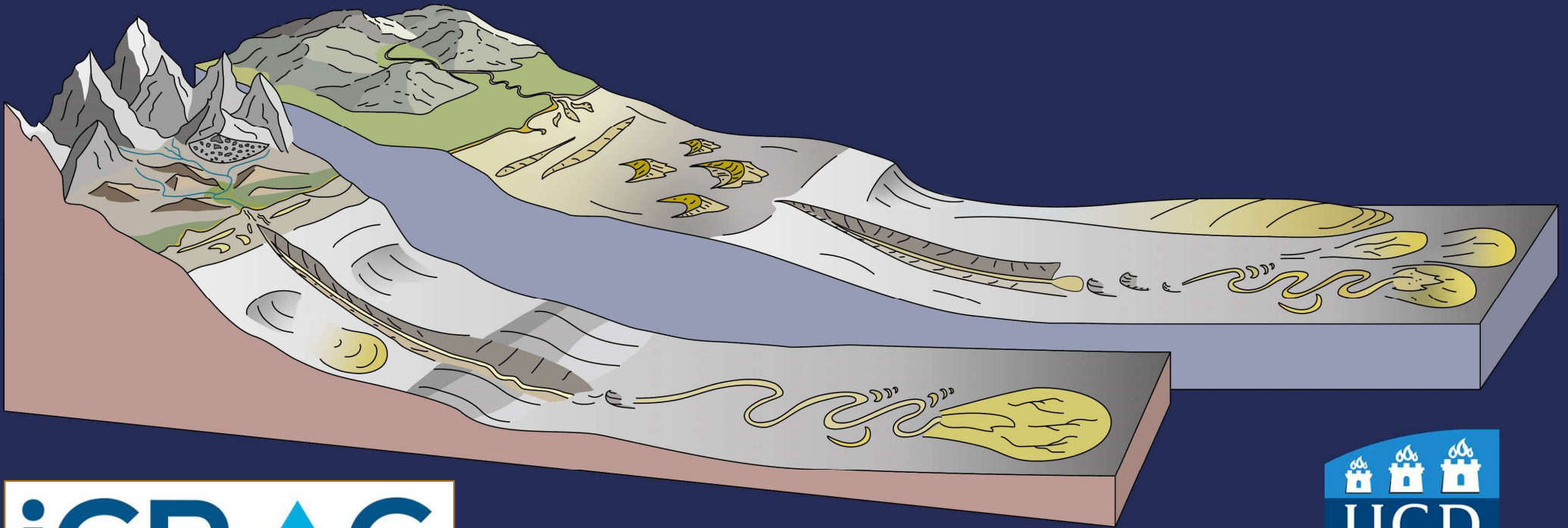


Sand detachment processes in modern deep marine environments: Analogues for updip stratigraphic traps

John W. Counts, Lawrence Amy, Rob Dorrell, Aggeliki Georgiopoulou, Peter Haughton, Ivan Lokmer

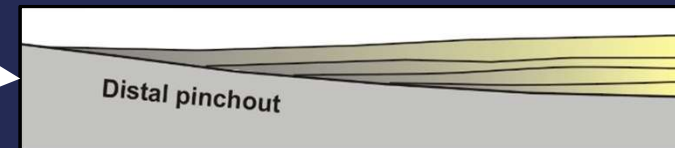
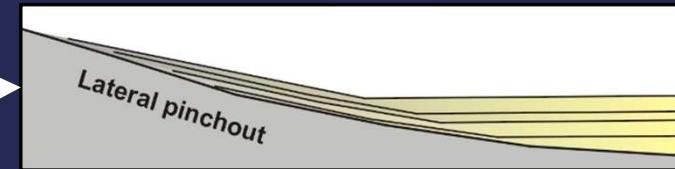
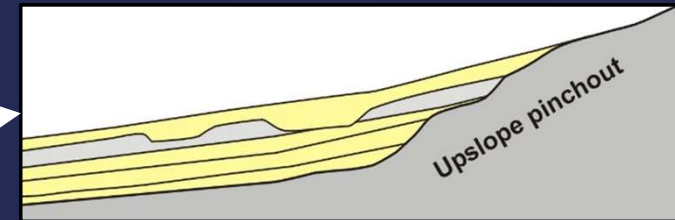
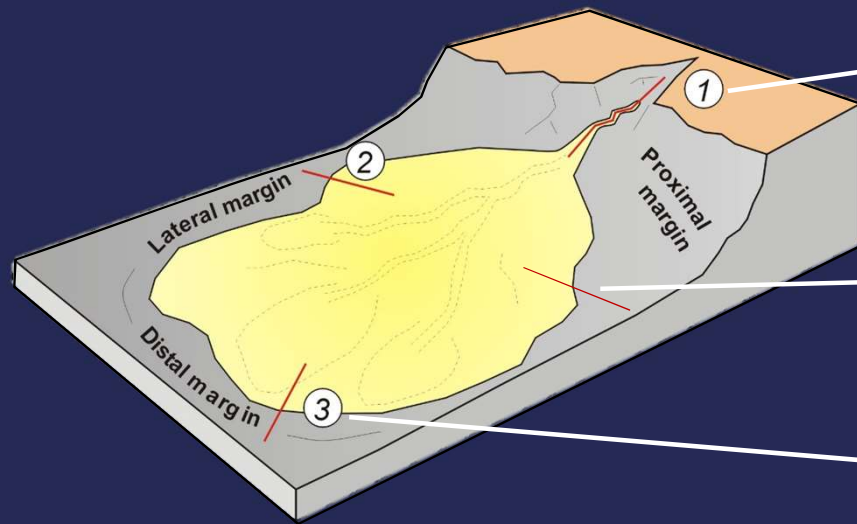


A 1.5-year postdoc project with iCRAG and
University College Dublin School of Earth Sciences

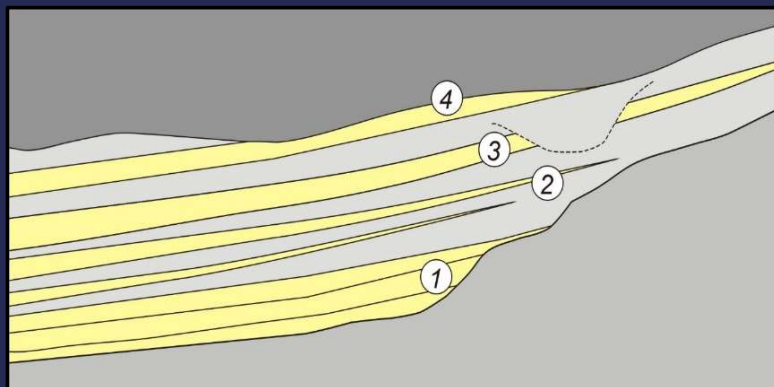


UNDERSTANDING STRATIGRAPHIC TRAPS

Pinchout types



Amy, 2019



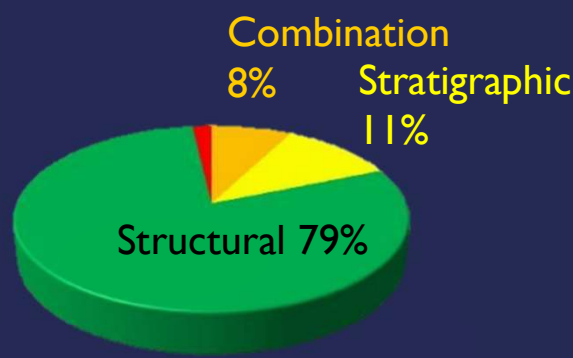
Stratigraphic pinchout occurs in multiple parts of a submarine fan system. This study is part of a larger project focusing on updip strat. traps.

UNDERSTANDING STRATIGRAPHIC TRAPS

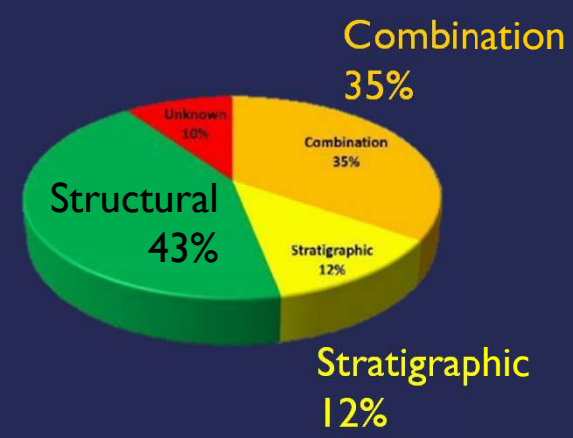
Components of numerous productive hydrocarbon systems



Historical Distribution
(2.9 Trillion BOE
1143 Fields)



