

Basin Screening for Seal-rock Quality, New Zealand Region*

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K. Jones¹ and R. Daniel²**

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Abstract

This study provides the first New Zealand-wide assessment of the hydrocarbon seal-rock potential of twenty sedimentary basins and is designed to help evaluate pre-drill seal-risk assessment. Seal-rock quality has been assessed using key petroleum wells and seismic lines. Deep-sea drilling research holes provide glimpses of the stratigraphy in some of the more distal basins. The Taranaki Basin is currently New Zealand's only producing basin — all others are frontier basins, and many have no or few exploration wells and rather sparse seismic coverage. We have produced maps of inferred seal-rock quality (extrapolated from selected wells) and rock property data such as XRD-derived mineralogy, mercury injection threshold pressure data, and open-file hydrocarbon column heights, as well as drillhole montages, example seismic line panels, and photographs of outcrop analogues. Our results are compiled into an ArcGIS project and Geodatabase, allowing multiple layers of data, such as paleogeography and licence blocks, to be interrogated. We infer good seal quality to be widespread in Cretaceous to Neogene rocks in most basins. Most sample data are from the Taranaki Basin and the relationship of membrane entry pressures to key parameters, such as maximum depth of burial and mineralogy, are complex, with few trends apparent, though depositional setting and hydrothermal alteration appear to be key parameters in some cases. There appears to be a straightforward relationship between entry pressures and stratigraphic age in the East Coast Basin, based on a limited sample set. For the Canterbury Basin existing data indicates membrane seal quality is likely to be a key risk.

Reference Cited

Field, B.D., D.P. Strogon, H.D. Zhu, T.R. Sahoo, A.G. Griffin, C. Martin, R. McDonnell, and K. Jones, 2014, An ArcGIS project on seal rocks of the New Zealand region, GNS Science Consultancy Report 2014/232. Ministry of Business, Innovation and Employment, Wellington, open file Petroleum Report 5040. 78 p.

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150 YEARS
of **SCIENCE**

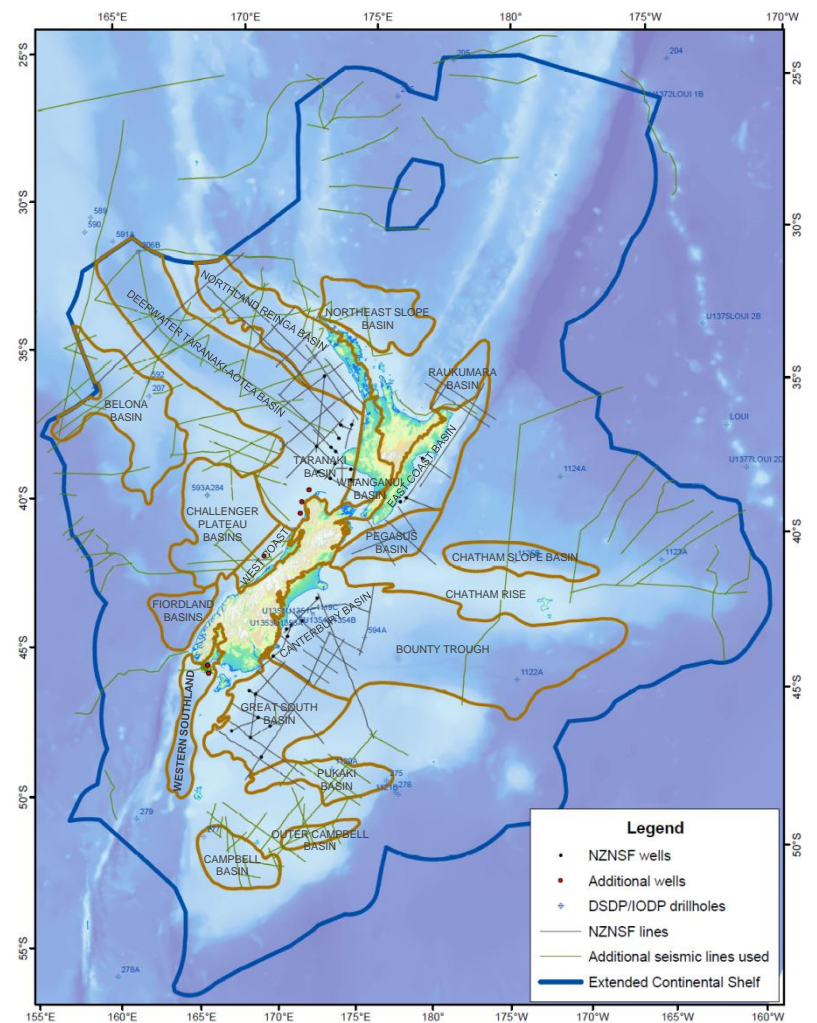
For a better New Zealand

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The DAP is managed by New Zealand Petroleum and Minerals (NZPM) division of the Ministry of Business, Innovation and Employment. The aim is to accelerate investment in petroleum exploration, particularly the country's untapped oil and gas resources and to increase the prosperity of New Zealanders.

