

New Zealand's Deepwater Frontier*

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Abstract

New Zealand's marine territories, the exclusive economic zone (EEZ) and extended continental shelf (ECS), have a combined total area of 5.2 million square kilometres. Of this area, approximately 1.2 million square kilometres is underlain by sedimentary basins which may be thick enough to generate and expel hydrocarbons.

To date, exploration has concentrated on the onshore and nearshore basins and only one, Taranaki, has produced significant volumes of hydrocarbons. The main reason for this is thought to be the active plate boundary which runs through the country, creating numerous petroleum traps and deforming them further, to compromise their integrity. The inference is that regions remote from the effects of the present plate boundary stand most chance of containing large volumes of trapped hydrocarbons.

Most basins have deepwater components that, until recently have been largely ignored by industry and have received only minimal research efforts. However, this is changing as both industry and government are beginning to recognise the potential of the deepwater basins.

New seismic data has been acquired over active exploration permits in the Deepwater Taranaki, Great South and Canterbury basins, and drilling commitments are due from companies in each of these basins within the next year. Meanwhile, both government and industry are acquiring reconnaissance seismic surveys across basins that have never been investigated with modern seismic.

The history of most basins dates from the early Mesozoic, when they formed as the Gondwana margin developed. Many styles are apparent from rift basins with little post-rift deformation, through rift basins with various degrees of post-rift inversion and compressional basins, later rifted. Previously, rocks older than Late Cretaceous were considered to be economic basement, the new information has extended the range of potential source rocks and petroleum systems. The potential of New Zealand's sedimentary basins is considered to be high and New Zealand may become the "North Sea" of the southwest Pacific.

New Zealand's Deepwater Frontier

AAPG New Orleans April 2010



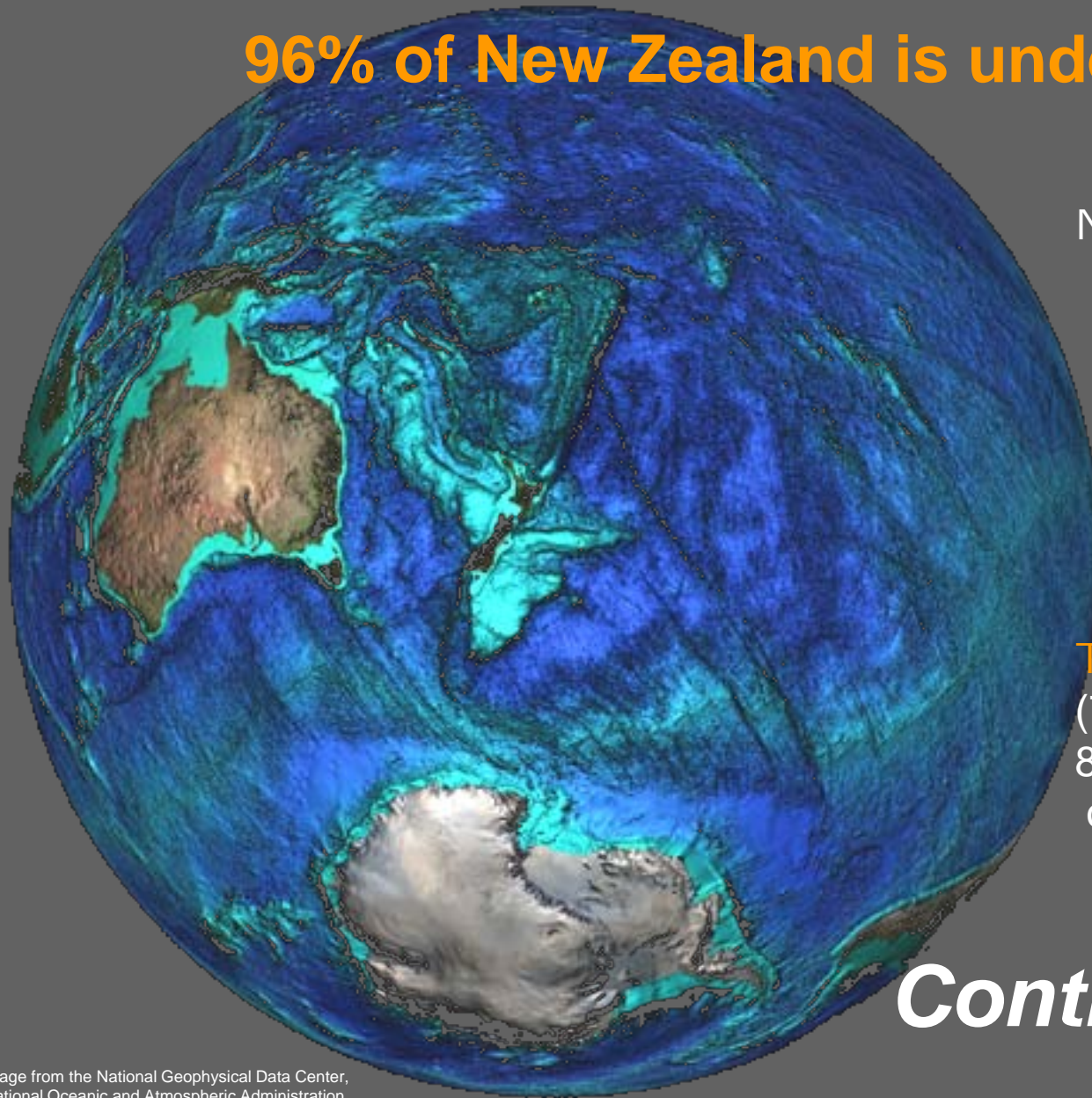
Chris Uruski

Frontier Basins

GNS Science



96% of New Zealand is under water



New Zealand
250,000 km²

EEZ & territorial sea
4,100,000 km²

Continental shelf
1,700,000 km²

Total > 6 M km²

(79% of area of Australia
82% of contiguous states
of USA)

Continental-scale Resources !

Image from the National Geophysical Data Center,
National Oceanic and Atmospheric Administration,
U.S. Department of Commerce

Notes by Presenter (see previous slide): The islands of New Zealand are the emergent fragments of a vast submarine continent that stretches from Tonga, Fiji and the Coral Sea in the north to the sub-Antarctic islands in the south. New Zealand's maritime estate includes the EEZ, continental shelf, and responsibility for the Ross Sea.

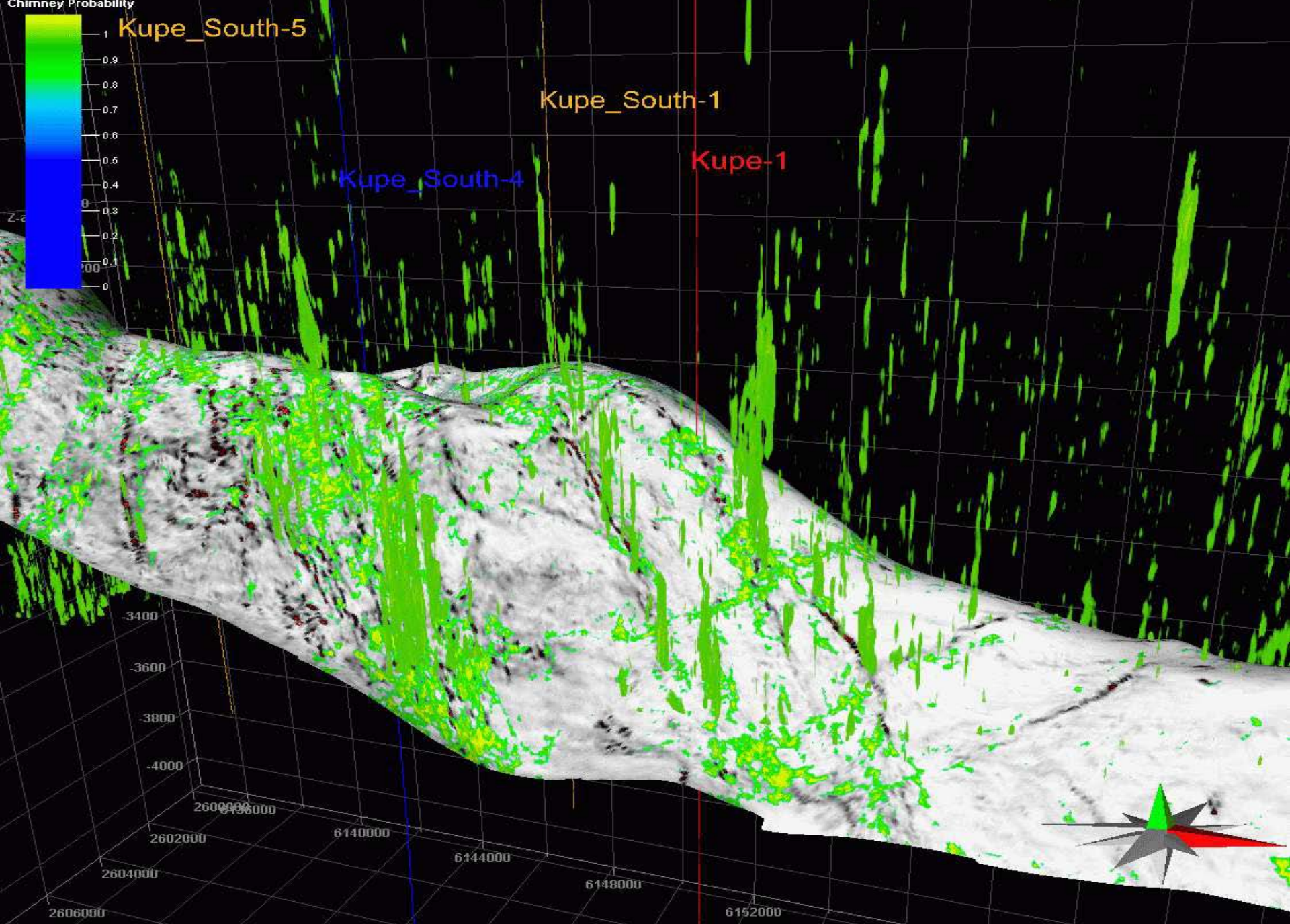
New Zealand is quite isolated today, but it was once connected to Antarctica and Australia, part of the Gondwana super-continent. A plate tectonic boundary runs through New Zealand, and if it were not for this, New Zealand would be below sea level like the rest of the surrounding plateaus.

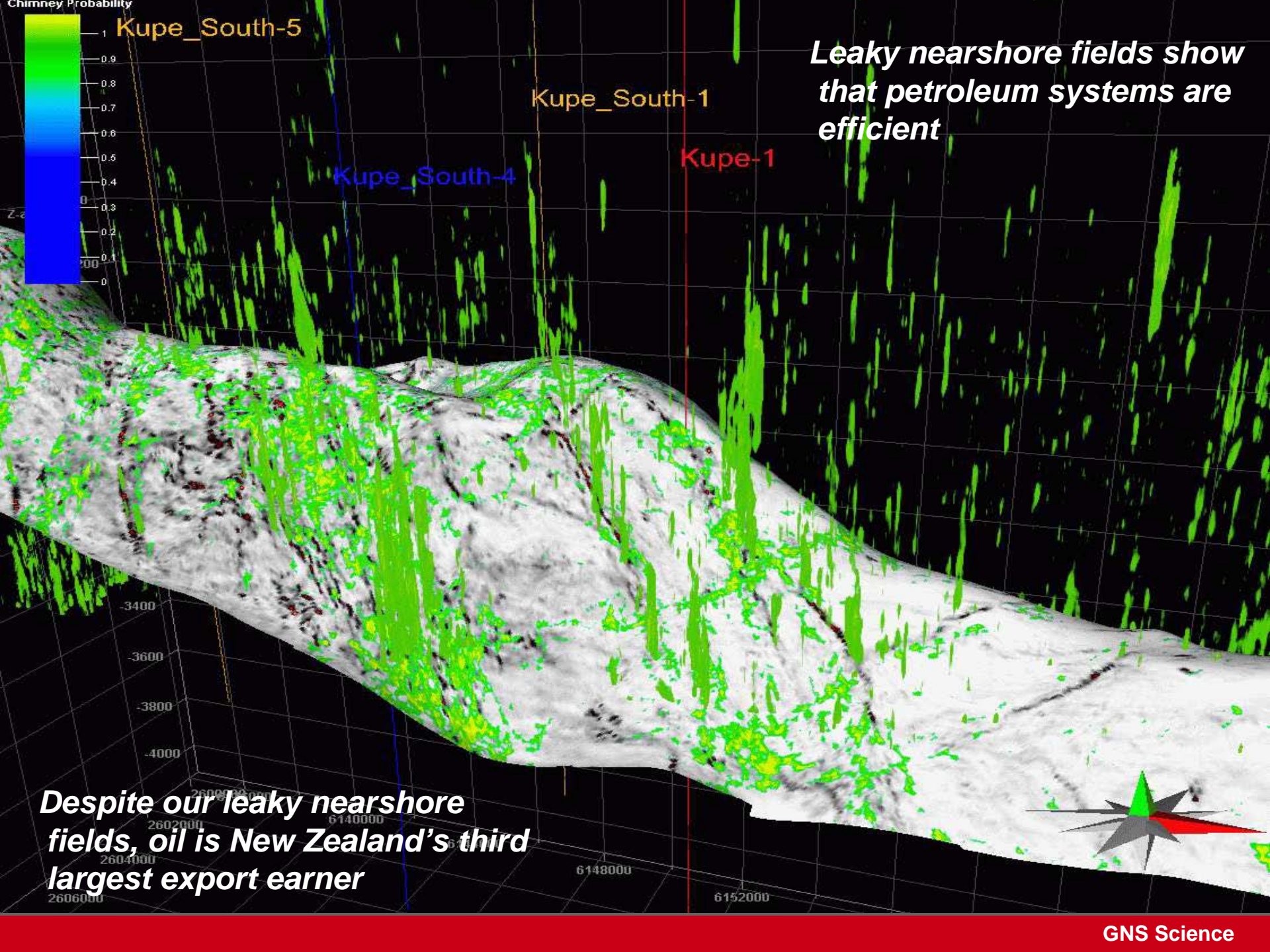
New Zealand has a land area of about 250,000 km², about the same as the UK. It has the fifth largest EEZ in the world, encompassing an area of about 4 million km². A 10-year project to determine the extent of the continental shelf beyond the EEZ has just been completed, and after discussions with the UN, we expect confirmation that it is of the order of 1.7 million km². In addition, New Zealand has responsibility for about 1.5 million km² in the Ross Sea. If we consider the land area, EEZ and legal continental shelf, then about 96% of New Zealand is under water.

This large area is certain to have resources that will contribute to New Zealand's future economic prosperity. Although we know something about some of the resources that are there, we know so little about the offshore region that we cannot predict where they are. In addition, we know that we will find resources that we have not even thought about today. Knowledge of the ocean - the water column, the sea floor, what lives on it, and what lies beneath it - is essential for informed management of New Zealand's offshore mineral resources.

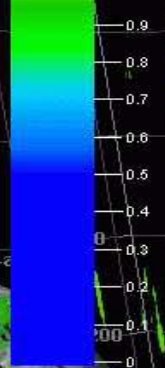
Why Explore in deep water?







