

EMERGING CONTINUOUS GAS PLAYS IN THE COOPER BASIN, SOUTH AUSTRALIA

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DMITRE

APPEA 2012 Conference and Exhibition

PACE *exploration*
mining
energy
2020 *global*



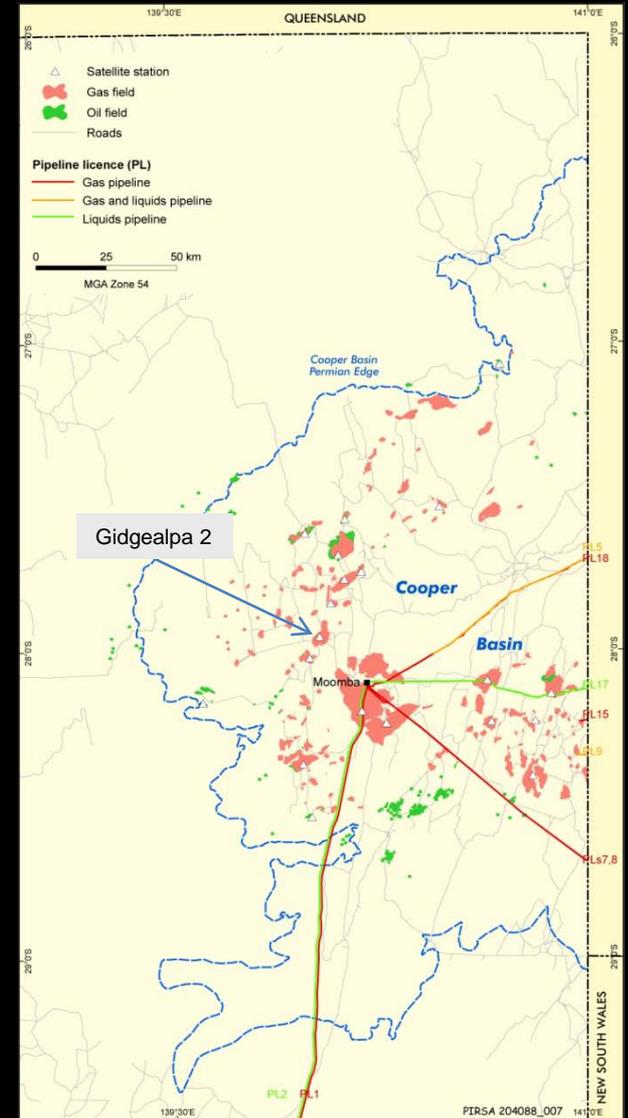
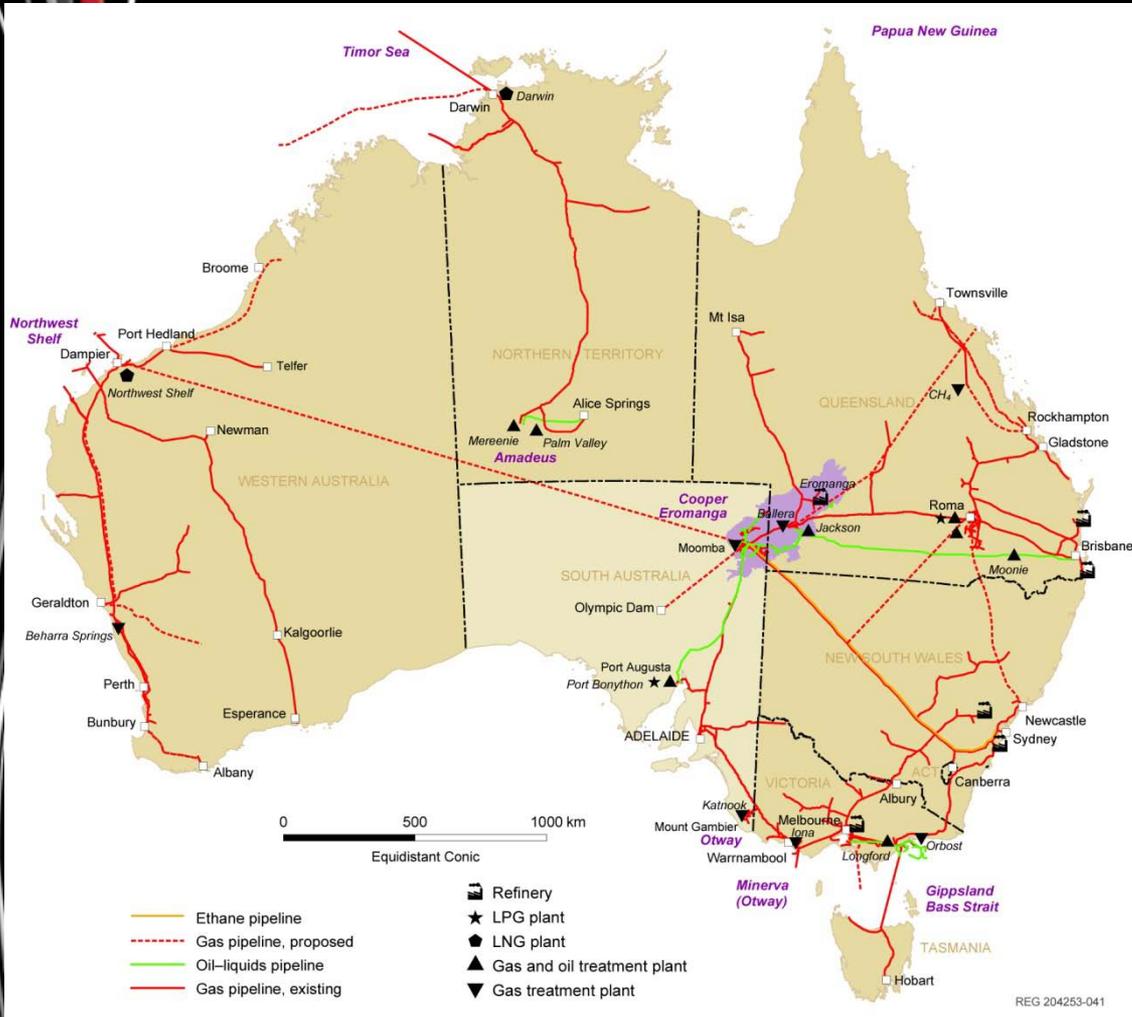
Government
of South Australia

Department for Manufacturing,
Innovation, Trade,
Resources and Energy

OUTLINE

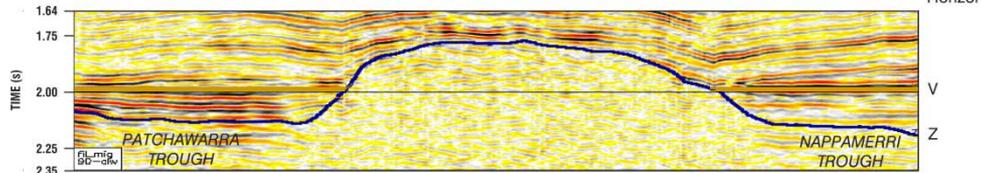
- Cooper Basin Overview
- Exploration for Unconventional Gas
- Shale Gas
- Tight Gas (Basin-centred gas)
- Coal Seam Gas
- Resource Estimates
- 2012 Drilling Activity

COOPER BASIN OVERVIEW

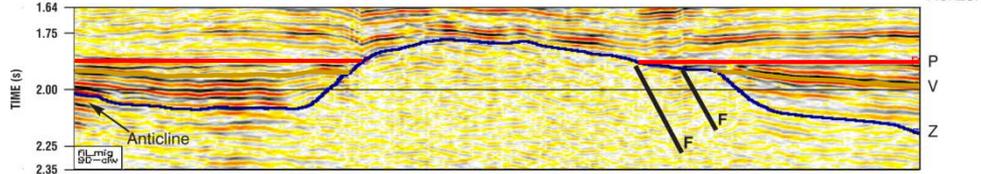


COOPER BASIN OVERVIEW

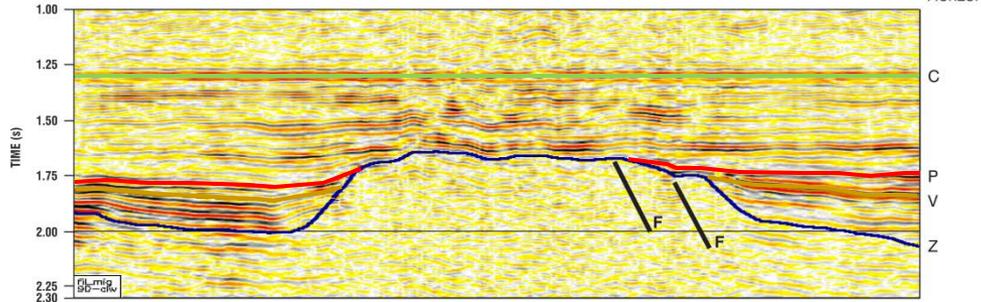
(a) Datum V horizon (Top Patchawarra)



(b) Datum P horizon (Near Top Permian)



(c) Datum C horizon (Top Cadna-owie)

