

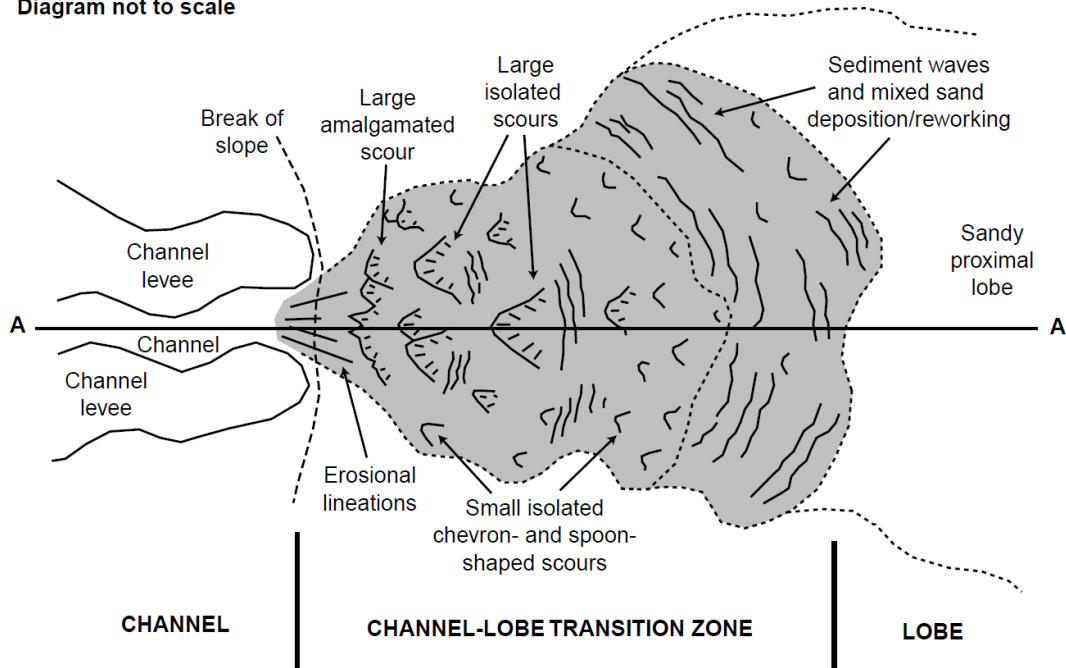


First measurement of a flow mechanism responsible for enhanced erosion in channel-lobe-transition zones

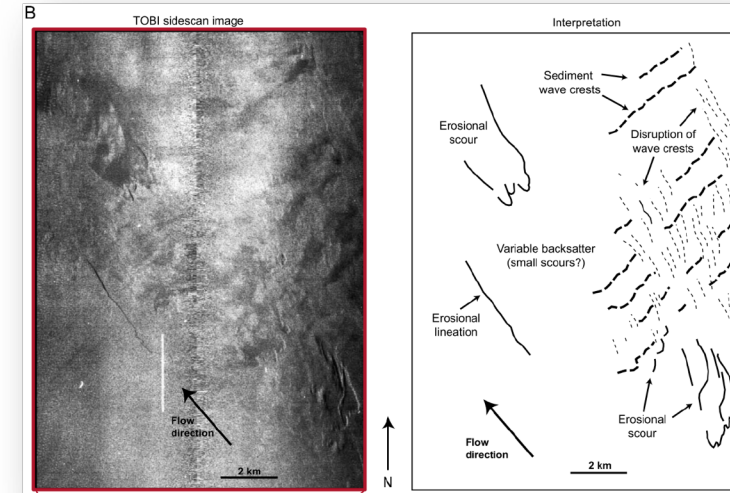
PICO 1.1

Florian Pohl, Joris Eggenhuisen, Mike Tilston, Matthieu Cartigny

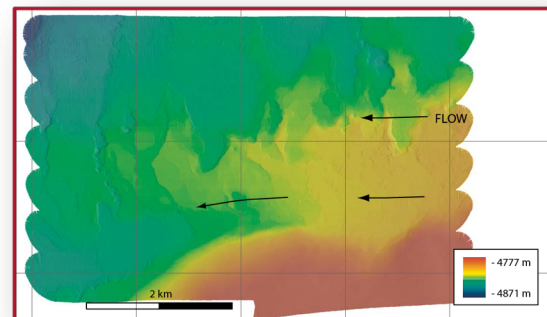
Diagram not to scale



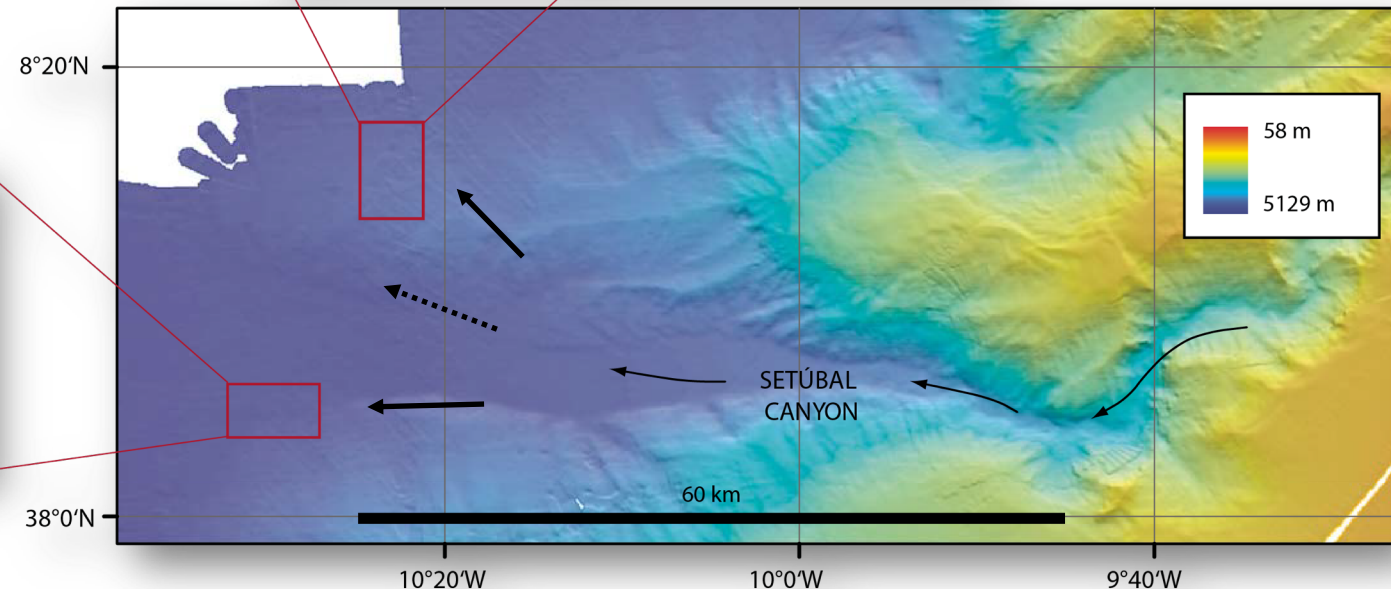
Wynn et al., (2002)



Wynn et al., (2002)



Macdonald et al., (2011)

