ePS Facies-Belt Pinch-Out Relationships in a Distal, Mixed-Influence Shallow-Marine Reservoir Analogue: Lower Sego Sandstone Member, Western Colorado, USA*

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Abstract

Lateral and proximal-to-distal facies relationships in mixed, wave- and tide-influenced shallow-marine deposits are poorly documented in both reservoirs and outcrop analogues. This study focuses on outcrops of the Lower Sego Sandstone Member, western Colorado, where tide-dominated sandstones interfinger with wave-dominated delta-front deposits within a series of stacked regressive-transgressive tongues. The stratigraphic relationships and facies-belt pinch-outs between tide- and wave-dominated deposits have been documented along continuous exposures over an area of 7 by 12 km.

Wave-dominated deposits are characterized by coarsening-upward successions with hummocky-cross stratified, very fine-grained sandstone in the upper parts. Tide-dominated facies are dominated by trough and herringbone cross-stratified, fine- to medium-grained sandstone, with intercalations of heterolithic sand-mudstone and inclined heterolithic strata. Tidal deposits are coarser grained and have a higher net-to-gross ratio, compared to wave-dominated facies, and hence have superior reservoir characteristics. Erosively based tidal deposits overlie wave-dominated lower shoreface deposits and form either (1) thick, amalgamated sand bodies, or (2) thinner sand bodies intercalated with wave-dominated deposits. Clear proximal-distal trends exist, which follow the