The Bitumen Bearing McMurray Formation: Description Of Reservoir Units In A Large Fluvio-Estuarine Setting From The Athabasca And Christina Rivers Outcrops (Alberta, Canada)

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TOTAL

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Objectives and outline of this outcrop study presentation

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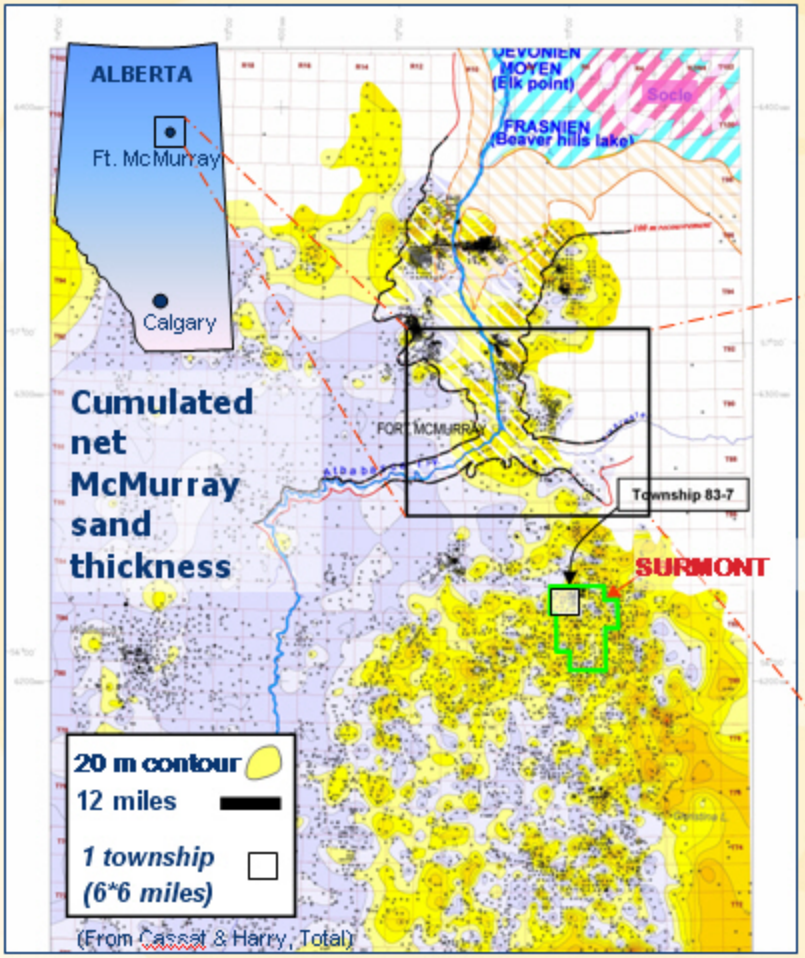
Objectives:

- ✓ To present the geometrical variations of the McMurray channels along a North-South depositional axis,
- ✓ To detail some of the sedimentary facies along point bars (I H S, Inclined Heterolithic Stratifications)

Outline:

- ✓ Outcrop locations and stratigraphic setting of the McMurray Fm
- ✓ Geometry, architectural style and facies of the Middle McMurray Fm channels
- ✓ Brief comparison with the Upper McMurray Fm channels
- ✓ Conclusions

Location of the presented outcrops



Middle McMurray outcrops

Upper McMurray outcrops

Schematic stratigraphic framework of the McMurray Fm

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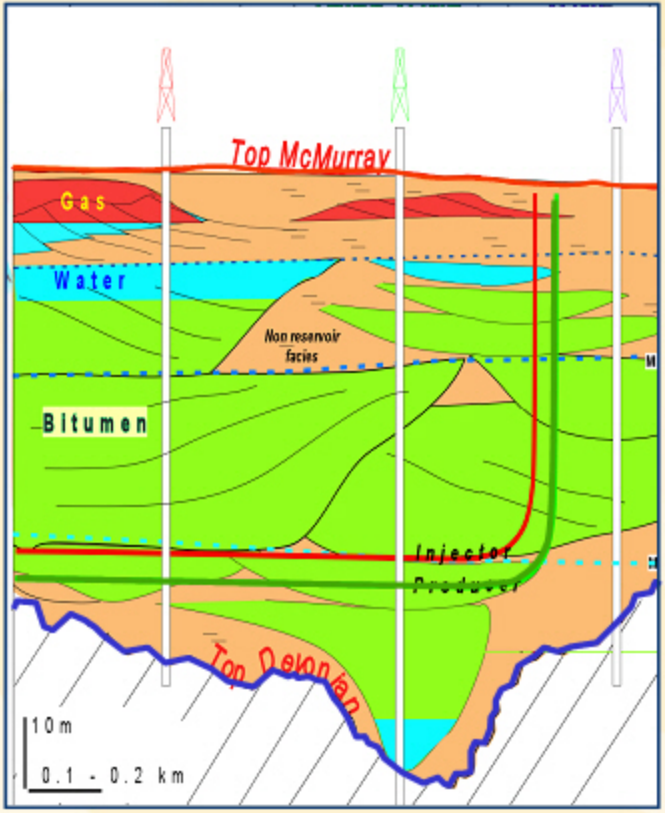

Offshore to shoreface		Wabiskaw Mbr	ALBIAN
Fluvio-estuarine	Upper	McMurray Fm	ALBO-APTIAN
	Middle		
	Lower		
Green marls and cabonates			DEVONIAN

Regional stratigraphic architecture of the McMurray Fm

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Surmont area

N

S

McMurray Fm

V.H Estuarine

Outer estuarine

Very High Estuarine

Fluvio-lacustrine

Fluvial

Proximal

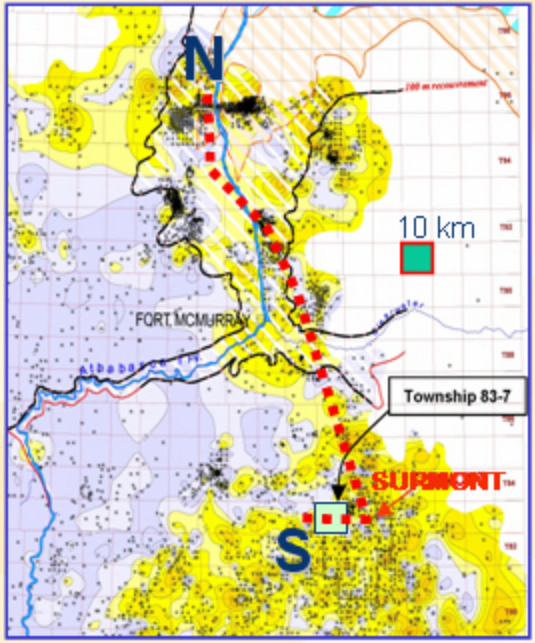
Fluvio- lacustrine to fluvial

Pre McMurray Reworking

Devonian carbonates

(modified from Hein et al., 2001)

Distal



This regional stratigraphic framework is the result of the palynological analysis of 20 wells. Units are clearly landward stepping (transgressive trend)

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The McMurray Fm – a large fluvio esturine environment