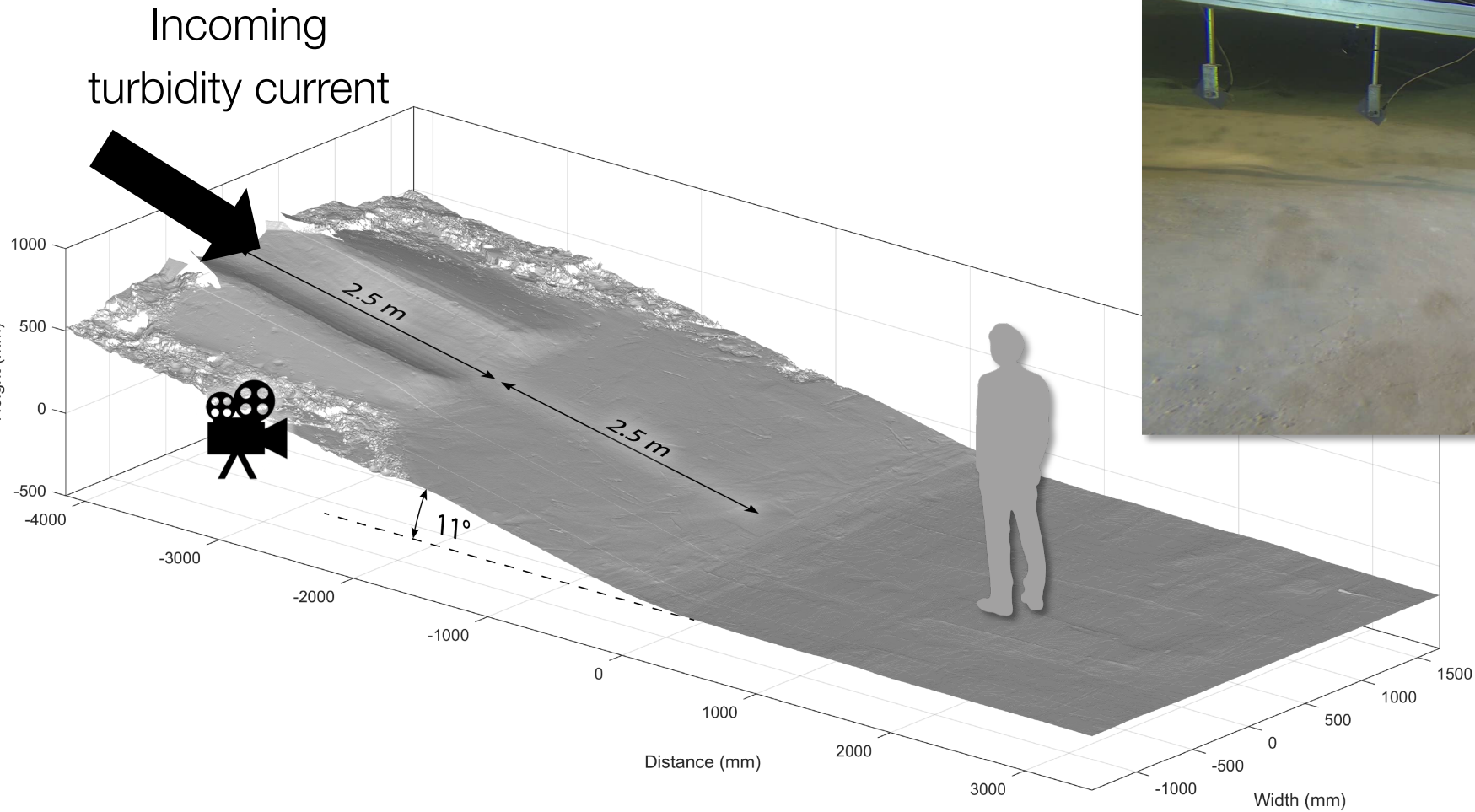




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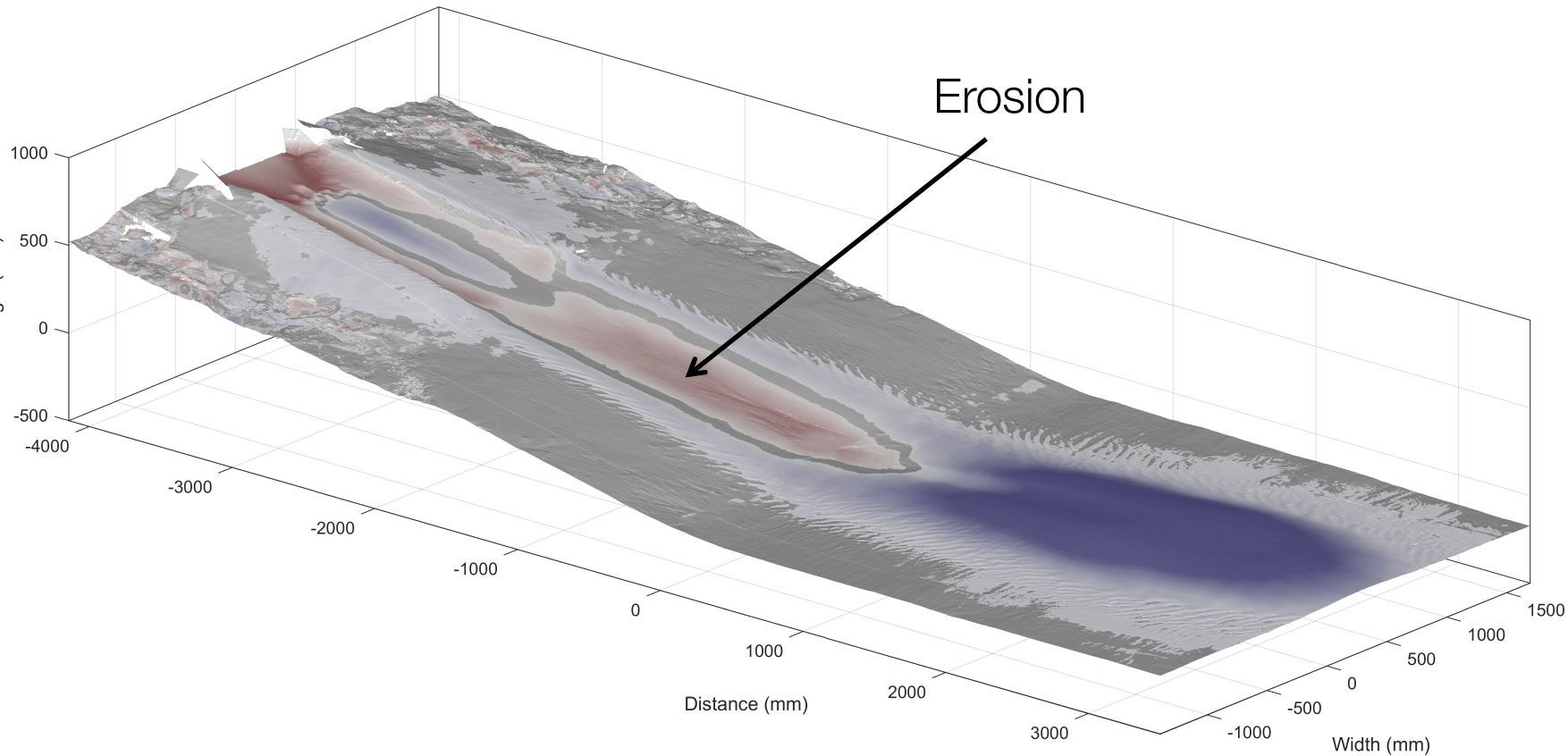


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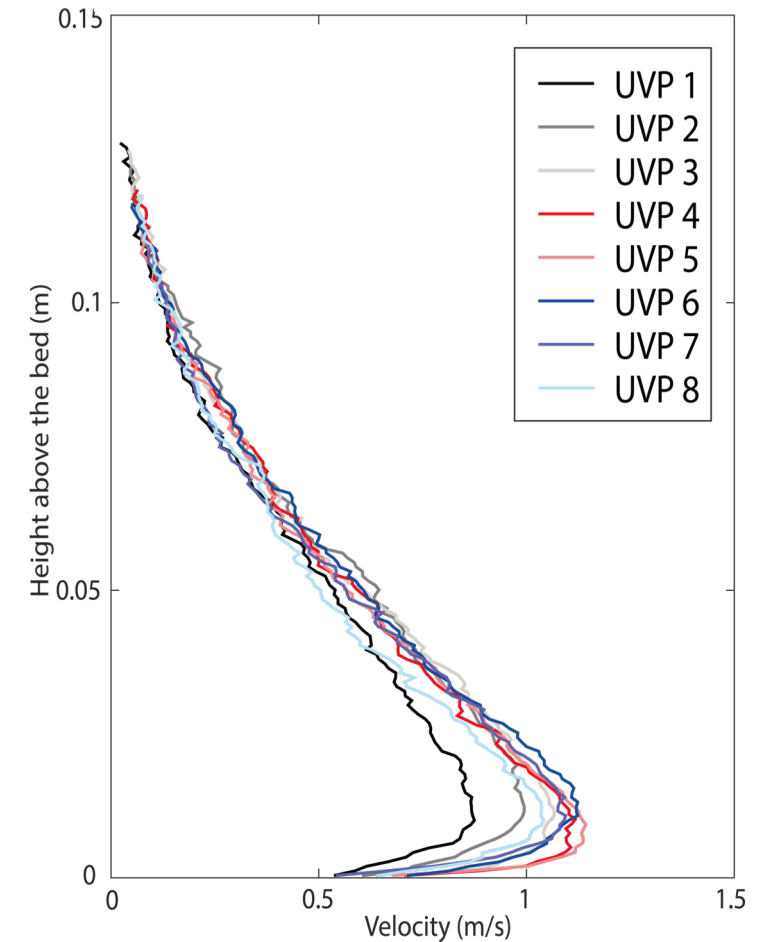
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Morphology



Velocity structure

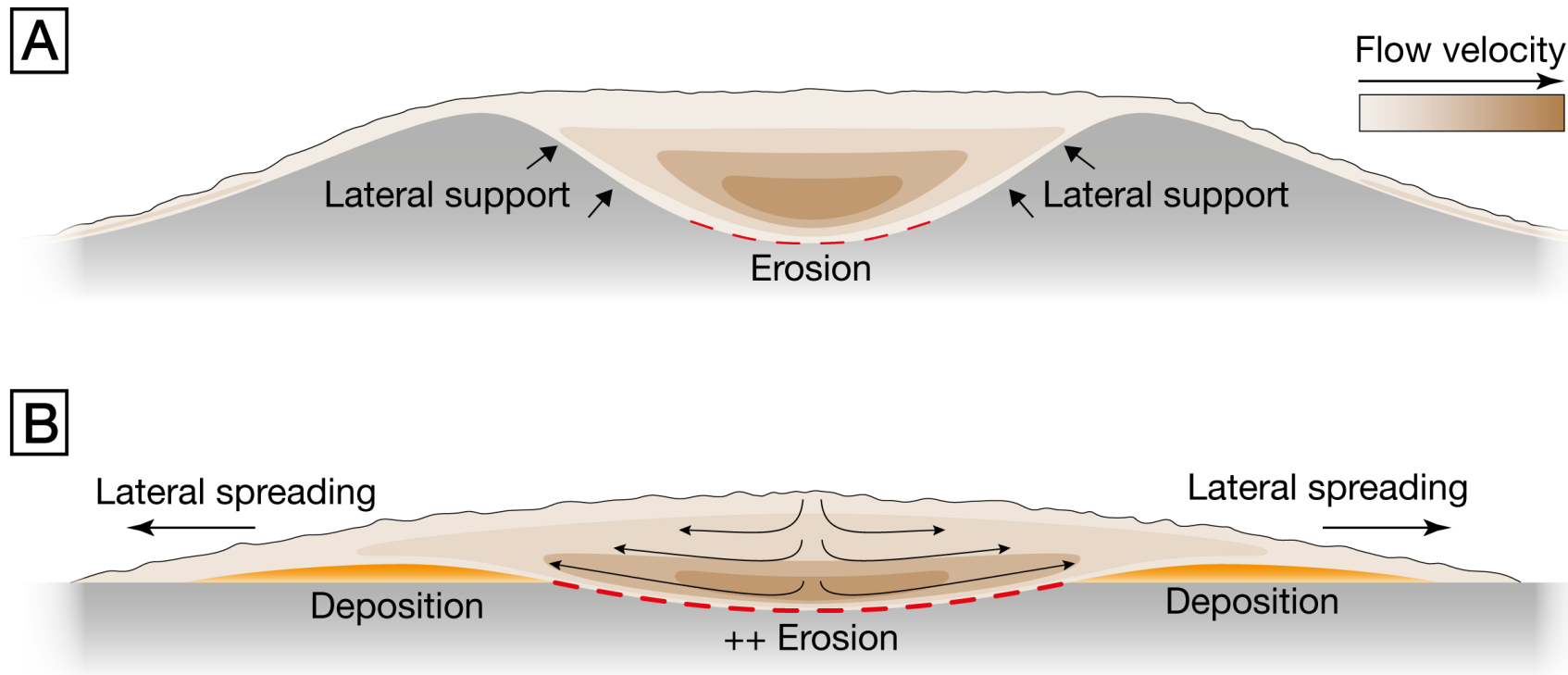




First measurement of a flow mechanism responsible for enhanced erosion in channel-lobe-transition zones