Distribution Since 2000



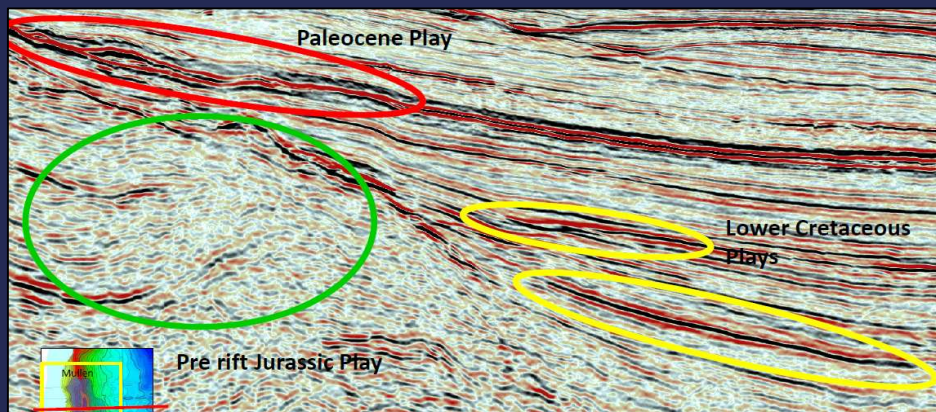
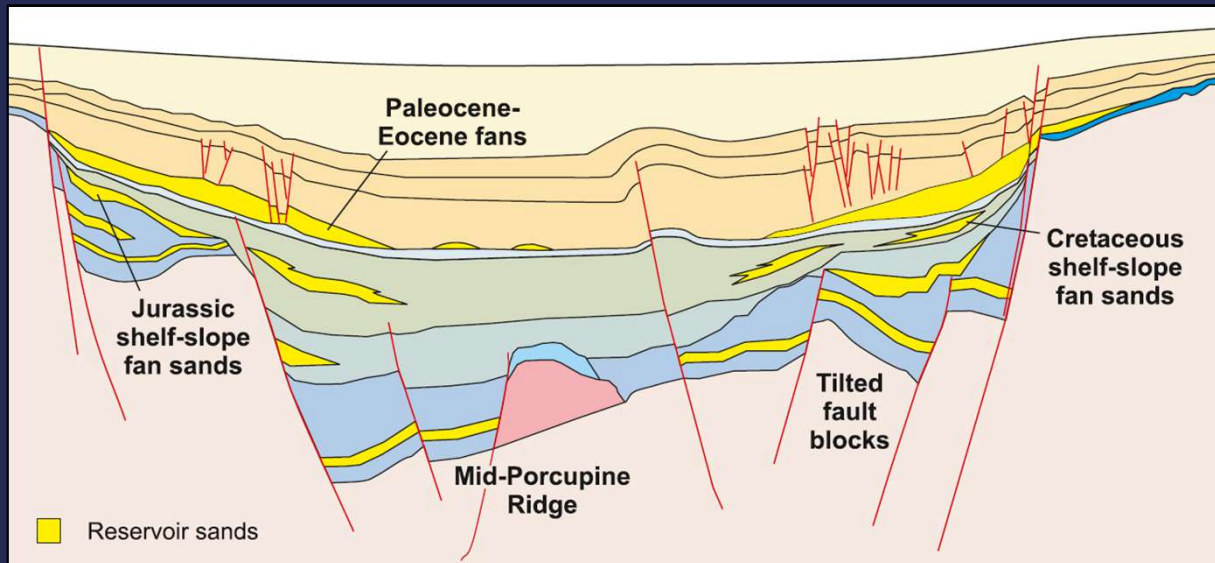
Dolson et al., 2018

*~21 producing fields **reported/inferred** to have upslope stratigraphic pinchout trapped reservoirs
**EUR values for fields (P50 values from various sources)

STRATIGRAPHIC TRAPS

Presence in the Porcupine Basin

PAD, 2006

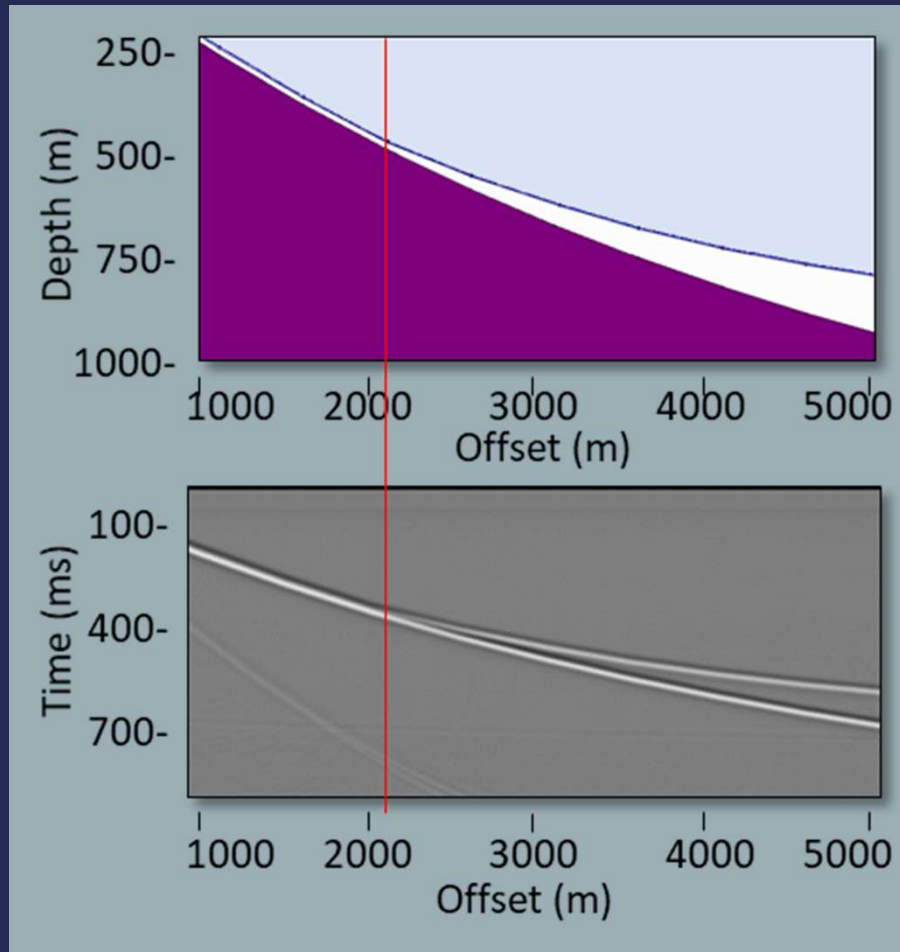


Stratigraphic traps may be present in the Porcupine Basin, where numerous fan systems are present and can be seen onlapping onto pre-rift sediments.

http://www.europaoil.com/documents/I40605Ireland_001.pdf

UNDERSTANDING STRATIGRAPHIC TRAPS

Limitations of seismic imaging



Olubukula et al. 2019 (in prep)

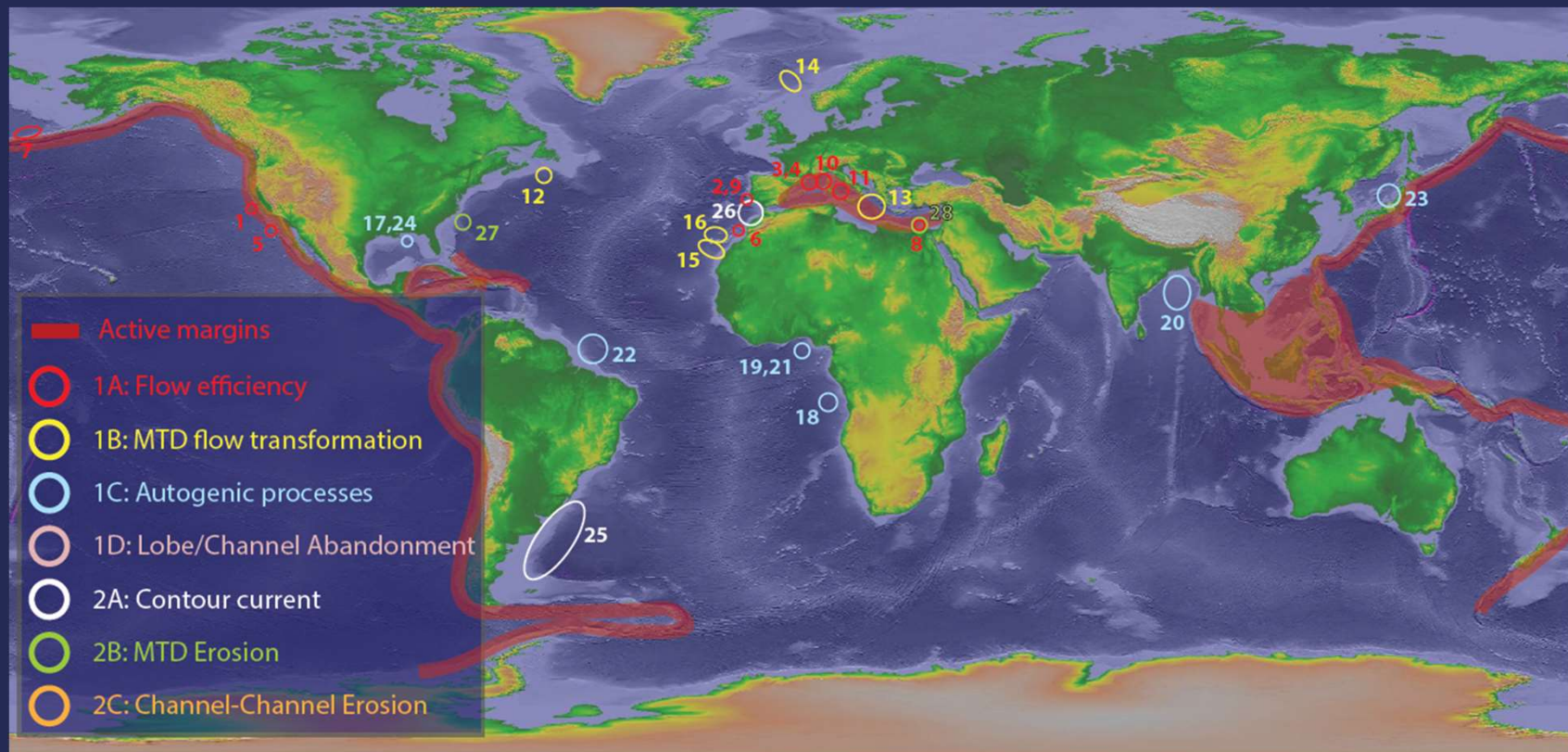
Stratigraphic traps may be falsely depicted by lower-resolution seismic data. Updip pinchouts in particular are at high risk for thin thief zones that are not visible in seismic.

Additional information is therefore necessary to help de-risk potential plays.

