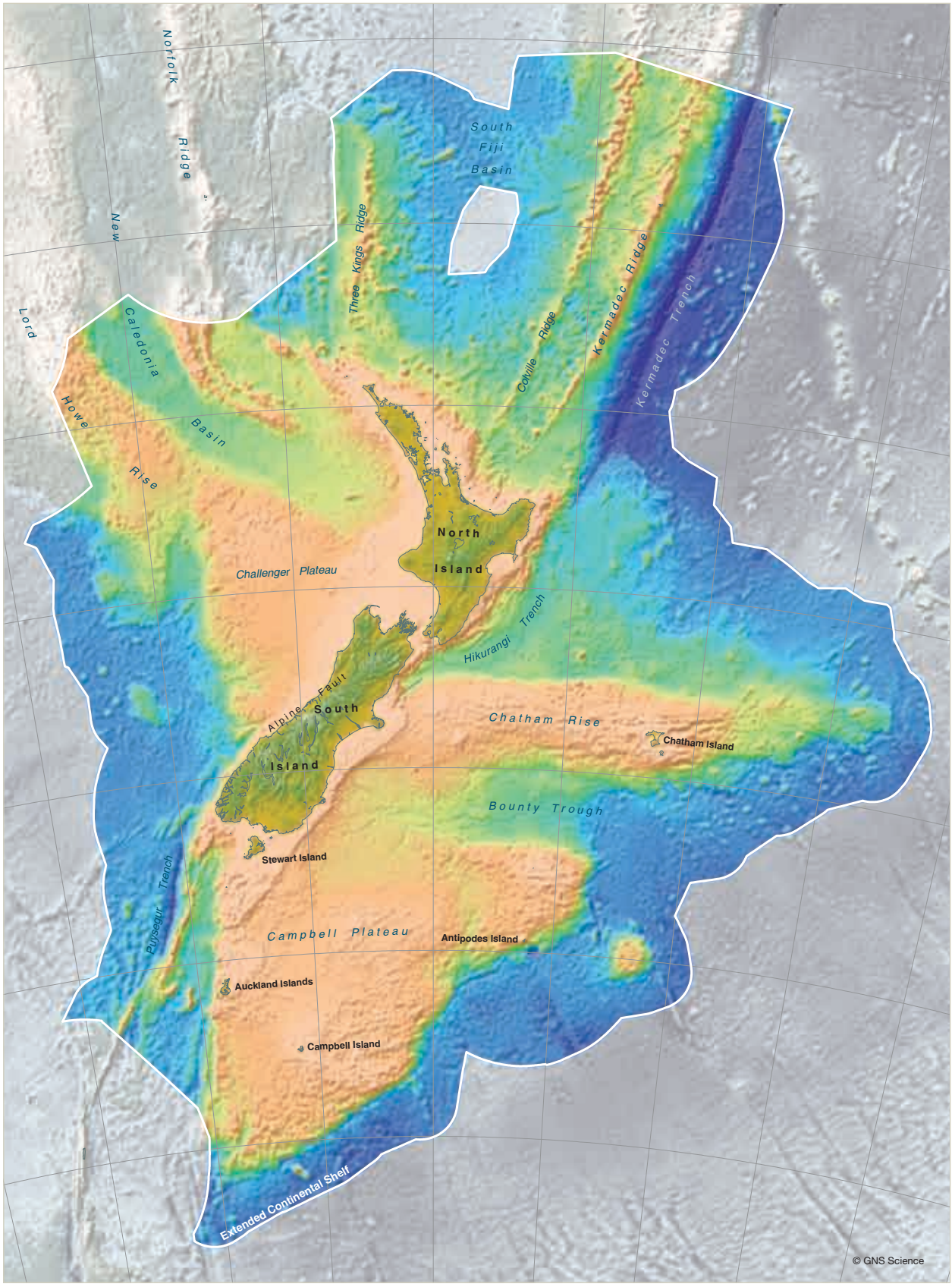

Norfolk Ridge
New
Lord
Caledonia Basin
Howe Rise
South Fiji Basin
Three Kings Ridge
Colville Ridge
Kermadec Ridge
Kermadec Trench
North Island
Challenger Plateau
Hikurangi Trench
Alpine Fault
South Island
Chatham Rise
Chatham Island
Bounty Trough
Stewart Island
Puysegur Trench
Campbell Plateau
Antipodes Island
Auckland Islands
Campbell Island
Extended Continental Shelf
© GNS Science

