

# The late Palaeoproterozoic Glyde package across the greater McArthur Basin



Tim J Munson

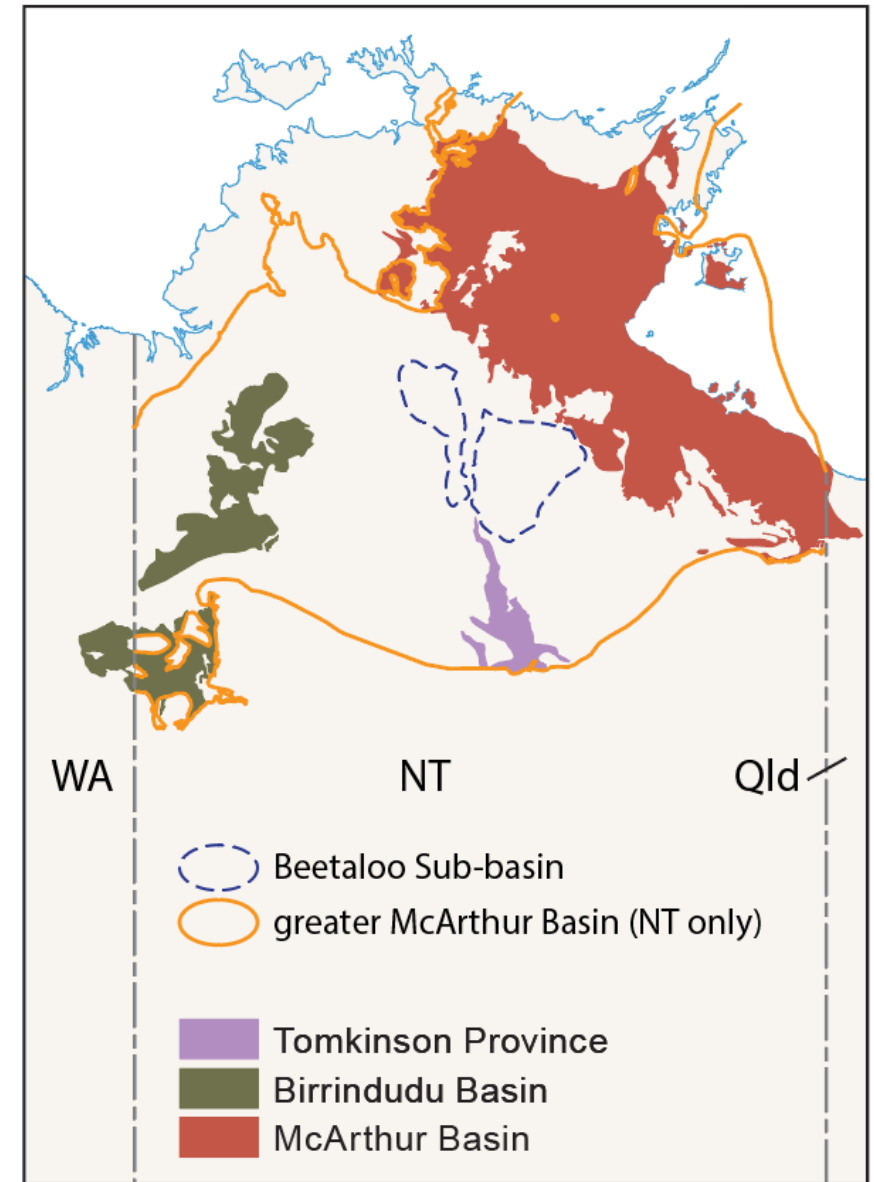


# greater McArthur Basin

Informal term (Close 2014) for a vast predominantly sedimentary terrane stretching across the northern NT from northeastern WA to northwestern Qld.

Includes Palaeo- to Mesoproterozoic successions of McArthur Basin, Birrindudu Basin and Tomkinson Province, interpreted to be linked in the subsurface.

These successions overlie Archaean and early Palaeoproterozoic metamorphosed and deformed rocks of the North Australian Craton (NAC) and are unconformably overlain by Neoproterozoic to Phanerozoic cover.



# Depositional packages

Sedimentary successions of the greater McArthur Basin have been divided into five basin-scale depositional ‘packages’.

Originally defined in the McArthur Basin as an ‘amalgamation of lithostratigraphic units with similar ages, stratigraphic position, lithofacies or lithofacies associations, and style and composition of volcanism’ (Rawlings 1999: 705):

Mesoproterozoic

- Favenc, Wilton packages

Palaeoproterozoic

- Redbank, Goyder, Glyde packages

Subsequently informally extended across greater McArthur Basin by Close (2014).

Rawlings (1999)	Jackson <i>et al</i> (1999, 2000) Southgate <i>et al</i> (2000)
Wilton package (Roper Group)	Roper Superbasin
Favenc package (Mount Rigg/Nathan groups)	Isa Superbasin
Glyde package (McArthur, Vizard, Balma and Habgood groups)	
Goyder package (Parsons Range, upper Spencer Creek groups)	Calvert Superbasin
Redbank package (Katherine River, Tawallah, Donydji, lower Spencer groups)	
	Leichhardt Superbasin
basement	basement

