

Mesoproterozoic Unconventional Plays in the Beetaloo Basin, Australia: The World's Oldest Petroleum Systems*

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Abstract

Unconventional oil and gas shale plays have been mapped and confirmed by recent drilling by the Shenandoah well in the depocenter of thick Precambrian rocks in the Beetaloo Basin, Northern Territory, Australia. Only 12 wells have been drilled in the entire basin. Total depths rarely exceeded 2000 m, though at least 3000 m of potentially prospective section is present. Structural traps and conventional sandstone reservoirs have also been identified, as has a pervasive tight-sand gas play near the basin center.

Reinterpretation of the basin's burial history based on new and existing 2-D seismic data has revealed substantial exploration potential from plays and leads that were not evaluated by earlier drilling. Highly encouraging shows were noted in several of these wells. Any production to be established would be among the oldest in the world.

Organic-rich shales and quartzose sandstones in the upper portion of the Mesoproterozoic Roper Group (~1.4 Ga) are the key objectives. Work on the burial history of these strata suggests that peak hydrocarbon generation may have occurred in the Jurassic, much later than previously thought, greatly increasing the potential for preserved traps.

The Shenandoah-1 was drilled by PetroHunter Energy in 2007 to a total depth of 1550 m. The well noted hydrocarbon shows in the Hayfield Sandstone at a depth of 780 m. This zone and significant oil pay zones in the upper Kyalla Shale at depths of 943 to 1020 m are regarded as highly prospective, with about 40 m considered to be an oil pay upon subsequent stimulation. The top of a Basin Centered Gas Accumulation (BCGA) was penetrated at the mid- Kyalla Sandstone at 1464 m with numerous gas shows.

Falcon Oil & Gas deepened this well as the Shenandoah-1A in 2009 to 2714M. Multiple gas zones in the lower Kyalla Shale, Moroak Sandstone and Velkerri Shale were noted. These include:

- Gas shows in the lower Kyalla from 1500-1718 m,
- A Moroak conventional gas play from 1717 to 2060m, with the upper 88 meters indicating high permeability,
- intermittent gas shows in Moroak sandstones to 2200 m,
- A Mid-Velkerri gas shale play from 2400 to 2558 m.

Results of the planned 2010 completion of this well are discussed.

References

Duddy, I.R., B. Erout, P.F. Green, P.V. Crowhurst, and P.J. Boulton, 2003, Timing constraints on the structural history of the western Otway Basin and implications for hydrocarbon Prospectivity around the Morum High, South Australia: APPEA Journal, v. 43/1, p. 59-83.

Law, B., T. Ahlbrandt, and D. Hoyer, 2010, Source and reservoir rock attributes of Mesoproterozoic shale, Beetaloo Basin, Northern Territory, Australia: AAPG Annual convention, New Orleans, Louisiana, 2010, Search and Discovery article #110130, Web accessed January 17, 2010, http://www.searchanddiscovery.com/documents/2010/110130law/ndx_law.pdf

Thomasson Partner Associates, 2005. Hydrocarbon potential of the Beetaloo Basin, Northern Territory, Australia: Proprietary report for Sweetpea Corporation Pty Ltd., Australia.

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September 14, 2010

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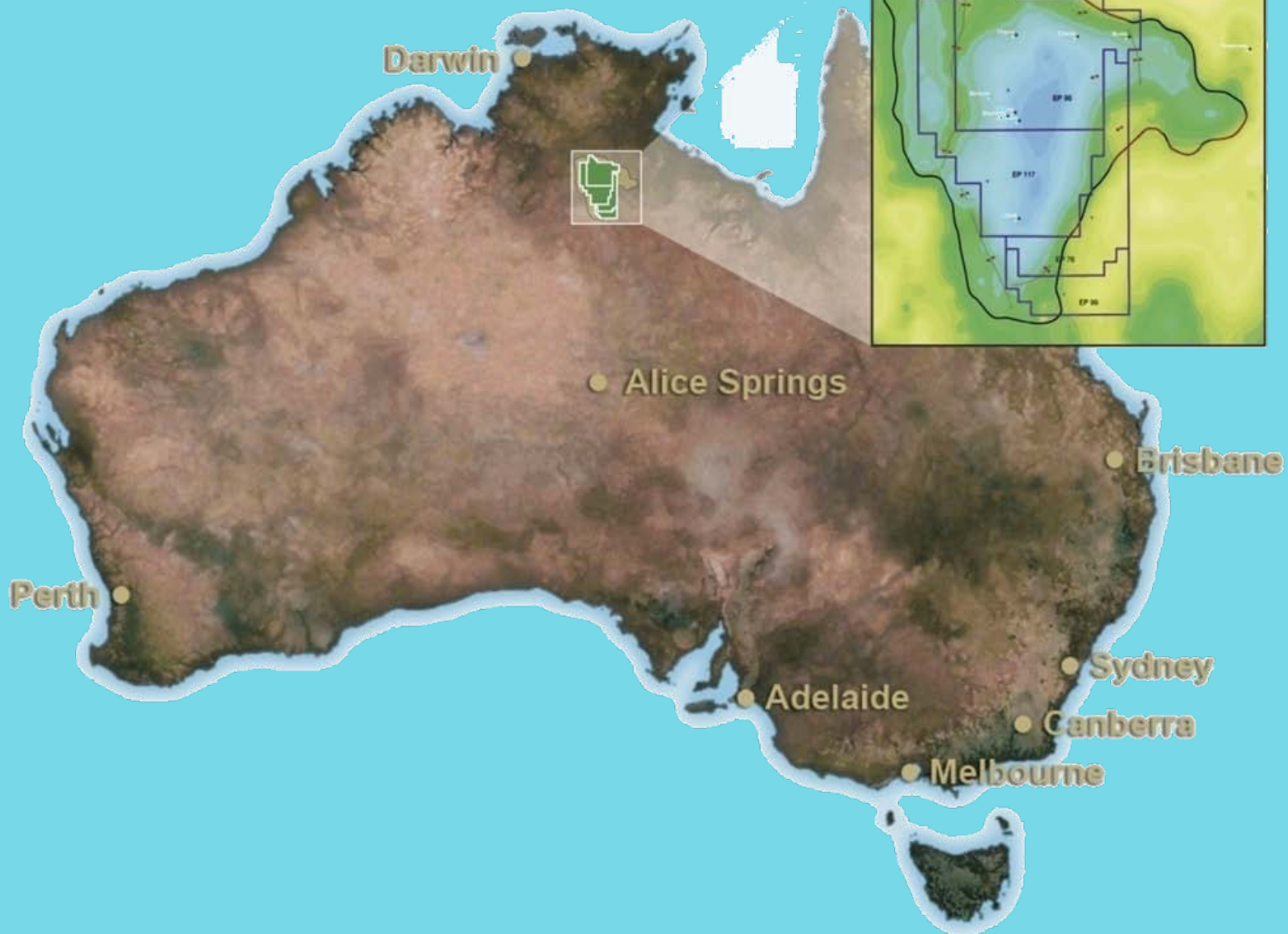
If you have to leave early

**The Beetaloo Basin has significant potential for both
unconventional resources (oil and gas)
and conventional structures**

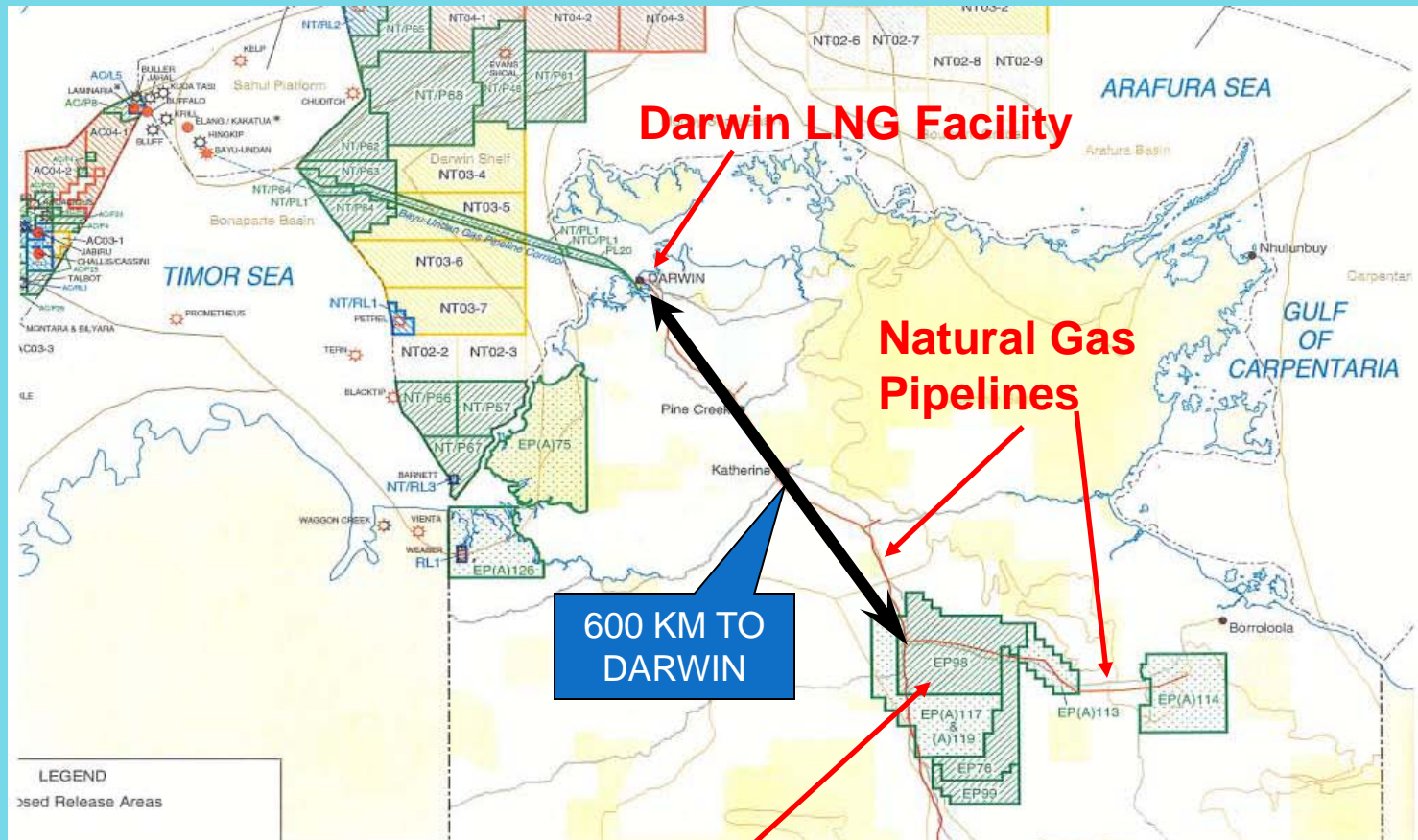
- *8.8+ million acres, the size of the Williston Basin*
- *193 BBO In Place; 19 BBO Recoverable Resource**
- *385 TCF Gas In Place; 64 TCF Recoverable Resource**
- *Three Total Petroleum Systems (Kyalla - 800M and Velkerri - 800M, Hayfield - 450M)--thermally mature for oil and gas*
- *World Class Source Rocks in Kyalla and Velkerri
with Abundant Oil and Gas Shows*
- *Six Potential Sandstone Reservoir Units with Shows and Light
Oil Recoveries*