APPROACH

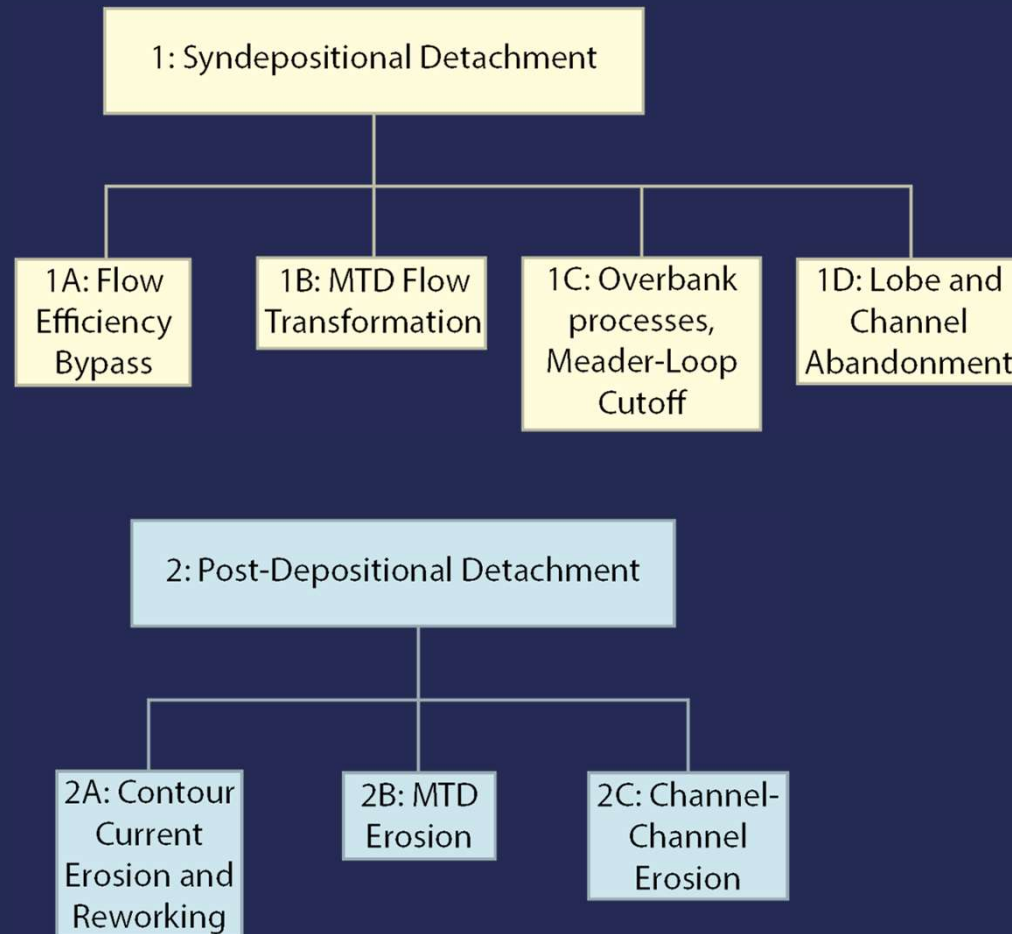
- Provide a better understanding of the processes and mechanisms responsible for the detachment and isolation of sand bodies in the marine environment
- Utilize the modern seafloor to offer new and different views on sand deposition, and put sedimentological processes into their oceanographic and geologic context.
- Address the following questions:
 - What depositional processes are involved in sand isolation?
 - At what point in the system does detachment occur?
 - How effective are different detachment processes?

REVIEW METHODOLOGY



Over 100 papers encompassing several dozen localities were examined for this study. Examples of detached sands were classified by process to create a catalogue of detachment mechanisms and their depositional products.

DETACHMENT PROCESSES



- Seven types of processes were identified in the literature, with varying degrees of abundance in the modern ocean.
- Processes can be classified based on the timing of detachment (syndepositional vs. postdepositional).

Equilibrium Flow and Grade

Non-equilibrium erosional flow

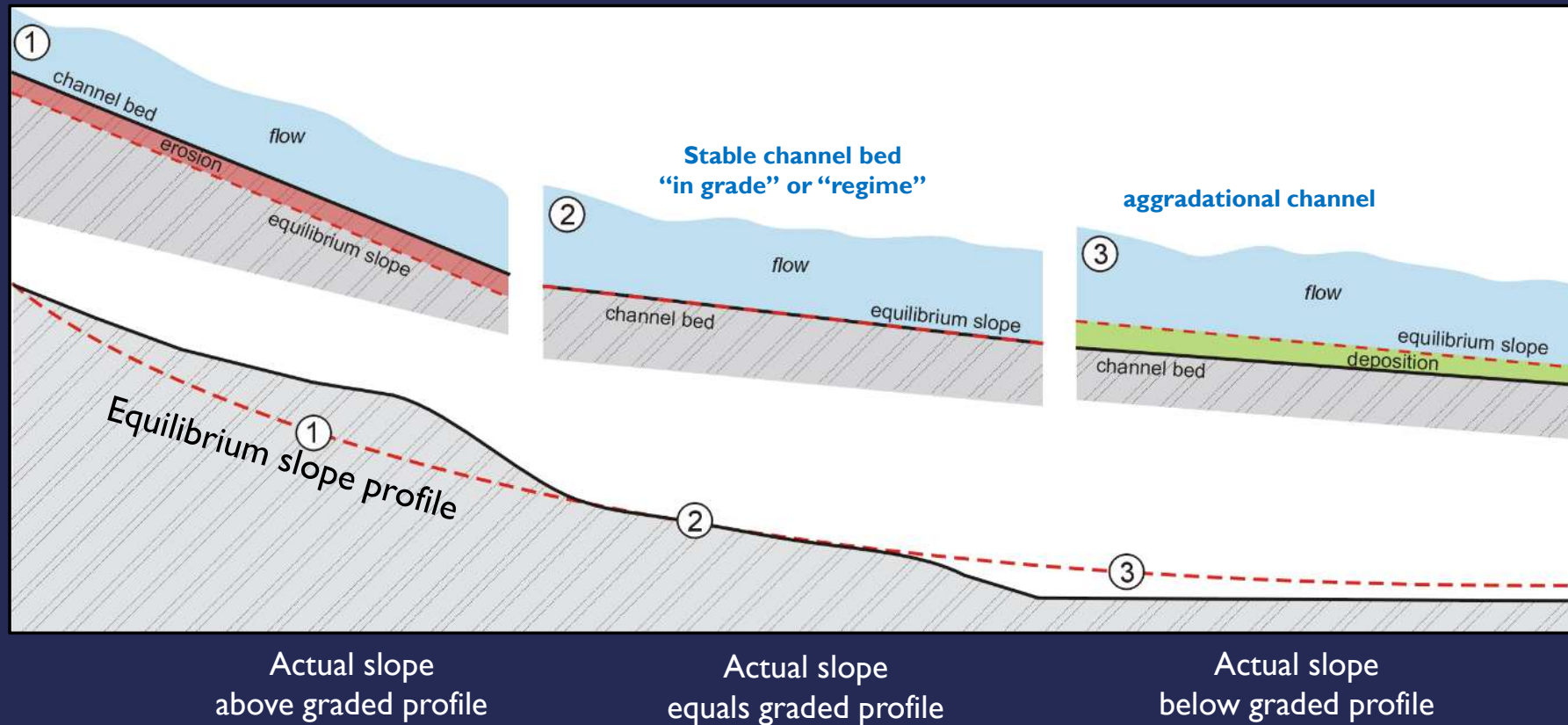
flow under capacity
sediment in < sediment out

Equilibrium flow erosion = deposition

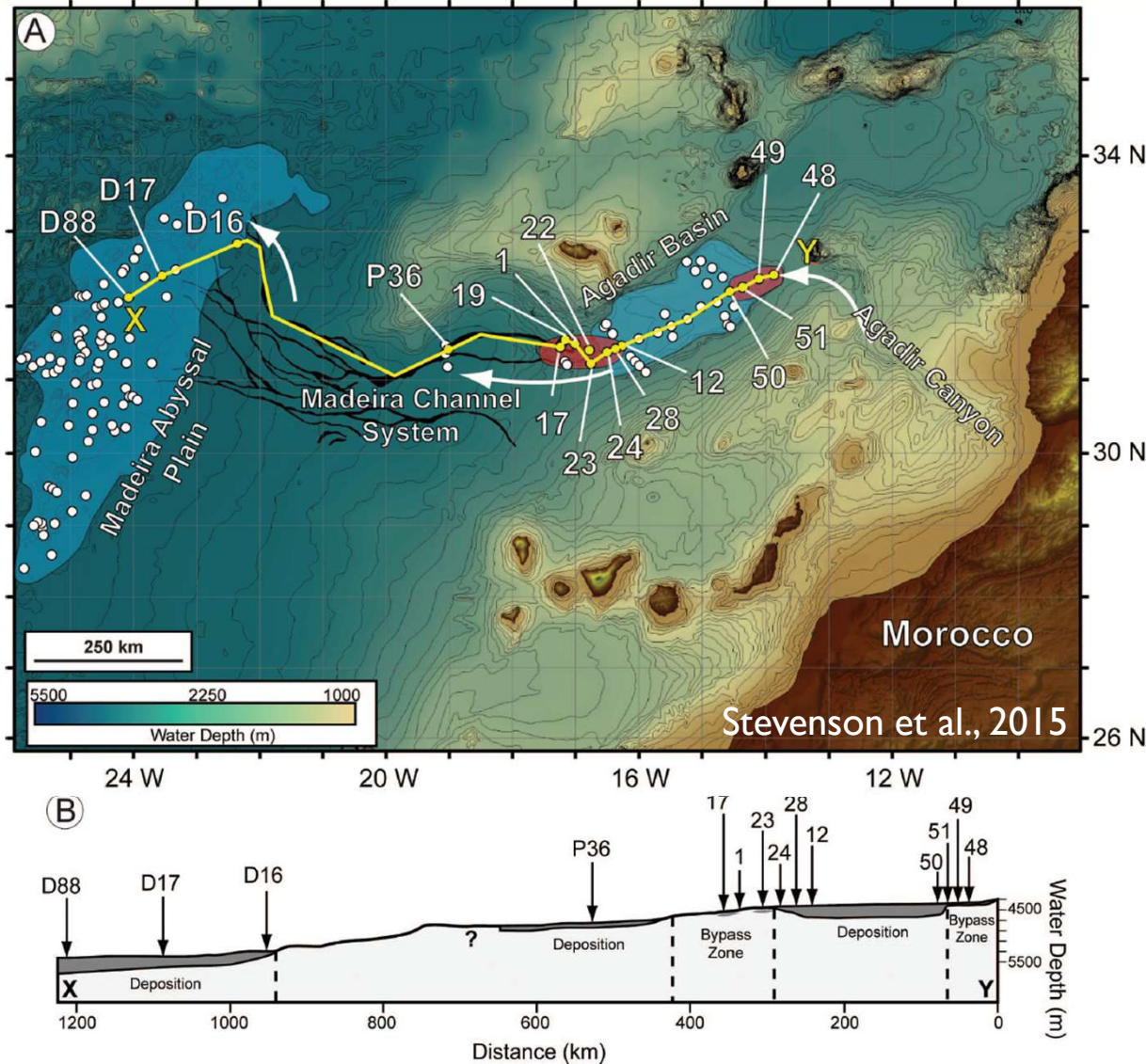
flow at capacity limit
sediment in = sediment out