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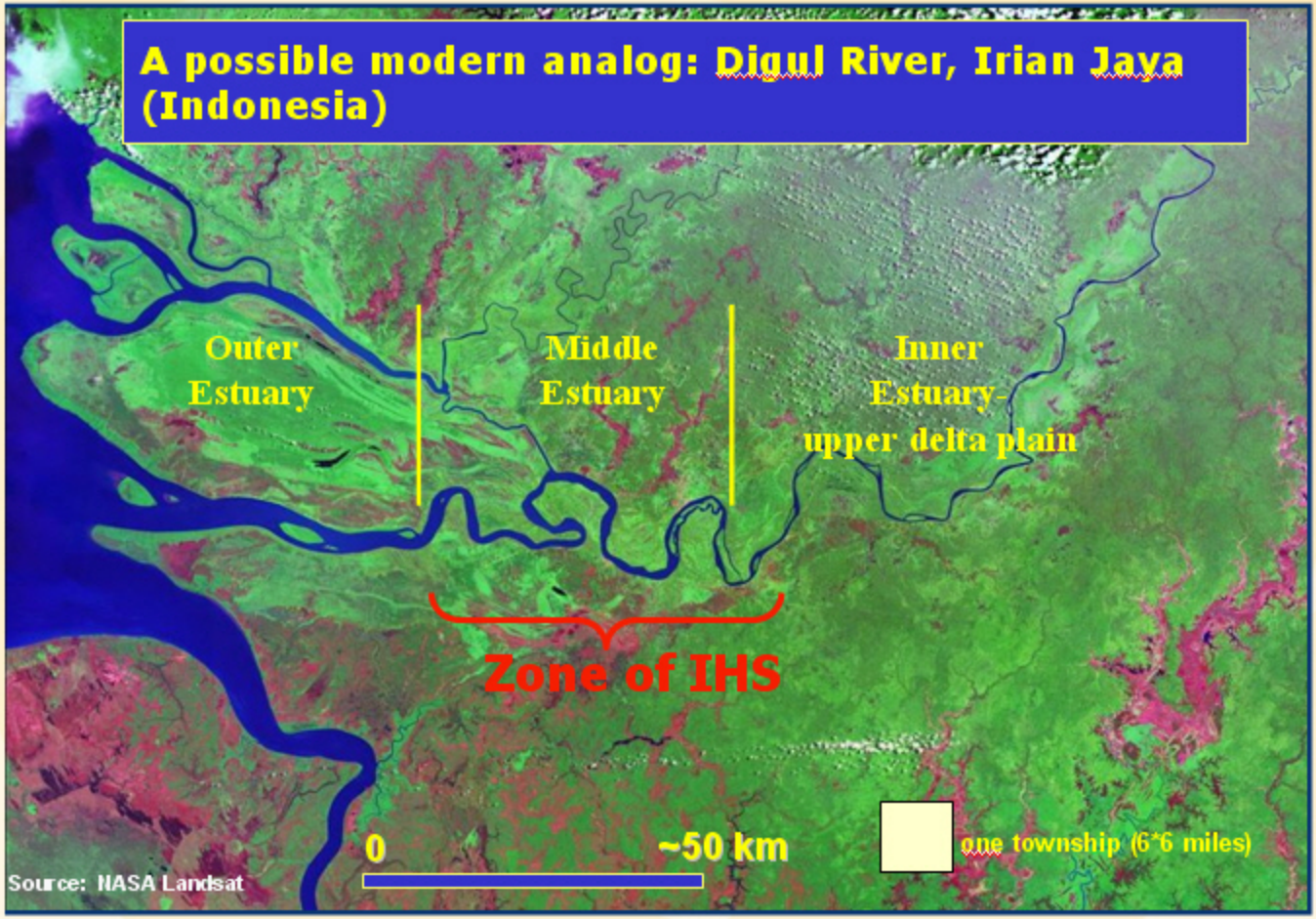

Middle McMurray, lower delta plain setting, (outer to) middle estuary

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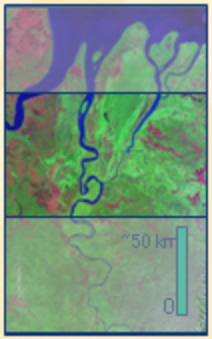
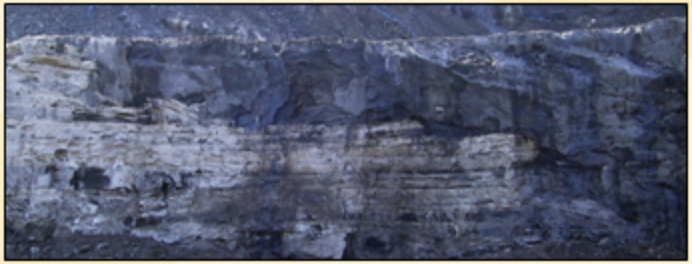
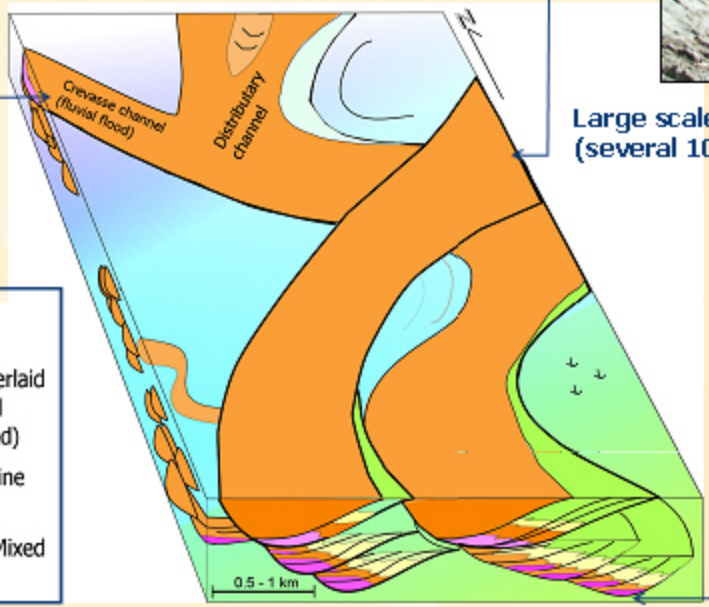


Lower delta plain, inner estuary



Erosive crevasse channel (~ 15 m)