*Ryder Scott

Sweetpea's Licenses



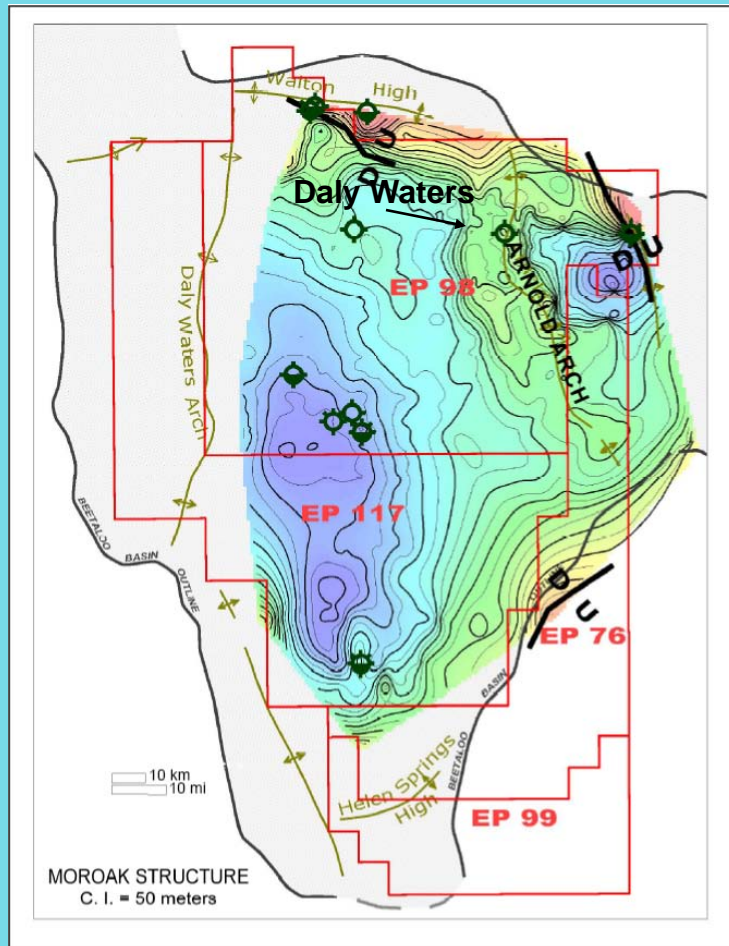
Northern Australia



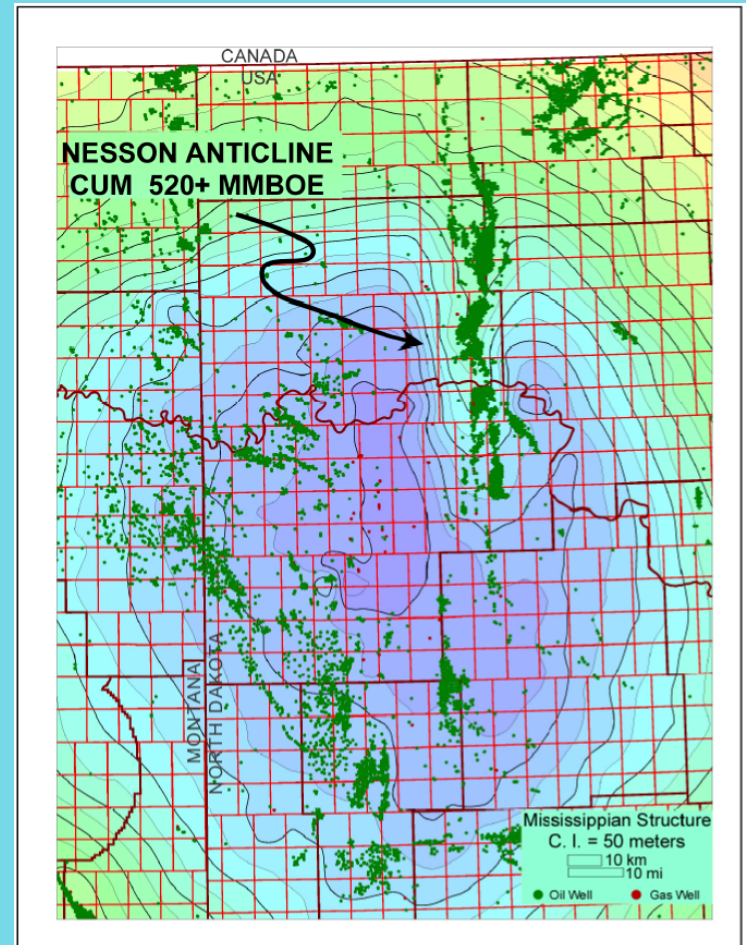
Beetaloo Exploration Permits

Comparative Size

Beetaloo Basin Australia

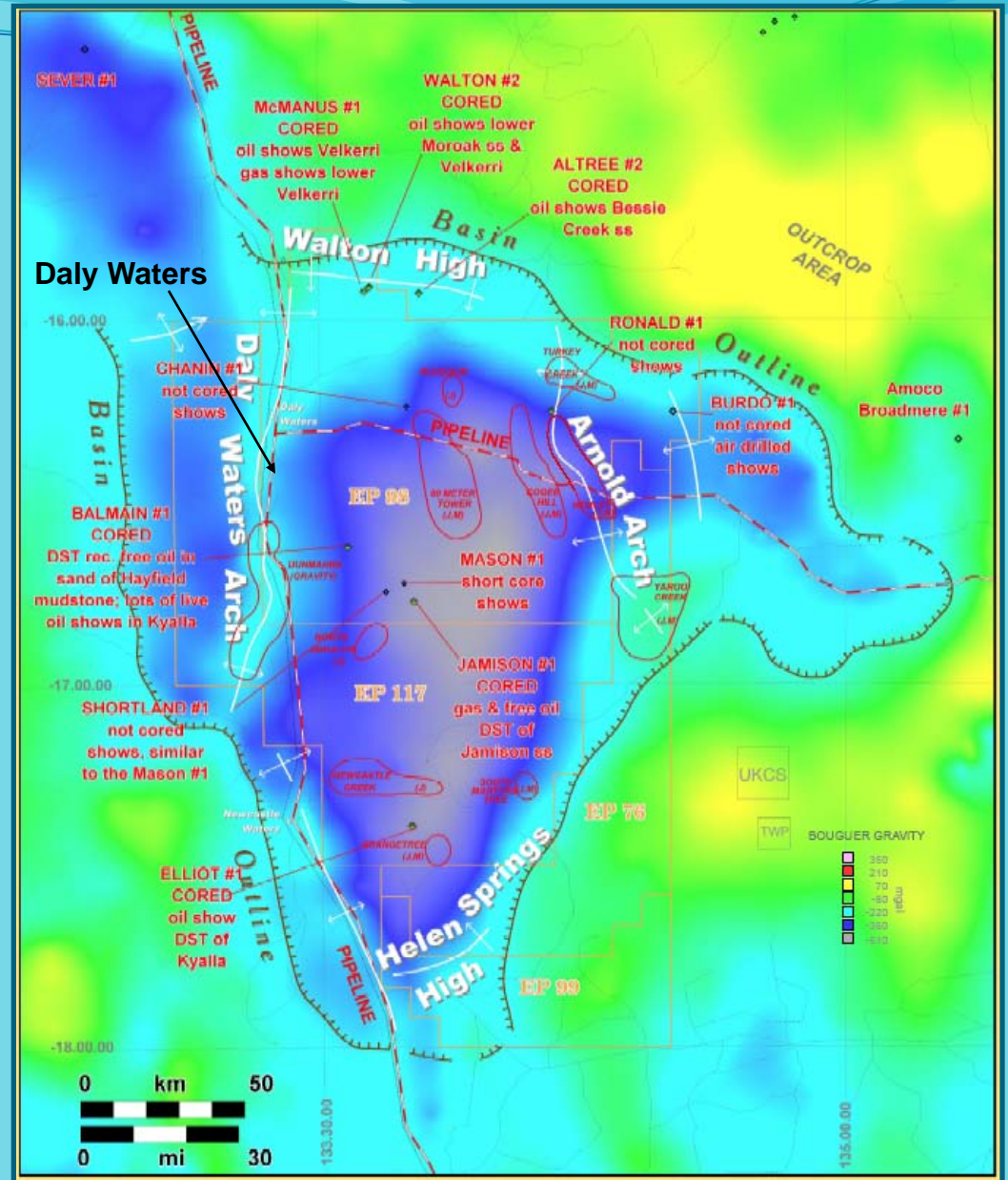


Williston Basin USA & Canada



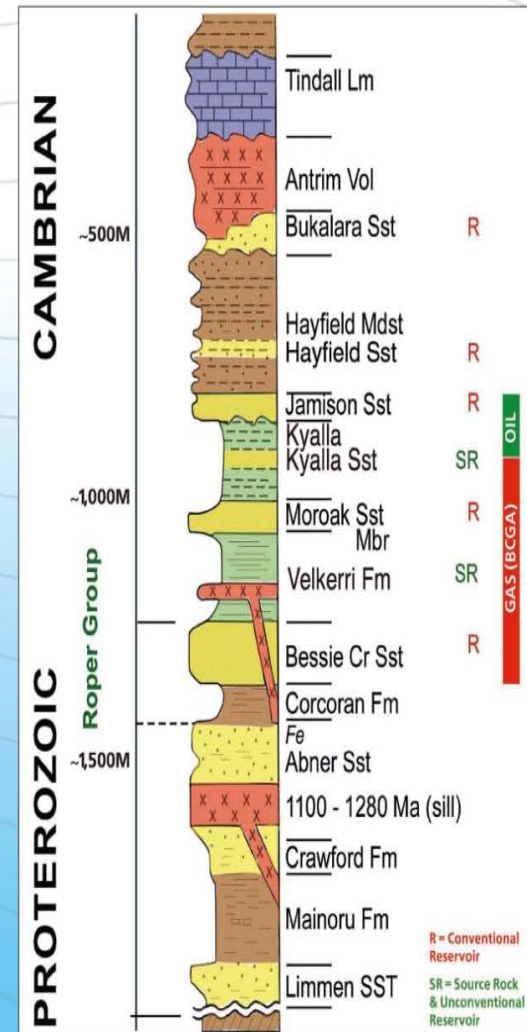
**Wide
distribution
of oil and gas
shows and
tests
throughout
Basin.**

***This is an
active
hydrocarbon
system.***



Beetaloo Basin Stratigraphic Column & Petroleum Plays

- More than 3,000 Meters of Sediment in Basin Center
- Over 1,400 Million Years Old
- Peak Oil Generation is Less Than 200 Million Years Ago
- Early Rift Basin with Later Compressional (Transpressional) Structures



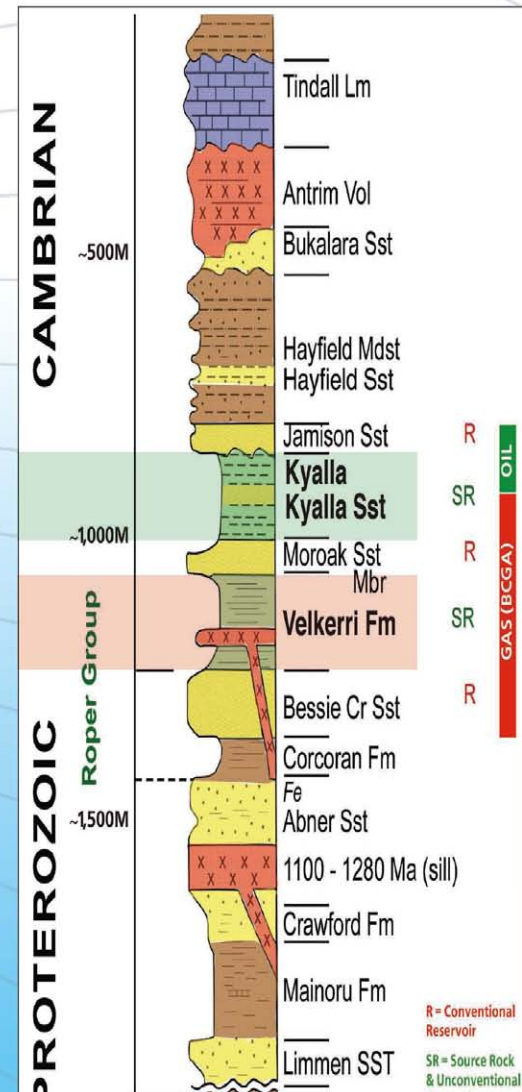
Two Thick Organic Rich Shales – Thick Self-Sourcing Reservoirs

Kyalla Shale

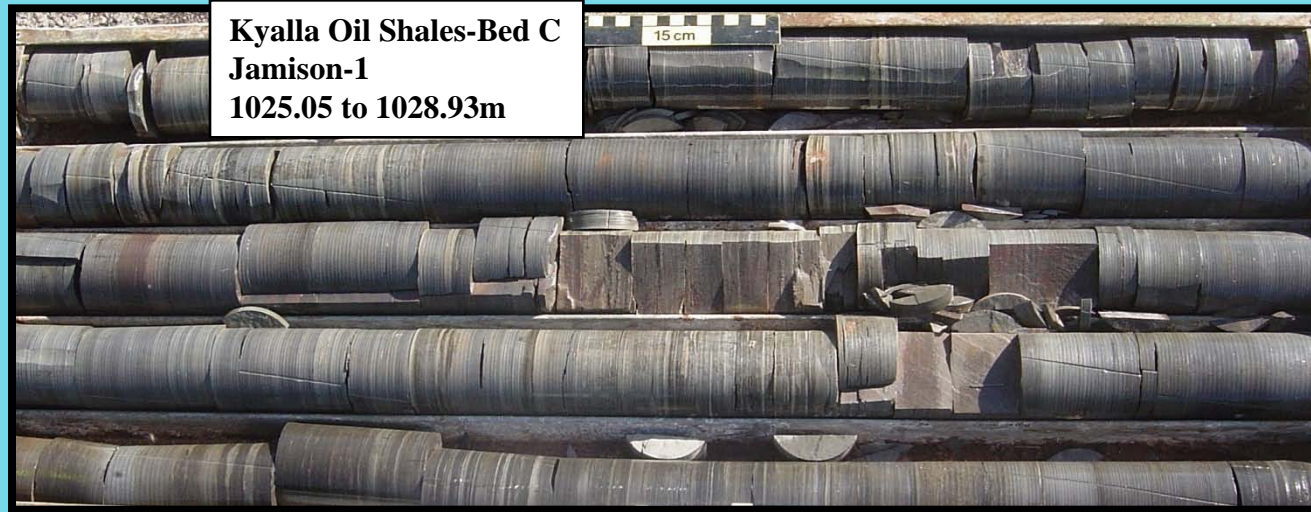
- Up to 800 Meters Thick
- TOC 2-3%, Thin Intervals to 9%
- Oil-Prone & Currently in Oil Window
- Highly Fractured