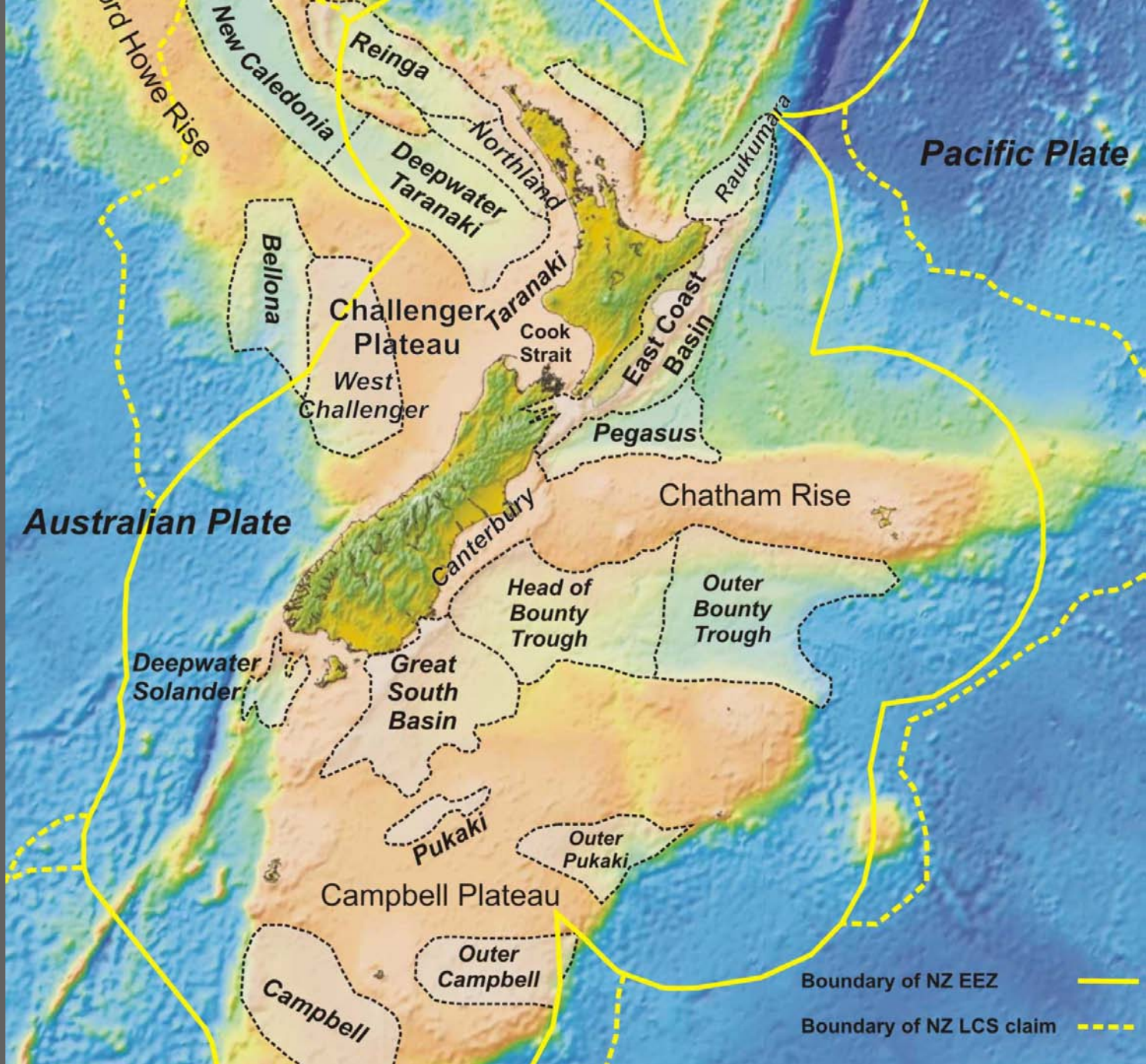
Chimney Probability



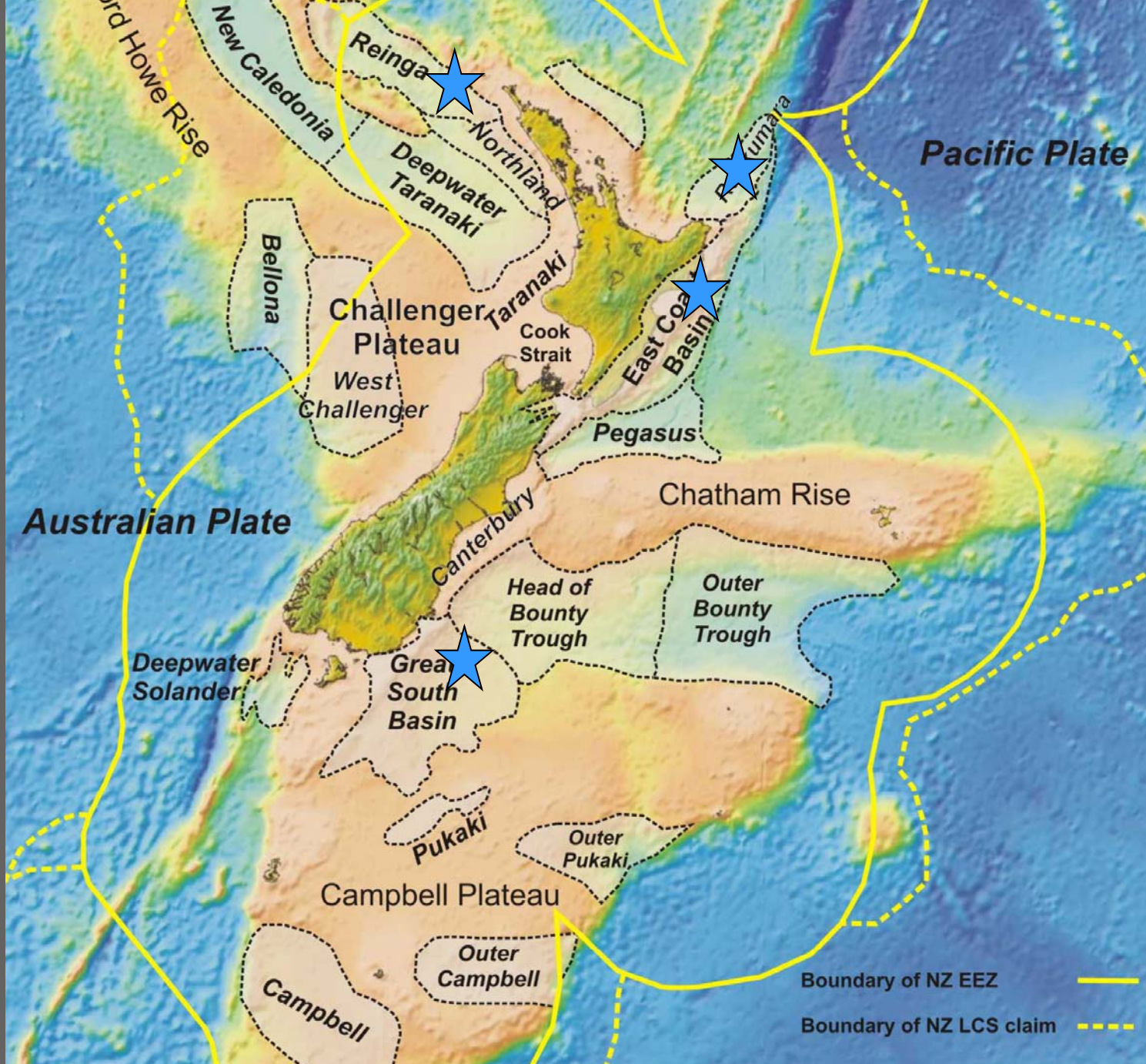
Leaky nearshore fields show that petroleum systems are efficient

Despite our leaky nearshore fields, oil is New Zealand's third largest export earner

