



## Galilee Basin – How big can this get?

Technical Presentation to Queensland Petroleum Exploration Association (QUPEX)

17 July 2018



Comet Ridge Limited

ASX Code : COI

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## Investment risk

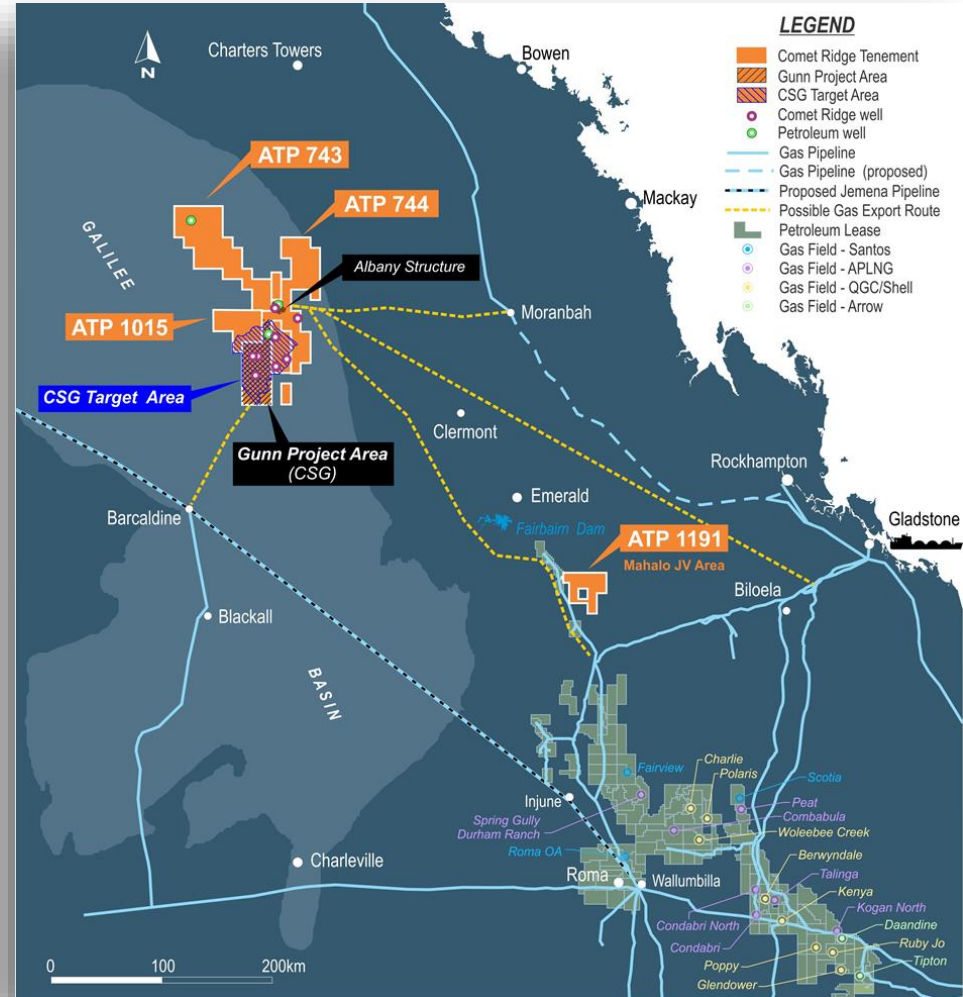
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# Galilee Basin Background



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- Large area (~250,000km<sup>2</sup>) covering a big part of central western Queensland
- Land use is grazing – cattle and sheep on large stations
- Historical sandstone exploration - oil targeted and small gas flows
- Later basin-wide focus on CSG
  - One operating CSG pilot in the basin (by GLL)
  - One shorter term single-well production test by Comet Ridge
- Significant Potential for further exploration and appraisal for conventional and unconventional resources
  - Low seismic and well density to date
- Significant coal mine province evolving in the shallow coals in the east
- Pipeline options progressing
- Comet Ridge holds a big position at 9685 km<sup>2</sup>



# Stratigraphy



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## Oil and gas is generated in the underlying Belyando and Drummond Basins

BASIN	AGE	GROUP	FORMATION
GALILEE BASIN	Triassic		Moolayember Formation
			Clematis Sandstone
			Rewan Formation
	Permian		Betts Creek Beds
	Early Permian to Late Carboniferous	Joe Joe Group	Aramac Coal Measures
			Jochmus Formation
			Jericho Formation
			Lake Galilee Sandstone
DRUMMOND BASIN	Early Carboniferous	Cycle 3	Natal Formation
			Bulliwallah Formation
			Star of Hope Formation
		Cycle 2	Raymond Formation
			Mount Hall Formation
			Scartwater Formation
	Late Devonian	Cycle 1	St Annes Formation
			Basal Volcanics / Marine Sediments
BELYANDO BASIN	Early to Middle Devonian	Ukalunda Beds and equivalents – ? Belyando Basin?	
Basement	Proterozoic	Thompson Orogeny Metasediments	

Oil / Gas

### CSG

- 600 to 1100 metres
- GLL's Glenaras Pilot (online)
- Small gas flows to date
- COI's Gunn 2 production test

### Lake Galilee Sandstones

- 2500 to 2800 metres
- Small Gas flows 1964 to 1995
- Oil recovered 1964
- 230,000 mcf/d gas flow in June 2018
- Concept demonstrated
- Significant thickness over wide area

### Marine Shales?

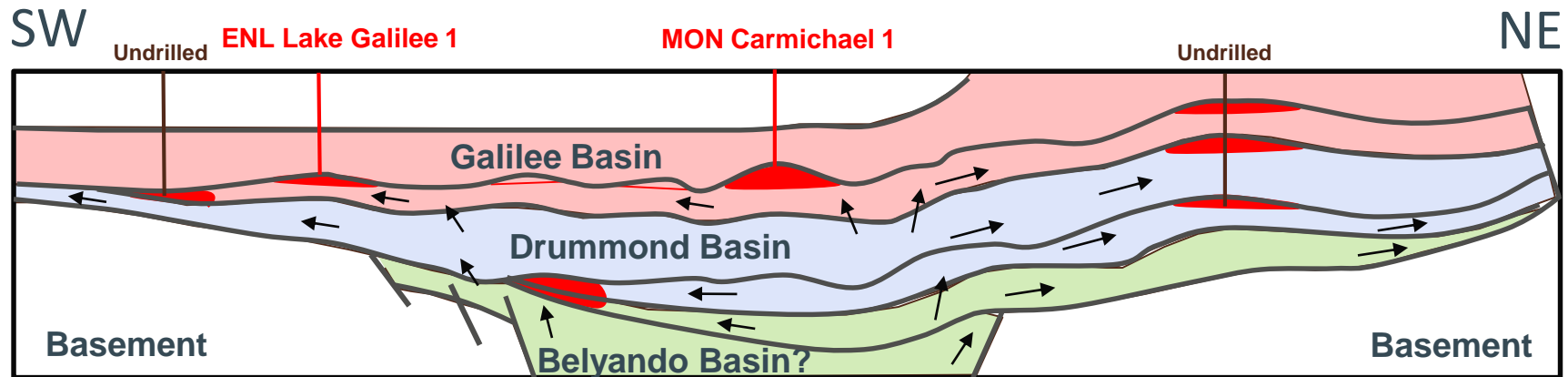
- Indicated by Devonian typed oil in (1964) Lake Galilee 1 well
- Large potential volume
- Not yet penetrated by wells
- Seismic suggests 2500 to 4500 metres on eastern side

# Cross-section



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Hydrocarbon traps/targets exist at a range of levels



