

Oil Migration in the Mesoproterozoic Roper Superbasin, Northern Australia: an Assessment of Fluid Inclusions and Solid Bitumen

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Honours Project
29 January, 2009

Significance

- Running out of Oil
- Precambrian Basins
= Final Frontier

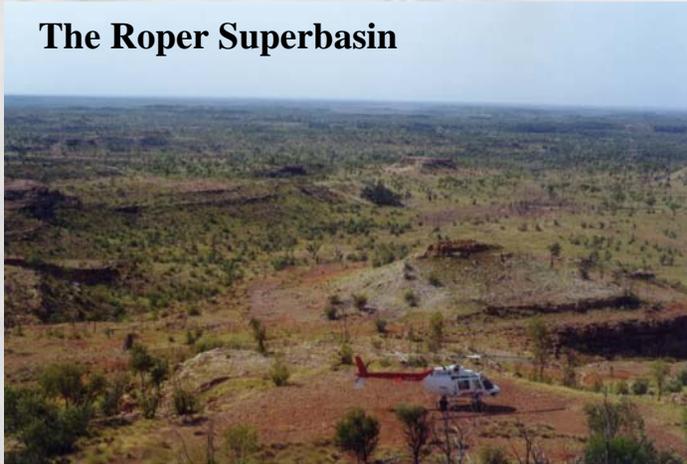
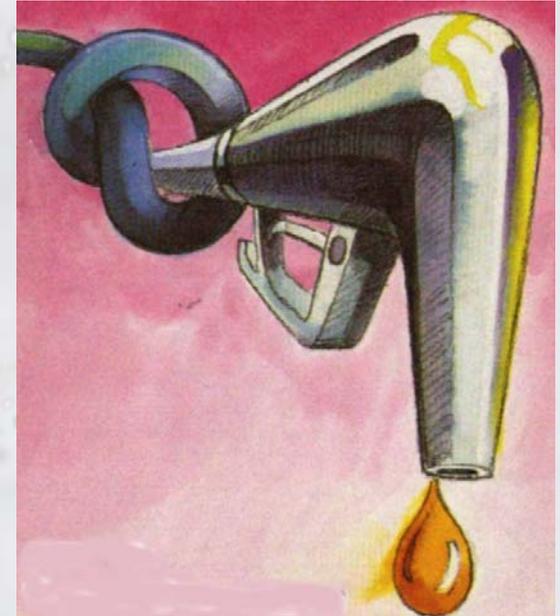


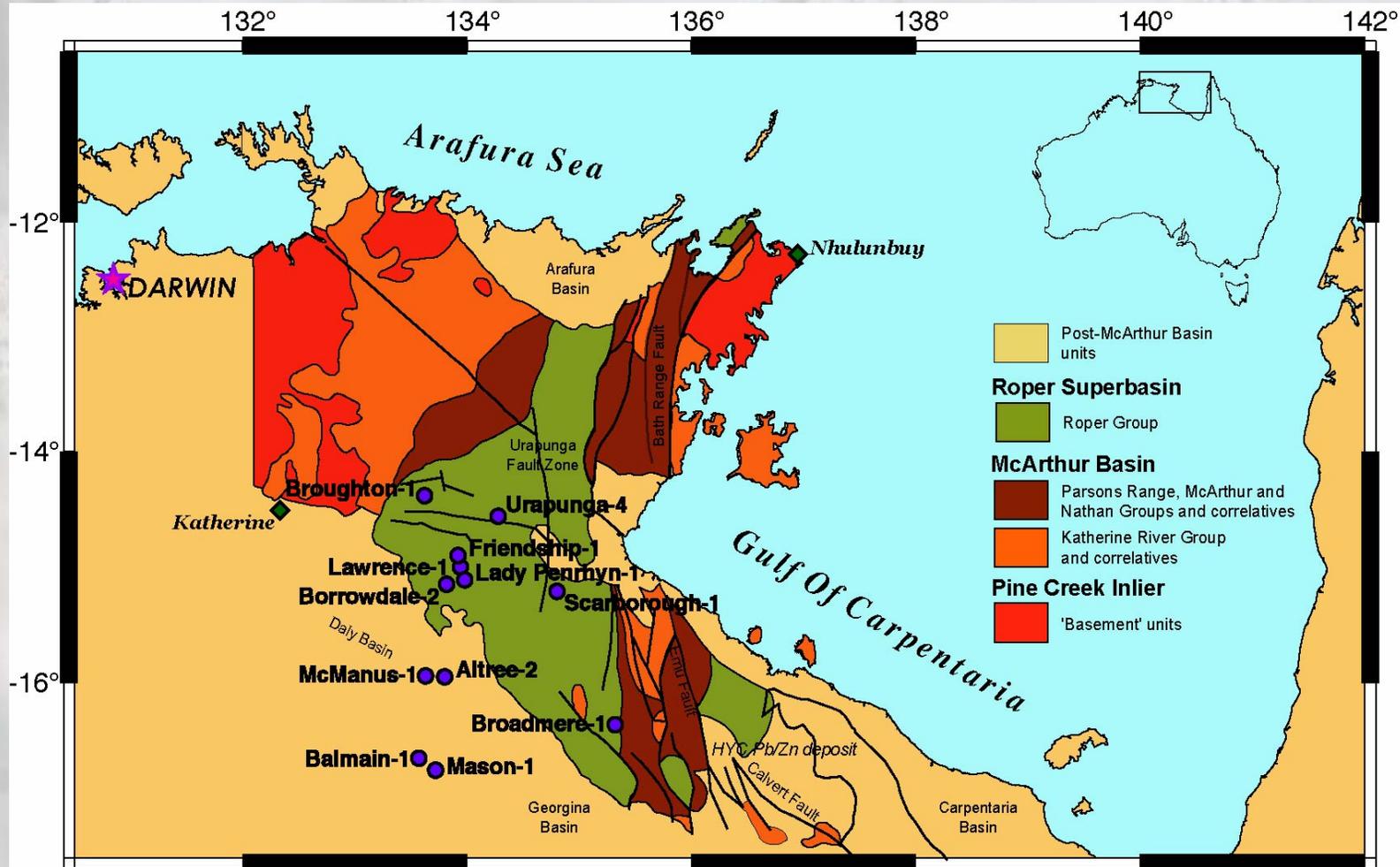
Photo: Dr David Rawlings

- What do we know
of ancient basins?

