

Explorers from New Zealand: Application of Modern and Ancient Depositional Environments to Construct Paleo-Depositional Environment Maps of the Canterbury and Great South Rift Basins*

Robert C. Shoup¹ and Nick Cozens²

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Abstract

Predicting reservoir occurrence ahead of the bit is a challenge in areas with few wells. At the prospect and field scale, interpreters must rely on a thorough understanding of modern depositional environments to make reasonably accurate predictions of the distribution of reservoir facies. For regional studies and basin analysis, we can use modern and ancient analogues to better understand and predict the distribution of depositional environments within a basin.

There are relatively few wells drilled in the Canterbury and Great South rift basins of New Zealand. In order to assess the likelihood of finding reservoir and charge in any given prospect, it is necessary to construct regional paleo-depositional environment maps. To construct those maps, it is first necessary to understand the distribution of depositional environments in a developing rift basin. Drawing from modern and ancient analogues, we can understand the distribution of the various depositional environments of a rift basin. This, in turn, can be used to construct paleo depositional environment maps for the Canterbury and Great South Basins rift sequence.

The Triassic-aged rift basins exposed in the Khorat Plateau of Northeast Thailand provide an excellent ancient analogue. Additionally, well log and seismic evaluation for a number of basins in the Gulf of Thailand and the South China Sea (Shoup, 2007, Shoup et al, 2012) has shown that the distribution of the depositional environments in the synrift sequence of continental rift basins is very similar from basin to basin and from region to region.

References Cited

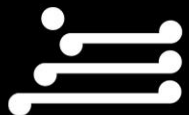
Shoup, R. C., 2007, Tertiary Paleogeography of the North Malay Basin: GREAT Conference, Chulalongkorn University, Bangkok.

Shoup, R.C., R.J. Morley, T. Swiecicki, and S.A. Clark, 2012, Tectono-stratigraphic Framework and Tertiary Paleogeography of Southeast Asia: Gulf of Thailand to Vietnam Shelf: Search and Discovery Article #30246, Web Accessed July 4, 2015, http://www.searchanddiscovery.com/documents/2012/30246shoup/ndx_shoup.pdf.

Explorers From New Zealand

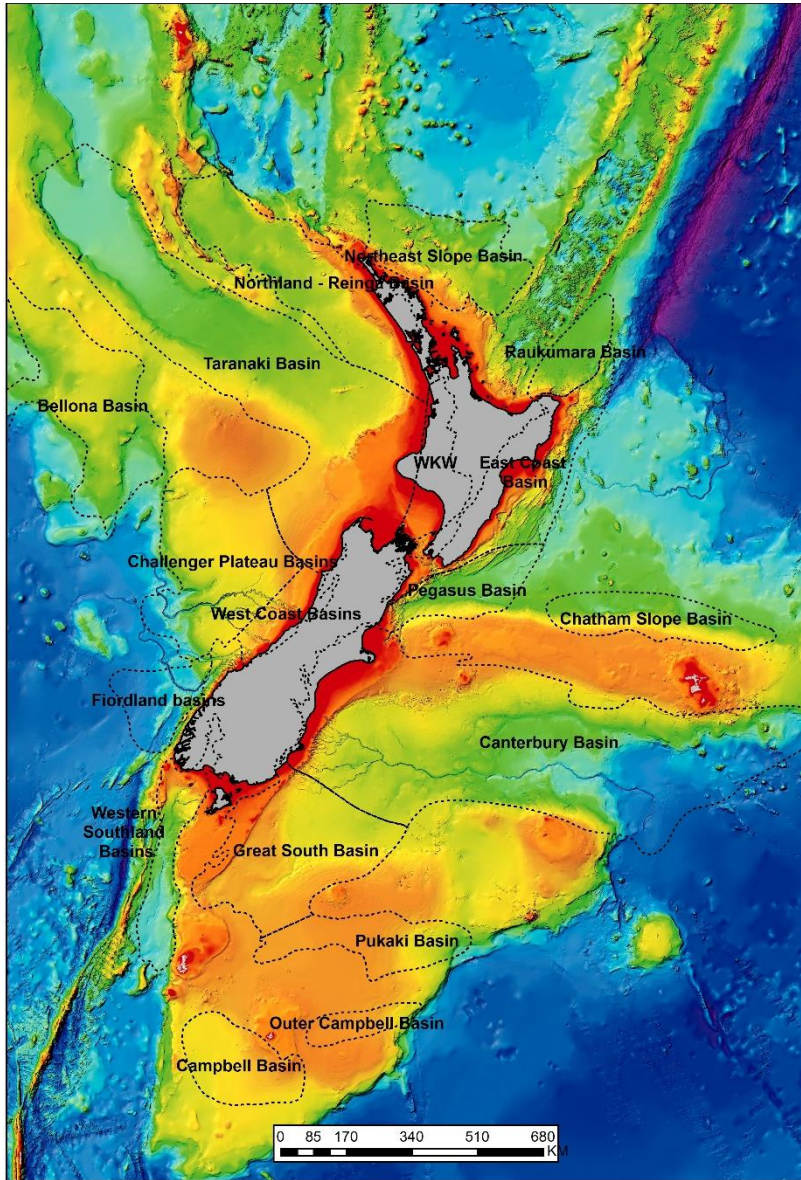
**Application of Modern and Ancient Depositional Environments to Construct
Paleo-depositional Environment Maps of the Canterbury and Great South Rift Basins**

Robert C Shoup; Clastic Reservoir Systems
Nick Cozens; New Zealand Oil and Gas



THE EXPLORERS
NEW ZEALAND OIL & GAS





1. Rift Basin Depositional Sequences

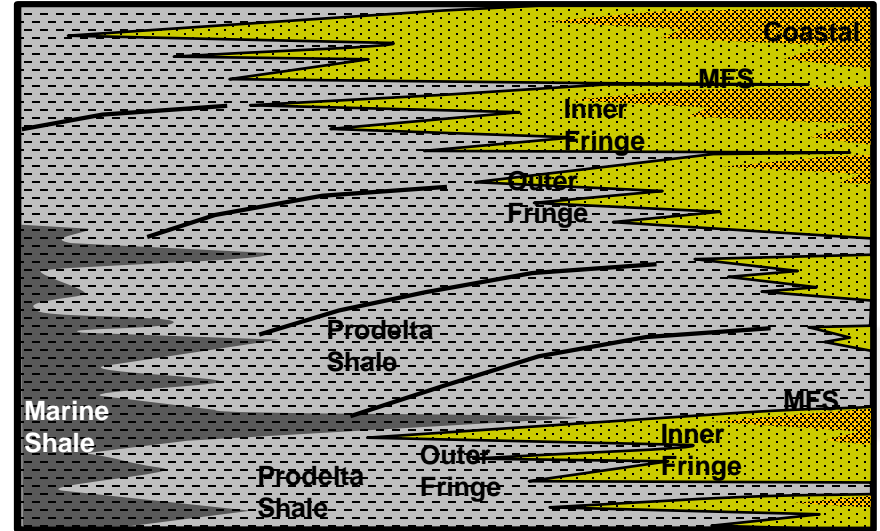
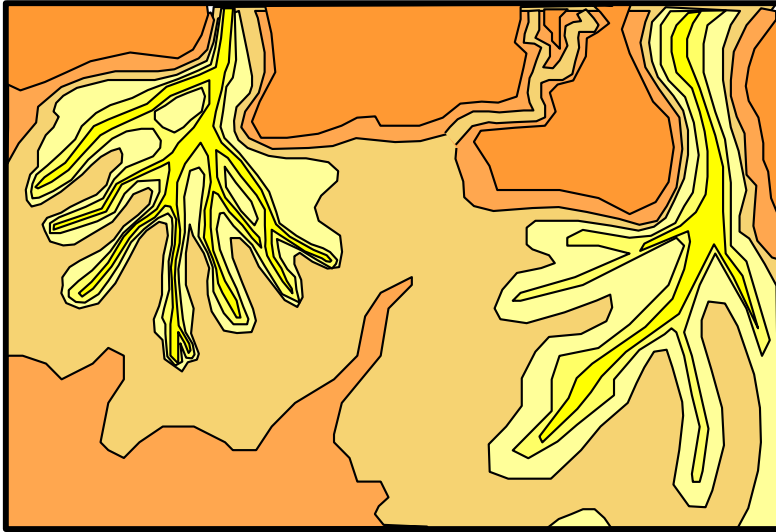
2. Canterbury / Great South Basin Rift Basin Characteristics

3. Canterbury – Great South Basin paleo-depositional environments

- A. Basement
- B. Middle Cretaceous
- C. Upper Cretaceous
- D. Paleocene

4. Summary

The Use of Modern & Ancient Analogues



Wax Lake Delta, Gulf of Mexico

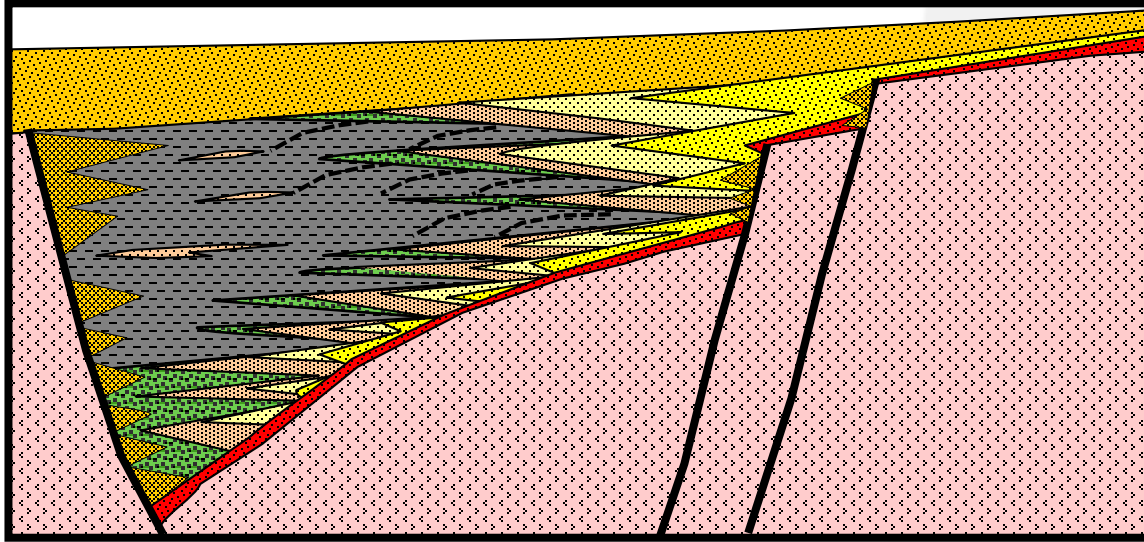


Deltaic Deposits, County Clare Ireland

We use modern and ancient analogues to understand the **distribution of facies within a depositional environment**