Field, B.D., Strogen, D., Zhu, H., Sahoo, T., Griffin, A., Martin, C., McDonnell, R. and Jones, K., 2014. An ArcGIS project on seal rocks of the New Zealand region, GNS Science Consultancy Report 2014/232. Ministry of Business, Innovation and Employment, Wellington, open file [Petroleum Report 5040](#). 78 p. **Datapack**

- ECS (mostly)
- 20 “basins”
- mainly offshore
- reconnaissance
- NZNSF wells/lines (+)
- Arc GIS project



Components of study

Well data, log motifs

Outcrop analogue data

Tabulated rock property data

Seismic facies recognition

Paleogeographic maps

Traffic light (CRS) maps

Arc GIS project

(for reservoirs see APP studies)

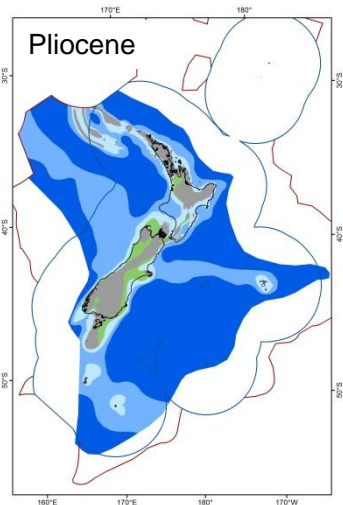
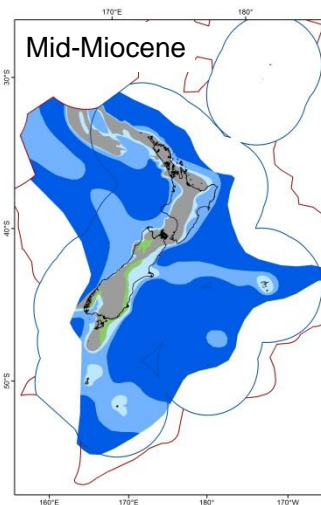
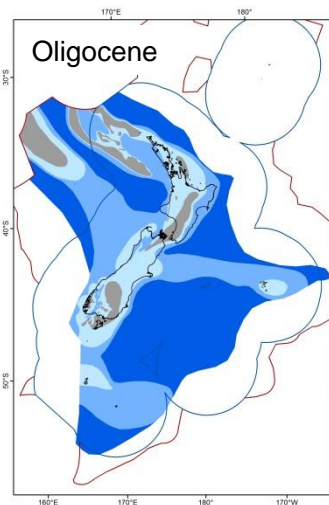
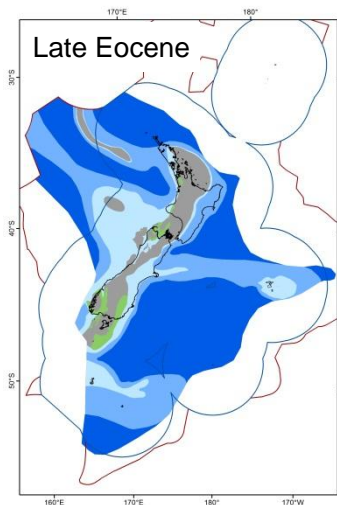
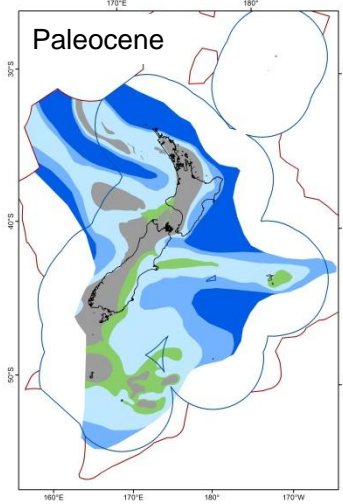
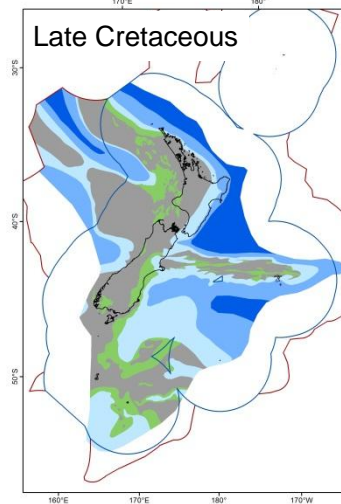
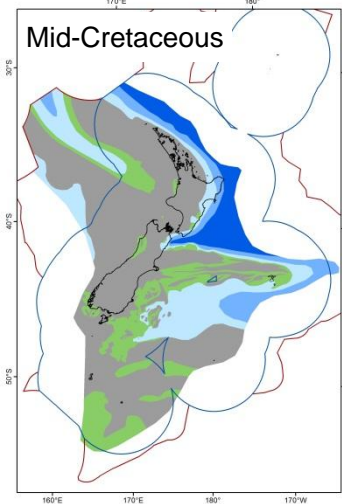
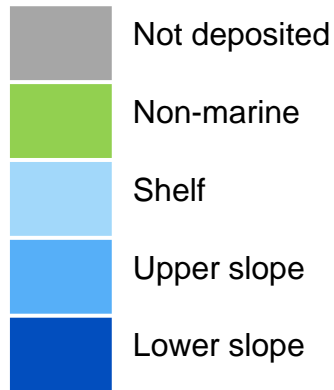
Rock property data – wells and outcrops

- Little good well material
- Outcrop analogues:
 - Burial histories?
 - Proximal?
 - + “Whole core”
 - + Multiple analyses
 - + Context



Paleogeographic maps

(present plate geometry)



