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# NEW FRACTURED BASEMENT PLAY AND 2011 DRILLING UPDATE

Central Petroleum Limited (ASX:CTP) ("Central" or the "Company") has pleasure in releasing a Technical Note by Greg Ambrose, Manager Geology, and John Heugh, Managing Director, "Fractured Basement Hydrocarbon Plays and "Buried Hill" Plays in Central Australia" (CTP Technical Note 11.07.15). The report concludes, inter alia, that :

- Hydrocarbon production from fractured crystalline basement terranes occur on a global scale with production in 30 countries; Vietnam, Russia and Argentina are noteable examples, particularly the Cu Long Basin White Tiger and Bach Ho fields, with combined production reaching in excess of 40,000 BOPD.

- These plays are completely unexplored in Central Australia despite favourable geological criteria in several basins and numerous examples from many basins around the globe.

- CTP's holdings in the Amadeus, Georgina and Pedirka basins include specific areas where structurally deformed crystalline basement terranes have potential to reservoir hydrocarbons generated from known source sequences in close vertical proximity to basement.

- The Mirrica Prospect in the Southern Georgina Basin is a large fault dependent closure mapped at basement and higher levels against the Toomba Fault updip of the Toko Syncline. The UGIIP (Undiscovered Gas Initially In Place) at Middle Cambrian levels may exceed 4 TCFG if the structure is filled to spill. (ie "high" estimate). Mirrica-1 intersected partly weathered granitic basement within closure but little is known of this secondary target. Higher in the section, brittle carbonates of the Thorntonia Limestone are blanketed by regionally developed shales of the lower Arthur Creek Formation (source and seal) and these constitute a regional fracture play.

"The fractured basement play type development may produce some exciting exploration targets in subsequent campaigns" said Mr Heugh, Central's Managing Director today. "Meanwhile Central is pushing ahead with expediting planning for its second half of the year drilling programme."

The Company has secured casing supplies for the 3 well programme and is well advanced with other hardware supplies, road maintenance to allow easy access for the drilling rig and evaluation and selection of service contractors.

The Company anticipates making a final rig selection within a fortnight via a Letter of Intent process leading to a more detailed contract with a view to re-entering Surprise late August or early September, which is aimed to enable the drilling to Total Depth of all three programmed prospects, Surprise-1, Madigan and Mt Kitty, before the wet season usually commences.

John Heugh

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- *EP-82 (excluding the Central subsidiary Helium Australia Pty Ltd ("HEA") and Oil & Gas Exploration Limited ("OGE") (previously He Nuclear Ltd) Magee Prospect Block) - HEA 100%*
- *Magee Prospect Block, portion of EP 82 – HEA 84.66% and OGE 15.34%.*
- *EP-93, EP-105, EP-106, EP-107, EPA-92, EPA-129, EPA 130, EPA-131, EPA-132, EPA-133, EPA-137, EPA-147, EPA-149, EPA-152, EPA-160, ATP-909, ATP-911, ATP-912 and PELA-77 - Central subsidiary Merlin Energy Pty Ltd 100% ("MEE").*
- *The Simpson, Bejah, Dune and Pellinor Prospect Block portions within EP-97 – MEE 80% and Rawson Resources Ltd 20%.*
- *EP-125 (excluding the Central subsidiary Ordiv Petroleum Pty Ltd ("ORP") and OGE Mt Kitty Prospect Block) and EPA-124 – ORP 100%.*
- *Mt Kitty Prospect Block, portion of EP 125 - ORP 75.41% and OGE 24.59%.*
- *EP-112, EP-115, EP-118, EPA-111 and EPA-120 - Central subsidiary Frontier Oil & Gas Pty Ltd 100%.*
- *PEPA 18/08-9, PEPA 17/08-9 and PEPA 16/08-9 - Central subsidiary Merlin West Pty Ltd 100%.*

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# Fractured Basement Hydrocarbon Plays and "Buried Hill" Plays in Central Australia

**(CTP Technical Note 11.07.15)**

## Executive Summary


- **Hydrocarbon pools produced from fractured crystalline basement terranes occur on a global scale with production in 30 countries; Vietnam, Russia and Argentina are noteable examples, particularly the Cu Long Basin White Tiger and Bach Ho fields, with combined production reaching in excess of 40,000 BOPD.**

- **These plays are completely unexplored in Central Australia despite favourable geological criteria in several basins and numerous examples from many basins around the globe.**

- **CTP's holdings in the Amadeus, Georgina and Pedirka basins include specific areas where structurally deformed crystalline basement terranes have potential to reservoir hydrocarbons generated from known source sequences in close vertical proximity to basement.**

- **Much of the southern Amadeus Basin, includes Neoproterozoic Gillen Member lacustrine shales which have potential to generate wet and dry gas which, together with helium formed via radiogenic decay in basement, form an important play,(The "Heavitree Play"). Regional vertical seal is provided by ubiquitous remobilised salt (from the Gillen and Loves Creek Members) and secure top seal is a very important component of the play. The tectonic stresses responsible for widespread development of thrust belts and salt diastrophism were established during the Petermann Ranges Orogeny (Late Neoproterozoic).**

- **Two plays have emerged in the Amadeus Basin from this study, 1) a "Buried Hill" play whereby oil migrates from source rocks in the cover (Gillen shales) which in turn onlap a tectonised basement palaeohigh; 2) Hydrocarbons entrapped in the foot wall of imbricate thrust sheets with source and seal as described above. Remobilised salt forms a regional decollement surface dislocating structures above and below, with large thrusts dissipating into this layer of plastic deformation. Regional top salt seal is fundamental to the plays.**

- **In the Simpson Desert area (stacked Devonian, Permian and Mesozoic basins) two potential fractured basement plays have been interpreted: 1) A "Buried Hill" play at the Simpson East Prospect where Devonian carbonate platform sediments onlap a basement high which may have been brecciated by major faulting and/or karst development. Transgressive Devonian shales provide a possible vertical seal, 2) Fractured basement plays on the faulted southern margin of the Hale River Block, the latter being a major regional focus for oil migration. Oil may have penetrated into fractured basement by flowing up and/or across the main fault planes or by invasion of fractured basement via relay ramps formed along the main fault trend.**

- **The Mirrica Prospect in the Southern Georgina Basin is a large fault dependent closure mapped at basement and higher levels against the Toomba Fault updip of the Toko Syncline. The UGIIP (Undiscovered Gas Initially In Place) at Middle Cambrian levels may exceed 4 TCFG if the structure is filled to spill. (ie "high" estimate). Mirrica-1 intersected partly weathered granitic basement within closure but little is known of this secondary target. Higher in the section brittle carbonates of the Thorntonia Limestone are blanketed by regionally developed shales of the lower Arthur Creek Formation (source and seal) and these constitute a regional fracture play.**

