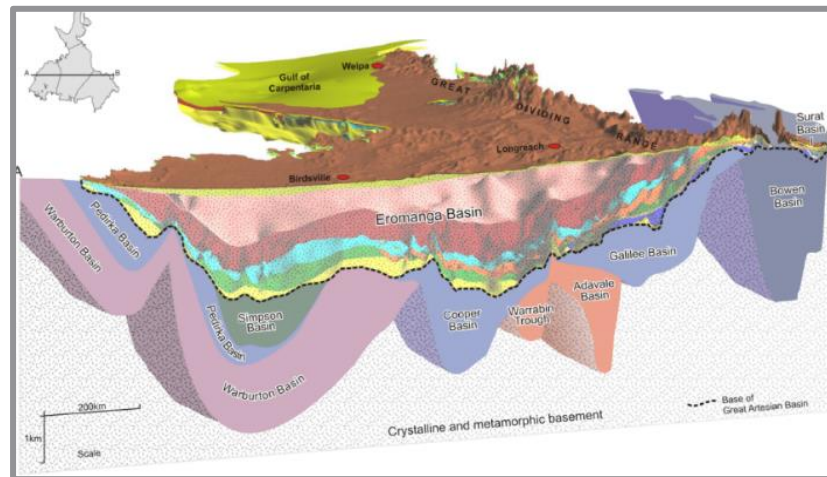




A Regional Chronostratigraphic Framework for Play-Based Resource Assessments in the Eromanga Basin

Barry Bradshaw, Nadege Rollet,
Jeremy Iwanec, Tom Bernecker



Play Based Resource Assessments

GTS2012																																		
Age (Ma)	Era	Sub-Era Period	Epoch	Stage	Spore-Pollen Zones		Dinocyst Zones		Regional Play Intervals		Regional Picks SUMMARY SET																							
					modified from Partridge, 2006		modified from Partridge, 2006		Intervals	Sub-plays	New, 2010																							
120	CRETACEOUS	Early	Early	Aptian	<i>C. hughesii</i>	<i>B. limbatus</i> Zone of Backhouse 1988	<i>D. davidii</i>	U	K40																									
							<i>O. operculata</i>						L			K40.0 SB (KA)																		
126.3				Barremian	<i>F. wonthaggiensis</i>			<i>M. australis</i>				K30																						
130.8																Hauterivian		<i>M. testudinaria</i>																
133.9																										<i>P. burgeri</i>		<i>S. tabulata</i>						
135				Valanginian								K20																						
																<i>R. australiensis</i>																		
139.4				Berriasian						Upper	<i>E. torynum</i>		K10																					
											<i>B. reticulatum</i>					15.0-19.0			K16.0 SB (DLS15)															
	<i>D. lobispinosum</i>	10.0-14.0									K15.0 SB (DLS5)																							
	<i>C. delicata</i>																																	
	<i>K. wisemani</i>										K10.2 MFS (K)																							
140						Lower																												

NWS Early Cretaceous regional play intervals (Marshall and Lang, 2013)

- Systematic assessment of key risk elements for regional play intervals within an area of interest (basin/stacked basins) based on reservoir-seal pairs bounded by unconformities and regional flooding surfaces linked to tectonostratigraphic events



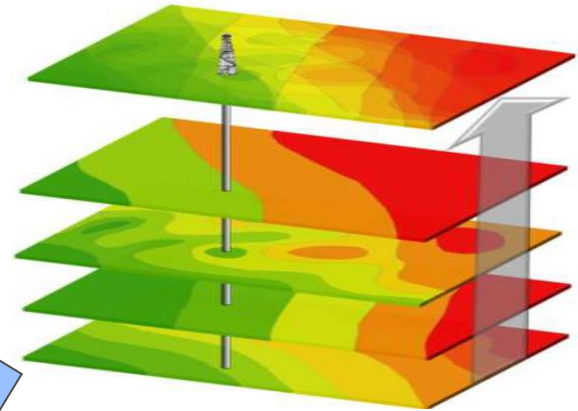
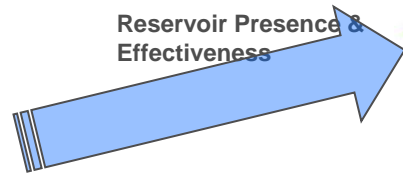
Result
Play fairway map (shows overall play risk)

Charge (hydrocarbons)

Trap Presence

Seal Presence & Effectiveness

Reservoir Presence & Effectiveness



(Longley & Brown, 2016; Cockerill, 2019)

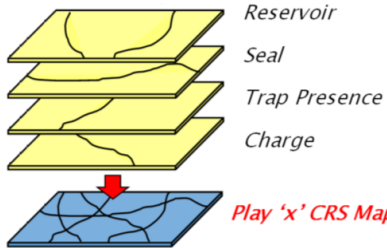
Geoscience Australia's Play-Based Resource Assessments