After: Draper and Boreham, 2004

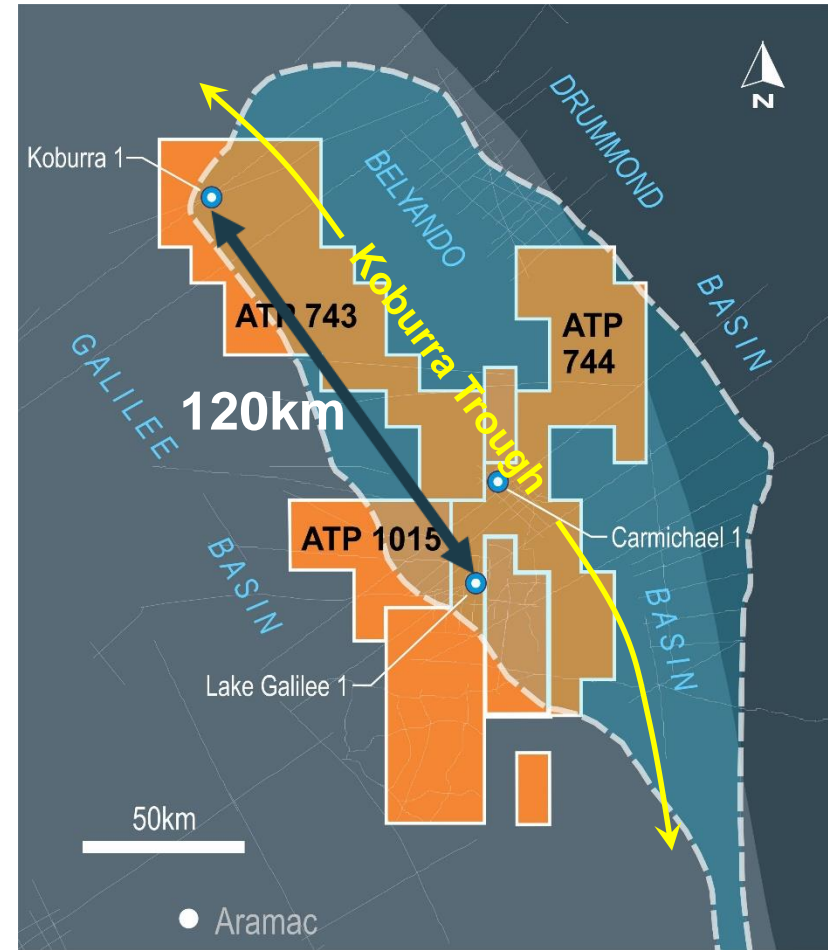


# Koburra Trough – Petroleum System



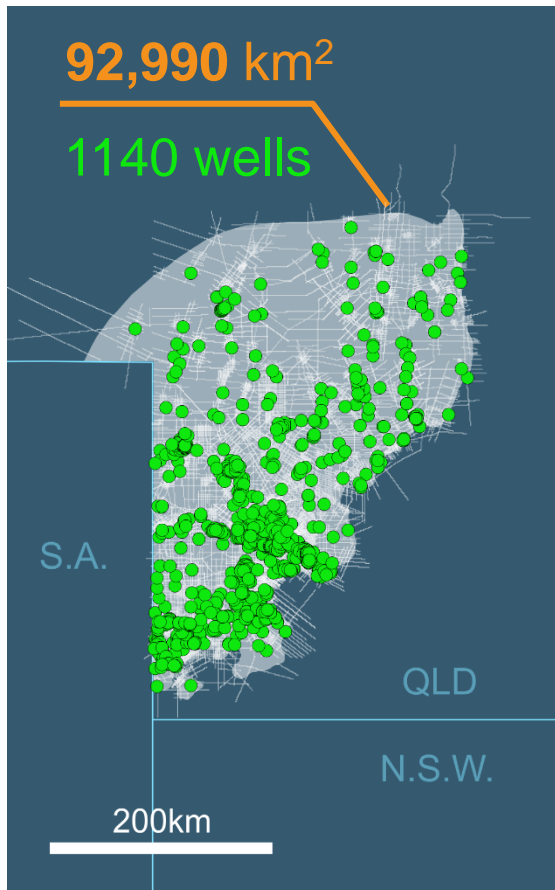
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- 3 historic petroleum wells within ATP 743 and ATP 744
- All demonstrated moveable hydrocarbons
  - recovered gas and/or oil from Lake Galilee Sandstone at base of Galilee Basin section
  - Koburra 1, Carmichael 1 and Lake Galilee 1 flowed gas to surface at low rates
  - Lake Galilee 1 – oil recovered
  - Evidence of active petroleum system sitting over the Koburra Trough
- None appropriately tested the prospectivity due to lack of closure or heavily overbalanced drilling
- Only Carmichael-1 closure adequately defined by seismic
- Potential for significant hydrocarbon volumes
- Potential for additional oil and gas resources

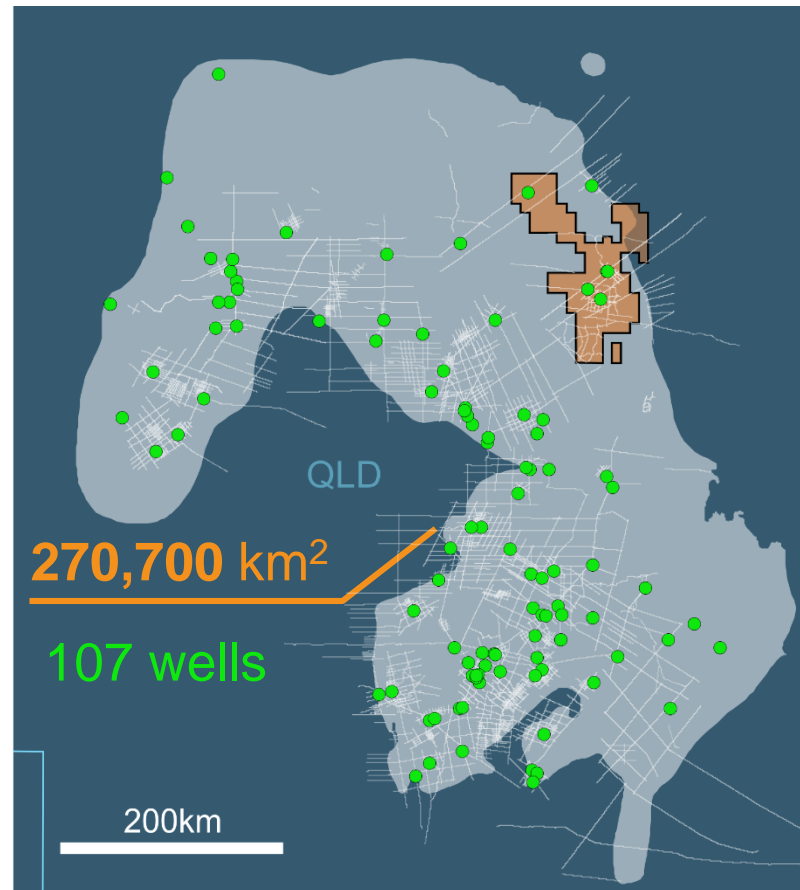


# Galilee very underexplored compared to Cooper

## Cooper Basin



## Galilee Basin



- Galilee Basin has 30 times lower well density than Qld side of Cooper Basin
- Few wells near Koburra Trough kitchen in northeast where the Albany 1 well was drilled in June

# Target 1 – Lake Galilee Sandstone





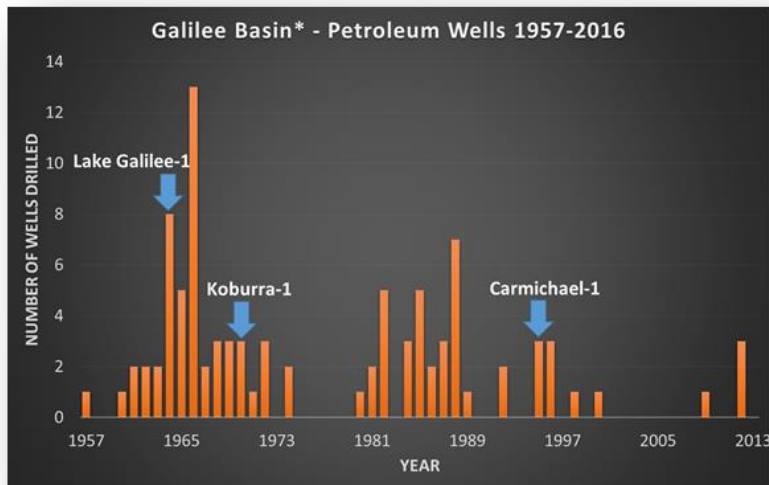
# Lake Galilee Sst – Previous Exploration



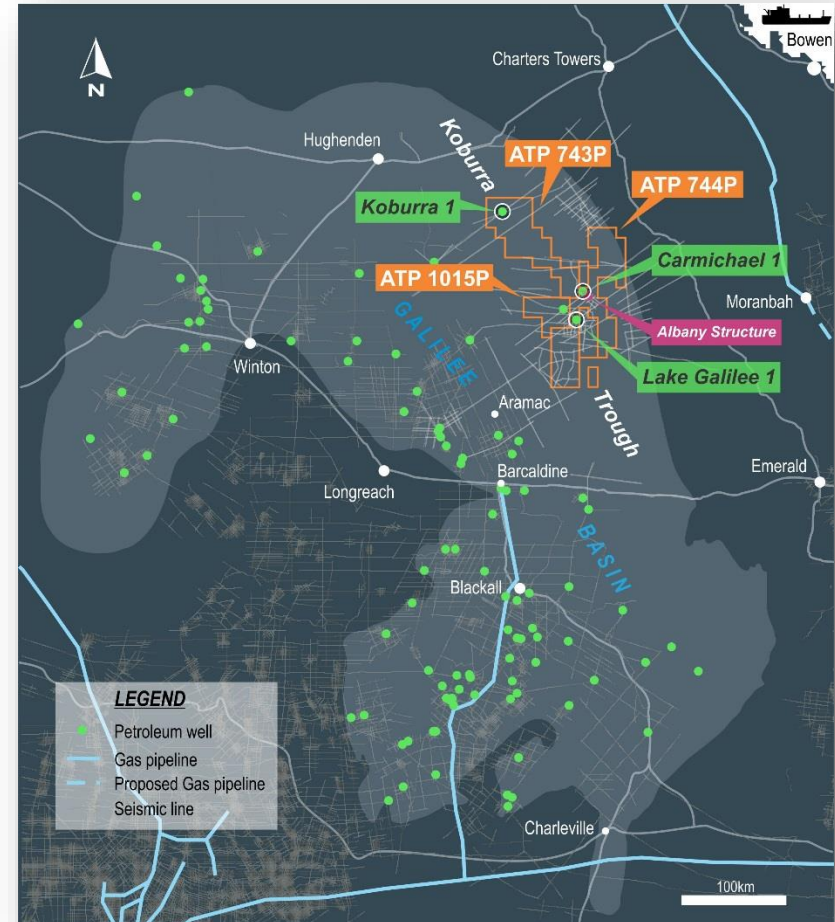
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## Conventional Exploration

