Play mapping workflow: a practical example from the onshore Otway Basin, South Australia

Discovery Day 2024

Geological Survey of South Australia

Paul Strong | 28 November 2024

Acknowledgements | Chris Cubitt, Rob Kirk and Tim Rady

GEOLOGICAL SURVEY OF South Australia

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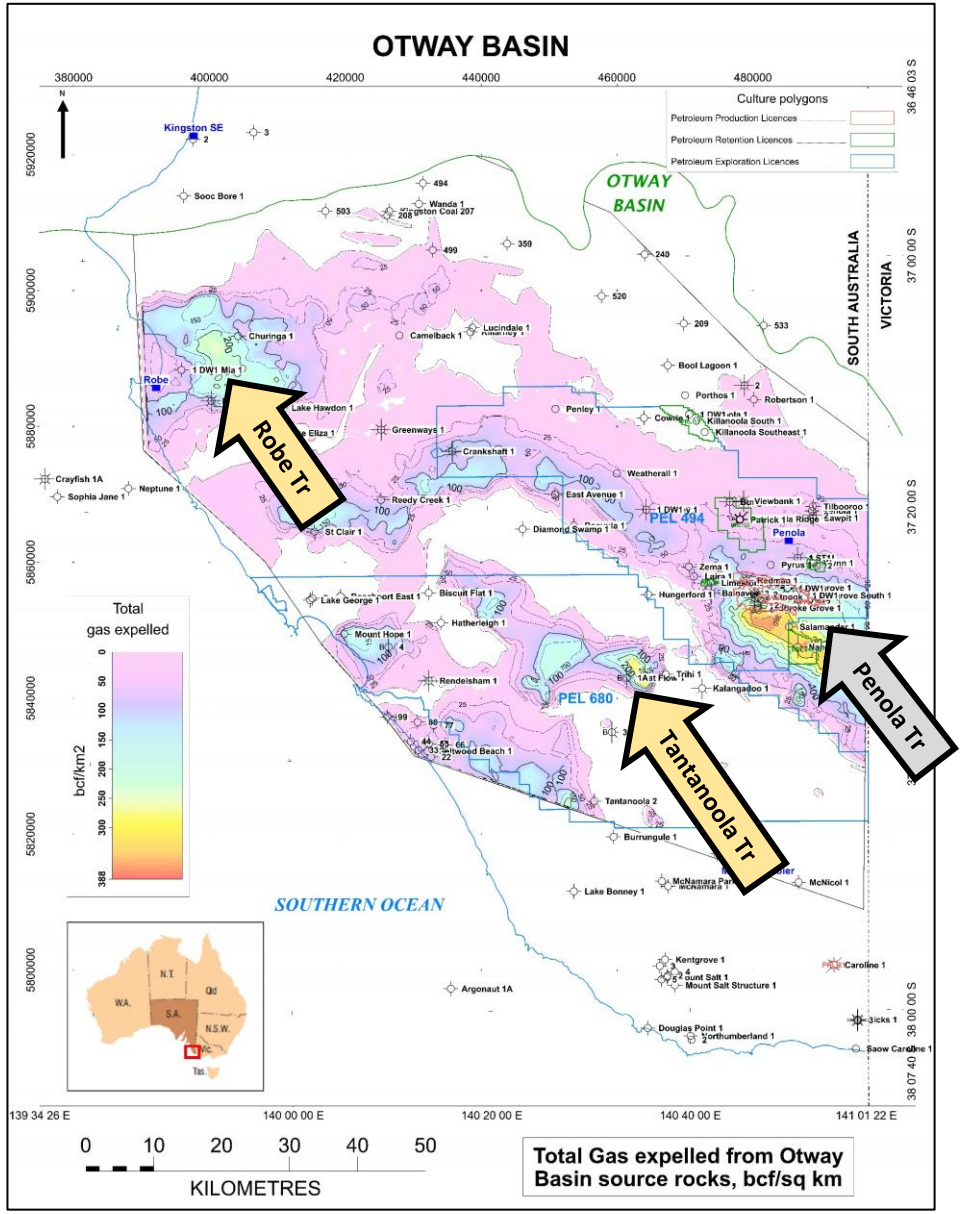
Background
Part of the Otway Project

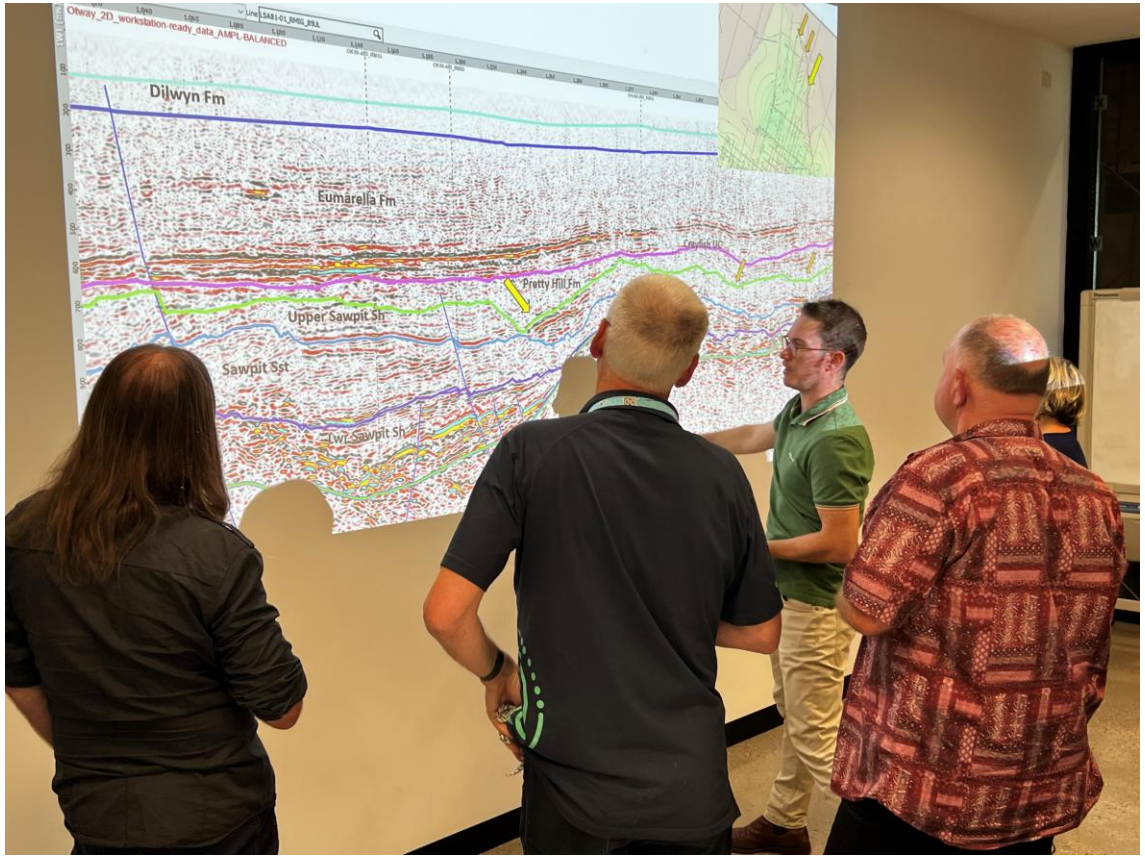
- Whole of basin petroleum system model
- Commenced 2020 and completed Q4 2023
- Generate new datasets
- Generate new exploration concepts
- Stimulate the next phase of exploration in the onshore Otway Basin

- Play analysis conducted in 2024
  - Play-Based Exploration Overview
  - Otway Basin Plays Reviewed
  - Play Analysis example – Pretty Hill Sandstone



Click here for link to Otway Basin Petroleum Systems Model 2023 data

Revisiting the rocks and seismic



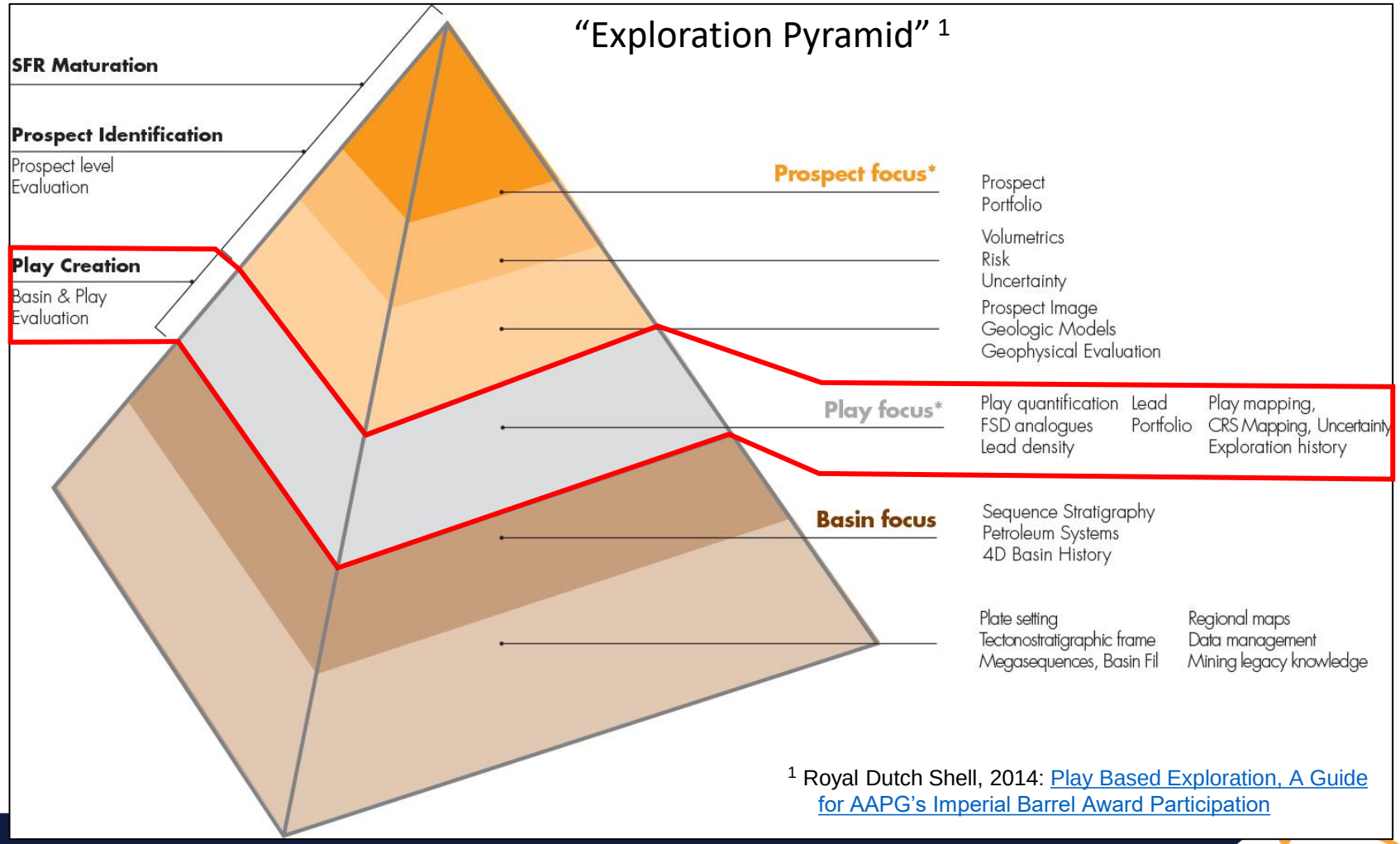
Play-Based Exploration Overview 1

Play-Based Exploration

- Understanding of petroleum system in basin
  - ➢ identification, mapping and quantification of plays
- Maps:
  - Play elements
  - Summary play maps
  - Common risk segments
    - ➢ Identification of sweet spots

Analysis of plays using this process is **not static**

- Iterative feedback required following new information



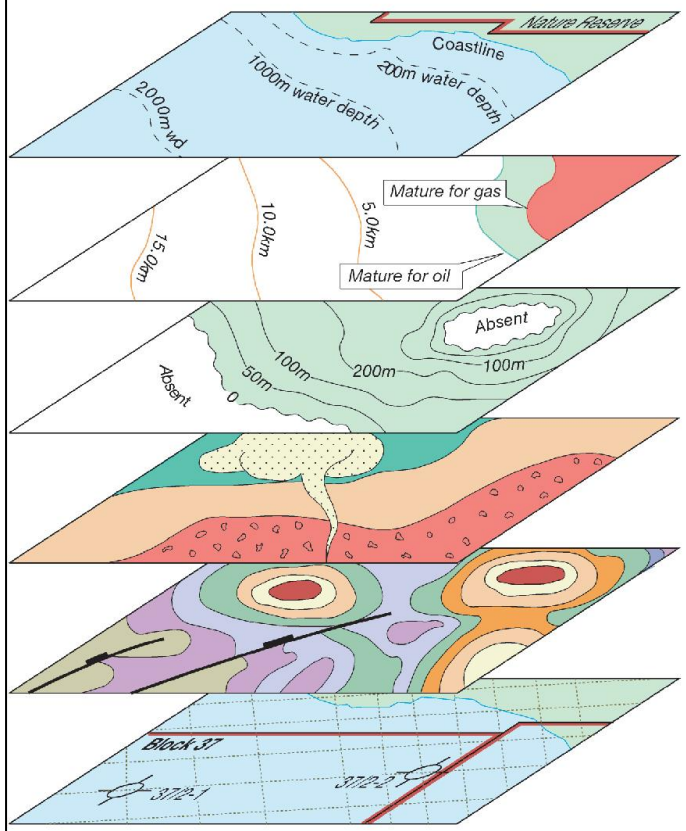
[1] Royal Dutch Shell, 2014: Play Based Exploration, A Guide for AAPG's Imperial Barrel Award Participation