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Flow relaxation



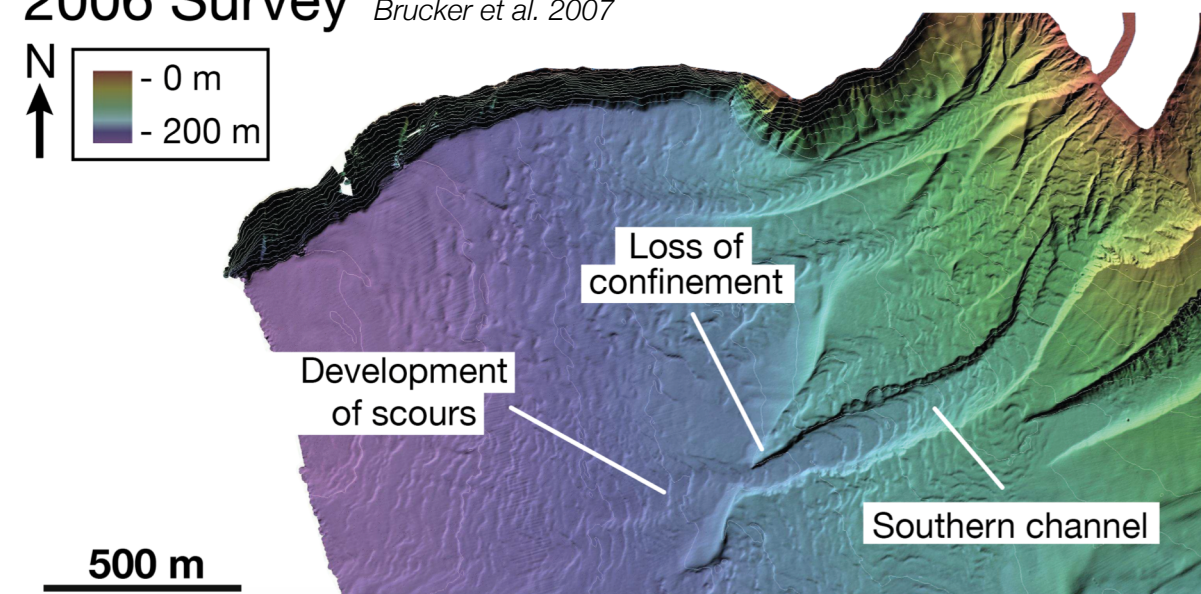


First measurement of a flow mechanism responsible for enhanced erosion in channel-lobe-transition zones

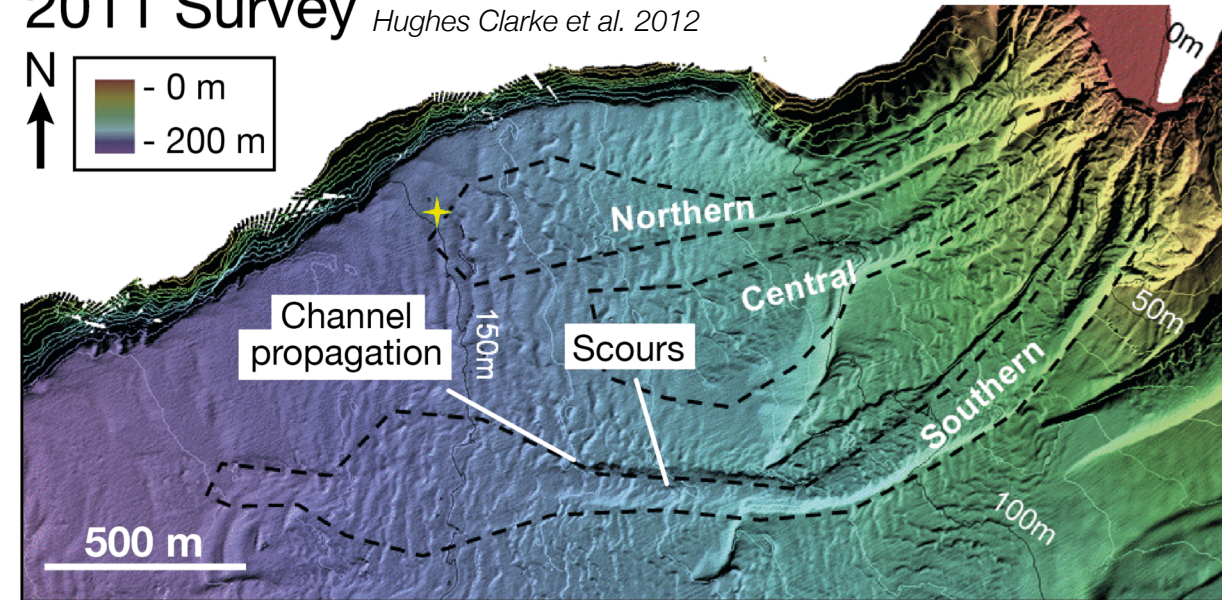
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2006 Survey *Brucker et al. 2007*

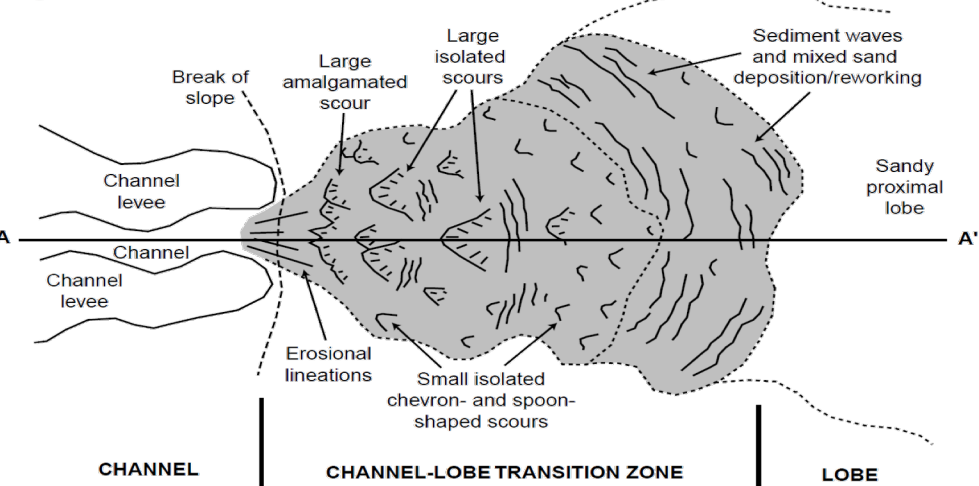


2011 Survey *Hughes Clarke et al. 2012*



Introduction: study motivation and rationale

Diagram not to scale



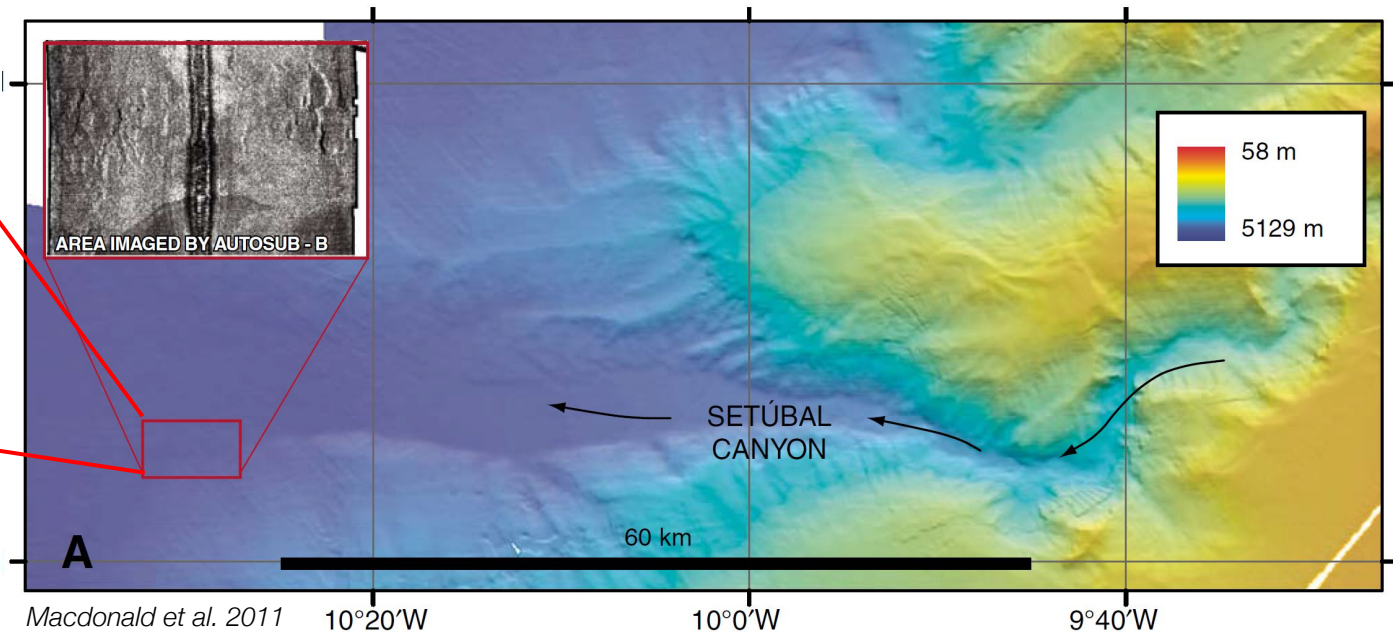
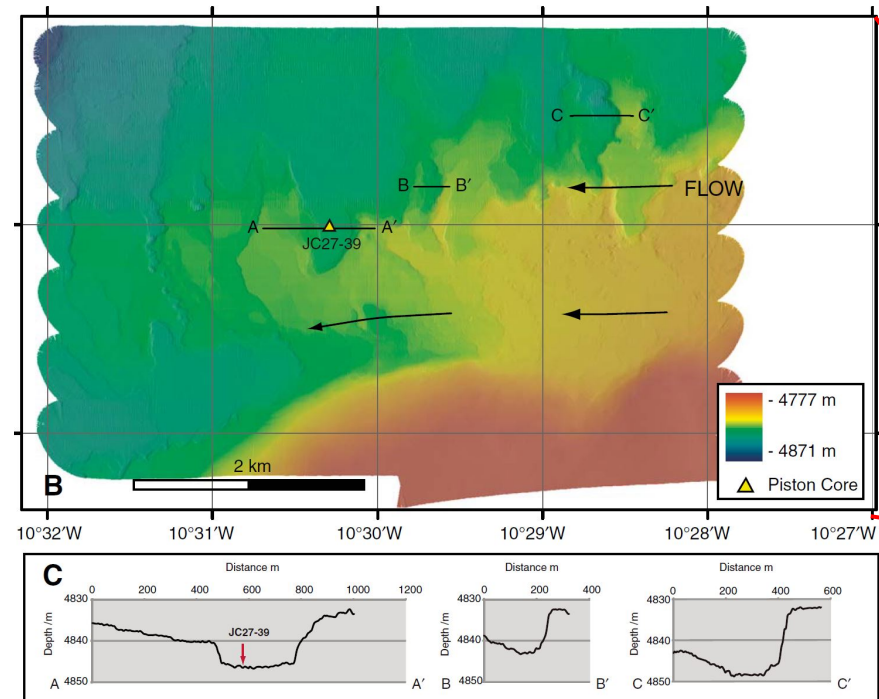
Wynn et al. 2002

CLTZ's: Poorly understood region connecting well defined channels and lobes (Mutti and Normark, 1987)