THE CONTINENT OF NEW ZEALAND

A SUBMERGED CONTINENT

The islands of New Zealand have a total area of 250,000 km^2 and are the emergent parts of an extensive, mainly submerged continental landmass with a total area of 6 million km^2. Northwest, south and east of New Zealand are large areas of relatively shallow sea underlain by plateaux and ridges that border the deep ocean basins of the Pacific Ocean and Tasman Sea.

New Zealand established an Exclusive Economic Zone (EEZ) defined by a line 200 nautical miles from the New Zealand coastline and, under the United Nations Convention on the Law of the Sea (UNCLOS), also defined an Extended Continental Shelf (ECS) beyond the EEZ. In August 2008, a United Nations Commission confirmed the extent of New Zealand's maritime entitlement. New Zealand now has sovereign rights over more than 5.7 million square kilometres of seabed. This is an area 22 times greater than our land area; equivalent in size to the European Union, the North Sea, and a quarter of the Mediterranean combined.

NEW ZEALAND'S SEDIMENTARY BASINS

A large area of New Zealand's offshore territory is covered only by reconnaissance surveys, however the available data suggest large sedimentary basins that may host oil and gas cover about 20% of New Zealand's territory - over a million square kilometres. For some of the basins, present understanding is based on modern, industry-standard seismic surveys (e.g., Deepwater Taranaki 2001–2009, Raukumara 2005–2007, Reinga 2009 and Pegasus 2010). For other basins there is a range of seismic data acquired from the 1970s onward, of variable quality. For remote areas there are limited seismic surveys completed for the 2008 New Zealand continental shelf submission to the United Nations. Additional information from gravity and magnetic surveys and satellite data help define little known basins.

The basin boundaries shown on the map (on page 4) are mainly determined by major geological structures or seafloor physiography. In general, regions with stratigraphic continuity and a common geological history are included within a single basin. In places, the basin limits are set at a minimum sediment thickness. For some, sub-basins and provinces can be differentiated on geological or geographical criteria respectively.