Rift Basin Depositional Sequences

1. Basal Conglomeratic Sequence

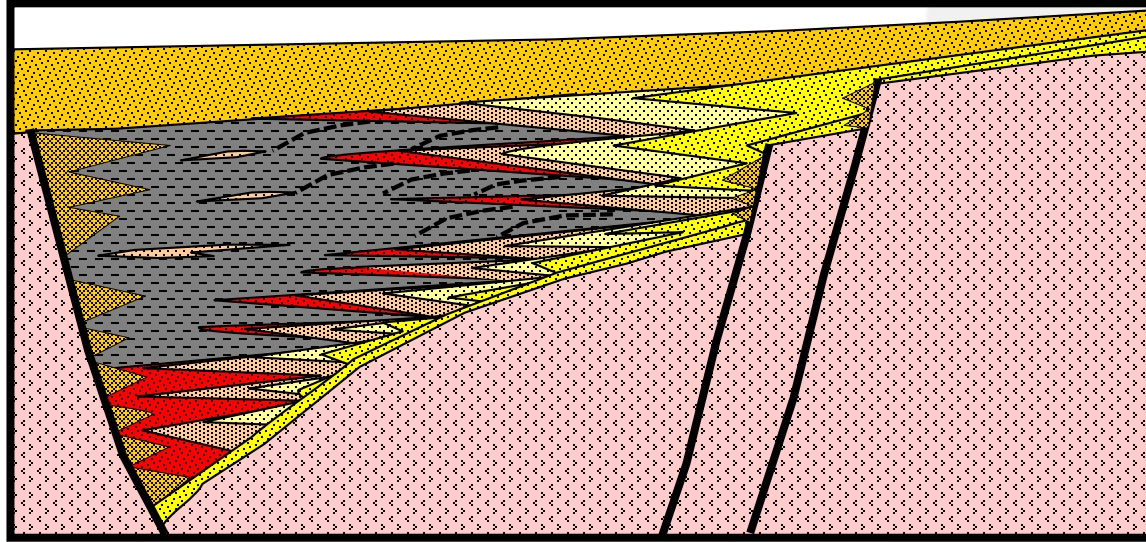


Horse Range Formation. North Otago, New Zealand

Basal Conglomerate, N.E. Thailand

Rift Basin Depositional Sequences

2. Swamp Sequence



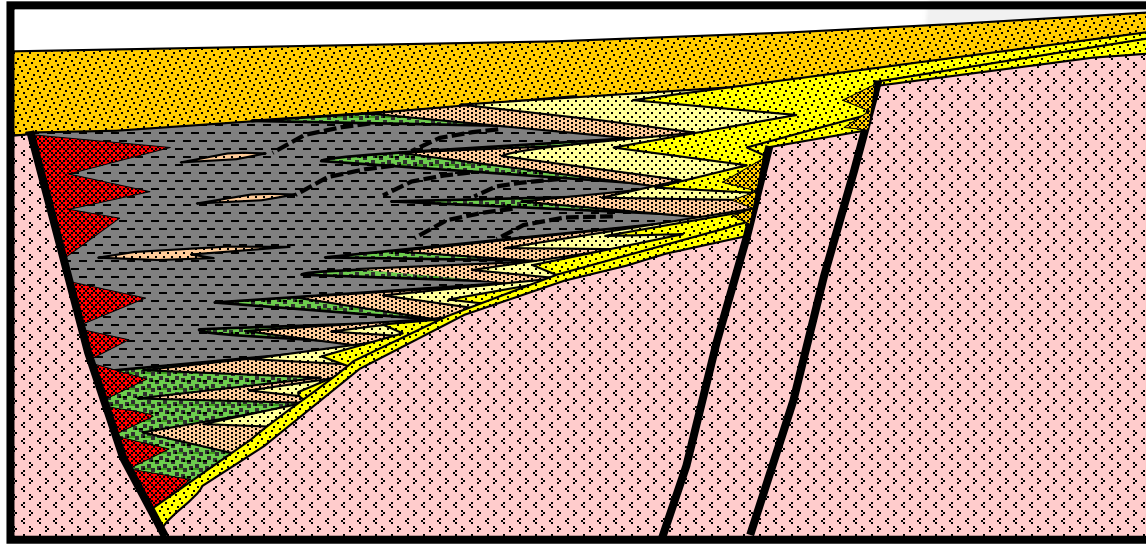
Podocarp swamp. West Coast, New Zealand



Swampy, coal rich outcrop. NE Thailand

Rift Basin Depositional Sequences

3. Alluvial Fan & Fan Delta Sequence



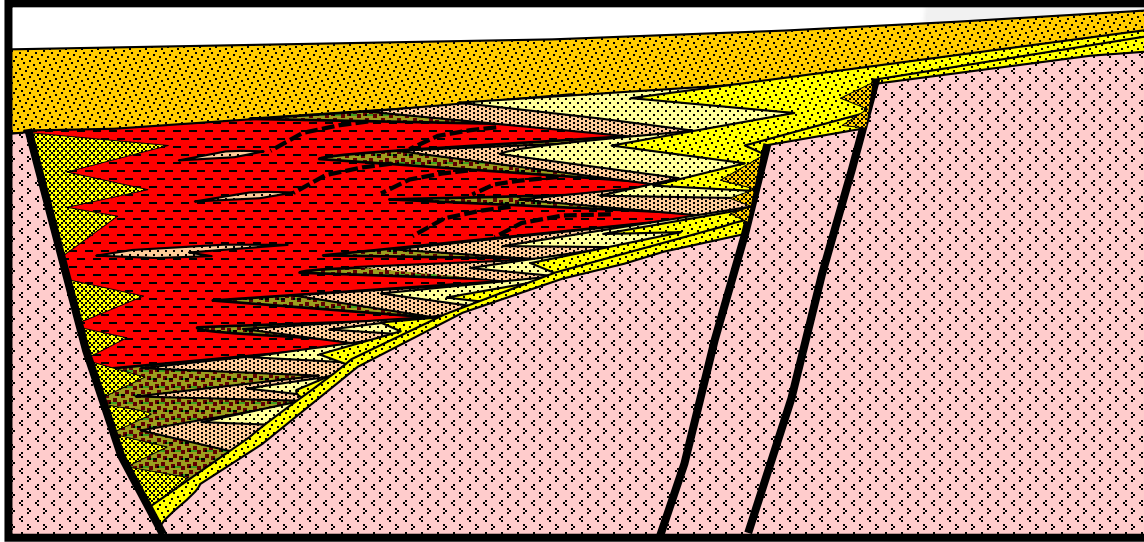
Fan delta. South Island, New Zealand



Alluvial fan delta. N.E. Thailand

Rift Basin Depositional Sequences

4. Lacustrine Sequence



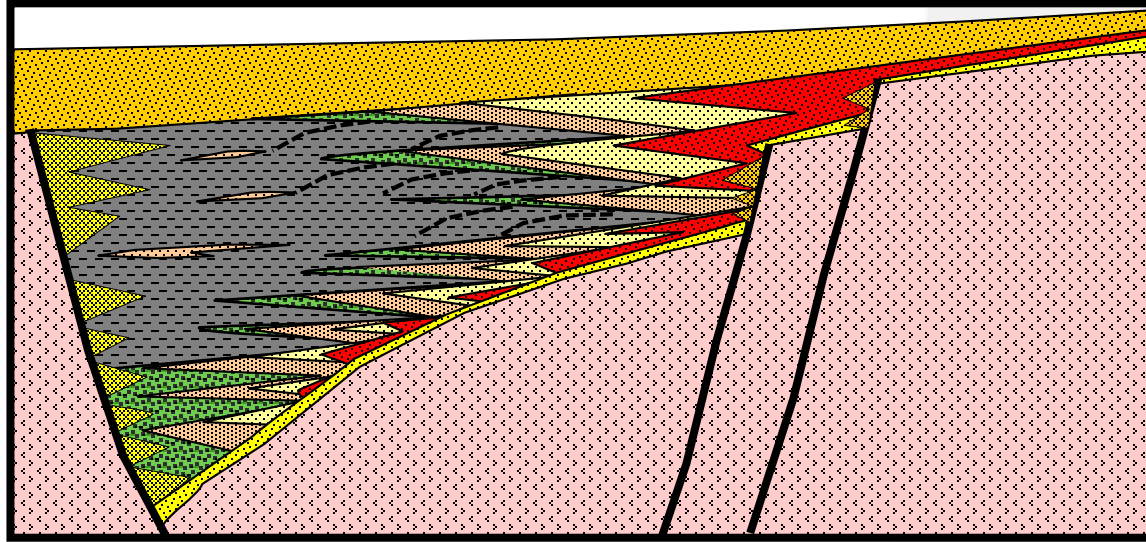
Rotorua, New Zealand



Lacustrine bedding. N.E. Thailand

Rift Basin Depositional Sequences

5. Fluvial / Shoreface Sequence



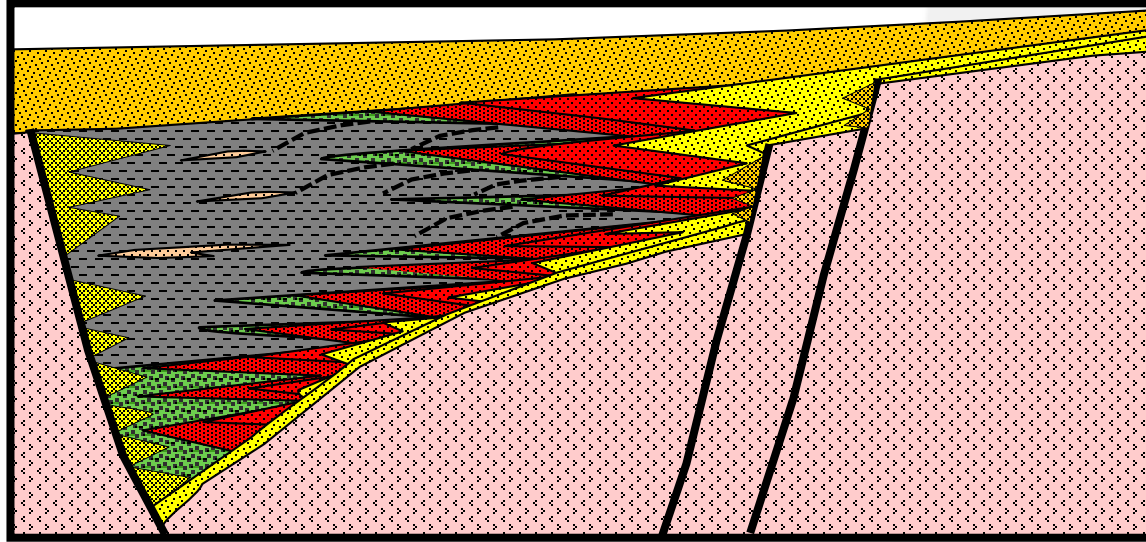
Taieri River Mouth. Otago, New Zealand



Shoreface deposits. N.E. Thailand

Rift Basin Depositional Sequences

6. Deltaic Sequence



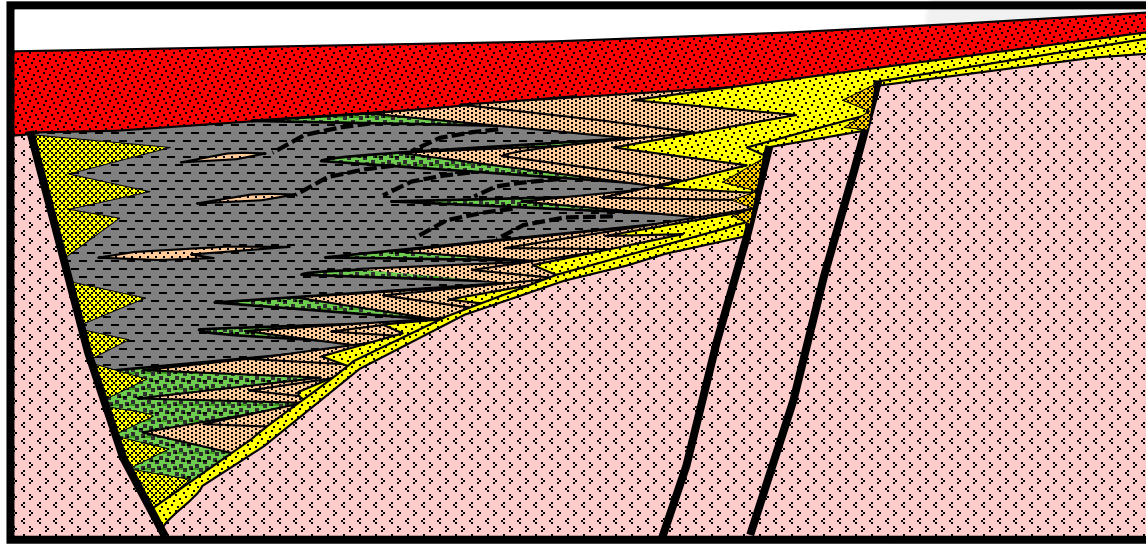
Lacustrine Delta. Dart River Mouth. New Zealand



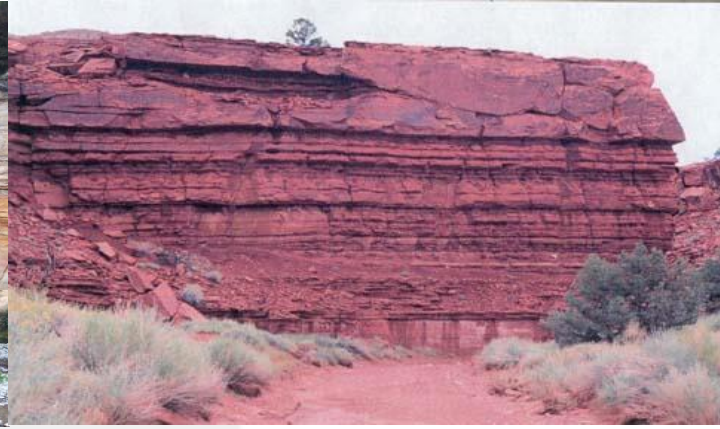
Deltaic Deposits. N.E. Thailand

Rift Basin Depositional Sequences

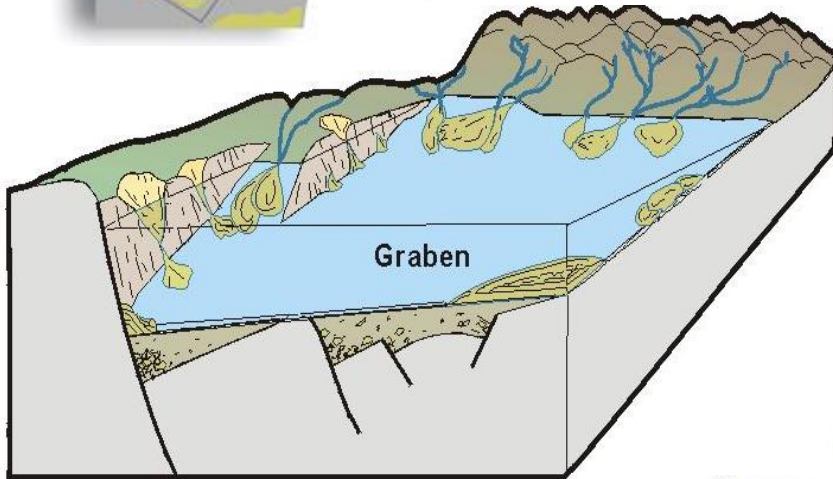
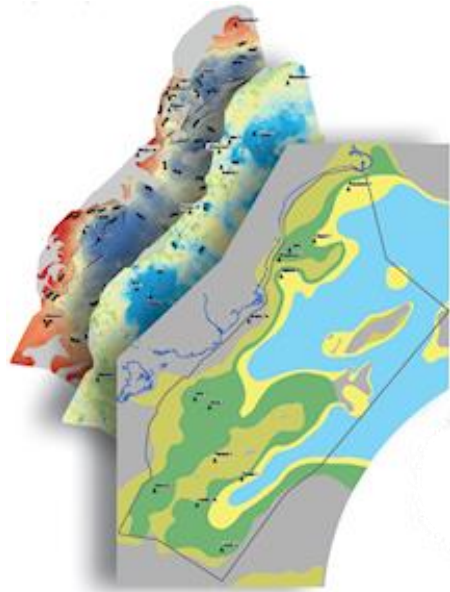
7. Transitional Sequence



Herbert Formation. North Otago, New Zealand



Continental sourced Red Beds. Utah, United States.



