Unlocking the shale gas of the Beetaloo Sub-basin

Alex Bruce and Daniela Garrad

www.empireenergygroup.net
Empire Energy Group
Level 19, 20 Bond Street,
Sydney NSW 2000
info@empiregp.net

Empire Energy Group Limited

- Largest independent operator in the Beetaloo Sub-basin
- Listed on the ASX (Code:EEG)
- Operates all its permits

Asset Status: Appraisal

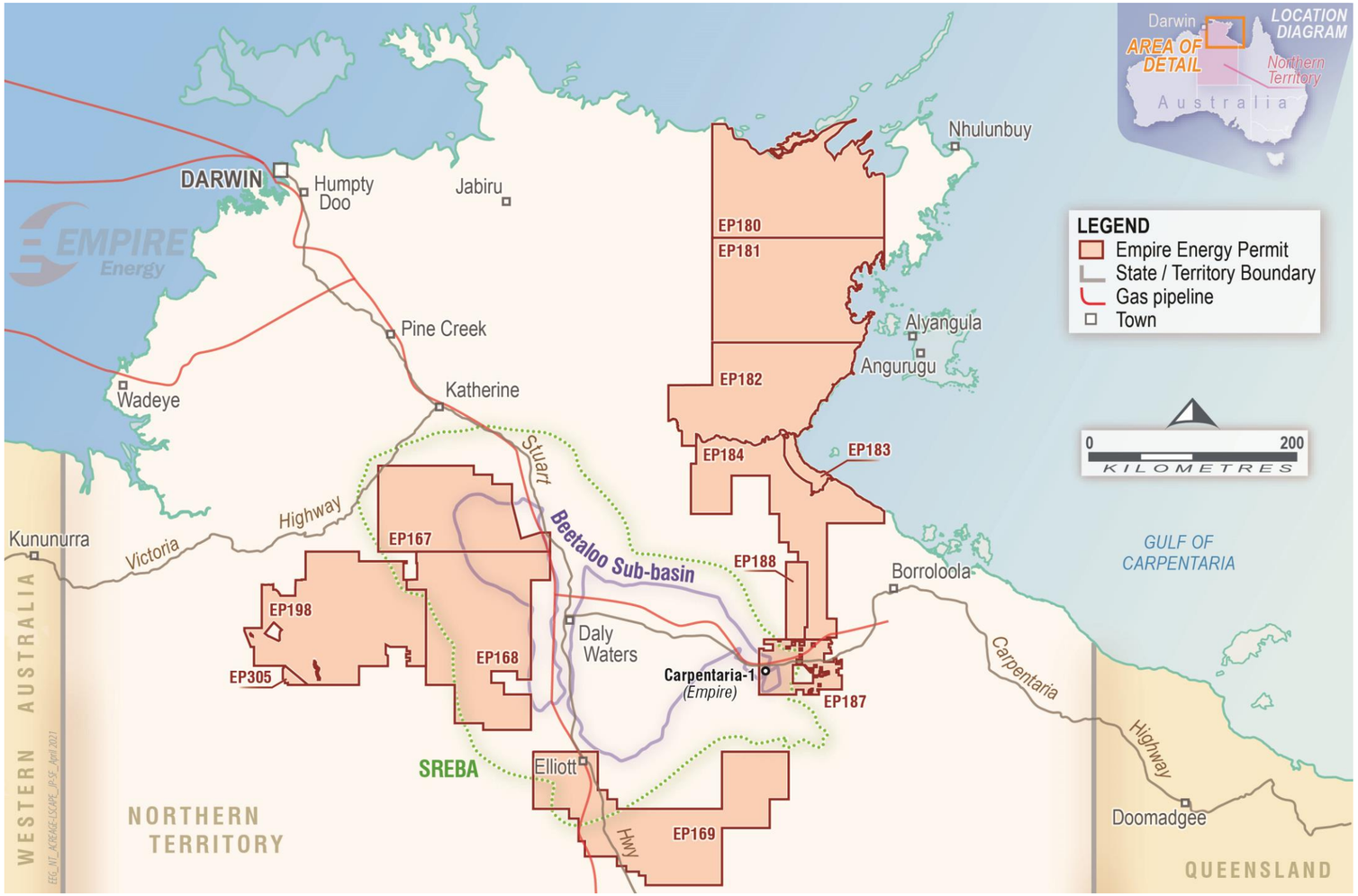
EMPIRE Energy

Key Messages

1. Eastern boundary of the Beetaloo Sub-basin shown to extend further east than previously mapped

2. Liquids rich mud gas observed in Carpentaria-1 places more focus on more accurately measuring thermal maturity

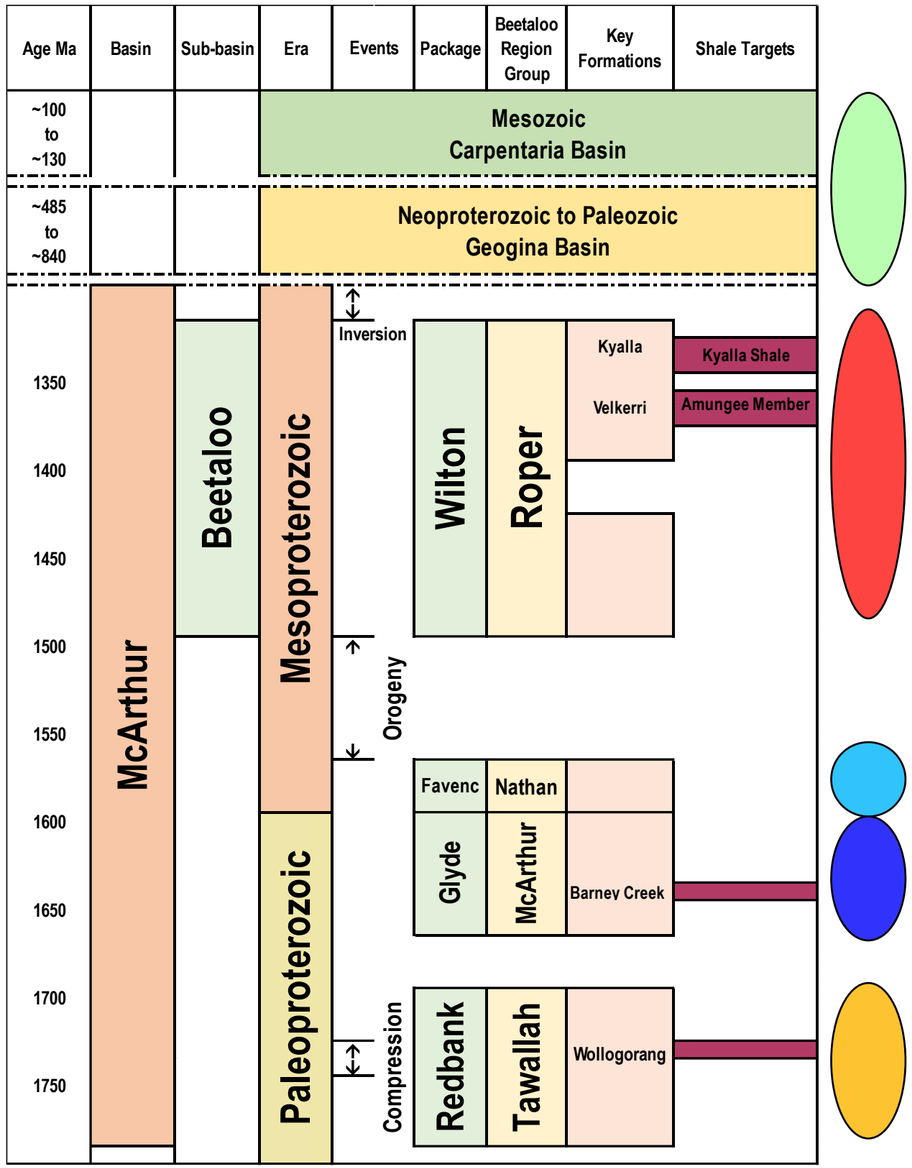
Where the Beetaloo Sub-basin is



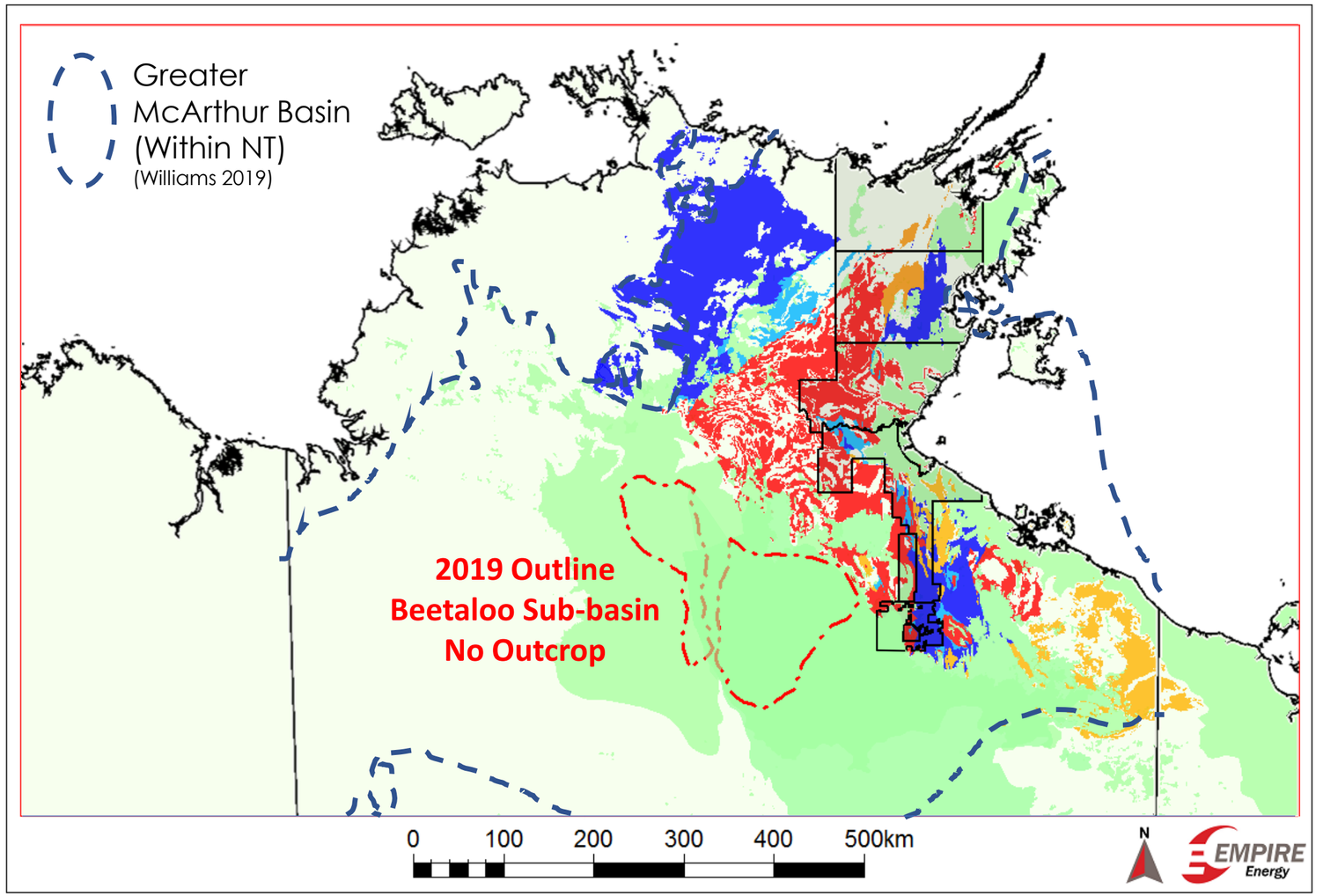
EP198, EP305, EP167, EP168 and EP169 will be acquired through acquisition of Pangaea Resources Northern Territory assets