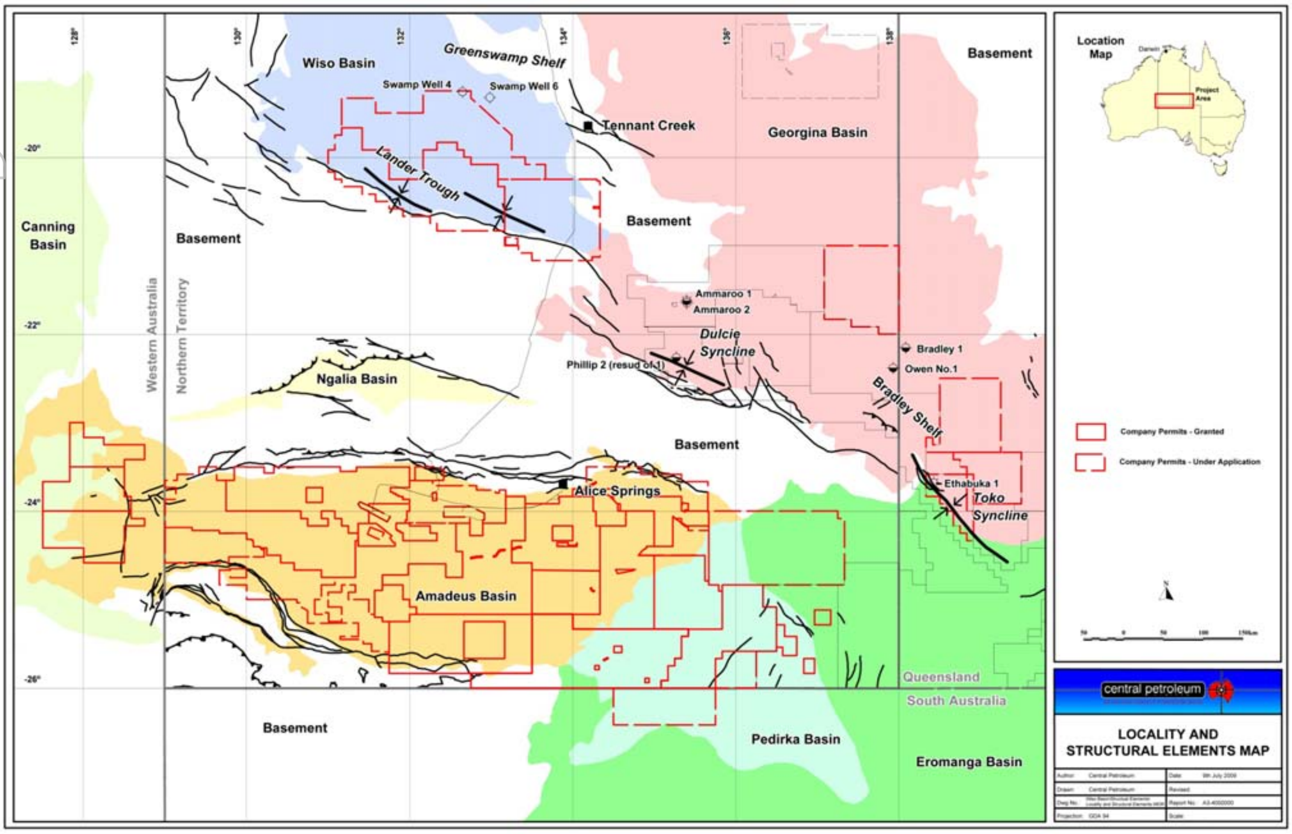


**Figure 1: Basin Location**

## Introduction

This paper addresses some new fractured basement play types in CTP's central Australian acreage holdings. Fractured basement oil and and gas production is widely reported on a worldwide basis; examples include :

China : The Yaerxia oilfield and the Xinglongtai oil and gas field in basement metamorphics and granites respectively.
Egypt : The Murghadu field and the Zeit Bay field in granite and metamorphics respectively.
India : The Cauvery Basin finds in weathered granite basement
Indonesia : the Beruk Northeast field hosted, inter alia, in metamorphics and granite.
Vietnam : The Cu Long Basin Bach Ho and White Tiger oil fields hosted partially in fractured granite or granitoid basement.

Other records of hydrocarbons being hosted in igneous or volcanic rocks include :

Algeria : Saharan plateau basalts
Argentina : Andesitic sills
Brazil : Fractured volcanics of the badejo and Linguado fields in the Campos Basin
Canada : Granite hosted oil at Fort McMurray
Chile : The Lago-Mercedes field.

Note that for the purposes of this report, basement is regarded as any metamorphic or igneous rock which is unconformably overlain by a sedimentary sequence. The new fractured basement plays described in the Amadeus, Pedirka and southern Georgina basins include the following:

1) Fractured basement plays developed in regions of significant tectonic dynamics eg thrust belts in the southern Amadeus Basin; plays in the Pedirka Basin such as buried karsted surfaces formed at the crest of rotated fault blocks in the Devonian Warburton Basin sequence and major basement blocks (Hale River Block) bound by massive normal faults. The Toomba Fault Zone, which bounds the gas prone Toko Syncline in the southern Georgina Basin, also holds potential for fractured basement plays.

2) Fractured basement plays incorporated in palaeogeomorphic features are often referred to as " buried hill " plays. Plays reliant on these geomorphic features can be composed of weathered/karsted carbonate (limestone/dolomite), quartzite, volcanics or other types of crystalline basement including igneous rocks. The cover sediments provide hydrocarbon source and the fractured pre-cover basement rocks are weathered/karsted and/or heavily fractured to provide a viable reservoir trapping hydrocarbons/Helium migrating upwards or laterally into structural highs. In some instances, there may downward migration of hydrocarbons due to differential stresses between overburden and basement.

Reservoir quality, and hence hydrocarbon production from basement plays, usually relies upon the presence of open fracture networks because matrix porosity and permeability are very low ; porosities< 0.5%) except in localised weathered zones which can have porosities up to 5-10% (Gutmanis et al, 2010). Bulk fracture porosity values of between 0.1% and 1% are typical for fractured reservoirs in basement terranes (Nelson,2001, Narr et al 2006). Production usually depends on features offering enhanced permeability such as fault damage zones, fracture corridors or extensive weathered zones at top basement level. Descriptions of these plays in CTP's tenements in the Amadeus, Pedirka (Simpson Desert area) and southern Georgina Basins occur below.

**Figure 2: Gillen Member Shales in outcrop-source rock horizon for the gas/condensate at Magee-1, 1992. Helium in this well was sourced from the granitic basement and the hydrocarbons and 6.2% helium were sealed by salt horizons in the Gillen Member of the Bitter Springs Group.**

## Amadeus Basin

The Amadeus Basin is very heavily structured and structuring was dominated by major crustal shortening during the Petermann Ranges Orogeny (late Neoproterozoic) which saw the development of complex, imbricate thrust belts on and near the southern basin margin. Later thrust belts associated with the Devonian – Carboniferous Alice Springs Orogeny provide the main structural mechanism on the northern basin margin which saw exhumation of the Arunta Basement block and emplacement of the MacDonnell Homocline. Thick synorogenic molasse facies were developed on both basin margins during these separate orogenic events. These loading events played a pivotal role in the maturation history of Palaeozoic and Proterozoic source rocks deposited in the northern and southern depocentres respectively.

The initiation of the Amadeus Basin coincided with the onset of Mesoproterozoic rifting, which was associated with the Giles Event (1080–1040 Ma) and may have centred on the Musgrave Province ; a number of resultant northwest-trending faults were reactivated at this time (SRK 2004). This process defined the shape of the basin and location of basement highs, while crystalline basement of the Arunta Block and Musgrave Block formed the northern and southern limits of the basin. Fractured basement plays within thrust belts related to the Petermann Ranges Orogeny are shown as the Southern Thrust Belt in Figure 4.This play leverages imbricate, basement involved thrust belts where Gillen Member source rocks and reasonably shallow thrusted basement are key components. The distribution of thermally mature Gillen source rocks is outlined in Figure 3. This distribution serves to define the area of prospective Heavitree play for subsalt gas, condensate, helium and possibly oil, first drilled in 1992 by Pacific Oil and Gas, a CRA subsidiary, at Magee-1 in the Southern Amadeus.