Velkerri Shale

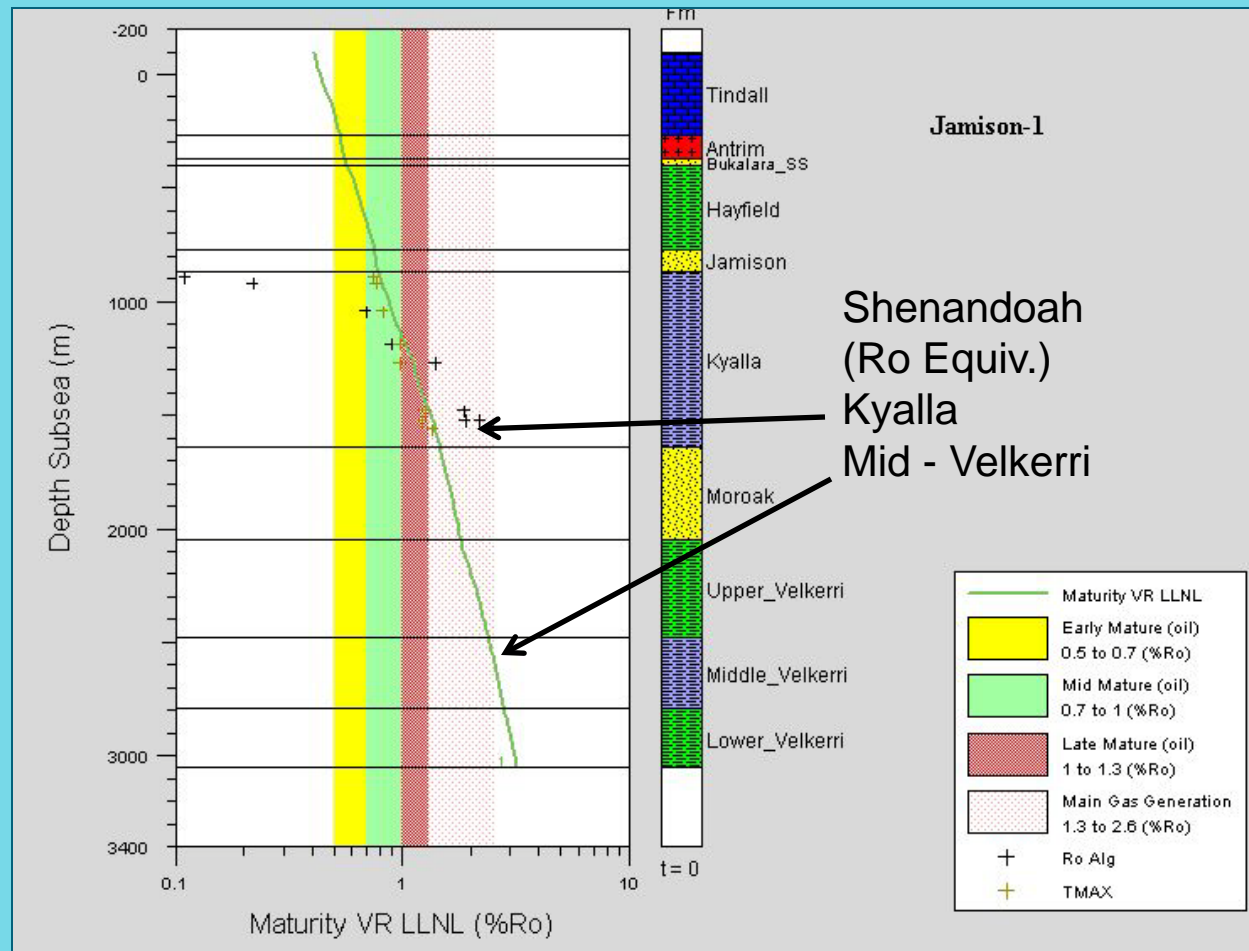
- Up to 800 Meters Thick
- TOC Up to 12%
- Mature for Oil & Gas
- Gas Shale in BCGA



Source Rock – Shale Play Cores



Jamison 1 BasinMod Thermal Maturity

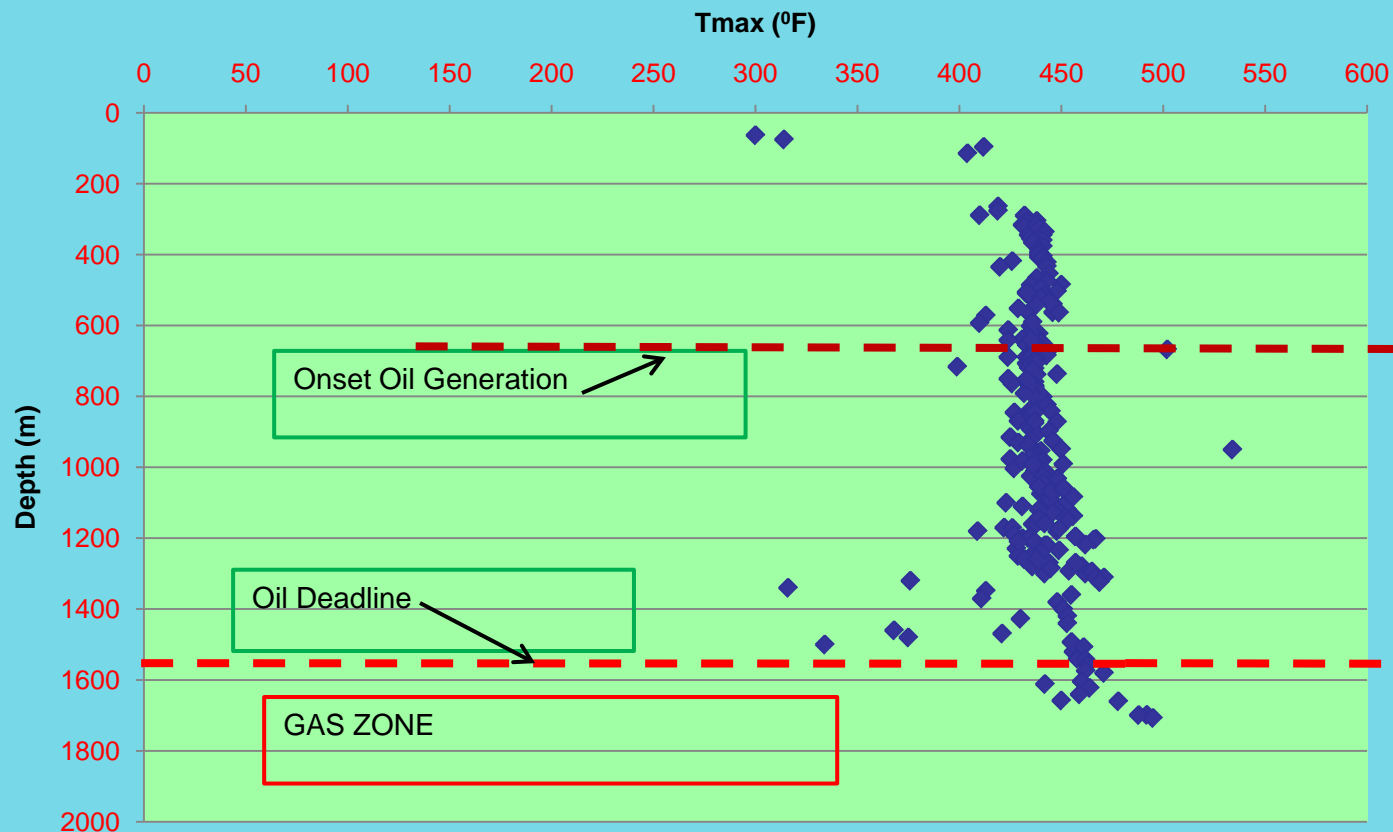


Jamison-1 is near basin center.

Kyalla oil/gas mature, Velkerri gas mature

9 wells
n=256

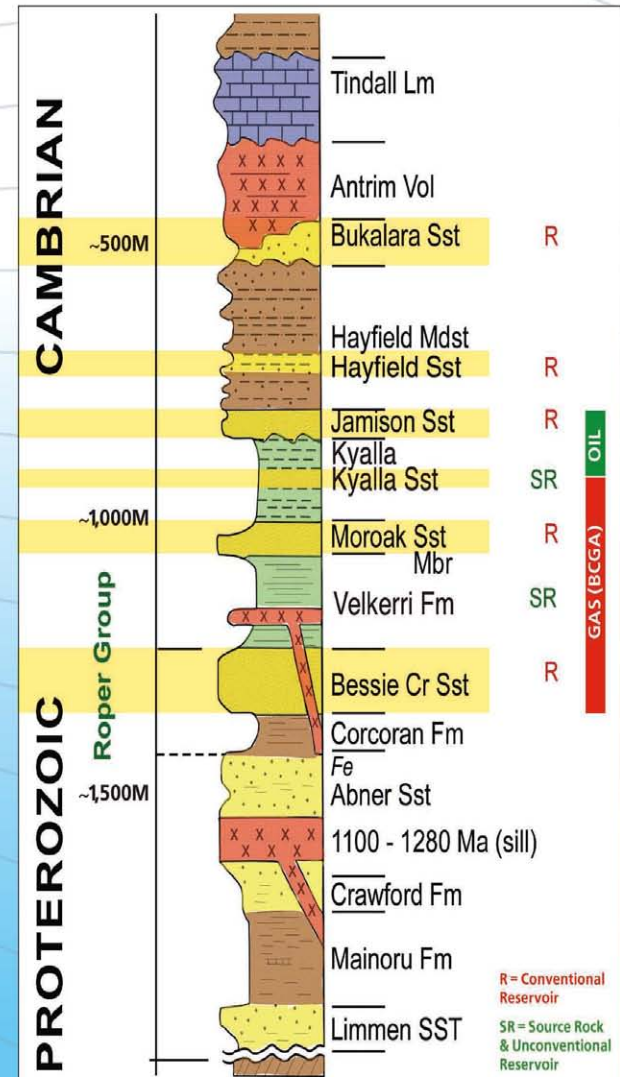
Beetaloo-- Tmax vs. Depth



Six Sandstone Reservoirs

- Bukalara Sandstone – $\leq 50\text{M}$
- Hayfield Sandstone – 10M AVG.
- Jamison Sandstone – $75\text{-}160\text{M}$
- Kyalla Sandstone – 15M AVG.
- Moroak Sandstone – $<300\text{M}$
- Bessie Creek Sandstone – $300\text{M}+$