Seismic facies mapping

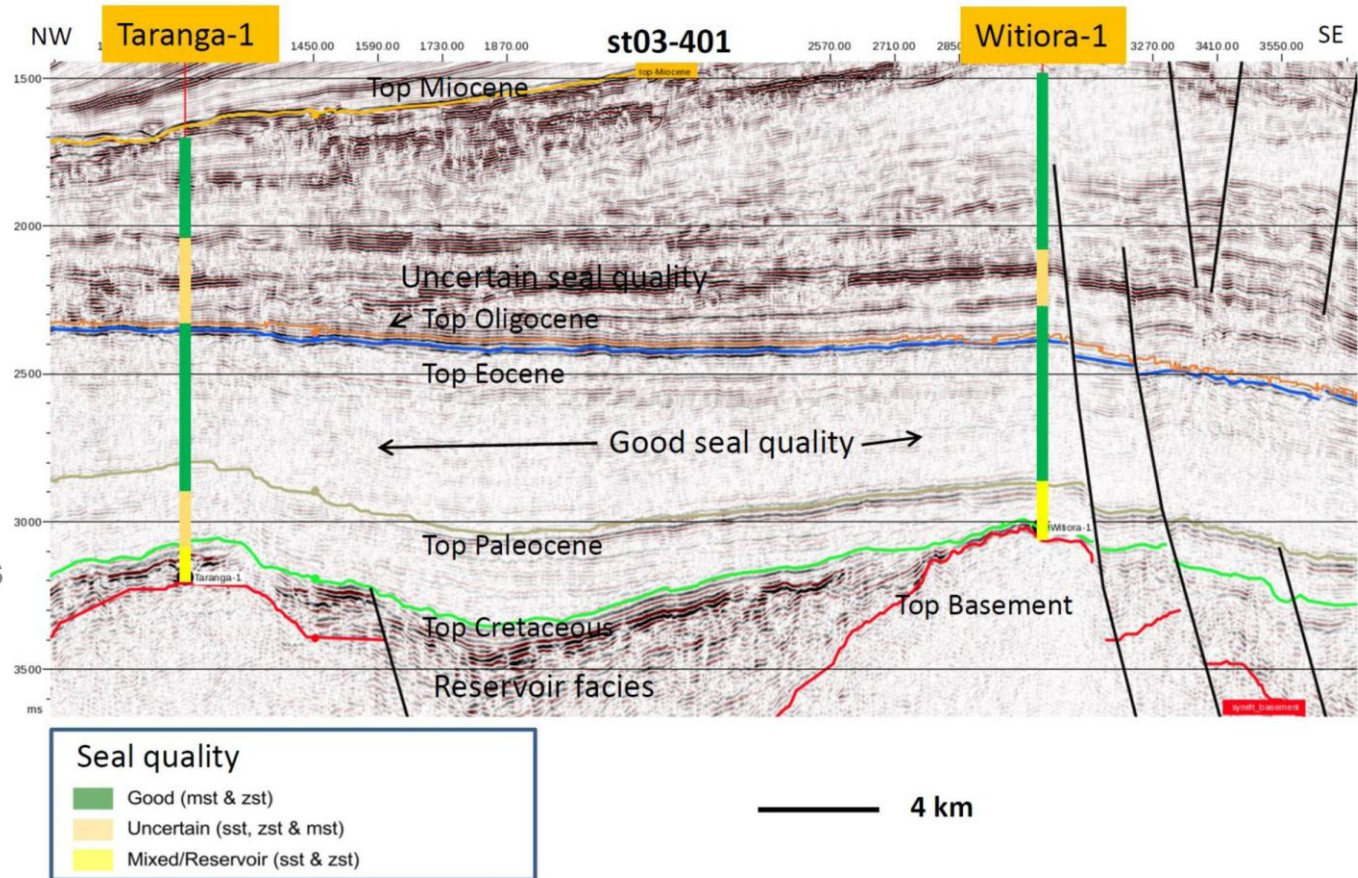
between wells



away from wells



no wells



Seismic facies → Common Risk Segment maps

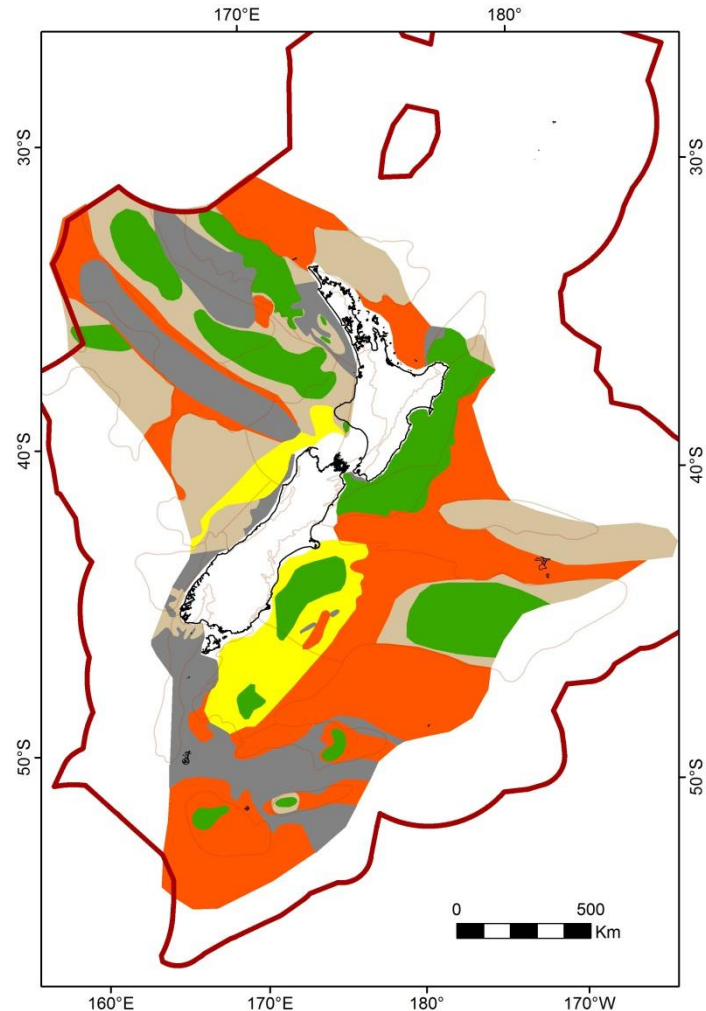
Good (Mst & Zst)	
Uncertain (Sst, Mst, Zst)	
Mixed/Reservoir (Sst, Zst)	
Present overburden < 1000 ms	
Non-deposition or erosion	