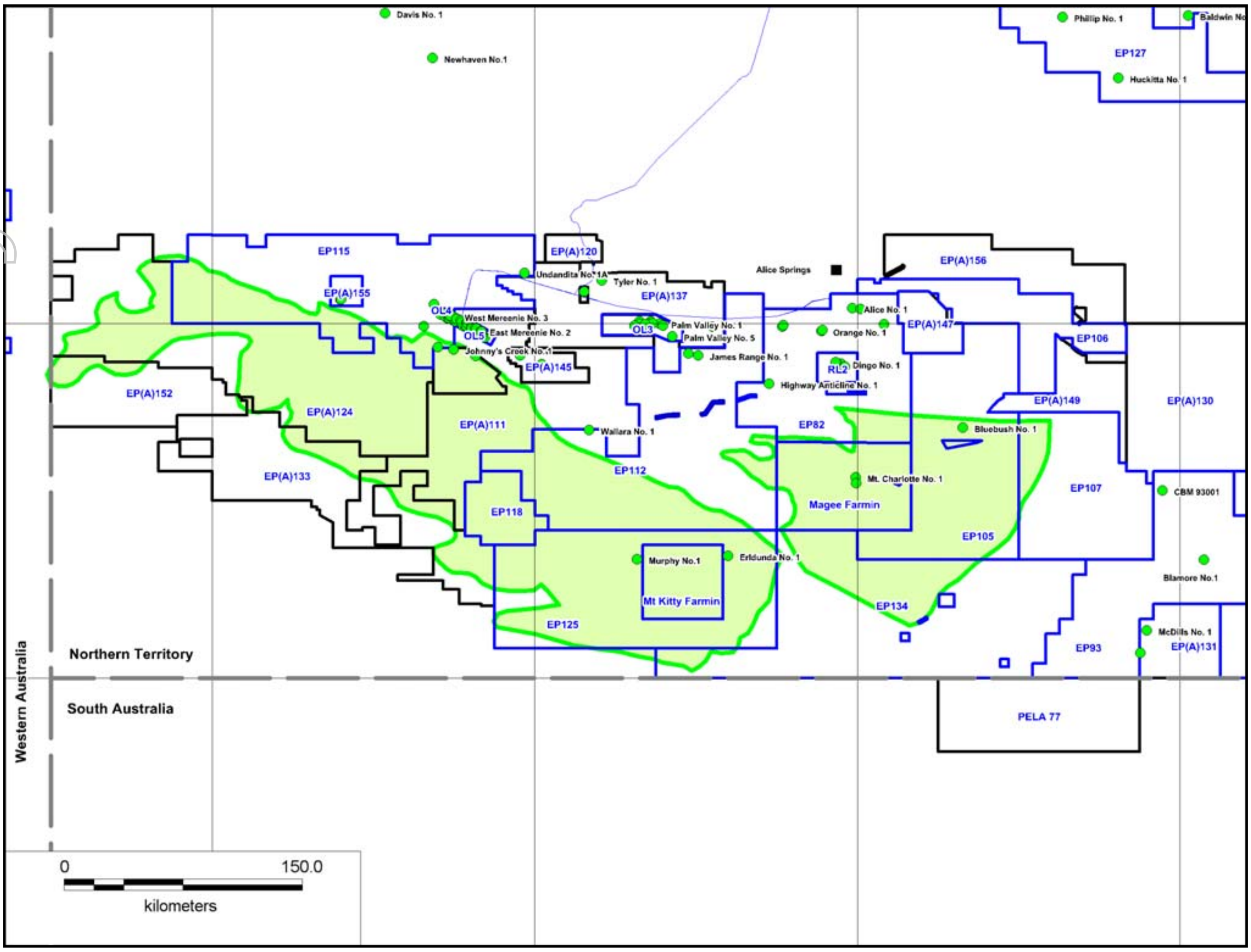


**Figure 3: Distribution of Thermally Mature Source Rocks of the Gillen Member (Bitter Springs Formation)**

Renewed rifting in the Amadeus Basin, related to continued northeast-directed extension, occurred at the commencement of the Neoproterozoic (800–840 Ma) and ultimately lead to the breakup of the Rodinian Supercontinent along the Tasman line (Powell *et al* 1994). Faults defining the basement fabric were intermittently rejuvenated during later rifting and orogenesis through to the Palaeozoic.

Underlying most of the Amadeus Basin is a pre-Neoproterozoic basement terrane comprising crystalline igneous basement and/or high grade metamorphics. However, in the Bloods Range region, located in the southwest Amadeus Basin, a thick package of sediments and volcanics (Tjauwata Group) unconformably overlies crystalline basement of the Musgrave Province. Incipient rifting at this time resulted in the deposition of quartz-rich sediments, volcanoclastic sediments and bimodal volcanics of the Tjuninanta Formation (Close *et al* 2005).

Conformably overlying this succession is the Mount Harris Basalt, which comprises an estimated 1–2 km thick accumulation of basaltic flows 1080 Ma in age. The overlying Bloods Range Formation comprises red beds, volcanoclastic rocks and fine-grained to conglomeratic clastic rocks.

A change from this alluvial / fluvial setting to a shallow marine–tidal depositional environment (Heavitree Quartzite/Dean Quartzite) marks the onset of the Amadeus Basin succession *sensu stricto*. Note, the Heavitree Quartzite is a misnomer; it is not a metamorphic rock nor is it universally heavily silicified by diagnesis (where studied to date-outcrop and one exploration well, Magee-1) but it has shown significant porosity up to 10%.

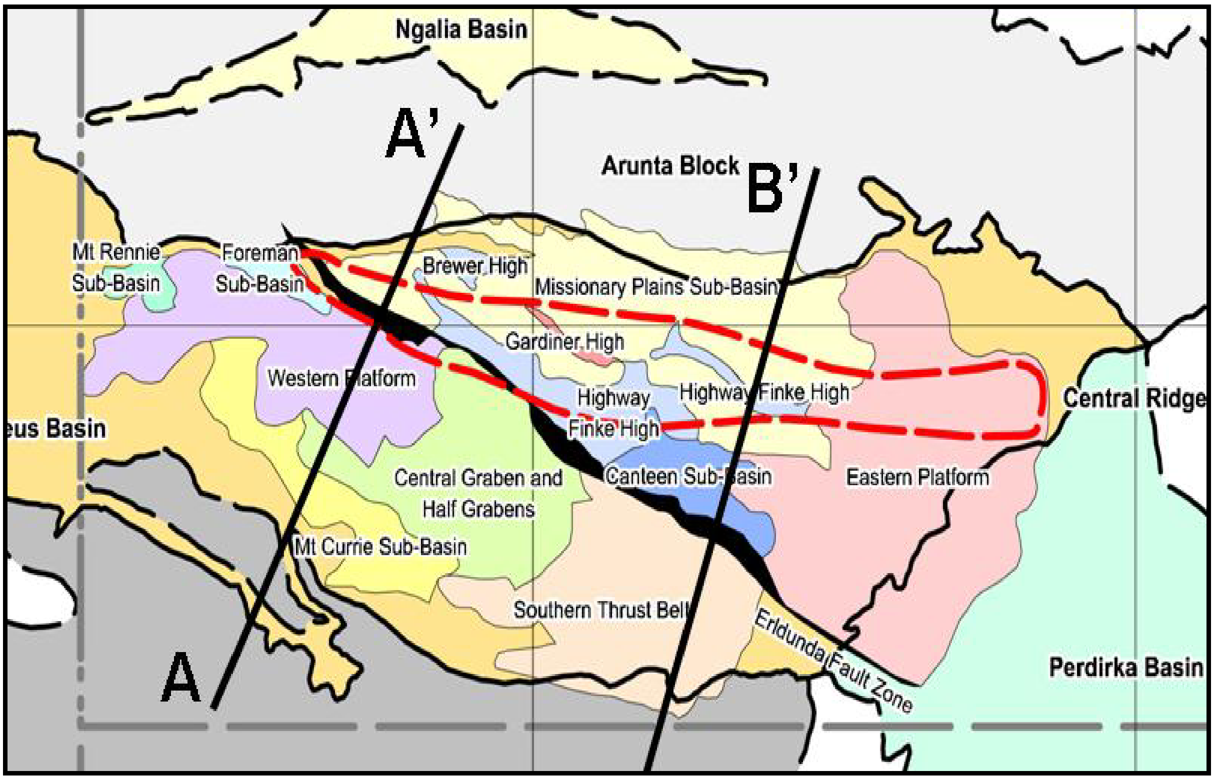


**Figure 4: Amadeus Basin Tectonic Elements**

The pre – Heavitree Tjauwata Group is present in the southwestern portion of the basin in the area of the Western Platform and the Central Graben/ Half Graben Region (Figure 4). The most important source rock in this area are Gillen Member shales; in the Mt Currie Sub-basin this unit is covered by Late Neoproterozoic molasse deposits. Sediment loading at this time would have pushed the Gillen source sequence through the gas window with gas charge into the Western Platform and the Central Graben / Half Graben regions.

