



Geological Survey of
Western Australia



GOVERNMENT OF
WESTERN AUSTRALIA

Department of Energy, Mines,
Industry Regulation and Safety
Geological Survey of Western Australia

A preliminary assessment of regional CO₂ storage potential in the onshore northern Perth Basin

Louisa Ellis, Charmaine Thomas, Julie Cass, Arthur Mory, Deidre Brooks



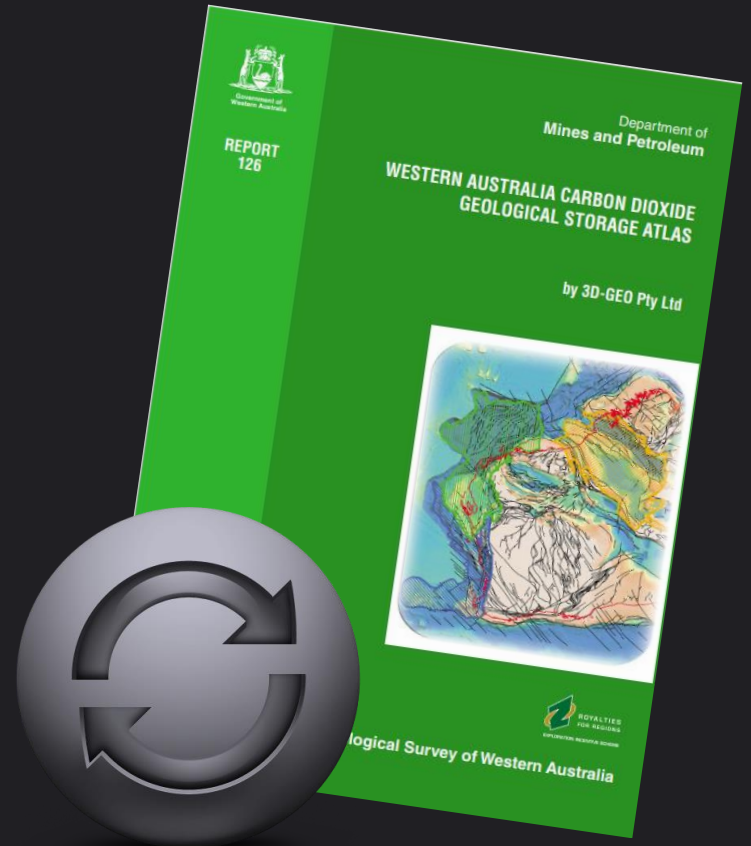
CARBON CAPTURE AND STORAGE (CCS) ATLAS REFRESH

Original Atlas published in 2013:

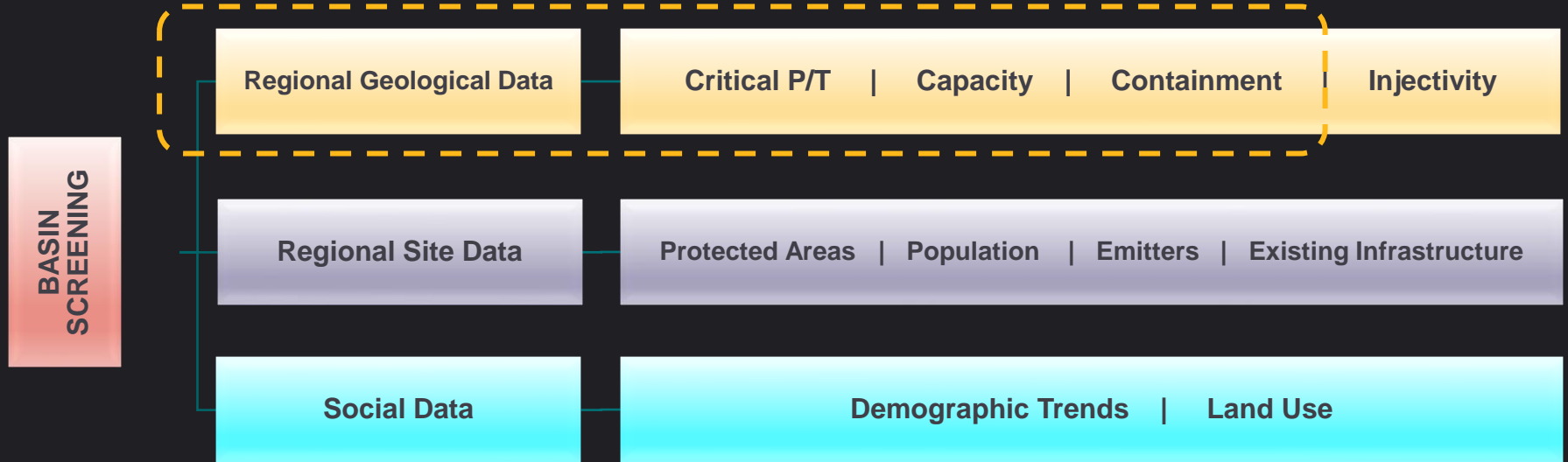
- CO₂ storage prospectivity

Refresh for publication in 2024:

- increased scope
- updated CO₂ storage prospectivity
- statewide datasets



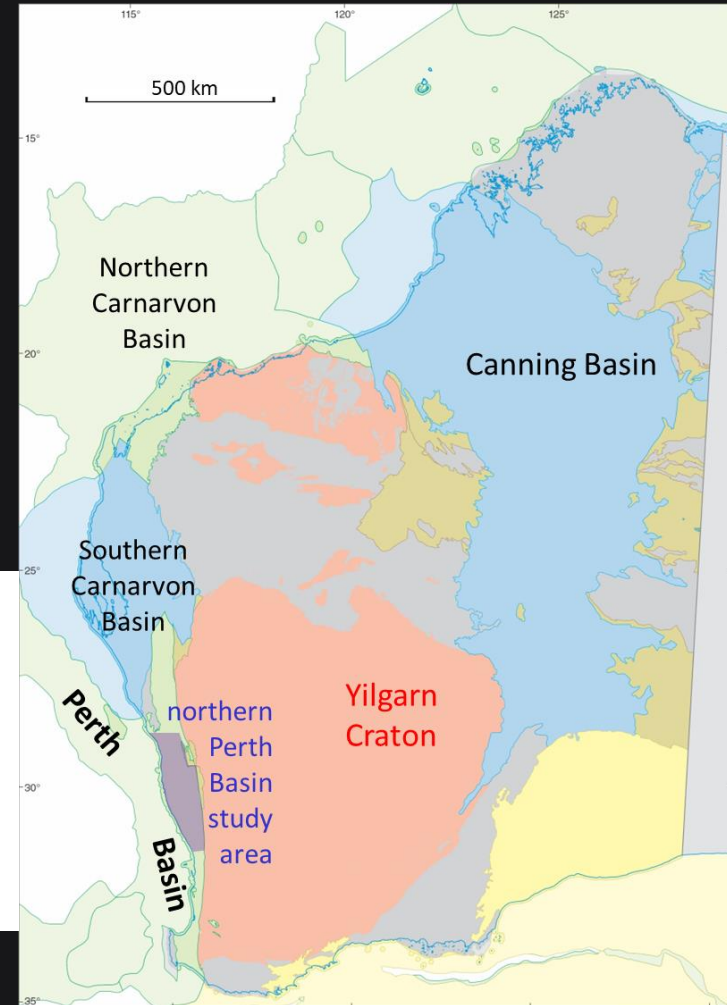
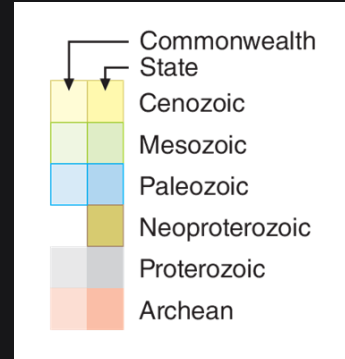
BASIN SCREENING DATA