Pliocene
Miocene
Oligocene
Eocene
Paleocene
Cretaceous

Cretaceous

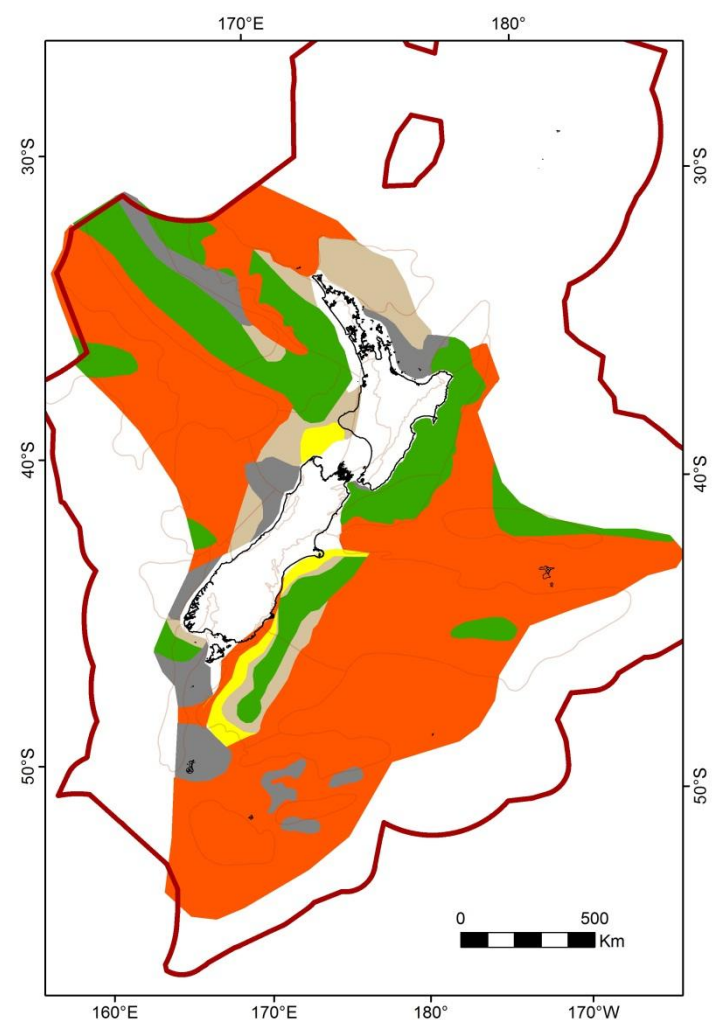
Large areas with:

- <1000 m overburden
- quality doubtful
- reservoir facies
- Good seal inferred in Reinga, Deepwater Taranaki-Aotea, Great South and Canterbury basins, Bounty Trough and Pegasus-East Coast-Raukumara basins.



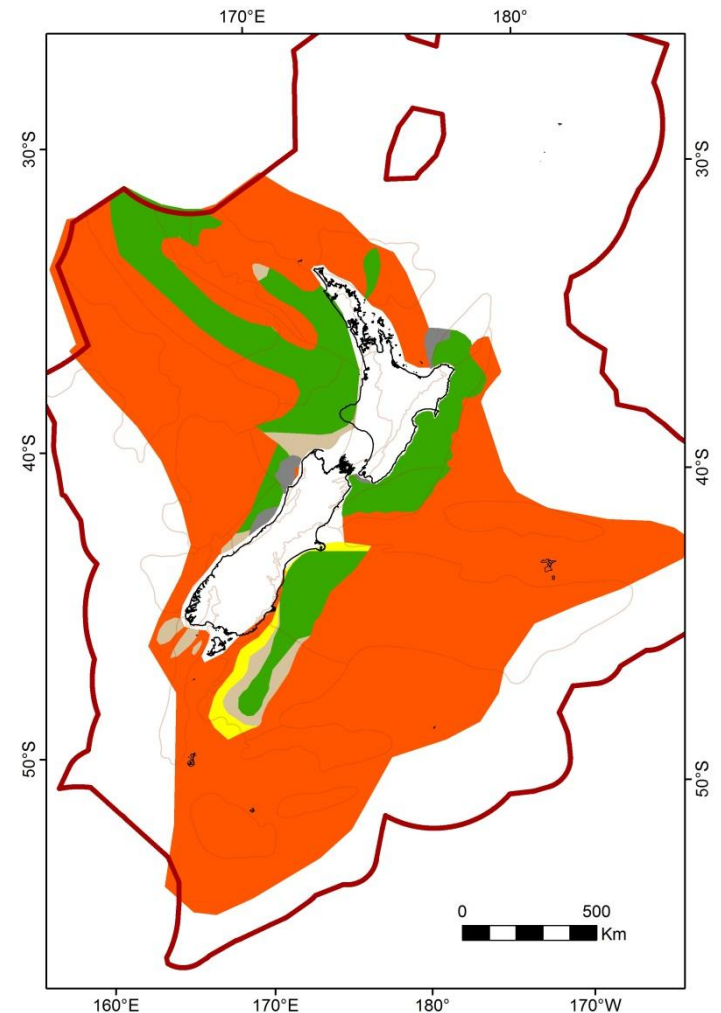
Paleocene

- Sediment cover <1000 m for most of the ECS;
- Good seal inferred for offshore Northland, Deepwater Taranaki-Aotea, Western Southland, Great South Basin, Canterbury and Pegasus-East Coast-Raukumara basins.