established regional paleogeography. The proximal (western) area comprises tidal channels that erode into subtidal to upper intertidal deposits. Towards the distal (eastern) area, tide-dominated deposits form increasingly sheet-like sand bodies, which were exclusively formed in subtidal environments. Along the same proximal-to-distal trend, tidal sandstones decrease in thickness from 32 to 16 m over a distance of 8 km and pinch-out within another 4 km. Towards the pinch-out, tidal sandstones are increasingly reworked by waves due to successive flooding. Hence, sand-body geometry reflects a combination of original tidal deposition and subsequent modification by wave reworking.

This study quantifies the intertonguing and pinch-out relationships within this mixed-influenced shallow-marine setting, providing analogue data that could improve the understanding of reservoir architecture and potential production behavior of similar reservoirs. Future work will assess the impact of these complex facies relationships, and the detail with which they are represented, on flow patterns and estimated recoveries in reservoir-simulation models.

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Kauffman, E.G., and W.G.E. Caldwell, 1993, The Western Interior Basin in Space and Time, *in* W.G.E. Caldwell, and E.G. Kauffman, (eds.), Evolution of the Western Interior Basin: Geological Association of Canada Special Paper, v. 39, p. 1-30.

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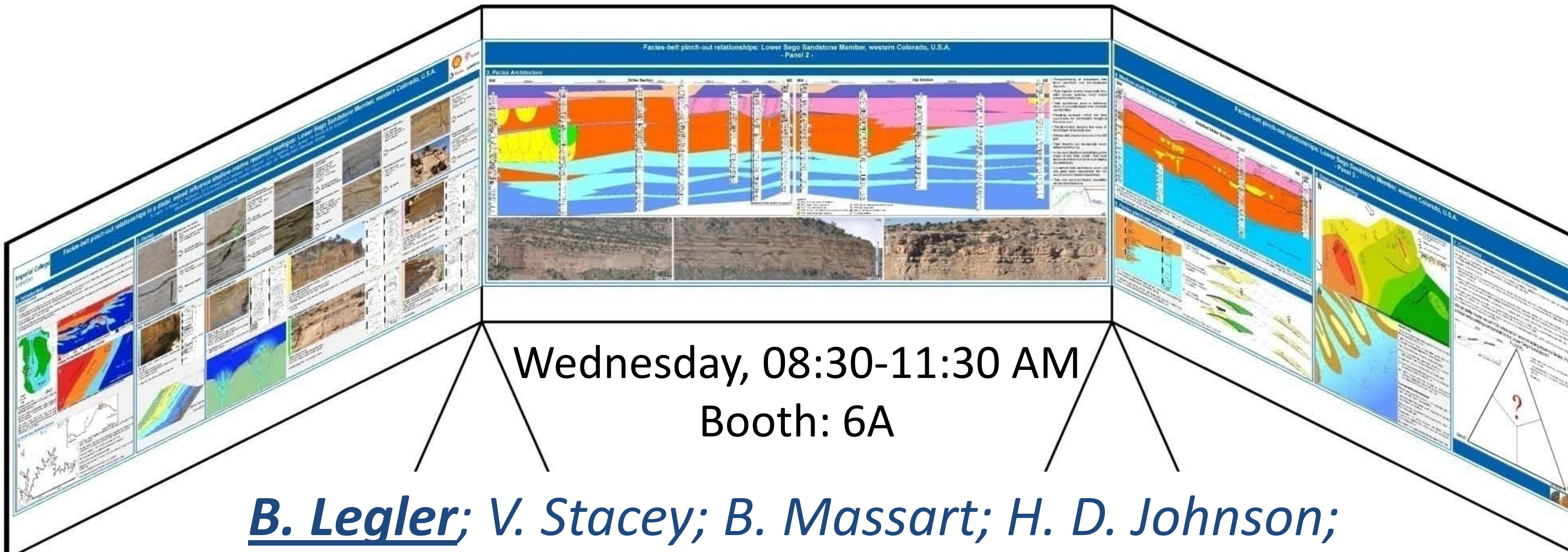
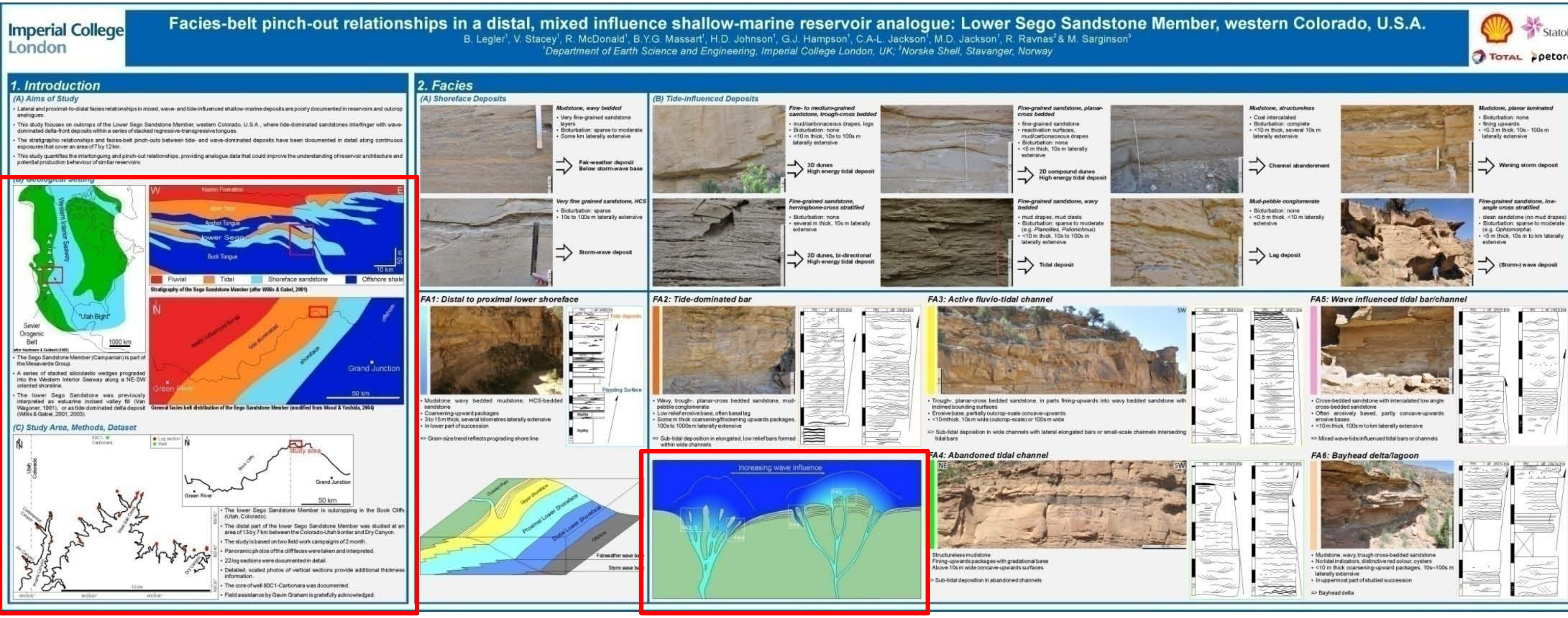