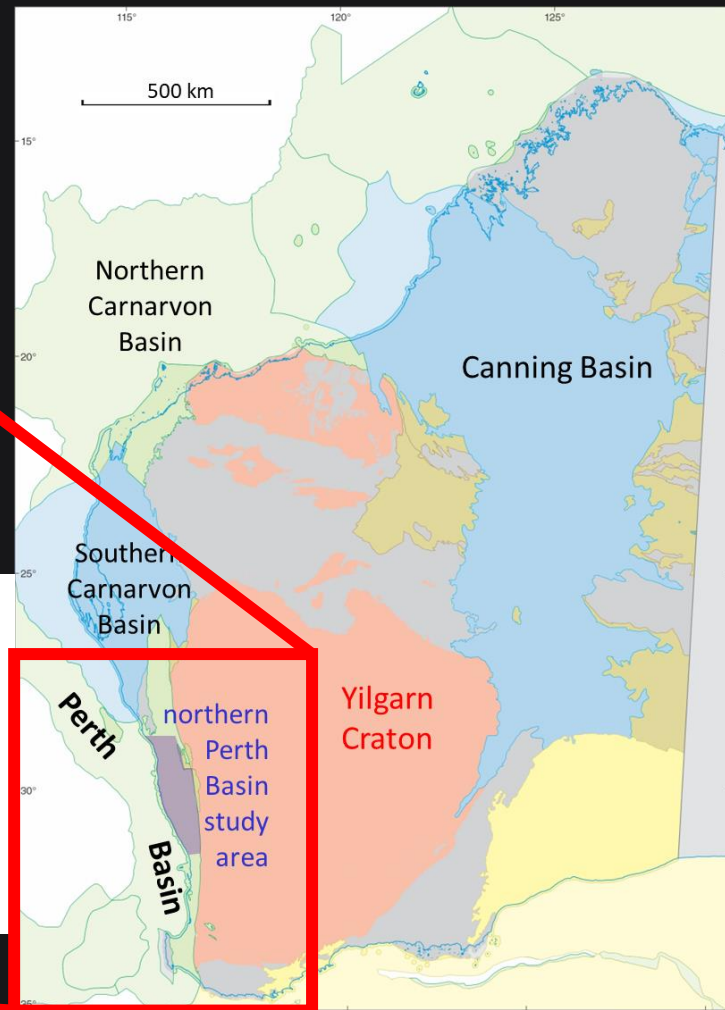
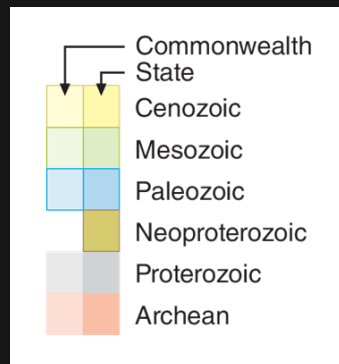
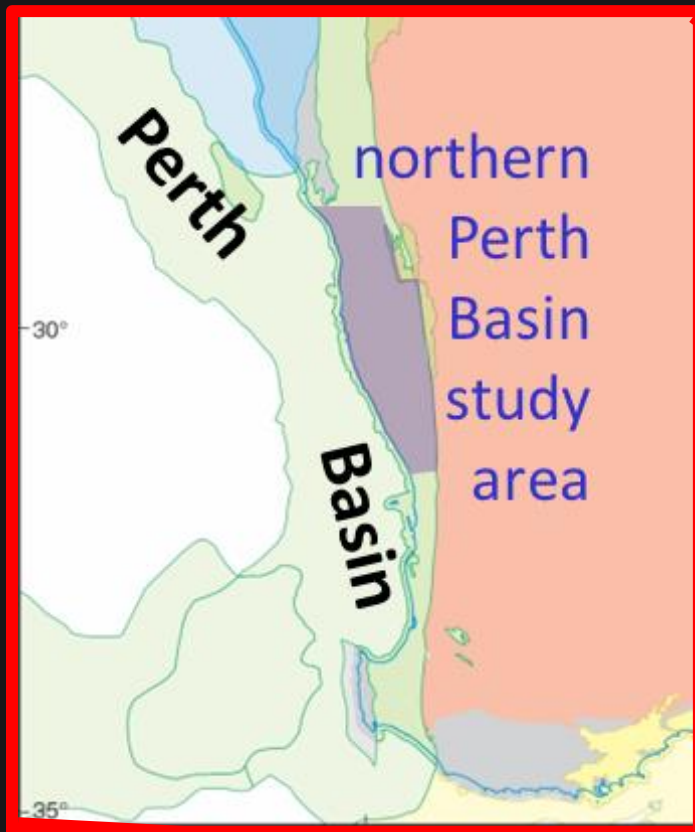
Modified from, DOE NETL (United States Department of Energy, National Energy Technology Laboratory) 2017. BEST PRACTICES: Site Screening, Site Selection, and Site Characterisation for Geologic Storage Projects, 1844 National Energy Laboratory.

Our focus is on the geological data, however regional proximity and social context are also important basin screening considerations

