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Arckaringa Basin

PEL121 & PEL122

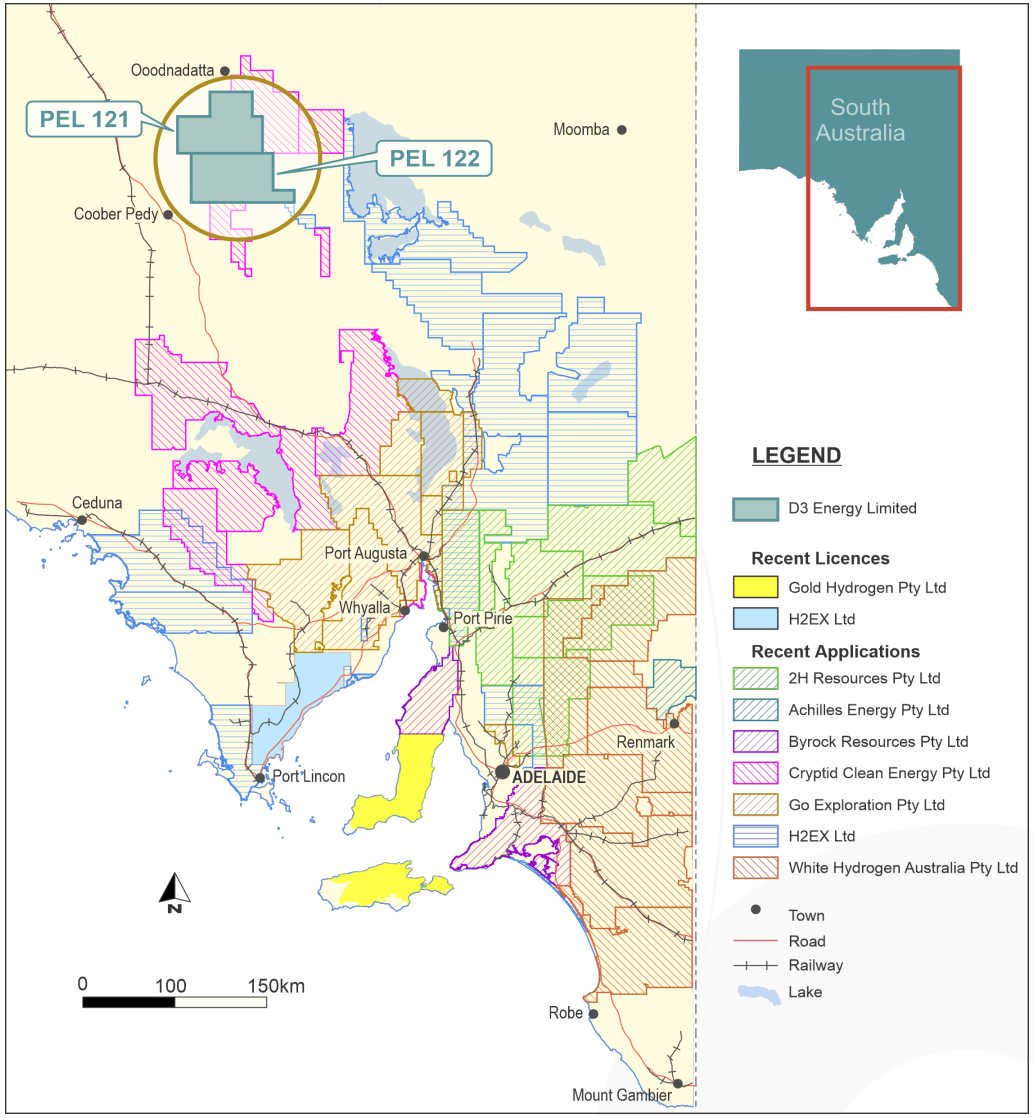
A New Helium & Hydrogen Play in South Australia

June 2025

Arckaringa Basin – Location

Why the Arckaringa?

- A very large land position of around 5,865 km^2 (1,450,000 acres)
- Identified source, seal and reservoir
- Mapped Tonian evaporite (salt) which is proven seal and present in PEL121 & PEL122
- Only 2 wells drilled below salt in analogous Amadeus Basin and both recovered Helium and Hydrogen
- Analogous Mt Kitty-1 measured **9% Helium and 11% Hydrogen**
- Previous wells in Arckaringa have NOT drilled below salt
- Mapped basement faults are ideal for serpentinization and Hydrogen production
- Extensive seismic data set has identified 4-way closure on 2 prospects with multiple leads in PEL121 alone
- TCF's of in-place gas potential



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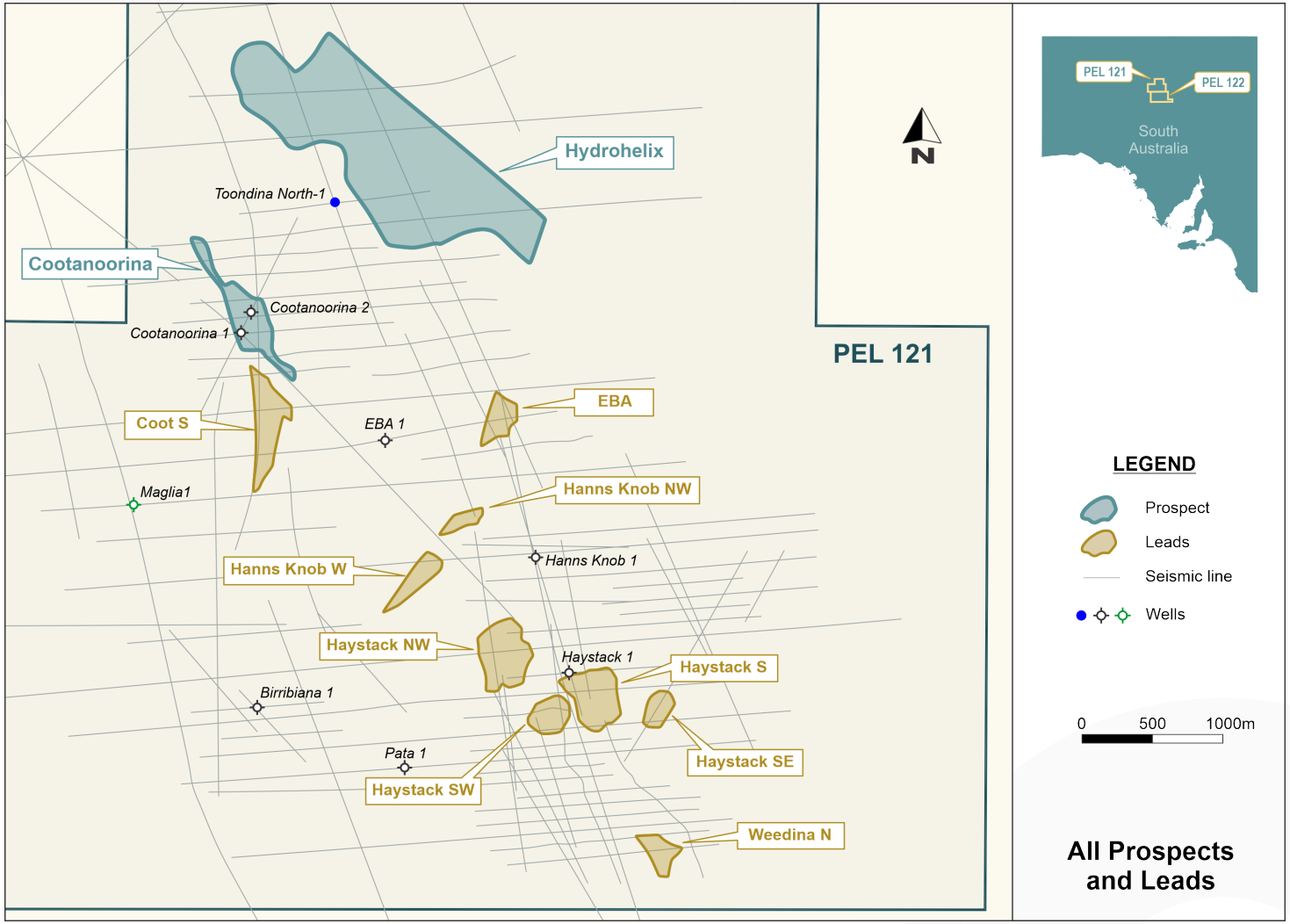
Arckaringa Basin – Prospects and Leads