Fractured Tjauwata Group volcanics /sediments could offer fracture plays analogous to those described for fractured crystalline basement in the Southern Thrust Belt. However, the latter area is mainly a crystalline basement terrane and hence fractures are the sole migration pathways and also provide the main hydrocarbon storage mechanism. The non-crystalline Tjauwata Group volcanoclastics have a larger hydrocarbon storage capacity with Gillen sourced gas and basement derived helium being key drivers for the play.

There is excellent oil production from volcanic sequences in many parts of the world eg the Cuu Long Basin in Vietnam produces oil from volcanics in the Dragon and Ruby fields at rates up to 20,000 BOPD.

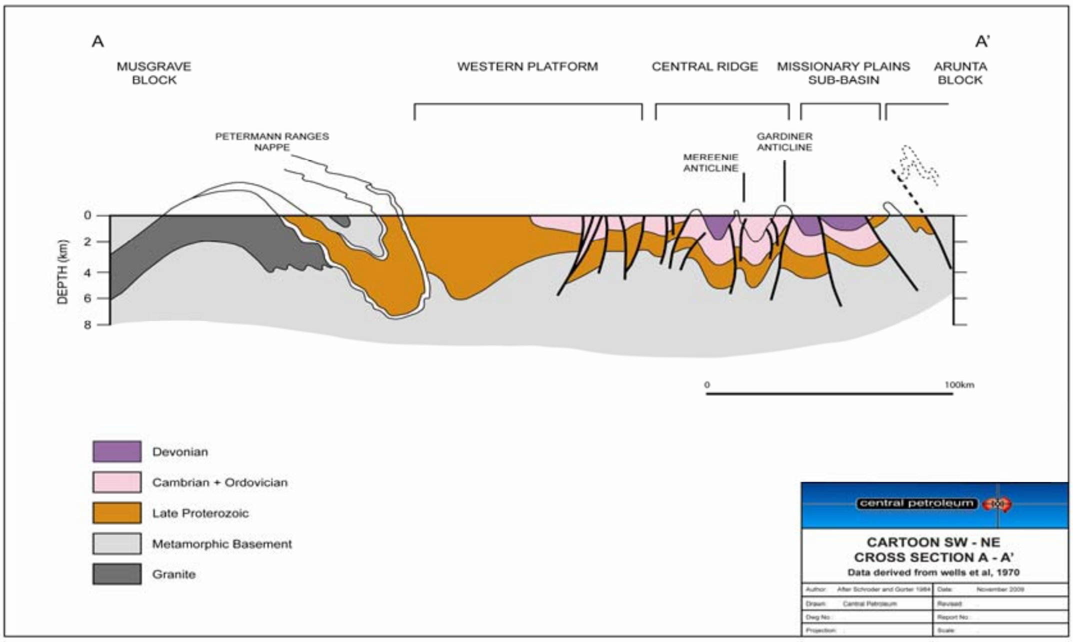


**Figure 5: Cross-section A-A' from the Mt Currie Sub-basin to the Western Platform**

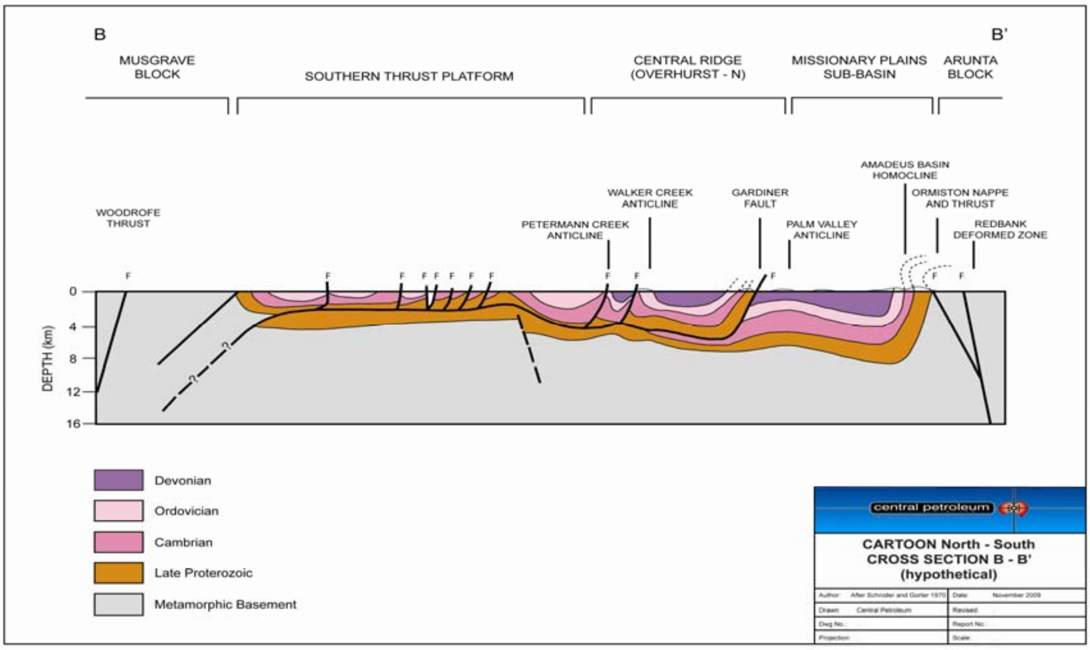


**Figure 6: Cross section B-B' through the Southern Thrust Belt to the Northern Amadeus Basin**

## Amadeus Basin Fracture Subsets

Separate from examination of the gross family of fracture subsets occurring in a basin is the need to identify which fracture subsets are more dynamically active and permeable for hydrocarbon migration. A case in point is the Amadeus Basin where most production to date has been dependent at least to some extent on fractures. Gillam et al (2010) presented a model for the formation of natural fractures in the fold and thrust belt of the Amadeus Basin where 113 MM BOE have been produced from two fields, namely Mereenie and Palm Valley fields. Hydrocarbon production is primarily from fractures at Palm Valley but less so in the Mereenie field. Two distinct classes of reservoir-effective fractures (normal to each other), namely fold related fractures (largely axial) and regional fractures (parallel to the direction of crustal shortening) dominate folds in the northern part of the basin (Gillam et al, 2010). Both fracture sets formed in response to orogenic strain during foreland basin formation.

**Mereenie Field:** The Mereenie structure is a southeast plunging cylindrical fold with 4-way dip closure provided by minor plunge reversal at the northeastern end of the structure. The Palm Valley structure has a far more dome-like geometry. Fold related fractures are most dense along the Mereenie fold axis as reflected by high values of normal curvature. Overall however, there is an absence of extensive fold related fractures (Gillam et al; 2010) and regional fracture swarms appear to have more influence on permeability than the former although where the two fracture sets coexist there is improved fracture permeability.

The overall impact on reservoir performance is relatively limited compared to Palm Valley field where fracture swarms are more closely spaced. There are implications for upcoming appraisal drilling at Ooraminna field where it appears, based on the above model, the most productive zones could occur where regional fracture (swarms) intersect fold related fractures.

