Zealandia

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SUMMARY

Zealandia is a mainly submerged continental block, one third the size of Australia. Before 85-55 Ma Tasman Sea spreading, orogenic trends in Queensland, New South Wales, Victoria and Tasmania continued along what is now the Lord Howe Rise towards their counterparts in New Zealand.

Geologically credible comparisons between selected trans-Tasman and SW Pacific geological provinces and units, especially those that contain significant mineralisation in Australia, can help provide a useful exploration framework for New Zealand.

Additional geological events that have affected Zealandia's regional mineral prospectivity include more widespread 125-85 Ma magmatism and extensional exhumation, superposition of Neogene volcanic arcs in the North Island, and localised Neogene exhumation in the South Island.

Key words: New Zealand, Zealandia, Australia, regional geology, mineral prospectivity.

INTRODUCTION

The large distances, and disparate sizes, between the vast landmass of Australia and the small islands of New Zealand do not, at first glance, suggest that they have much in common geologically. Australia contains some of the oldest rocks on Earth and was a key part of the ancient supercontinent of Gondwanaland. The numerous orogenic belts and intracratonic sedimentary basins, combined with relative tectonic quiescence in the past 100 Ma have resulted in a country in which minerals and coal play a large part in the economy. In contrast, New Zealand, with its active volcanism and earthquakes, is a typical Pacific Rim country in which public awareness, and earth science employment, is typically focussed more on geological hazards than on geological resources.

GNS Science recently began a six-year research programme called Mineral Wealth of NZ and its EEZ (MWE). The aim of one of the objectives in the MWE programme is to improve New Zealand's attractiveness to overseas mineral exploration companies by (1) drawing attention to the fact that New Zealand basement rocks are continuations of the mineralised orogenic belts of eastern Australia and (2) providing credible geological correlations between specific rock units in both countries, particularly those in prospective areas in eastern Australia.

The purpose of this short paper is to outline the presently understood geological framework of the New Zealand-Australia-New Caledonia region in both a Gondwanaland and Pacific rim context. The existence of the largely submerged, continental mass of Zealandia is emphasised. Results from the targeted research work will be of direct relevance to mineral prospectivity, will be presented in the coming years.

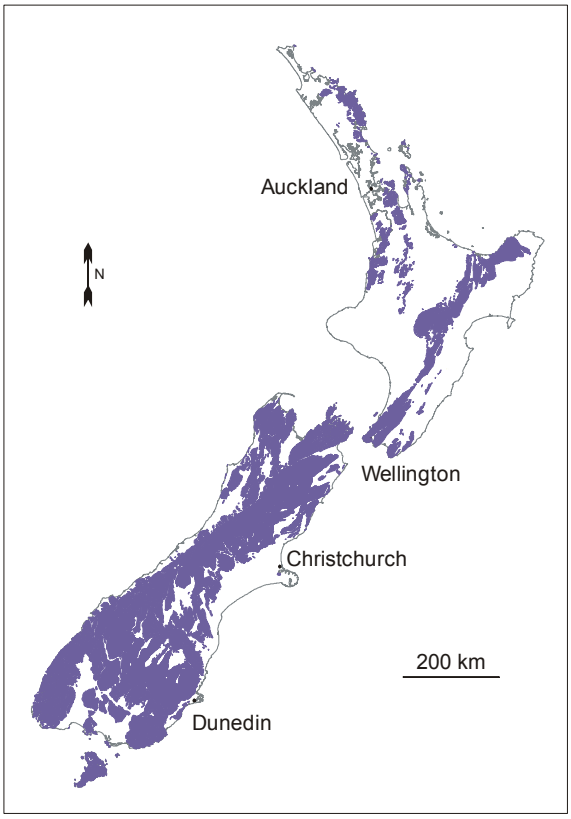

Figure 1. Area of outcrop of the crystalline basement rocks of onland New Zealand (purple).