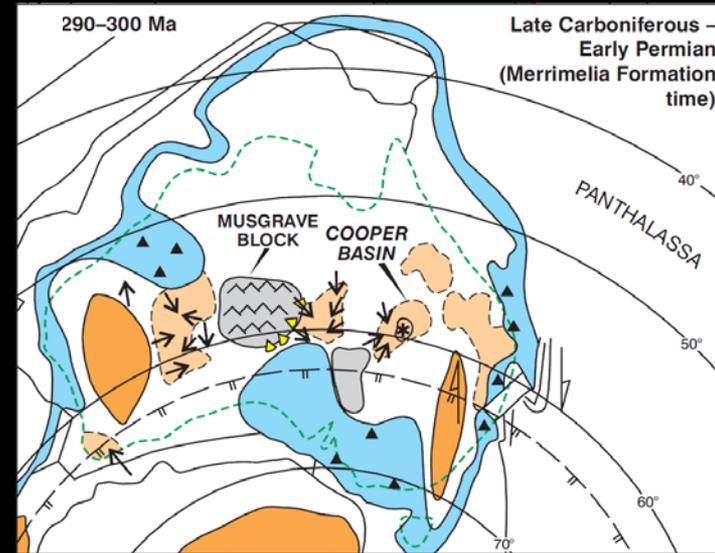


COOPER BASIN OVERVIEW

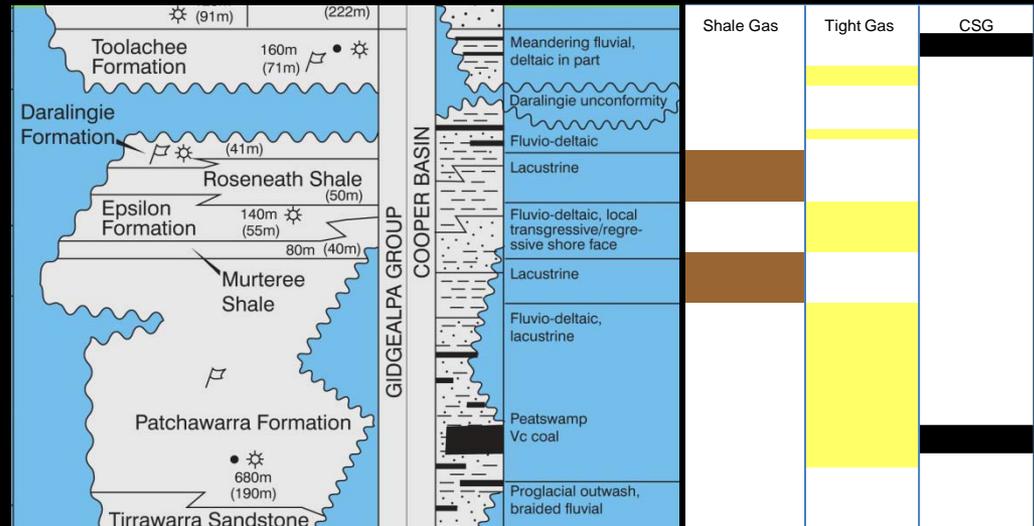
SYSTEM	AGE		PALYNOLOGICAL ZONE	ROCK UNIT	LITHOLOGY	DEPOSITIONAL ENVIRONMENT	
	SERIES	STAGE					
CENO-ZOIC	LAKE EYRE BASIN						
	EROMANGA BASIN • ✱						
TRIASSIC	Late	Norian to Rhaetian	PT5	Cuddapan Formation (36m)		Floodplain, Meandering fluvial	
		Carnian	PT4				
	Middle	Ladinian	PT3	Tinchoo Fm (100m/70m)		Sinuosity meandering streams, Fluvio-lacustrine	
		Anisian					
	Early	Scythian		PT2	Wimma Sandstone Mbr (100m/70m), Paring Mbr (150m/74m), Arrarbury Formation (222m)		Braided fluvial channel belt and floodplain
				PT1	Callamurra Member (125m/91m)		Floodplain, lacustrine, palaeosols, moderate/sinuosity fluvial channels.
PERMIAN	Late	Tatarian	PP6	Toolachee Formation (160m/71m)		Meandering fluvial, deltaic in part	
		Kazanian	PP5				
		Ufimian					
	Early	Kungurian		PP4	Daralingie Formation (41m)		Daralingie unconformity, Fluvio-deltaic, Lacustrine
					Roseneath Shale (50m)		Fluvio-deltaic, local transgressive/regressive shore face
		Artinskian		PP3	Epsilon Formation (140m/55m)		Lacustrine
					Murteree Shale (80m/40m)		Fluvio-deltaic, lacustrine
		Sakmarian					Peatswamp Vc coal
							Proglacial outwash, braided fluvial
		Assestian		PP2	Patchawarra Formation (680m/190m)		Terminoglacial, proglacial, glaciolacustrine, aeolian.
CARBONIFEROUS	Late	Stephanian	PP1	Tirrawarra Sandstone (75m/37m)			
				Merrimelia Formation (450m/70m)			
CAMBRO-ORD.	WARBURTON BASIN • ✱						

Geological summary of the Cooper Basin.

Maximum Thickness 450m
Average Thickness (55m)

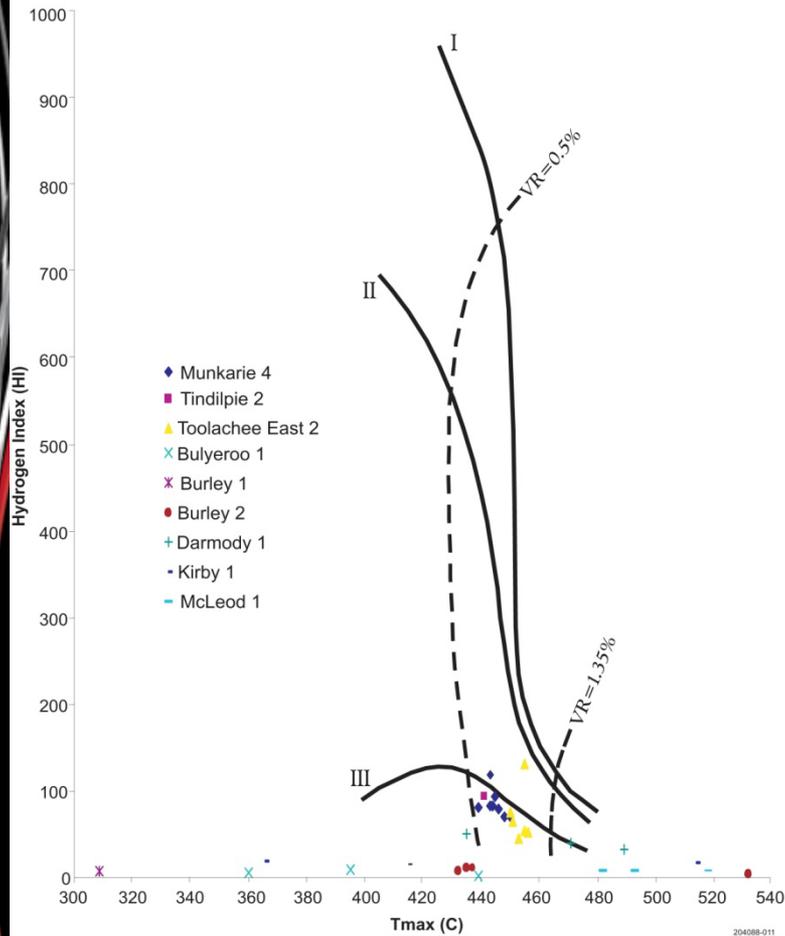


Palaeogeographic reconstruction of the Australian Plate, Late Carboniferous to Early Permian (after Veevers, 1984 and Baillie et al., 1994).

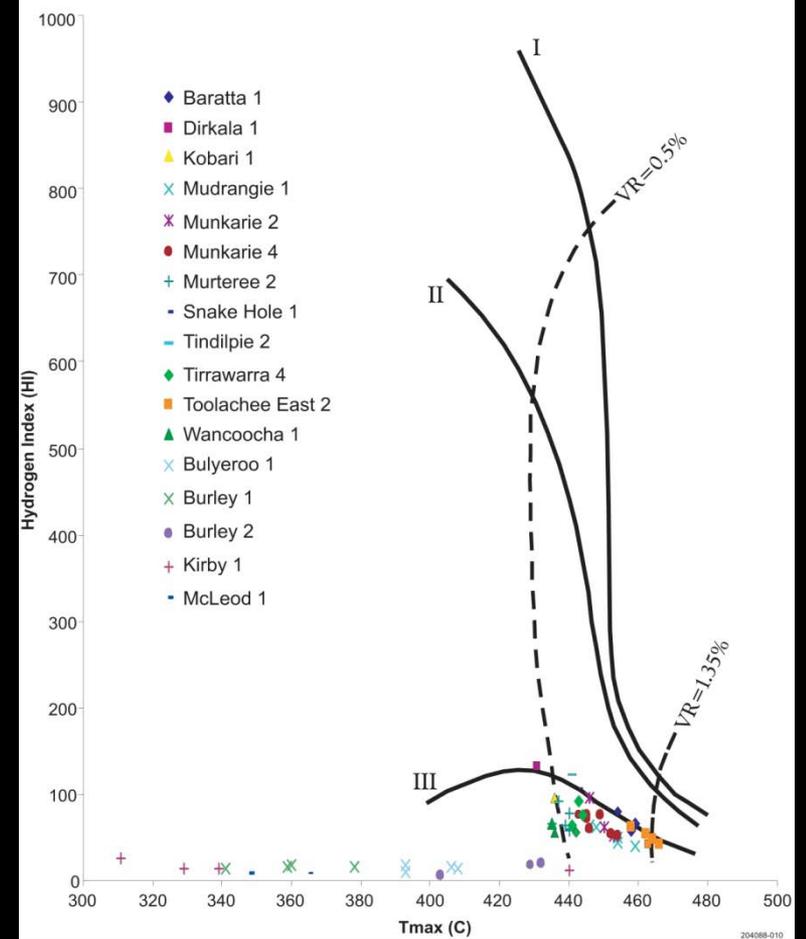


SHALE GAS

Tmax vs HI - Roseneath Shale

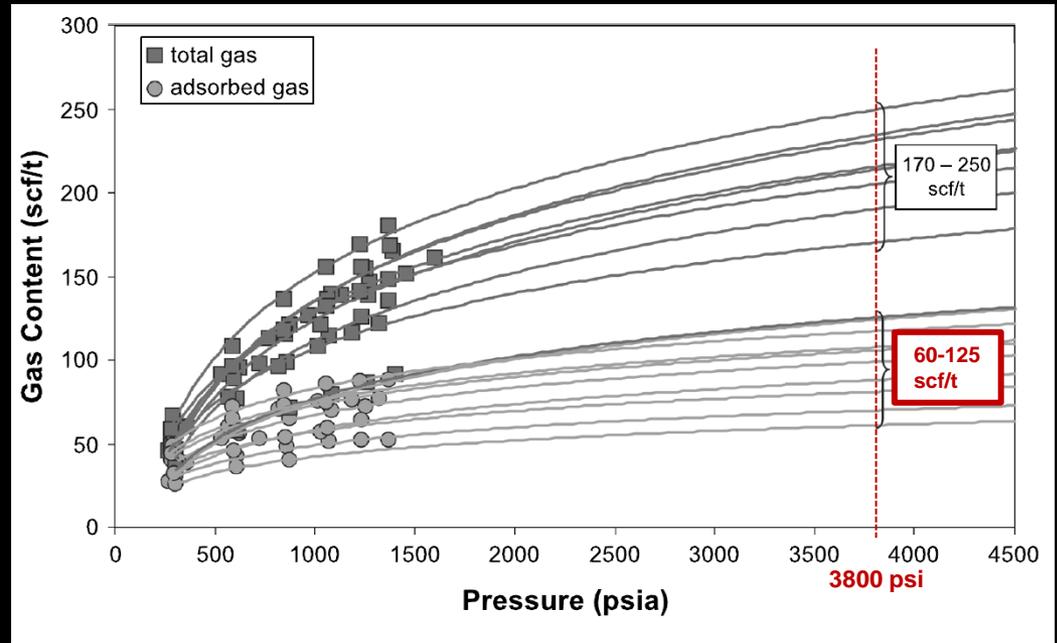


HI vs Tmax - Murteree Shale



SHALE GAS

Adsorption isotherms for Barnett Shale core samples
 Mitchell Energy 2 T.P. Sims well, Wise County – No temperature information provided.