**Palm Valley Field**

Palm Valley has a more domal geometry compared with Mereenie structure and fold fracturing is more widespread. However, it is pervasive fracture swarms at Palm Valley that dominate well performance where present. Indeed, Gillam et al (2010) suggest that this pervasive regional fracture network extends through the Horn Valley Siltstone and connects the Pacoota Sandstone and Stairway Sandstone which are in pressure communication. Some field production data (Palm Valley 6A and 6B) supports the idea that regional fracture swarms are responsible for vastly enhanced gas production rates in the field.

**Amadeus Basin Fractured Basement and "Buried Hill" Hydrocarbon Plays**

Two attractive plays can be invoked, firstly where Gillen member source rocks onlap a basement palaeohigh and secondly a thrust belt structural play (Figures 7 and 8). Results from Magee-1 suggest the Gillen is capable of sourcing wet gas while the Heavitree Quartzite (a misnomer, it is a sandstone showing up to 10% primary porosity) also flowed Helium (6.2%), derived by the radiogenic decay of minerals in basement granites. The main components of the play, which would be very common in the thrust belts of the southern Amadeus Basin, include the following:

1) An upthrust, fractured basement block which resulted in development of a geomorphological palaeohigh possibly rimmed by Heavitree Quartzite which itself provides a target.

2) Oil-gas mature lacustrine shales of the overlying Gillen Member onlap or transgress the basement high.

3) Top seal above the Gillen Member is provided by remobalised salt which blankets the Heavitree and is a very effective regional barrier to vertical migration of hydrocarbons and helium.

4) Lateral migration of hydrocarbons into fractured granite lithologies offer better prospects because they have better connected fracture systems compared to layered metamorphics which generally have more limited fracture dimensions. There are exceptions to this assertion, one being the Yaerxia basement oil field in China. Here oil production of up to 1000 bopd /well occurs from a sequence of phyllite, slate, and meta-sandstone. The joints, faults and fractures within the sequence are well developed and connected in part; there are numerous other examples of this type of production from metamorphics but in general there is a bias to granitic lithologies.

5) Downward migration of hydrocarbons could occur where there are differential stresses between the overburden and basement which could be widespread considering the major salt infused decollement surface is a regional feature of the southern Amadeus.

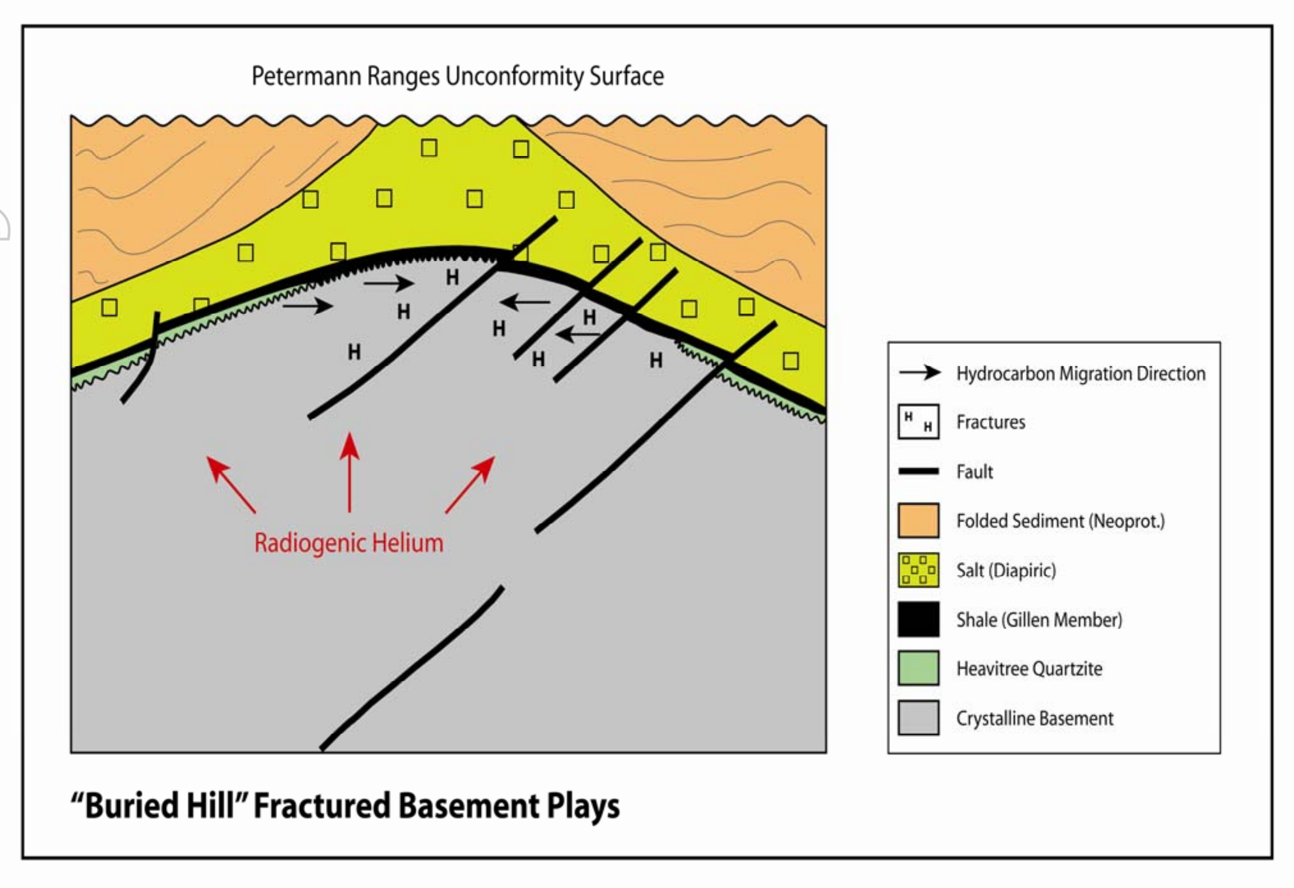


**Figure 7: "Buried Hill" Fractured Basement Play in the Southern Amadeus Basin.**

### The Cuu Long Basin Vietnam-an analogous play type

Granite basement contributes greater than 70% of total oil production in the Cuu Long Basin. The first oil discovery in basement in this basin was the Bach Ho field in 1988. Oil in the granite basement is stored in macro-fractures, micro-fractures and vuggy pores. The matrix porosity of the granite body is negligible.

Fractures within the basement originate from tectonic activity, hydrothermal processes, weathering and exfoliation. Basement oil production is up to 14,000 BOPD.

Another example is the White Tiger oilfield in the Cuu Long basin which produces 28,000 BOPD from fractured granitoid basement.

