Australian Government
Geoscience Australia

Australia's Future Energy Resources Project:

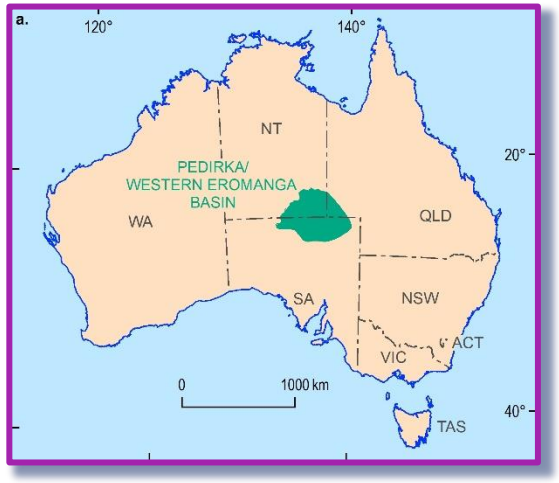
the untapped potential of onshore low carbon energy resources

Tom Bernecker, Barry Bradshaw, Jeremy Iwanec, Keith Bradey, Ryan Owens, Andrew Feitz, Aleks Kalinowski, Lidena Carr

Minerals, Energy & Groundwater Division

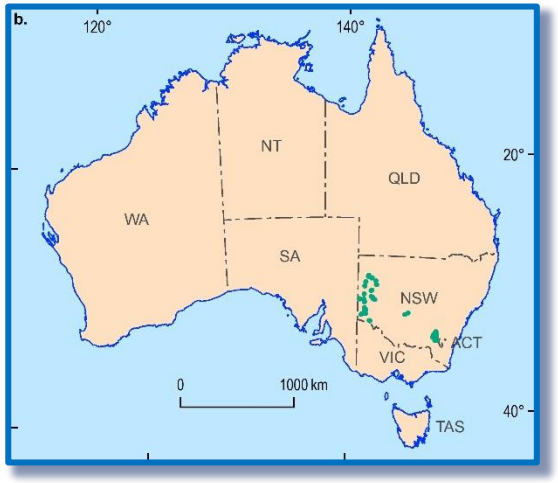
Australia's Future Energy Resources (AFER) Project:

Focus areas



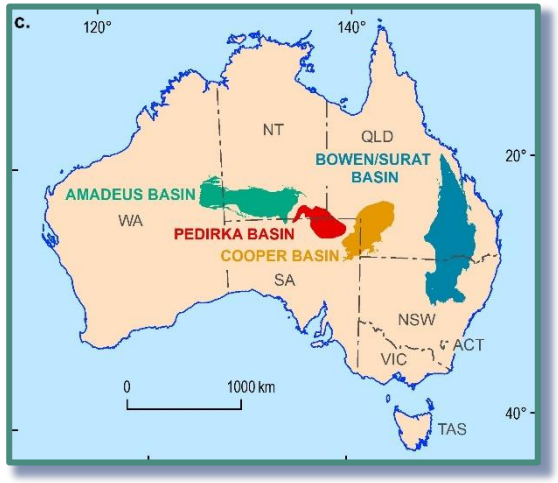
Resource assessment

- **Targets**
  - Conventional HCs
  - Unconventional HCs
  - CO_2 storage potential
- **Methods**
  - Well failure analysis
  - Seismic repro/interp.
  - Play-based mapping
- **Outputs**
  - Reproc'd seismic data
  - CRS maps
  - Petrophysical interpret'ns



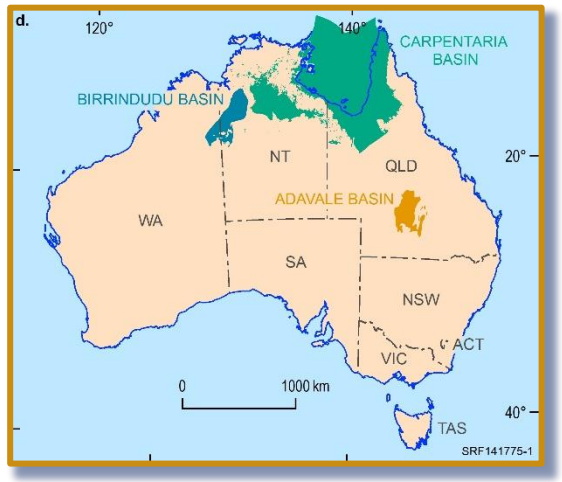
Hydrogen studies

- **Targets**
  - Natural gas accumulations
  - Soil gas in western NSW
  - Subsurface salt occurrences
- **Methods**
  - Geochemical analysis
  - Soil gas sampling
  - Geophysical imaging of salt
- **Outputs**
  - Salt distribution map
  - H2 economic fairways tool
  - Natrl. hydrogen occurrences



Residual oil zones + CC(U)S

- **Targets**
  - Oil fields
  - Palaeo-oil columns
- **Methods**
  - Screening and ranking
  - Petrophysical analyses
  - Multiphase modelling
- **Outputs**
  - New storage plays
  - ROZ well composites
  - New reservoir models

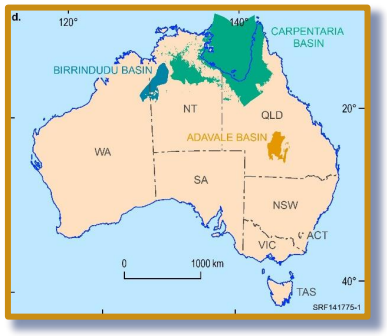


Basin inventories

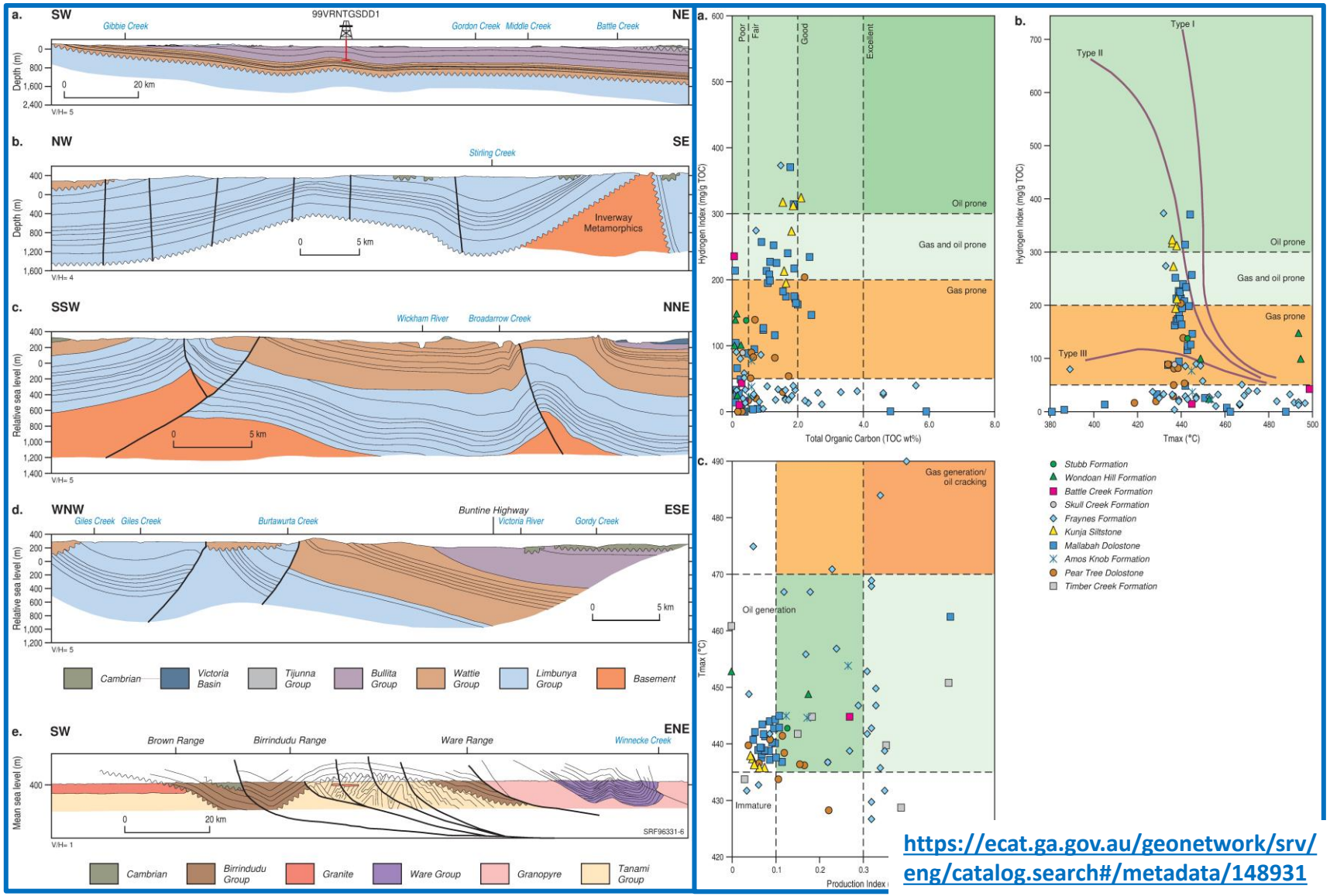
- **Targets**
  - Underexplored basins
  - Subsurface resources
- **Methods**
  - Gap analyses
  - Stratigraphy reviews
  - Source rock geochemistry
- **Outputs**
  - Prospectivity overviews
  - Geochemical data sets
  - Petroleum system models

Basin inventories module:

Results (example): geological summaries, gap analysis



- **Reports providing a whole-of-basin inventory of:**
  - geology
  - petroleum systems
  - exploration status
  - data coverage (and where to access)
  - knowledge and data-gaps
- **The Onshore Basin Inventories provide foundational data and underpin investigations into basin-hosted resources:**
  - hydrocarbons
  - hydrogen
  - basin-hosted mineral systems

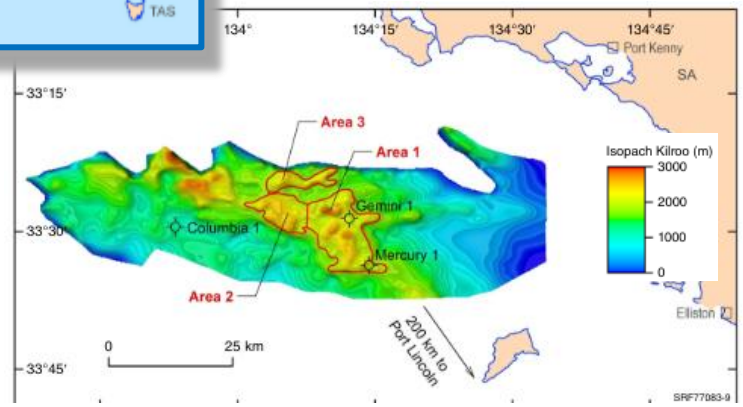


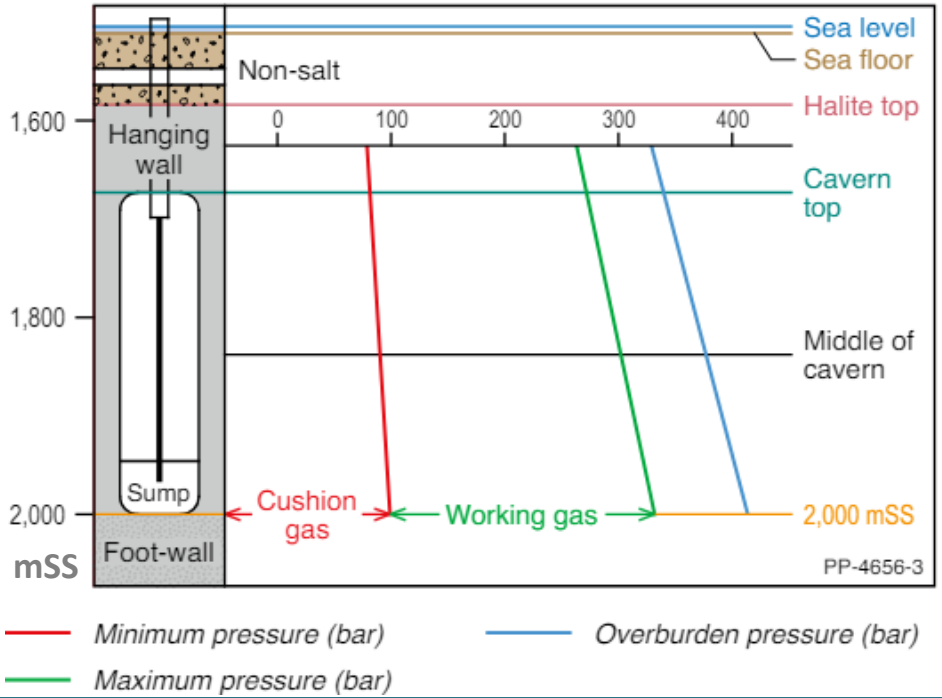
https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/148931

