NIWA
Taihoro Nukurangi

From exploration to extraction of marine mineral resources: Knowledge, potential and challenges

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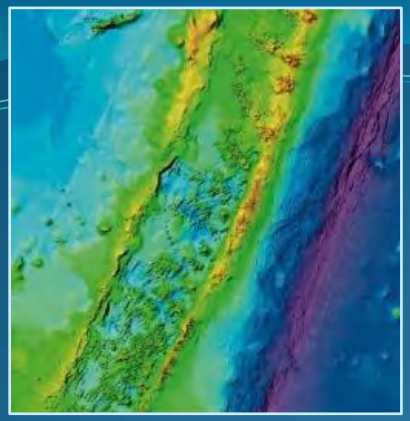
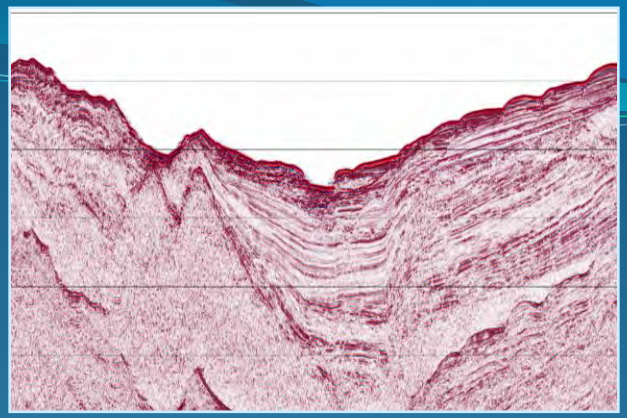
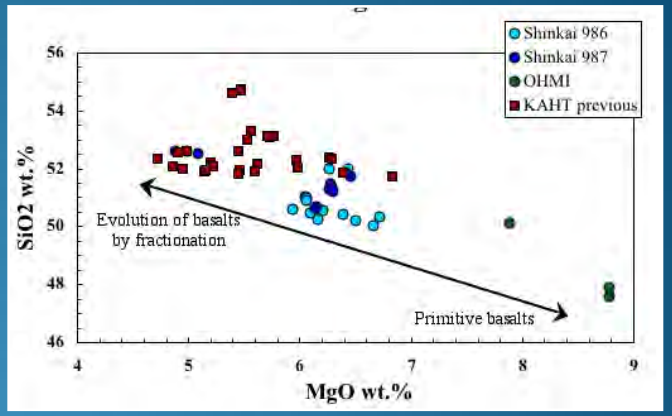
A presentation to the PECC Seminar
The Management of Deep Sea Marine Resources and Oceans as a Means of Communication
Auckland 4-5 December 2012





Outline

1. Short presentation of NIWA
2. New Zealand marine environment
3. Seafloor resources stock-take
4. From exploration to exploitation



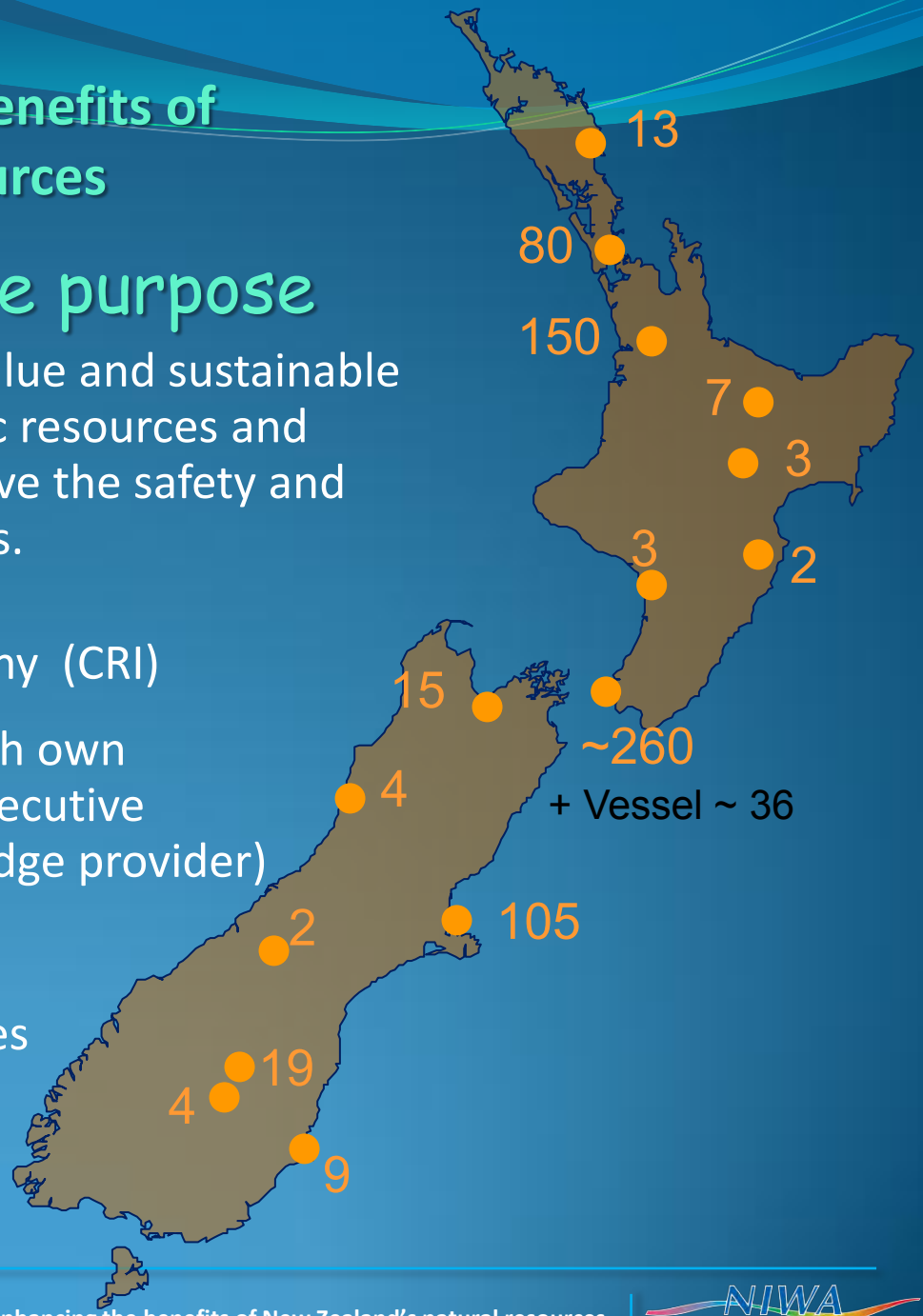
NIWA

To enhance the benefits of NZ's natural resources

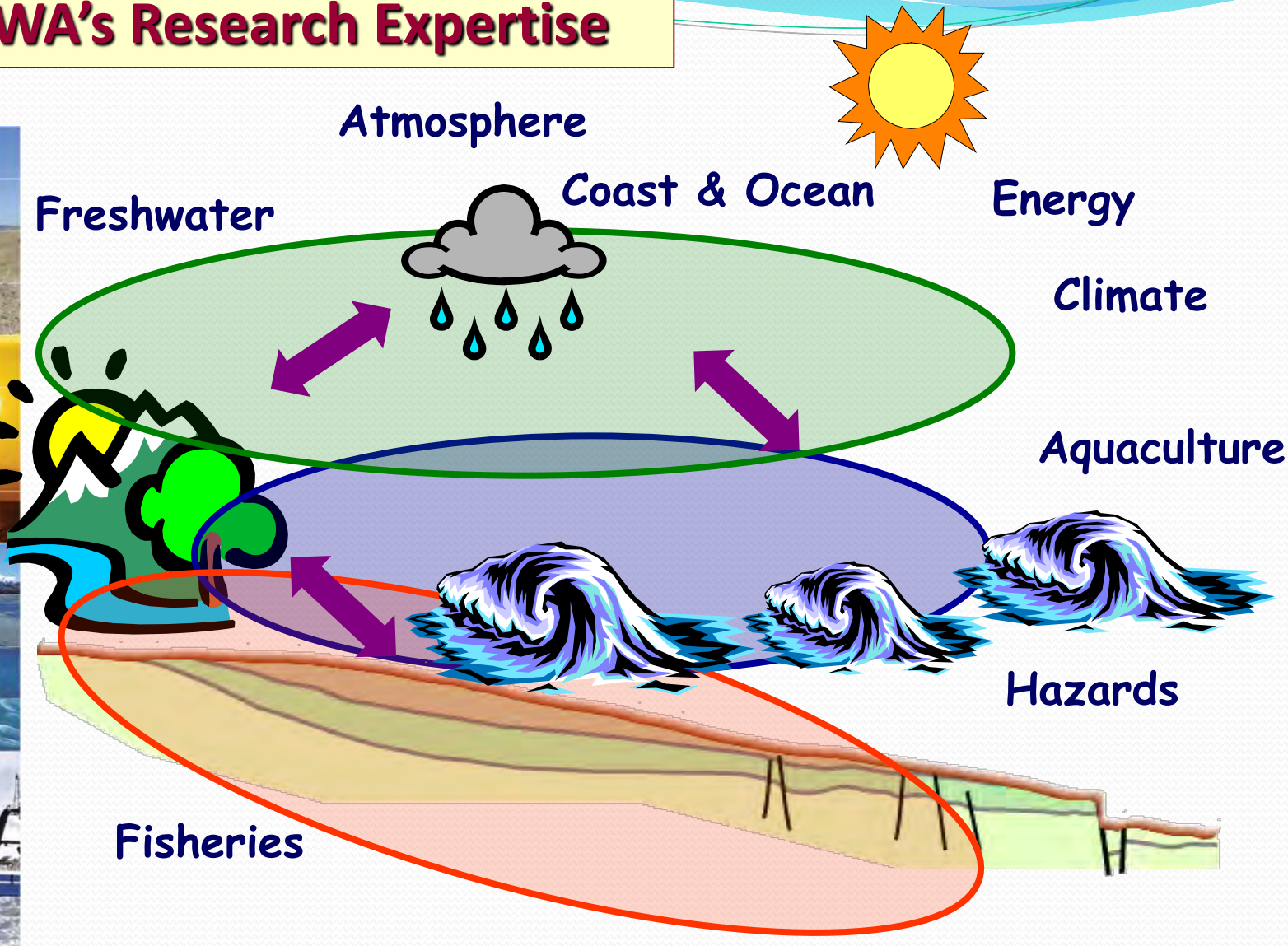
Statement of core purpose

To enhance the economic value and sustainable management of NZ's aquatic resources and environments, to […] improve the safety and wellbeing of New Zealanders.

