Facies, Architecture and Compartmentalization of Basin-Floor Deposits: Upper and Middle Kaza Groups, British Columbia, Canada*

Viktor Terlaky[1], Hugues Longuépée[1], Jonathan Rocheleau[1], Lori Meyer[1], Kelsey Privett[1], Greg van Hees[1], Gillian Cramm[1], Adam Tudor[1] and R. William Arnott[1]

Search and Discovery Article #50301 (2010)
Posted August 31, 2010

* Adapted from an oral presentation at AAPG Annual Convention and Exhibition, New Orleans, Louisiana, USA, April 11-14, 2010

[1]Dept. of Earth Sciences, University of Ottawa, Ottawa, ON, Canada. (vterl078@uottawa.ca)

Abstract

Excellent exposures of basin-floor deposits of the proximal Upper Kaza Group and more distal Middle Kaza Group provide a unique opportunity to study terminal-splay/lobe deposits in the Windermere turbidite system. Although both the Upper and Middle Kaza groups are populated by similar architectural elements, including deep and shallow channels, sandy terminal-splays, and inter- and intra-splay turbidite sheets, it is the relative abundance of these elements that shows significant variation, and which, in turn, has a significant impact on reservoir continuity and compartmentalization estimates.

A major difference between the Upper and Middle Kaza groups is the greater abundance of fine-grained inter-/intra-splay turbidite sheets in the more distal Middle Kaza, resulting in an overall higher net-to-gross in more proximal deposits. Another difference is that both deep and shallow channels with rapid lateral facies changes are more common in the proximal Upper Kaza, but largely absent in the Middle Kaza. Finally, muddy debrites are absent in more distal deposits, but present in proximal strata. These differences result in better vertical connectivity (due to scouring and amalgamation), but significantly diminished lateral continuity (due to rapid lateral facies changes in channel fills) in sand-rich proximal basin floor reservoirs compared to seemingly similar sand-rich units deposited in more distal settings.

An understanding of the basic architectural elements and their relative abundance at different locations along a depositional transect is essential especially in cases where stratigraphic data are limited and seismic only resolves a “sheet like” geometry irrespective of local morphology. These 5-55 m thick seemingly self-similar units are, however, populated by different relative abundances of the smaller composite architectural elements, and thus despite their seismic similarity, may have very different reservoir characteristics based on location in the depositional system.

Reference

Ross, G.M., 1991, Tectonic setting of the Windermere Supergroup revisited: Geology, v. 19/11, p. 1125-1128, DOI: 10.1130/0091-7613

Facies, Architecture and Compartmentalization of Basin-Floor Deposits: Upper and Middle Kaza Groups, British Columbia, Canada

Viktor Terlaky*, Hugues Longuépée, Jonathan Rocheleau, Lori Meyer, Kelsey Privett, Greg van Hees, Gillian Cramm, Adam Tudor and R. William C. Arnott

Dept. of Earth Sciences
University of Ottawa, ON, Canada
*vterl078@uottawa.ca

Windermere Consortium · Anadarko Petroleum Corporation · ConocoPhillips · Chevron · devon · Husky Energy · nexen · NSERC CRSNG · uOttawa

The Windermere Supergroup (WS)