- 107 petroleum wells (intersecting Galilee sequence) over 70 years
- Targeted Late Carboniferous to Permian sandstones to depths of ~3000m
- 3 wells had significant hydrocarbon shows – Koburra Trough inside Comet Ridge’s current ATP 743 / 744
- 2015 – Comet Ridge achieved Galilee’s first sandstone contingent resource



\*wells intersecting Galilee Basin sequence



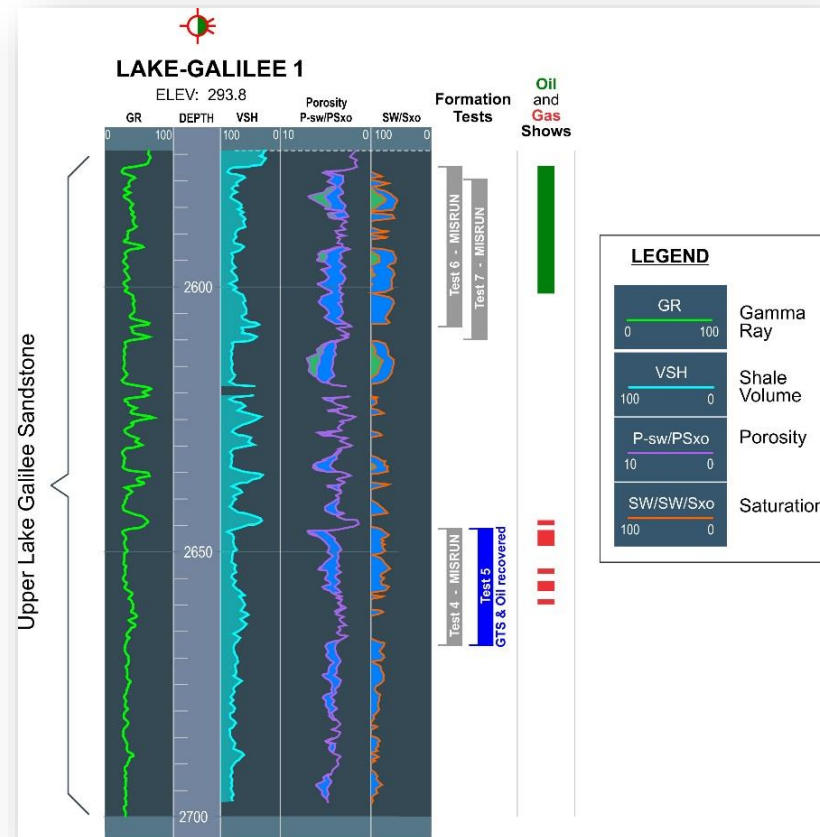
**Albany Structure  
(ATP 744)**

**153 PJ (2C)<sup>1</sup>  
417 PJ (3C)<sup>1</sup>**

# Lake Galilee Sst – Results to Date

## Lake Galilee 1 – by Exoil NL in 1964

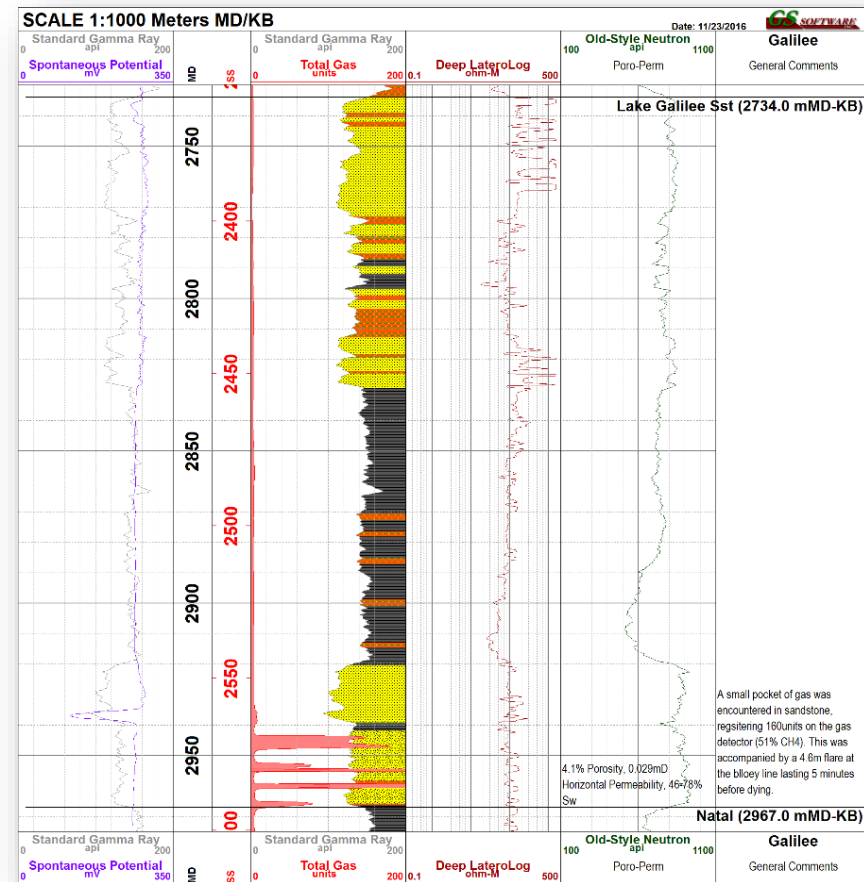
- First deep petroleum well in Kiburra Trough
- Targeted poorly defined 4-way dip closure
  - >260m gross sandstone over Lake Galilee Sandstone
  - GTS and oil recovered from DST-5
  - 3m light green oil @ 43.1°API gravity (Source: likely Devonian marine)
  - High mud overbalance
  - Untested sandstone section with hydrocarbon bearing zones
    - Lower Sw suggests hydrocarbon recovery is possible
  - Gas analysis indicates slightly wet gas composition
- Indicated active hydrocarbon system in Kiburra Trough



# Lake Galilee Sst – Results to Date

## Koburra 1 – by Flinders Petroleum in 1970

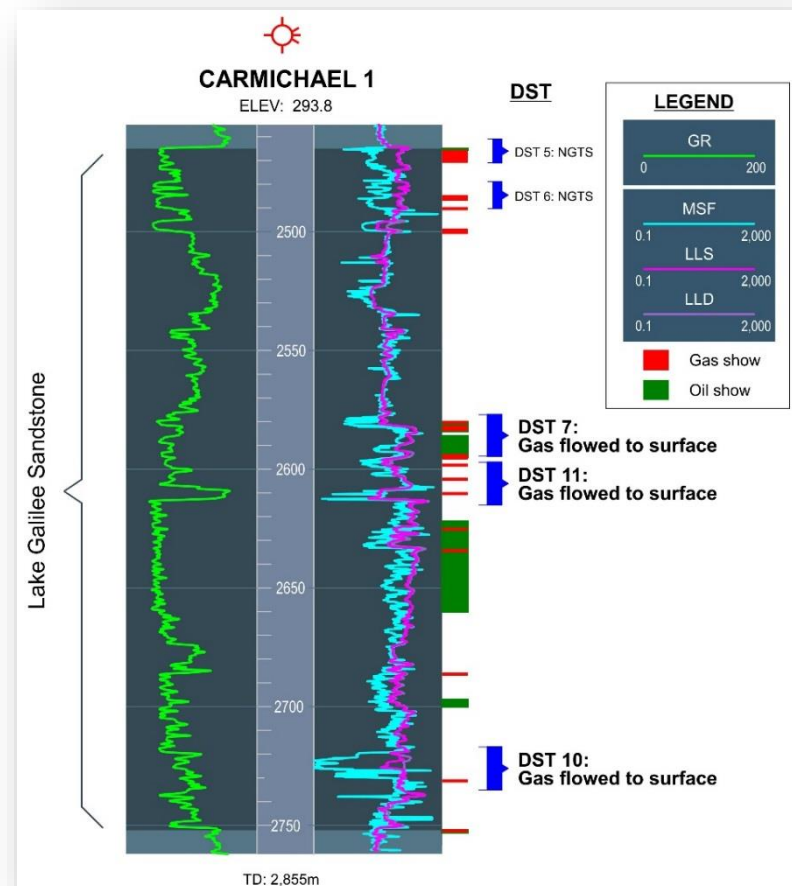
- First deep petroleum well in northern Koburra Trough
- Drilled one-line rollover defined by 1966 6-fold seismic data grid
- Trap poorly defined – (not a valid structural test?)
- Results:
  - >120m gross sst in Lake Galilee Sst
  - 160 units gas at 2948m over tight sandstone – 15 “(4.6m) flare from blooie line, loaded with water in later test
  - Volcanic derived sandstone (different source to south)
- Confirmed hydrocarbons in basal section of Galilee Basin in northern Koburra Trough