- Is a crown-owned company (CRI)
- Stand-alone company with own Board of Directors and Executive (an independent, knowledge provider)
- >700 staff,
- 7 major, 9 minor campuses
- $120m revenue



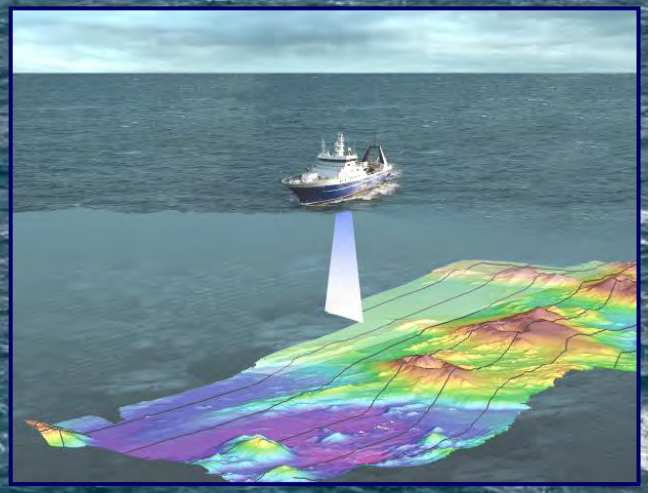
NIWA's Research Expertise



Environmental Information - Pacific Rim -Te Kuwaha-Maori

NIWA's Research Vessel *Tangaroa*

NIWA
Taihoro Nukurangi



- EM302 swath bathymetry system with full water column imaging
- Dynamic positioning (DP2) system; the only one on a NZ vessel
- Seafloor morphology & substrate from 100 m water depth
- Continuous surveying at ~20 km/h, 24/7 from sub-tropical to Antarctica

www.niwavessels.co.nz

Paths to Outcomes

Government Agencies	Government Operational Research Development of Environmental Guidelines & Regulations Hydrographic Survey International Treaties (Kyoto's; UNCLOS)	*MED, MBIE, MfE, MFAT, MPI* *EQC ; MCDEM, LINZ, DOC; MNZ*
Regional Authorities	Port Development/Survey; Desktop Studies Environmental Impact Assessments Risk & Hazard Assessment; Charts	*Auckland, Wellington, Christchurch, etc…*
Scientific Community	Education; Research; Public outreach International Science Programs	CRI's; NZ Univ.; US, UK, Australia Germany, France …
Industry	Offshore Engineering Mineral Exploration / Resource Evaluation Pipelines/Platform/Cables Route Surveys Provision of Marine Dataset	*Anadarko, Neptune* *Nautilus, Rio Tinto* *Chatham Rock Phos.,* *TransTasman Res.*
NGO International Institutions	Environmental Baseline Environmental Framework Desktop Studies	*Pew Foundation* *SPC/SOPAC* *World Bank*

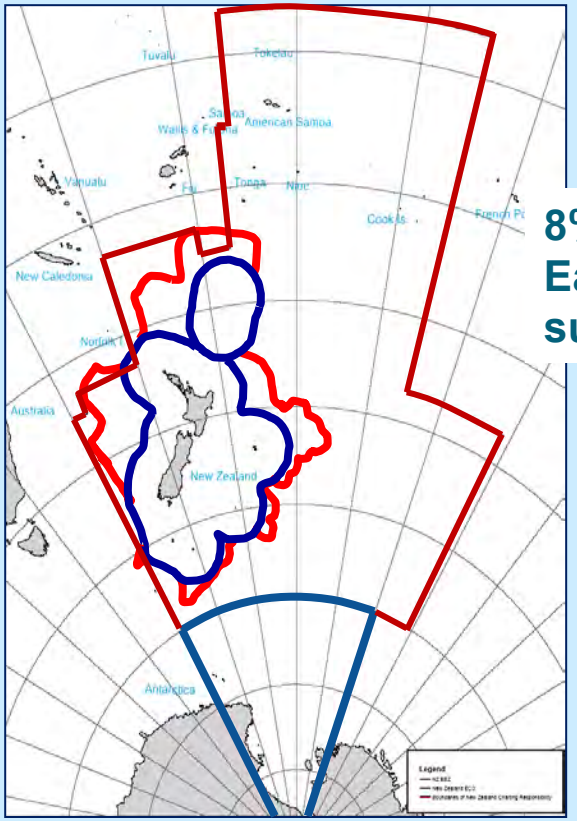
New Zealand

268,000 km² emerged

4,100,000 km² EEZ

+ 1,700,000 km² ECZ

NZ continent is 95 % submerged.



8% of Earth's surface

NZ's Sovereignty and Responsibilities

- Hydrographic
- LCS
- EEZ
- Antarctica

South-West Pacific

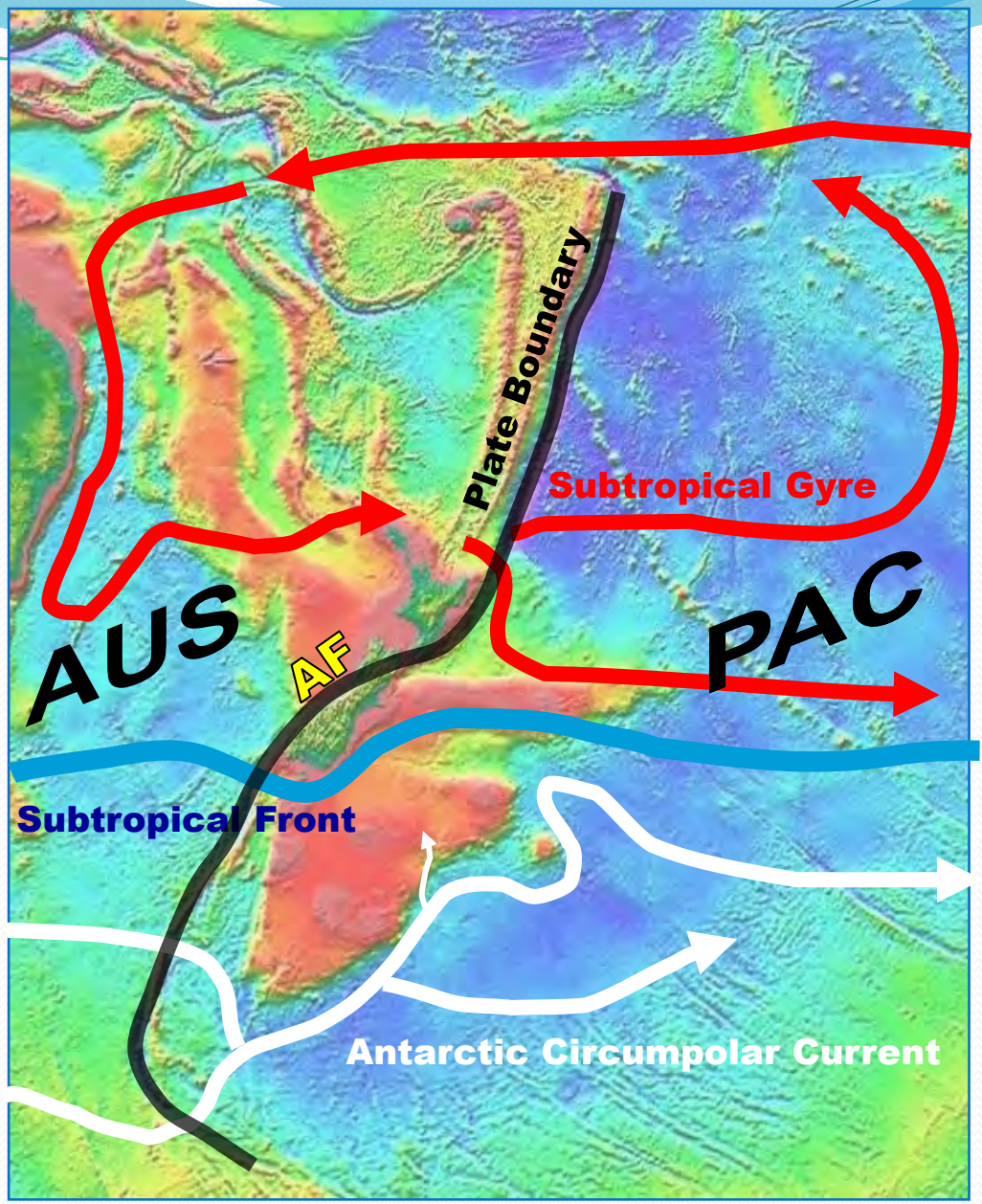
An exceptional environment for the study of earth, ocean and climatic processes