Beetaloo Sub-basin Location

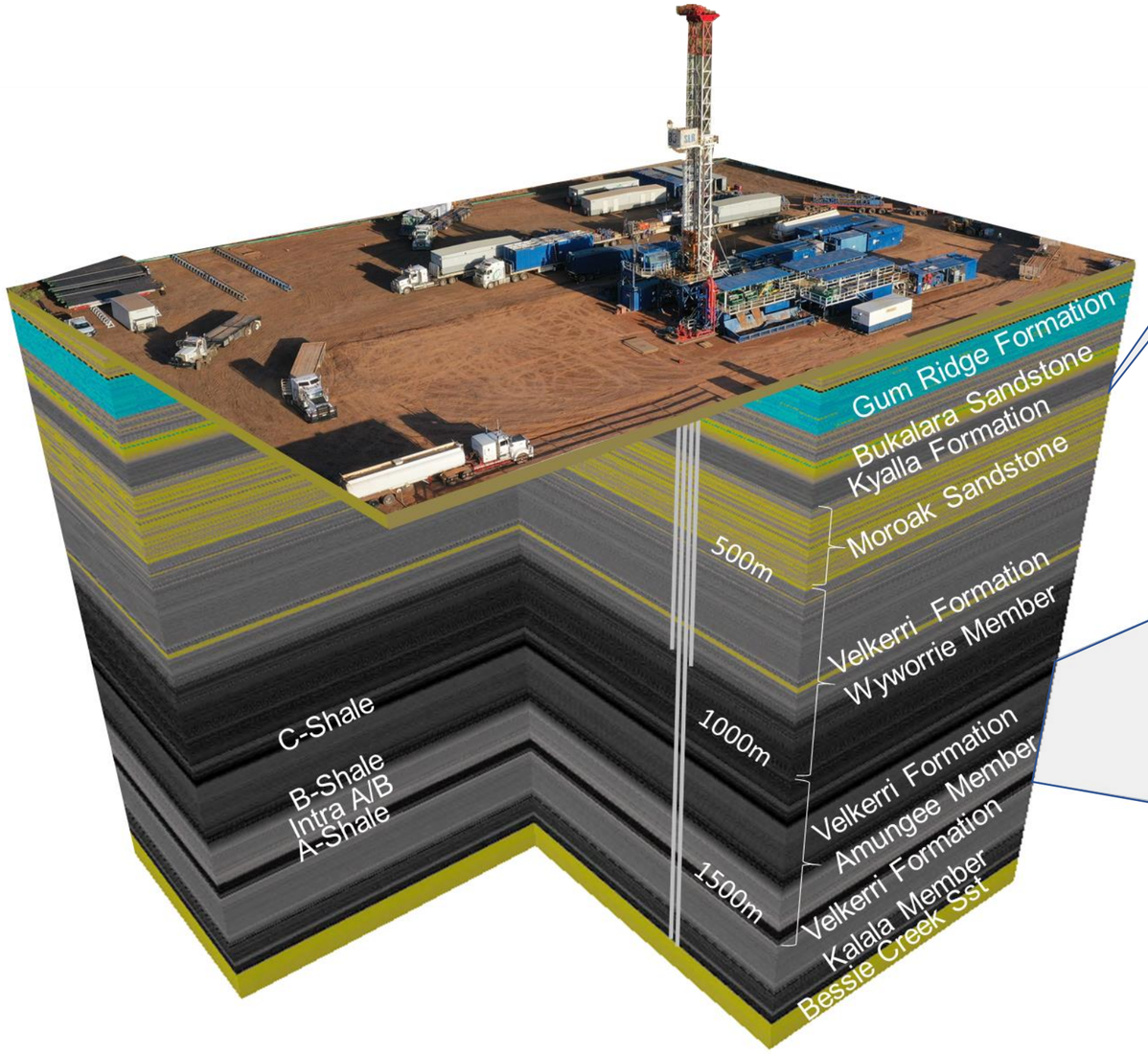
Simplified Stratigraphic column

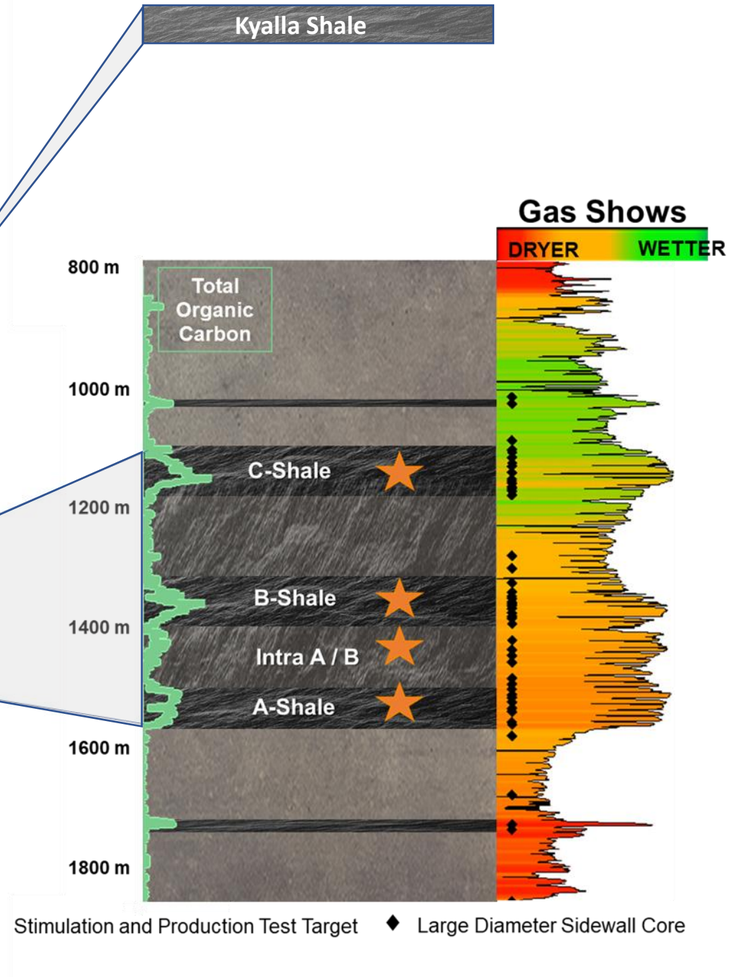


Outcrop Map colour coded by Package



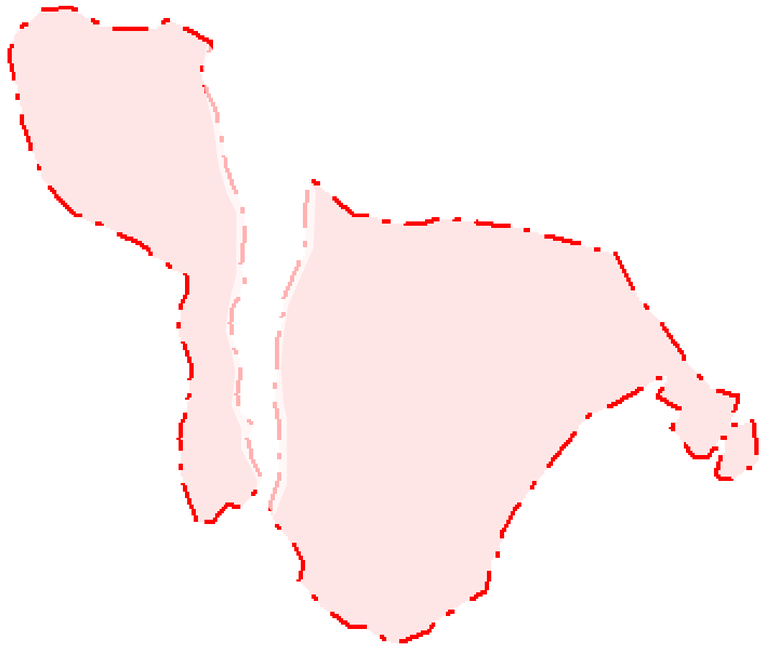
Shale Targets in the Beetaloo Sub-basin





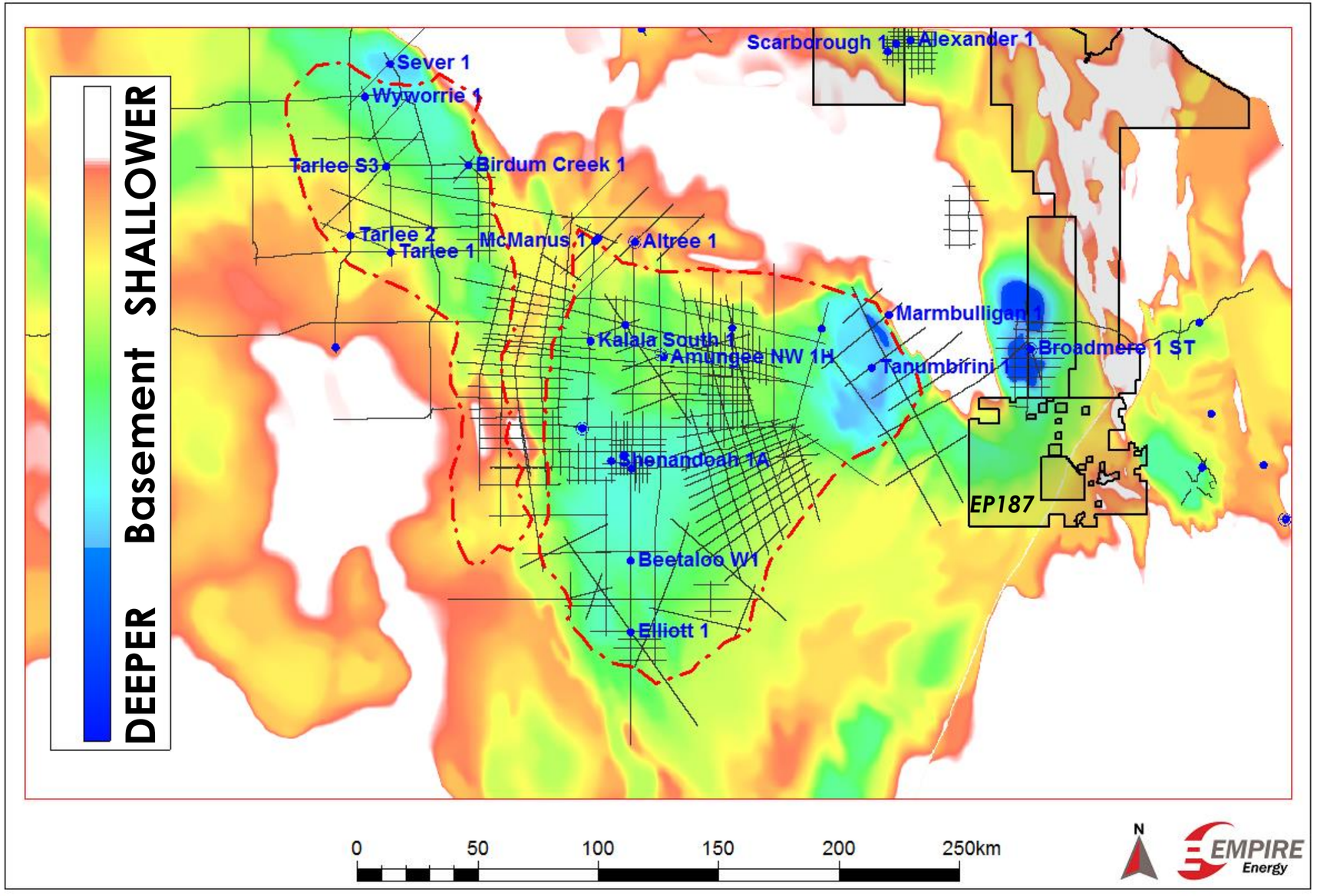
- Shales are the source of the hydrocarbons
- Shales are the reservoir of the hydrocarbons
- As the shales are buried and heated they generate hydrocarbons
- The shales generate oil first, with greater heat gas is generated
- Some escapes to conventional targets, but some is retained in the shale.