Morphologic characteristics:
massive scours and sediment bypass

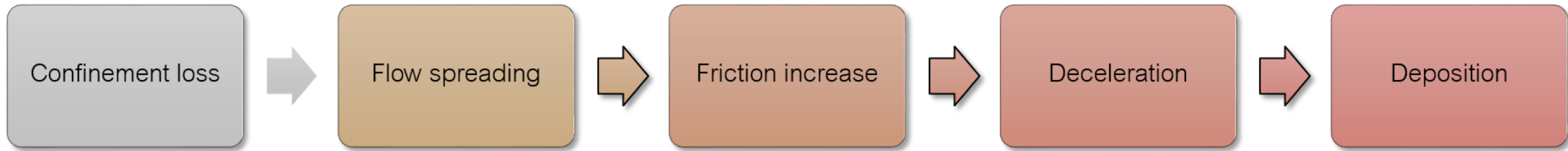
Flow transformation mechanisms:

1. Break of slope (BOS)
2. Loss of lateral confinement (LLC)

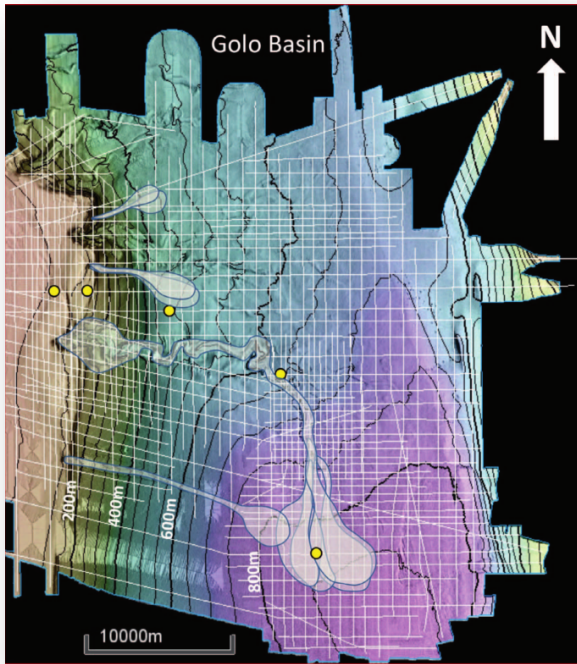


Macdonald et al. 2011

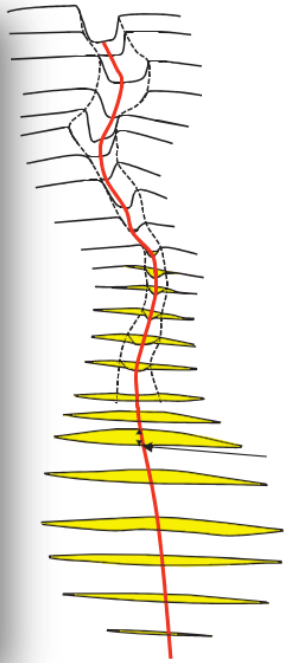
Introduction: study motivation and rationale



Golo System: **non-erosive**



Hamilton et al. 2017



End member CLTZ's:

- 1. Non-erosive
- 2. Erosive

Break of slope:

Doesn't always produce well defined CLTZ

Loss of lateral confinement:

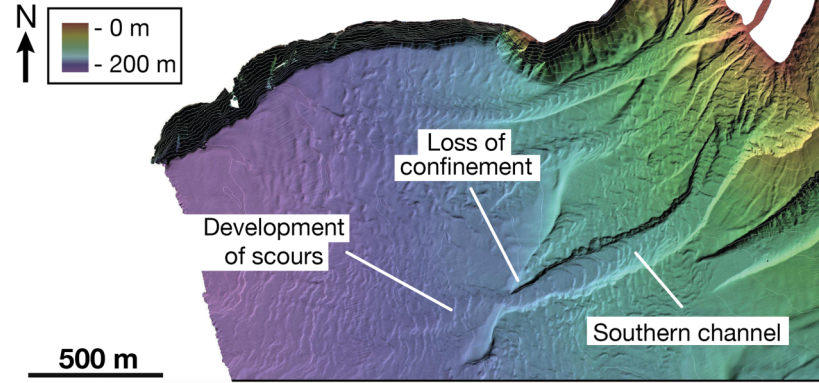
SHOULD NOT produce well defined CLTZ...it can!

Question:

How can loss of lateral confinement lead to massive scour formation?

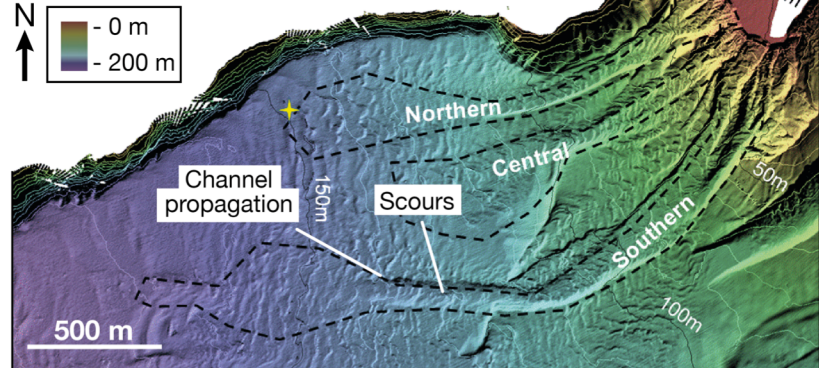
Squamish system: **erosive**

2006 Survey



Brucker et al. 2007

2011 Survey

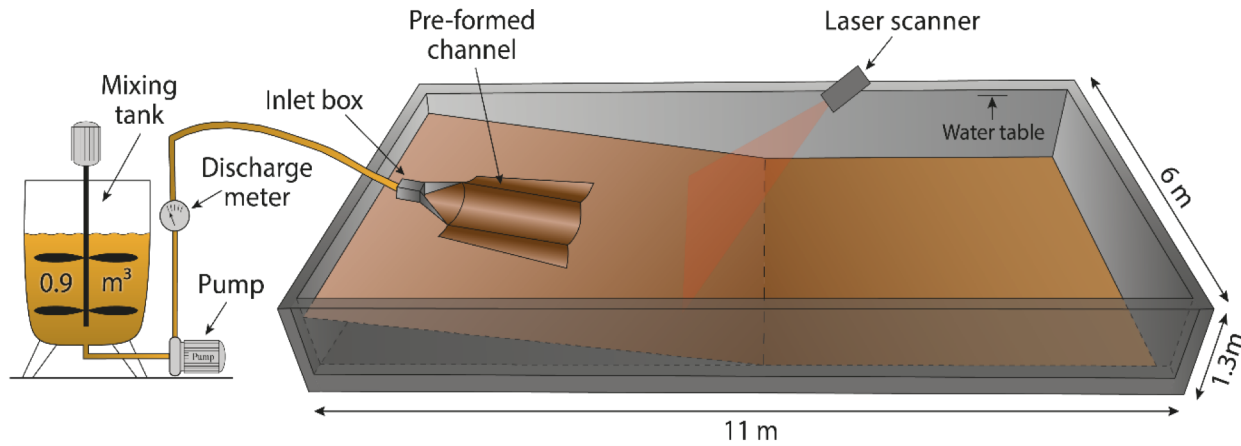


Hughes Clarke et al. 2012

Can we reproduce this behavior in the lab?

➡ **Flow Relaxation**

Experimental setup



Experimental characteristics:

Channel Length: 5.0 m

Loss of confinement: 2.5 m

d_{50} : $\sim 140\mu\text{m}$

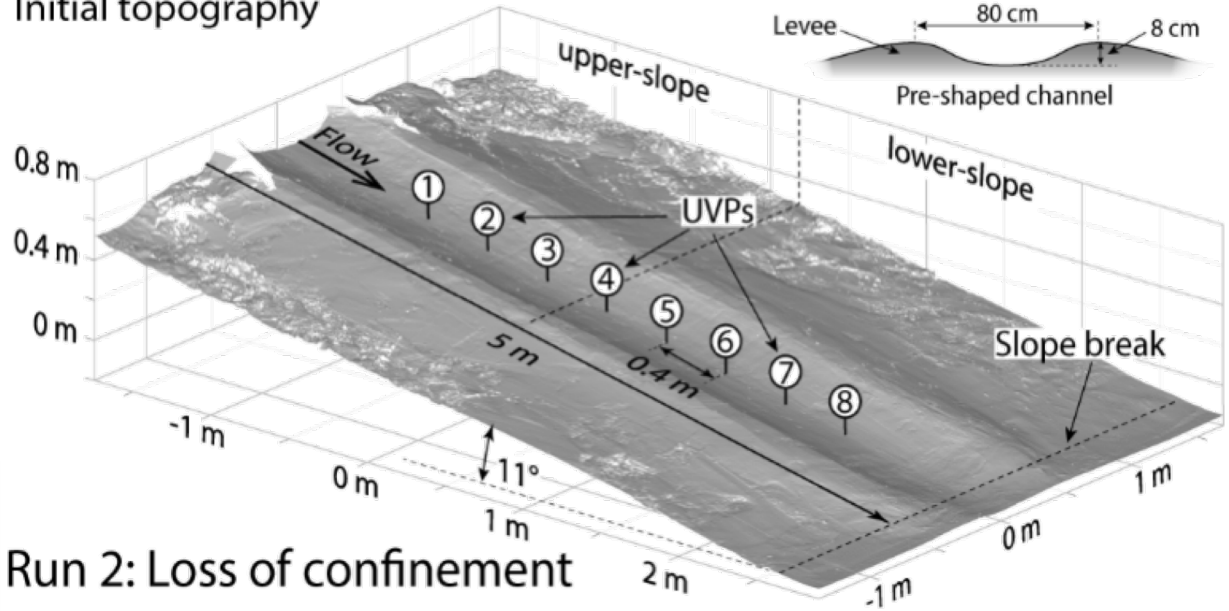
Data acquisition:

Topography: Photogrammetric reconstruction (laser sheet)

Velocity: 9 UDV's (longitudinal array)