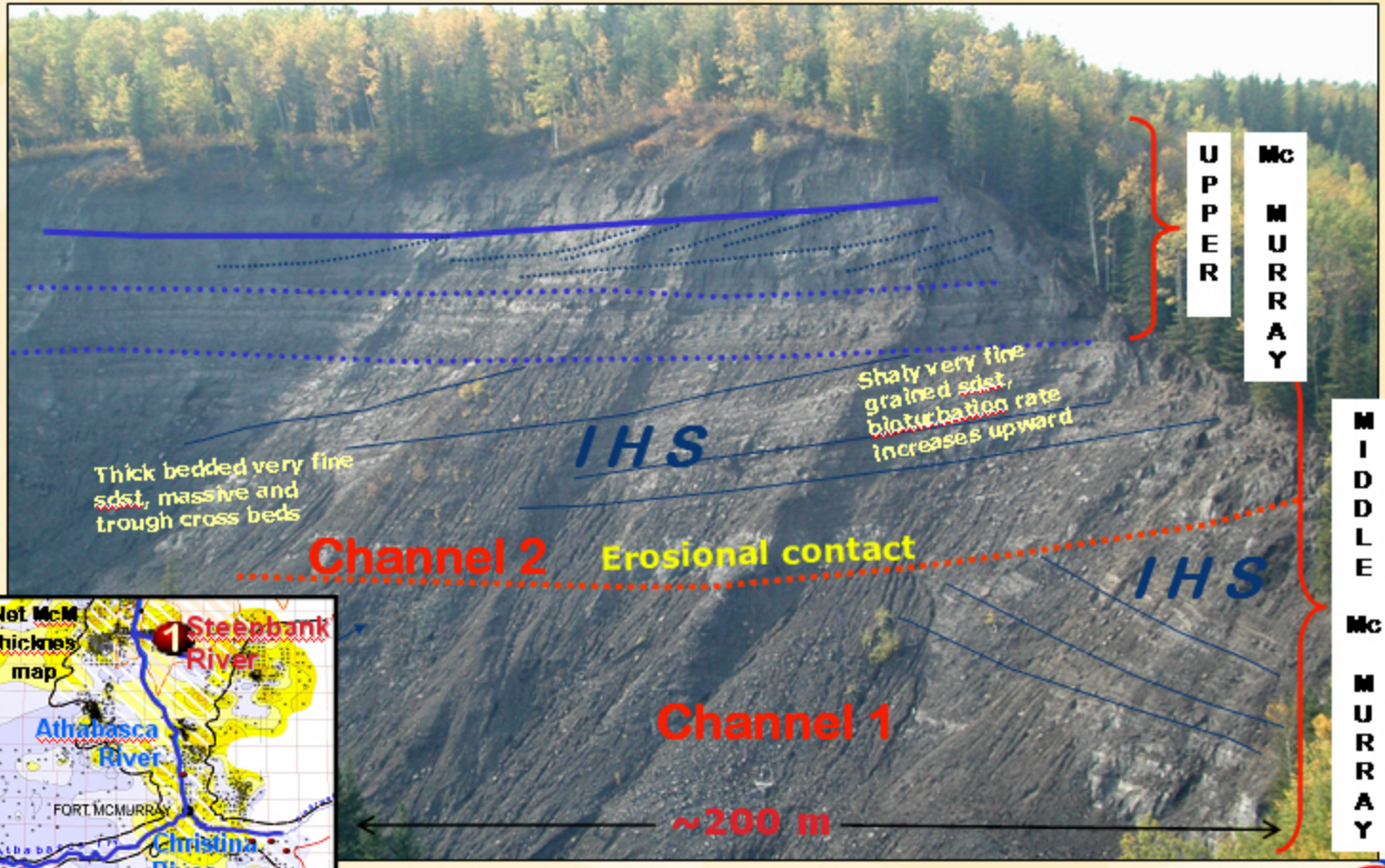
Large scale point bars (several 100s m)



- Mudstone breccia
- Massive sandstones overlaid by trough cross bedded sandstones (fine grained)
- Climbing ripples (very fine grained)
- Upper delta plain to Mixed sand/mud flat

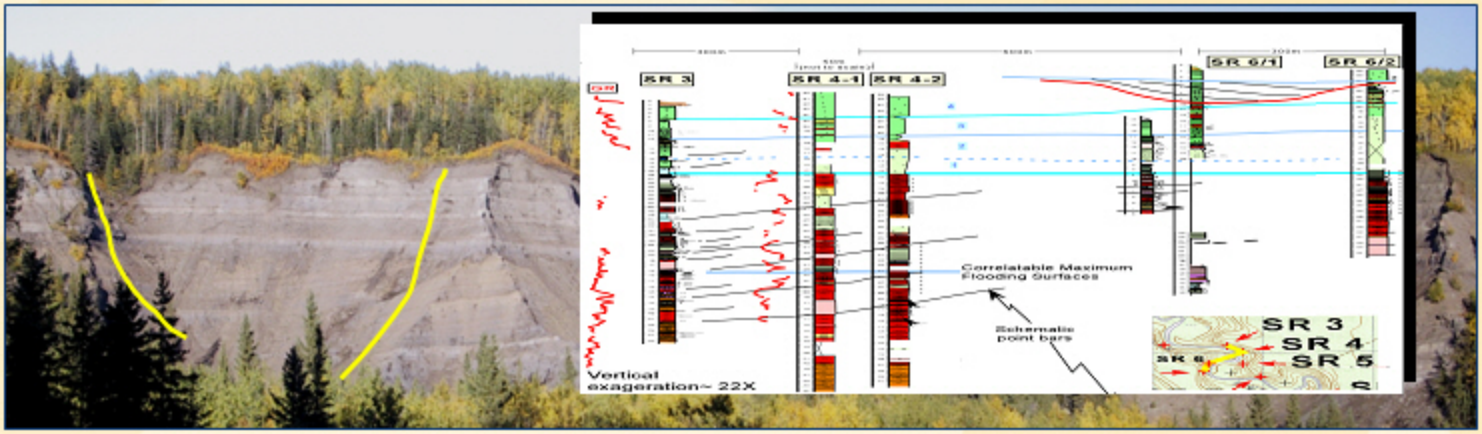
Mudstone breccia at the base of channels

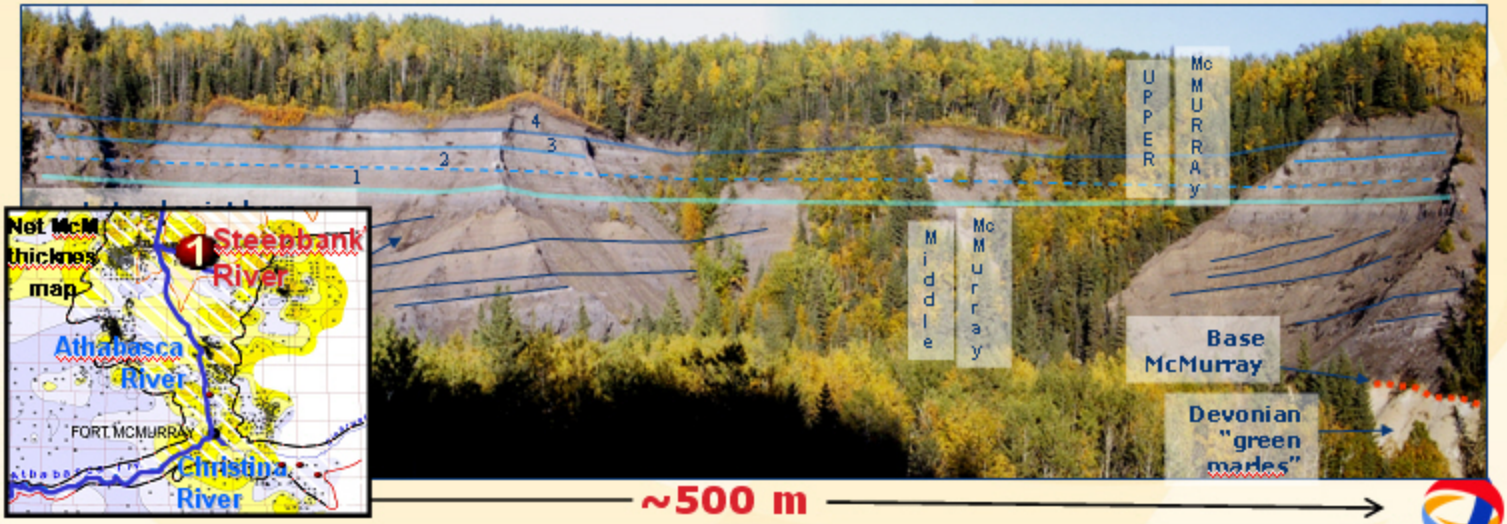
Middle McMurray: outcrop #1
Steepbank River – channel geometry