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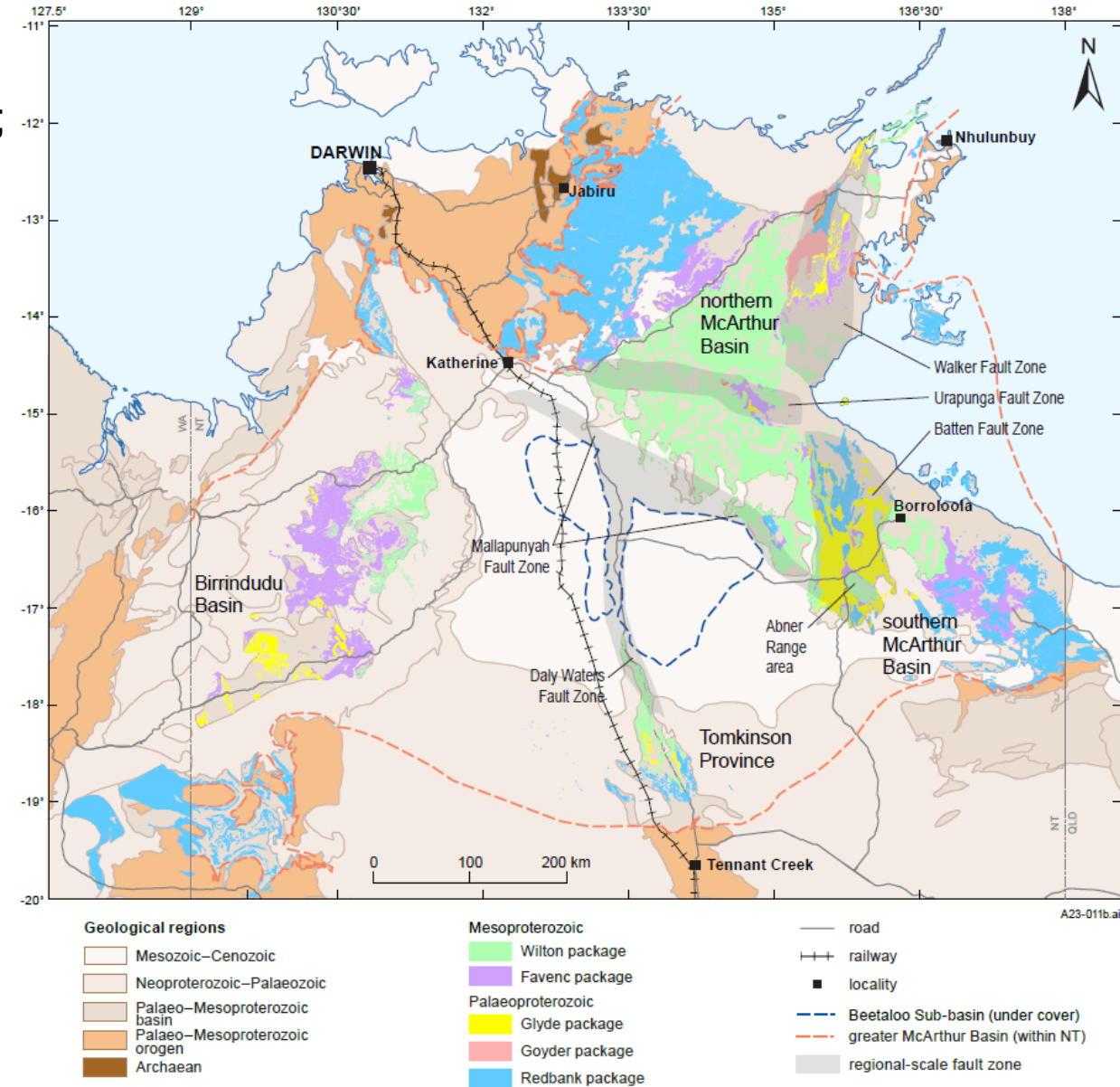
# Distribution of packages

Three main depocentres: subsurface Beetaloo Sub-basin; inverted Batten Fault Zone (BFZ); and inverted Walker Fault Zone (WFZ). BFZ and WFZ were formally termed 'troughs'.

Redbank, Favenc and Wilton packages outcrop widely across greater McArthur Basin.

Goyder and Glyde packages have more restricted distributions:

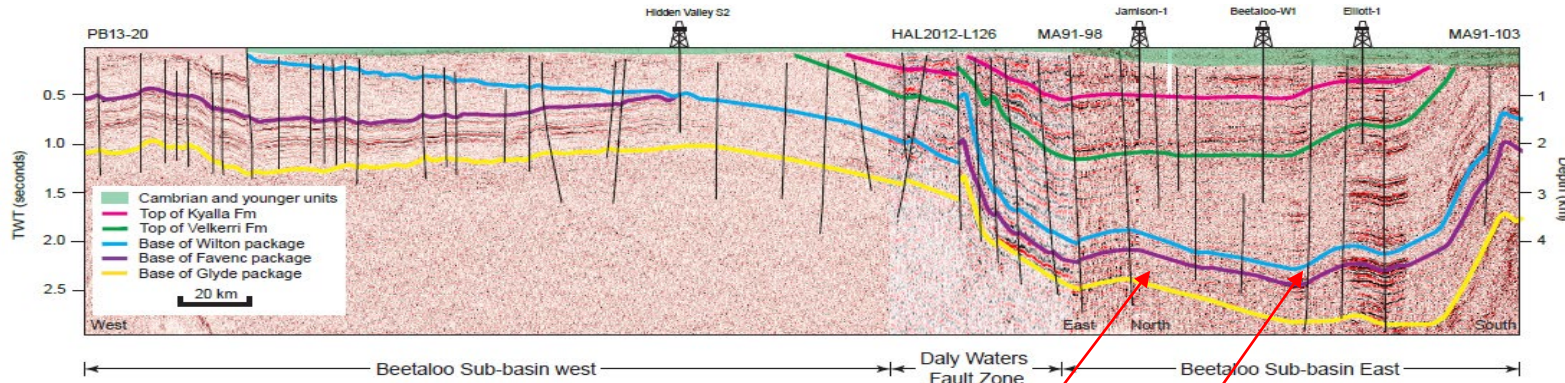
- Goyder package only occurs in WFZ.
- In northern McArthur Basin, Glyde package also only occurs in WFZ.
- In southern basin, Glyde package is more widespread. Not present in SE (zero edge to E of BFZ). Extends S to vicinity of Murphy Province.
- Packages young towards from basement towards depocentres.



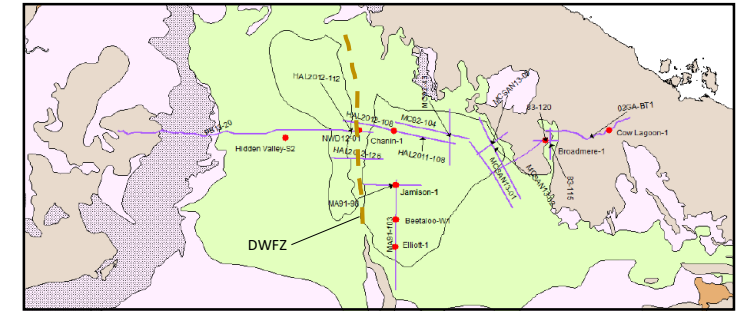


# Are Glyde and Favenc packages present in Beetaloo Sub-basin?

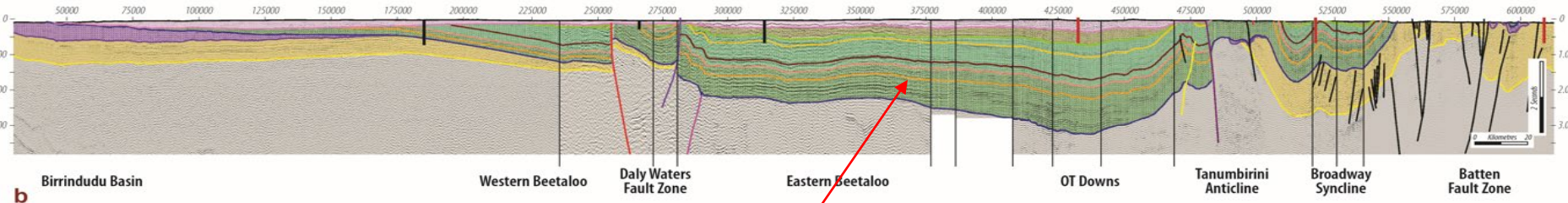
- West of Daly Waters Fault Zone (DWFZ), both packages are present, truncated beneath Wilton package.
- East of DWFZ, all drill intersections are terminated in Wilton package.
- Glyde and Favenc packages identified at depth in most previous seismic interpretations (eg Williams 2019). This is the current NTGS interpretation.
- These intervals reinterpreted by Garrad (2023) as lower Wilton package, or lower Wilton and Favenc packages, with Glyde package truncated under an erosional unconformity to east of Beetaloo Sub-basin.