MODERN SETTING

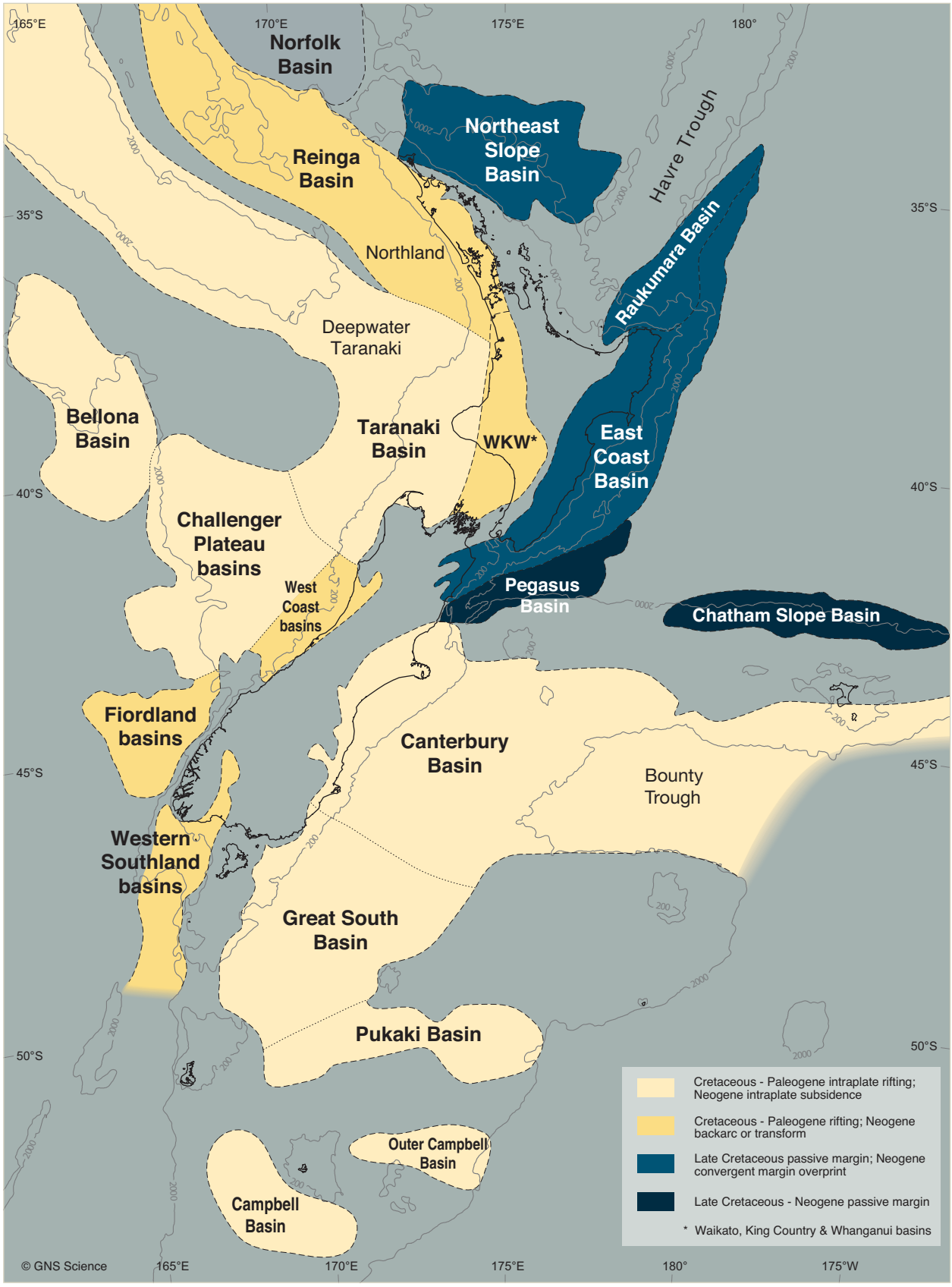
New Zealand's land area straddles the active boundary between the Australian and Pacific tectonic plates, and is above sea level mainly because of deformation and uplift in the last 20 million years. North Island is a part of the Australian Plate and South Island is mainly on the Pacific Plate. In the east, the Pacific Plate is moving southwest and downward beneath North Island but southwest of South Island the polarity is the reverse; the Australian Plate is being forced eastward and down beneath South Island. These opposing subduction systems (represented by the Hikurangi Trough and Puysegur Trench) are connected by the Alpine Fault, a major strike-slip zone that borders the Southern Alps. Close to the active plate boundary, deformation is moderate to intense but, away from it, seismic surveys show that in many of the basins the thick successions of sedimentary rocks are little disrupted.

MESOZOIC BASIN INITIATION

In Paleozoic and early Mesozoic time, the basement rocks of New Zealand's islands and offshore plateaux were part of the Pacific margin of the Gondwana supercontinent, adjacent to the continental hinterlands of Australia and Antarctica. Triassic and Jurassic sedimentation in back-arc settings close to the Gondwana margin formed the thick marine and non-marine, structurally simple, low metamorphic grade Murihiku rocks of western and southern New Zealand, traditionally considered as economic basement.

Evidence from radiometric dating indicates that subduction persisted at the active continental margin until Early Cretaceous time (about 100 to 120 million years ago). After subduction ceased, the subsequent Gondwana continental break-up was preceded by a period of extensional tectonics, including rifting, with one margin-parallel rift basin becoming the Tasman Sea.