Play-Based Exploration Overview 2

Geological boundaries required for all elements of Petroleum System:

- Extent and type of Reservoir interval
- Hydrocarbon Charge:
  - Extent of likely Source Rock
    - Maturity of Source Rock
    - Limits of potential migration from Source Rock
- Entrapment:
  - Extent of Sealing interval
  - Structural elements

Input data example[1]



Focus map
ARC Gis/
Openworks Concessions
Partnerships

Source and Maturity Map
Flux map
Slicks/seeps
Inversion Timing
SR Quality
Temperature
Fetch map

Top Seal Isopach Map
TA I Fault seal risk
TAII Pressure Analysis
Timing

Reservoir Facies Map
Isopach
Porosity/PermNet/
Net to Gross
AVO/
Amplitudes
Provenance

Top Reservoir Structure Map
Tectono-strat Timing
Velocity Sensitivity
Fault Analysis

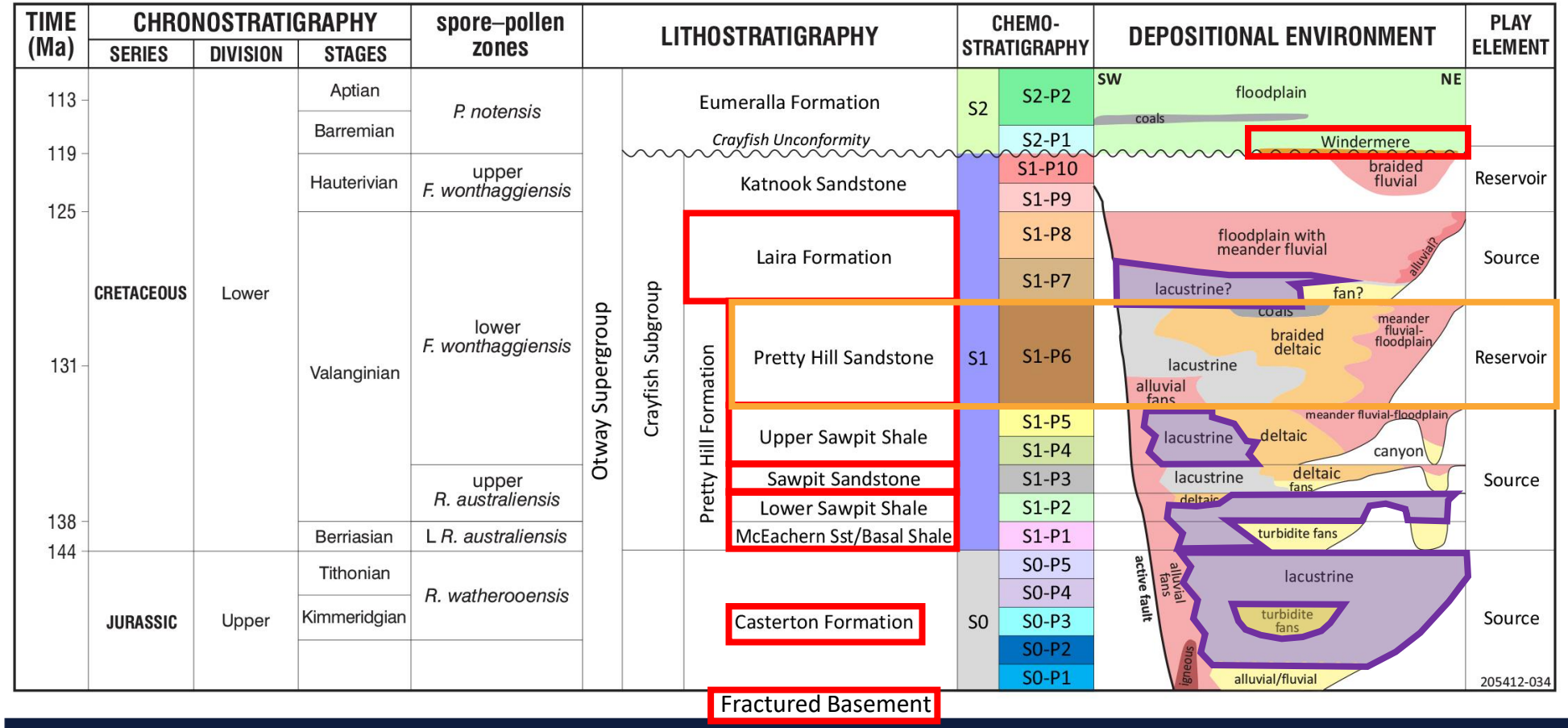
Database Map
Wells/Penetration Map
Success/Failure analysis
Risk statistics
Field Analogues

[1] Royal Dutch Shell, 2014: Play Based Exploration, A Guide for AAPG's Imperial Barrel Award Participation

Otway Basin Stratigraphy

Plays reviewed

Source rocks



Play analysis example shown in this presentation

After Kirk (2024)

Core to seismic 1

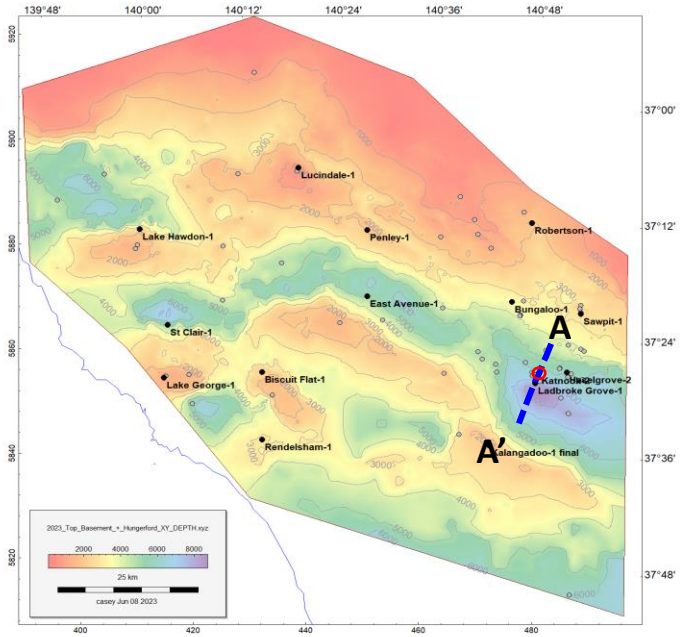
Core Description
Katnook 2

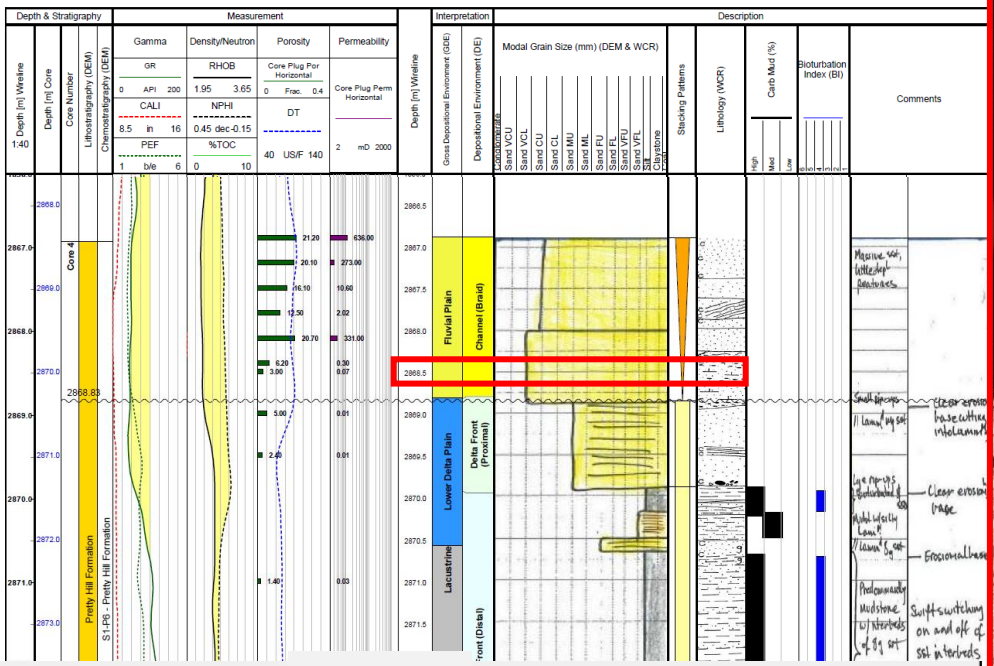
Department for Energy and Mining: South Australia

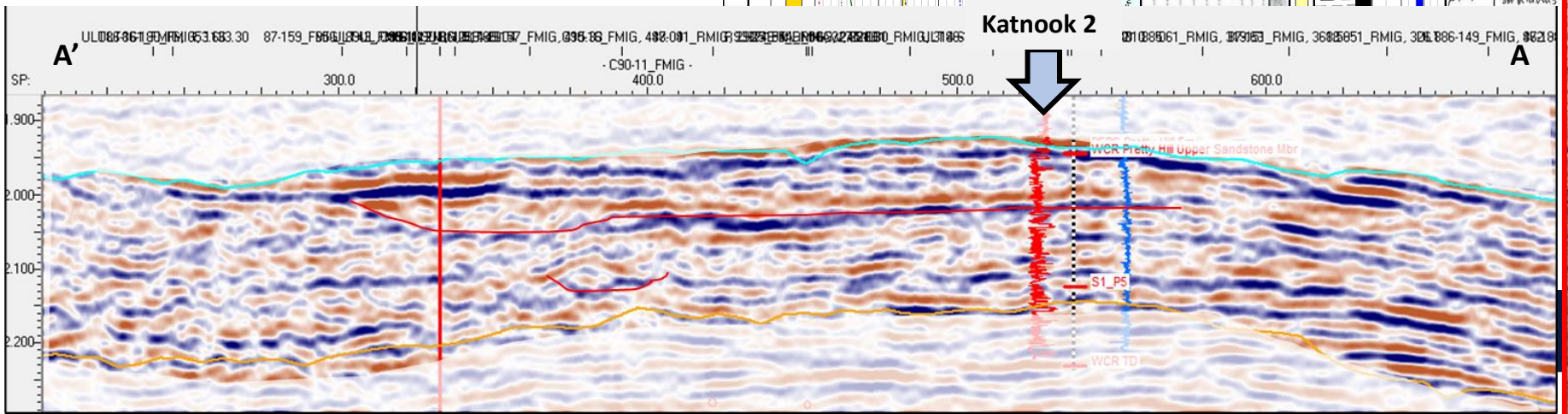
Country (State):	Australia (South Australia)	Spud Date:	01/12/1988
Basin:	Otway (Onshore SA)	KB/RT:	67.97m
Permit (2022):	PEL 32	TD:	3,478.073m
Well Operator:	Ultramar	Depth Shift:	C3/-0.6m & C4/-1.5m
Author:	Ultramar & P. Strong (DEM-July 2023)	Scale:	1:40
Compiled By:	C. Cubitt [DE-GDE] (SADEM - July 2023)		