PEL121

- There are two prospects and nine leads that have been identified on the seismic data to date
- Two main prospects are Hydrohelix and Cootanoorina
- Volumetrics have been calculated for both prospects
- Assumed that structural closure is required for an accumulation.
- Work is ongoing to high grade leads to prospects



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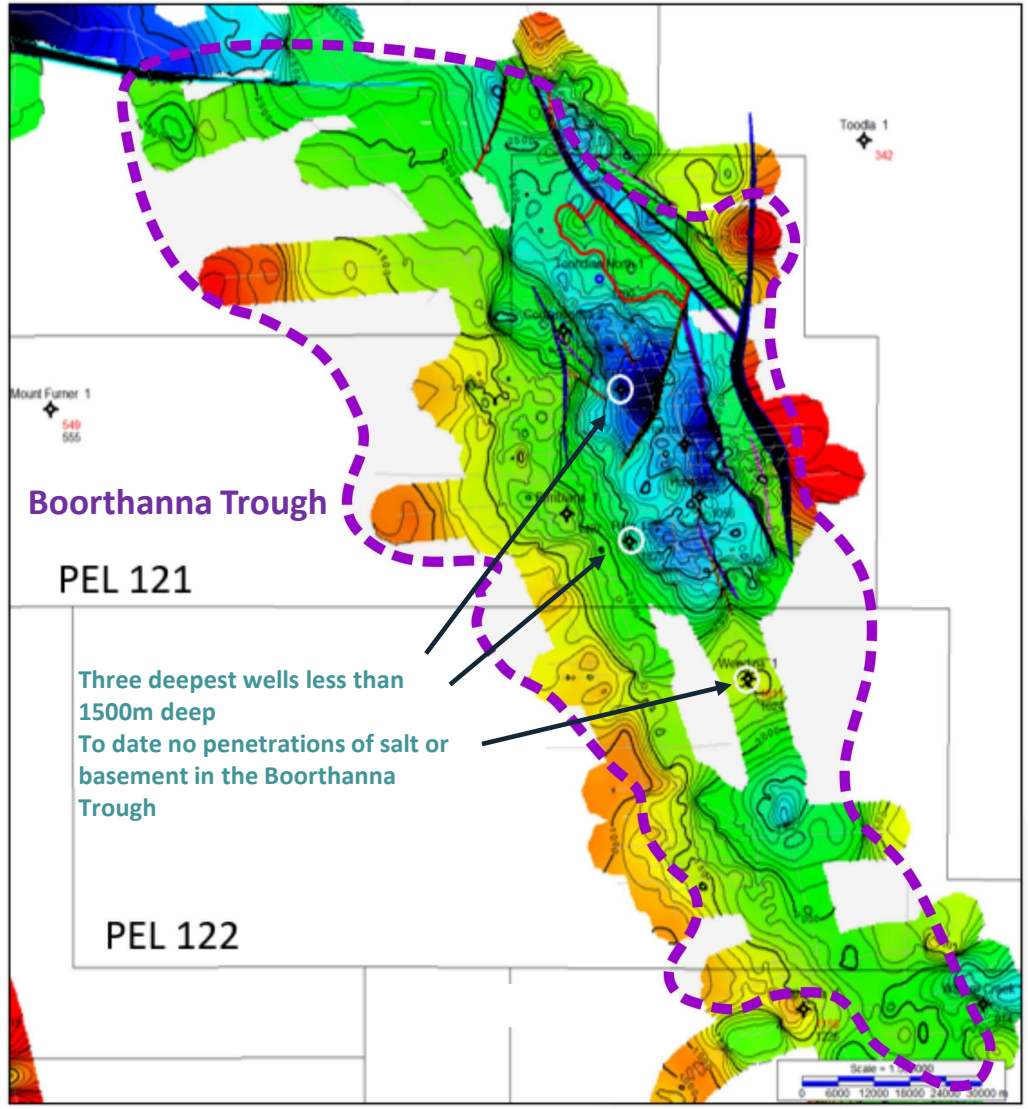
Arckaringa Basin – Boorthanna Trough

- Boorthanna trough sits on the northeastern side of the Arckaringa Basin
- Huge variations in depth to basement in the trough, highly structural area
- Deepest point in the basin is about 5,000 m
- Highly underexplored area with only three wells exceeding 1,500 m in depth across PEL121 and PEL122
- EBA-1 is the deepest well in the area and it drilled only a third of the Pre-Permian sequence and stopped hundreds of meters above the interpreted salt
- **No wells have penetrated the target basement or the salt seal above the basement**
- Heavily faulted area with large offset on the faults indicates that the basement should also be heavily fractured hence a good candidate for Hydrogen generation



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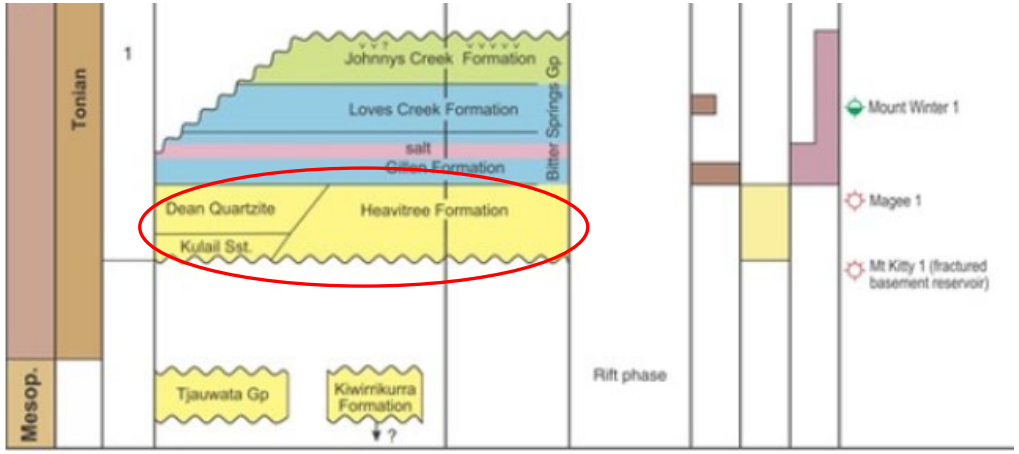
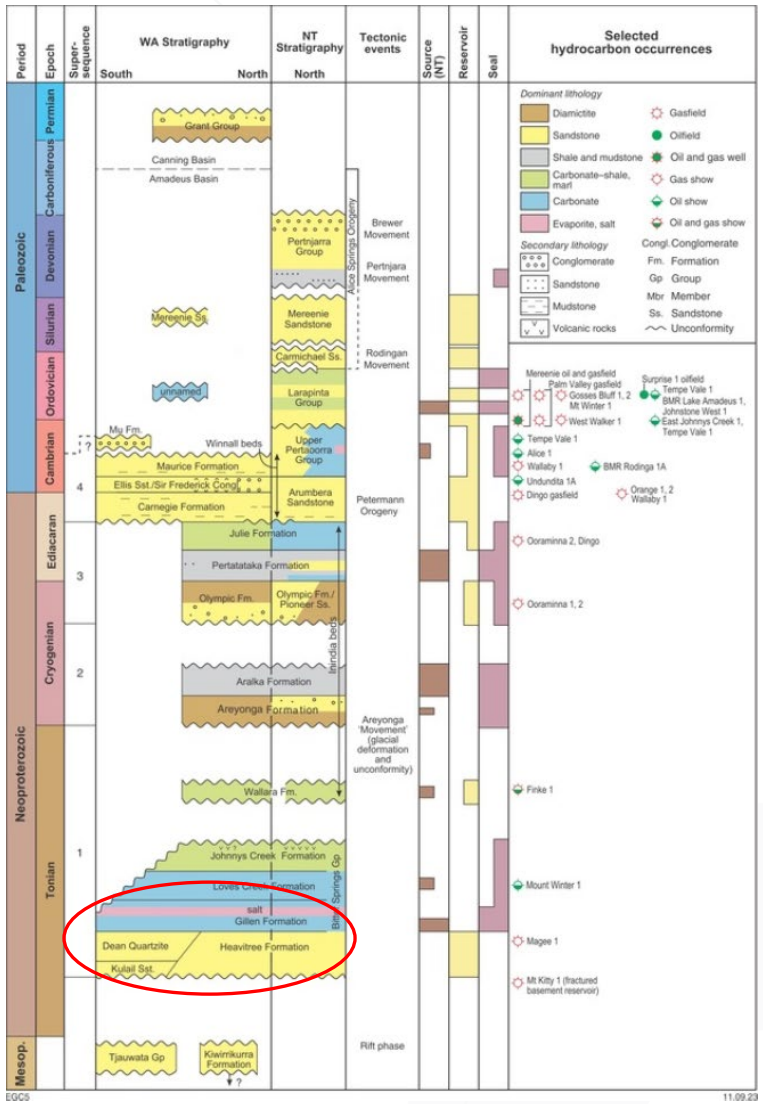
Arckaringa Basin – Reservoirs

