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Why some players are leaving the Georgina Basin - while others remain

Good Oil 2015

Presented by Steve Newman

Formalities

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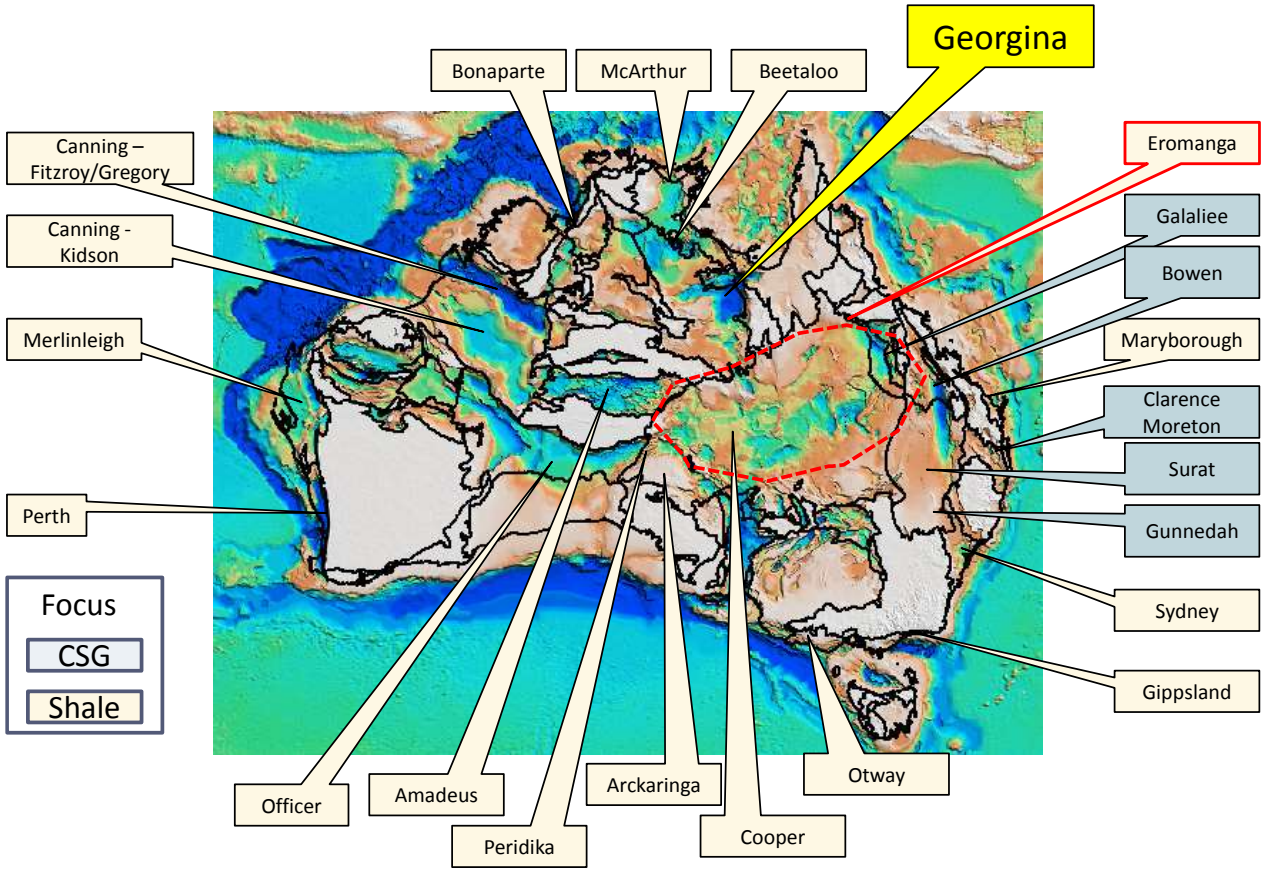
Onshore Basins in Australia



- Georgina is one of many basins onshore Australia which has potential for petroleum resources
- Basins have both conventional and unconventional potential
- Generally formed prior to Gondwana break-up in Jurassic and older than US unconventional plays

Australian Onshore Basin Players 2012

Basin	Local players	IOC players
Cooper	Beach, Senex, Cooper, Drillsearch, Icon, Origin, Rawson, Santos, Strike, NSE, Adelaide	BG, Chevron
Perth	AWE, Norwest. Origin, Empire, Titan	None
Maryborough	Blue, Adelaide	None
Canning (Fitzroy)	Buru	Mitsubishi
Canning (Kidson)	NSE, Green Rock, Oil Basins, Rey Resources, Kingsway	Hess, COP, Petrochina
Georgina	**Petrofrontier, Central, Wiso, Armour, Baraka, Blue Energy**	**Statoil, Total**
Betaloo	Falcon, Armour, Central, Amour, Pangea, Tamboran, Wiso, Imperial, Arafura	(Hess)
Eramanga	Exoma	CNOOC
Bonaparte	Advent, Beach	None
Amedeus	Central, Magellan, Santos	None
Arkaringar	Linc	None
Perdirka	Central, Santos Senex	None
Melinleigh	NSE	None
Sydney	AGL	None
Gippsland	Armour, Beach, Icon, lakes Oil, Somerton	None
Otway	Cooper, Beach, Somerton Armour, Adelaide, Rawson	None
McArthur	None	None
Officer	None	None

- Local players chasing conventional and unconventional opportunities
- International players mainly looking for the materiality of unconventional plays

