Understanding Deep-Water Architecture from Process Interpretation at Outcrop: An (Ancient to Modern)[2] Perspective*

Ole J. Martinsen[1] and John B. Thurmond[1]

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[1]StatoilHydro Research, Bergen, Norway (ojma@statoilhydro.com)

Abstract

Outcrops provide vital information for understanding both modern and ancient deep-water sedimentary systems. Still, interpretation of plan view geometries in outcrops is challenging and usually ambiguous, in contrast to those in 3D seismic, where deep-water architecture is readily observed. Attention to classic details such as paleocurrents, bed thickness changes and geometries, and bed stacking is vital to understand processes and architecture in outcrops. Classic outcrops, such as the Ainsa system of Spain and the Ross and Gull Island Formations of western Ireland, show that both subtle and larger differences in processes cause substantial changes in interpreted architecture between channels and channel-related lobes. The presentation focuses on how these key observations can be transferred to subsurface settings where population of seismic geometries with detailed process understanding is vital for exploration and production.

Understanding Deep-Water Architecture from Process Interpretation at Outcrop: An (Ancient to Modern)^2 Perspective

Ole J. Martinsen and John B. Thurmond

With insight from Drs. Tore Løseth, Trond Lien & Chris Leppard

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Aims of presentation

- **Challenge: outcrop recognition of deep-water processes and architecture**

- **Relations to other research arenas dealing with process control on architecture**

Point Lobos, Monterey, California

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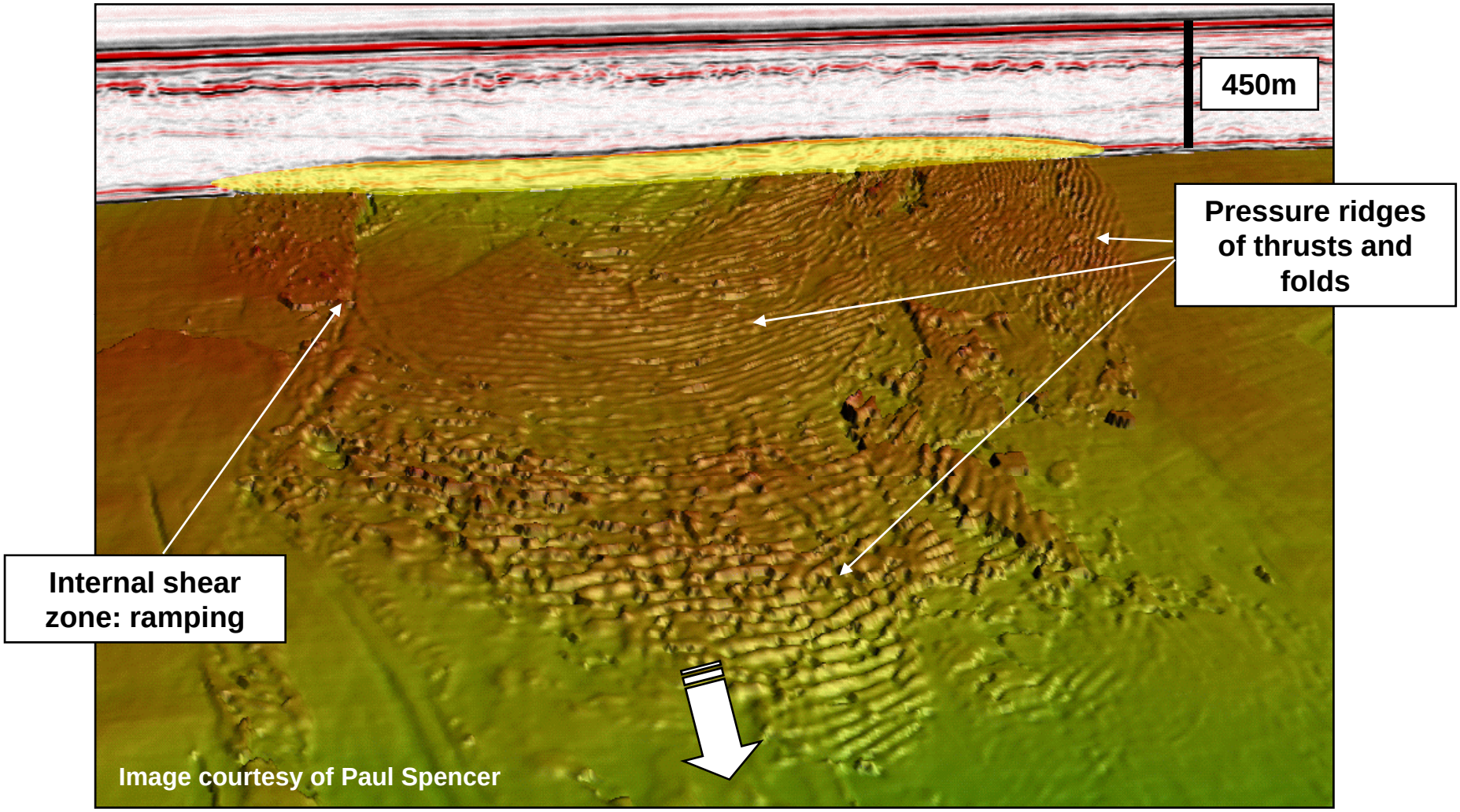
Aim of process vs. architecture control: 4D insight



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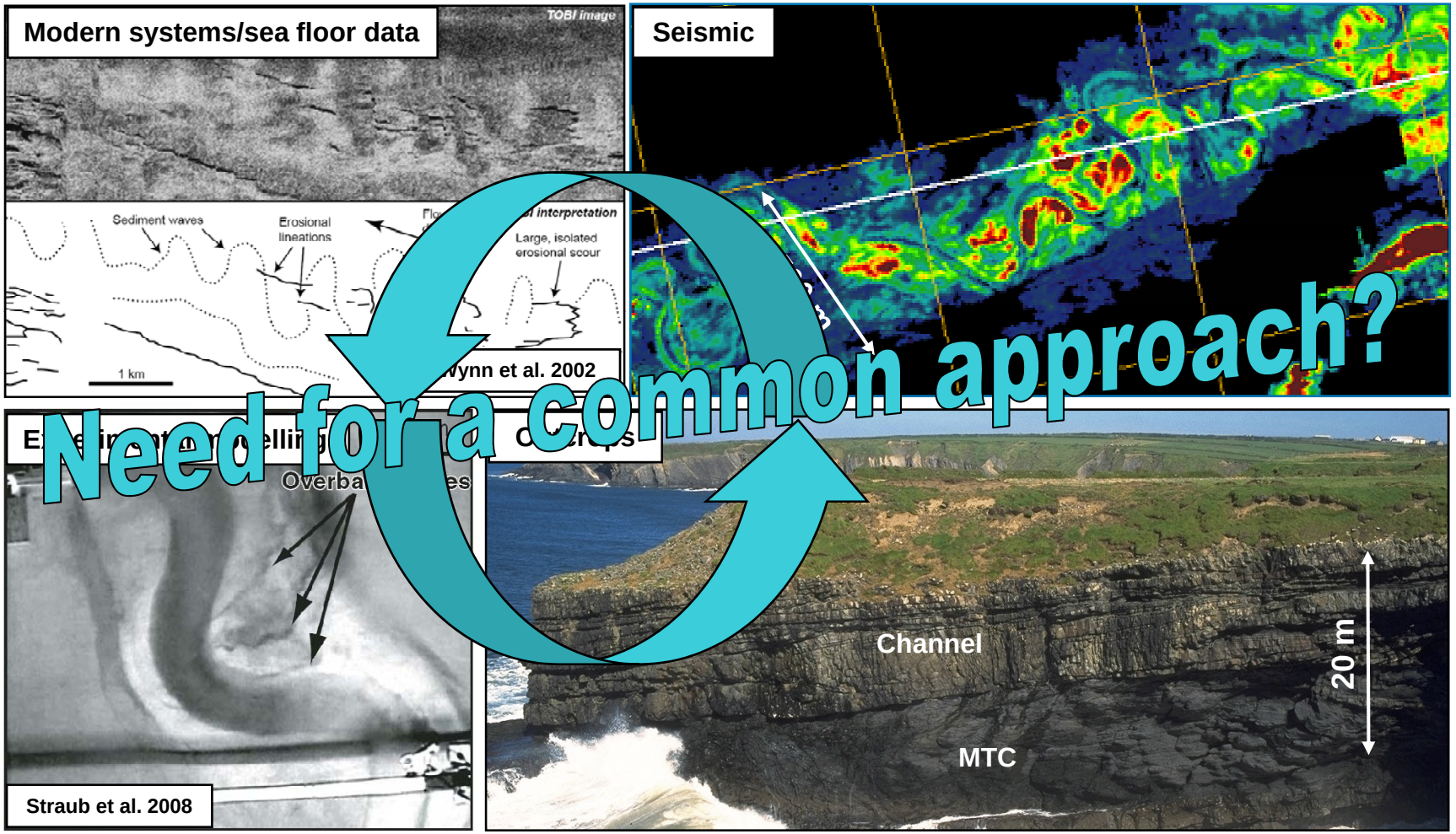
Arenas for process-architecture understanding



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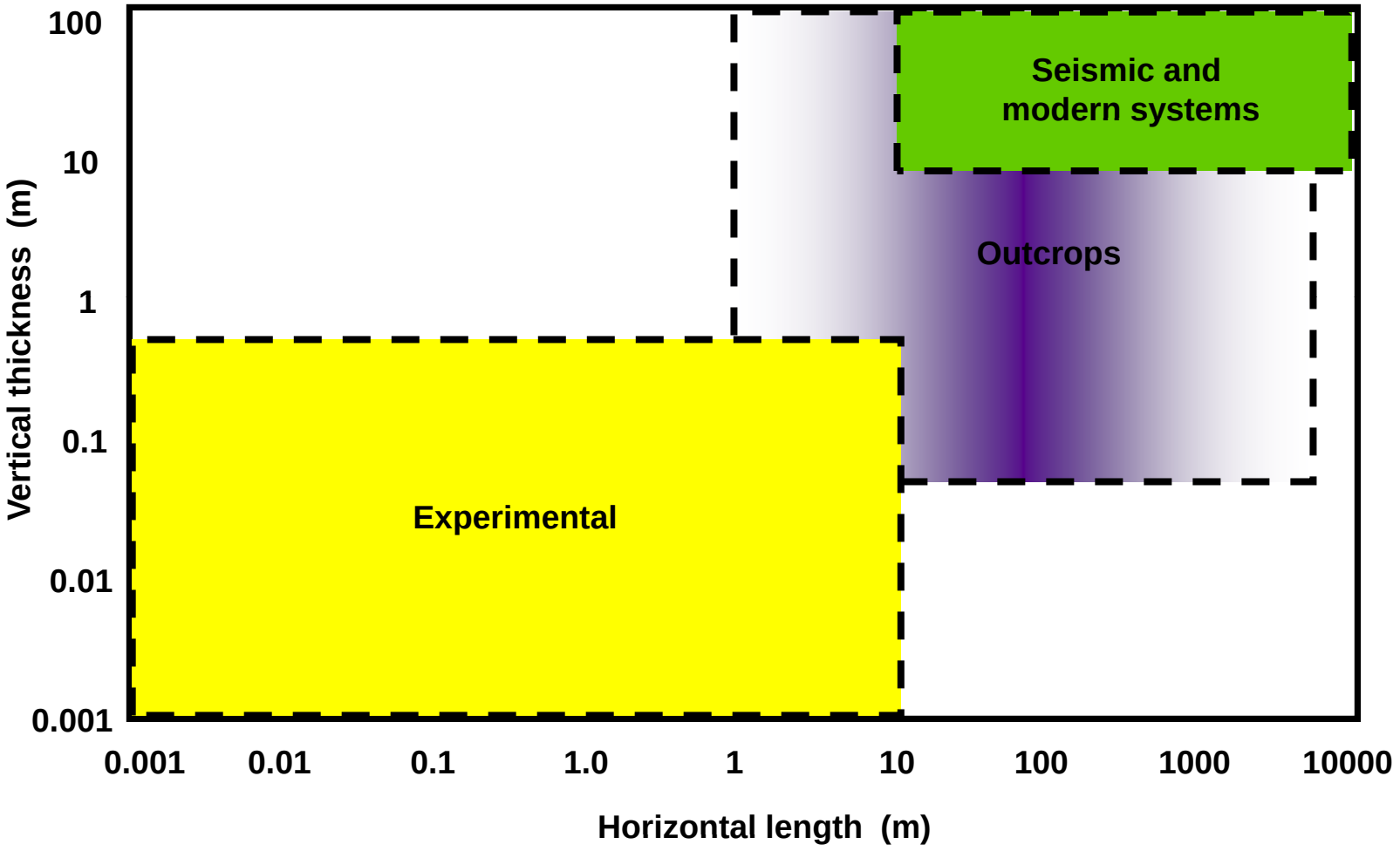
Scales: just a reminder for quantitative minds!