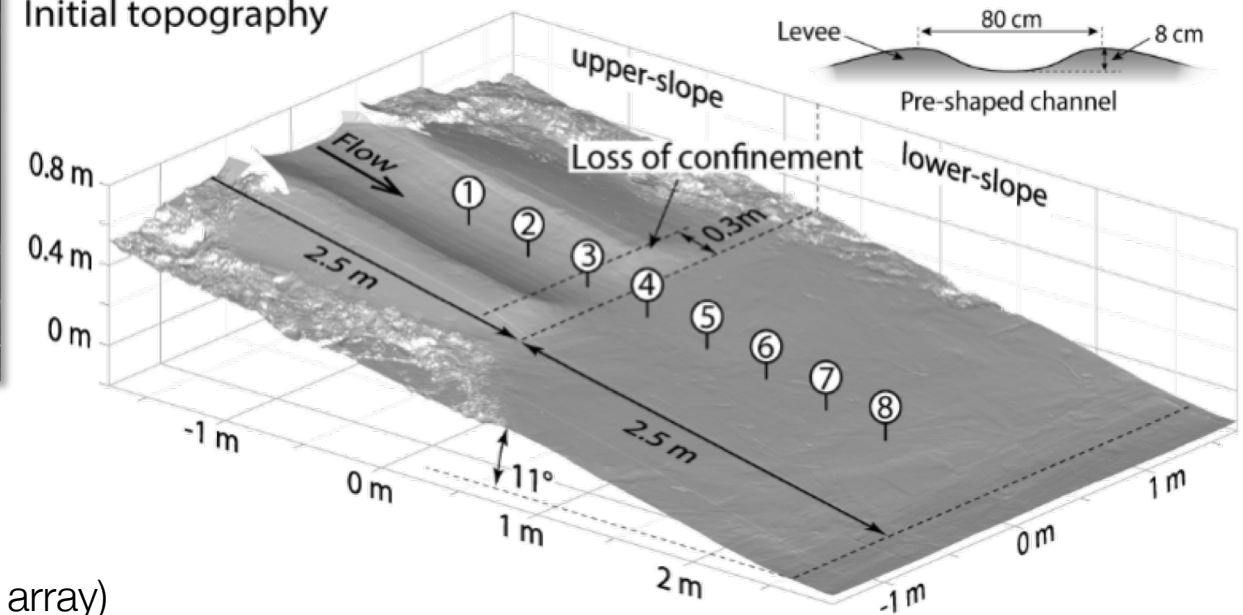
Run 1: Continuous confinement

Initial topography

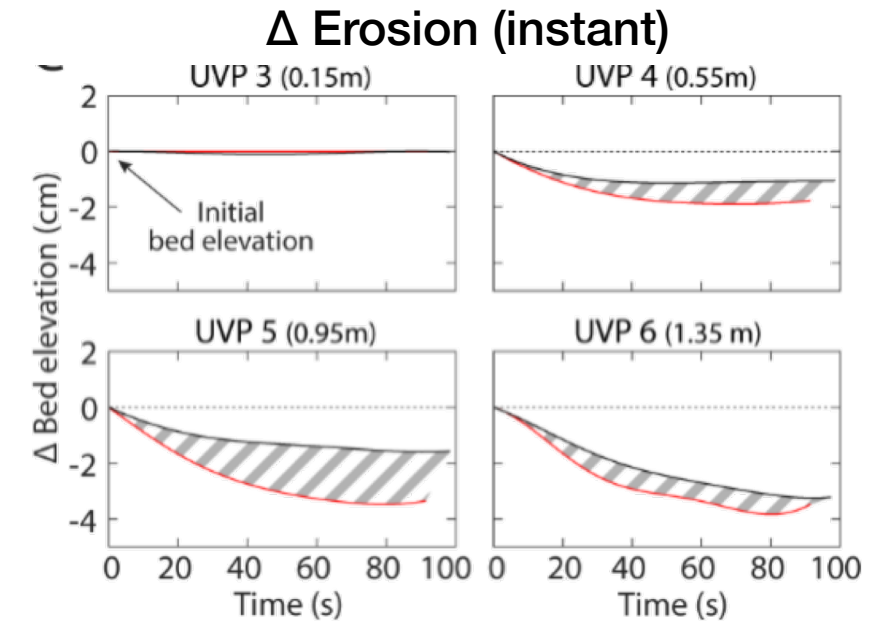
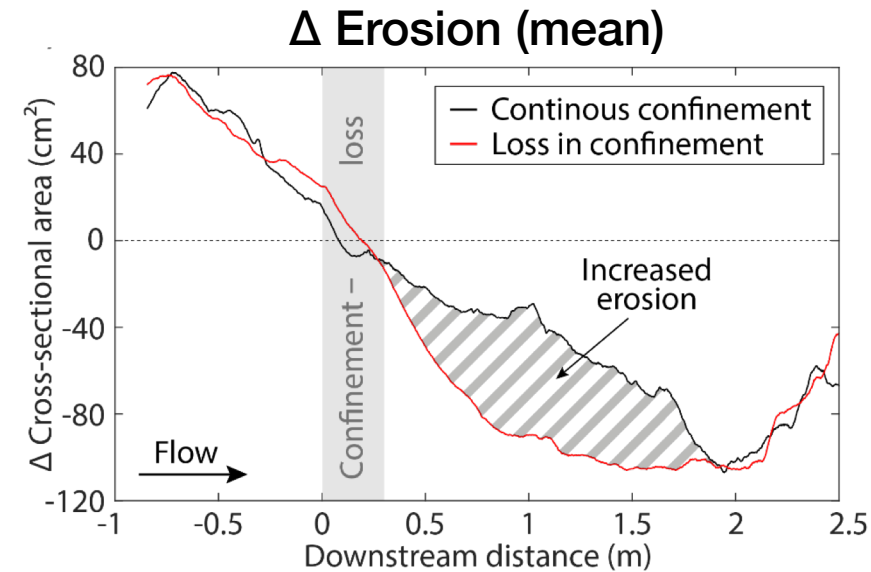
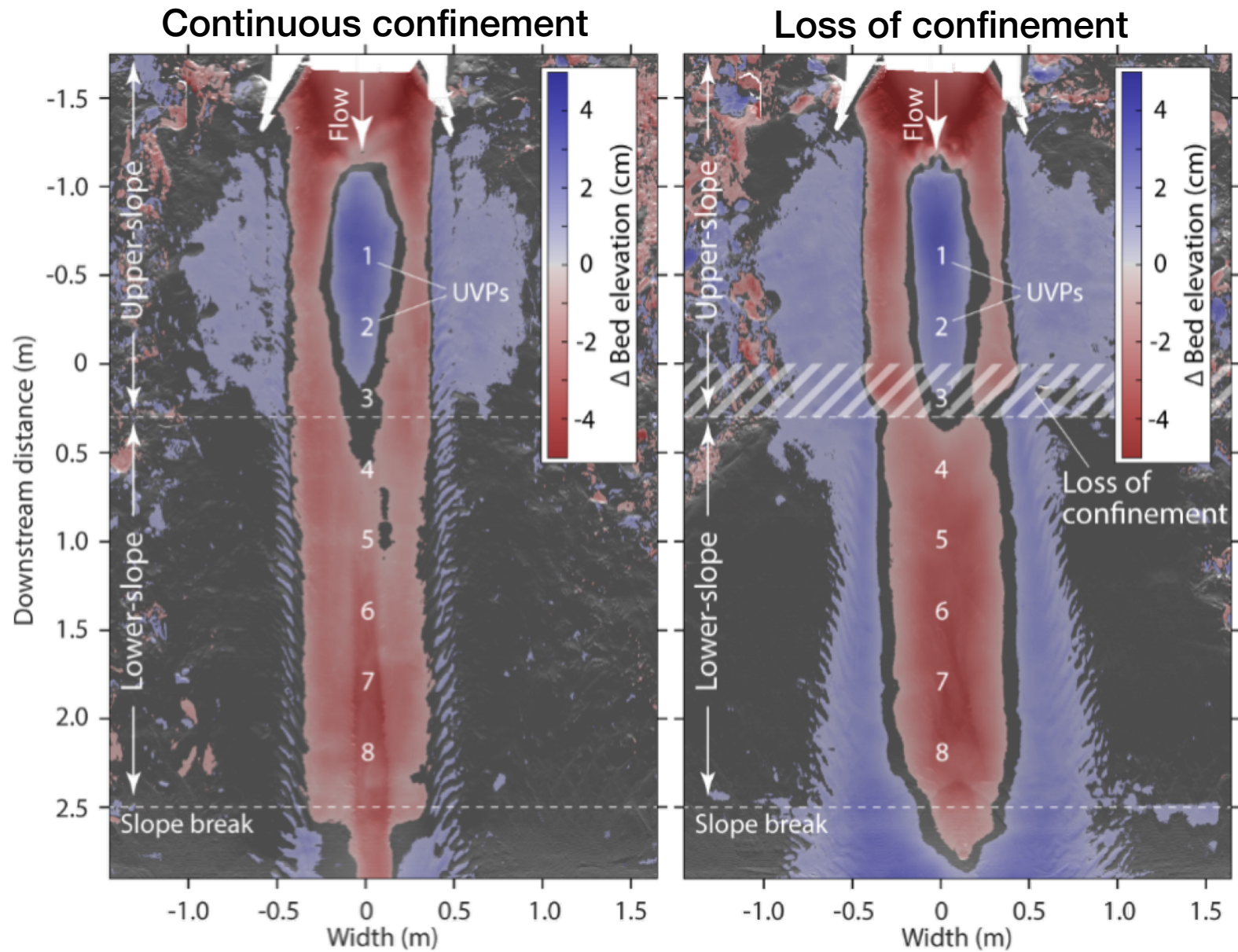