The Georgina Basin

Remote and harsh environment

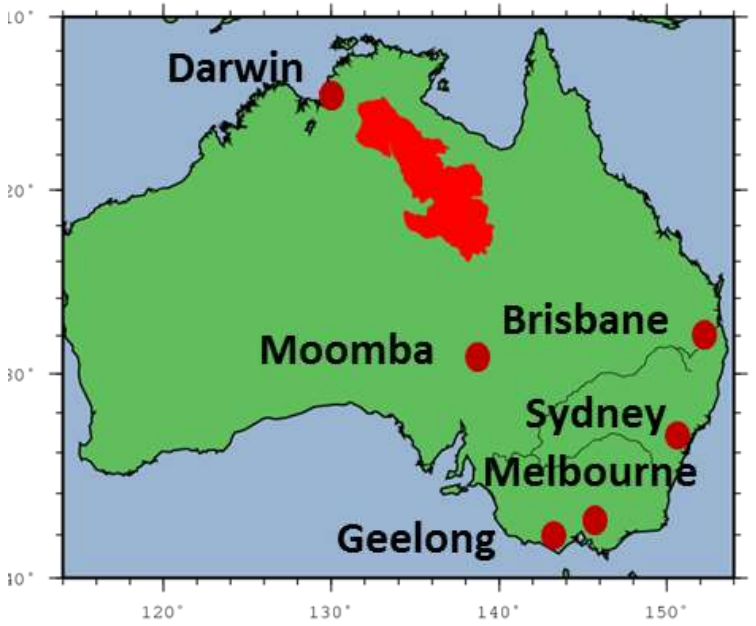
- Huge area covering ~325,000 km^2
- Mostly in the Northern Territory but also spills into Queensland.
- Sparsely populated with two small commercial centres located in Mount Isa and Alice Springs
- Heavy rainfall from December to March can isolate road network and restrict access

Commercial Options

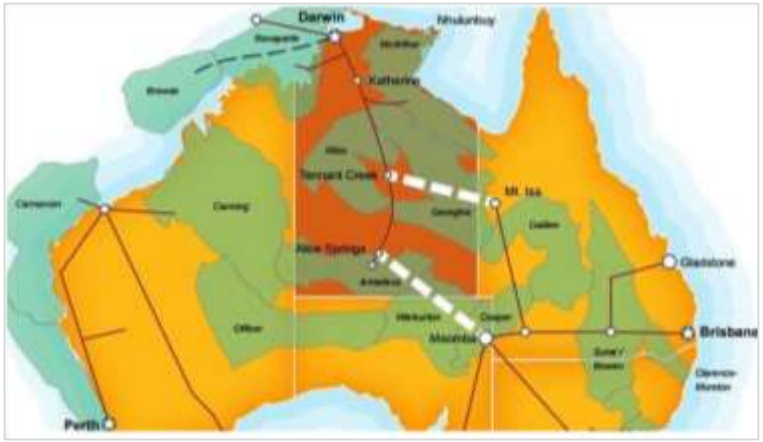
- Gas
  - New-build pipeline to support a development, either to Darwin or to connect with the eastern gas market - e.g. $1 billion North East Gas Interconnector
  - Development of small scale LNG into a local market such as Moomba
- Liquids
  - The supply chain would be long - e.g. trucking to Geelong

Substantial opportunity worth the challenges

- Prevailing view was that the Georgina Basin had substantial potential as a regional oil shale play

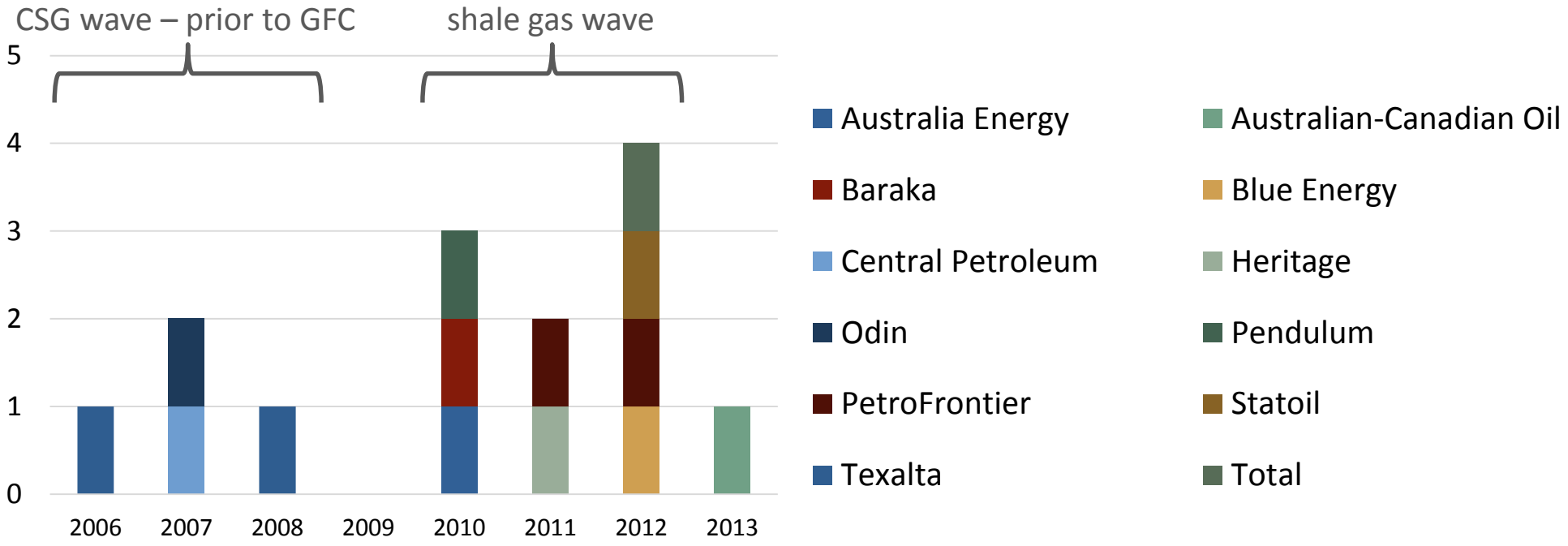


Proposed routes for NEGI (08/15)