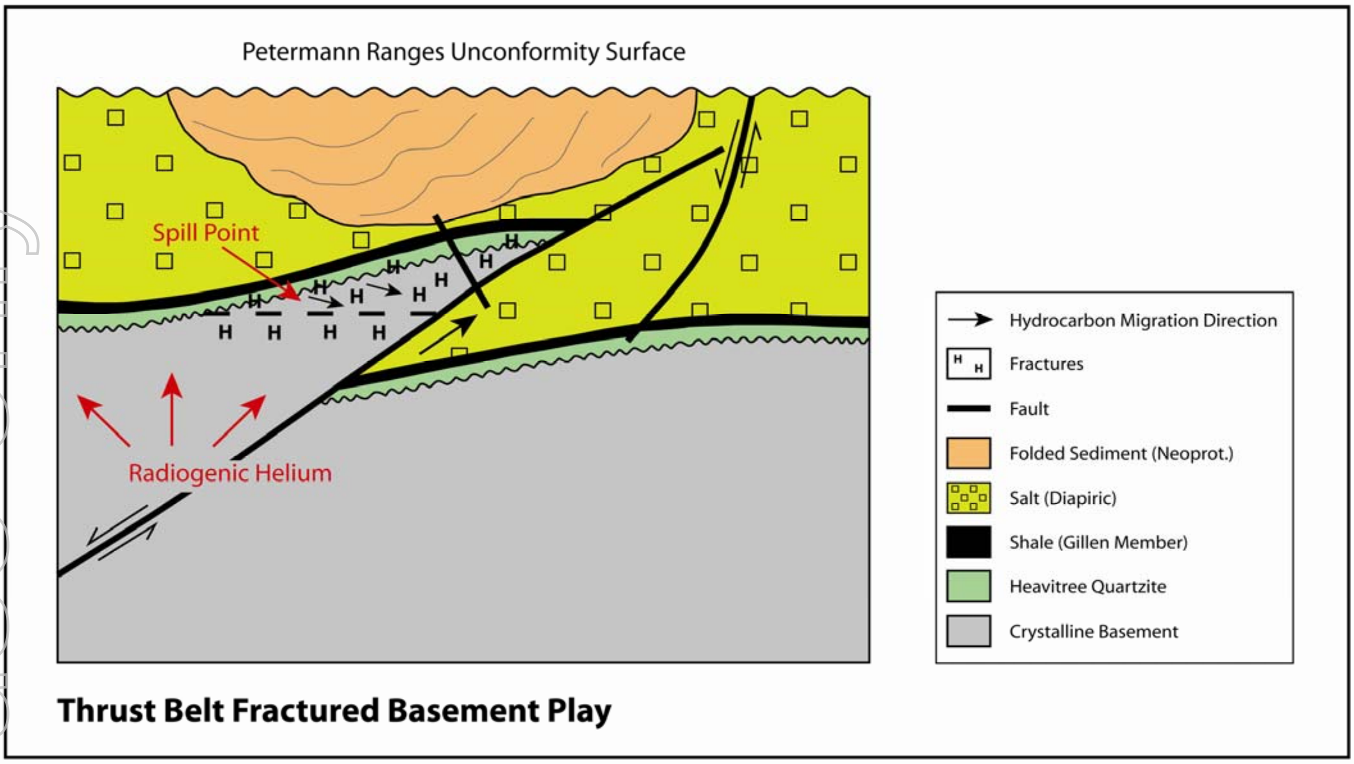


**Figure 8: Thrusted Basement Play, Southern Amadeus Basin – Gillen Shale Source Rock**

## Simpson Desert Area-Pedirka Basin

In this region, fractured basement plays can be considered as secondary targets along the McDills / Hector Trends which suffered major compression during the Kanimblan Devonian Orogeny and along the faulted margins of the Hale River Block. Sedimentary facies in the Devonian carbonates clearly show km scale subsidence on the Pellinor Fault during the Devonian. There was little drape and compaction/faulting during the Jurassic- Cretaceous although the block was a subtle palaeohigh at this time and would have been a focus for oil migration from the Madigan Trough during the Late Cretaceous. Major uplift during the Miocene saw development of a major monocline centred on the Pellinor Fault.

**Hale River High**

The Hale River Block is a palaeo-high on the northern margin of the Pedirka Basin comprising a complex fault block with a core of Mesoproterozoic meta-sediments and Early Cambrian volcanics. The bounding structural elements are the compressive Hector Fault Trend on the northwestern margin and the extensional Pellinor Fault Trend on the southern margin. The north trending Hector Fault, which is contiguous with the Hallows and Mc Dills Trend, was subject to compression during the Devonian Kanimblan Orogeny and again during Late Triassic uplift followed by massive fault reactivation during the Miocene-Recent. The Pellinor fault zone is a system of normal faults which controlled Warburton Basin, Pedirka Basin and to a lesser degree Simpson – Eromanga Basin sedimentation on the southern margin of the Hale River Block. This fault trend probably comprises a complex system of normal faults with displacement transferred via zones of ductile deformation (relay ramps), with major sedimentary thickening in the hanging wall as demonstrated by the deposition of the thick Devonian barrier reef complex.

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The focus of hydrocarbon migration from various possible source rock facies making up the Barrier Reef Complex is updip towards the footwall basement block. Fractured basement is a secondary play to hanging wall fault plays in the backreef and other barrier reef and fore-reef plays. Most of the Hale River Block may have been exposed for a long time span, possibly forming a weathering profile breccia which could have a similar pore structure to sandstone or conglomerate. If significant volumes of hydrocarbons have migrated to this regional high, then fractured and indeed fractured/weathered basement become potential targets. In the case of "buried hill" plays on the high, oil distribution would be controlled by buried hill shape rather than fault block architecture; detailed interpretations await further seismic.

The massive normal fault bounding the southern margin of the Hale River Block is shown in figure 10. The main plays reside in the Devonian carbonate sequence and the presence of source rocks in this sequence is pivotal not only to these targets, but also potential secondary plays in fractured basement. Oil could penetrate into fractured basement rocks by flowing up or across the main fault plane(s), or by direct penetration into fractured basement at relay ramps occurring along the main fault trend; radiogenic helium is also a target.

**Simpson East Prospect**

The Devonian carbonate platform described in Ambrose (2008) and Ambrose and Heugh (2011) presents a number of plays including updip pinchout of the platform facies onto a rotated fault block which is also a basement high point. Seismic indicates that at the location of the Simpson East fault block the pre-Devonian sequence appears to be Precambrian basement or, Cambrian volcanics. The main play resides in the platform itself and its rimmed margin which could have enhanced porosity. The Simpson East Prospect, in terms of its seismic signature and interpreted structural/stratigraphic setting has the hallmarks of a "buried hill" play at basement level which provides a secondary target at this prospect. Source intervals are not readily discerned in the Devonian but the presence of gas chimneys and HRDZ's downdip of this structure suggest source potential is present. The Simpson East closure is N-S elongate parallel to an adjacent normal fault trend which could have set up fracture networks in the Devonian sequence and in basement. There is a possibility of a near top basement weathered breccia given the suggested timespan of the unconformity (120 ma). Fractured basement should be considered one of the secondary targets in this well.