Conventional Hydrocarbons

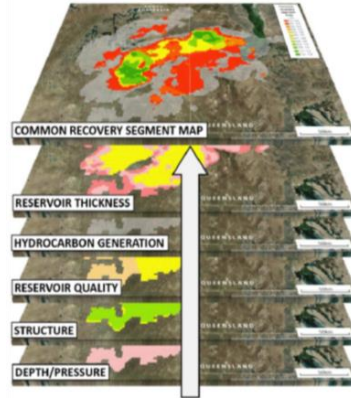
Unconventional Hydrocarbons

Geological Storage
(Carbon Capture & Storage, Hydrogen)

Groundwater & Other Sediment Hosted Resources

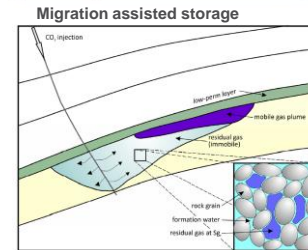
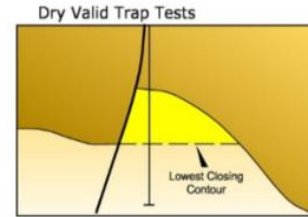


(Longley & Brown, 2016)

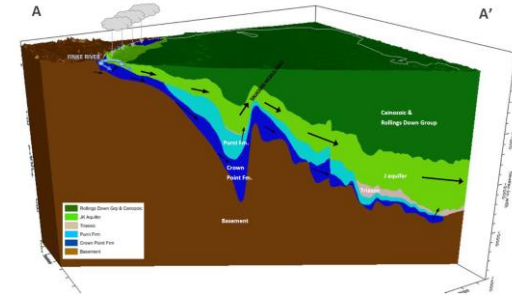


Common Recovery Segment Mapping

(Cockerill, 2019)

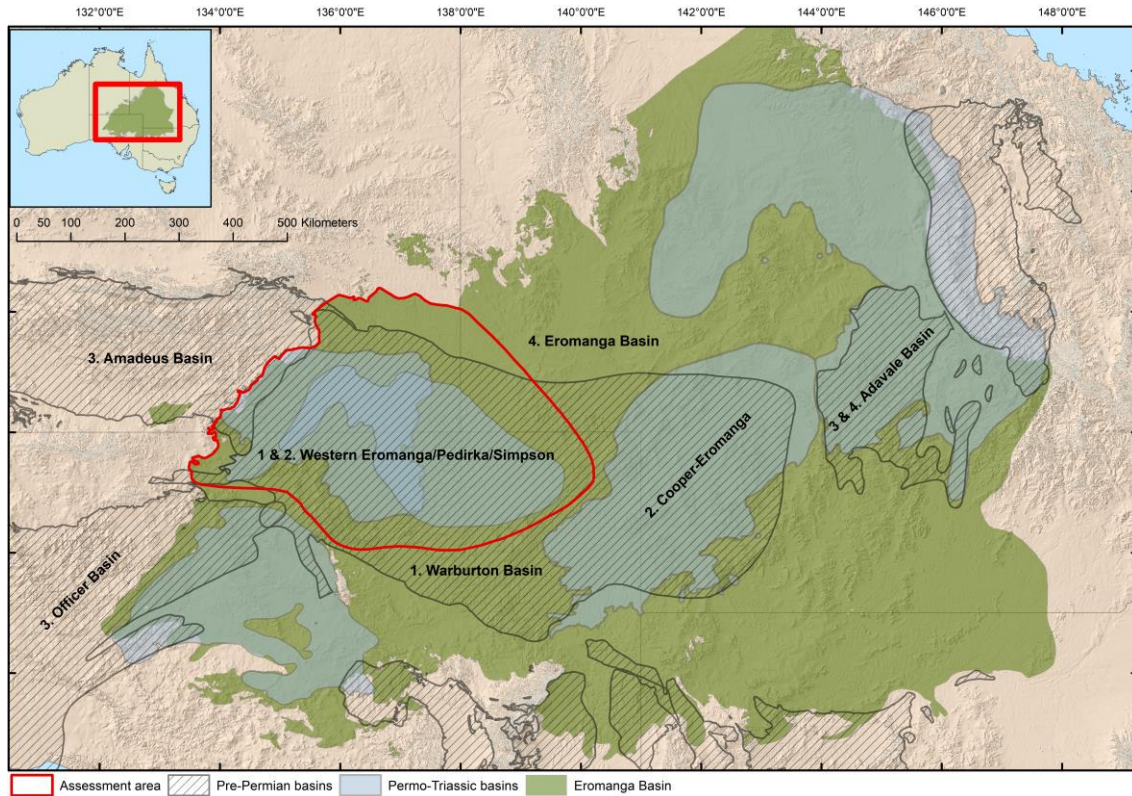


(Bradshaw et al, 2009)