# Lake Galilee Sst – Results to Date

## Carmichael 1 – by Maple Oil in 1995

- First well based on modern seismic - 27km NE of Lake Galilee 1
- Robust NW plunging anticlinal structure on western flank of Koburra Trough
- Targeted oil with high mud overbalance
- Three drill stem tests flowed gas to surface at low rates – two other tests over better reservoir quality, but did not flow
- 150m gross sandstone with >30m net pay showing hydrocarbon saturation and porosities up to 13%.
- Discovered large gas accumulation deemed uneconomic then (1995)
- Productivity of reservoir not optimally tested or assessed due to well design
- Well confirmed sandstone prospectivity in Koburra Trough

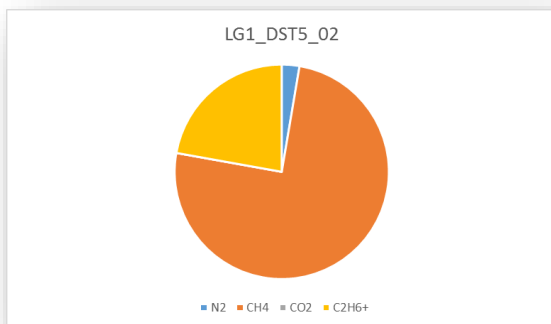




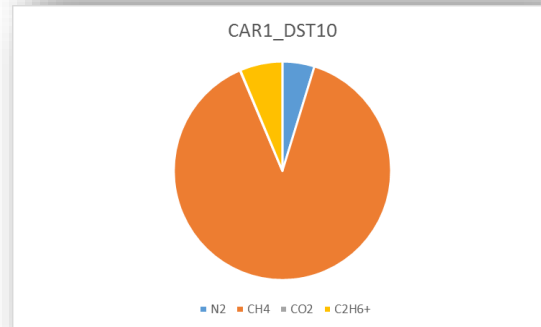
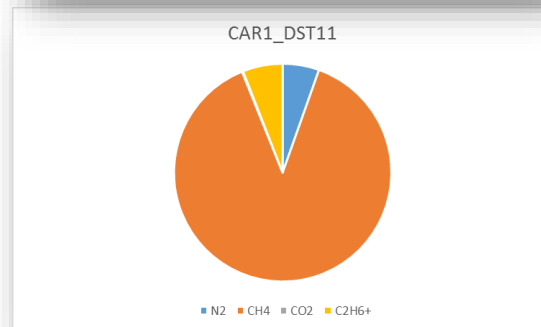
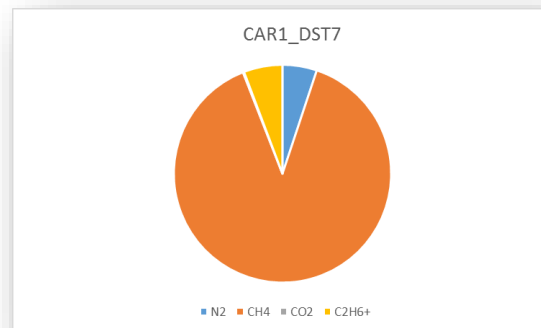
# Lake Galilee Sst - Gas Composition

## Gas Composition – High Quality

Lake Galilee 1



Carmichael 1



- >88% CH<sub>4</sub> in Carmichael
- Larger proportion of C<sub>2</sub>+ in Lake Galilee 1
- <1% CO<sub>2</sub>
- 3-5% N<sub>2</sub>

# Lake Galilee Sst - Albany 1 well flowed gas - late June 2018



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- < Initial 13 metre section of Sandstone produces stabilised gas flow of 230,000 scf/d
- < Most significant hydrocarbon flow recorded from Galilee Basin to date
- < Approximately 100 metres of sandstone yet to be penetrated in Albany 1
- < Drilling suspended due to wellbore difficulties
- < Pre-drill objectives of improving flow through underbalanced drilling and confirming the reservoir as an excellent stimulation candidate have been met
- < Hydrocarbon analysis from rig indicates approx
  - < 94.23% C<sub>1</sub>
  - < 3.92% C<sub>2</sub>
  - < 1.24% C<sub>3</sub>
  - < 0.45% C<sub>4</sub>
  - < 0.16% C<sub>5+</sub>
- < From Carmichael 1 in 1995, expectation is
  - < no H<sub>2</sub>S,
  - < very little to no CO<sub>2</sub>
  - < 5% N<sub>2</sub>



**Vintage Energy recently farmed-in as part of Sandstone “Deeps” project**

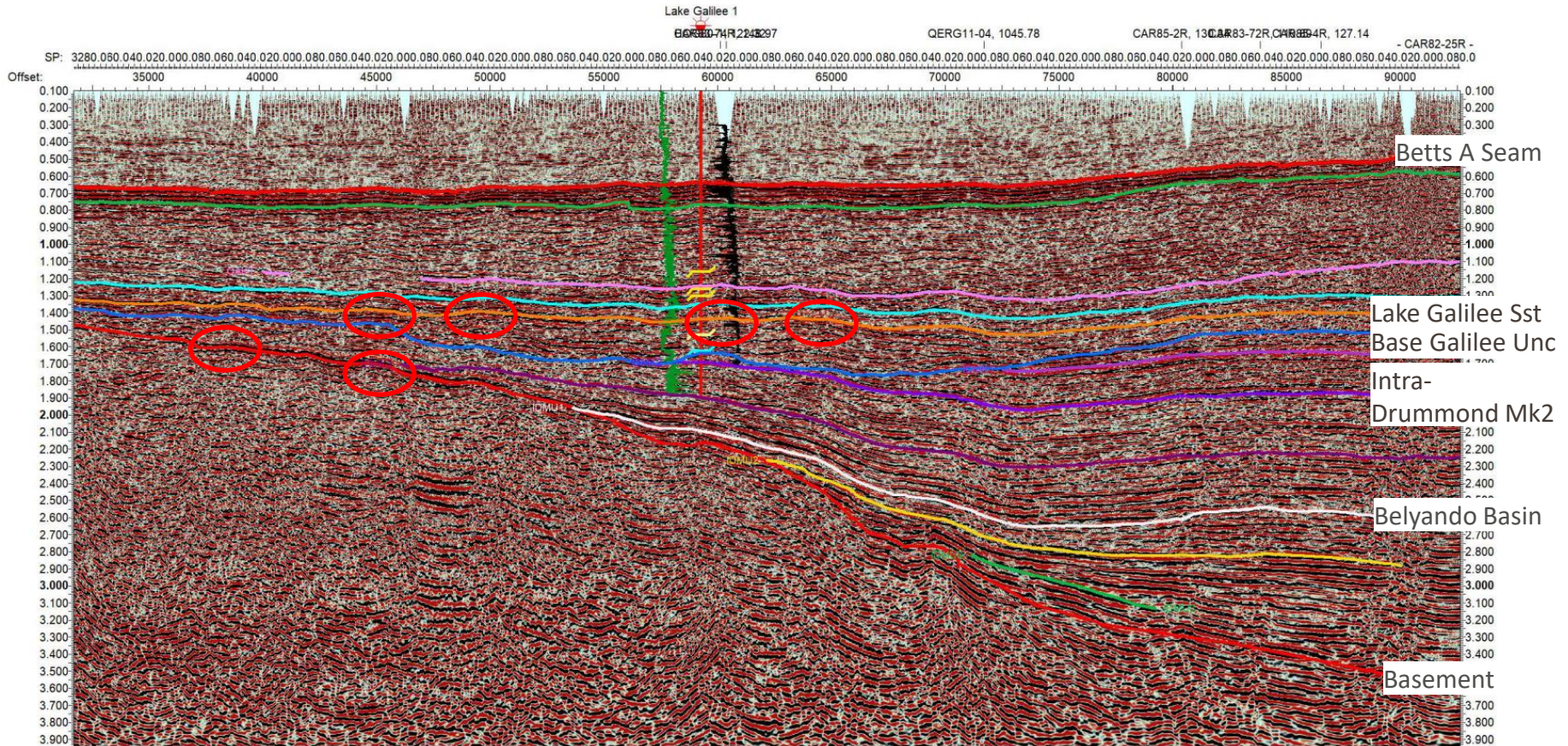


# Sandstone Targets - Drilling Opportunities



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## Seismic Line CAR82-25R



- Closures exist near Lake Galilee 1 as a result of basement involved faults
- Onlap plays exist to the west of Lake Galilee 1 in the Intra-Drummond Basin at reasonable depths