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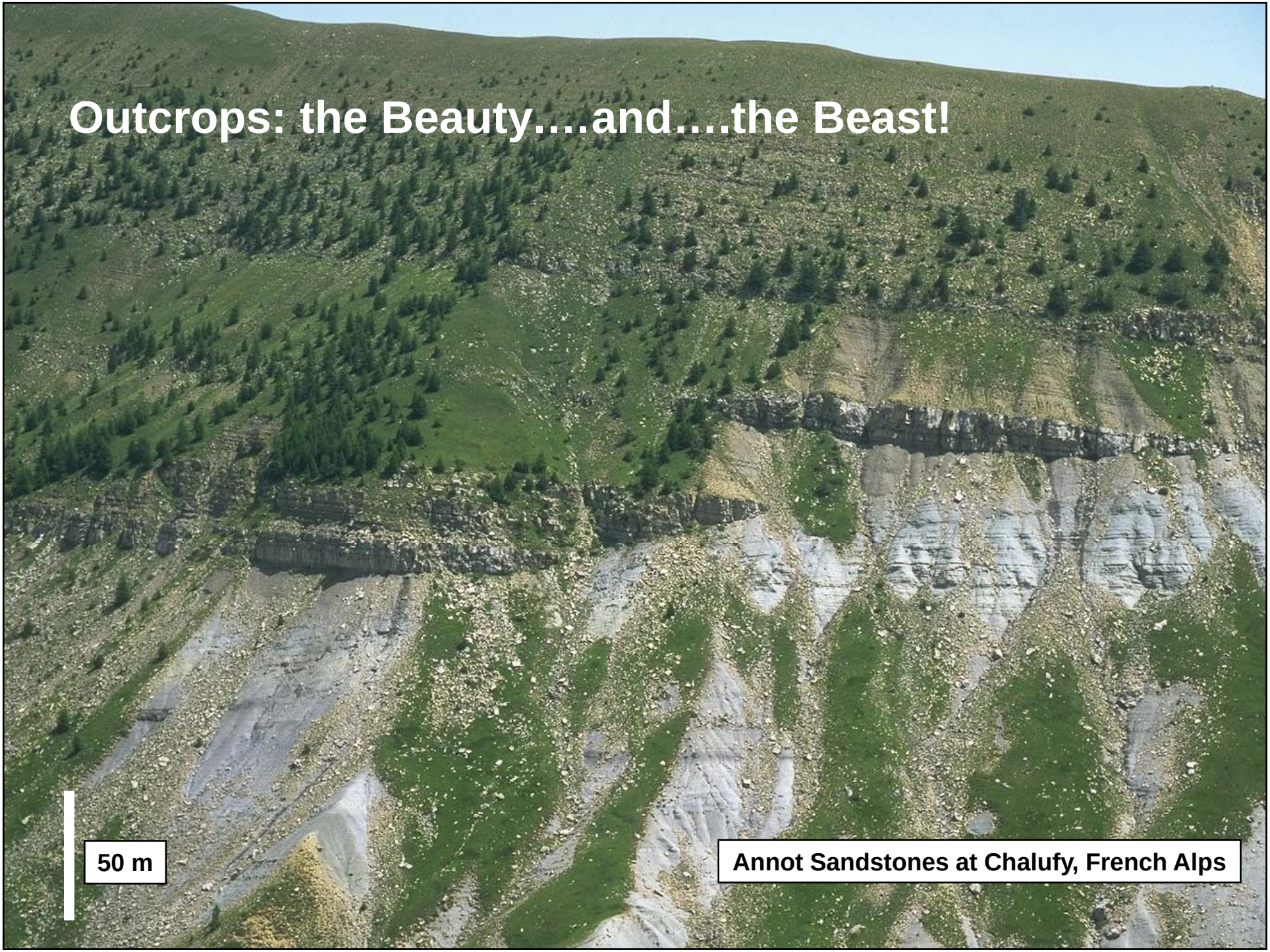
Outcrops: the Beauty….and….the Beast!
50 m
Annot Sandstones at Chalufy, French Alps

Outcrop challenge: process and 3D recognition

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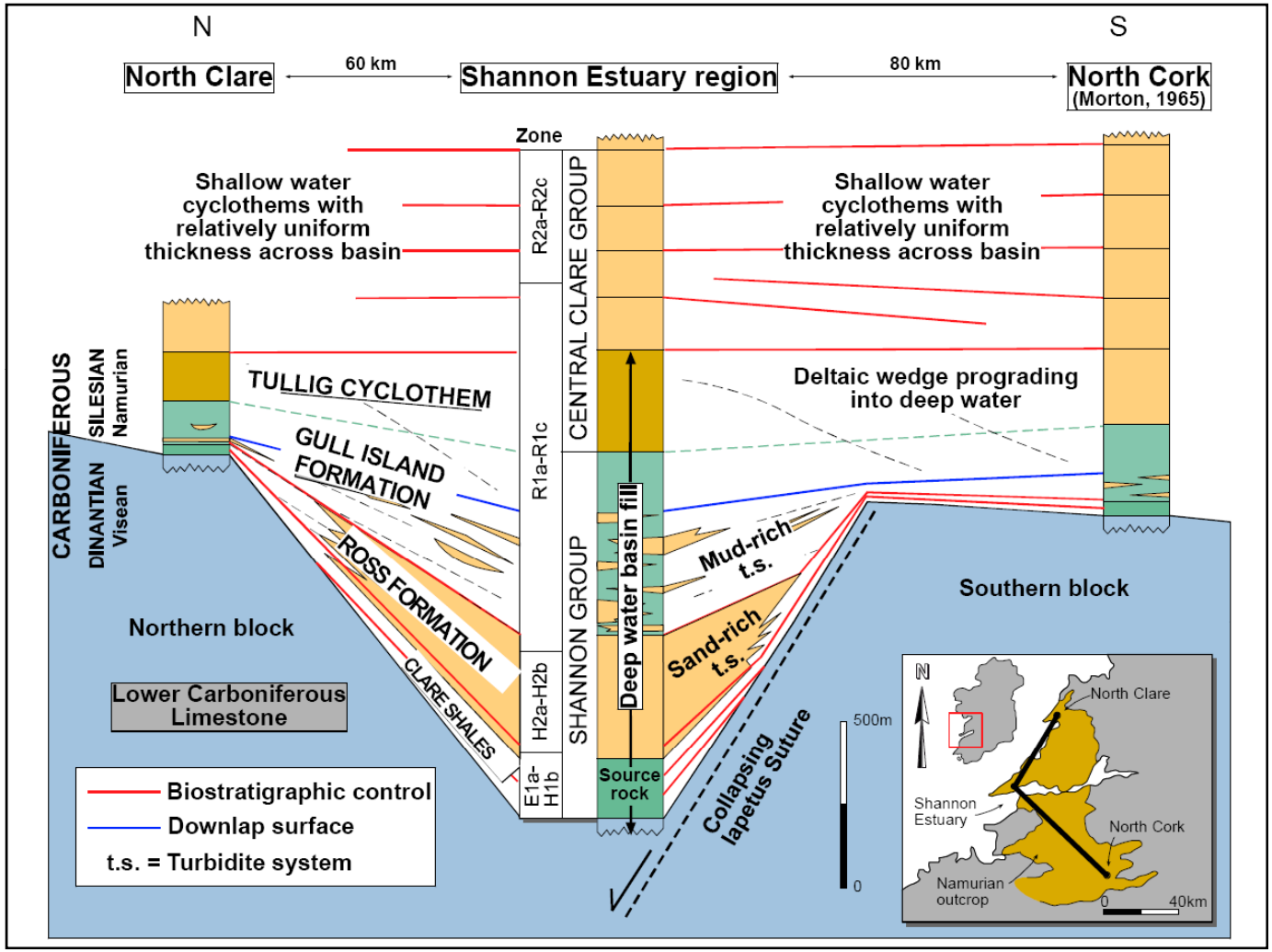
Ross Sandstone: classical outcrop approach