Williams (2019)



Glyde and Favenc packages



Garrad (2023)

No Glyde or Favenc packages



# Glyde package

45 formations plus named and unnamed members in 7 groups and 2 subgroups

## northern McArthur Basin

Habgood Group  
lower Balma Group

## central McArthur Basin

Vizard Group

## Birrindudu Basin

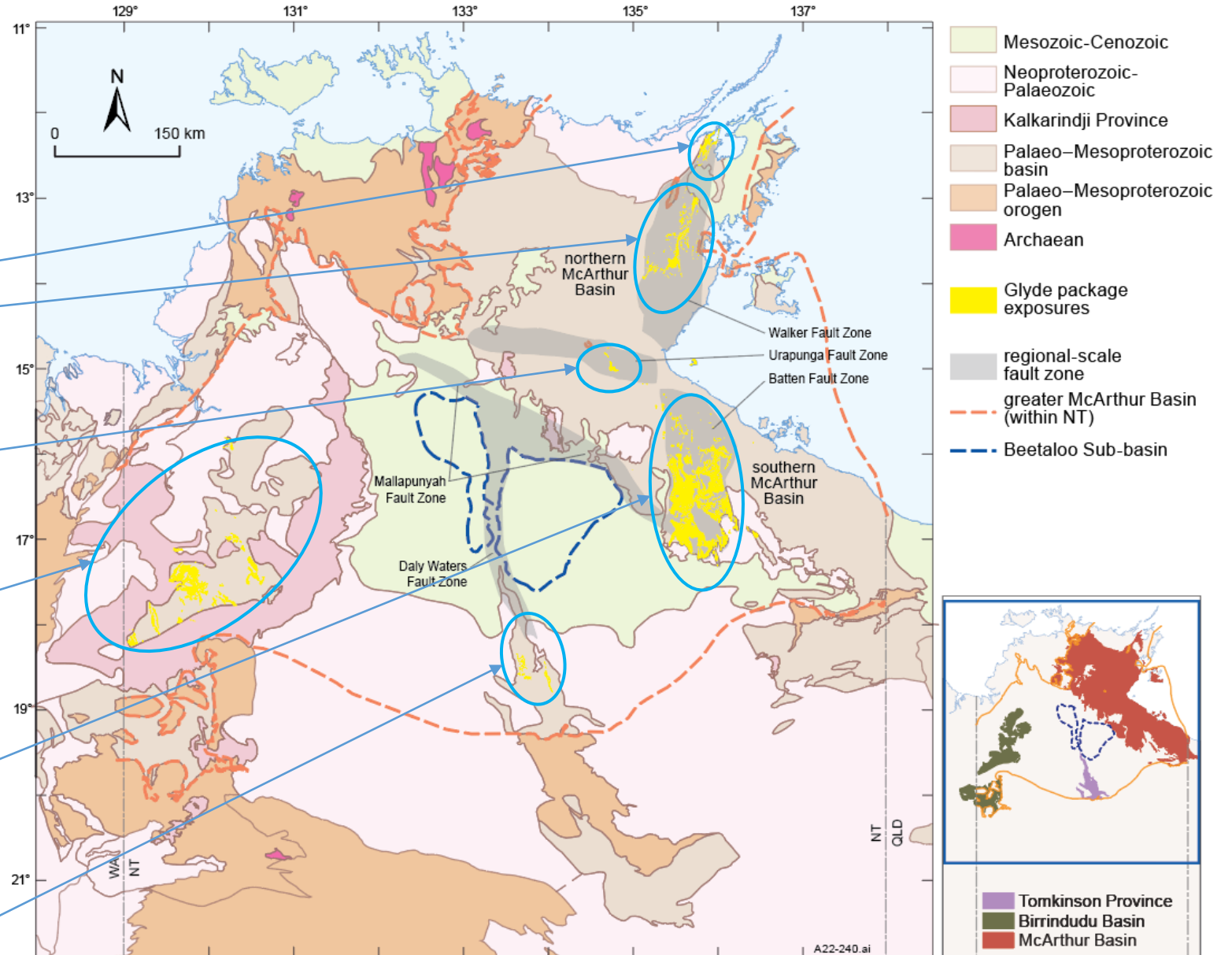
Limbunya Group

## southern McArthur Basin

McArthur Group  
lower Balbirini Dolostone (Nathan Group)