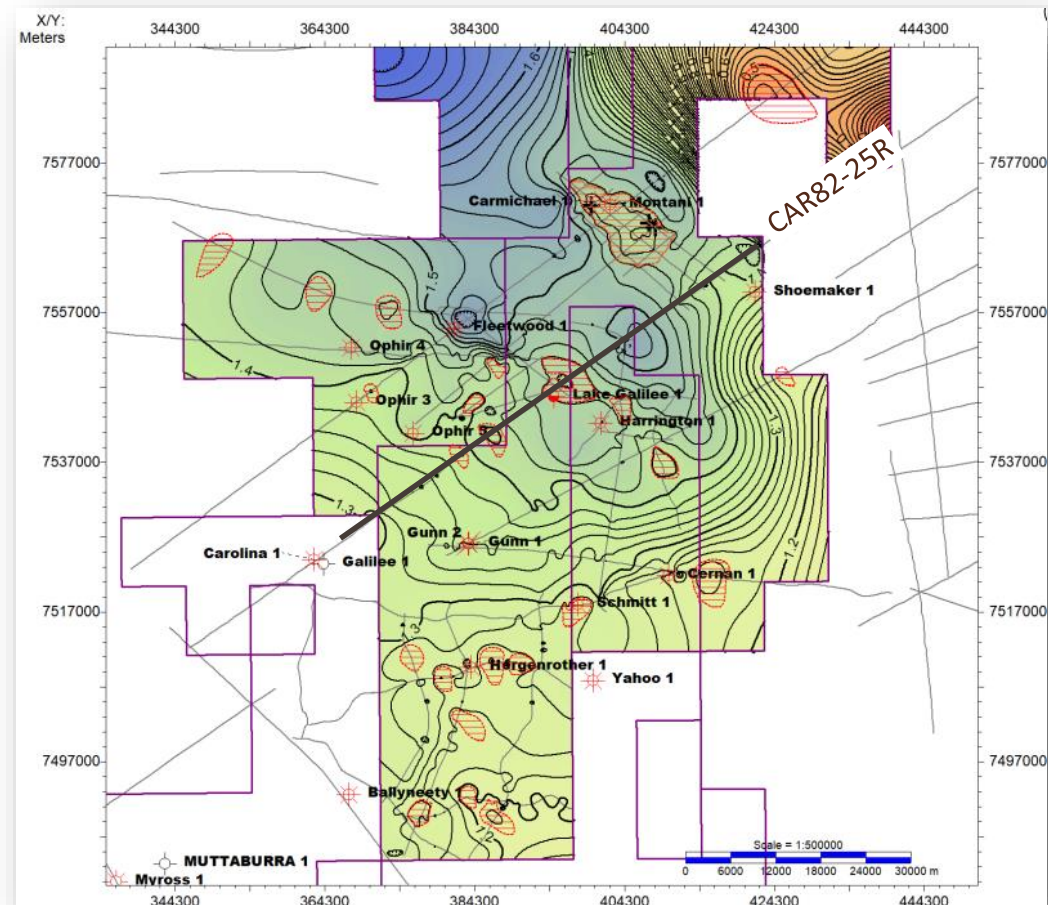
# Lake Galilee Sst – Drilling Opportunities



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- Opportunities require additional seismic to firm up – planning for 2H 2018
- Lake Galilee Sandstone Targets
  - Preliminary review identifies 20+ opportunities
    - From small up to 75 km<sup>2</sup>
    - From small up to 300 PJ recoverable
- Structural and stratigraphic targets are being mapped in the Drummond Basin sequence

Two Way Time Structure (secs) – Lake Galilee Sandstone





# Target 2 – Coal Seam Gas

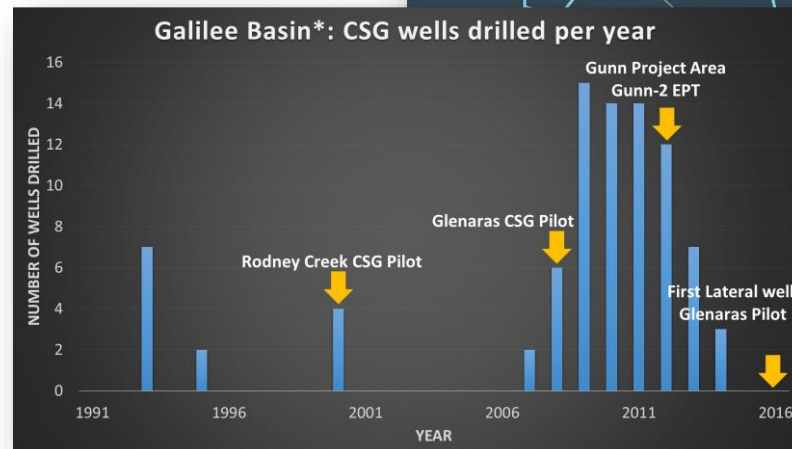
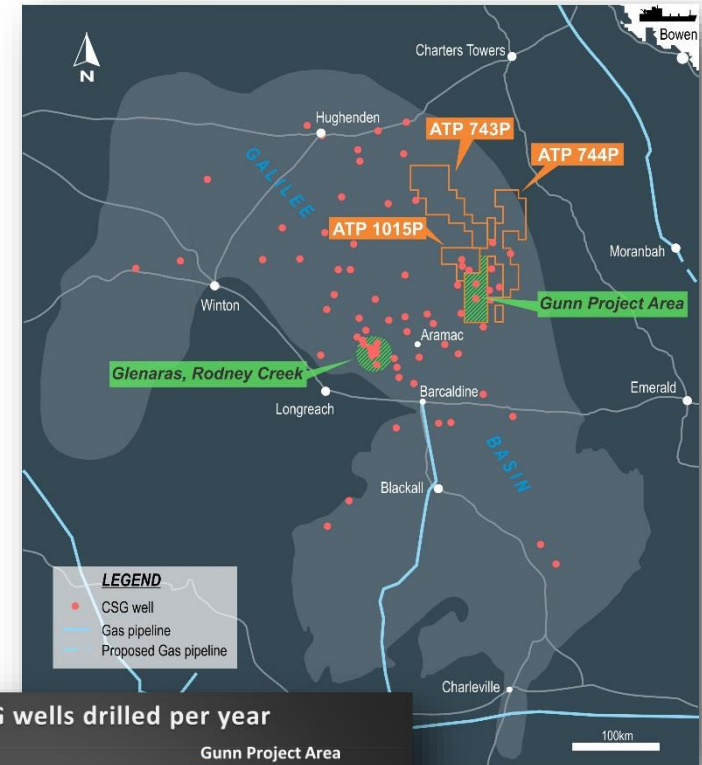
GUNN1  
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P+A 26.6.10  
COMET RIDGE  
LTD

# Galilee Basin – CSG Exploration



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- Glenaras 1 drilled 51 years ago highlighted CSG potential of Galilee Basin *“no significant hydrocarbon shows were encountered. Observed methane gas associated with coals”*
- 1993-1995: Enron drilled early CSG wells with potential at Rodney Creek and Crossmore
- 2000: Rodney Creek CSG Pilot by Enron
- 2008: Glenaras CSG Pilot – by Galilee Energy - some gas produced
- 2008-2014: Major CSG exploration phase – definition of Gunn Project Area and Gunn 2 production test
- 2016: First lateral well drilled at Glenaras Pilot by Galilee Energy
- 2018: Multi-lateral pilot scheme added by Galilee Energy and now online



# Galilee Coals – recoverable gas over 1,865 km<sup>2</sup>

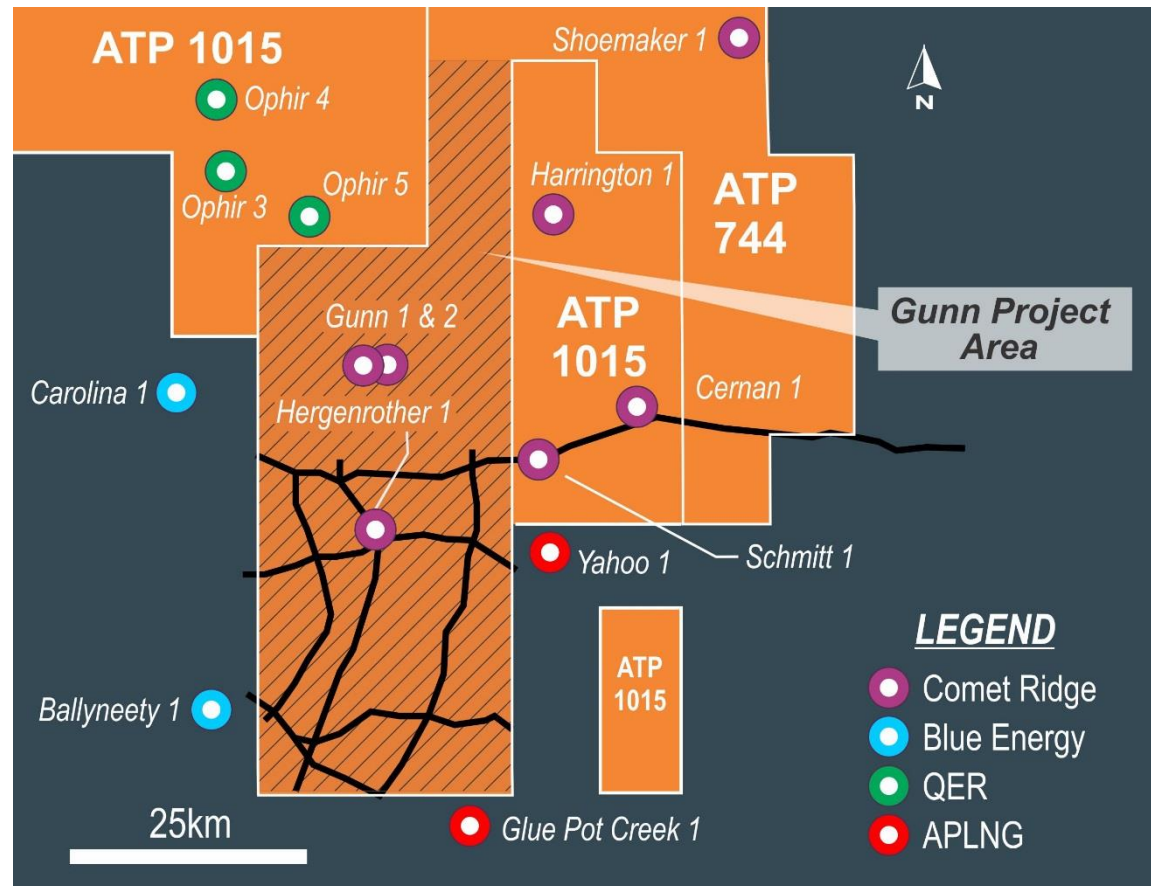


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**Gunn Project area and ATP 1015 area (COI 100%) coals contain recoverable gas over an estimated 1,865 km<sup>2</sup>**