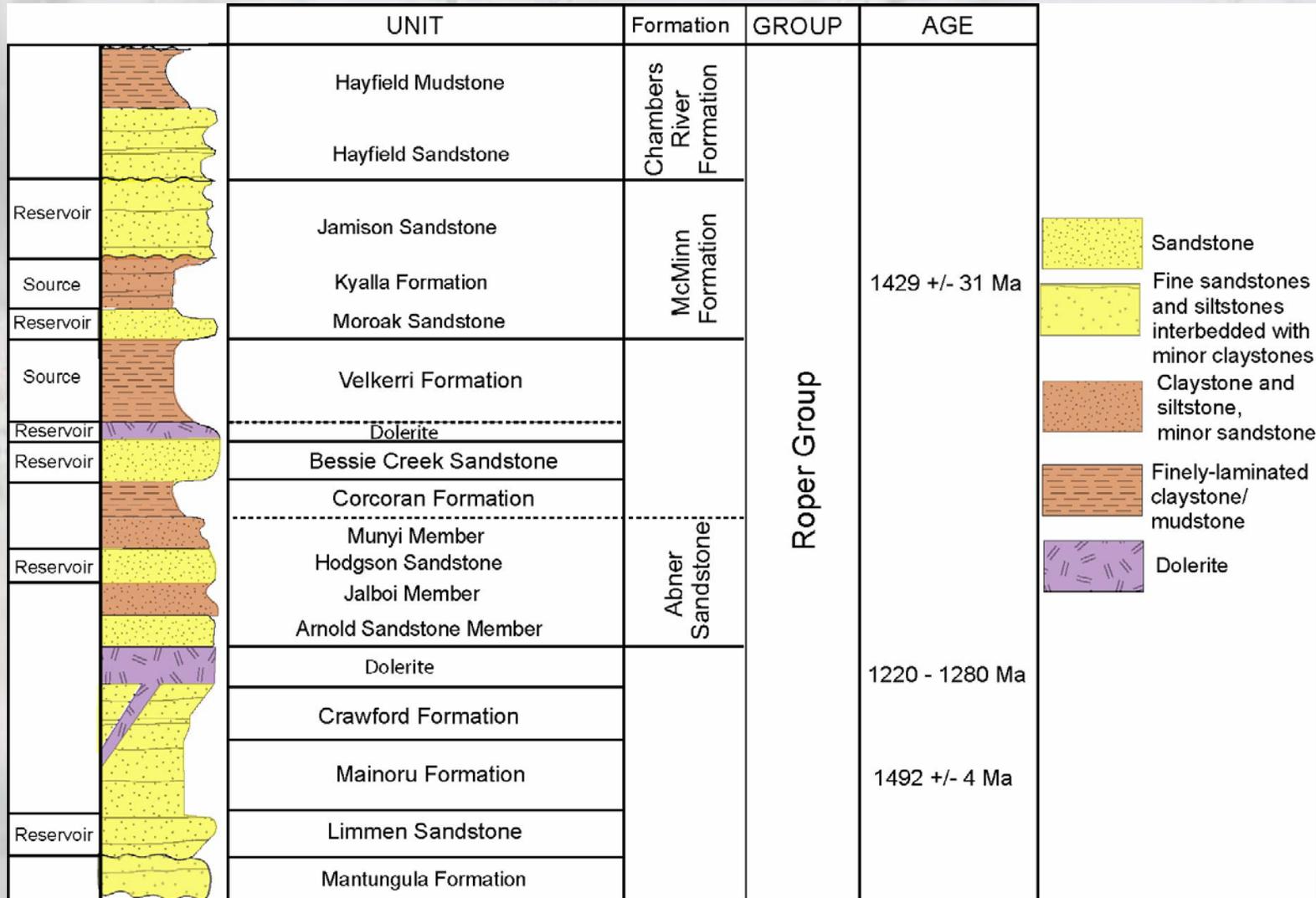
Aims

- Has oil migrated through the basin?
- What is the timing of oil migration and entrapment?
- Under what conditions did the oil migrate and become entrapped?
- What is the molecular composition of solid bitumen from the Roper Superbasin?