Run 2: Loss of confinement

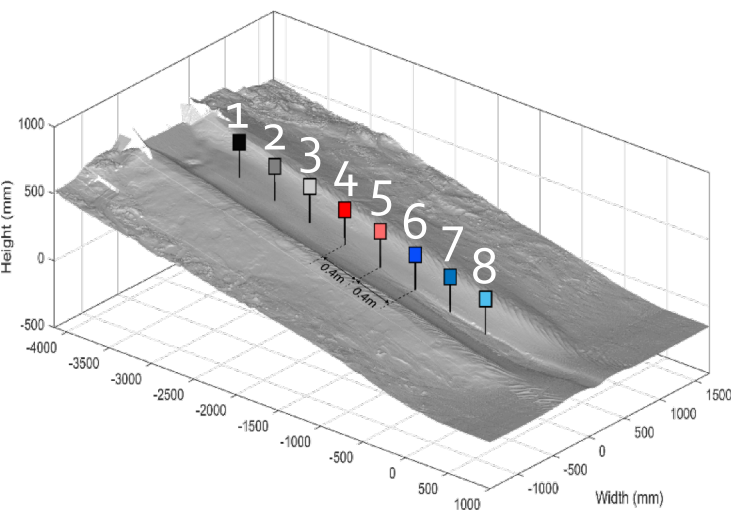
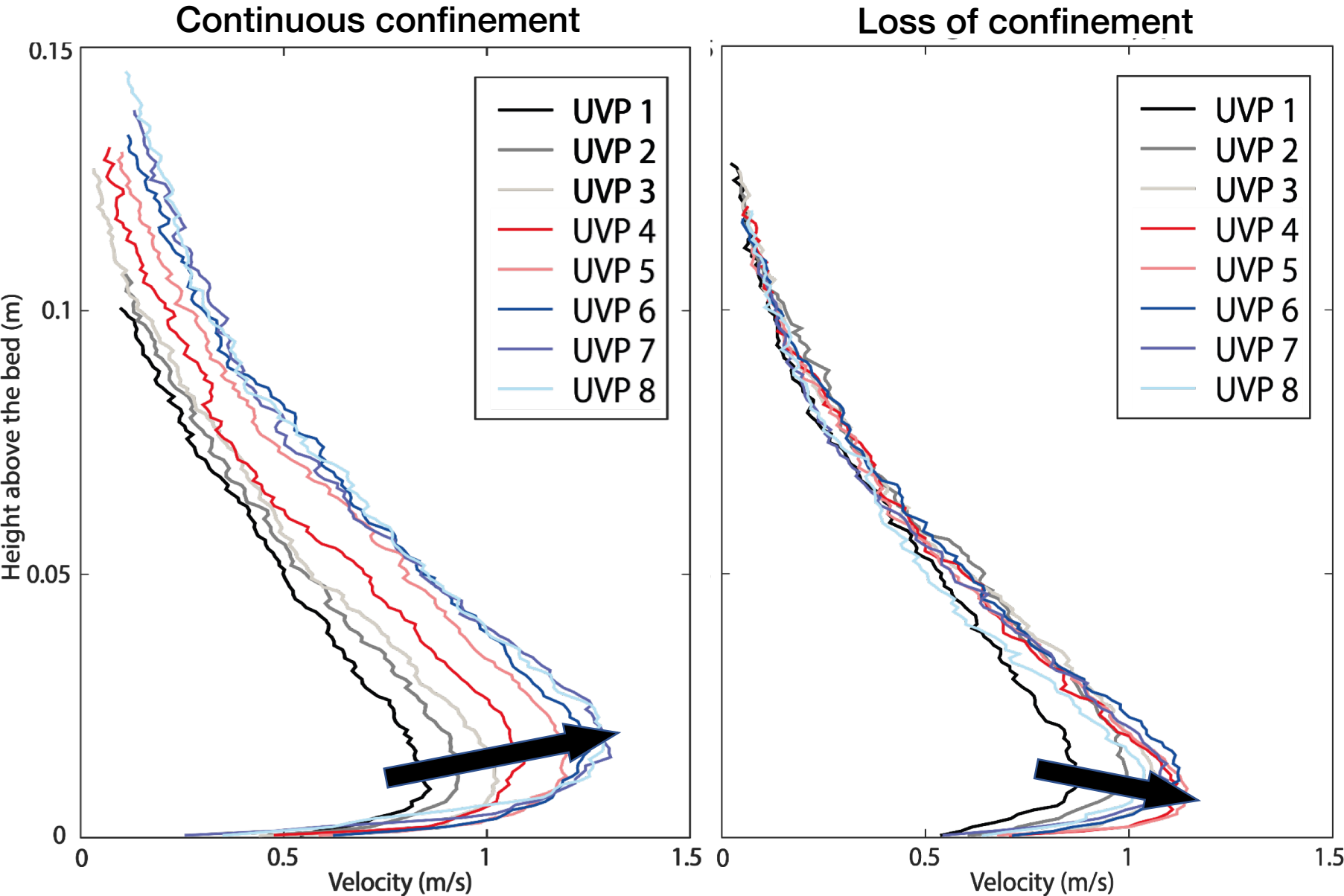
Initial topography



Results: erosional & depositional trends



Results: longitudinal velocity trends



Upper slope

Continuous flow acceleration

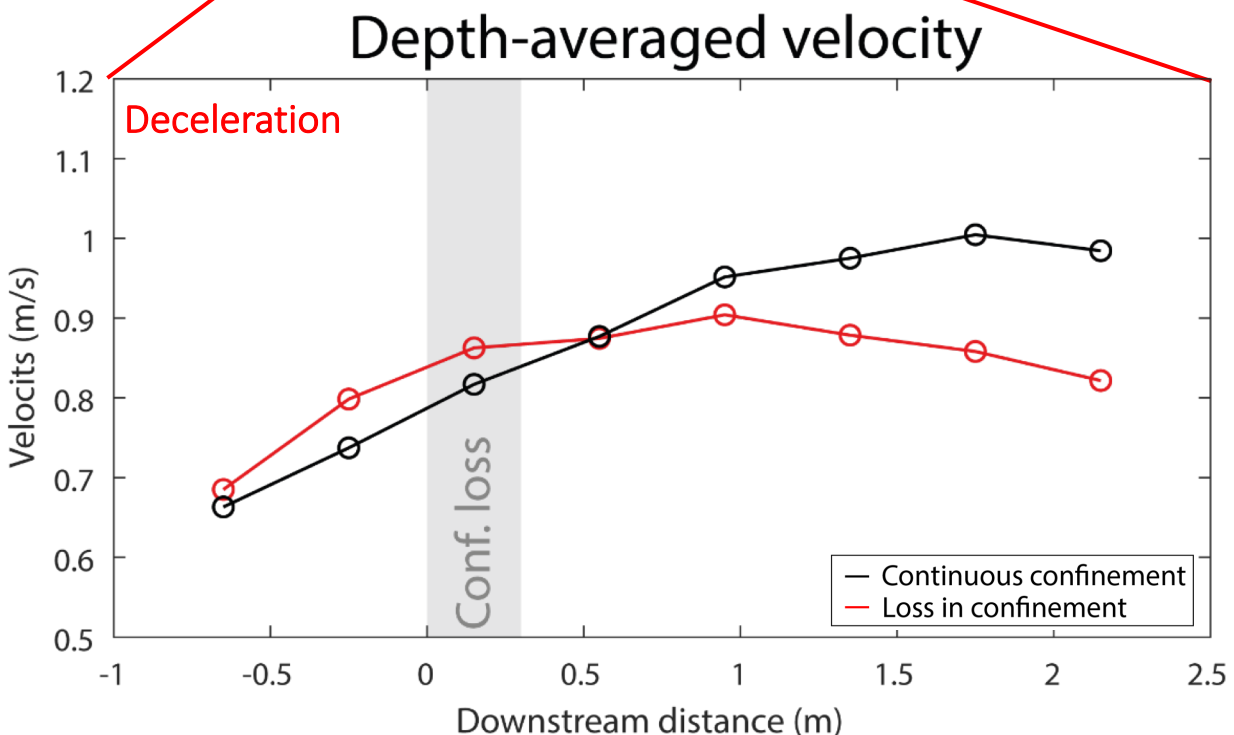
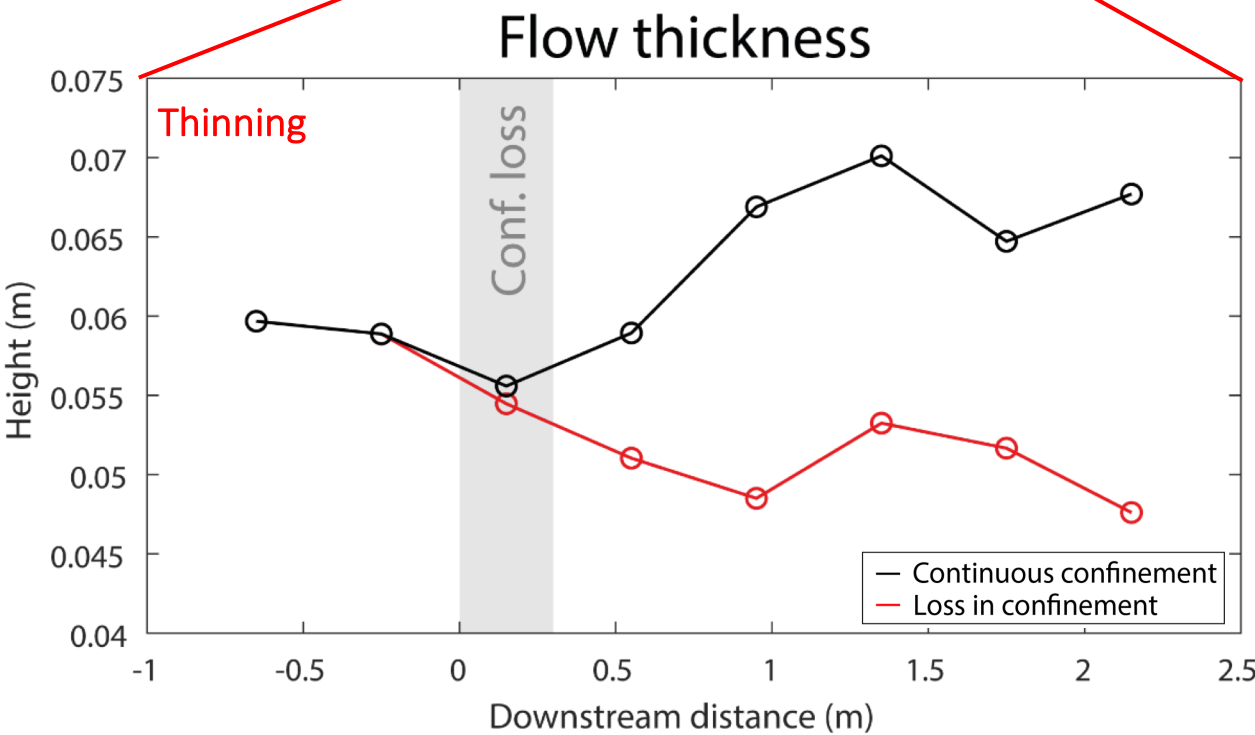
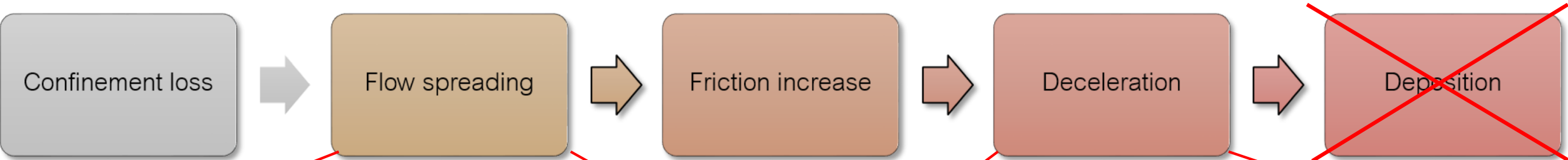
Lower slope

Continuous confinement: flow accelerates → ↑shear (& mixing) between current and ambient fluid → flow thickening