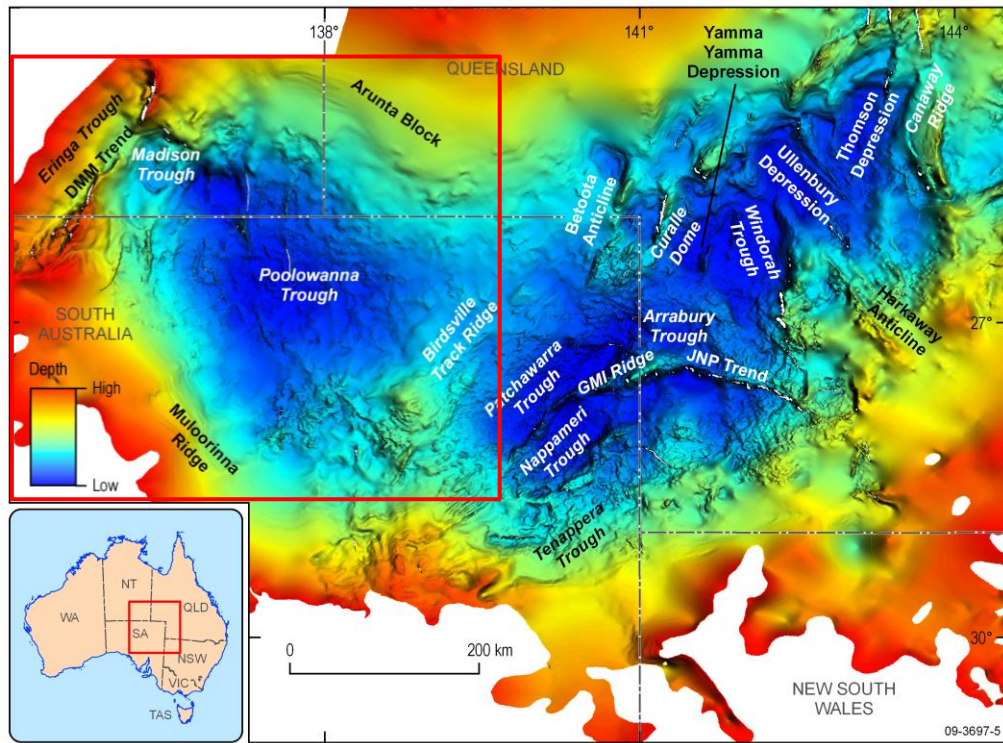
(Peat & Yan, 2015)

Australia's Future Energy Resources Project



- Investigating 'Yet To Find' Energy Resources as part of the [Exploring for the Future Program](#)
- Collaborative project with SA DEM, NTGS & industry stakeholders
- Project components include:
 1. play-based assessments of hydrocarbon, CCS and groundwater resources in western Eromanga and underlying basins ([this paper](#))
 2. potential for EOR in residual oil zones ([poster – Kalinowski et al](#))
 3. hydrogen resources and storage opportunities
 4. basin inventories

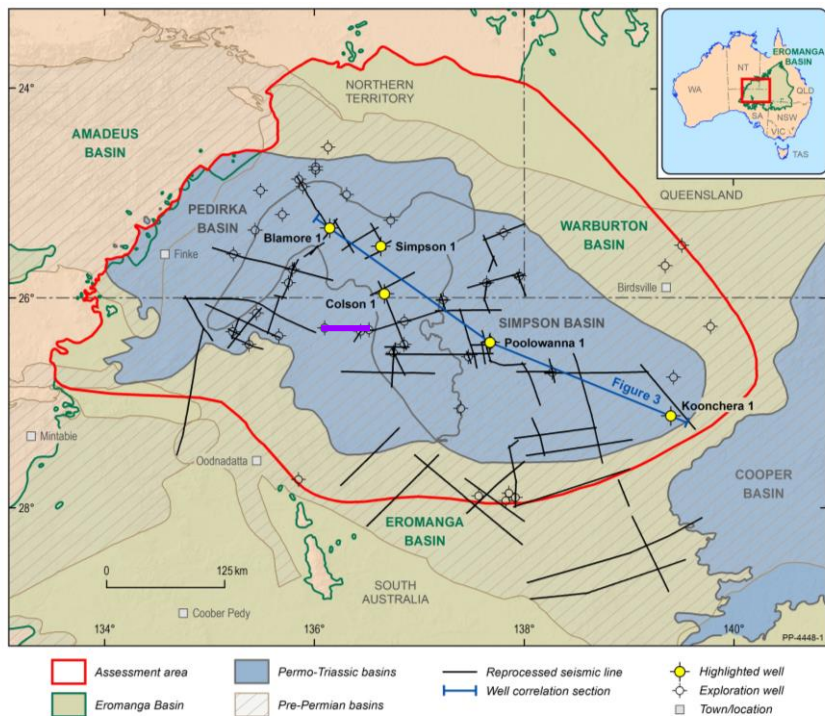
Eromanga Basin – Regional Geological Framework



Eromanga Basin structural elements on Cretaceous 'C' horizon (Radke, 2009)