1. Rift Basin Depositional Sequences

2. Canterbury / Great South Basin Rift Basin Observations

3. Canterbury – Great South Basin paleo-depositional environments

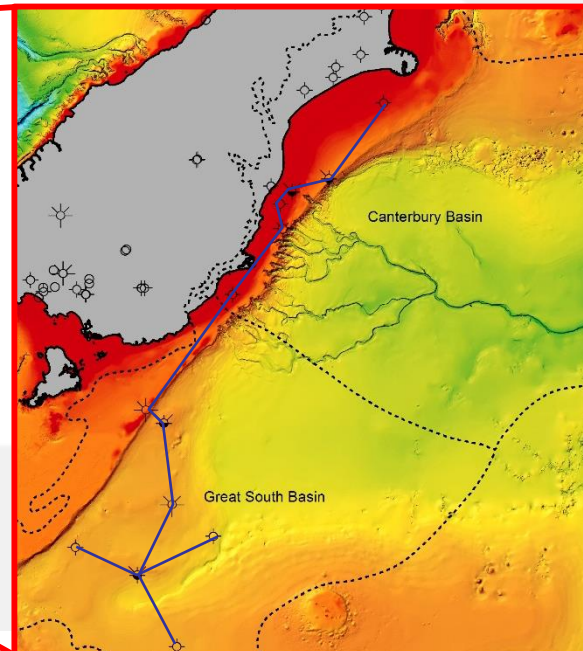
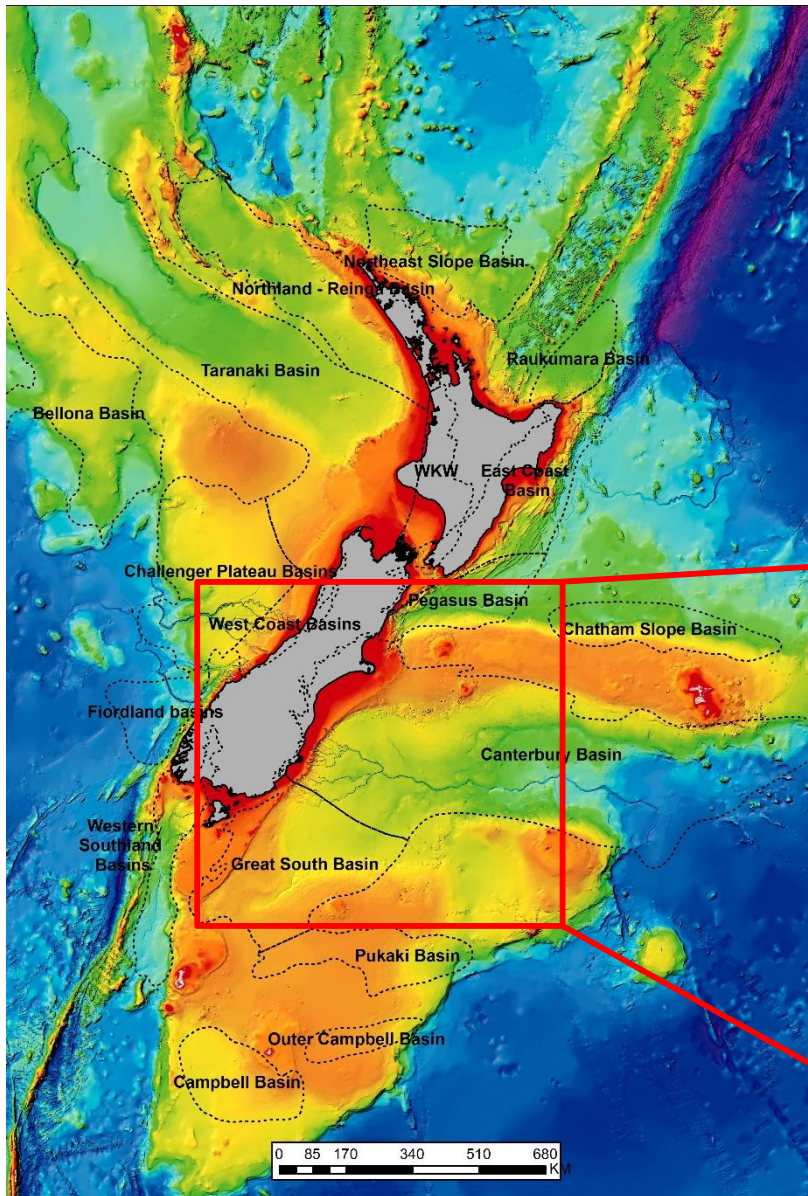
- A. Basement
- B. Mid Cretaceous
- C. Late Cretaceous
- D. Paleocene

4. Summary

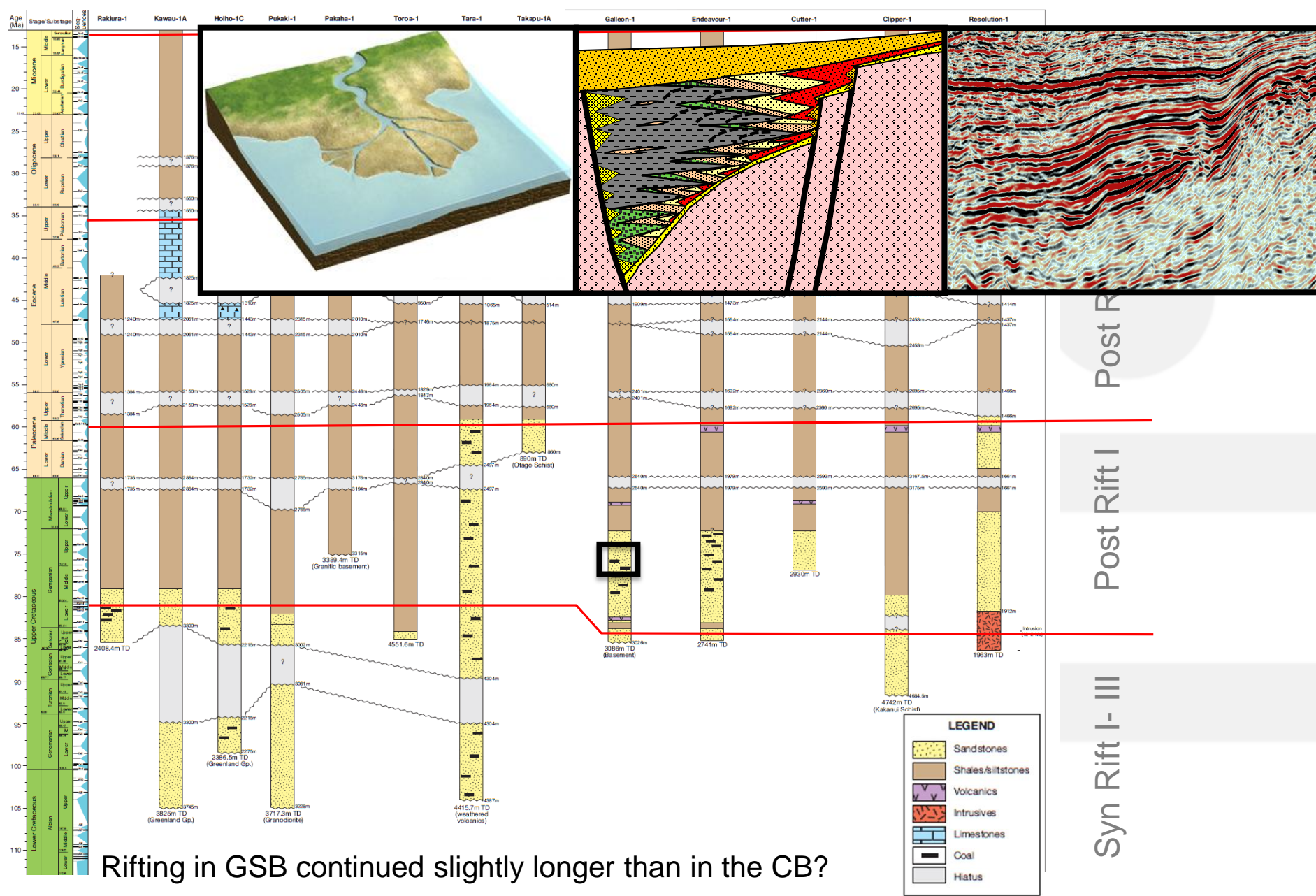
Stratigraphic Framework

Rift basin character was evaluated in the CB/GSB using:

1. Well data
2. Biostratigraphy
3. Comparison to seismic amplitude mapping
4. Conceptually driven analogues

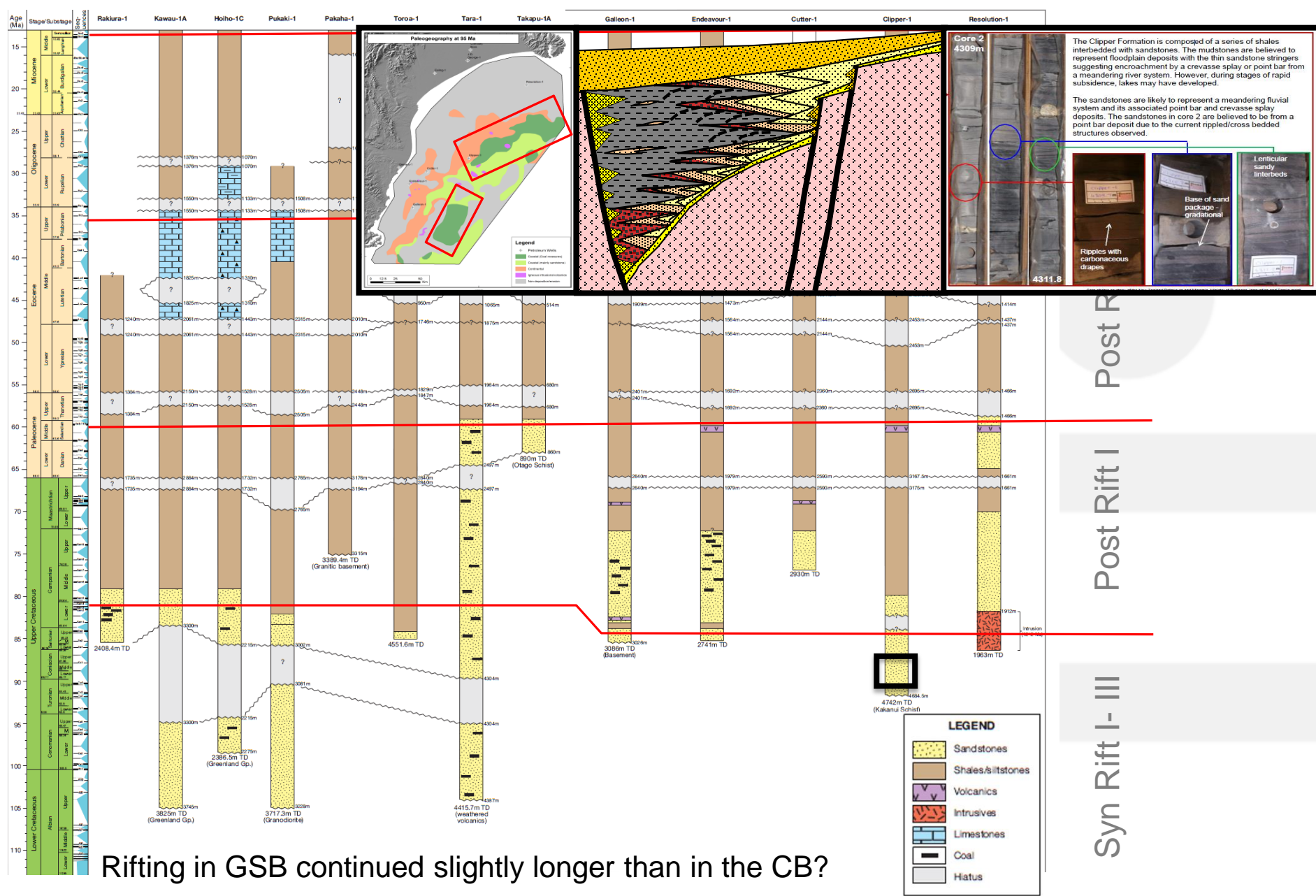


Chronostratigraphic Framework: Great South And Canterbury Basins

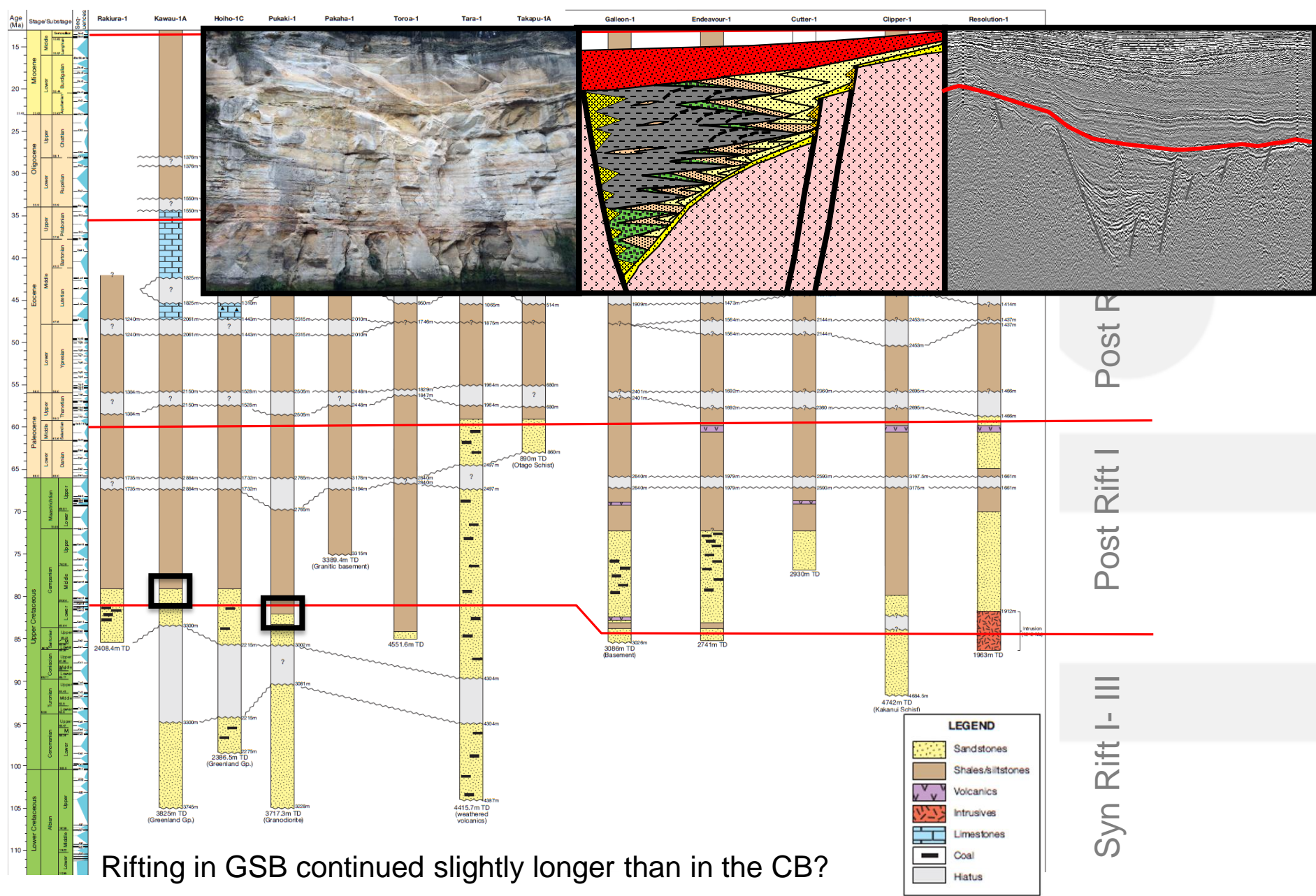


Rifting in GSB continued slightly longer than in the CB?

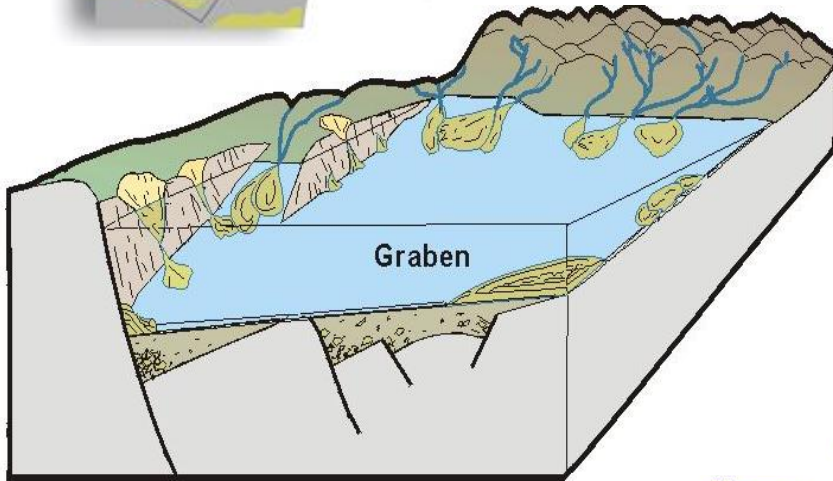
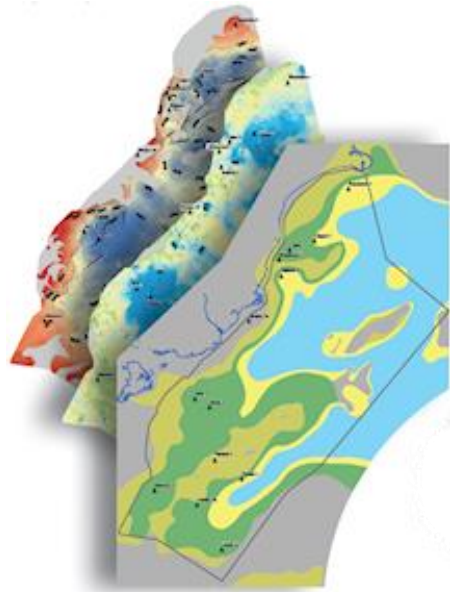
Chronostratigraphic Framework: Great South And Canterbury Basins



Chronostratigraphic Framework: Great South And Canterbury Basins



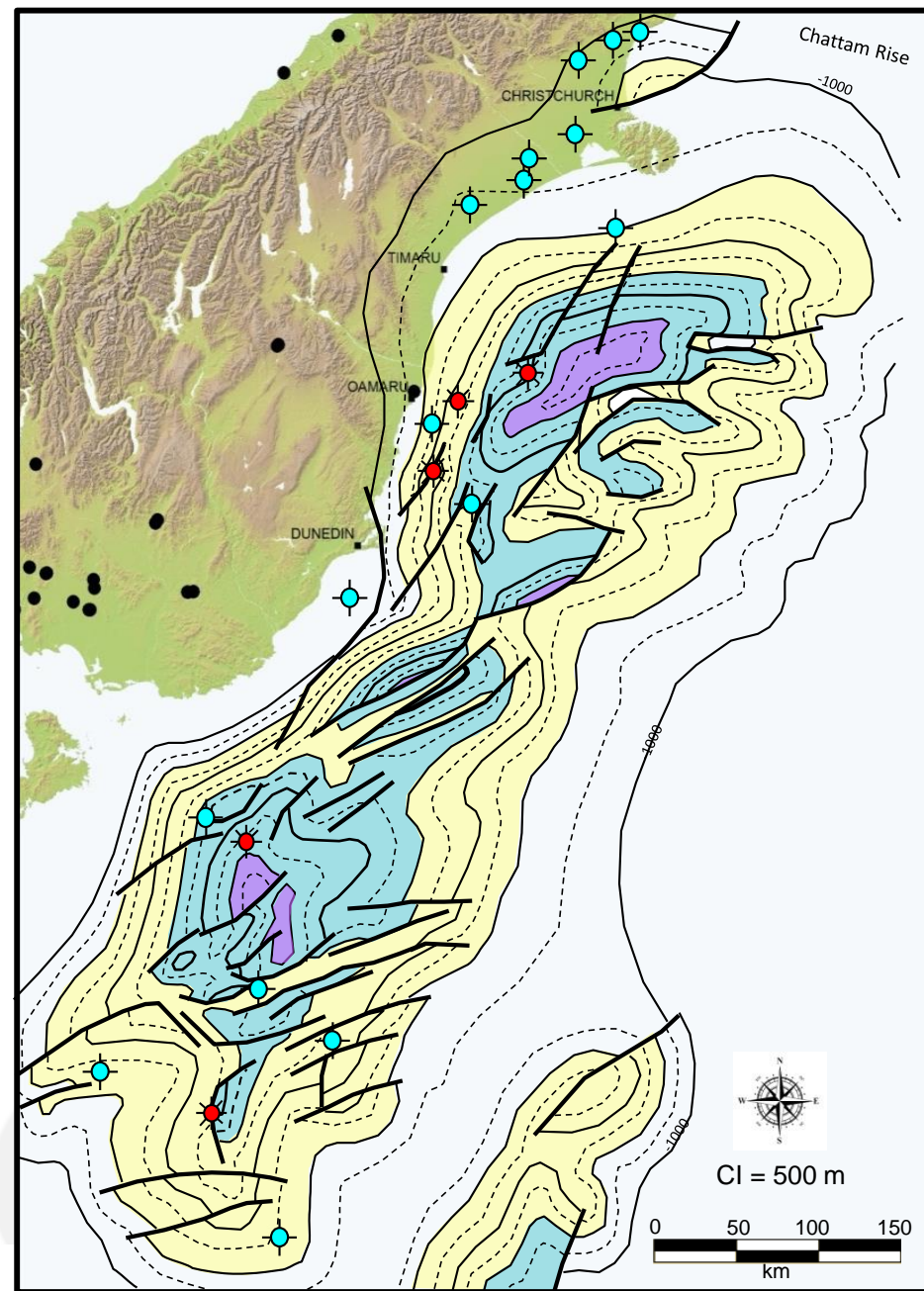
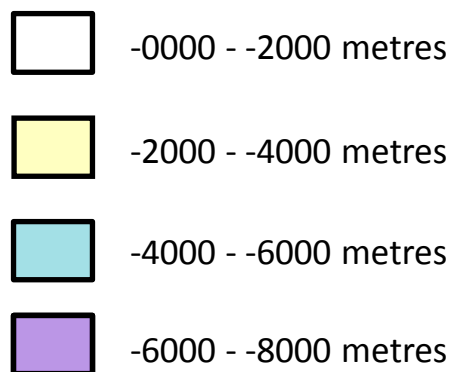
Rifting in GSB continued slightly longer than in the CB?