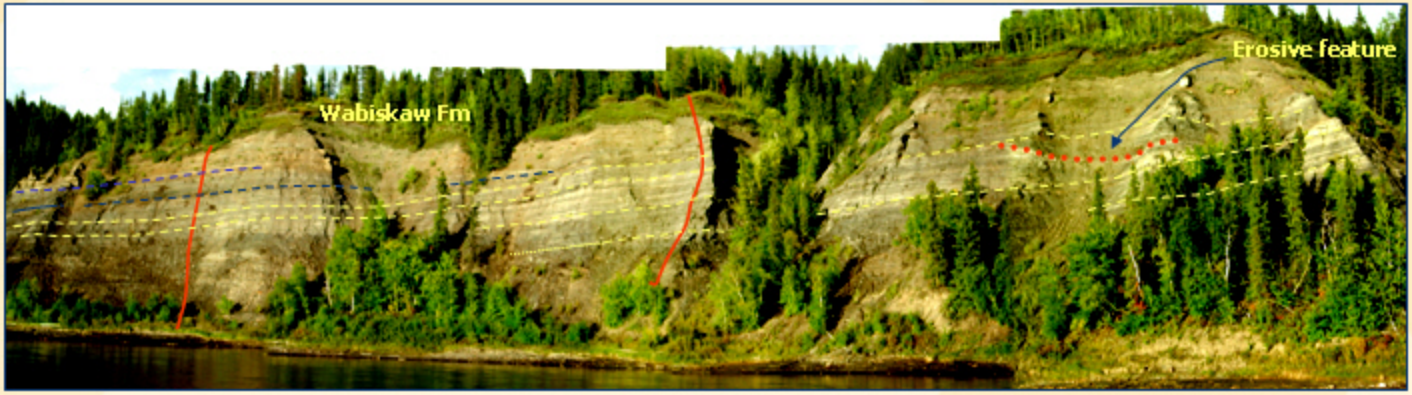
Middle McMurray: outcrop #1
Close up on a point bar (I H S)

Middle McMurray: outcrop #1'
Steepbank River – stratigraphic interpretation

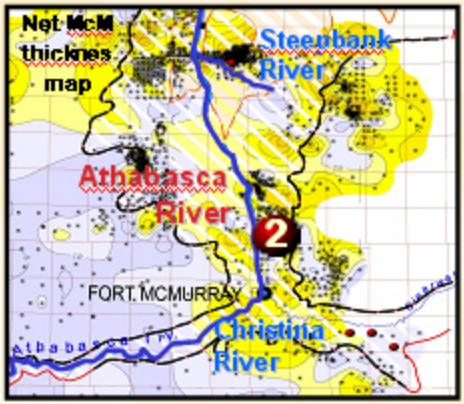




Middle McMurray: outcrop #2- channel geometry showing the size of the I H S

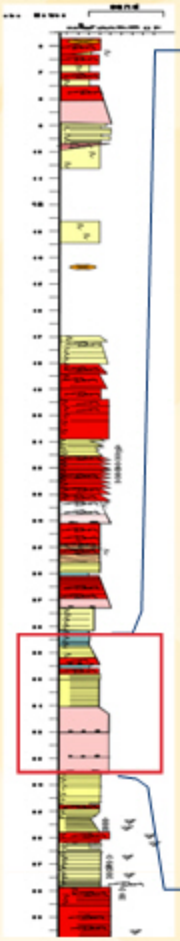


> 500 m



Lateral point bars are physically correlatable over more than 1km → channel width was at least 1km

Middle McMurray: outcrop #2- Close-up on fining-up I H S bed sets (1)

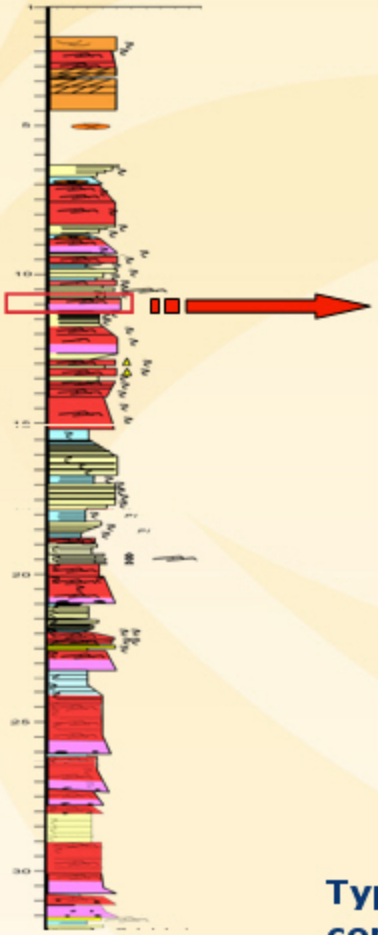


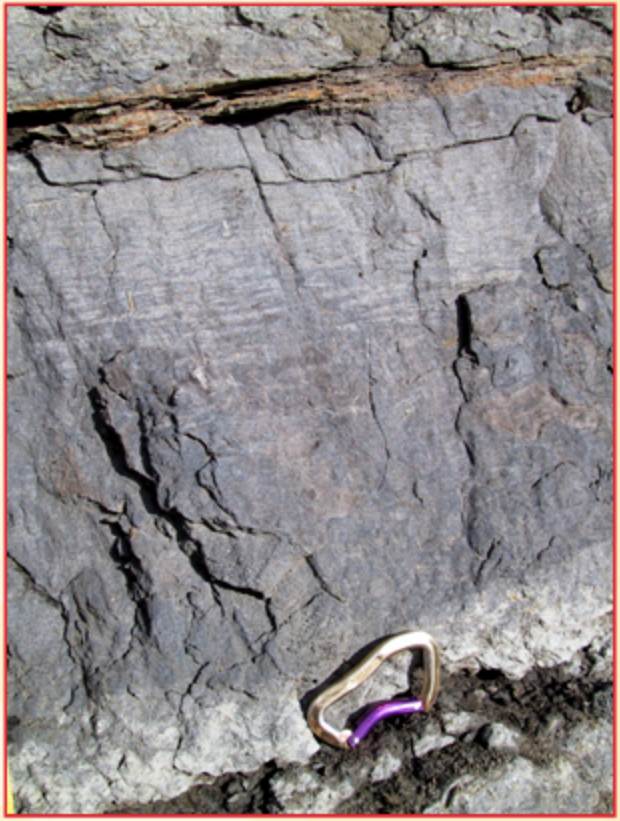
Top

- Laminated silty shale
- Very fine to fine, parallele lam-inations
- Very fine to fine, climbing ripples
- Massive sandstone
- Mudstone breccia
- Fine to medium, trough cross stratification

Base

Middle McMurray: outcrop #2- Close-up on fining-up I H S bed sets (2)