- 6 individual coal seams
- Depth to coal 700 - 1,000m
- 16 to 24m net coal deposited over large area
- Average gas content 4.3 m<sup>3</sup>/t (high 7.3 m<sup>3</sup>/t)
- Good to excellent permeability within target coals
- Significant CSG resource independently certified
- COI working towards CSG pilot drilling 2H 2018

**Gunn Project (ATP 744)**      **67 PJ (2C)<sup>1</sup>**  
**1,870 PJ (3C)<sup>1</sup>**

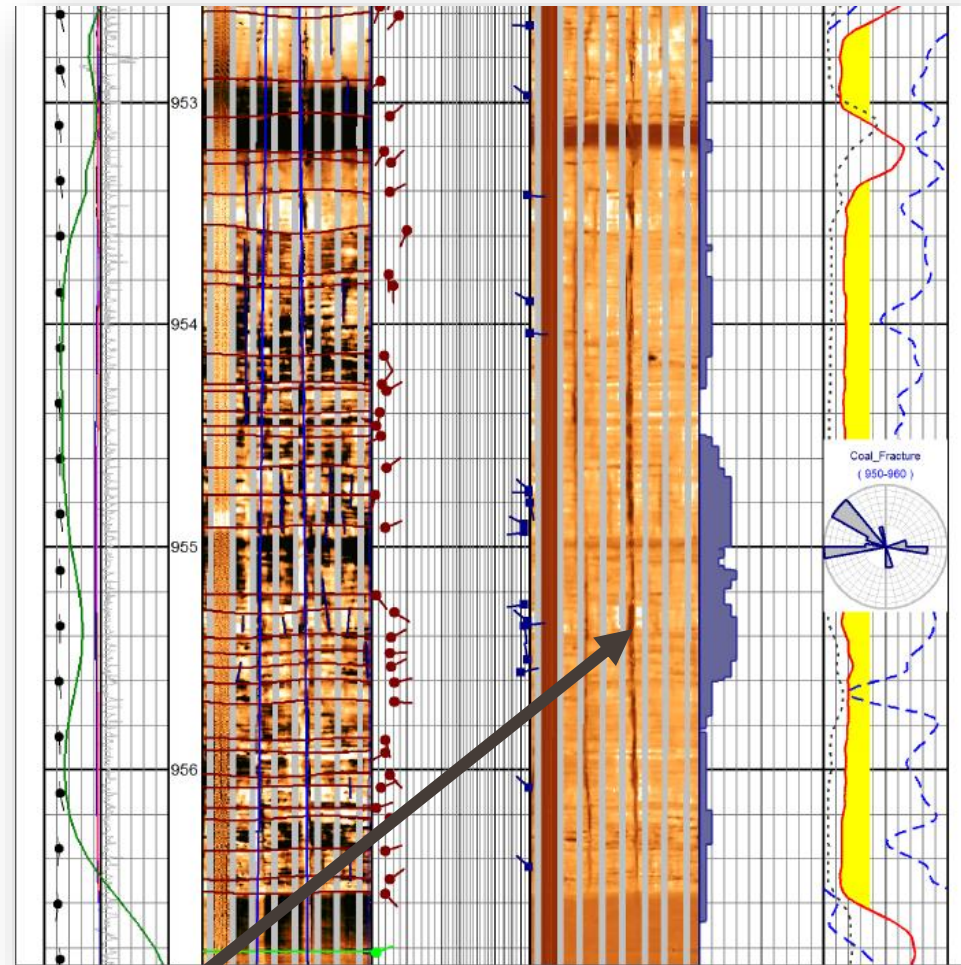
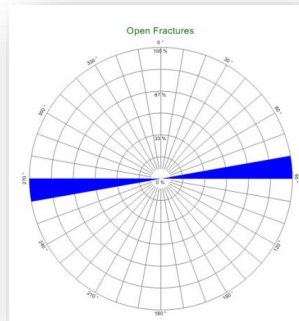
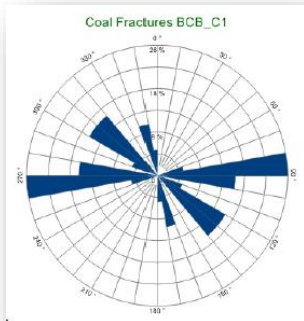




# CSG – Gunn Project Area

## C1 Reservoir - Gunn wells

- Avg. gas content 4.74m<sup>3</sup>/t
- >99% CH<sub>4</sub>
- 40-50mD perm
- 91% saturation
- 4.30m net coal
- Seam isolated above and below by impermeable mudstone
- Excellent master cleat development (roof to floor)
- Key risks:
  - Gas Saturation
  - Isolation from sst



Master  
cleats

Gunn-2: Image log – C1 seam

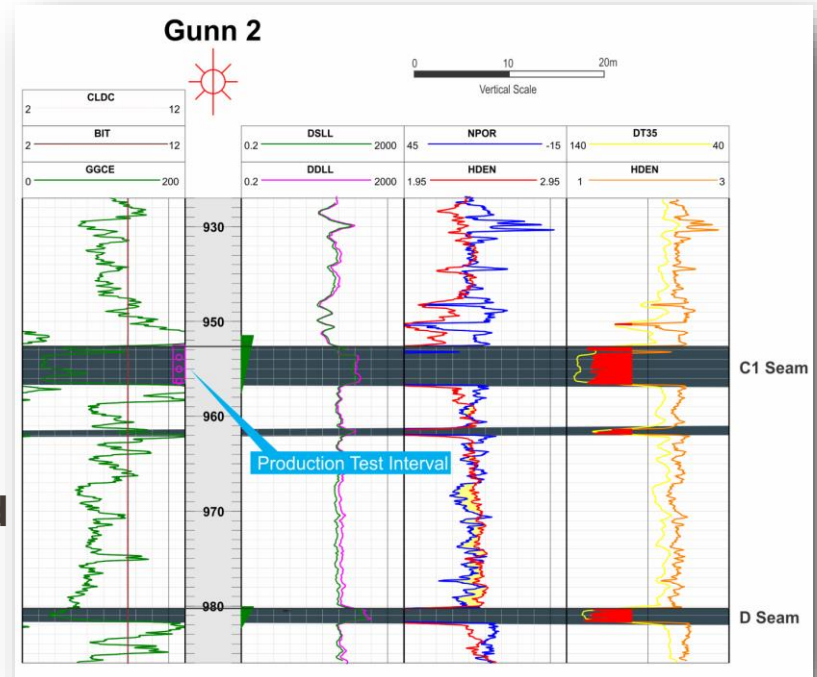


# CSG – Gunn 2 Extended Production Test



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- Perforated over 4m interval - C1 coal seam only
- First well in the basin to test whether case and perforation provided sufficient connection to coal permeability without stimulation
- Seam isolated above and below by impermeable mudstone
- Designed to ensure water only produced from coal and not adjacent sandstones
  - **Highly successful test – achieved 400 bwpd (from coal at 952m)**