Basins initiated during this period contain both marine and terrestrial sediments, including coals. Although many onshore outcrops exhibit low-grade metamorphism, samples from offshore wells remain un-metamorphosed and immature for petroleum generation. Although no petroleum accumulations have yet been geochemically typed to source rocks older than Late Cretaceous age, where carbon-rich facies are present under the right conditions, they may be effective source rocks, particularly in the deep-water frontier basins.


165°E
170°E
175°E
180°
175°W
35°S
40°S
45°S
50°S
Norfolk Basin
Reinga Basin
Northeast Slope Basin
Havre Trough
Raukumara Basin
Northland
Deepwater Taranaki
Bellona Basin
Taranaki Basin
WKW*
East Coast Basin
Challenger Plateau basins
West Coast basins
Pegasus Basin
Chatham Slope Basin
Fiordland basins
Canterbury Basin
Bounty Trough
Western Southland basins
Great South Basin
Pukaki Basin
Outer Campbell Basin
Campbell Basin
Cretaceous - Paleogene intraplate rifting; Neogene intraplate subsidence
Cretaceous - Paleogene rifting; Neogene backarc or transform
Late Cretaceous passive margin; Neogene convergent margin overprint
Late Cretaceous - Neogene passive margin
* Waikato, King Country & Whanganui basins
© GNS Science

SEDIMENTARY BASINS OF NEW ZEALAND

BASIN	AREA (SQ KM)	LATE CRETACEOUS CHARACTER	NEOGENE CHARACTER
TARANAKI BASIN	330,000	Intraplate rift, subsidence and marine transgression	Intraplate to back-arc subsiding, minor compression
CANTERBURY BASIN	360,000	Intraplate rift, subsidence and marine transgression	Intraplate subsiding basin
GREAT SOUTH BASIN	130,000	Intraplate rift, subsidence and marine transgression	Intraplate subsiding basin
BELLONA BASIN	80,000	Intraplate rift, subsidence and marine transgression	Intraplate subsiding basin
CAMPBELL BASIN	40,000	Intraplate rift, subsidence and marine transgression	Intraplate subsiding basin
CHALLENGER BASINS	120,000	Intraplate rift, subsidence and marine transgression	Intraplate subsiding basin
OUTER CAMPBELL BASIN	20,000	Intraplate rift, subsidence and marine transgression	Intraplate subsiding basin
PUKAKI BASIN	60,000	Intraplate rift, subsidence and marine transgression	Intraplate subsiding basin
REINGA BASIN	170,000	Intraplate rift, subsidence and marine transgression	Back-arc subsiding basin, some compression
WAIKATO, KING COUNTRY, AND WHANGANUI BASINS	40,000		Back-arc subsiding basin, some compression
WEST COAST BASINS	25,000	Intraplate rift, subsidence and marine transgression	Transform
WESTERN SOUTHLAND BASINS	40,000	Intraplate rift, subsidence and marine transgression	Transform to back-arc
FIORDLAND BASIN	35,000		Transform
EAST COAST BASIN	120,000	Passive margin, subsidence and marine transgression	Convergent margin fore-arc
RAUKUMARA BASIN	36,000	Passive margin, subsidence and marine transgression	Convergent margin fore-arc
NORTHEAST SLOPE BASIN	80,000	Passive margin, subsidence and marine transgression	Convergent margin fore-arc
PEGASUS BASIN	25,000	Passive margin, subsidence and marine transgression	Passive margin, subsidence and marine transgression
CHATHAM SLOPE BASIN	40,000	Passive margin, subsidence and marine transgression	Passive margin, subsidence and marine transgression

RIFTS AND A PASSIVE MARGIN

In onshore and nearshore New Zealand, an unconformity representing Early Cretaceous uplift and erosion separates the Cretaceous and Cenozoic sedimentary rocks from underlying basement. A large part of the New Zealand region was land in Early Cretaceous time. Early basin-fill sedimentary rocks remain poorly dated. By the late Early Cretaceous, non-marine clastic sediments were accumulating in fault-controlled basins. The oldest basin-fill rocks are typically coarse-grained alluvial fan, fluviatile and lesser lacustrine facies, restricted to grabens and half-grabens. Deposition of thick passive margin marine sequences also began in the New Zealand region of the Gondwana margin in the late Early Cretaceous.