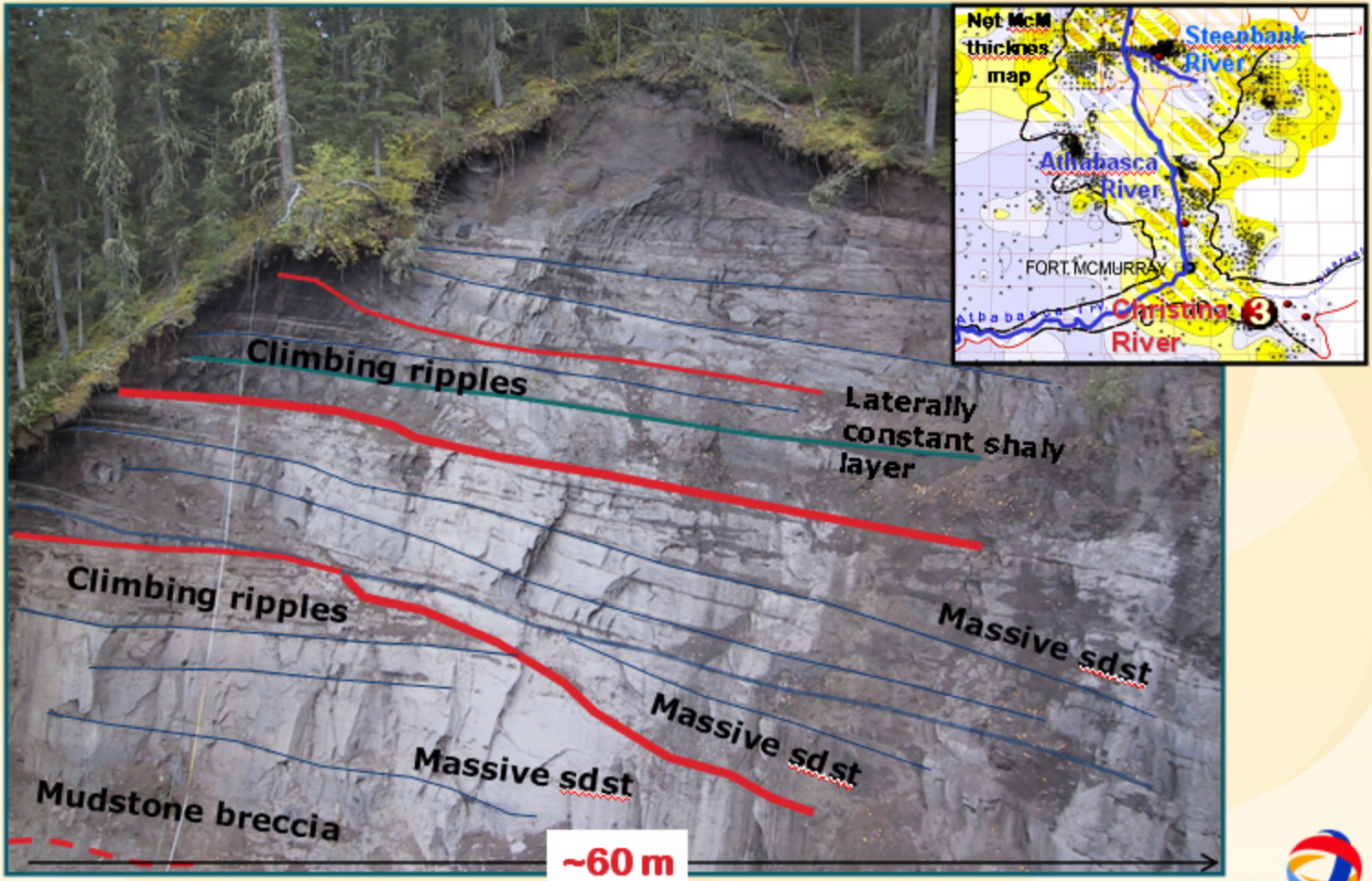
Climbing ripples

Apparently massive sdst with mud chips

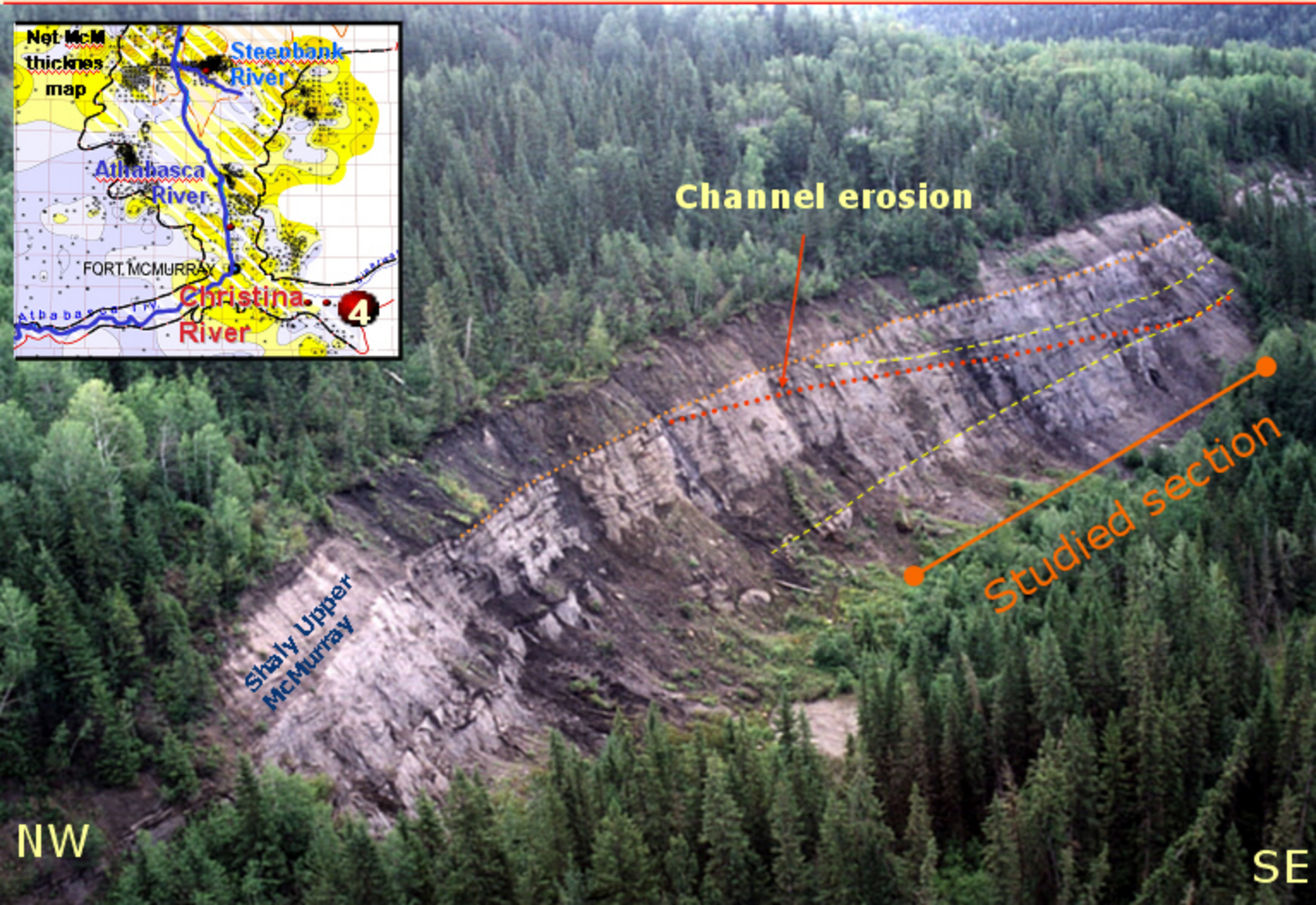
Erosive base

Typical erosive fining up sequence that constitutes a "point bar"