New Zealand's Deepwater Sedimentary Basins



Past projects

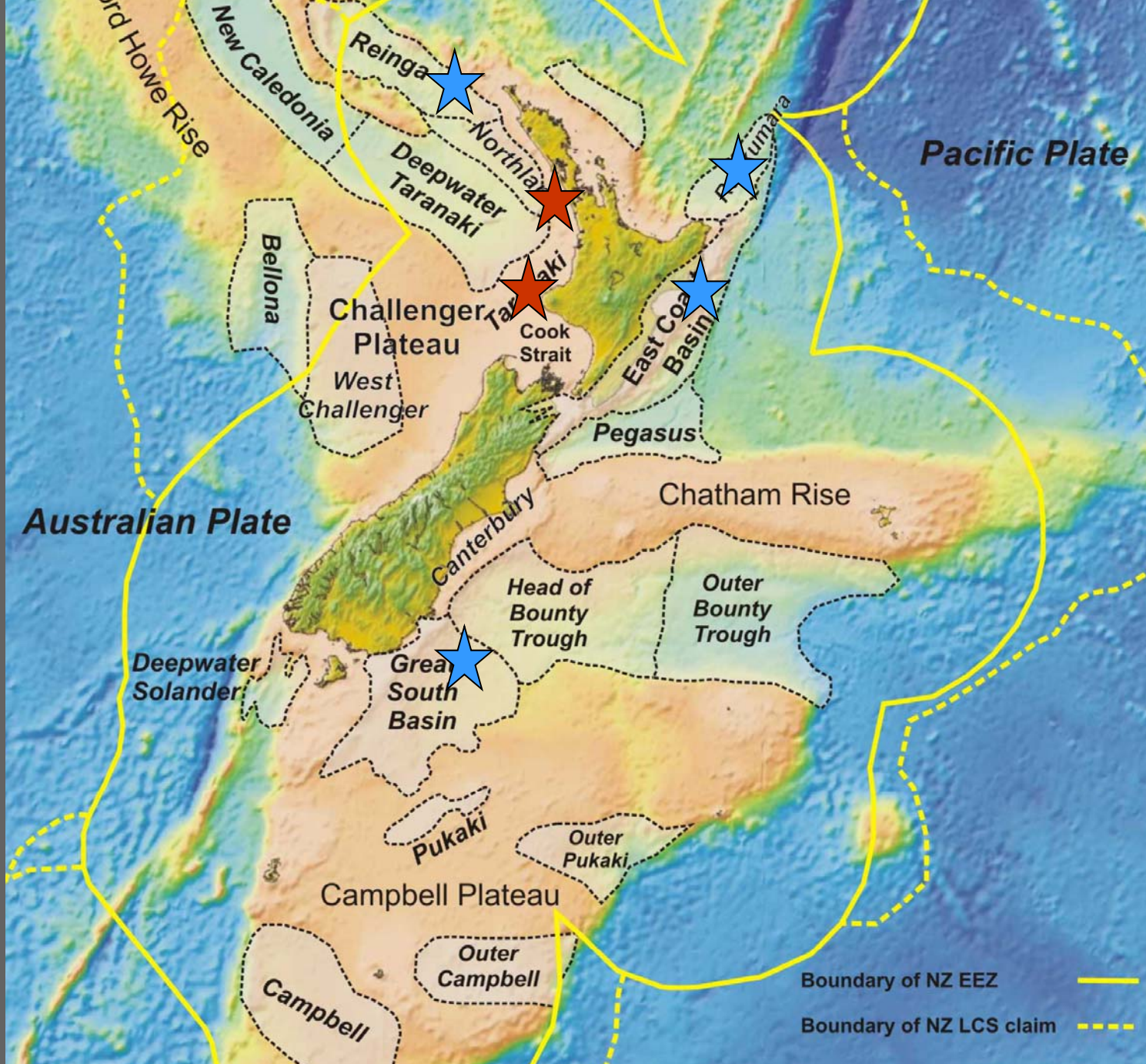


Boundary of NZ EEZ ———
Boundary of NZ LCS claim - - - -

Past projects



Drilling imminent



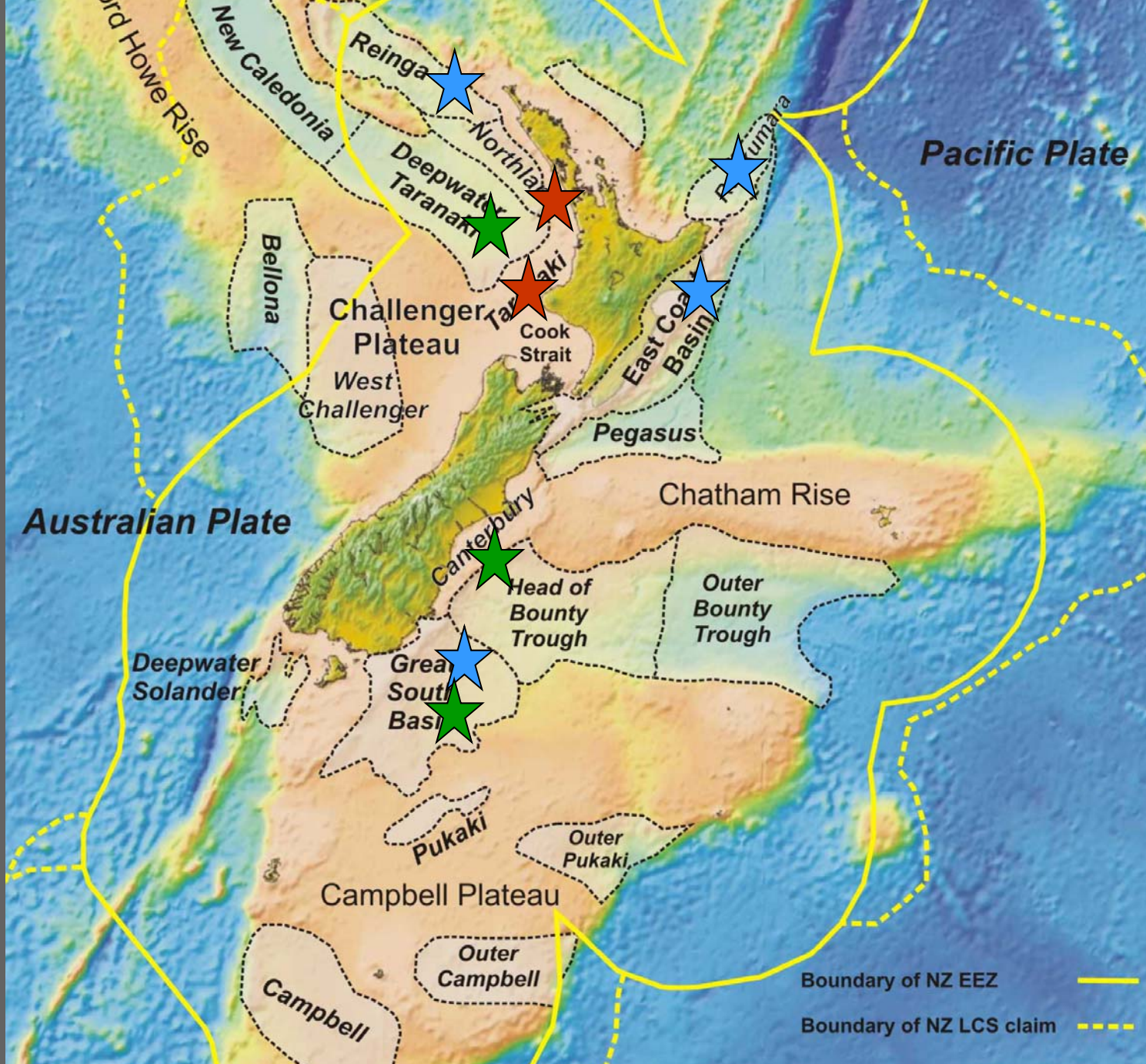
Past projects



Drilling imminent



Awaiting wells



Past projects



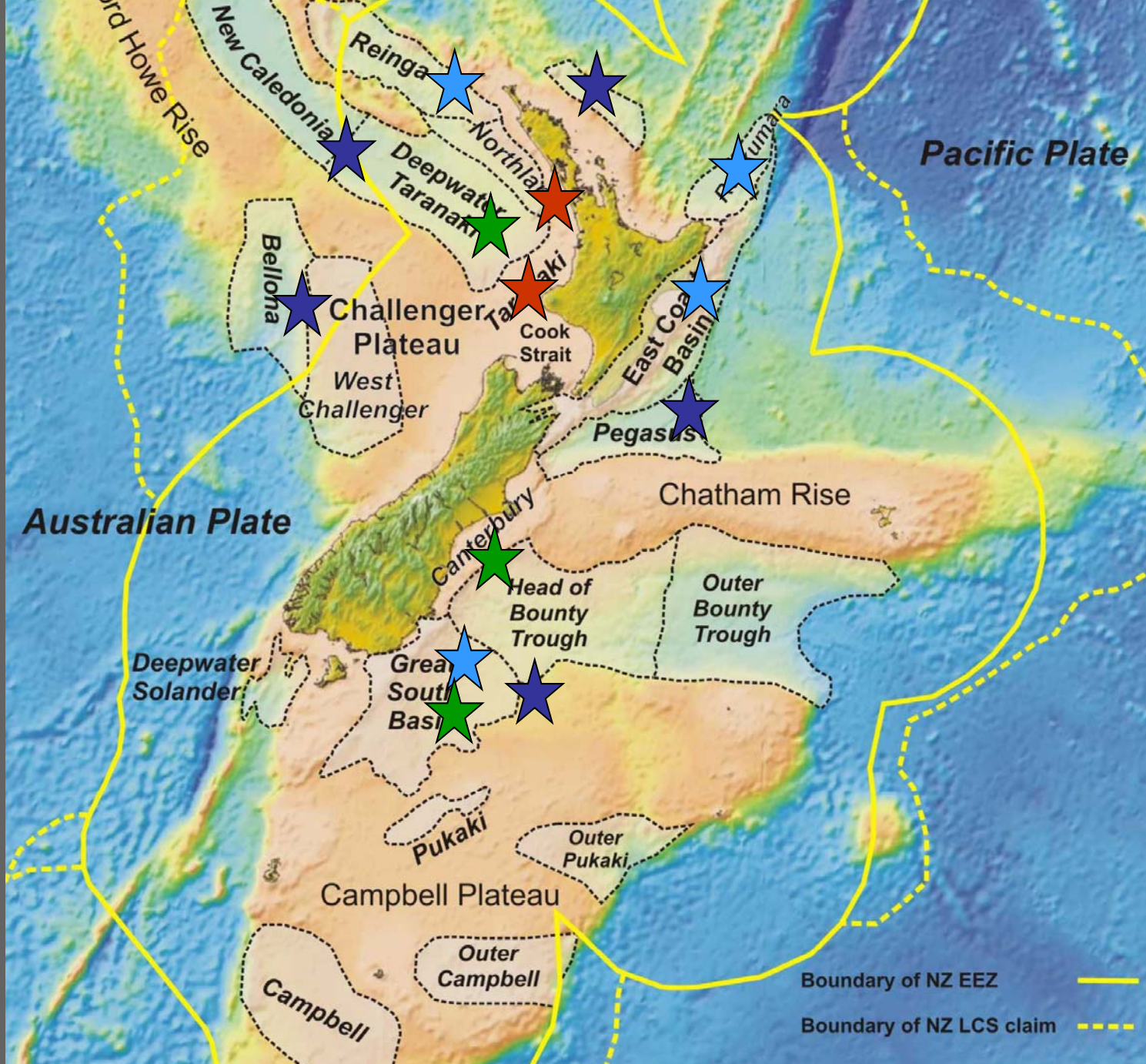
Drilling imminent



Awaiting wells



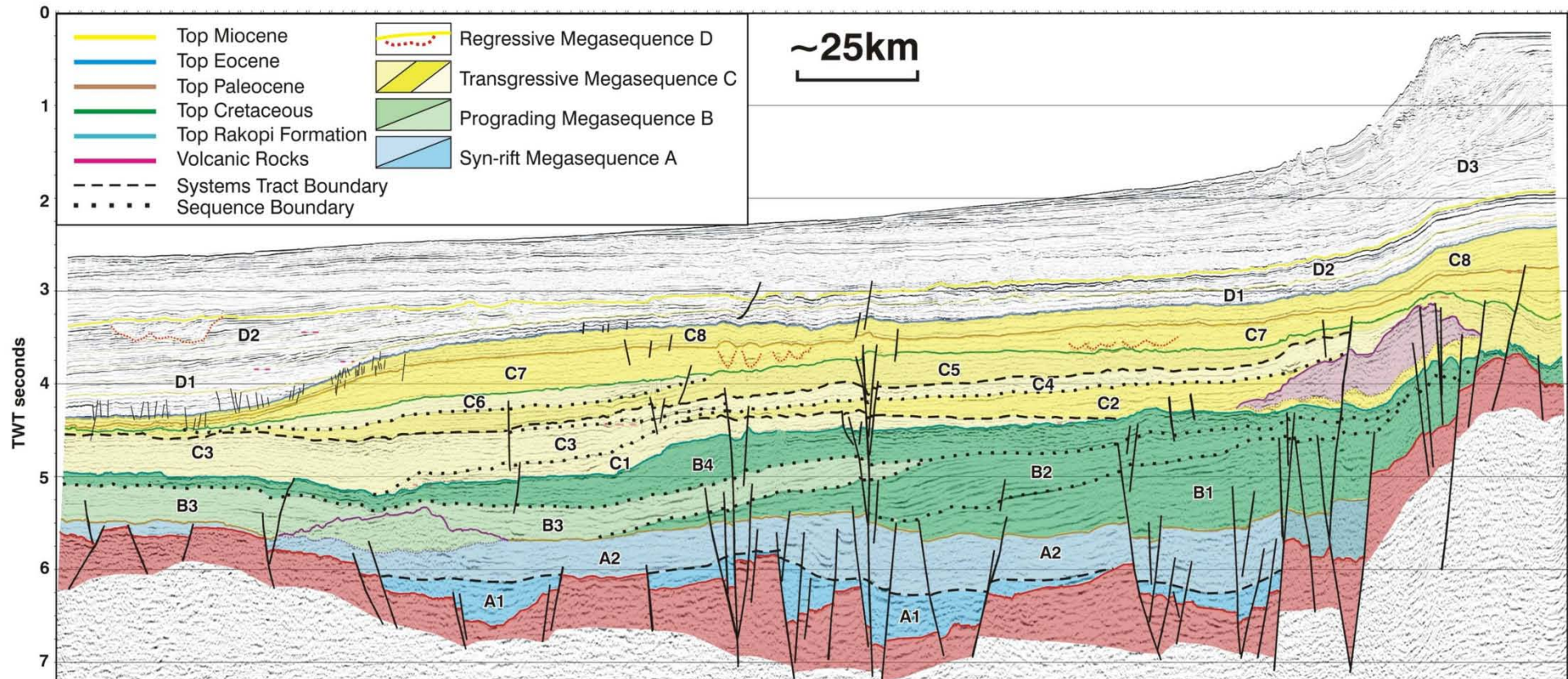
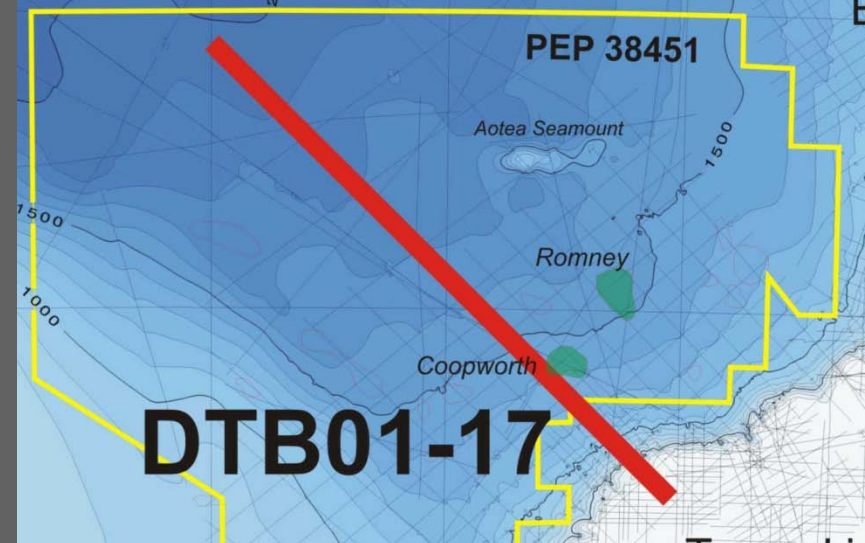
Crown surveys imminent



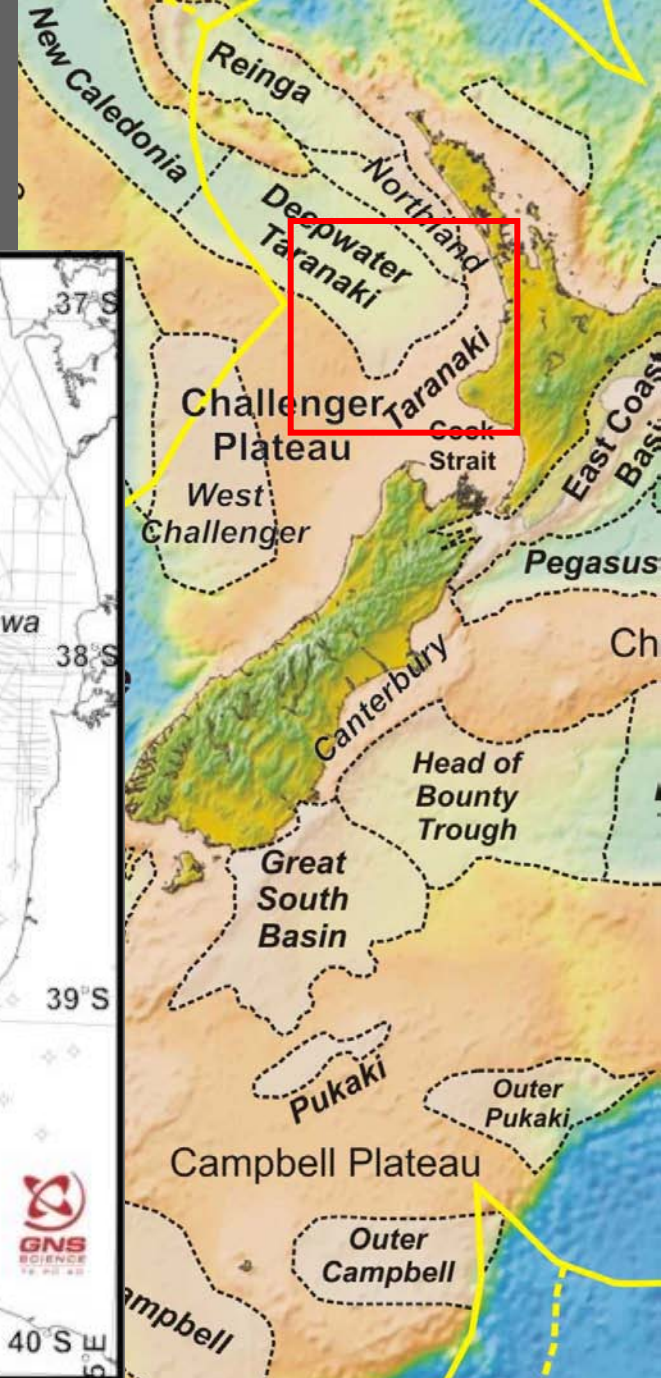
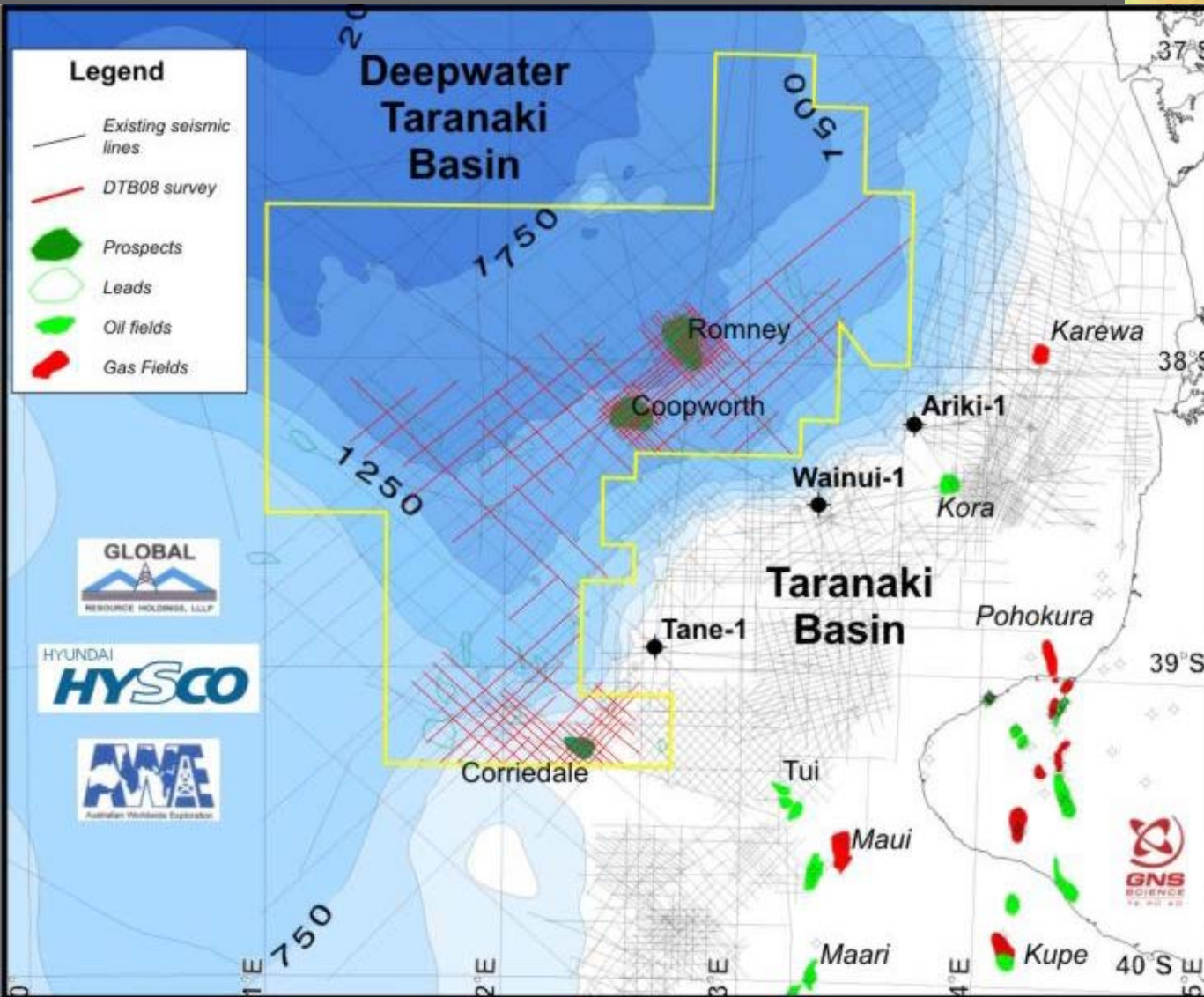
Boundary of NZ EEZ

Boundary of NZ LCS claim

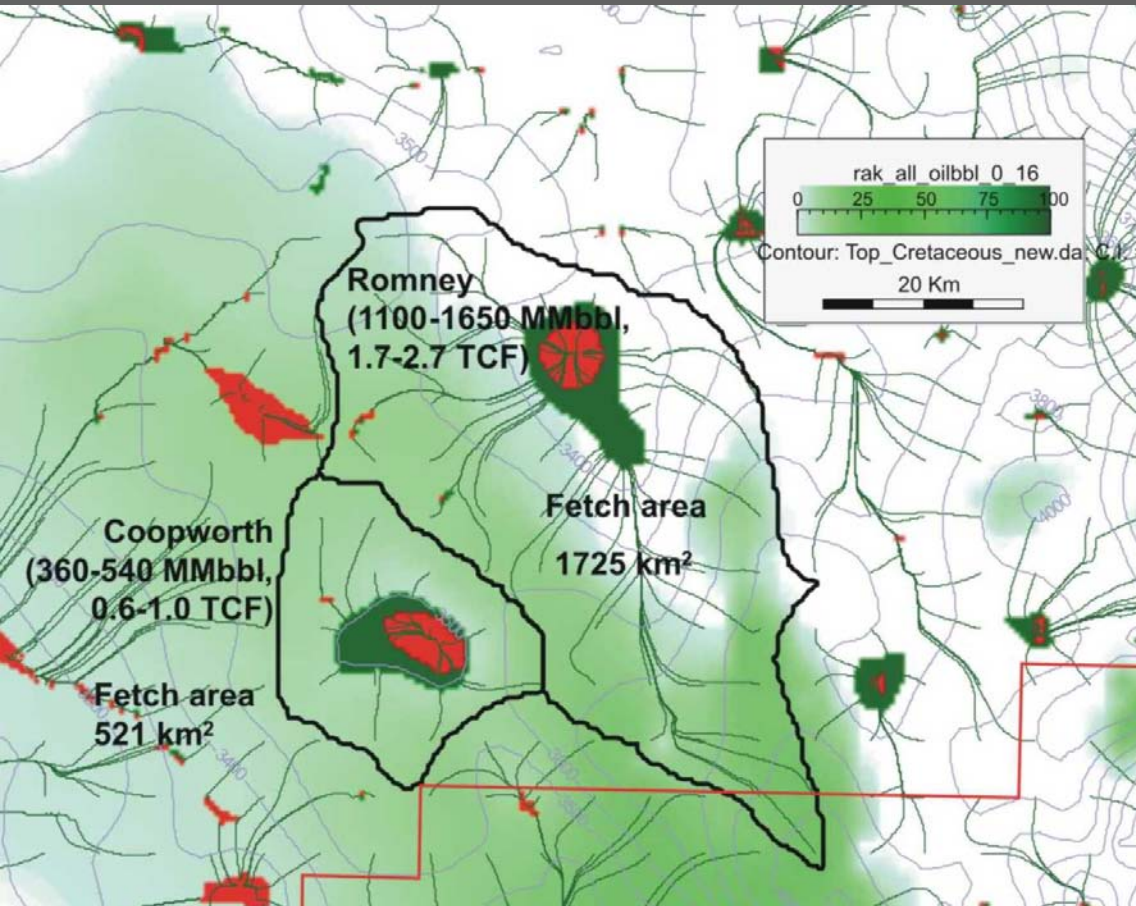
The Taranaki Delta



PEP 38451 DEEPWATER TARANAKI BASIN



Migration and Trapping



Romney Prospect

Water depth: ~ 1600 m
Fetch Area: 1725 km²
Expelled: 10,830 MMbbl oil
Area of Closure: 200 km²
Charge: 1100-1650 MMbbl oil
Filled to spill: 2,800 MMbbl oil