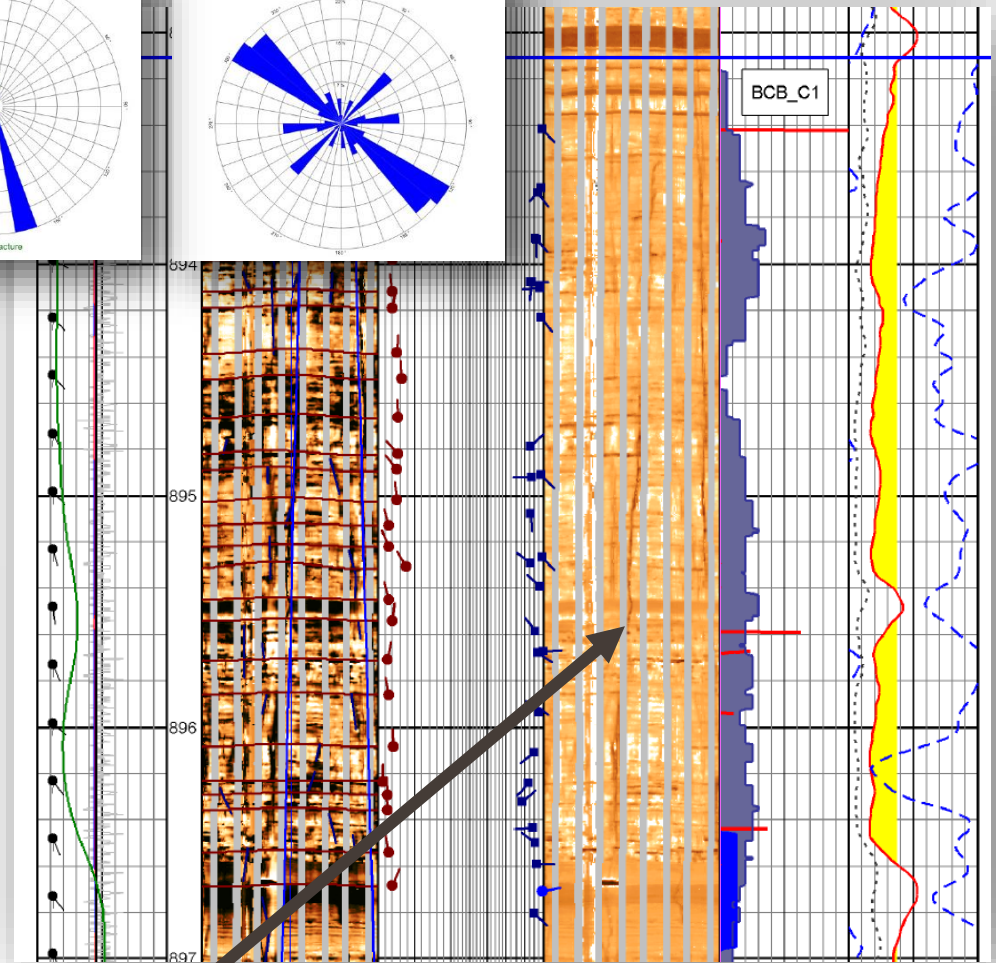
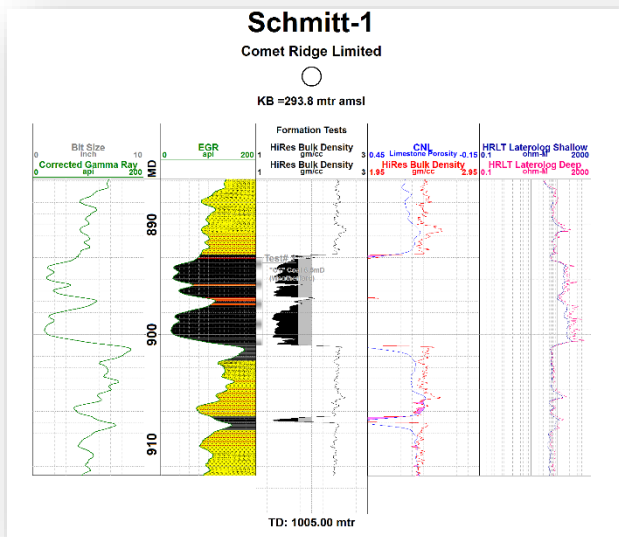
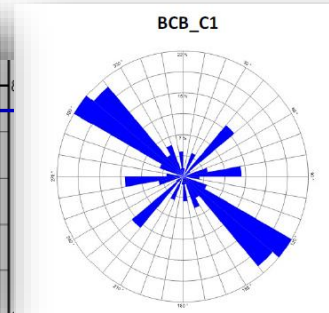
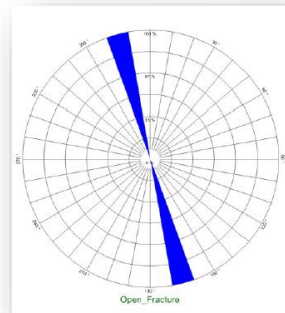


## CSG – C1 Reservoir – Schmitt 1 well



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- Avg. gas content 4.73m<sup>3</sup>/t
- >99% CH<sub>4</sub>
- 76% saturation
- 6.5mD perm
- 7.55m net coal
- Excellent master cleat development
- Suspended as an appraisal well for production testing
- Strong pilot candidate for 2H 2018