Wednesday, 08:30-11:30 AM
Booth: 6A

B. Legler; *V. Stacey; B. Massart; H. D. Johnson; G. J. Hampson; C. Jackson; M. D. Jackson; R. Ravnas; M. Sarginson*

Imperial College London, Norske Shell Stavanger

Panel 1: Introduction and Facies



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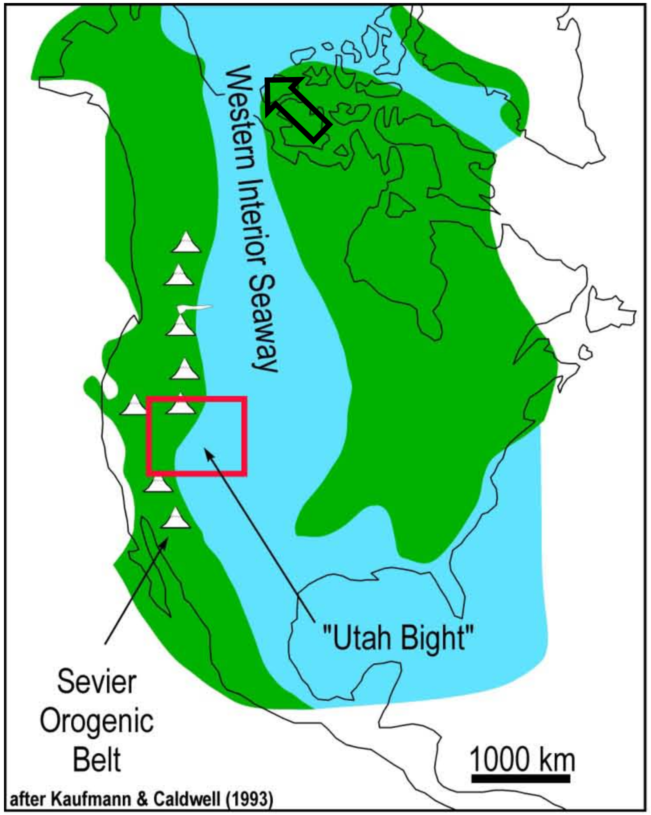
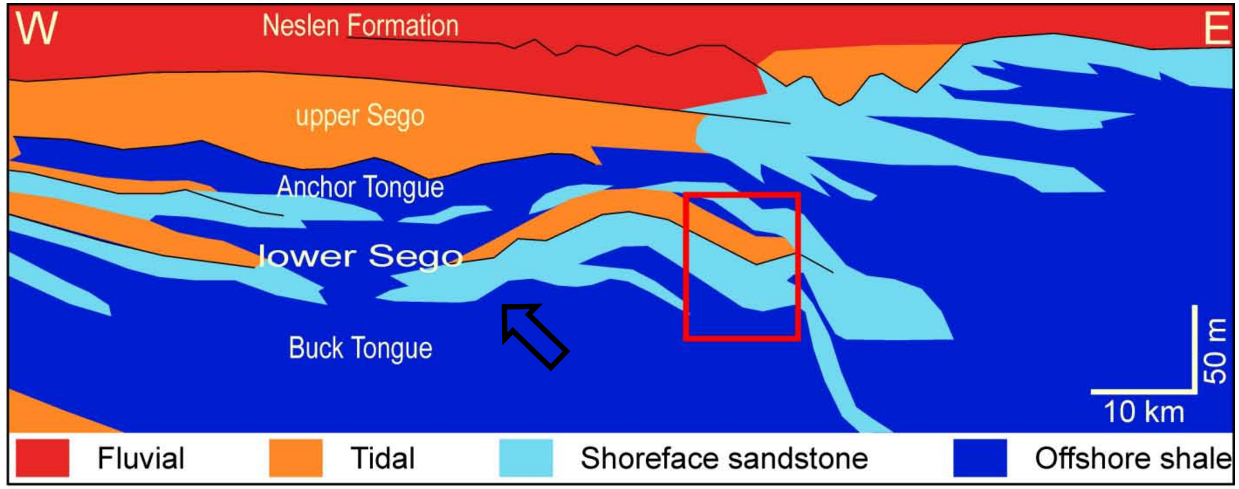
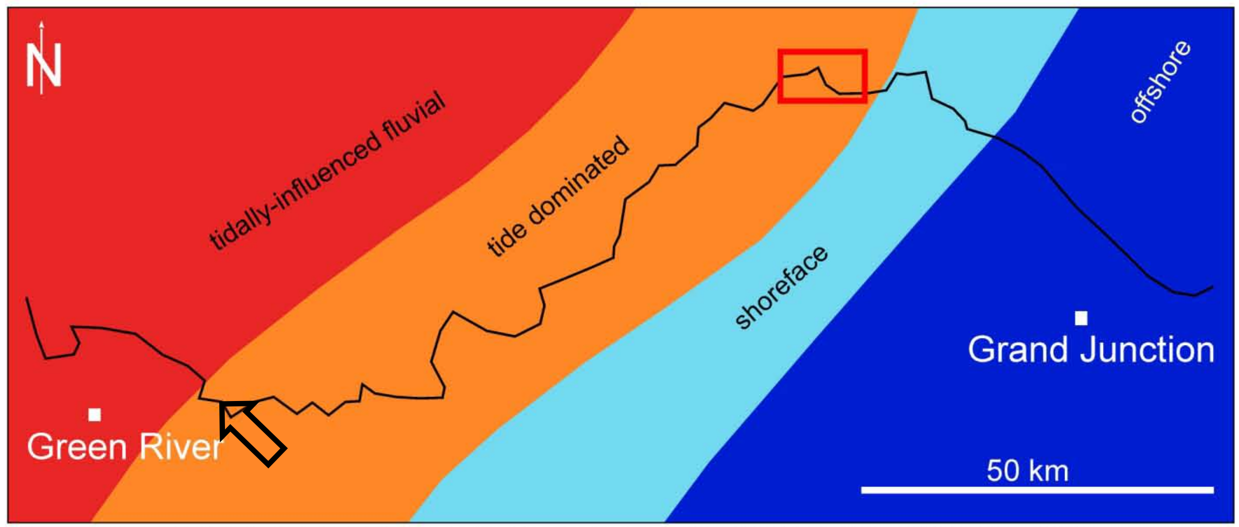
Panel 1: Introduction





