SA is situated between the Archaean Shield and eastern orogenic belts. As a result, the State’s geological record has preserved a unique history of sedimentation from Proterozoic - Ordovician and from Early Devonian - Cenozoic.
URAPUNGAN - Mesoproterozoic
- McArthur Basin

CENTRALIAN - Neoproterozoic
- Amadeus (NT), Officer

LARAPINTINE - Early Palaeozoic
- tropical seaways, marine source rocks from Australia to China

GONDWANAN - Late Palaeozoic
- mountain building, glaciation
- extensive and thick coal measures

WESTRALIAN, MURTA, AUSTRAL - Mesozoic
- Gondwana break up
- oil & gas in rifted margins
- Intracratonic basins

CAPRICORN - Eocene
- Oil shales in rifts
- Carbonate system

From Bradshaw (2016)
2/3 world’s known conventional petroleum resources are generated from Jurassic-Cretaceous source rocks.
Petroleum wells and seismic survey coverage
Oil and Gas shows in SA basins

Bona fide oil shows discovered in many frontier basins which remain only lightly explored.

Santos Wilkatana 1 (1955): Cambrian oil shows focussed interest on SA

‘Alf Flat 1’ drilled to 7.6 m depth in 1866-68. First oil well in Australia.

Reconstruction of steam powered rig used near Salt Creek
SA’s petroleum systems

CENTRALIAN - Neoproterozoic
- Amadeus (NT), Officer

LARAPINTINE - Early Palaeozoic
- tropical seaways, marine source rocks from Australia to China

GONDWANAN - Late Palaeozoic
- mountain building, glaciation
- extensive and thick coal measures

MURTA - Mesozoic
- Gondwana break up
- Intracratonic basins – Jurassic non-marine deposition, E Cret. marine then
Proterozoic basins

**MESOPROTEROZOIC**

**URAPUNGAN PETROLEUM SYSTEM**
No evidence of viable petroleum systems in SA, unlike the NT’s McArthur Basin.

**NEOPROTEROZOIC**

**CENTRALIAN PETROLEUM SYSTEM**
Widespread marine to non-marine deposition, in a rift setting, minor igneous activity. *Adelaide Fold Belt* - potential source rocks, reservoirs, seals, shale gas plays, but folded, faulted, uplifted – preservation risk. Blinman 2 recorded traces of gas in 1992. *Officer Basin* – widespread oil shows, oil bleeds indicate viable source rocks, reservoirs, seals (salt) and traps – timing, preservation?
CENTRALIAN PETROLEUM SYSTEM

Shows – oil shows across basin and stratigraphy (bleeds, staining, fluorescence).

At least 2 Neoproterozoic petroleum systems identified (McKirdy & Tingate, 2003).

Source – black pyritic shales
Reservoir – sandstone and carbonate
Seal – marine shale and salt
Traps – variety of structural styles, salt diapirs
Migration – shows
Preservation risk in some areas due to Peterman Ranges Orogeny, Delamerian Orogeny and Alice Springs Orogeny.

Pindyin Sandstone
Porosity = 22.6% Permeability = 1.5 Darcies

Officer Basin

Seals

Charge

Reservoir

Observable Hill Fm. 219.75m
Cambrian – Ordovician

**LARAPINTINE PETROLEUM SYSTEM**
Low latitudes, marine shale and carbonates, volcanism, intrusions, orogeny.

**Officer Basin** – 2 Cambrian petroleum systems identified by McKirdy and Tingate (2003).


**Arrowie Basin** – oil shows at Wilkatana and gas shows in Moorowie 1, potential marine shale and carbonate source rocks. Trap preservation? Lightly explored.