Industry Activity in the Georgina Basin

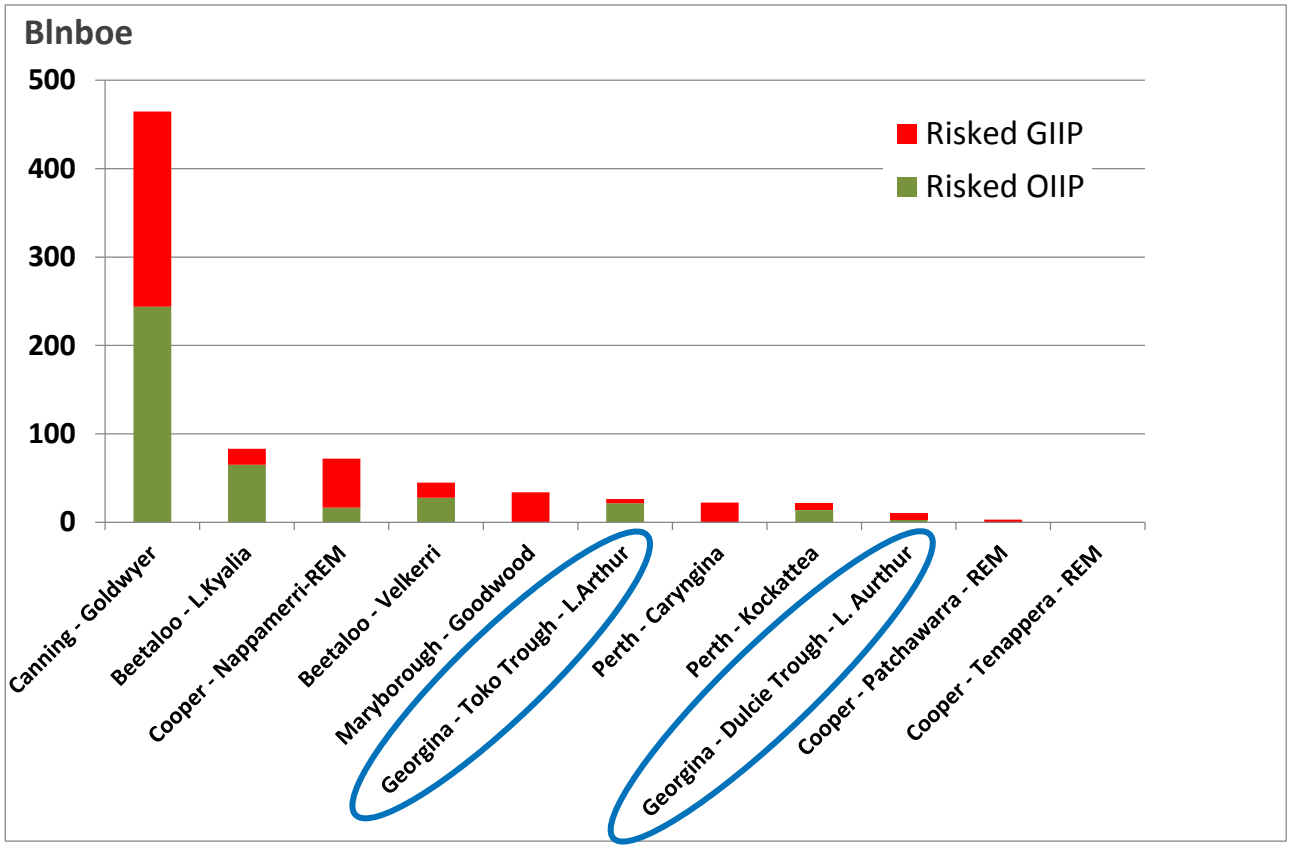
Number of transactions in Georgina Basin (IHS)



- The primary interests of larger players (Statoil, Total and PetroFrontier) in material unconventional play, analogous to the Bakken Shale
- APPEA 2014
  - Statoil presented at a five-well high-impact shale exploration program that it hoped would lead to a sizeable tight oil development
  - One well (Ozbeta-1) to be completed and tested
- Smaller players are interested in both unconventional and conventional plays