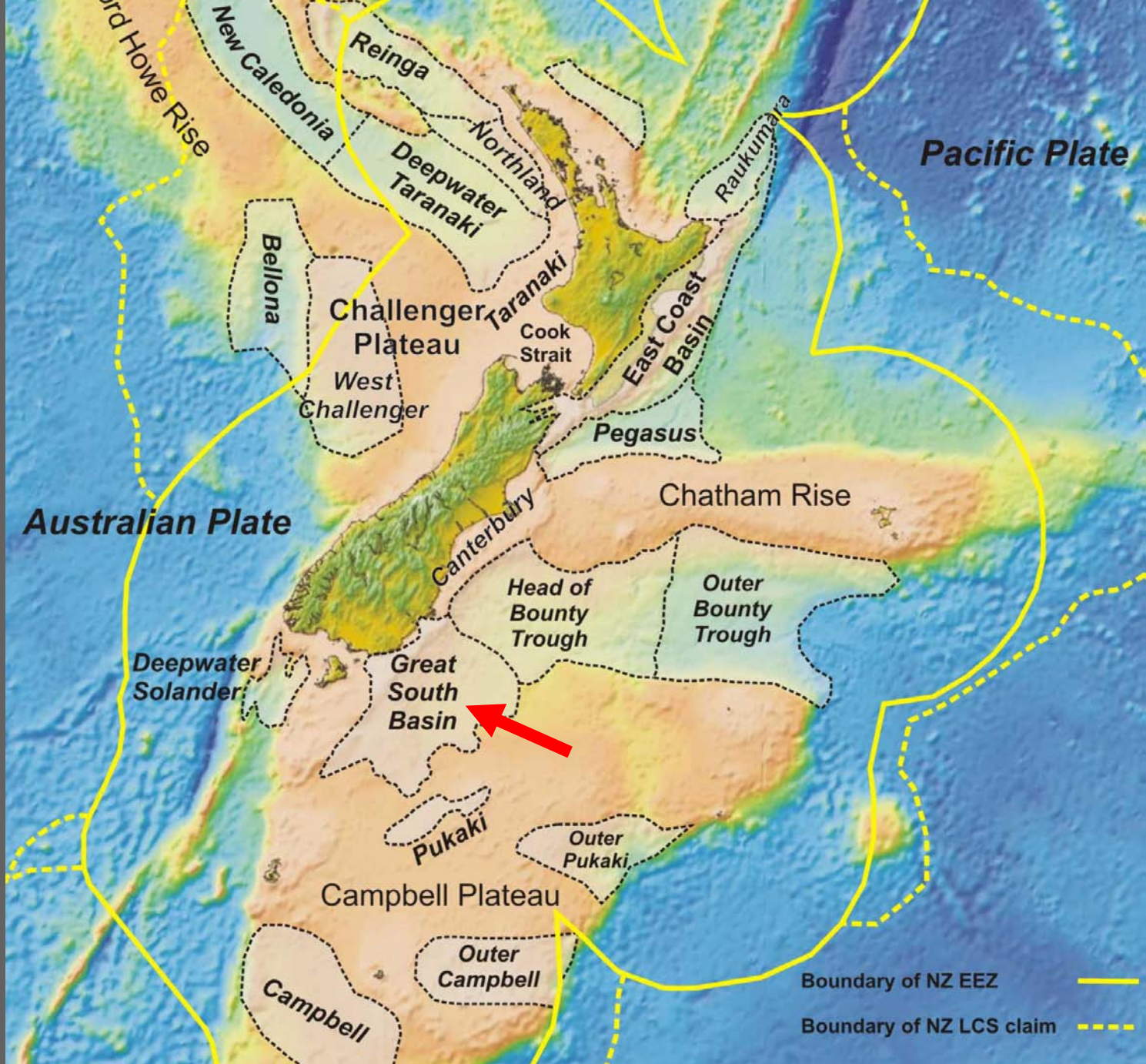
Coopworth Prospect

Water Depth: ~ 1400 m
Fetch area: 521 km²
Expelled: 3,850 MMbbl oil
Area of Closure 130 km²
Charge: 360-540 MMbbl oil
Filled to spill: 1,700 MMbbl oil

(Figures are for oil in place)



New Zealand's Deepwater Sedimentary Basins



GREAT SOUTH BASIN

A geological map of the Great South Basin, showing various sub-basins and well locations. The map is color-coded, with red and orange representing higher elevations or older rocks, and blue and green representing lower elevations or younger rocks. Several vertical lines represent well locations, and a black arrow points to the Pukaki Sub-basin.

Pukaki Sub-basin →

- AREA: 100,000 km²
- Up to 10,000 m thick
- Cretaceous rift basin
- Minor Neogene inversion
- 8 wells from 1976 to 1984
- Four with shows
- Kawau-1A 461 bcf gas-condensate

GREAT SOUTH BASIN

Tara-1

Pakaha-1

- AREA: 100,000 km²
- Up to 10,000 m thick
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- 8 wells from 1976 to 1984
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Pukaki Sub-basin

GREAT SOUTH BASIN

Kawau-1

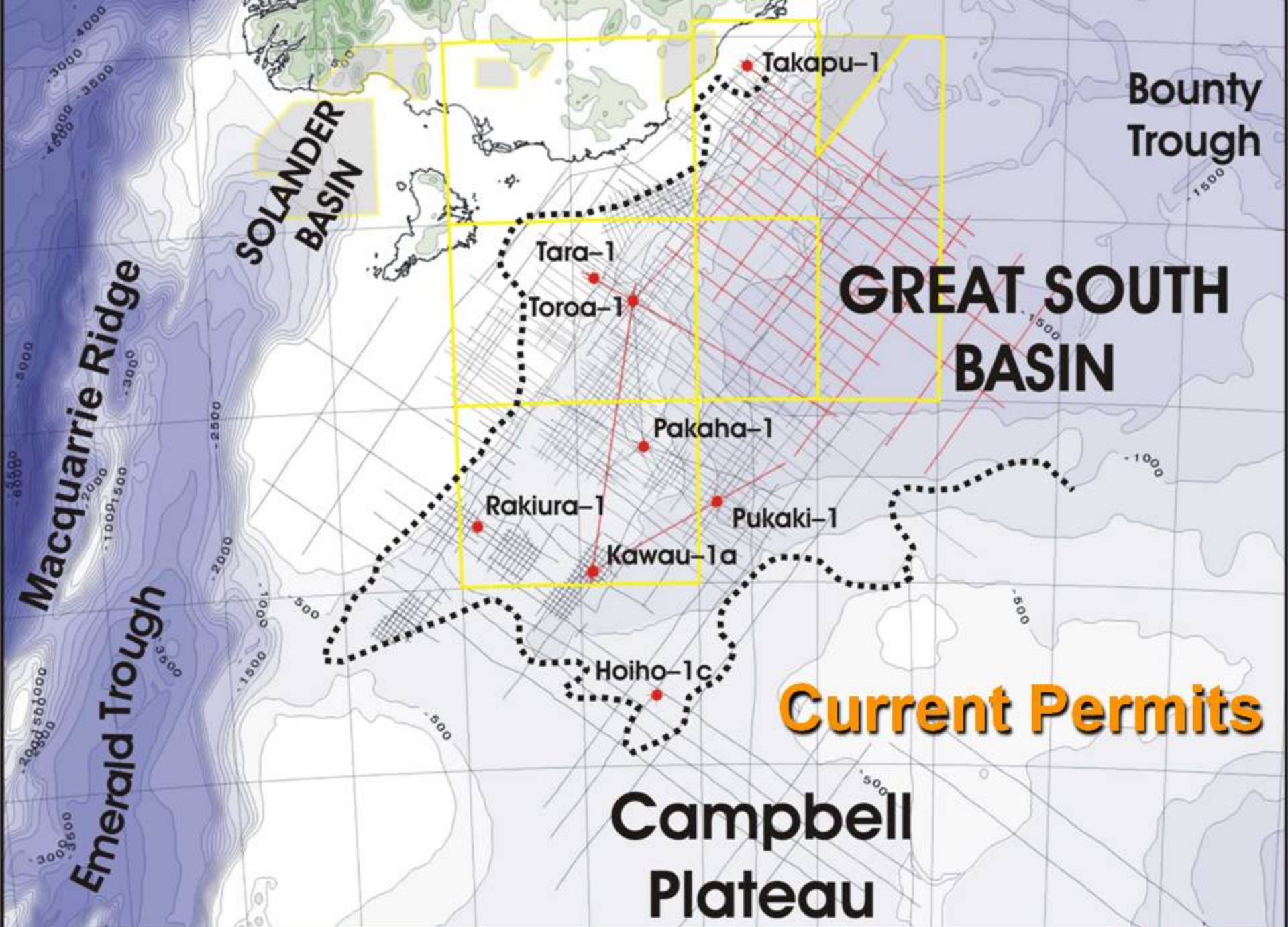
Pakaha-1

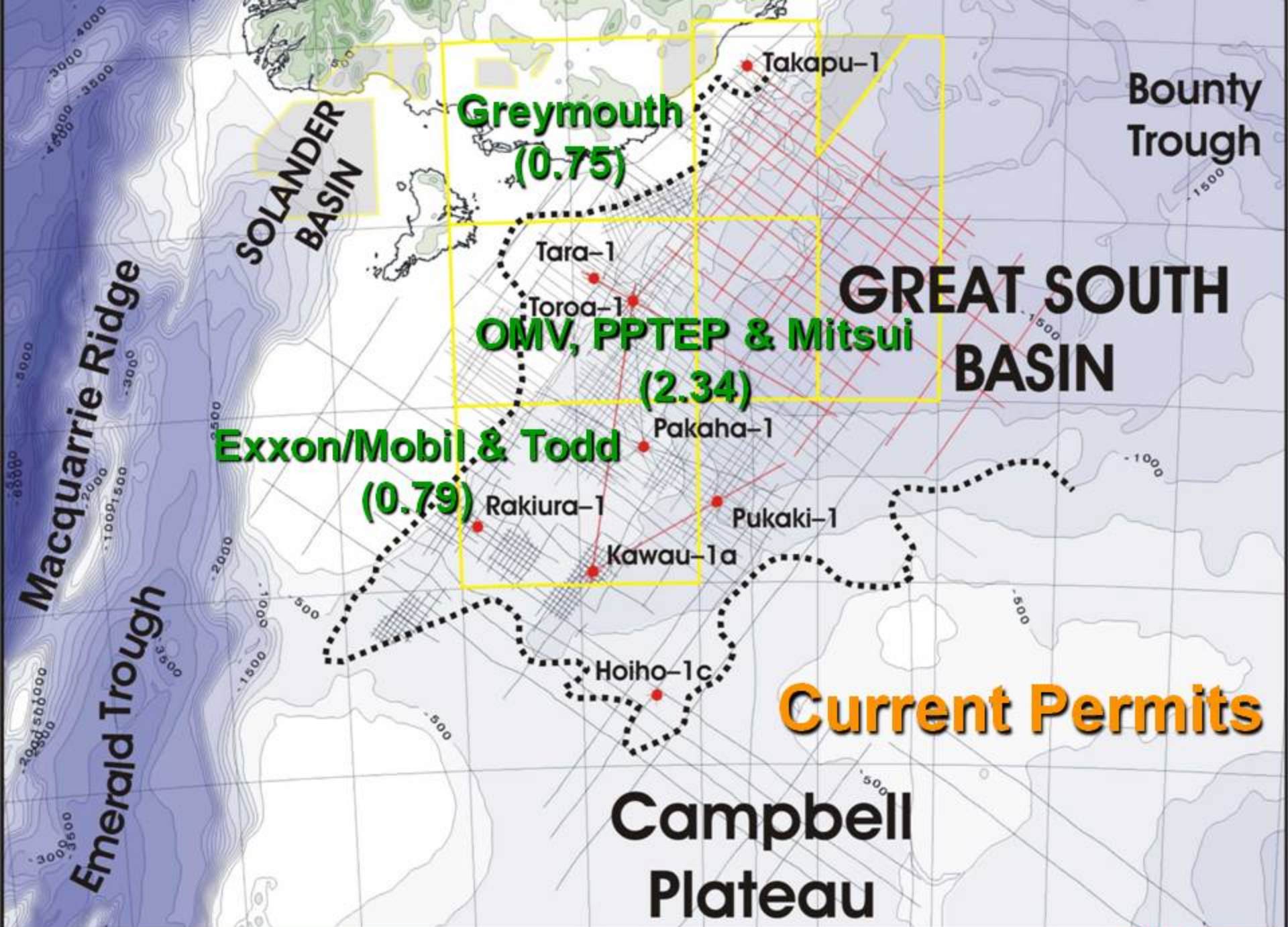
Tara-1

Toroa-1

Pukaki Sub-basin

- AREA: 100,000 km²
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Bounty Trough