**Stansbury Basin** – traces of oil recorded. Trap preservation? Lightly explored for oil and gas as well as gas storage.
Late Carboniferous to Triassic basins

**GONDWANAN** - Late Palaeozoic
**Most productive onshore Petroleum System**

- High latitudes, mountain building, glaciation followed by extensive and thick coal deposition. Coals important source of Cooper Basin oil and gas.
- Coal measures in Pedirka and Arckaringa basins – CSG, conventional potential.
- Evidence of active petroleum system: Cooper Basin production, Pedirka - shows, Arckaringa – Stuart Range Fm shale oil play.
- Triassic coal in Poolowanna Trough, Cooper Basin and in small intramontaine basins (e.g. Telford, Springfield and Boolcunda basins).
Hydrocarbon Generation Potential

- Total hydrocarbons generated by formation and lithology: the best source rocks are the Patchawarra coals and coaly shales, followed by those of the Toolachee Formation
- Total Hydrocarbons generated from the Permian Gidgealpa Group > 2000 billion bbis oil equiv

*Hydrocarbon Generation by Formation and Lithology (bboe)*

*Permian HCs Generated (mmboe/km²)*

*From Dr Lisa Hall (GA) 2016*
Jurassic to Cretaceous basins

**MURTA PETROLEUM SYSTEM** - *Eromanga Basin* - extensive intracratonic deposition, thick depocentres – Cooper region (>3km) and Poolowanna Trough (>3 km). Excellent reservoirs, seals. Source – how much Eromanga oil vs oil from down-dip Permian? Oil shows in Poolowanna Trough. Structural & stratigraphic traps. E Cretaceous Toolebuc Fm oil shale? E Jurassic Poolowanna Fm?

**AUSTRAL PETROLEUM SYSTEM**
Southern rifted margin, Gondwana break up *Otway Basin* – massive thickness of sediment (>9km), oil shows & economic gas onshore, offshore asphaltite strandings and shows, fault seal risk. *Bight Basin* – 15km thick. Oil shows in Greenly 1, gas anomalies, GA’s Jurassic oil shale grab sample.
Figure 10.4 Schematic representation of the Patchawarra Trough showing the migration of oil towards the Patchawarra sub-crop margin and the increased susceptibility to water washing with exposure to the open aquifer system of the Great Artesian Basin (after Allen and Gordon, 2004; Emoke, 2009).
Cenozoic

Trap formation, migration.
Reactivations, uplift – traps breached in some basins.
Neotectonics.
Summary

URAPUNGAN – no evidence yet of viable petroleum system in SA.
CENTRALIAN – at least 2 potential petroleum systems identified in Officer Basin.
LARAPINTINE – at least 2 potential Cambrian petroleum systems identified in Officer Basin, elsewhere no evidence yet for viable Cambro-Ordovician petroleum systems.
GONDWANAN – Cooper Basin production, unconventional reservoir plays.
Potential in Pedirka and Arckaringa basins?
AUSTRAL AND MURTA – production from Eromanga (Cooper region) and Otway basins.
Potential for Eromanga oil beyond Cooper Basin margin - Poolowanna Fm? E. Cretaceous Toolebuc Fm oil shale potential in SA?
Potential for oil and unconventional reservoir plays in Otway Basin?
Potential for conventional oil and gas plays in Bight Basin?
Energy Resource Division is:

- Undertaking pre-competitive prospectivity research to better understand the State’s prospectivity and address critical uncertainties for priority basins - in collaboration with ASP, SACGER, GA, international (e.g. USGS) and interstate.
- Generating new datasets, reports and products – e.g. Cooper Basin Atlas. Otway Basin next for review and modelling using Trinity package.
- Collating data to build new models for all key SA basins. Review overlooked basins and plays.
- Developing new data products – e.g. PEPS-SA online, downloadable LAS well logs, seismic, more GIS data.

Please say G’day at the Australian stand to discuss further.
South Australia’s door is open.

- Rated most attractive petroleum jurisdiction in Australia by Fraser Institute
- Bight Basin attracting billions in exploration investment
- Cooper Basin remains Australia’s largest onshore oil and gas province
- A framework placing local companies into a global supply chain
- Australia’s first roadmap for unconventional gas projects
- Oil and gas roundtable with hundreds of members working to address priorities

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