Stratigraphy of the Sego Sandstone Member (after Willis & Gabel, 2001)



General facies belt distribution of the Sego Sandstone Member (modified from Wood & Yoshida, 2004)

Lower Sego Sandstone Member:

- Progradation in WIS
- Stacked siliciclastic wedges
- Study of distal part in western Colorado

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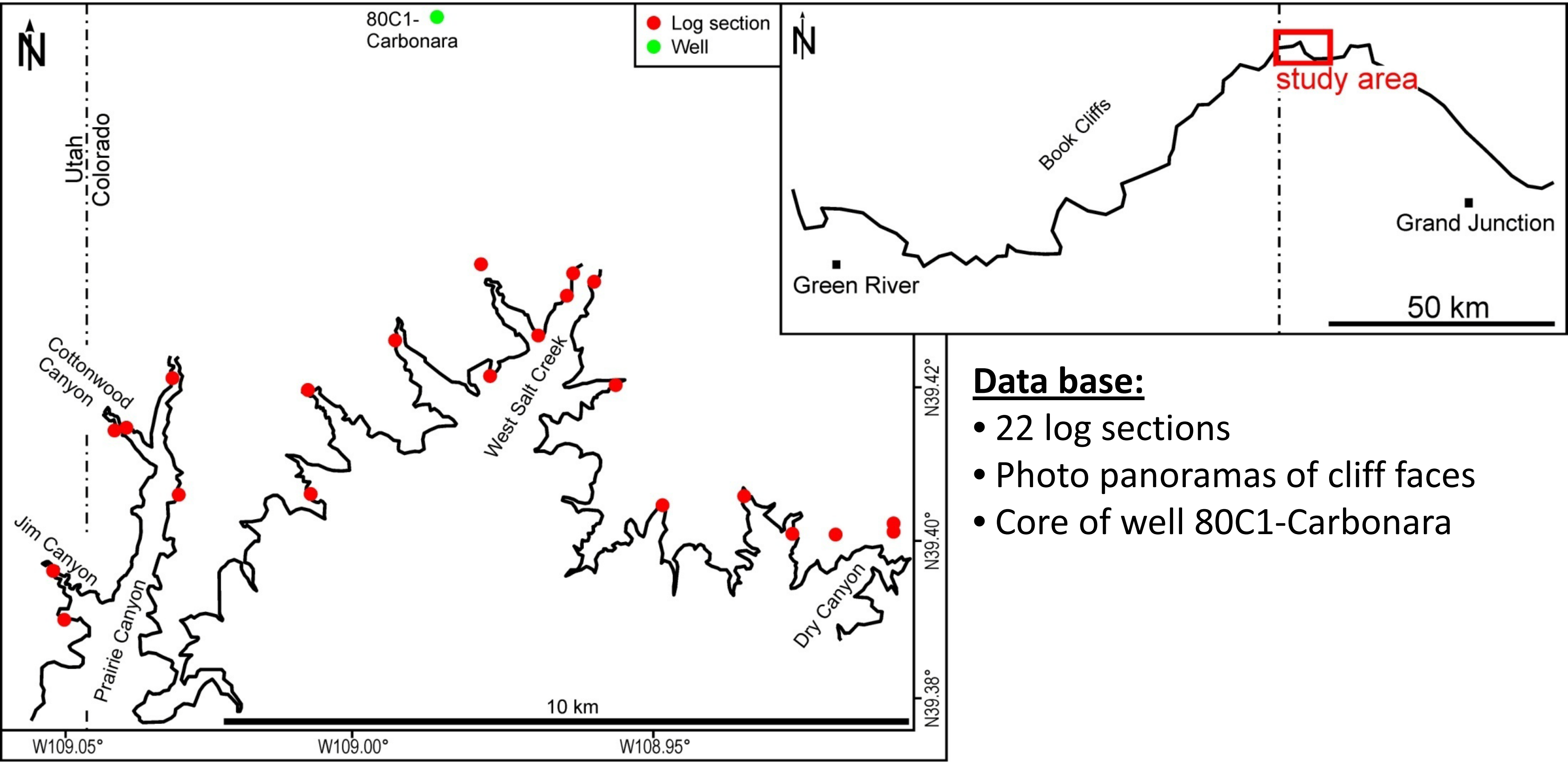
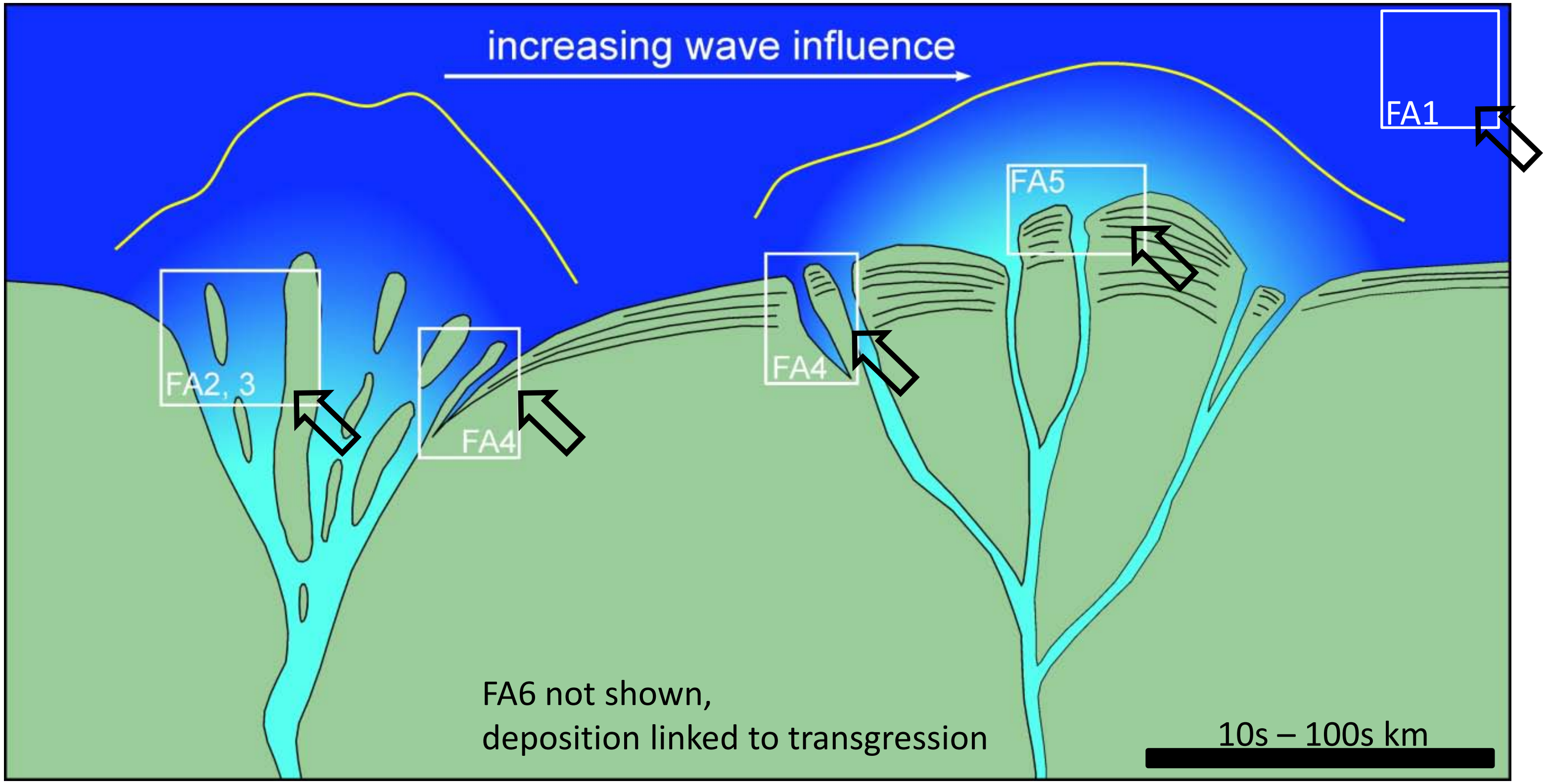
Panel 1: Introduction



Data base:

- 22 log sections
- Photo panoramas of cliff faces
- Core of well 80C1-Carbonara

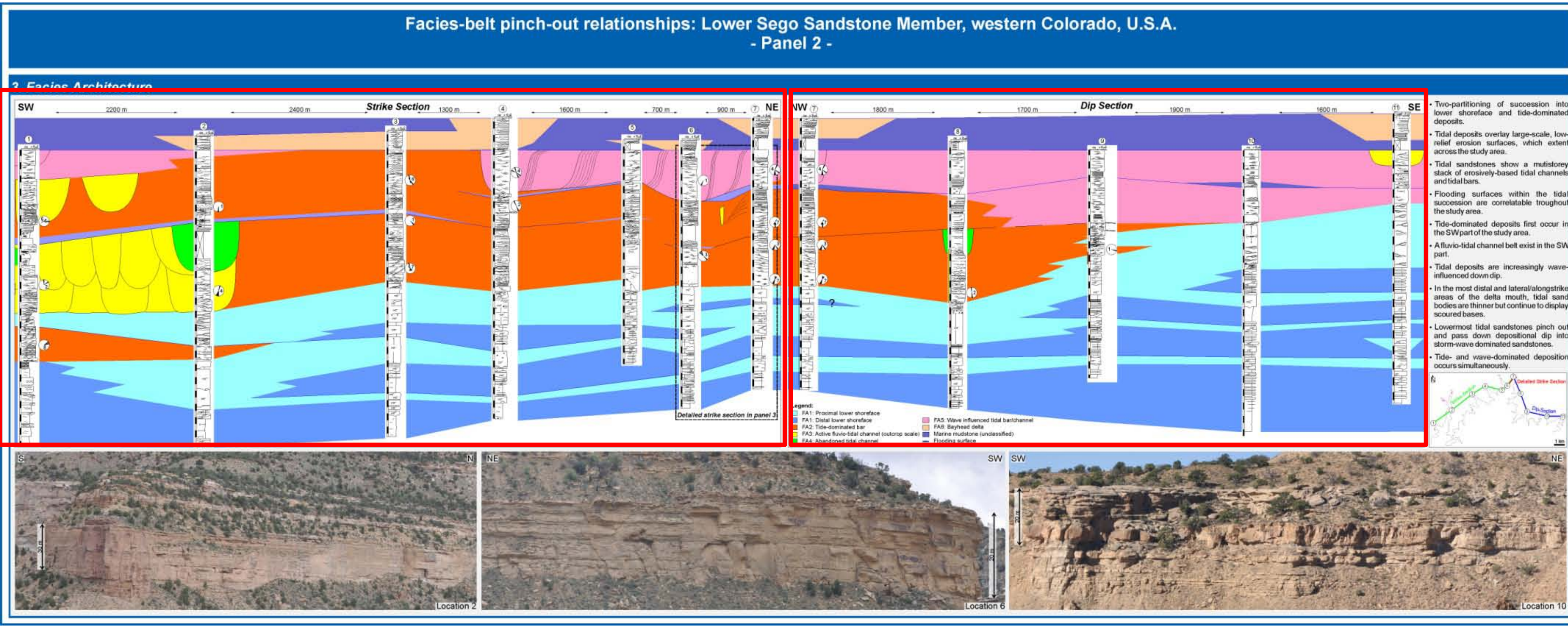
Panel 1: Facies



<u>Six facies associations:</u>

FA1: Distal to proximal lower shoreface
FA2: Tide-dominated bar
FA3: Active fluvio-tidal channel
FA4: Abandoned tidal channel
FA5: Wave-influenced tidal bar/channel
FA6: Bayhead Delta, Lagoon

Panel 2: Facies Architecture



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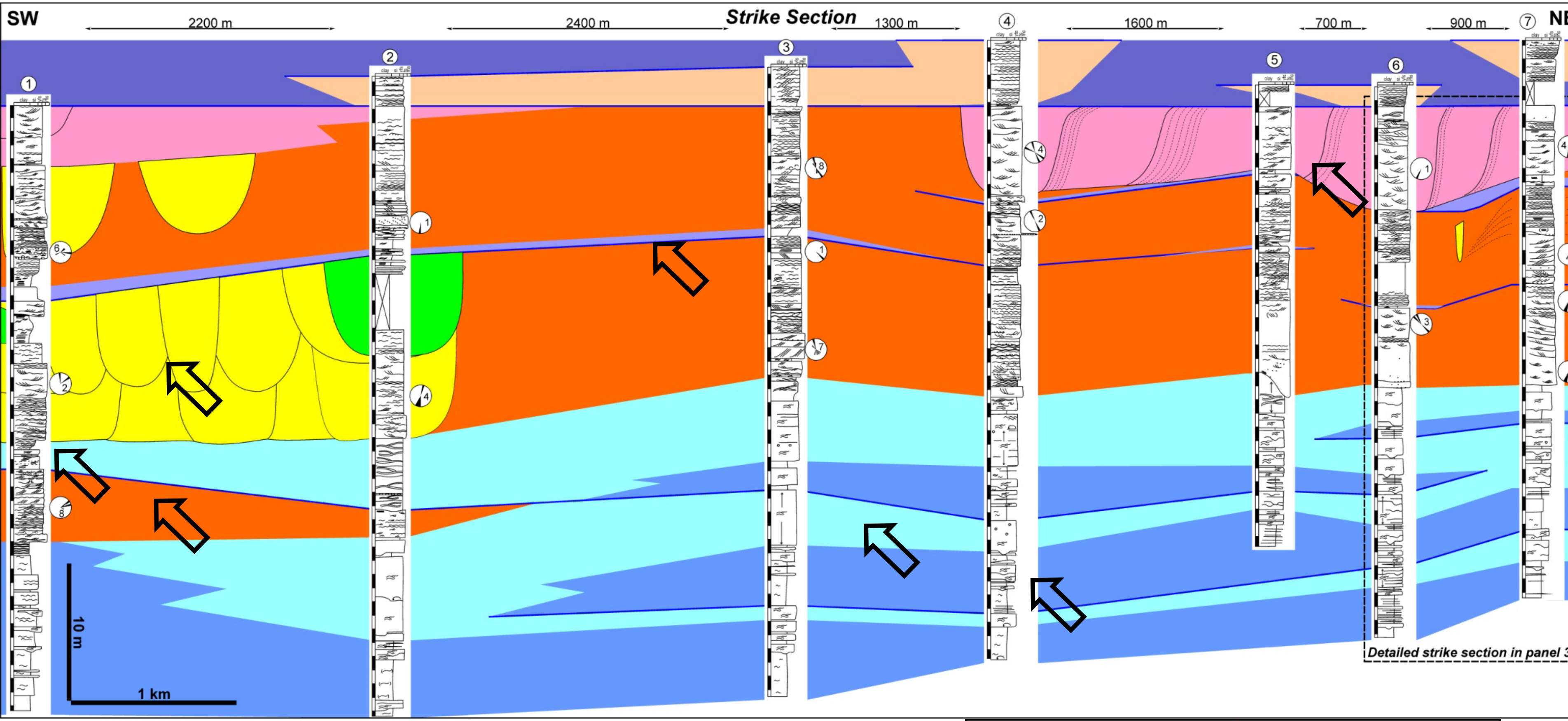
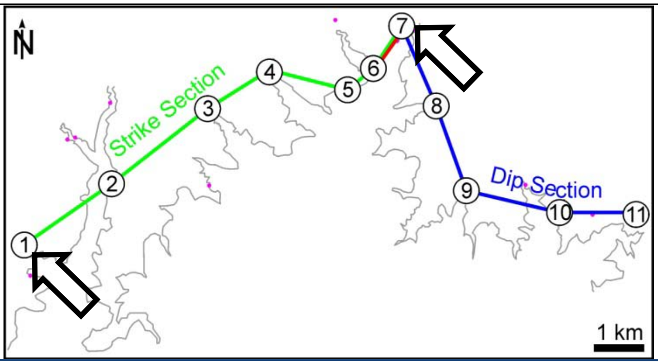
Panel 2: Strike Section



Legend:

- FA1: Proximal lower shoreface
- FA1: Distal lower shoreface
- FA2: Tide-dominated bar
- FA3: Active fluvio-tidal channel (outcrop scale)
- FA4: Abandoned tidal channel
- FA5: Wave influenced tidal bar/channel
- FA6: Bayhead delta
- Marine mudstone (unclassified)
- Flooding surface



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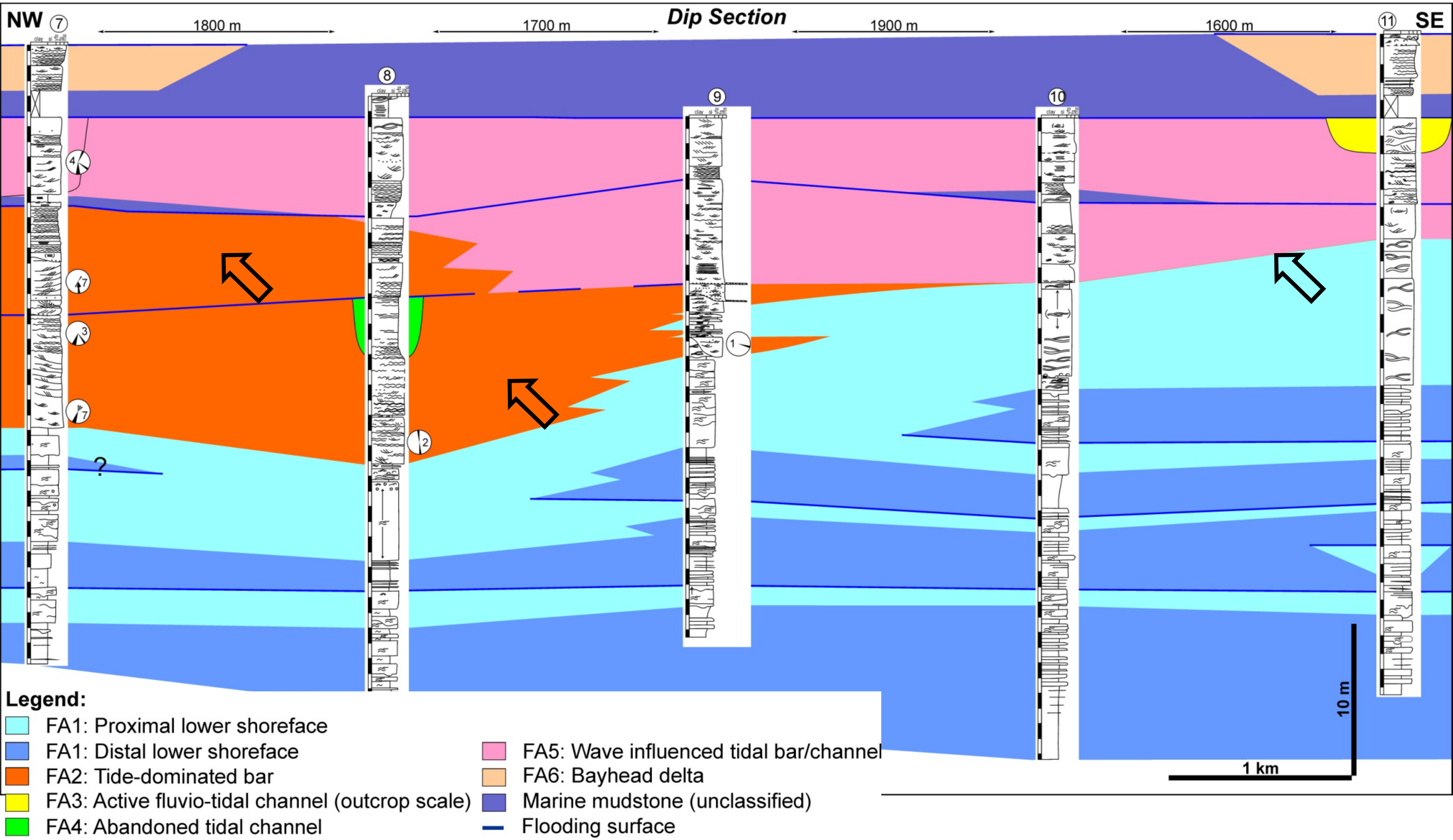
Panel 2: Facies Architecture



Legler et al. (2011): Facies-Belt Pinch-Out - Sego Sandstone, Colorado. AAPG Houston. Wednesday, 13. April 2011, 08:30-11:30 AM Booth: 6A.

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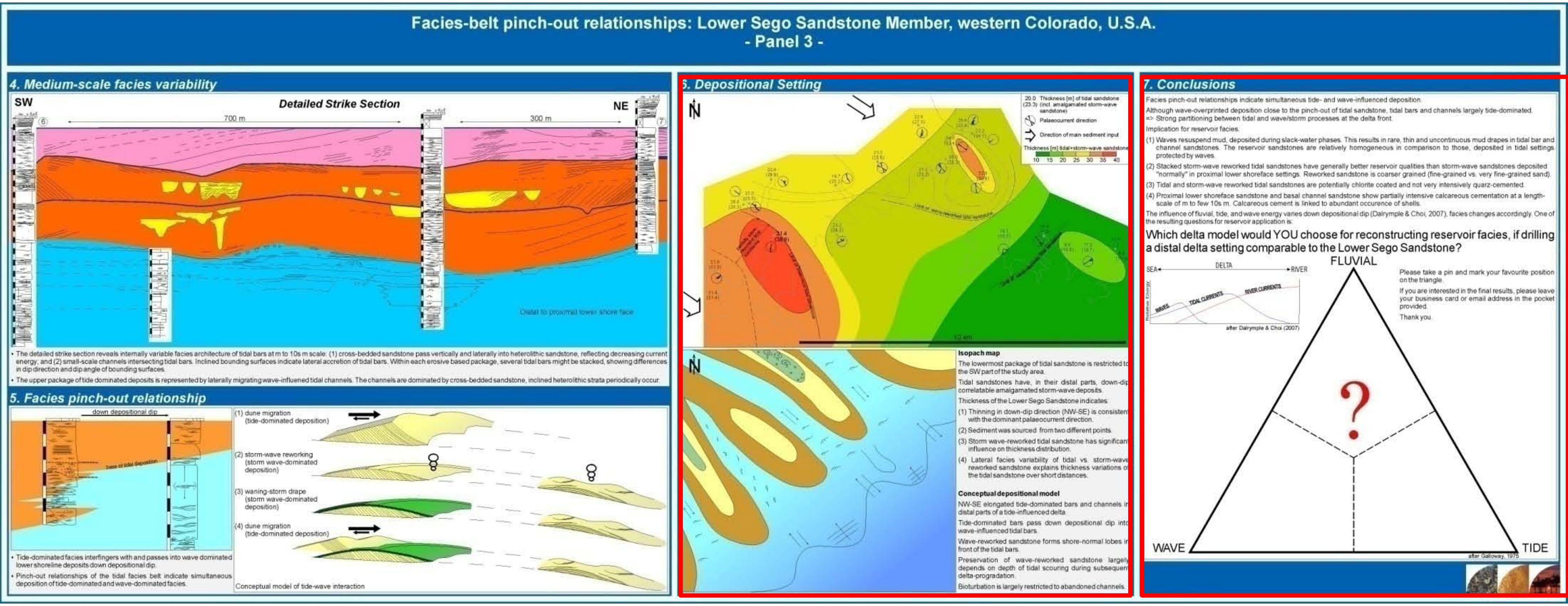
Panel 3: Interpretation & Conclusions