EIA Resource Estimates

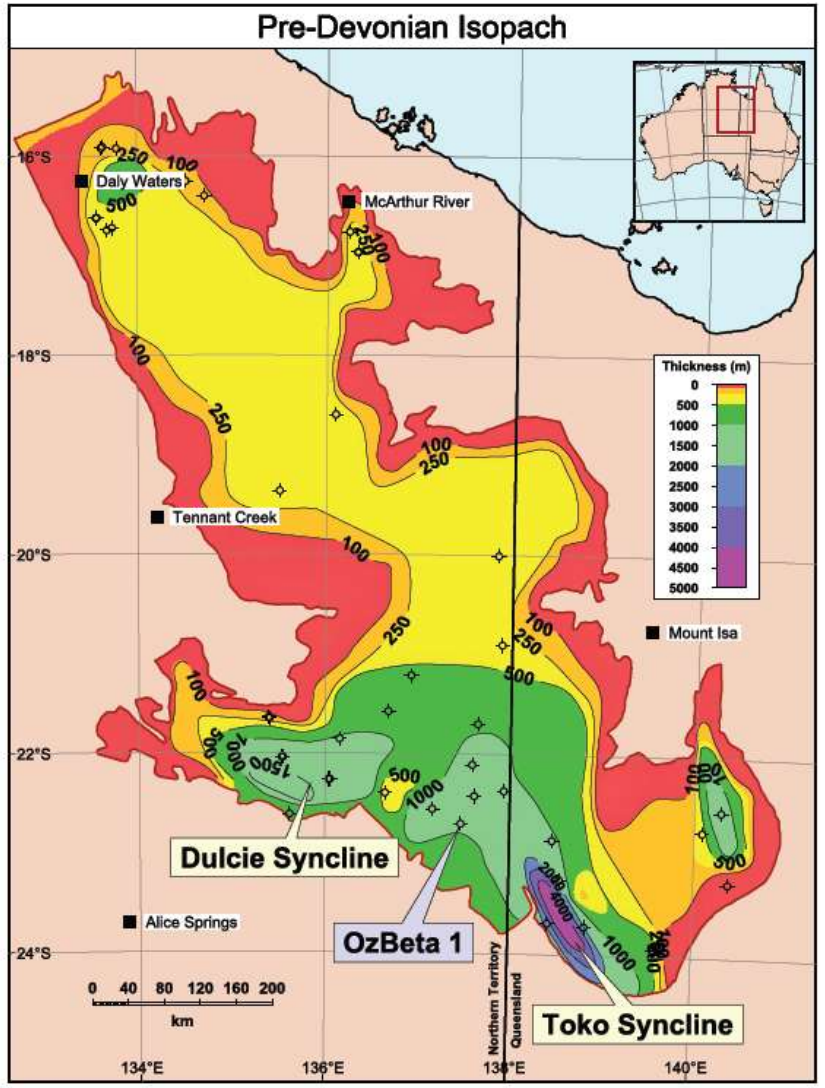
2013 EIA World Shale Gas Report



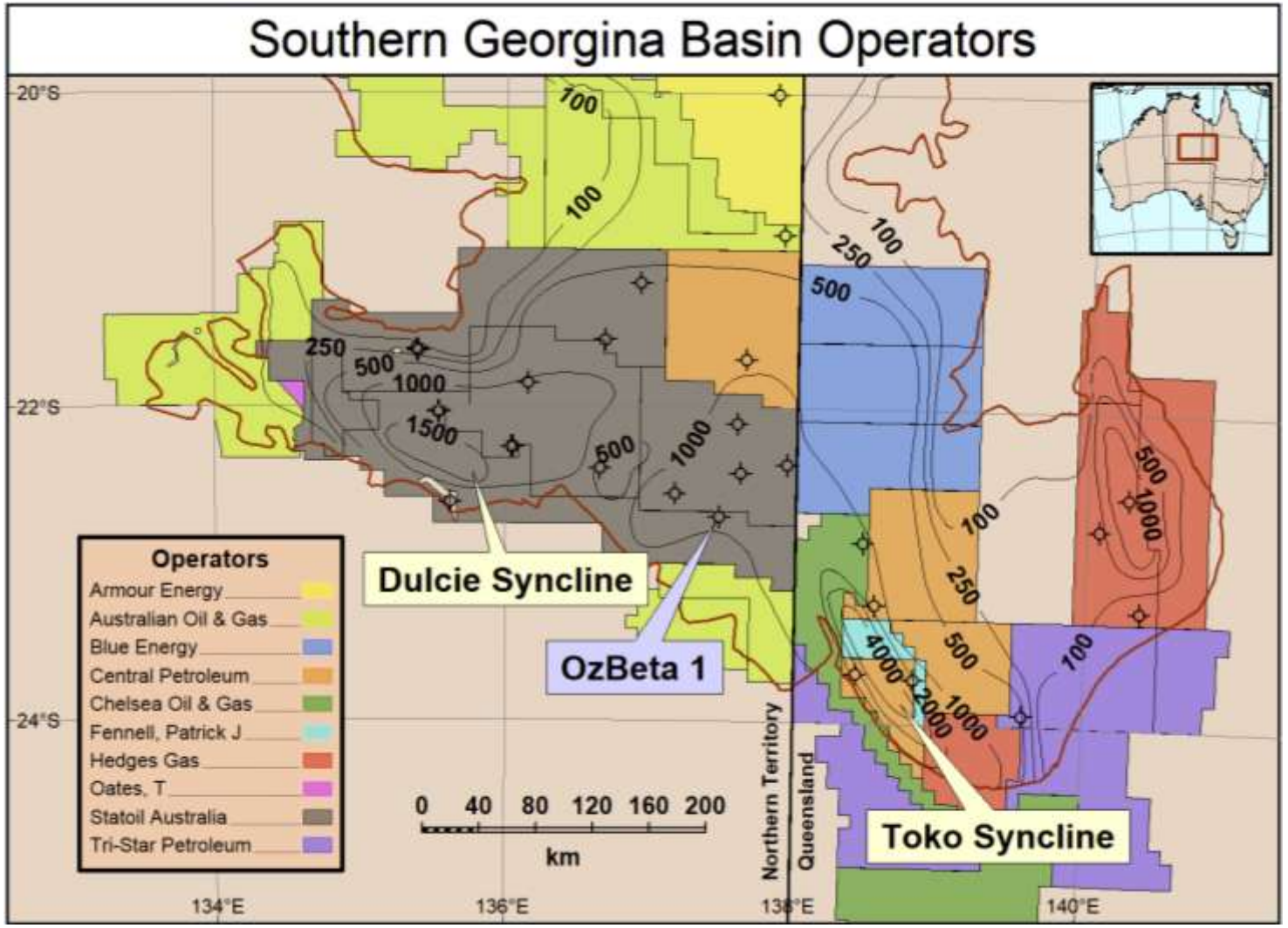
- Identified significant potential in Georgina Basin - particularly oil
- Carried risked in-place 25 billion barrels of shale oil and condensate and 67 Tcf of shale gas
- Supported ongoing investment activity