Beetaloo Sub-basin Eastern Extent



2019 Beetaloo Sub-basin Boundary

2019 Beetaloo Sub-basin Boundary over SEEBASE depth to Basement



2019 Criterion
Outline constrained by

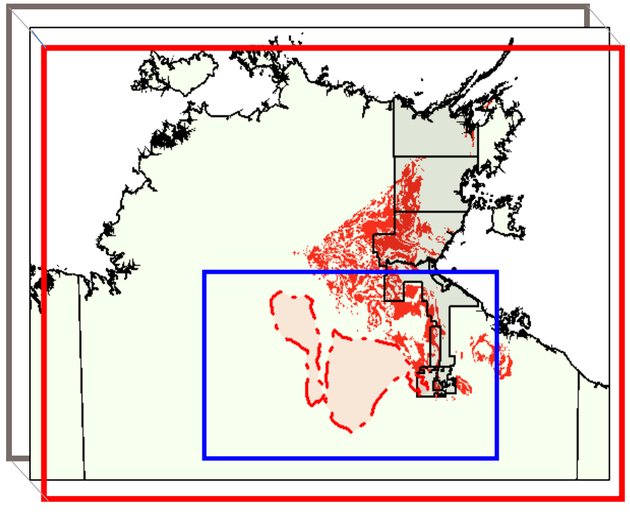
- 26 wells
- 96 seismic lines

Geological Criteria

- Contains Kyalla Formation
- Contains Velkerri formation

Measurement Resolution Criteria

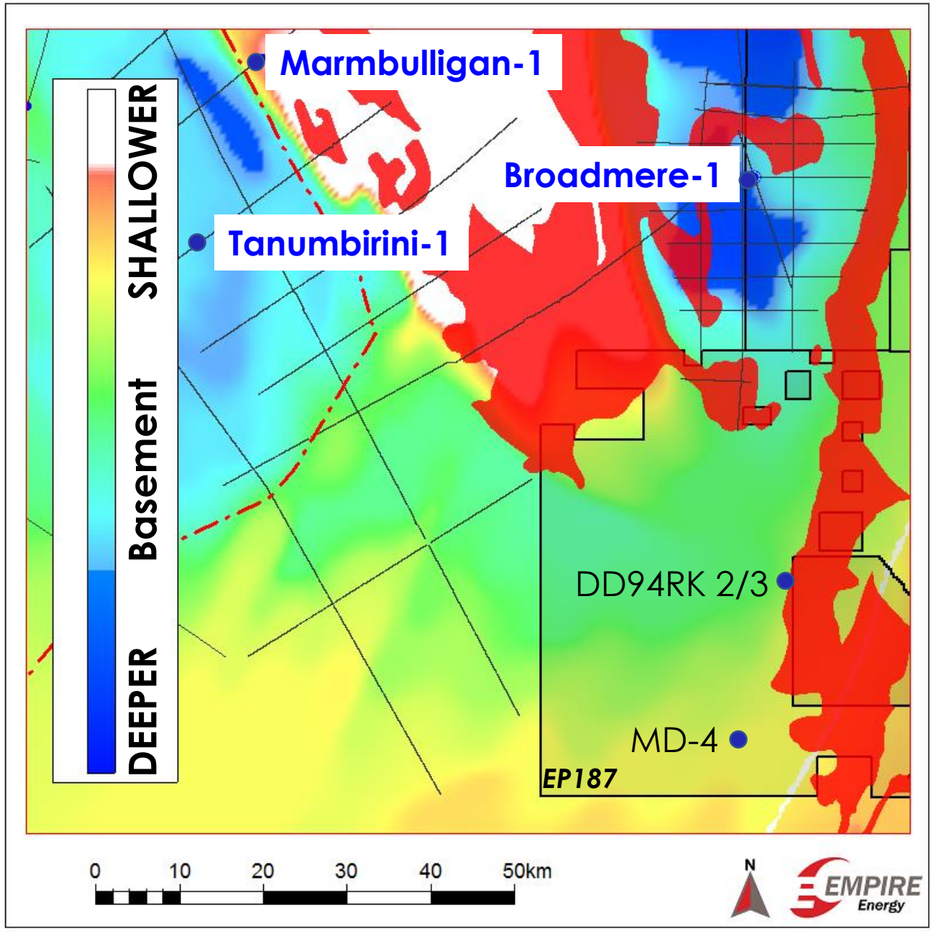
- Top Kyalla Formation 400 m below surface



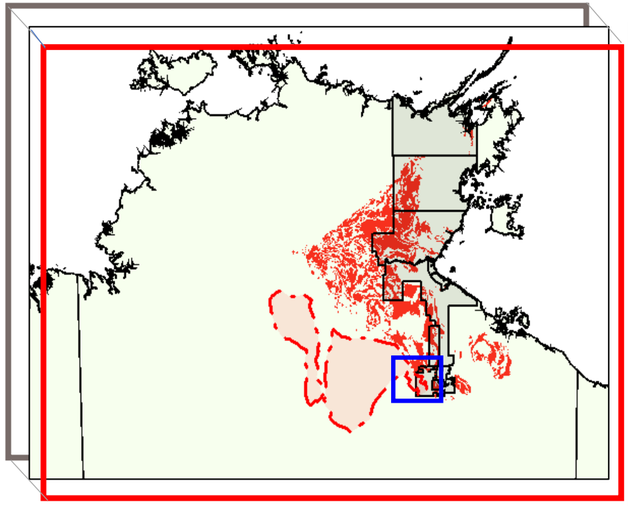
(Williams 2019)