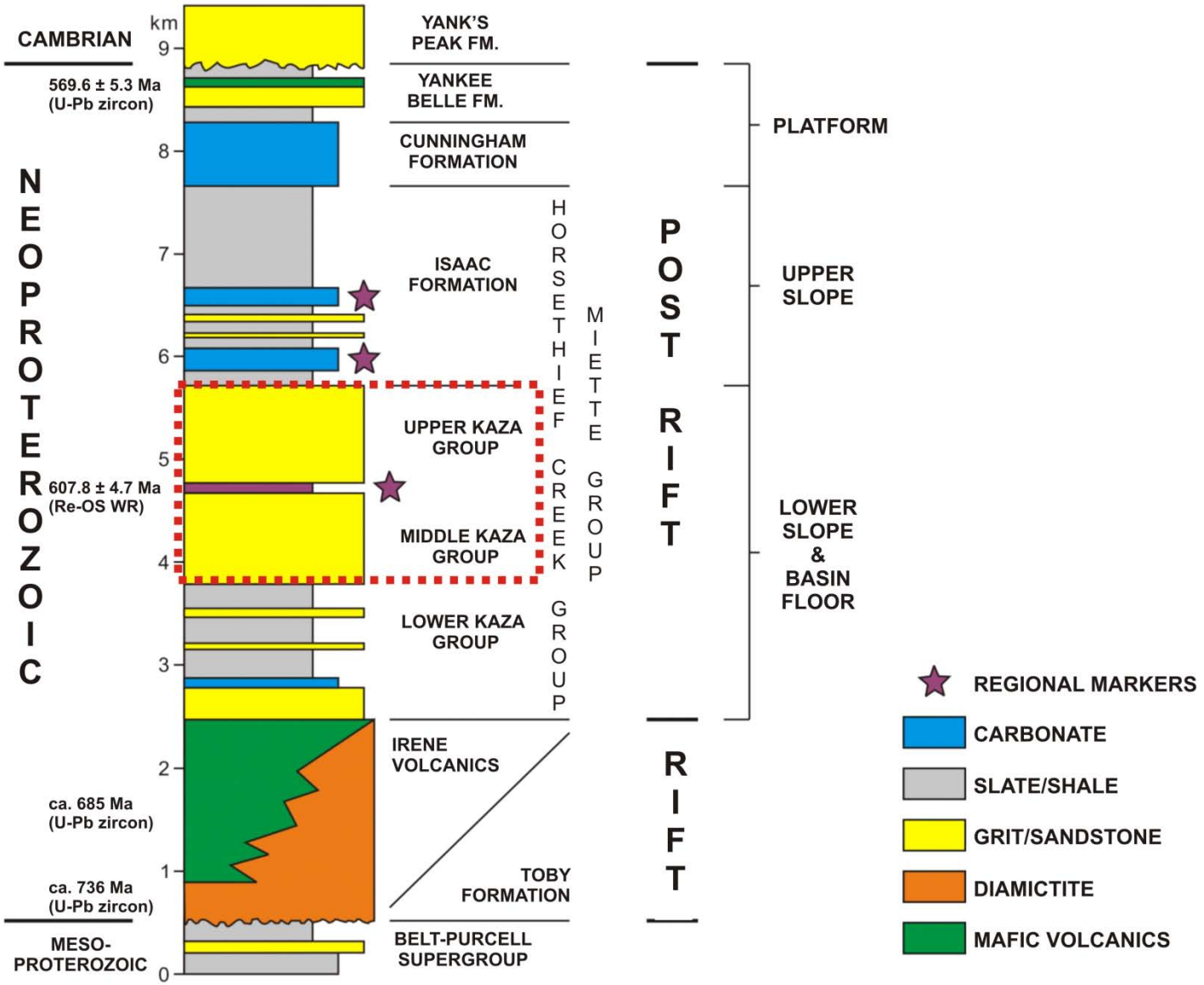
- The WS deposited on the newly developed passive margin of Laurentia during the break-up of Rodinia

- Total area of deep-water exposures in southern Canadian Cordillera: 35,000 km^2

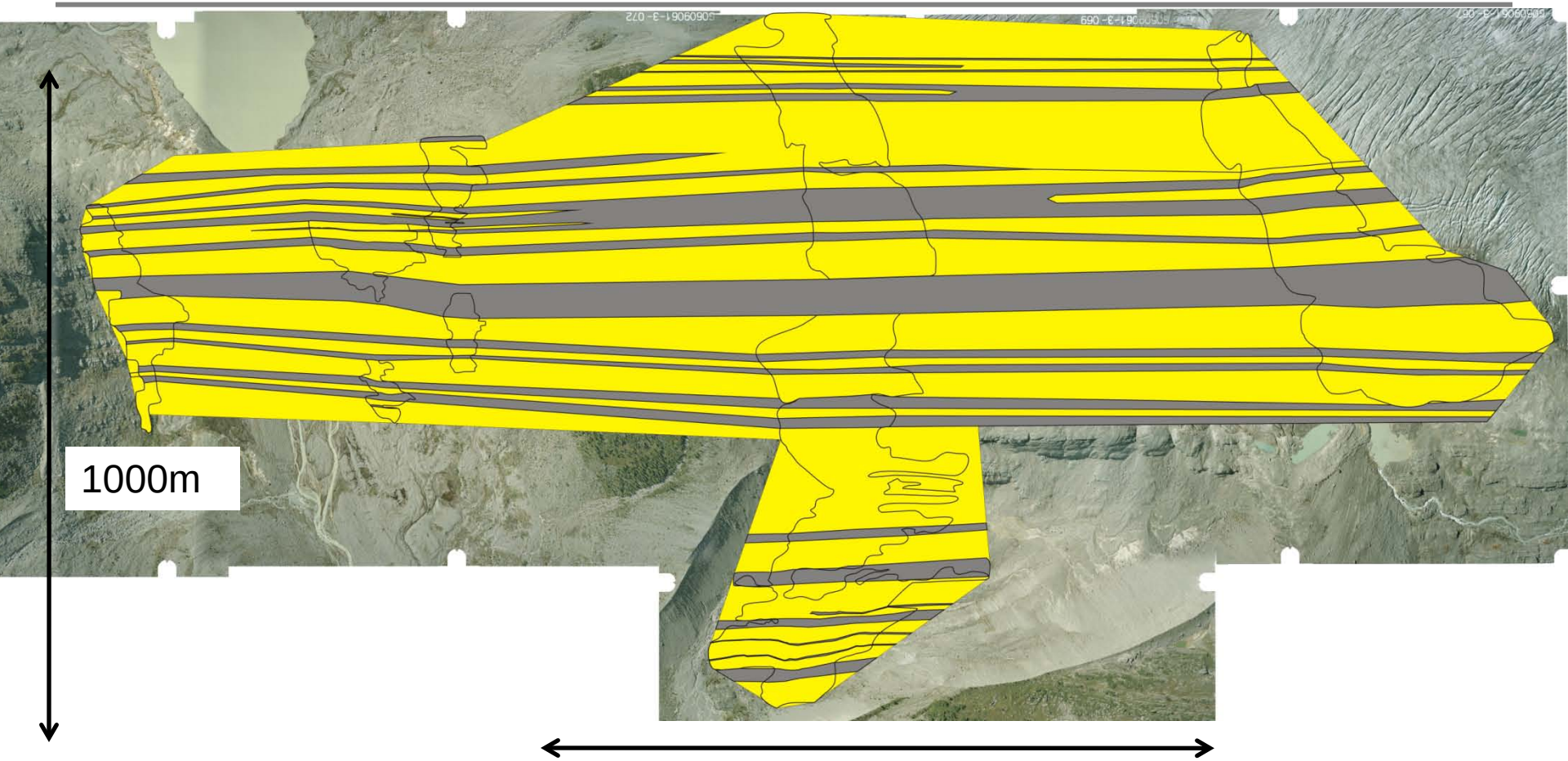
- The WS deep-water turbidite system has comparable size to modern Amazon and Mississippi fans – analogue!