Prospective Area of the Georgina Basin

- Huge early palaeozoic, intra-cratonic basin
- It was even bigger! Present outline is an erosional remnant of a larger basin
- The northern two-thirds of the basin is shallow, rarely exceeding 400m in thickness and is perceived to have low prospectivity
- The basin deepens in the Dulcie and Toko Synclines in the south, reaching thicknesses of 1500m and 4000m respectively
- The south has seen the majority of the exploration activity and is where the industry players have taken up acreage
- Relatively immature – only ~ 40 exploration wells have been drilled
- Recent focus has been on unconventional targets
- Ozbeta-1 (2014) ideally located to test the unconventional potential



Georgina Basin Operators (2015)

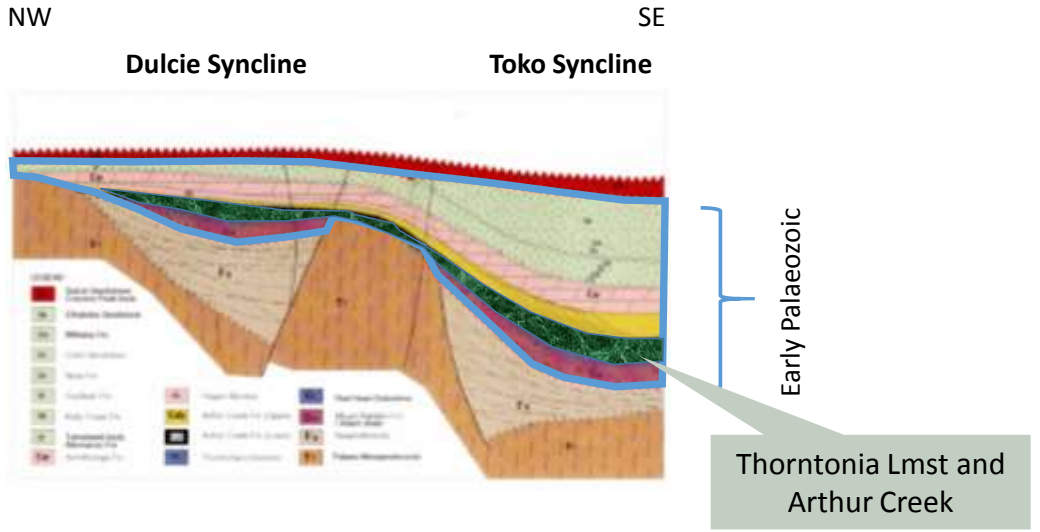


Concentration of activity over Dulcie and Toko Synclines

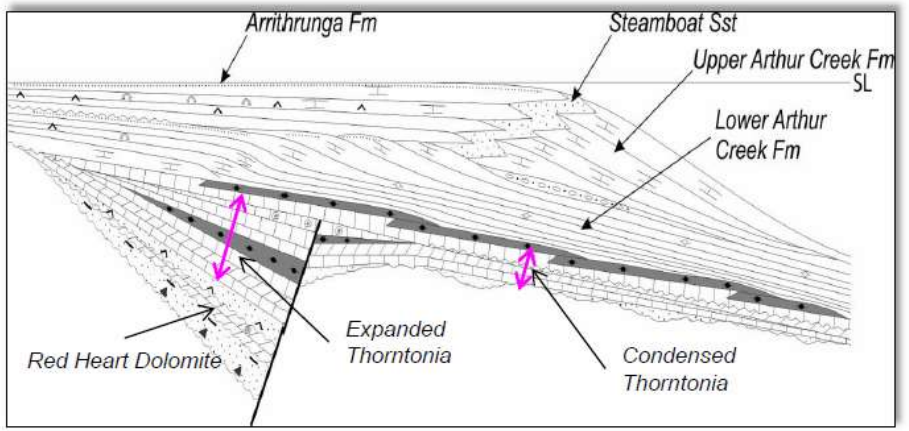
Tectonic History

- Basin was initiated during the early Cambrian
- A transgression in middle Cambrian led to the deposition of the Thorntonia Limestone and Arthur Creek Formation
- The Lower Arthur Creek Formation (Hot Shale) is rich in algal/bacterial organic matter
- Recent work suggests significant differences between the two depo-centres
- Followed by a thick interval of mixed carbonate and siliciclastic sediments in the late-Cambrian and Ordovician
- A number of tectonic episodes in the Ordovician and early Devonian caused uplift and erosion
- Followed by deposition of the Cravens Peak Beds in the Devonian
- **That's basically it!**

Ambrose et. al 2001



Willink et. al (APPEA 2015)



Arthur Creek Hot Shale

Excellent target for an unconventional oil play and a source for conventional targets:

- Between 20m and 100m thick
- Total organic carbons commonly making up 3 to 4 per cent and ranging up to 10 per cent
- Hydrogen index from wells indicates predominantly an oil prone source rock
- Geochemical analysis by Dunster et. al (2007), plus others, showed it to be oil mature over much of the basin