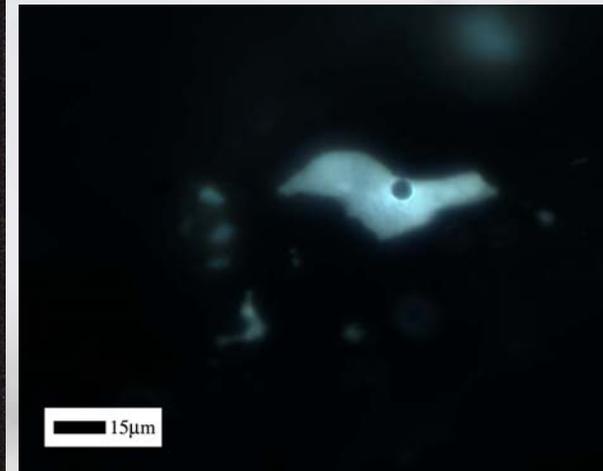
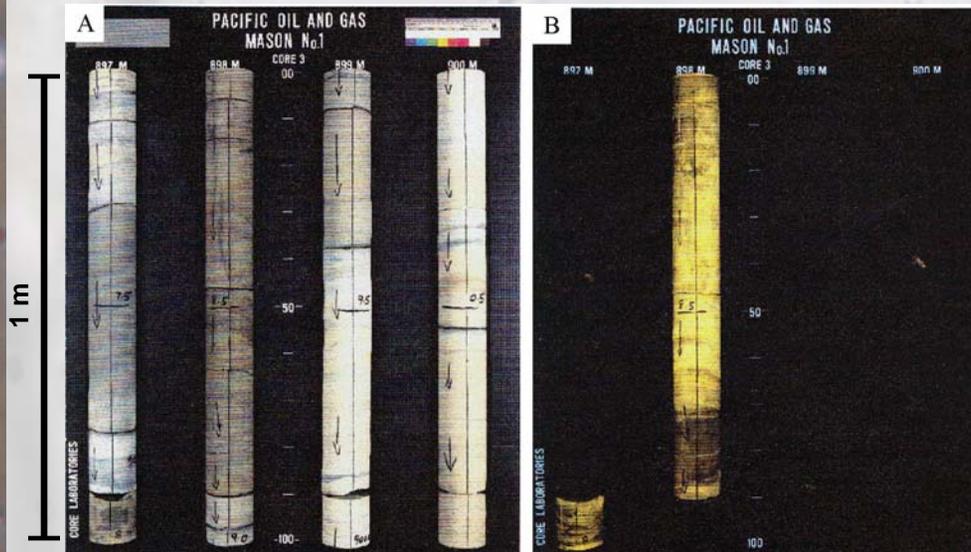
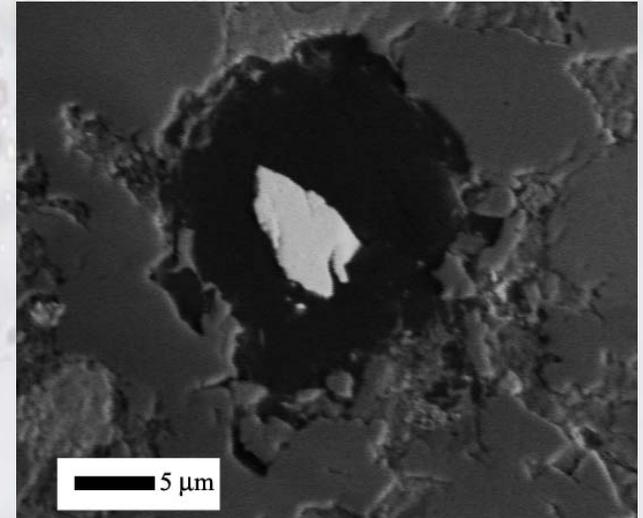
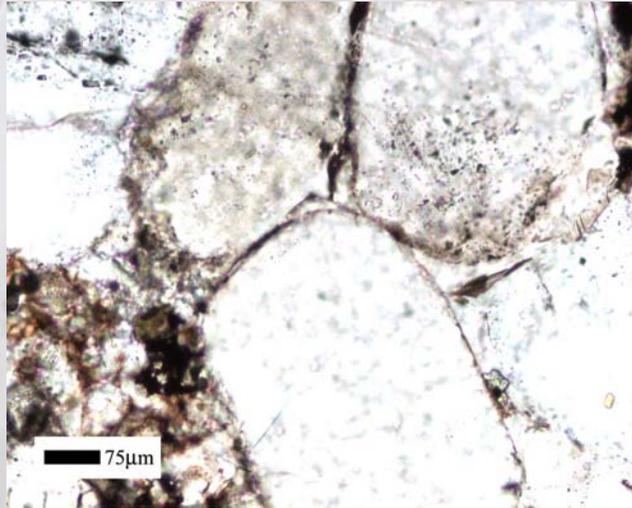
Geological setting



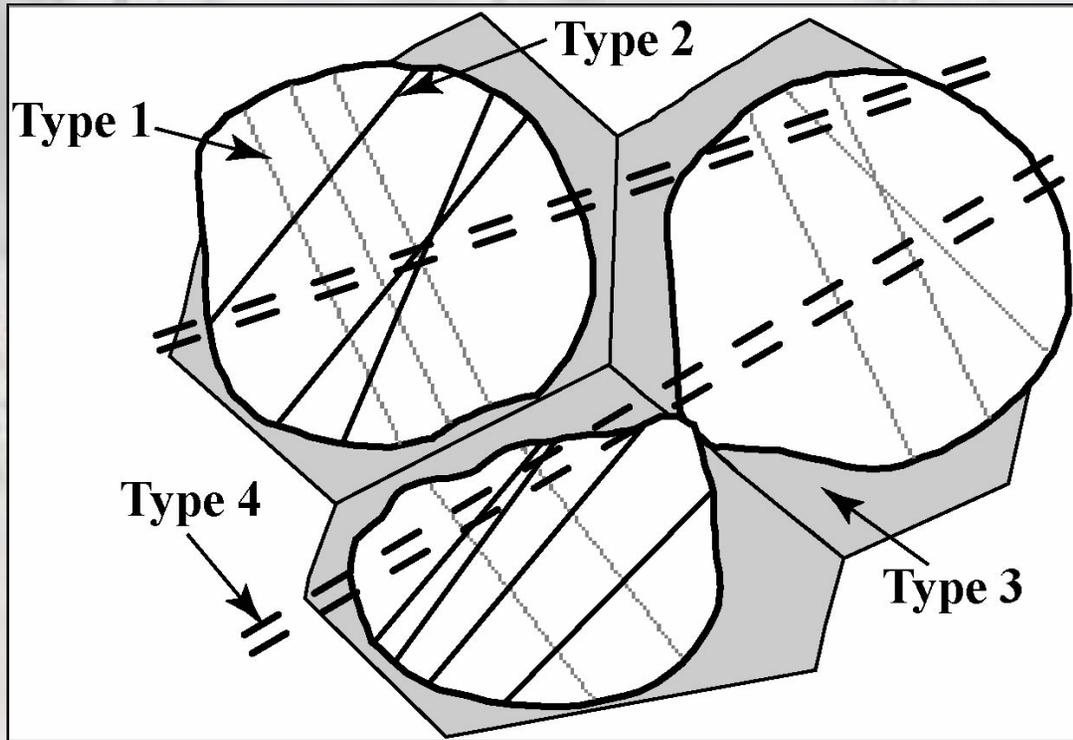
Stratigraphy



Hydrocarbon Shows



Inclusion Populations



The diagram illustrates four types of fluid inclusions within quartz grains. Type 1 is located in an intra-granular fracture. Type 2 is also in an intra-granular fracture. Type 3 is hosted within quartz overgrowth. Type 4 is located in a trans-granular fracture. The inclusions are shown as small, irregular shapes with internal features like halos and trails.