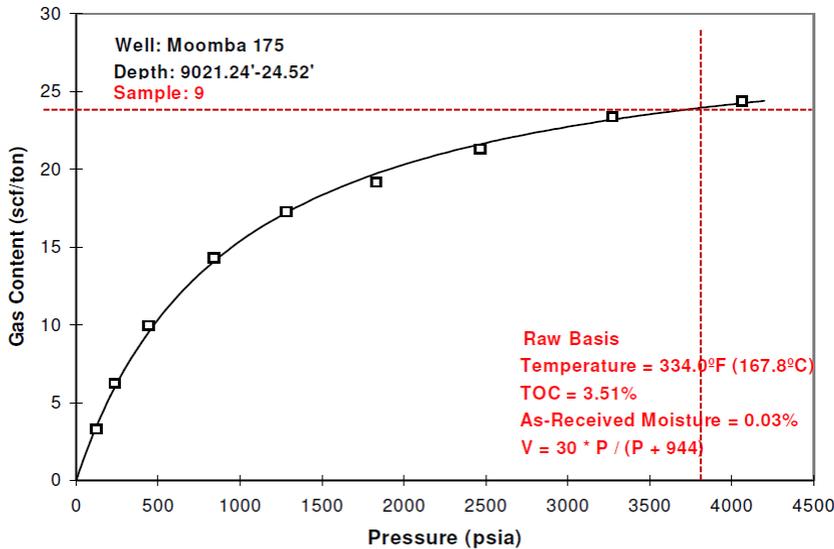


Adsorption isotherm for Roseneath Shale core sample, Moomba 175

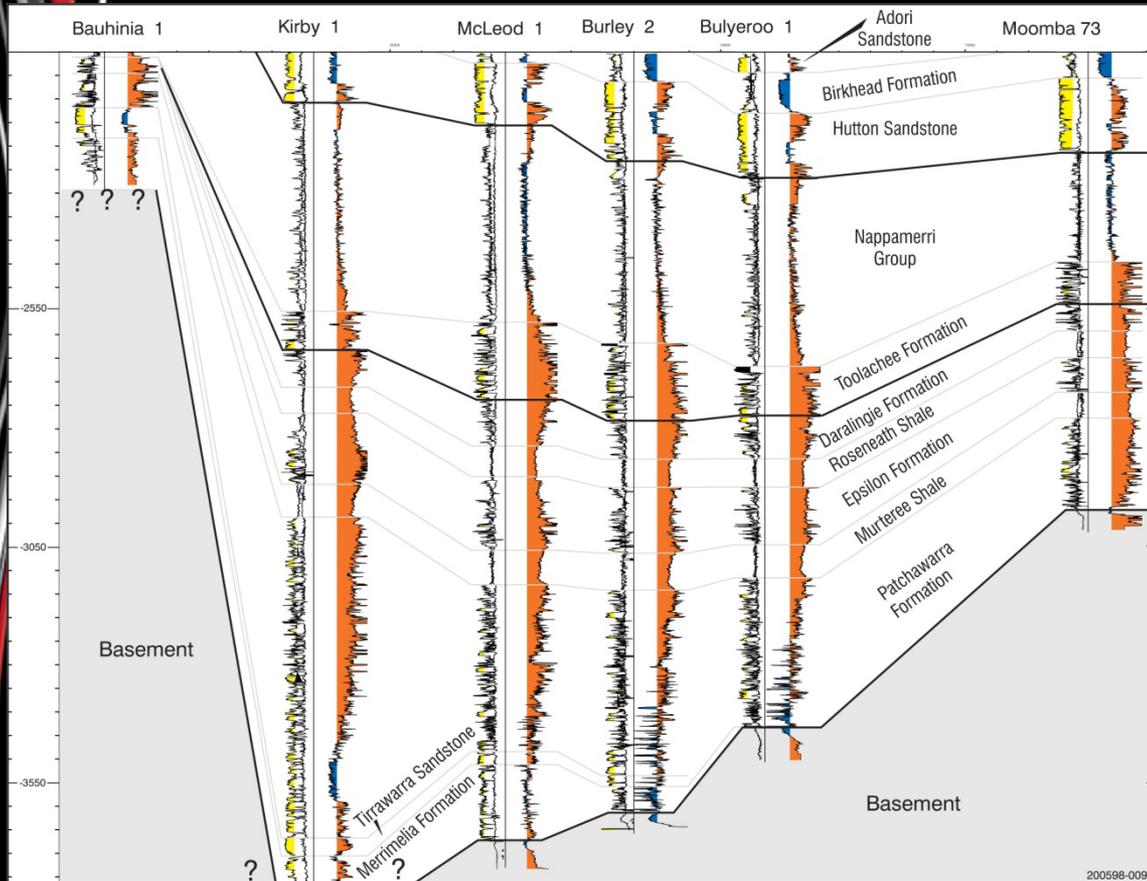
Figure from Montgomery et al, 2005. AAPG © 2005. Used by permission of the AAPG whose permission is required for further use.

~ 24 scf/t at 3800 psi, T = 167.8°C

Methane Adsorption Isotherm



TIGHT GAS

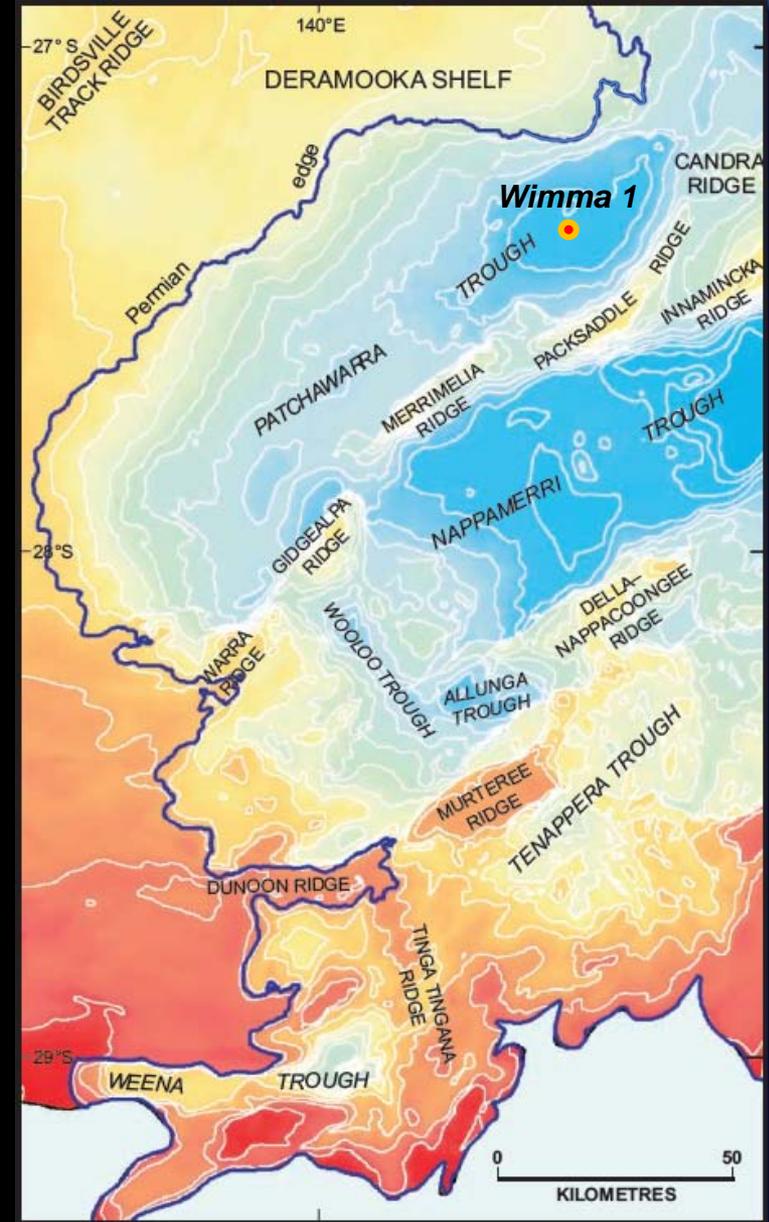


High resistivities in the Permian succession of the Nappamerri Trough suggest gas saturation (from Hillis et al, 2001)