SHOWS



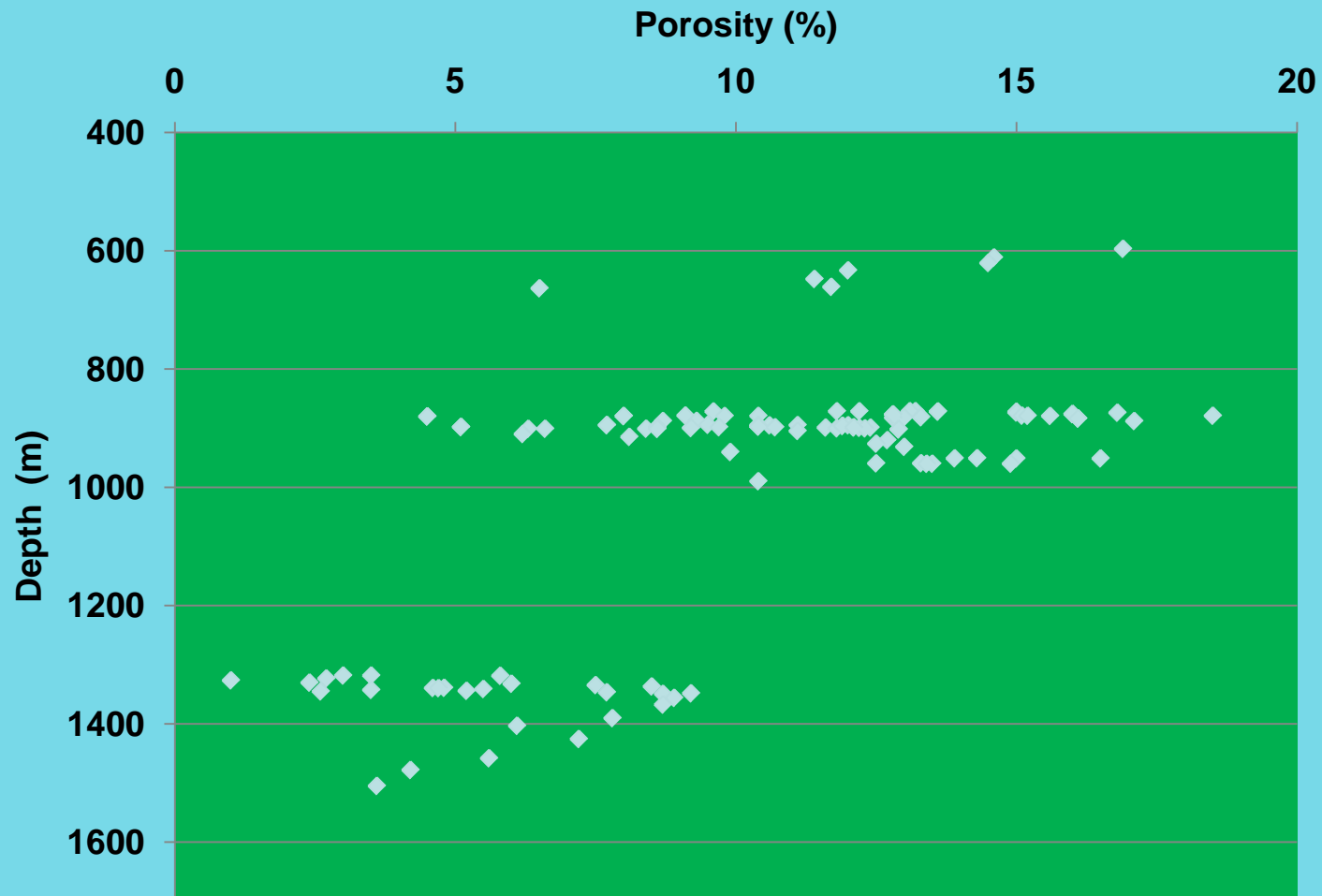
Jamison Sandstone Reservoir

Jamison - 1 Core



Jamison Porosity (core-derived)

4 wells
n=118



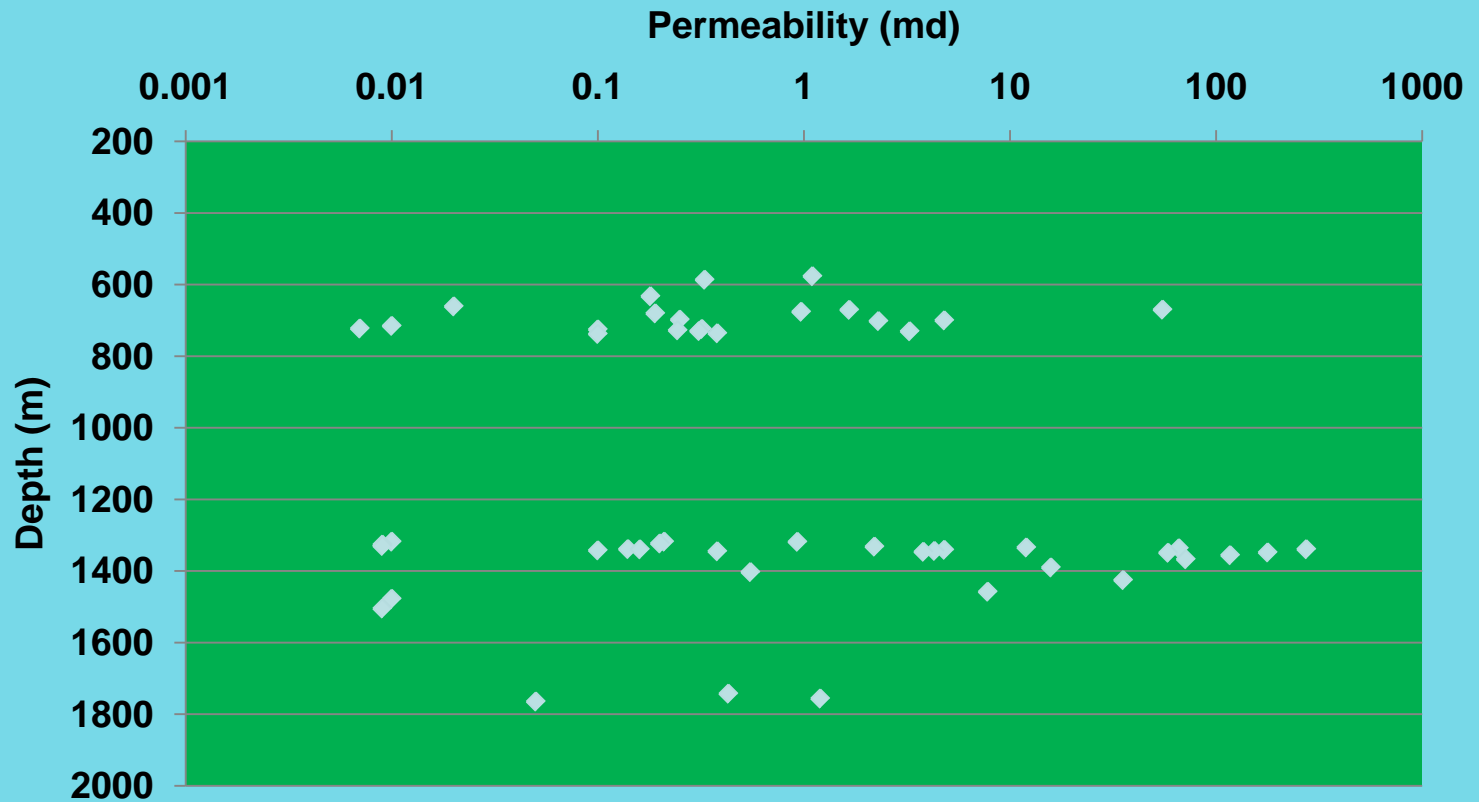
Moroak Sandstone Reservoir

Jamison - 1 Core



Moroak Permeability (core-derived)

3 wells
n=50



The World's Oldest Petroleum Systems (1.4Ga)

Mesoproterozoic oceans, continents, organic matter, sedimentary sequences different (the present is not the key to the past)

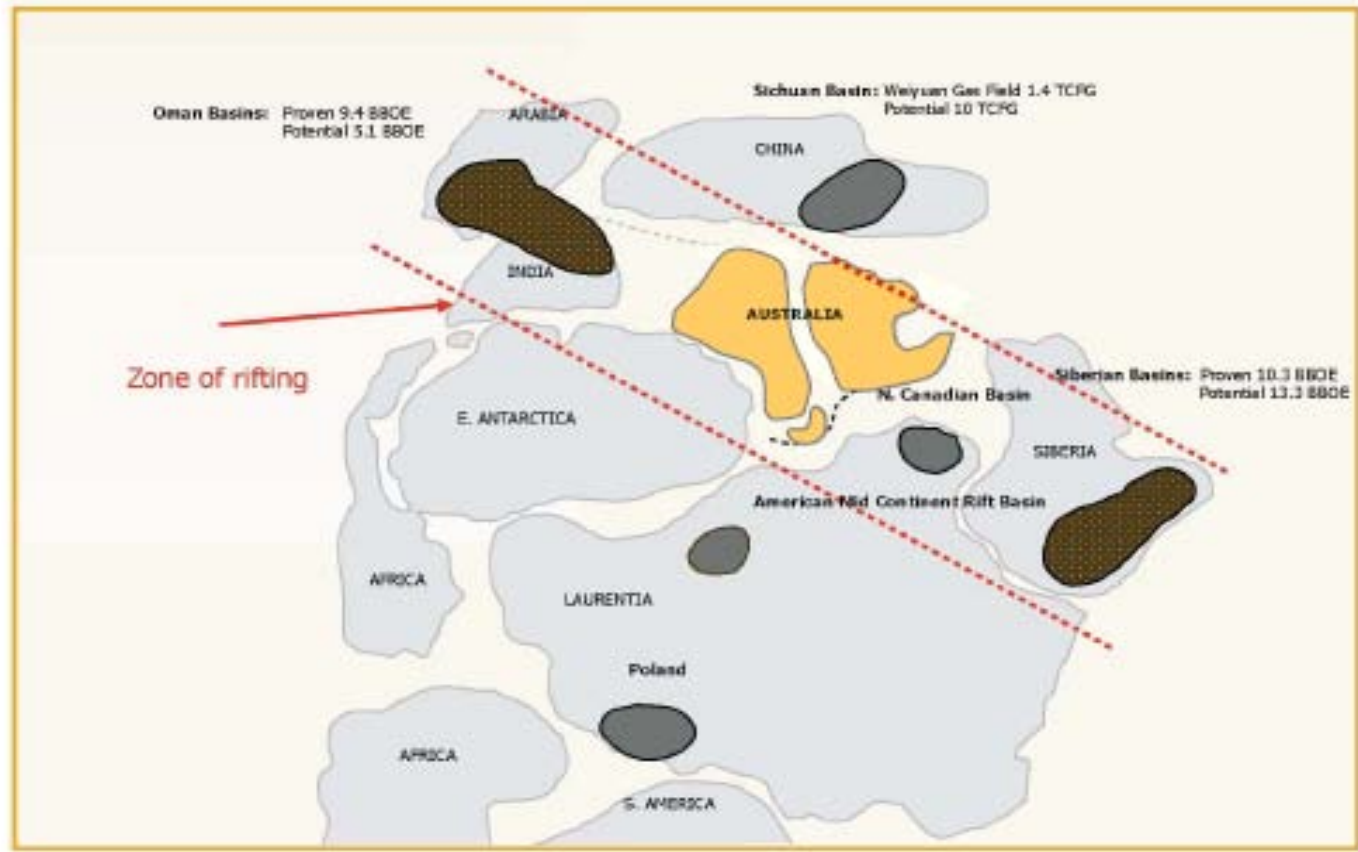
- **Pre-vitrinite**
- **Interesting sulfate minerals related to high sulfur and low oxygen oceans**
- **Weird fossils and sedimentary structures**
- **Significant hydrocarbon potential, high TOC, high HI's, good preservation of kerogen, kinetics different?**

Exploring in a basin where virtually everything is a new discovery;