ONLAND NEW ZEALAND

About half of New Zealand's rock outcrop consists of Cambrian-Cretaceous basement rocks (Figure 1). No Precambrian rocks are known but, like Australia, New Zealand has a rich Phanerozoic igneous, stratigraphic and tectono-metamorphic record of the growth and deformation of Gondwanaland's active southern margin. The Cambrian to Early Cretaceous basement rocks consist of at least nine major

volcano-sedimentary terranes, three composite regional batholiths, and three regional metamorphic-tectonic belts that overprint the terranes and batholiths (Mortimer, 2004).

ZEALANDIA

The continental shelf edge of greater New Zealand lies close to the 2000 m isobath. Basement schists, greywackes and granitoids are exposed on scattered islands and have been sparsely sampled in dredges on the Campbell Plateau, Chatham Rise, Challenger Plateau, Lord Howe Rise, Dampier Ridge and Norfolk Ridge. The term Zealandia is used to describe this mainly submerged continental mass, whose area is about one third that of Australia (Figure 2).

Zealandia is a rifted piece of Gondwanaland that, before 85-55 Ma sea floor spreading, was contiguous with Australia and Antarctica. On a Late Cretaceous reconstruction (Figure 3), the New England and Lachlan Orogens strike along the Lord Howe Rise towards New Zealand and continue through into Marie Byrd Land.

Additional geological events that have affected onland New Zealand, but not onland eastern Australia, include more widespread 125-85 Ma magmatism and extensional exhumation, development of mesothermal-level Mesozoic accretionary prism terranes, superposition of epithermal-level Neogene volcanic arcs in the North Island (Figure 2), and localised Neogene exhumation in the South Island.

AUSTRALIA-NEW ZEALAND CORRELATIONS

There have, of course, been many papers dealing with general and specific Australia-New Zealand geological correlations in the past. General treatments include those by Griffiths (1971), Grindley and Davey (1982), Cawood (1984) and Sutherland (1999). This list is not comprehensive.

There are at least three reasons why it is timely to compare New Zealand and Australian geology again: (1) increased knowledge of seafloor geology resulting in better continental fits; (2) larger number of dredged rocks, recovered during the past 10 years, that can be used for interpolation; (3) better quality New Zealand geological datasets with which to make comparisons, particularly in regard to zircon dating and petrology.

Targeted studies

Initially, the focus of the MWE team is on the New England Orogen. Work in Queensland on the Permian and Triassic sequences of the Gympie Au province, and adjacent Paleozoic Yarrol, Shoalwater and Wandilla Terranes near Rockhampton, is well advanced. Sampling of the Cu-Mo-Au Cretaceous Whitsunday Volcanic Province (Bryan et al., 1997) has just been completed and results will be integrated with a broader assessment of the Queensland-New Zealand plutonic record.

The paleogeographic reconstruction of Figure 3 shows that, even with the Tasman Sea closed, New Zealand terranes are 1500 km distant along strike from their Australian counterparts. In this context, geological differences as well as similarities should reveal important first-order information about processes and geological events along the Paleozoic-Mesozoic Gondwana margin.

CONCLUSIONS

In terms of basement rocks types and belts, New Zealand is as geologically prospective for mineral deposits as eastern Australia. The additional Late Cretaceous-Neogene magmatic and exhumation events in New Zealand should be taken into account in regional exploration.