2021 Beetaloo Sub-basin boundary

2019



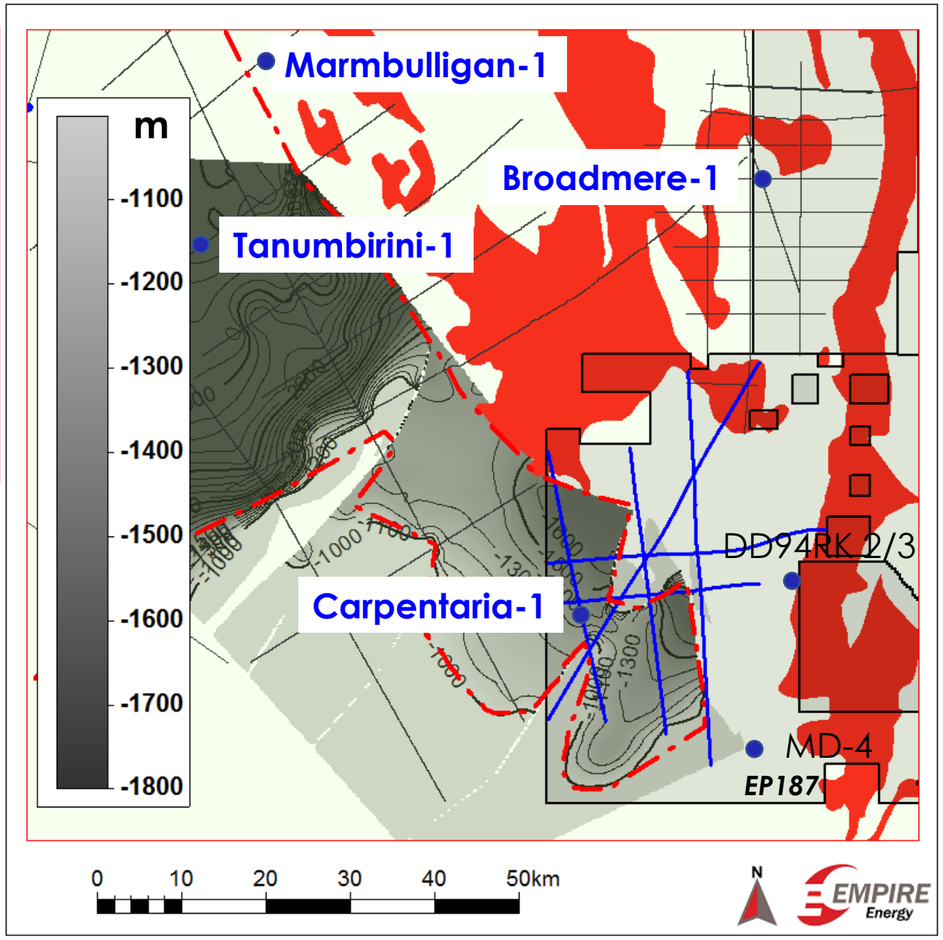
SEEBASE Map



Acquired 2D Seismic

Drilled Carpentaria-1

2021



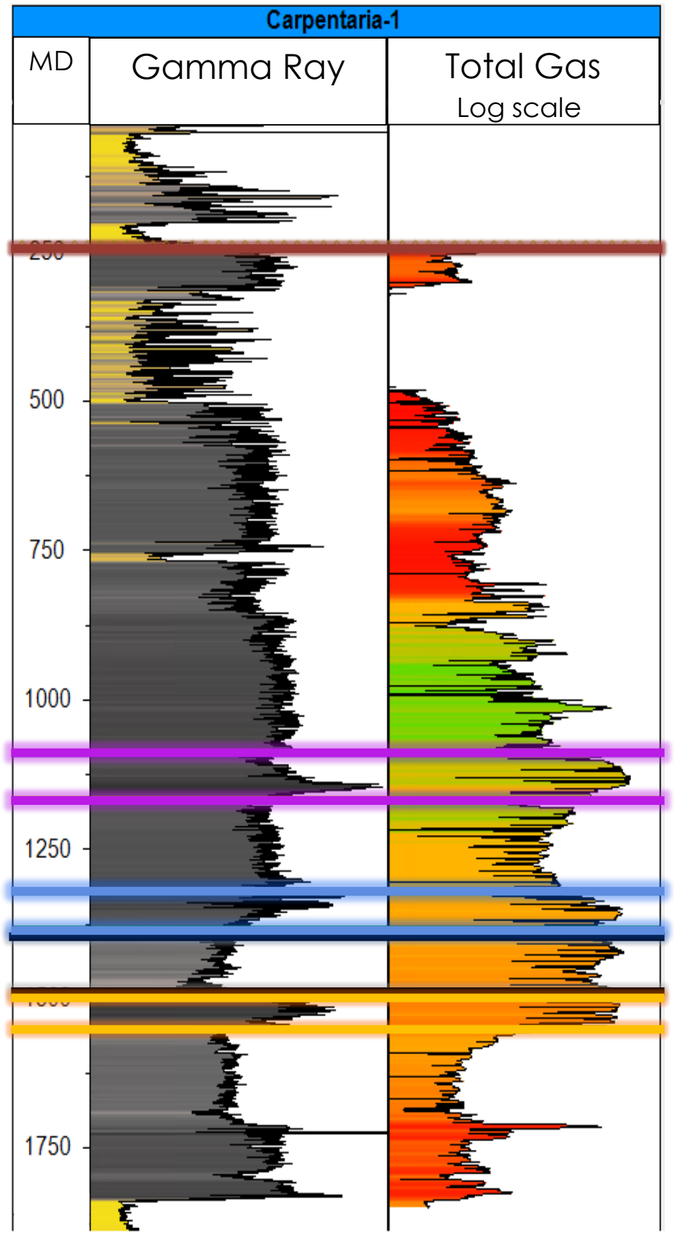
Depth to Base Velkerri B Shale

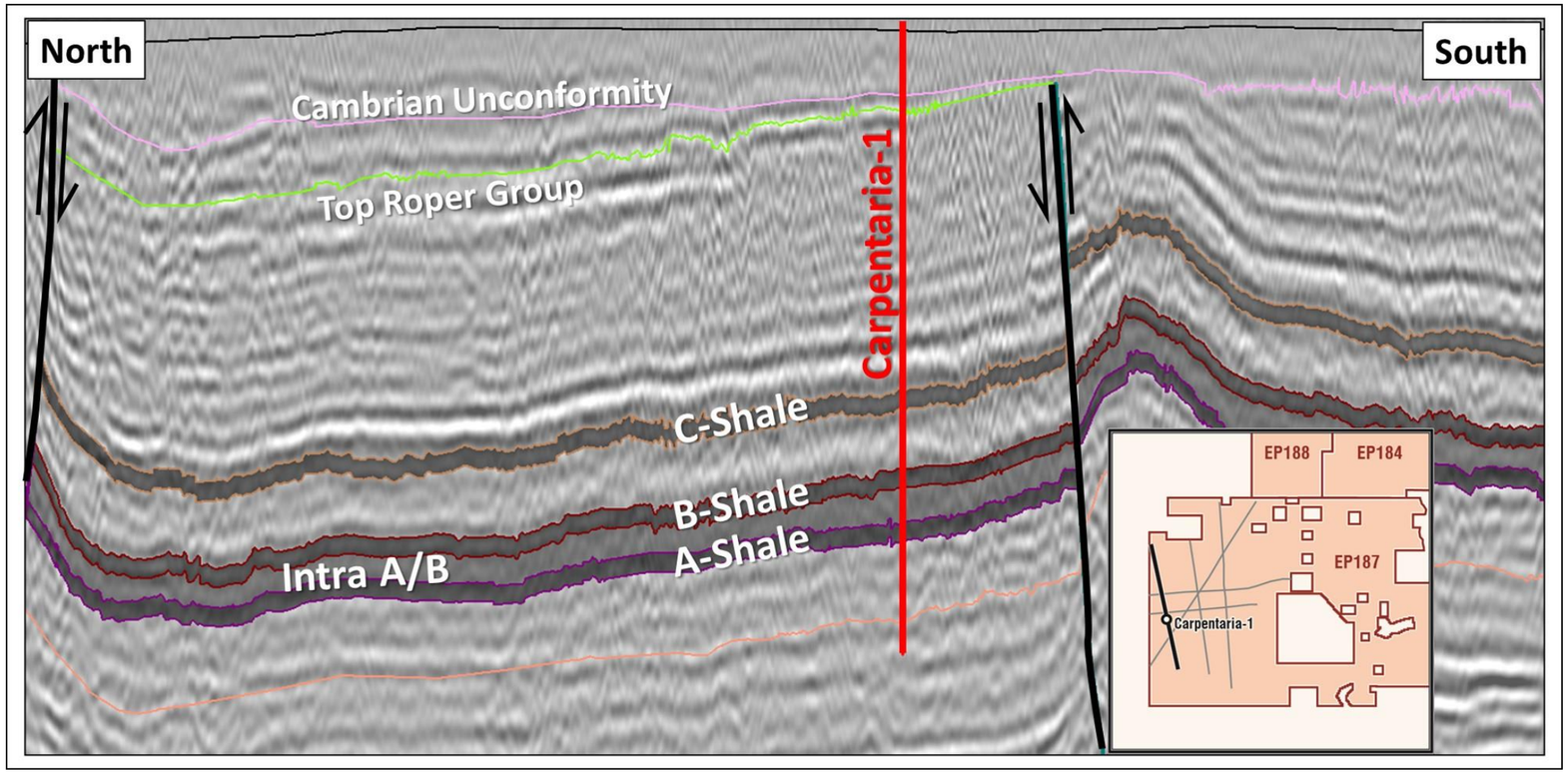
Basin Outline

Beetaloo Sub-basin units (Roper) outcrop

Empire 2D Seismic

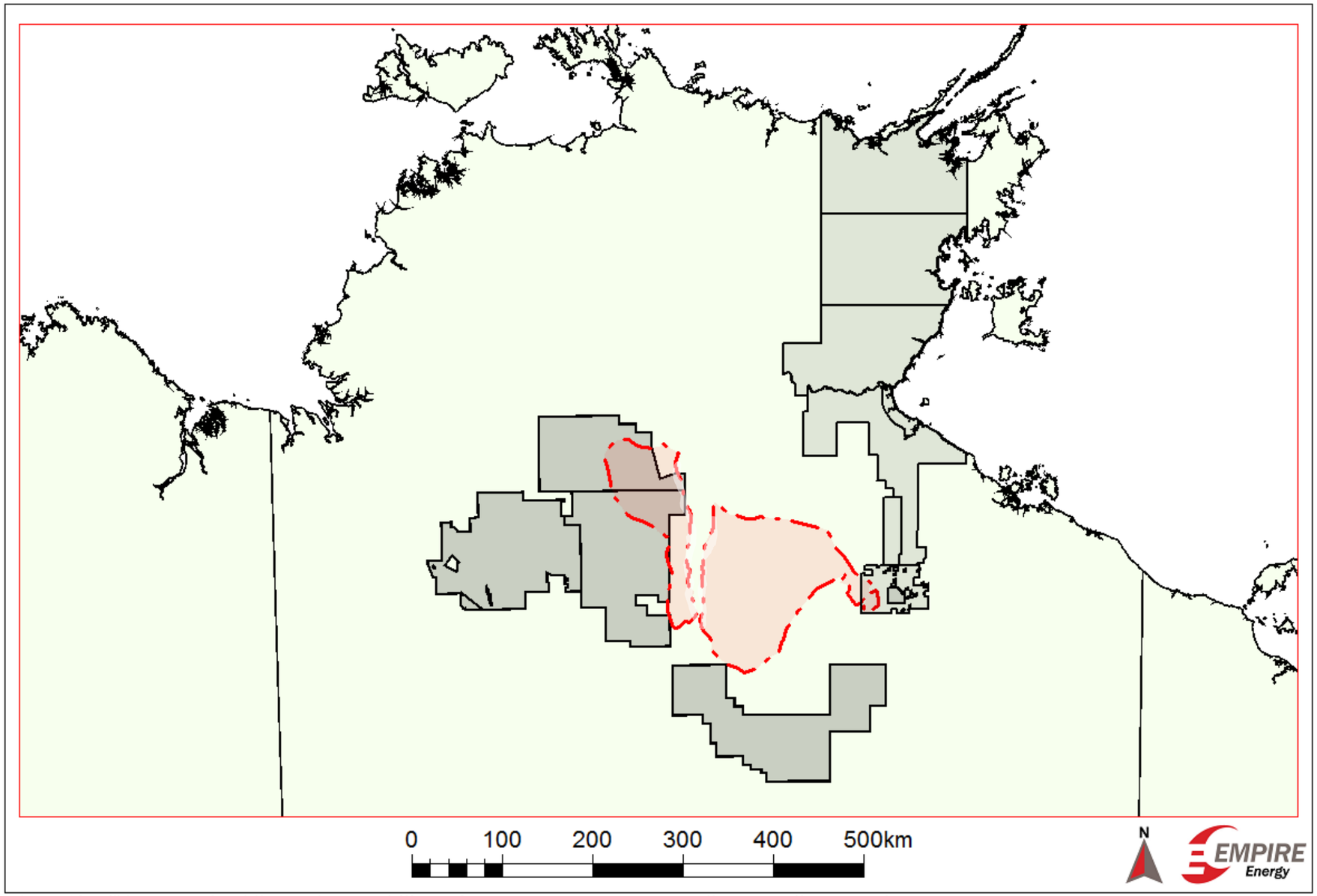
Beetaloo Sub-basin Eastern Extension





Seismic line 2019-04