Figure modified from Ross (1991)

Windermere stratigraphy



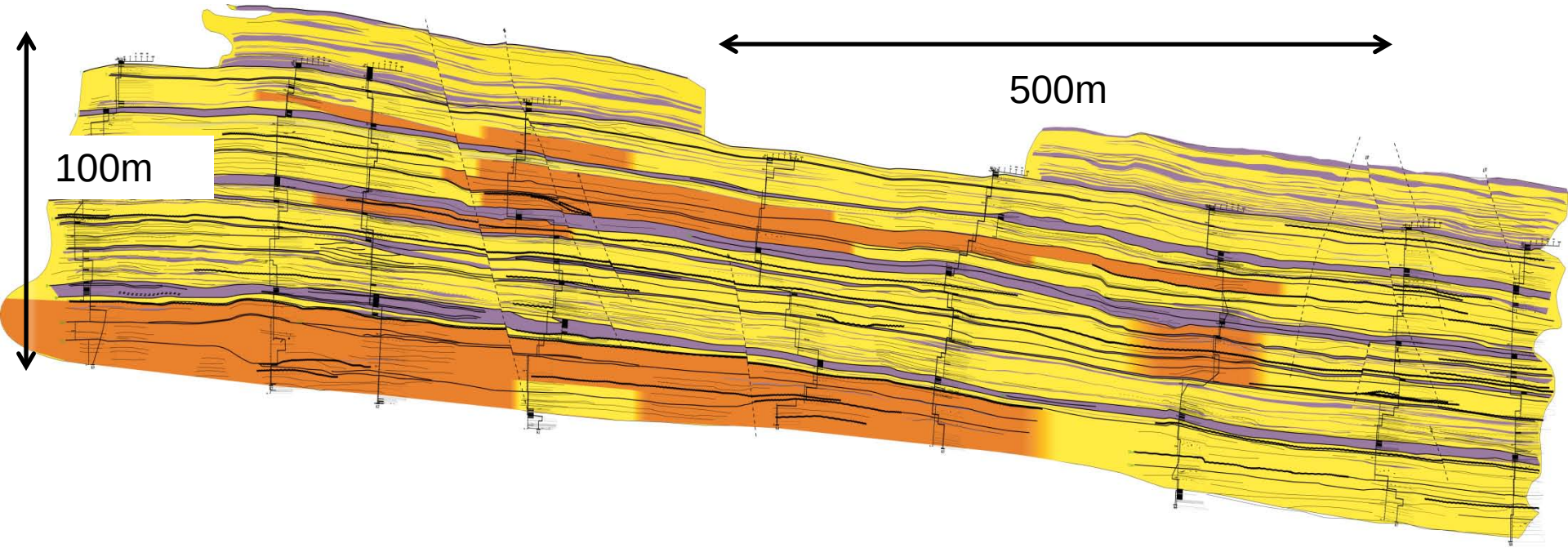
The Middle Kaza Group



Sandstone

Fine-grained units, occasionally interbedded with sst.