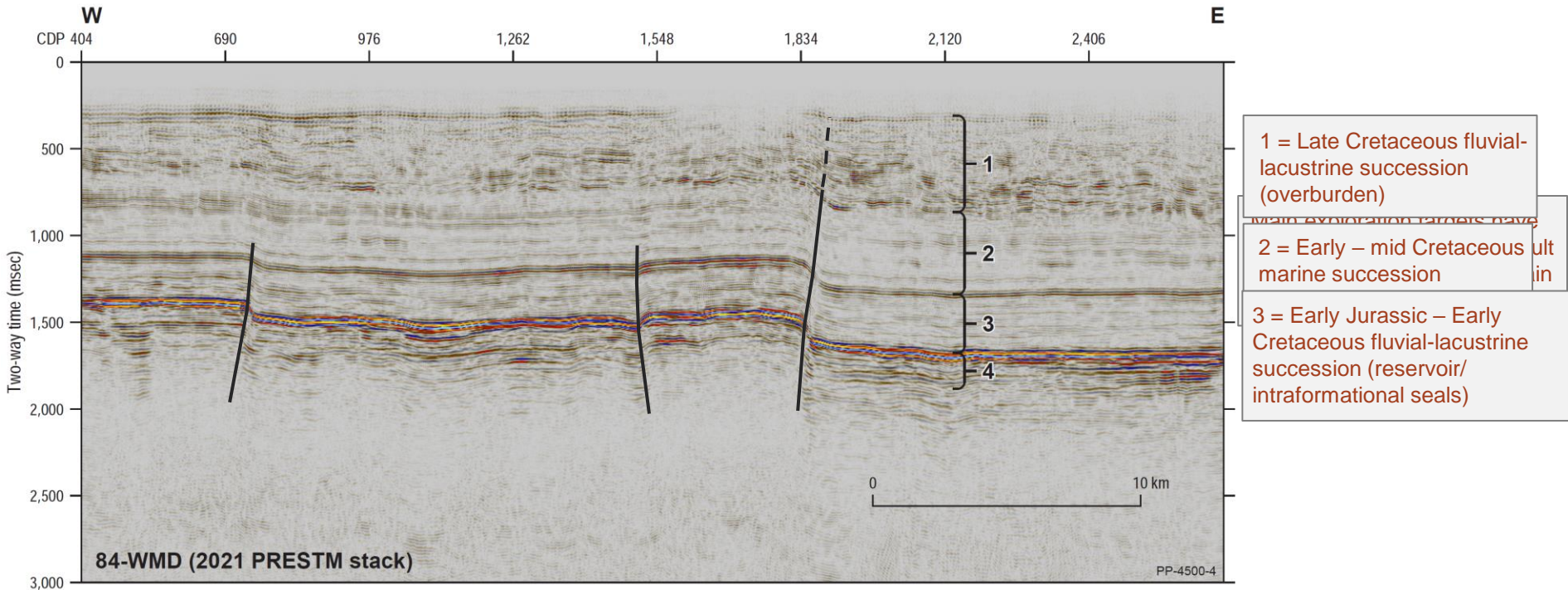
- Large Jurassic to Cretaceous age intracratonic basin (1,000,000 km²)
 - Tectonostratigraphic evolution driven by regional tectonic activity along the convergent eastern Australian margin (mantle driven dynamic topography – e.g. Harrington et al. 2019)
- Main tectonic elements in the western Eromanga include the Poolowanna Trough, Birdsville Track Ridge and Erimba Trough
 - up to 3,000m of sediments deposited in Poolowanna Trough

Western Eromanga Basin – Exploration History



- Western Eromanga Basin and underlying Permo-Triassic basins underexplored
 - 43 petroleum wells drilled;
 - 15,000 km of 2D seismic data (mostly 60s, 70s and 80s vintage);
 - GA reprocessing ~3,750 km of data
- Oil recovered from Triassic and Jurassic reservoirs at Poolowanna 1 (residual oil in Blamore 1, Colson 1, Simpson 1)
- Central Petroleum CSG exploration (2008–10; result = undersaturated coals)
- Tri Star and BR Simpson currently exploring other unconventional and CCS opportunities