- The target reservoir zones are the Heavitree Sandstone and the Fractured Basement
- **The Heavitree is normally over 200m thick but can thin over basement highs**
- These underlie the Tonian halite and evaporites of the Gillen Formation.
- However, these have not been penetrated in the Boorthanna Trough
- Stratigraphy chart is taken from the Amadeus Basin to the north where the analogous Mt Kitty-1 and Magee-1 wells are located



Mt Kitty-1 & Magee-1 are only wells to be drilled below the Tonian salt seal



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Arckaringa Basin – Source Rocks

Hydrogen Source

- Naturally occurring radiolysis of water by alpha, beta and gamma radiation released in the radioactive decay of Uranium, Thorium and Potassium bearing minerals (as in granite) is an abiogenic source of Hydrogen. **Well data supports elevated heat flow likely associated with a radiogenic basement**
- Serpentinization occurs when Fe^{2+} comes in contact with water and oxidises to Fe^{3+} which releases H_2 . Also, Mg^{2+} comes into contact with water to make Mg^{3+} which also releases H_2. This needs a lot of water (**heavily fractured basement**) and ultramafic rocks (olivine).

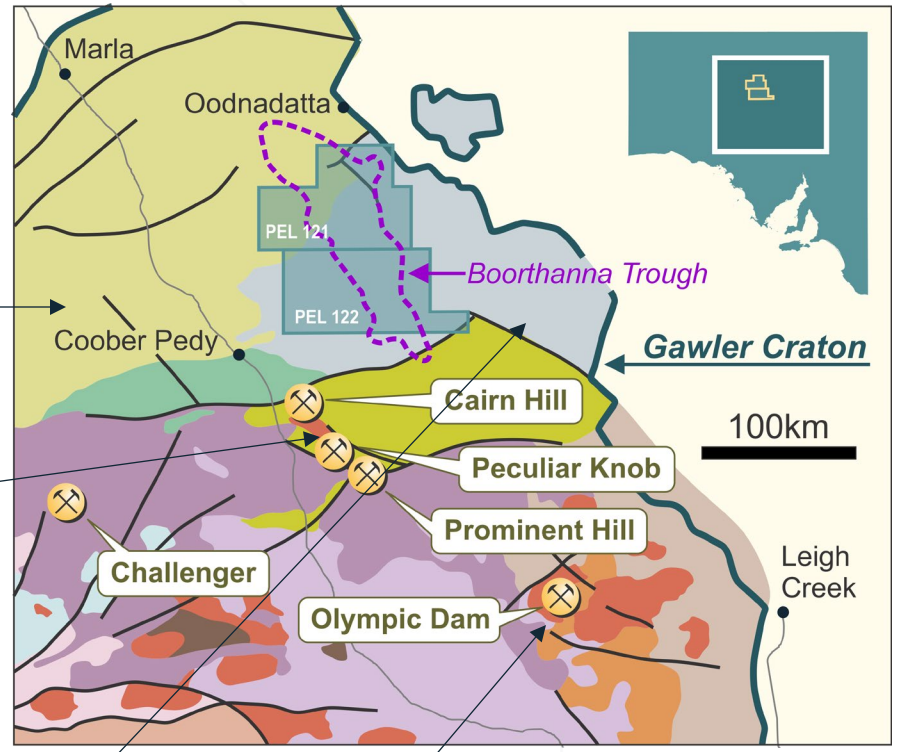
Helium Source

- The process of radioactive decay is a natural source of Helium
- The Gawler Craton has Uranium and Thorium (Olympic Dam) as prospective minerals which are both radioactive sources.

Gawler Craton Source Rocks

Underlying the basin is the **Nawa Domain**(Metasedimentary and meta- igneous rocks)

Mt Wood Domain metamorphic (upper amphibolite-granulite facies) supracrustal and granitic rocks are preferrable for radiolysis and serpentinization – mineral exploration drilling has identified Mt Wood Domain rocks near current Hydrohelix prospect



Peake Denison Domain
Proterozoic metasedimentary rocks

Olympic Dam: The world's largest uranium deposit

Australian Resources & Investment February 21, 2025, 10:10 am

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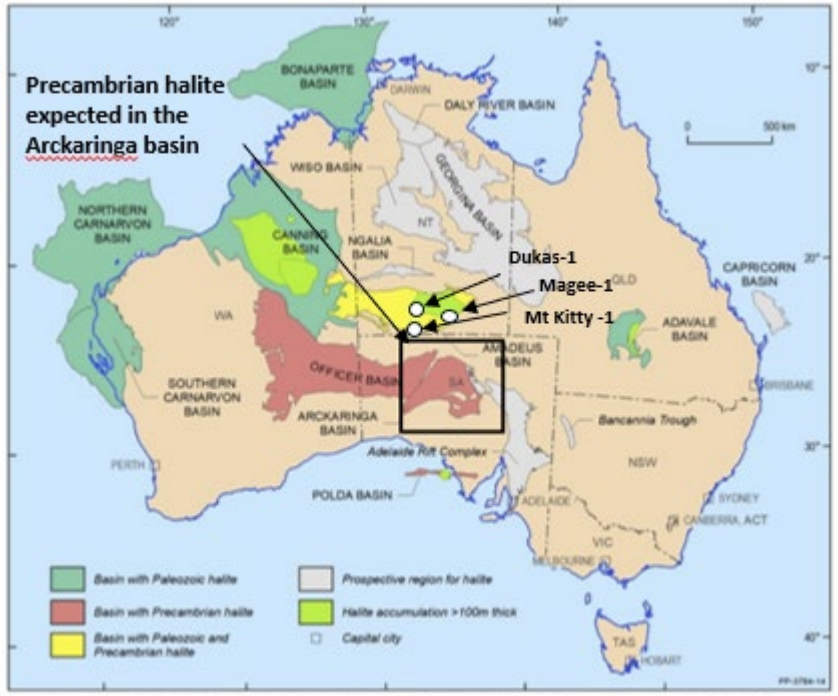
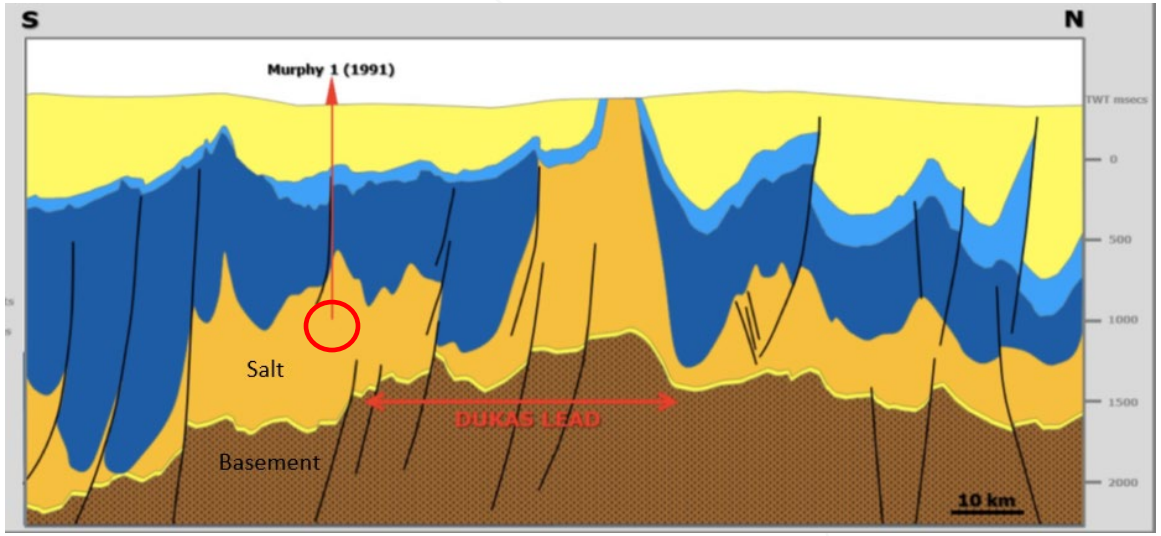
Arckaringa Basin – Seal

