[PS]Rhyolitic Pumice Provides a Chronology for Sedimentation and Deformation in Whanganui Basin, New Zealand*

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Abstract

Whanganui Basin contains up to 5km of Pliocene to Recent sediment including rhyolitic pumice layers from central North Island preserved within one of the most complete Quaternary stratigraphic records in the world. These pumice beds provide valuable chronological marker horizons within the basin which overlies the eastern and western parts, respectively, of the Paleogene to middle Neogene Taranaki and East Coast basins. Both primary airfall pumice (tephra) and pumice reworked by fluvial and marine processes are present. Tephrostratigraphy and bio-facies have been used to establish a high resolution chronostratigraphy and paleoenvironmental reconstruction of the sedimentary succession in the basin. This approach has been particularly valuable in constraining the timing of syn- and post-depositional deformation in the Whanganui Basin.

Faulting and associated folding along the Wellington-Mohaka Fault, Ruahine Fault, and unexposed active faults farther west are uplifting the axial ranges forming piercement structures as deformed Mesozoic basement is elevated and stripped of its late Neogene coverbeds. This tectonism is part of the deformation associated with crustal shortening along the present day North Island subduction margin. Pumice units present in the coverbeds provide chronostratigraphic horizons that constrain the timing of uplift in the main axial range and formation of other actively deforming anticlinal structures, such as Pohangina Anticline, identified farther west. The presence of the rhyolitic pumice also provides a chronological framework for paleoenvironmental reconstruction using sedimentary and bio- facies preserved in the coverbeds.

The thickest succession, which lies offshore, has not been drilled. Onshore, four exploration wells drilled in the Whanganui – Manawatu region between 1942 and 1964, encountered basement at 2400m or less. Each of these wells was located on one of a number of growing folds in the area. A study by Melhuish et al. (1996) suggested folding associated with these anticlines had been going on for at least 3My. However, tephrostratigraphy farther east in the southern Ruahine Range suggests that this area was experiencing estuarine and shallow marine conditions 1My ago and that piercement of the greywacke has occurred largely since this time. Prior to the uplift of the ranges the Whanganui Basin

extended well to the east of the present Ruahine Range. The uplift of the ranges, due to this faulting and associated folding, is gradually dissecting the basin cutting the central part of the basin off from its eastern counterpart.

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Abstract

Whanganui Basin (Fig. 1) contains up to 5km of Pliocene to Recent sediment including rhyolitic pumice layers from central North Island (CNI) preserved within one of the most complete Quaternary stratigraphic records in the world. These pumice beds provide valuable basin wide chronological marker horizons within the Whanganui Basin which overlies the eastern and western parts, respectively, of the Paleogene to middle Neogene Taranaki (TB) and East Coast (EC) basins. Both primary airfall pumice (tephra) and pumice reworked by fluvial and marine processes are present.

Tephrostratigraphy and bio-facies have been used to establish a high resolution chronostratigraphy which when integrated with paleoenvironmental interpretation provides valuable constraints on the timing of syn- and post-depositional deformation in the Whanganui Basin.