The Upper Kaza Group

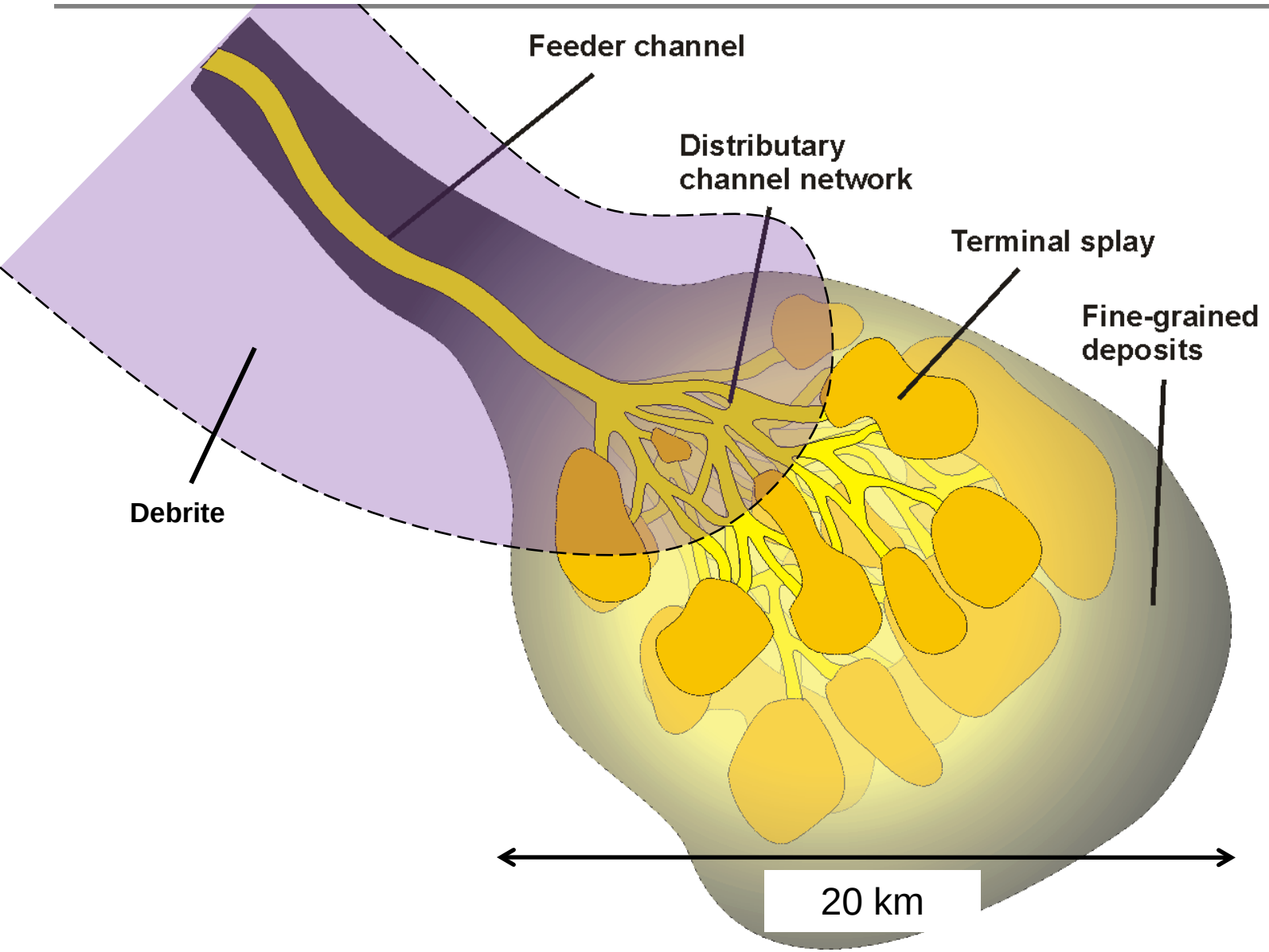


Amalgamated Sandstone

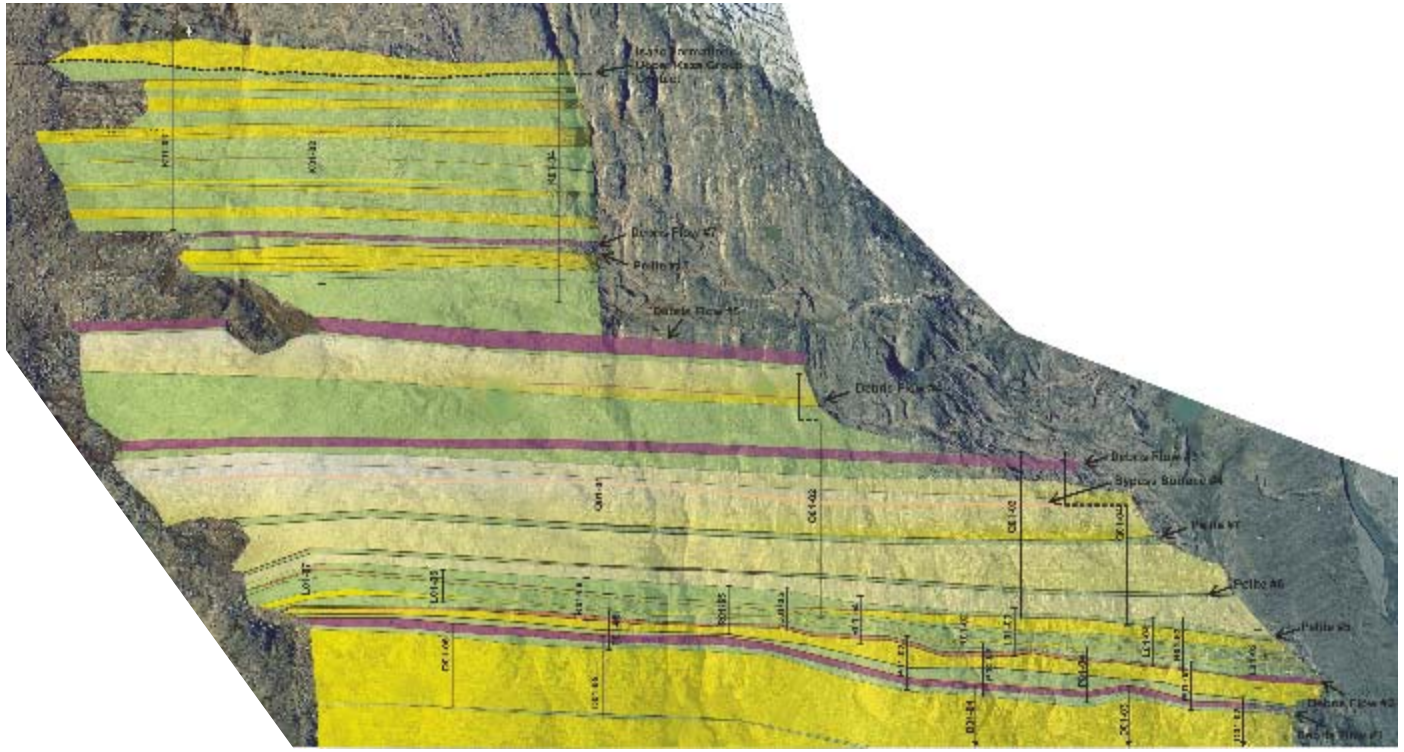
Graded Sandstone

Fine-grained units, occasionally interbedded with sst.