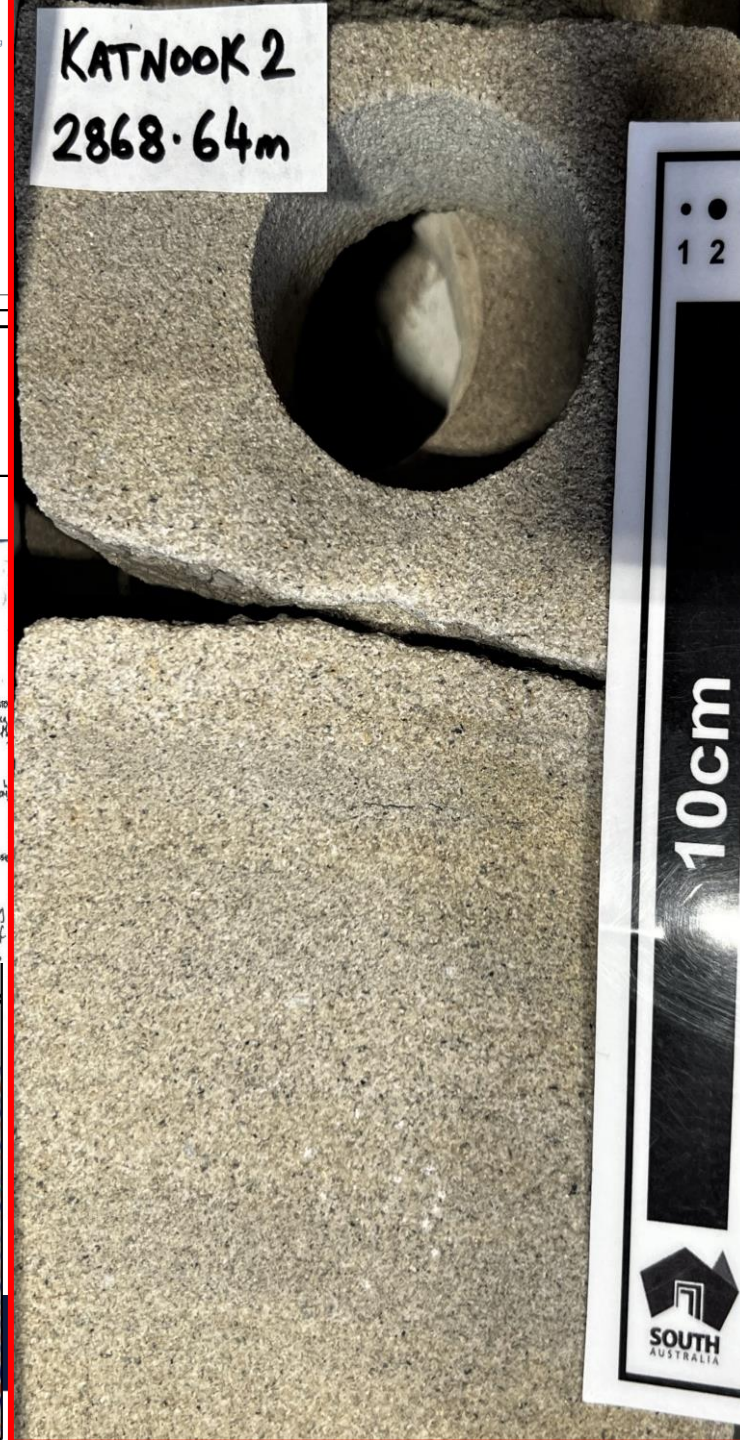
Gross Depositional Environment: Fluvial Plain; Flood Plain; Lacustrine; Lower Delta Plain

Depositional Environment: Channel (Meander); Channel (Braid); Floodplain; Floodplain (Lacustrine); Delta Front (Proximal); Delta Front (Distal); Lacustrine (Deep)









Core to seismic 2

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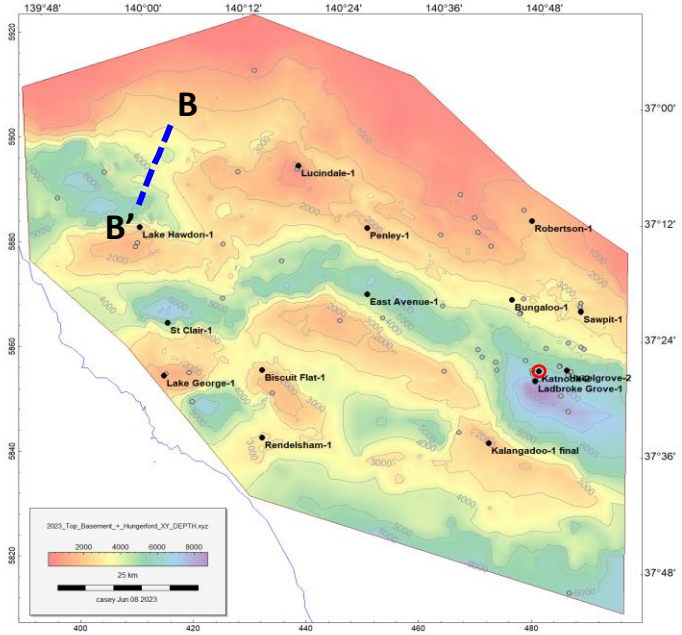
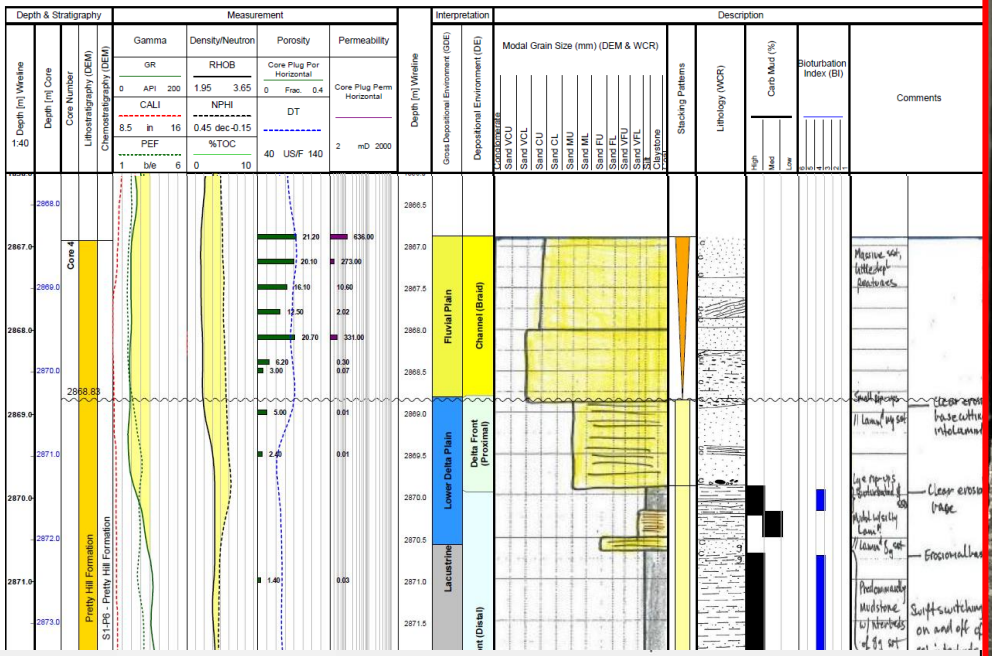
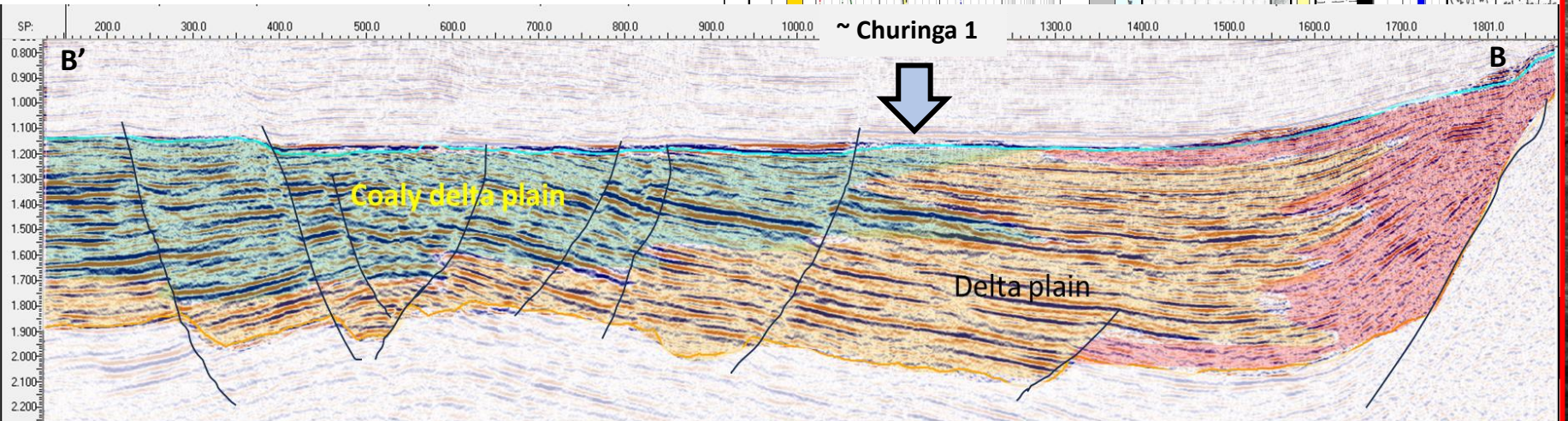
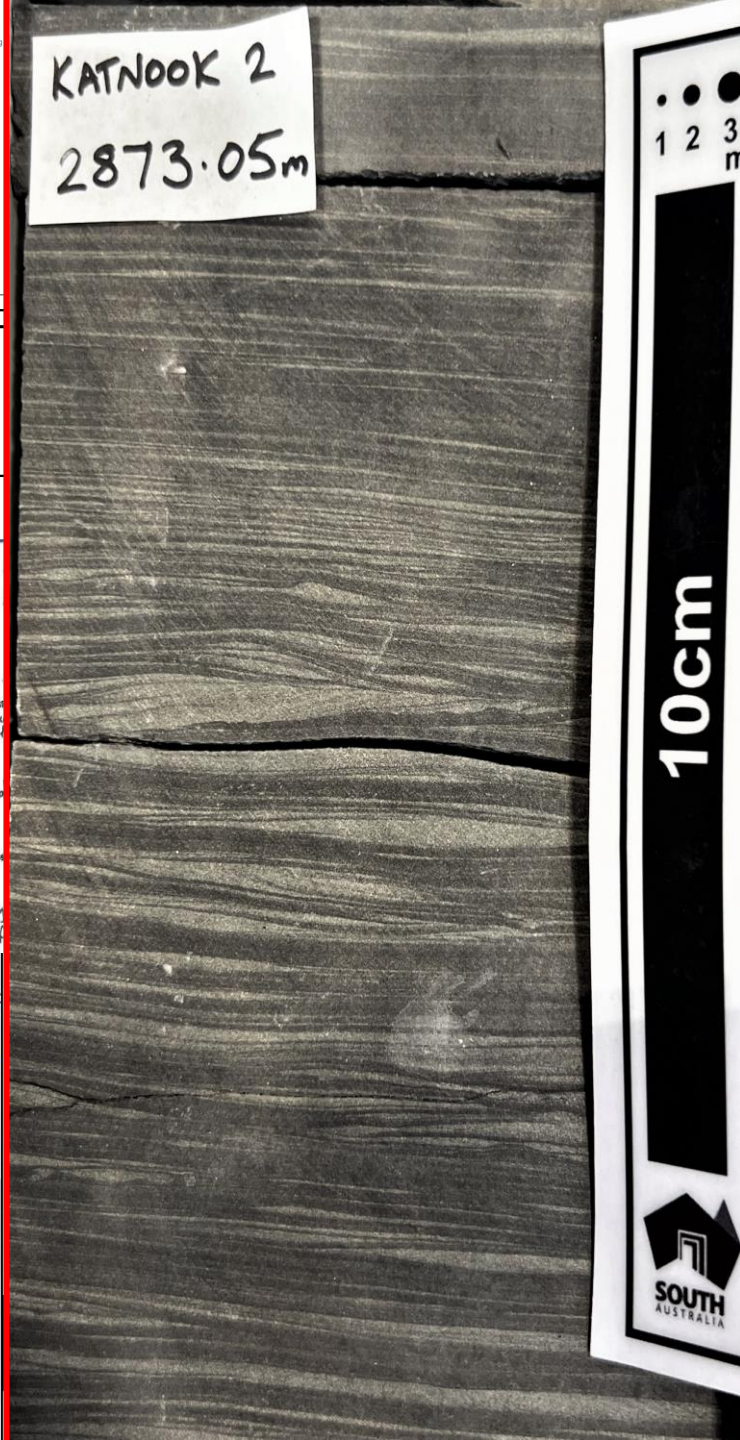