1. Rift Basin Depositional Sequences
2. Canterbury / Great South Basin Rift Basin Characteristics
3. **Canterbury – Great South Basin paleo-depositional environments**
 - A. **Basement**
 - B. **Mid Cretaceous**
 - C. **Late Cretaceous**
 - D. **Paleocene**
4. **Summary**

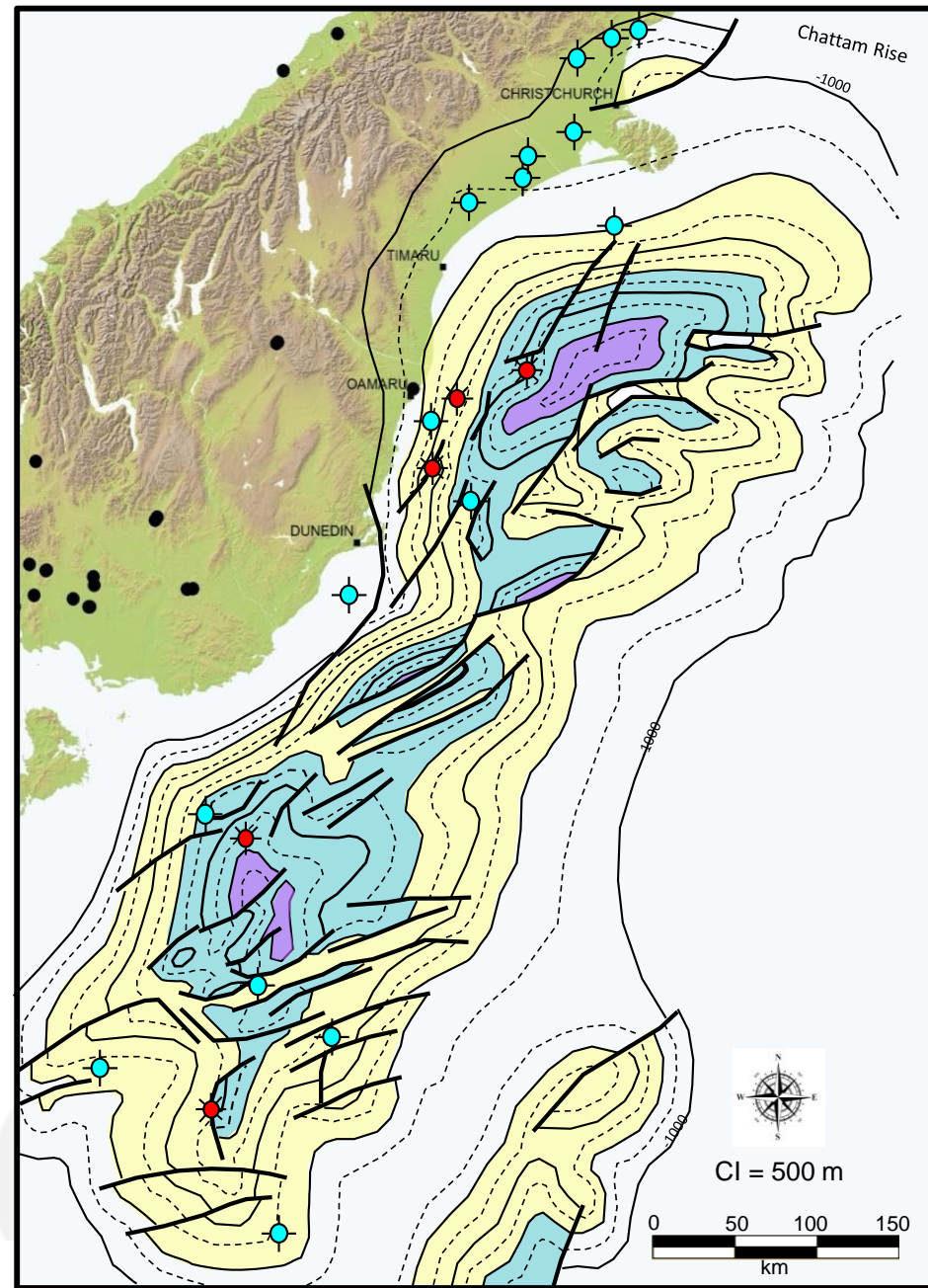
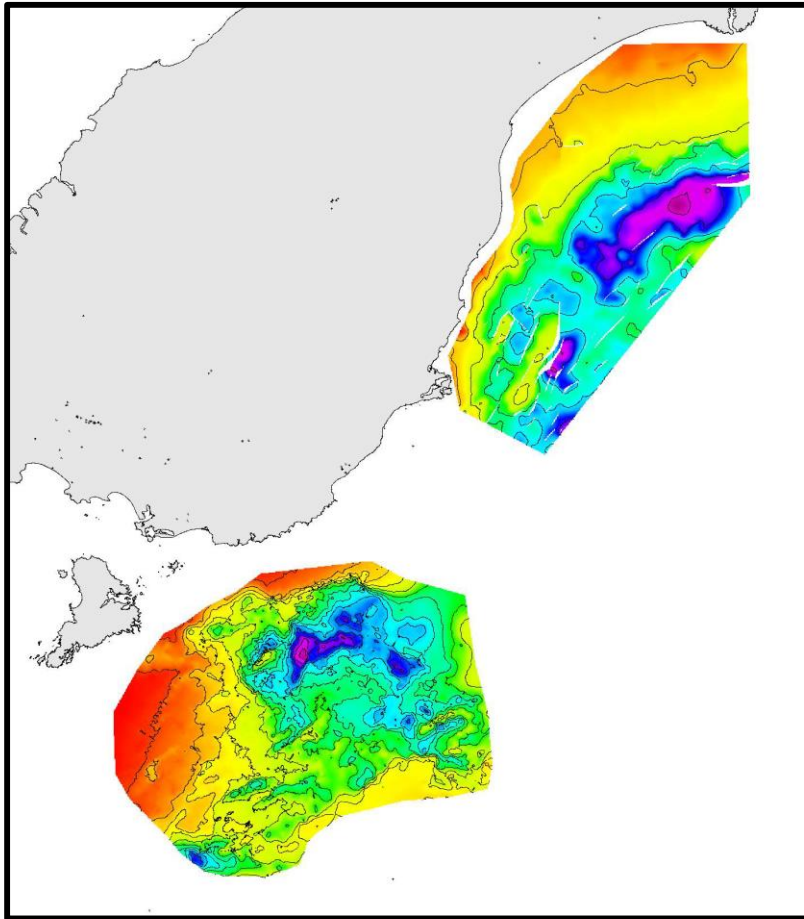
Structural Framework: Basement

Basement grain in GSB is likely to be influenced by the underlying terrane groups, which run perpendicular to the rift axis, whereas the Canterbury Basin aligns better to the rifting axis.



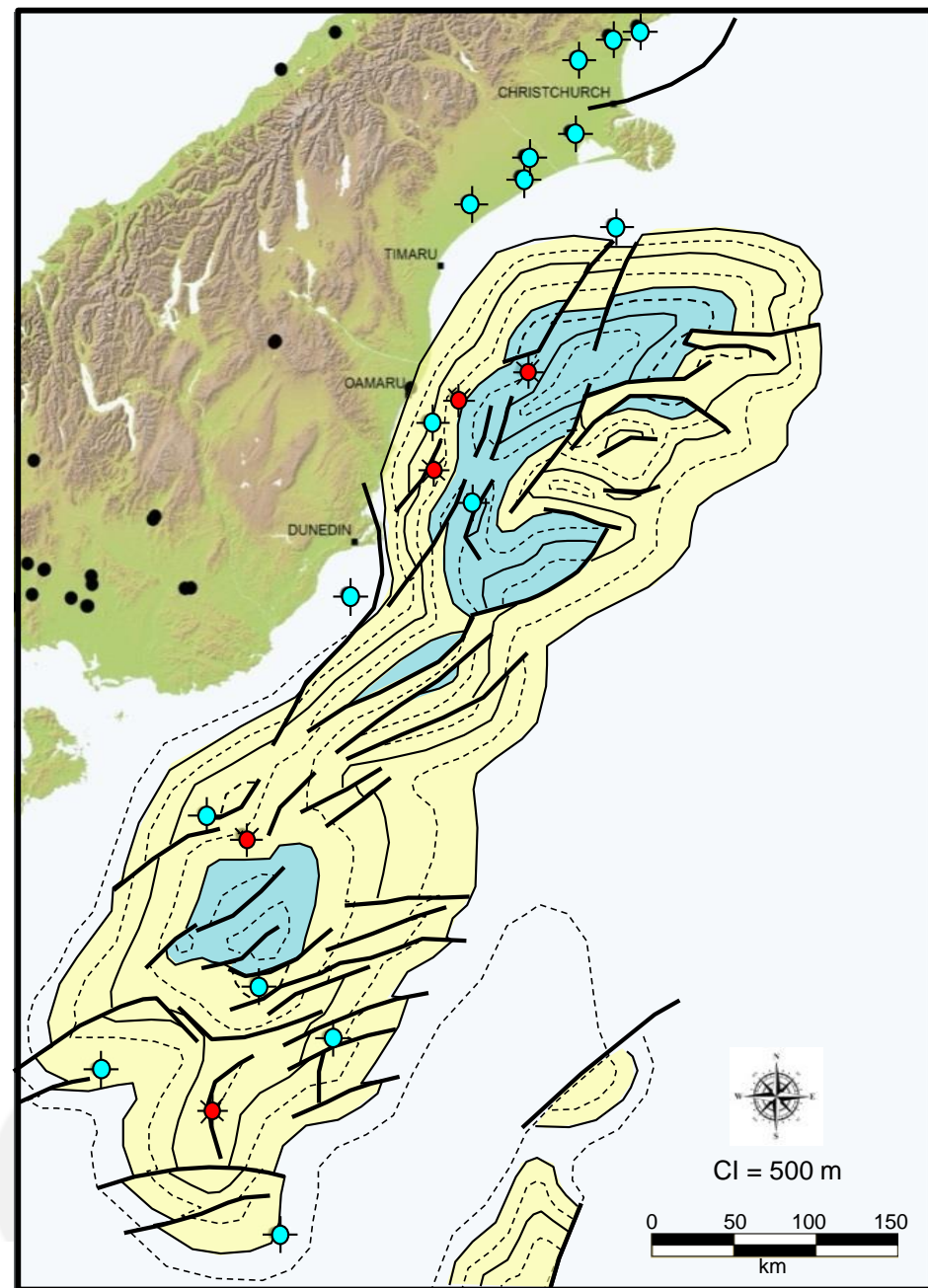
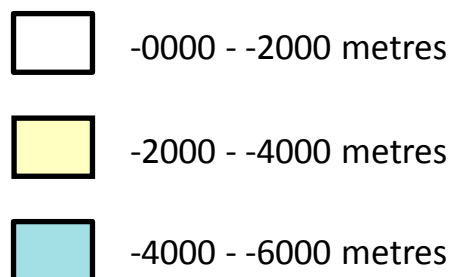
All structure maps were compiled from multiple publications, proprietary reports, and seismic interpretations and hand-contoured with a 500 meter contour interval

Structural Framework: Basement



Structural Framework: Middle Cretaceous

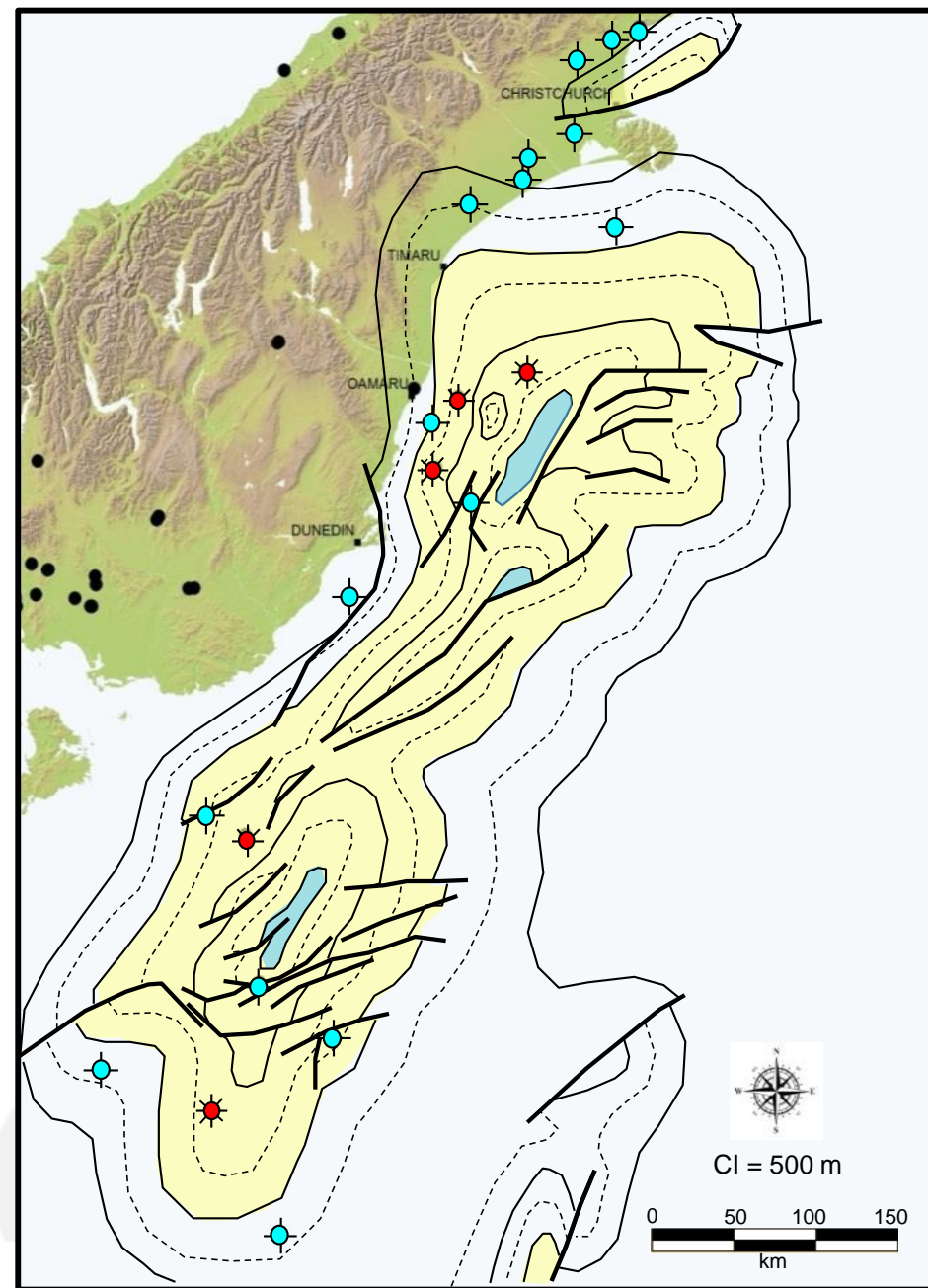
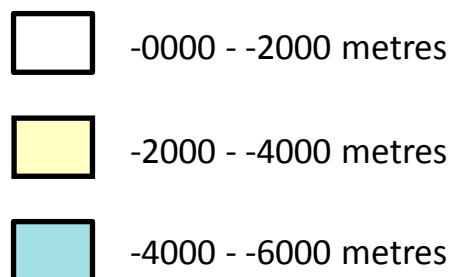
Dominated by continental deposition, the maximum depth in both basins do extend over ~ 4500m but is deeper and more widespread in the Canterbury Basin