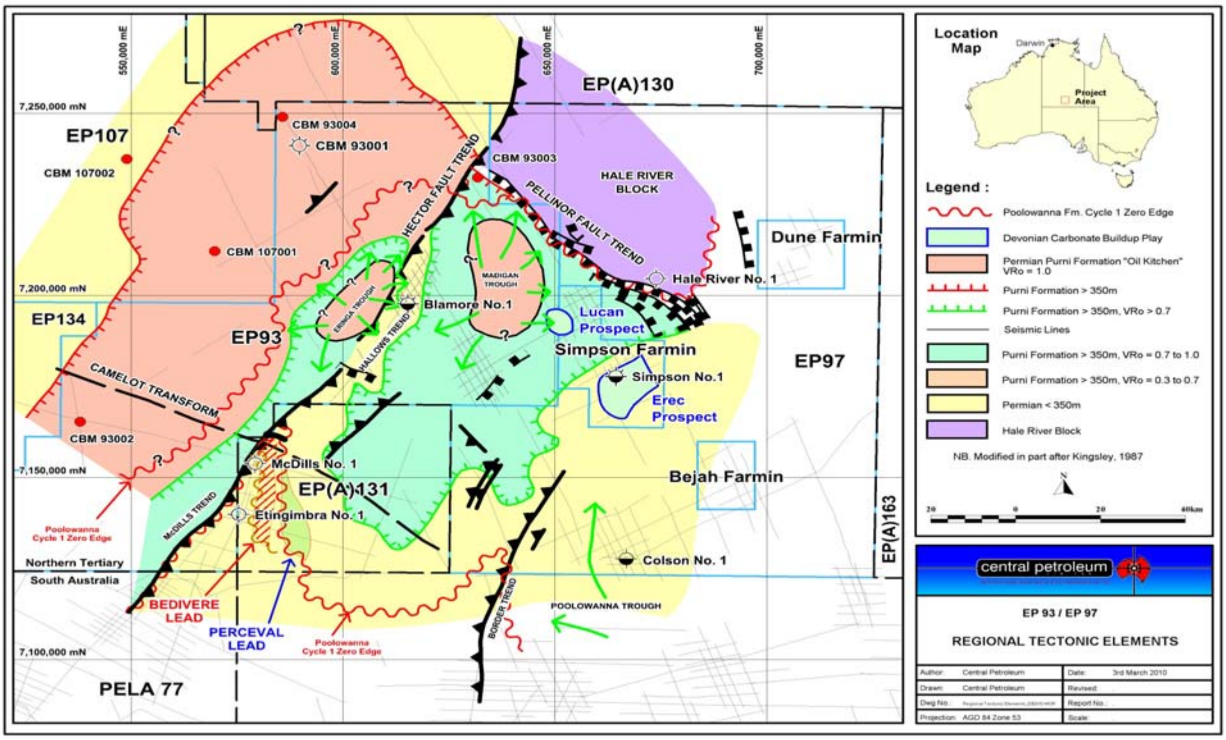


**Figure 9 : Simpson Desert Area – Regional Tectonic Elements**

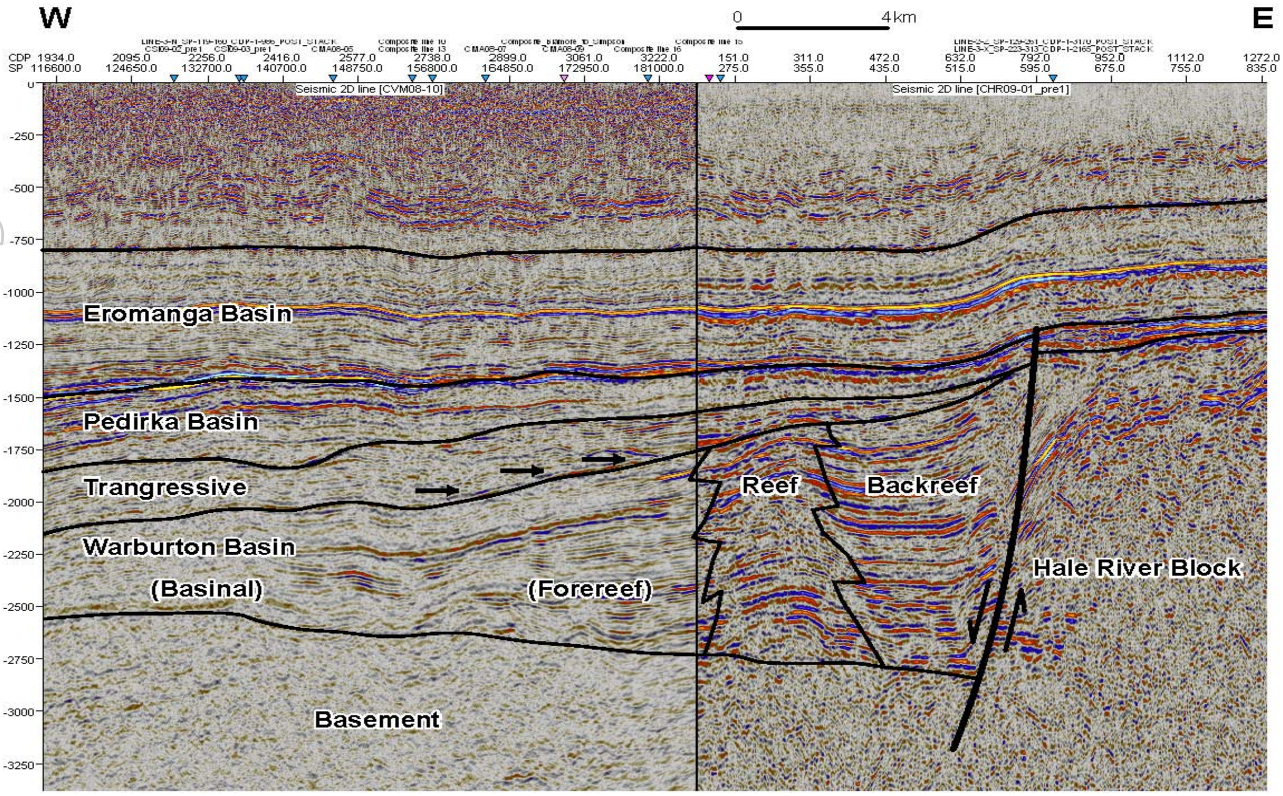


**Figure 10: The Hale River Fault bounding the Hale River Block With Devonian Barrier Reef Complex**

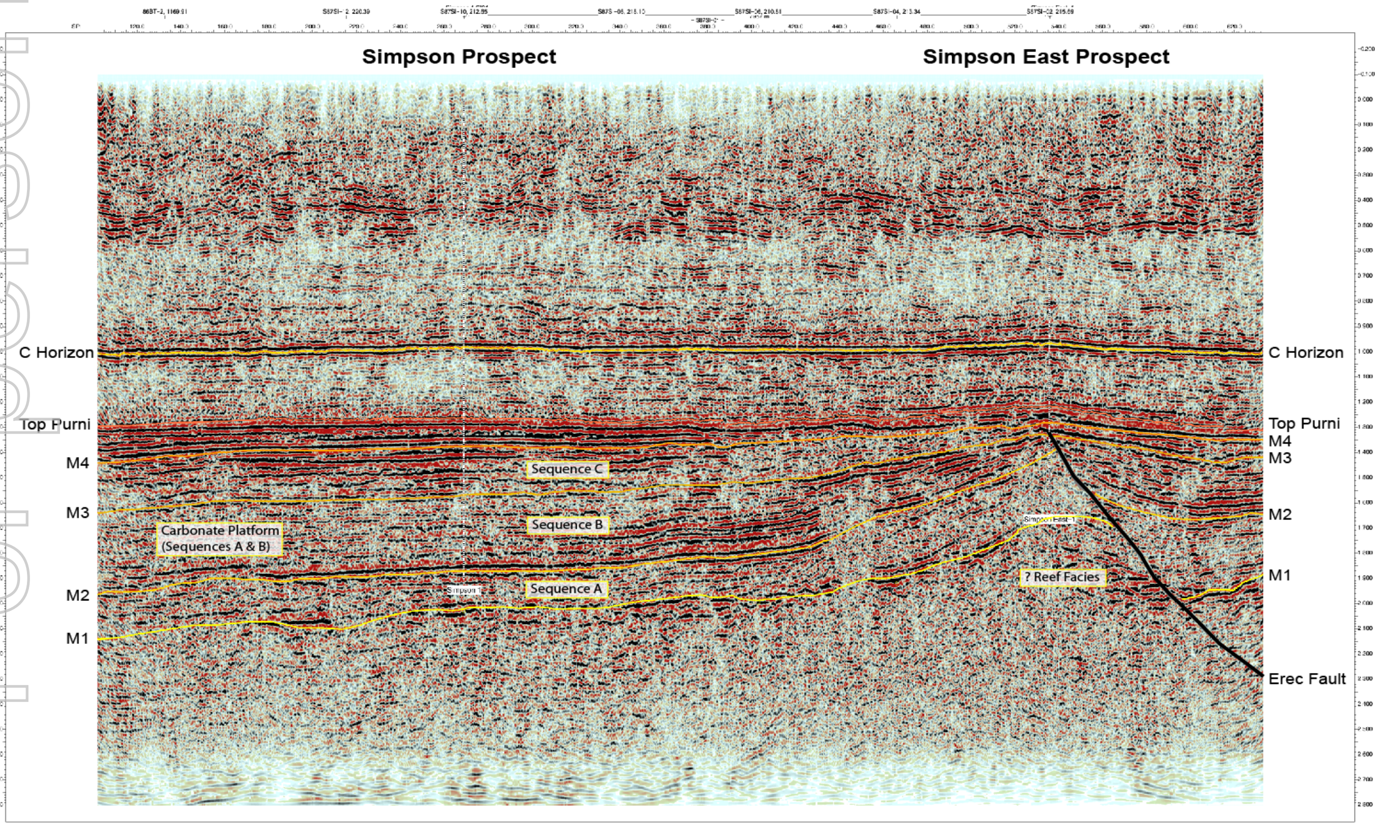


**Figure 11: Simpson East Prospect**

## Georgina Basin

A significant basement play in the southern Georgina Basin leverages possible brecciation along the main bounding fault zone on the western margin of the Toko Syncline, ie the Toomba Fault. The Bradley Shelf to the east has potential for palaeogeographic plays (ie "buried hill" plays) but definition of these requires incremental seismic.