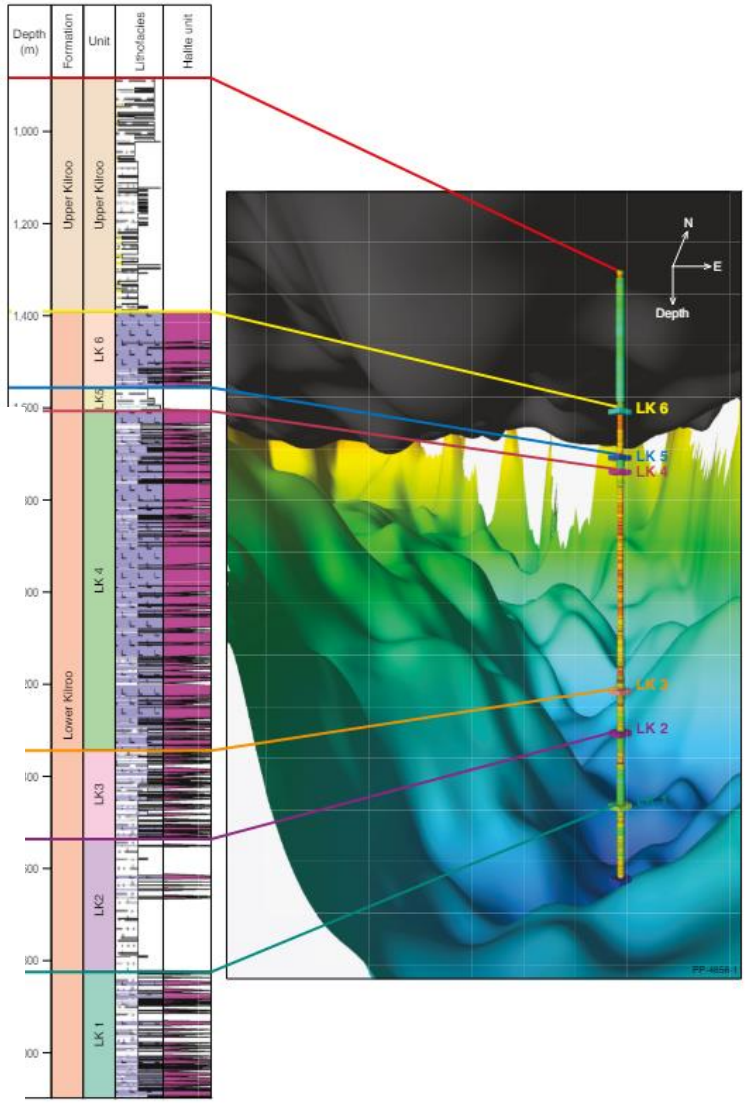
Hydrogen studies module:

Results (examples): petrophysical appraisal of subsurface salt

Mercury - 1







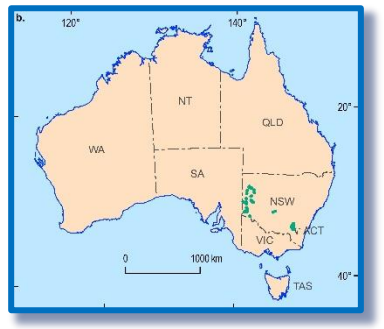
Identified salt cavern storage potential in offshore Polda Basin

- Massive halite deposits in an anticlinal structure
- Low geothermal gradient (cold basin)
- Formation overburden pressure gradient enables favourable gas operation pressures for working gas.

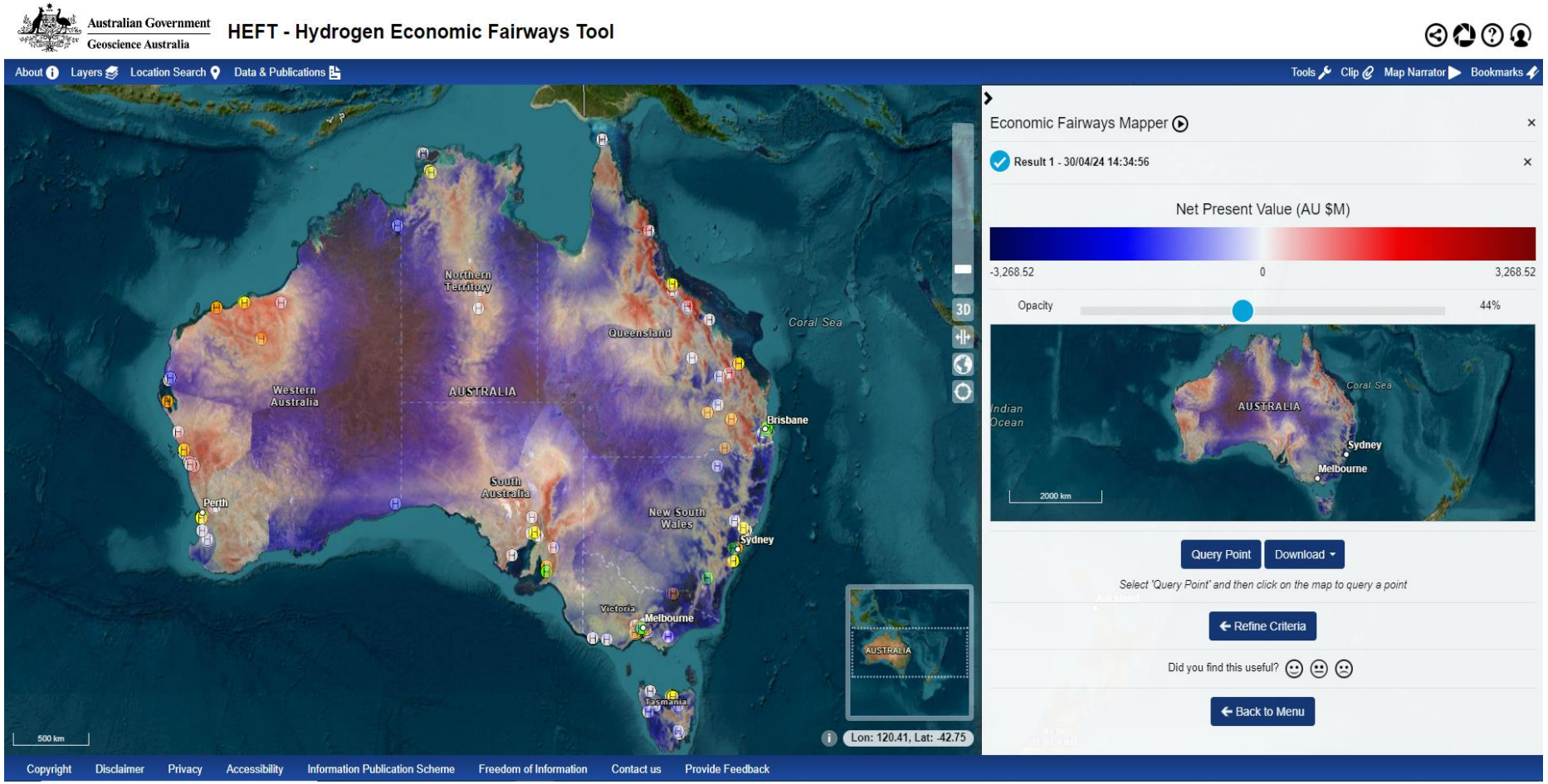
AUSTRALIAN MUSEUM EUREKA PRIZES 2023 WINNER

MONASH University

Hydrogen studies module:



Results (examples): interactive online data discovery tool

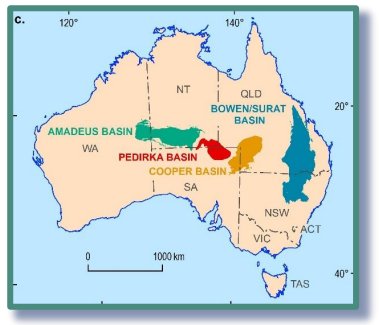


- Designed to support implementation of Australia's National Hydrogen Strategy
- Assists with identification of suitable regions for hydrogen production in Australia
- Based on an open-source economic model that maps the economic viability of hydrogen production opportunities across Australia

https://portal.ga.gov.au/persona/heft

Residual oil zones + CCS module:

Results (examples): petrophysical analyses



Resistivity

Shows in cuttings and core

Hydrocarbons *More oil* →

Dullingari 29

Current OWC

Palaeo OWC

MPZ

MPZ

TZ

ROZ

?

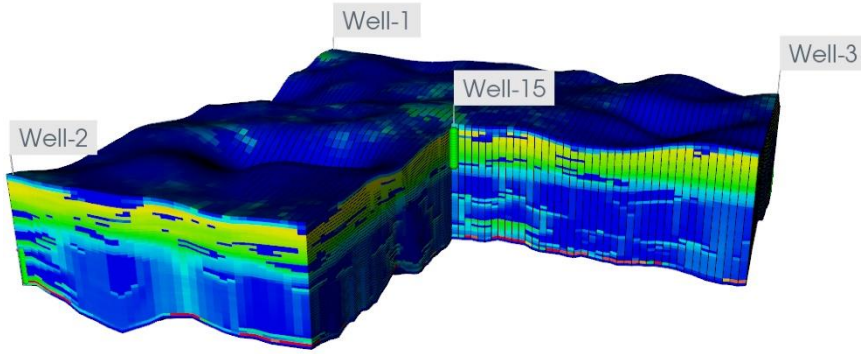
DST #1 Q 2658 BPD oil, REC 110 BBLS

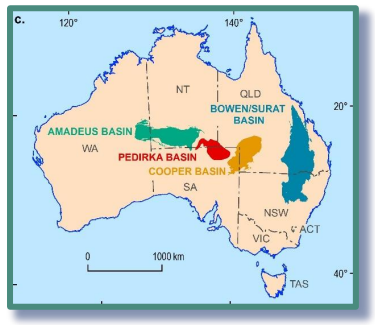
Dullingari field
Eromanga Basin, SA

- Main pay zone readily identified by resistivity log and shows in cores and cuttings
- Shows in cuttings become weaker in transition zone
- **Confirmed ROZ that can be seen in multiple wells below transition zone, S_o 15-30%**
- Weak oil indications below may be sporadic, not part of a ROZ