All structure maps were compiled from multiple publications, proprietary reports, and seismic interpretations and hand-contoured with a 500 meter contour interval

Structural Framework: Upper Cretaceous

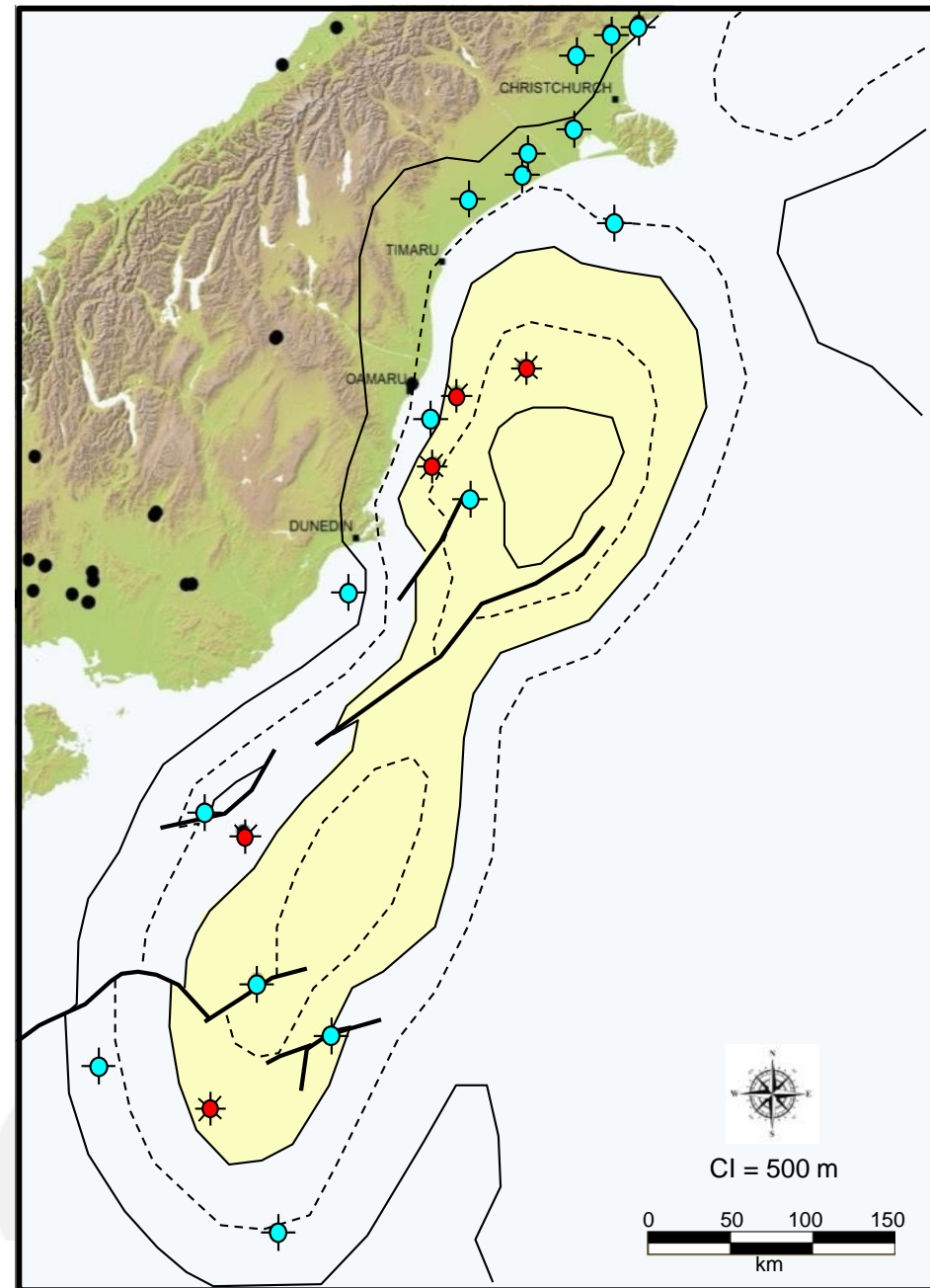
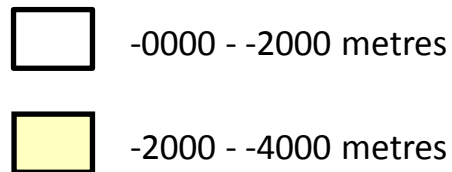
Dominated by brackish to marginal marine deposits, the maximum depth in both basins is reasonably similar at ~ 4000m



All structure maps were compiled from multiple publications, proprietary reports, and seismic interpretations and hand-contoured with a 500 meter contour interval

Structural Framework: Paleocene

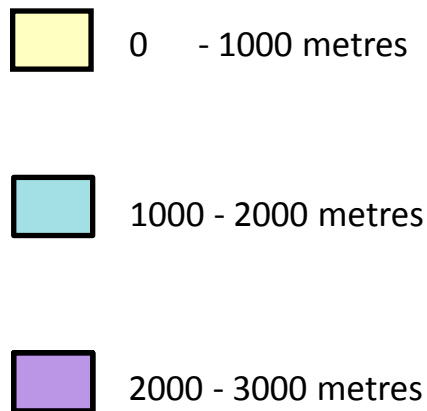
Dominated by marine deposits, the Paleocene represents the transition from synrift to postrift. A thicker and more widespread section ~ 3000m thick is exhibited in the Canterbury Basin.



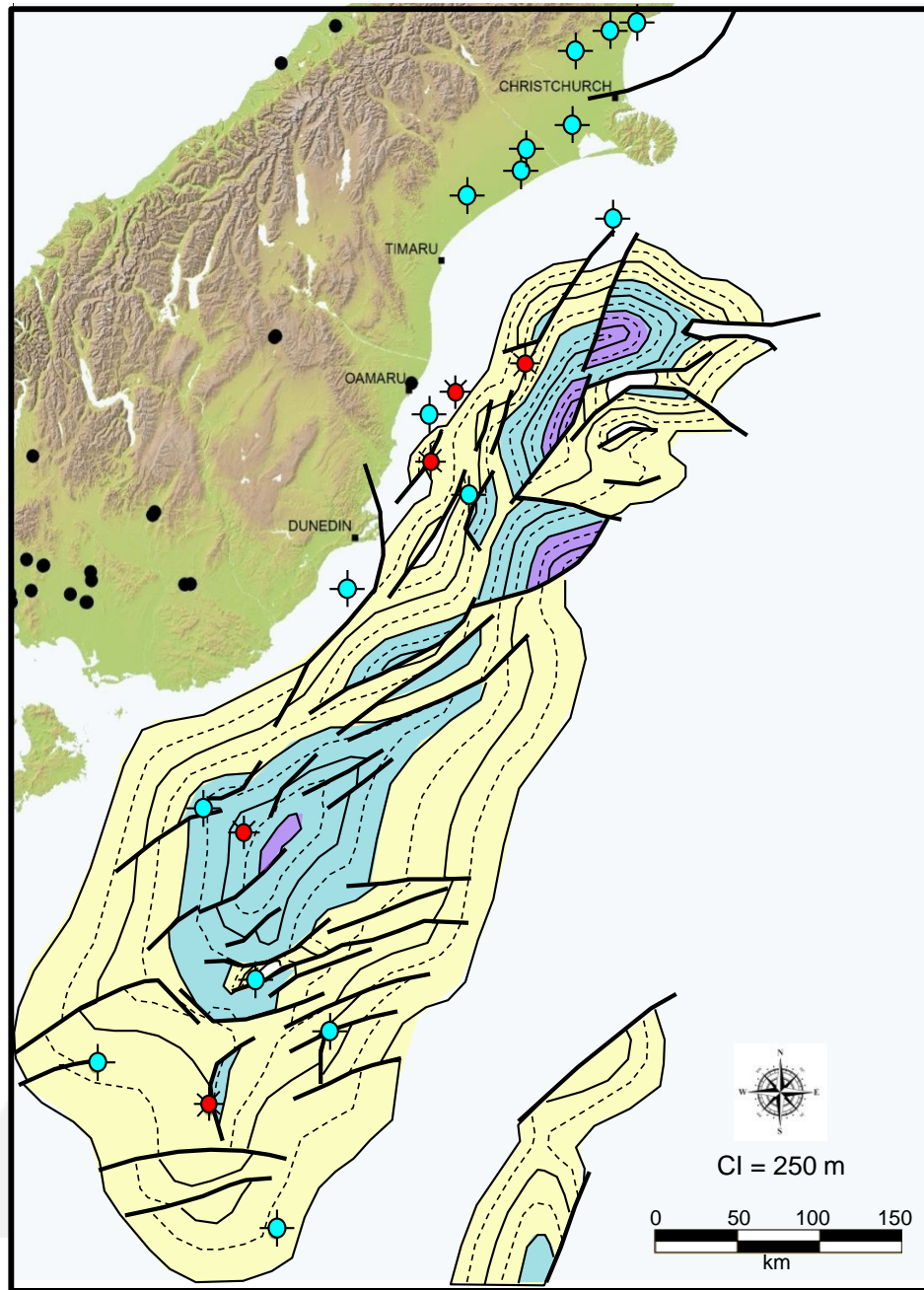
All structure maps were compiled from multiple publications, proprietary reports, and seismic interpretations and hand-contoured with a 500 meter contour interval

Structural Framework: Middle Cretaceous – Basement Isochore

Middle Cretaceous generally thickens into the basins from all flanks. The thickest sections are observed on the downthrown side of rift related faults