SOLANDER BASIN

**Greymouth
(0.75)**

Takapu-1

Tara-1

Toroa-1

**OMV, PPTEP & Mitsui
(2.34)**

**GREAT SOUTH
BASIN**

**Exxon/Mobil & Todd
(0.79)**

Pakaha-1

Rakiura-1

Pukaki-1

Kawau-1a

Hoiho-1c

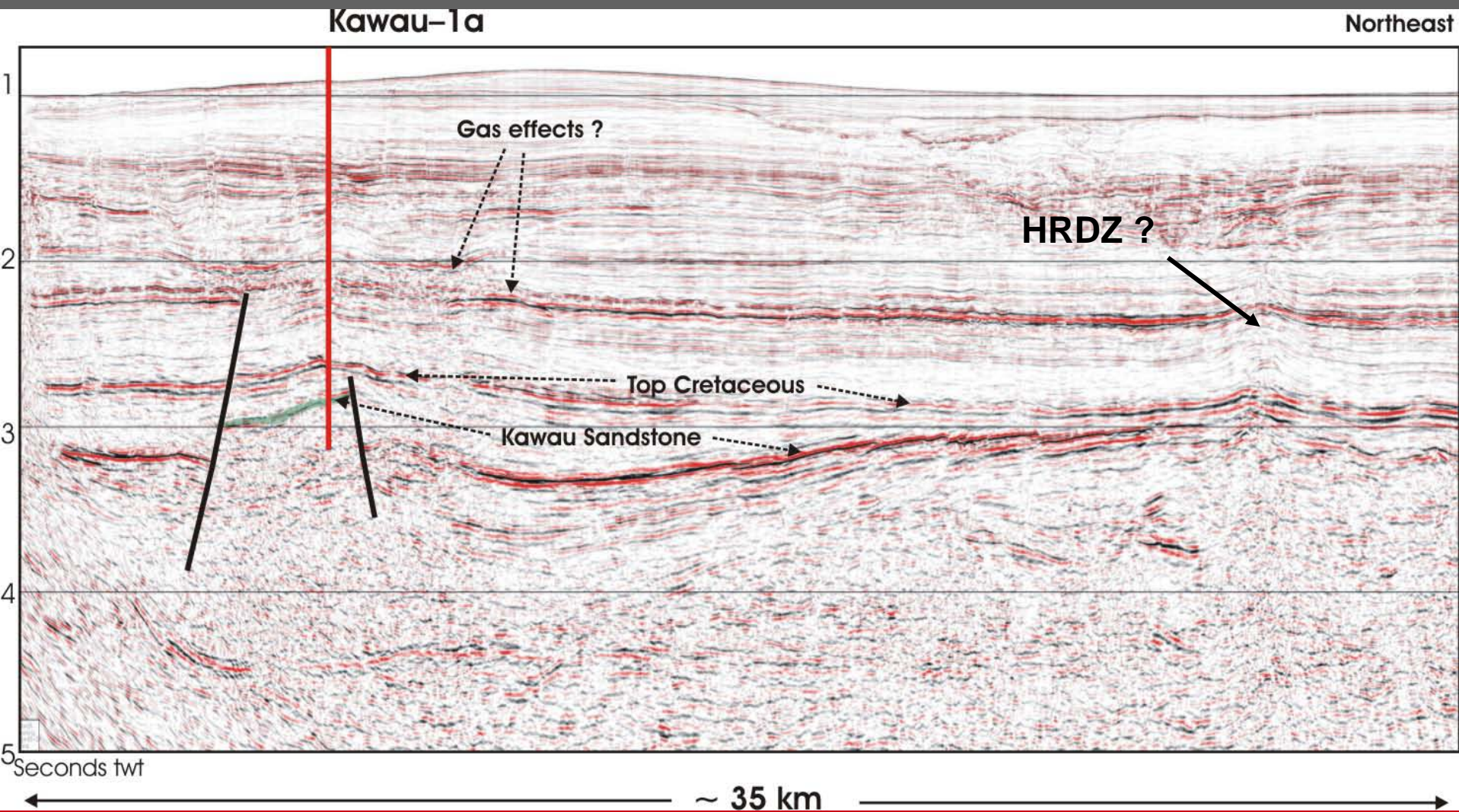
Current Permits

**Campbell
Plateau**

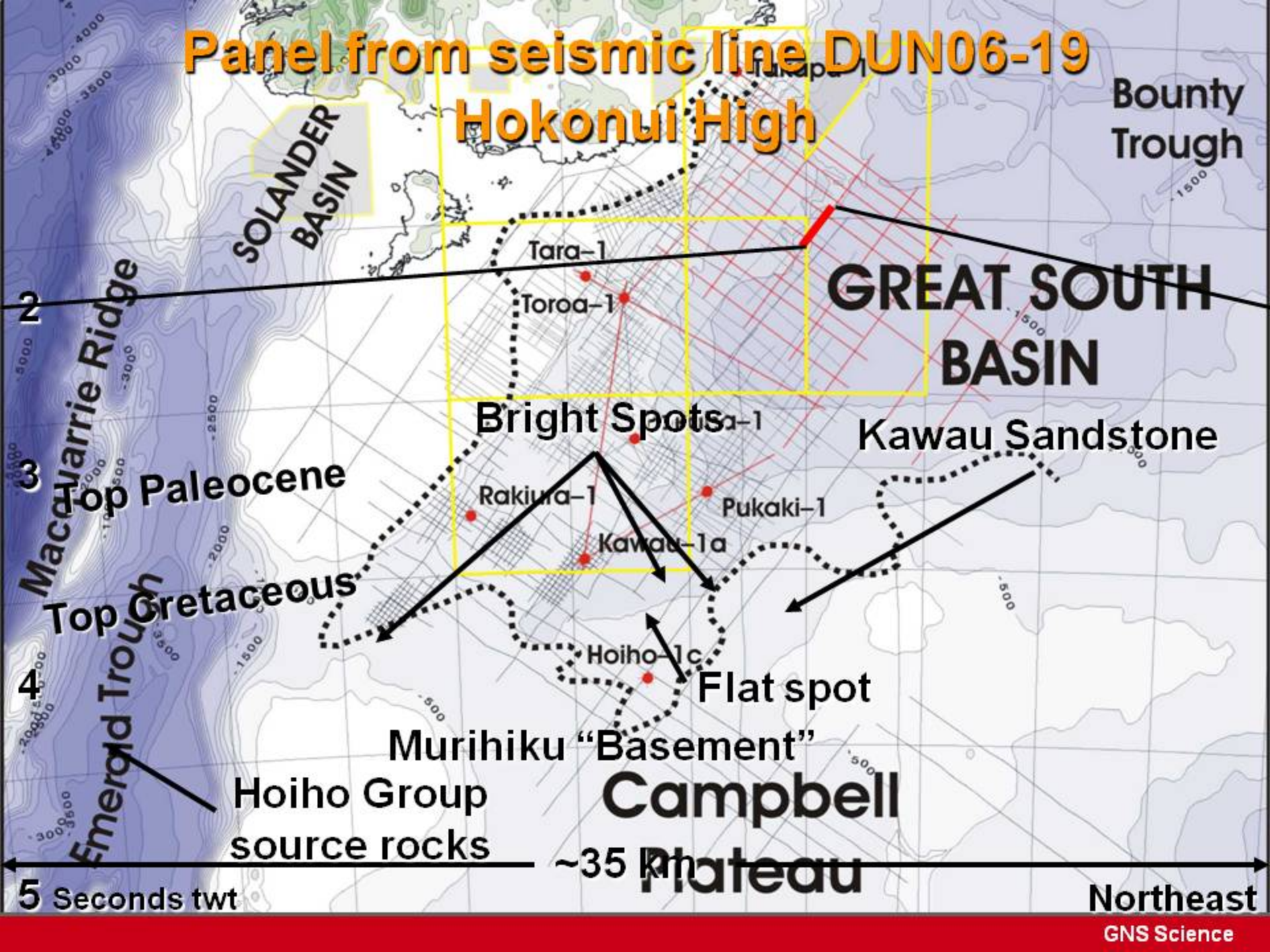
Macquarrie Ridge

Emerald Trough

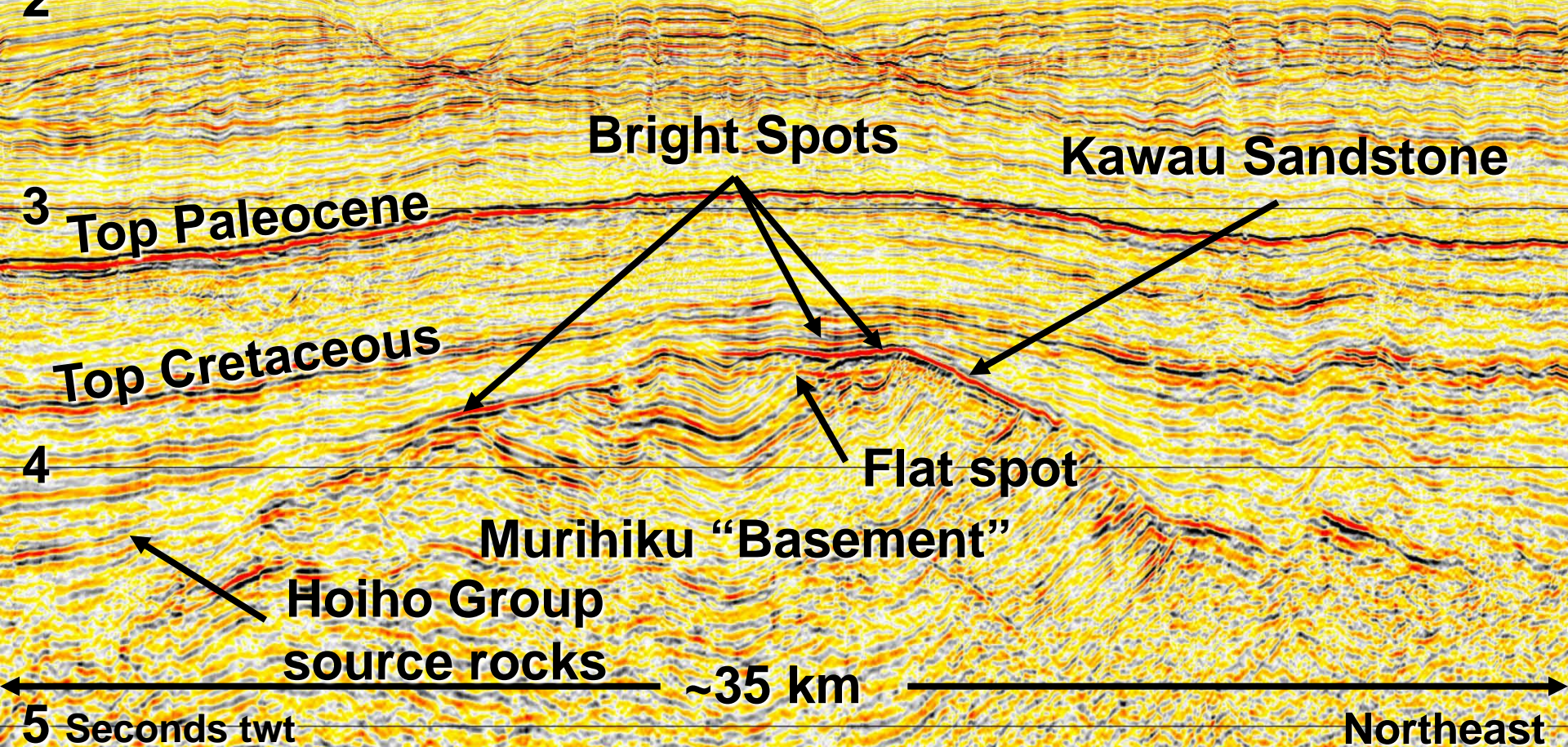
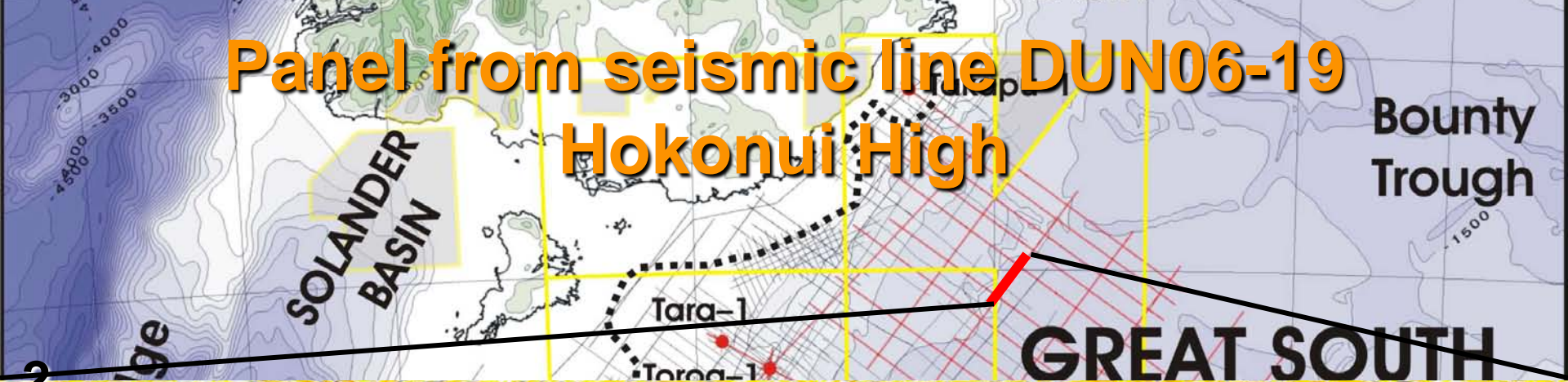
Kawau gas-condensate discovery



Panel from seismic line DUN06-19 Hokonui High



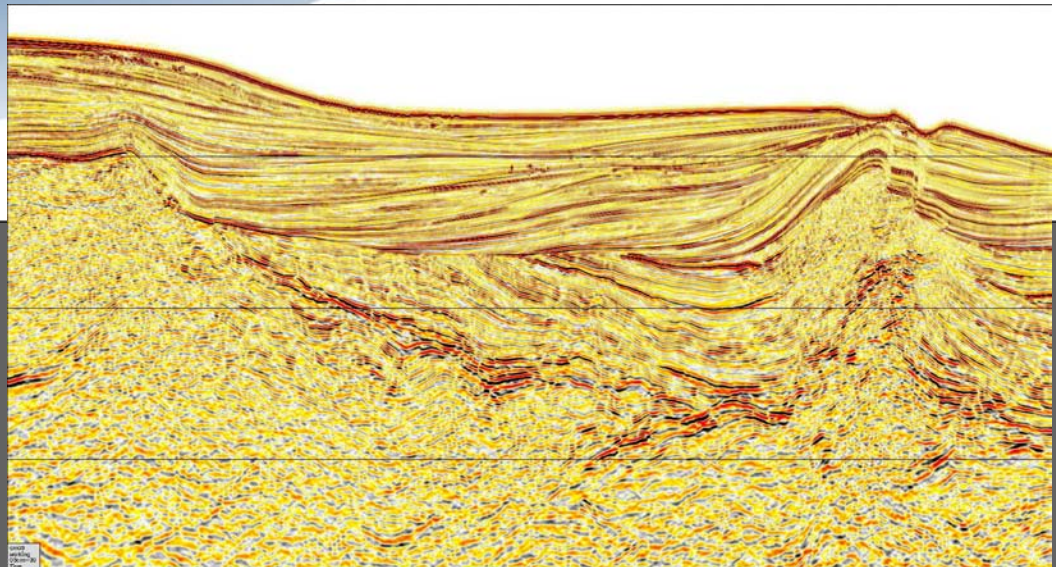
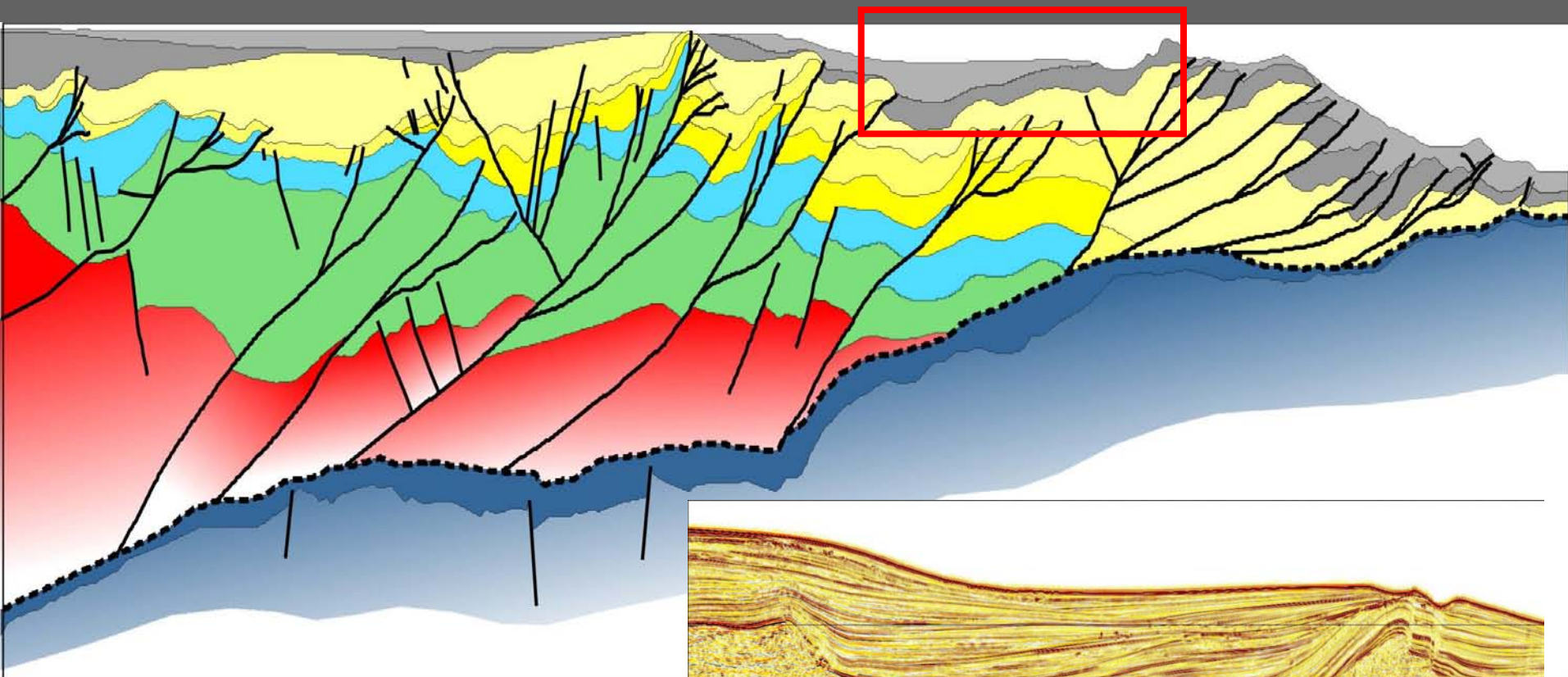
Panel from seismic line DUN06-19 Hokonui High