## Tomkinson Province

lower Namerinni Group





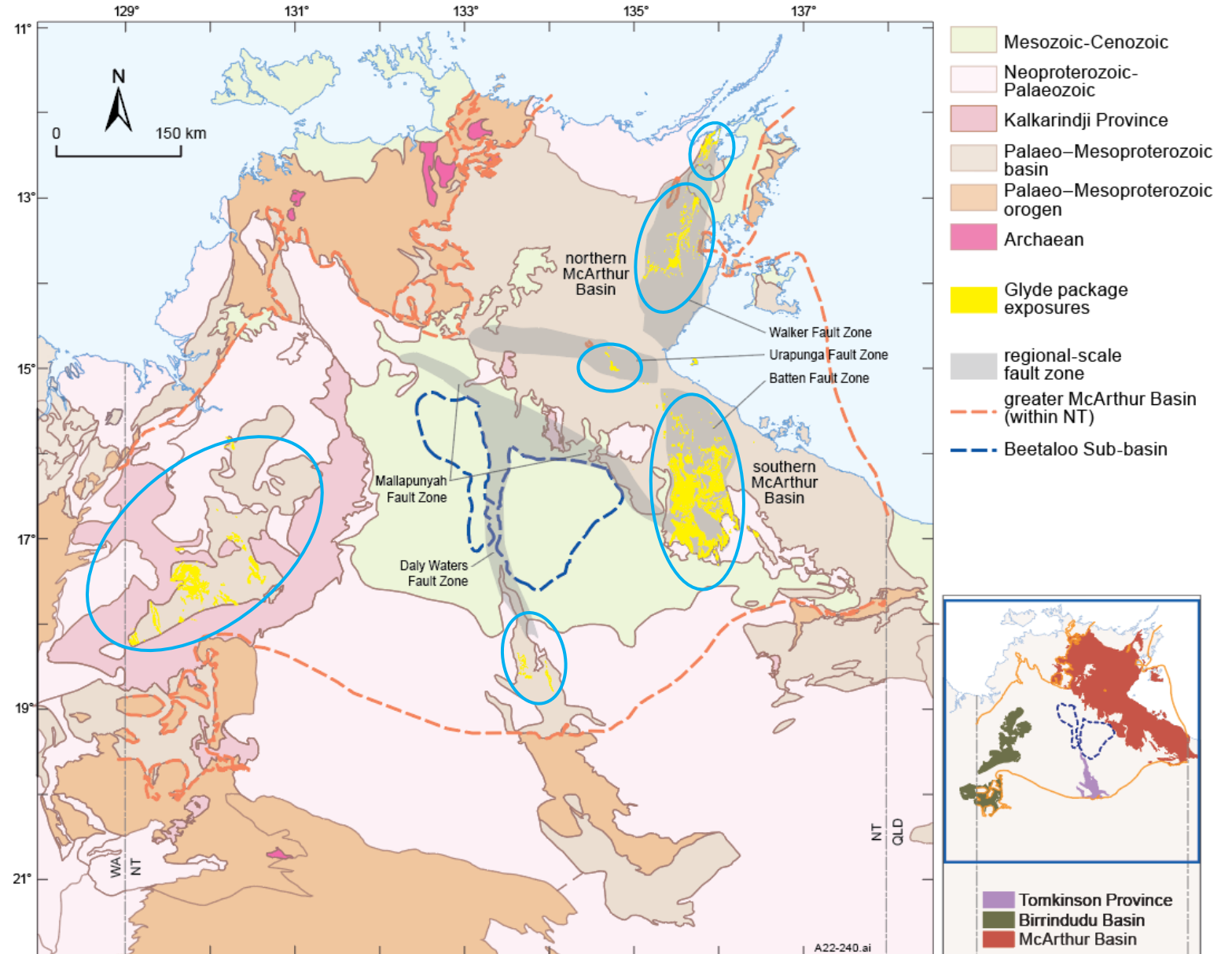
# Glyde package

Successions are heterolithic. A wide range of rock types includes:

- siliciclastic rocks
- carbonate rocks
- mixed carbonate/fine-grained siliciclastic rocks
- bedded evaporitic rocks.

Thicknesses of successions:

- up to about 5000 m in northern and southern McArthur Basin
- about 1500 m in Birrindudu Basin
- up to about 2000 m in Tomkinson Province.

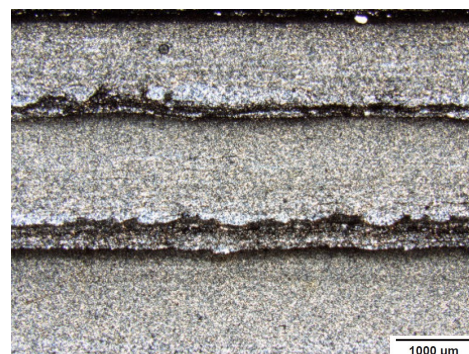




# Glyde package sedimentary facies: siliciclastic rocks



Hummocky cross-beds in Tatoola Sst (McArthur Gp, Sth McArthur Basin).



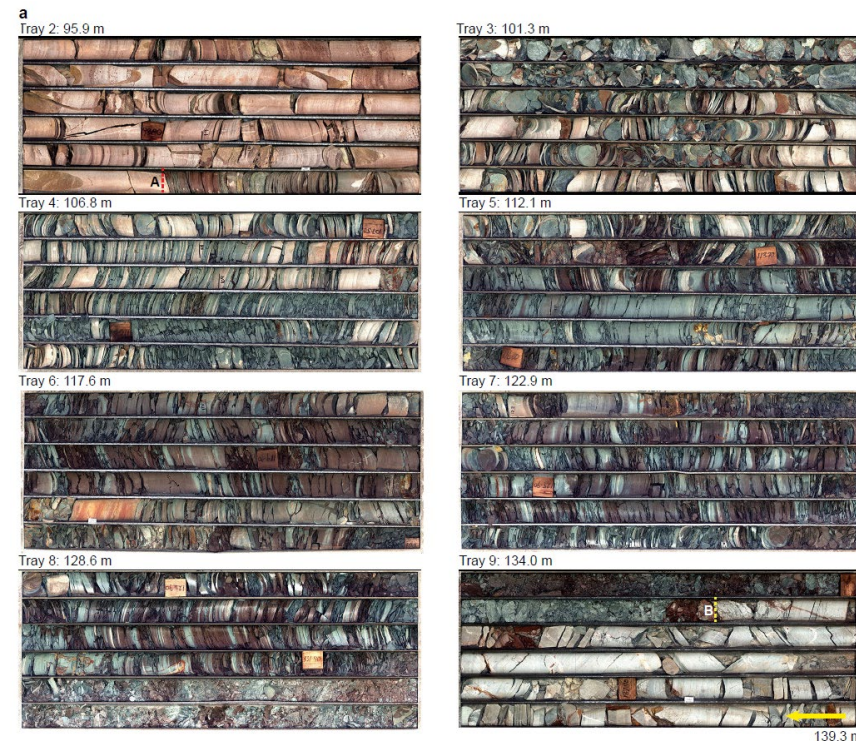
Graded siltstone-claystone with load and flame structures (Slippery Creek Sltst, Habgood Gp, Nth McArthur Basin). TS, XN.

Ripple pavement in Masterton Sst (McArthur Gp, Sth McArthur Basin).



Ngilipitji Conglomerate Member (Yarrowirrie Fm, Balma Gp, Nth McArthur Basin). Cherty carbonate clasts in sandstone matrix.

Dune cross-bedded sandstone with normally graded laminae (Stirling Sst, Limbunya Gp, Birrindudu Basin).



Kunja Sltst (Limbunya Gp , Birrindudu Basin): (a) Mosaic of core trays with complete intersection of formation. (b) Exposure in type section – about as good as it gets.



# Glyde package sedimentary facies: carbonate rocks



Campbell Springs Dlst (Limbunya Gp, Birrindudu Basin).



Edgewise breccia (Mara Dlst Mbr, Emmerugga Dlst, McArthur Gp, Sth McArthur Basin).