Non-equilibrium depositional flow

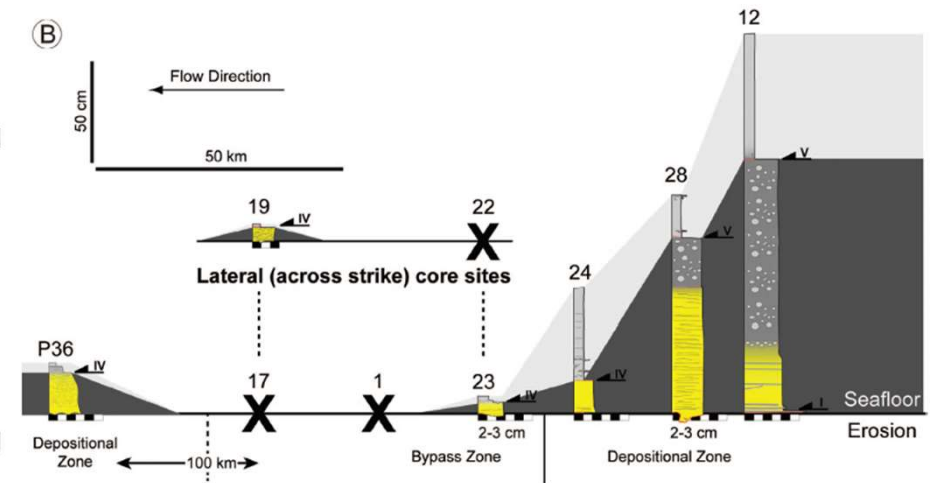
flow over capacity
sediment in > sediment out



Bypass in Natural Systems: Agadir Basin

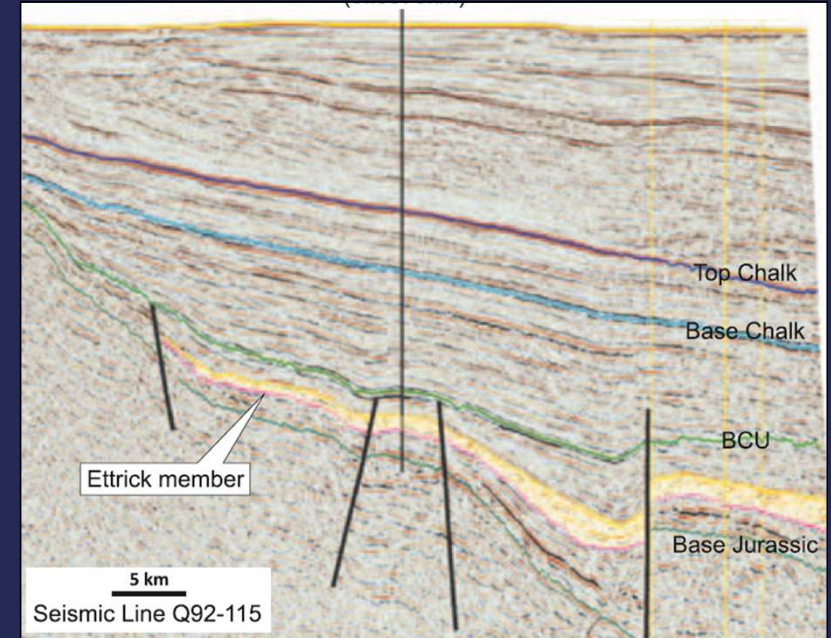
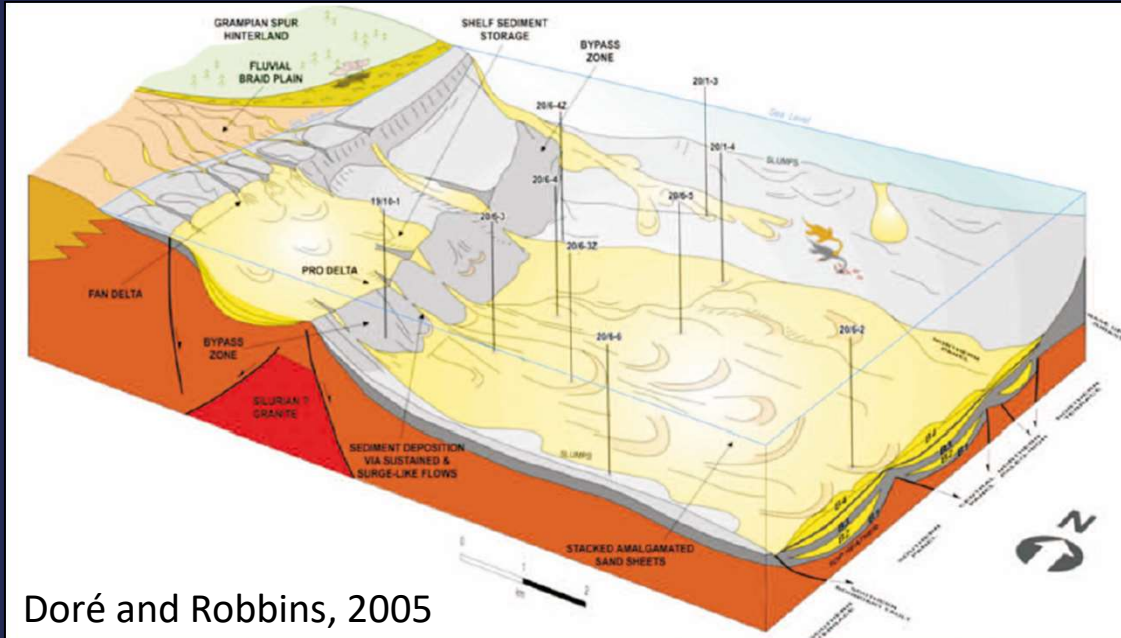


The Agadir system encompasses a series of Oligocene- Recent turbidites sourced from southern Morocco.



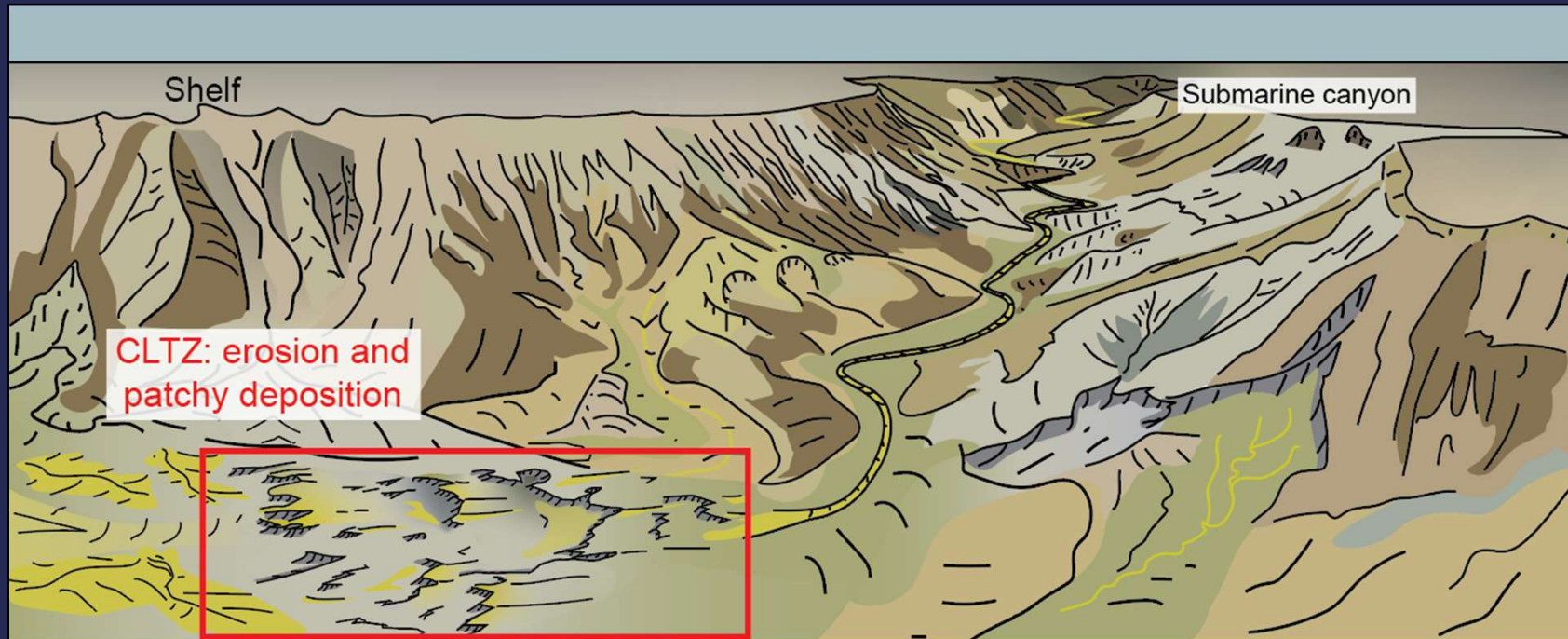
Bypass is observed in higher-gradient parts of the Agadir turbidite system. Locations where non-deposition occurs fit with recent models of flow efficiency.

Bypass in the Subsurface: Buzzard Field



Buzzard field provides a well-studied example of a stratigraphic pinchout trap onto a fault-controlled margin but where faulting at the reservoir level is not believed to ultimately control trapping.