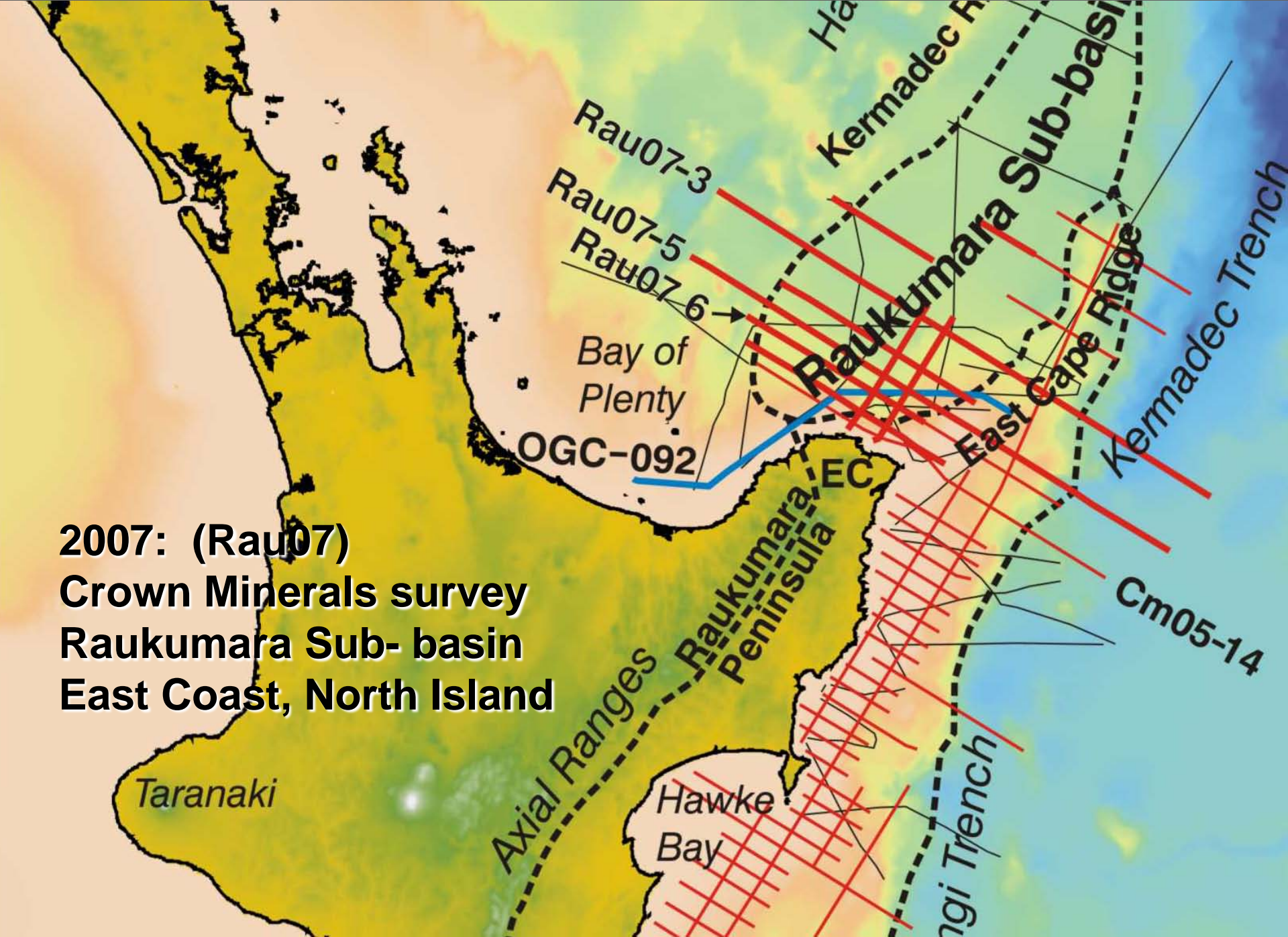
Basins along the collisional margin



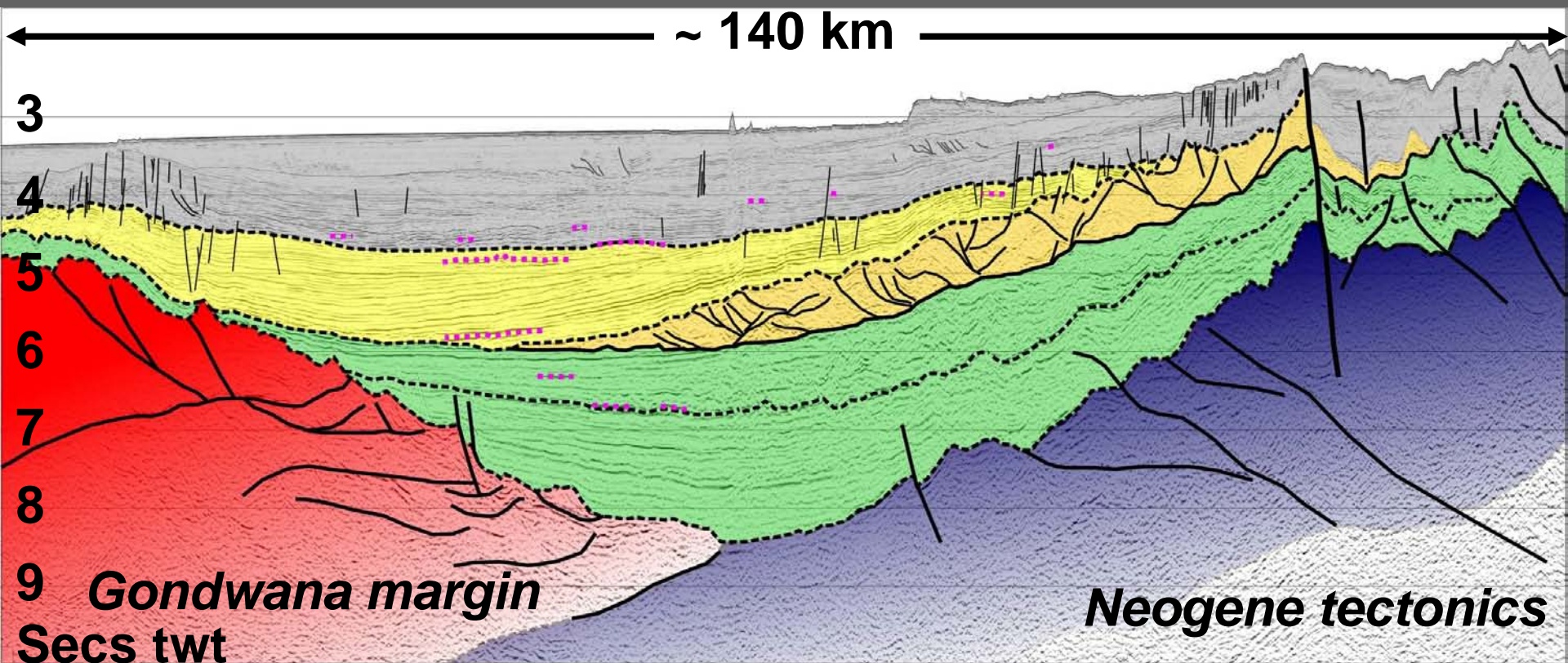
Typical East Coast complexity



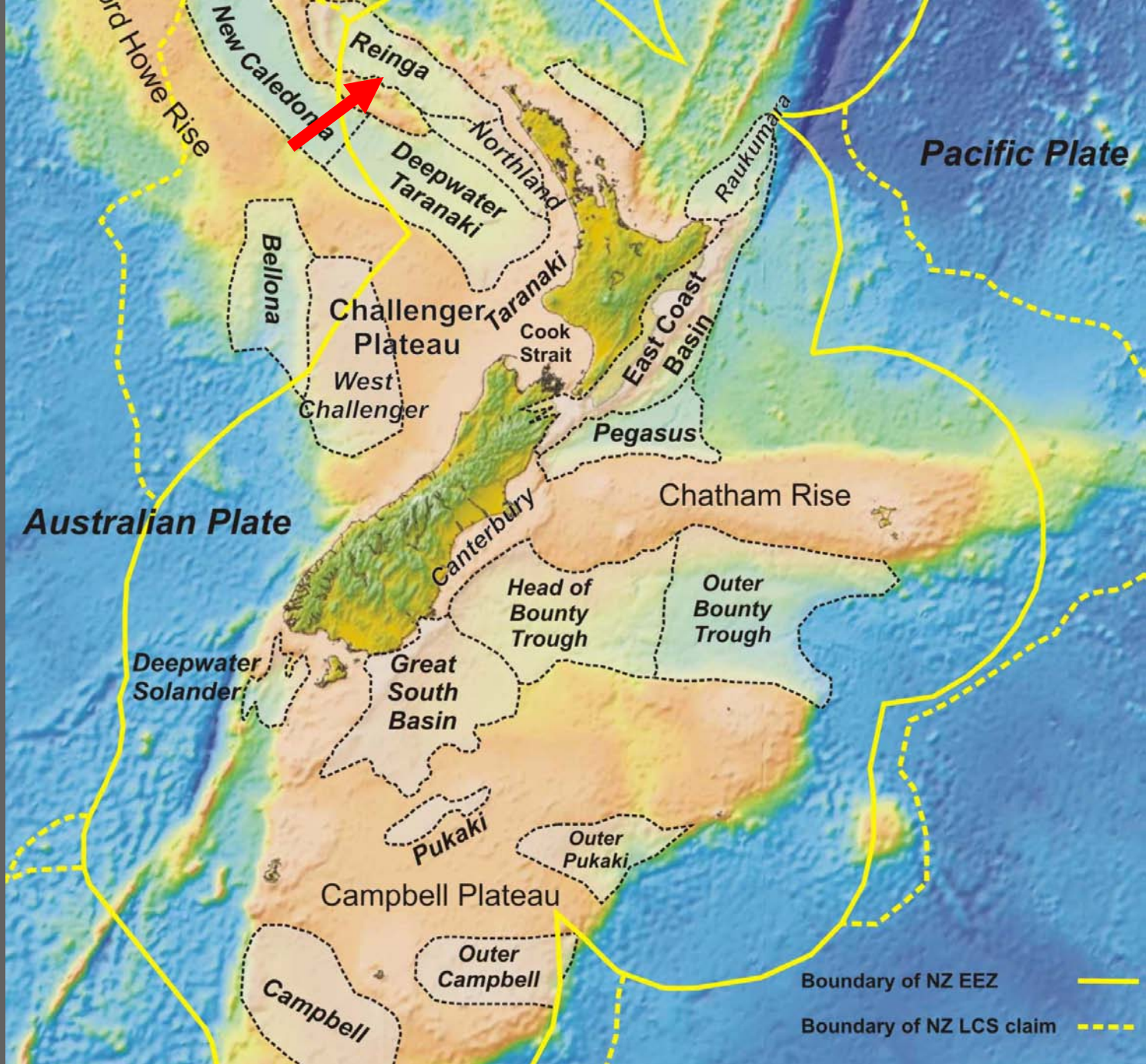
**2007: (Rau07)
Crown Minerals survey
Raukumara Sub-basin
East Coast, North Island**



Raukumara Sub-basin (RAU07-003)



New Zealand's Deepwater Sedimentary Basins





Reinga Basin 2D survey 2009

Reinga/Northland Basin

Thick sediments – large areas mature

~ 100 km



West Norfolk Ridge

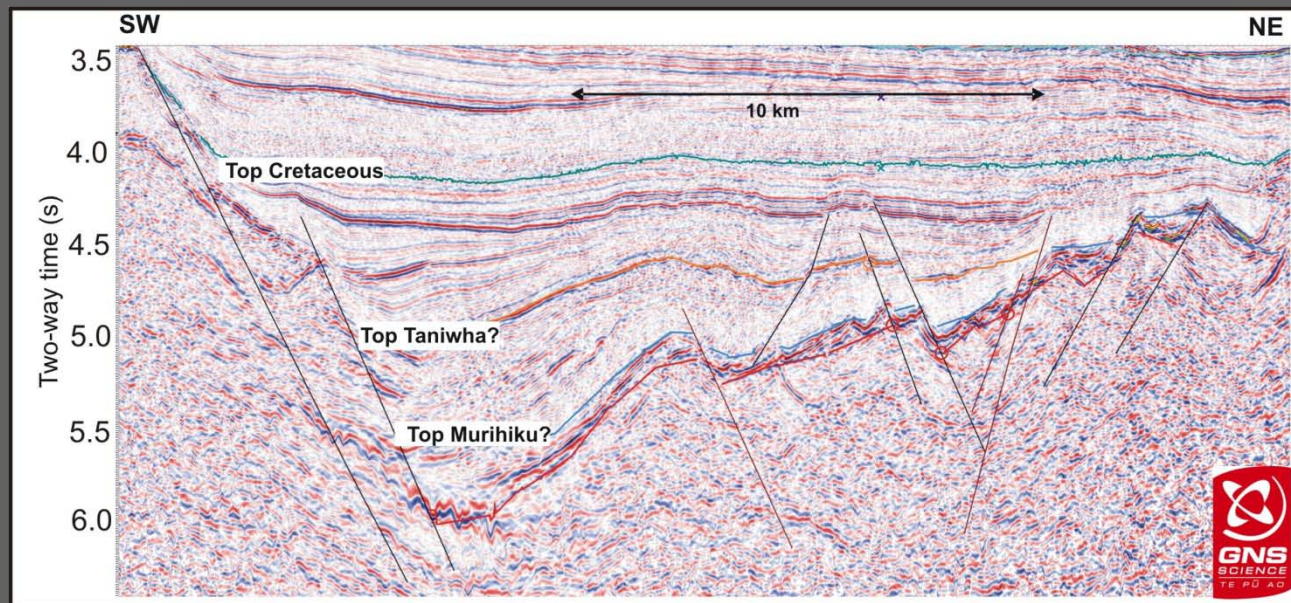
Total sediment thickness 2
-8000 -6000 -4000 -2000 0