2021 Beetaloo Sub-basin



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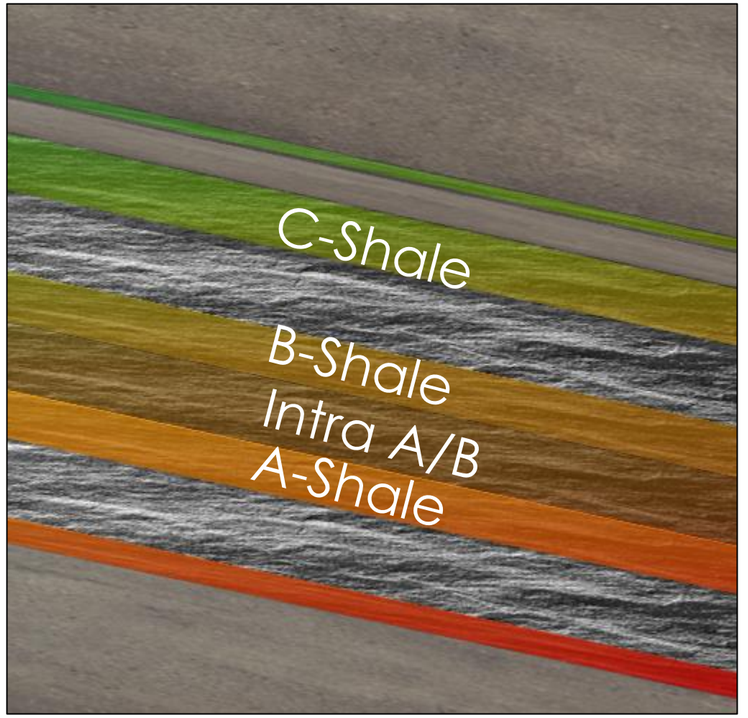
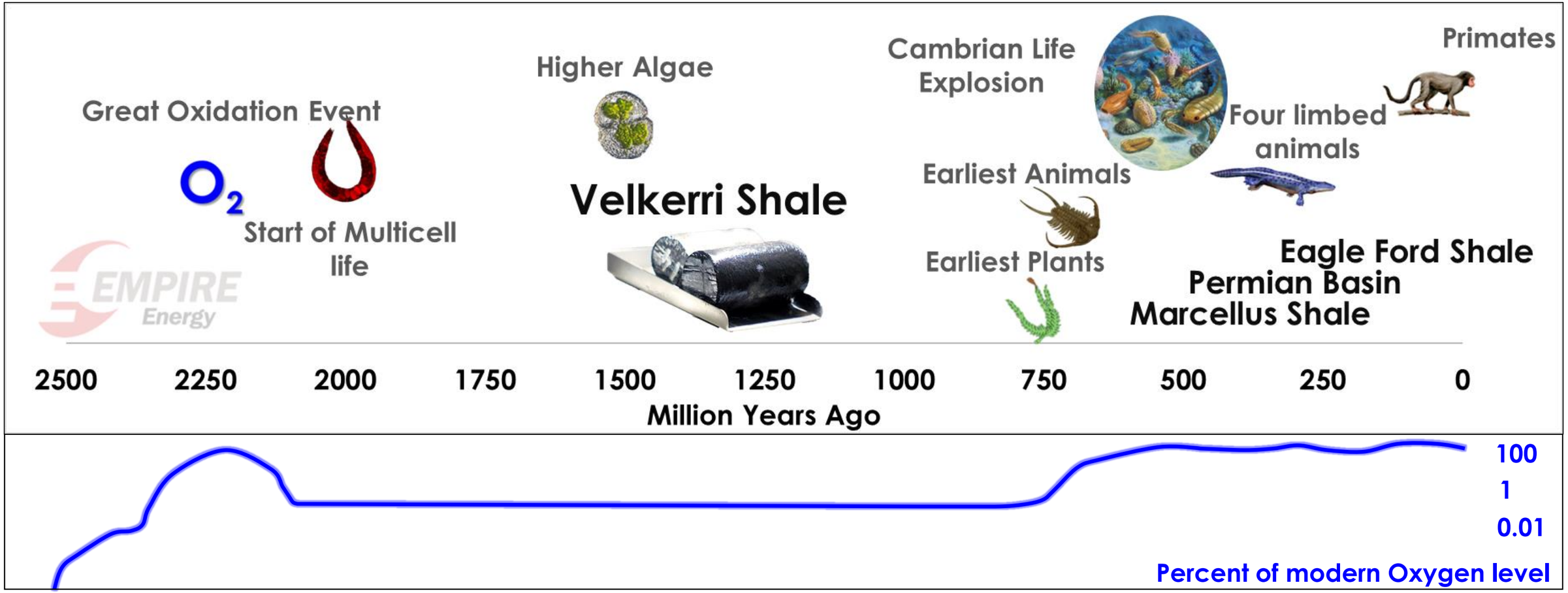
Thermal Maturity
Gas or Liquid Hydrocarbons or both



Age of the source Rocks



- Velkerri Shales much older than United States Analogues
  - Both productive USA and Velkerri shales are marine origin
- More simple organic material in the Velkerri shale source rocks due to age