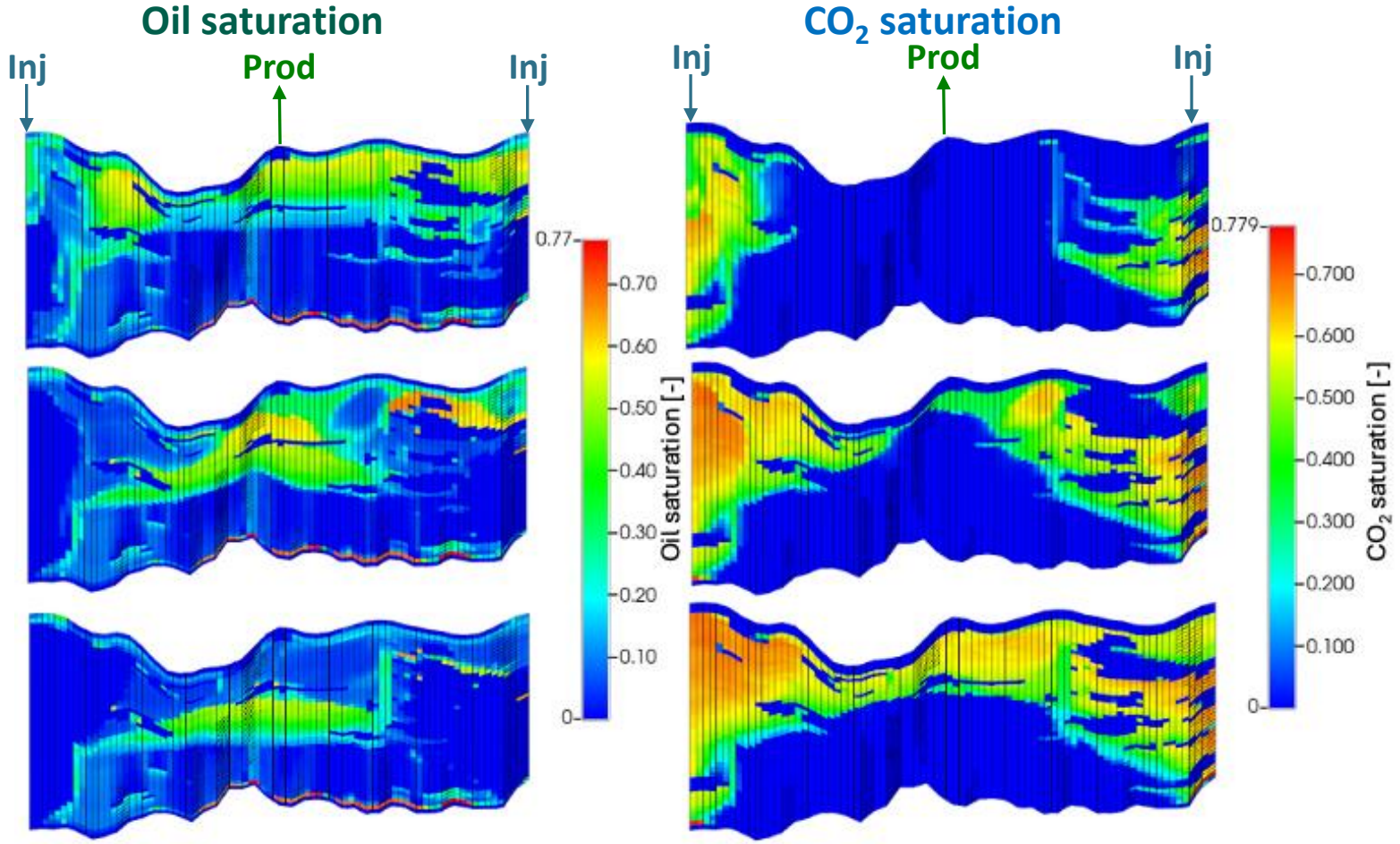
Residual oil zones + CCS module:

Results (examples): multiphase modelling





Modelling study results



Scenario details…

- Injection wells are completed only in the bottom third of the domain
- Production well is completed in the top third of the domain

Details to be presented by Aleks Kalinowski in Session 27

Play-based resource assessment workflow

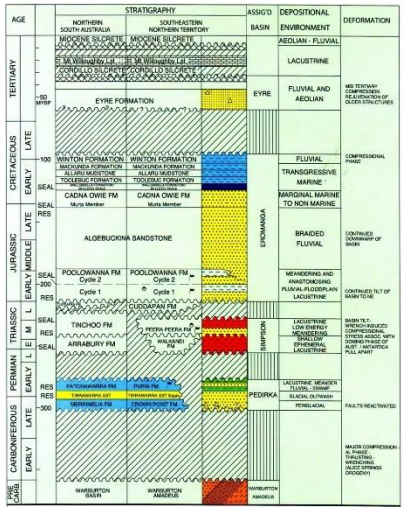
Gap Analysis

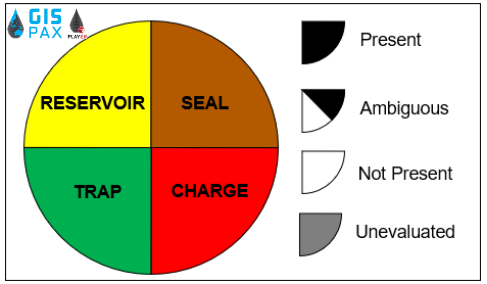
Post-drill Analysis
Seismic Reprocessing and Interpretation

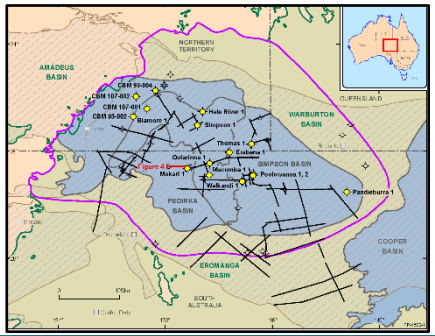
Play Definition
Stratigraphic Correlation