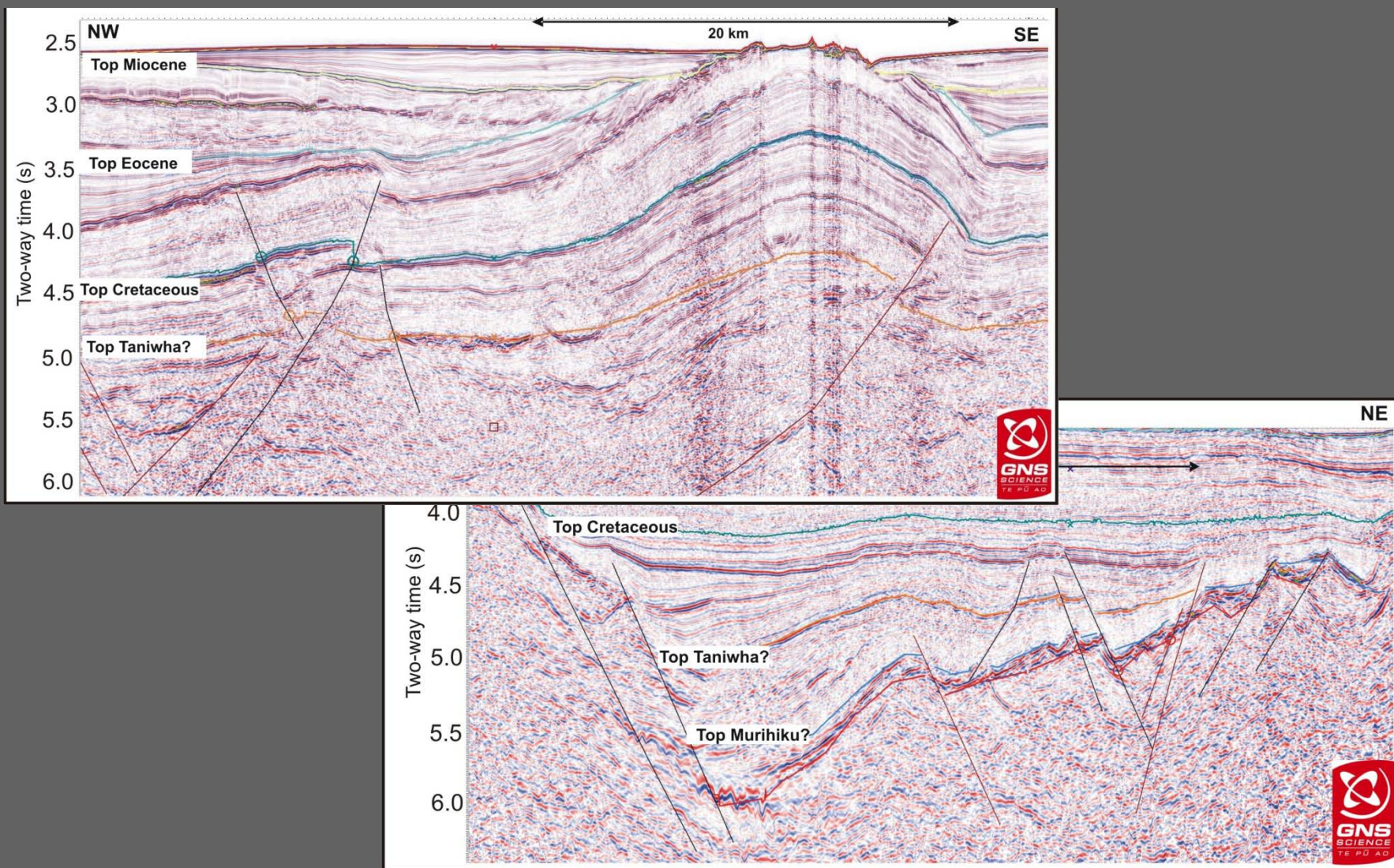
Waka Nui-1



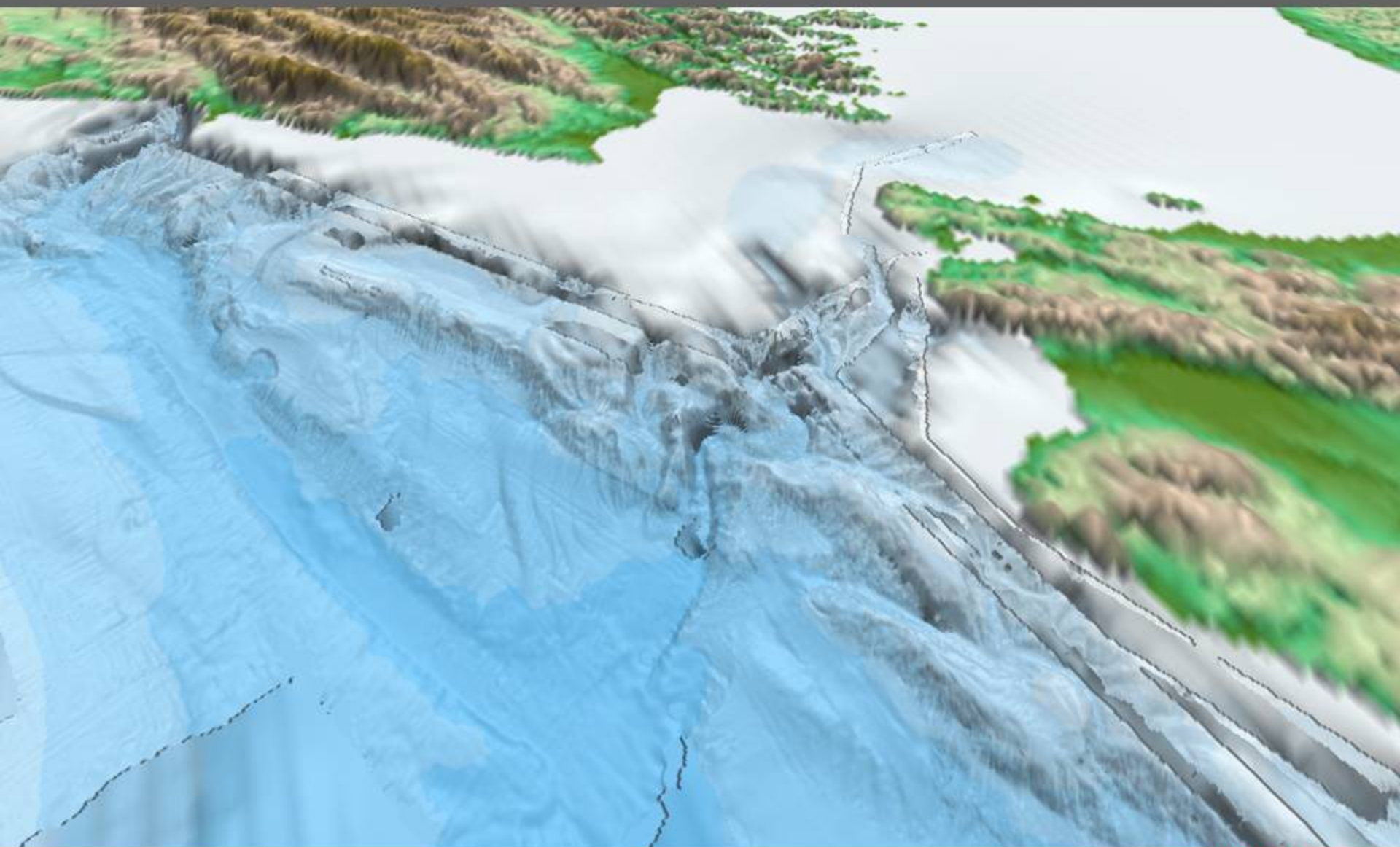
Extensional and compressional structures



