Depositional setting and stratigraphic architecture of the Roper Group (McArthur Basin): insights from a sedimentological analysis of core and well data

Rhodri Johns, Brenton Schoemaker, Sandra Menpes (Santos)
and Howard D Johnson (Imperial College London)

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Depositional setting and stratigraphic architecture of the Roper Group (McArthur Basin): insights from a sedimentological analysis of core and well data

Santos

Rhodri Johns,[1] Brenton Schoemaker,[1] Sandra Menpes[1] and Howard D Johnson[2]

[1] Santos, [2] Department of Earth Science & Engineering, Imperial College London, Prince Consort Road, London, SW7 2BP, UK

Scope of McArthur Basin Core Review

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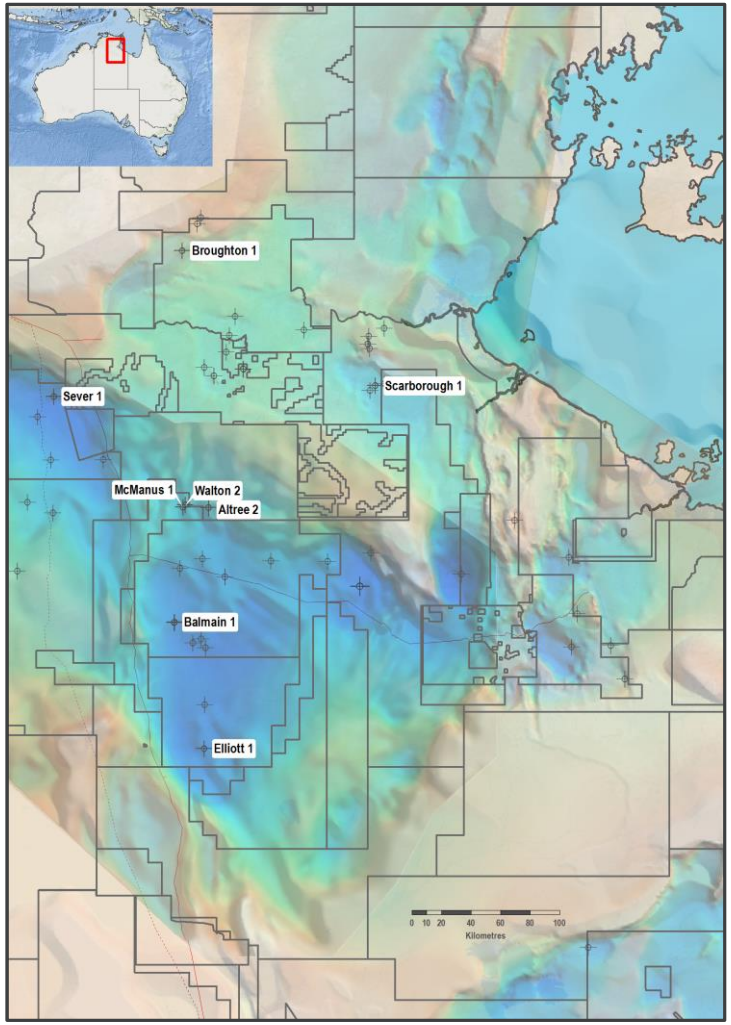
High quality continuous cores (100s m) through Roper Group from 1980/90s petroleum wells

- Santos regional studies initiated in 2011/2 to better understand and evaluate the potential of the Mesoproterozoic shale plays of the McArthur Basin
- Focus on an improved understanding of the depositional setting of the Roper Group
- Over 3km of core reviewed, logged and interpreted
- Opportunity to enhance skills of Santos geoscientists
- Depositional model developed with new insights into origin of organic rich mudstones