Middle McMurray: outcrop #3
Thicker bedded erosive channels

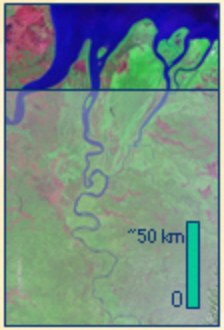


Middle McMurray: outcrop #4
Thicker bedded erosive channels



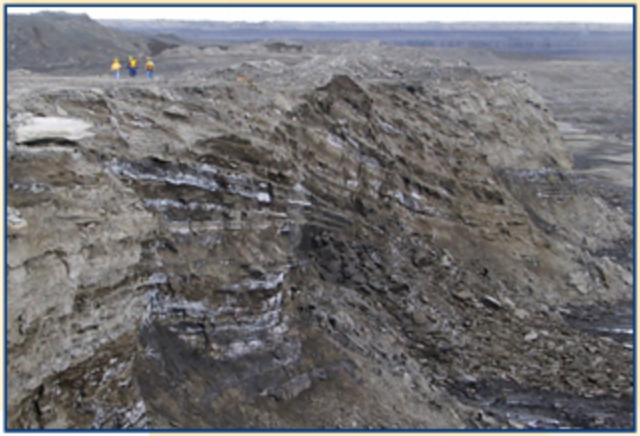
Middle McMurray: outcrop #4
Thicker bedded erosive channels

Upper McMurray, lower delta plain to outer estuary

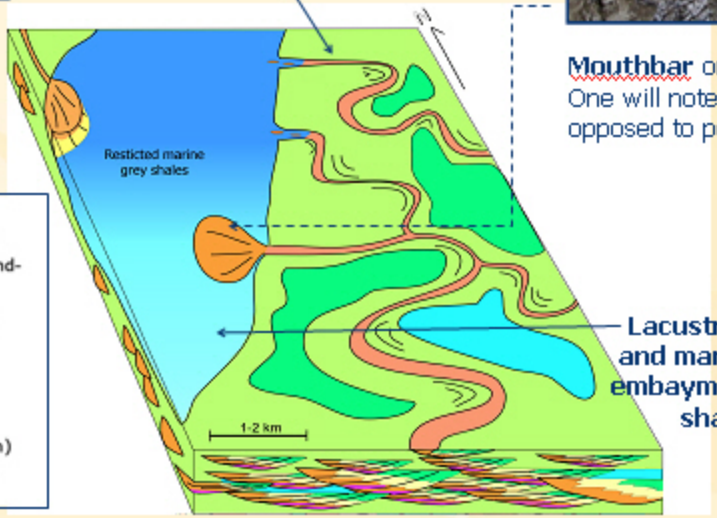


Lower delta plain, outer estuary

Distributary channels

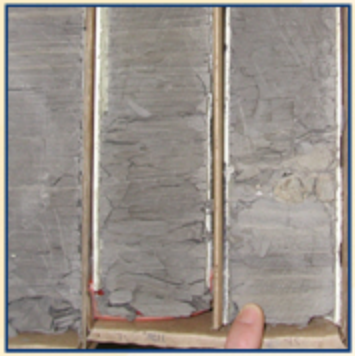


Mouthbar on a mine face (max. thickness is 15 m). One will note that foresets thin downwards as opposed to point bars.