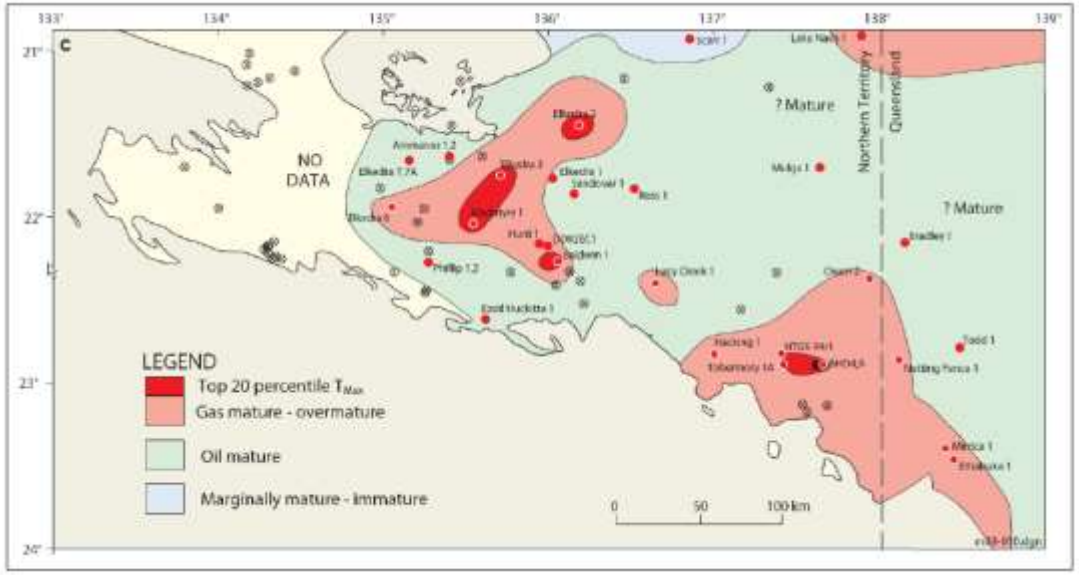
Geochemical analysis of well data

WELLS

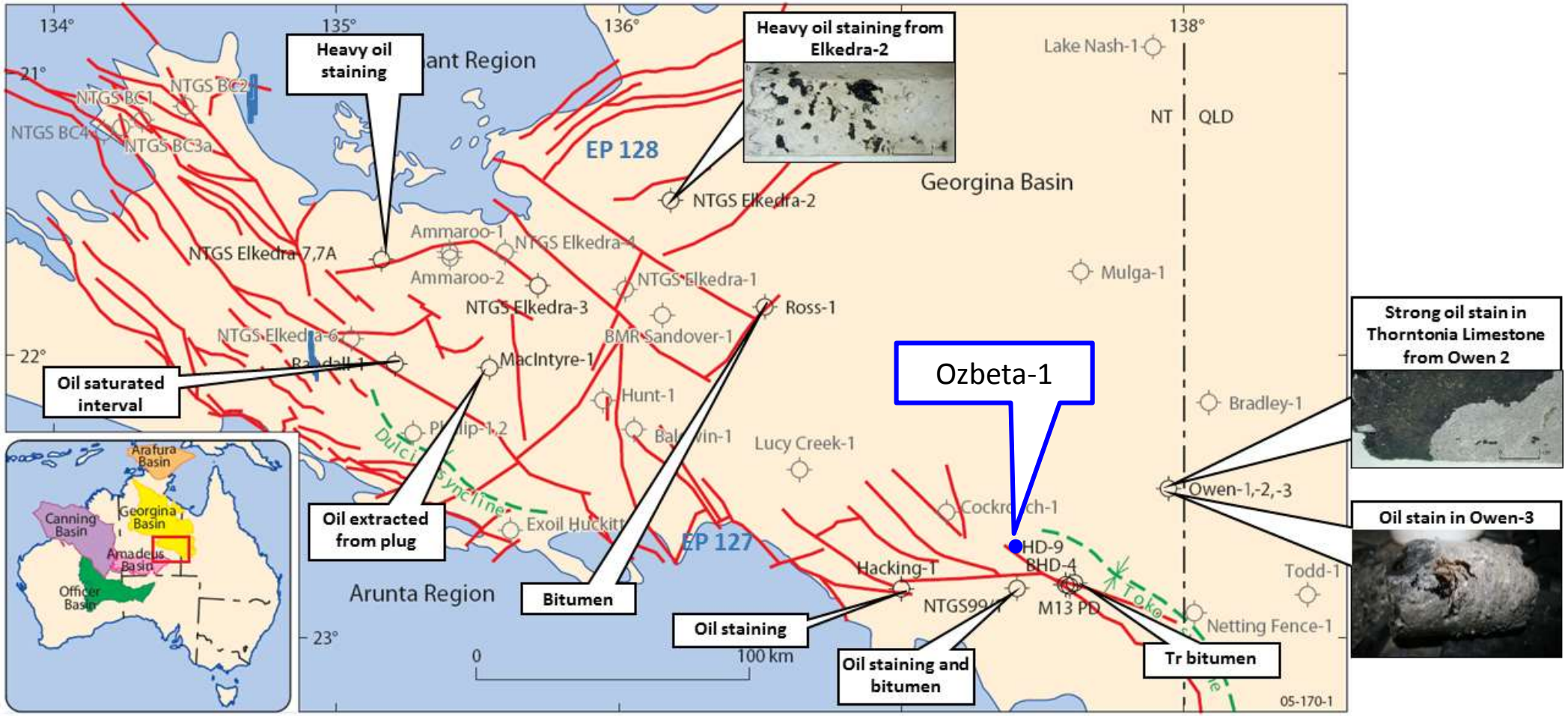
Sample	Well	Depth (m)	Formation	TOC	T_{Max}	S1	S2	S3	PI	HI	OI
20030378	Elkedra-3	106.8	Arthur Creek Formation	10.08	443	1.08	6.69	0.40	0.14	66	4
20030379	Hacking-1	1193.7	Arthur Creek Formation	1.85	463	0.52	1.16	0.01	0.31	63	0
20030380	MacIntyre-1	797.9	Arthur Creek Formation	3.57	461	0.62	2.08	0.47	0.23	58	13
20030381	Owen-2	995.3	Arthur Creek Formation	0.66	438	0.05	0.73	0.03	0.06	108	5
20030382	Owen-2	1019.85	Arthur Creek Formation	1.179	437	0.83	9.53	0.06	0.08	532	3
20030383	Owen-2	1049.3	Arthur Creek Formation	2.48	425	0.84	12.74	0.22	0.06	513	9
20030384	Elkedra-7A	282.7	Thorntonia Limestone	0.63	432	0.14	2.09	0.05	0.06	330	8
20030385	NTGS 99/1	575.9	Thorntonia Limestone	0.45	476	0.10	0.17	0.00	0.37	37	0
20030386	Owen-2	1076.1	Thorntonia Limestone	5.60	442	1.55	42.60	0.09	0.04	7.60	2