- An effective seal is critical to trapping Hydrogen and Helium which are essentially the smallest molecules on the planet
- Halite beds (salt) provide the best seal as seen in the nearby Amadeus Basin



Preliminary map showing the location of major salt deposits for onshore Australia (plus offshore Polda Basin). Salt deposits could provide underground storage spaces for hydrogen in Australia or act as seals for storing in underlying permeable sandstone rocks (Version 3, October 2021).



Examples of Thick Salt in Amadeus Basin

- Murphy-1, 20 km NW of Mt Kitty-1 called TD at 2,888 m. It did not drill deep enough to get through the salt.
- Dukas-1 (2019) 50 km N of Mt Kitty-1 was meant to be the third salt penetration and reach basement but TD at 3,700 m. It drilled through 2.3 km of salt prior to plugging immediately above the target formation due to potential well control problems associated with over-pressure.

"The Boorthanna trough is underlain, in part, by a thick succession of Adelaide rift sedimentary rocks , including evaporites, and salt tectonics may have influenced deposition in this area." (Menpes, Korsch and Karr, 2008).

"The salt features interpreted on seismic data underlying the Arckaringa Basin (eastern Officer Basin extending to the west of the Adelaide Rift Complex) may also be Tonian in age" (Bradshaw et al,2023)

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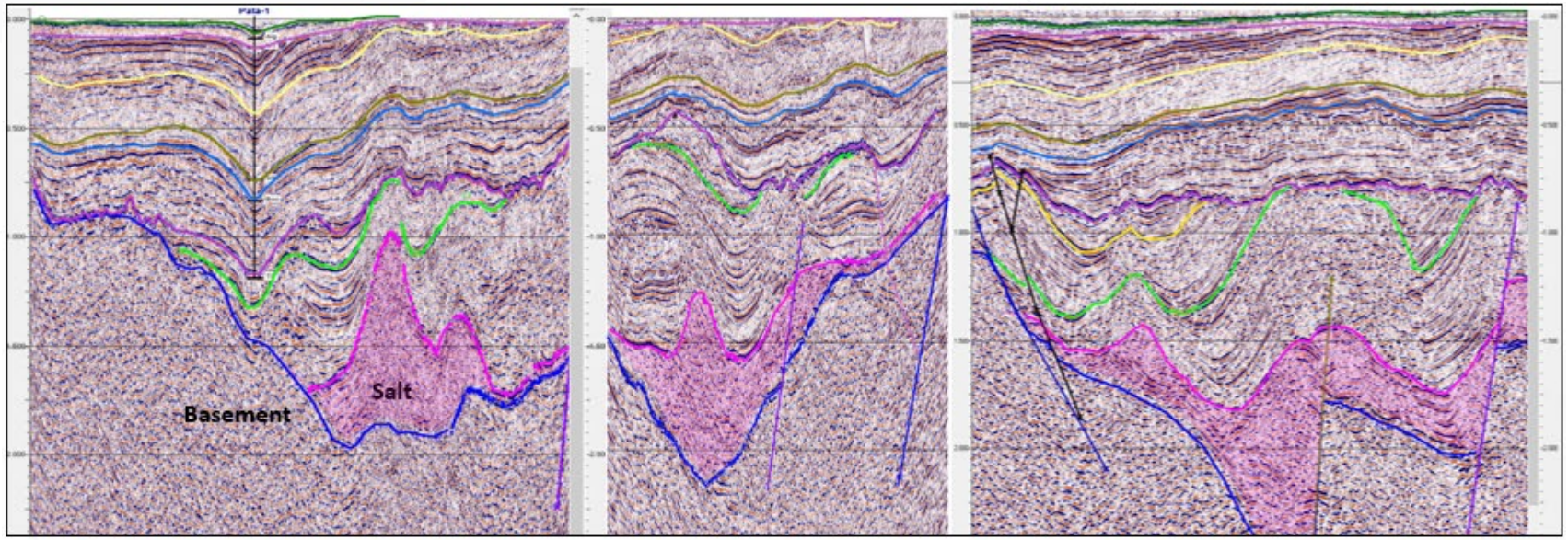
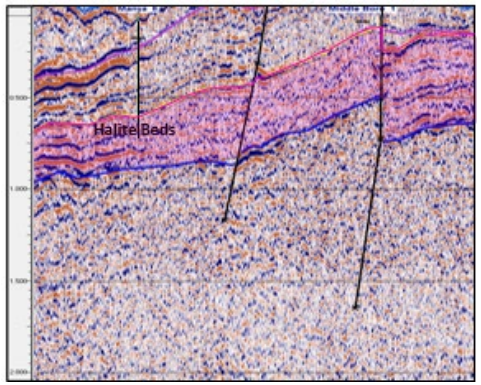
Arckaringa Basin – Seal

Salt Seals

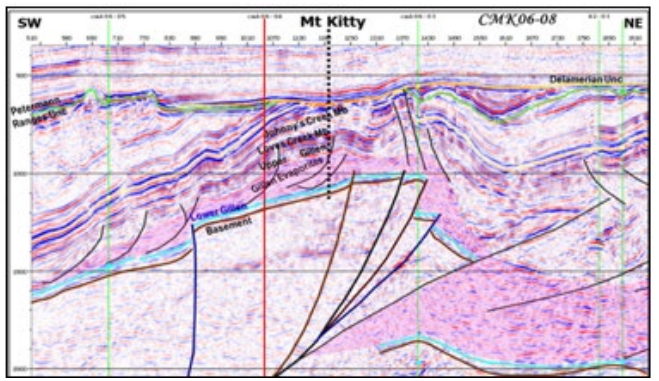
- Halite beds in Manya-6, Mt Kitty-1 and Magee-1 (pink shading) show very little movement as the halite is shallow
- Magee-1 had a thick evaporite section with 190 m of halite in one bed that was tectonised
- **But deeper in the Boorthanna trough there is evidence of significant salt and significant movement similar to the Amadeus Basin**