- Velkerri Shales are well persevered due to lower oxygen levels at the time

Thermal Maturity And Tomatoes

Burial Heating

Generating Liquid Hydrocarbons
difficult to produce in tight shales

Burial Heating

Generating lighter Liquid Hydrocarbons

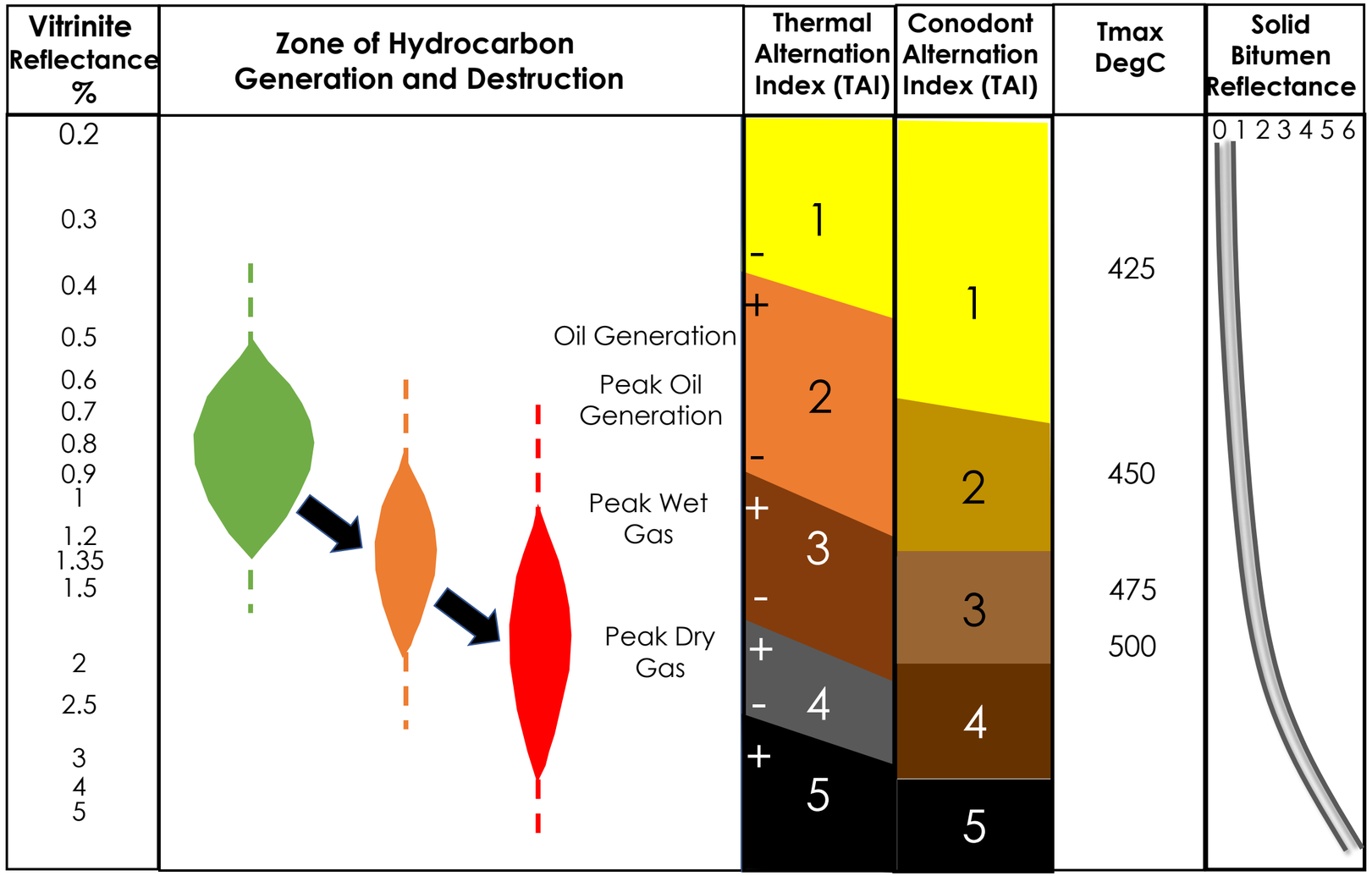
Burial Heating

Generating mix of gas and liquid Hydrocarbons
Gas aids production with liquids improving economics
Focus is to determine the optimum ratio of gas and liquids