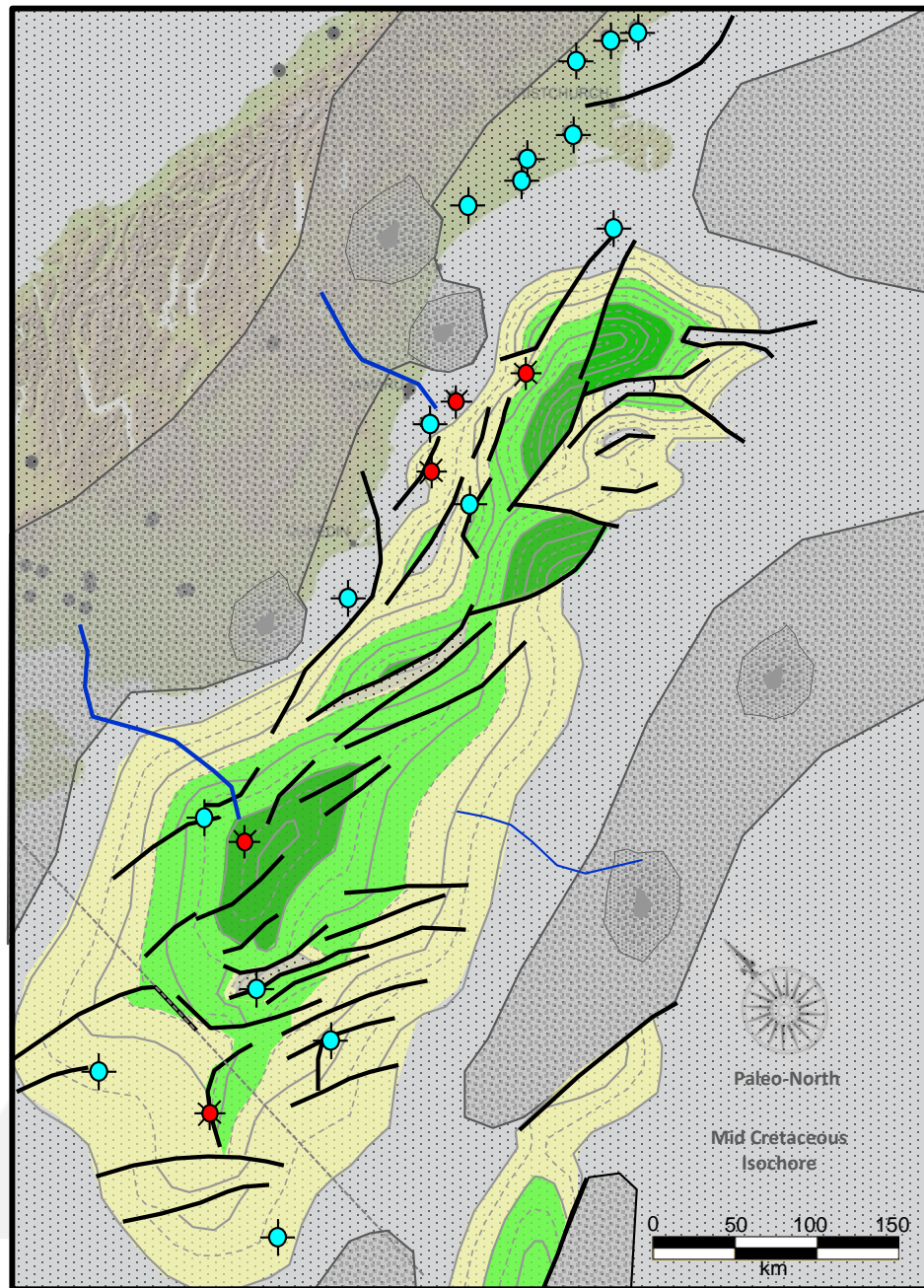


All structure maps were compiled from multiple publications, proprietary reports, and seismic interpretations and hand-contoured with a 500 meter contour interval



Middle Cretaceous Depositional Environment

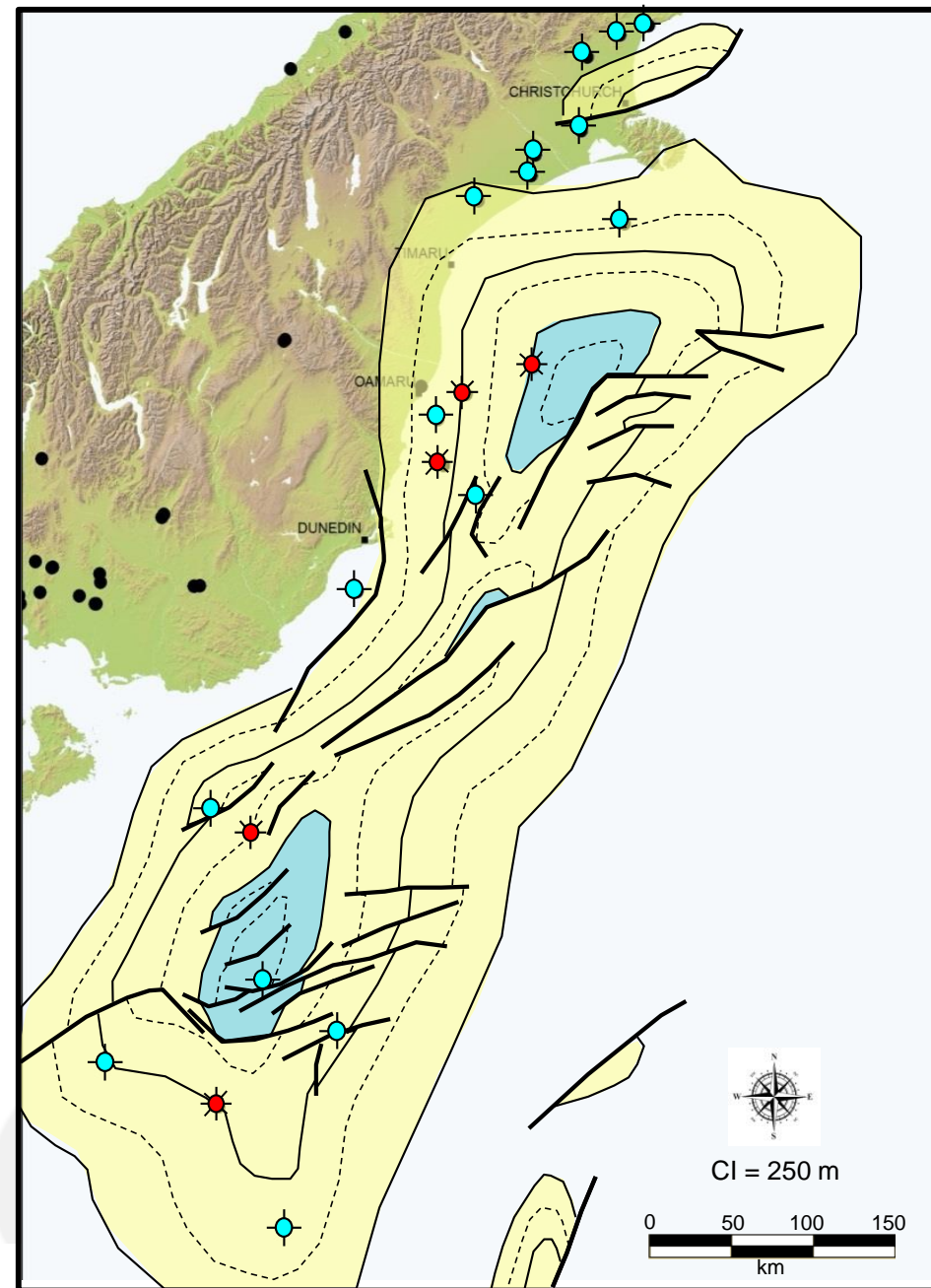
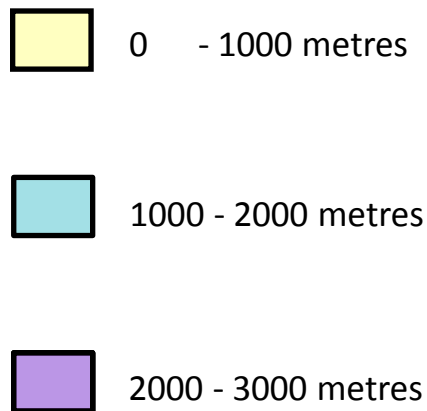
Sediments enter the rifting basin from eroding highlands. The flanks are characterised by fluvial deposition and the deeper parts of the basin by swamps and perhaps open lakes



All structure maps were compiled from multiple publications, proprietary reports, and seismic interpretations and hand-contoured with a 500 meter contour interval

Structural Framework: Upper – Middle Cretaceous Isochore

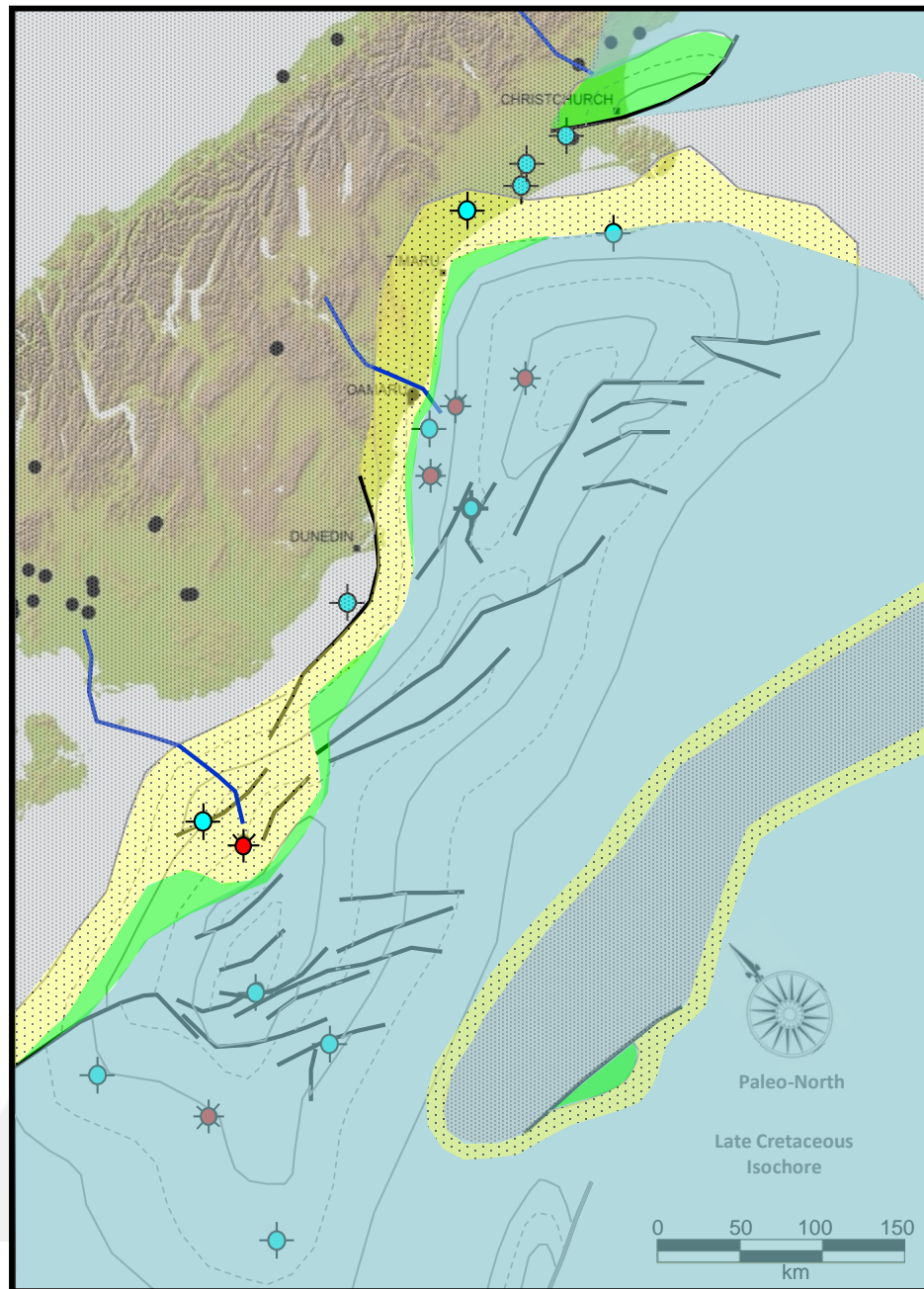
Gradual thickening into the basin from
all flanks to a thickness over 2000m



All structure maps were compiled from multiple
publications, proprietary reports, and seismic interpretations
and hand-contoured with a 500 meter contour interval