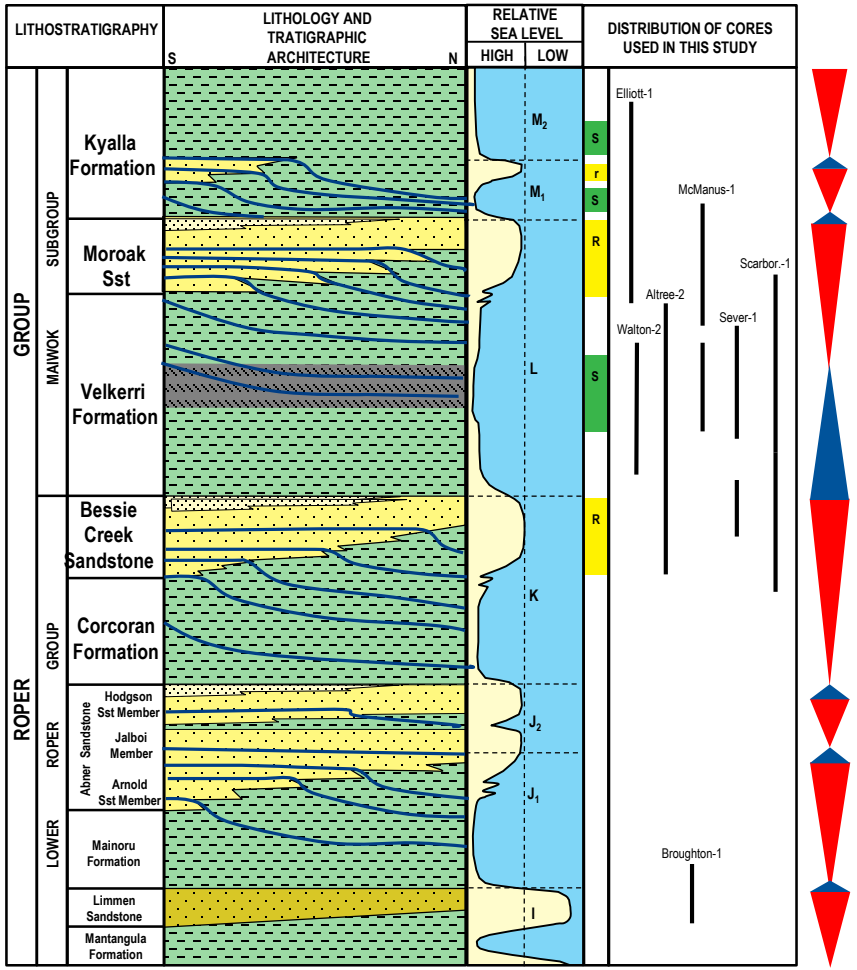


Well cores reviewed

Mesoproterozoic Roper Group stratigraphic framework

Six stacked conformable regressive transgressive (R-T) sequences

(Modified after Jackson et al. (1998)



Kyalla major R-T sequences (M_1 and M_2):

Velkerri-Moroak R-T sequence Major R-T cycle (L):

Corcoran-Bessie Creek R-T sequence Major R-T cycle (K):

Two major R-T sequences (J1 and J2):

Major R-T sequence (I):

Regressive phases

Transgressive phases

Clinoforms

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Conceptual depositional model Velkerri-Moroak Sandstone R-T Sequence