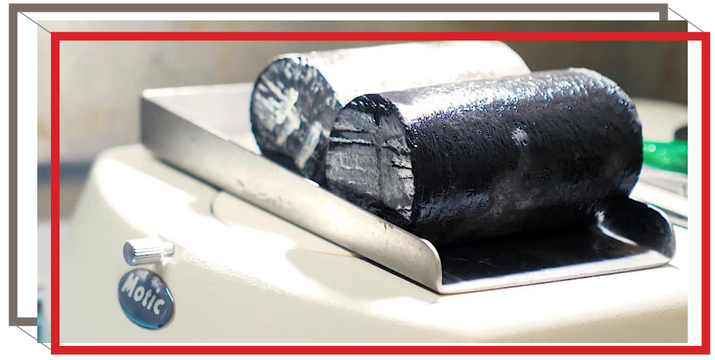
Burial Heating

Generating and converting liquids to dry gas

Measure of Thermal Maturity - shale



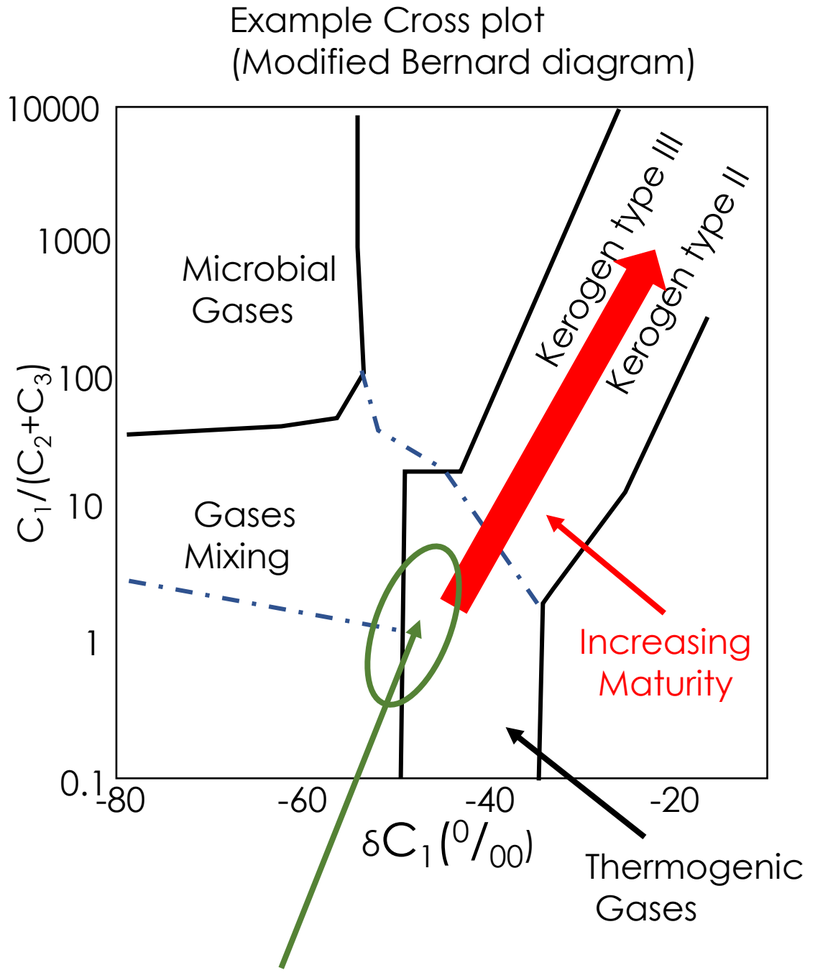
- Measures the rocks directly
- Methods proxy to Vitrinite Reflectance
  - plant based source rock
- Calibrated on limited datasets 1 billion years younger than the Beetaloo Sub-basin



(Hackley and Cordott 2016)

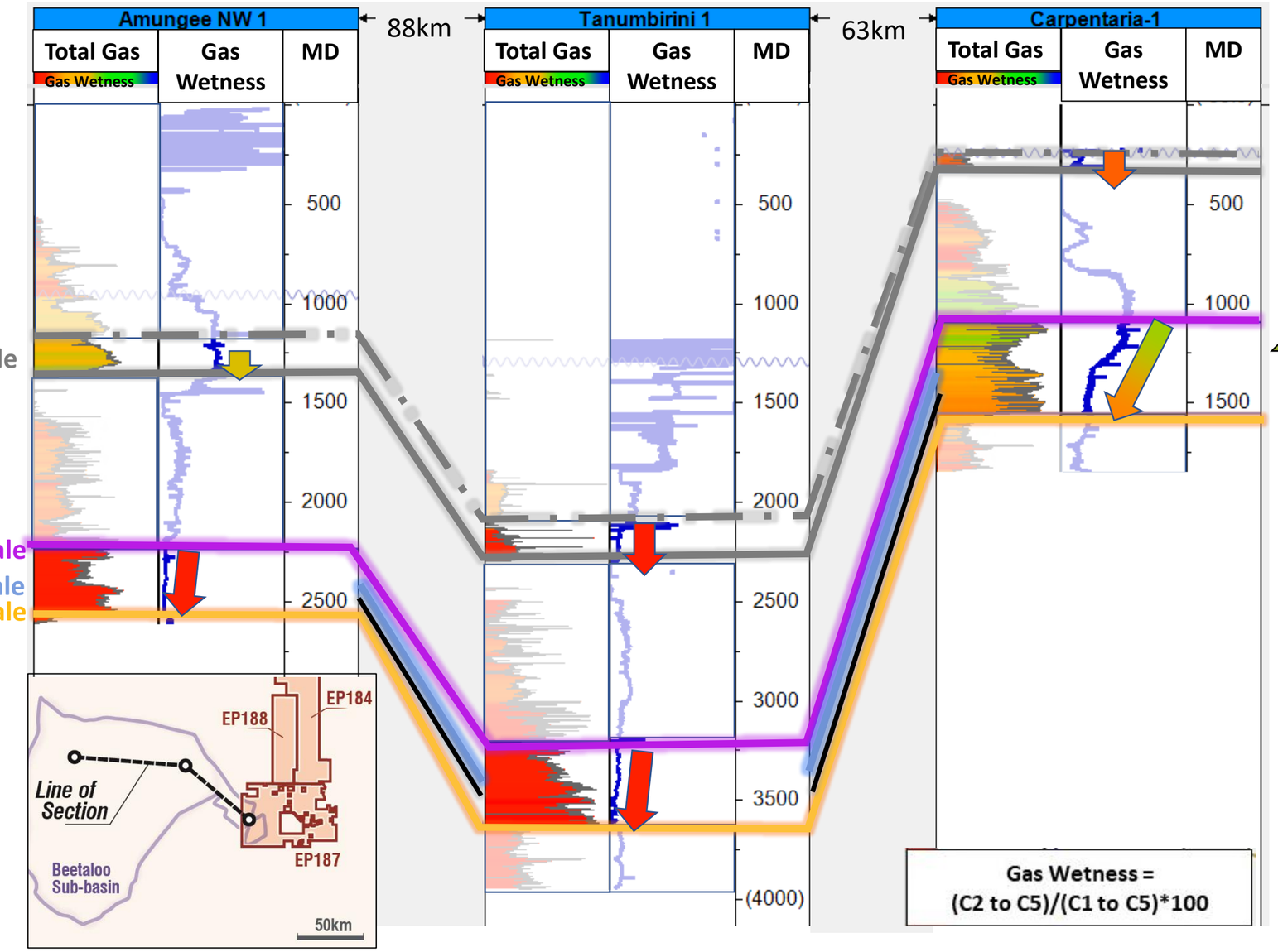
Measure of Thermal Maturity - gas

- Method measures the gas directly for thermal maturity
- Captures mudgas samples whilst drilling over regular depth intervals
- Analysis of carbon isotopes provides a proxy for thermal maturity
- Tied back to direct rock measurements
- Calibrated on limited datasets 1 billion years younger than the Beetaloo Sub-basin