Poolowanna Trough – Reprocessed Seismic Section



1 Late Cretaceous (non-marine)

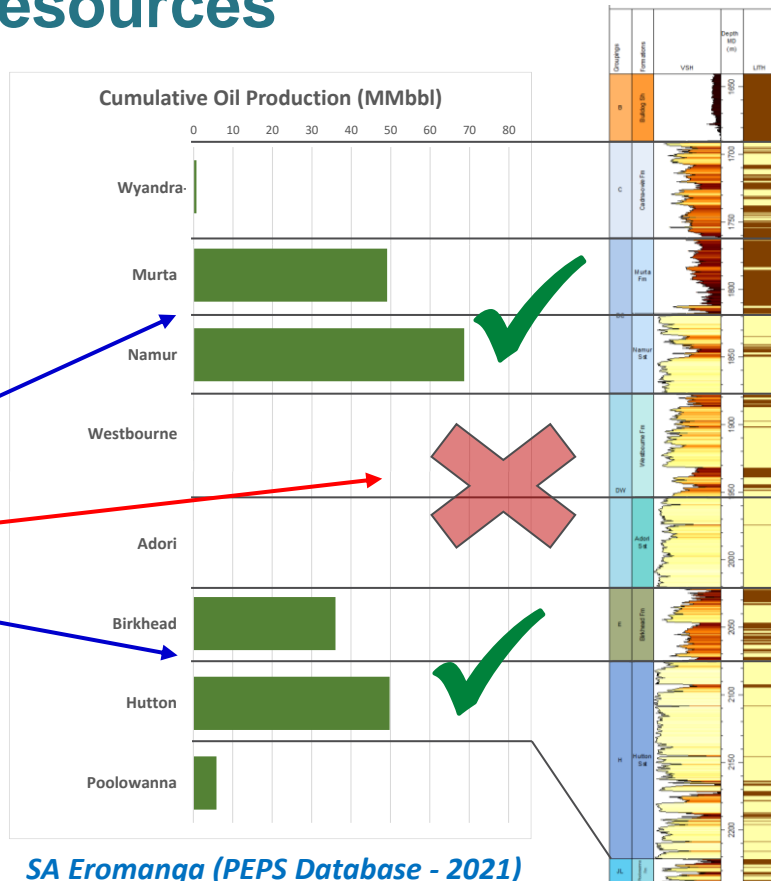
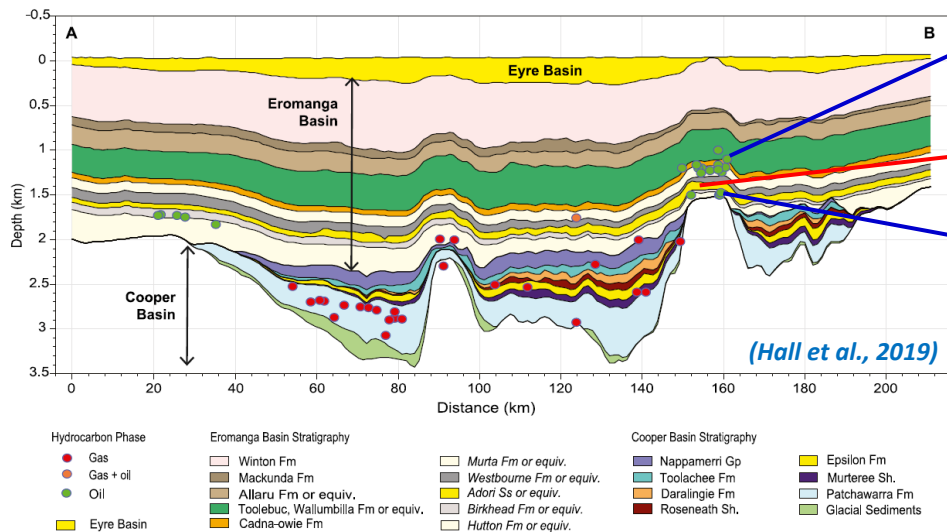
2 Early Cretaceous (marine)

3 Early Jurassic–Early Cretaceous (non-marine)

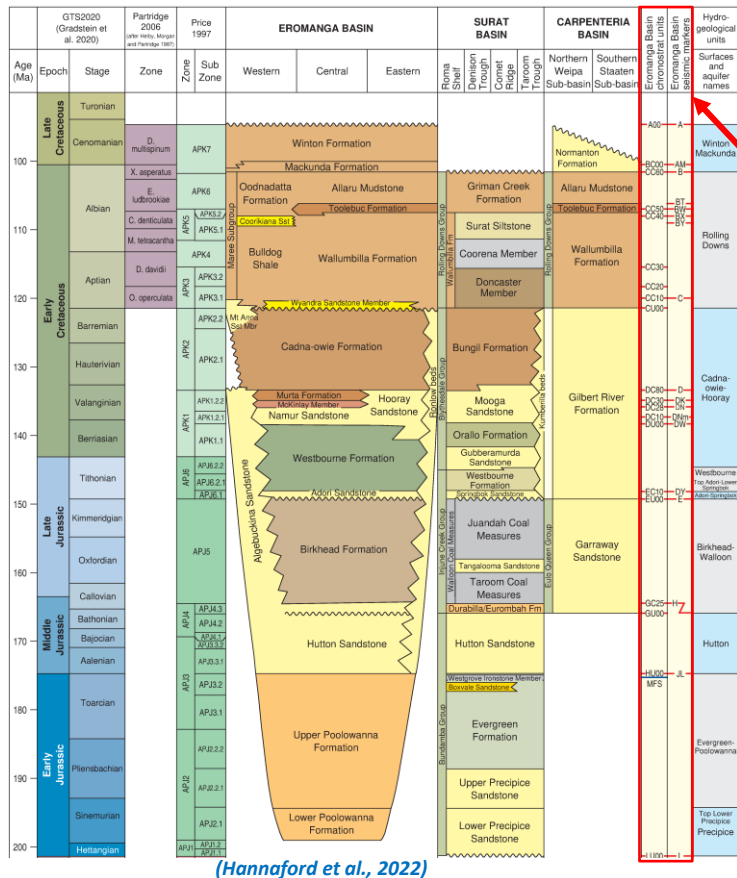
4 Permian (non-marine)