Architectural elements

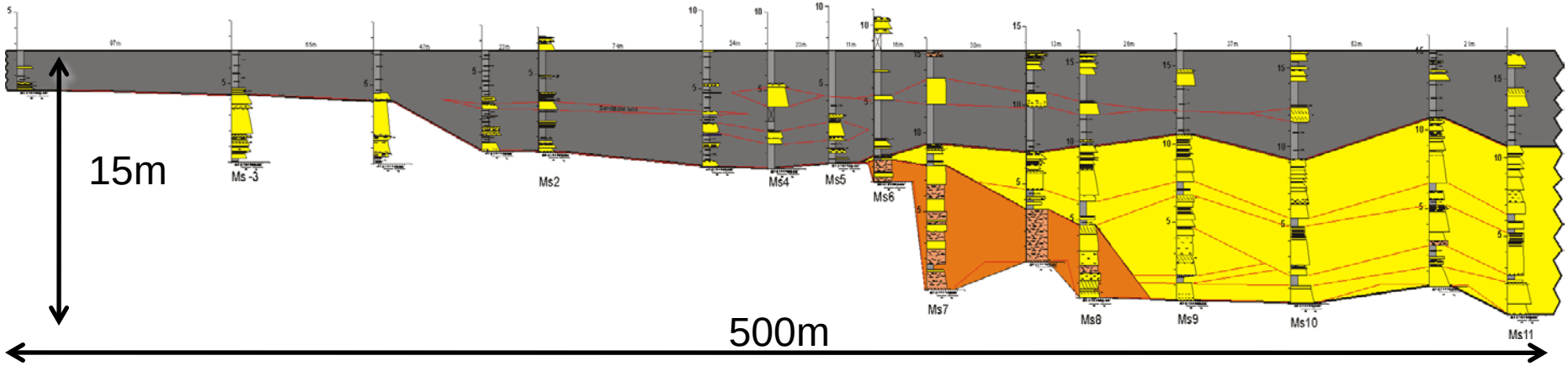


Debrites



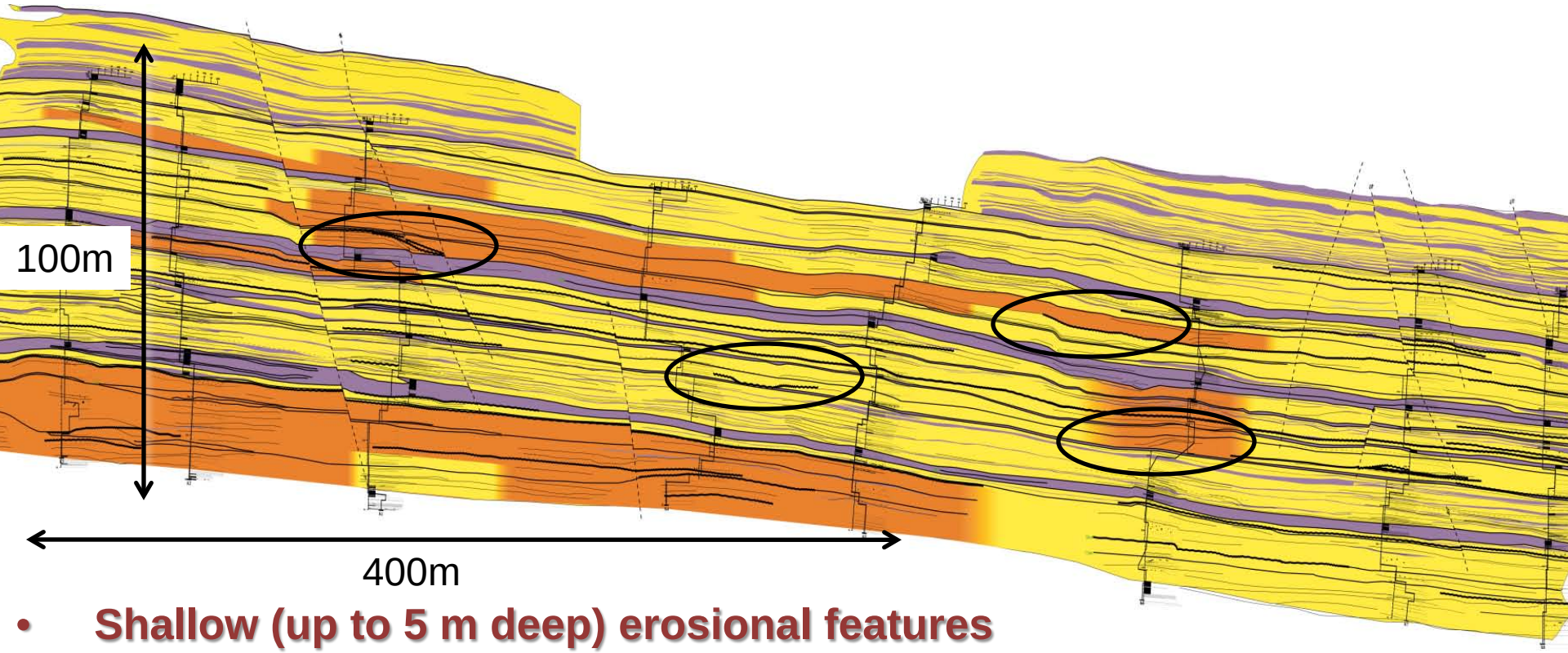
- **Purple: mud-rich chaotic facies**
- **Laterally continuous units, upward thickening trend**
- **Only observed in the Upper Kaza**

Feeder channels



- Several episodes of erosion and fill
- Orange: bypass facies – mudclast breccia and dune cross-stratified sandstone, abundant scouring