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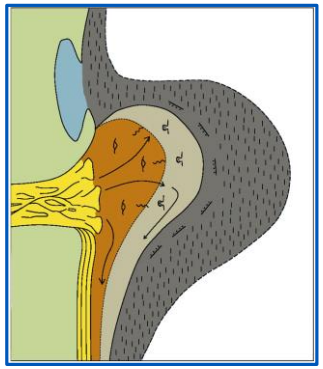
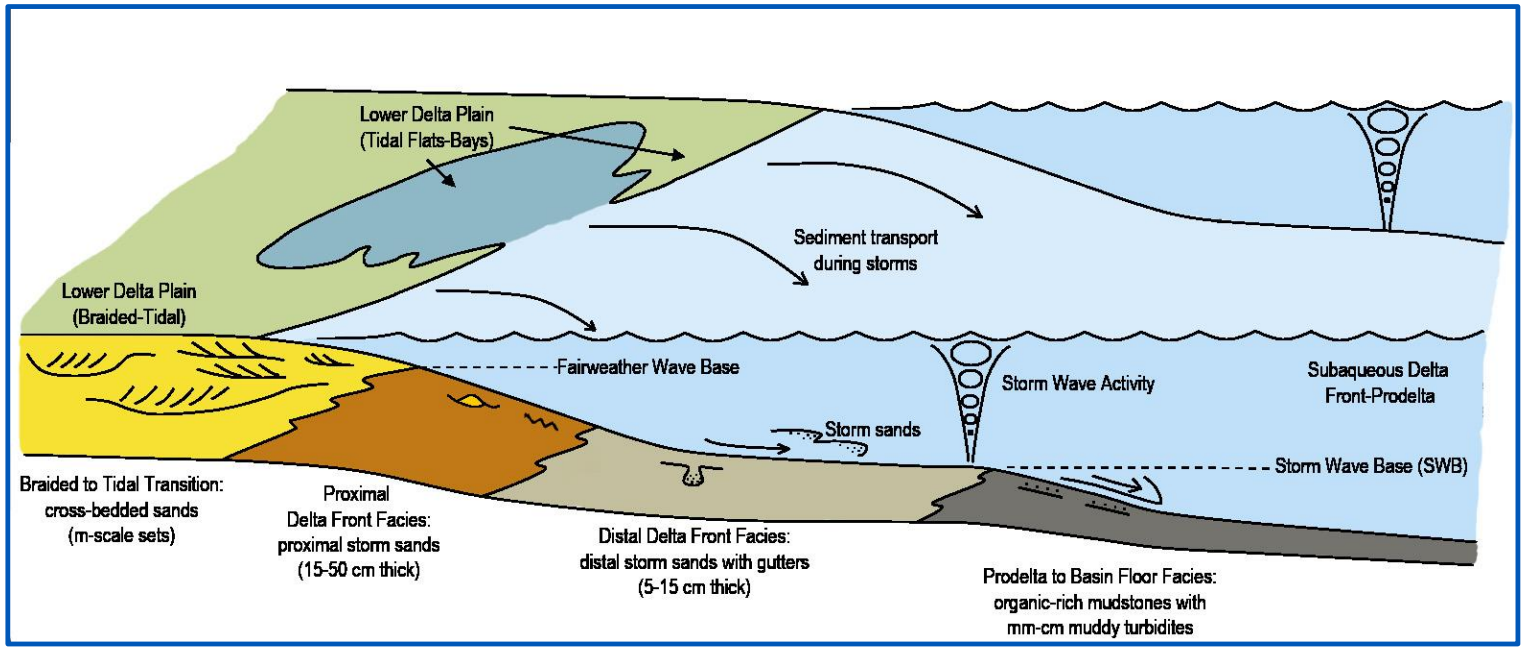
Spectrum of depositional environments from fluvial to basin floor



Plan View



sandy braided river upper delta plain to **fluvio-tidal lower delta plain -** above FWB

proximal delta front/subaqueous delta platform - mixed energy tide, waves and storm processes

distal delta front - storm processes

prodelta to basin floor (below SWB) dilute gravity flows - accumulation of reworked organic material

Corcoran-Bessie Creek R-T Sequence (Altree-2)

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Regressive, aggrading and retrograding coastal-deltaic sequence