(Bernard et al 1978)

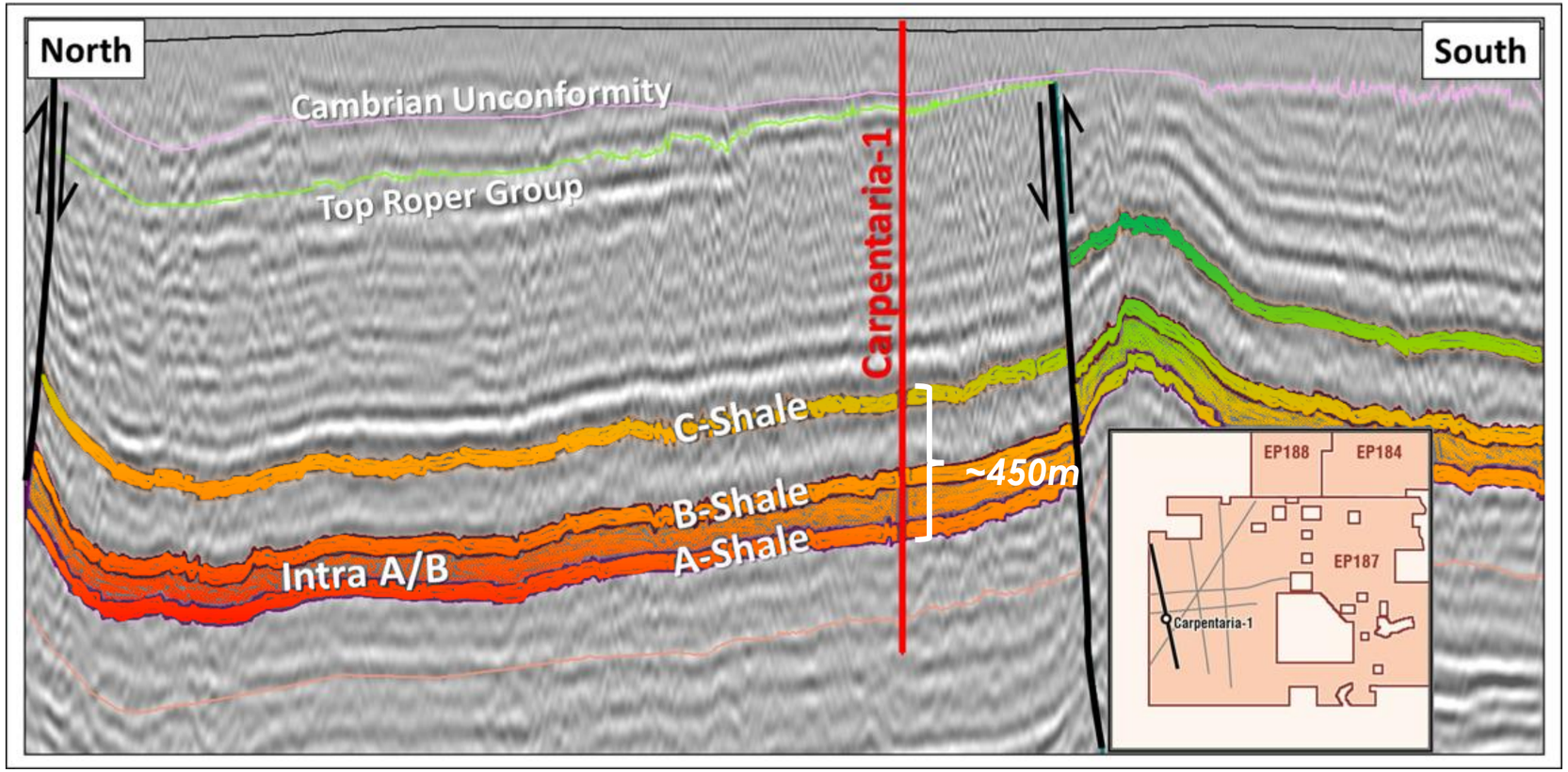
Liquids Rich Gas at Shallower Depths



- Mudgas wetness ratios displayed
- Future production testing required to calibrate the interpretation
- With depth and thermal maturity gas becomes dryer with depth
- Liquids to gas gradient is observed in the Carpentaria-1 well
- This gradient likely changes spatially with different burial histories and temperature

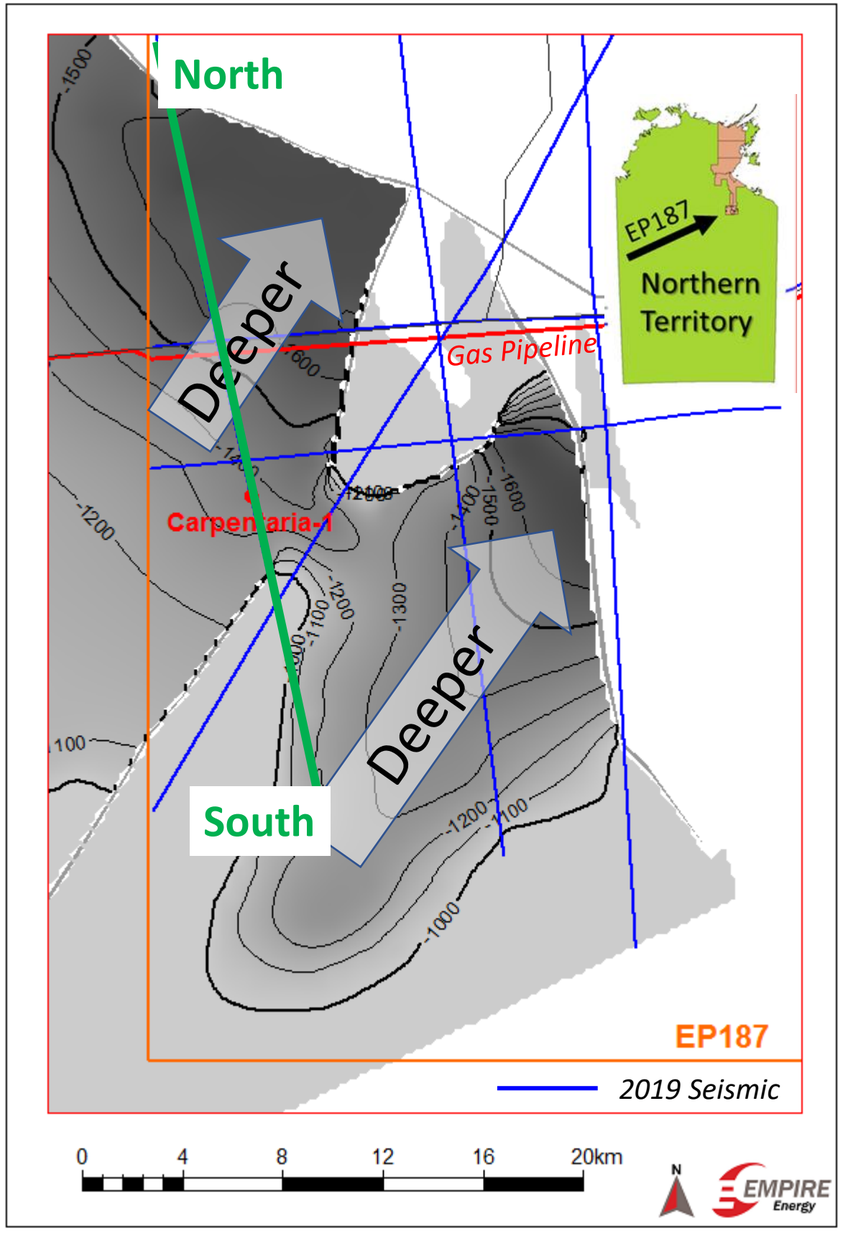
Colour scale of gas wetness, although based on actual gas ratios, is illustrative only.

Why we want to know thermal maturity?



DRYER ⇦ Hydrocarbons ⇨ LIQUIDS

- Velkerri stacked Shale play
- We need to come up with a method of predicting gas and liquids ratios away from well control
- Shopping list of liquids rich gas targets



Key Takeaways

1. Eastern boundary of the Beetaloo Sub-basin shown to extend to the east

2. Liquids rich mud gas observed in the stacked Velkerri shale at Carpentaria-1 provides multiple target options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