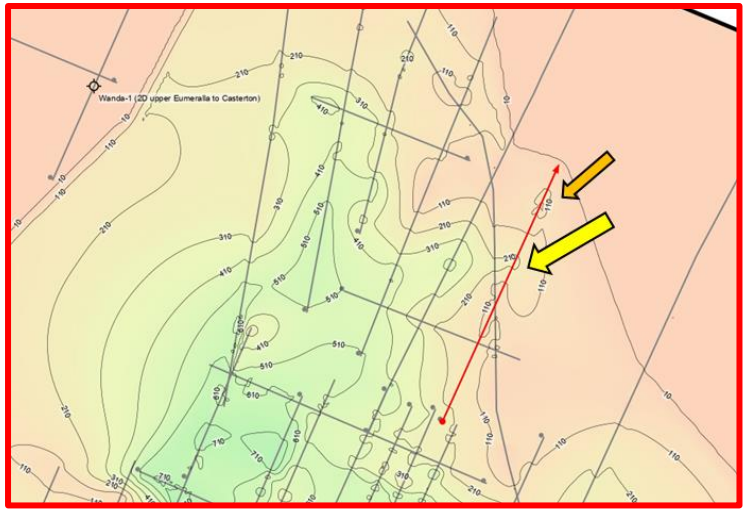


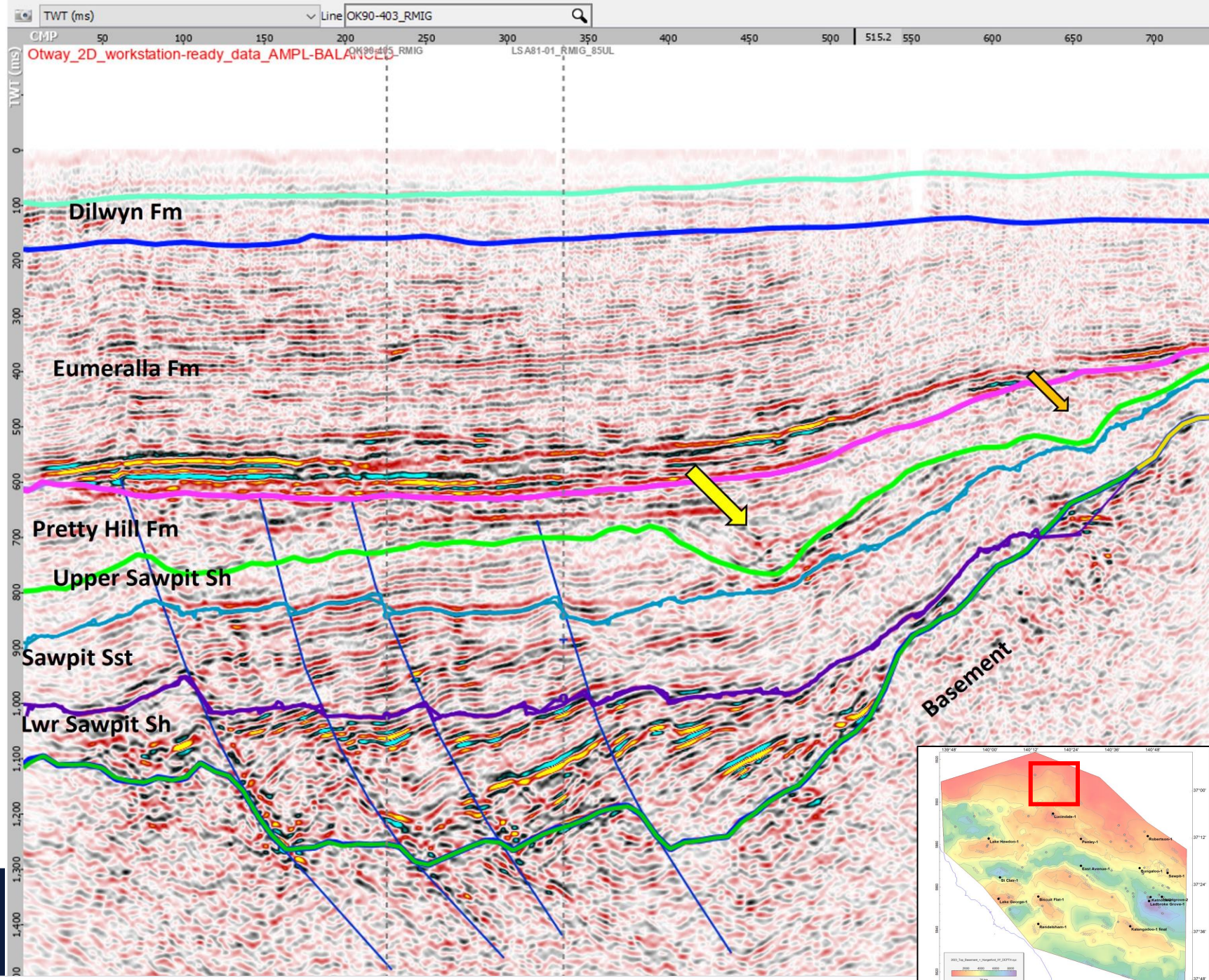


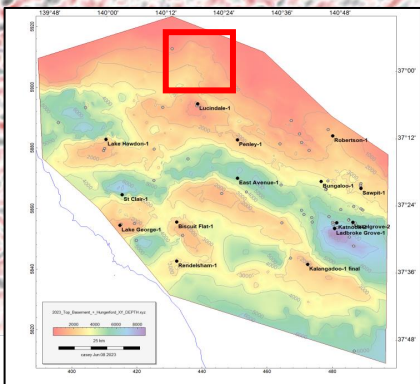


Pretty Hill Sst Distribution

Sediments enter basin via canyons east of Wanda 1 and disperse to the west (Robe Trough) and east (Penola Trough)







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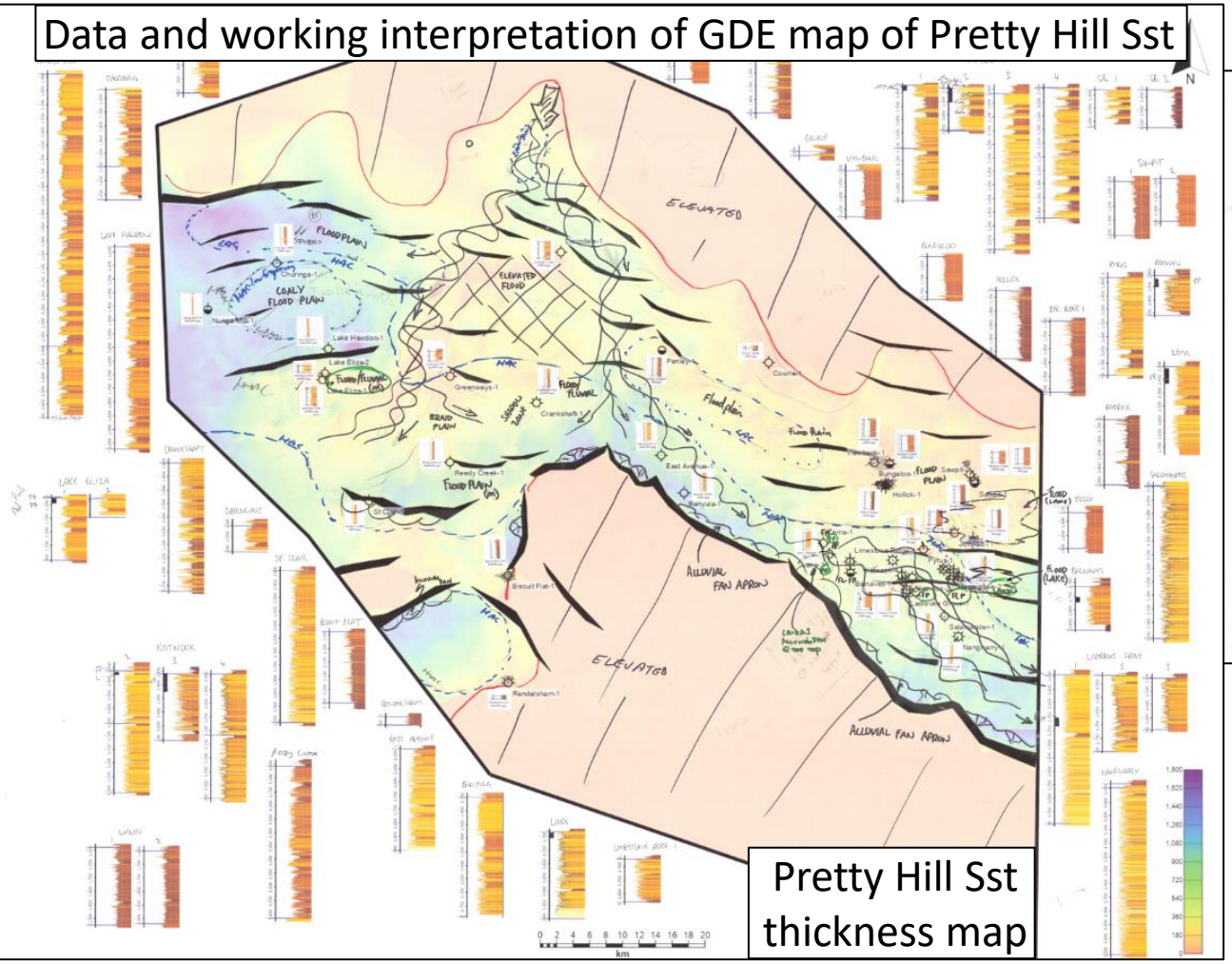
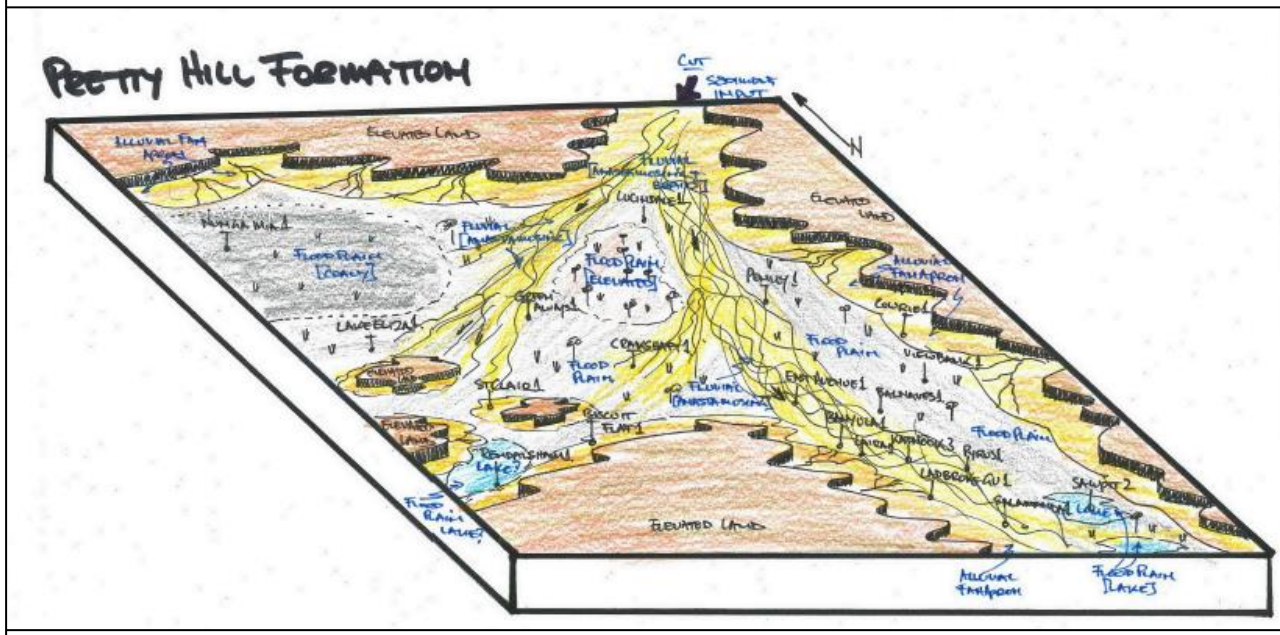
Iteration of interpretation

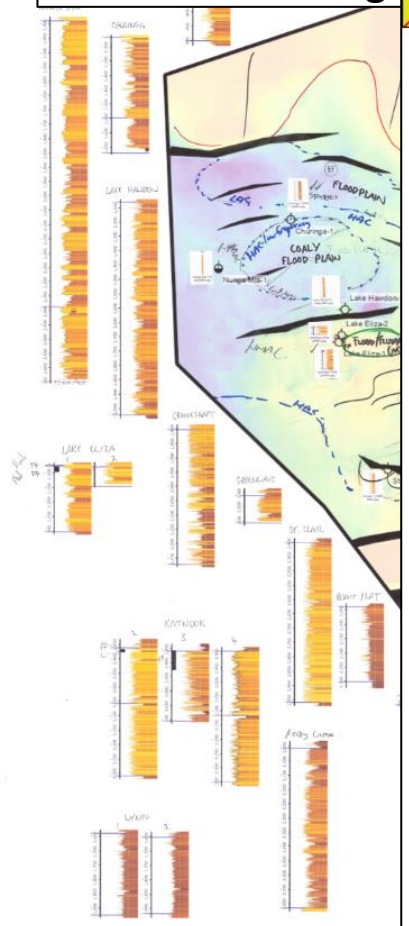
Data and working interpretation of GDE map of Pretty Hill Sst