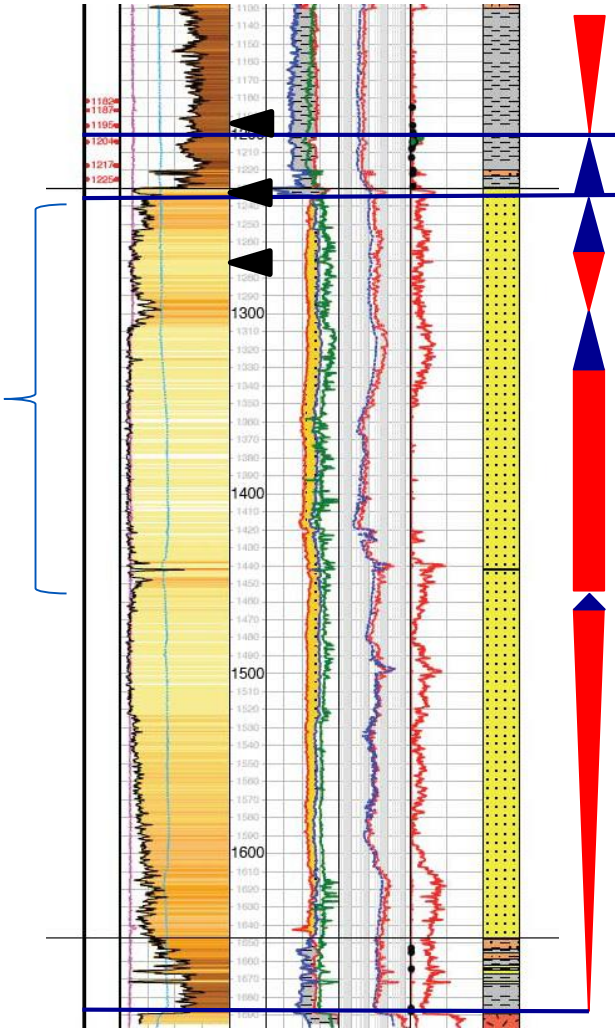
+ **Lower Delta Plain to Delta Front**

+ Fluvial, tide and wave/storm processes

+ Trough cross bedding, sand dominated

+ Heterolithic facies, mud drapes (tidal)

Altree-2



Lower Velkerri

Prograding Storm-Influenced Offshore/Shelf

MFS

Retrograding Storm-Influenced Offshore/Shelf

WRS

Retrograding
Fluvio-Tidal
Inshore-Estuary

Aggrading
Fluvio-Tidal
Coastal to
Lower Delta Plain

Bessie Creek

Prograding to
Aggrading
Fluvio-Tidal
Lower Delta Plain

Proximal
Storm-/Tide-
Influenced
Delta Front

Distal Storm-Influenced
Delta Front-Prodelta

Corcoran

Proximal Section - Velkerri-Moroak Sandstone R-T Sequence (Elliott-1)

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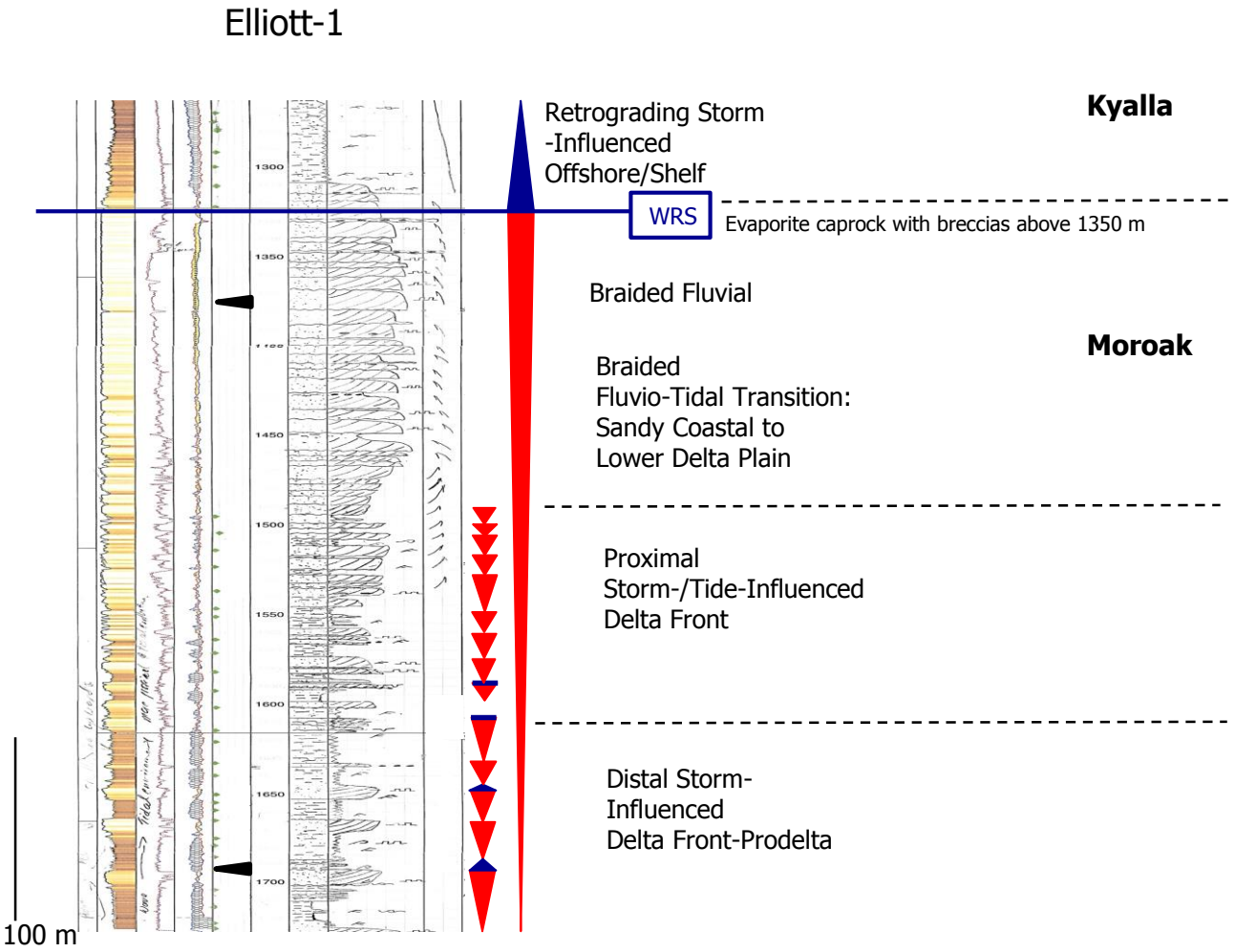
Amplified progradational sequence from distal delta front to braided fluvial