- Yellow: fill facies – med. bedded turbidites and siltstones, limited scouring
- Gray: abandonment facies – siltstones and few sandstone interbeds, limited scouring
- Only observed in the Upper Kaza

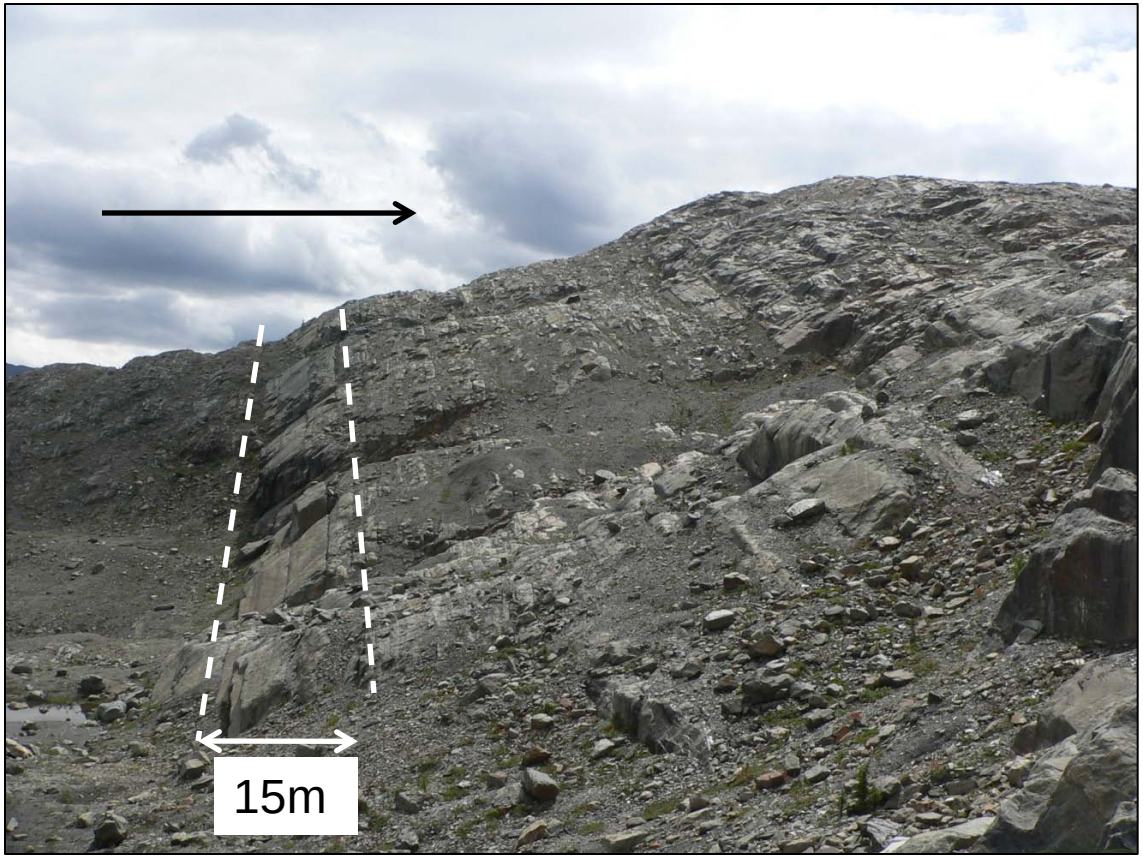
Distributary channels



- Shallow (up to 5 m deep) erosional features
- Coarse sand and bypass facies in depositional axis
- Fining and thinning towards margins
- Common in the Upper Kaza, rare in the Middle Kaza