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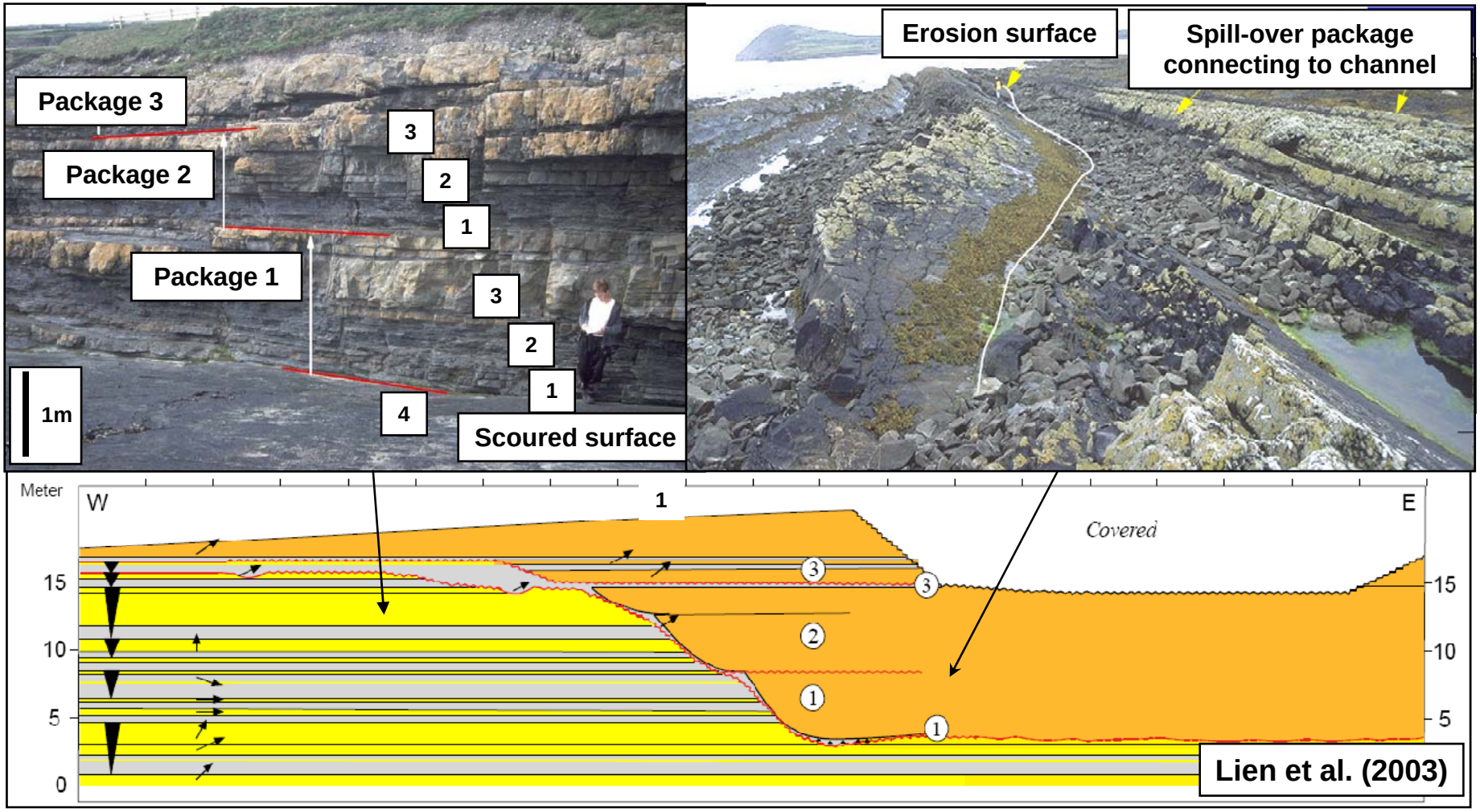
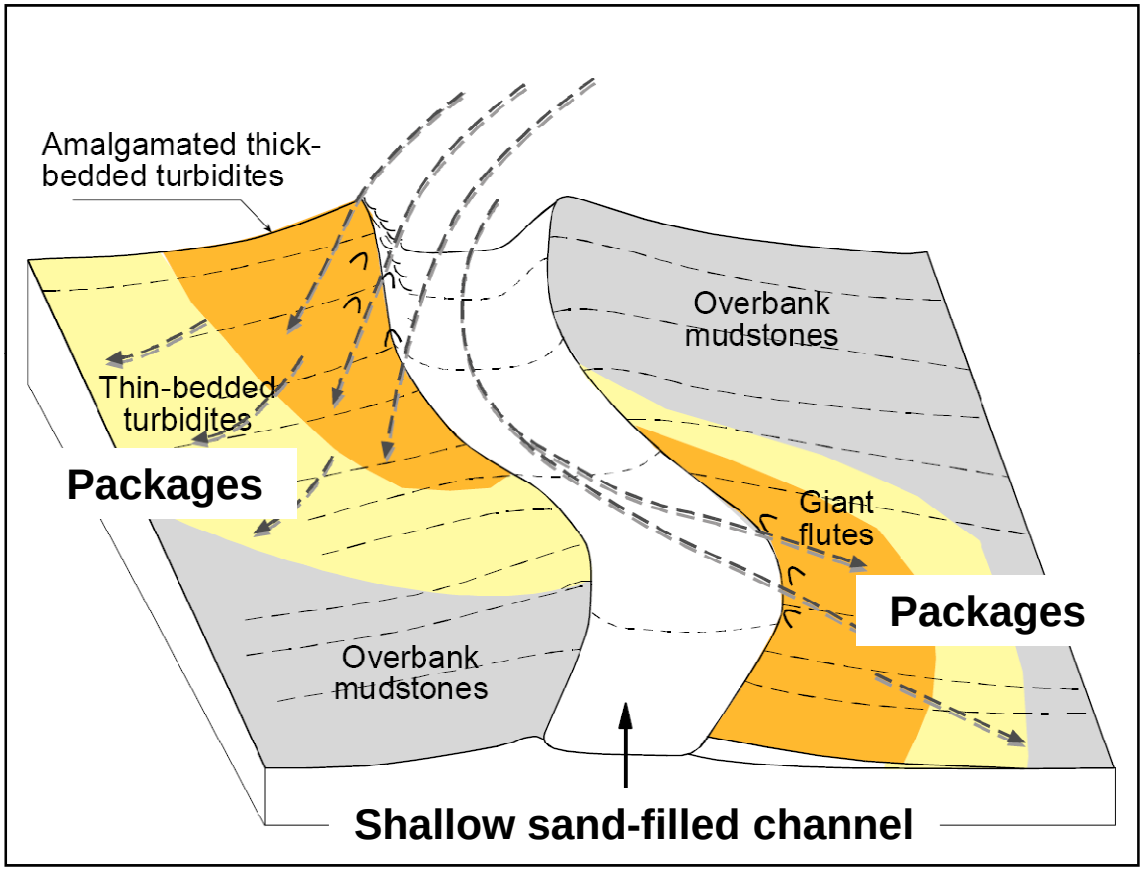
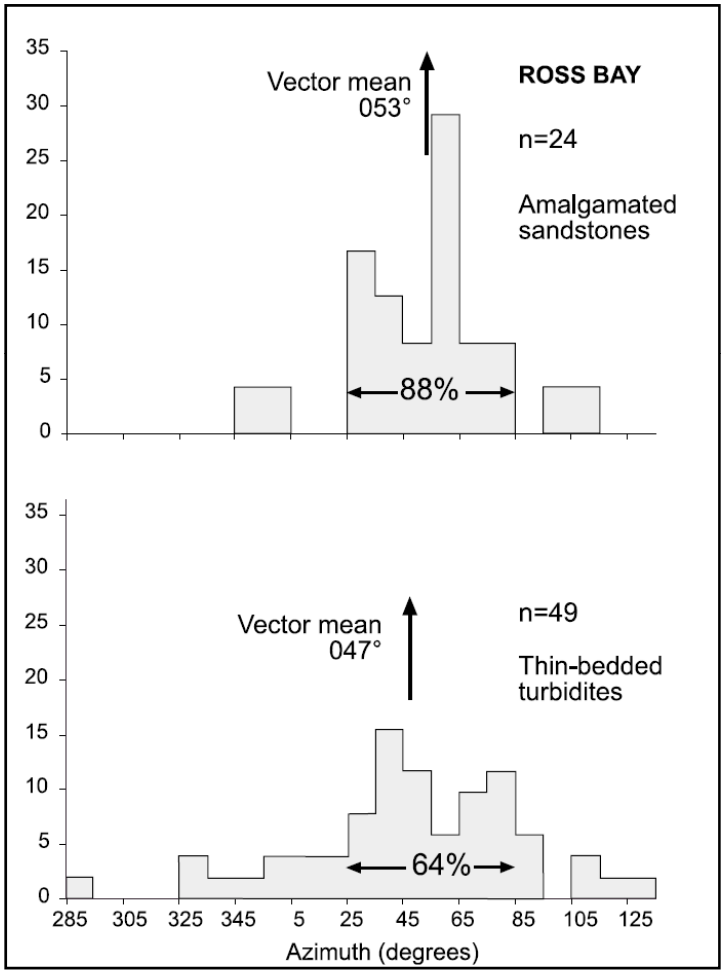
Ross Sandstone depositional elements in 2D



Ross Sandstone single channel and splay model



Lien et al. (2003)