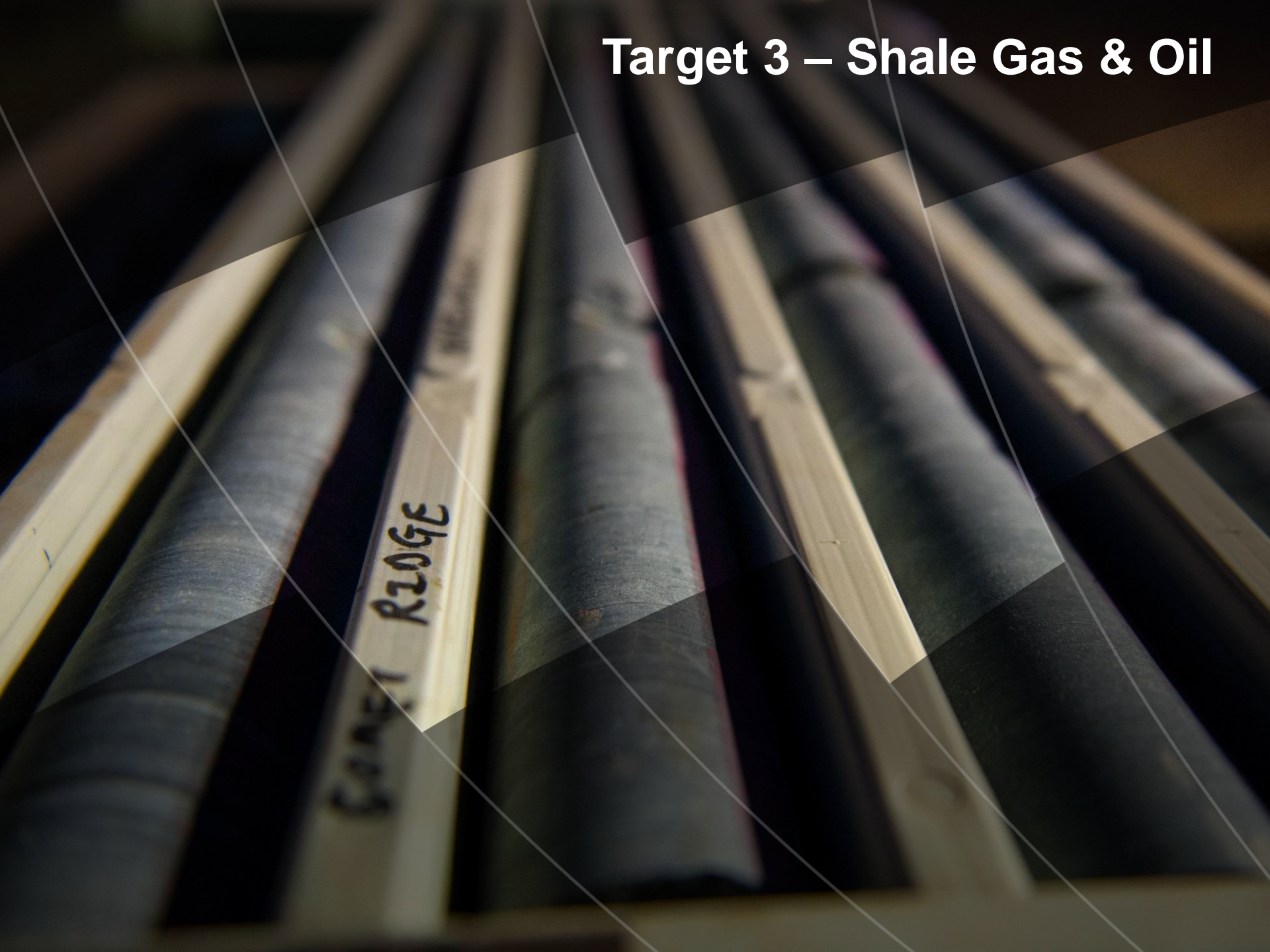


## Master cleats

### Schmitt-1: Image log – C1 seam



# Target 3 – Shale Gas & Oil



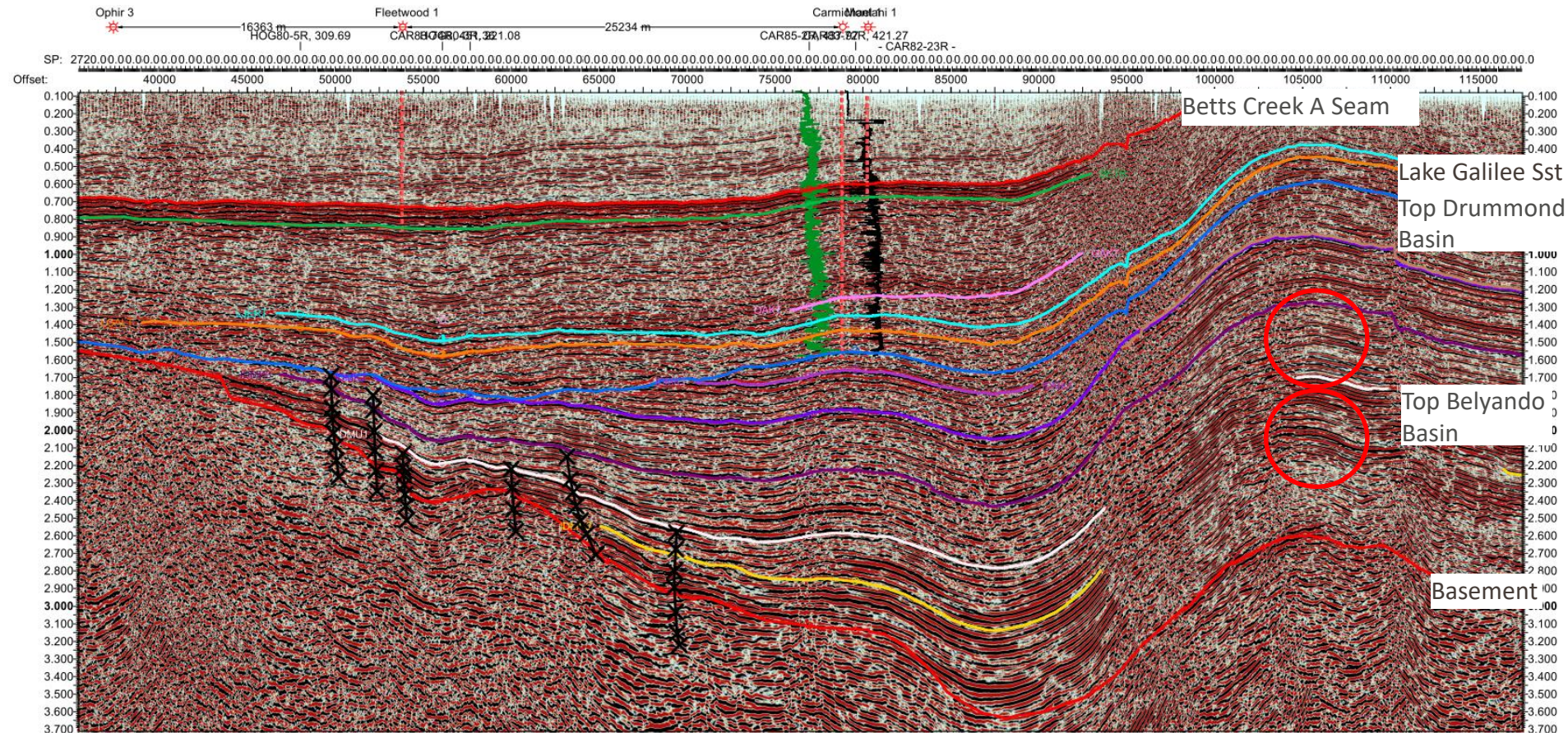


# Galilee Basin – Potential Marine Shale Targets



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## Seismic Line CAR82-23R



- basal Drummond Basin & Belyando Basin Marine Shale targets shallow on eastern side of permits

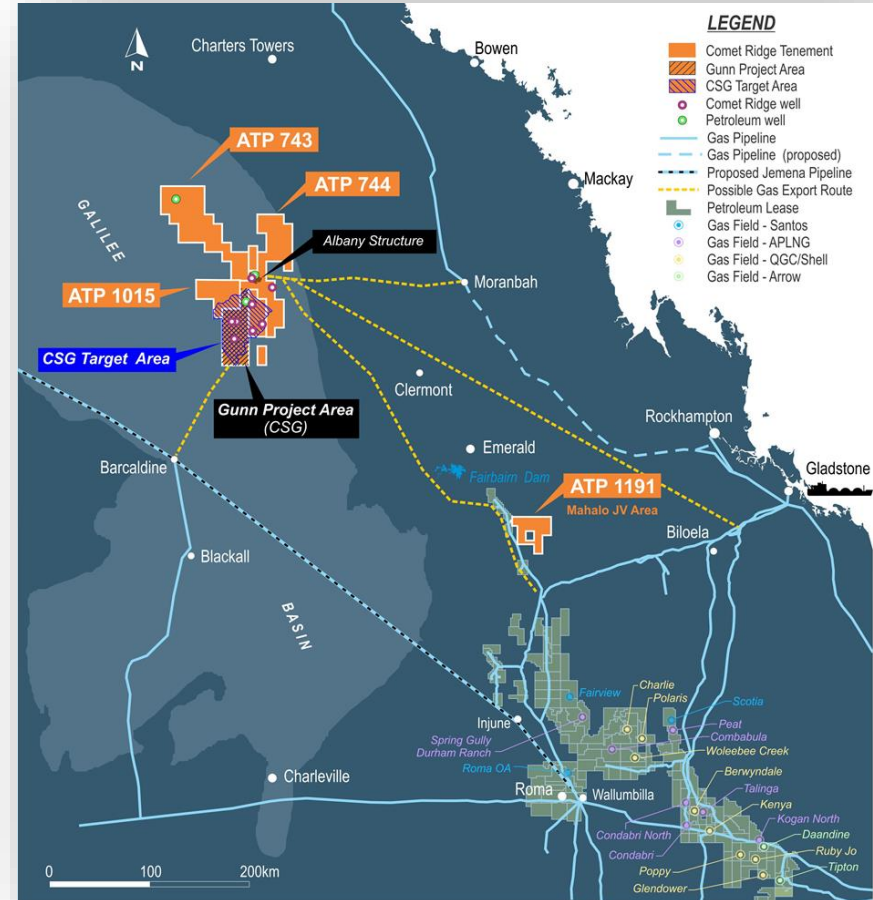


# This basin could become a significant producer



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- Galilee is a massive onshore basin not yet connected into the east coast market, with a very large contingent resource in sandstone and CSG, and (as yet) no 2P and 3P reserves
- Overlies an active petroleum system sourced from the Drummond and Belyando basins with potential for additional sandstone and shale targets ranging from 2500m to 4000+m
- Conventional exploration was largely oil focused
  - Then 20 years ago focus moved towards CSG
  - Recent focus on sandstones, but for gas, not oil
- Historic small gas flows have been ignored due to distance to market and very low gas prices
- The recent Albany 1 well was drilled into the top of the Lake Galilee Sandstone reservoir - Comet Ridge and Vintage Energy have demonstrated a change in drilling methods can generate measurable gas flows with more than 100m sandstone yet to drill
- The Galilee Basin could be the supply solution for the east coast gas market





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# ASX Listing Rule 5 Disclosure



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## Competent Person Statement and ASX Listing Rules Chapter 5 - Reporting on Oil and Gas Activities

The Contingent Resource for the Albany Structure located ATP 744 are taken from an independent report by Dr Bruce McConachie of SRK Consulting (Australasia) Pty Ltd, an independent petroleum reserve and resource evaluation company. The Contingent Resources information has been issued with the prior written consent of Dr McConachie in the form and context in which they appear in this Annual Reserves Statement for 2016. His qualifications and experience meet the requirements to act as a qualified petroleum reserves and resource evaluator as defined under the ASX Listing Rule 5.42 to report petroleum reserves in accordance with the Society of Petroleum Engineers ("SPE") 2007 Petroleum Resource Management System ("PRMS") Guidelines as well as the 2011 Guidelines for Application.

The estimate of Reserves and Contingent Resources for the Mahalo Project as part of ATP 1191P provided in this presentation, is based on, and fairly represents, information and supporting documentation determined by Mr Timothy L. Hower of MHA Petroleum Consultants LLC Inc (MHA) in accordance with Petroleum Resource Management System guidelines. Mr Hower is a full-time employee of MHA, and is a qualified person as defined under the ASX Listing Rule 5.42. Mr Hower is a Licensed Professional Engineer in the States of Colorado and Wyoming as well as being a member of The Society of Petroleum Engineers. Mr Hower has consented to the publication of the Reserve and Contingent Resource estimates for Mahalo in the form and context in which they appear in this presentation.

The reserve and contingent gas resource estimates for ATP 1191P provided in this presentation were originally released to the Market in the Company's announcement of 28 August 2014, updated in an announcement dated 2 December 2015, and further upgraded in an announcement dated 6 March 2018 and were estimated using the deterministic method with the estimate of contingent resources not having been adjusted for commercial risk.

The contingent resource estimates for the unconventional gas located in ATP 744 provided in this presentation are based on and fairly represent, information and supporting documentation determined by Mr John Hattner of Netherland, Sewell and Associates Inc, Dallas, Texas, USA, in accordance with Petroleum Resource Management System guidelines. Mr Hattner is a full-time employee of NSAI, and is considered to be a qualified person as defined under the ASX Listing Rule 5.42 and has given his consent to the use of the resource figures in the form and context in which they appear in this presentation.

The contingent gas resource estimates for ATP 744 provided in this statement were originally released to the Market in the Company's announcement of 25 November 2010, and were estimated using the deterministic method with the estimate of contingent resources for ATP 744 not having been adjusted for commercial risk.

COI confirms that it is not aware of any new information or data that materially affects the information included in any of the announcements relating to either ATP 1191P or ATP 744P referred to above and that all of the material assumptions and technical parameters underpinning the estimates in the announcements continue to apply and have not materially changed.

The contingent resource estimates for PEL 6, PEL 427 and PEL 428 referred to in this presentation were determined by Mr Timothy L. Hower of MHA Petroleum Consultants LLC in accordance with Petroleum Resource Management System guidelines. Mr Hower is a full-time employee of MHA, and is a qualified person as defined under the ASX Listing Rule 5.42. Mr Hower consented to the publication of the resource figures which appeared in the announcement of 7 March 2011 made by Eastern Star Gas Limited (ASX:ESG) and any reference and reliance on the resource figures for PEL 6, PEL 427 & PEL 428 in this presentation is only a restatement of the information contained in the ESG announcement.

The contingent resource estimates for PEL 6, PEL 427 and PEL 428 were estimated using the deterministic method with the estimate of contingent resources for PEL 6, PEL 427 and PEL 428 not having been adjusted for commercial risk.

COI confirms that it is not aware of any new information or data that materially affects the information included in the ESG announcement of 7 March 2011 and that all of the material assumptions and technical parameters underpinning the estimates in the announcements continue to apply and have not materially changed.