Loss of confinement: flow spreads & thins → acceleration ceases

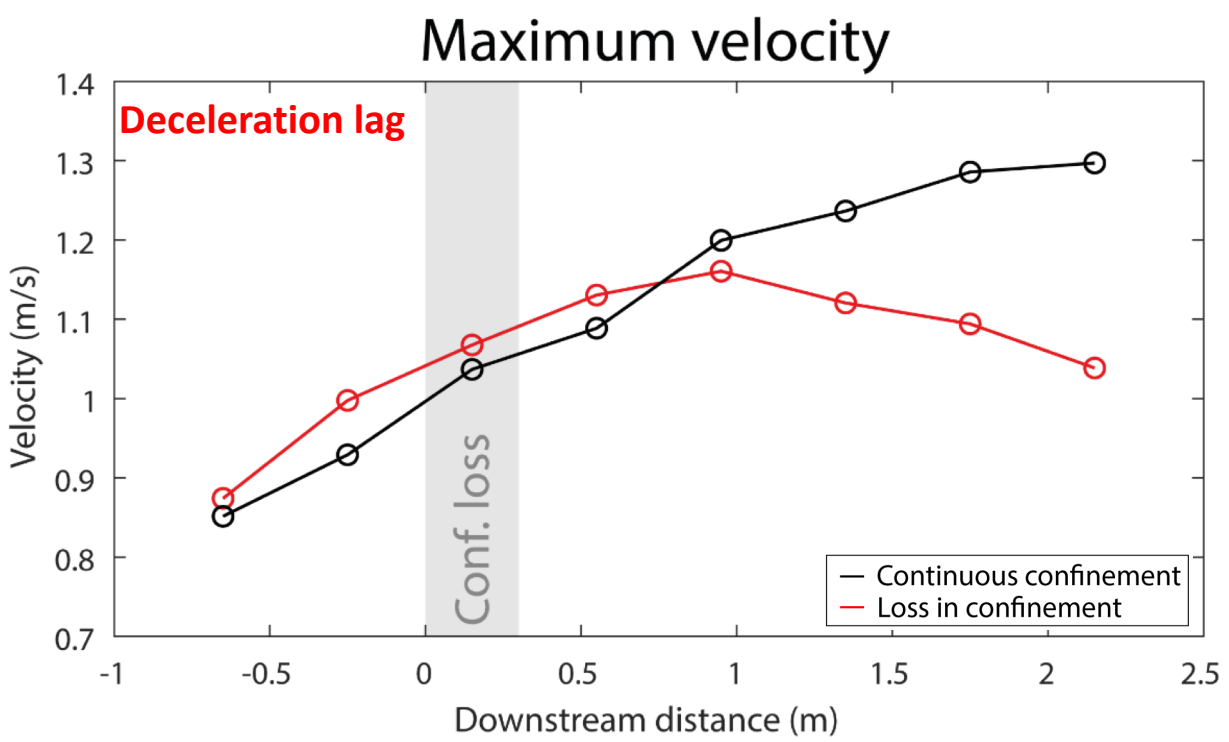
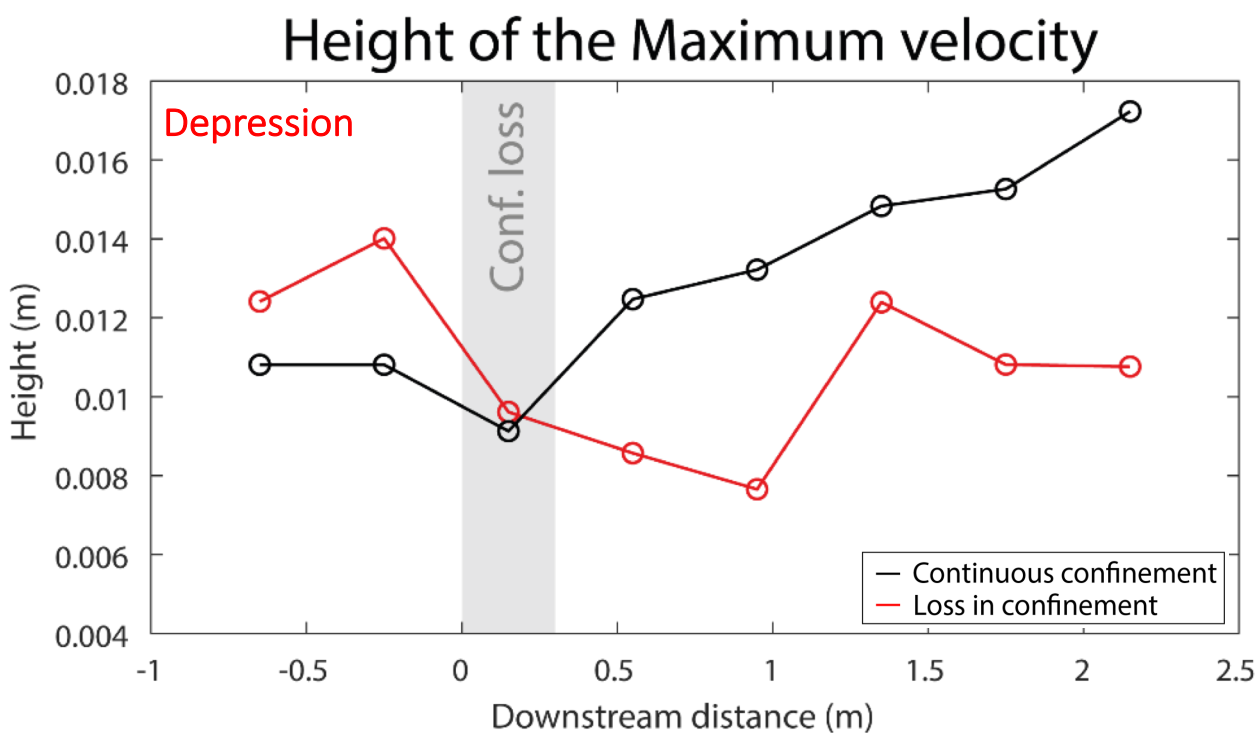
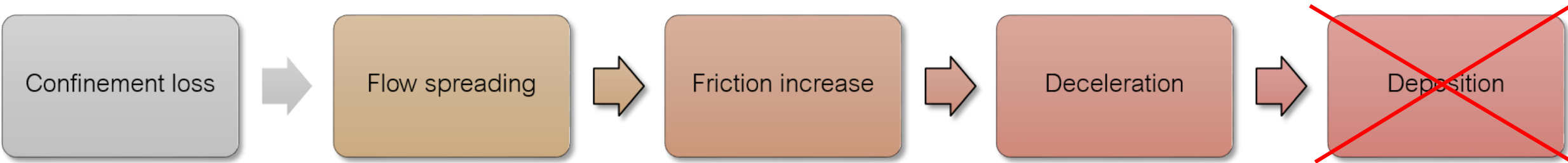
How does this result in erosion?

Results: model vs. depth-averaged flow properties

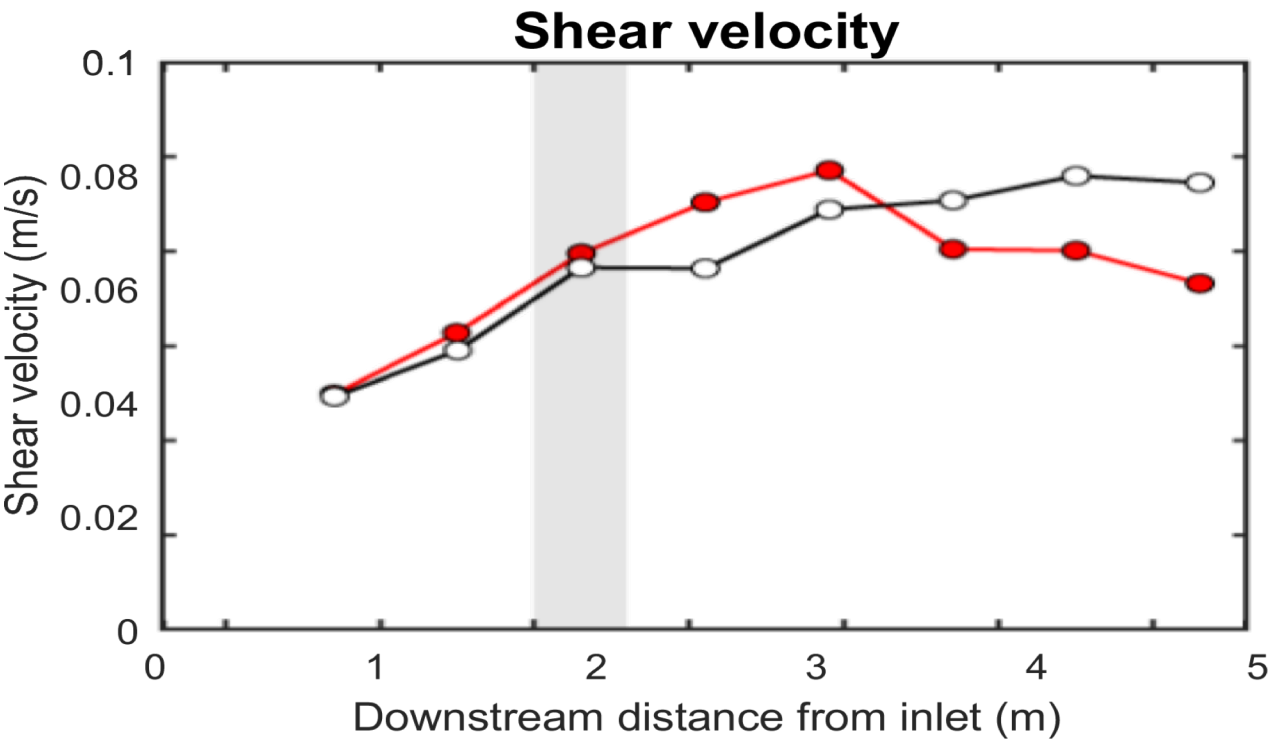
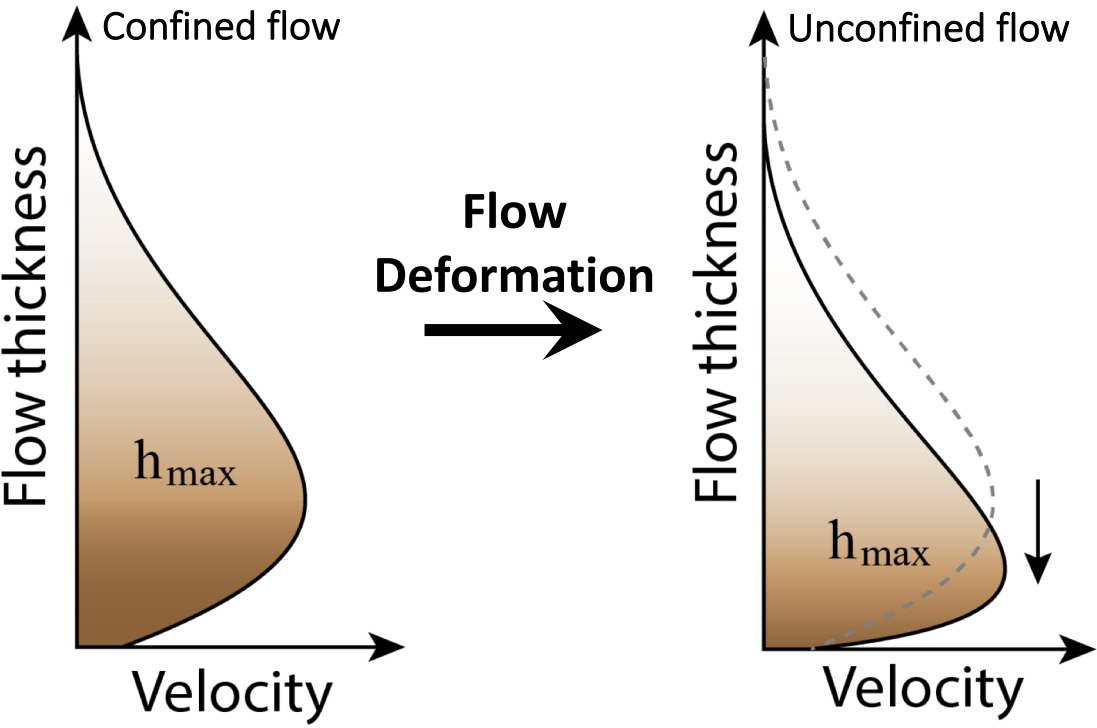
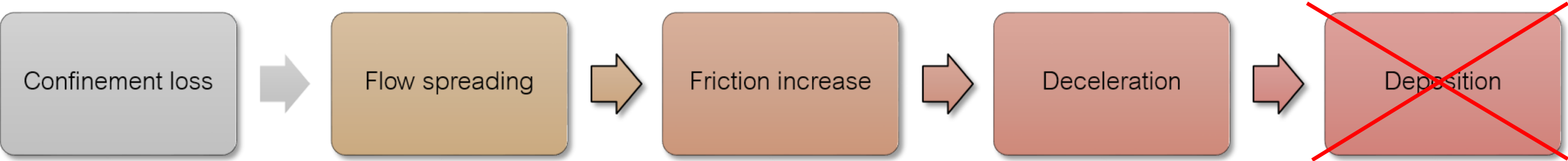