Boorthanna Trough

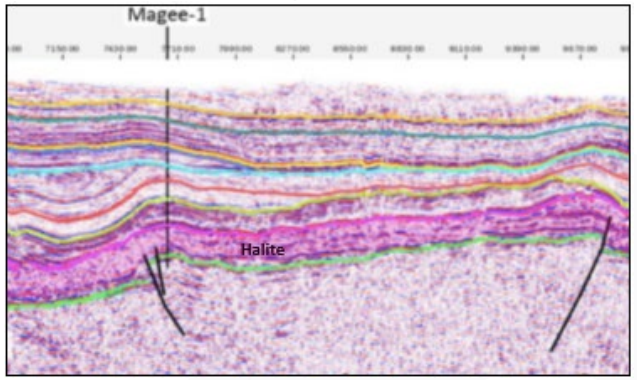




Manya-6



Mt Kitty-1



Magee-1

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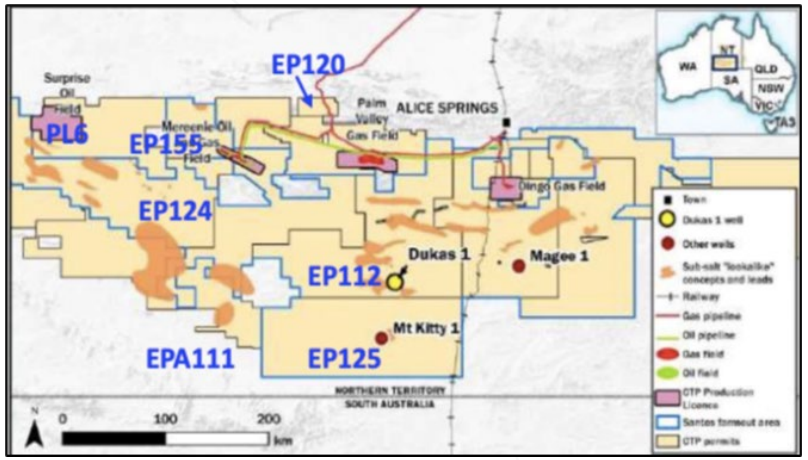
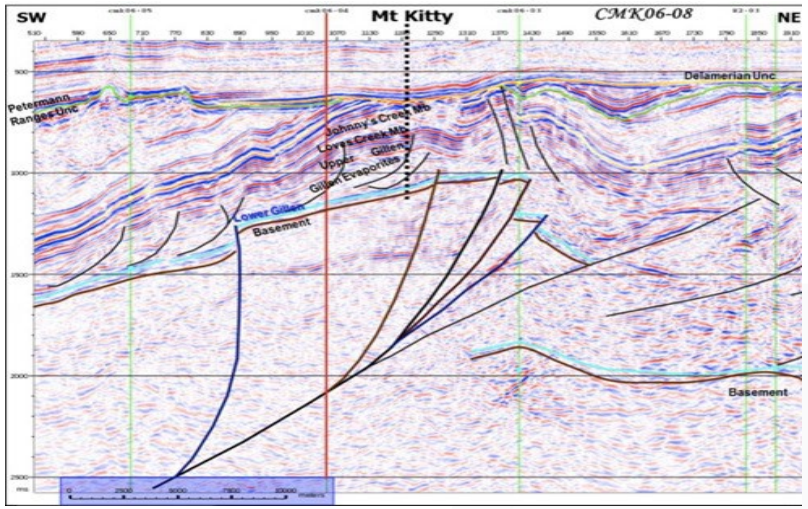
Arckaringa Basin – Analogues

Amadeus Basin – Mt Kitty-1

- Drilled on a broad compressional feature in the basement with multiple faults, basement rock is granodiorite
- Basement fracturing forms the migration pathway and reservoir, no Heavitree Sandstone present
- Thick Tonian evaporite section above basement creates the seal
- Radiolysis in basement generates both Helium (9%)[1] and Hydrogen (11.5%)[1] however such large concentrations of Hydrogen suggests serpentinization is happening as well
- 20 m of black bituminous shale lies at the base of the Gillen giving rise to the high Methane(13%)[1] and Ethane (5%)[1]
- Flowed from 2,144 m at 500 Mscfd[1], declining to 70 Mscfd[1] after 10 minutes
- Second test from 2,156 m flowed at 530 Mscfd[1] decreasing to 420 Mscfd[1] after 18 minutes





Mt Kitty-1

[1] Mt Kitty 1 Interpreted Well Completion Report – Santos Australia
https://geoscience.nt.gov.au/gemis/ntgsjspui/handle/1/90912

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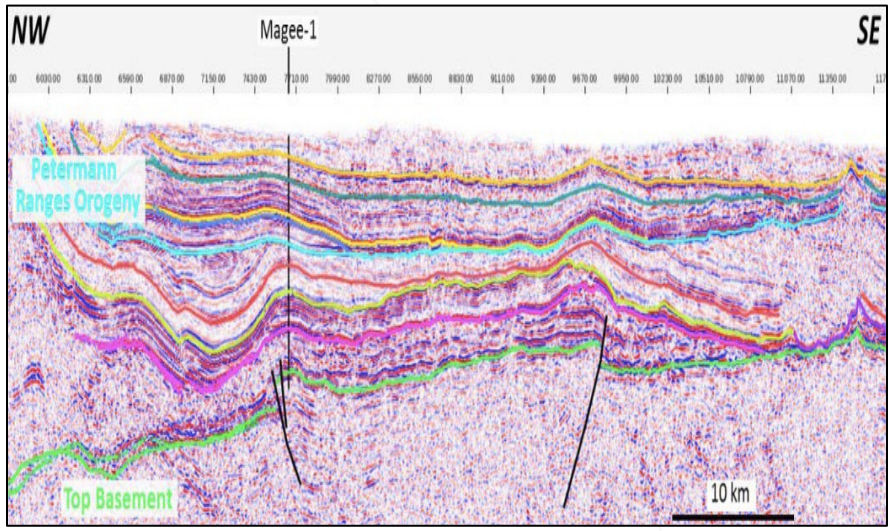
Arckaringa Basin – Analogues

Amadeus Basin - Magee-1

- Drilled on a more localized pop-up block (less faulting)
- Basement is Gneiss (muscovite, biotite, quartz and feldspar) and Biotite Schist (80% biotite) [2]
- Basement fracturing forms migration pathway
- Reservoir is the Heavitree Sandstone just above the basement (6.3 m thick instead of more regionally 230 m)
- Thick Tonian halite forms the seal
- Radiolysis in basement creates the Helium (6%)
- Tested 63.1 Mscfd [2] from a fracture in the Heavitree Sandstone
- The low Hydrogen (0.03%) [2] at Magee-1 suggests that serpentinization may not be happening because of the paucity of faults
- High Methane fraction (39%) [2] suggests a source rock below the salt as seen in Mt Kitty-1

Only 2 wells from the Northern Territory have drilled through the Gillen salt and intersected basement, and BOTH Mt Kitty-1 and Magee-1 measured high Helium concentrations.