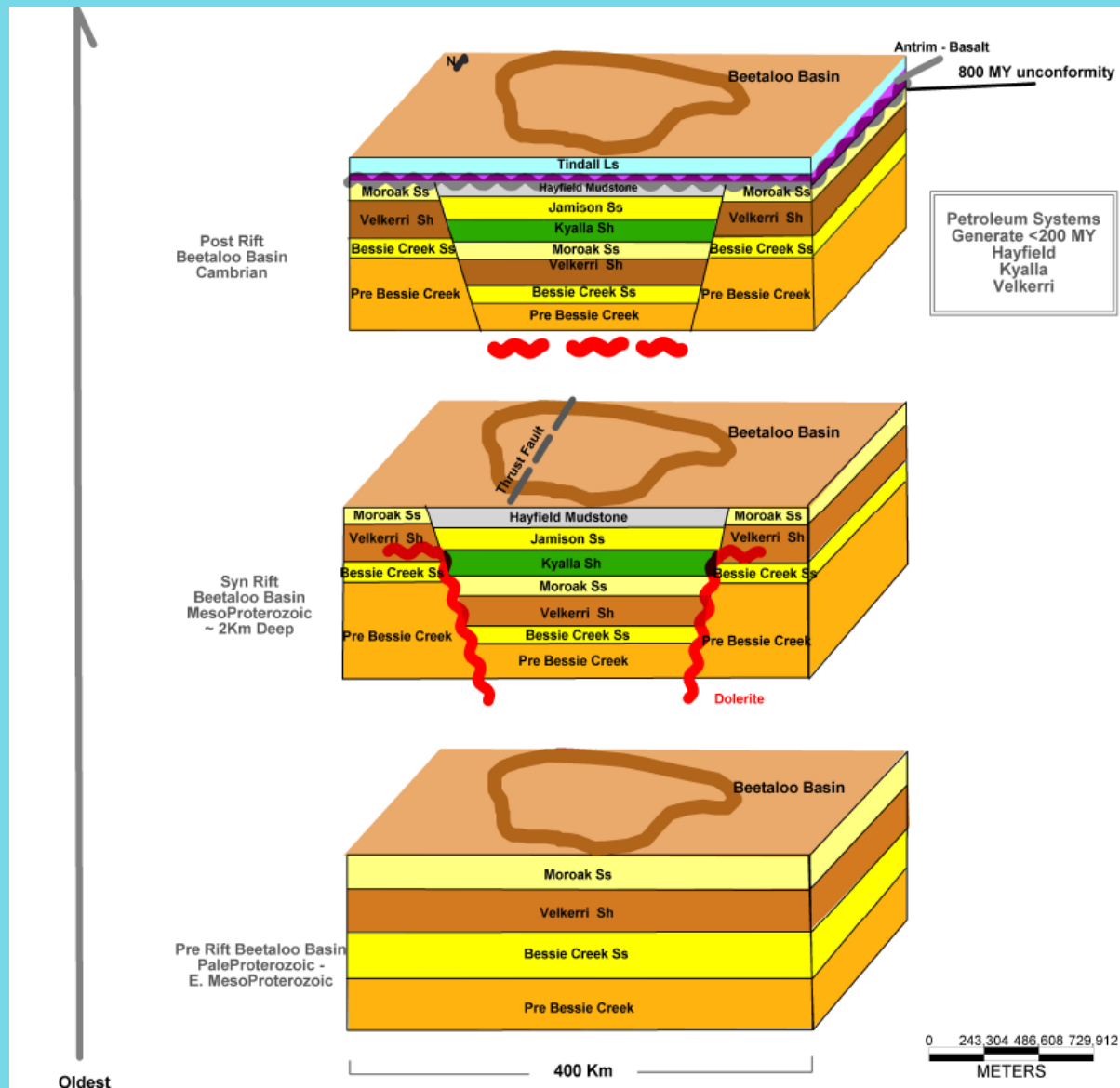
- **aborted rift basin, not an intracratonic sag**
- **Unknown 175-km long thrust belt**

Beetaloo Basin Paleogeography Compared to Major Neoproterozoic Producing Basins

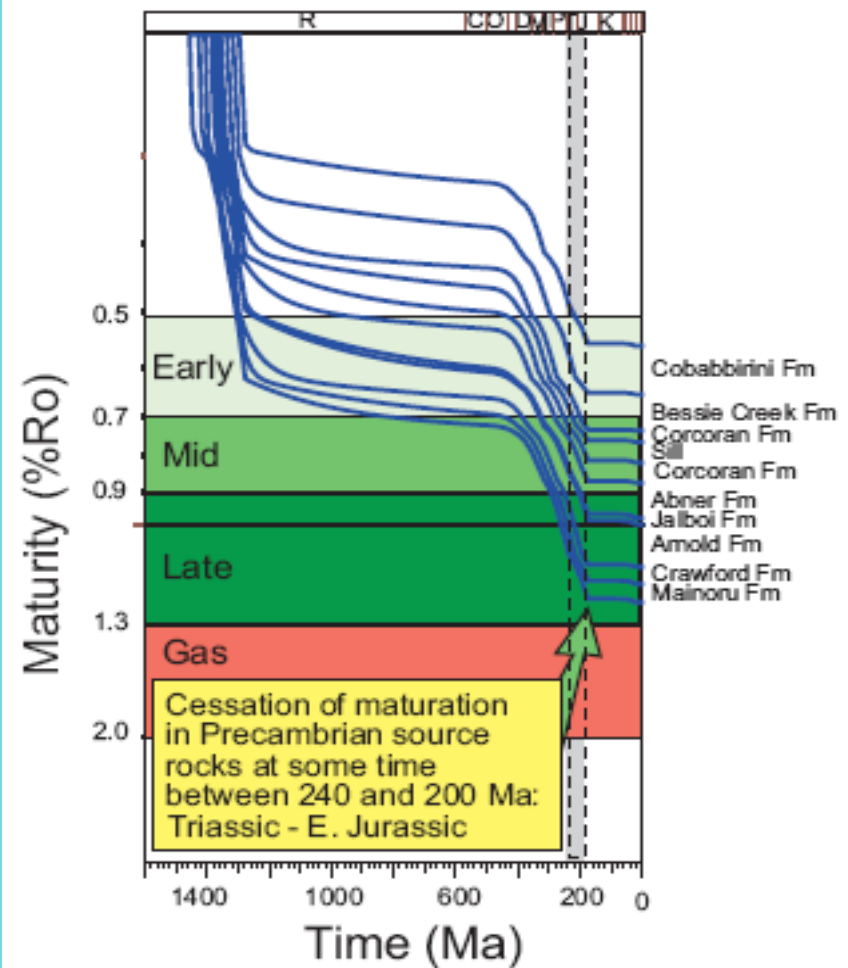
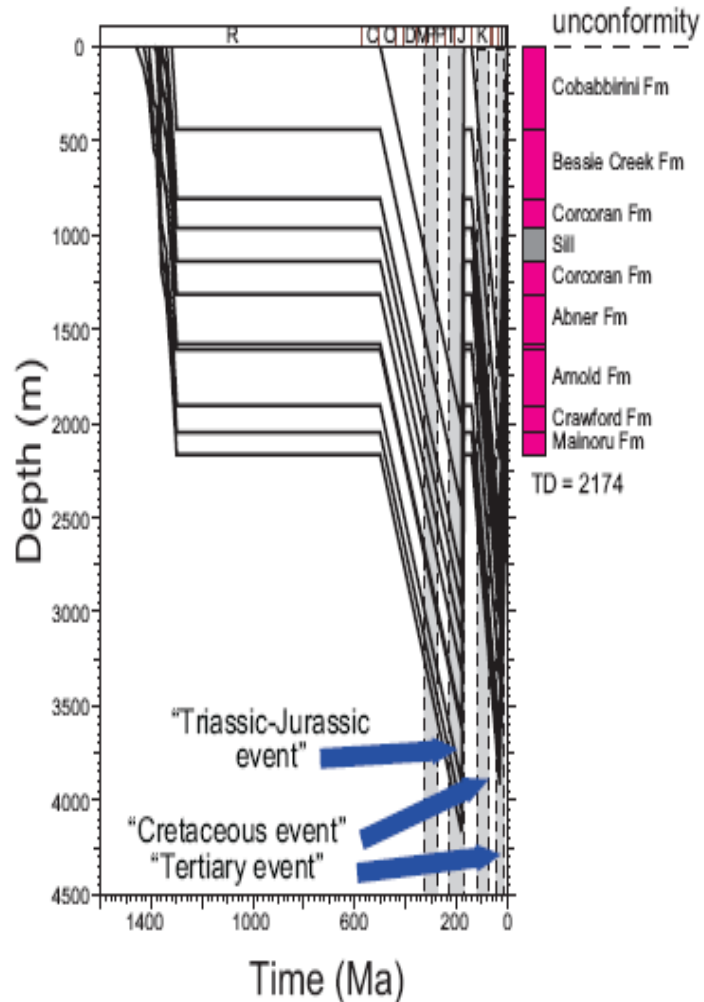
Neoproterozoic~750 Mya



Beetaloo Basin Rift Model



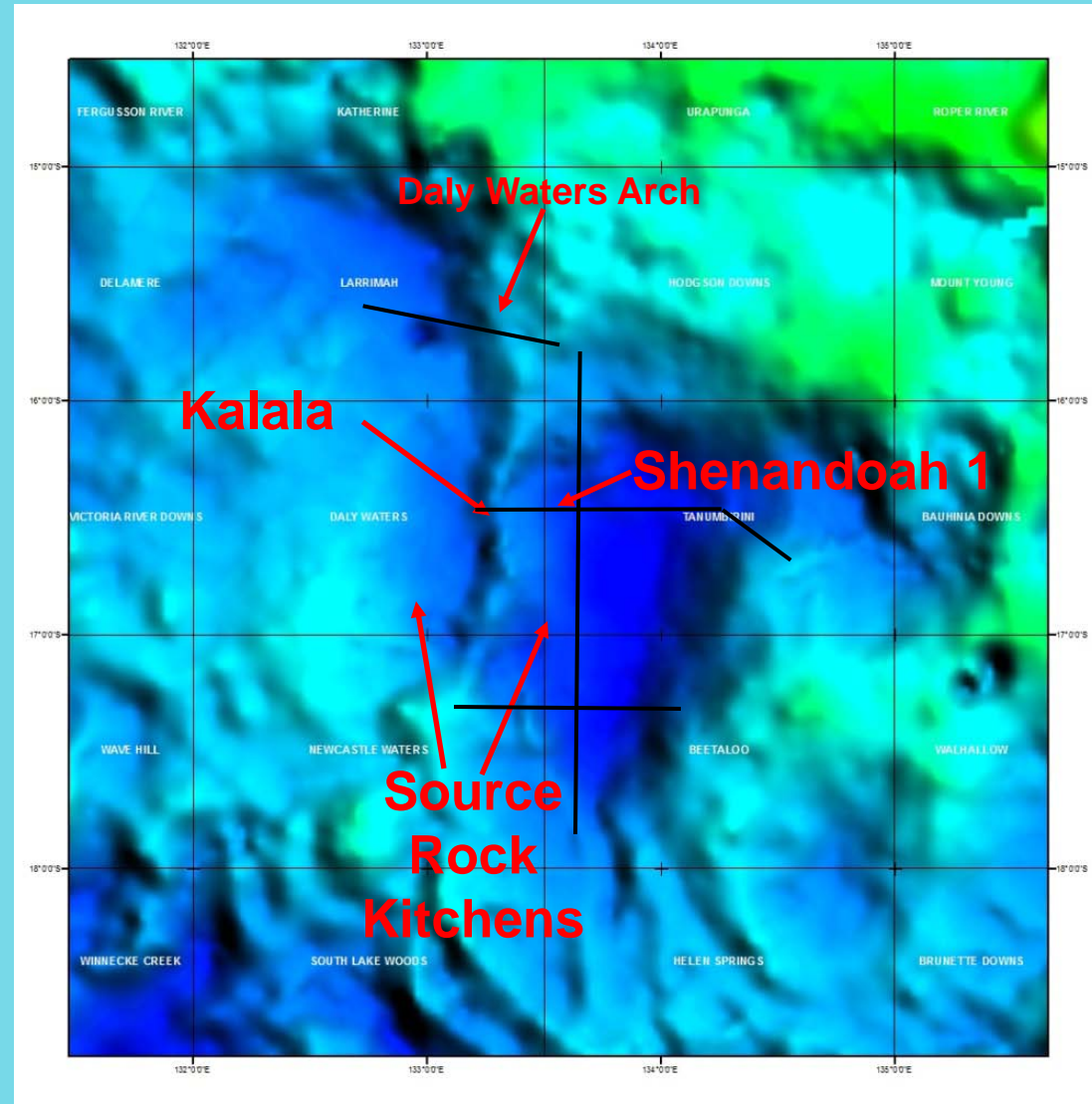
Burial History: AFTA



Beetaloo Basin Thrust Belt

(Daly Waters
Arch)