+ **Braided Fluvial**

+ **Proximal Delta Front**

+ **Distal Delta Front - Prodelta**



Distal Section — Velkerri-Moroak Sandstone R-T Sequence, and lower part of the Kyalla R-T Sequence (McManus-1)

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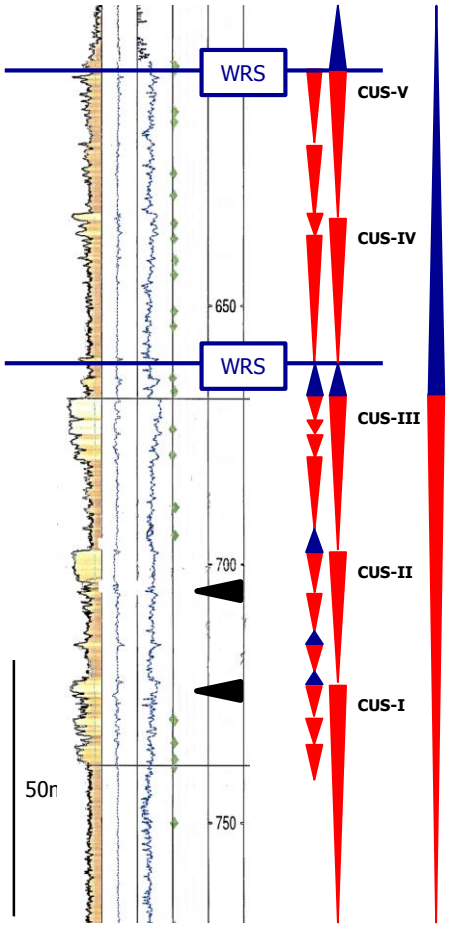
Prograding distal delta front. Lateral equivalent to Elliott-1

+ **Distal Delta Front**

+ **Distal to Proximal Delta Front**



Capped by major transgressive phase

Retrogradationally-Stacked Storm-Influenced Distal Delta Front (CUS IV-V)

Kyalla

Top Moroak Sandstone

Progradationally-Stacked Storm-Influenced Distal to Proximal Delta Front (CUS I-III)

Moroak

Top Velkerri Formation

Distal Storm-Influenced Delta Front-Prodelta

Schematic stratigraphic cross-section through the Velkerri-Moroak Sandstone R-T Sequence