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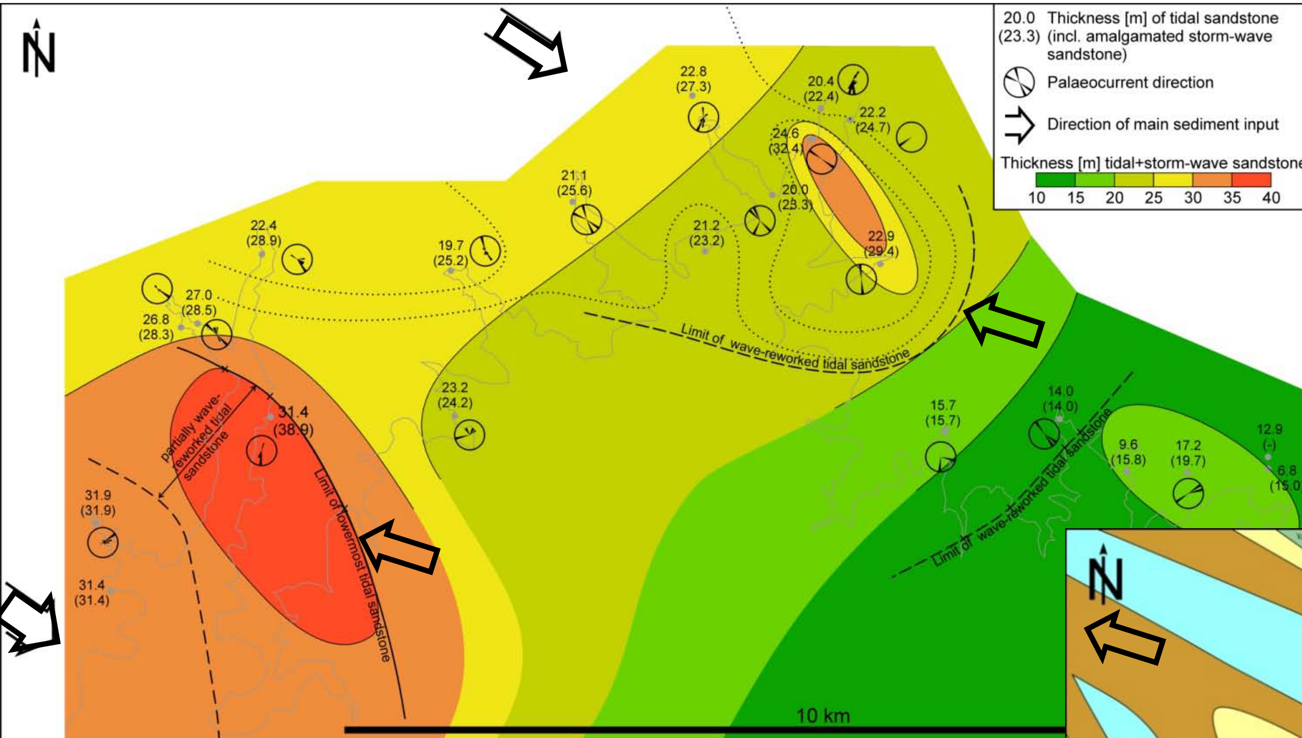
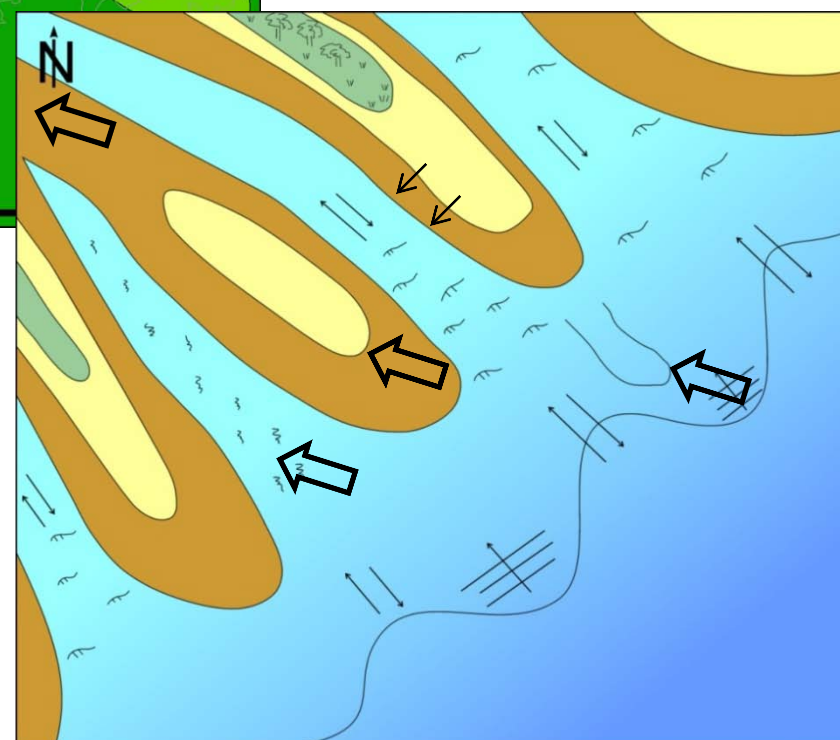
Panel 3: Depositional Setting