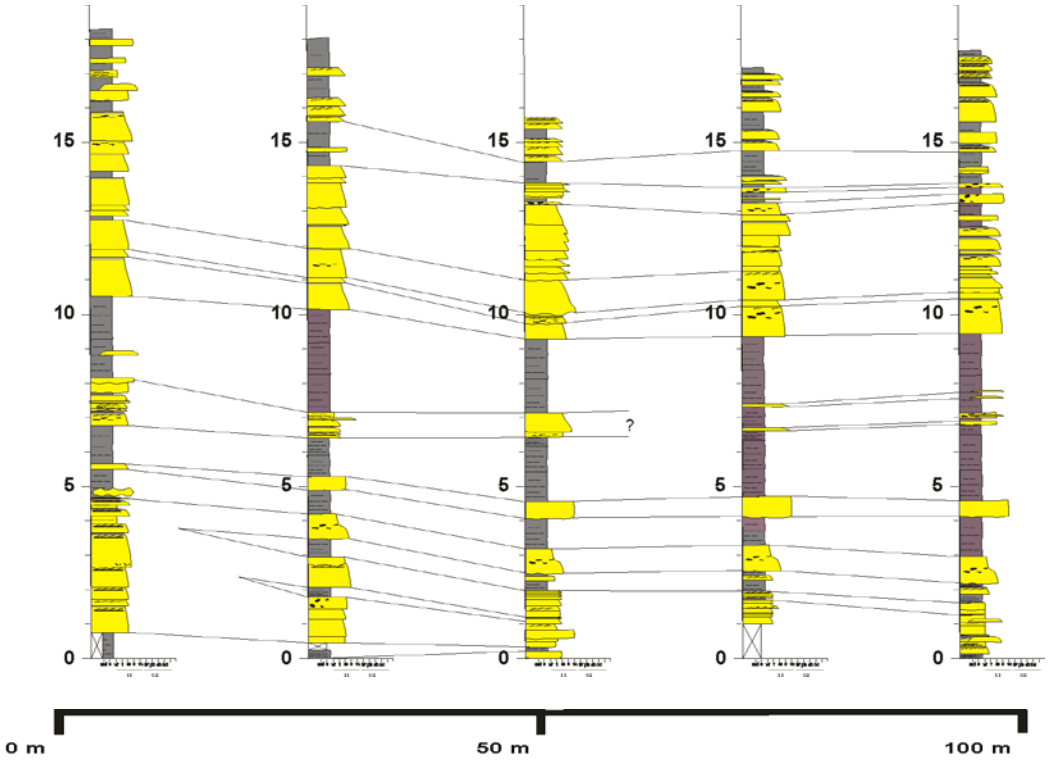
Terminal splays

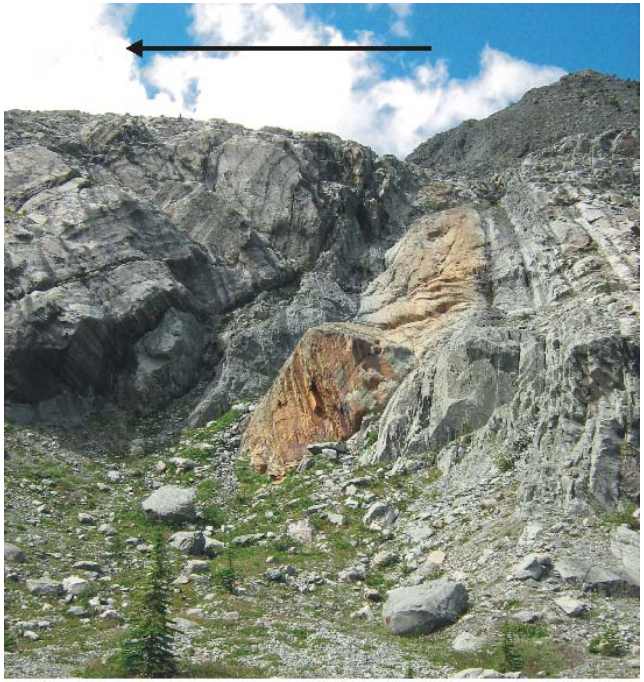
- Common in both outcrops, but more abundant in Middle Kaza
- Coarse-grained amalgamated sandstone in depositional axis, continuous for 100's of meters