Eromanga Basin – Petroleum Resources

- About 215 MMbbl of oil produced from Early–Middle Jurassic and Early Cretaceous reservoirs in the South Australian part of the Eromanga Basin (oil-prone basin)
- Evidence for ‘leaky’ intraformational seals with Birkhead Fm and Murta Fm containing significant oil, and no oil trapped in the Adori Sandstone



Geoscience Australia's Revised Chronostratigraphy



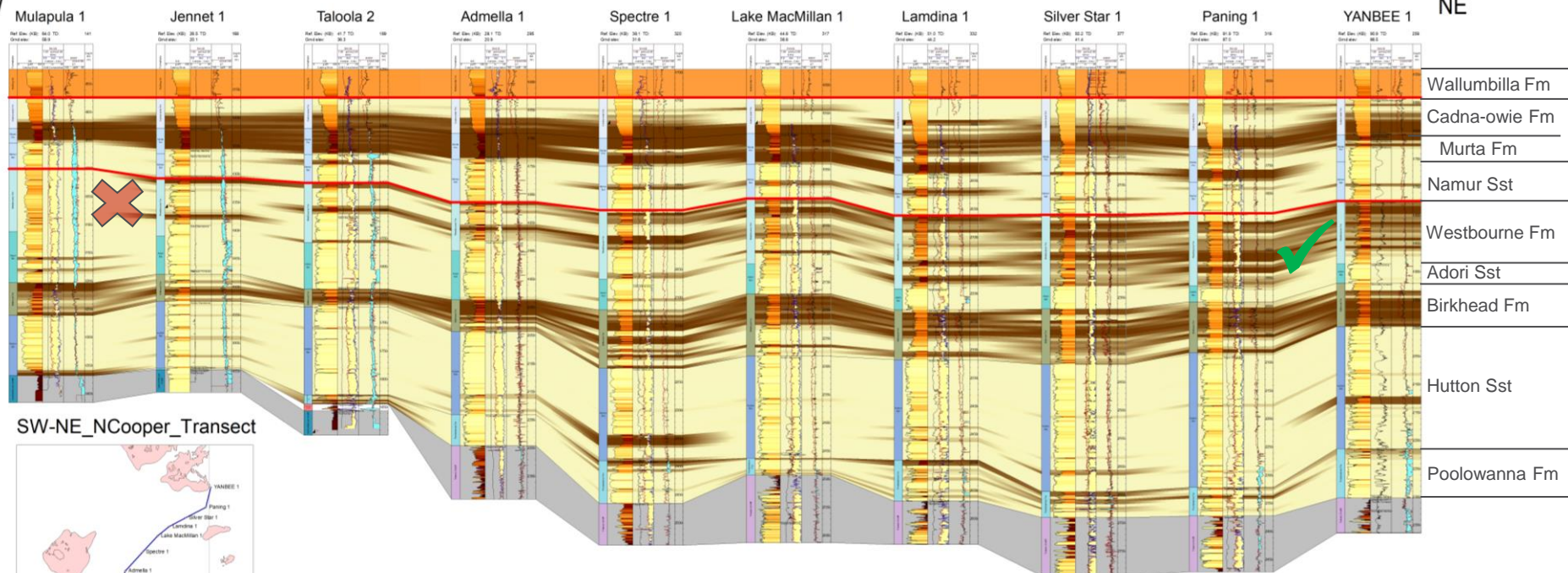
(Hannaford et al., 2022)

- GA's Great Artesian Basin Groundwater Project has recently published a chronostratigraphic framework for the Eromanga, Surat and Carpentaria basins
 - links lithostratigraphic units to regional chronostratigraphic markers ('Santos' surfaces)
- Improved understanding of geological characterisation for hydrogeological units
 - lateral and vertical facies variations
 - compartmentalisation vs connectivity of aquifers
- Results provide improved understanding of regional geological framework for groundwater, petroleum and CCS resources

Geoscience Australia's Great Artesian Basin Project

SW

NE



Regional cross-section highlighting heterogeneity in regional reservoir (aquifer) and seal (aquitard) intervals (from Norton and Rollet, 2022)