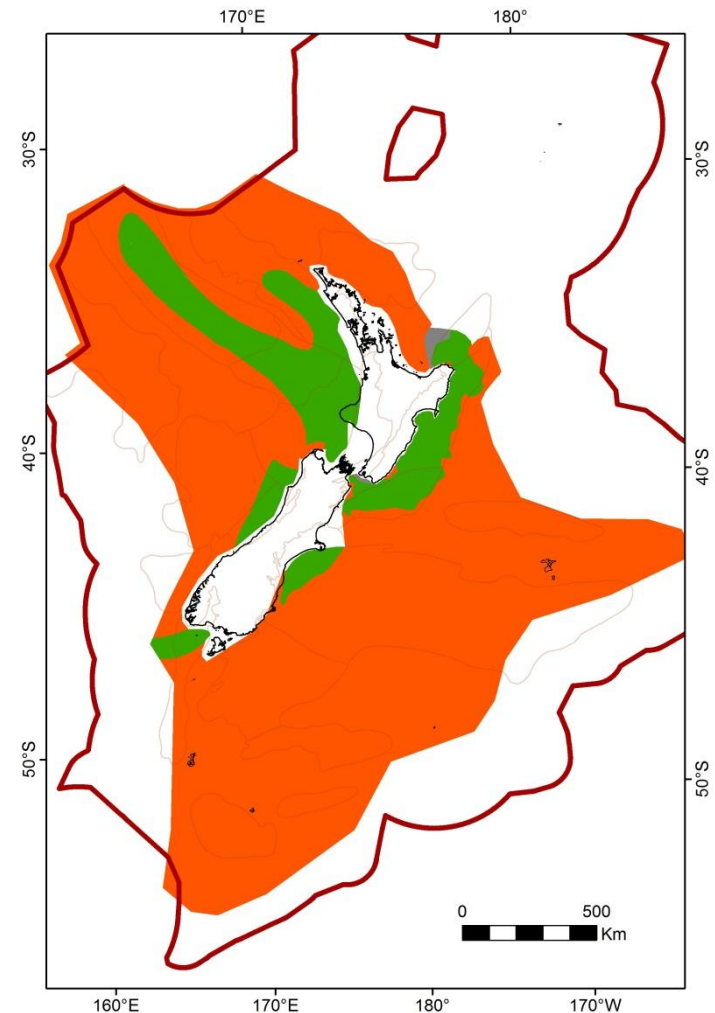
Eocene

- Decreased reservoir facies due to regional subsidence;
- Good seal quality inferred for northwestern basins (Turi Fm), West Coast, Canterbury and Pegasus-East Coast.



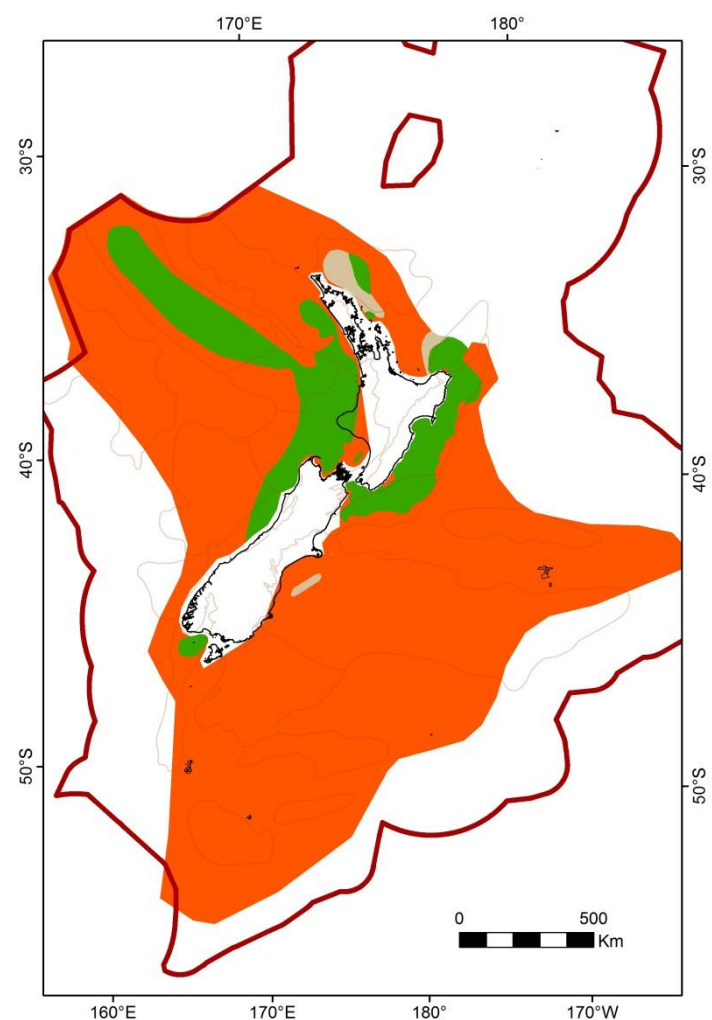
Oligocene

- Nearing maximum transgression, with good seal quality, but geographic extent limited by thin overburden/post-Oligocene successions;
- Generally marl and limestone.