Magee-1

Sub-Salt Gas Composition		
Gas Type	Magee 1	Mt Kitty 1
Methane	39%	13%
Ethane	10%	5%
Nitrogen	44%	61%
Helium	***6%***	***9%***
Hydrogen	***0.03%***	***11.5%***

[2] Magee 1 EP 38 Northern Territory Well Completion Report – Pacific Oil and Gas
https://geoscience.nt.gov.au/gemis/ntgsjspui/handle/1/79387

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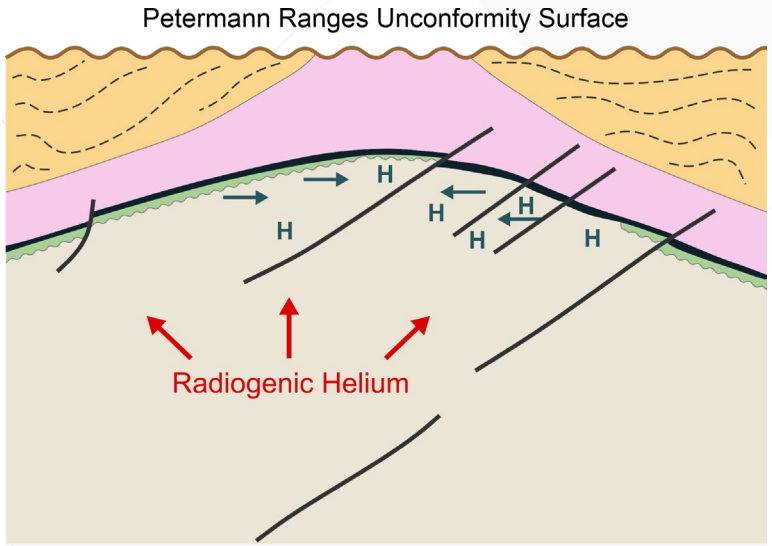
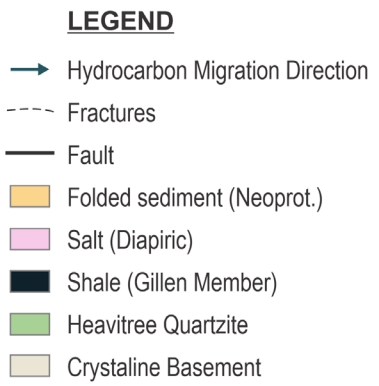
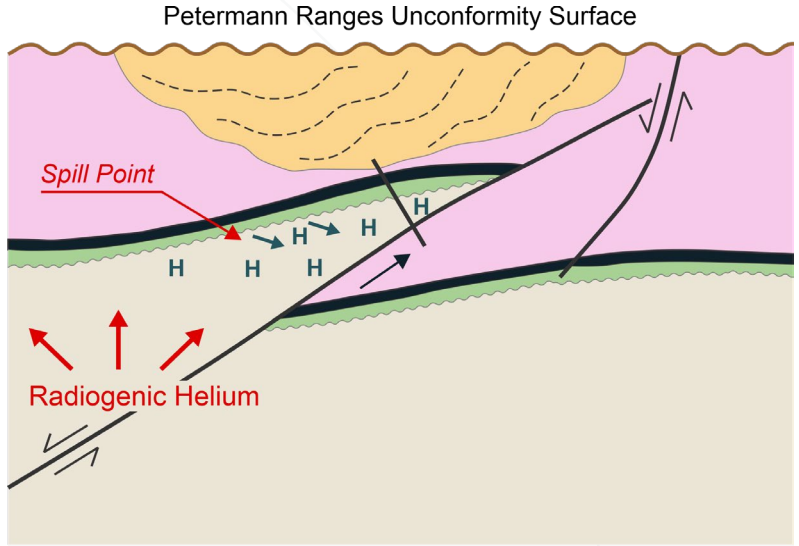
Arckaringa Basin – Fracture Basement Reservoir Examples