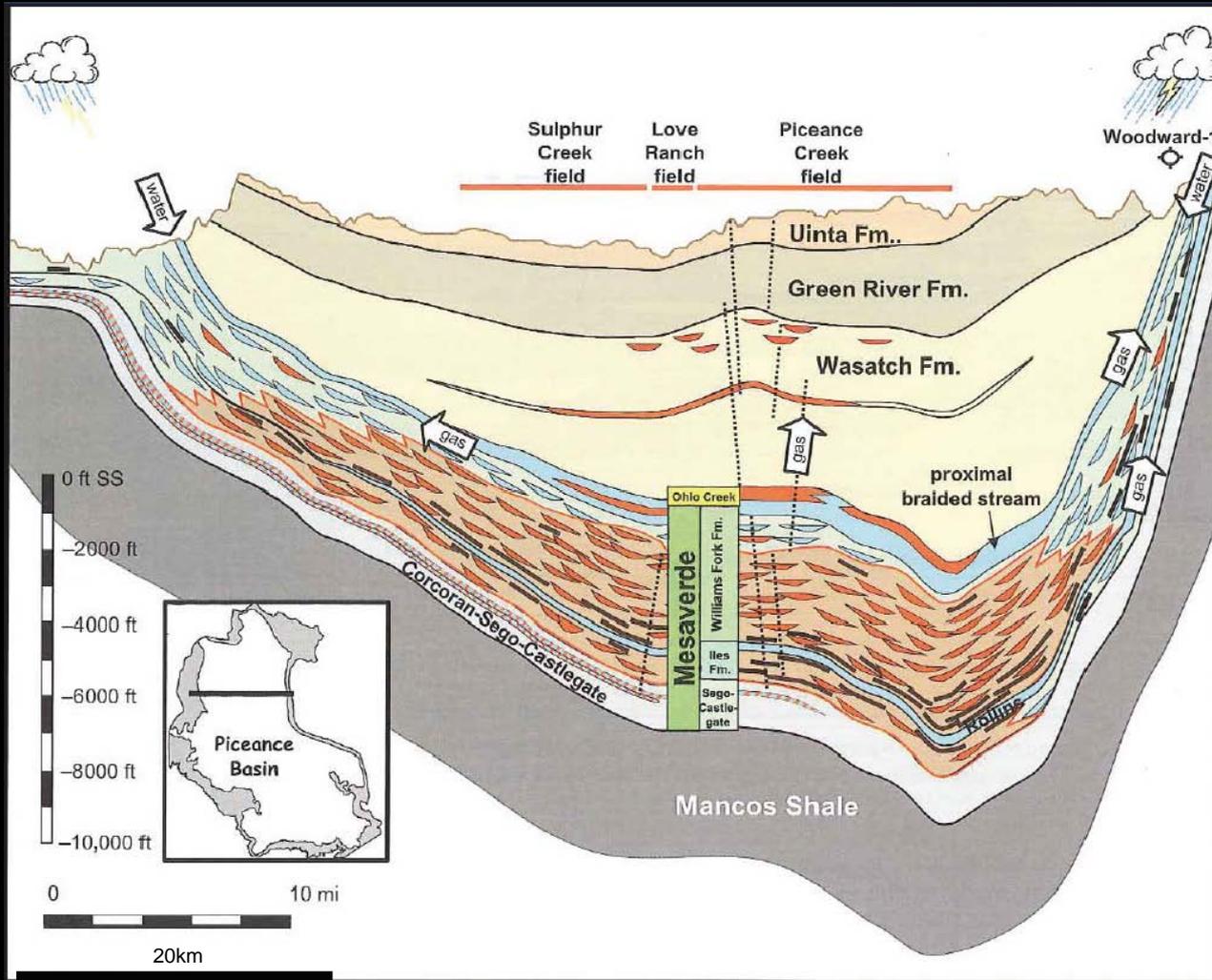
TIGHT GAS

WIMMA 1 (from WCR)

- High mud gas readings in Permian sandstones
- Log interpretation indicates tight section, with low Sw (30-40%)
- Small gas flows from Permian sands on DST
- DST pressure charts indicate **LOW PERMEABILITIES** but **HIGH FORMATION PRESSURES**



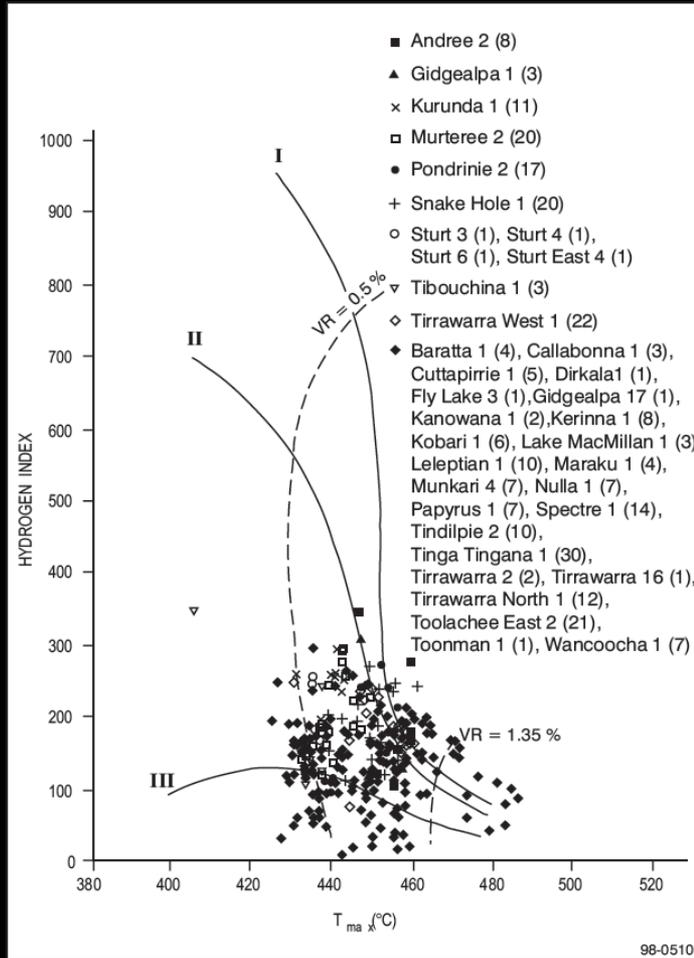
TIGHT GAS



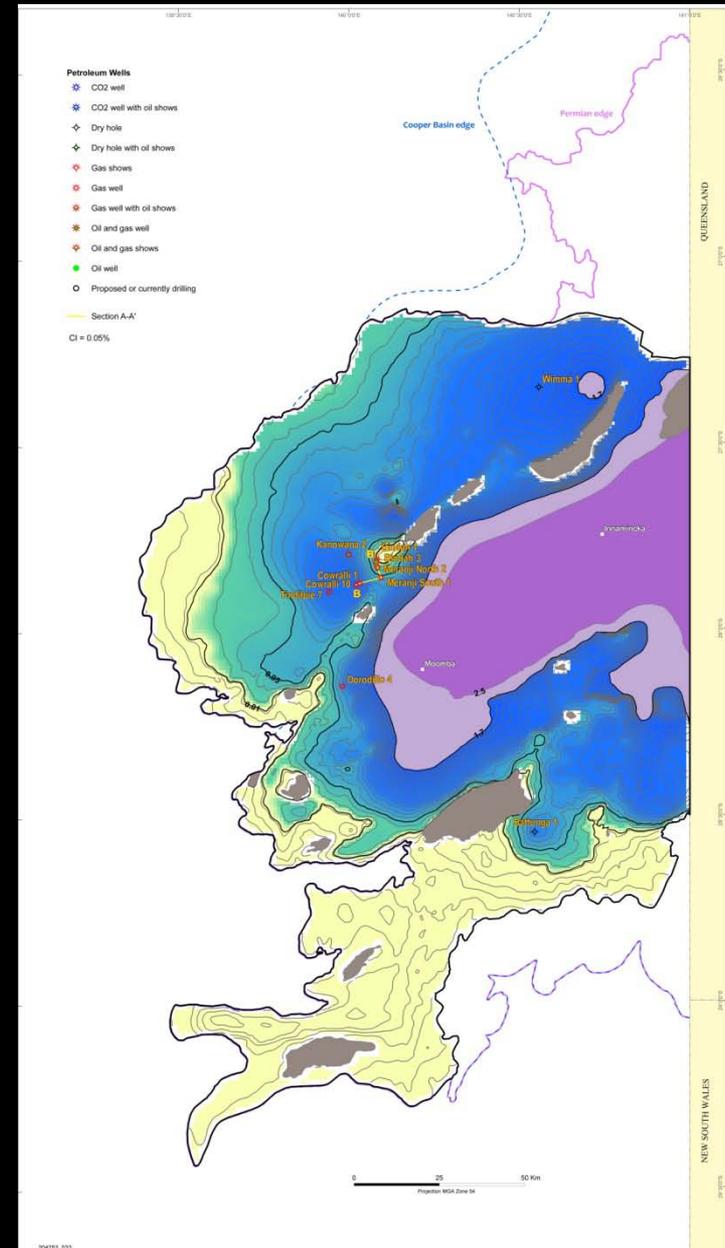
Regional east-west cross section through the northern Piceance Basin depicting the regional distribution of gas and water within the Mesaverde (from Yurewicz et al, 2008. AAPG © 2008. Reprinted by permission of the AAPG whose permission is required for further use).