ACKNOWLEDGMENTS

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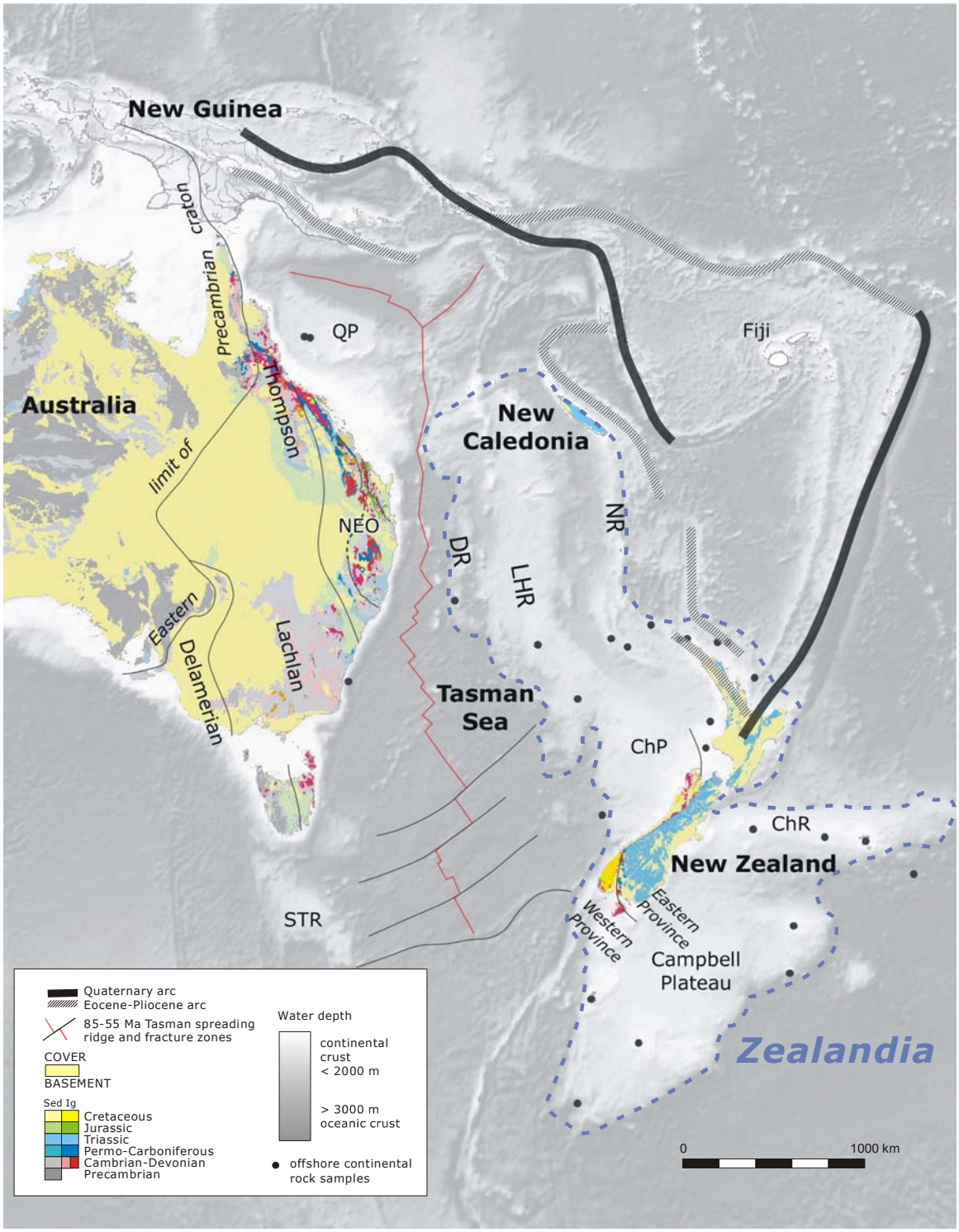

Figure 2. Geology and bathymetry of the Australia-New Zealand-New Caledonia area, including Tasman Sea spreading ridge and major fracture zones. The continental mass of Zealandia is emphasised. Bathymetry is from the dataset of Sandwell and Smith (1997); abyssal plains are dark grey, plateaux, ridges and rises are white. The onland geological legend is intentionally not defined at this scale. Black dots represent offshore island, dredge and drillcore sites at which continental basement samples have been sampled. QP=Queensland Plateau, LHR=Lord Howe Rise, NR=Norfolk Ridge, DR=Dampier Ridge, ChP=Challenger Plateau, ChR=Chatham Rise, STR=South Tasman Rise.