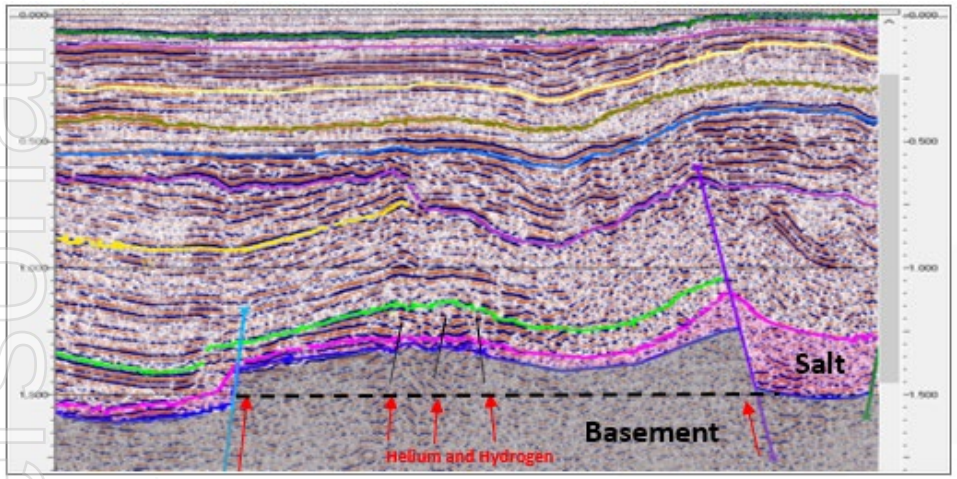






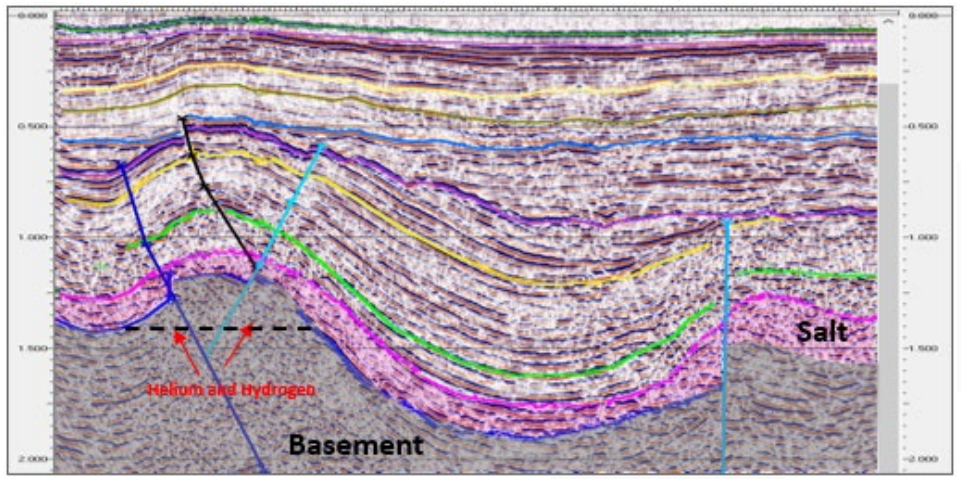
"Buried Hill" Fractured Basement Plays

Thrust Belt Fractured Basement Play



Hydrohelix Prospect

Cootanoorina Prospect



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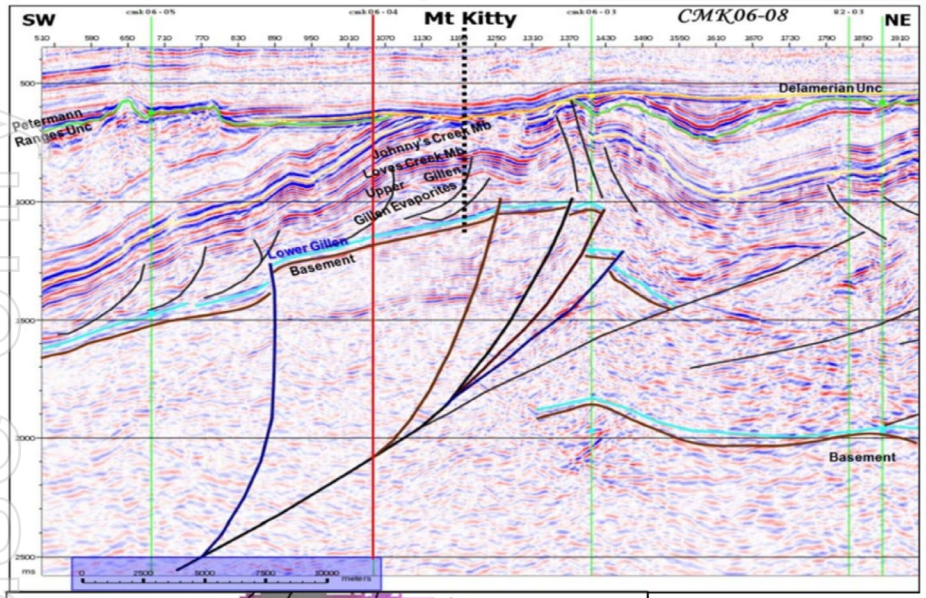
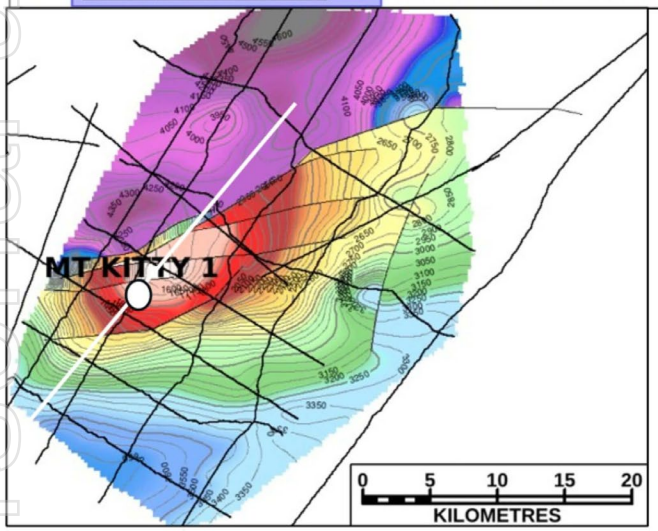
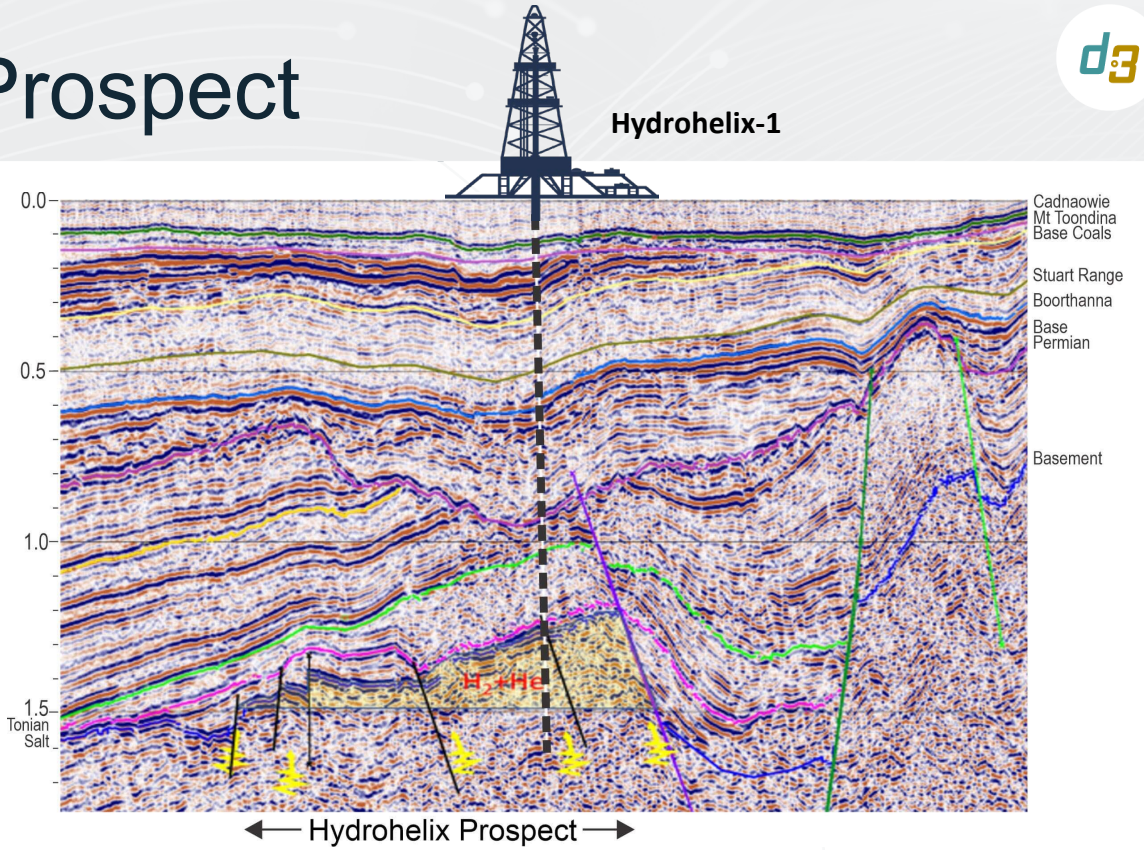
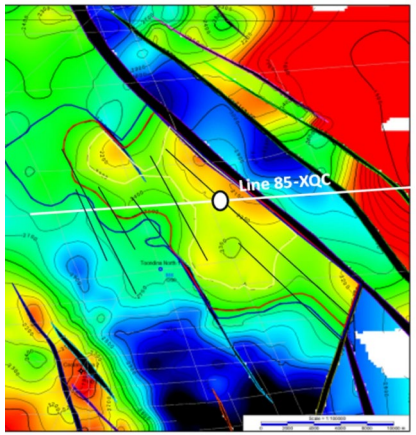
Arckaringa Basin – Drill Ready Prospect





Mt Kitty post-drill Seismic Interpretation – Line CMK06-08





Hydrohelix - Line 85-XQC

The Hydrohelix (HL) prospect shares a lot of similarities with Mt Kitty:

1) They are at a similar structural depth to basement ✓
2) They have a similar thickness of evaporites (salt) ✓
3) They both appear heavily faulted (HL more so) ✓
4) Both have structural closure controlled by faults ✓
5) Hydrohelix is much bigger at 148km^2 ✓✓

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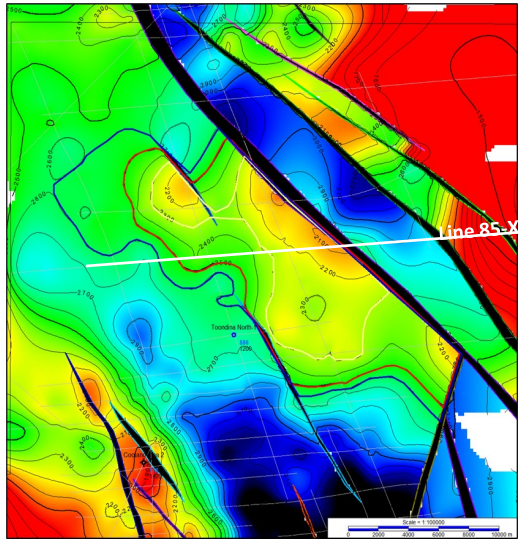
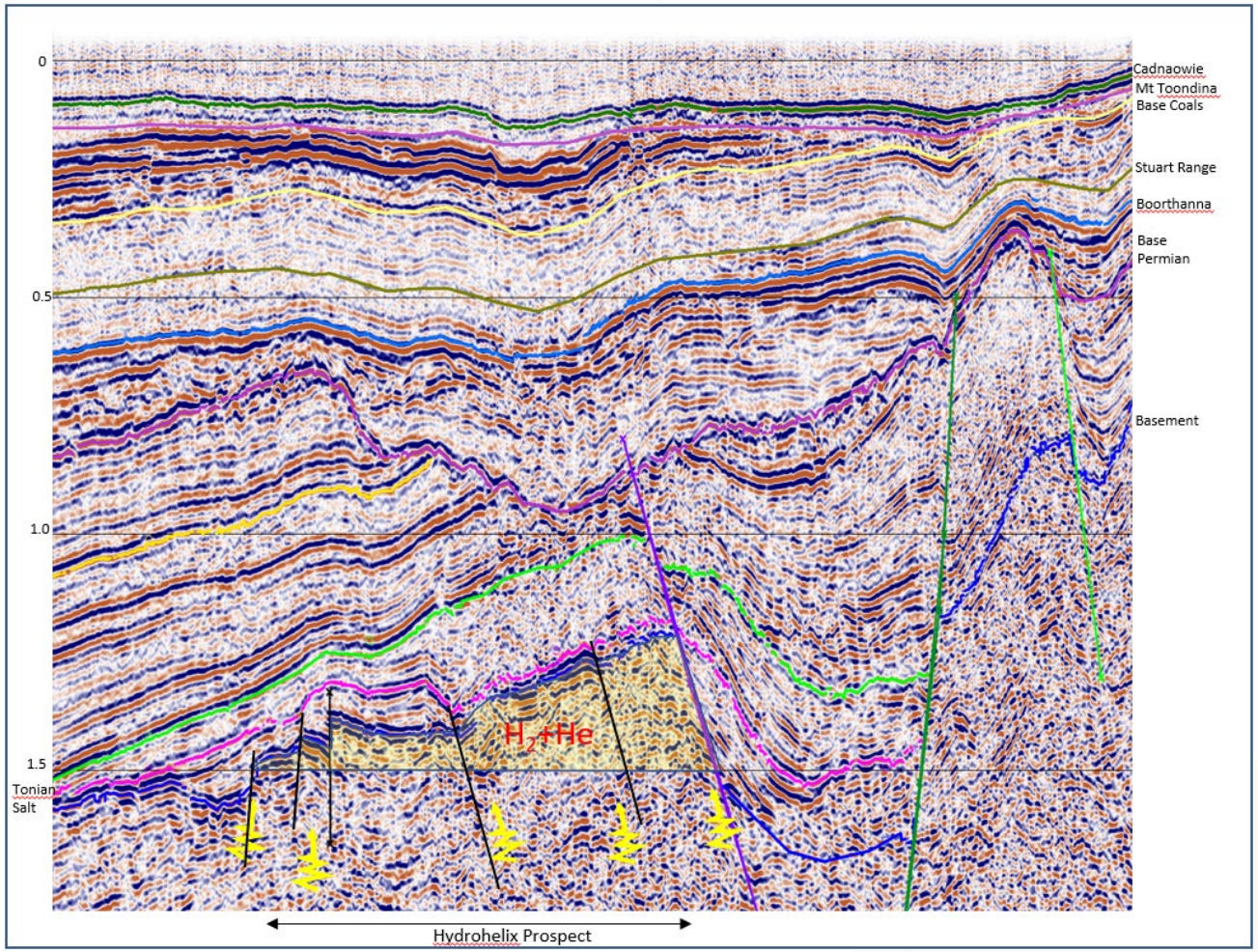
Arckaringa Basin – Hydrohelix Prospect