NORTH PERTH BASIN STUDY AREA



NORTH PERTH BASIN STUDY AREA



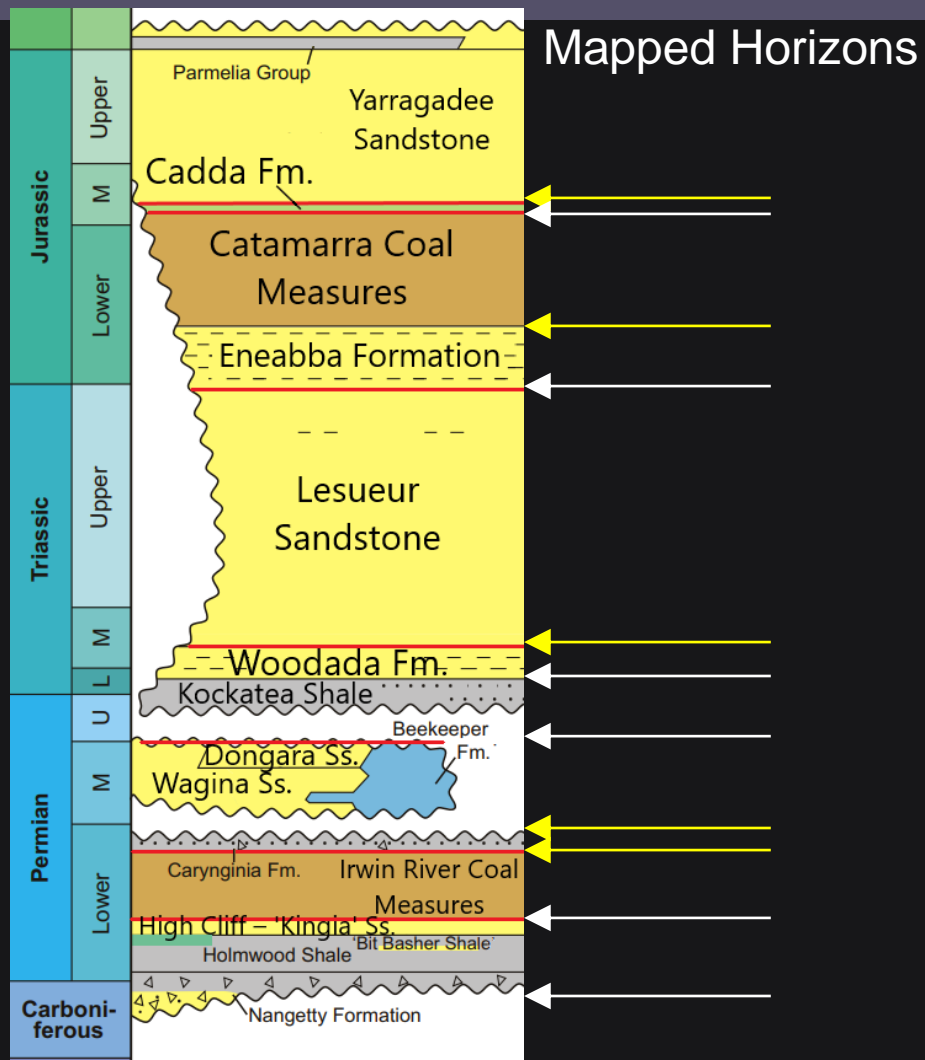
NORTHERN PERTH BASIN MAPPED HORIZONS

Regional Depth Maps

← Seismic Mapping

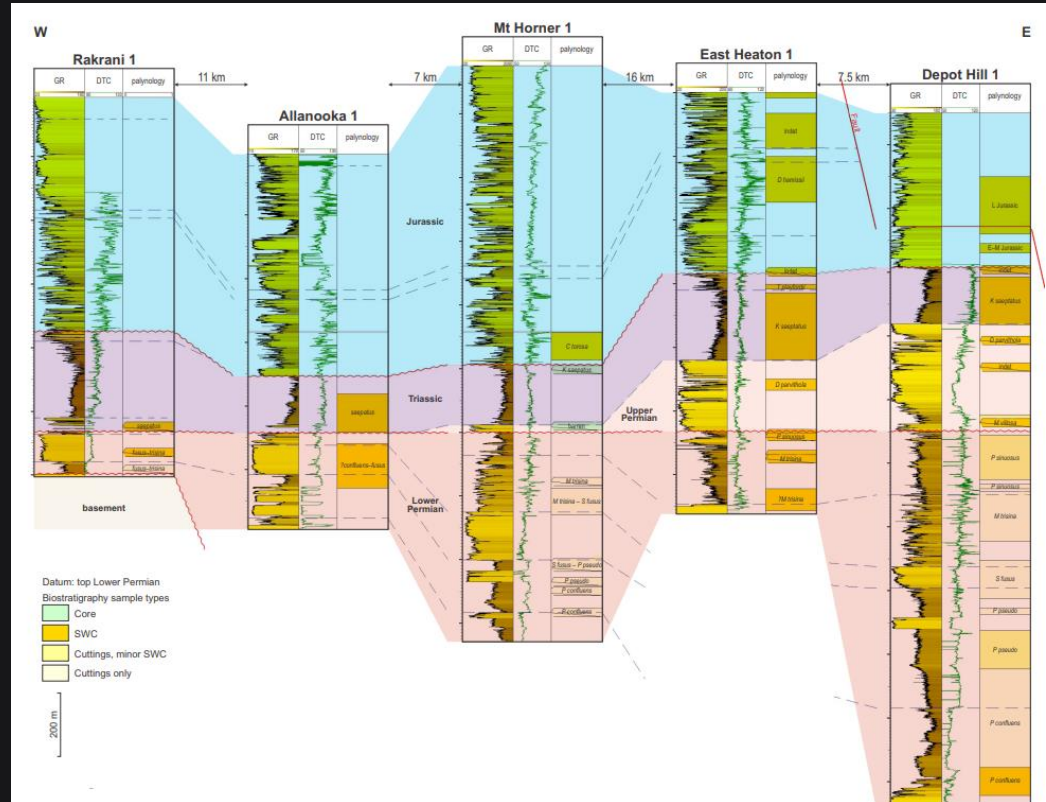


Maps derived from correlation gridding





NORTHERN PERTH BASIN WELL CORRELATIONS

Well correlations
tied to depth
mapping

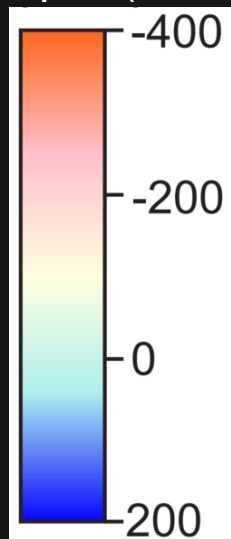


NORTHERN PERTH BASIN MAPPED SEISMIC HORIZONS

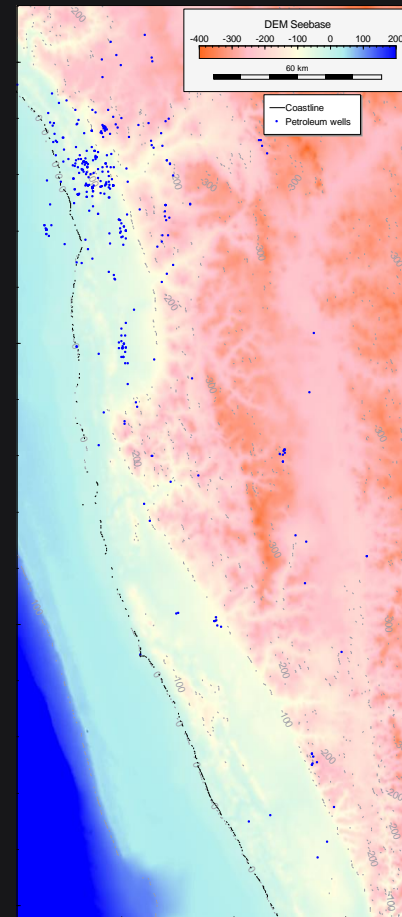
Regional depth maps
compiled from seismic
data

-  Petroleum Wells
-  Coastline

Depth (mSS)





Surface DEM



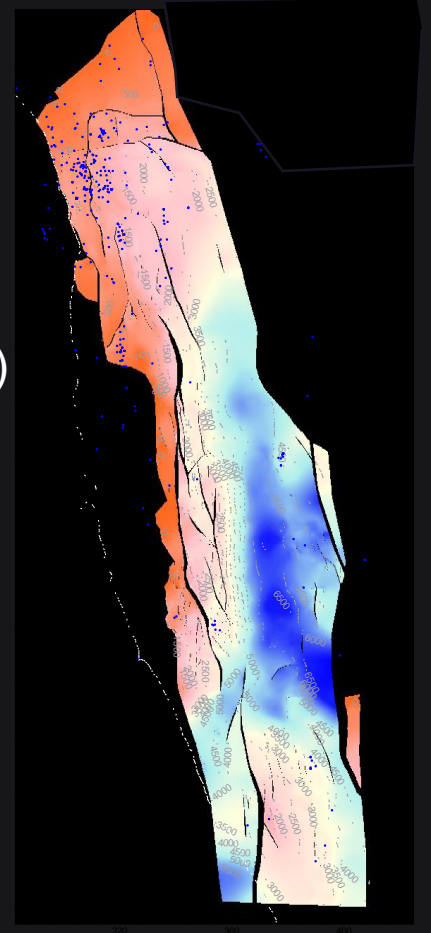
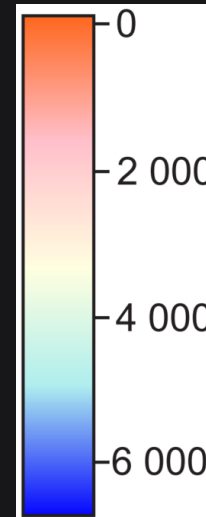
NORTHERN PERTH BASIN MAPPED SEISMIC HORIZONS

Regional depth maps
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-  Coastline



Top Cattamarra

Depth (mSS)

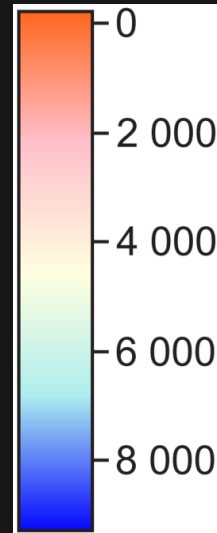


NORTHERN PERTH BASIN MAPPED SEISMIC HORIZONS

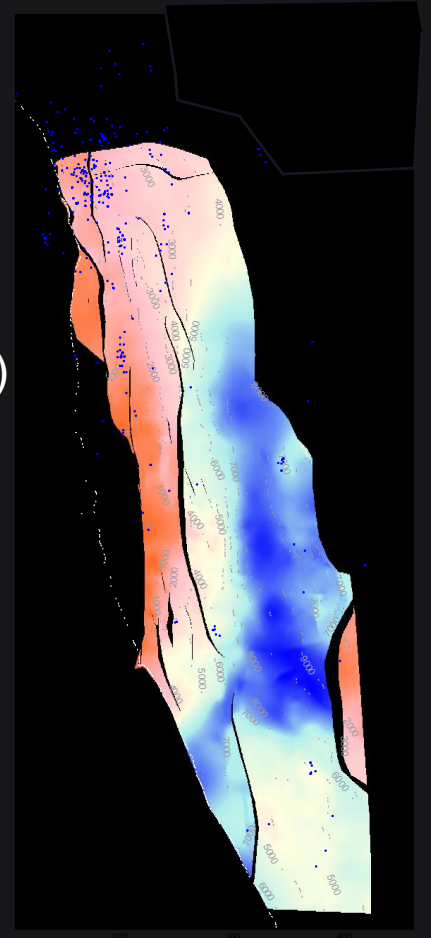
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Depth (mSS)





Top Lesueur

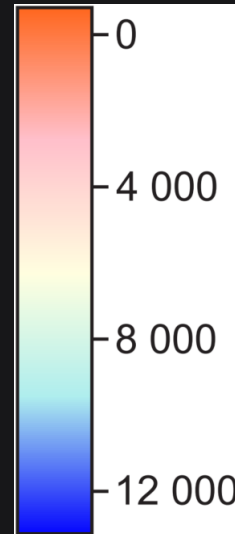


NORTHERN PERTH BASIN MAPPED SEISMIC HORIZONS

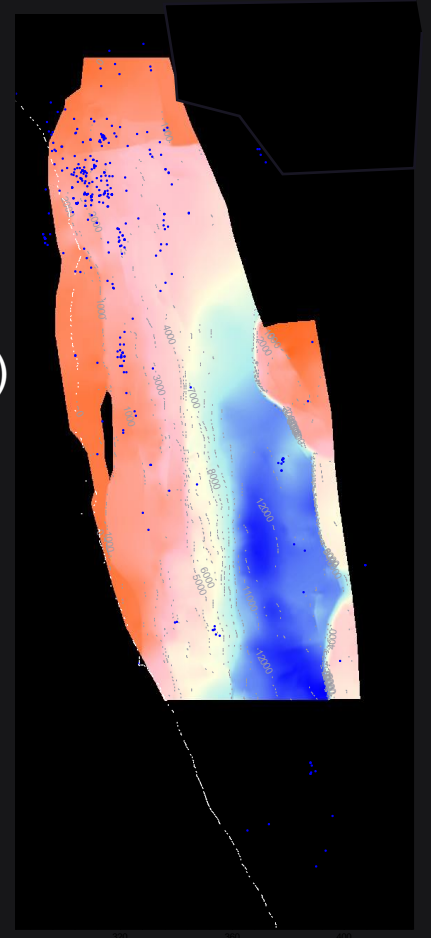
Regional depth maps compiled from seismic data