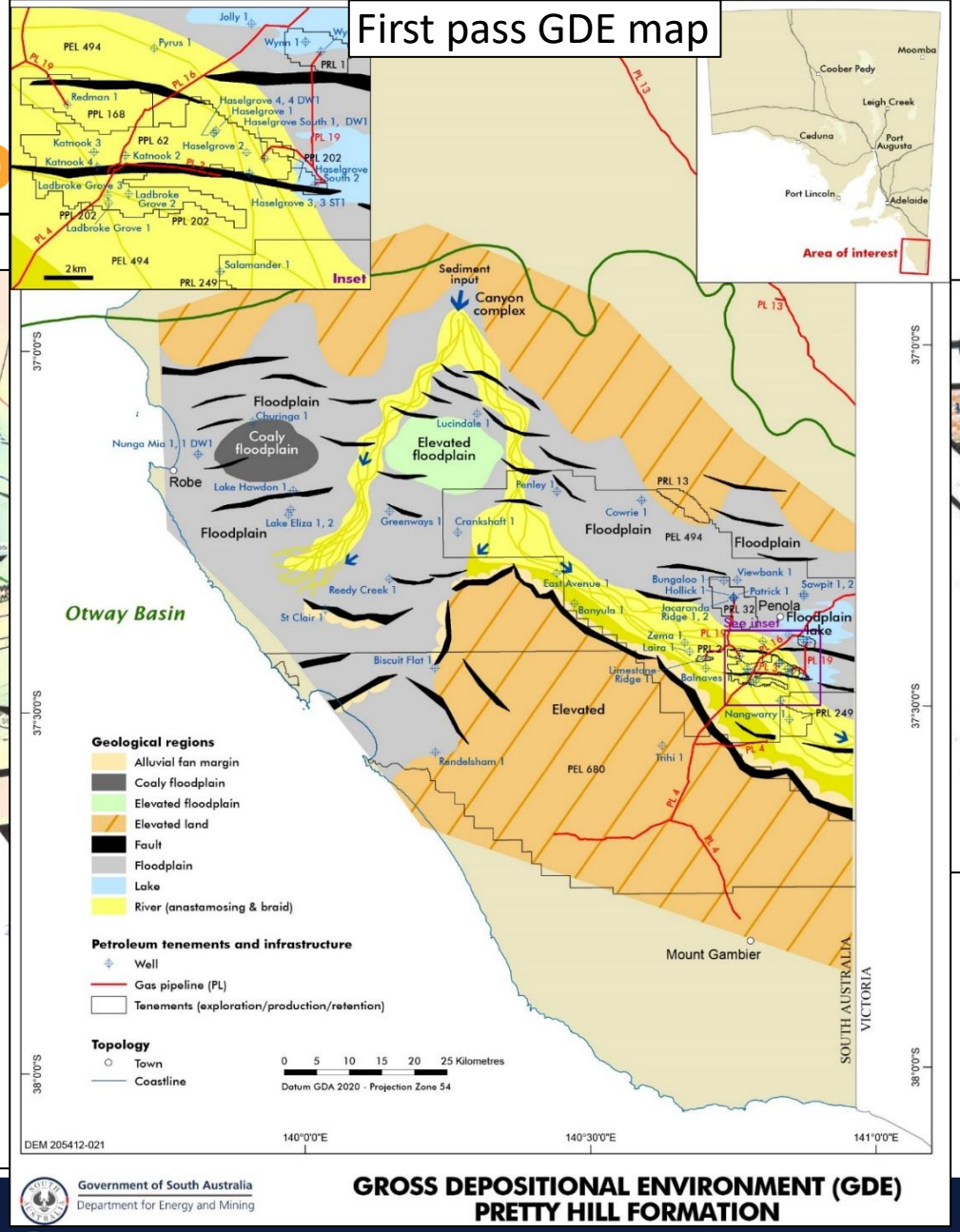


Iteratio

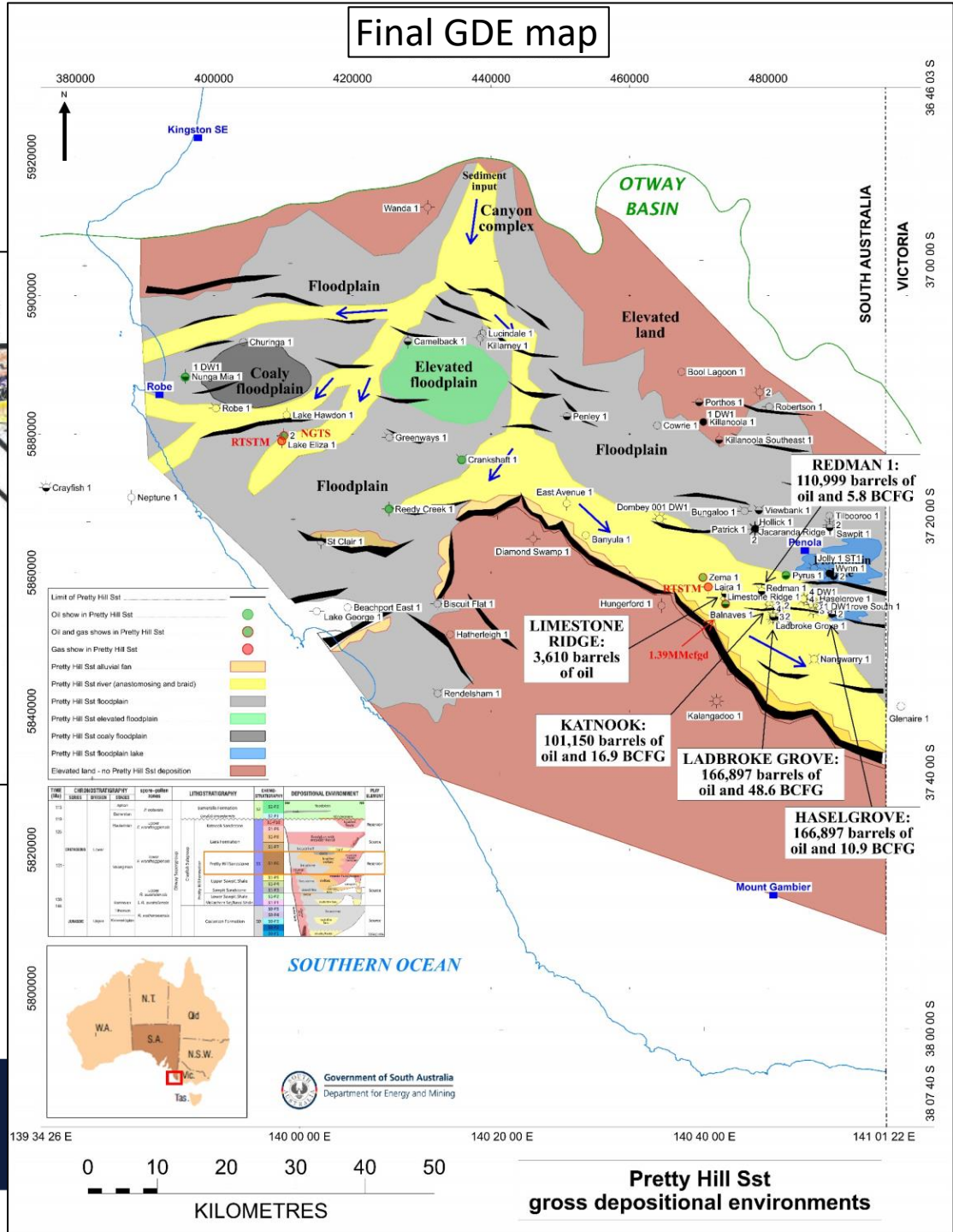
Data and working



First pass GDE map



Final GDE map



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