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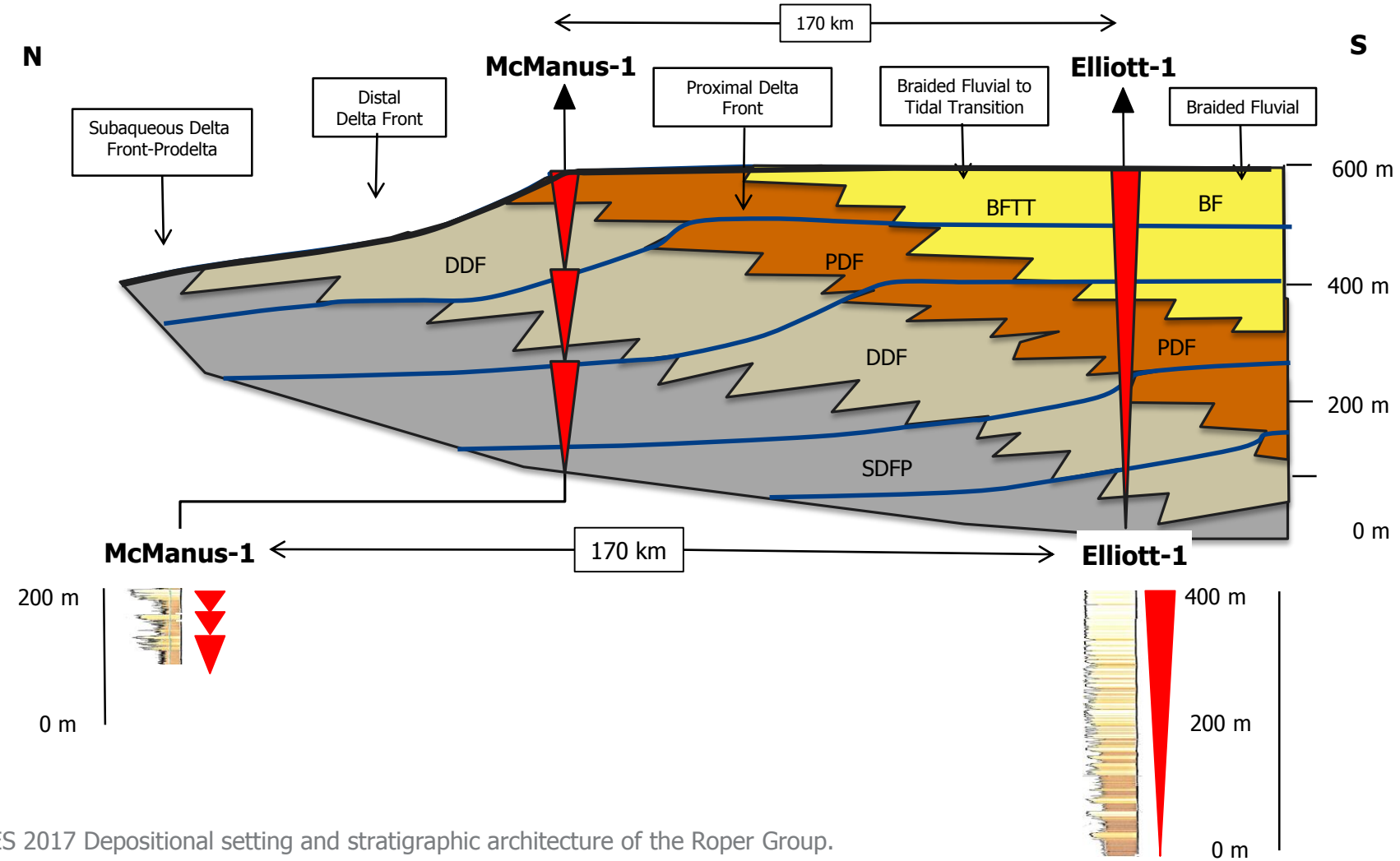
Proximal to distal section, Elliott-1 to McManus-1



Velkerri-Moroak R-T Sequence (Scarborough-1)