Type 1	Inherited aqueous fluid inclusions within intra-granular fractures
Type 2	Oil and coeval aqueous fluid inclusions within intra-granular fractures
Type 3	Aqueous fluid inclusions, hosted within quartz-overgrowth
Type 4	Oil and coeval aqueous fluid inclusions within trans-granular fractures

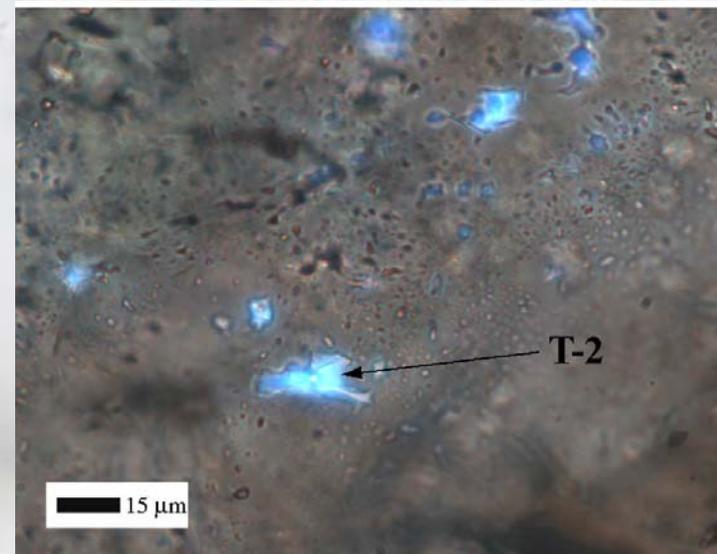
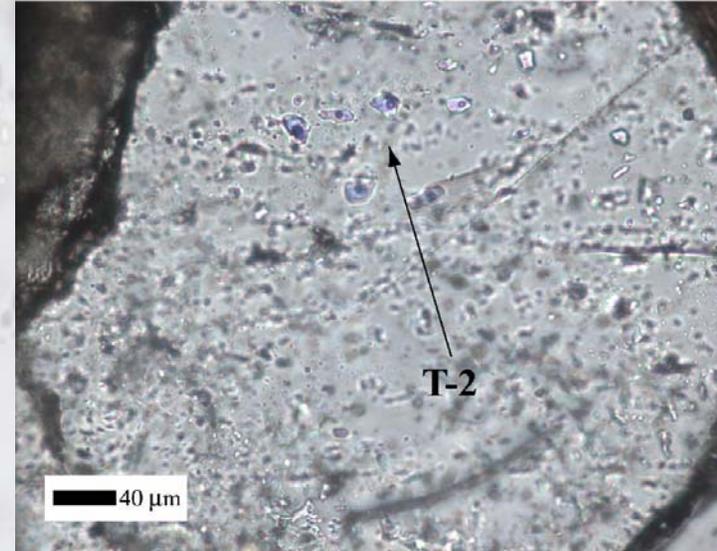
Hydrocarbon + Coeval Brine Migration

- Type 2
- Oil + Coeval Aqueous
- Intra-granular
- Entrapment:
 - 100-180°C
 - ~ 30 MPa
 - ~ 3.2 wt% NaCl_{equiv}

During Diagenesis

Mesoproterozoic

Fresh water input



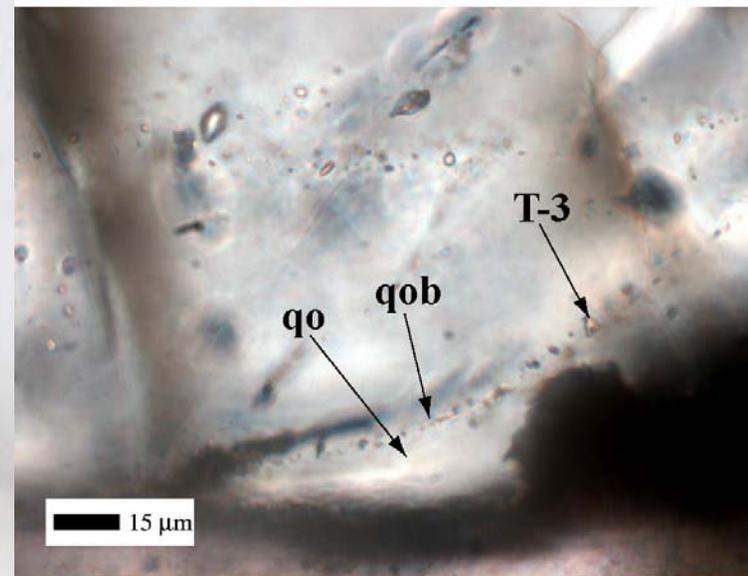
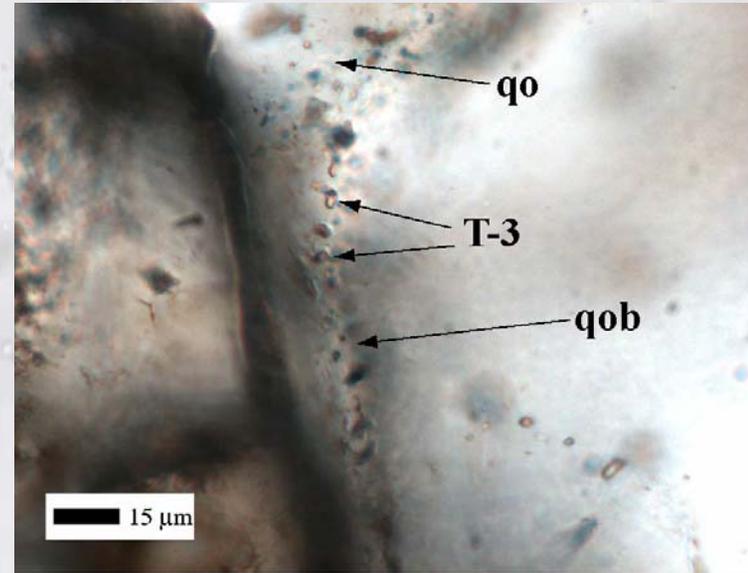
Brine Migration

- Type 3
- Aqueous
- Quartz overgrowth
- Entrapment:
 - 180°C to > 200°C
 - ~ 30 MPa
 - ~ 3.3 wt% NaCl_{equiv}