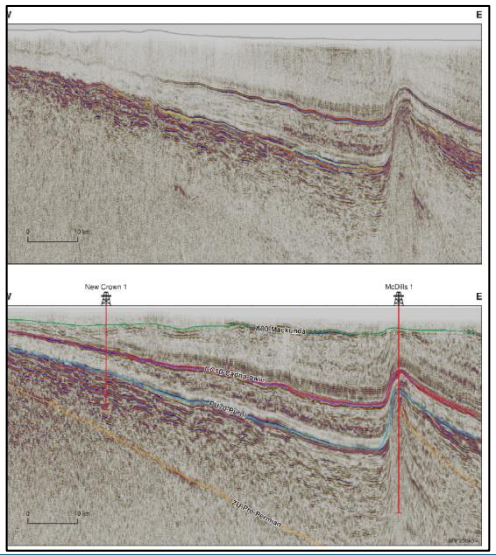
Qualitative
Resource Assessments

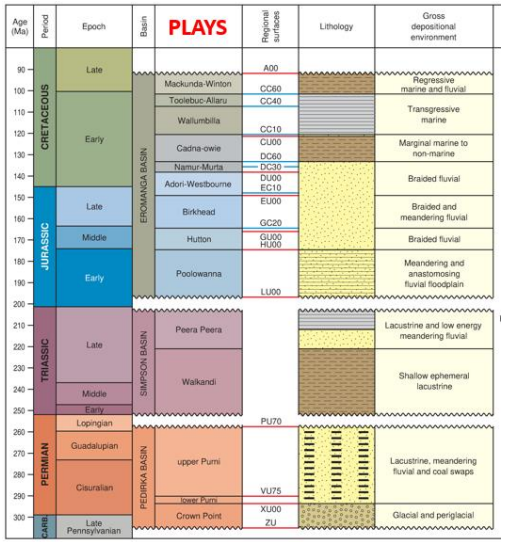
Quantitative
Resource Assessments

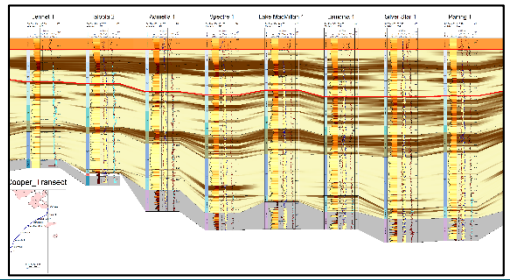


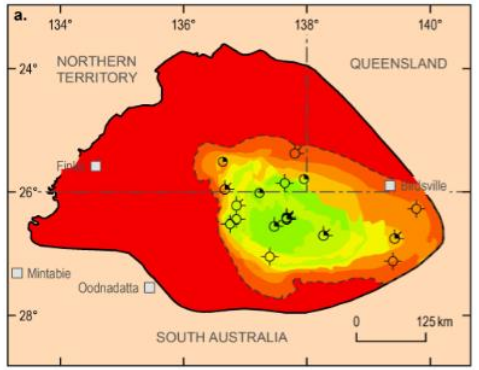


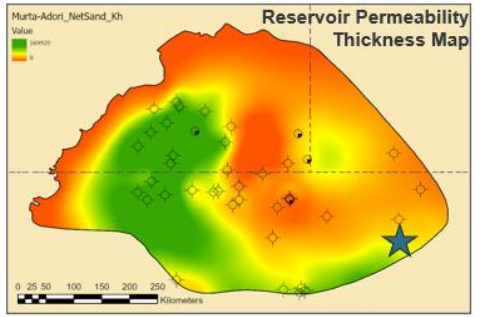


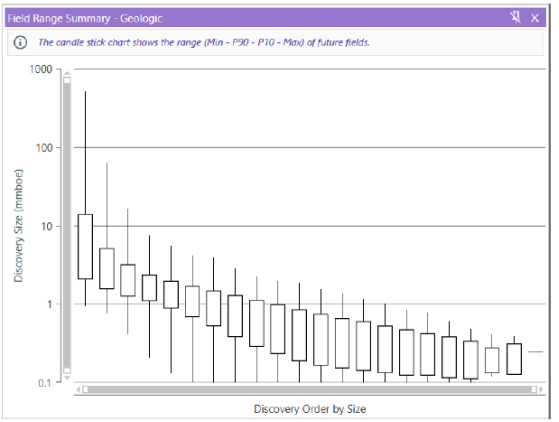


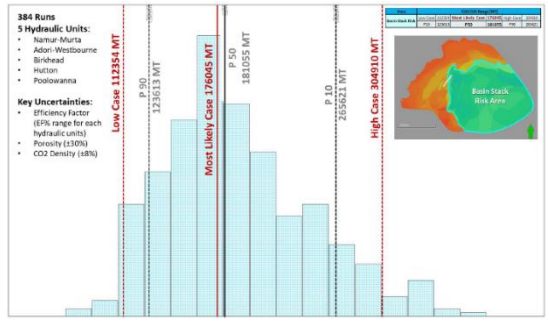




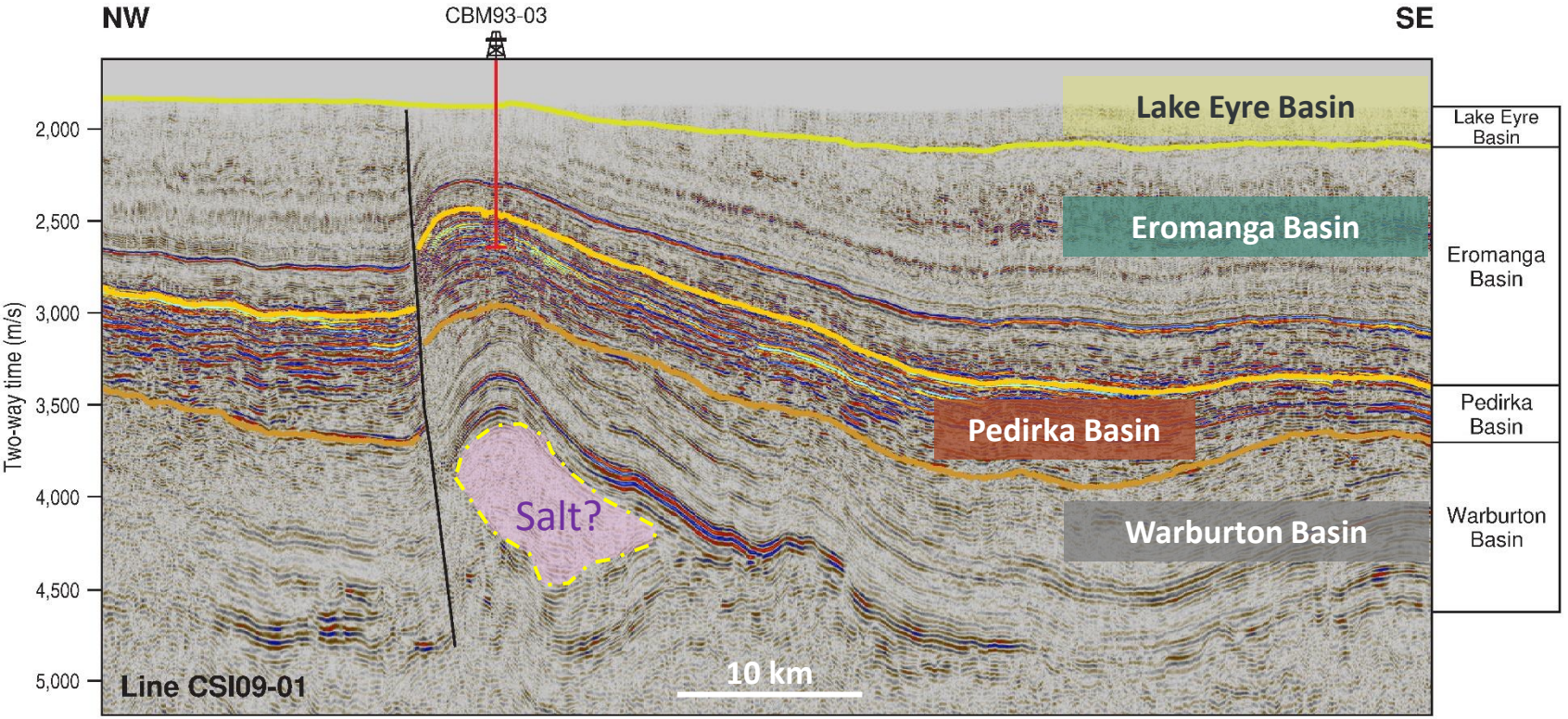


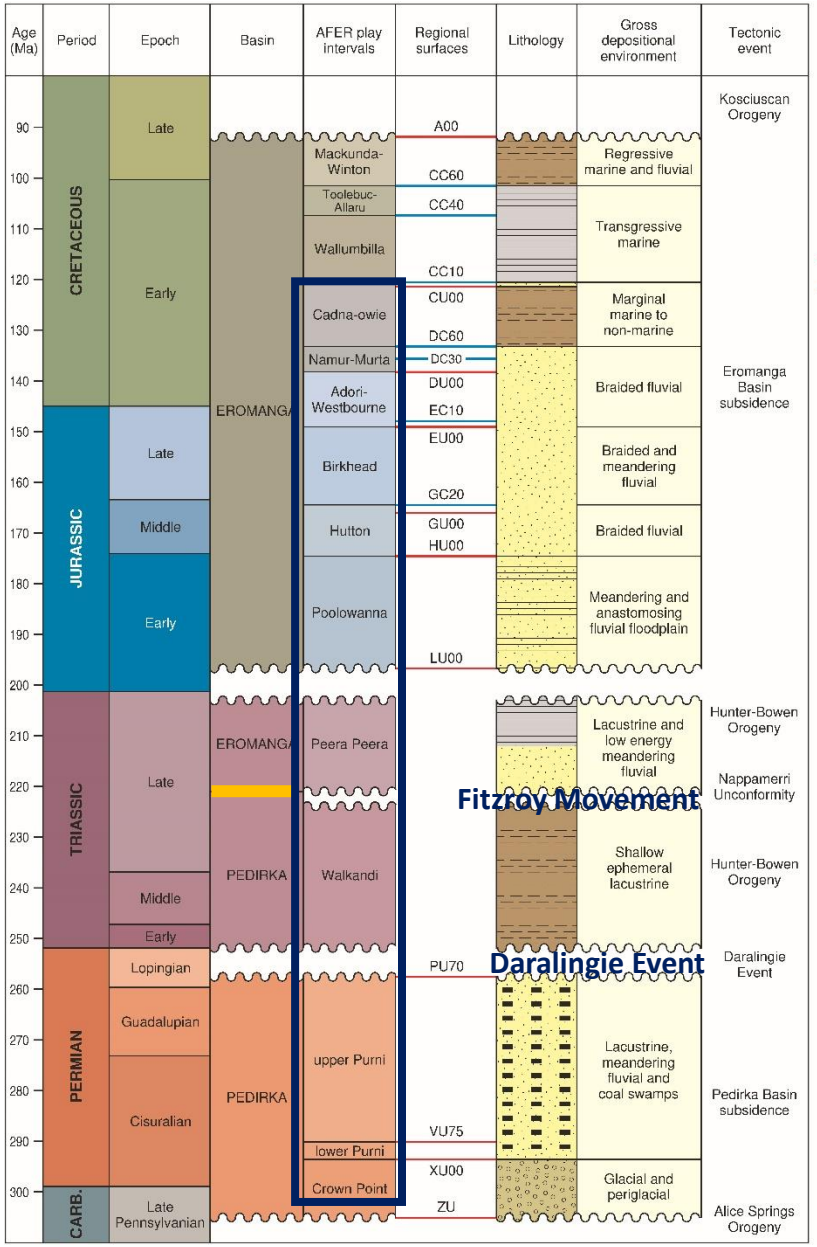






Energy resources assessment module: seismic reprocessing

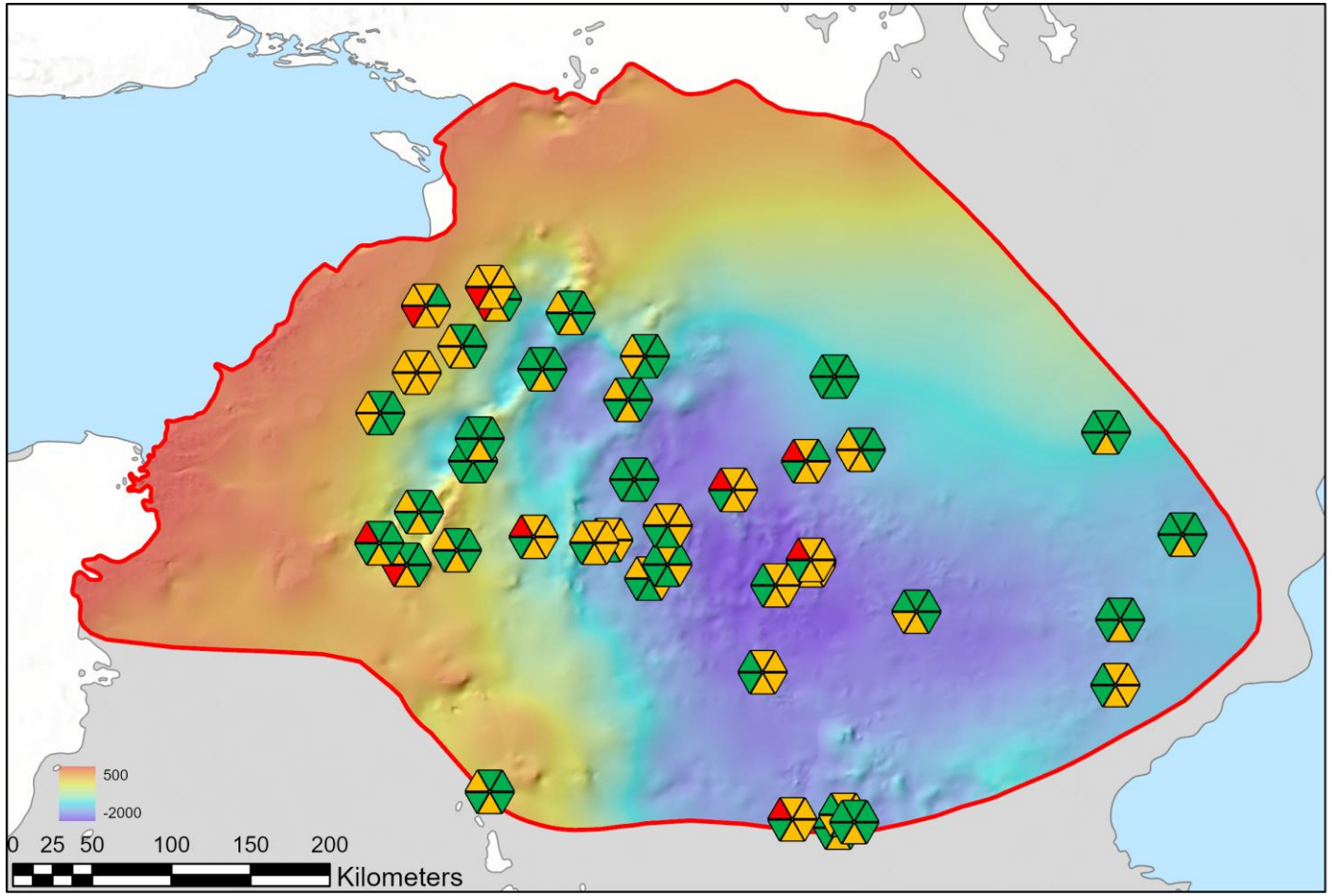




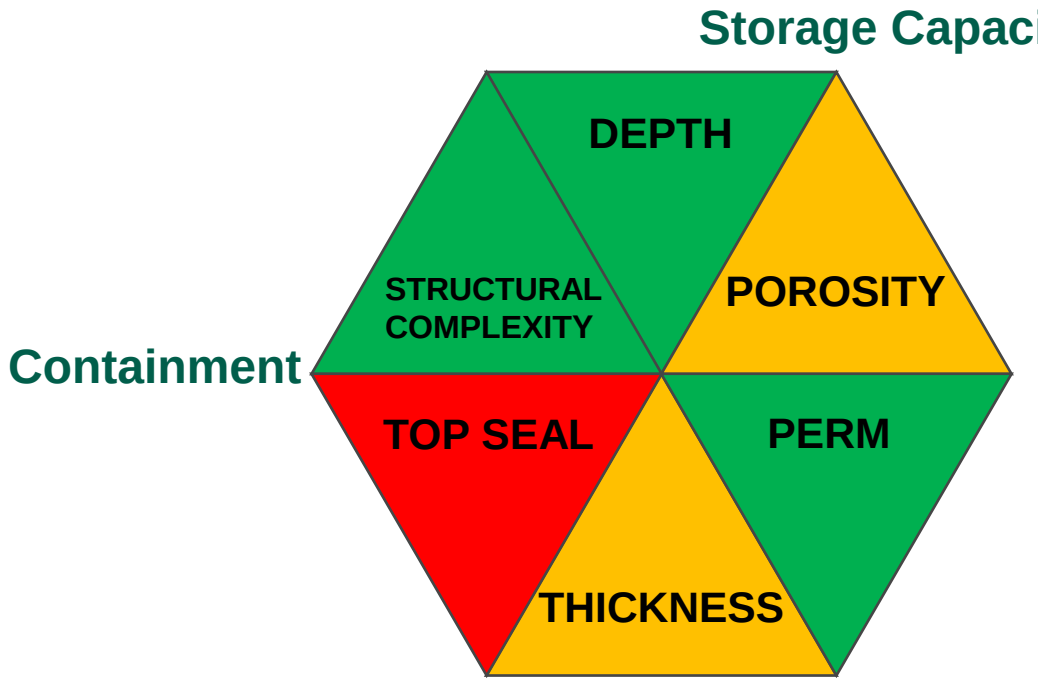
- Unconformities at top-Permian and base Jurassic levels very subtle
- **Daralingie Event** is not recognised as a basin boundary, while **Nappameri Unconformity** (regionally recognised as the **"Fitzroy Movement"**) represents the initiation of the Eromanga Basin
- Seismic interpretation informed the definition of **play intervals**
- **Possible presence of salt-body linked to increased water salinity readings in shallow sandstones**