The Toko Syncline is asymmetric, wedge-shaped and lies between the Toomba Fault and the northward trending Bedourie Block. It was a major depocentre from the Neoproterozoic (tensional rifting) through to Devonian/Carboniferous foreland basin development during the Alice Springs Orogeny (ASO). The loading event, which facilitated initial oil generation from rich Middle Cambrian source rocks in this depocentre (ie Lower Arthur Creek Formation/ Thorntonia Limestone), probably occurred in the Early Ordovician when sediment loading in the axis of the syncline exceeded 2000 m. Palaeogeothermal gradients were probably relatively high given the proximity to the Arunta Block.

Additional sediment loading, with associated elevated geothermal gradients, occurred later during several phases of the Alice Springs Orogeny, the earliest being the Late Ordovician Rodingan Movement. At this time synorogenic deposition of the Ethabuka Sandstone occurred over a wide area of the Toko Syncline reaching a thickness of up to 1100 m. This, together with additional loading during the Early-Middle Devonian phase of the ASO (Cravens Peak Beds), resulted in thermal cracking of earlier formed oil deposits eg. In Ethabuka-1. at the Coolibah Fm/Nora Fm interface.

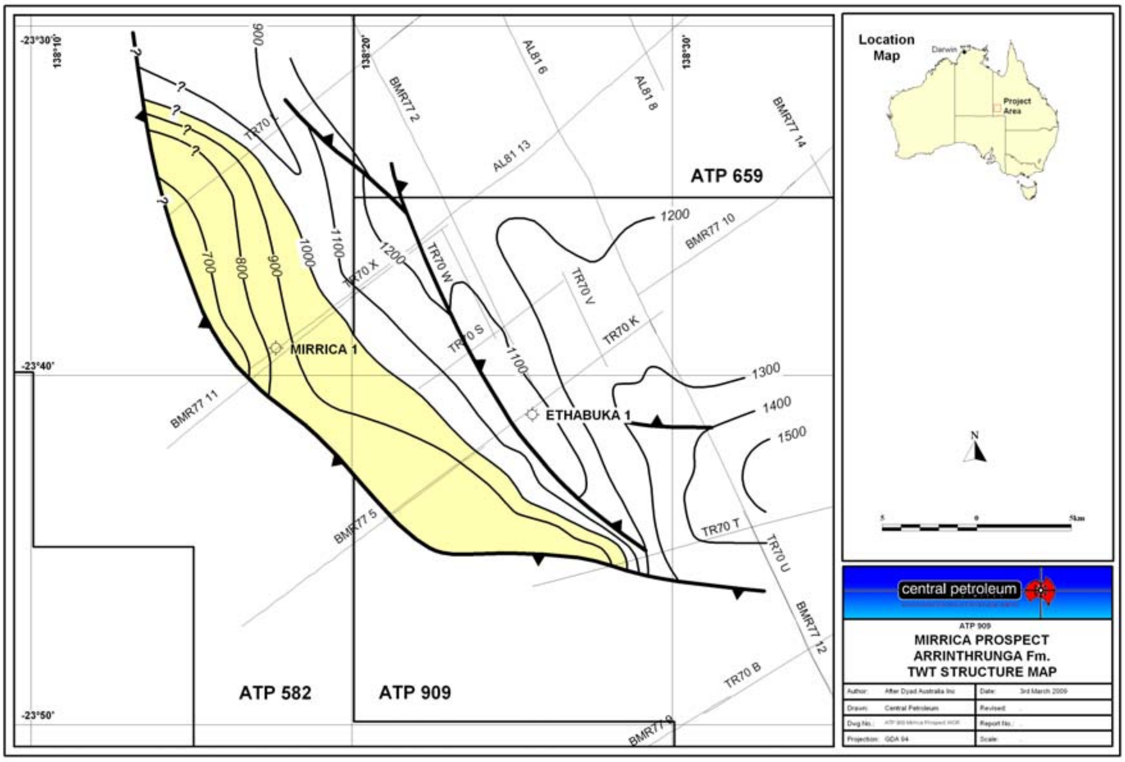


**Figure 12: Mirrica Basement Lead – Southern Georgina Basin**

Structural mapping at basement level defines a large closure against the Toomba Fault (41,700 acres) with a similar area of closure at higher levels in the Middle Cambrian Arthur Creek Formation. The northern extremity of the trap was tested in part by Mirrica-1 where the Middle Cambrian appears gas saturated but is tight. Little is known of the basement except that it is granitic with evidence of weathering at the unconformity. The crest of the basement structure lies 16 km southeast of Mirrica-1 where the high point on the structure lies nearly 300 ms ( over 2000 ft) above basement in Mirrica-1. The undiscovered prospective gas resource-in-place (unconventional) at the Middle Cambrian level could exceed 4 Tcf if the structure is filled to spill. The total vertical closure at basement level could exceed 4000 ft but there is no definite indication of fracture development or gas saturation at present. The Mirrica Prospect thus has substantial potential at Middle Cambrian levels (fractured conventional trap). If the granitic basement is fractured and gas saturated this in-place resource could be greatly expanded.

Another potentially important fracture play resides in the Middle Cambrian Thorntonia Limestone which is often fractured/brecciated and in some instances is strongly altered by hydrothermal fluids. Hydrocarbon shows are common in this unit and where the shale content is high it is regarded as a good source rock (eg Owen-2, Bradley-1).This target is blanketed by black, organic rich shales of the Lower Arthur Creek Formation ( the " Hot" shale – Ambrose et al, 2001) which provide an extensive top seal/source cover unit. This play requires a quiescent structural setting where most fracturing relates to diagenesis at a regional unconformity surface. In more tectonised areas the play requires some evidence of protection from invasion by hydrothermal fluids.

## Conclusions

- Fractured basement plays are productive in 30 countries around the globe. They are completely unexplored in Central Australia despite favourable geological criteria in several basins and numerous examples from many basins around the globe.

- Fractured basement plays in the Amadeus Basin are especially favoured as a result of regional salt seal blanketting extensive generative lacustrine shales which in turn overlie crystalline basement which is a source of radiogenic helium. Fractured Heavitree Quartzite and basement are the target reservoirs.

- The Hale River Block in the northern Simpson Desert area has been a focus for hydrocarbon migration since the early Mesozoic. Massive normal faults mark the southern margin of this high but the western margin is denoted by compressive reverse faults. The primary targets reside in the Devonian and Mesozoic sequences; some plays rely on seal against the main fault plane but incursion of oil into fractured basement could occur at relay ramps and other structural discontinuities

- The Georgina Basin has seen major oil migration initially during the Ordovician and later during the Devonian –Carboniferous. New interest in unconventional gas/oil reflects the paucity of reservoirs in the very organic rich Middle Cambrian carbonate sequence. The Middle Cambrian Thorntonia Limestone is a brittle carbonate blanketed by organic rich shales of the lower Arthur Creek Formation and where unaffected by hydrothermal alteration it provides an attractive fractured carbonate play. Fractured basement is little known in the Georgina Basin but granite has been intersected in several wells and this play is considered a secondary target.

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