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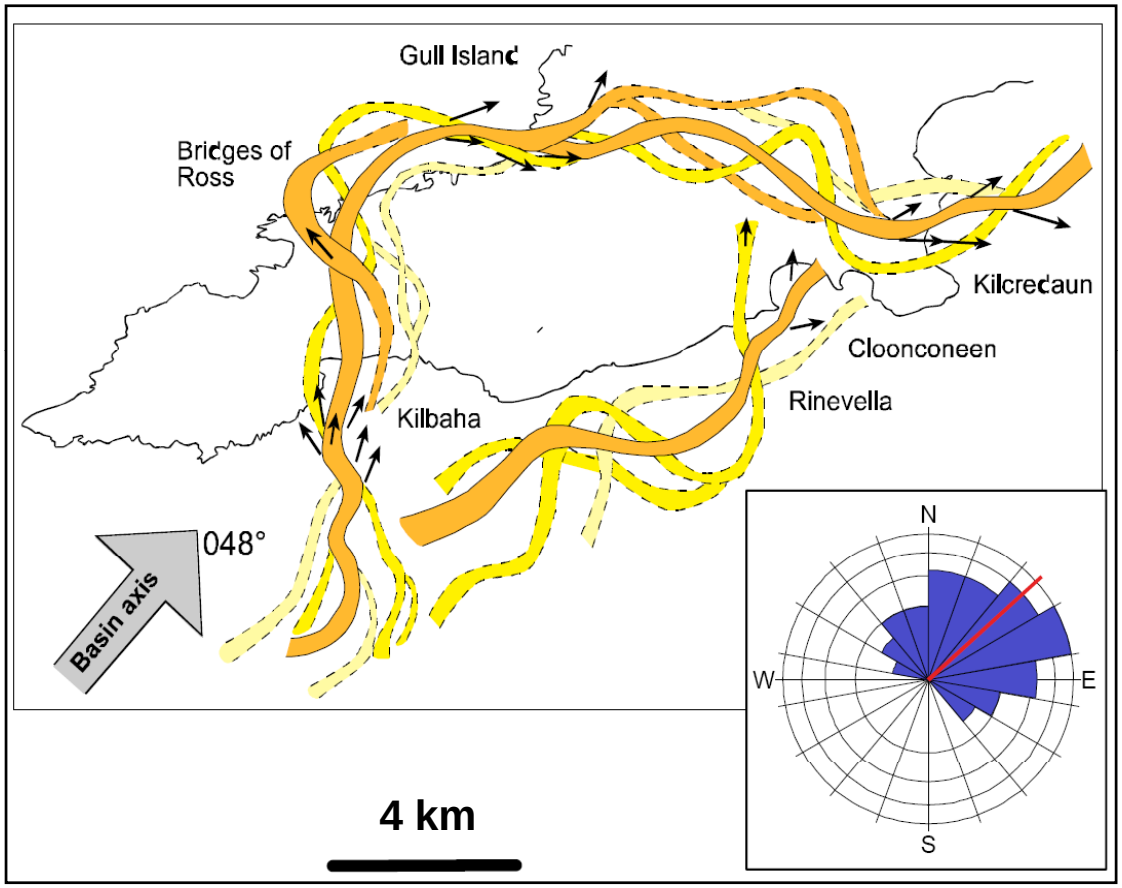
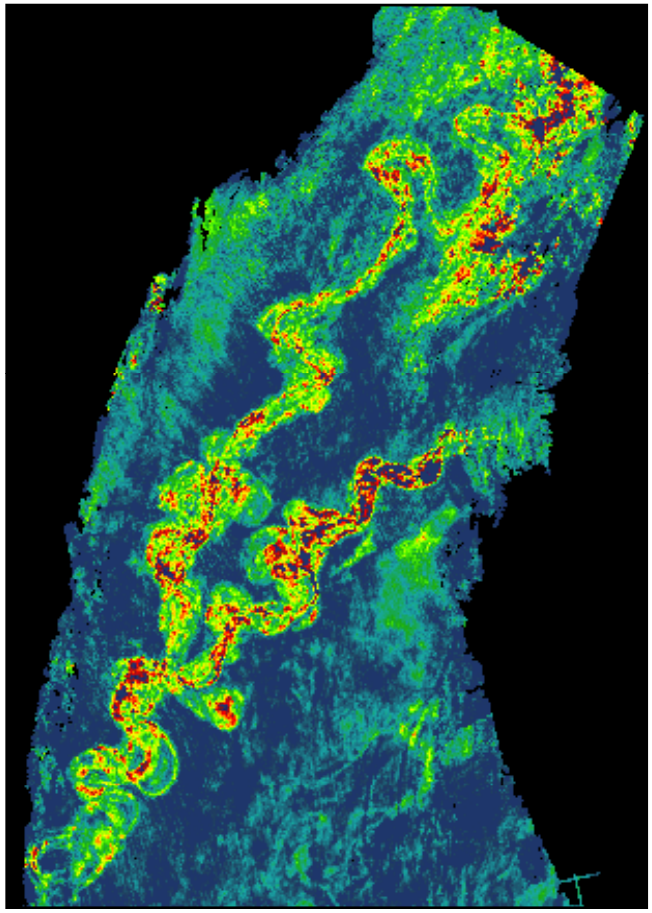
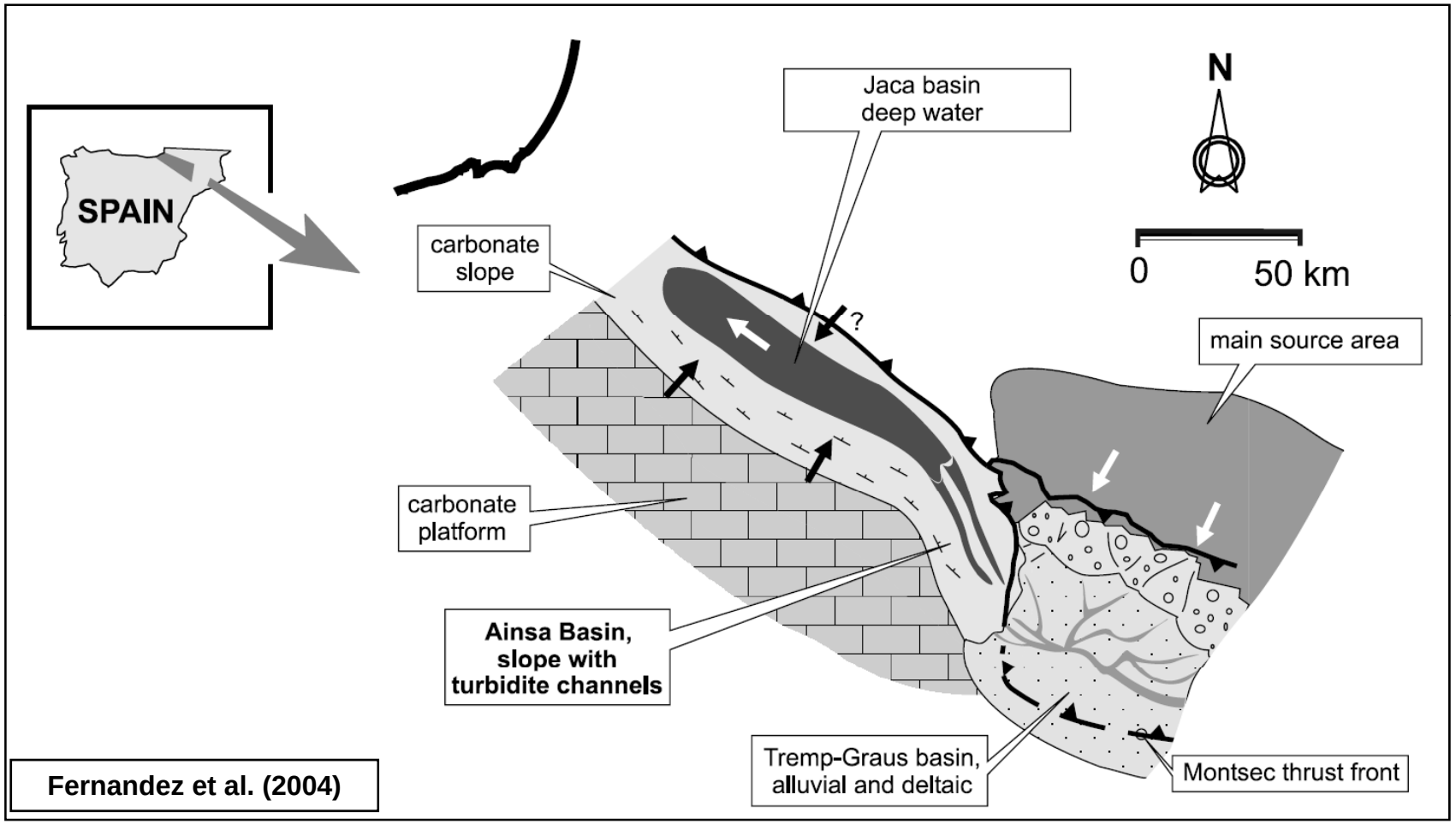
Ross Sandstone overall channel model





Ainsa example: new quantitative approach



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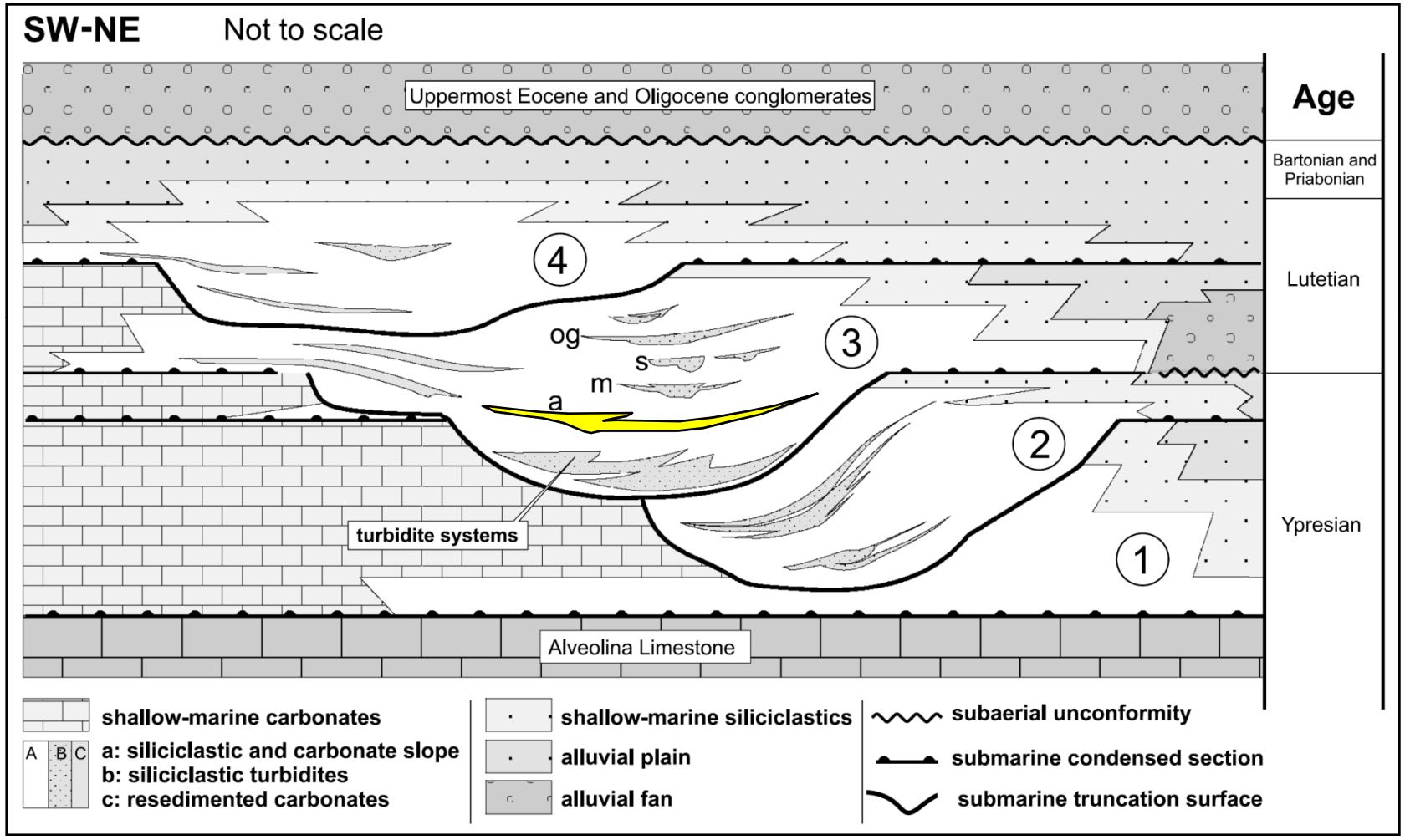
Ainsa example

Fernandez et al. (2004)



