Latest Permian emplacement of the Marlborough Block duplex: the major mountain-building phase of the Hunter-Bowen Orogeny in the northern NEFB

T.Harbort, R.J. Holcombe, P.Vasconcelos & C.R.Fielding

The University of Queensland

The Hunter-Bowen Orogeny of the northern New England Fold Belt in Queensland is now fairly well understood to have been produced by westwardly propagating fold-thrust belts that initiated at the eastern margin of the continent at about the beginning of the Late Permian (~270 Ma) and persisted episodically until about the end of the Middle Triassic (~235 Ma). Although, locally, syntectonic sediments accumulated in front of, and were subsequently incorporated into, the westwardly-stepping fold-thrust fronts (Fielding *et al*., 1997) it wasn't until the latest Permian that a major foreland basin system developed to the west of the then active orogenic belt A thick terrestrial sequence then accumulated through the Early and Middle Triassic (Fielding *et al*., 2000).

Toward the end of the Late Permian the active front of the thin-skinned fold-thrust belts was at least as far west as the Gogango-Overfolded Zone(GOZ)/Connors Arch which was the focus of crustal thickening by thrust duplication (Fergusson, 1991) to that point. Subsequent to development of the first wave of fold-thrust belts, a substantial crustal thickening occurred to the east of the GOZ by an out-of-sequence thrust duplex forming the Marlborough Block (Fig. 1). The horses of the Marlborough duplex are themselves remnants of at least two cycles of earlier, thrust duplicated, slices from progressively shallower crustal sources. Strongly ductile amphibolite-facies shear zones separate sheets of metagranite/metasedimentary schist from an ophiolitic suite. A further set of greenschist facies ductile shear zones emplaces this higher grade sandwich against lower grade metasedimentary rocks of the accretionary complex. Final semi-brittle emplacement of the Marlborough Block has produced at least two tilted duplex horses separated by brittle thrusts and a brittle floor thrust. Erosion has removed the full extent of this complex as well as any overlying rocks. The wider occurrence of magnesite as lag deposits on exhumed Tertiary erosion surfaces suggest that the influence of weathering of ultramafic rocks extended at least 30-50 Km southwest of the

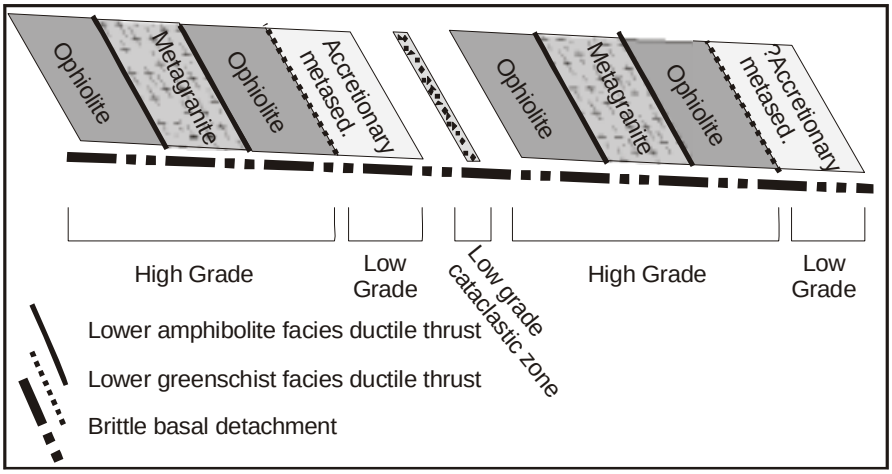

Fig.1 Schematic E-W cross-section of the Marlborough Block showing the cyclic arrangement of internal thrust sheets. The ophiolitic component is Neoproterozoic MORB cratonised during earlier (Delamerian?) orogenesis

current western margin of the Marlborough Block.

The mechanics of emplacing a thin (1-3 km) Marlborough Block as a thrust nappe sheet over a basal surface of 80-100 Km extent are problematical. We believe that a simple solution is if the Marlborough Block represents the basal duplex detachment zone below a more substantial major nappe sheet (Fig. 3) similar to the small-scale duplexed detachment shown as the cover photograph of the March, 1998, issue of *Geology*.

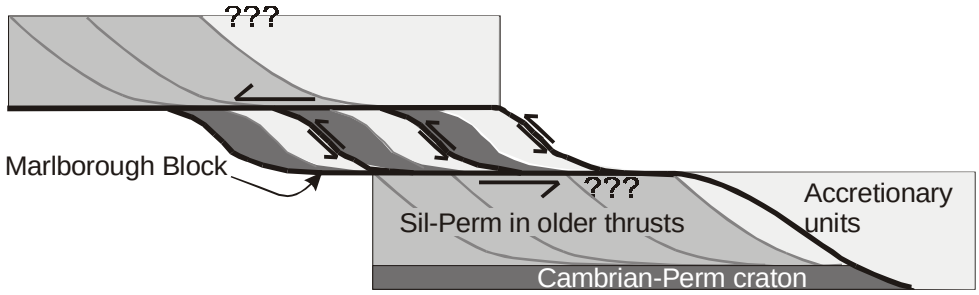

Fig. 2: Marlborough Block modelled as a thin basal detachment zone consisting of duplexed slices of craton and accretionary elements on which an overlying nappe was transported westwards.

The duplication of crustal section in such a structure would produce a major NEFB mountain structure and is reminiscent of plateau-building phases in the Andes foreland that also involve superimposed thrust duplication.

The timing of final emplacement of the Marlborough duplex is provided by the age of Late Permian sediments in the underlying imbricate thrust stacks, and by the age of intrusive rocks that either are cut by the basal detachment or pierce both the detachment and the internal thrusts. Twenty previously published K/Ar ages and three Rb/Sr ages have been supplemented by twenty two new $^{40}Ar/^{39}Ar$ step-heating data. These data constrain emplacement of the Marlborough Block to be ~253 Ma, that is, latest Permian and that emplacement of the duplex nappe sheet, and intrusion by a substantial granitic complex, occurred over an interval of less than 8 my.

The timing of emplacement of the Marlborough Block coincides with the rapid foreland loading of the Bowen Basin at the end of the Permian. We believe this event was triggered by the development of a substantial mountain system along what is now the coastal section of Queensland. Although the Marlborough Block is the only place where a major allochthonous sheet has been recognised, the odd juxtaposition of other terranes in the northern NEFB may also reflect large scale allochthoneity, driven by the same event.

References

Fergusson C.L. 1991. Thin-skinned thrusting in the northern New England Orogen, central Queensland, Australia. *Tectonics* **10**, 797-806.

Fielding, C.R., Stephens, C.J., and Holcombe, R.J., (1997). Submarine mass-wasting deposits as an indicator of the onset of foreland thrust loading - Late Permian Bowen Basin, Queensland, Australia. *Terra Nova,* **9**, 14-18.

Fielding, C.R., Sliwa R., Holcombe, R.J., and Kassan, J. (2000). A new palaeogeographic synthesis of the Bowen Basin of Central Queensland. Bowen Basin Symposium.