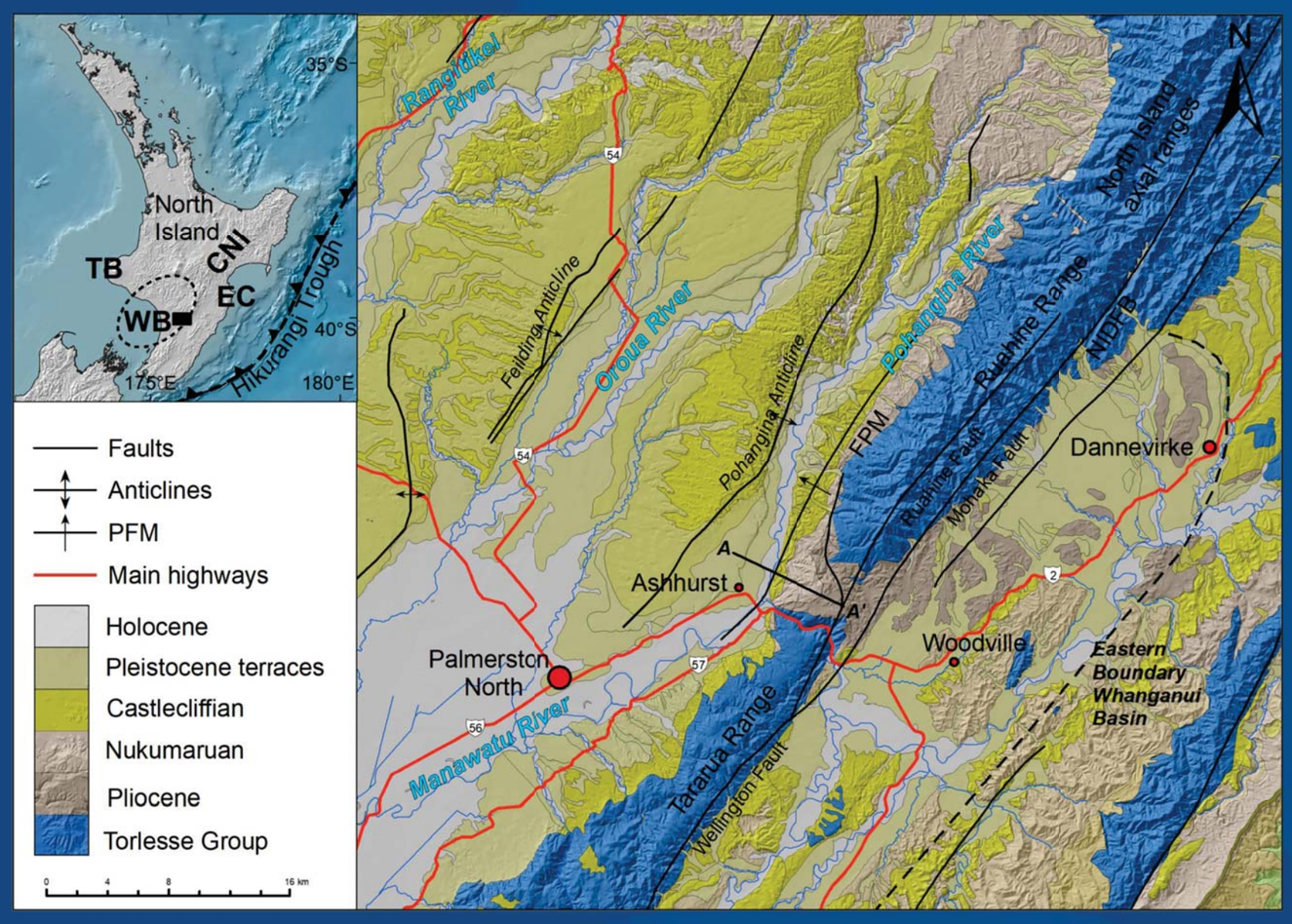

Fig. 1 Map of Whanganui Basin (WB) showing regional tectonic features including North Island Dextral Fold Belt (NIDFB) and Faulted Pohangina Monocline (FPM) (from Rees, 2015; Data sourced from GNS Science, NIWA and LINZ).

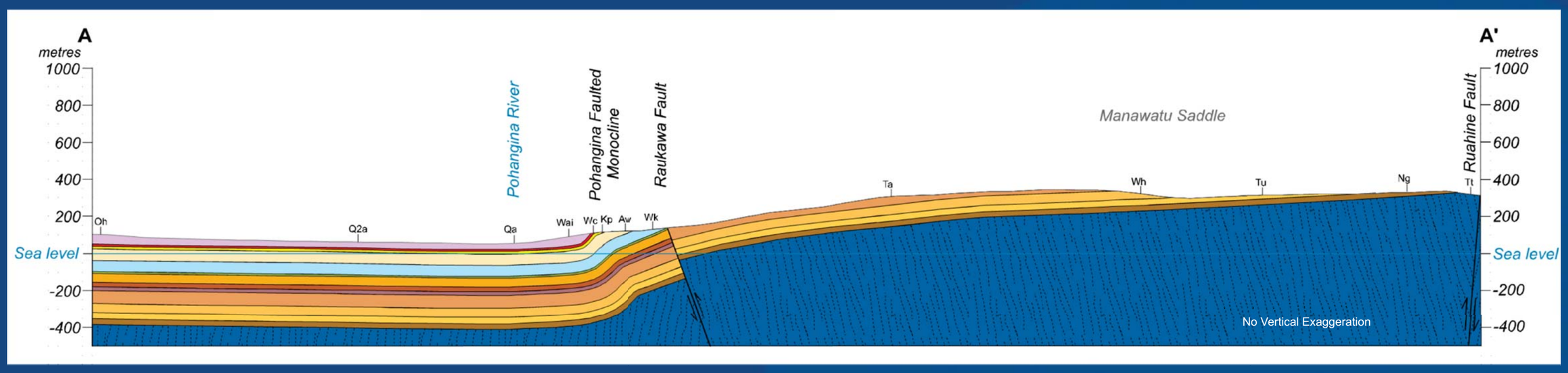

Fig. 2 Cross section A to A' across Manawatu Saddle. Uplift along the North Island Dextral Fault Belt has tilted the Pliocene-Pleistocene to the west. Faulting and associated folding along the Wellington-Mohaka Fault, Ruahine Fault and unexposed active faults farther west are uplifting the axial ranges forming piercement structures as deformed Mesozoic basement is elevated and stripped of its late Neogene coverbeds This tectonism is part of the deformation associated with crustal shortening along the present day North Island subduction margin.