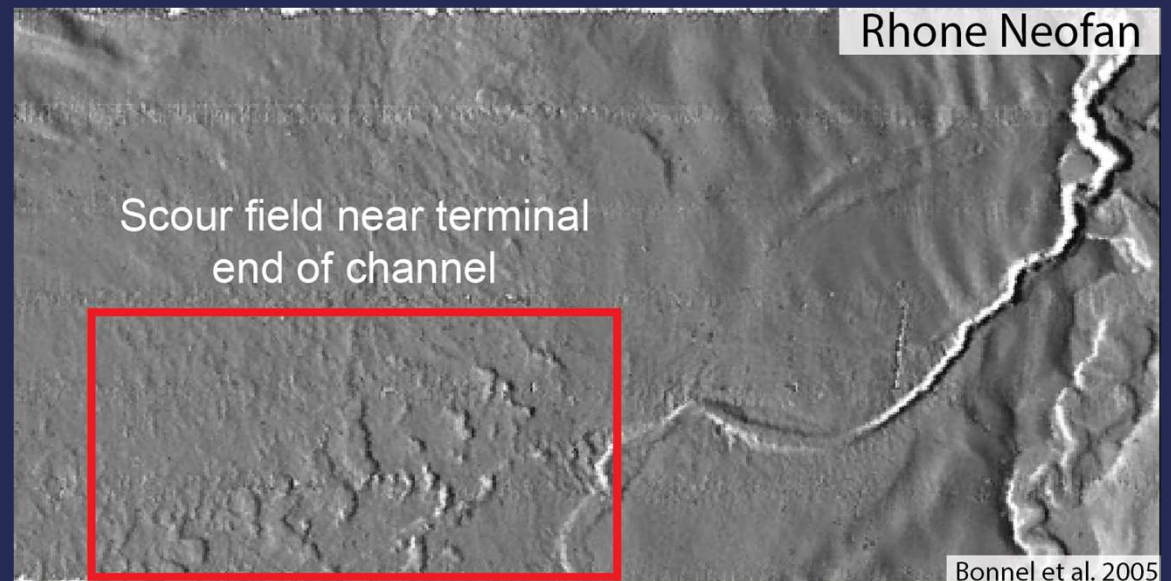
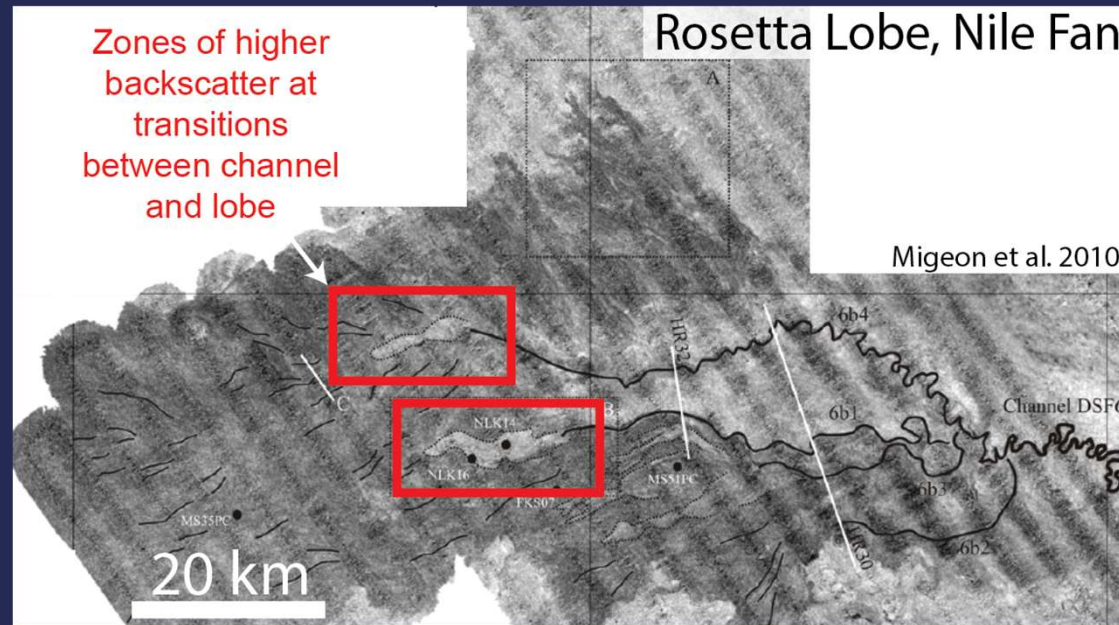
Bypass in Channel-Lobe Transition Zones



Bypass may also occur at channel-lobe transition zones (CLTZs) due to hydraulic jumps or flow relaxation. This forms a scour zone recognizable in many of the world's submarine turbidite systems.

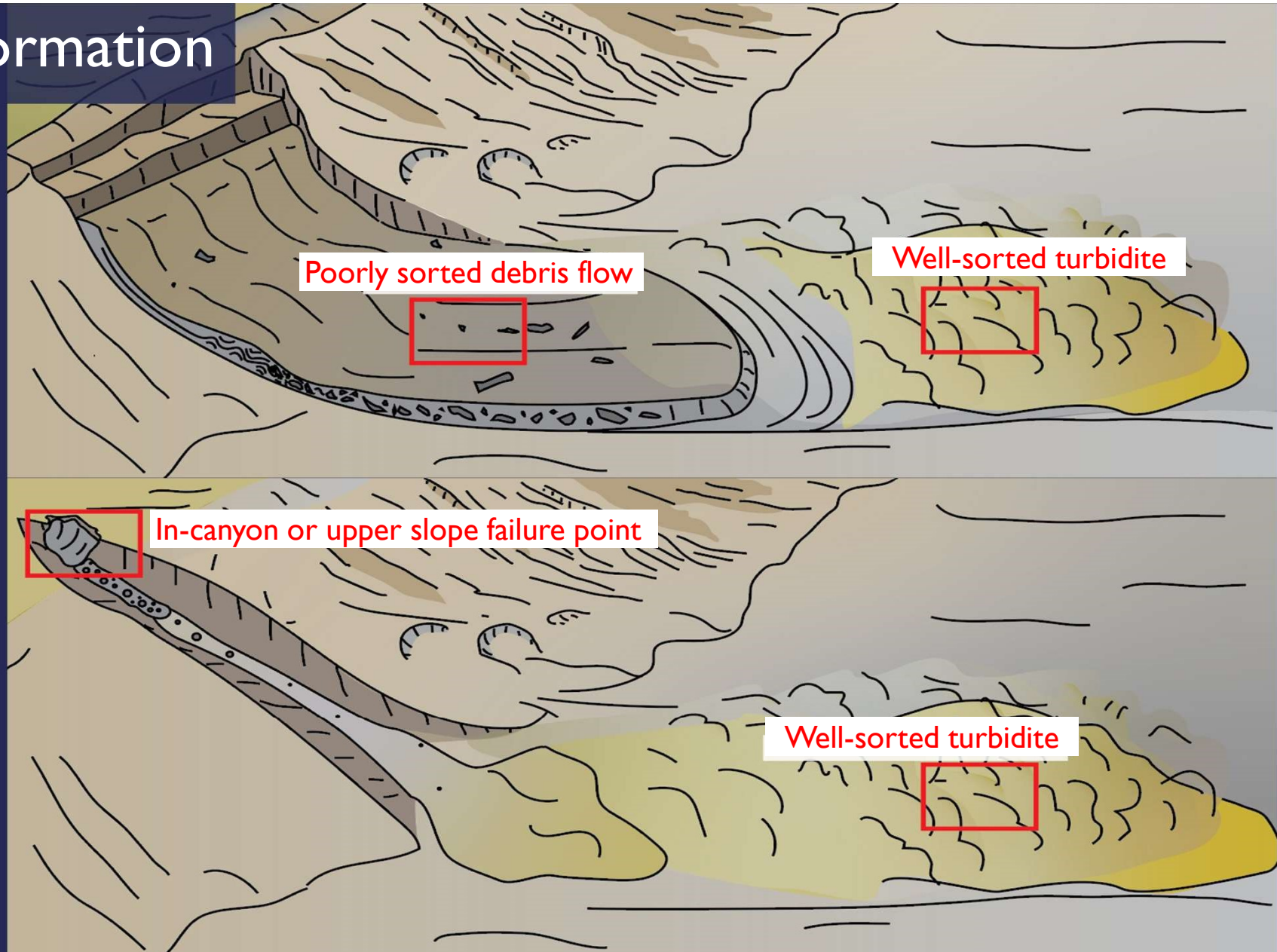
CLTZs

Partial bypass in CLTZs can be seen in backscatter/bathymetry data, often in the form of patchy scours and changes in grain size. Detachment is likely incomplete.