Isopach map:

- Two main sediment sources
- Storm-wave reworked sand significantly influences thickness
- Lateral facies variability – thickness variations over short distances



Conceptual depositional model:

- NW-SE oriented, elongated tide-dominated bars
- Down-dip transition into wave-influenced tidal bars
- Storm wave reworked sandstone forms shore-normal lobes
- Preservation of lobes depends on depth of tidal scour
- Bioturbation largely restricted to abandoned channels

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Panel 3: Conclusions

Implications for reservoir facies:

(1) Rare, thin and discontinuous mud drapes due to wave action

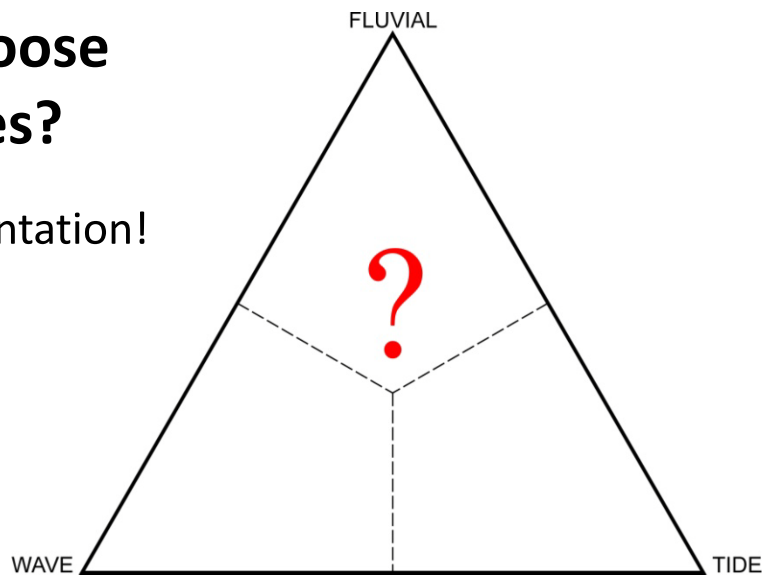
(2) Stacked storm-wave reworked tidal sandstones with better reservoir qualities than proximal lower shoreface sandstones (grain-size separation)

(3) Tidal and storm-wave reworked tidal sandstones potentially decreased quartz cement

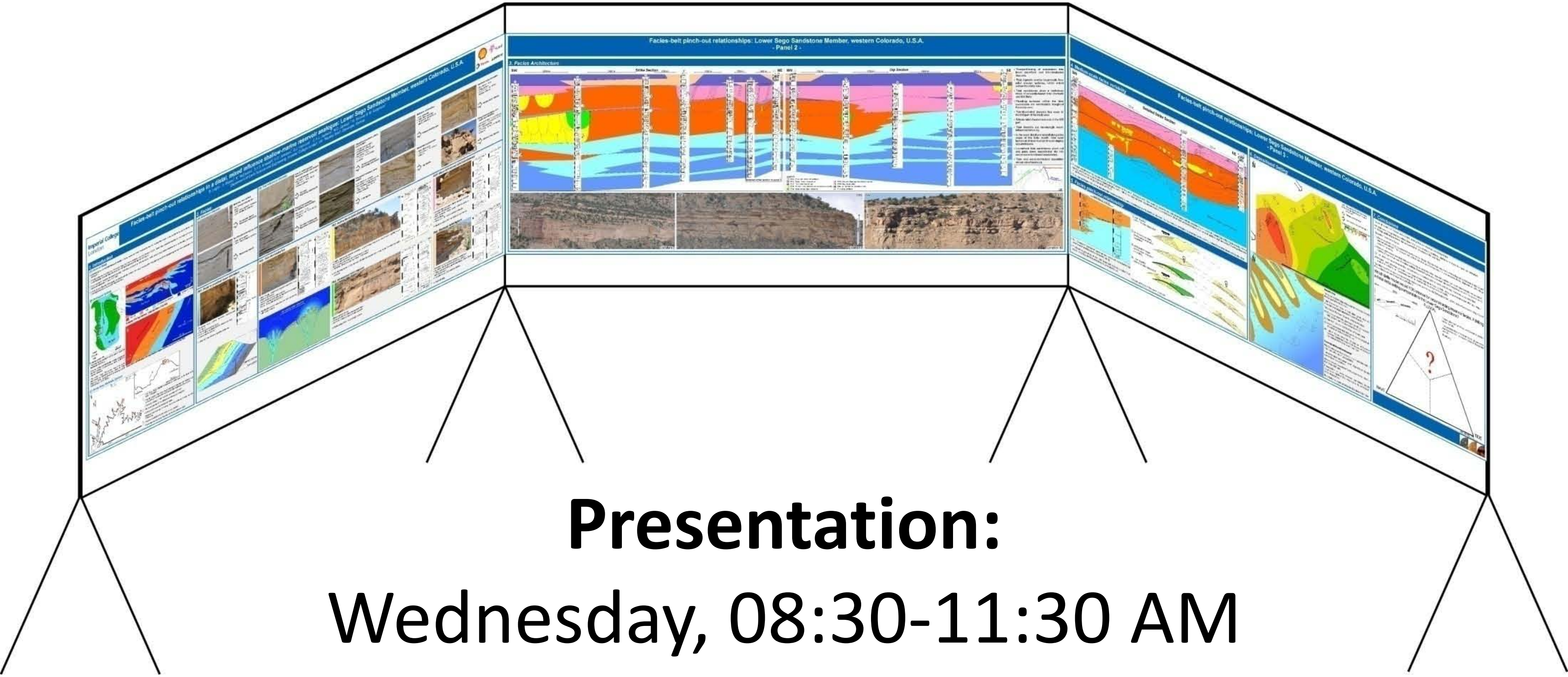
(4) Partially carbonate concretions up to a few 10s m in length

Which delta model would YOU choose for reconstructing reservoir facies?

=> Please take your pick during the poster presentation!



See you there...



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