Magnetic anomalies show seafloor spreading in the Tasman Sea was well established in the Late Cretaceous (83-79 million years ago), by which time most of the major seafloor physiographic features of the New Zealand region had been formed. Large river systems developed and thick accumulations of non-marine and paralic sediments, including coal measures, accumulated in the valleys and extensive coastal plains. A thick progradational sequence that is present offshore from Taranaki represents the delta of a major river, built out into the accommodation space of an abandoned rift basin. It is capped by Late Cretaceous coal measures; in Taranaki, these coal measures became the source rocks for a large proportion of the oil discovered to date. Late Cretaceous marine shelf and slope sediments accumulated adjacent to the PaleoPacific continental margin and in the more restricted seaways elsewhere.

QUIESCENCE AND TRANSGRESSION

Active seafloor spreading in the Tasman Sea and southern Pacific Ocean prevailed in Late Cretaceous, Paleocene and earliest Eocene time, when the New Zealand region was tectonically stable. With post-rift thermal subsidence and associated marine transgression, early-formed rift basins were progressively inundated. By Paleocene time, rift sedimentation was confined to small sub-basins while, at the margins of the land, coastal plain, marginal marine and shelf deposits accumulated. They include thick units of coal measures that are source rocks for oil and gas accumulations. Eocene deposits represent late-rift and post-rift transgressive sequences and, by Middle Eocene time, the reduced landmass was surrounded, in the west and south, by extensive coastal plains. Fine-grained clastic sediments and carbonates accumulated in marine settings distal from land areas.

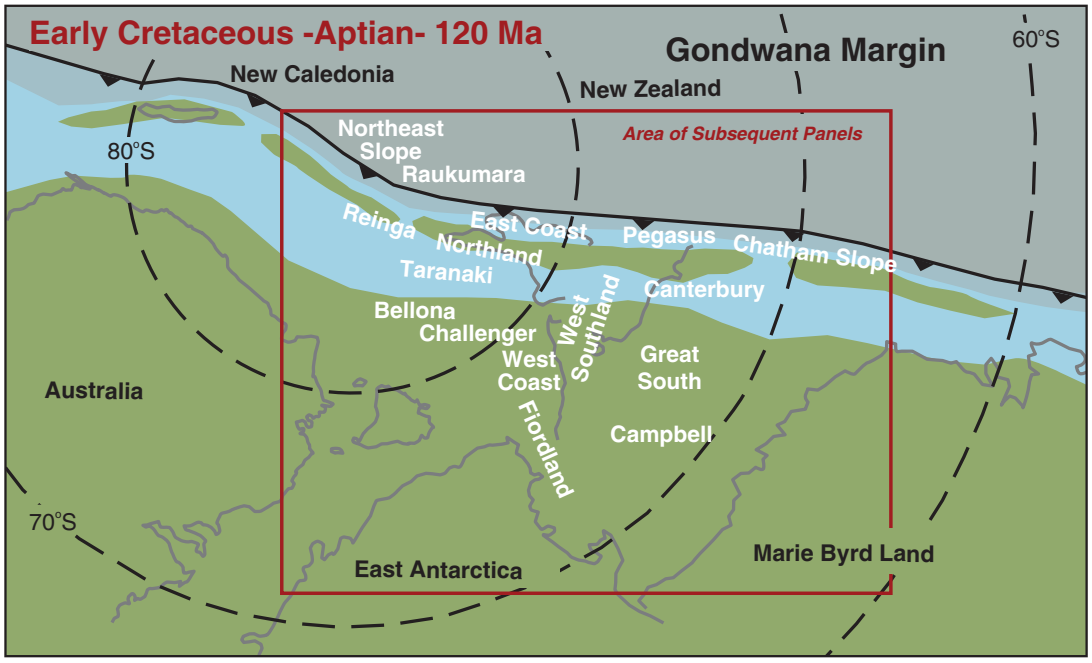
PLATE BOUNDARY PROPAGATION AND INUNDATION