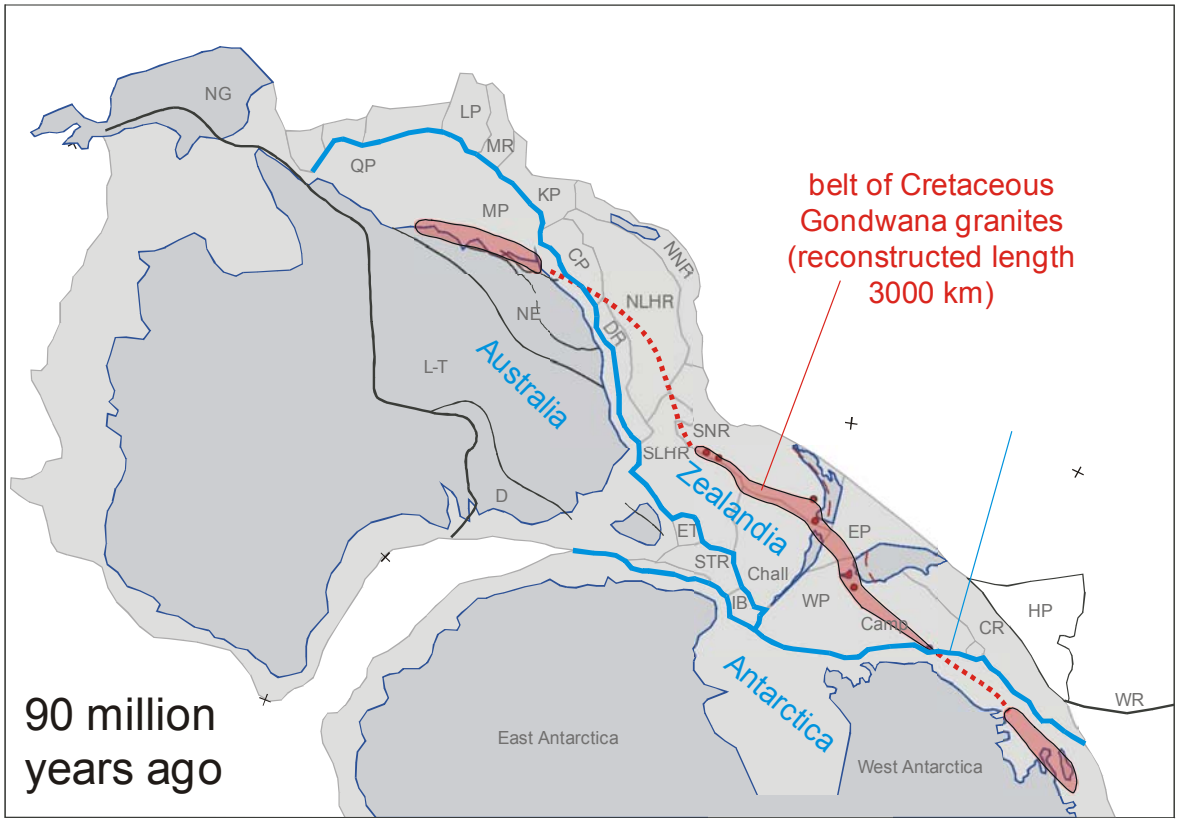

Figure 3. Figure 3. An "untightened" reconstruction of the continental blocks of Australia, Zealandia and Antarctica showing possible along-strike correlation between Median Batholith of New Zealand and Early Cretaceous Whitsunday Province of Queensland (Tulloch et al., 2005). Ocean basins have been closed but no attempt has been made to unstretch continental crust beneath Cretaceous sedimentary basins or beneath Cretaceous core complexes. Reconstruction is based on Gaina et al. (1998) and Sutherland (1999). Thick blue lines show the places where the major Tasman Sea and Southern Ocean oceanic crust spreading eventually took place, and circles are restored locations of offshore samples and islands. Geographic/bathymetric features: NG=New Guinea, QP=Queensland Plateau, MP=Marion Plateau, LP=Louisiade Plateau, MR=Mellish Rise, KP=Kenn Plateau, CP=Chesterfield Plateau, DR=Dampier Ridge, LHR=Lord Howe Rise (N & S), NR=Norfolk Ridge (N & S), ET=East Tasman Rise, STR=South Tasman Rise, Chall=Challenger Plateau, Camp=Campbell Plateau, CR=Chatham Rise, HP=Hikurangi Plateau, WR=Wishbone Ridge, Ant=Antarctica (W & E). Geological features: D=Delamerian Orogen, L-T=Lachlan-Thomson Orogen, NE=New England Orogen, EP=Eastern Province, WP=Western Province.