Kalala Structure



GA Bouguer Gravity

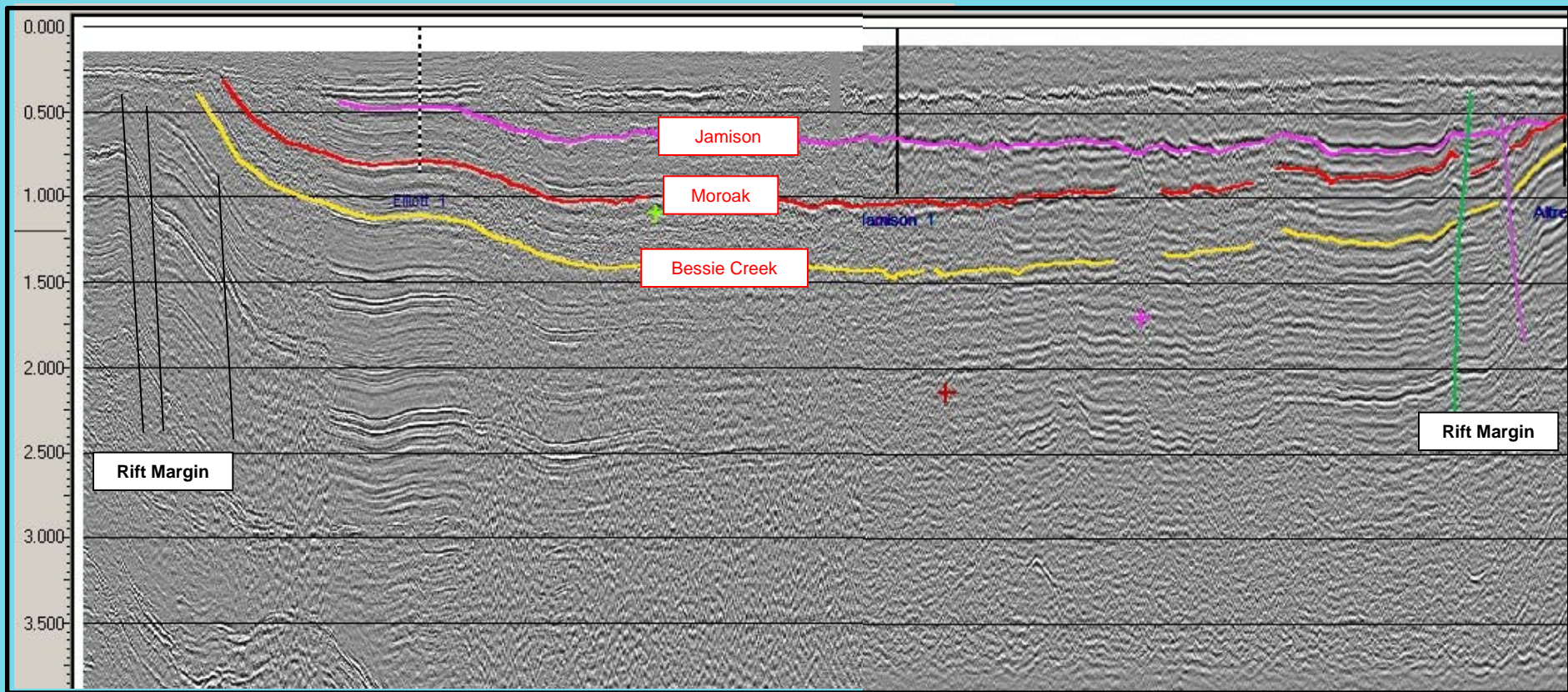
N-S Line 103

← 200 Km →

Elliott #1

Jamison #1

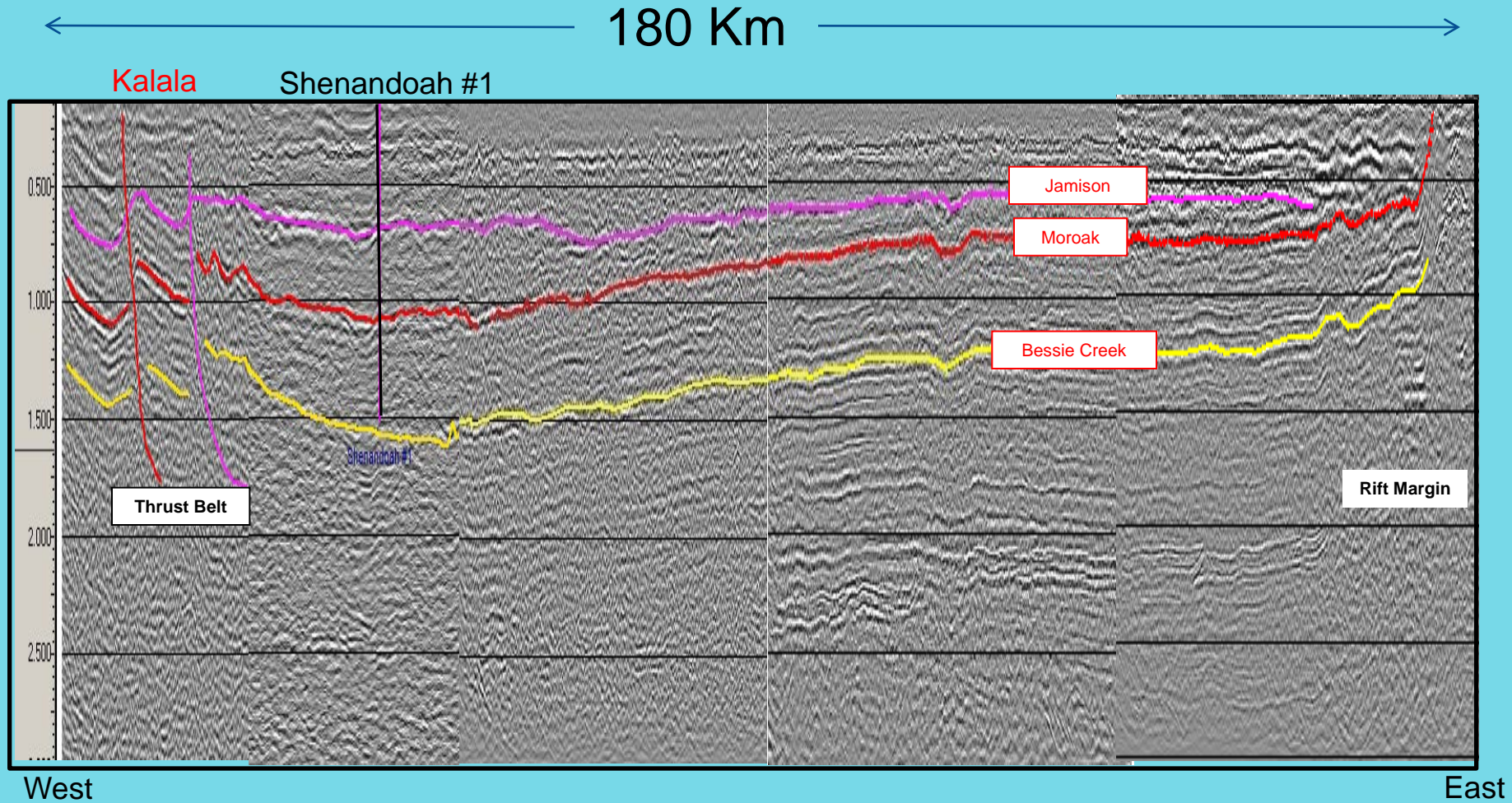
Altree #1



South

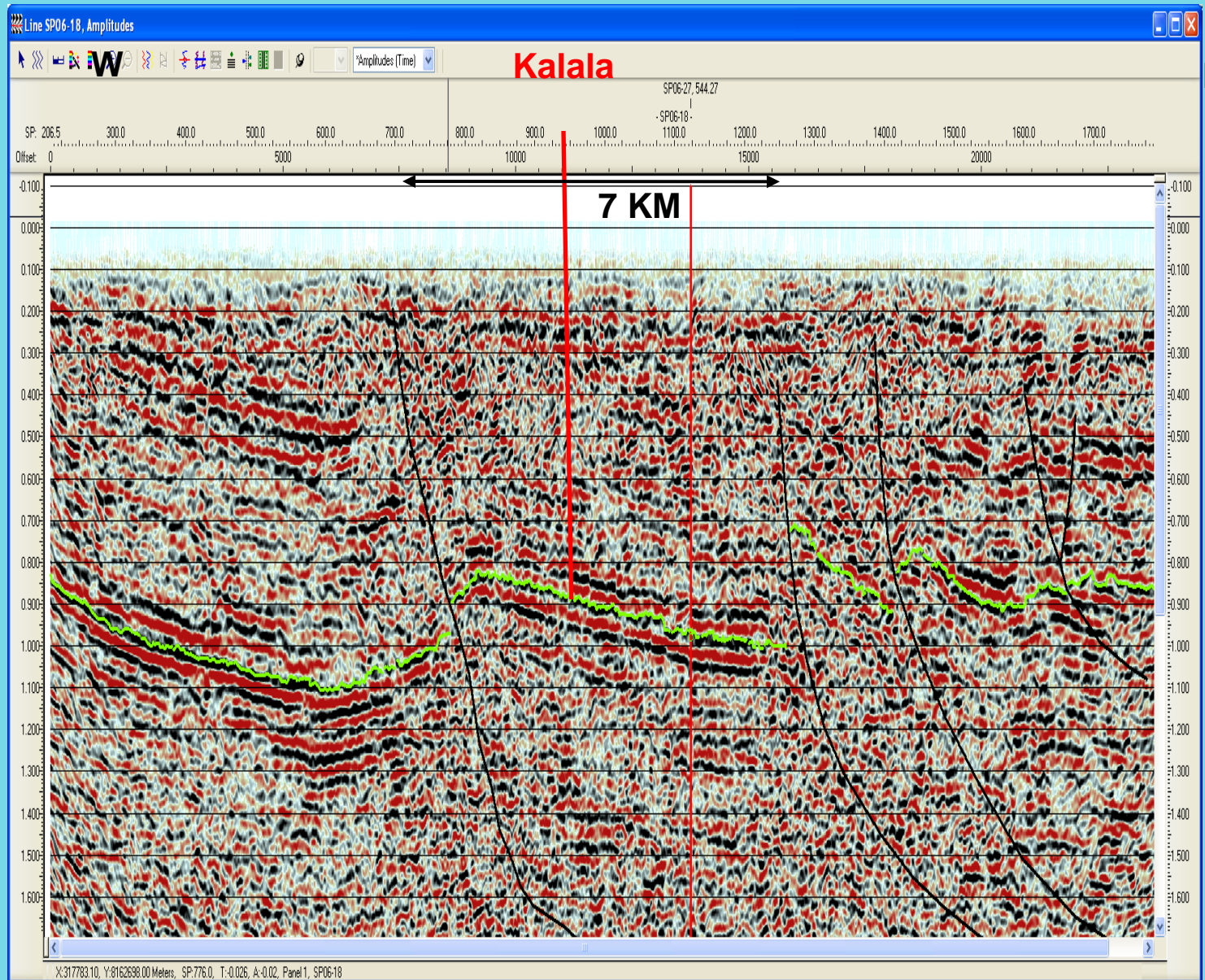
North

Middle W-E Line



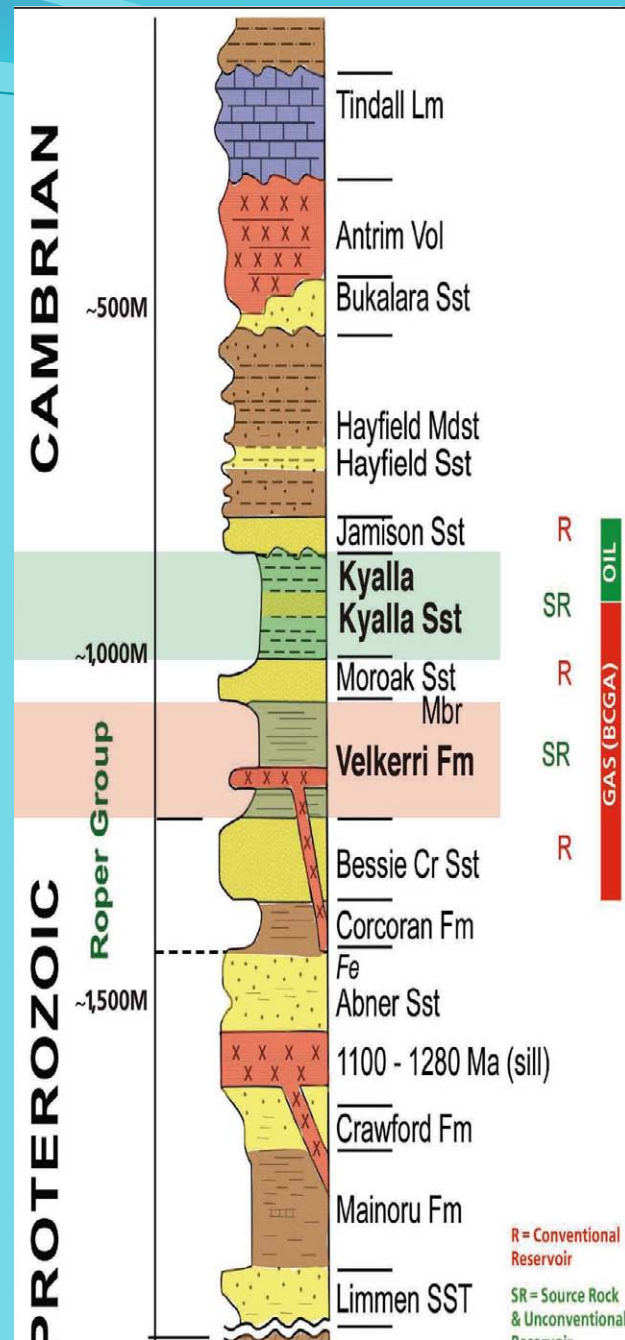
Kalala Structure—Line SP06-18

500 M

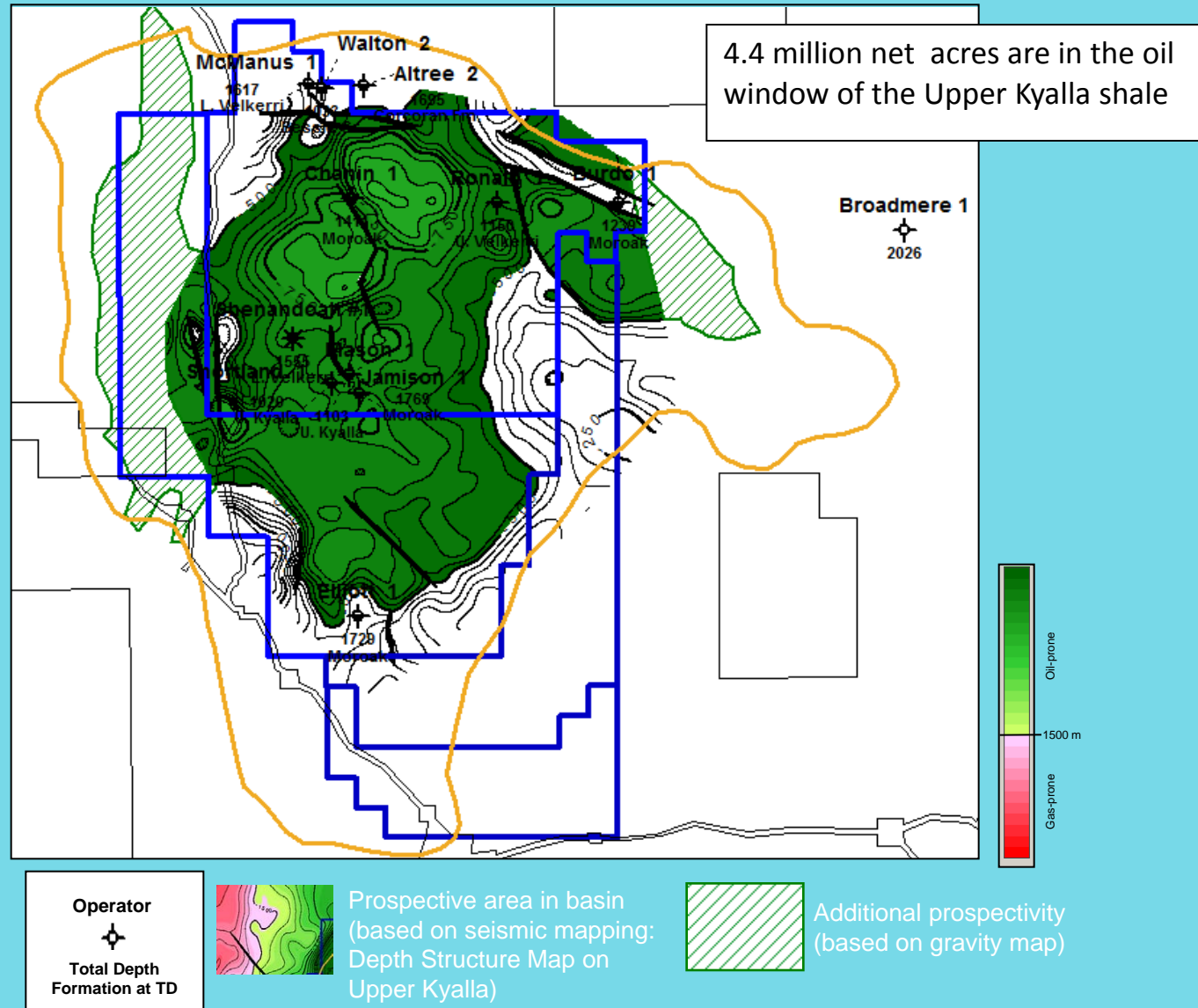


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Upper Kyalla Shale Oil