- Rapid fining and thinning of beds over a distance <100 m near the margins

Fine-grained units



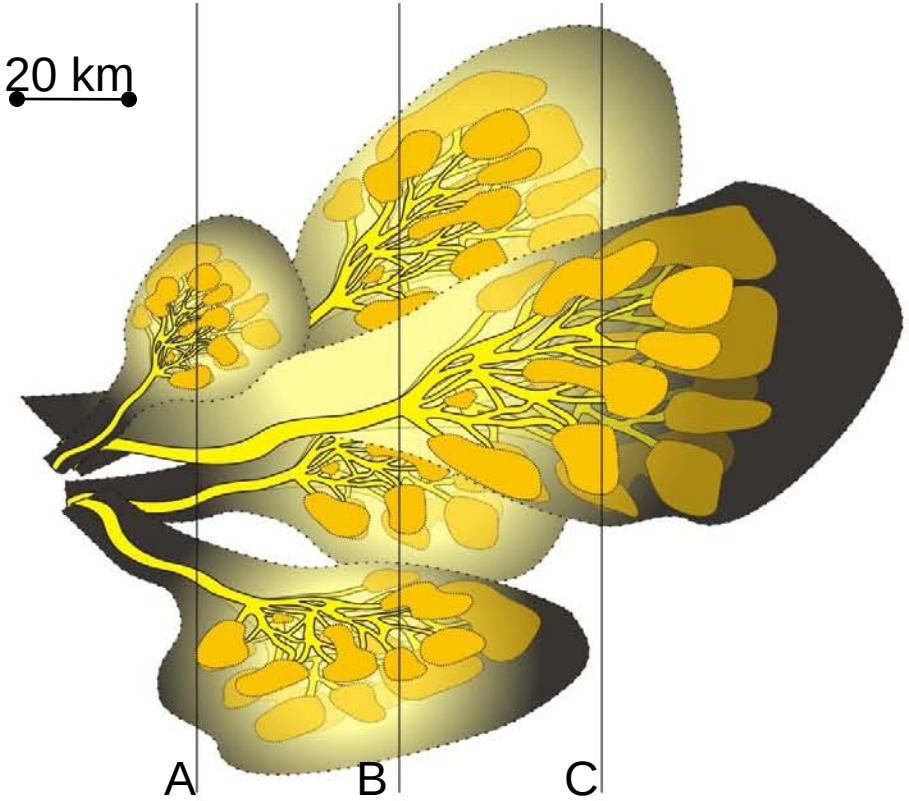


- In both outcrops, but thicker and more continuous in Middle Kaza
- Thin to medium-bedded fine-grained T_{cd} turbidites
- Two end-members: with sandstone interbeds (left) and no sandstone interbeds (right)

Differences between the U. and M. Kaza

	Upper Kaza	Middle Kaza
Debrites	Present, upward thickening trend	Absent
Scours/channelization	Abundant	Rare
Fine-grained deposits	~30% of rock volume, discontinuity due to scouring not rare	~50% of rock volume, laterally continuous units
Terminal splay sheet sands	Present	Abundant

Depositional model

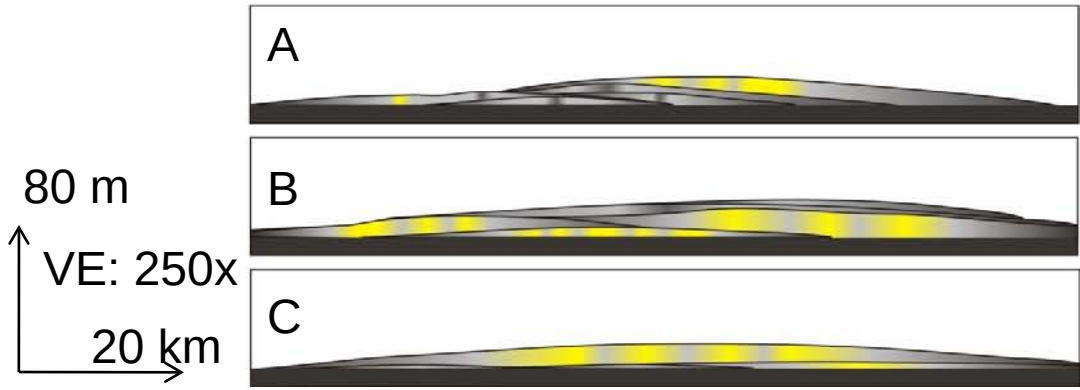


Lithology in cross-sections

- Coarse sandstone
- Heterolithic channel fill
- Lateral gradational change from coarse sandstone to fine-grained deposits

Architectural elements

- Channel elements
- Splay elements
- Thickness of lobe deposit and grain size change



Windermere Consortium · Anadarko Petroleum Corporation · ConocoPhillips · Chevron · devon · Husky Energy · nexen · NSERC CRSNG · uOttawa

Conclusions: reservoir continuity and connectivity

- Similar architectural elements in both the Upper and Middle Kaza, but their distribution and abundance differs
- Upper Kaza more proximal than Middle Kaza
- Upper Kaza better vertical connectivity, but poor lateral continuity
- Middle Kaza poor vertical connectivity, but better lateral continuity