-  Petroleum Wells
-  Coastline

Depth (mSS)





Top Kockatea

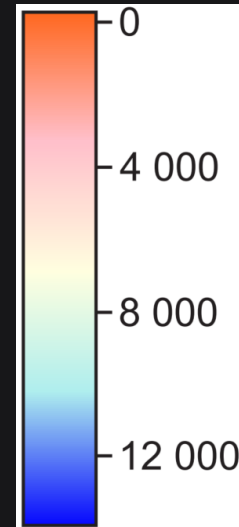


NORTHERN PERTH BASIN MAPPED SEISMIC HORIZONS

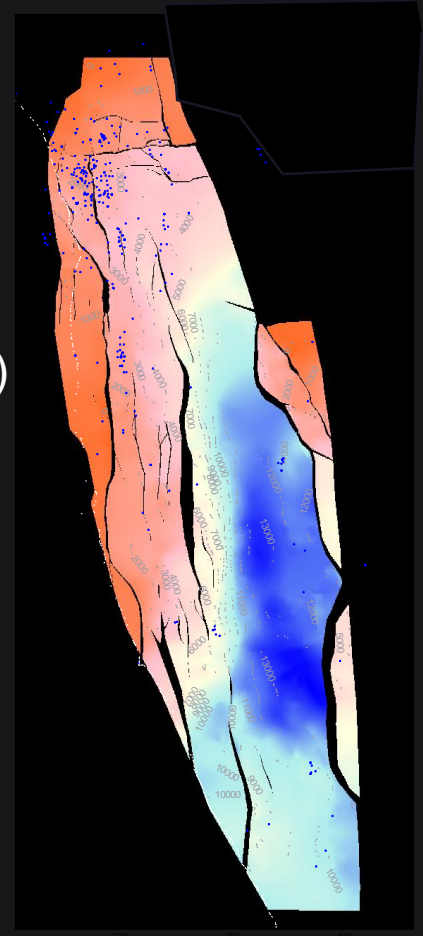
Regional depth maps
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Depth (mSS)





Top Permian

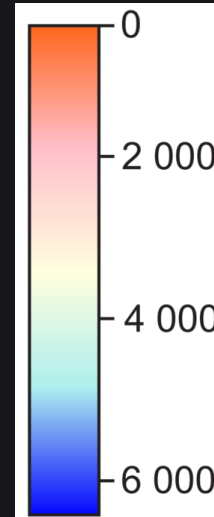


NORTHERN PERTH BASIN MAPPED SEISMIC HORIZONS

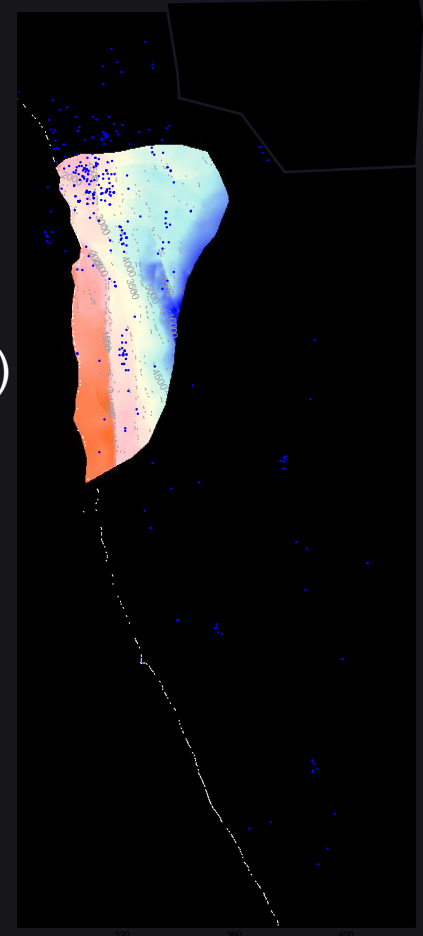
Regional depth maps compiled from seismic data

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Depth (mSS)





Top Kingia

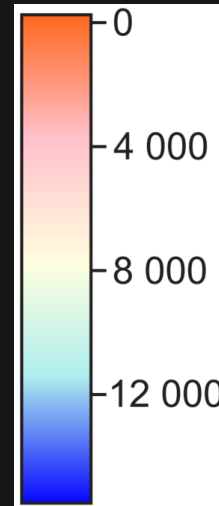


NORTHERN PERTH BASIN MAPPED SEISMIC HORIZONS

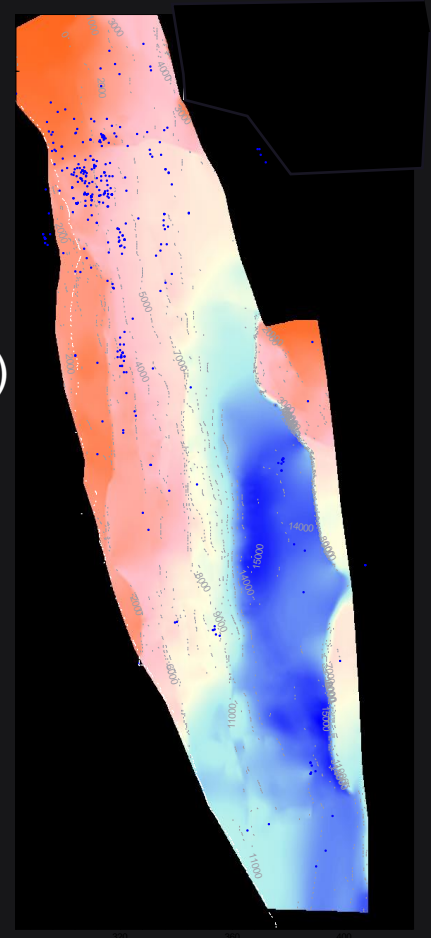
Regional depth maps
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-  Petroleum Wells
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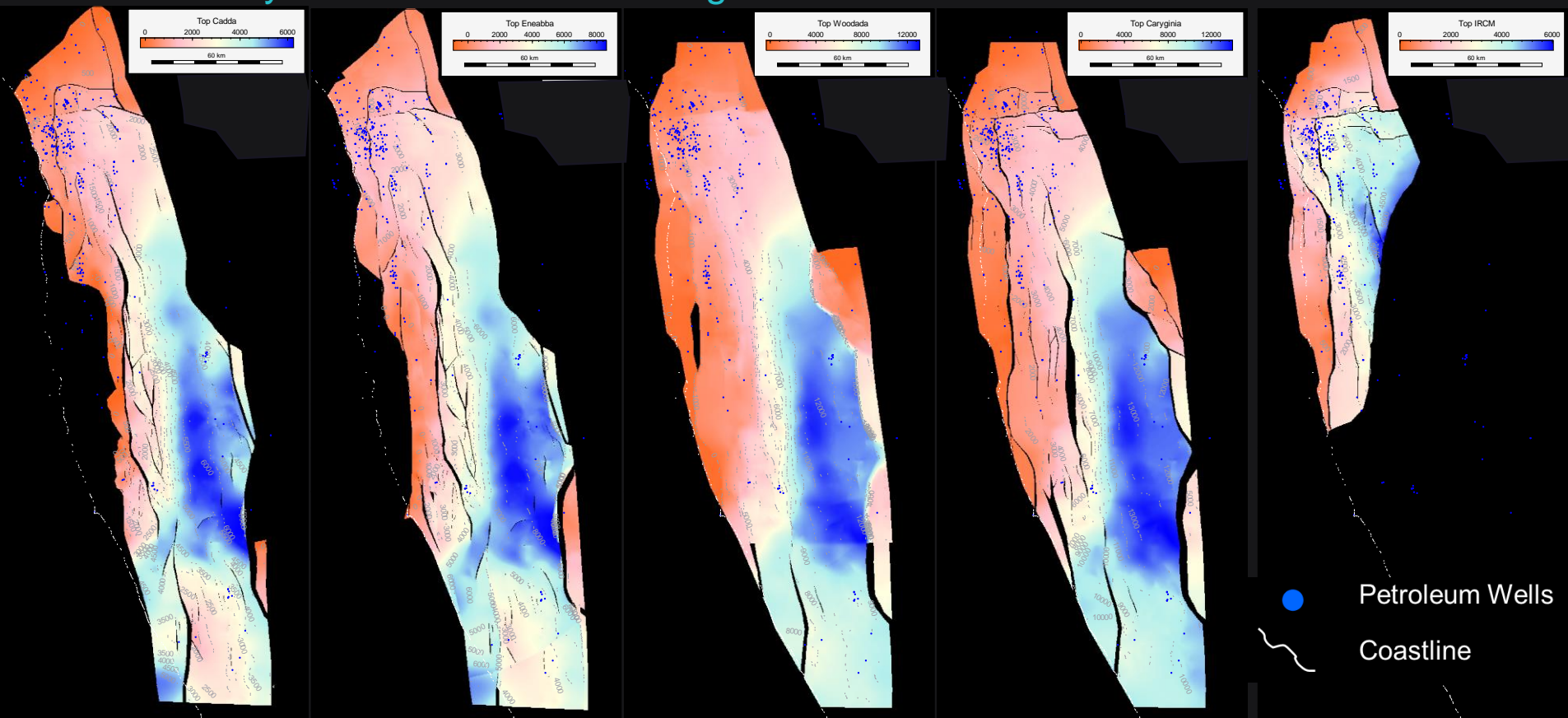
Depth (mSS)