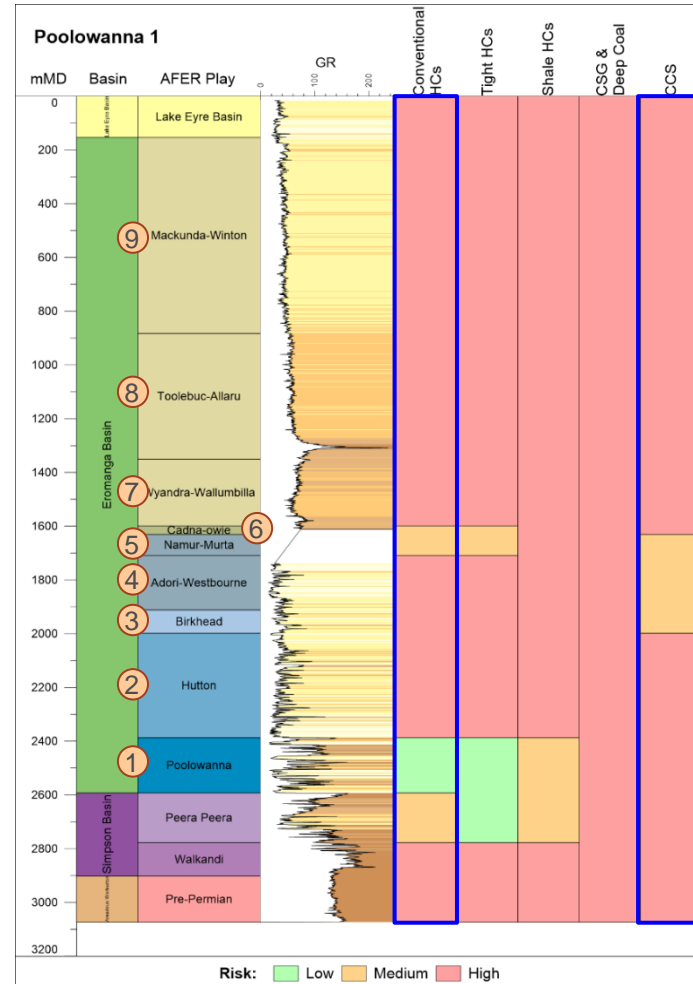
Eromanga Basin Play Scheme

- Eromanga play intervals defined using chronostratigraphic framework published in GA's Great Artesian Basin Groundwater Study
 - Nine regional play intervals named after main component stratigraphic units
 - Six bounding surfaces are regional unconformities ('U'), other four play interval boundaries relate to regional transgressive or flooding events
- North West Shelf play scheme of Marshall & Lang (2013) tested but rarely get a one-to-one correlation of play intervals between Eromanga Basin and North West Shelf

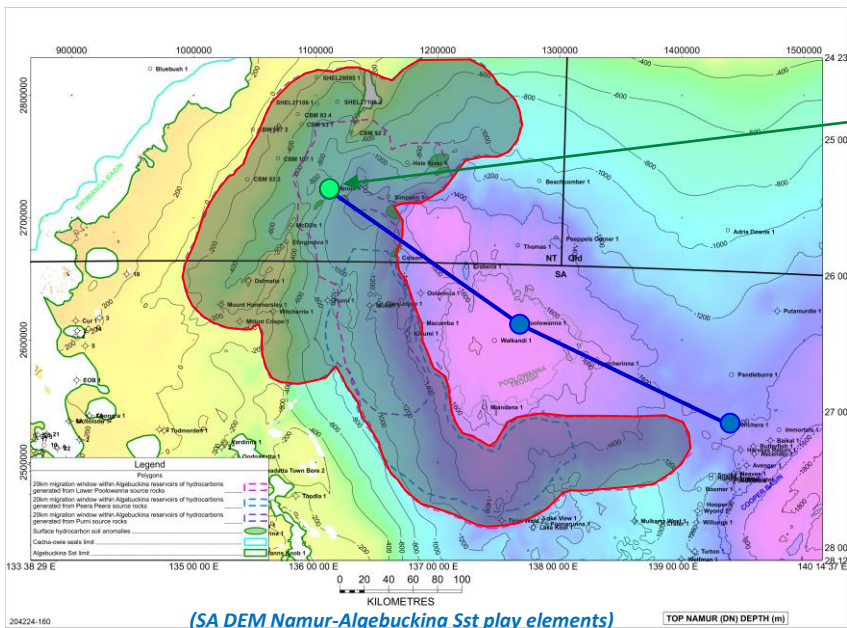
Eromanga Basin chronostratigraphic units	This study	Marshall and Lang (2013)	
	Eromanga play interval	NWS play interval	NWS surfaces
	A00		K50.0 SB
9	Makunda-Winton CC60	?	K47.1 TS
8	Todebec-Allaru CC40	? K40	K43.0 SB
7	Wyandra-Wailumbilla		K42.0 SB
	CU00		K40.0 SB
6	Cadna-owie DC80	K30	K30.2 MFS
		? K20	
5	Namur-Murta DU00		K20.1 TS K20.0 SB
		K10	K13.2 MFS K10.2 MFS
4	Adori-Westbourne EU00	J50	K10.0 SB J53.0 SB J50.0 SB
3	Birkhead GC25	J40	J47.0 SB J40.0 SB
		J30	J30.1 TS
			J29.0 SB J28.0 SB J27.0 SB
2	Hutton HU00		J26.2 MFS J25.2 MFS
		J20	J25.0 SB J24.2 MFS J24.0 SB
1	Pootowanna LU00		J20.2 MFS J20.1 TS
		J10	J20.0 SB J12.0 SB
		TR30	J10.0 SB
			TR30.1 TS
		TR20	