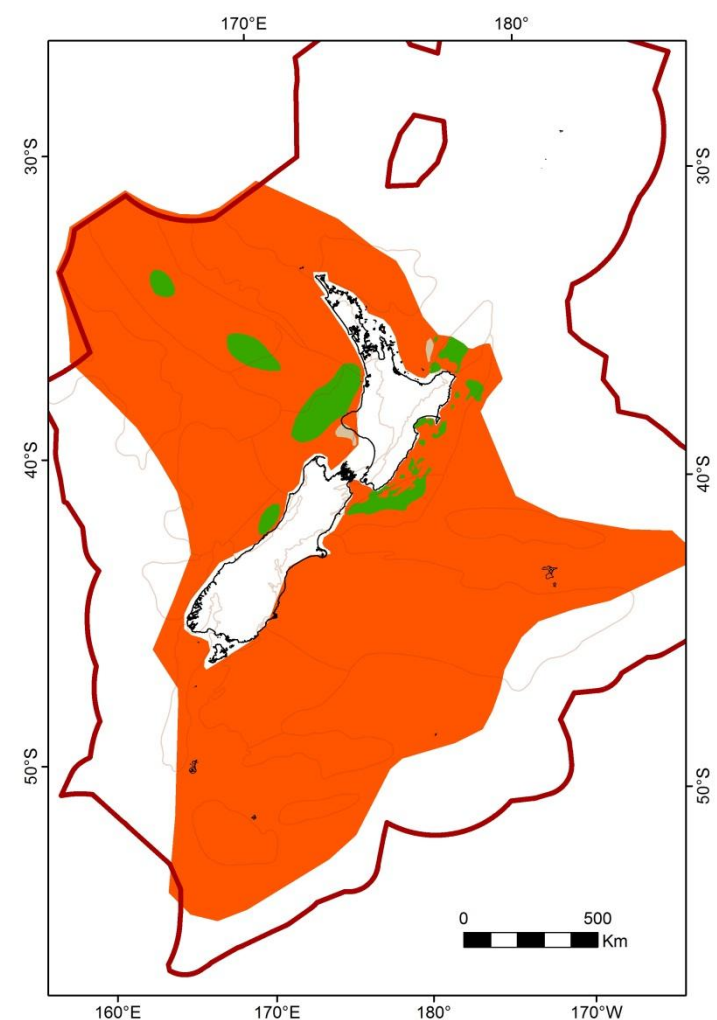
Miocene

- **Good reservoirs in Taranaki and East Coast basins, but also good seal present (generally mudstones).**
- **Sediment thickness cut-off increasingly restrictive.**

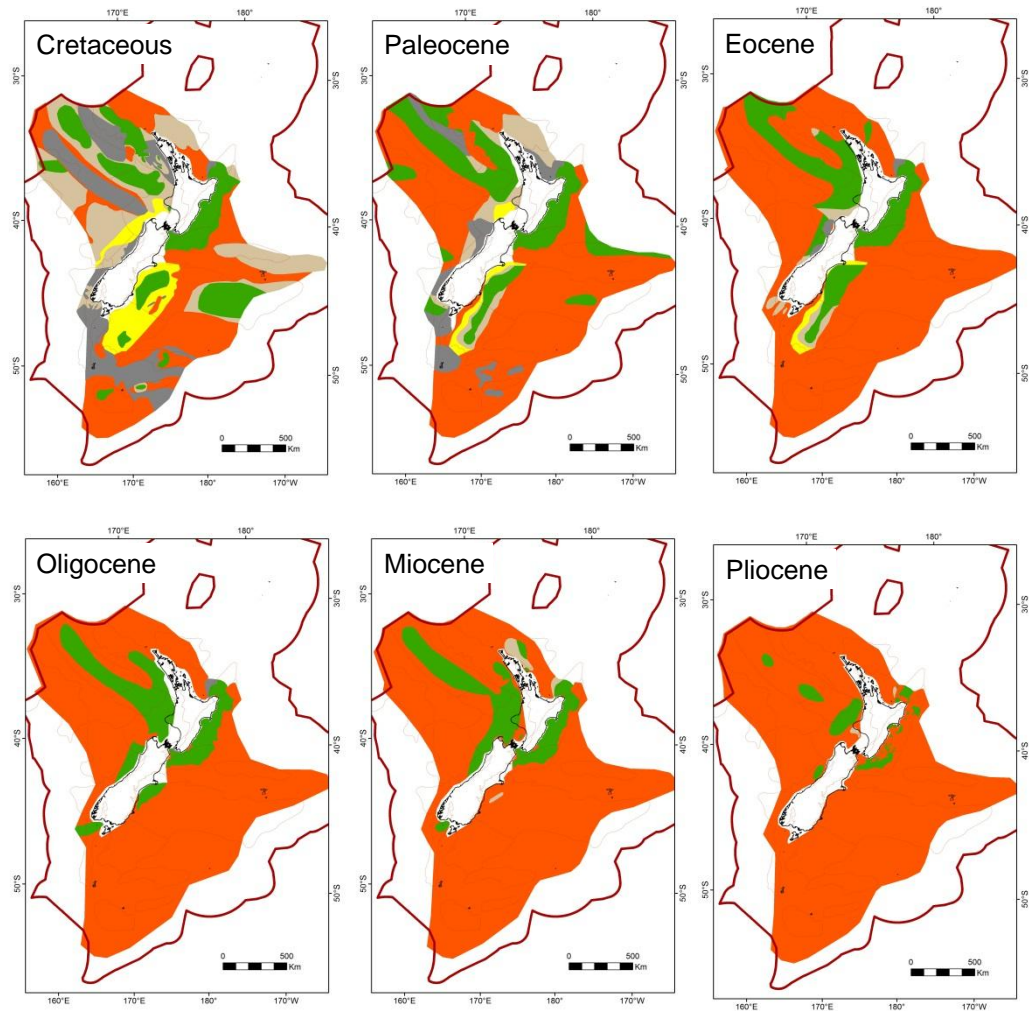


Pliocene

- Locally good reservoirs, with little compaction, but mudstones likely compromised due to shallow burial;
- Good seal inferred for parts of northern Taranaki, the West Coast and Pegasus-East Coast-Raukumara basins.