TIGHT GAS

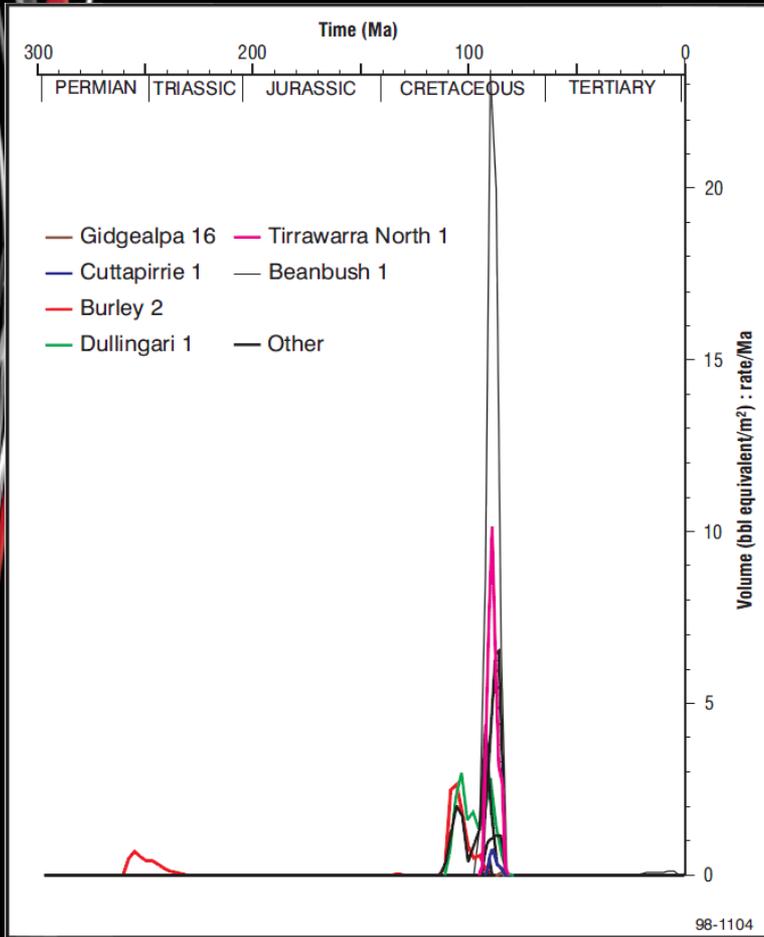
Patchawarra Formation Tmax vs HI cross plot



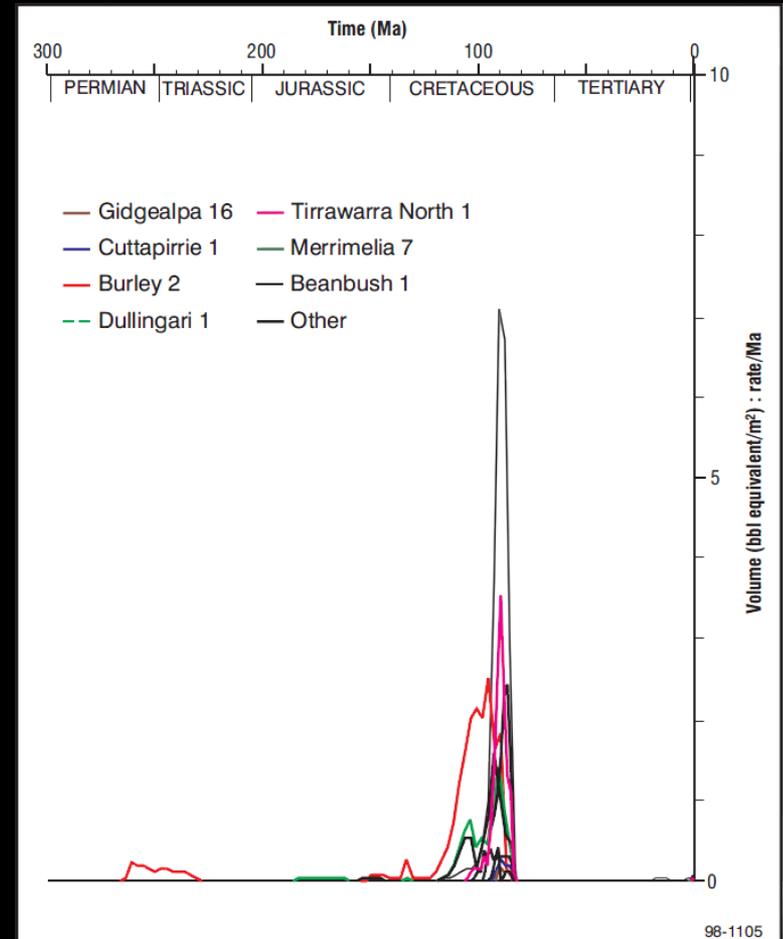
Base Patchawarra Formation maturity



TIGHT GAS



Oil expulsion versus time, Cooper Basin (PGSA Volume 4: Cooper Basin – Figure 9.32)



Gas expulsion versus time, Cooper Basin (PGSA Volume 4: Cooper Basin – Figure 9.33)

TIGHT GAS

Bulyeroo 1

Nappamerri Group

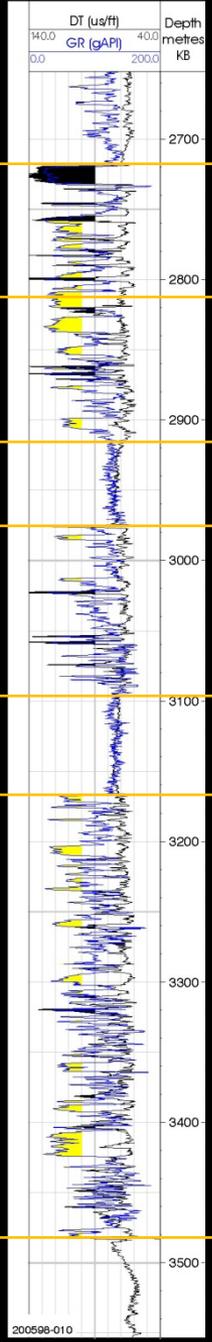
Regional Seal

Roseneath Shale

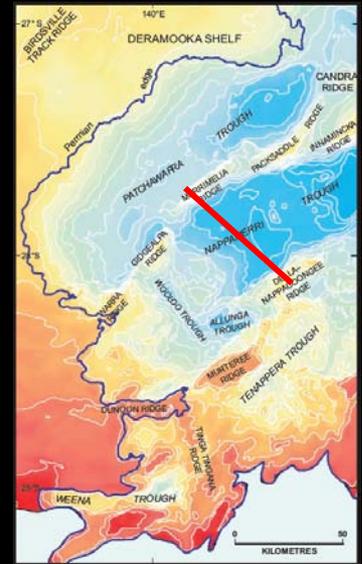
Regional Seal

Murteree Shale

Regional Seal



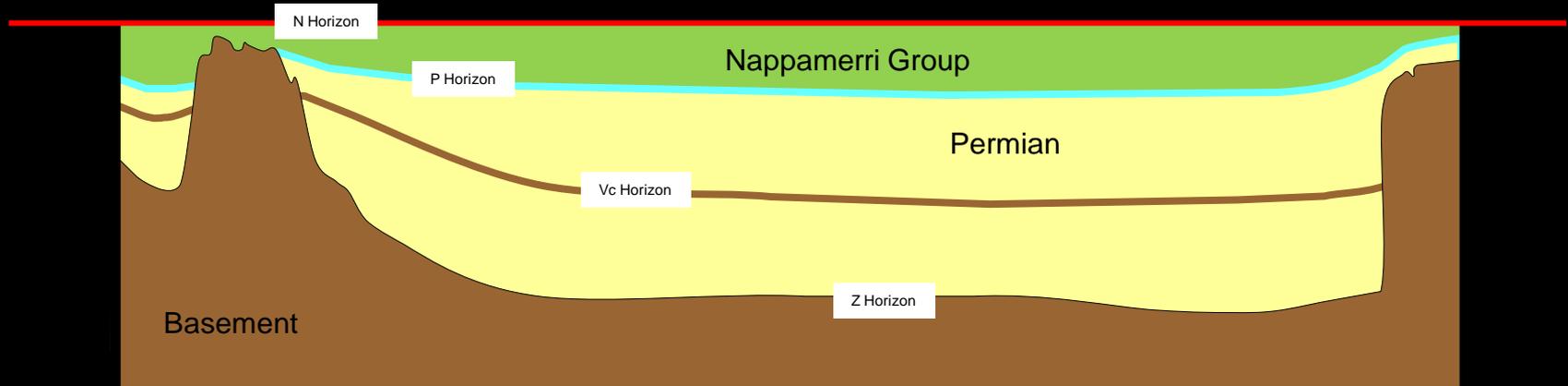
TIGHT GAS



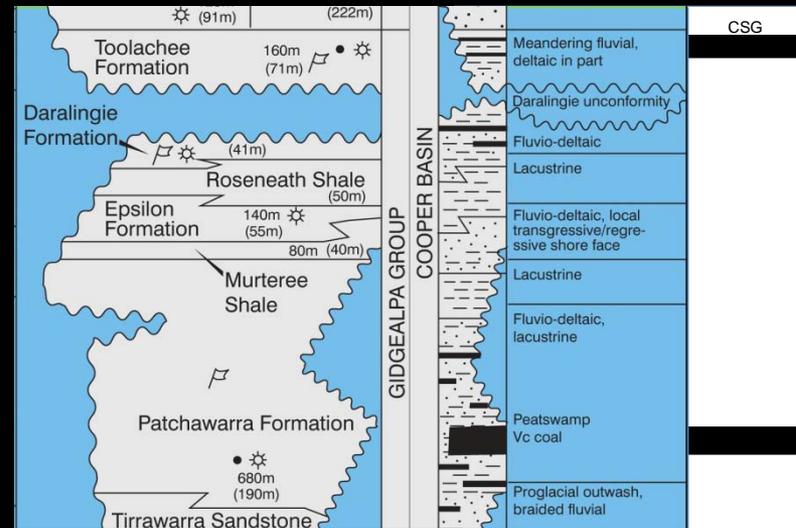
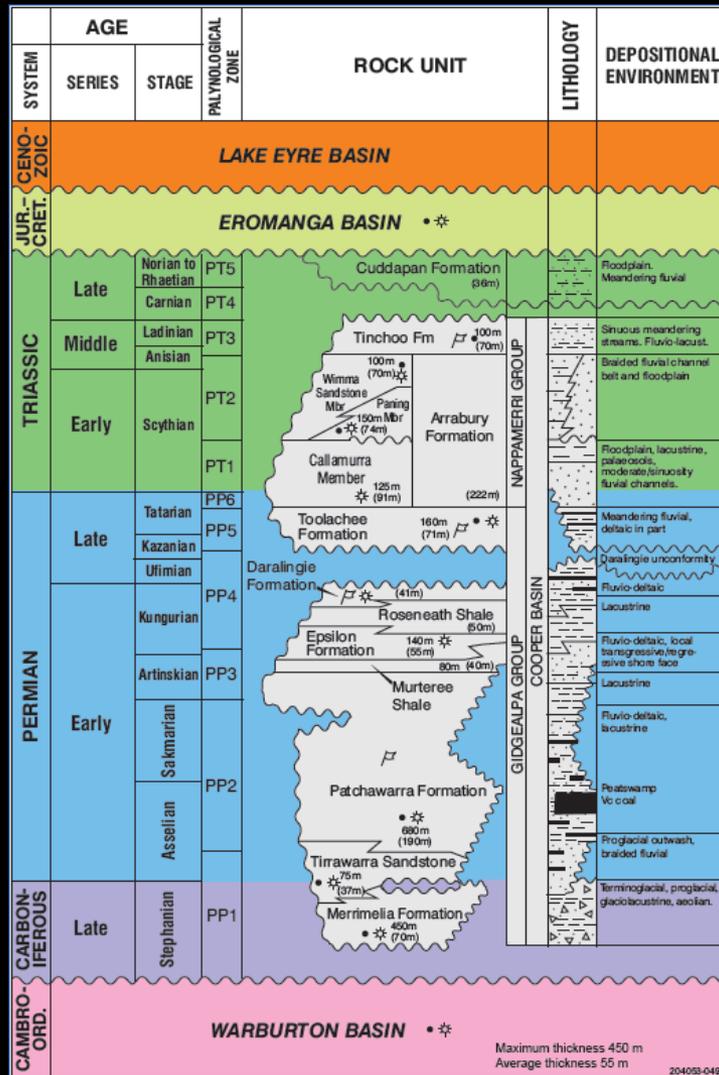
Merrimelia Ridge