A look at the wells drilled in the Georgina Basin. *(Source: Boreham & Ambrose, 2007)*

Geochemical maturity map



Oil Shows

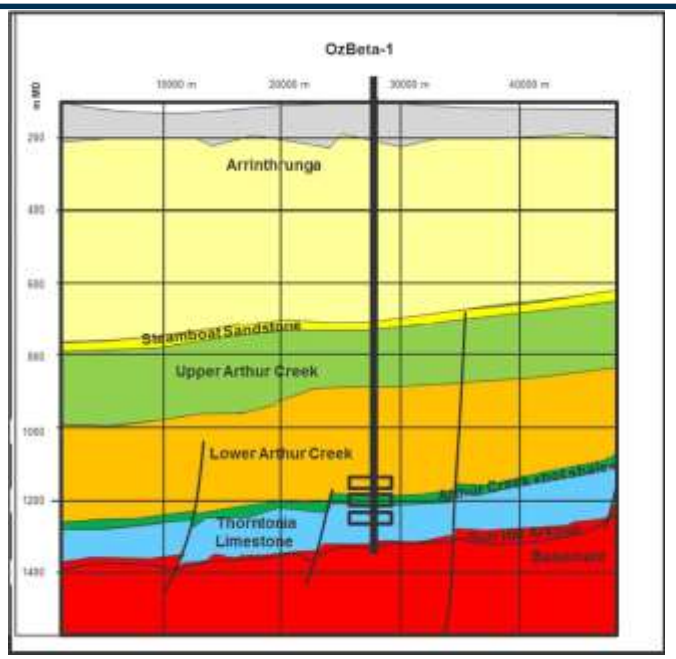


Source: Boreham & Ambrose, 2007

Strong support for oil potential from oil shows

Results from Ozbeta-1

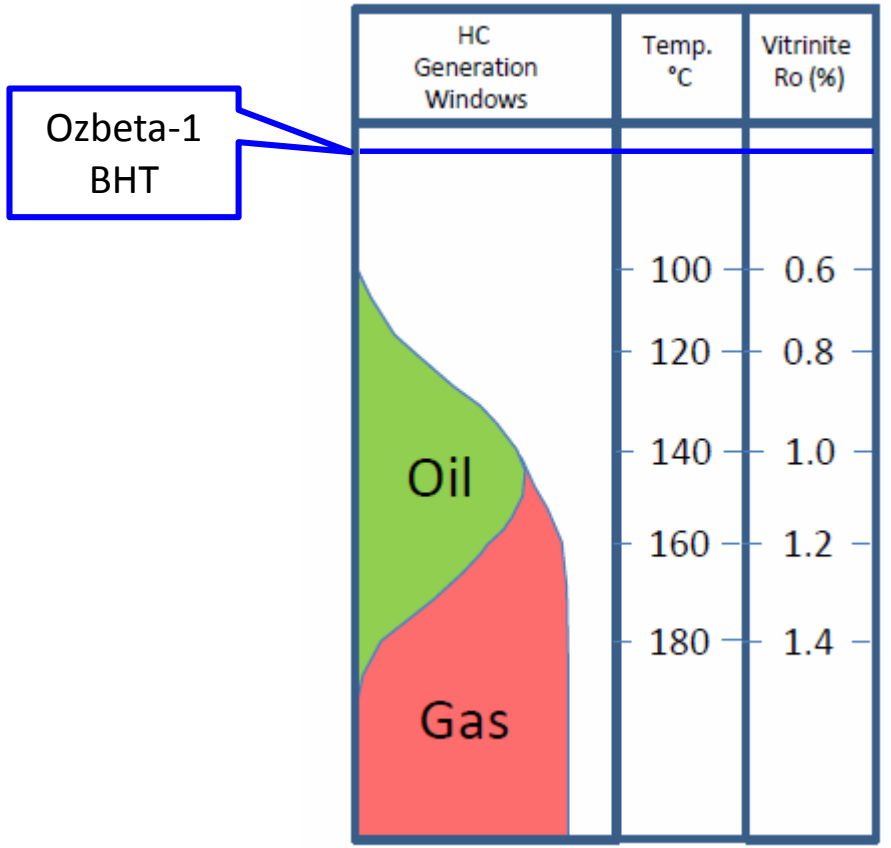
- Ozbeta-1 drilled by Statoil in May 2014
- Objective to de-risk the Arthur Creek Hot Shale and Thorntonia Limestone as unconventional targets by proving moveable hydrocarbons through testing
- Encountered the Arthur Creek Hot Shale at 1330m
- A single stage hydraulic frac was successfully completed but no oil or gas was detected
- Mud log data in the Arthur Creek Hot Shale showed low percentage of C1 and gold florescence which suggests mainly dead oil and no fluorescence was seen in core.
- The Thornton Limestone was more encouraging with vuggy porosity seen in core along with some fluorescence
- Suggested more heterogeneity in the source rock than previously thought
  - Encountered lower TOC and more gas prone source intervals than previously encountered in the basin
  - No surprise to Willink I'm sure!