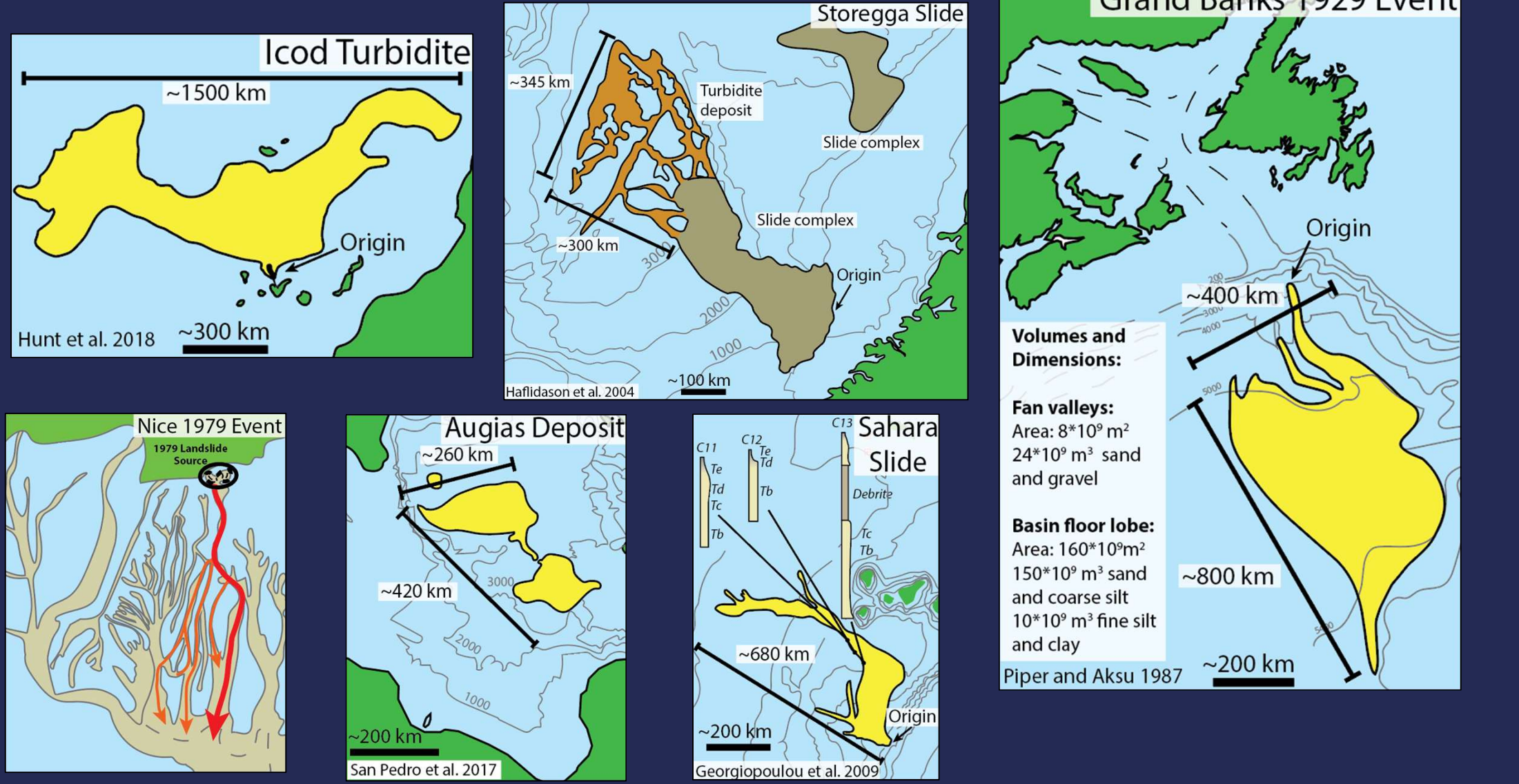


I B: Flow Transformation

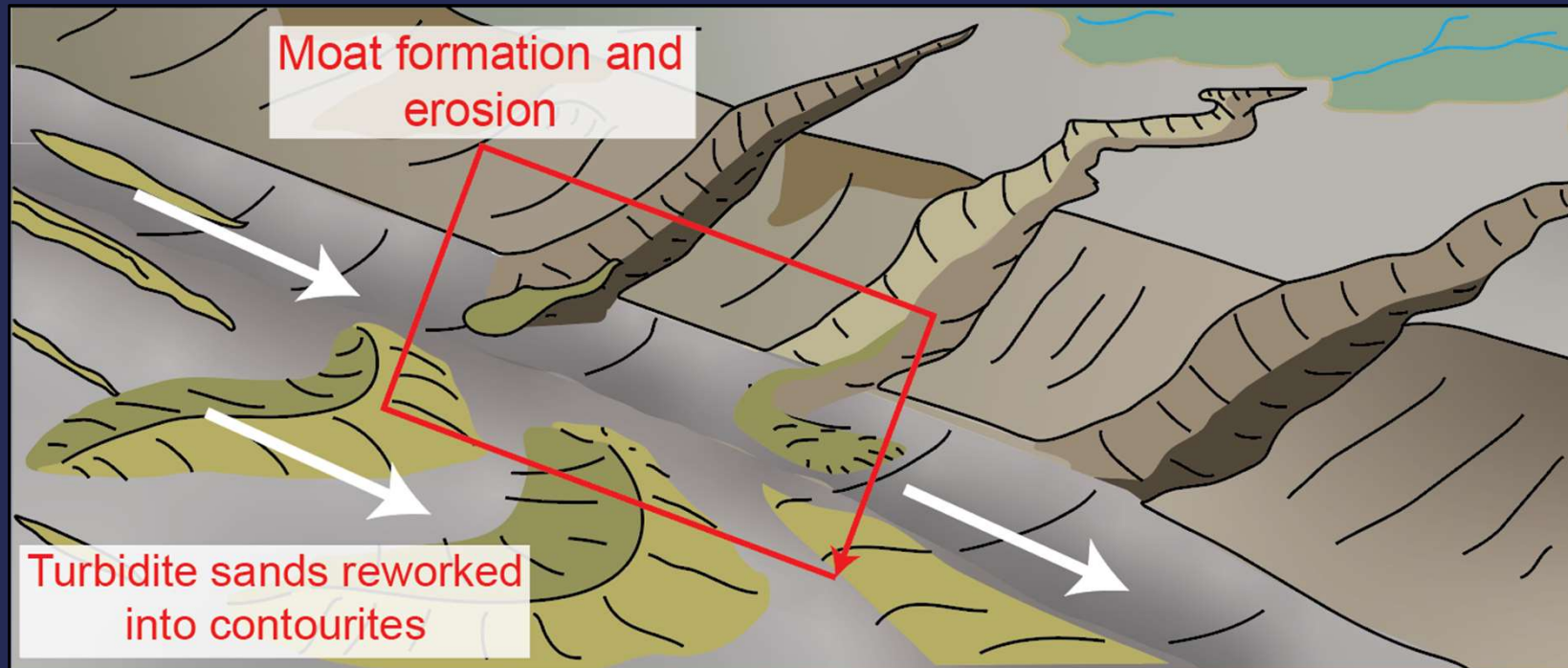
Slope failures often lead to mass-transport deposits on the seafloor, however, these can transform into turbidity currents that segregate sands into discrete beds.