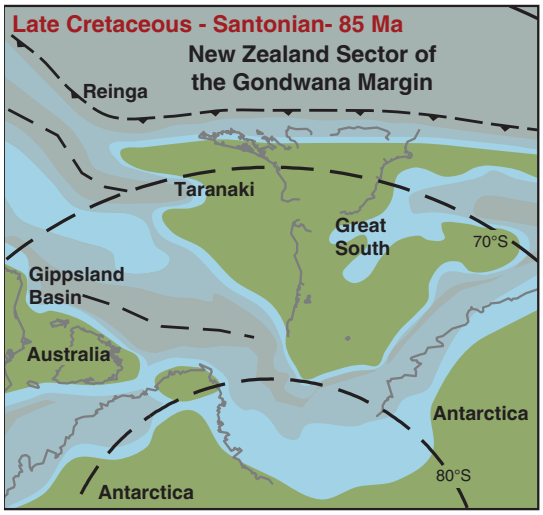
Seafloor spreading ceased in the Tasman Sea in Early Eocene time but continued in the southern Pacific Ocean. A new Australia-Pacific plate boundary formed south of New Zealand, where opening of the Emerald Basin resulted in anticlockwise rotation of eastern New Zealand relative to the west. For much of the region there was only minor deformation. In Southland there was rifting and the rotation resulted in compression in the Reinga Basin. By Late Oligocene time, the land area was greatly reduced and New Zealand may have been completely submerged. The Oligocene rocks are mainly calcareous. Differential compaction across basement highs and deformation associated with the new plate boundary formed a range of structures during this time.

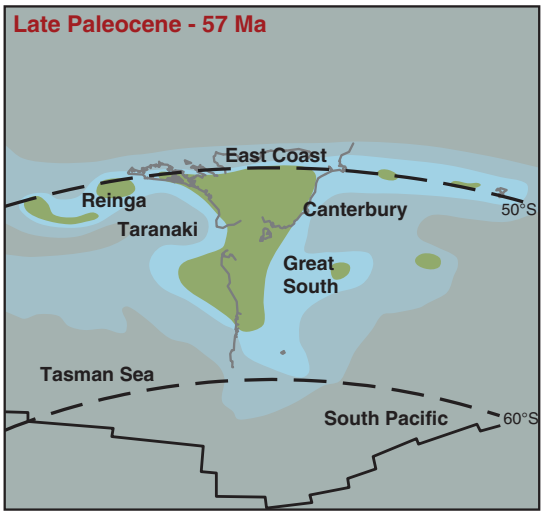
NEOGENE PLATE BOUNDARY – UPLIFT AND DEPOSITION

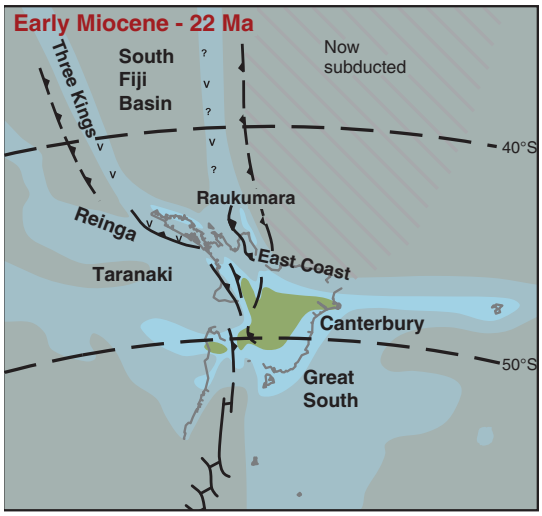
By earliest Miocene time, a southwest-dipping subduction zone was present in northern New Zealand. Large calc-alkaline stratovolcanoes erupted on and immediately west of what is now Northland, a part of the overriding Australian Plate. The Reinga Basin, originally a rift, became an intraplate back-arc basin. The thick Cretaceous to Oligocene passive margin sedimentary sequence which had accumulated northeast of the New Zealand landmass was obducted and emplaced part-way into the Reinga, East Coast and Raukumara basins as a series of thrust sheets (Northland and East Coast allochthons). Southwest-directed subduction in northernmost New Zealand was short-lived and calc-alkaline volcanism had all but ceased there by the end of the Early Miocene. Allochthon emplacement took place over about three million years.