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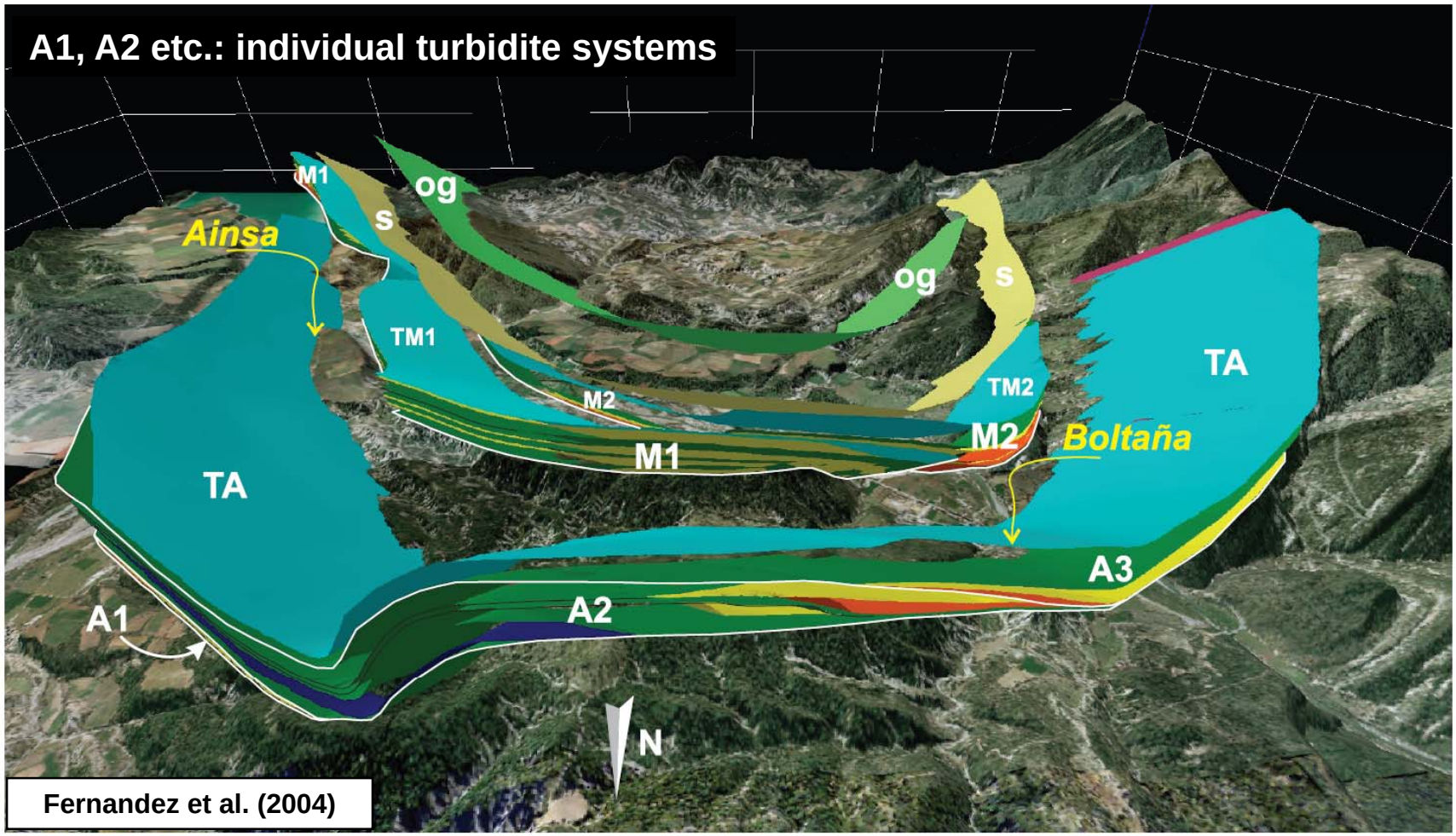
Ainsa syncline structural reconstruction



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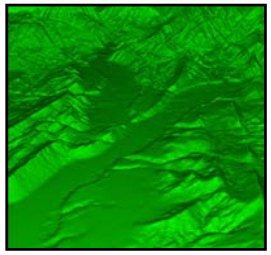
Photorealistic mapping to derive 3D digital model

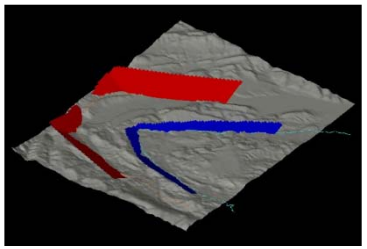
Create DEM's



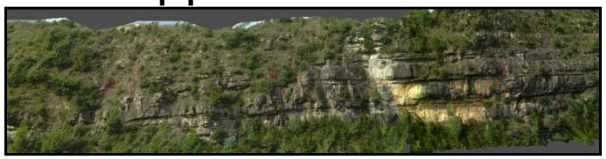
Register spatial data onto DEM

3D Data capture in field

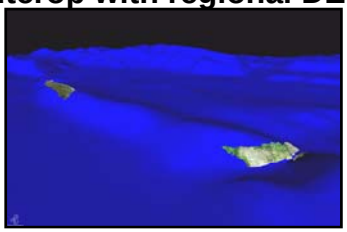
Construct structural surfaces



Register outcrop photos with laser-scanned DEM's

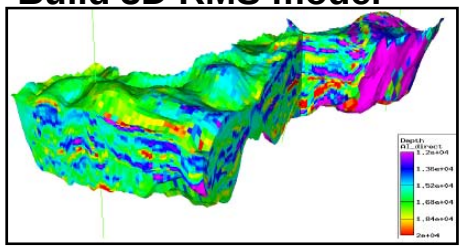


Merge photorealistic outcrop with regional DEM

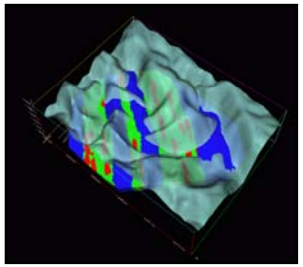


Photorealistic outcrop into CAVE & digitize surfaces

Build 3D RMS model



Fully integrated 3D model



Løseth et al. (2008)

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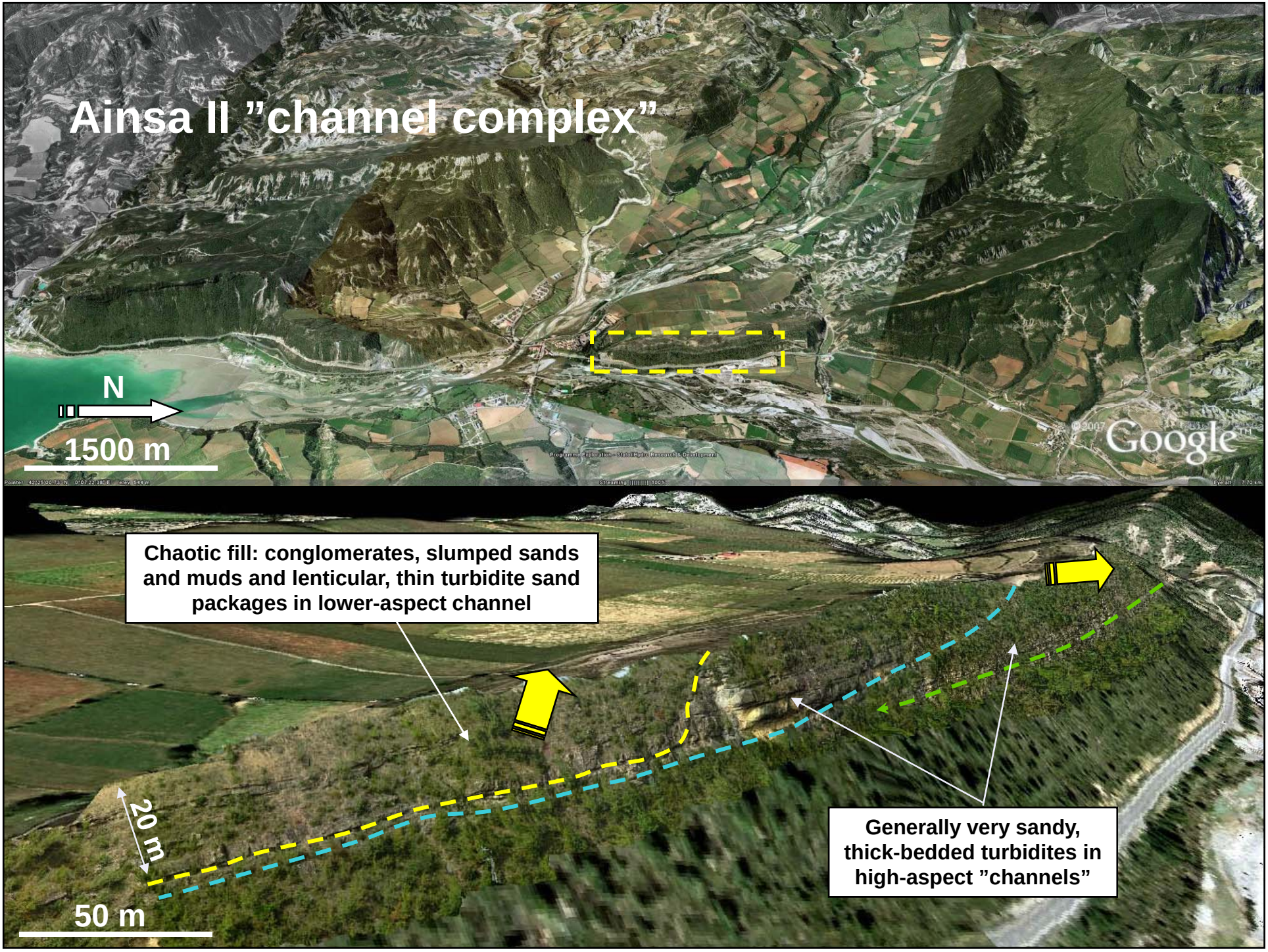
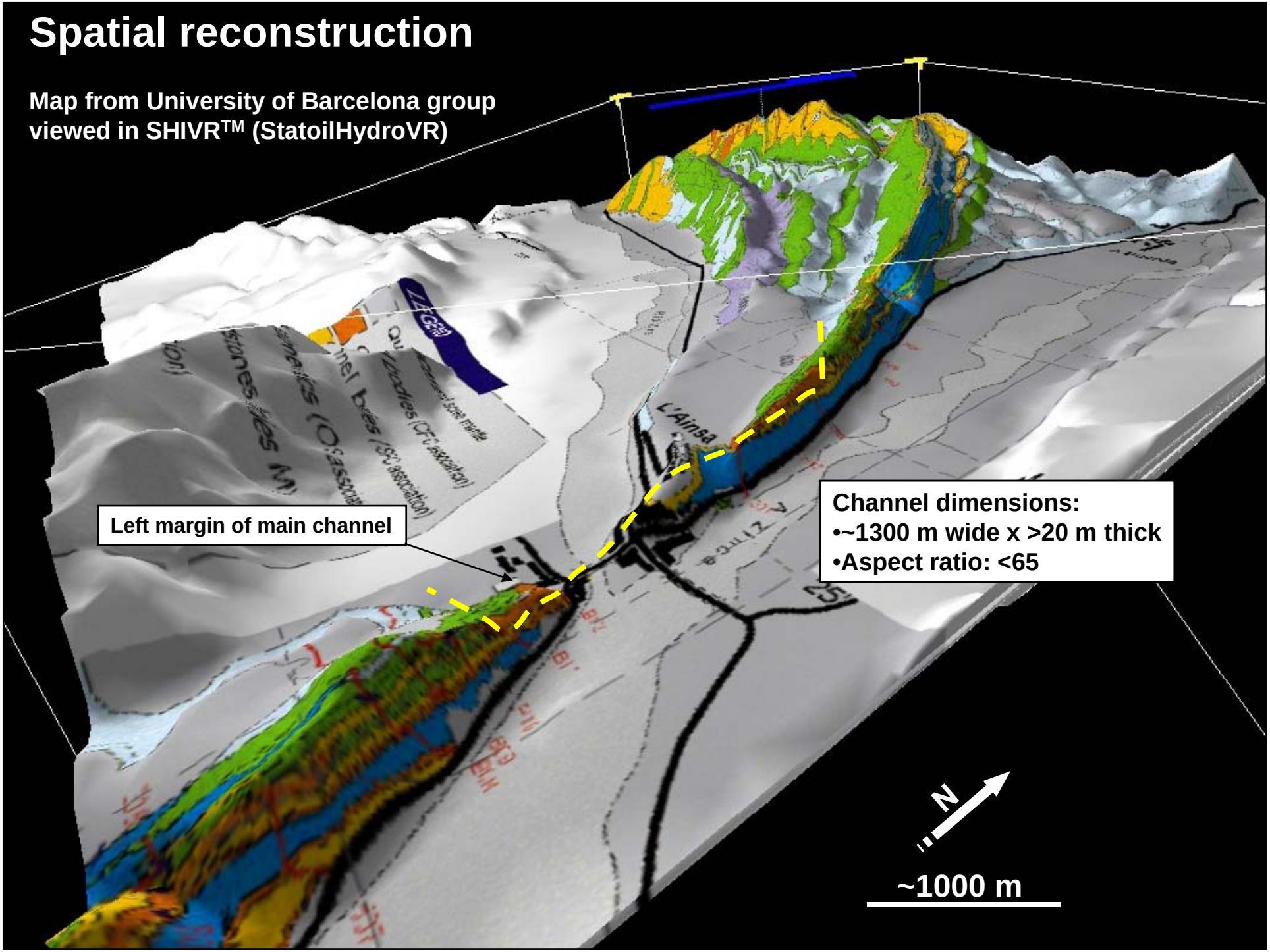
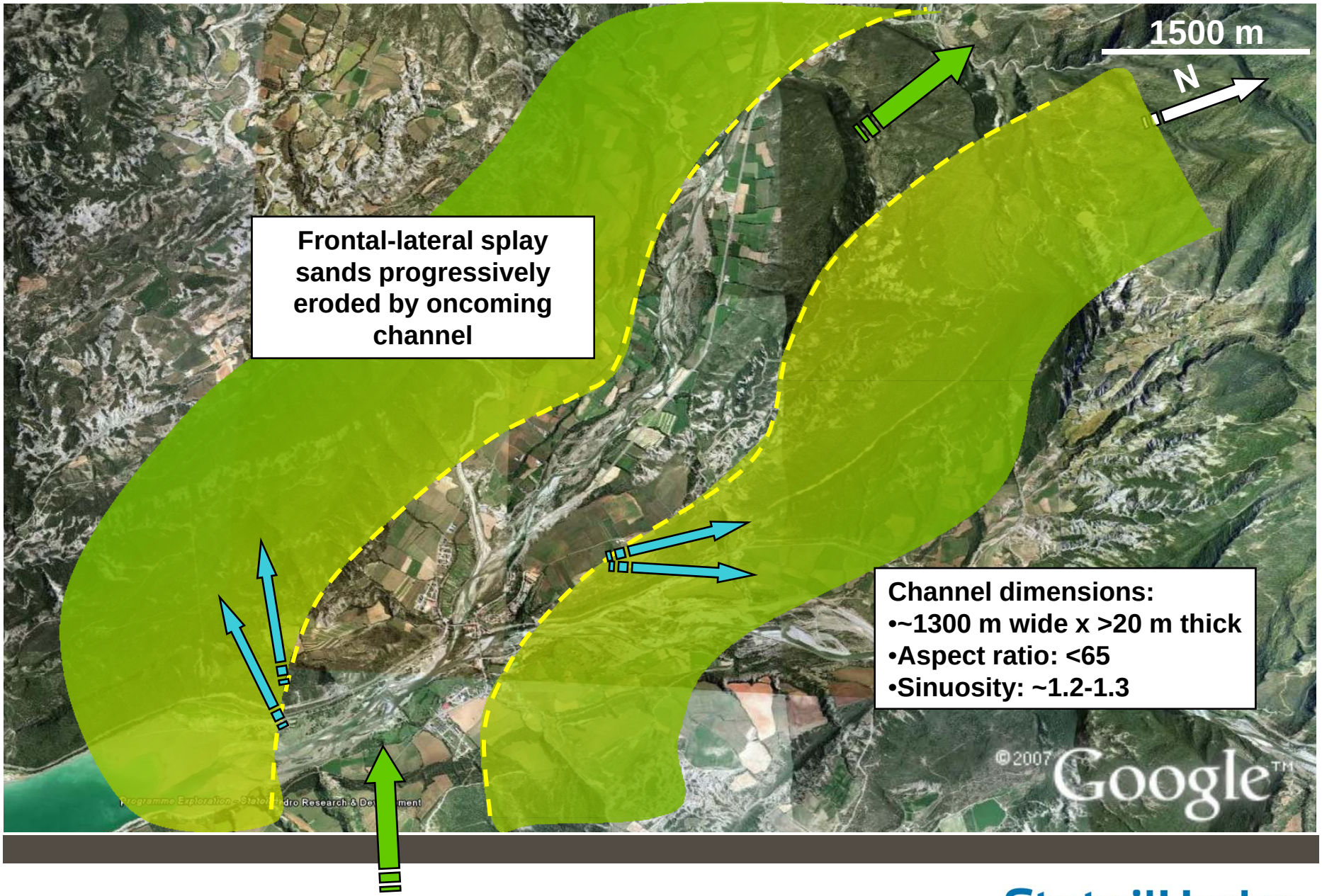