I B: Flow Transformation Examples



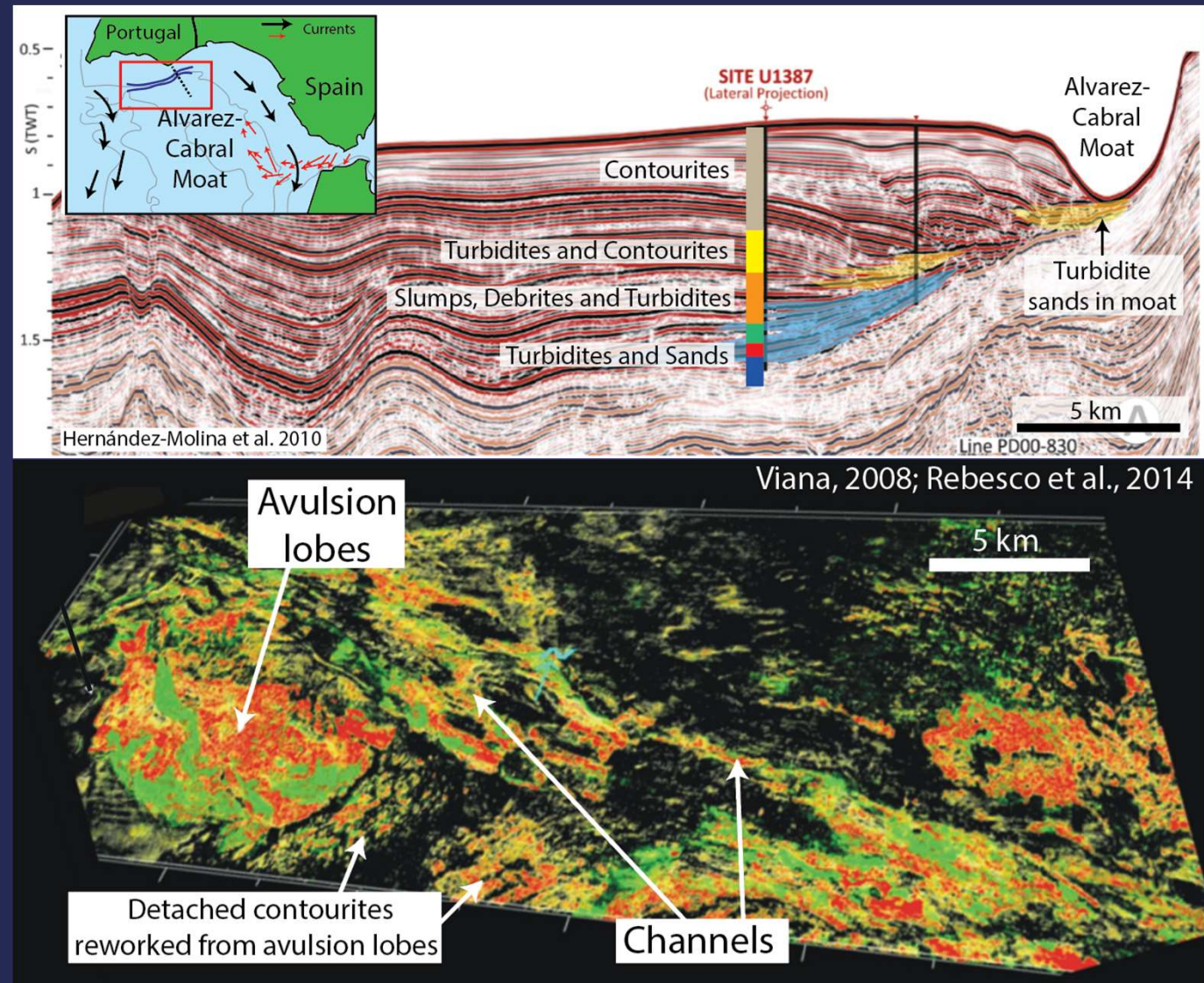
2A: Contour Current Erosion



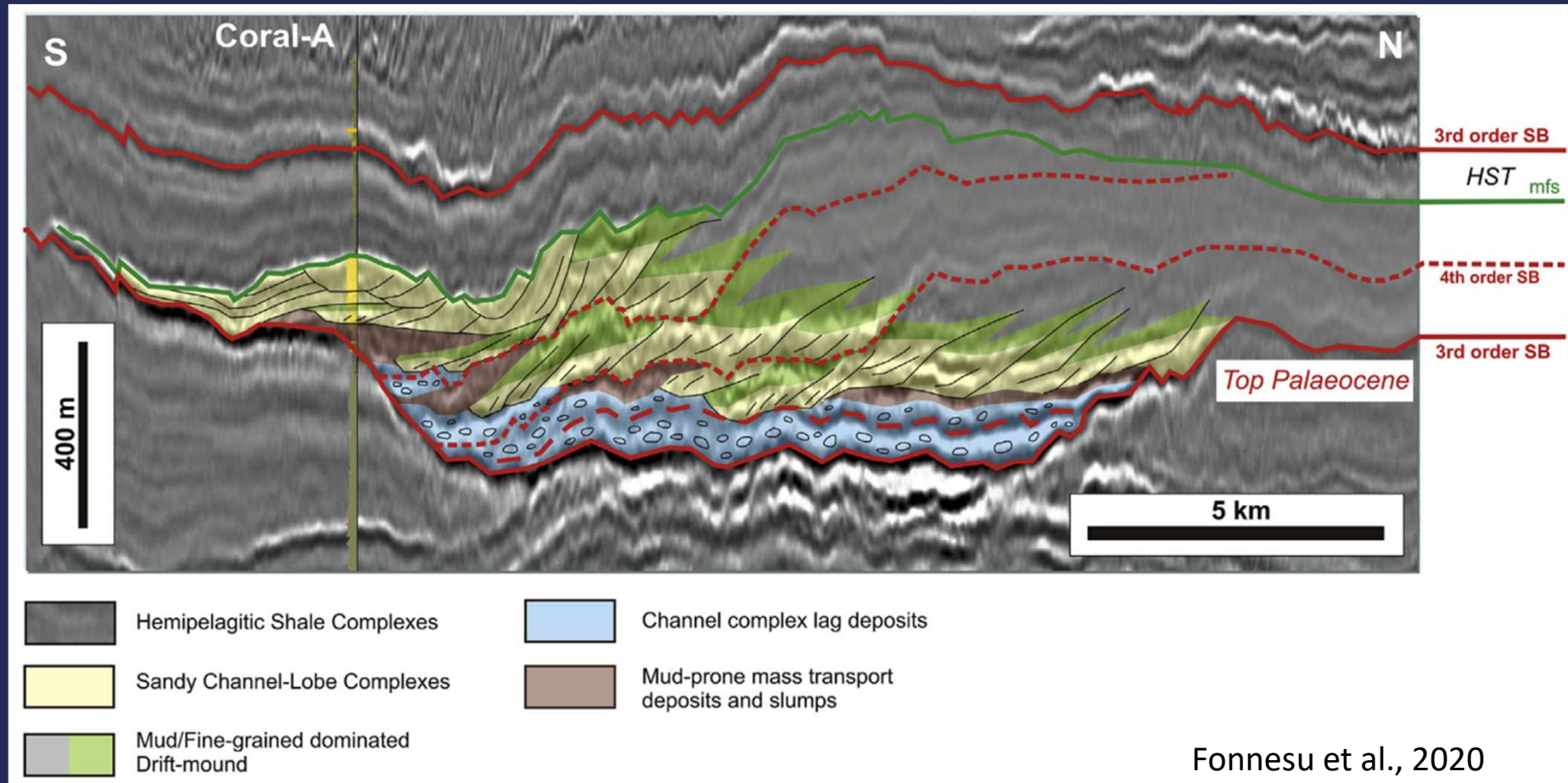
Contour currents may transport or modify the properties of turbiditic sands, in some cases leading to detached, isolated sand bodies. More often, however, they winnow fines from existing deposits, improving their reservoir quality.

2A: Contour Current Erosion

Examples of detached sandy contourites on the seafloor are uncommon. Most shallow subsurface examples show these deposits as smaller components of current-influenced turbidite systems.

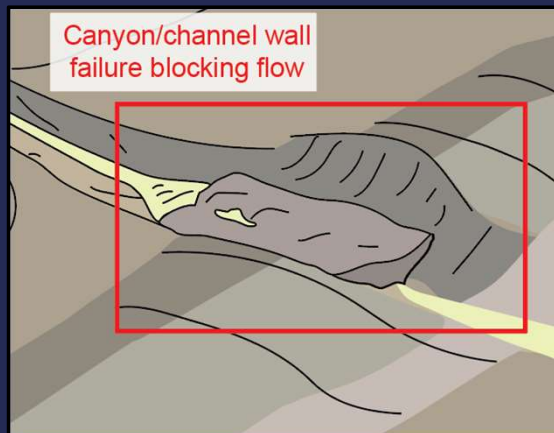
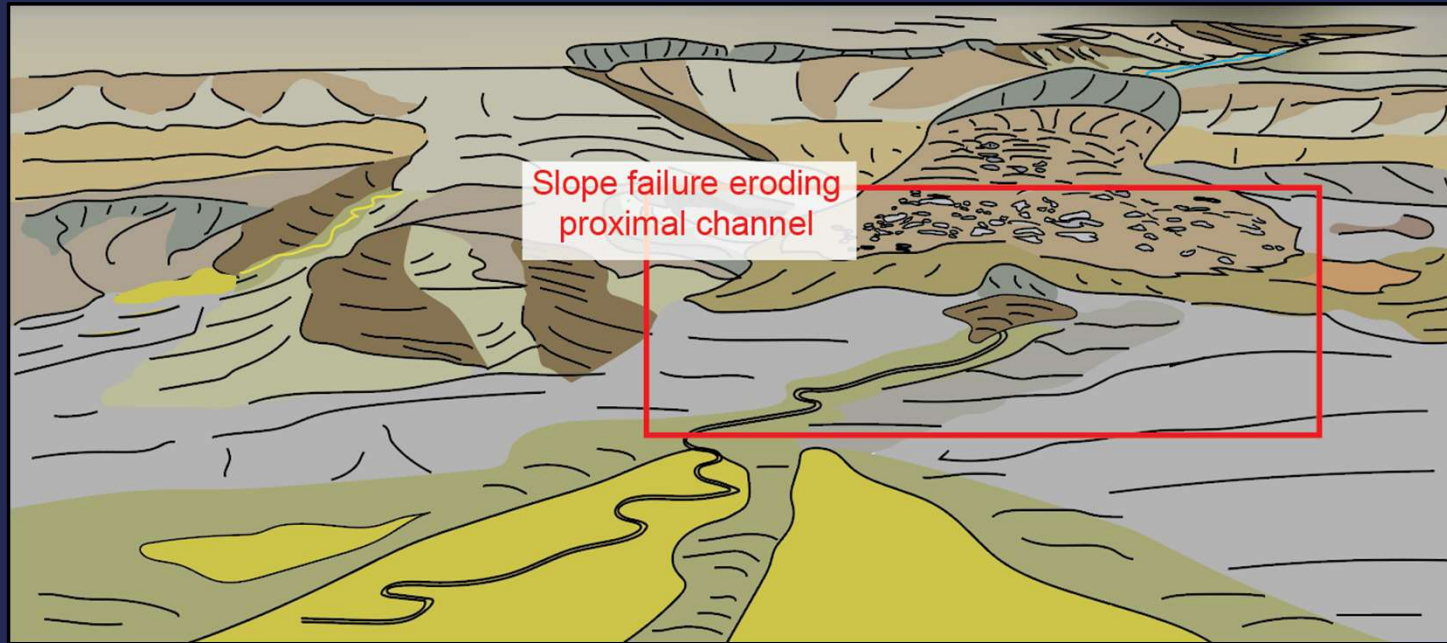


2A: Contour Current Erosion



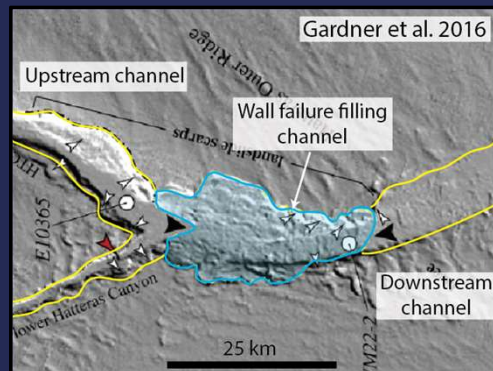
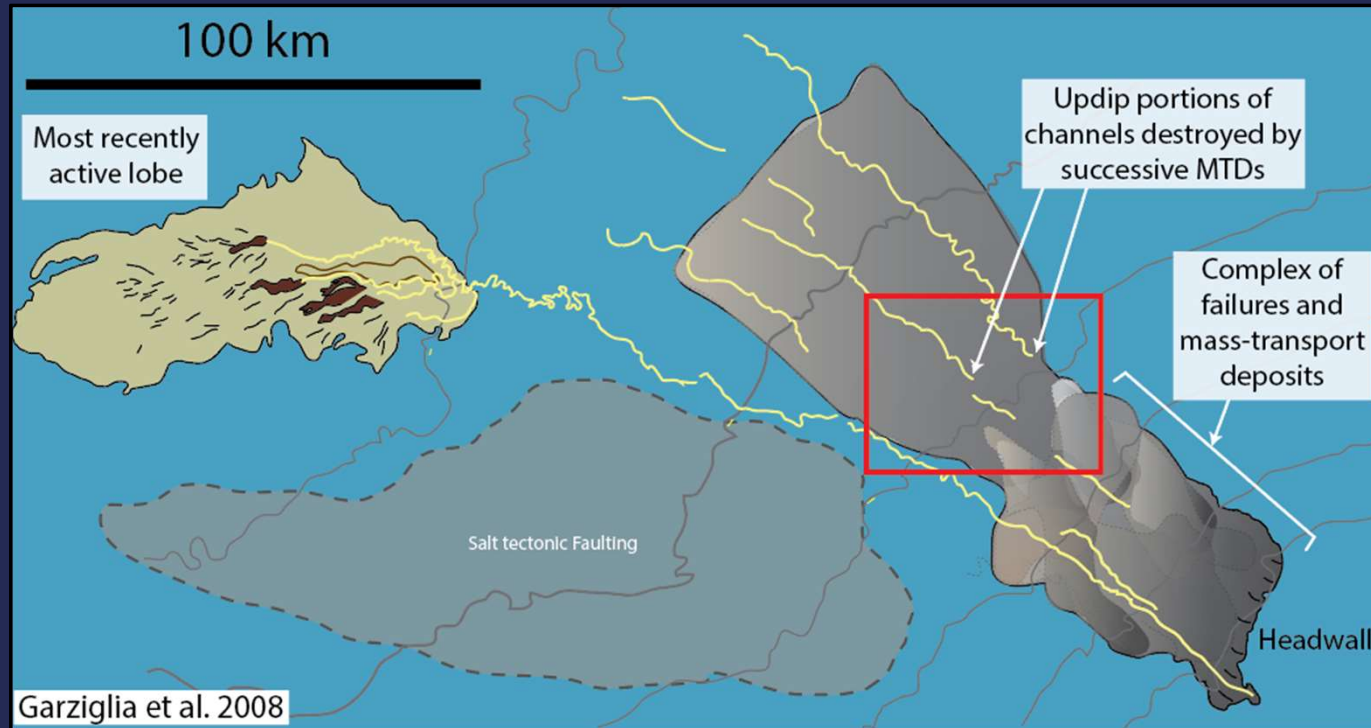
Coral field, offshore Mozambique: a combined turbidite-contourite play with multiple TCF potential; upslope bypass channel trap