Nappamerri Trough

Della -
Nappacoongee Ridge



COAL SEAM GAS



COAL SEAM GAS

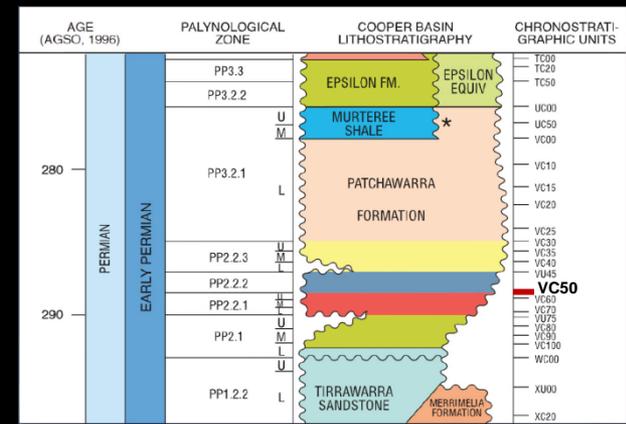
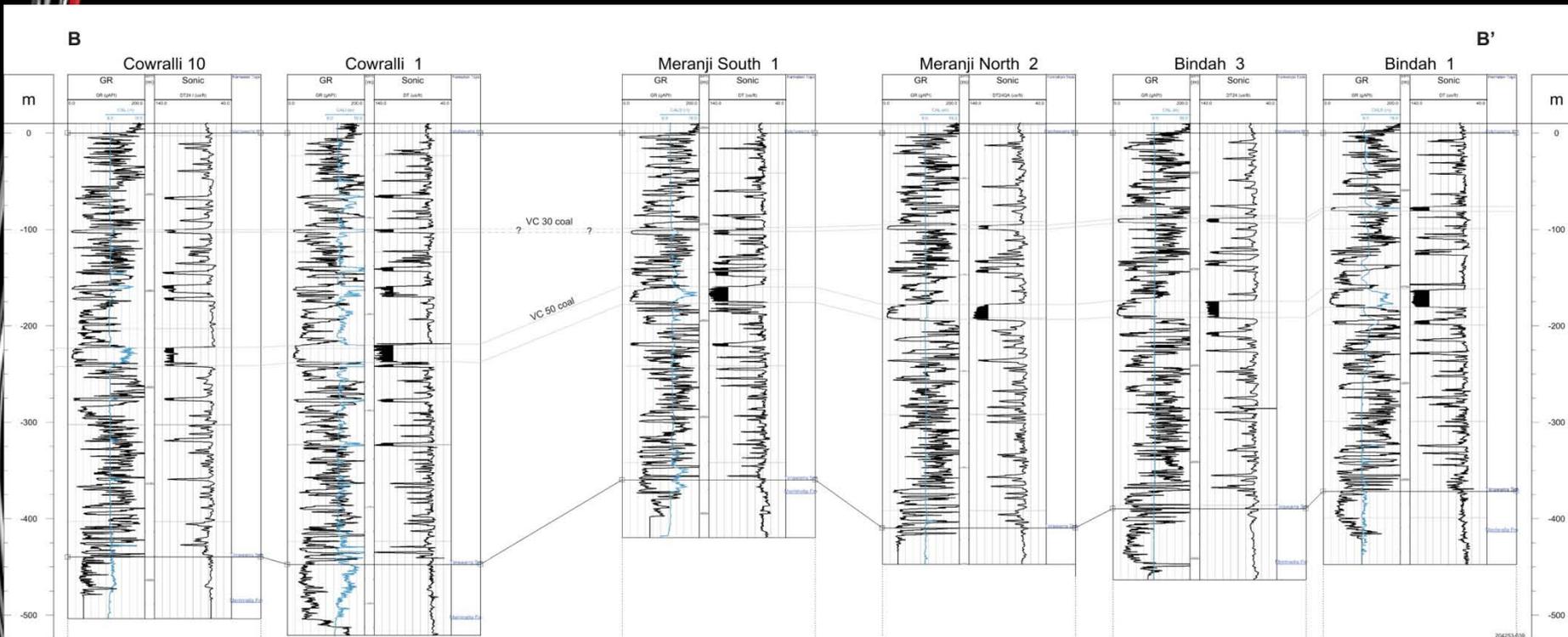
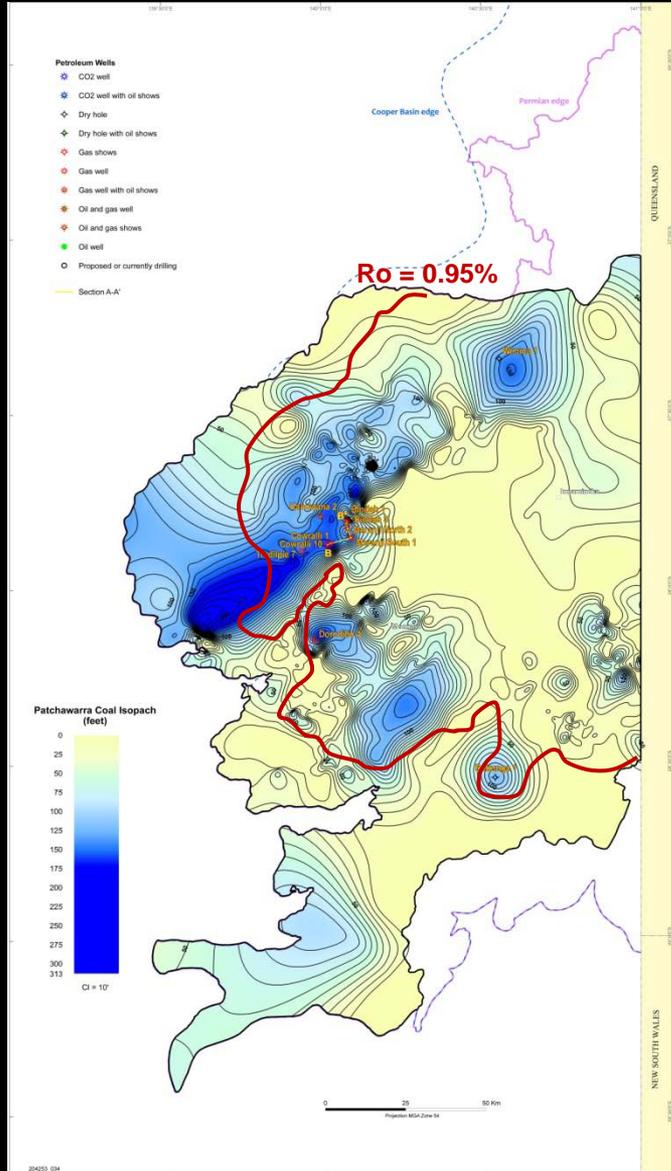