During Diagenesis

Mesoproterozoic

Fresh water input



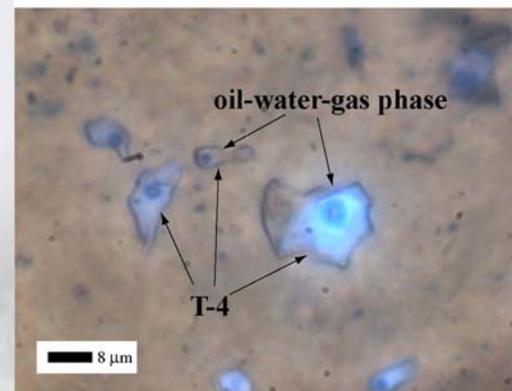
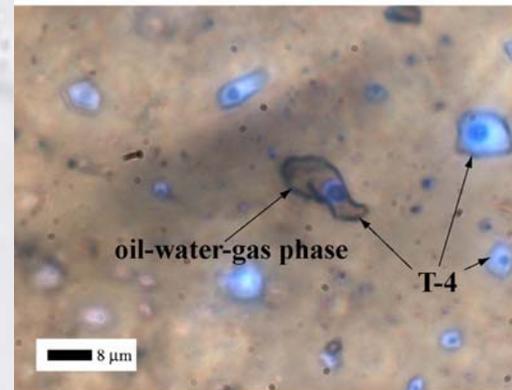
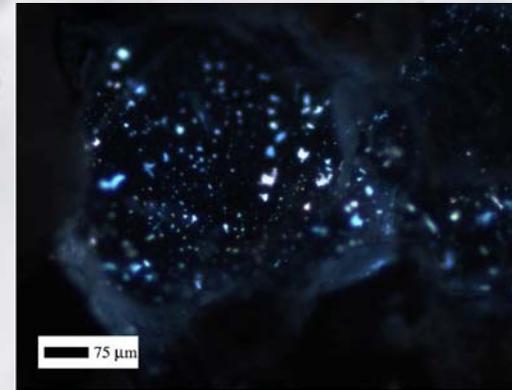
Hydrocarbon + Coeval Brine Migration

- Type 4
- Oil + Coeval Aqueous
- Trans-granular
- Entrapment:
 - 80°C to 160°C
 - ~ 25-30 MPa
 - 19-22 wt% NaCl_{equiv}