Ainsa II "channel complex"
N
1500 m
Chaotic fill: conglomerates, slumped sands and muds and lenticular, thin turbidite sand packages in lower-aspect channel
20 m
50 m
Generally very sandy, thick-bedded turbidites in high-aspect "channels"

Spatial reconstruction

Map from University of Barcelona group viewed in SHIVR™ (StatoilHydroVR)





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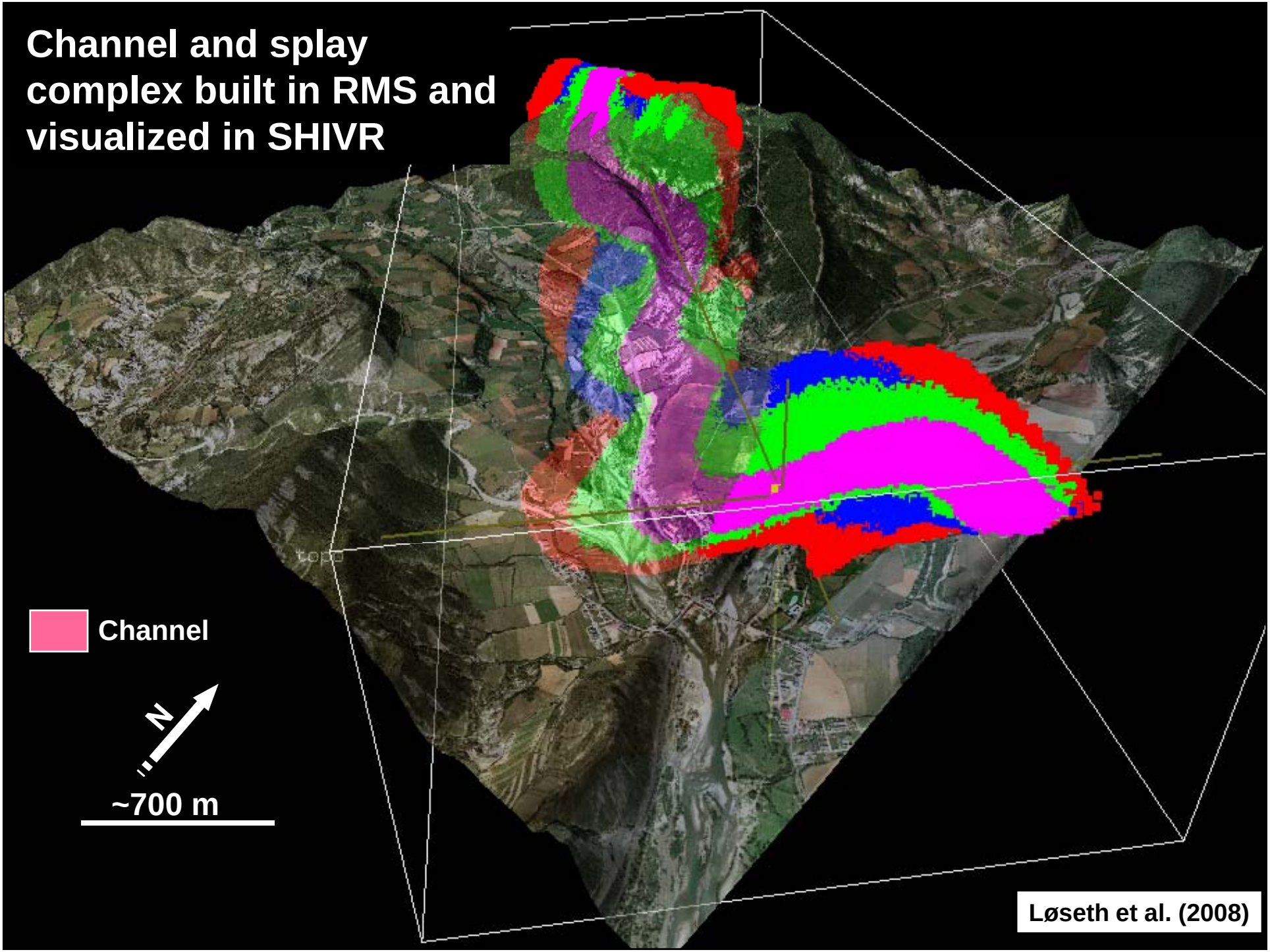
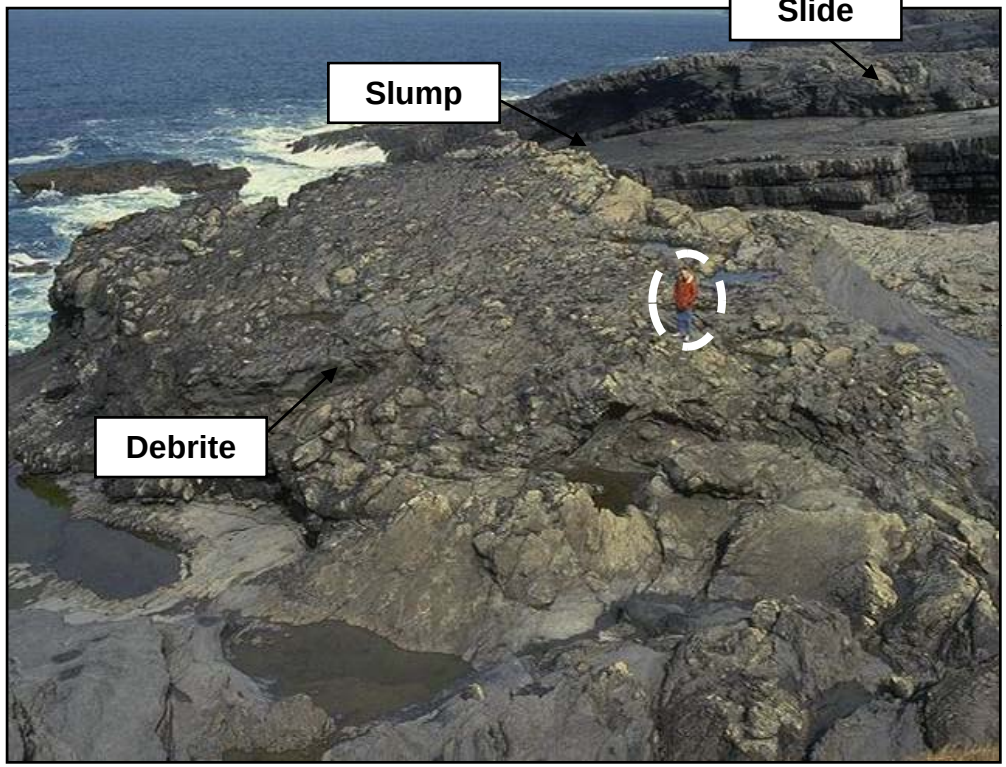

