure 1. *Cretaceous reconstruction adapted from Grindley and Davey (1982) showing structural elements mentioned in text.*

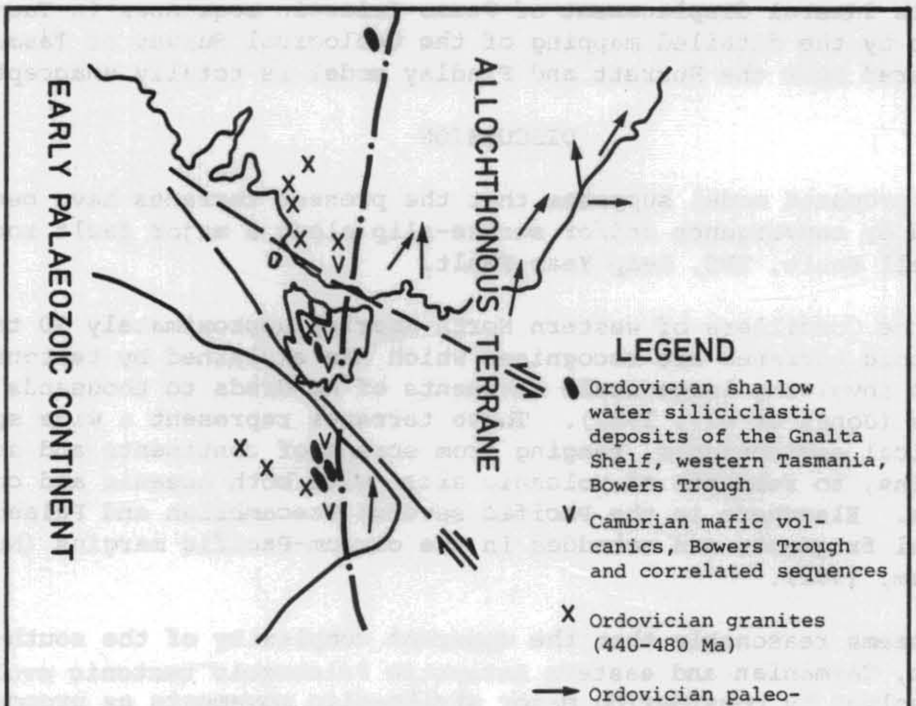

Figure 2. *Reconstruction at time of docking, showing position of faults, along which movements give configuration of Figure 1.*

Previous correlations of the Bowers Trough with the Dundas Trough of western Tasmania (Laird *et al.*, 1977) are open to doubt because of the relative lack of felsic volcanic rocks in the Bowers Trough (Grindley and Davey, 1982). This difficulty of correlation is resolved with the proposed reconstruction, as the Bowers Trough falls into line with Cambrian mafic volcanics known from areas lying east of the Tyennan region and west of the TFS in Tasmania (Matthews, 1974; Leaman, 1976) and the Victorian Mt Stavely Greenstone Belt which is also lacking in felsic volcanic rocks (Crawford and Keays, 1978).

Palaeocurrent directions obtained from Ordovician turbidite sequences of the LFB (Powell, 1983*a*, *b*; Fenton *et al.*, 1982; Cas *et al.*, 1983) and the Robertson Bay Group of North Victoria Land (Tessensohn *et al.*, 1981) indicate an overall southerly derivation for sediment-bearing currents (fig. 2). There is no suggestion of westerly derivation of sediments, nor any recognised transitional facies between shelf and flysch deposits, which would be expected if a major continent had existed to the west during the time of deposition (Powell, 1983*b*). This, together with the lack of Ordovician granites east of the lineament; the evidence provided by the Heathcote and Mt Wellington Greenstones, which suggest that the LFB is essentially rootless (Crawford, 1983); lead to the conclusion that the LFB and correlates in north-east Tasmania and eastern North Victoria Land is an allochthonous terrane and the major N-S lineament represents the line along which docking took place.

The recent reconstruction of the region by Burrett and Findlay (1983) places north-eastern Tasmania in juxtaposition with shallow and deeper water Ordovician clastic carbonate sequences of the Surprise Bay area of south-western Tasmania. As no detrital carbonate is known within the Mathinna Beds it is considered that this fit is most unlikely. Furthermore the Burrett and Findlay model proposes that strike-slip movement along the TFS , and its extension into Victoria, took place in the Cretaceous. As no large-scale lateral displacement of Permo-Triassic sequences in Tasmania has been shown by the detailed mapping of the Geological Survey of Tasmania, it is considered that the Burrett and Findlay model is totally unacceptable.

DISCUSSION

The proposed model supposes that the present terranes have been juxtaposed by convergence and/or strike-slip along a major fault zone, *i.e.* Stawell Fault, TFS, Leap Year Fault.

In the Cordillera of western North America approximately 50 tectono-stratigraphic terranes are recognised which are explained by tectonic juxtaposition involving large-scale movements of hundreds to thousands of kilometres (Jones *et al.*, 1982). These terranes represent a wide spectrum of geological environments, ranging from scraps of continents and scraps of ocean basins, to remnants of volcanic arcs with both oceanic and continental affinities. Elsewhere in the Pacific several Precambrian and Palaeozoic continental fragments are embedded in the circum-Pacific margins (Nur and Ben-Avraham, 1982).

It seems reasonable that the apparent complexity of the south-eastern Australian, Tasmanian and eastern Antarctic Palaeozoic tectonic evolution may be resolved by considering major strike-slip movements as proposed in this paper.

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