Figure from Strong et al, 2002

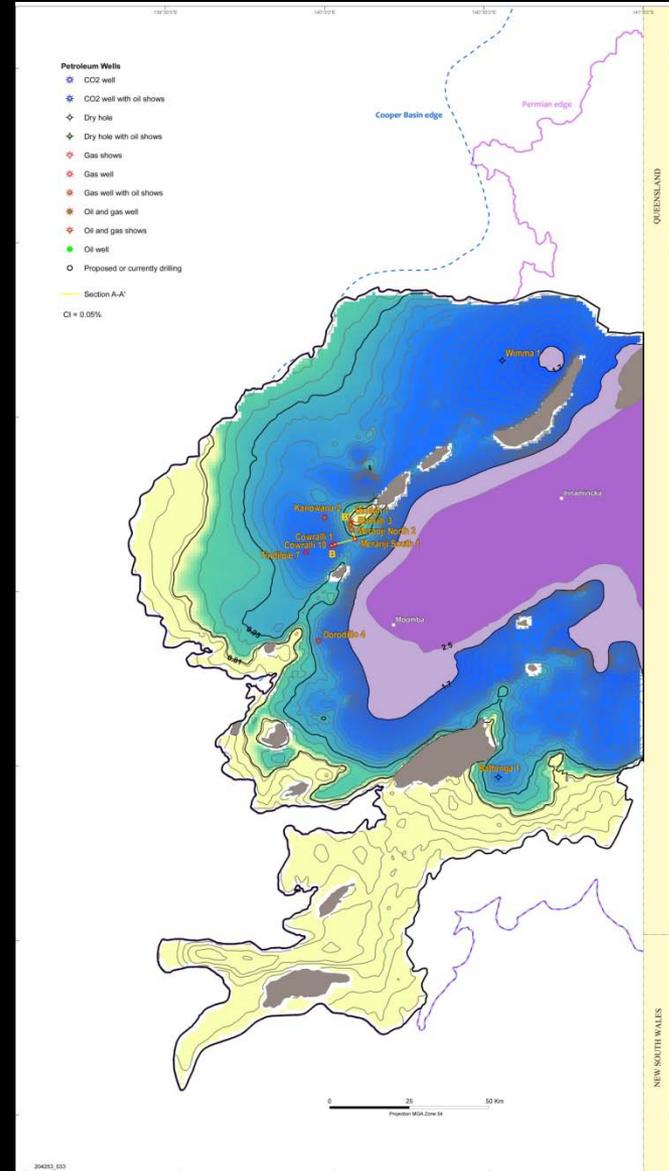


COAL SEAM GAS

Patchawarra Formation – coal isopach

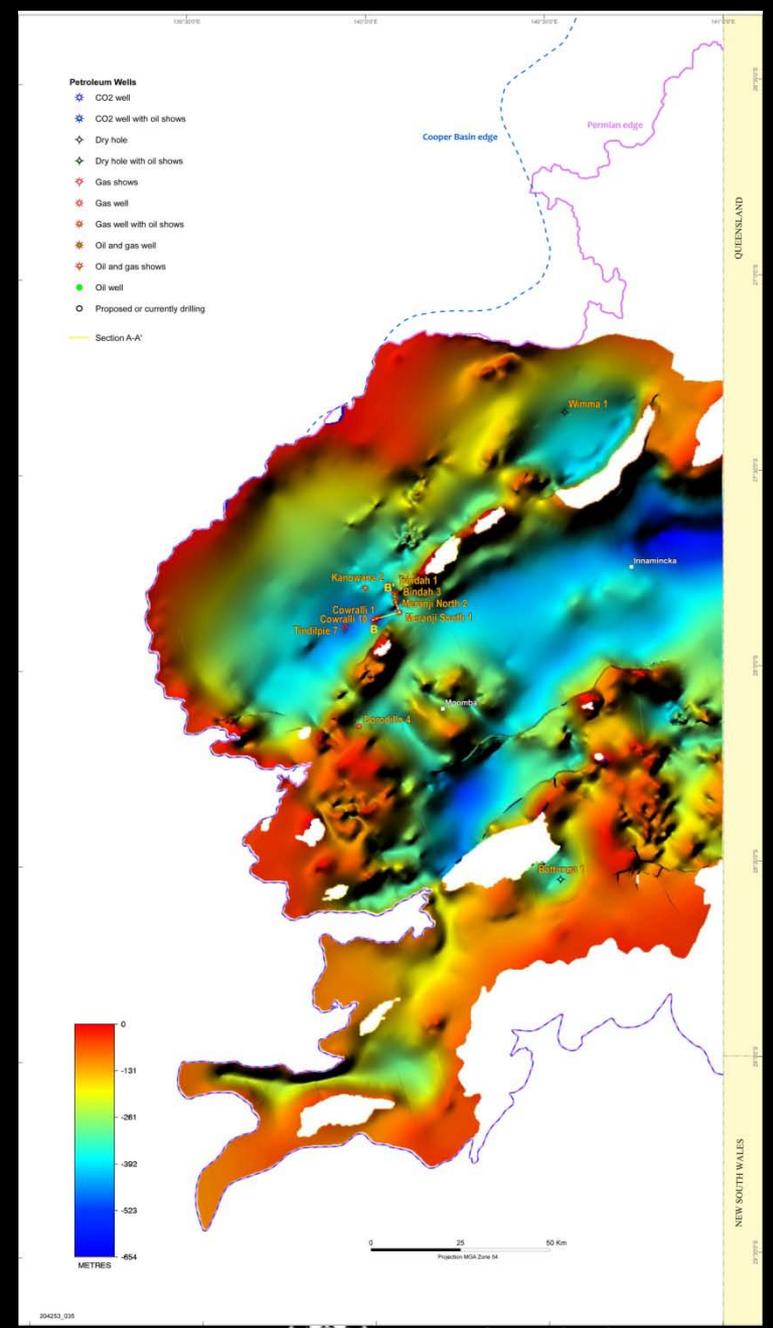


Base Patchawarra Formation maturity

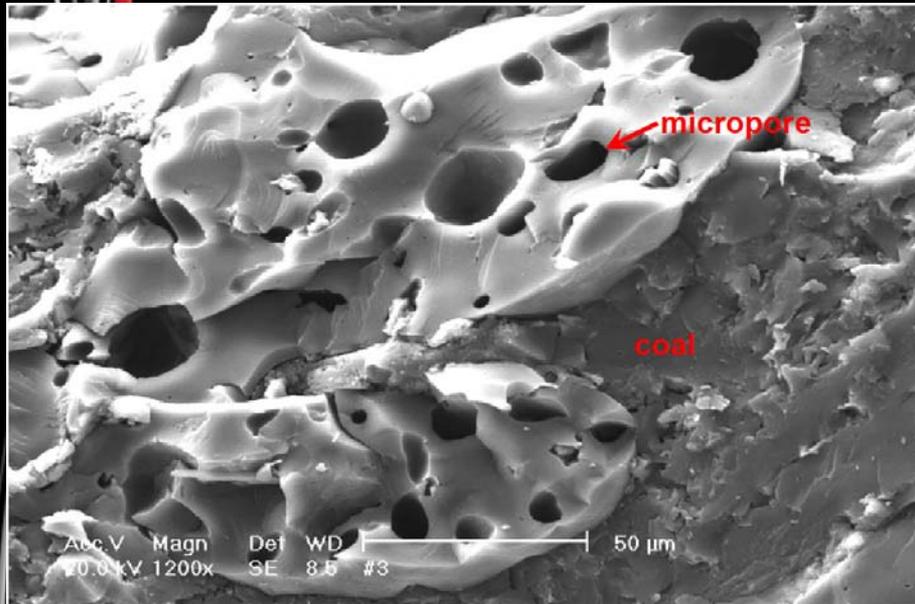


COAL SEAM GAS

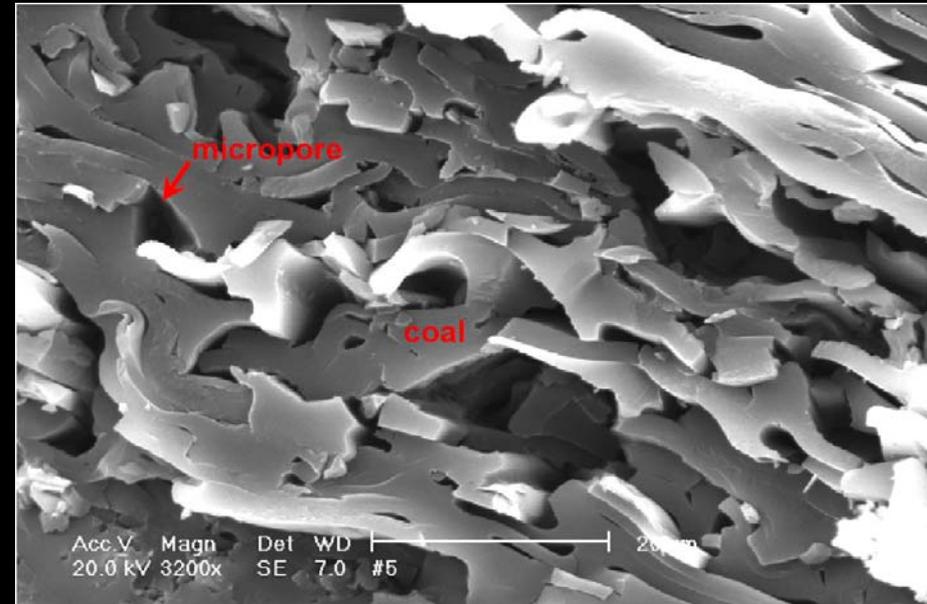
Well name	VC50 seam thickness (m)	Total gas (units)
Bindah-3	19	80-500
Meranji South-1	16	1,000
Cowralli-1	18	1,000-2,000
Cowralli-10	16	2,065-3,550
Kanowana-2	18	600-900
Tindilpie-7	16	1,000
Dorodillo-4	13	100-1,000
Battunga-1	23	1,835
Wimma-1	14	2,800