During Basin Uplift

Neoproterozoic

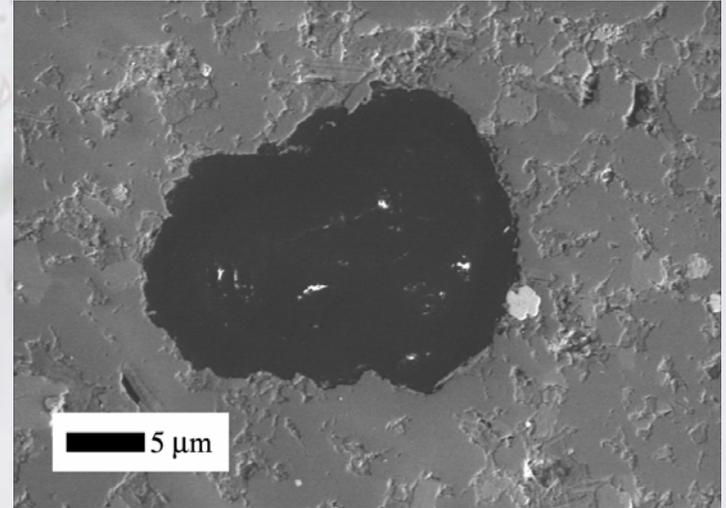
Hypersaline Brines



Regional Hydrocarbon Migration

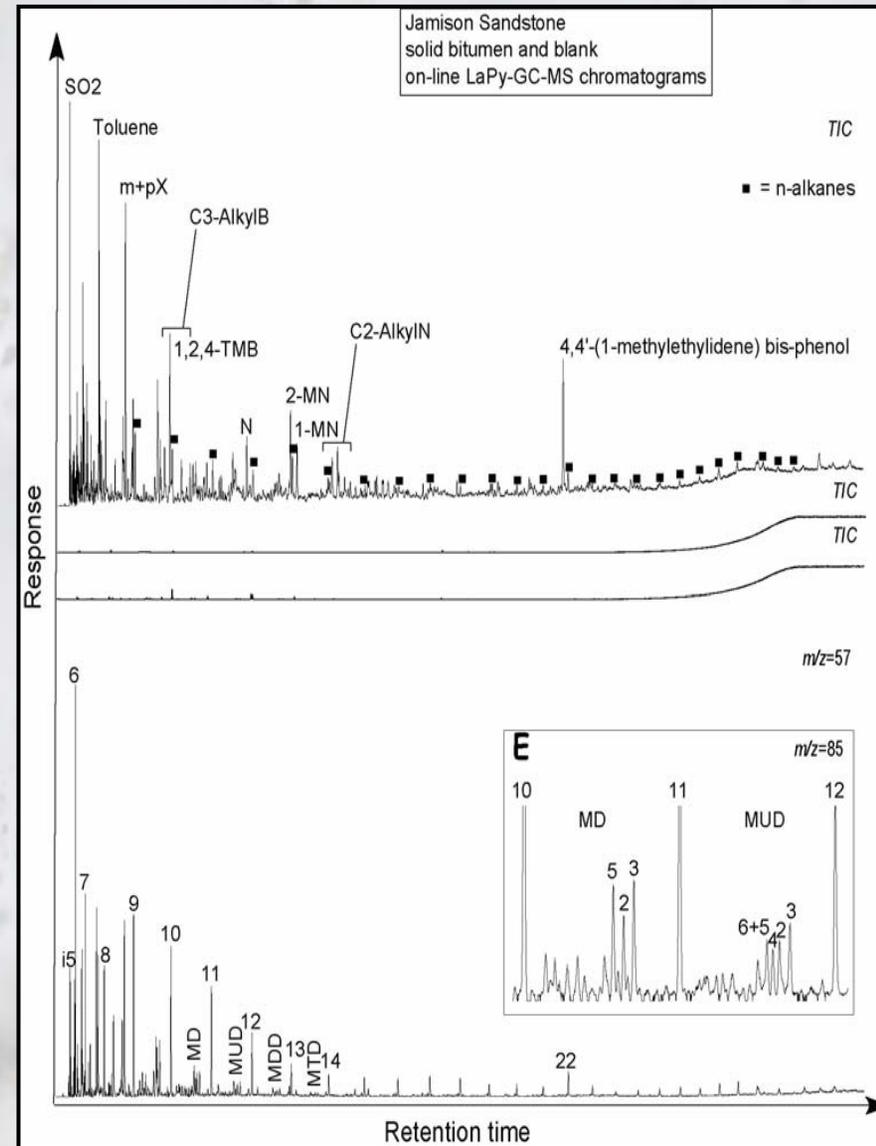
- Solid Bitumen
- Most Reservoirs

Diagenesis
Mesoproterozoic

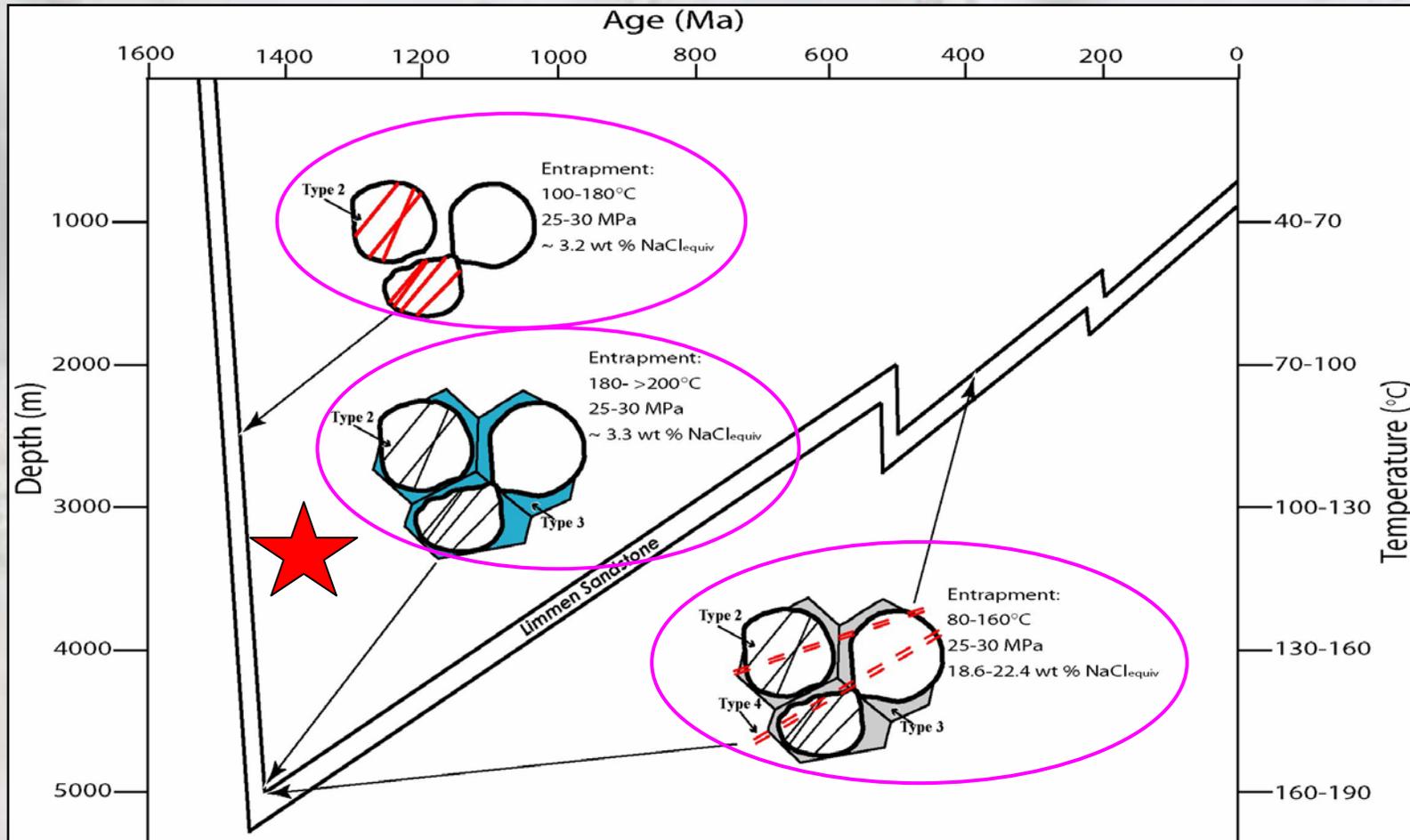


Solid Bitumen Composition

- Laser Micropyrolysis
- Non-biodegraded
- Proterozoic Oils
- ~0.9-1.1% VRE
- Cyanobacterial
- Velkerri Formation
- Kyalla Member



Conclusions



- Mature to over-mature
- Proterozoic (cyanobacterial)
- Velkerri Formation and Kyalla Member

Future Work

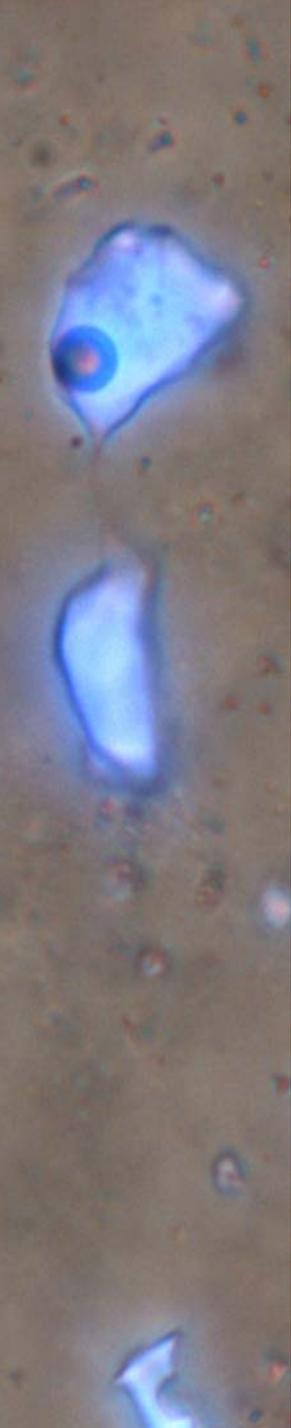
- Other Wells within the Roper Superbasin
- Solid Bitumen molecular composition
–CSIRO Petroleum