Channel and splay complex built in RMS and visualized in SHIVR
Channel
N
~700 m
Løseth et al. (2008)

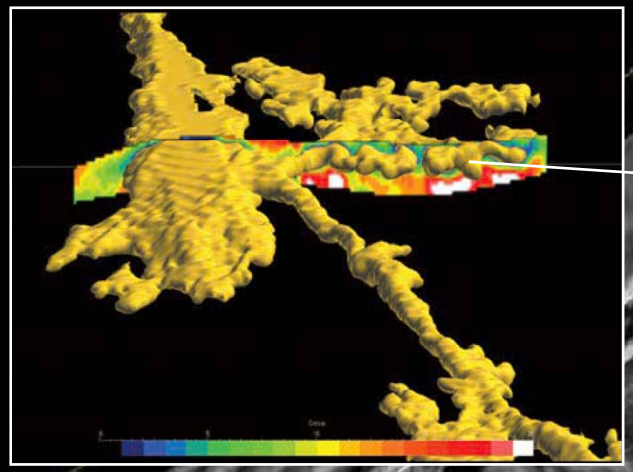
Process and 3D understanding at outcrop

- A relative and ambiguous matter!
- Digital and quantitative methods narrow the gap to other arenas
- Still work to do--also on the other arenas
- Common approach needed



**Ross ”Slide”, western Ireland:
debrite in foreground, slide in background**

Common ground: Geobody approach?

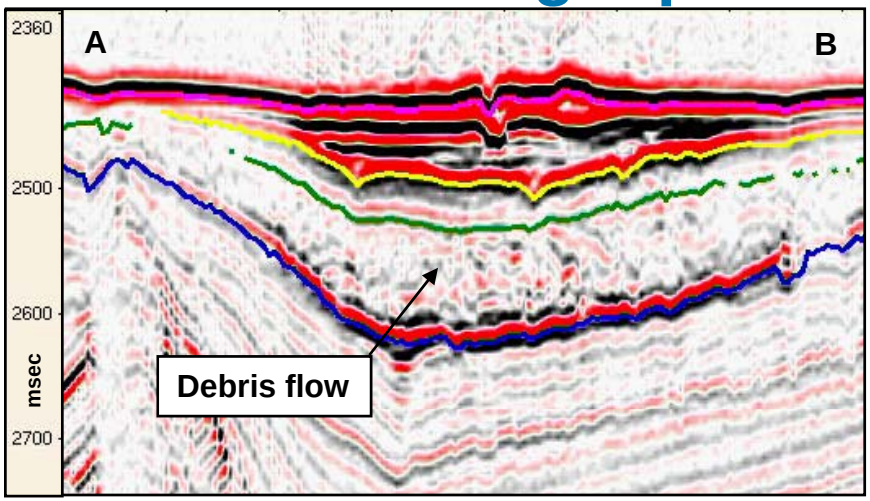


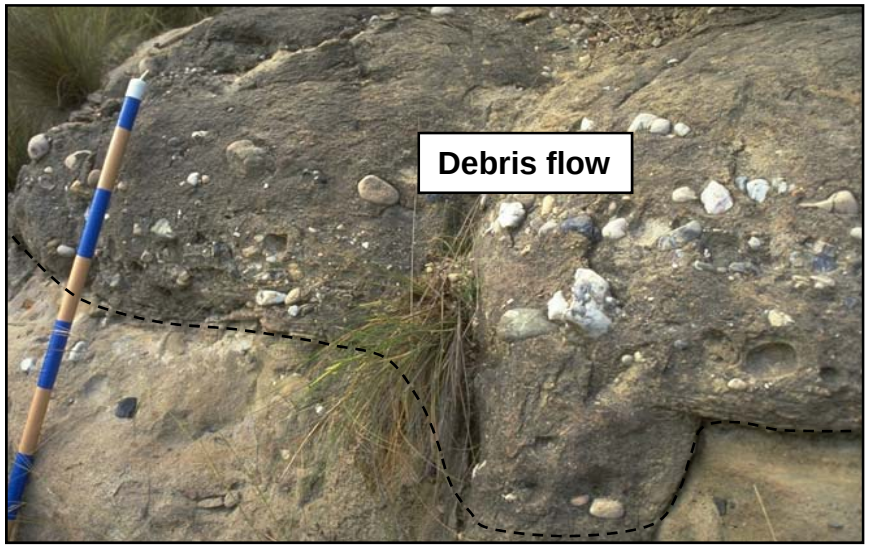
Geobody definition:

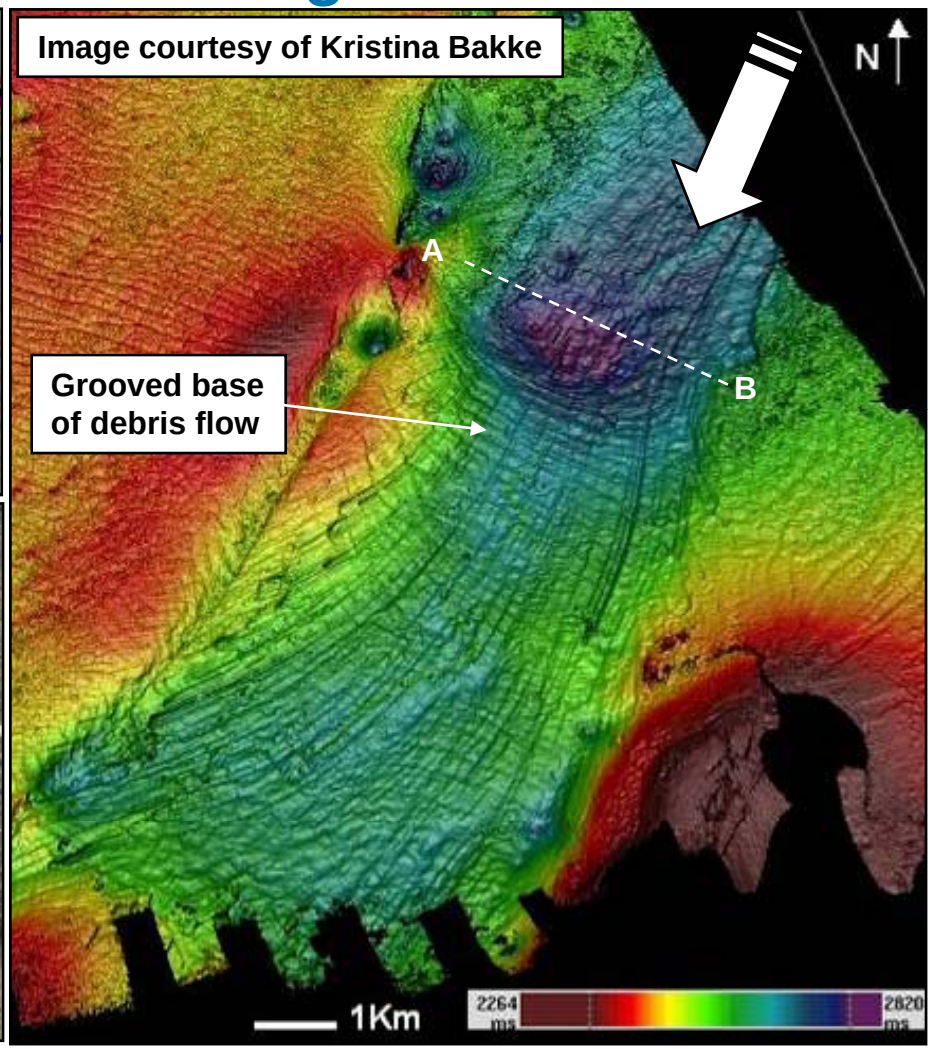
”A volume of cells (seismic) or rock with similar characteristics”

The Leading Edge (January 2007)

Seismic challenge: process link to geobodies







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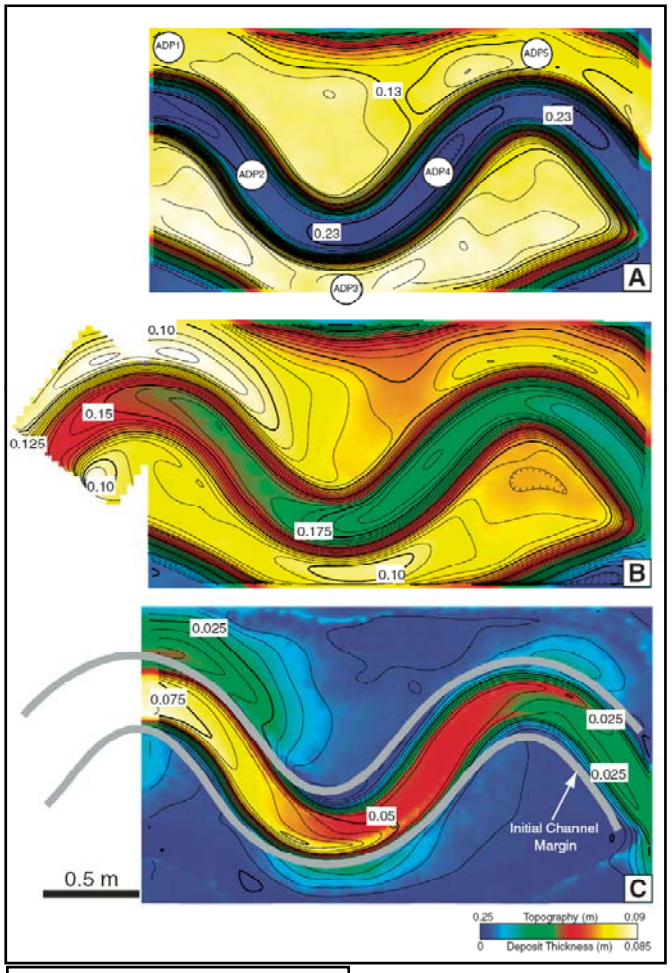
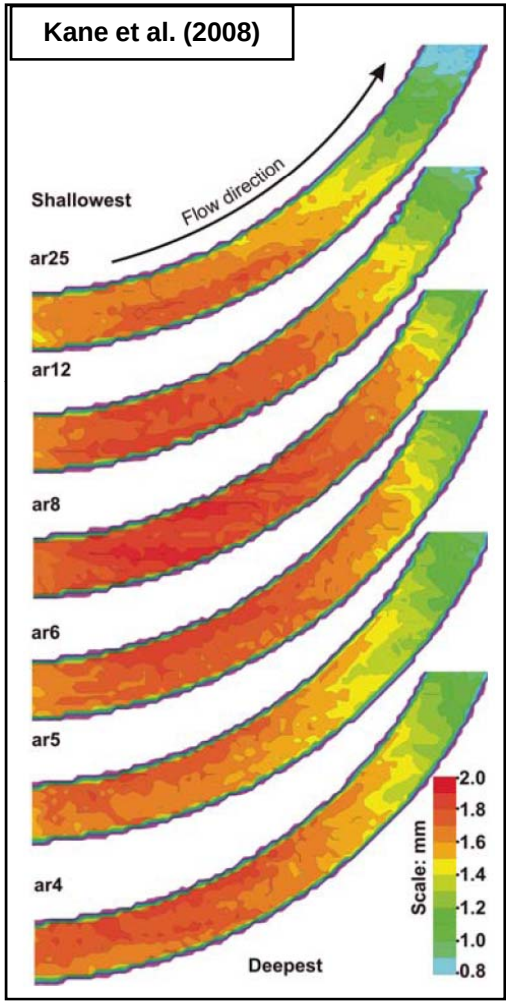
Geobody approach in experimental studies?