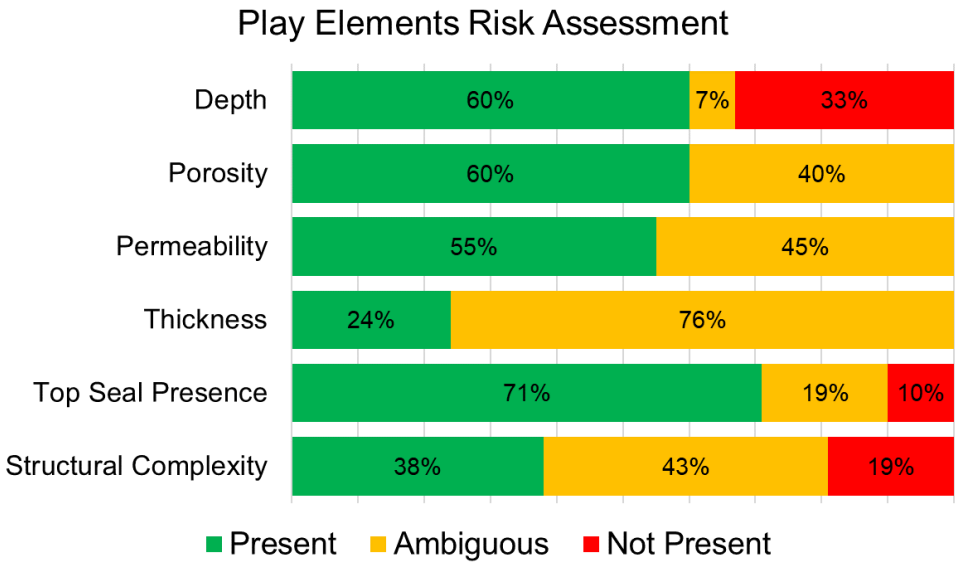
Post drill analysis:

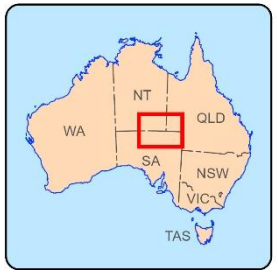
example: Carbon Capture & Storage – Namur-Murta Play



- PDA performed on 41 exploration wells
- 11 play intervals assessed for unconventional HCs, conventional HCs and carbon dioxide storage capability

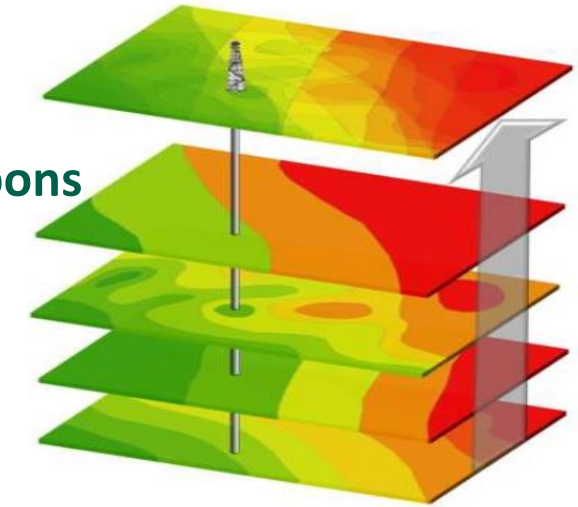


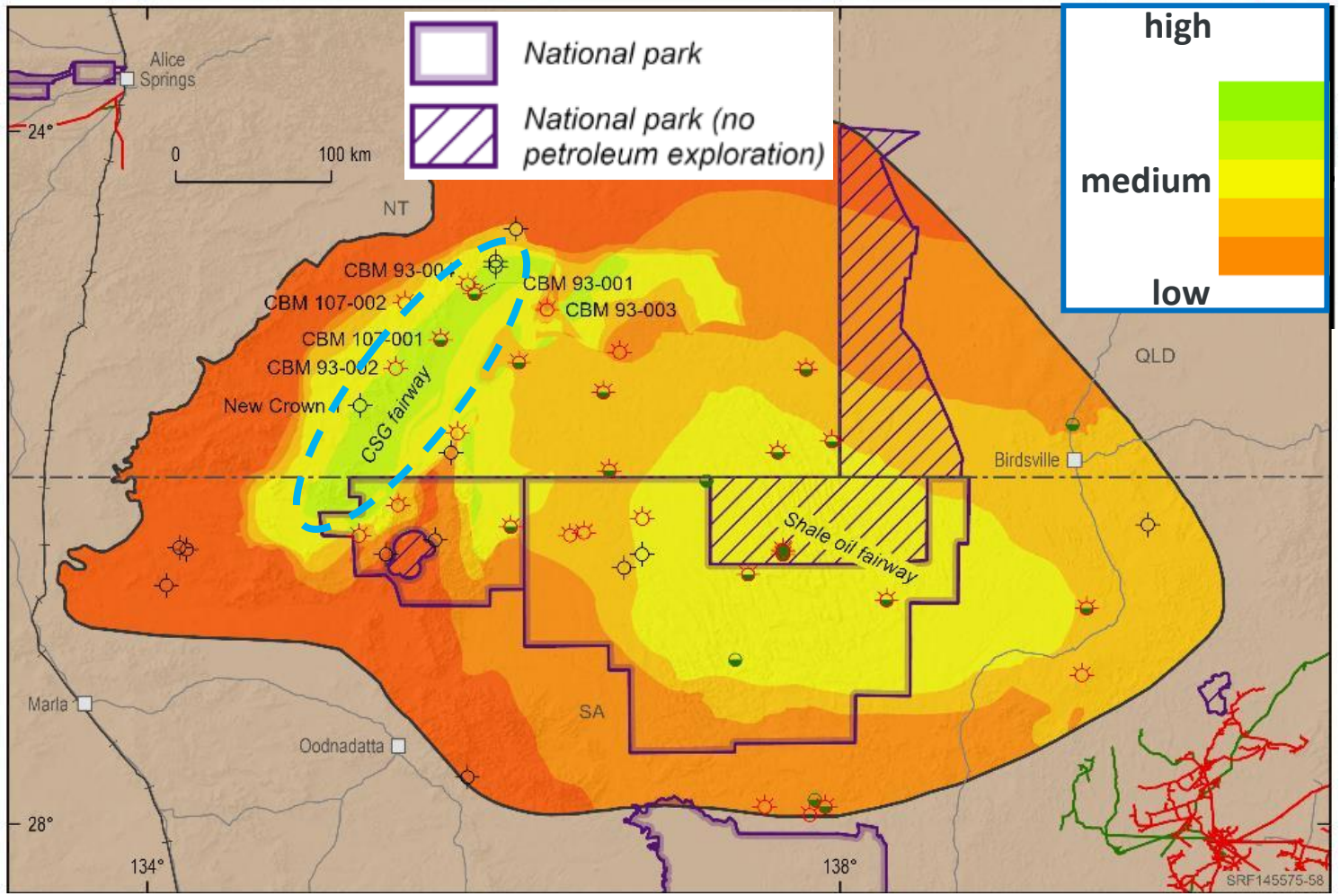




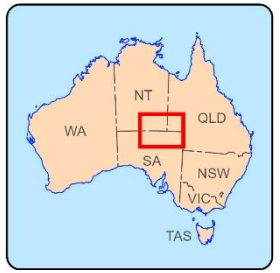
Energy resources assessment module

Results: resource potential of unconventional hydrocarbons





- Play fairway maps show the combination of all identified risks in a stacked plays arrangement
- Presence of thick coal-seam bearing sediments in the Purni Formation outline area of highest prospectivity for coal seam gas within the Eringa Trough
- However, the seams' overall low gas contents diminish the resource potential



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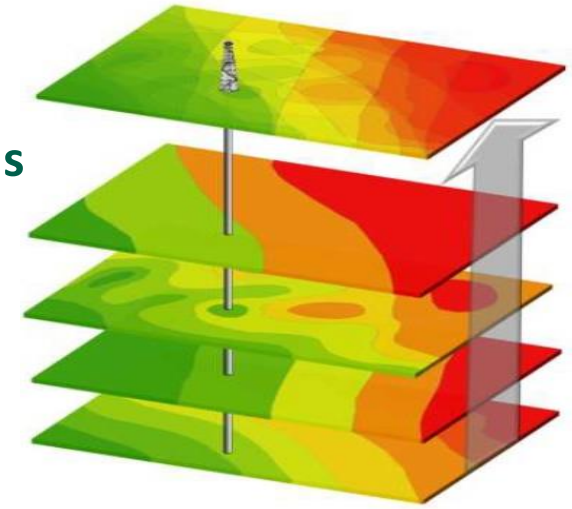
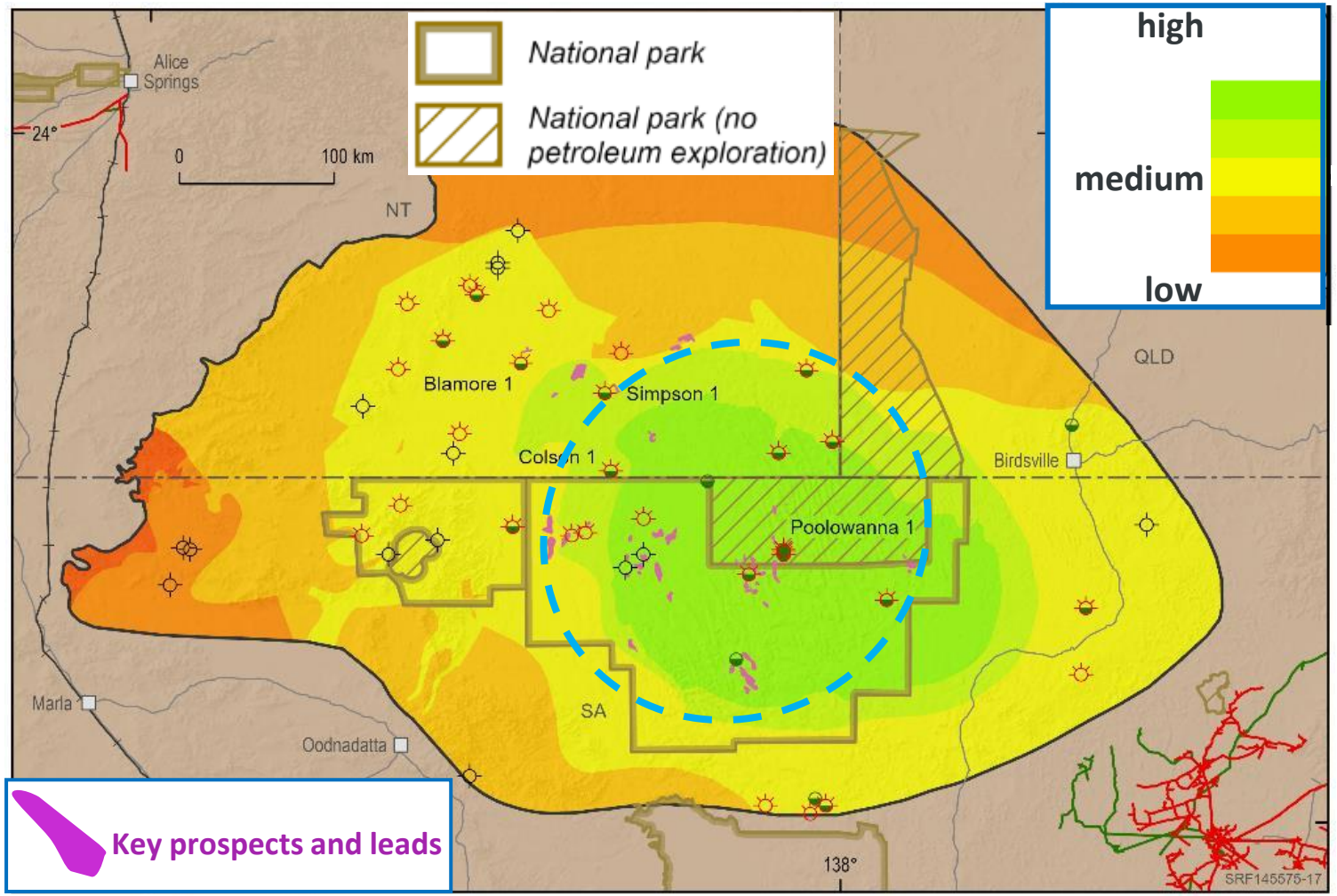