Geodynamic

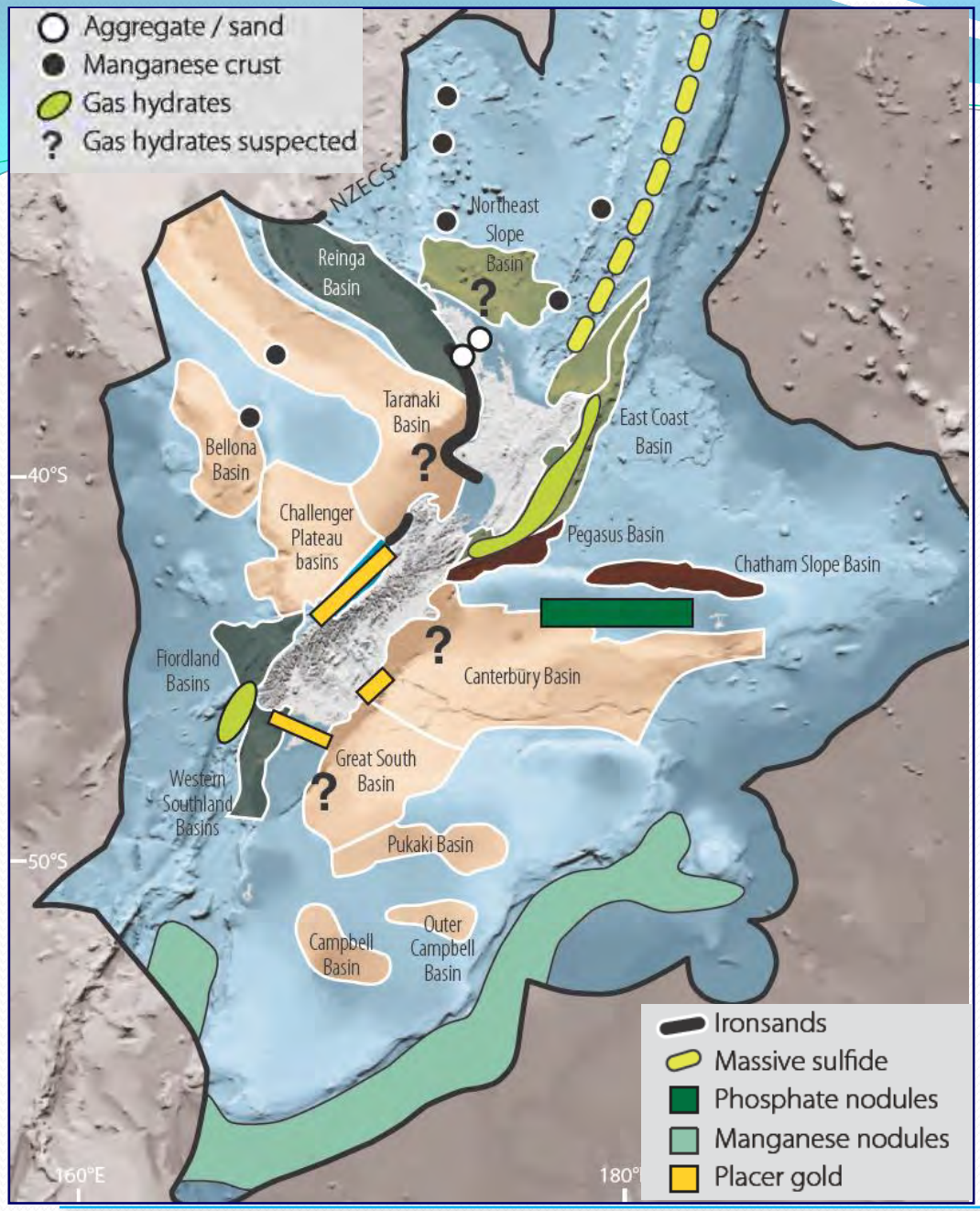
Climate

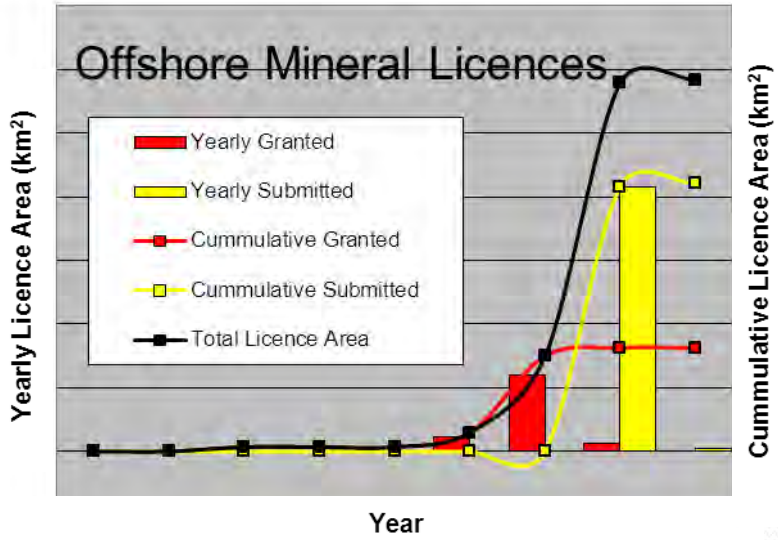
Oceanography

- Active plate boundary
- Confluence of sub-Antarctic & sub-tropical waters
- Strong westerly climate
- Strong tidal currents
- High sediment flux to ocean



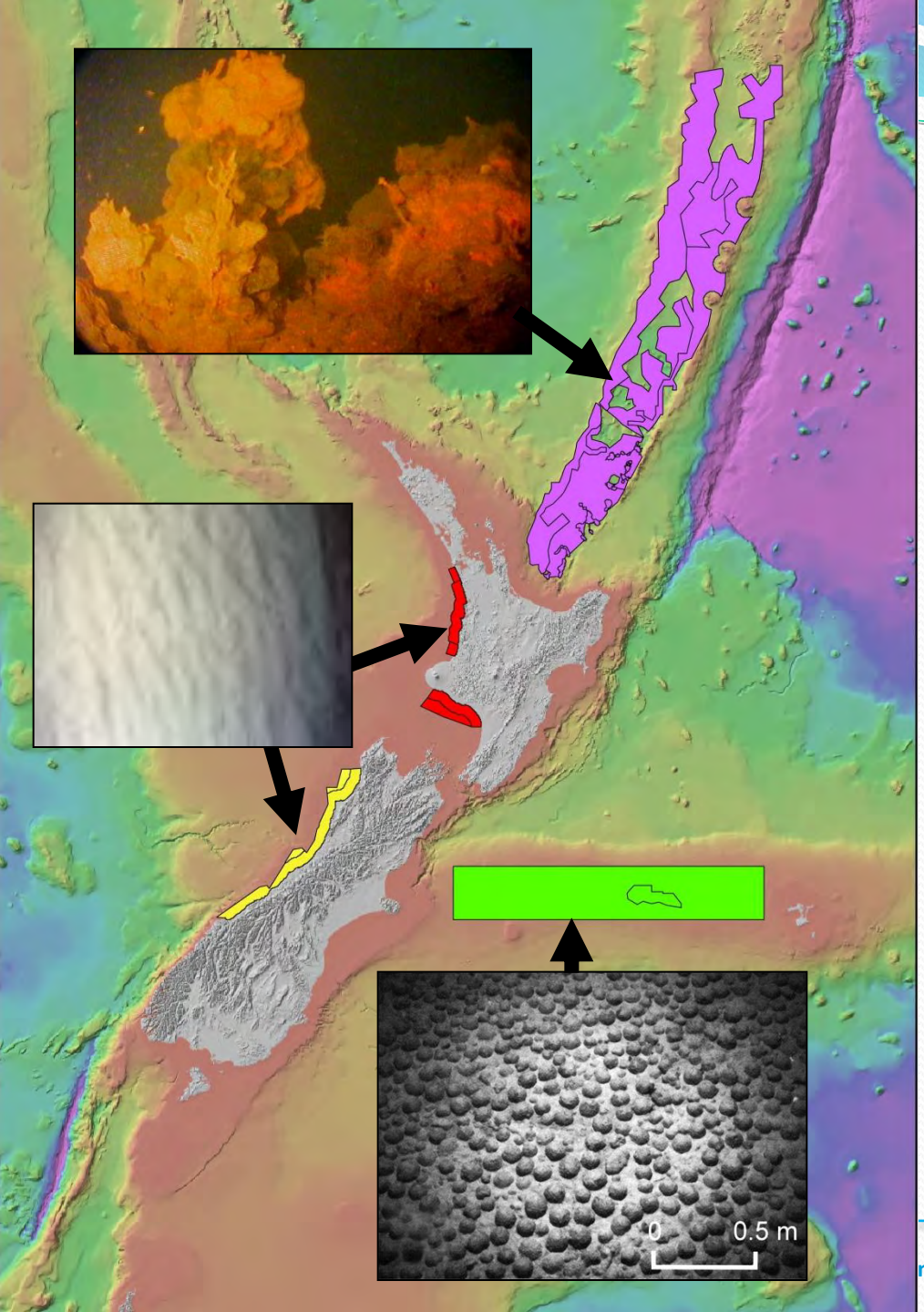
NZ Seafloor resources





Increasing interest in mining and drilling in EEZ

- Seafloor massive sulphides, ironsand, placer deposits, polymetallic nodules, …
- Increasing area under exploration & exploitation license,
- But applications ~7% of EEZ.
- $500b marine resources



Minerals license areas (2010)

- ***Seafloor Massive Sulphides***

Kermadec & Colville Ridges - 102,782 km^2,
Gold, copper, lead, zinc and silver
Nautilus Inc. & Neptune Inc.

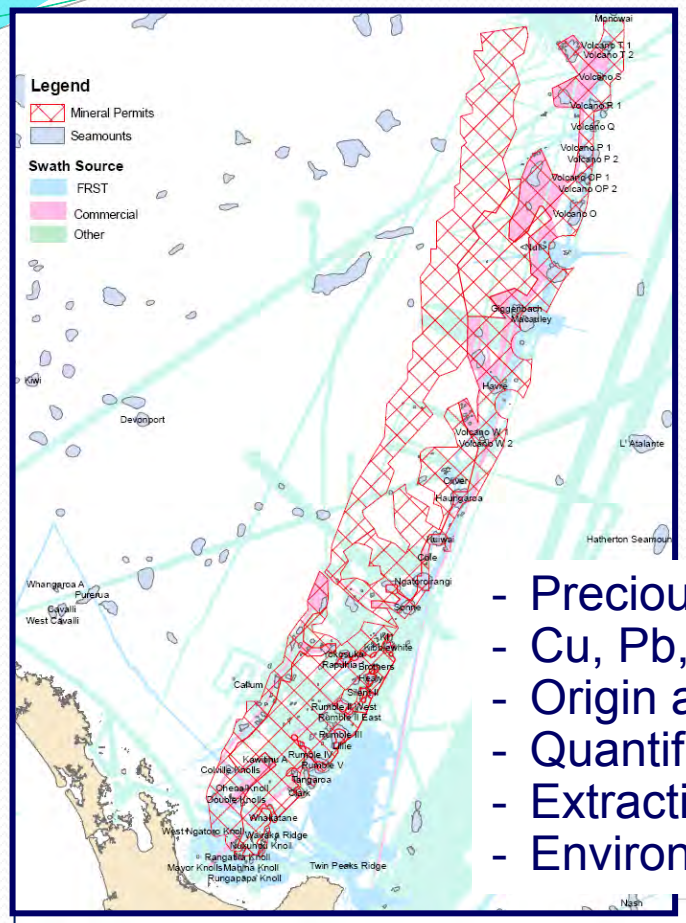
- ***Ironsands & other placer deposits***

West Coast – 18,726 km^2
Trans Tasman Resources (~10,000 km^2)
Resource estimate > 850 m.t.