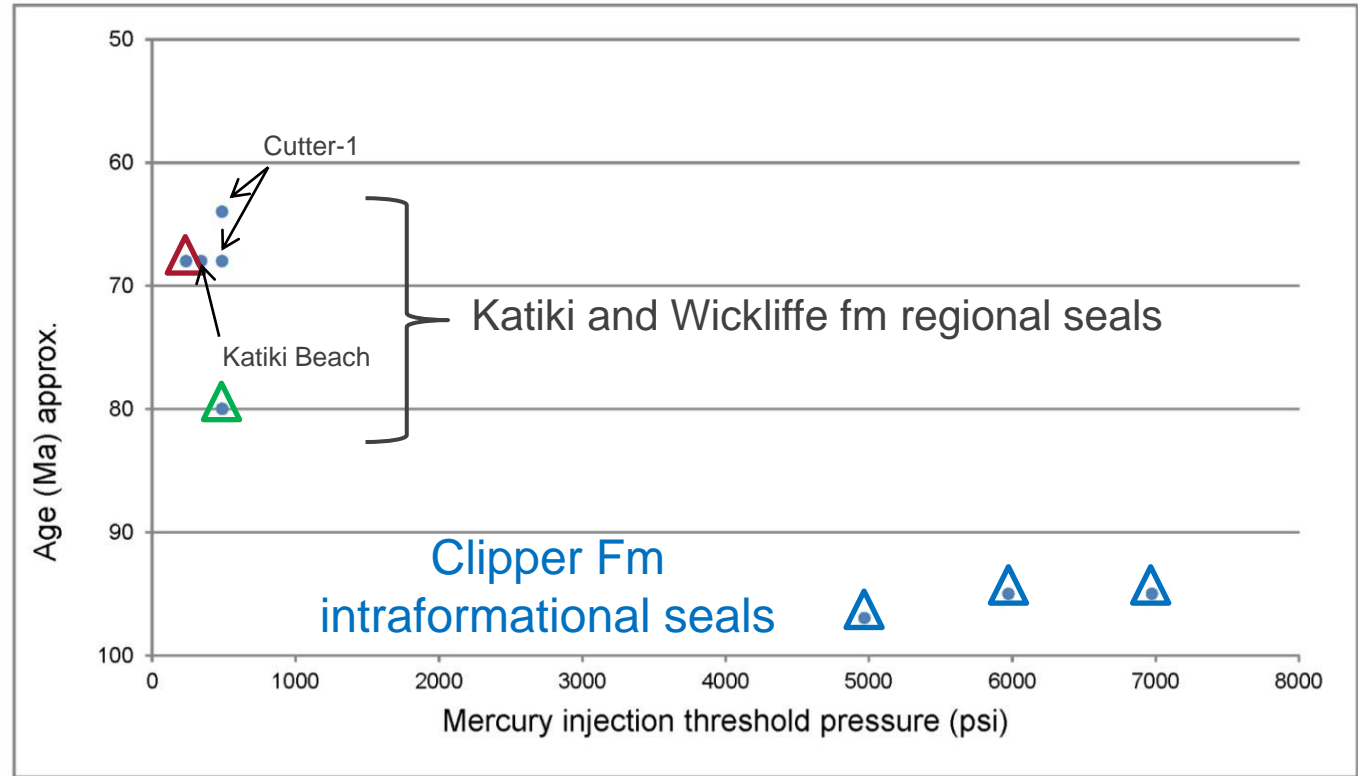


Good (Mst & Zst)	
Uncertain (Sst, Mst, Zst)	
Mixed/Reservoir (Sst, Zst)	
Present overburden < 1000 ms	
Non-deposition or erosion	