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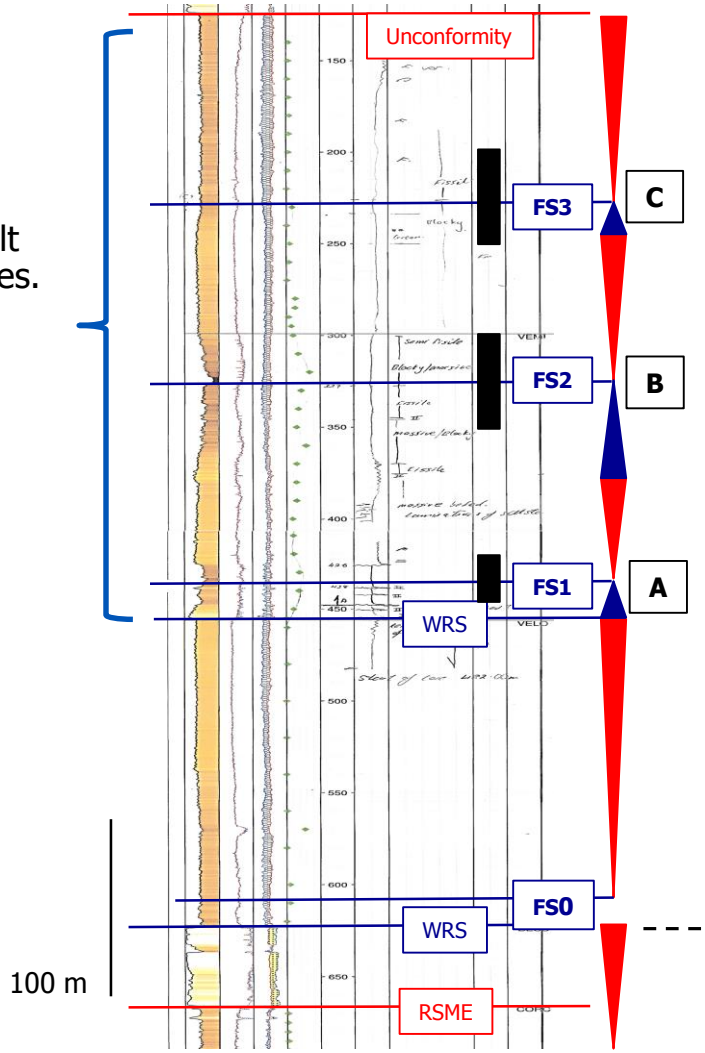
- **Prodelta to Basin Floor**
- Gradational facies boundaries
- Mudstone with mm-thick siltstone lamination Frequency of fine sand/silt beds defines CU sequences.
- Increased silt content reduces visual carbonaceous content
- Occasional debrite and slump beds
- Wave ripples absent (= below storm wave base)

Scarborough-1



C Shale:
- Organic-rich mudstones at c. 200-250 m

B Shale:
- Dark grey-black, organic-rich mudstones at c. 300-350 m)

A Shale:
- Dark grey-black, organic-rich mudstones straddles FS1

Lower Velkerri
- HCS and sporadic wave ripples occur immediately above the WRS/Top Lower Velkerri Marker (regional composite erosion surface)

Corcoran-Bessie Creek R-T Sequence

Forced Regressive Shoreline

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Conclusions

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- Roper group architecture can be explained by the stacking of fluvial to distal deltaic sedimentary facies in regressive/ transgressive sequences
- Depositional environments ranged from fluvial braid plain through to delta front to subaqueous delta platform and prodelta (subaqueous delta front) analogous to modern delta complexes
- Deposition of organic rich mudstones occurred below storm wave base in an environment dominated by numerous small dilute gravity flows probably triggered by storm events on the subaqueous delta platform
- Accumulation of organic rich sediment occurred with the most basinward part of the source to sink sediment transport system
- Origin of organic material is uncertain but we suggest the material is internally sourced reworked from a zone extending from intertidal to prodelta environments

Acknowledgements

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+ NTGS Core Store

+ Santos is thanked for permission to present and publish this paper