Upper (latest) Cretaceous Depositional Environment

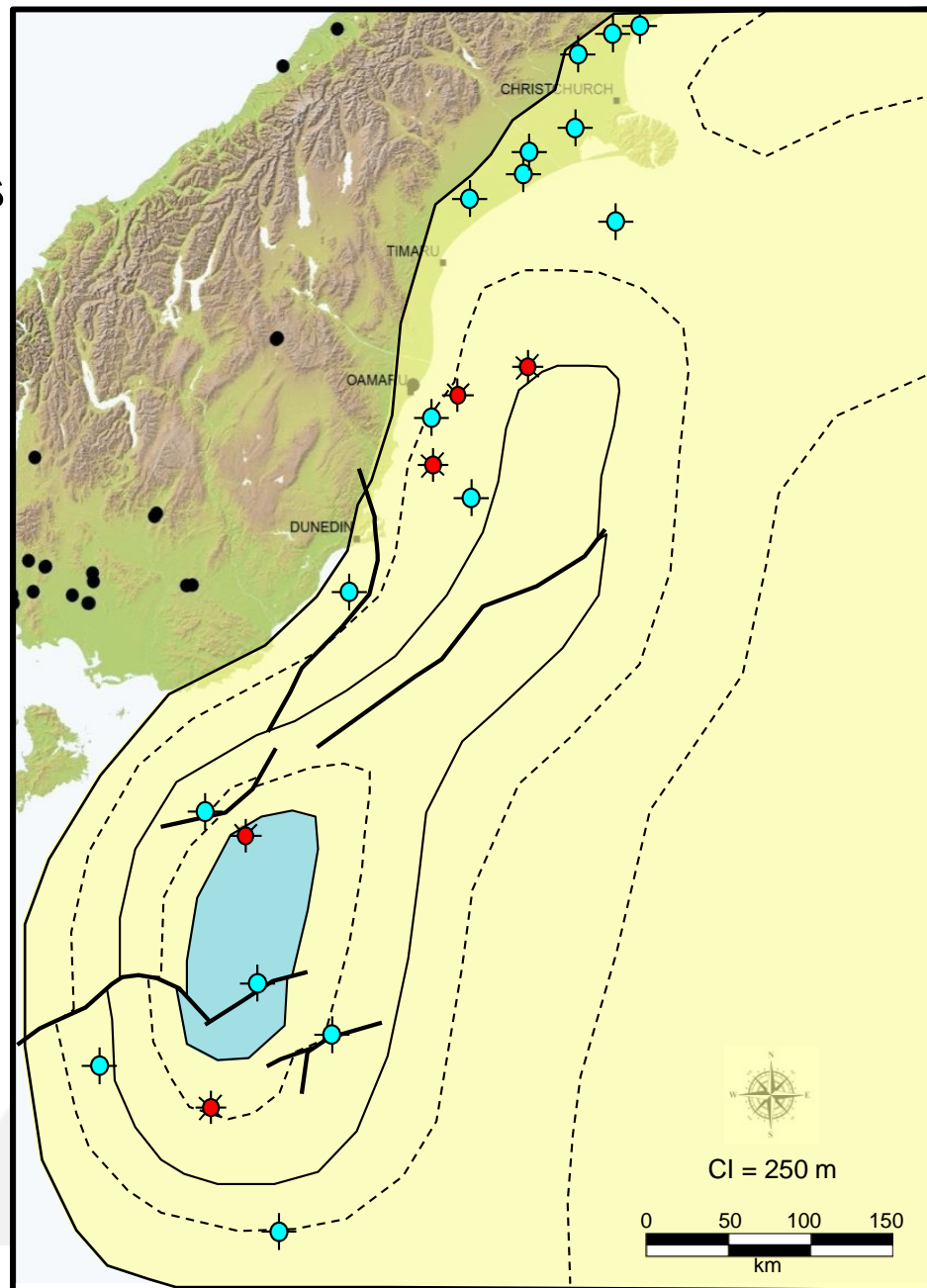
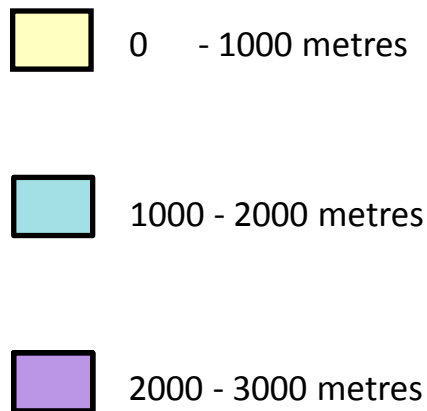
Open marine conditions prevail
across the region. Possible islands
outboard.



All structure maps were compiled from multiple
publications, proprietary reports, and seismic interpretations
and hand-contoured with a 500 meter contour interval

Structural Framework: Top Paleocene – Top Cretaceous Isochore

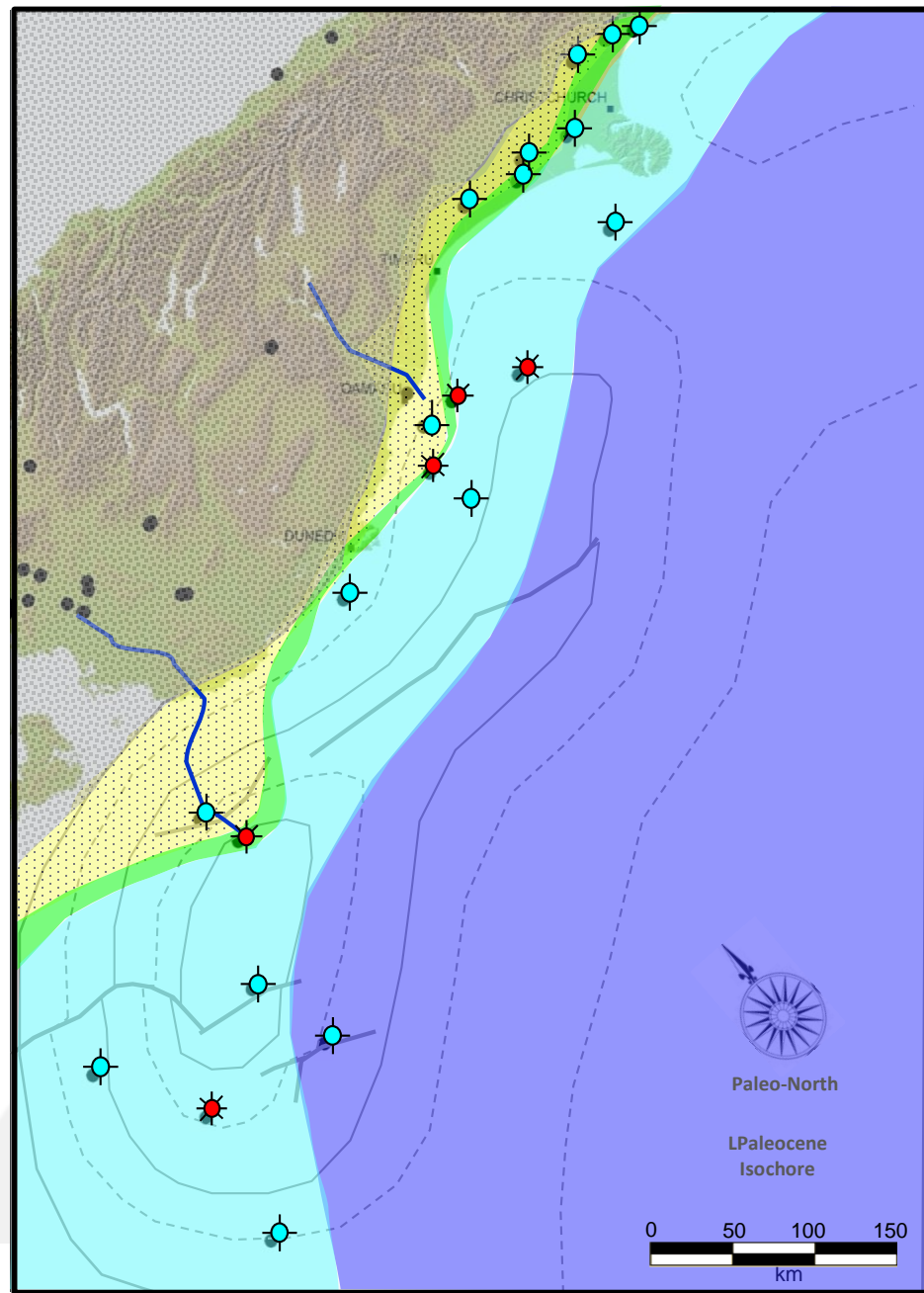
Open marine conditions prevail. A noticeably thick section is observed in the Great South Basin



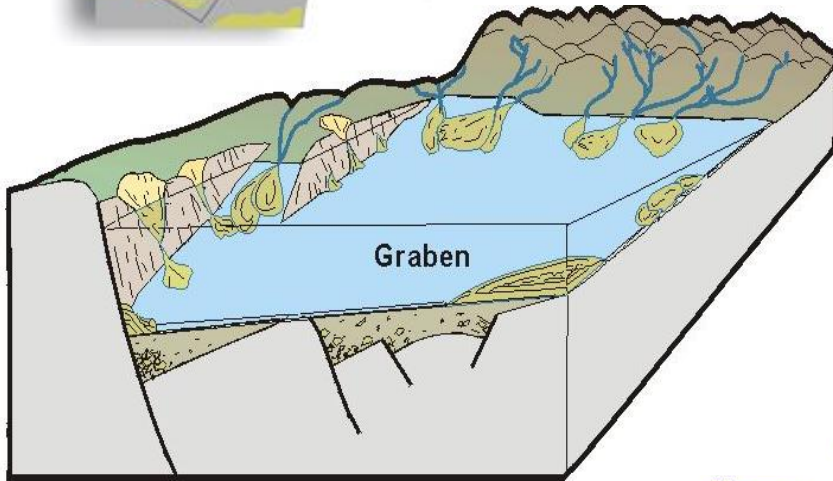
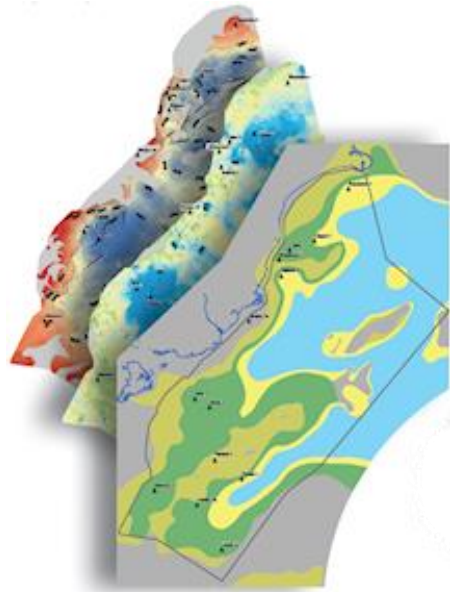
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Paleocene Depositional Environment

Deep marine incursion as transgression continues. Remaining source potential is now updip of all but the western most wells

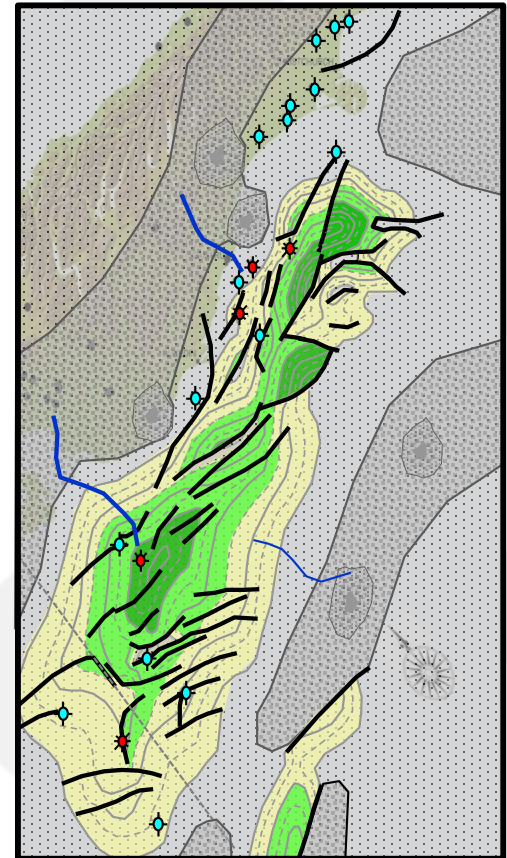
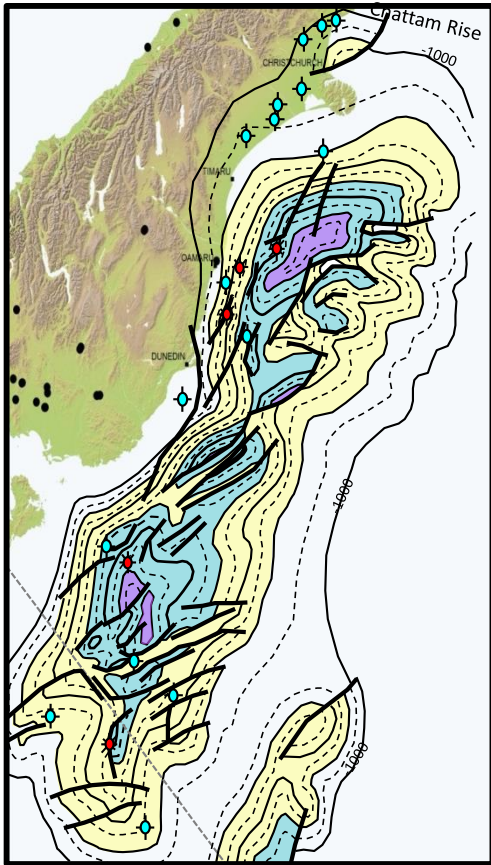


All structure maps were compiled from multiple publications, proprietary reports, and seismic interpretations and hand-contoured with a 500 meter contour interval



1. Rift Basin Depositional Sequences
2. Canterbury - GSB Stratigraphic Framework
3. Canterbury - GSB Structural Framework
4. Canterbury - GSB paleo-depositional environments
 - A. Basement
 - B. Mid Cretaceous
 - C. Late Cretaceous
 - D. Paleocene
5. Summary

Paleo Depositional Environment Maps



We have combined our understanding of the distribution of the various depositional environments in a basin and the structural and stratigraphic framework of the basin to predict the depositional environments within the Canterbury and Great South basins

Thank you