Upper Kyalla Oil Zone

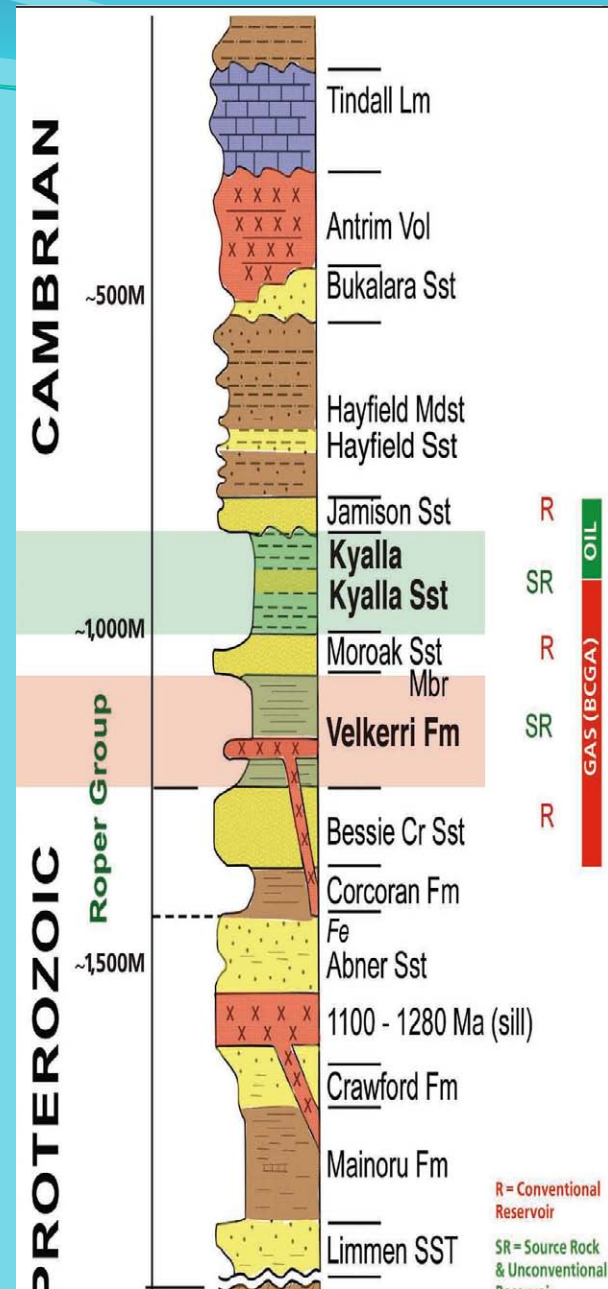


Upper Kyalla Shale Oil Core

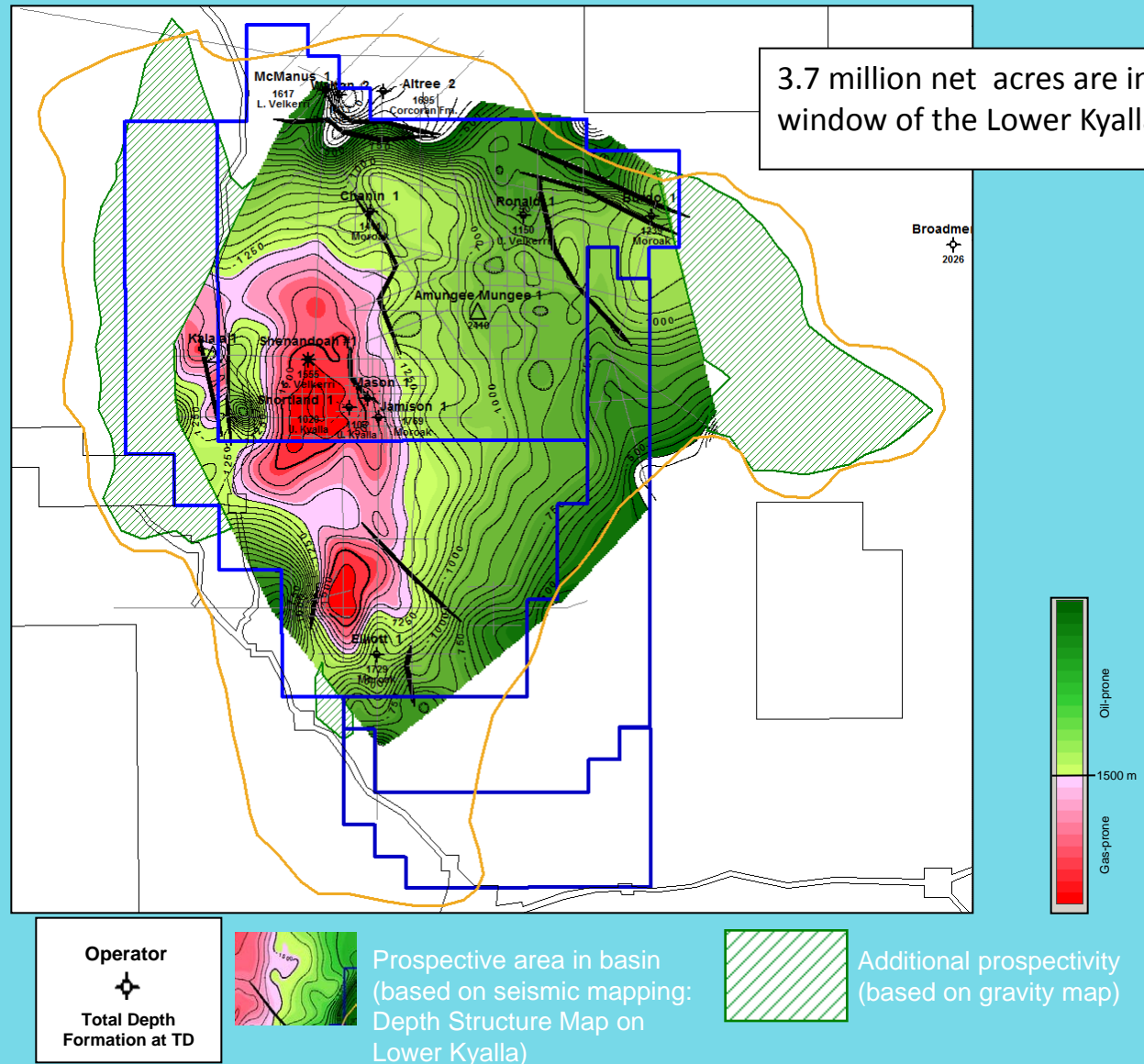


Kyalla Oil Shales-Bed C
Jamison-1
1025.05 to 1028.93m

Lower Kyalla Shale Oil



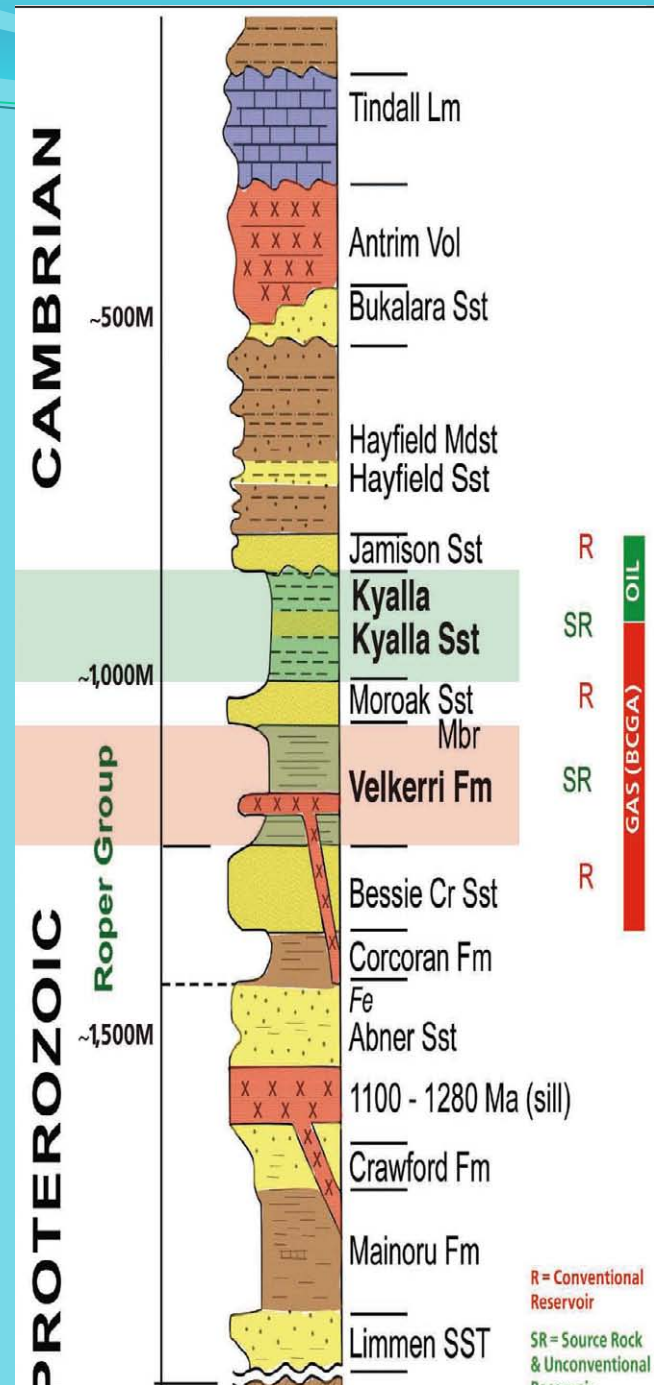
Lower Kyalla Oil and Gas Zones



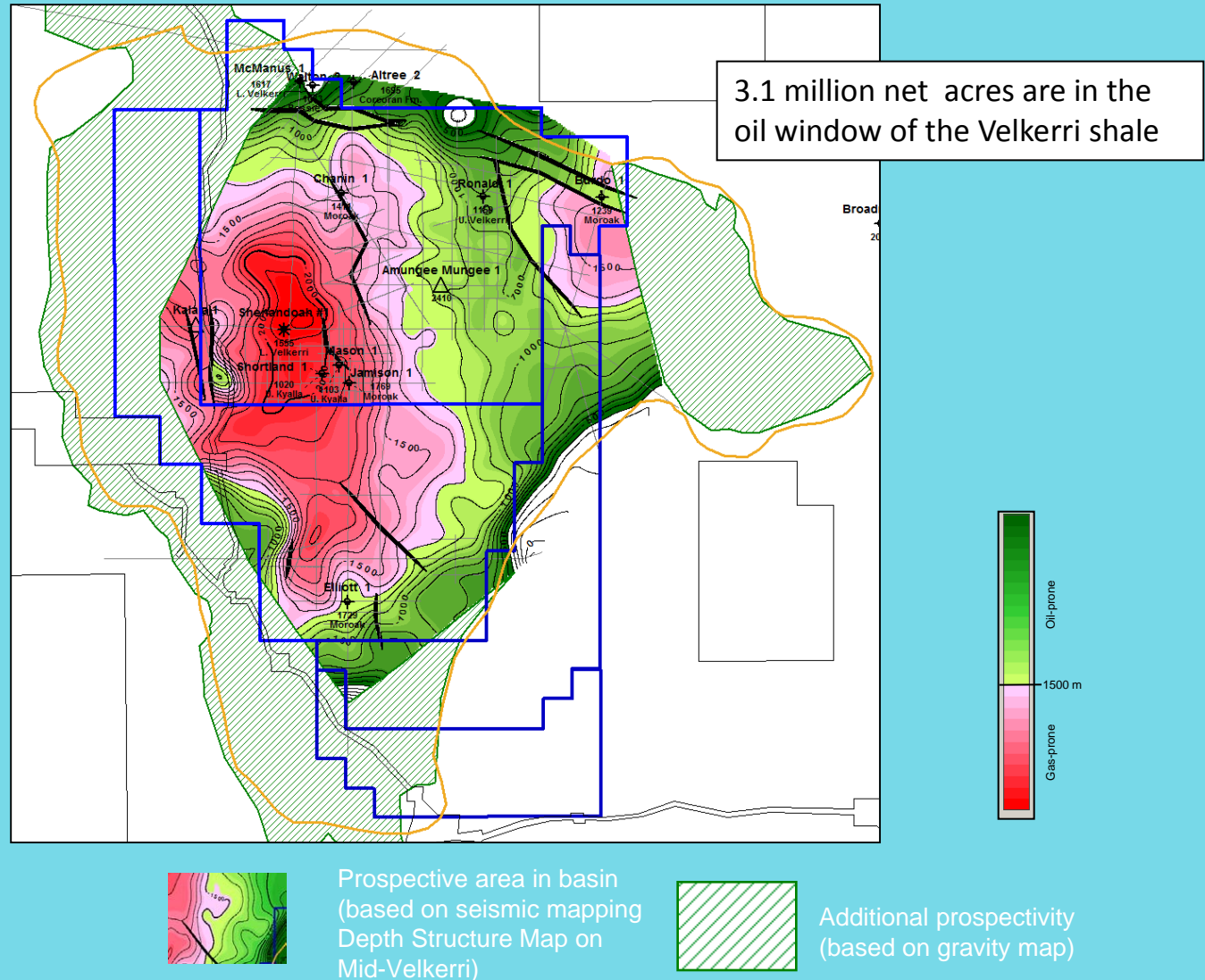
L. Kyalla Shale Open Fractures Shenandoah - 1A Core-1592M



Velkerri Shale Oil & Gas



Mid-Velkerri Oil and Gas Zones