Basement



Additional key formations created using well intersections



Top Cadda

Top Eneabba

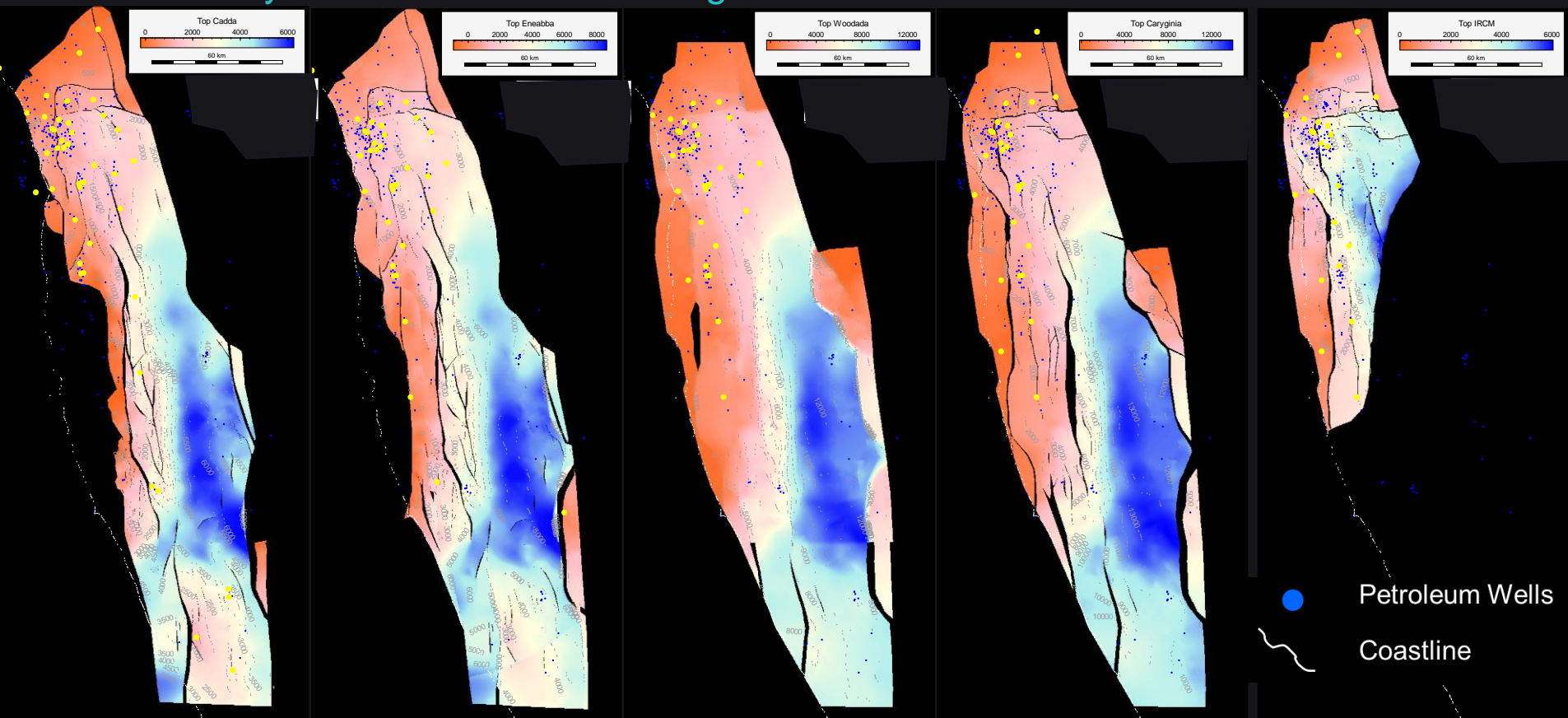
Top Woodada

Top Carynginia

Top IRCM

● Petroleum Wells
~ Coastline

Additional key formations created using well intersections



Top Cadda

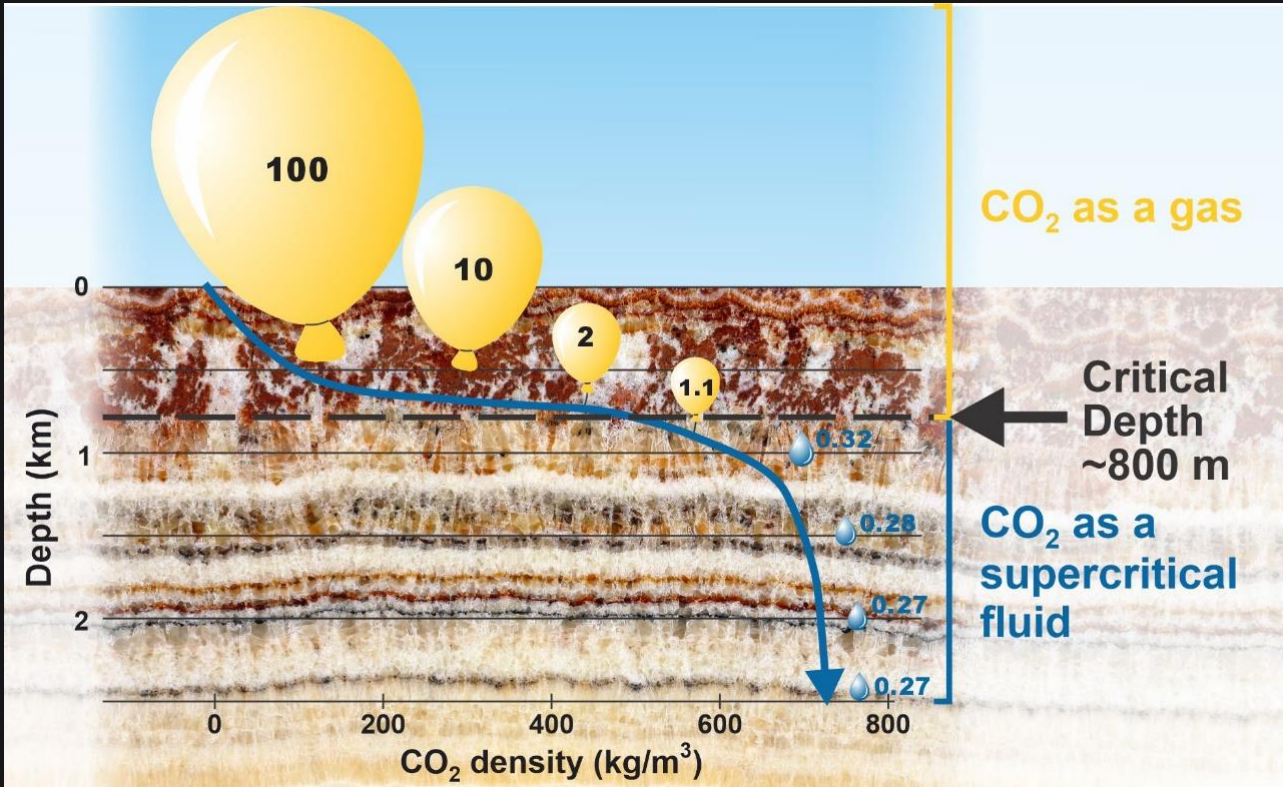
Top Eneabba

Top Woodada

Top Carynginia

Top IRCM

CRITICAL PRESSURE AND TEMPERATURE

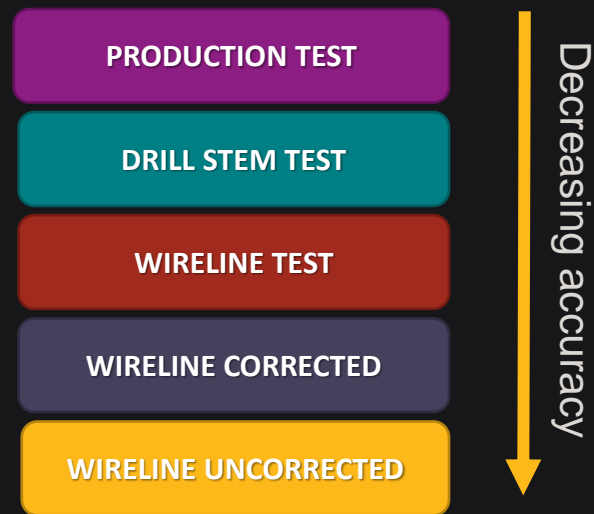


Supercritical CO₂ can take up 350 times less space than gaseous CO₂

TEMPERATURE DATABASE

Temperature data
have been
compiled from
available open file
reports

TEMPERATURE DATA CATEGORIES



TEMPERATURE DATABASE

- Downloadable spreadsheet
- Filter by temperature category

PRODUCTION TEST

DRILL STEM TEST

WIRELINE TEST

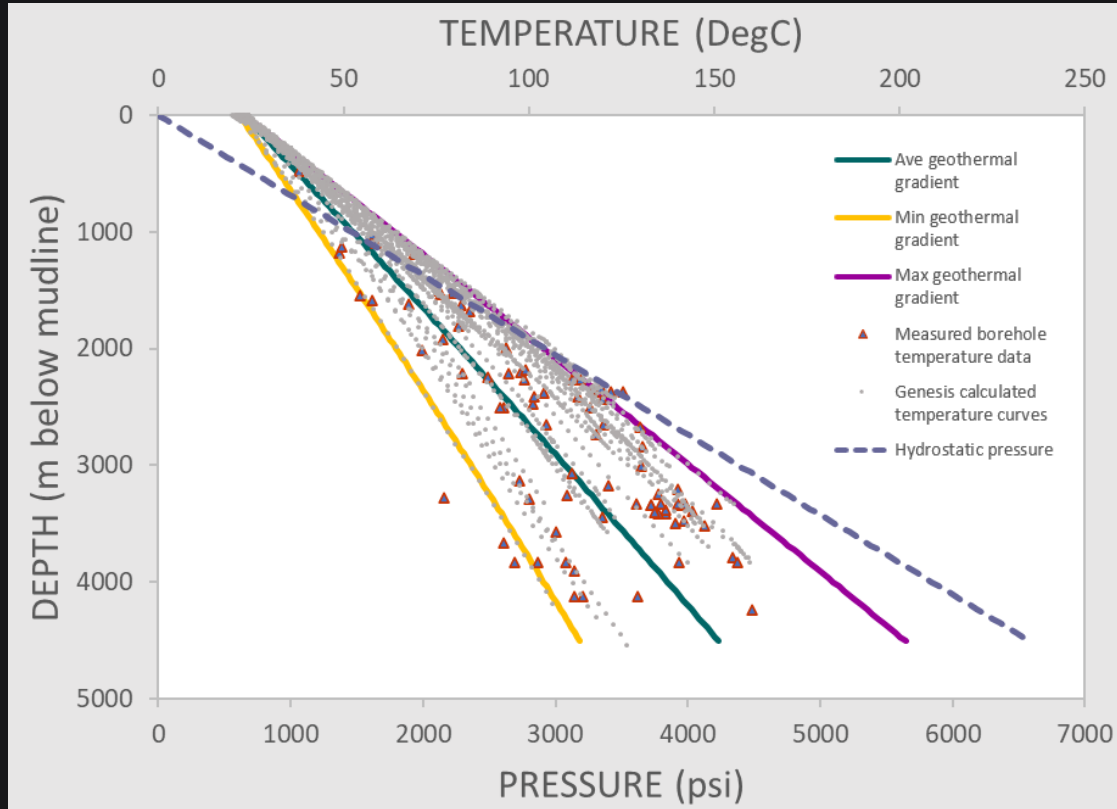
WIRELINE
CORRECTED

WIRELINE
UNCORRECTED

- Contains contextual information required for interpretation

TEMPERATURE | DEPTH | SOURCE | CIRCULATION TIME | TIME SINCE CIRCULATION | CORRECTION TYPE

TEMPERATURE DATABASE AND 1D MODELLING



northern Perth
Basin
temperature
data and
interpreted
temperature
gradients

TEMPERATURE MODELLING – BOUNDARY CONDITIONS

Thermal history controls