Acknowledgements

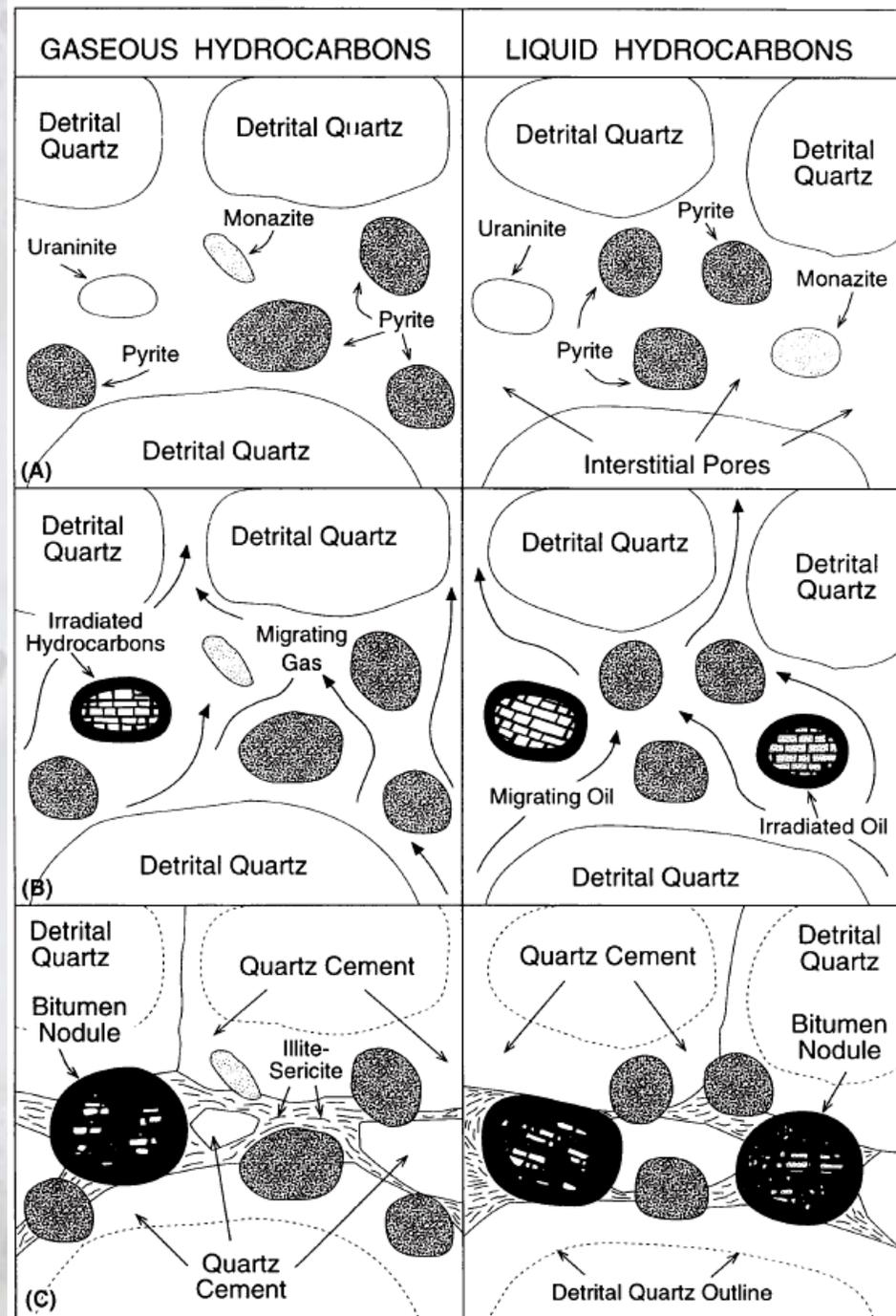
- Adriana Dutkiewicz (USYD)
- Herbert Volk (CSIRO)
- Stephen Sestak (CSIRO)
- Simon George (Macquarie Uni)