Extensional and compressional structures

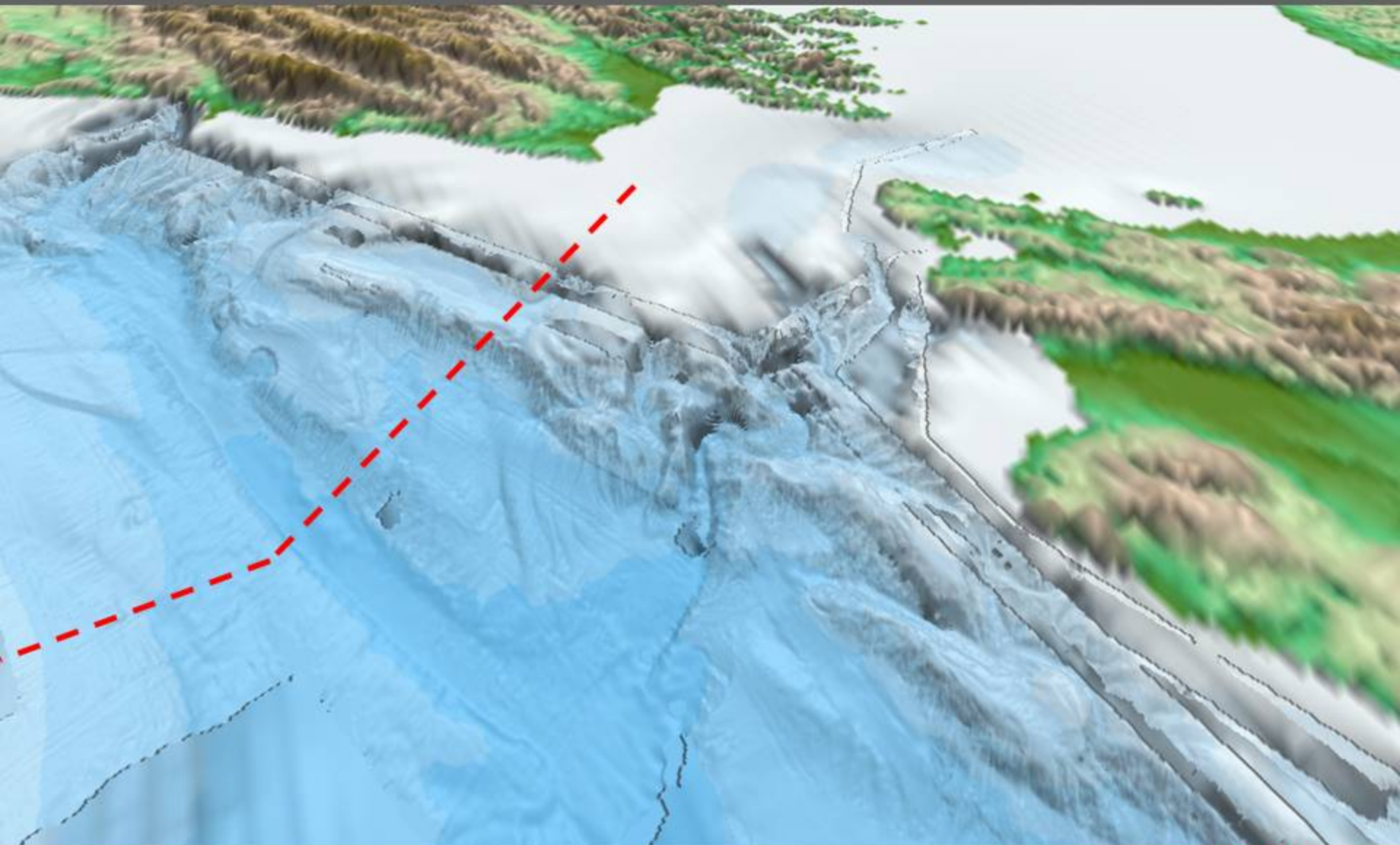


Future work: Pegasus sub-basin

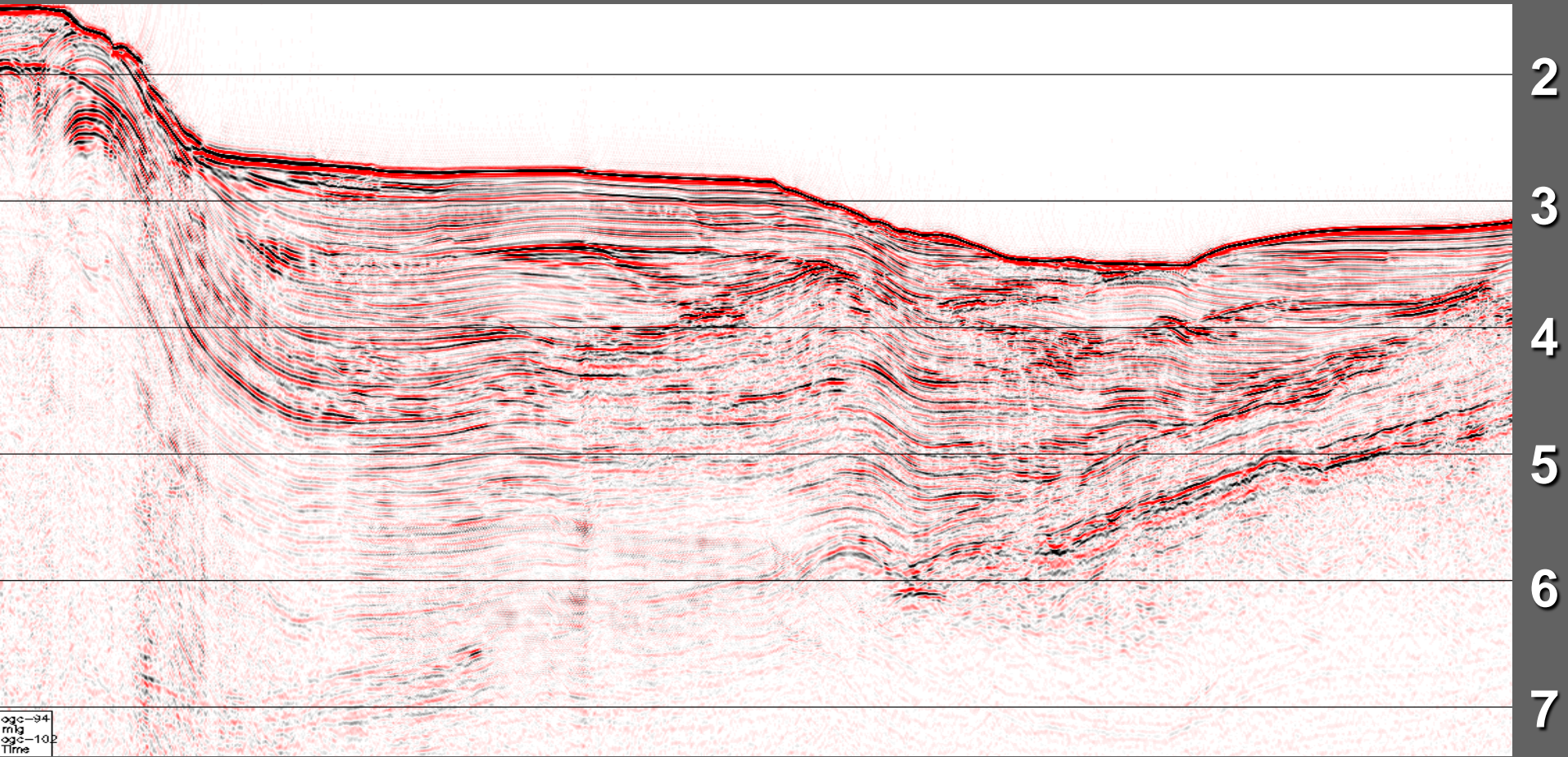


Present

~~Future~~ work: Pegasus sub-basin



Panel from seismic line OGS94-102



ogs-94
mlg
ogs-102
Tfrre

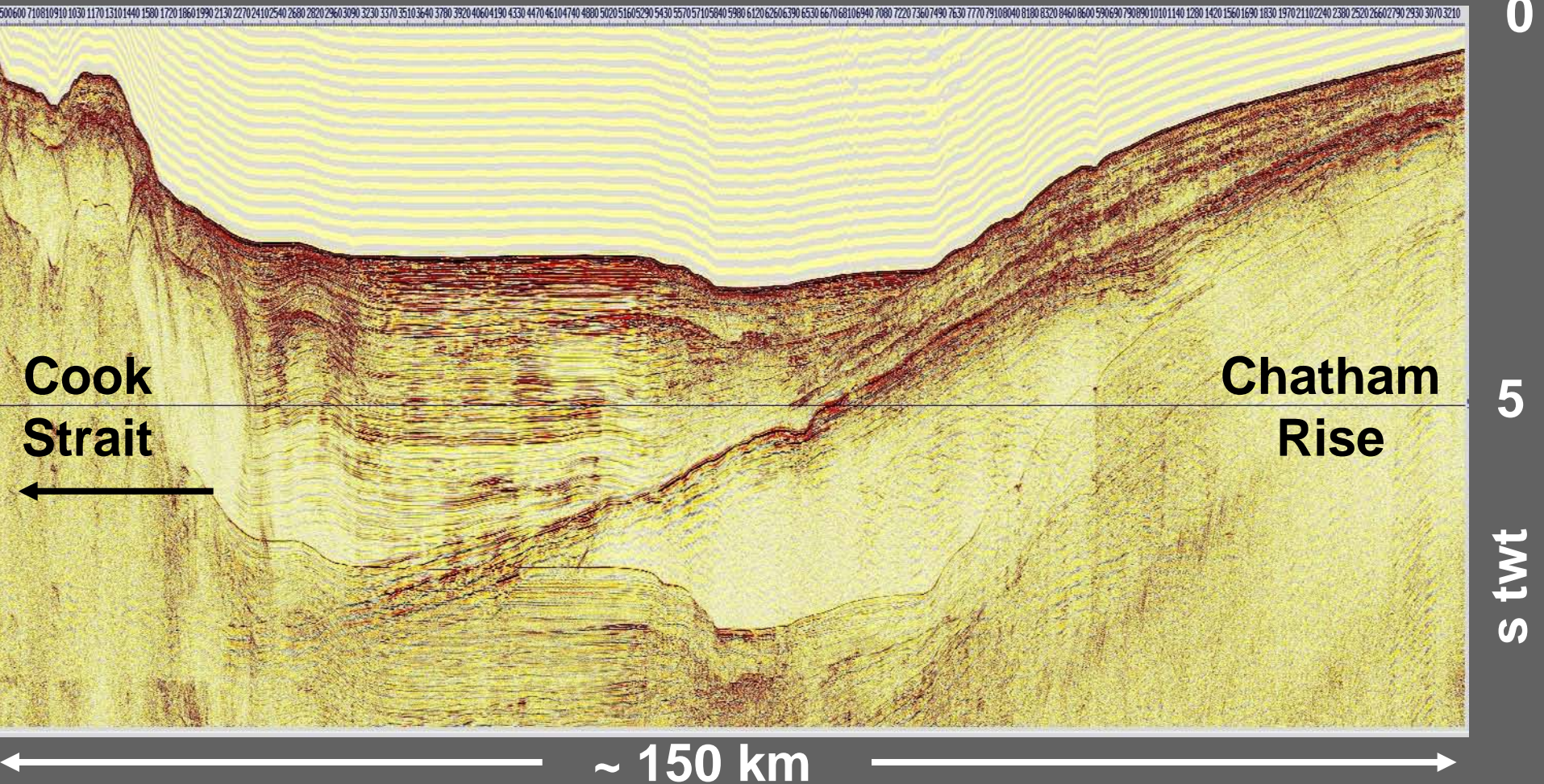
Northwest

PEGASUS SUB-BASIN

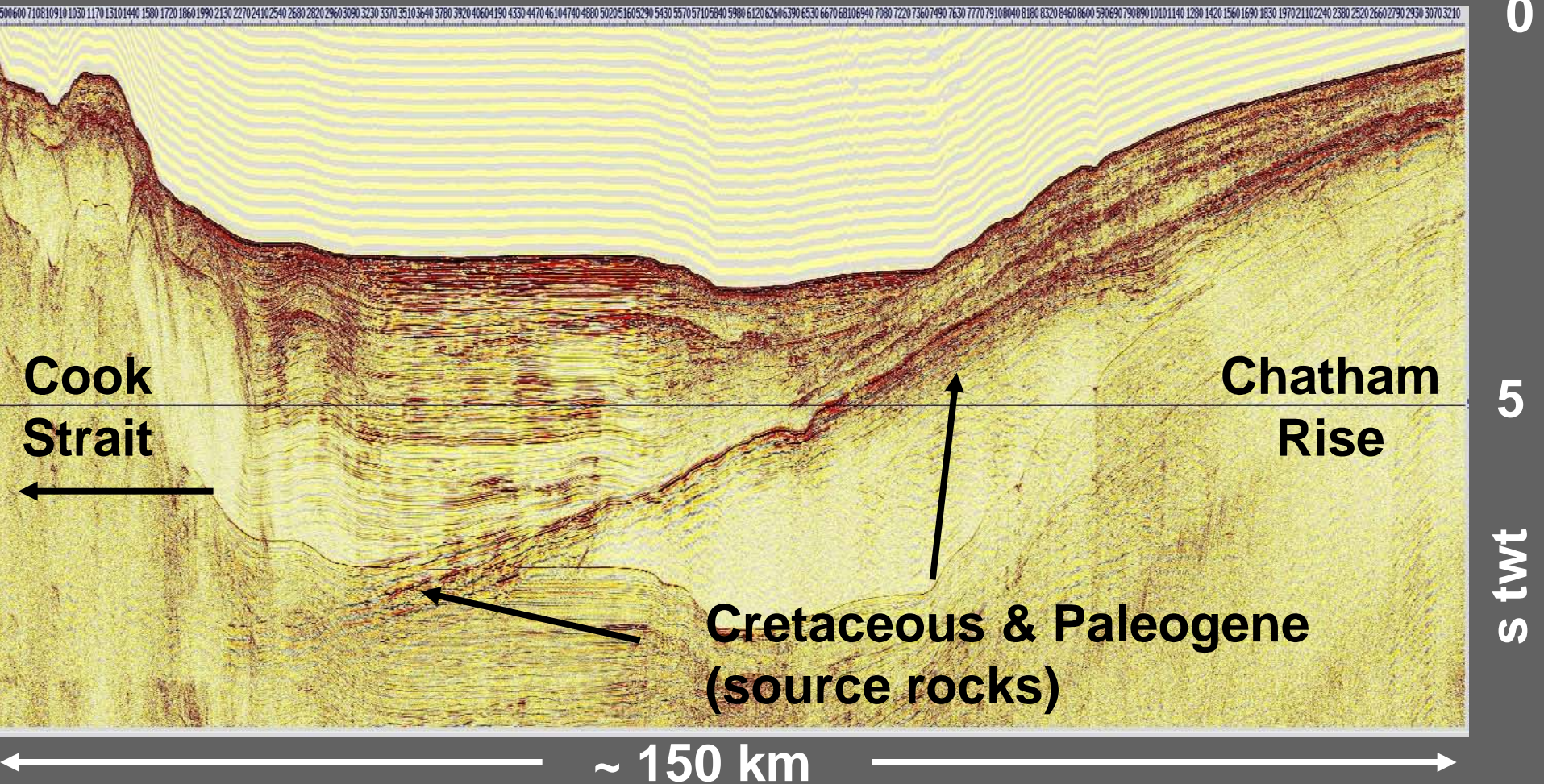
seconds

~100 km

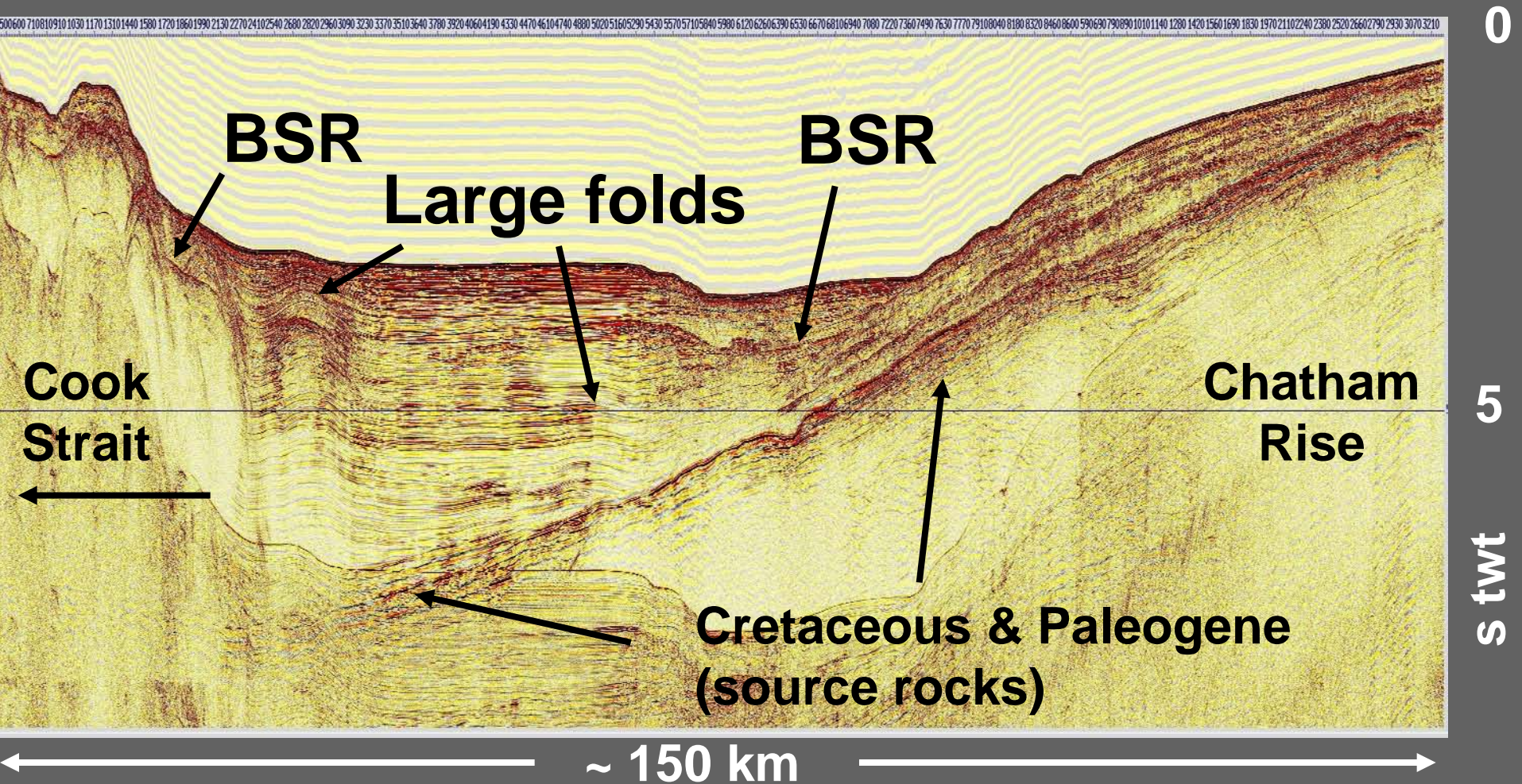
Peg09 jpeg of brute stack (emailed from Reflect Resolution)



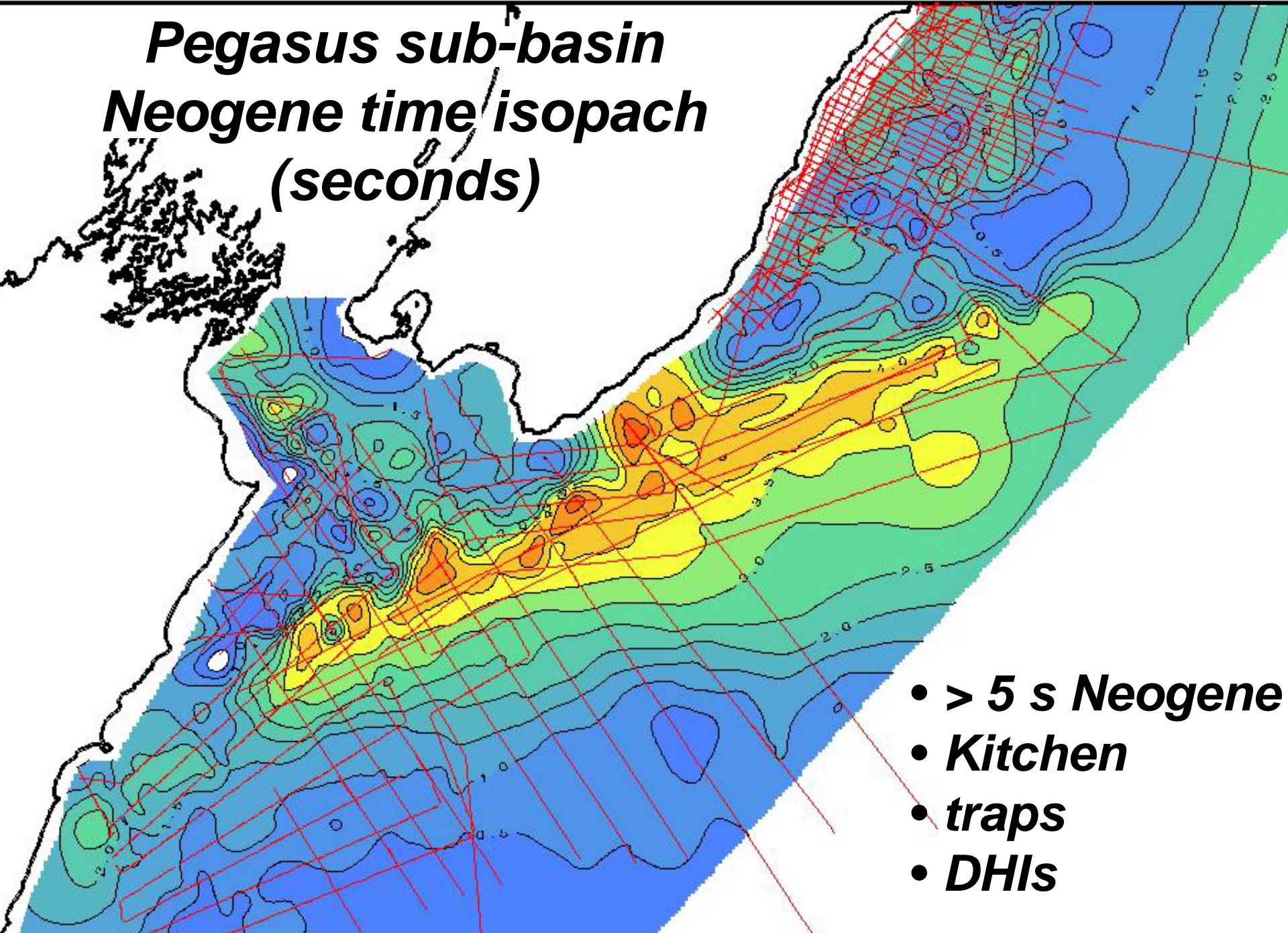
Peg09 jpeg of brute stack (emailed from Reflect Resolution)



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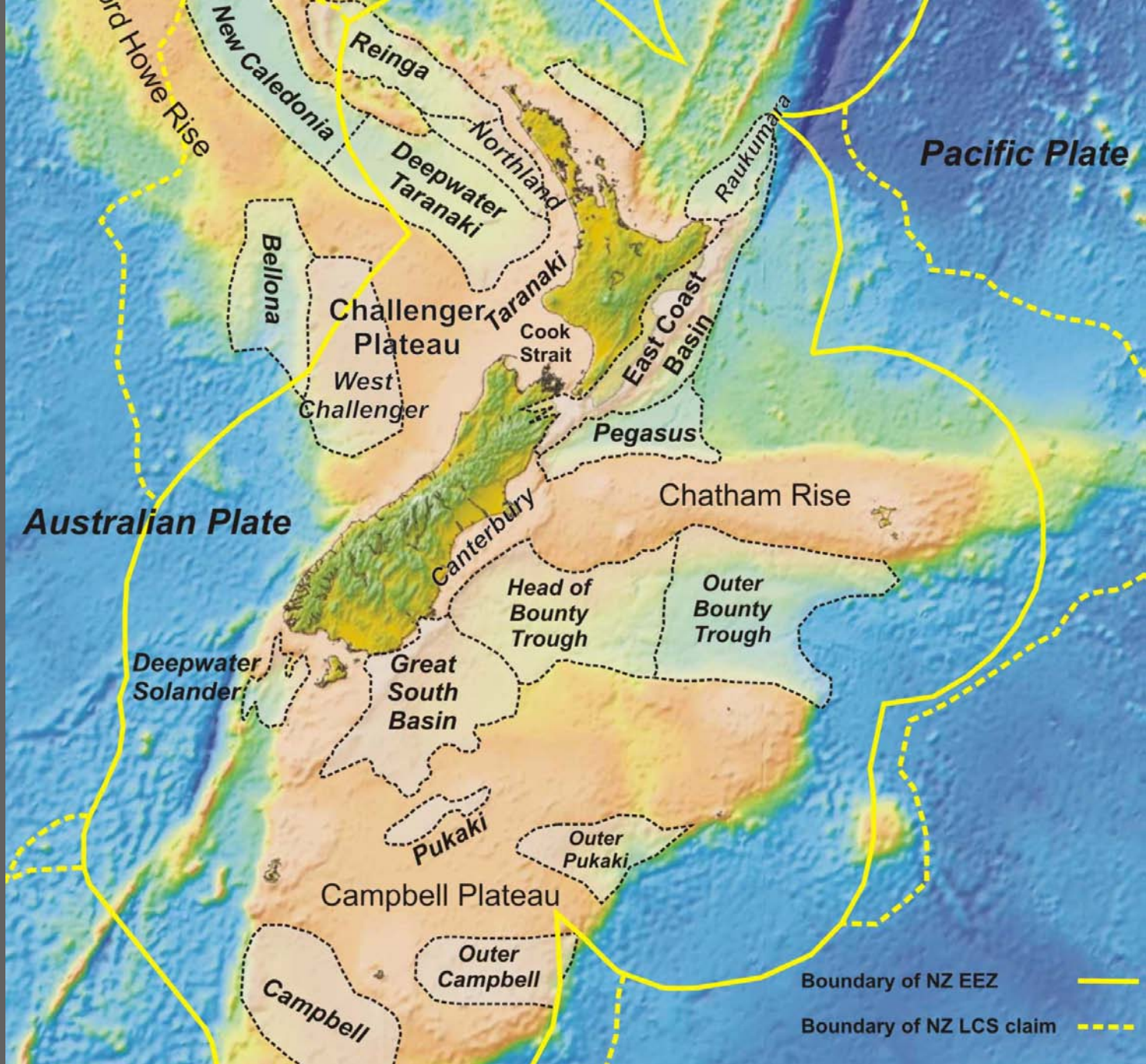


Pegasus sub-basin Neogene time isopach (seconds)



- ***> 5 s Neogene***
- ***Kitchen***
- ***traps***
- ***DHIs***

New Zealand's Deepwater Sedimentary Basins



Conclusions:

Petroleum Potential of New Zealand's Deepwater Basins:



Conclusions:

Petroleum Potential of New Zealand's Deepwater Basins:



**Area of Taranaki Basin:
~100,000 km²**

**Oil & gas found:
565 million barrels
1135 million boe of gas
(~ 1.7 billion boe)**

**Area of deepwater basins:
~1.2 million km²**

**Oil & gas to be found:
at least 20 billion boe**