- ***Phosphorite nodules***

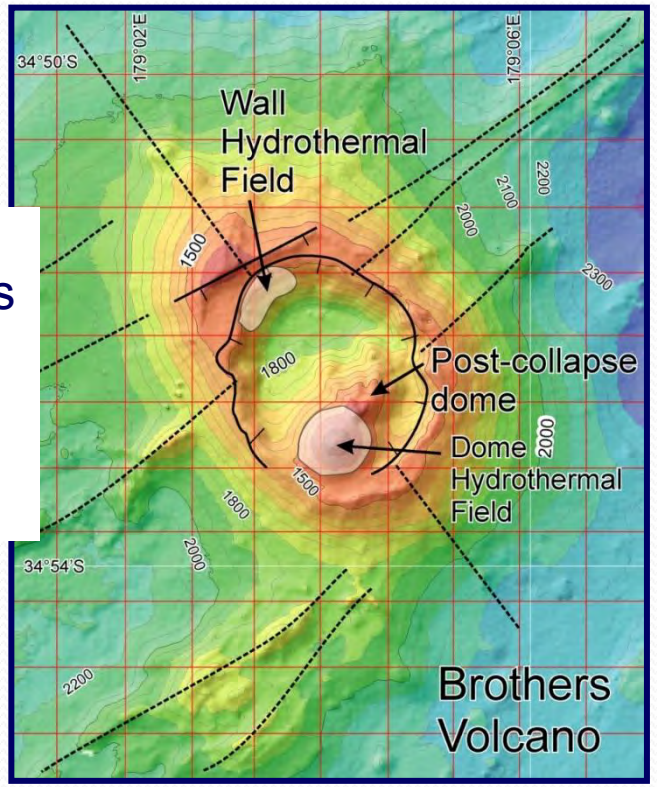
Chatham Rise, 4500 km^2 licensed area
Chatham Rock Phosphate
Resource estimates:
> 100 Mt.; $75 m p.y.

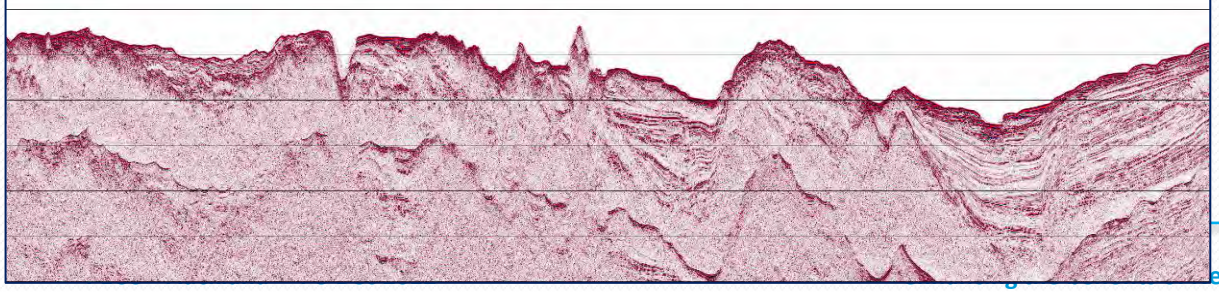
Seafloor Massive Sulphide (SMS)

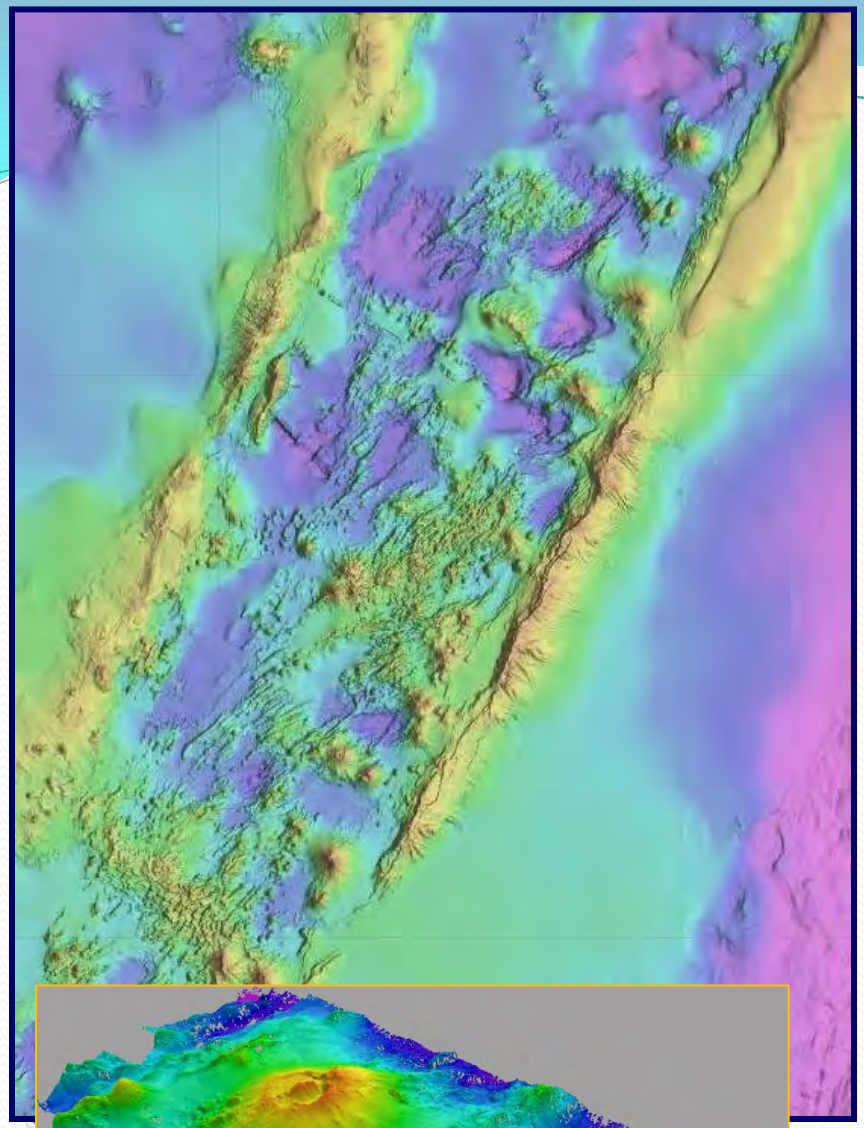


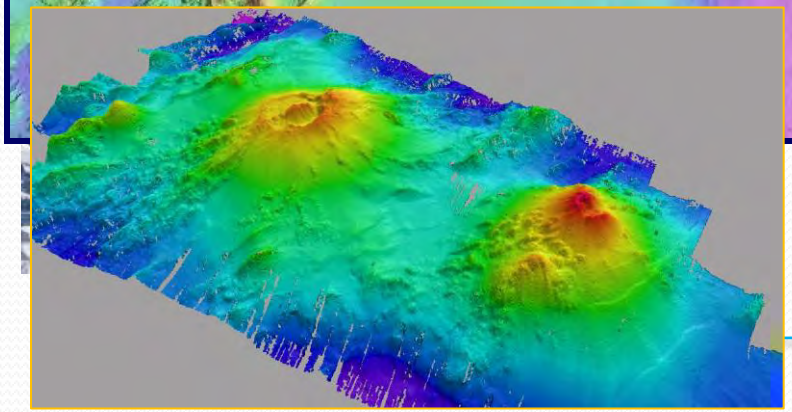
- GNS; NIWA
- Neptune; Nautilus
- NZP&M; EPA; MfE

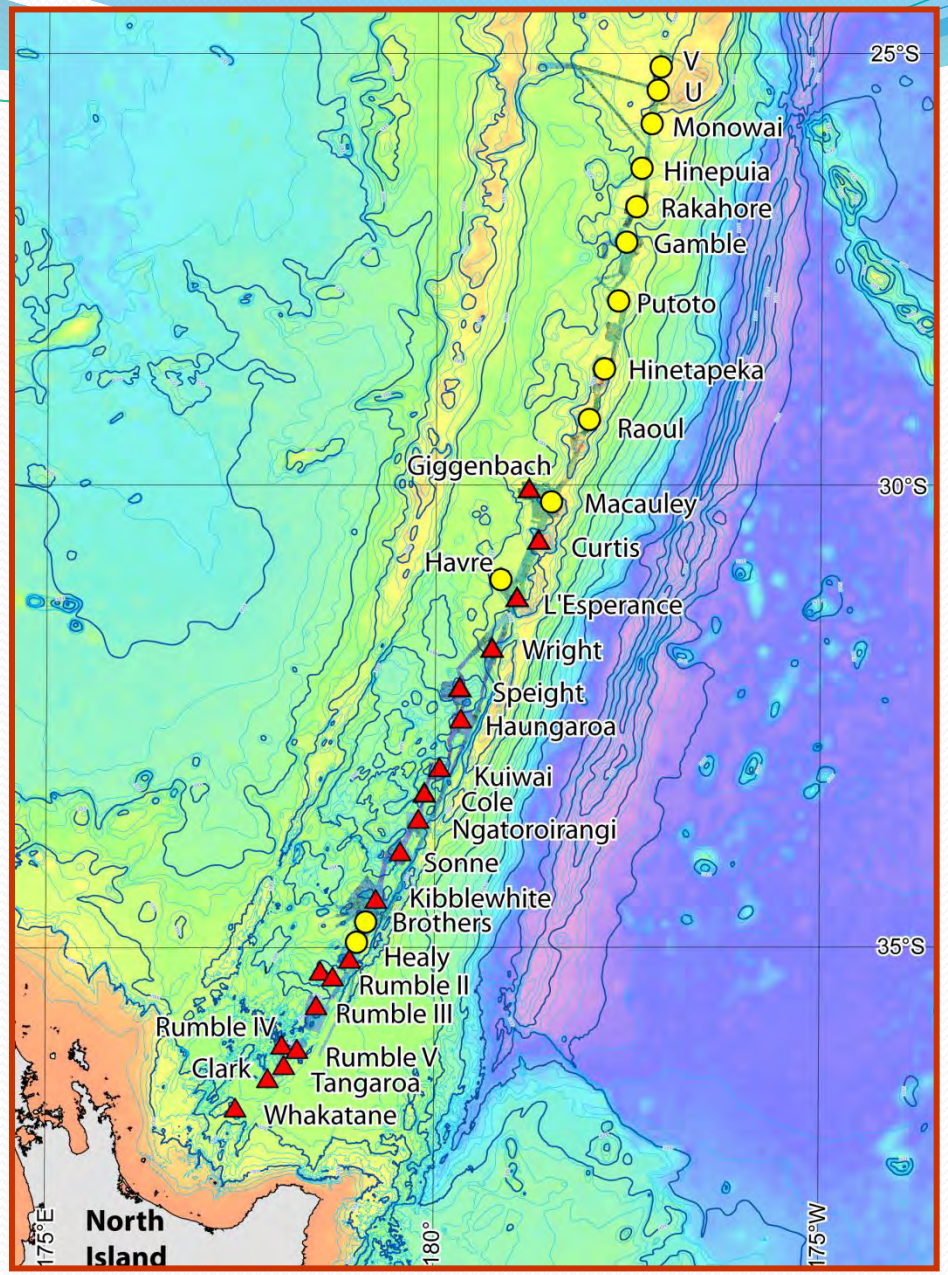
- Precious and base-metal
- Cu, Pb, Zn, Ag, Au + trace metals
- Origin and composition
- Quantification of resources
- Extraction technology
- Environmental impact