Thermal Model:

Thermal History Variation Model

Constant Rift model User defined

Base lithosphere temperature

User specified value deg. C

Calculate from thermal gradient

Calculate from measured temperature

Surface Temperature

Constant value C

User defined variation

Calculate from paleolatitude

Other Effects

Advective heat transport

Radioactive heat production

Apply to all wells

Transient heat-flow model

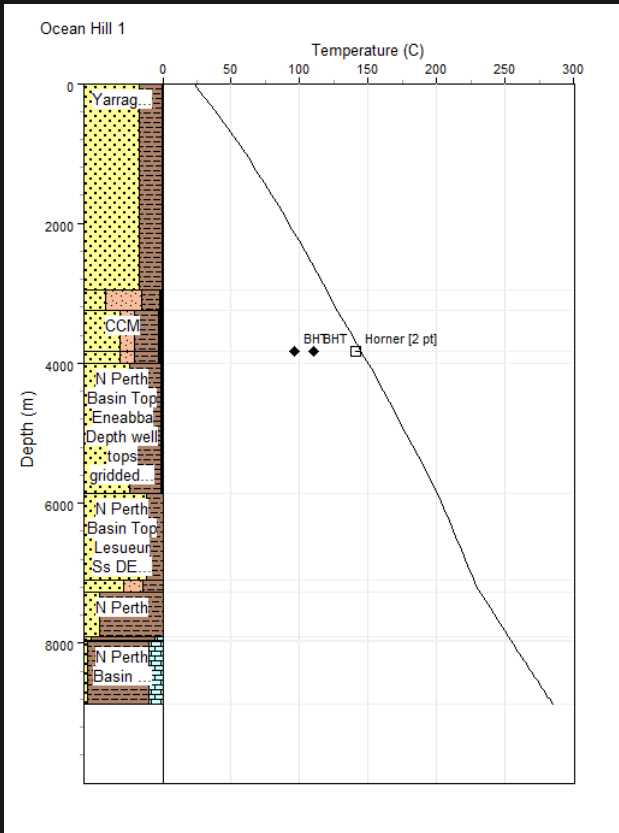
Bottom Boundary

1330°C at base lithosphere

Top Boundary

surface temperature

TEMPERATURE MODELLING



	Thickness (km)	Heat Production (microW/m ³)	Thermal Conductivity (W/m/K)	Density (kg/m ³)	Heat Capacity (J/kg/K)
Upper Crust:	16	4.2	3.5	2700	900
Lower Crust:	24	0	3.1	2900	1050
Mantle Lid:	80	0	2.5	3400	1200

Heat production depth decay (km)

Heat production half-life (my)

Crust/Sub crust stretch ratio (0=no crust stretching, 1=uniform stretching)

Depth to basement m

Total RHP from lithosphere = 41.32 mW/m² (0.99 HFU)

1D modelling

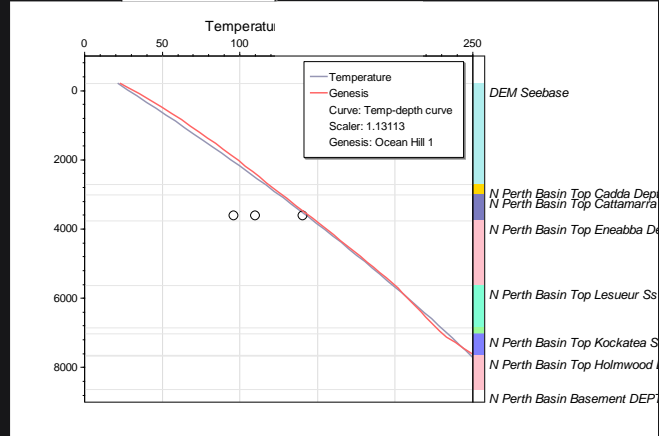
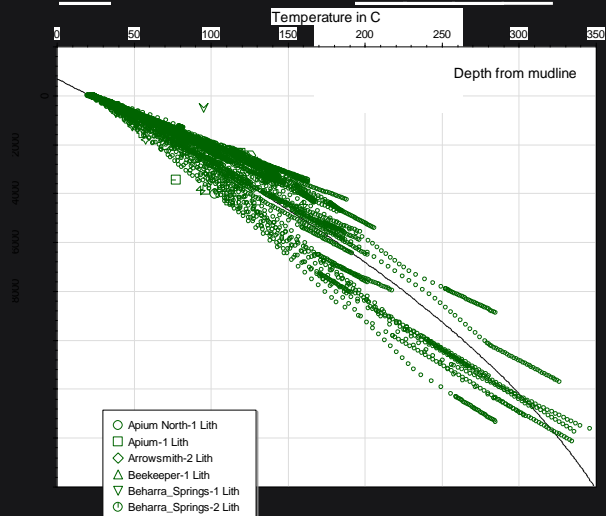
- Calibrated to measured borehole temperatures
- variable crustal thickness
- radiogenic heat production