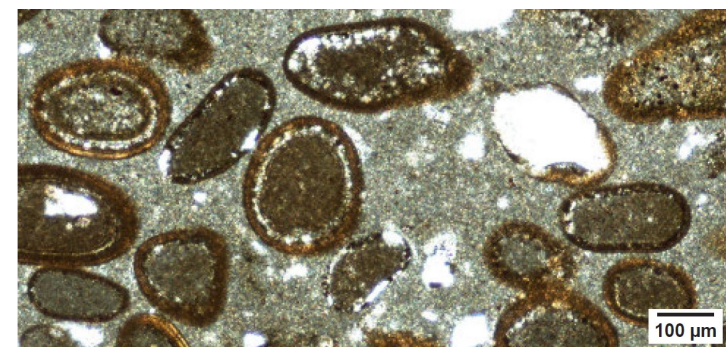
Trough cross-stratified dolarenite (Pear Tree Dlst, Limbunya Gp, Birrindudu Basin).



Chertified carbonate-mudrock and minor mudrock (Conway Fm, Balma Gp, Nth McArthur Basin).



Fine-grained dolarenite and dolosiltite. Planar-parallel laminae, trough cross-beds, basal scours and lags, normal grading (Reward Dlst, McArthur Gp, Sth McArthur Basin).



Ooids in recrystallised silty dolomicrite matrix. TS, PPL. (Pear Tree Dlst, Limbunya Gp, Birrindudu Basin).



# Glyde package sedimentary facies: mixed siliciclastic/carbonate rocks



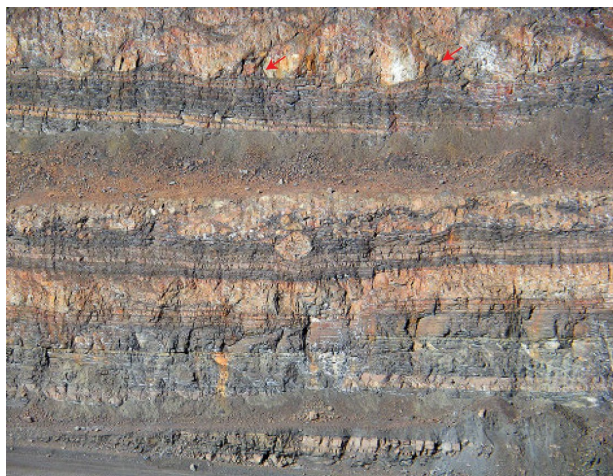
Dolomitic mudrock, silty dolomudrock and mudrock (Darwarunga Sst, Habgood Gp, Nth McArthur Basin).



Mudrock, silicified dolomudrock and stromatolitic dolostone (Margery Fm, Limbunya Gp, Birrindudu Basin).



Laminated carbonaceous black shale and dolomudrock (Mallabah Dlst, Limbunya Gp, Birrindudu Basin).



Dolomitic siltstone, black shale and dolostone breccia (Barney Creek Fm, McArthur Gp, Sth McArthur Basin).



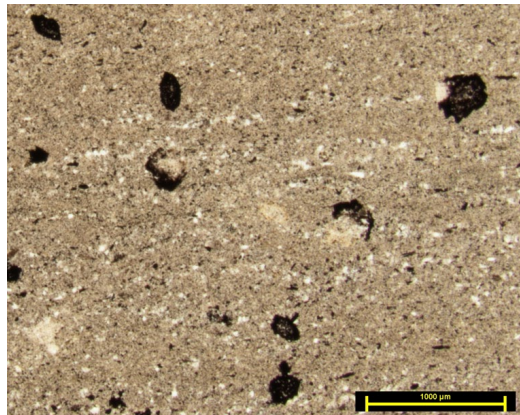
Left: dolomitic siltstone overlain by silicified carbonate rocks (Yarrowirrie Fm, Balma Gp, Nth McArthur Basin).

Right: dolomudrock, mudrock and fine-grained silty sandstone (Mallapunyah Fm, McArthur Gp, Sth McArthur Basin).





# Glyde package sedimentary facies: bedded evaporitic rocks



Pseudomorphs after gypsum crystals (prismatic, rosette-like aggregates) in silicified silty dolomudrock (lower Shillinglaw Fm, Namerinni Gp). TS; PPL.



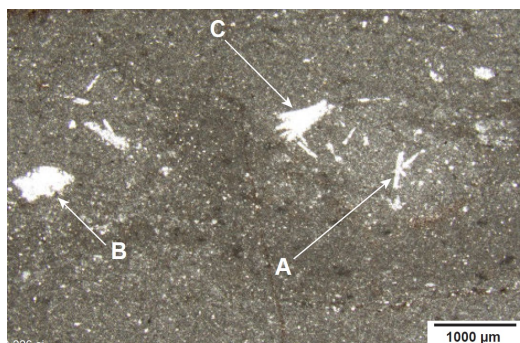
Discoloidal and pseudo-hexagonal gypsum crystal pseudomorphs, some coalesced into strings and clumps (Hot Spring Mbr, Lynott Fm, McArthur Gp, Sth McArthur Basin).



Cauliflower chert after anhydrite in dolomitic sandstone (Mallapunyah Fm, McArthur Gp, Sth McArthur Basin).



Mudcracks in dolomudrock (Killaloc Fm, Limbunya Gp, Birrindudu Basin).



Pseudomorphs after gypsum crystals in dolomudrock: A – prismatic; B – prismatic/lenticular; C - prismatic/hemi-bipyramidal twin complex (Killaloc Fm, Limbunya Gp, Birrindudu Basin). TS; PPL.



Halite hopper casts in dolomitic siltstone (Mallapunyah Fm, McArthur Gp, Sth McArthur Basin).



Redbed siltstone and fine sandstone on dolomudrock (lower Balbirini Dlst, Nathan Gp, Sth McArthur Basin).