Canterbury– Great South Basin

- △ Galleon-1
- △ Clipper-1
- △ Kawau-1A

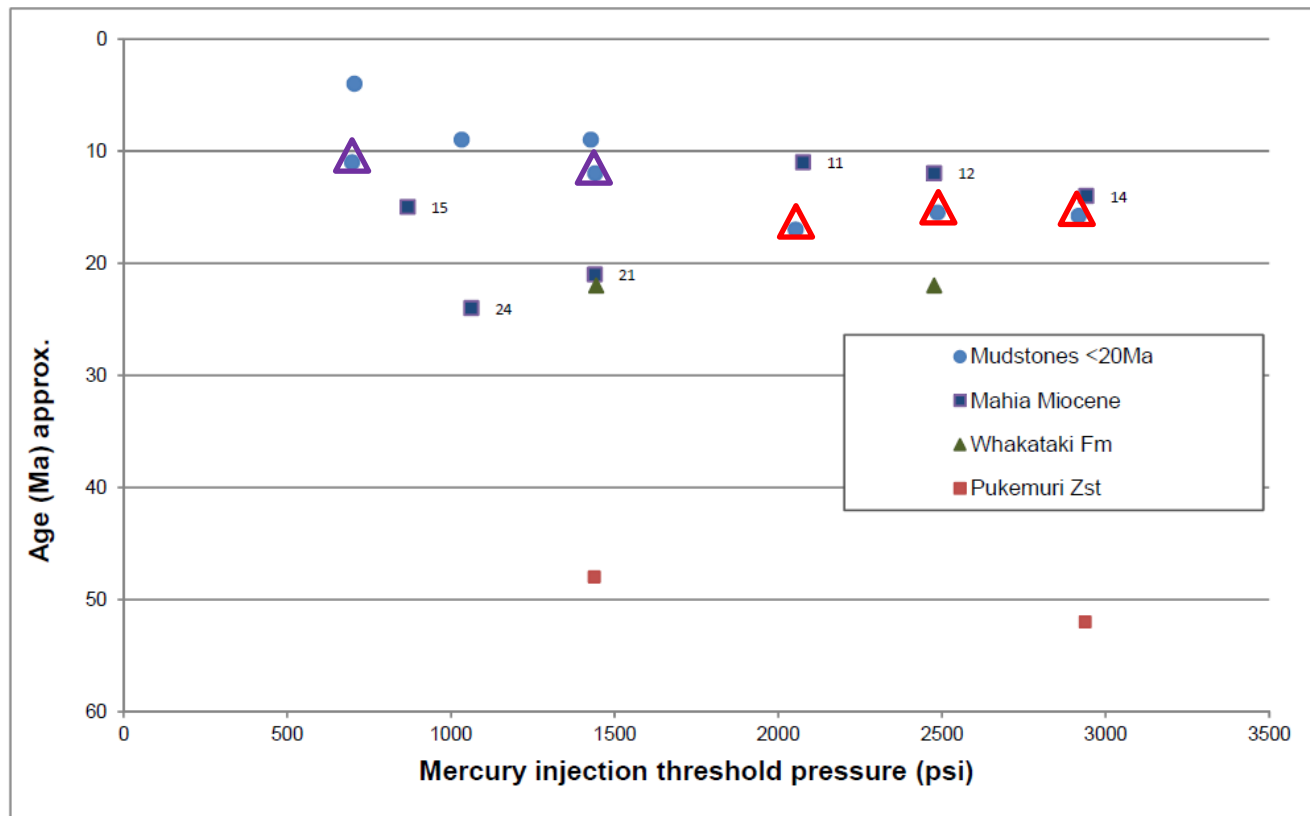


East Coast North Island

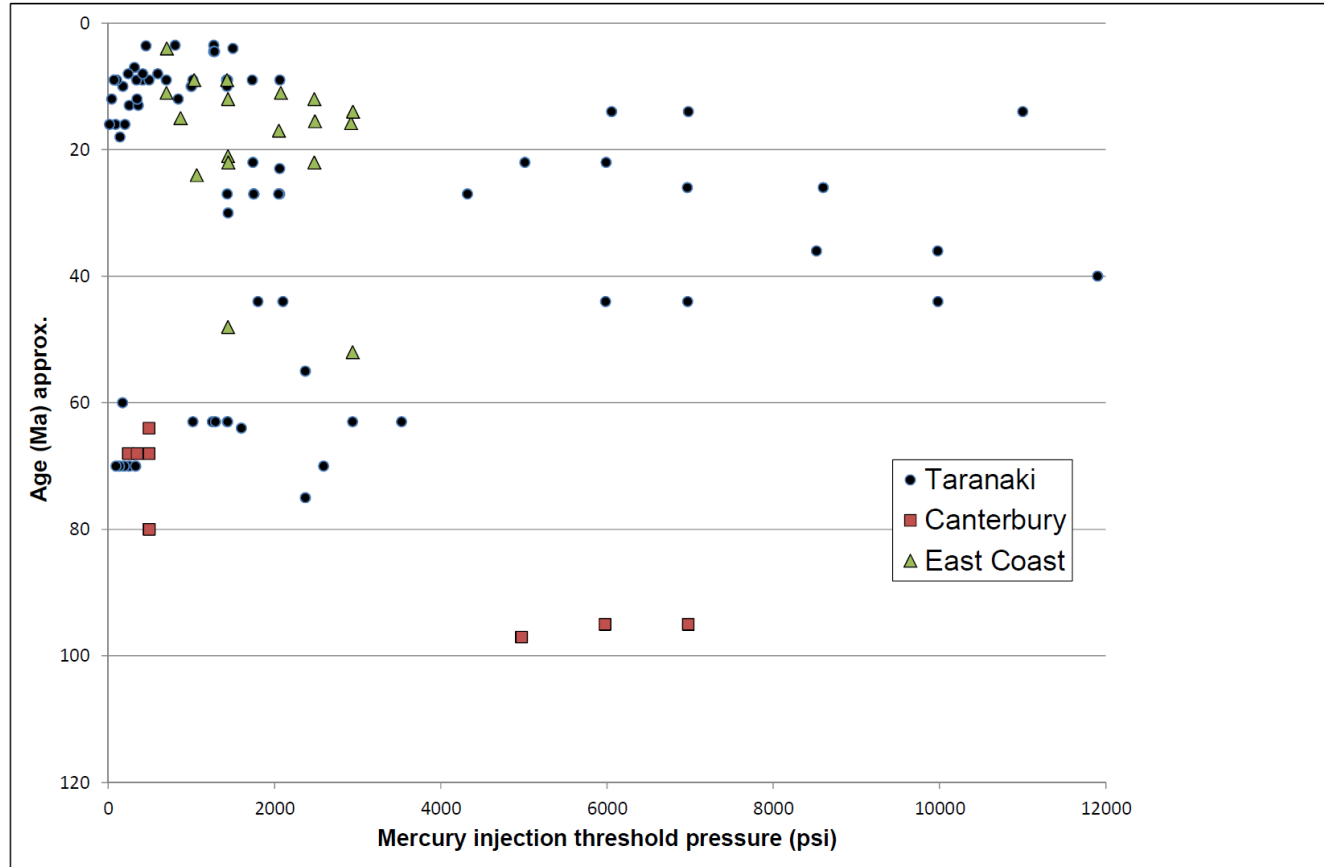
△ Titihaoa-1

△ Waingaromia-2

All others = outcrop



MICP entry pressures, all data



Conclusions

- **First attempt at NZ-wide seal evaluation – reconnaissance!**
- **Mudstones likely to have seal quality in all basins, though not uniform in distribution or quality.**
- **1000 m minimum overburden cut-off excludes large areas.**
- **Regional seals vs intraformational seals.**
- **Basis provided but much still to do....**

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