Conclusions from Ozbeta-1

- Estimated bottom hole temperate is ~ 70-75 deg C and indicates that the Arthur Creek Hot Shale is not currently deep enough to generate hydrocarbons
  - Not surprising given its shallow depth (1330m)
- It was buried deeply in the Ordovician, when it would have generated oil and left maturity markers
- It was uplifted during the Ordovician and Devonian orogenies and has remained at essentially the same depth ever since
- It has been out of the oil generation window for the past 390 million years and has been subject to bio-degradation, leaving residual oil
- Essentially, it has put the dampers on the Arthur Creek Hot shale as a regional oil shale play

Typical oil and gas windows



The Future

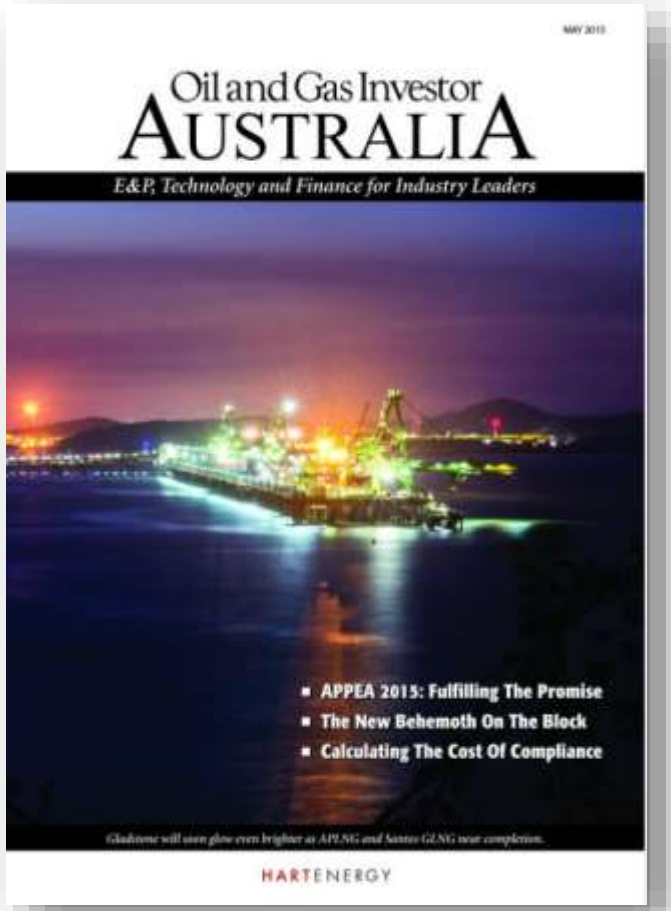
- The disappointing results of Ozbeta-1 have discouraged the industry players such as Statoil and PetroFrontier who were looking for material unconventional opportunities
- But there is still potential for smaller unconventional targets and conventional plays
  - The basin architecture is not fully defined and sweet spots may exist
  - The centre of the Toko Syncline could still be in the oil generation window and remains untested
  - Oil generation has clearly taken place, and so conventional traps could still work, if the accumulation has been left relatively undisturbed since the time of generation and migration
- We expect local companies to continue to pursue opportunities
  - Baraka is pursuing consolidation of ownership to 100% of EP127 and EP128 (approx. 8 million acres) to pursue conventional oil and gas targets

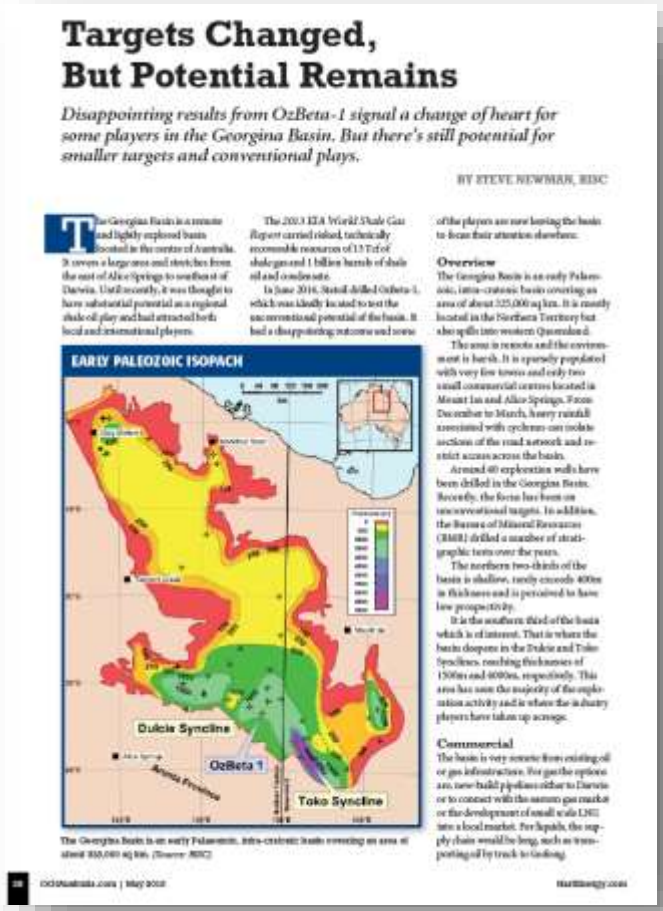
Want to Read More?

RISC is writing a series of articles on basins in the region for the *Oil and Gas Investor Australia*

2015

- March: Perth Basin
- May: Georgina Basin
- July: New Zealand
- September: Canning Basin
- November: Great Australian Bight





Thank you

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