Charge (hydrocarbons)

Trap Presence

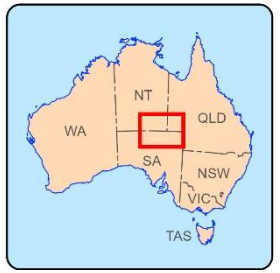
Seal Presence & Effectiveness

Reservoir Presence & Effectiveness



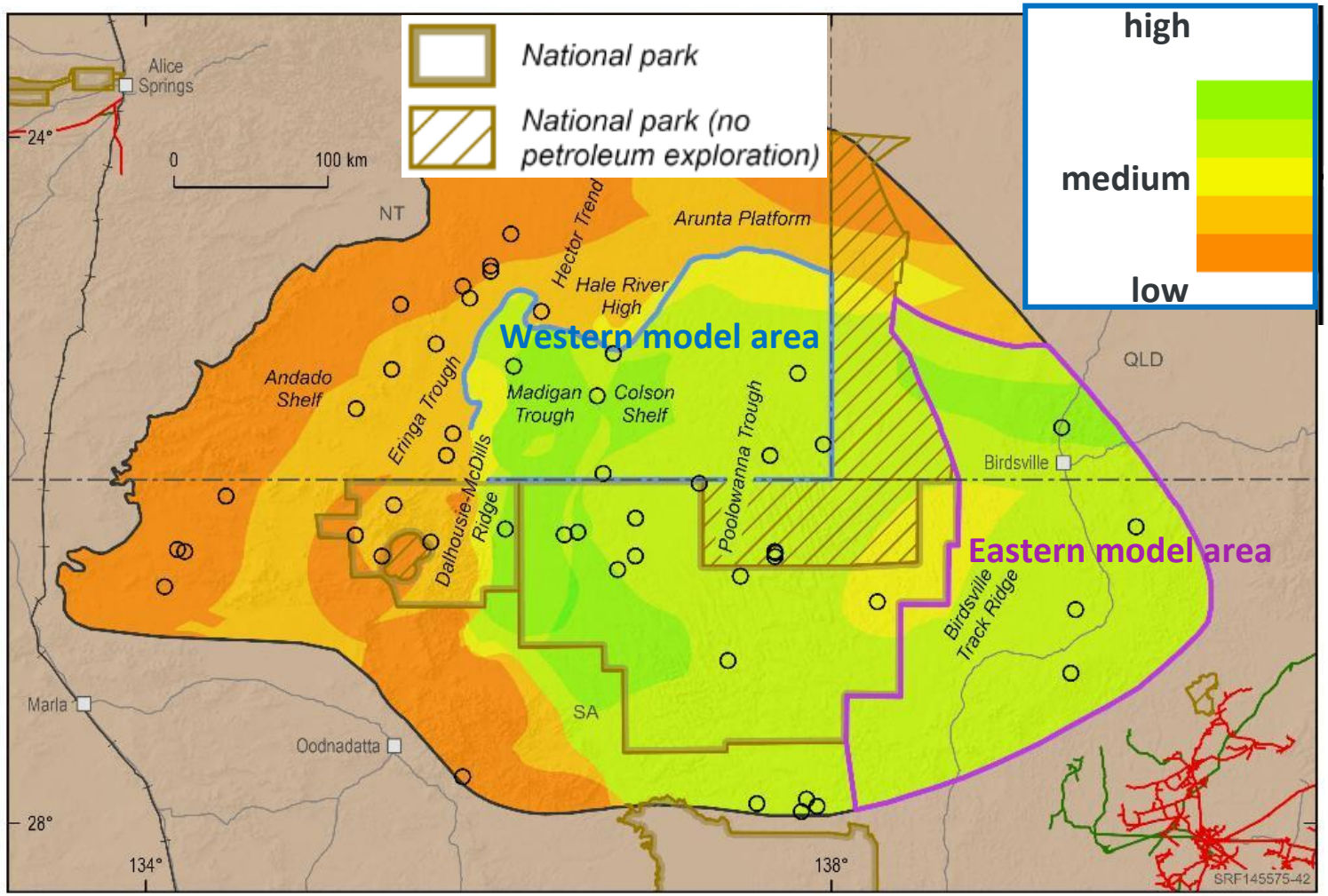
- Highest level of prospectivity confined to the Poolowanna Trough
- Trap development, presence and effectiveness of sealing lithologies identified as main risks identified
- Hydrocarbon charge recognised by multiple shows but recognised as a risk outside immediate source kitchen area.

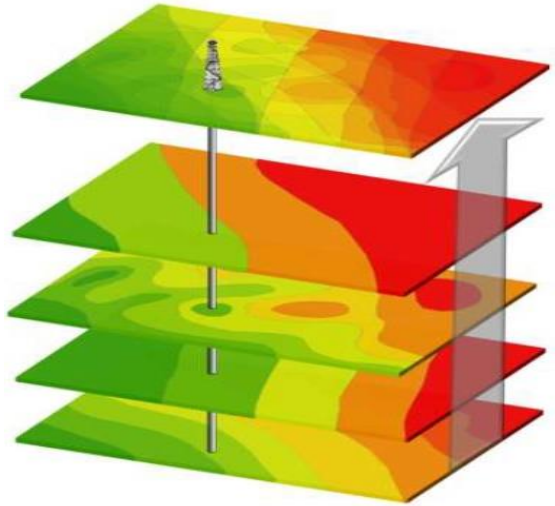
Yet-to-find analysis indicates a mean risked volume of 22MMbbl of oil could be discovered in the basin



Energy resources assessment module

Results: carbon dioxide storage potential

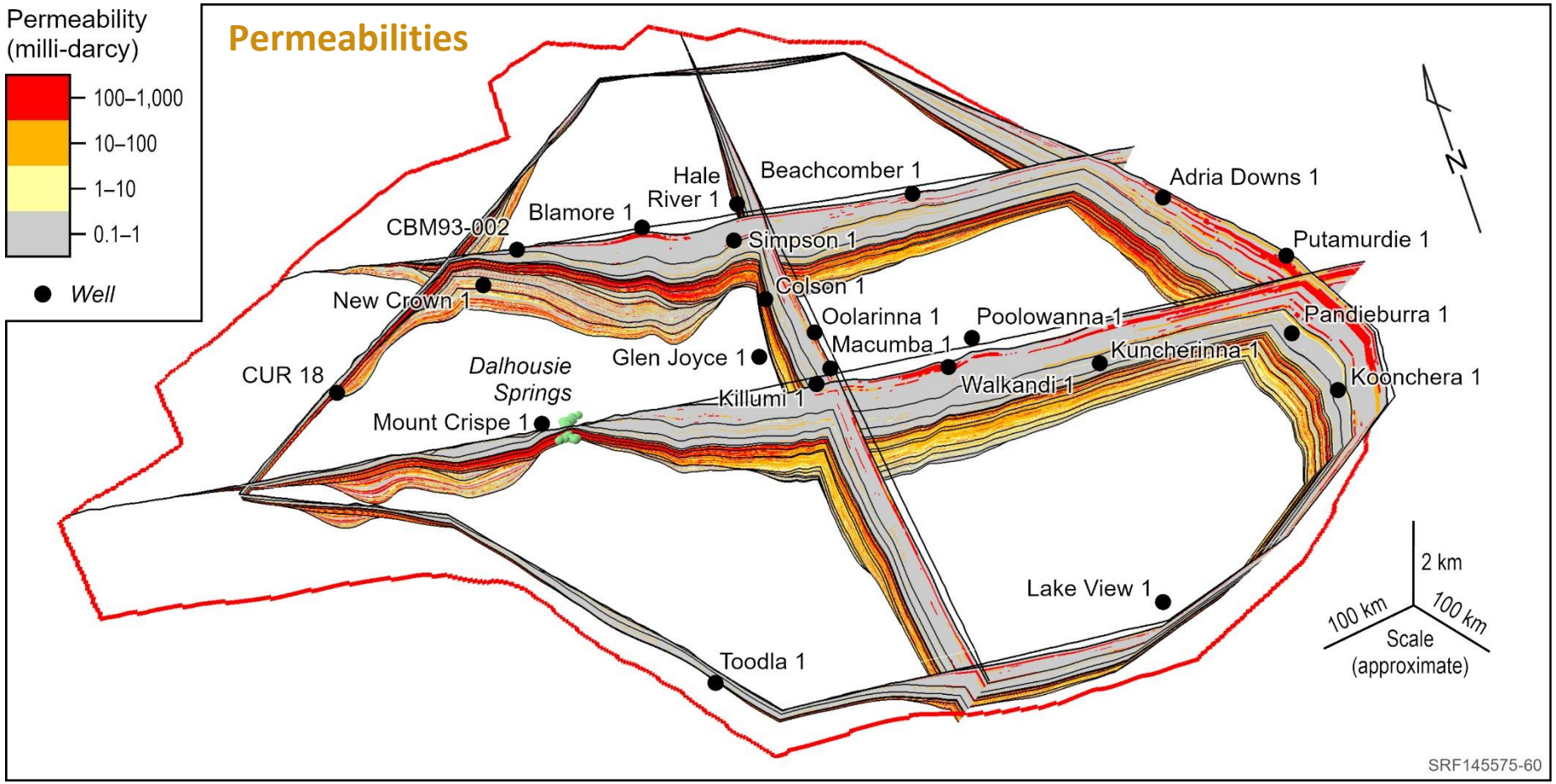




- Two areas within Pedirka/western Eromanga region identified as suitable for CO_2 storage
- Eastern area constrained by environmental restrictions and storage prospectivity; western area constrained by NT boundary and storage prospectivity
- Geological differences marked by increasing fine-grained lithologies towards the east

Energy resources assessment module:

Results: carbon dioxide storage potential



3D lithological models

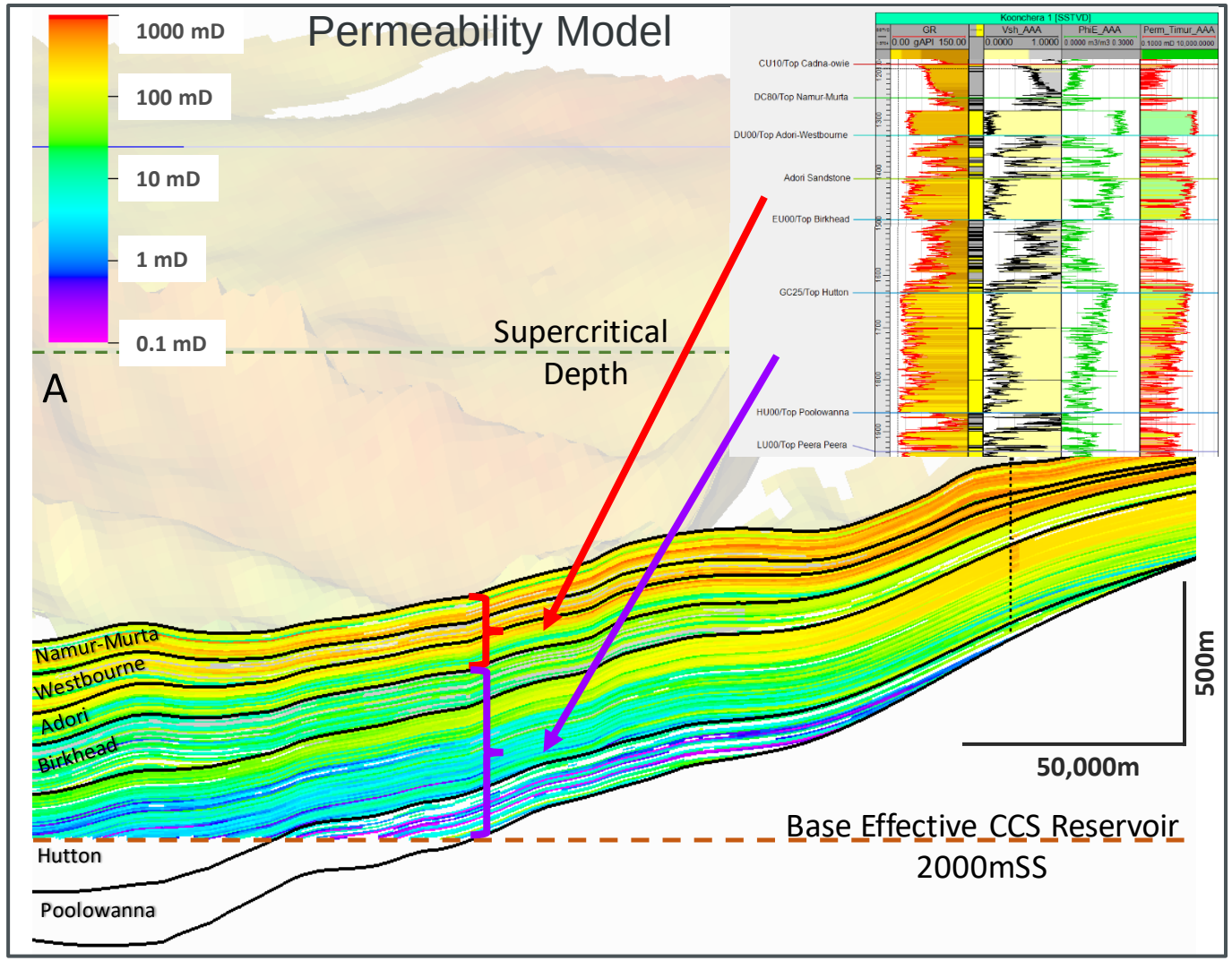
- Stacked reservoirs separated by permeability barriers representing either seals or baffles to vertical flow in the east
- Amalgamated reservoir section with limited vertical barriers in the west

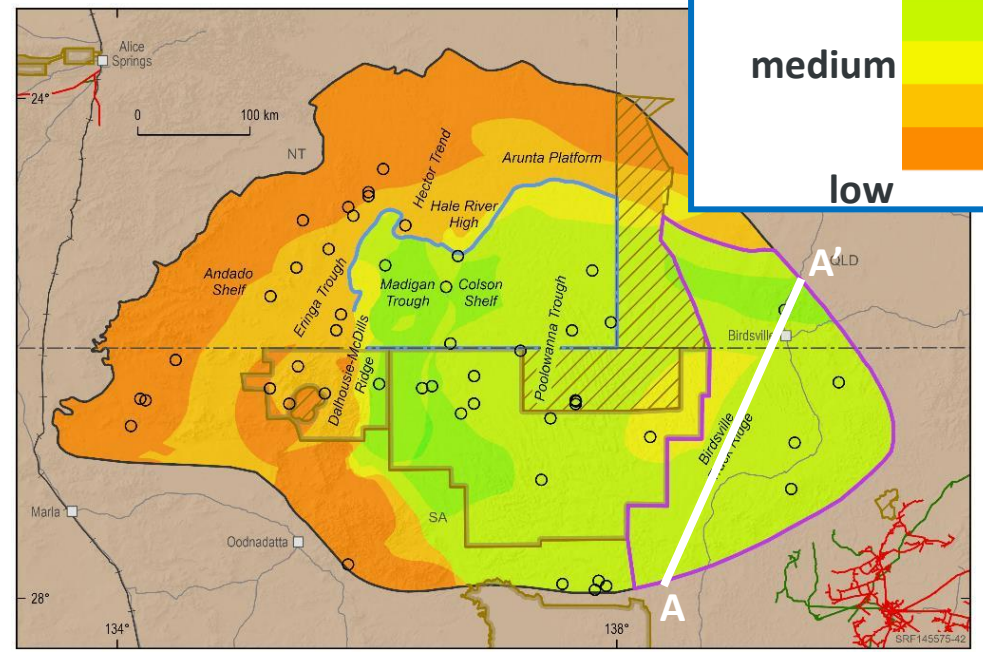
0.1-1.0 milli-Darcy: Presence of seal lithologies

Energy resources assessment module

Results: Estimated Ultimate Storage (EUS) volume

Eastern Storage Area (high heterogeneity)





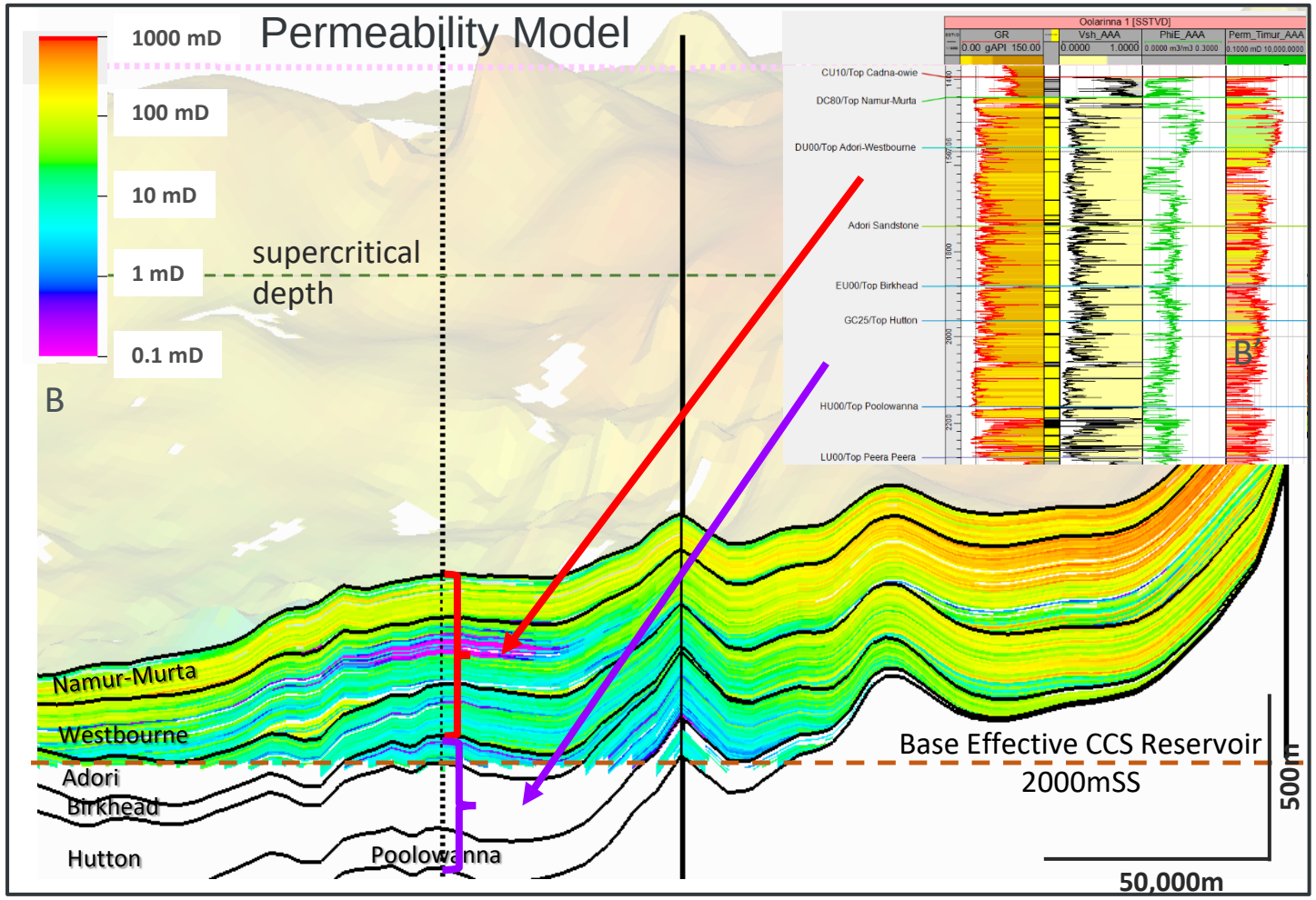
- Reservoir heterogeneity in fluvial-lacustrine intervals
- EUS for just the eastern-most prospective area about 21.5 Giga-tonnes CO_2
- Including underlying lower permeability reservoirs increases EUS to 65.4 Gt (a total area of 38,000 km^2)
- An industrial scale (50 Mt) project would extend over an area of 29 km^2

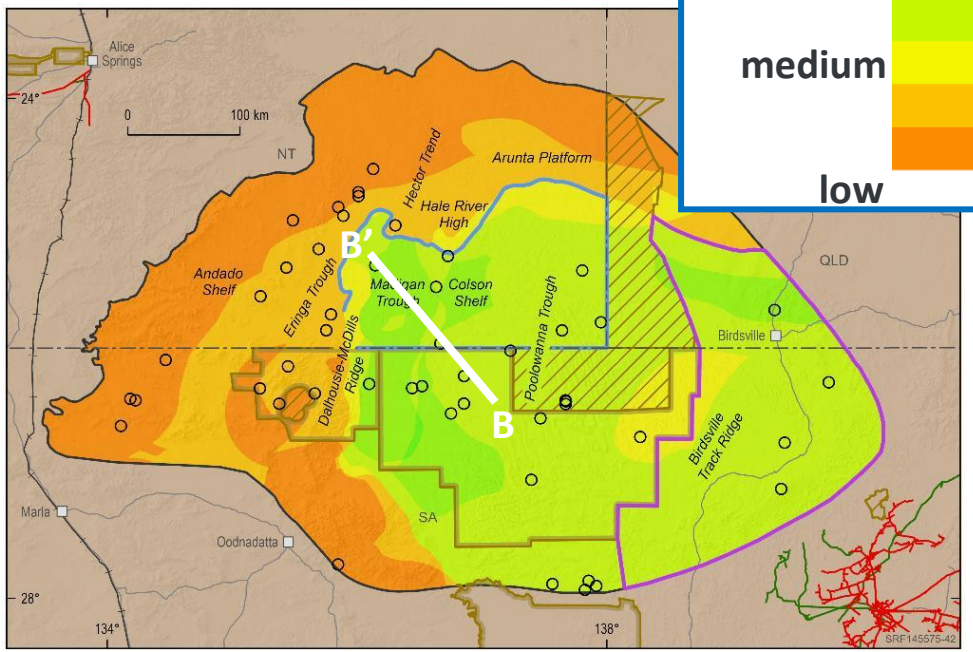
RISC

Energy resources assessment module

Results: Estimated Ultimate Storage (EUS) volume

Western Storage Area (low heterogeneity)