MULTI-1D MODELLING

1D model locations

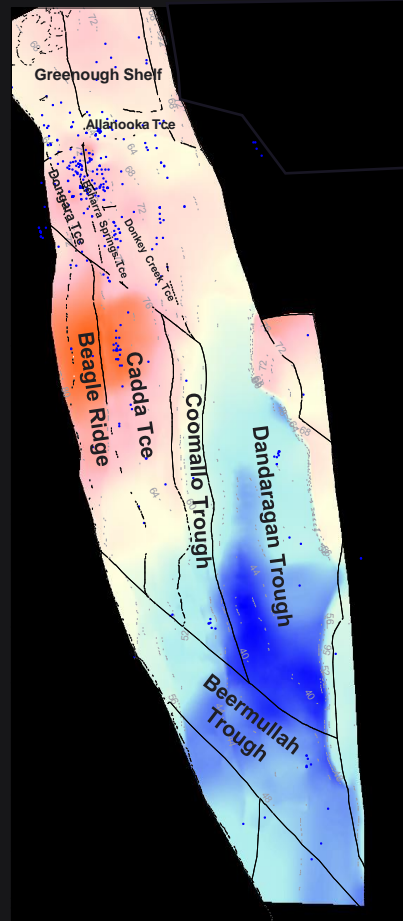


1D models
Coastline



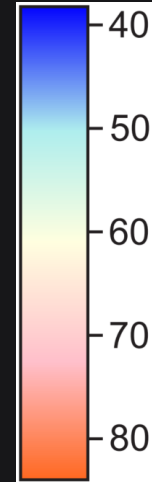
TEMPERATURE MODELLING

Modelled base sediment heat flow in the northern Perth Basin.



Basement Heat Flow

Heatflow (mW/m^2)

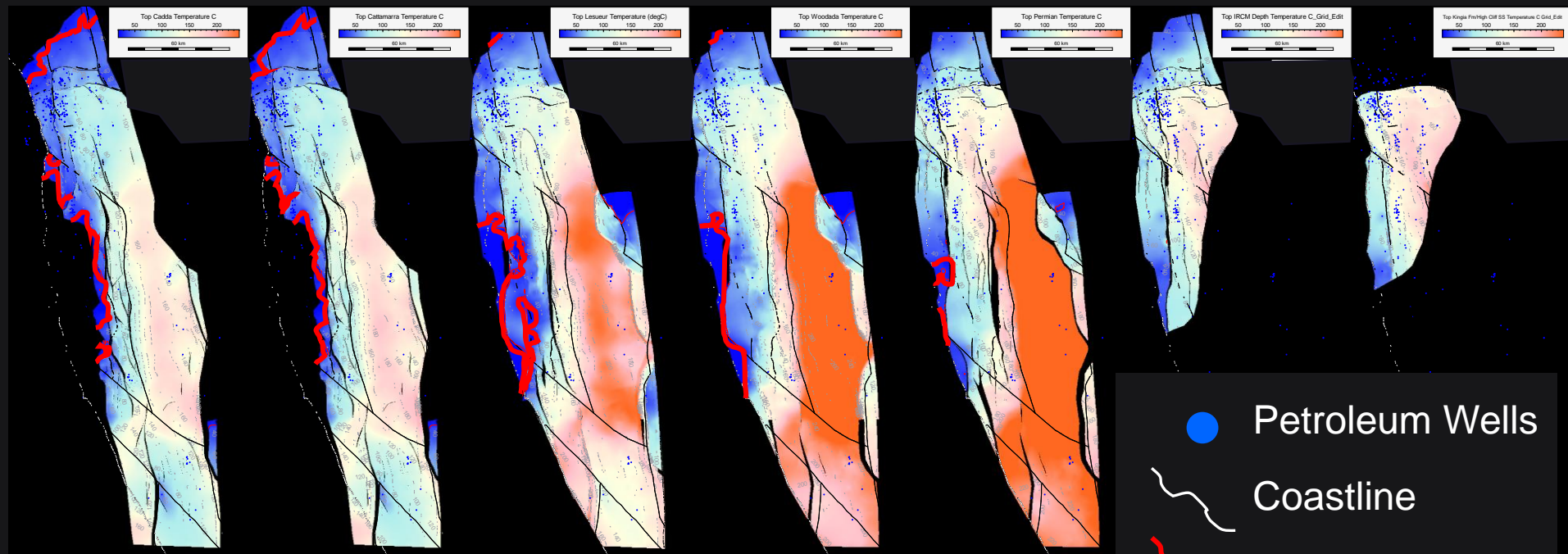


Petroleum Wells



Coastline

TEMPERATURE MAPS



Top Cadda

Top Cattamarra

Top Lesueur

Top Woodada

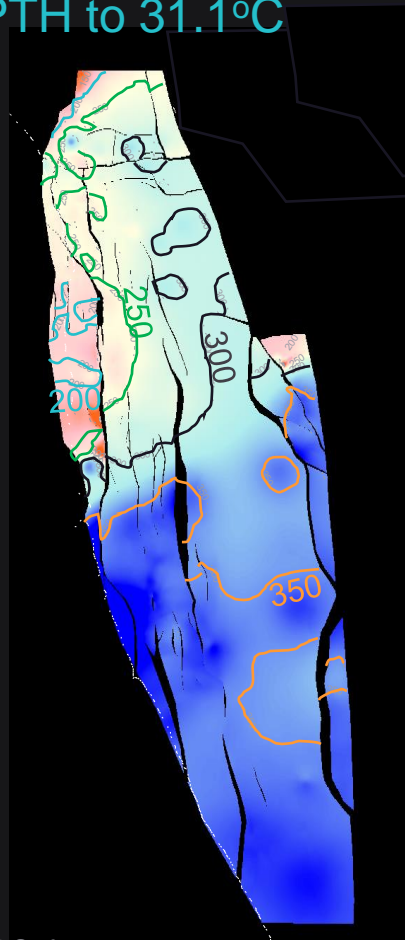
Top Permian

Top IRCM

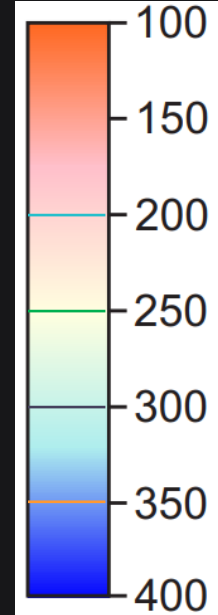
Top Kingia

ISOTHERMAL MAP – BURIAL DEPTH to 31.1°C

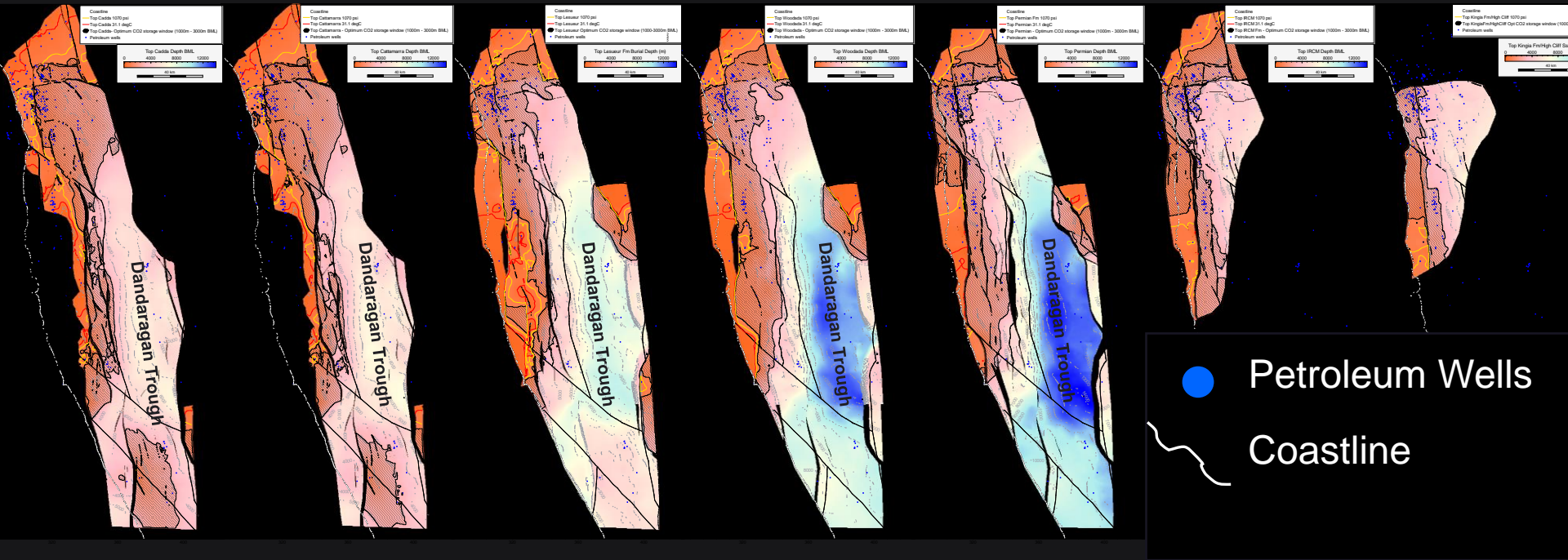
Northern Perth Basin 31.1 °C
isothermal (burial) depth map