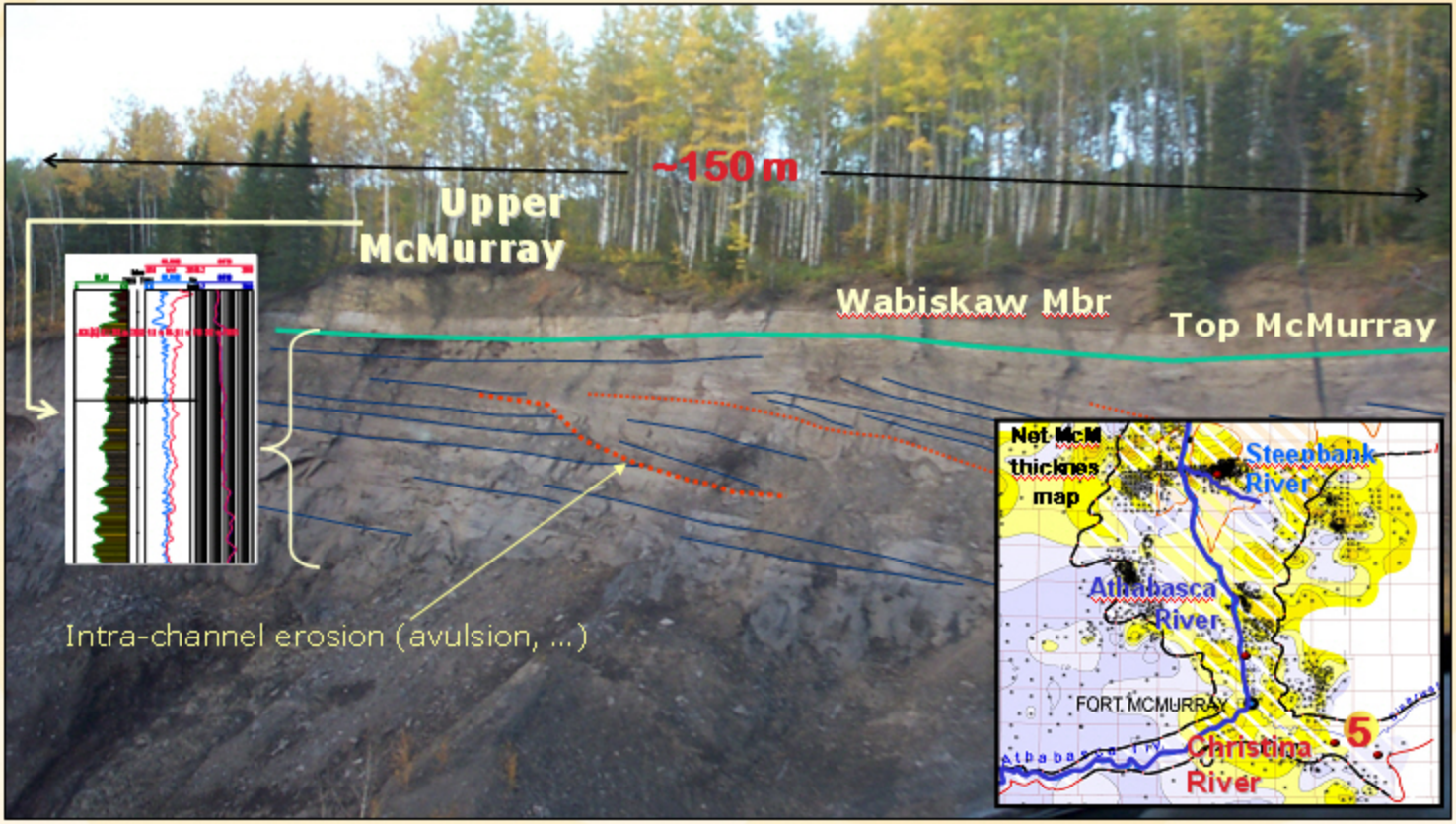


Lacustrine and marine embayment shales

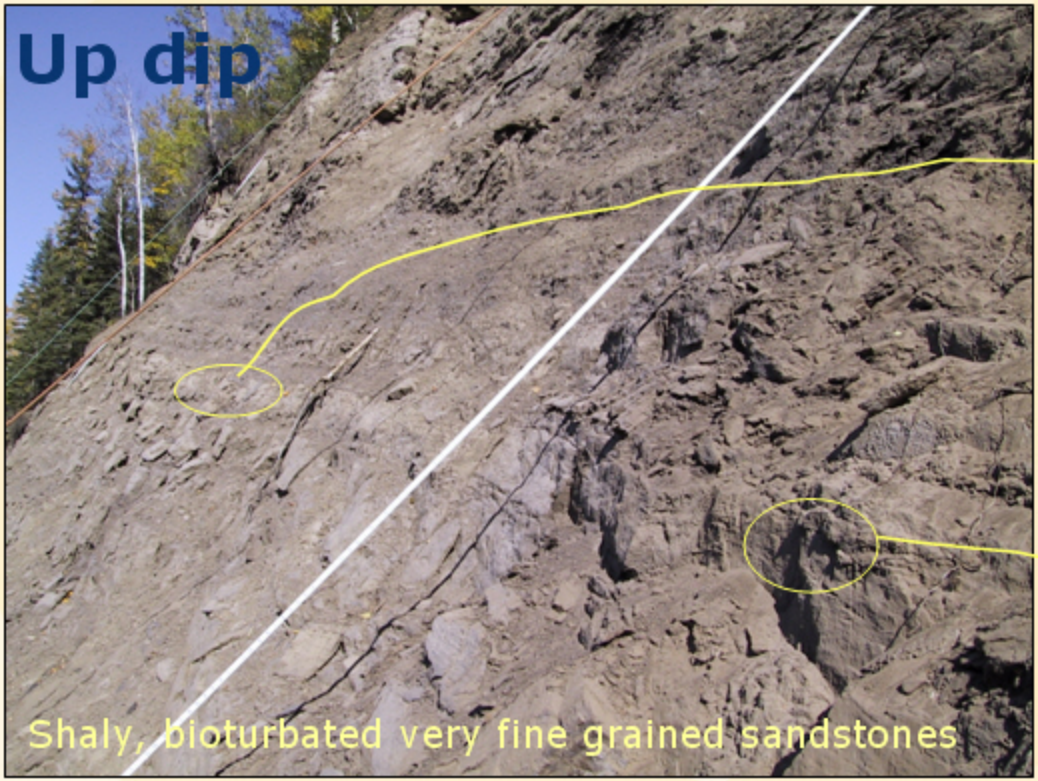
- Mudstone breccia
- Very fine to fine grained trough cross bedded sand-stones
- Shaly upper delta plain deposits to mud flats
- Climbing ripples (very fine grained)
- Muddy IHS (Inclined Heterolithic Stratification)
- Lacustrine to marine shales

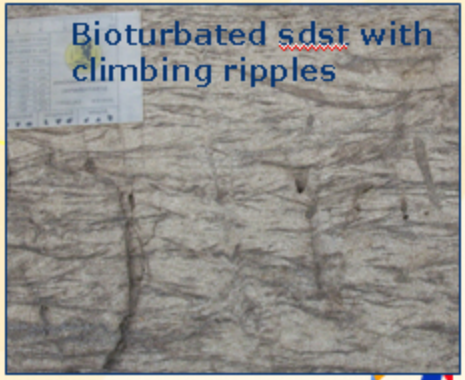


Upper McMurray – outcrop #5
smaller scale "Inclined Heterolithic Stratifications"

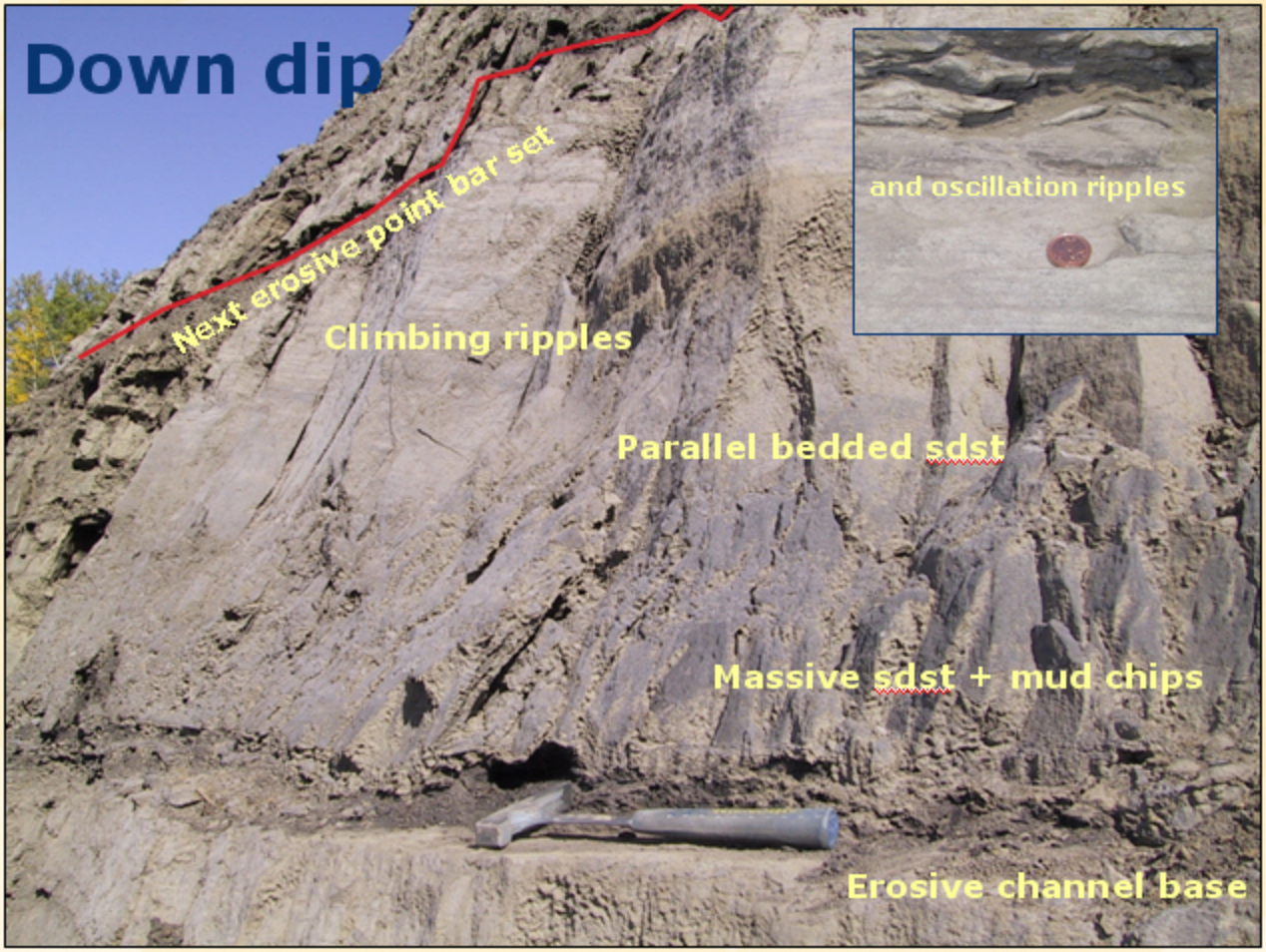


Upper McMurray – outcrop #5
Close-up on I H S (1)