- Homogenous reservoirs in high energy fluvial sheet sands
- EUS for just the most prospective western area about 6.8 Giga-tonnes CO_2
- Including underlying lower permeability reservoirs (25.9 Gt, total area of 25,600 km^2)
- An industrial scale (50 Mt) project would extend over an area of 49 km^2

RISC

Energy resources assessment module:

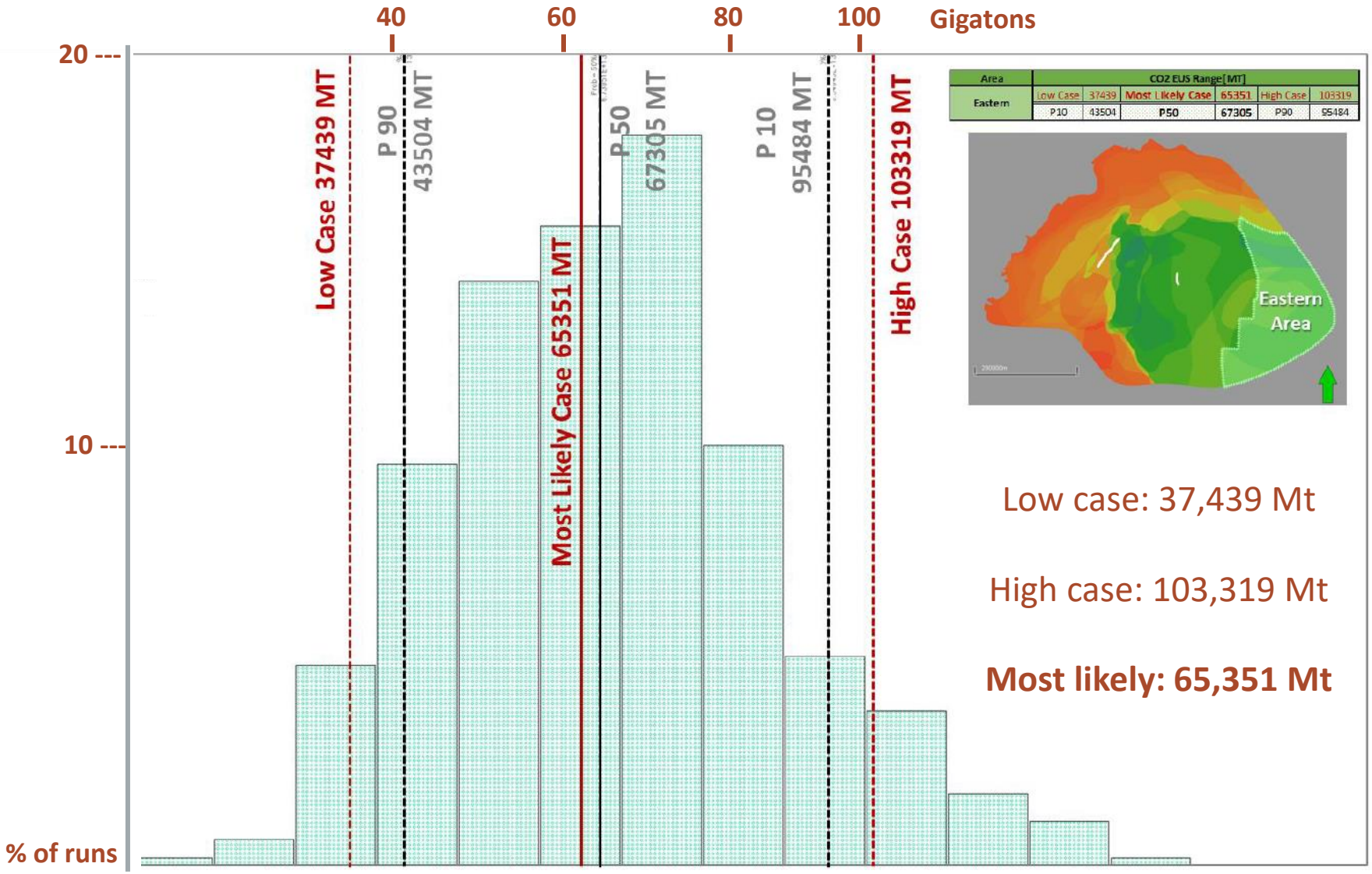
Results: estimated ultimate storage (EUS)

384 Runs
5 Hydraulic Units

- Namur-Murta
- Adori-Westbourne
- Birkhead
- Hutton
- Poolowanna

Key Uncertainties

- Efficiency factor (EF% range for each hydraulic units)
- Porosity (±30%)
- CO2 density (±8%)



Low case: 37,439 Mt

High case: 103,319 Mt

Most likely: 65,351 Mt

Reservoir engineering input provided by RISC

Energy resources assessment module:

Results: estimated ultimate storage (EUS)

384 Runs

5 Hydraulic Units

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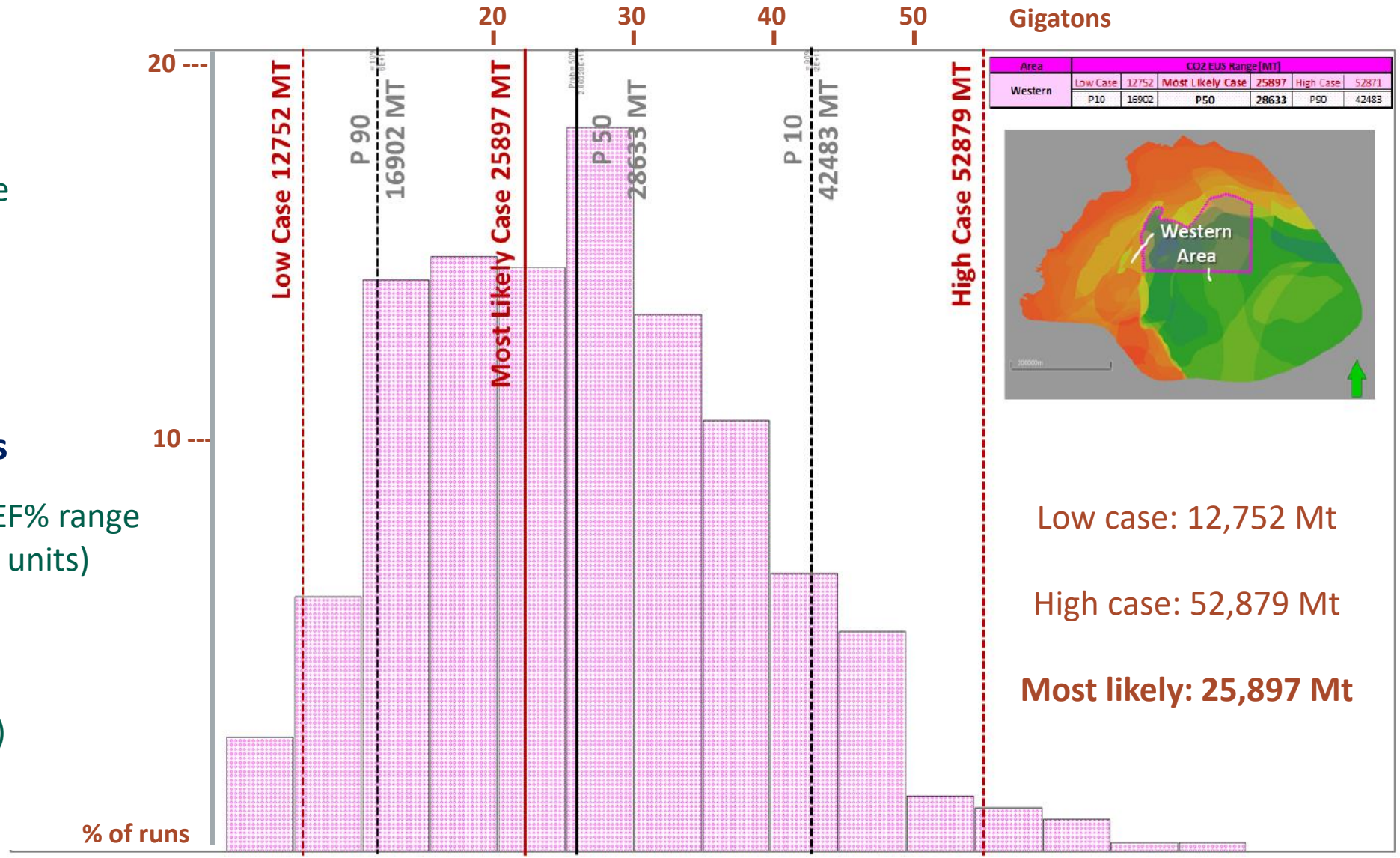


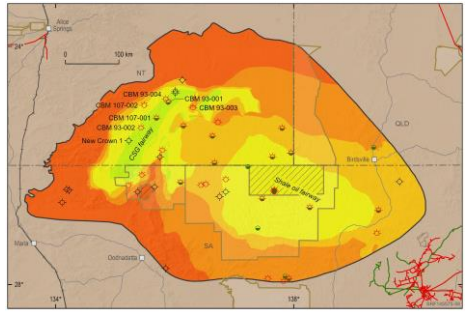
Reservoir engineering input provided by RISC

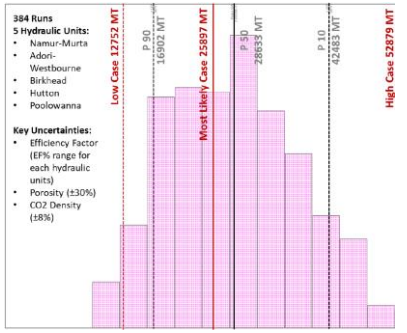
Summary and conclusions:

- The AFER project has been a multidisciplinary project targeting various energy commodity resources in underexplored regions

- Standard industry workflows for resource assessments have been expanded to include unconventional hydrocarbons and geological storage opportunities for carbon dioxide

- **Qualitative** assessment results indicate low prospectivity for unconventional hydrocarbons the Pedirka/western Eromanga region, while **quantitative** assessment results suggest extra volumes liquid hydrocarbons could be discovered and highlight significant potential to store carbon dioxide according to **estimated ultimate storage models** at regional scale





- **The AFER project's results can be used as a 'blueprint' for the assessment of energy commodity resources potential in data-poor regions.**

Acknowledgements and further information:

GIS PAX
GIS packages for exploration success

AUSTRALIA'S NORTHERN TERRITORY

RISC

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MGPALAEO
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CSIRO

Basin Science

tbc Petrophysics Pty Ltd

Overview of the Exploring for the Future program

https://www.eftf.ga.gov.au/

Onshore basin inventories

https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/148931

Hydrogen economic fairway tool

https://portal.ga.gov.au/persona/heft

Pedirka-Simpson Basin 2D Reprocessed Seismic Data Package 2021-2022

https://pid.geoscience.gov.au/dataset/ga/146309