The thickest Whanganui Basin succession, offshore, has not been drilled. Four onshore exploration wells, drilled between 1942 and 1964, encountered basement at 2400m or less. Each of these wells was located on one of a number of growing folds in the area. A study by Melhuish et al. (1996) suggested folding associated with these anticlines had been going on for at least 3My. However, tephrostratigraphy farther east in the southern Ruahine Range suggests that this area was experiencing estuarine and shallow marine conditions 1My ago (Fig. 3) and that piercement of the greywacke has occurred largely since this time. Prior to the uplift of the ranges the Whanganui Basin extended well to the east of the present North Island Axial Range (Fig. 1).

Whanganui Basin is gradually breaking up due to active and very rapid deformation. Uplift of the ranges, in response to faulting and associated folding, is gradually dissecting the basin cutting the central part off from its eastern counterpart.

Tephrochronology constrains the timing of this deformation while also enabling correlation of the Pohangina Valley succession to the well documented Whanganui cyclothem record exposed farther west (Fig. 3).

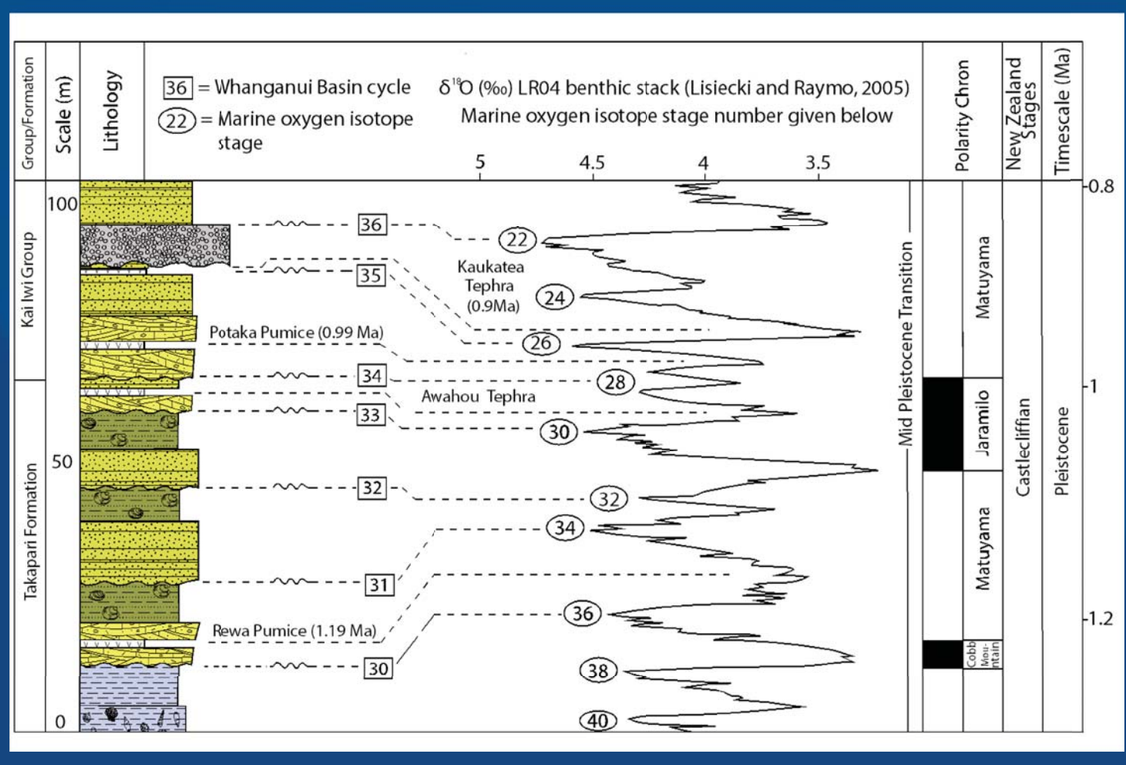

Fig. 3. The presence of Austrovenus stutchburyi in estuarine and shallow marine sediments between the Rewa (1.19Ma) and Potaka (0.99Ma) pumice beds at the foot of the axial ranges, 100+m above present sea level, means this area has undergone some 100m uplift in the last million years. Westward dipping older Pleistocene marine sediments crop out over the axial ranges, which reach up to 350m above present sea level, in this region.

References

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