Velkerri Shale Oil Cores

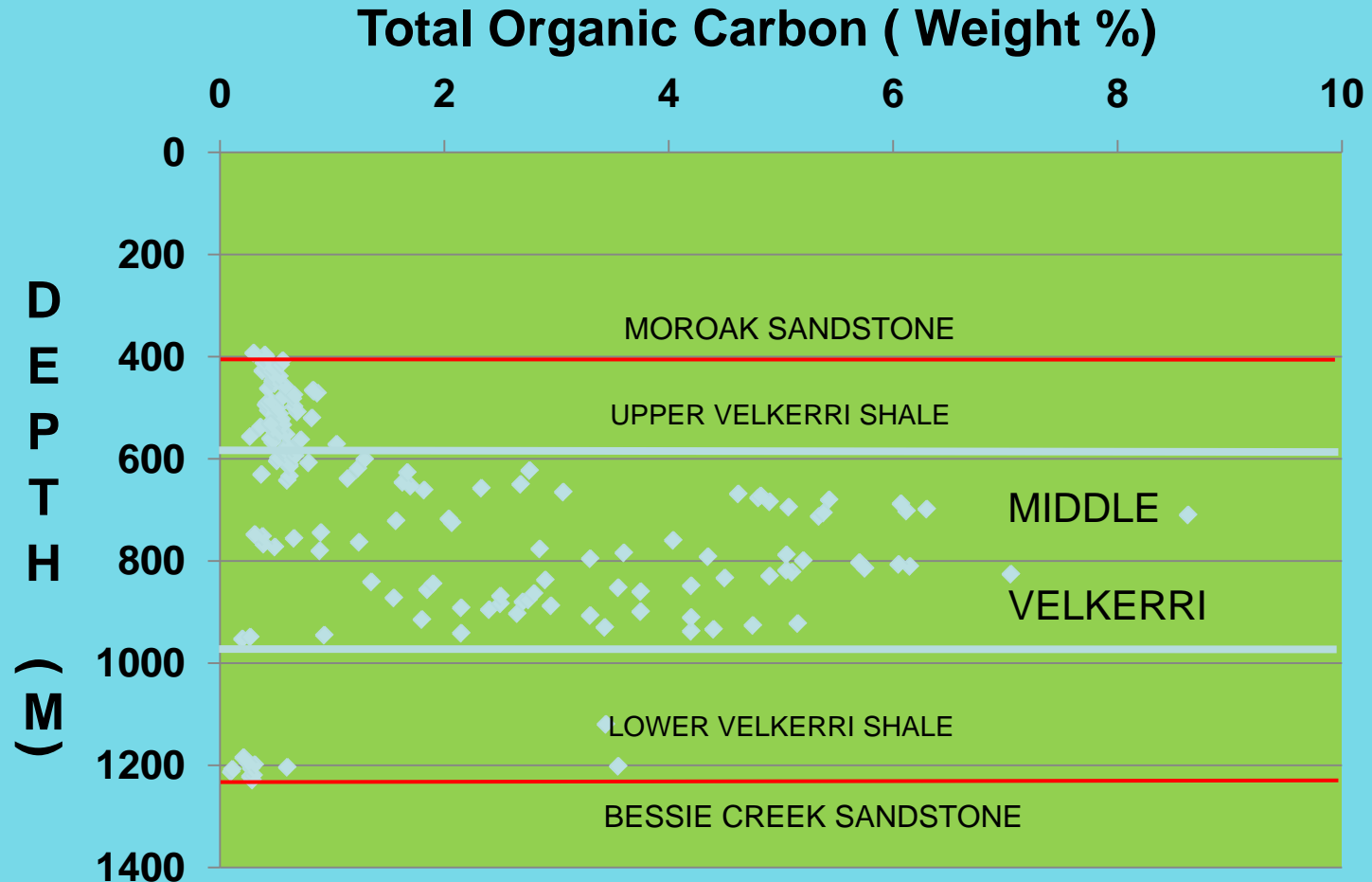


Mid Velkerri Oil Shales
Altree-2
993.96m to 938.2m

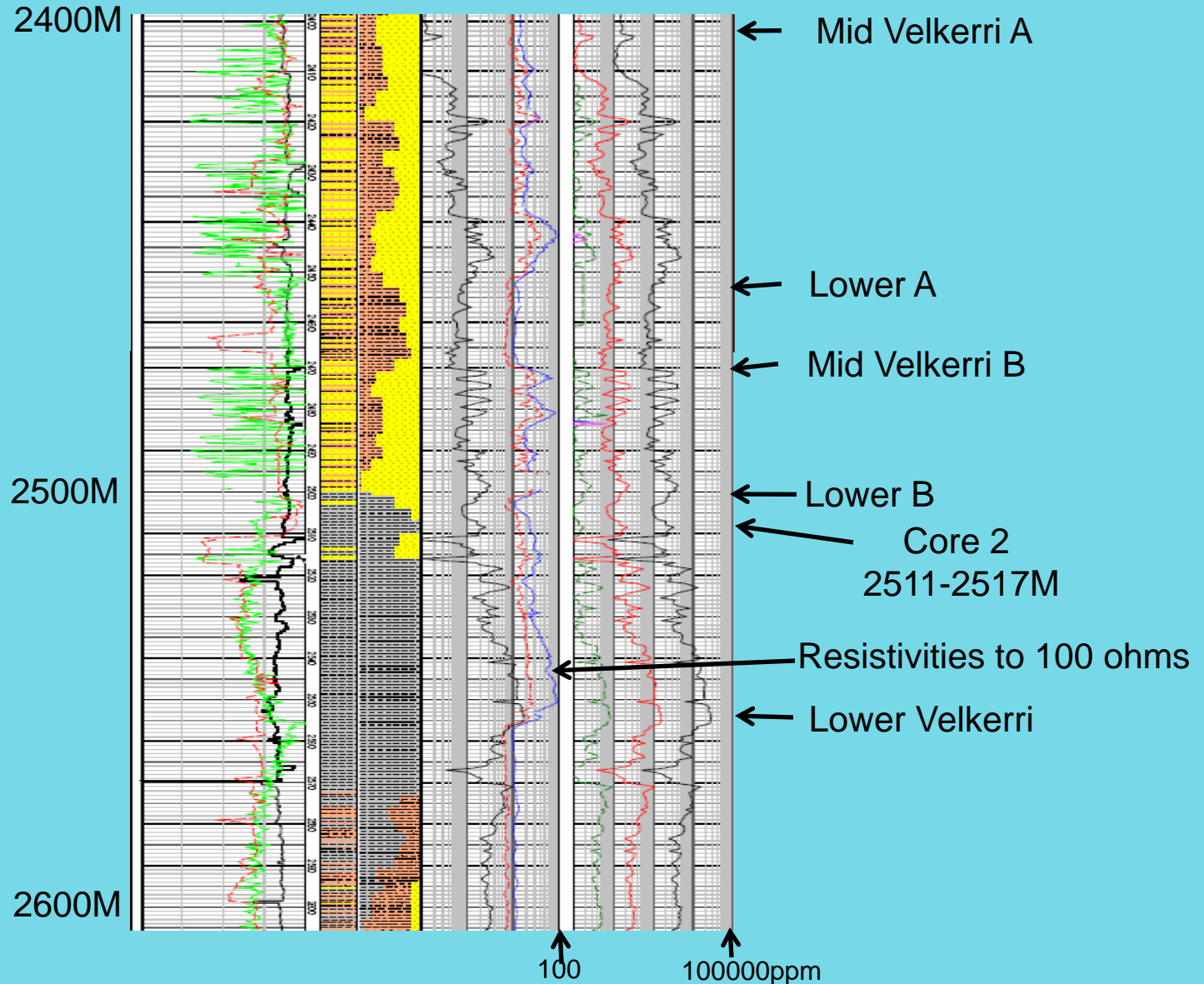
DEPTH vs. TOC –VELKERRI SHALE

Altree 2 Well

N=156



Mid Velkerri A & B Shale: Shows to 174 units C1 to C3: 30,000 ppm



Shenandoah #1

Central Beetaloo Basin



Thank You

Falcon Oil & Gas

PetroHunter Energy

Gerry Gerrard & Bill Peabody

Robert L. Bayless, Producer

Dugan Production Co.