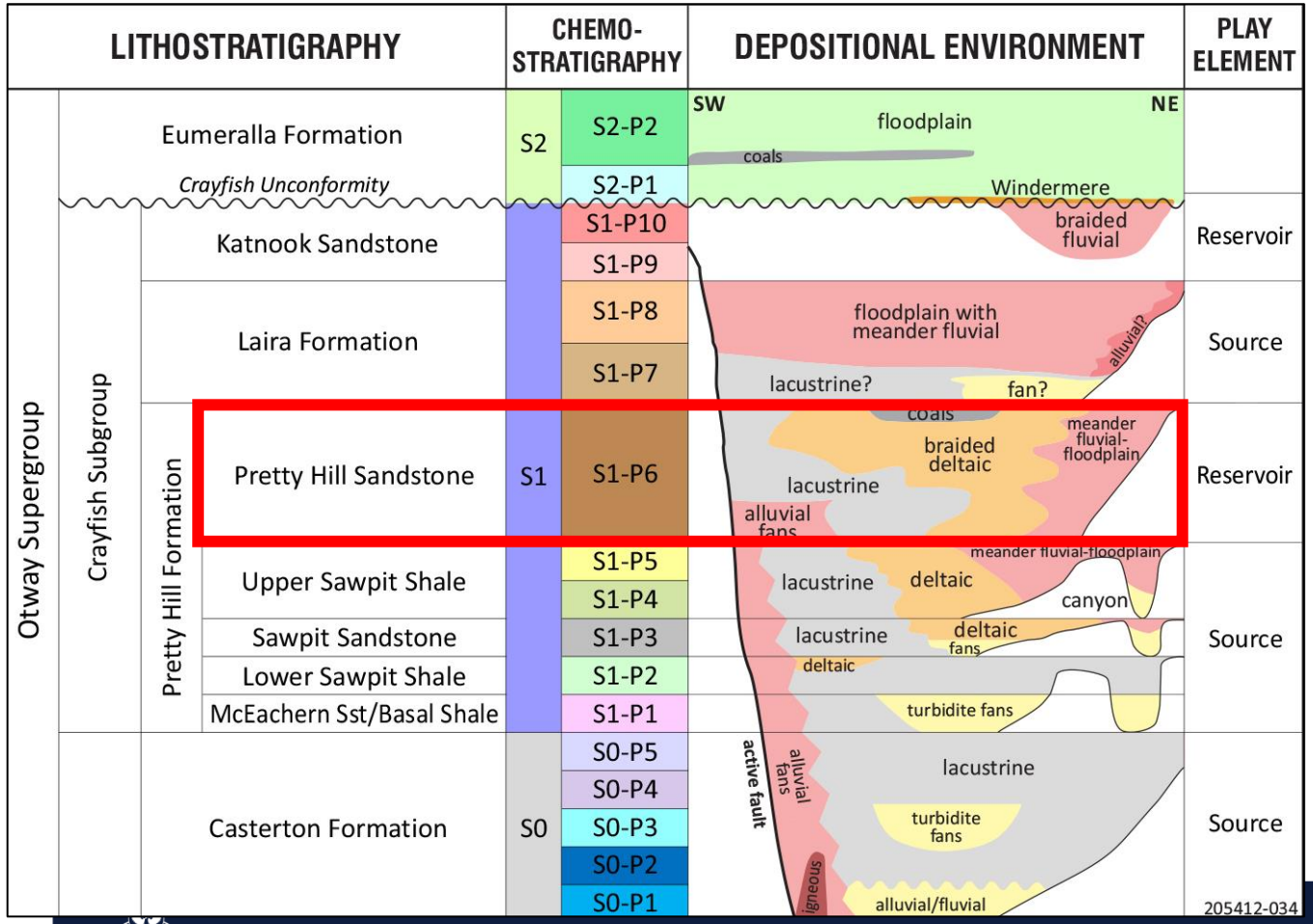
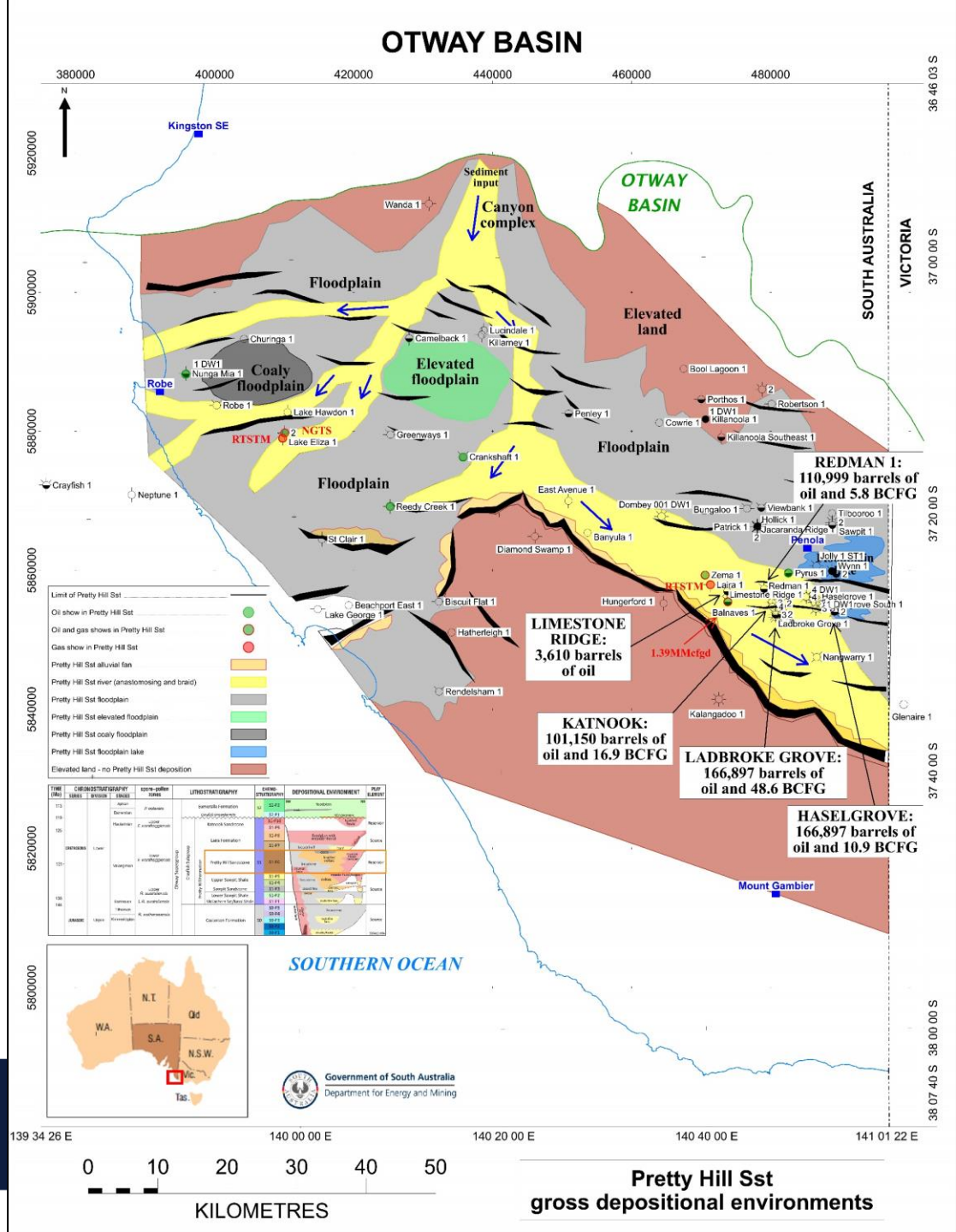
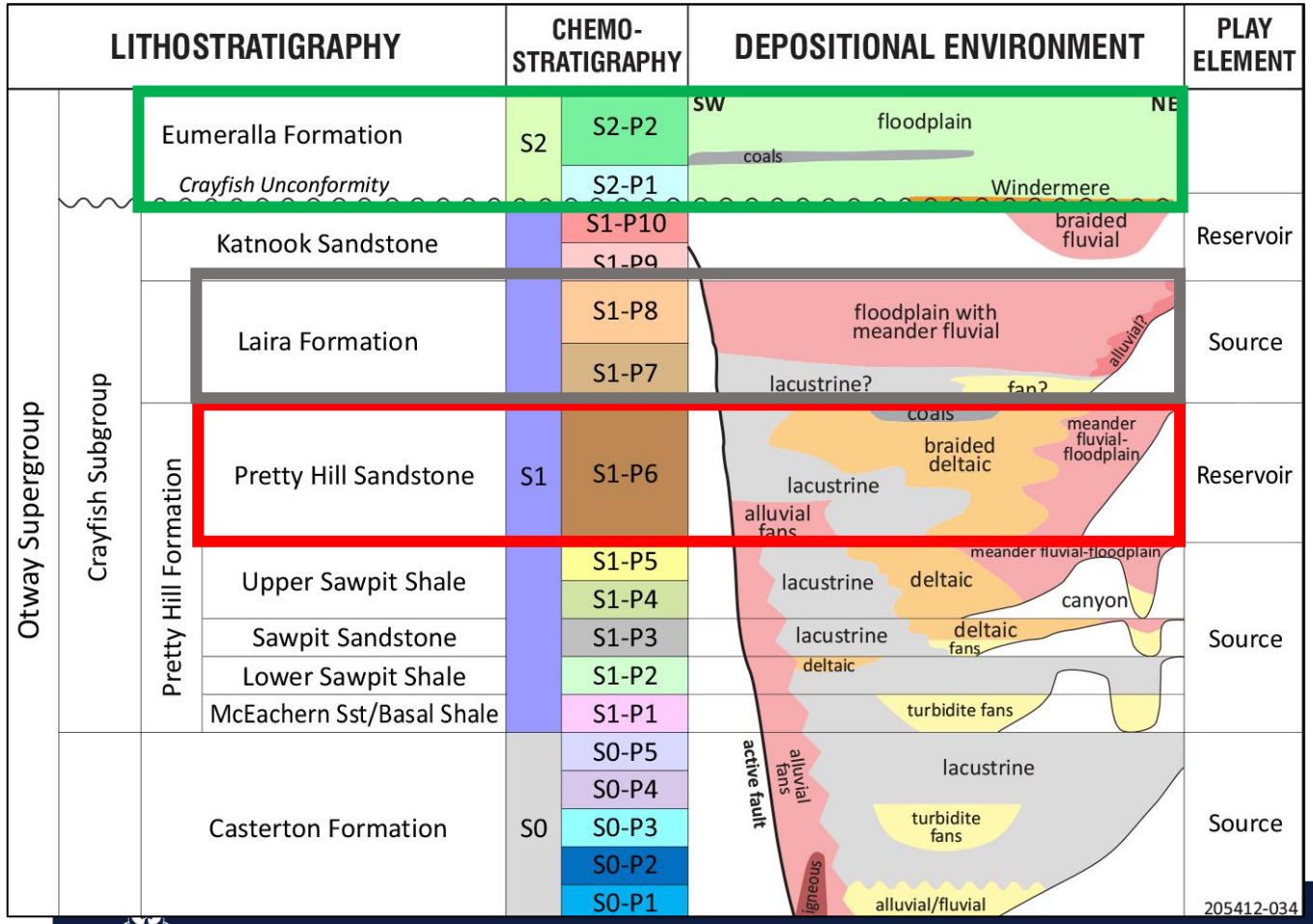
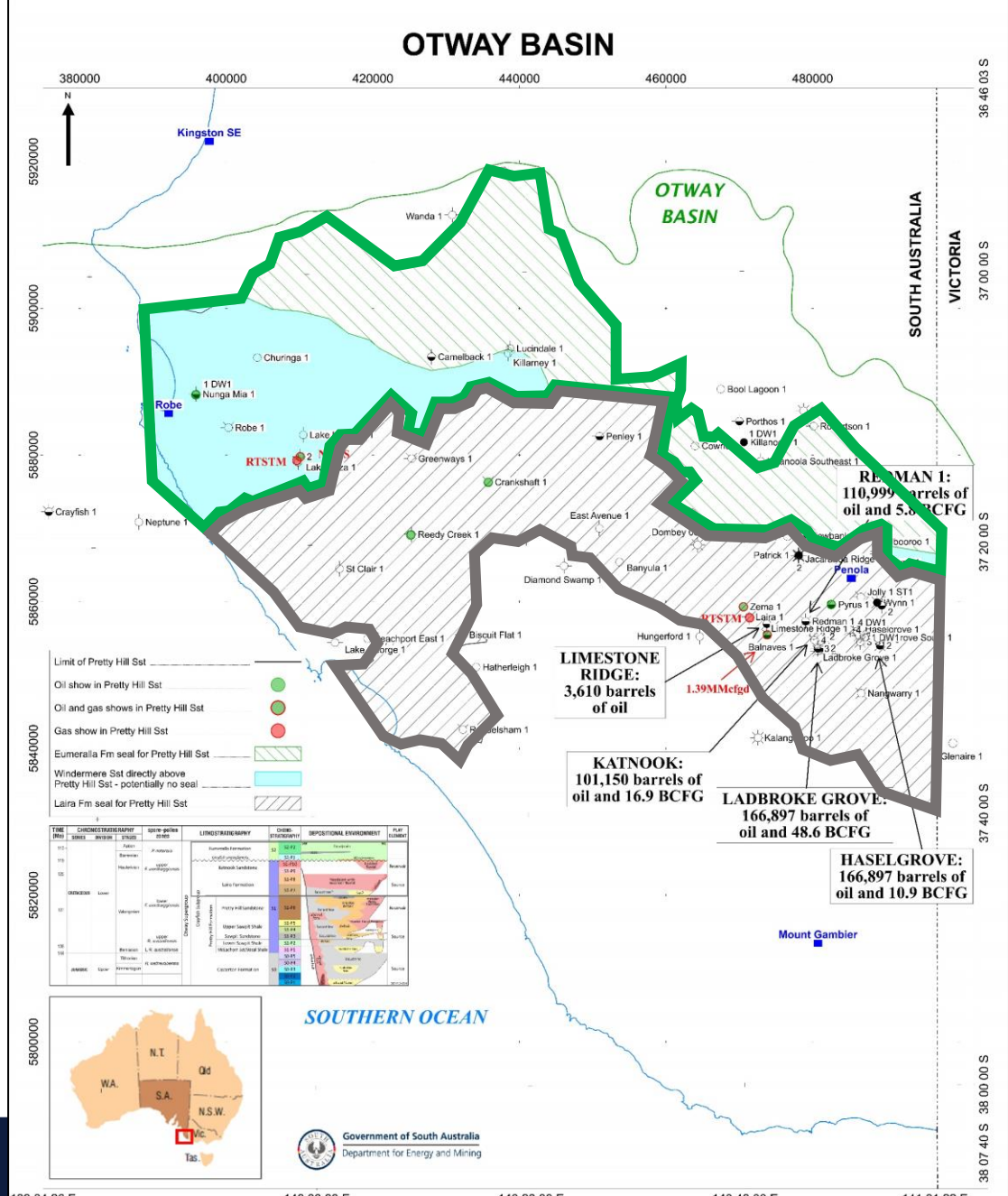
Pretty Hill Sst Play Elements: Reservoir