Burial Depth (m)



DEPTH (BELOW GROUND LEVEL) WITH OPTIMUM STORAGE WINDOW



Top Cadda

Top Cattamarra

Top Lesueur

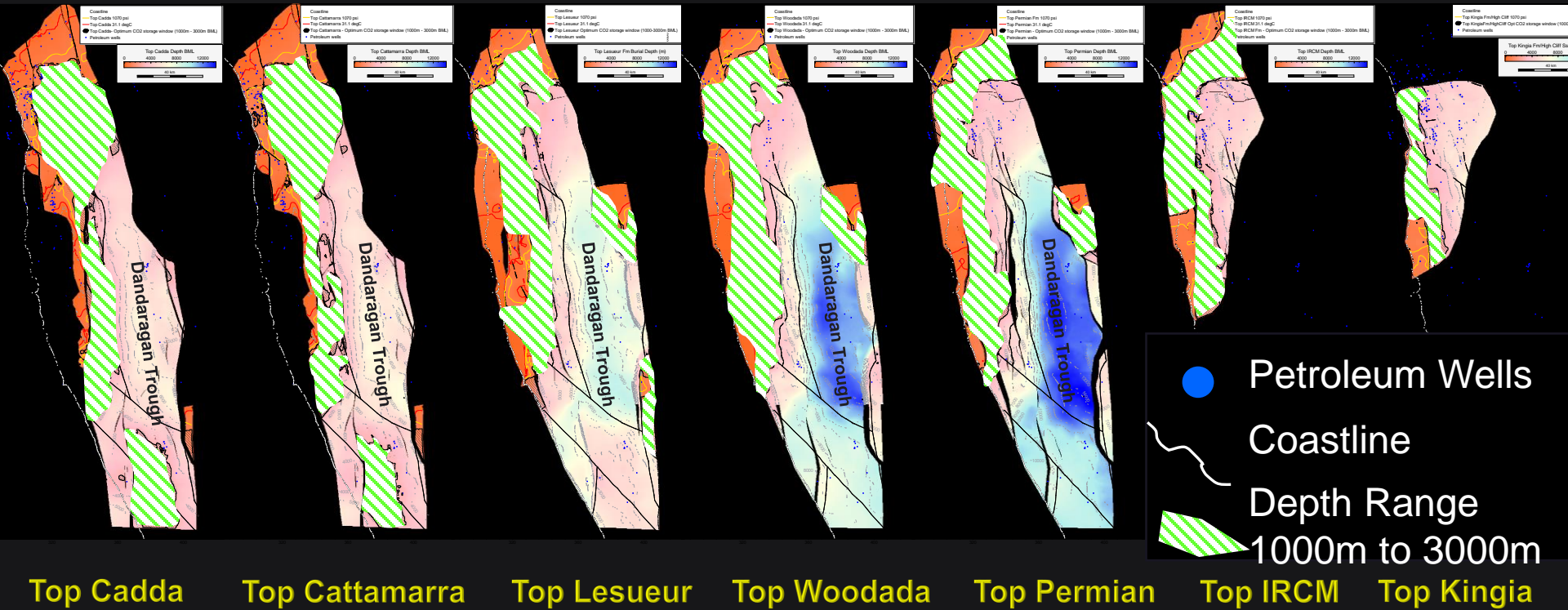
Top Woodada

Top Permian

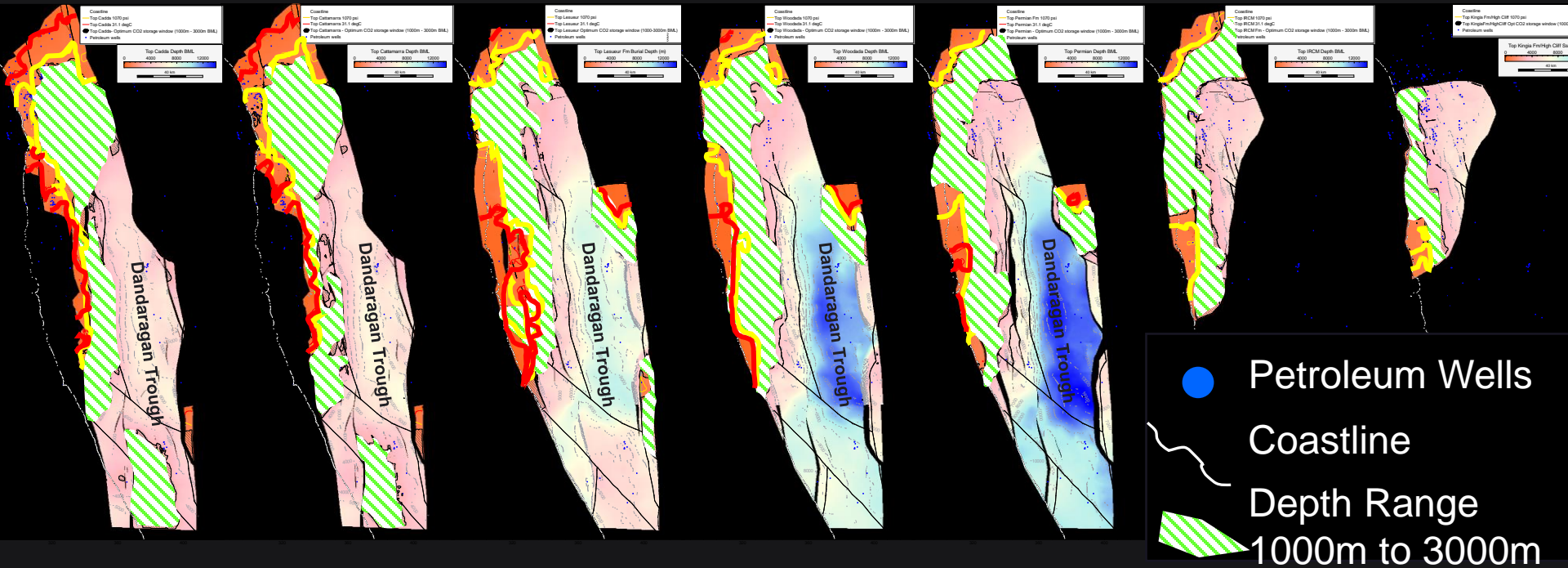
Top IRCM

Top Kingia

DEPTH (BELOW GROUND LEVEL) WITH OPTIMUM STORAGE WINDOW



DEPTH (BELOW GROUND LEVEL) WITH OPTIMUM STORAGE WINDOW



Top Cadda

Top Cattamarra

Top Lesueur

Top Woodada

Top Permian

Top IRCM

Top Kingia

WHERE TO FIND IT



<https://wapims.dmp.wa.gov.au/WAPIMS>

Welcome to WAPIMS
Petroleum & Geothermal Information Management System

Search the Petroleum Exploration Database

WELLS SURVEYS REPROCESSING TITLES FIELDS CORE LIBRARY FACILITIES RELEASE DOCUMENTS ACREAGE RELEASES GIS MAP

Well name Well operator Field
Title Is offshore? Spud date from Spud date to
Report types
Select... SEARCH CLEAR ALL

AVAILABLE NOW!

About WAPIMS
Western Australian Petroleum and Geothermal Information Management System (WAPIMS) is a petroleum exploration database containing data on titles, wells, geophysical surveys and other related exploration and production data. The system also contains the Core Library (Perth and Kalgoorlie) database.

Released Documents
Documents released on WAPIMS, searchable by date

Well Tops, Samples & Analyses
Open file well formation tops, samples & analysis data extracted from reports submitted to DMIRS.

Digital Core Atlas
An interactive display of multiple-datasets overlaid and linked to images of individual core trays

this one here
CO₂ Storage Atlas
Data, information and more... all in one place as part of the CO₂ Storage Atlas Project



Geological Survey of Western Australia

Thank You!

HOW THICK?!
↕

THEY SAMPLED THIS...! WHEN?
↙ ↘

APPLY DATUM SHIFT

MIN
MAX ?

? DATUM ?

FUTURE
CCS
SITE?

Department of Energy, Mines,
Industry Regulation and Safety
Geological Survey of Western Australia