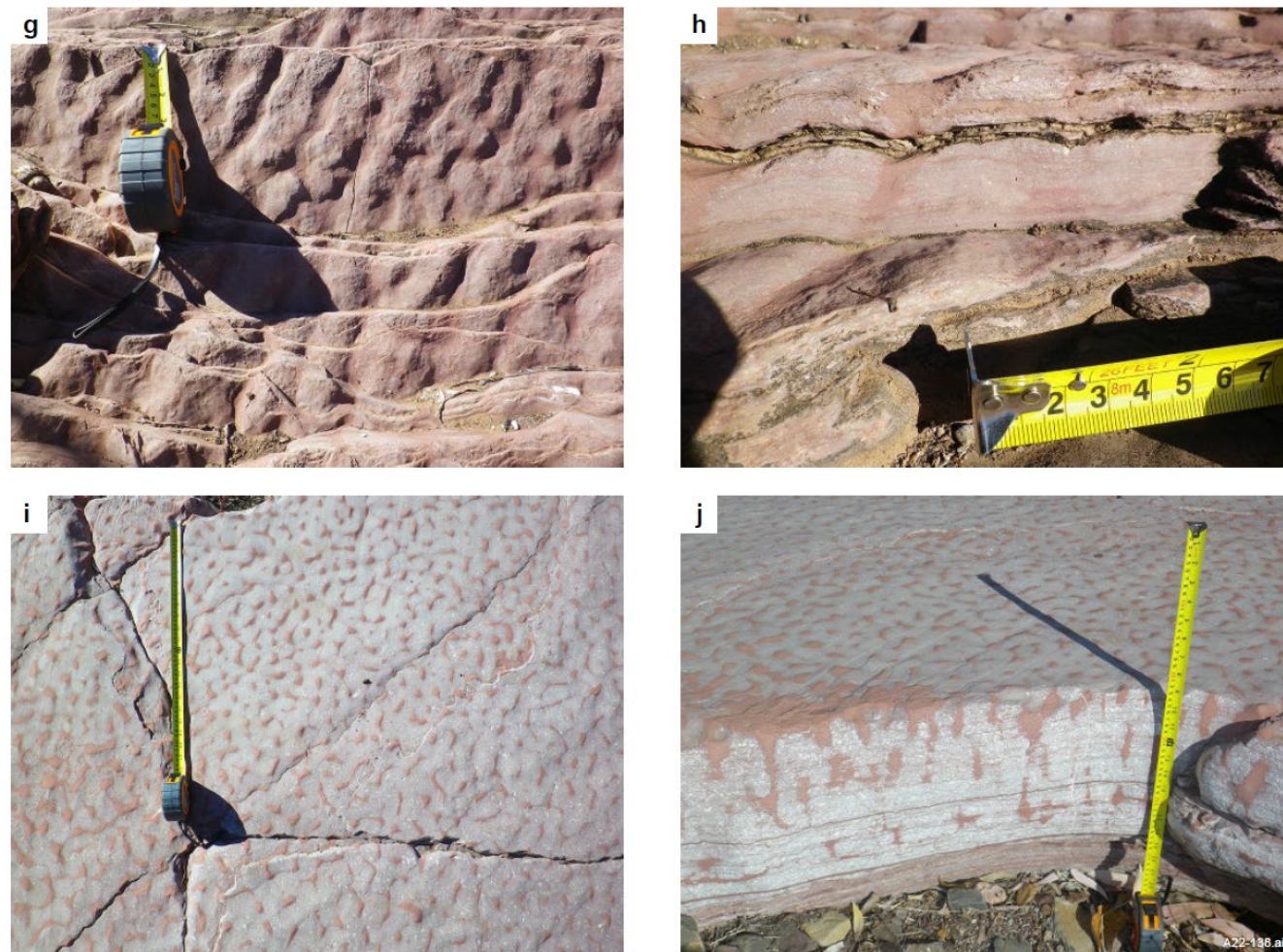
Current ripples in fine-grained redbed sandstone; palaeocurrent from R to L (Amos Fm, McArthur Gp, Sth McArthur Basin).



# Glyde package sedimentary facies: microbialites



Tooganinie Fm (McArthur Gp, Sth McArthur Basin) stromatolite morphologies: (a) Biostrome (linked domical). (b) As for (a) continuing into distance. (c) Linked small hemispheroids. (d) Large hemispheroids. (e) Linked subcylindrical columnar. (f) Branching divergent columnar.











Blue Hole Fm (Birringdudu Gp, Birringdudu Basin) stromatolite morphologies: (g–h) Thin biostrome with a linear columnar microbialite macrostructure resembling ripples in (g) plan view. (h) Longitudinal section. Bedding plane (i) and oblique (j) views of interpreted maceriate biostrome. Dolomudrock-infilled interspaces resemble syneresis cracks in cerebroid surface view; recrystallised interpreted microbial laminations with ragged edges are evident in longitudinal view.



# Package boundaries and intrabasinal correlation

- Base-Redbank, Redbank–Glyde, Favenc–Wilton and top-Wilton boundaries are all significant, regional, low-order tectono-eustatic unconformities across greater McArthur Basin.
- Goyder package is conformable between Redbank and Glyde packages.
- Glyde–Favenc boundary is a significant low-order unconformity in some areas, but is a concordant, high-order disconformity in other areas.

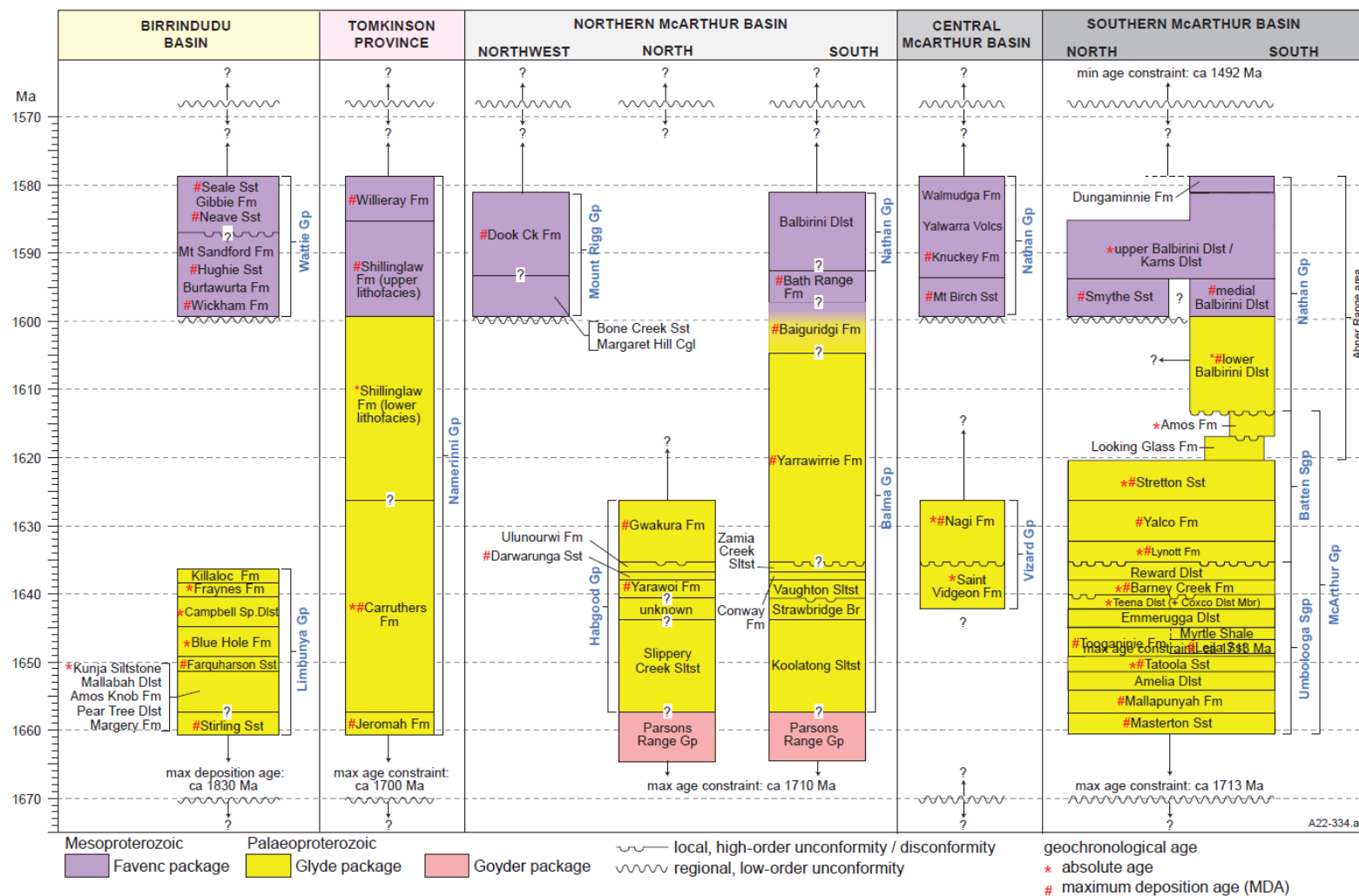
packages	Birrindudu Basin	Tomkinson Province	northern McArthur Basin	central, southern McArthur Basin
 Wilton	Tijunna Group	Renner Group	Roper Group	Roper Group
 Favenc	 Bullita, Wattie groups	upper Namerinni Group	Nathan, Mount Rigg, upper Balma groups	Nathan Group
 Glyde	Limbunya Group	lower Namerinni Group	lower Balma, Habgood groups	McArthur, Vizard groups
 Goyder			Parsons Range Group	
 Redbank	Birrindudu, Tolmer groups	Tomkinson Creek, Hatches Creek groups	Groote Eylandt, Donydji, Katherine River, Edith River, Spencer Creek groups	Tawallah Group
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# Glyde – Favenc package boundary in more detail