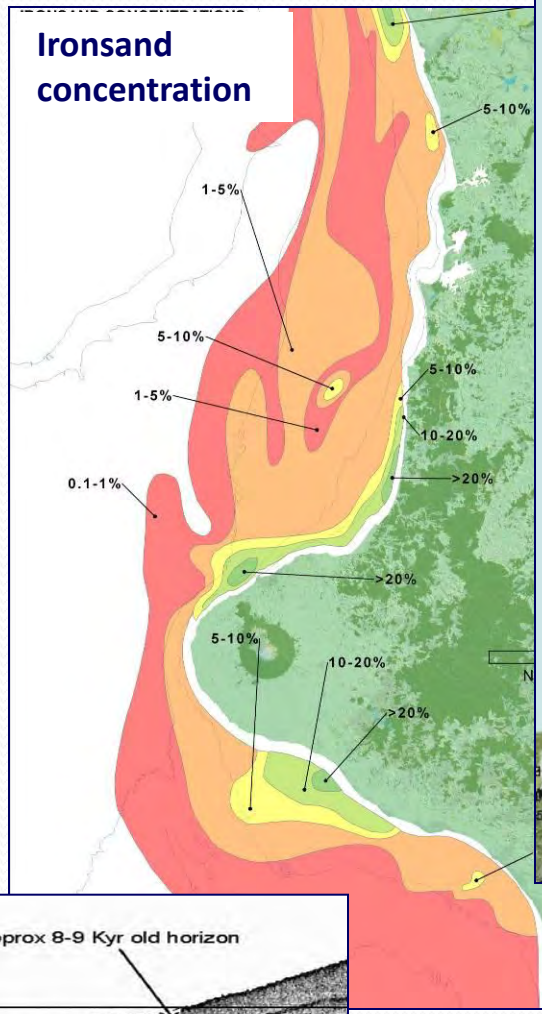


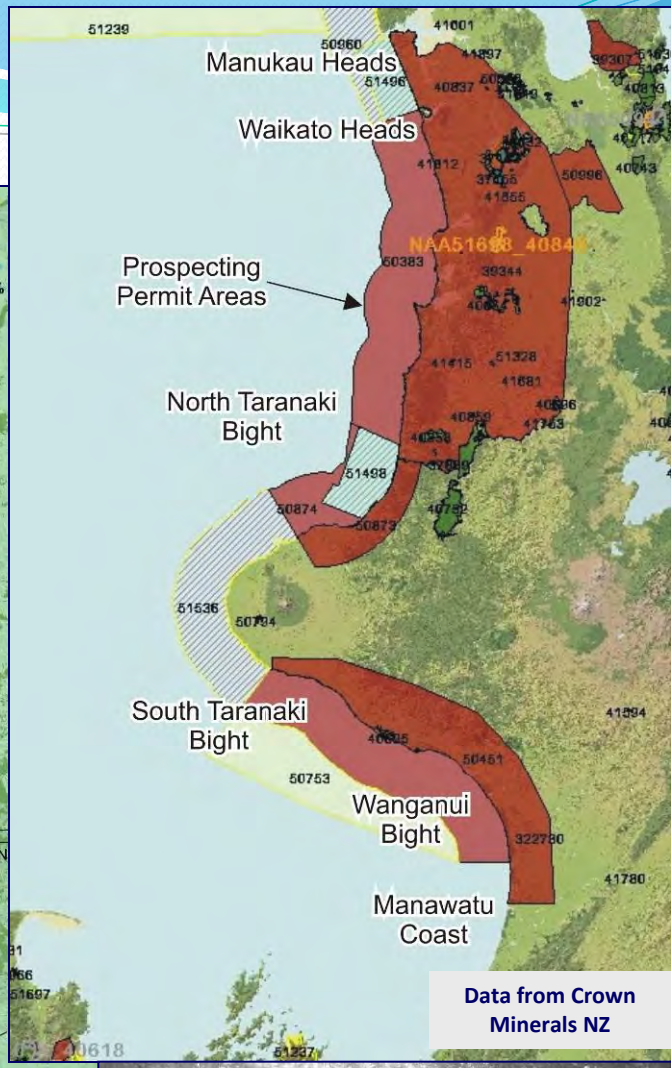


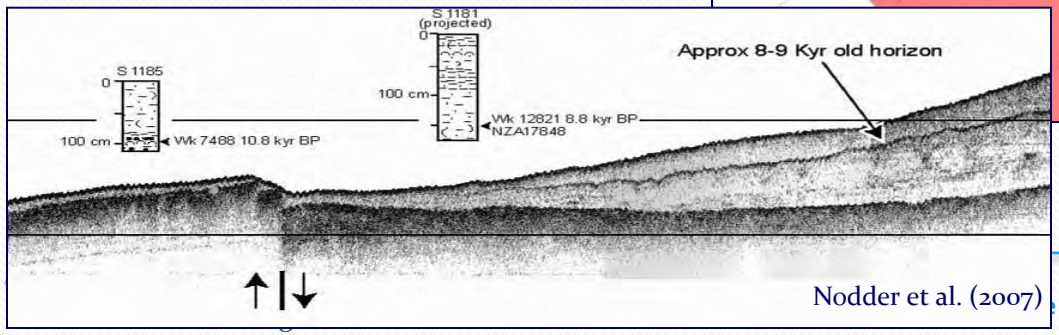

V
U
Monowai
Hinepuia
Rakahore
Gamble
Putoto
Hinetapeka
Raoul
Giggenbach
Macauley
Curtis
Havre
L'Esperance
Wright
Speight
Haungaroa
Kuiwai
Cole
Ngatoroirangi
Sonne
Kibblewhite
Brothers
Healy
Rumble II
Rumble III
Rumble IV
Rumble V
Clark
Tangaroa
Whakatane
North Island
25°S
30°S
35°S
175°E
180°
175°W

Offshore ironsand

- Surficial concentrations highest adjacent to river mouths
- Transport alongshore in shore-attached wedge
- Concentrations in lag deposits
- Subsurface distribution largely unknown and technically difficult to verify

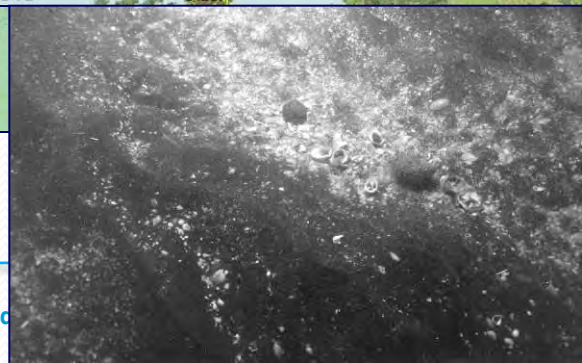






Nodder et al. (2007)

modified from Carter (1980)



Oil & Gas

- 75 % offshore

Offshore Licensed granted

- Taranaki Basin: 52,236 km^2
- East Coast: 5,992 km^2
- West Coast: 11,810 km^2
- Canterbury Basin: 11,424 km^2
- Great South Basin: 16,390 km^2
- Solander Basin: 11,400 km^2

Total: 109,252 km^2 - $2b p.y

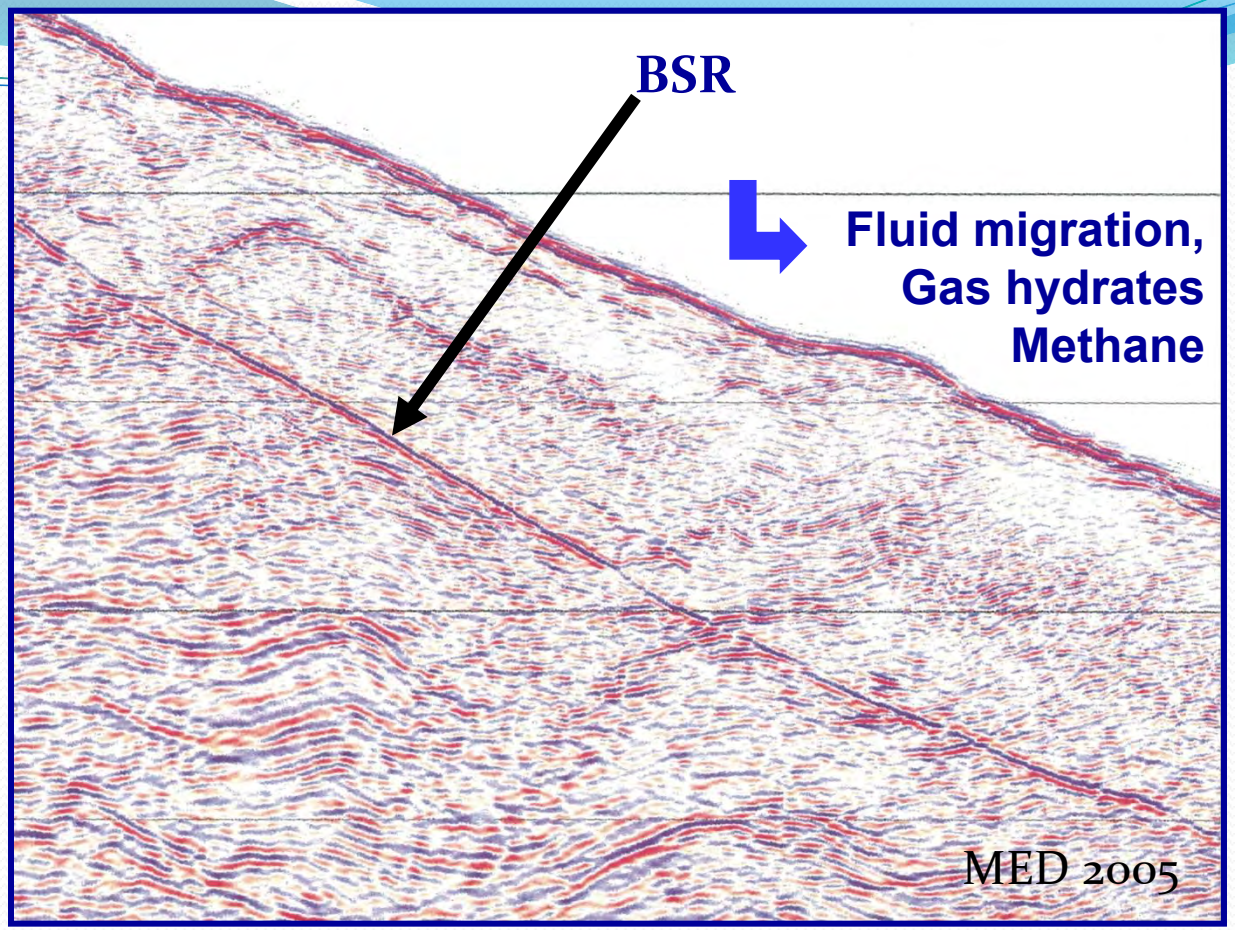
Reserve:

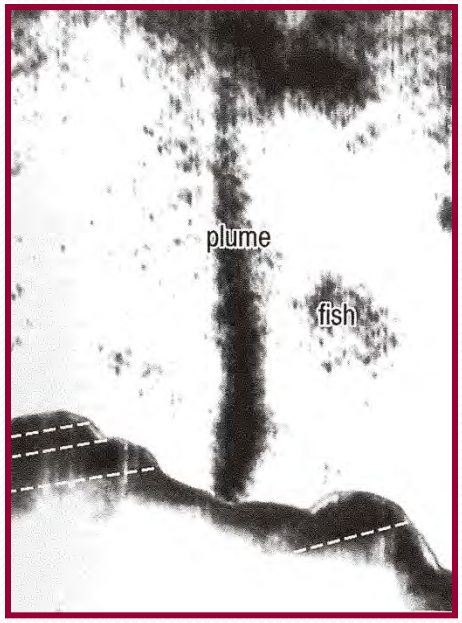
Oil : 2-25 billions barrels

Gas: 10-160 billions cft

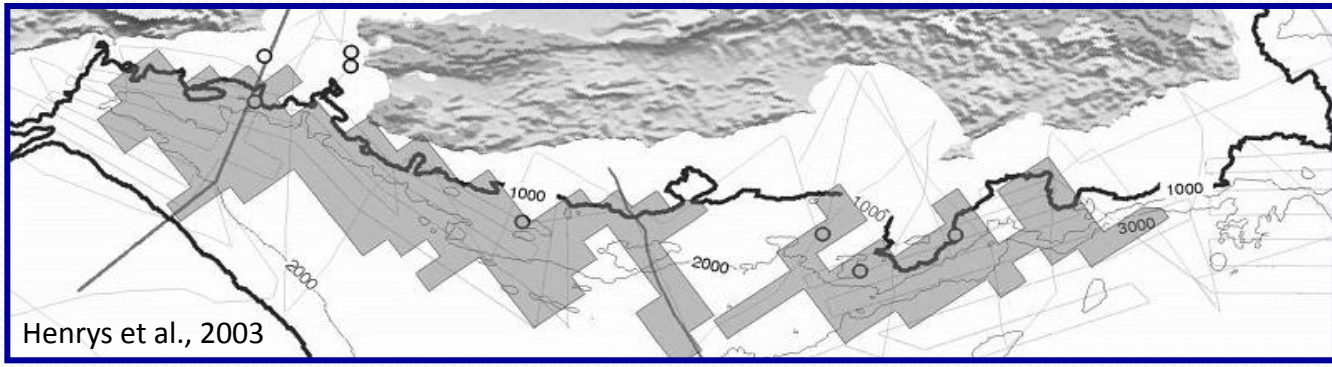
*GNS 2011

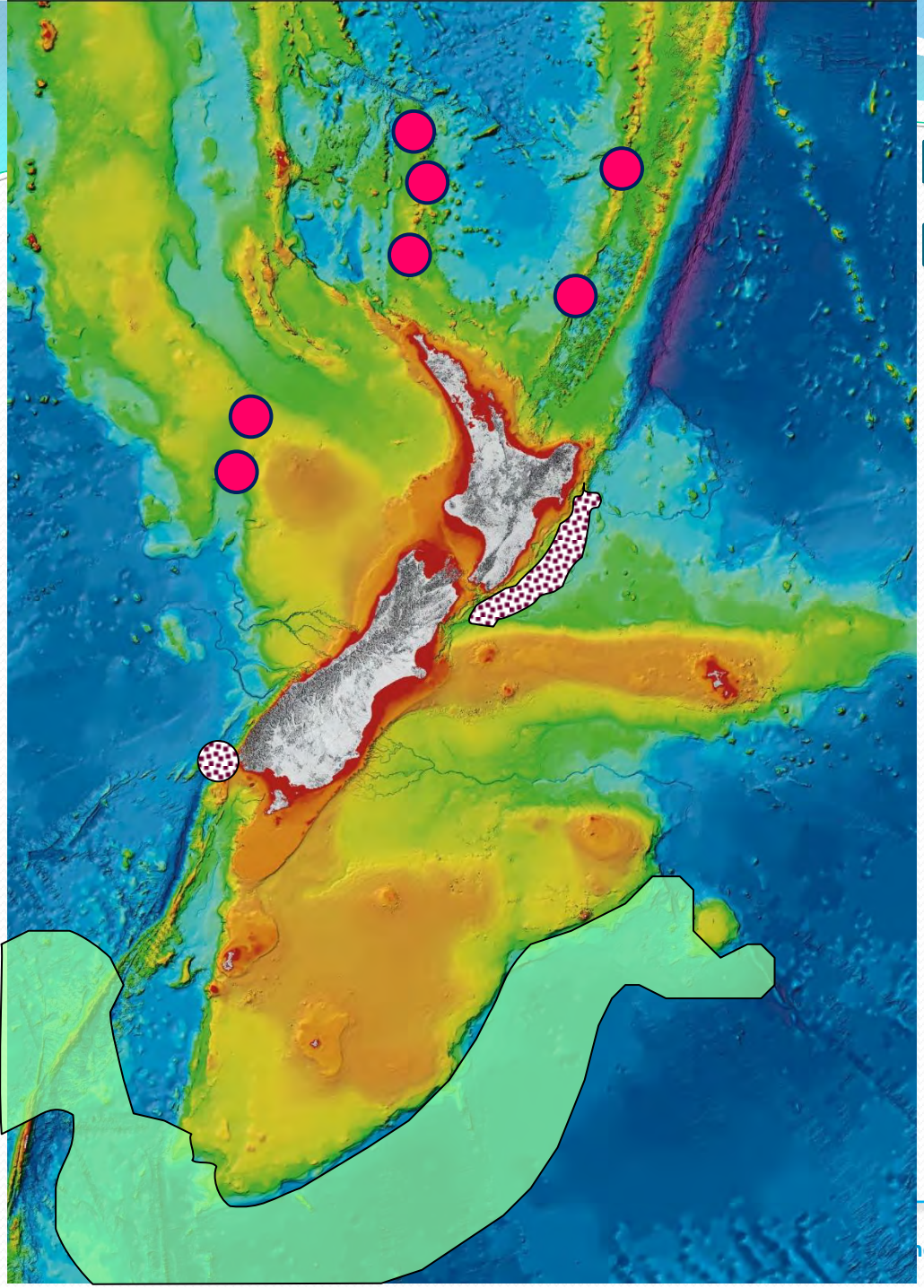
Gas hydrates





Fluid vents associated with acoustic flares in high frequency sounders





Future seabed Exploration & exploitation

Gas hydrates

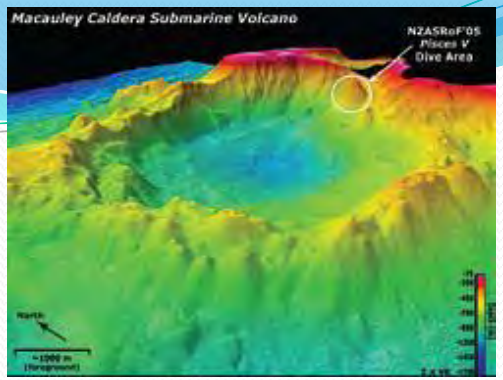
Hikurangi Margin - 50,000 km^2
("sweet spots" ~10% of area)
SW of Fiordland – ??? km^2

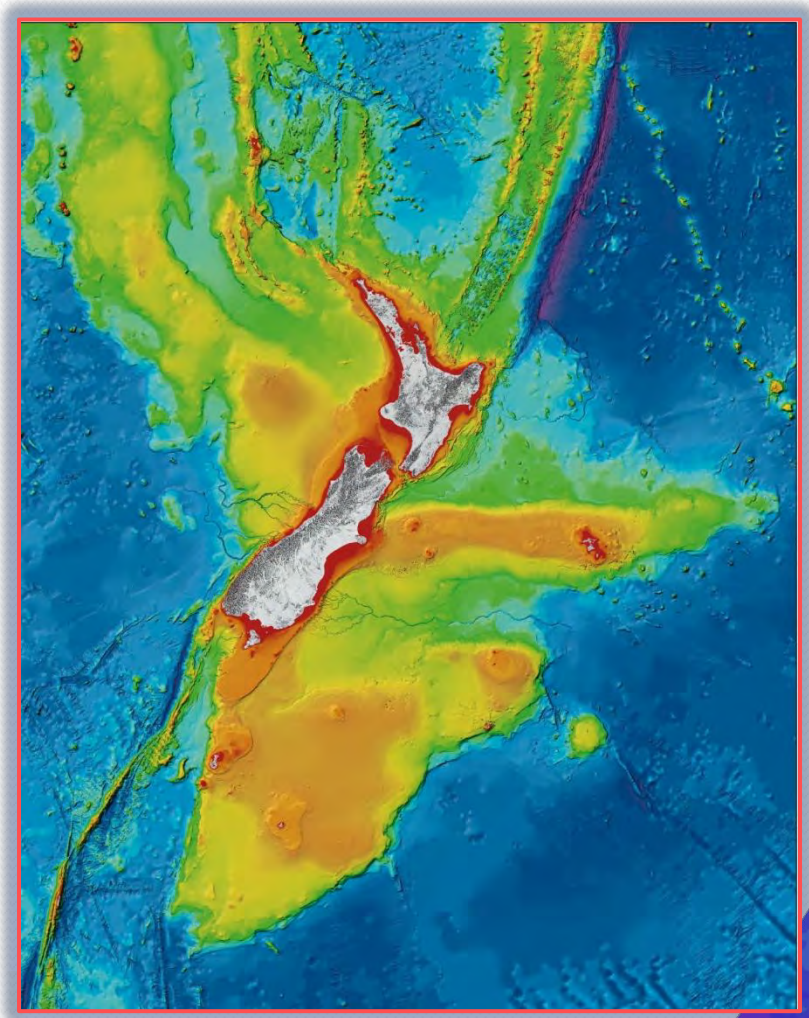
Polymetalic crusts & nodules

Isolated crustal deposits on Lord Howe Rise, Three Kings & Colville Ridges – ??? km^2