- Prospect is closed to the south and west by dip and to the east and north by major faults
- The Heavitree Sandstone, if present, may be much thicker than the 5-15 m assigned in the volumetrics as it is normally **230 m** thick in the Amadeus Basin.
- It is also a good example of the salt wall along the east bounding fault providing a good seal.





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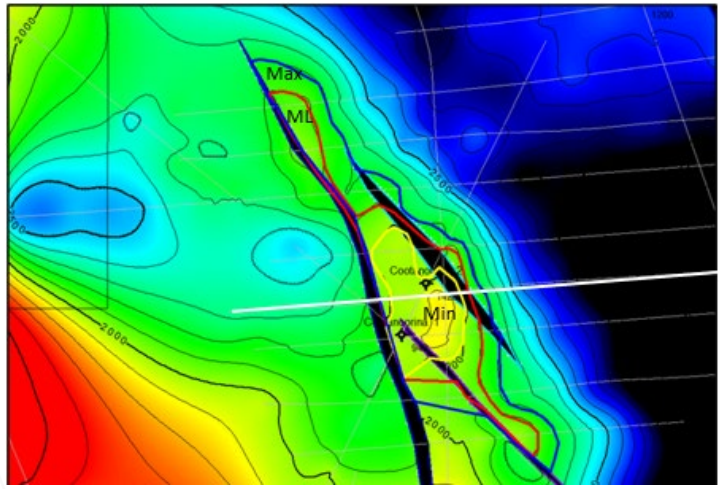
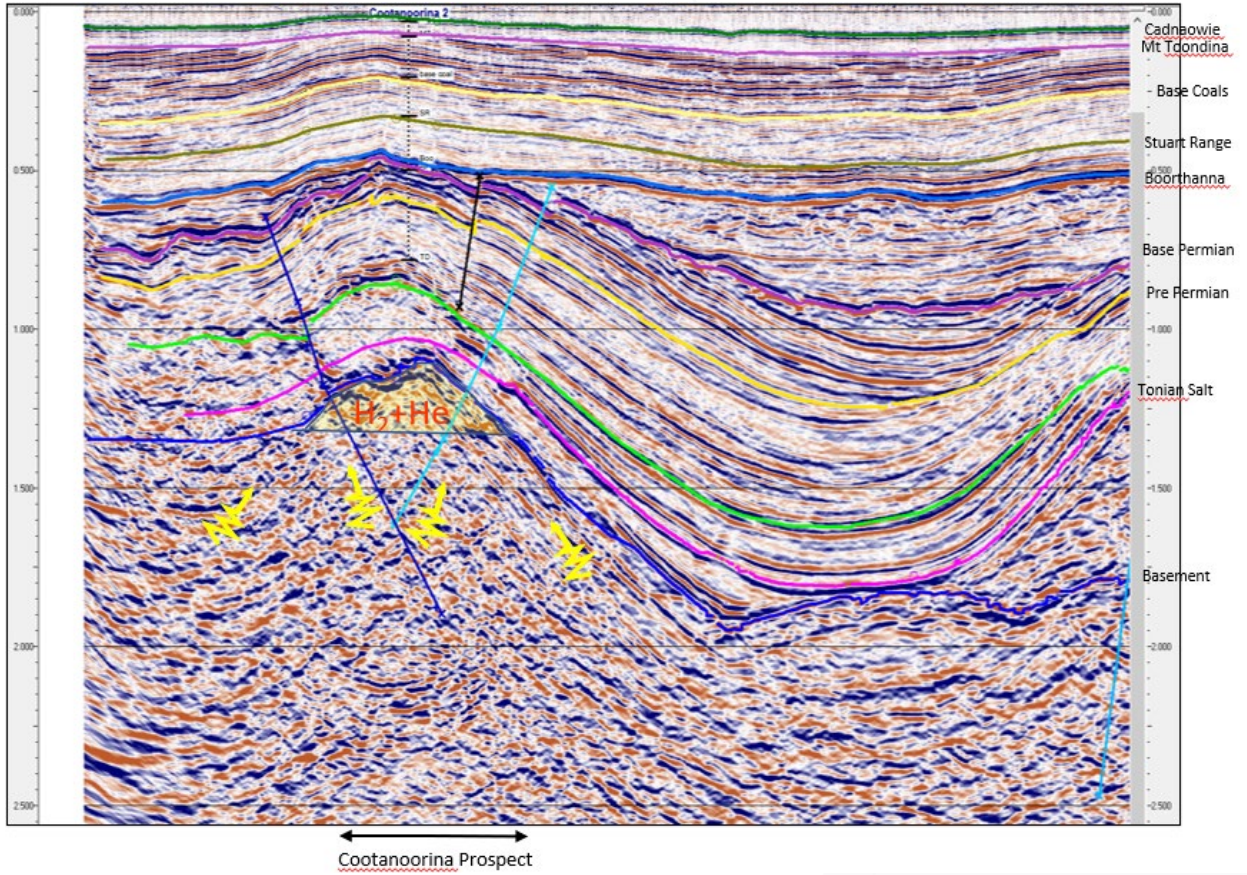
Arckaringa Basin – Cootanoorina Prospect

- Cootanoorina Prospect is a thrusted basement feature similar to Mt Kitty
- Situated underneath the Cootanoorina 1 and 2 wells on a 3-way dip closed structure against the western fault
- Forecast area of 3,400 acres and 200 m of relief.
- Crest of the structure at 1,900 m appears intensely faulted displaying a crestal collapse.
- Two wells drilled on the structure did not drill deep enough to test the Heavitree Sandstone or Fractured Basement.





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