Latest correlation chart (very likely to be revised pending more data!).

Glyde-Favenc unconformity is semi-regional.

- Deeply incised and erosional in Birrindudu Basin and much of southern McArthur Basin.
- Probable high-order eustatic disconformity in Abner Range area (southern McArthur Basin)', northern McArthur Basin and Tomkinson Province.
- Geochronological analyses of tuffs and detrital zircons indicates the Glyde-Favenc boundary is positioned at:
  - top of lower Balbirini Dolostone (southern McArthur Basin)
  - below Bath Range Fm and possibly Baiguridji Fm (northern McArthur Basin)
  - mid-Shillinglaw Fm (Tomkinson Province).

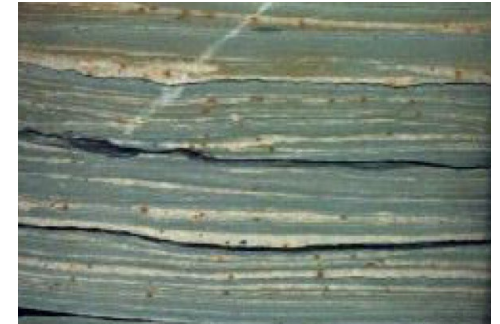
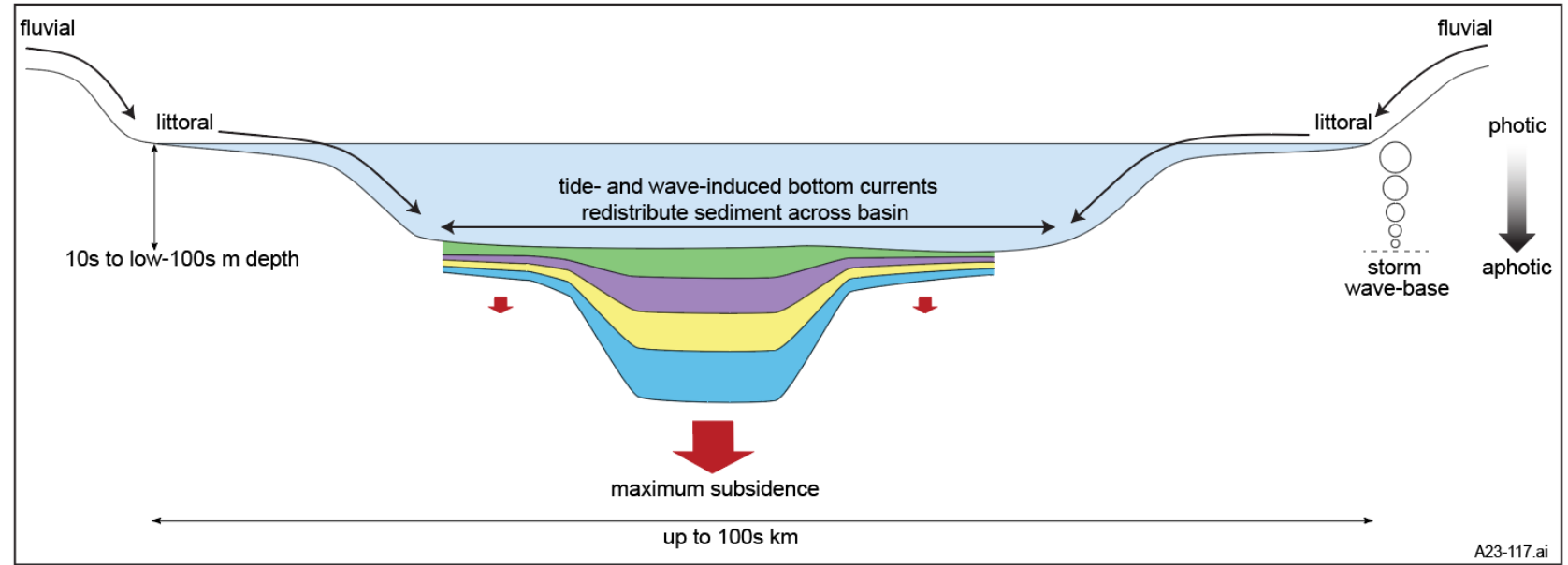




# Basin model for greater McArthur Basin

**greater McArthur Basin is an enclosed to semi-enclosed epicontinental basin:**

- Partial, distant, or no connection with open ocean at various times.
- Shallow sea floored by Archaean–early Palaeoproterozoic continental crust. No modern analogues. Terms like ‘continental shelf’, ‘continental slope’ not applicable.
- Accommodation space produced by subsidence and eustasy matched rate of sediment supply, so seafloor mostly remained shallow (eg Beetaloo Sub-basin). Some local deeper areas of deposition (eg Batten Fault Zone transtensional sub-basins).
- No life on land; areas of higher relief were easily eroded and could supply large volumes of sediment.
- Large areas above storm wave base and no marine infauna / epifauna / epiflora except microbialites in shallow photic zone.
- This enabled widespread redistribution of sediment across seafloor via wave- and tide-induced bottom currents.
- Long sediment pathways; high degree of sediment maturity.