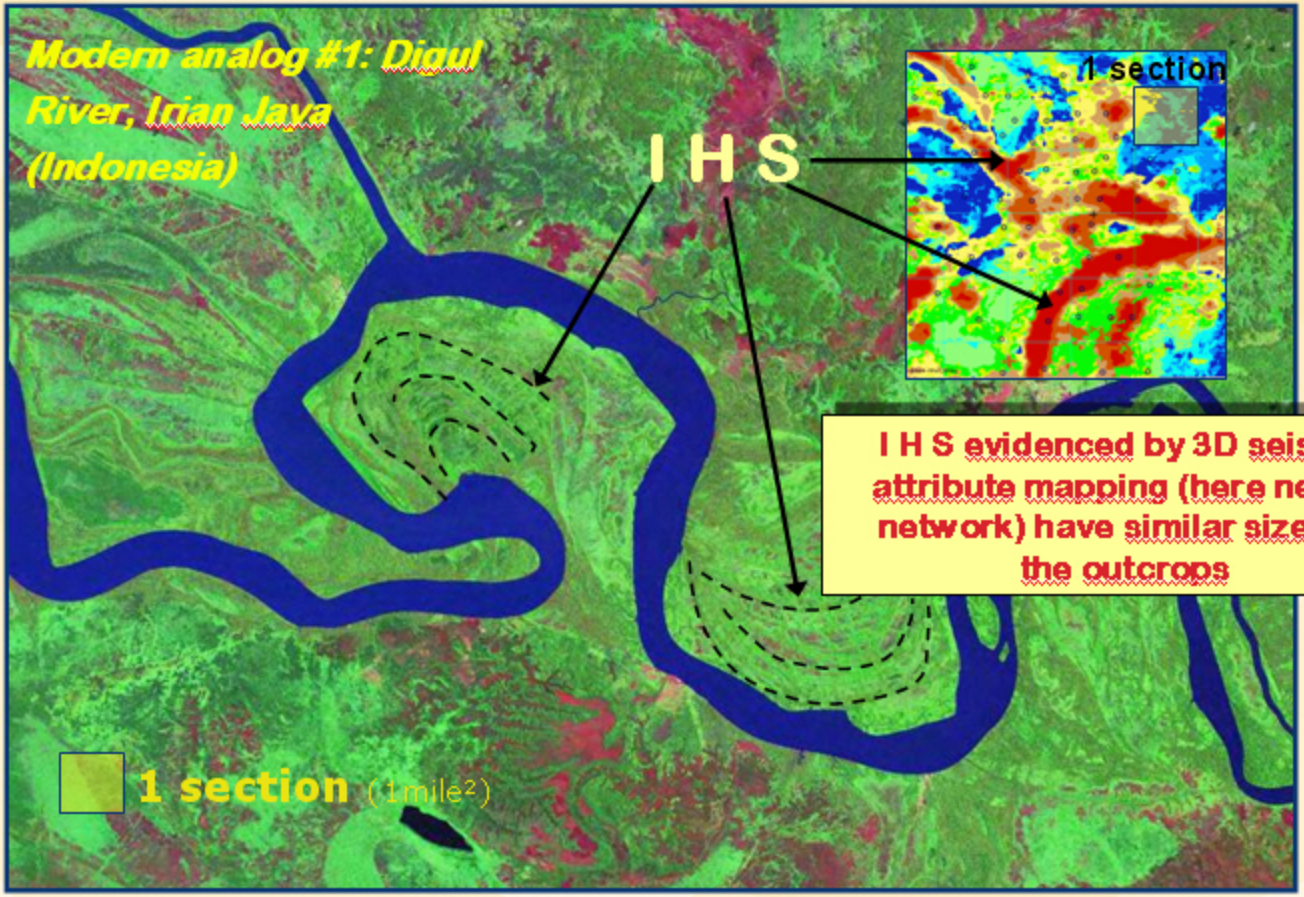




Upper McMurray – outcrop #5
Close-up on I H S (2)



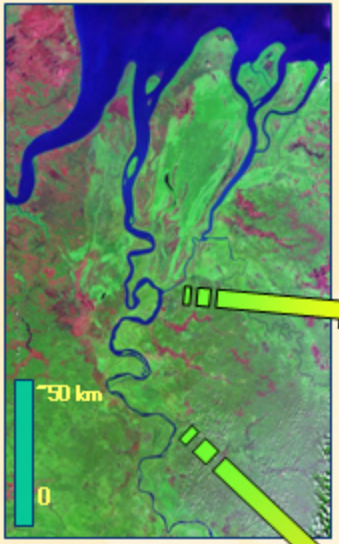
Conclusion (1): Middle McM I H S (Inclined Heterolithic Stratification) are large size fluvio-estuarine point bars



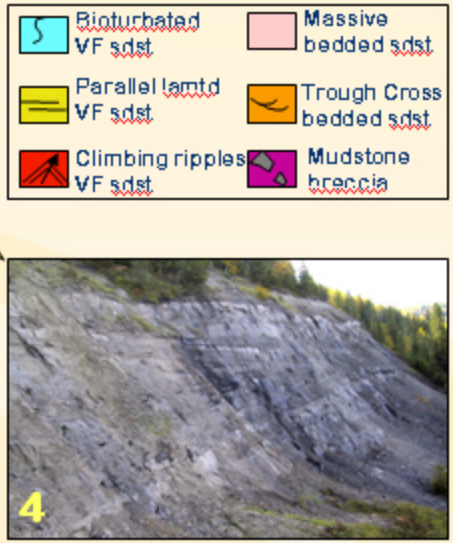
I H S evidenced by 3D seismic attribute mapping (here neural network) have similar sizes as the outcrops

~25 kms

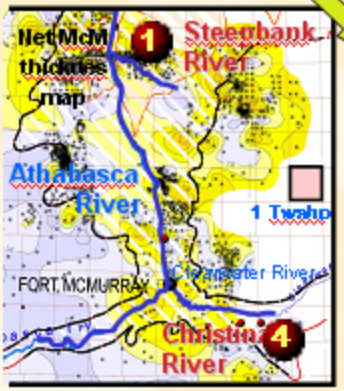
Conclusion (2): Middle McMurray Fm proximal – distal architectural variations – detailed facies variations



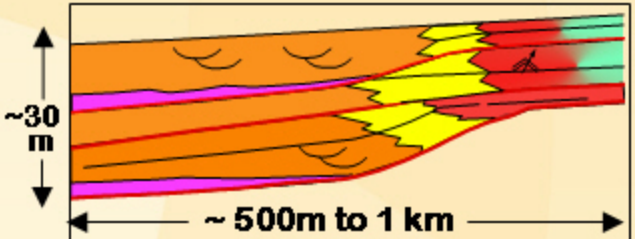
Steepbank River outcrops.



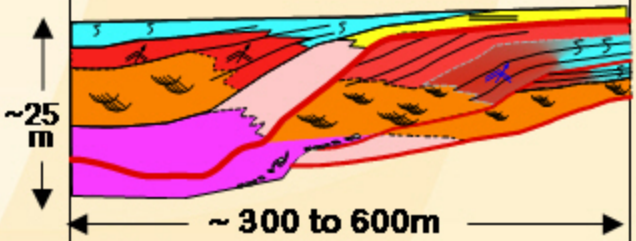
Christina River outcrops.



- Bioturbated VF sdst
- Massive bedded sdst
- Parallel lamtd VF sdst
- Trough Cross bedded sdst
- Climbing ripples VF sdst
- Mudstone breccia



Distal estuarine setting: several 100'm long IHS, rather flat erosions (scours).



Proximal estuarine to fluvial setting: high erosion rate, deeper channel incisions.

Conclusion (3) – Correlations within the McMurray Fm

- ✓ Principles of High Resolution correlations are successfully applied to the McMurray Fm fluvio-estuarine deposits (based on MFS identifications)
- ✓ However, further South of the studied outcrops, even if correlations are still valid within a narrow range (< 500m to 1.500 m?) , unpredicted channel erosions may occur, even betweeen 2 closely spaced wells.