"Campbell nodule field" – 80-240 km wide belt across almost entire southern region

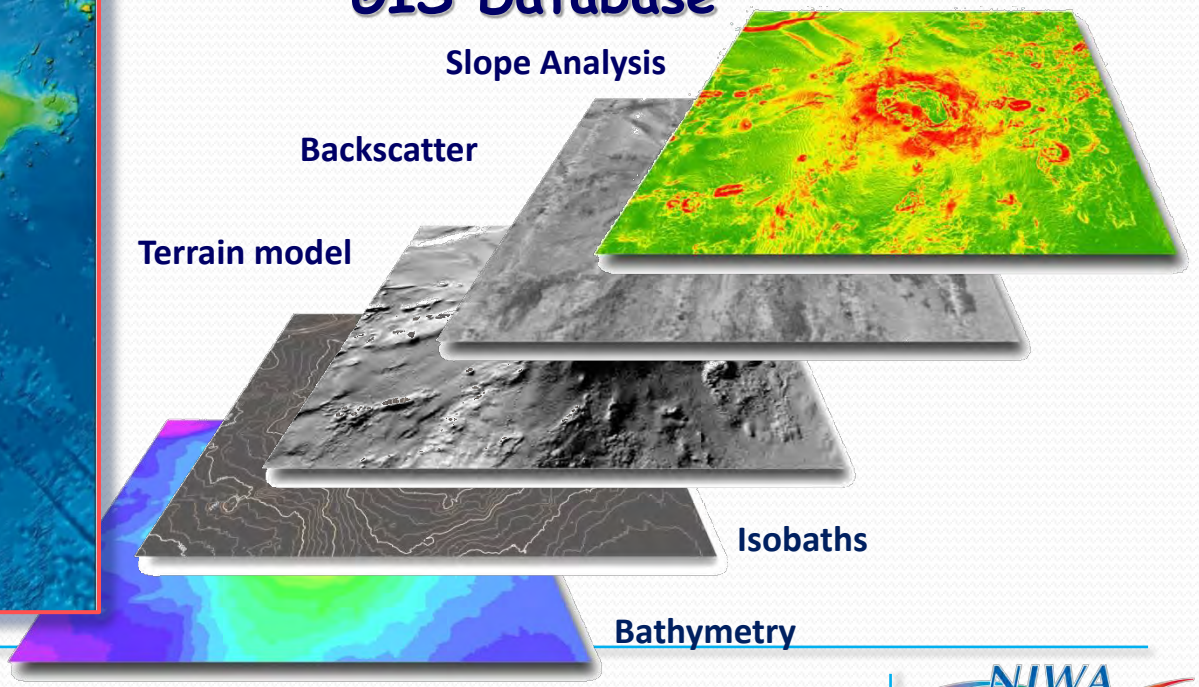
Seafloor morphology & composition, Resources Characterisation and Mapping Environmental Impact





- Seafloor Bathymetry
- Substrate composition
- Advanced backscatter processing
- Ground-truthing
- Charting and seafloor maps
- Web-serving of data

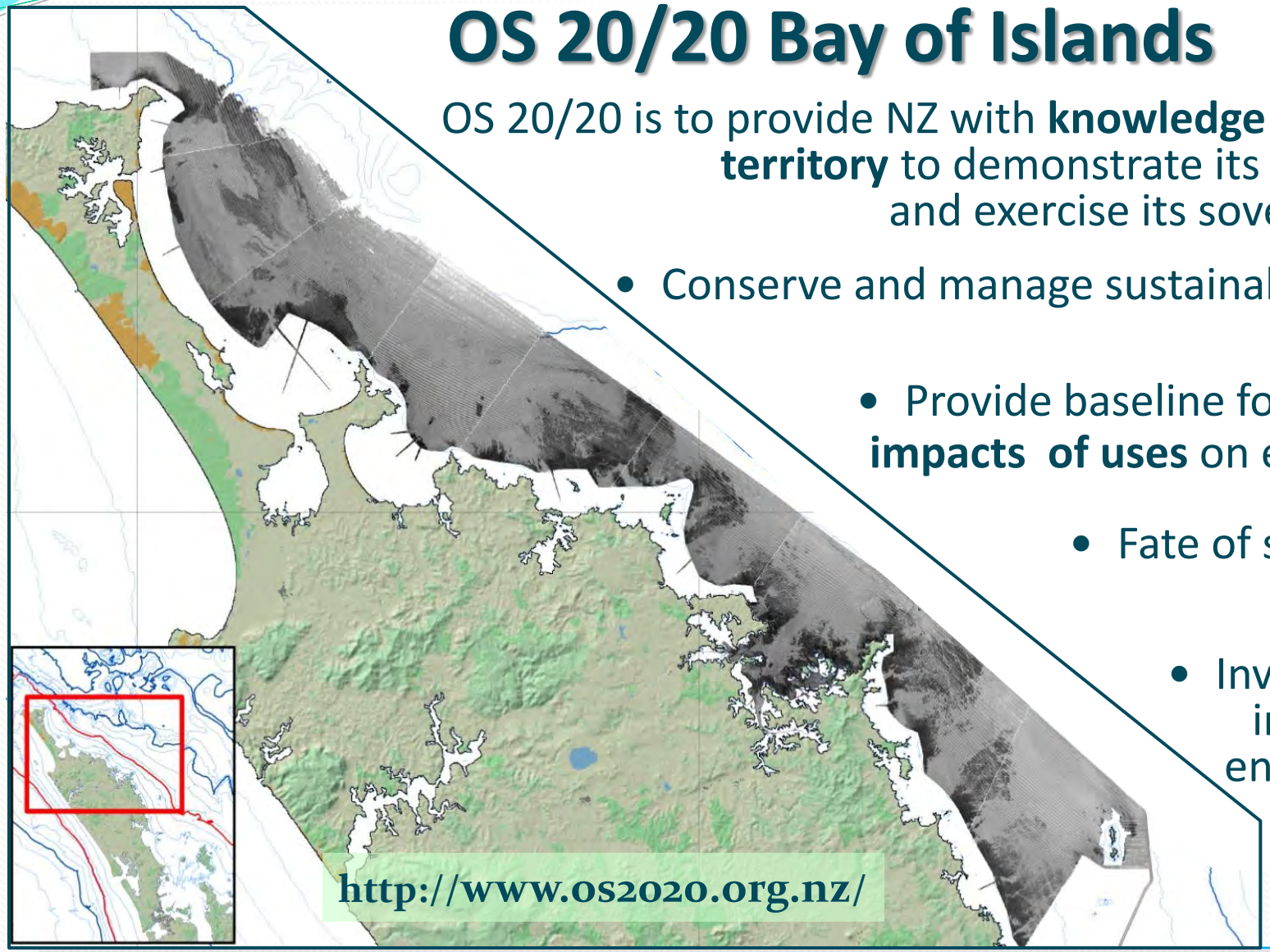
GIS Database



OS 20/20 Bay of Islands

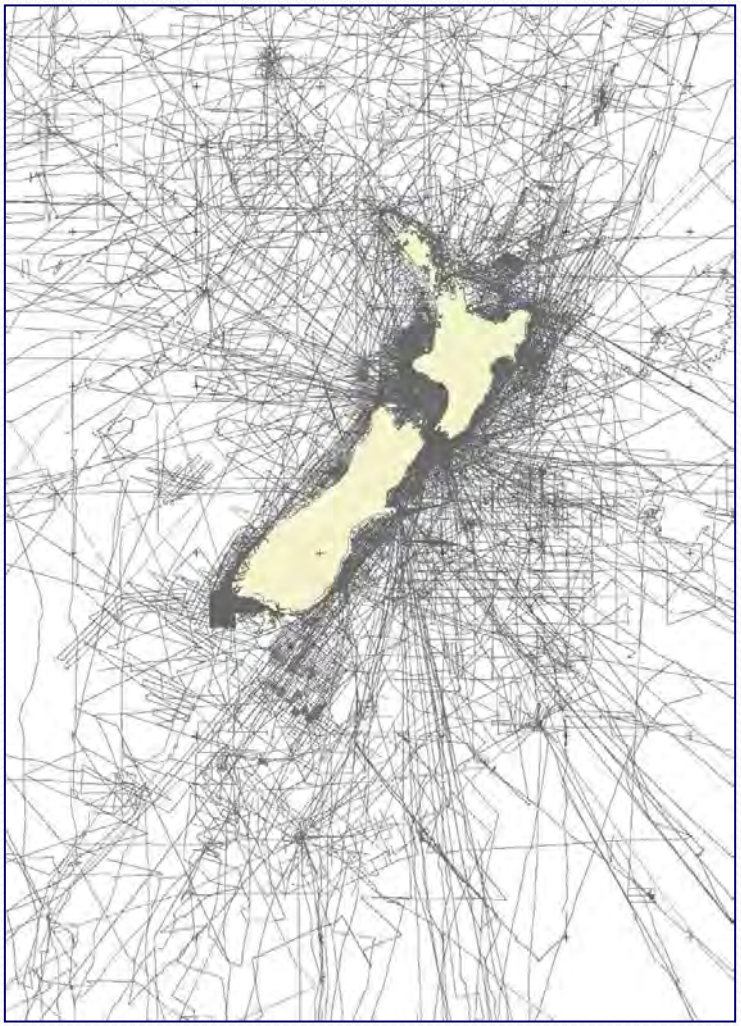
OS 20/20 is to provide NZ with **knowledge of its ocean territory** to demonstrate its stewardship and exercise its sovereign rights