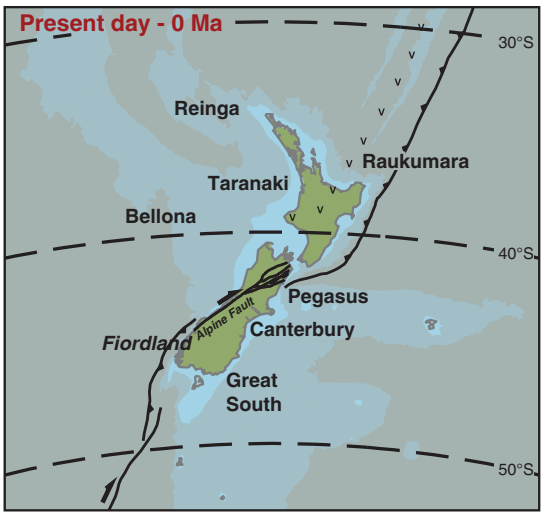
Southwest-directed oblique convergence at the plate boundary east of North Island and Kermadec Ridge continues at the present day. The Kermadec Trench and its prolongation as Hikurangi Trough extend south to meet Chatham Rise just south of Cook Strait. In South Island, deformation on the Alpine Fault is mainly strike-slip, with about 480 km of dextral offset in the last 20 million years. The rate of plate boundary convergence accelerated from Middle Miocene time, resulting in increasingly rapid uplift, with erosion of Northland volcanoes, the axial ranges of the North Island, and the elevated mountain chain of the Southern Alps. The supply of vast amounts of sediment resulted in progressive infilling of marine depocentres and progradation of the continental shelves. Most New Zealand basins have thick Neogene successions of slope and basin floor mudstones, with intercalations of turbidite sandstones. Burial by thick Neogene sequences has raised the maturity of underlying Cretaceous and Paleogene rocks to levels sufficient to generate and expel hydrocarbons.


Early Cretaceous -Aptian- 120 Ma
Gondwana Margin
60°S
New Caledonia
New Zealand
Area of Subsequent Panels
Northeast Slope
Raukumara
80°S
Reinga
East Coast
Pegasus
Chatham Slope
Northland
Taranaki
Canterbury
Bellona
Challenger
West Southland
Great South
West Coast
Australia
Fiordland
Campbell
70°S
East Antarctica
Marie Byrd Land


Late Cretaceous - Santonian- 85 Ma
New Zealand Sector of the Gondwana Margin
Reinga
Taranaki
Great South
70°S
Gippsland Basin
Australia
Antarctica
80°S
Antarctica


Late Paleocene - 57 Ma
East Coast
Reinga
Canterbury
50°S
Taranaki
Great South
Tasman Sea
South Pacific
60°S


Early Miocene - 22 Ma
Now subducted
South Fiji Basin
Three Kings
40°S
Raukumara
Reinga
East Coast
Taranaki
Canterbury
50°S
Great South


Present day - 0 Ma
30°S
Reinga
Raukumara
Taranaki
Bellona
40°S
Pegasus
Alpine Fault
Canterbury
Fiordland
Great South
50°S