Δ in flow thickness too rapid to be explained by particle settling.
Depth-averaged trends fit the model, but NOT the erosional/depositional patterns.

Results: loss of confinement and velocity maxima

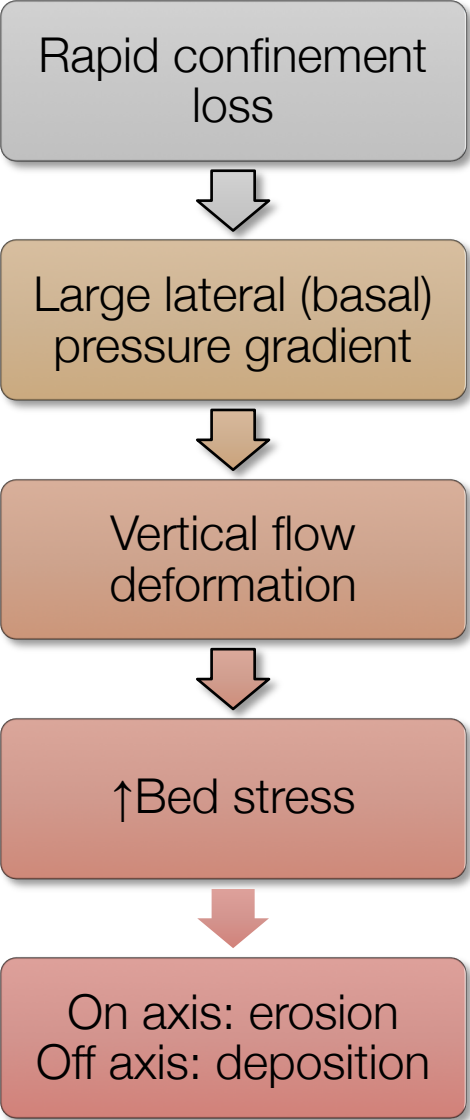


Results: loss of confinement and bed shear stress

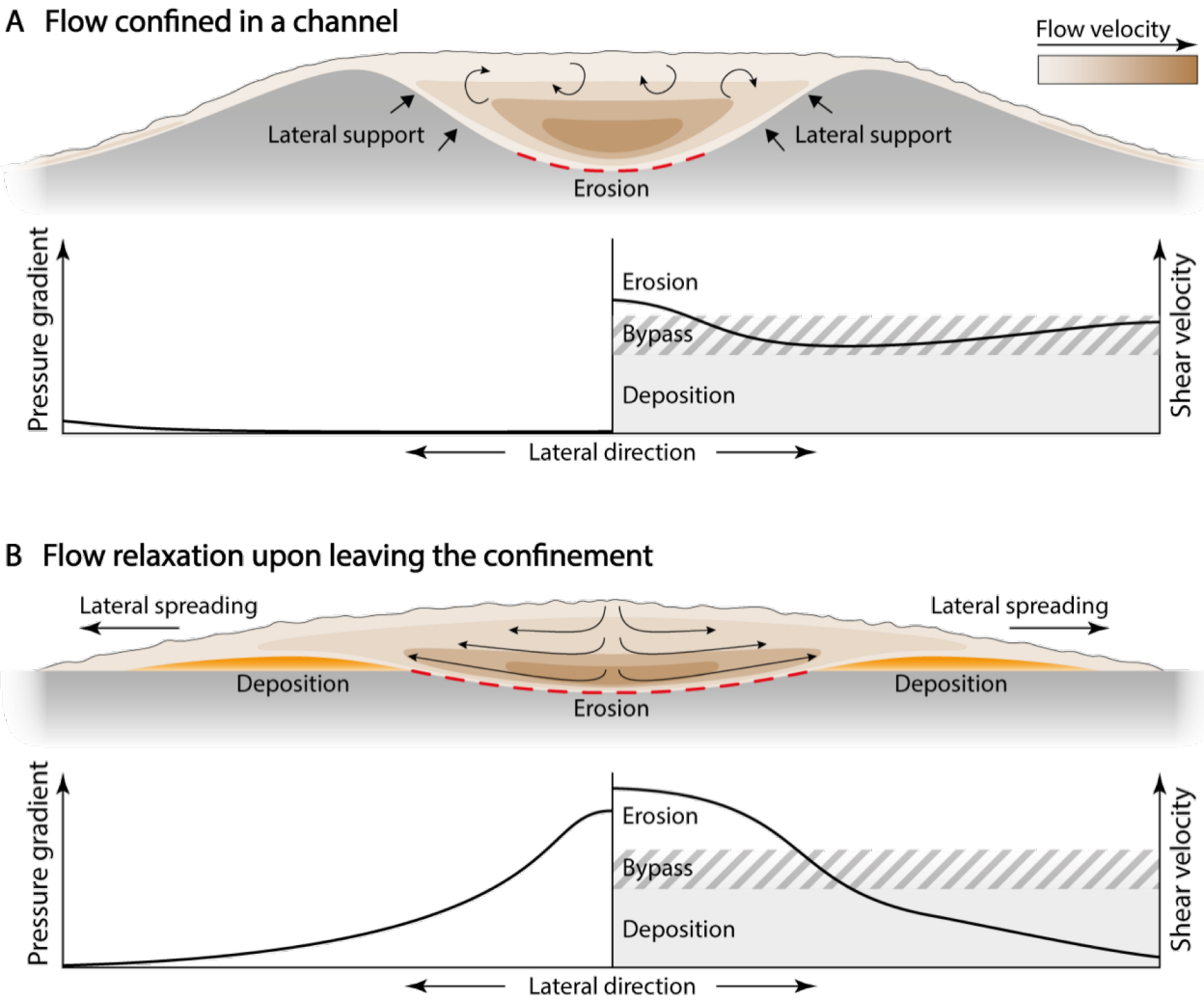


Discussion: flow relaxation model

Flow processes



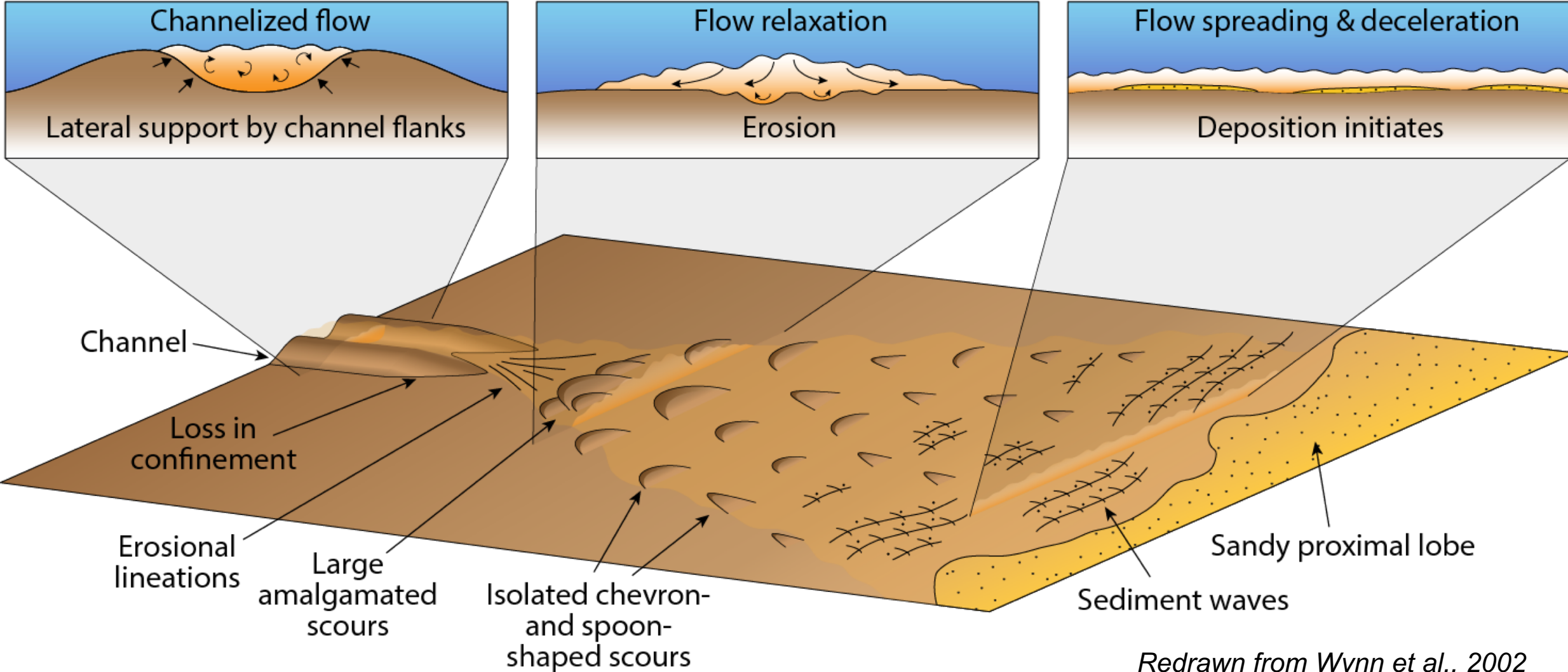
Conceptual model



Natural analogue



Final Remarks: flow relaxation in CLTZ's



Redrawn from Wynn et al., 2002

Future Research: rate of confinement loss effects