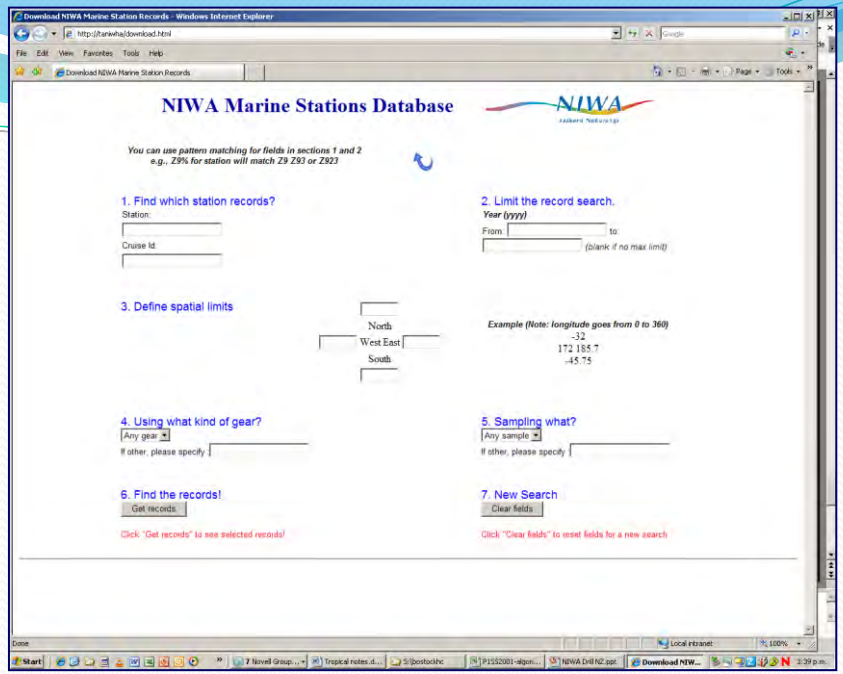
- Conserve and manage sustainably its ocean resources
- Provide baseline for estimating **impacts of uses** on ecosystems ;
- Fate of sediments & pollutants
- Involvement of indigenous & environmental groups.



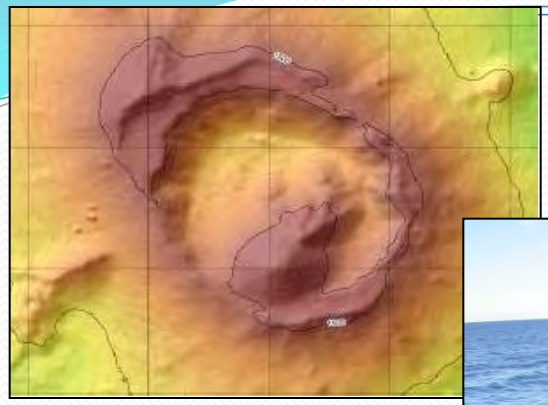
http://www.os2020.org.nz/

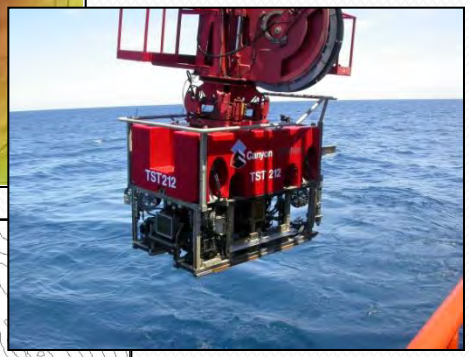
Geology, Geophysics, Biology archives & databases

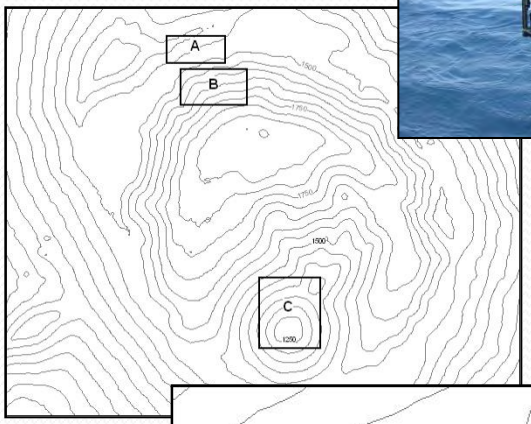


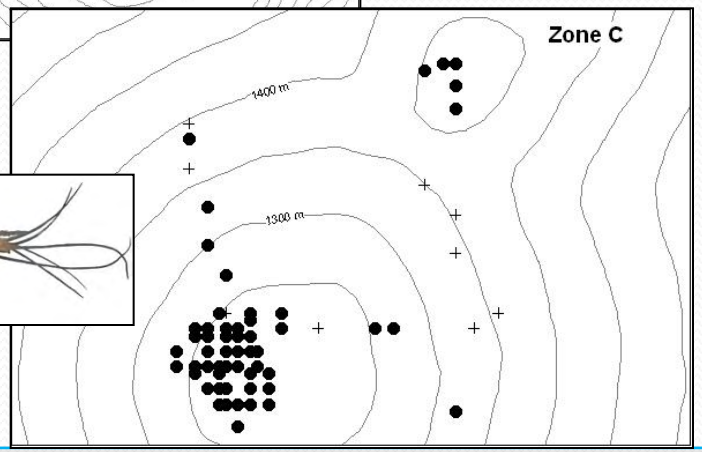


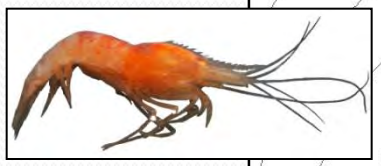
50 yrs legacy of NZ exploration











Industry partnerships

- Mineral resource companies in NZ have adopted international guidelines as 'best practice' during exploration
- Scientists involved in designing & undertaking environmental surveys
- Including Neptune Minerals Ltd explorations on Brothers (2005) & Rumble II West (2007)
- Valuable data contribution to scientific studies in region

Development of extraction heavy equipment

Offshore Process

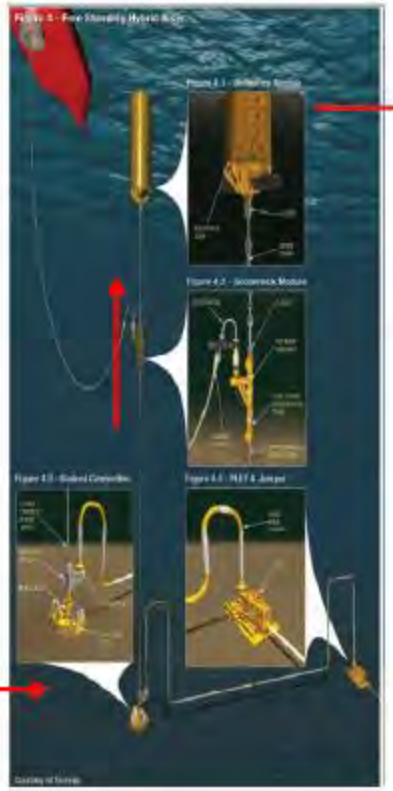
Seafloor Mining Equipment

Auxiliary Miner

Bulk Miner

Gathering Machine

Riser and Slurry Pump

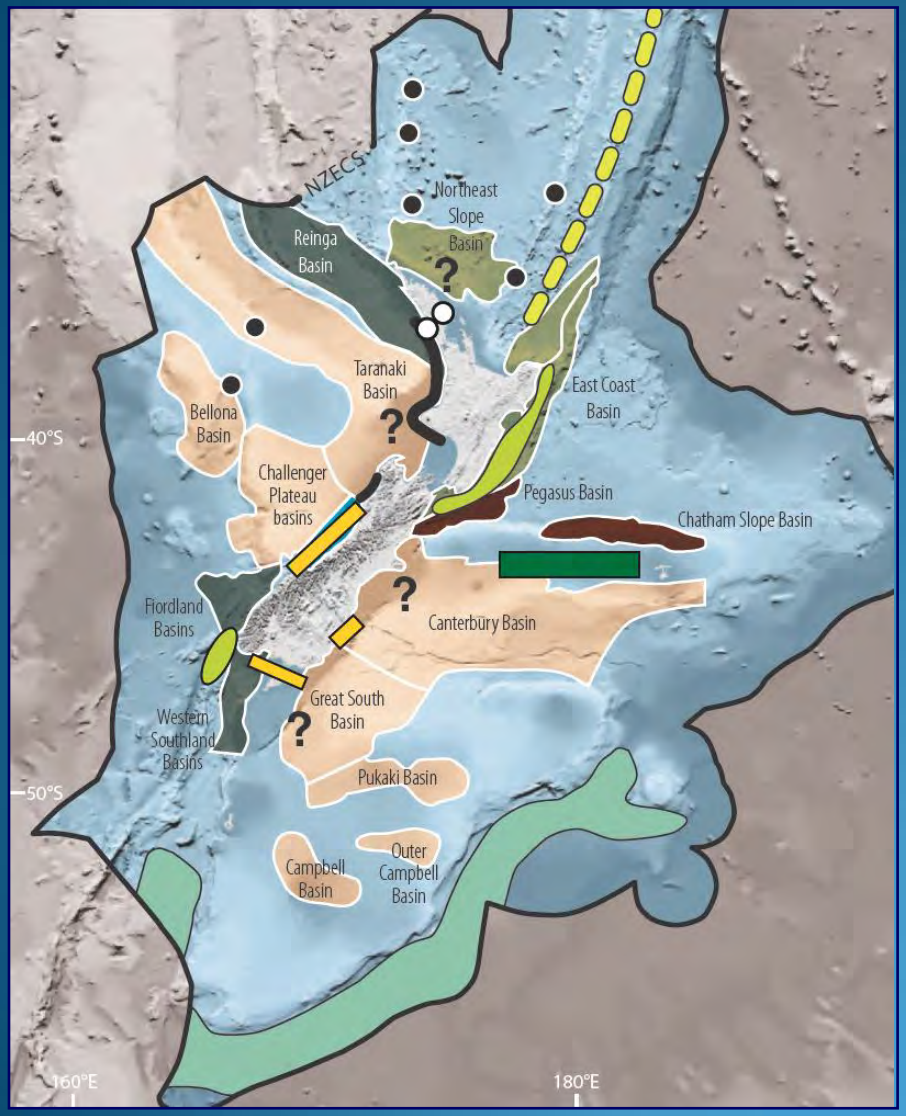


De-Watering and Transfer

PSV

Transfer Ship

Conclusion



- There is a consensus that seafloor resource are exploitable and would provide substantial economic benefit to ocean economies.
- But rigorous, quantitative research is still required to make estimate and model that would convince the industry
- There is need for much more conservation science to provide sound environmental management and balance between extraction and conservation