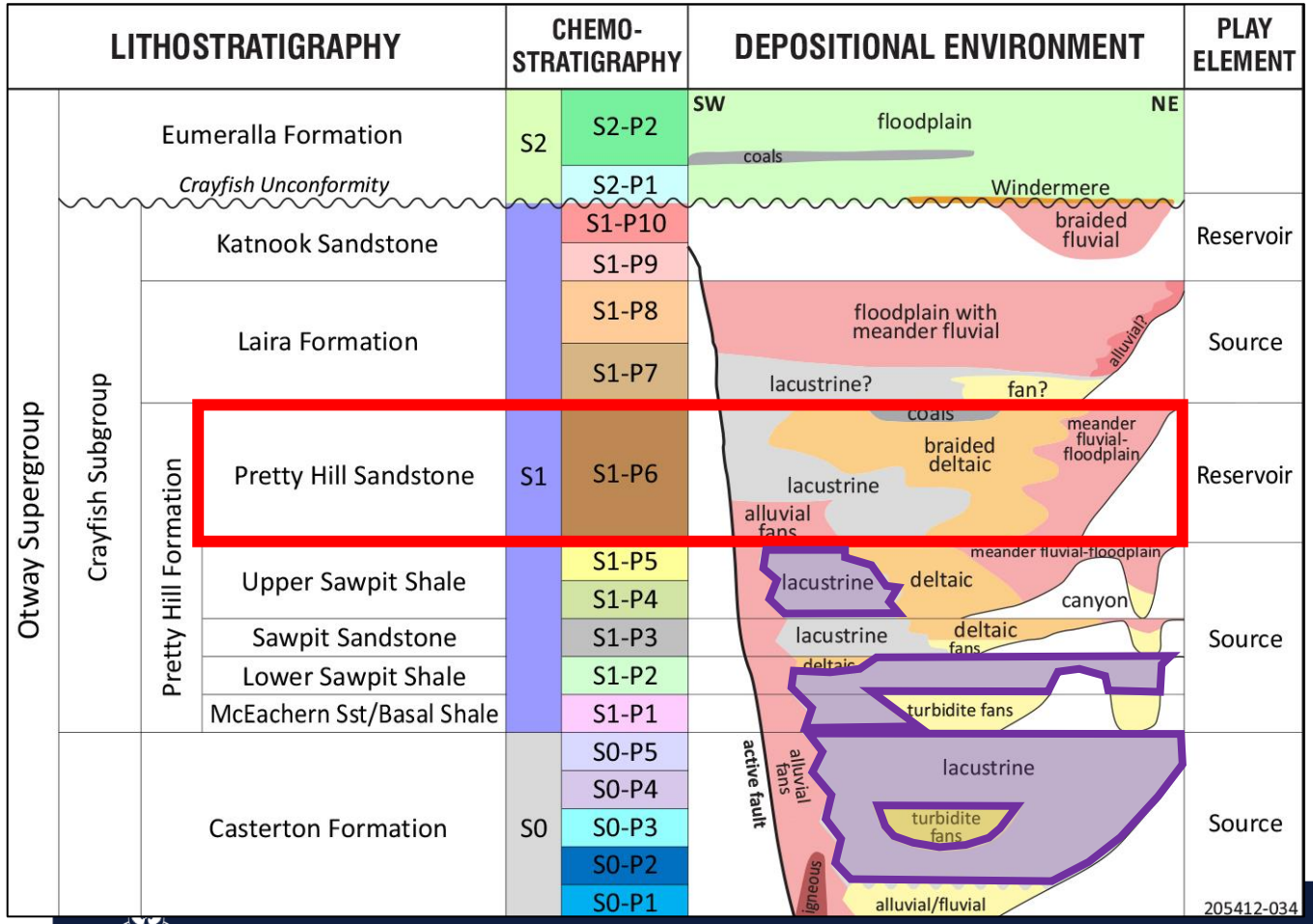


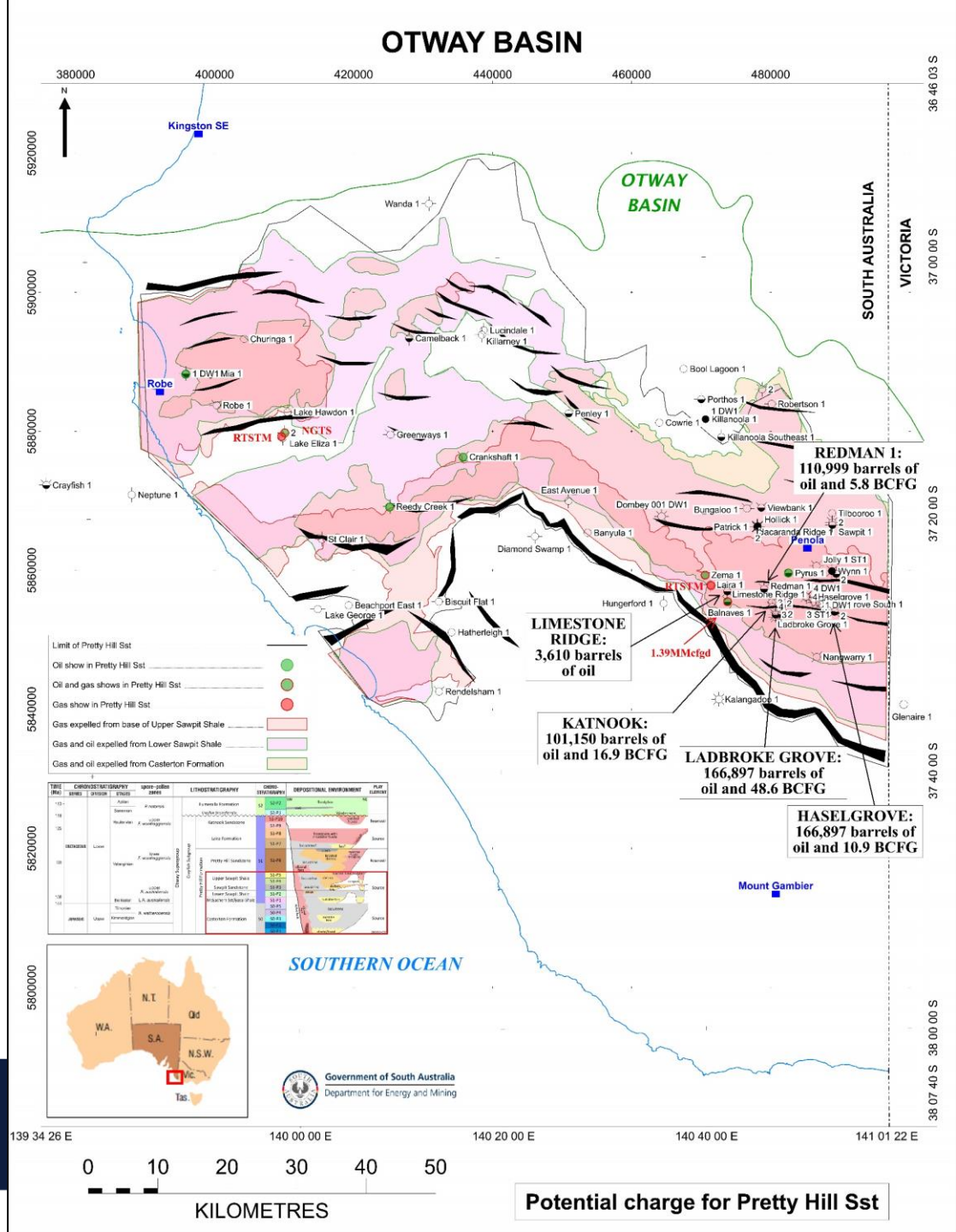
Pretty Hill Sst Play Elements: Seal



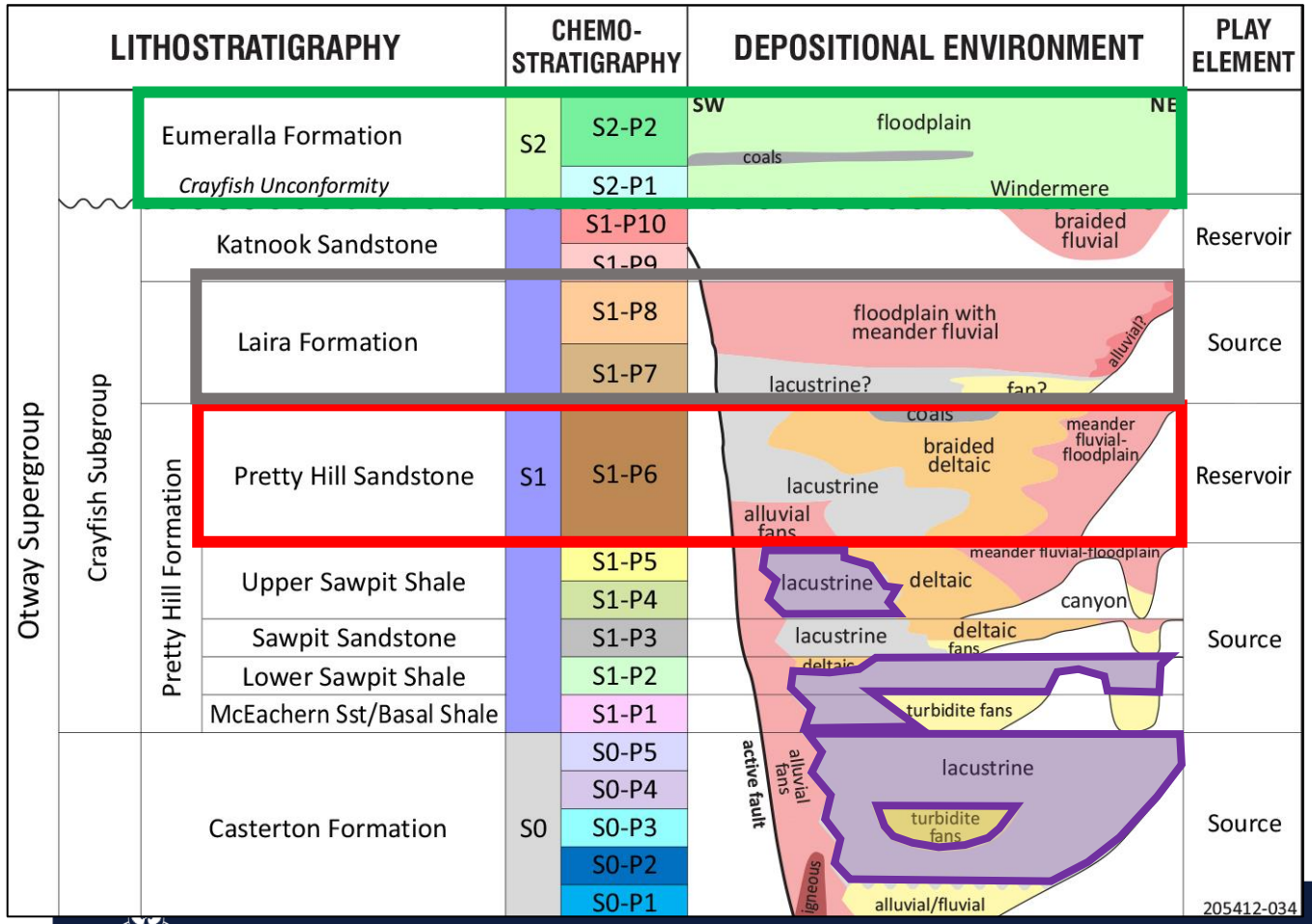


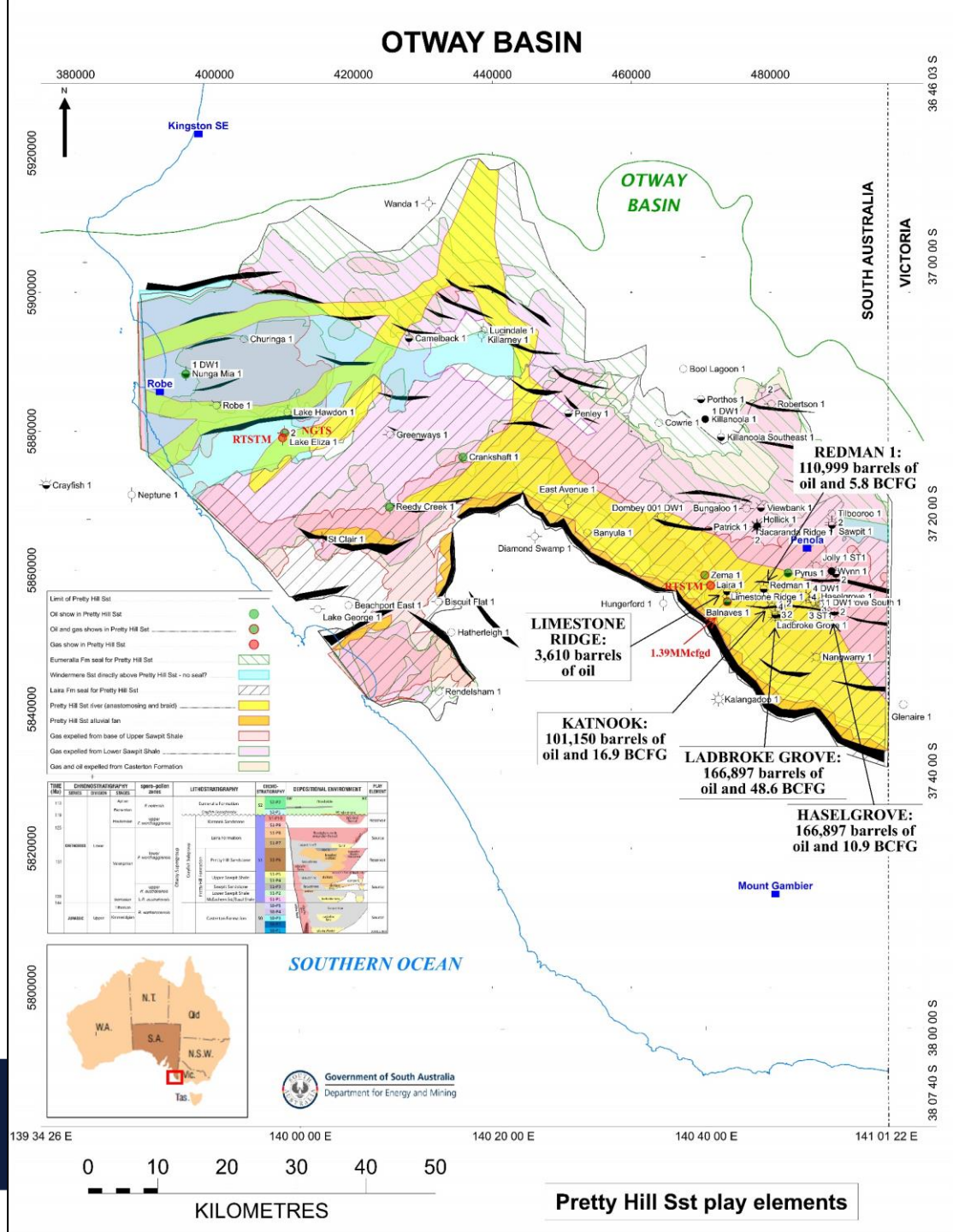
Pretty Hill Sst Play Elements: Source rocks





Pretty Hill Sst Play Elements





Pretty Hill Sst Play Map

Limit of Pretty Hill Sandstone

Oil show in Pretty Hill Sst

Oil and gas shows in Pretty Hill Sst

Gas show in Pretty Hill Sst

Sealed Pretty Hill Sst alluvial fan above mature Upper Sawpit Shale

Sealed Pretty Hill Sst alluvial fan requiring charge

Sealed Pretty Hill Sst river (anastomosing and braid) above mature Upper Sawpit Shale

Sealed Pretty Hill Sst river possibly charged by mature Upper Sawpit Shale - migration required