COAL SEAM GAS

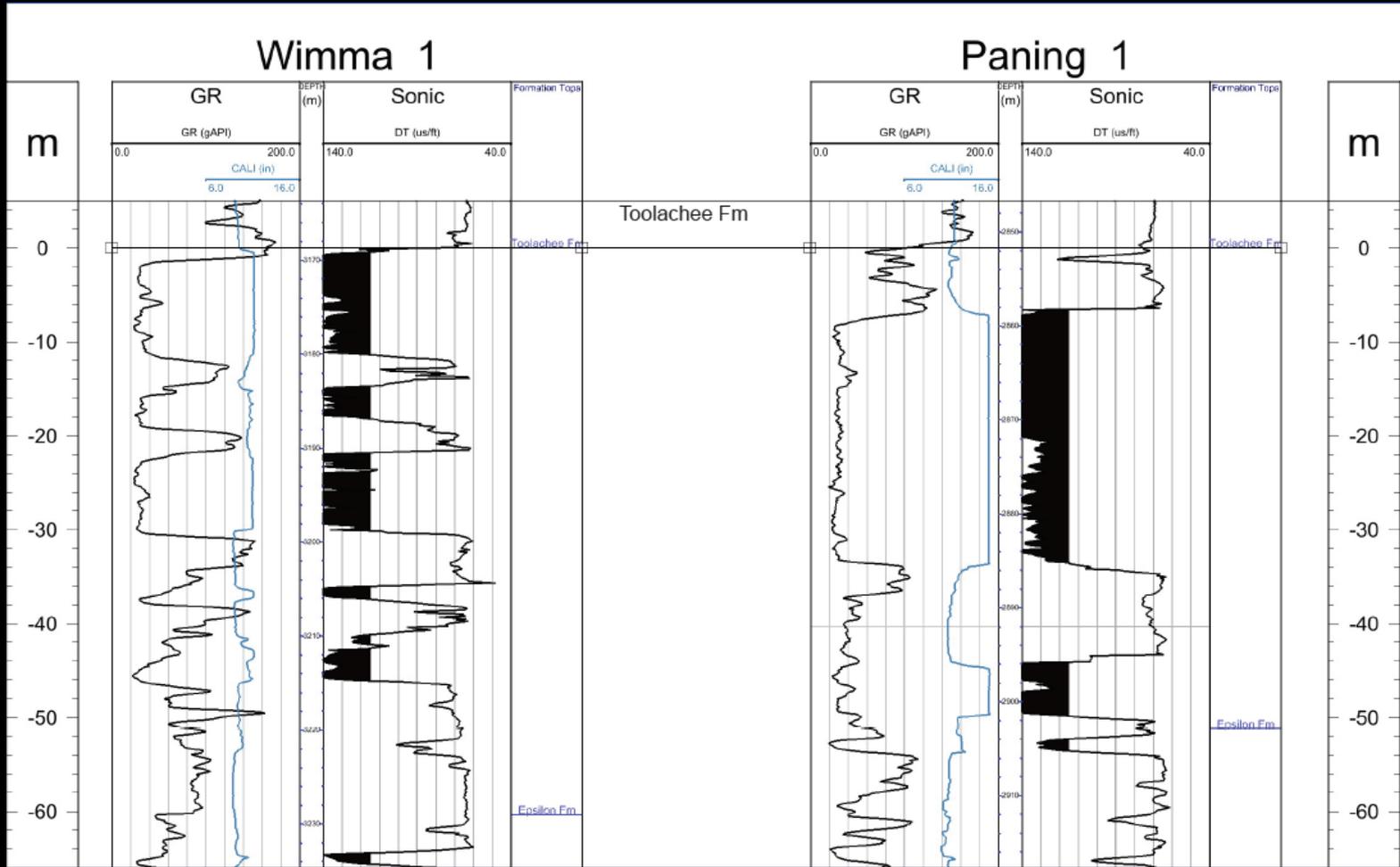


Bindah 3 VC50 coal (8971' 5''), SEM micrograph showing microporosity (from Weatherford Laboratories petrology report in Bindah 3 Well Completion Report).



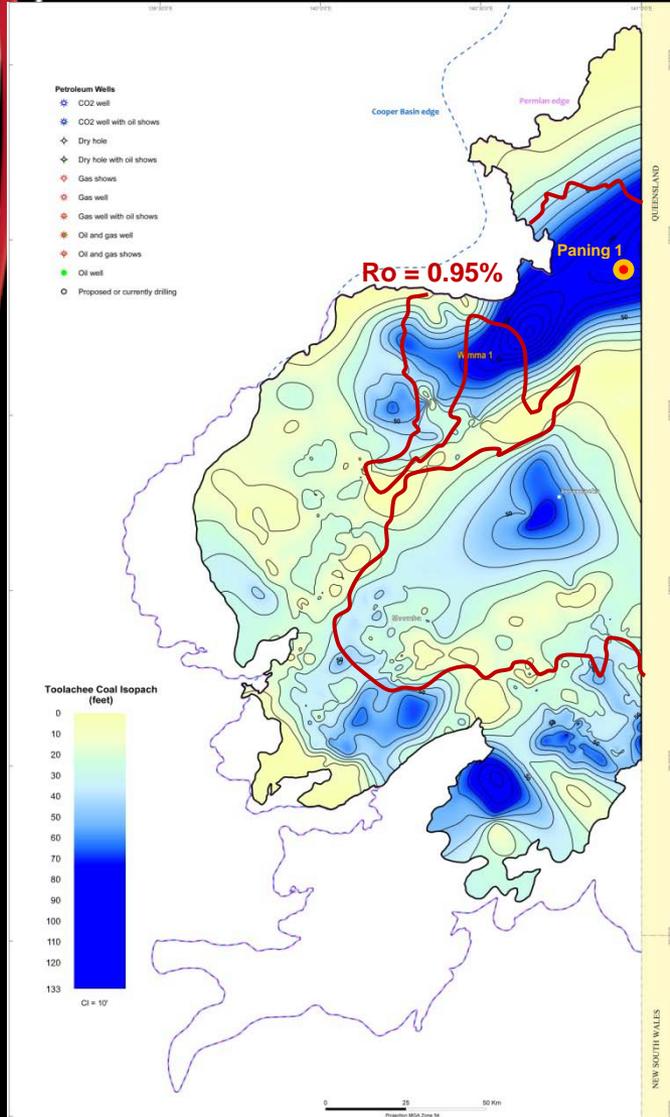
Bindah 3 VC50 coal (8977' 5''), SEM micrograph showing microporosity (from Weatherford Laboratories petrology report in Bindah 3 Well Completion Report).

COAL SEAM GAS

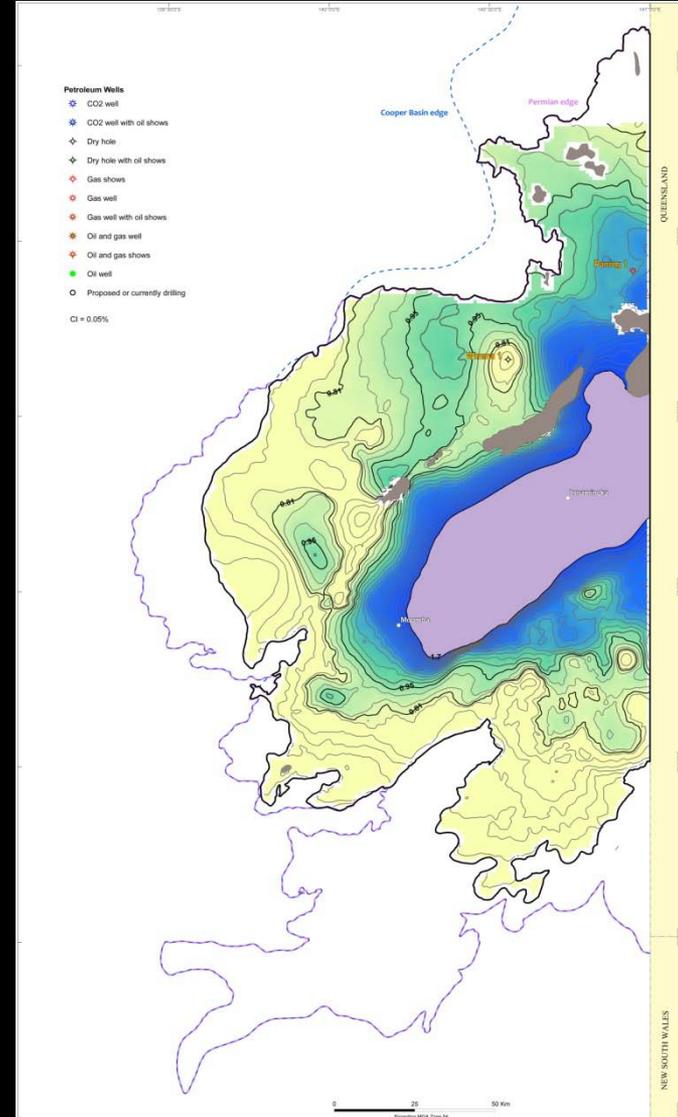


COAL SEAM GAS

Toolachee Formation – coal isopach



Top Toolachee Formation maturity



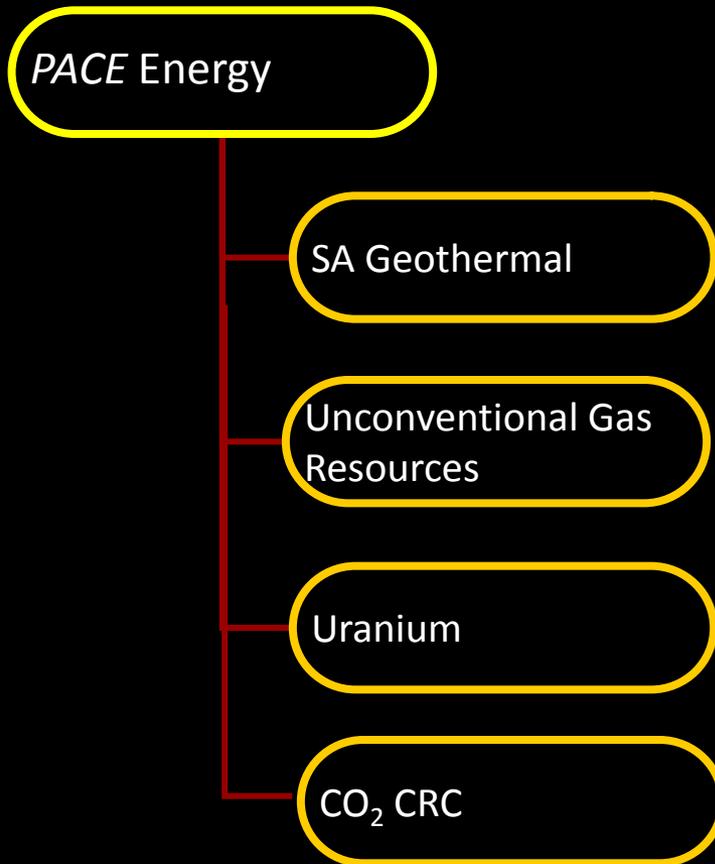
RESOURCE ESTIMATES

- Cooper Basin JV Unconventional Gas Project operated by Santos – 2C unconventional gas resource of **3.3 Tcf gas** (shale gas, tight sands and deep coal)
- Beach Energy's Nappamerri Trough Project - initial gross contingent resource of **2 Tcf** of sales gas constrained to a 10x10km area around Holdfast 1 and Encounter 1 (shale gas and tight sands)
- Beach has stated that there is potential for at least **15-20 Tcf** gas in terms of probable contingent (2C) resources in PEL 218 (*Gas Today Article, Nov 2011*).
- The US Energy Information Administration has estimated that the entire Cooper Basin (SA and QLD) has a risked recoverable shale gas resource of **85 Tcf**

2012 DRILLING ACTIVITY

- ~16 vertical wells planned to test continuous gas plays in the Cooper Basin (4 completed, 3 in progress)
- 3 horizontal wells to test shale gas deliverability

PACE 2020: ENERGY



- New PACE 2020 program with a clear focus on South Australia's Energy resources
- Research into:
 - Unconventional gas resources
 - Investigation of State's frontier basins
 - Geothermal Reservoirs and rock/fluid mechanics
 - State Uranium resources and exploration modelling
 - Gas storage

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