Post Drill Analysis – Poolowanna 1

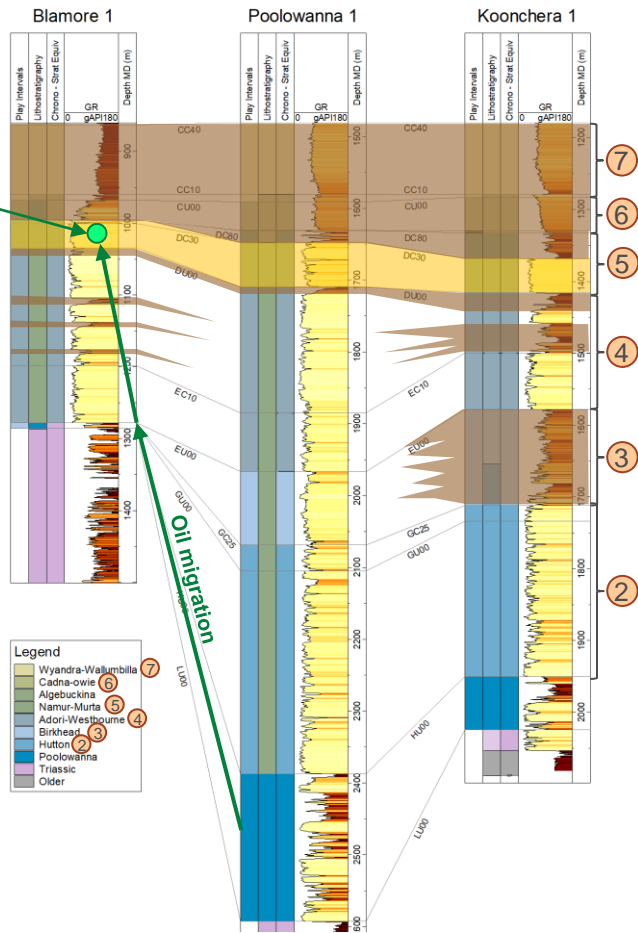
- Post Drill Analysis (PDA) is being conducted on 43 petroleum wells using the Player software by GIS-Pax™ to systematically evaluate the presence and effectiveness for the main conventional petroleum systems' play elements (reservoir, seal, trap and charge)
 - Results at Poolowanna 1 show proven play in Poolowanna interval and potential play in Namur-Murta interval
- Methodology to assess conventional hydrocarbons has been modified to assess the elements and criteria essential for unconventional petroleum resources and CCS potential
 - Potential CO₂ geological storage play in Namur-Murta, Adori-Westbourne and Birkhead intervals



Middle Jurassic – E. Cretaceous Plays



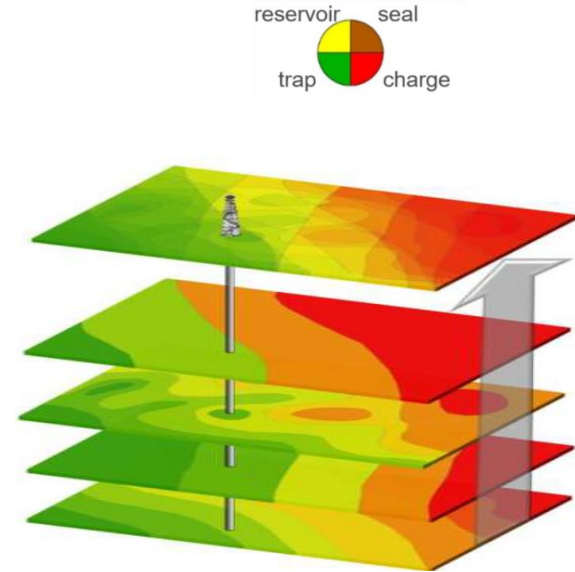
Residual oil column



- Marine siltstones and shales from Cadna-owie & Wyandra-Wallumbilla form regional seal to conventional hydrocarbon play (Namur-Murta) – residual oil at Blamore 1
- Stacked plays over eastern flanks of Poolowanna Trough & Birdsville Track Ridge – fluvial sheet and channel sandstones sealed by lacustrine shales
 - CCS potential & additional conventional plays?

Summary

- Geoscience Australia is using a play-based exploration approach to systematically evaluate the ‘yet to find’ energy resources in the western Eromanga Basin and other priority basin areas
 - key requirement is to develop a chronostratigraphic based regional play scheme
- A Jurassic–Cretaceous chronostratigraphic framework has recently been developed by Geoscience Australia, which is used to define nine regional play intervals bounded by sequence stratigraphic surfaces (unconformities and flooding surfaces)
- Regional play interval interpretations shows significant variation in the presence and effectiveness of Middle Jurassic–Early Cretaceous reservoirs and seals across the Poolowanna Trough
 - preliminary post drill analysis suggests potential for new hydrocarbon plays and CO₂ geological storage plays



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For more on this topic

- Visit our team at the Australian Government booth, 82
- EFTF Program: <https://www.ga.gov.au/eftf>
- Great Artesian Basin Groundwater Project <http://www.ga.gov.au/scientific-topics/water/groundwater/gab>