Pretty Hill Sst river above mature Upper Sawpit Shale, but below Windermere Sst - potentially no seal

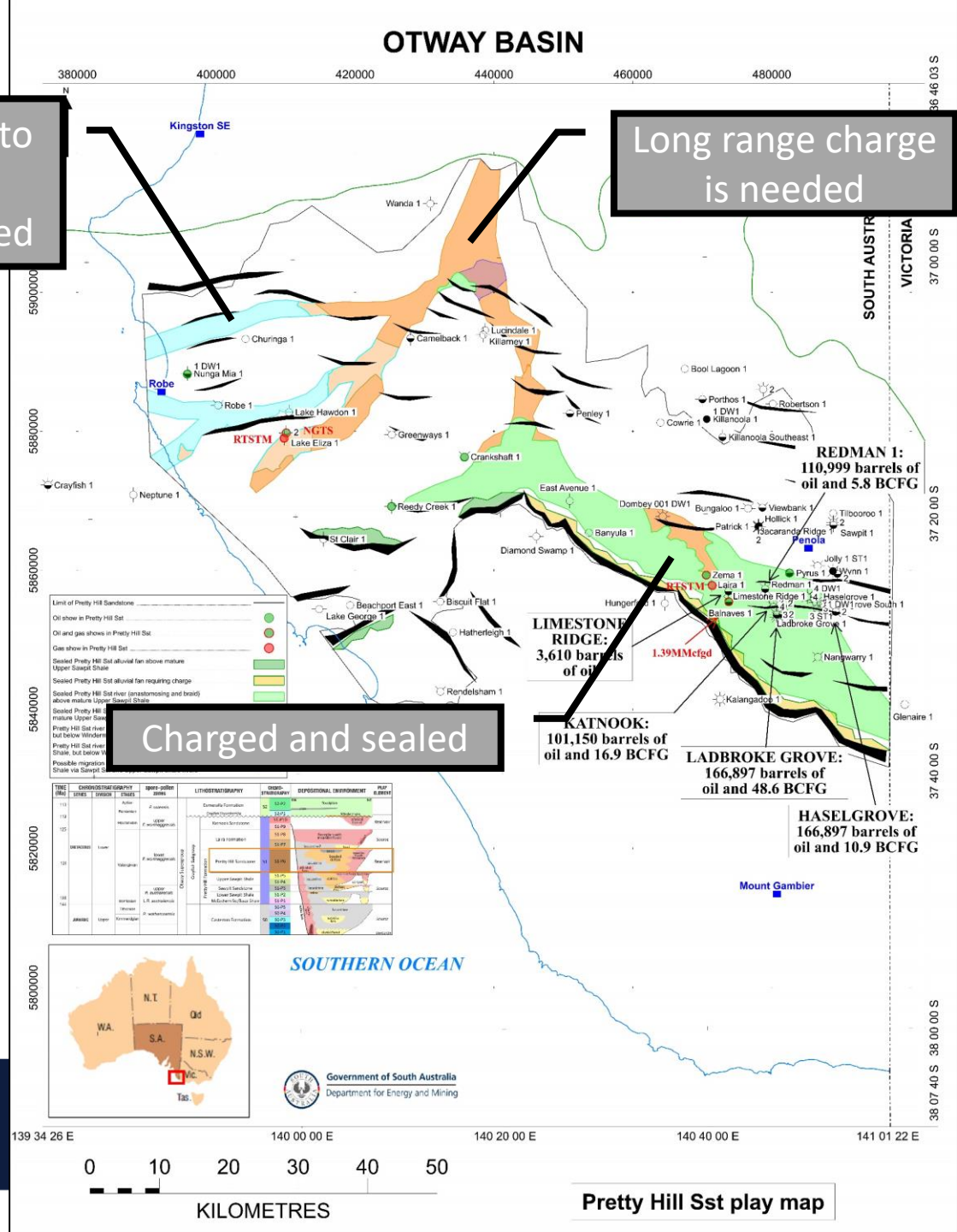
Pretty Hill Sst river possibly charged by mature Upper Sawpit Shale, but below Windermere Sst - potentially no seal

Possible migration into Pretty Hill Sst from Lower Sawpit Shale via Sawpit Sst and Upper Sawpit Shale rivers

Seal needs to be better characterised

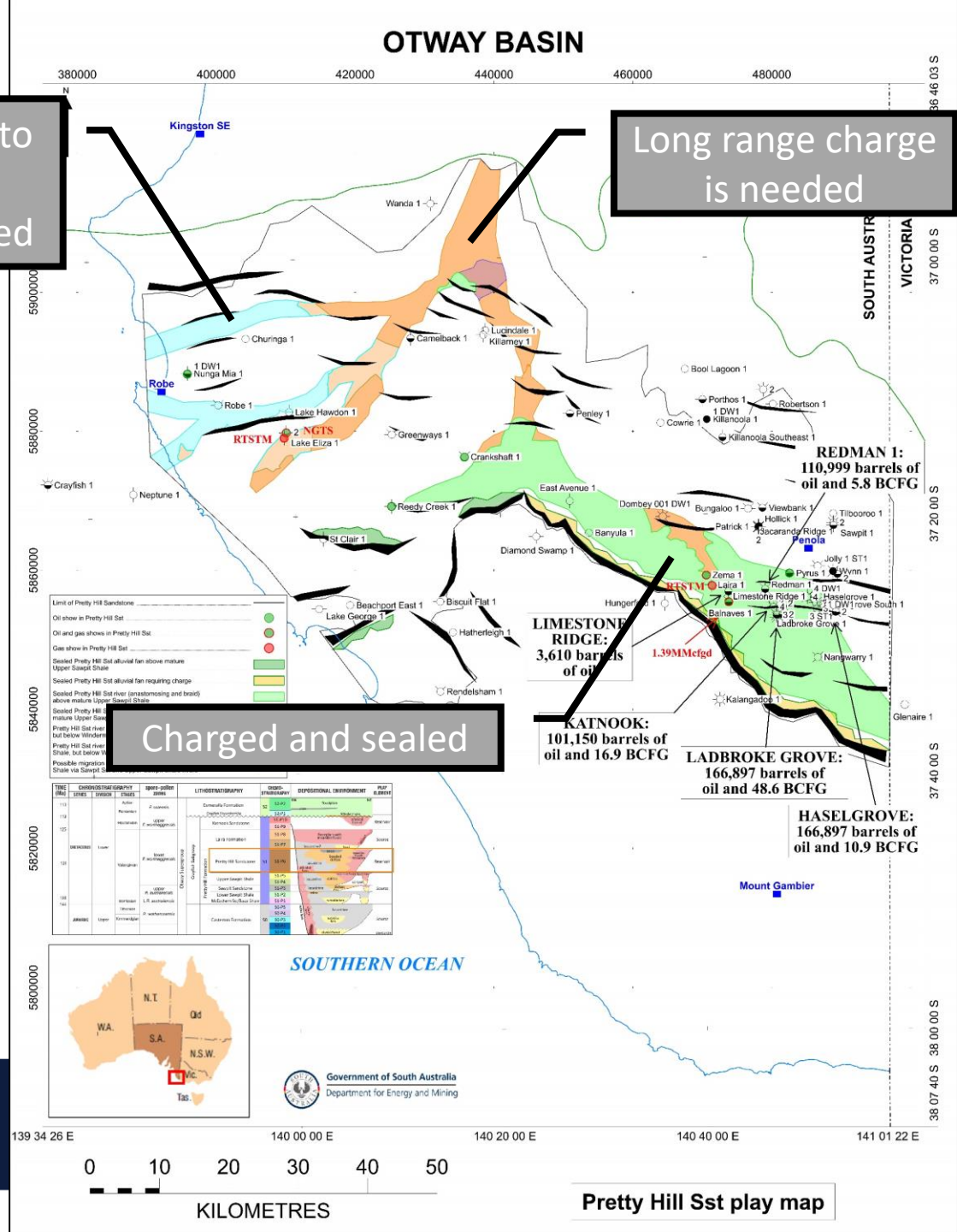
Long range charge is needed

Charged and sealed



Onshore Otway Basin Play Analysis Summary

- Play-Based Exploration:
  - Understanding of petroleum system in basin
  - Play summary maps:
    - ➢ Identification of sweet spots
  - **Not static** - Iterative feedback required following new information
- Onshore Otway Basin:
  - Petroleum system model completed Q4 2023
  - Play analysis conducted in 2024
    - Rocks and seismic are the key
    - 7 depositional intervals + Fractured Basement
  - Stimulate next phase of exploration in basin



Onshore Otway Basin Play Analysis Data Available

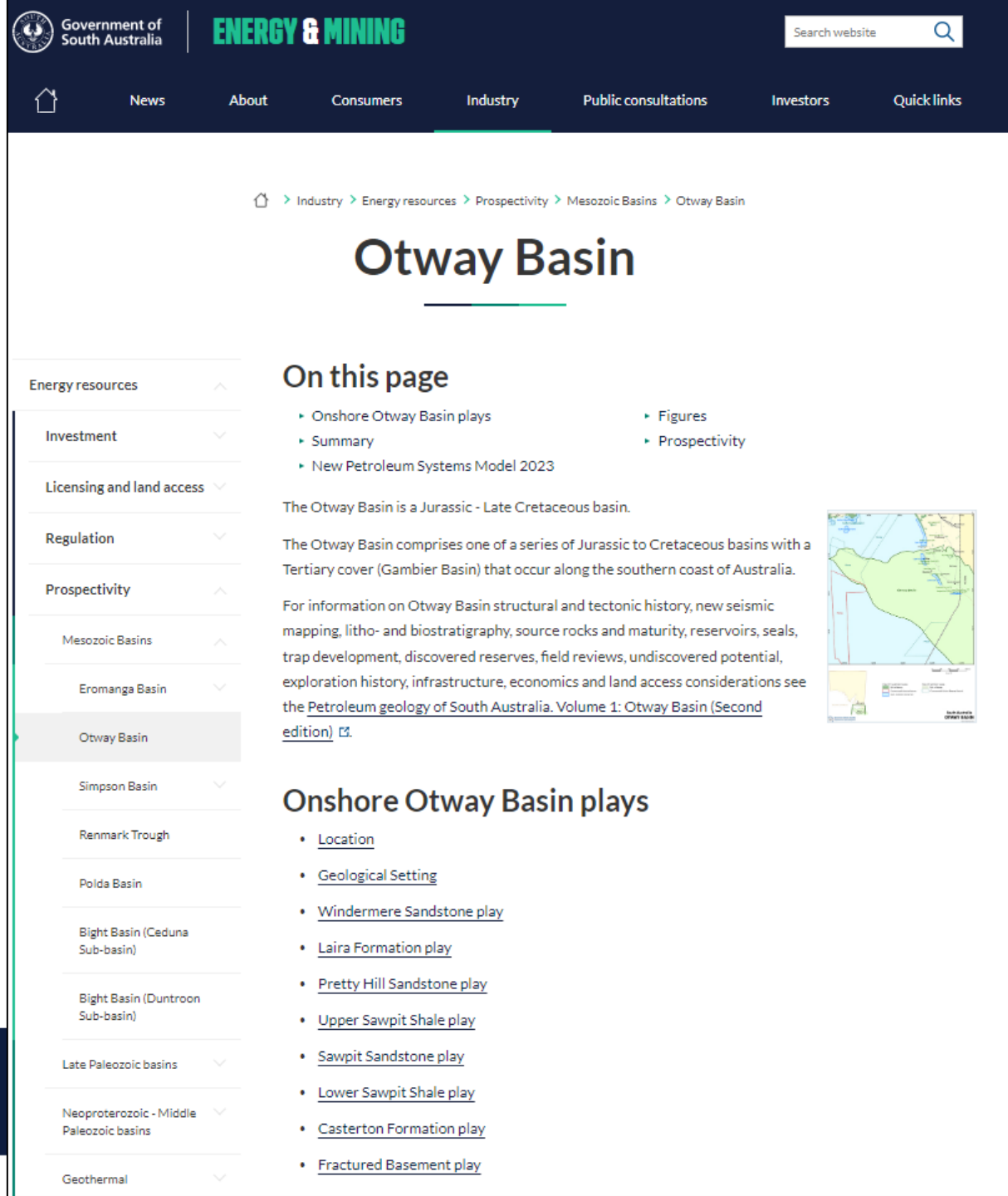
All plays reviewed in this study are documented on the DEM Energy Resources website under individual Basins:

https://www.energymining.sa.gov.au/industry/energy-resources/geology-and-prospectivity/mesozoic-basins/otway-basin

MESA Journal research article 3 (17–28) by Paul Strong and Chris Cubitt, November 2024 on this presentation:

MESAJ098017-028_11_2024.pdf

(https://sarigbasis.pir.sa.gov.au/WebtopEw/ws/samref/sarig1/image/DDD/MESAJ098017-028_11_2024.pdf)



Thank you
… and don’t forget to look at the rocks and seismic!