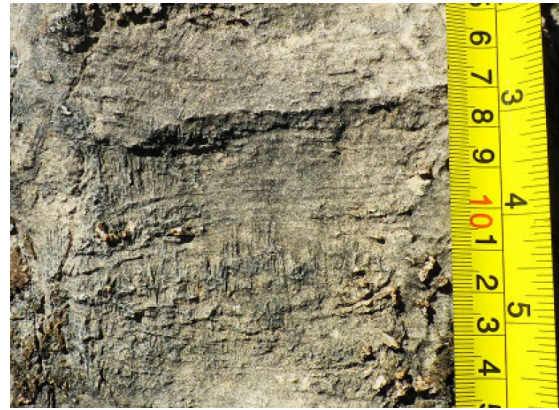


# Glyde package depositional environments

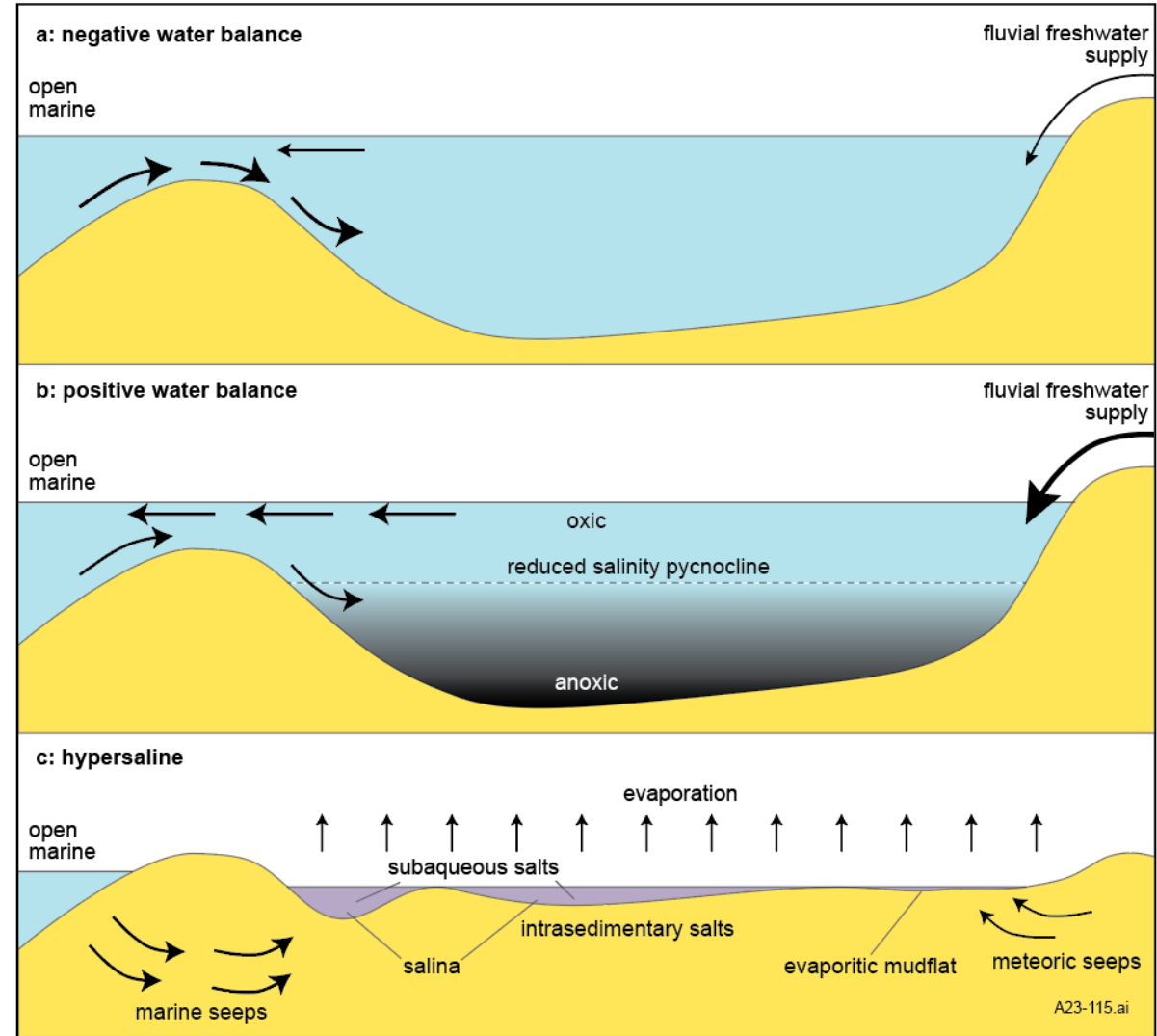
- Subject to periodic changes in base level (surface of equilibrium between deposition and erosion), resulting in a wide range of environments from shallow-marine to continental.
- Limited, distant, or no connection with open ocean (at various times).
- Subject to periodic changes in salinity related to variations in influx of marine and fresh water (negative and positive water balance), and hydrographic isolation.
- Water chemistry also varied through time (eg 'Coxco needle' seafloor aragonite cements indicate an alkaline, carbonate-saturated water chemistry).



Synaeresis cracks – Yarrawirrie Fm



Coxco needles – Coxco Dolostone Mbr





Munson TJ, in press. Sedimentary characterisation of the Glyde package, greater McArthur Basin, Northern Territory. *Northern Territory Geological Survey, Record*.

Sixty-five stratigraphic units fully described and illustrated from McArthur Group (southern McArthur Basin), Vizard Group (central McArthur Basin), Balma and Habgood groups (northern McArthur Basin), Limbunya Group (Birrindudu Basin), Namerinni Group (Tomkinson Province).

Includes:

- Previous work and nomenclature history
- Type and reference sections
- Distribution and thickness in outcrop and subsurface with maps
- Stratigraphic relationships and boundary criteria
- Full lithological descriptions, including rock types, sedimentary structures, thin sections with comprehensive illustrations
- Interpretations of depositional environment
- Age and intrabasinal correlations.



# References

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