2B: Erosion by MTDs



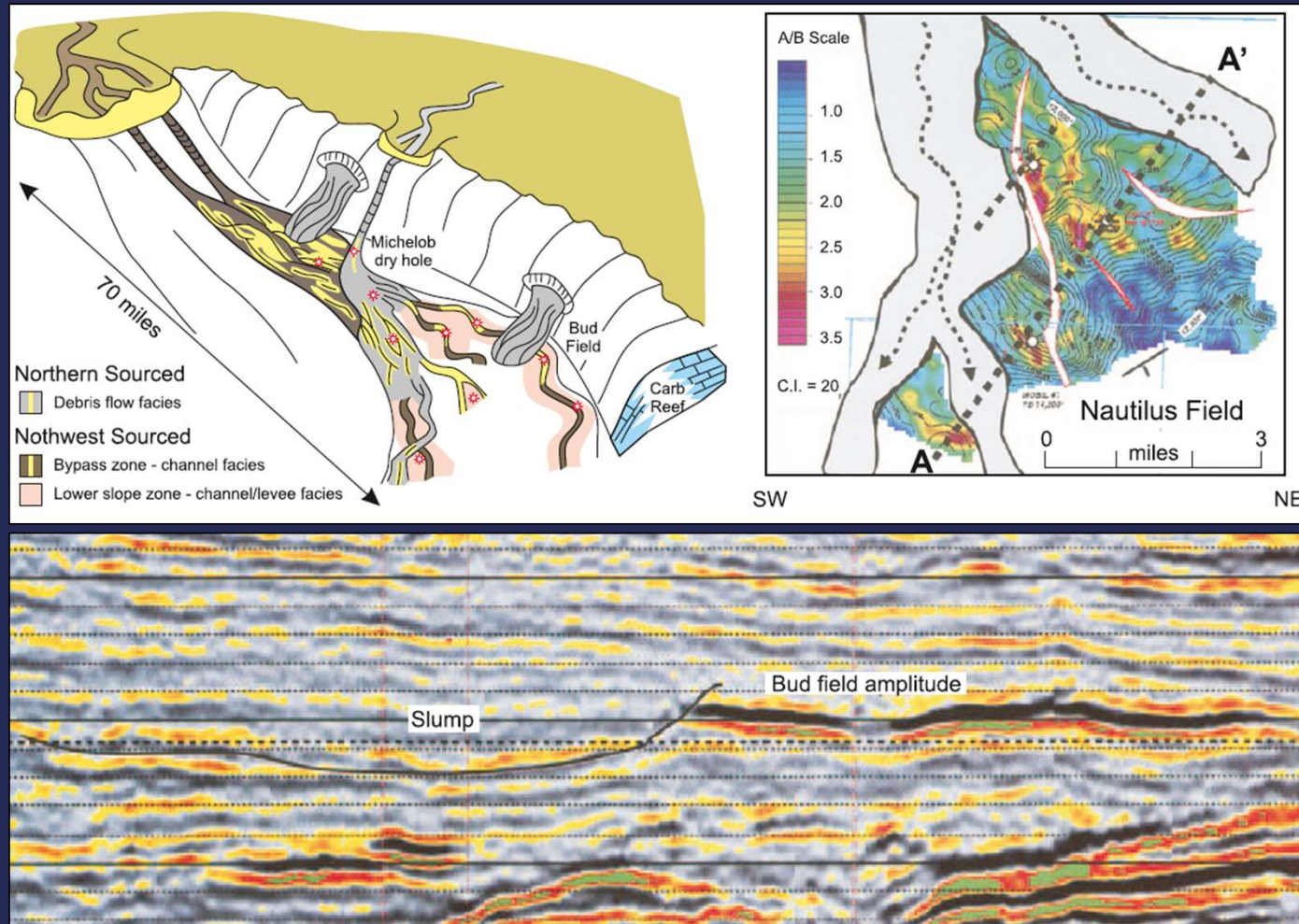
- Slope failure erodes canyons and proximal portions of channels
- In-canyon/channel collapse erodes and blocks future flows

2B: Erosion by MTDs



Channel decapitation and channel-blocking MTDs are found in the Nile and Hatteras systems, respectively.

2B: Erosion by MTDs



Godo, 2006

MTD-constrained fields and depositional models in the Gulf of Mexico.

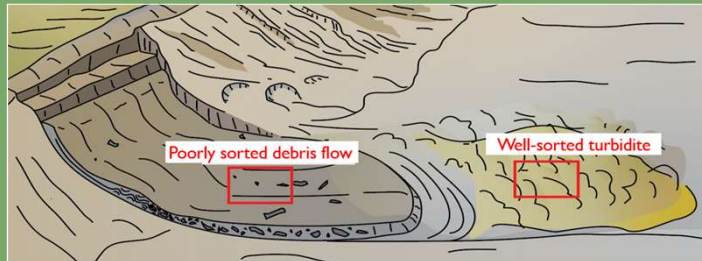
Summary

Unambiguous detachment

- Flow Efficiency Bypass



- Flow Transformation

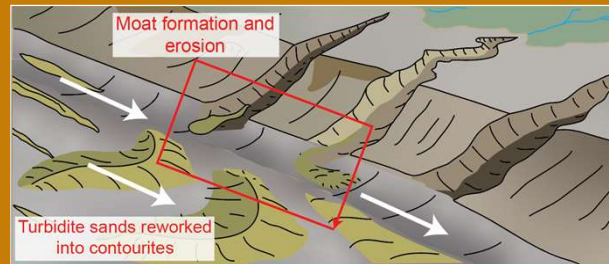


- MTD Erosion

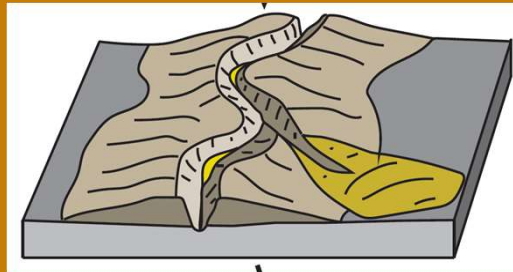


Potential for detachment

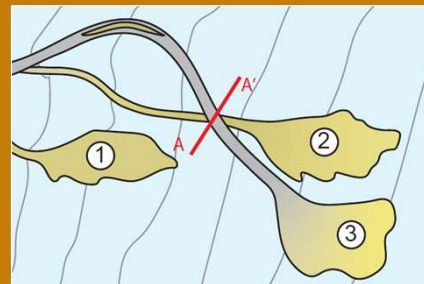
- Contourite Reworking



- Lobe abandonment

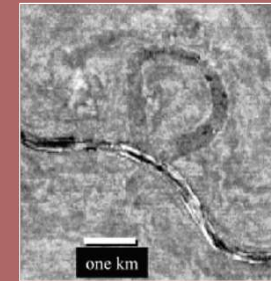


- Channel erosion



Unproven detachment

- Meander loop cutoff



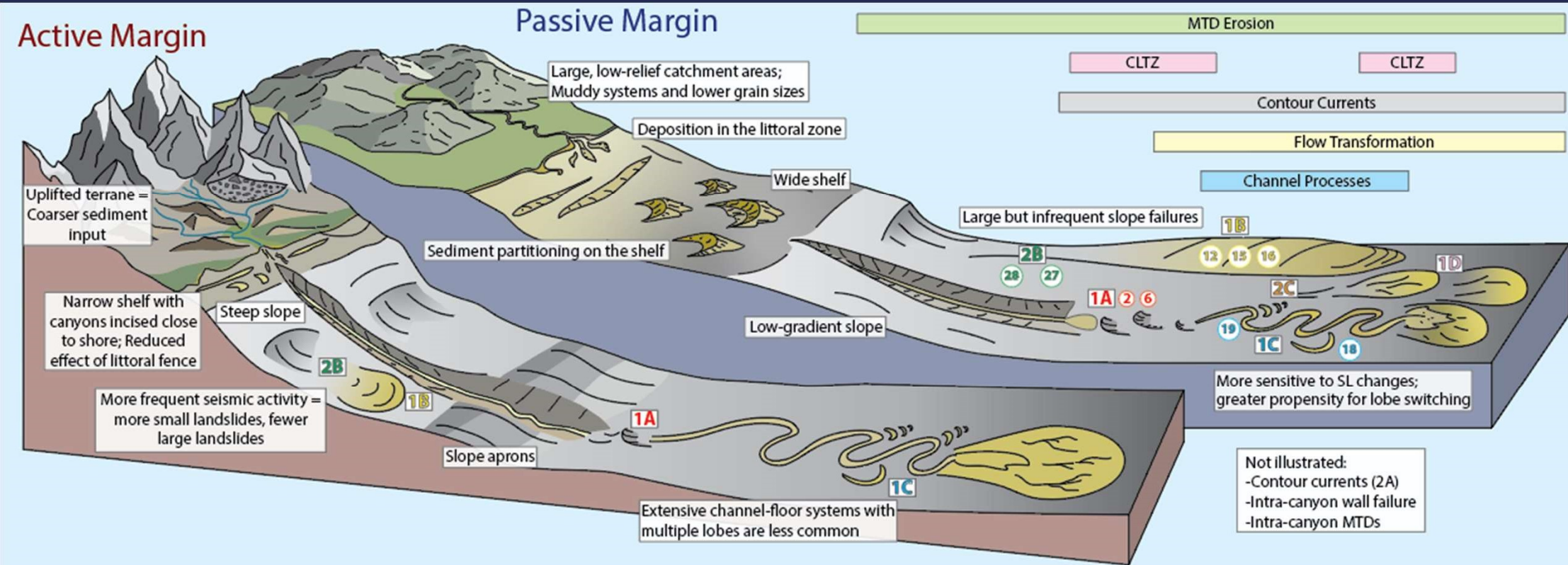
Working example in the subsurface?

- Bypass
- MTD Erosion
- Channel erosion
- Contourites

Reservoir-scale potential?

- Bypass
- MTD Erosion
- Flow Transformation
- Lobe abandonment

RESULTS



Detachment processes are the product of geological and oceanographic forces, and therefore occur at certain locations within the depositional system, as they are controlled by slope, sediment input, and tectonic forces, their frequency of occurrence can also be correlated to certain margin types

CONCLUSIONS

The modern seafloor can help to better our understanding of stratigraphic traps by:

- Providing a catalogue of the variety of potential sand isolation processes
- providing a better view of the spatial geometry of potential strat trap reservoirs
- Providing a larger context for stratigraphic pinchout and erosional processes
- Qualitatively derisking similar subsurface scenarios by providing modern analogues