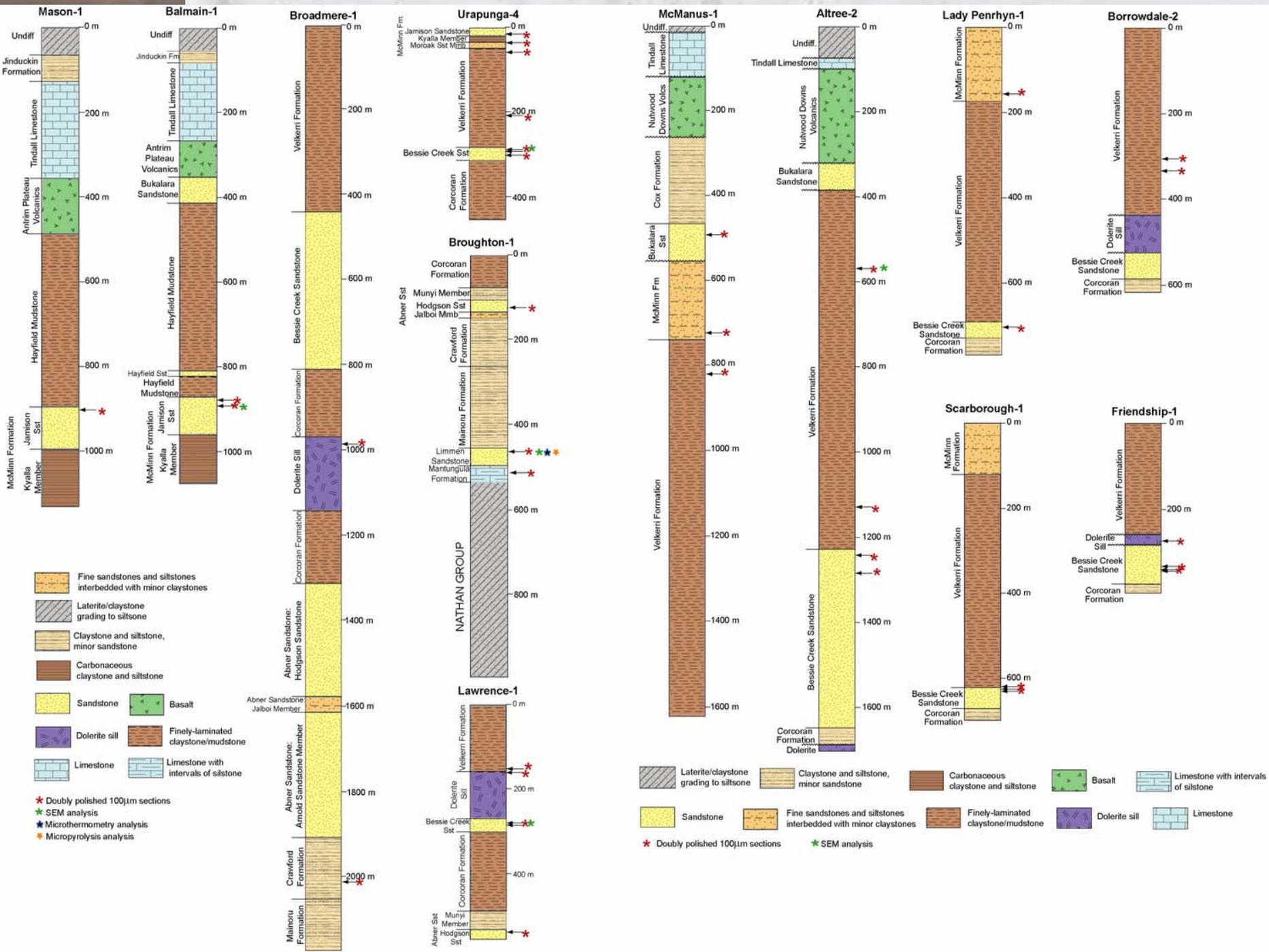
- ARC Research Foundation

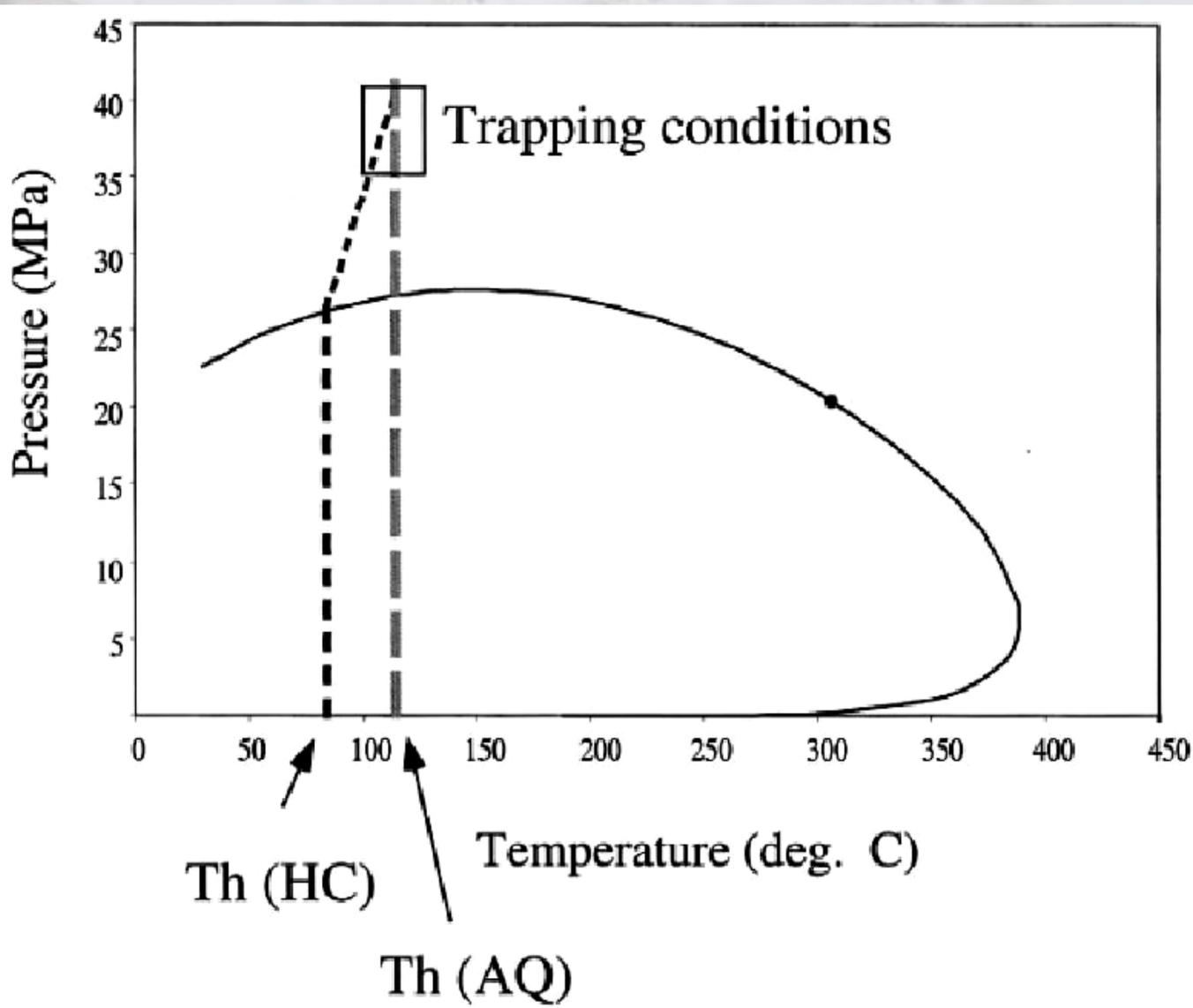
Questions?



- Schematic of bitumen nodule formation from Buick et al. (1998). Fluid hydrocarbons flow past radioactive grains. Higher radiation doses (uranite) are required for gaseous hydrocarbons to be polymerised compared to liquid hydrocarbons (monazite).
- (A) Premigration with the original porous heavy mineral seam; (B) migration with the nodule initiation by irradiation of migrating hydrocarbons; and (C) postmigration with the nodule entombment by diagenetic silicate precipitation (Buick et al., 1998).







(Munz, 2002)