Straub et al. (2008)

Kane et al. (2008)



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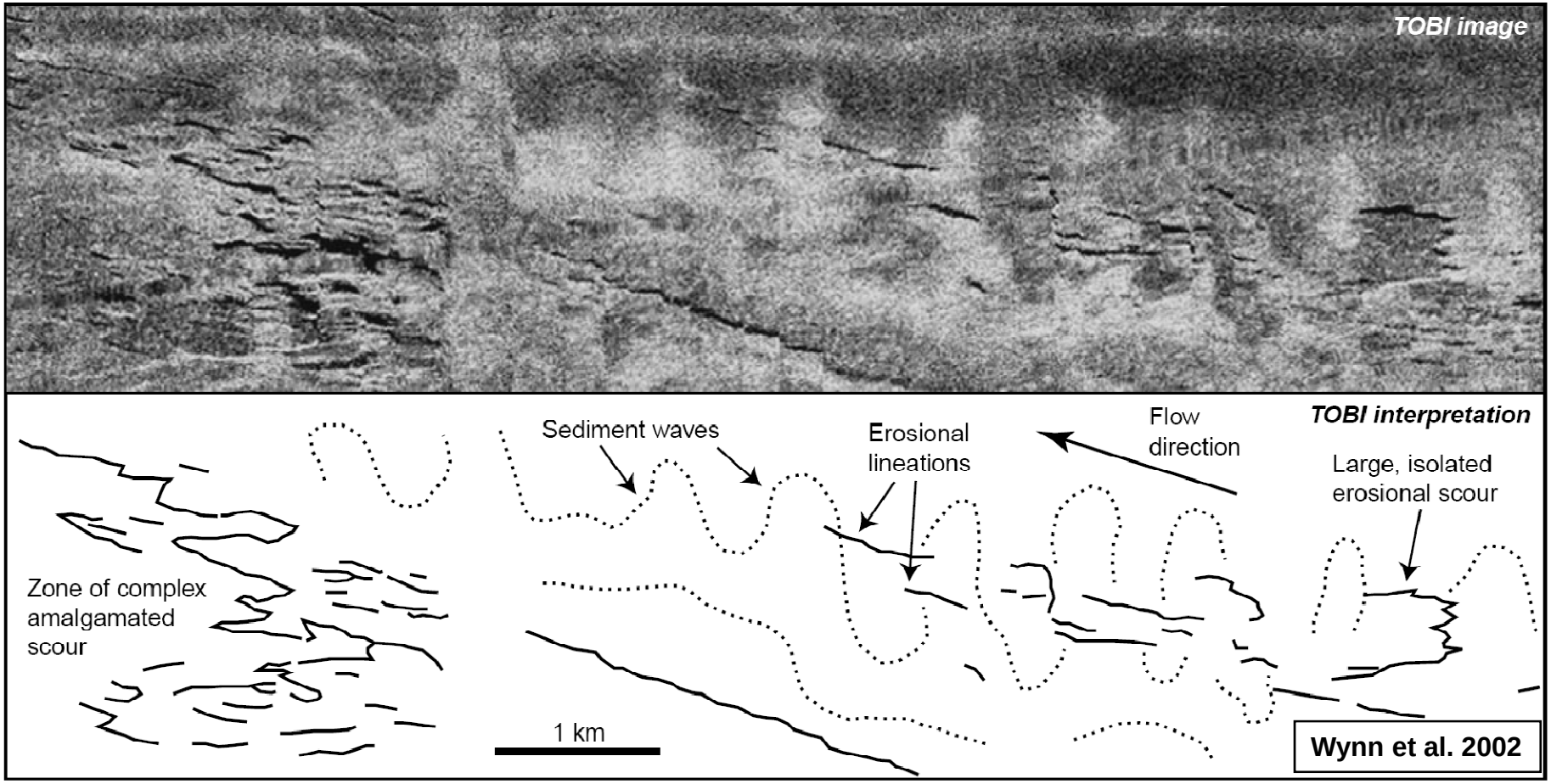
Modern systems challenge: geobody definiton?



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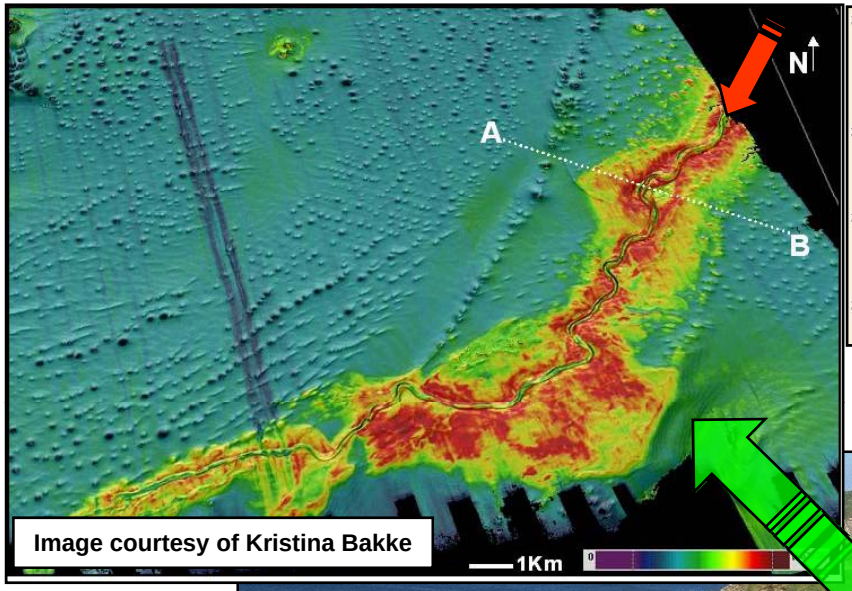
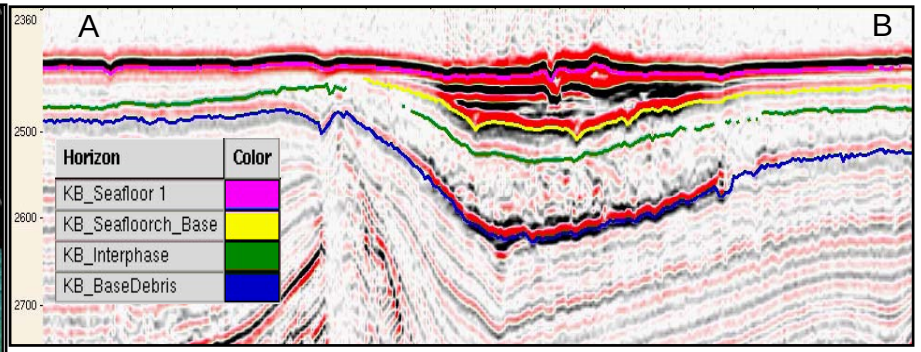
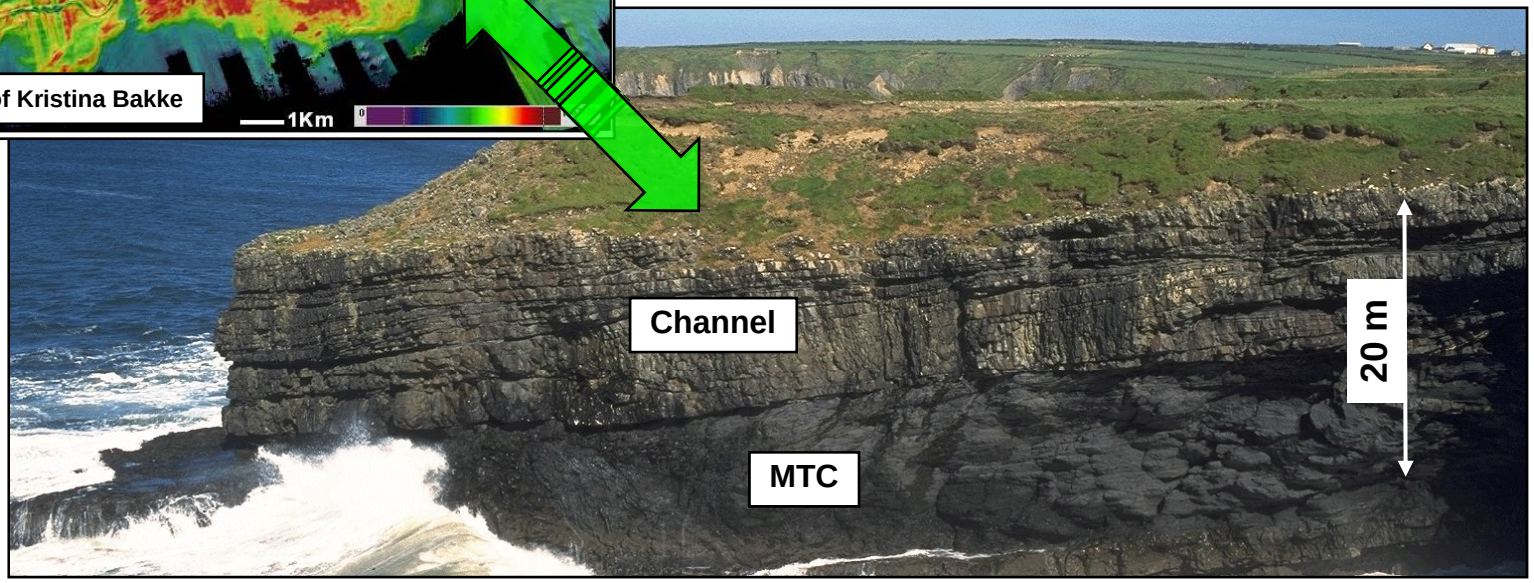
Conditioning outcrops to data from other arenas?







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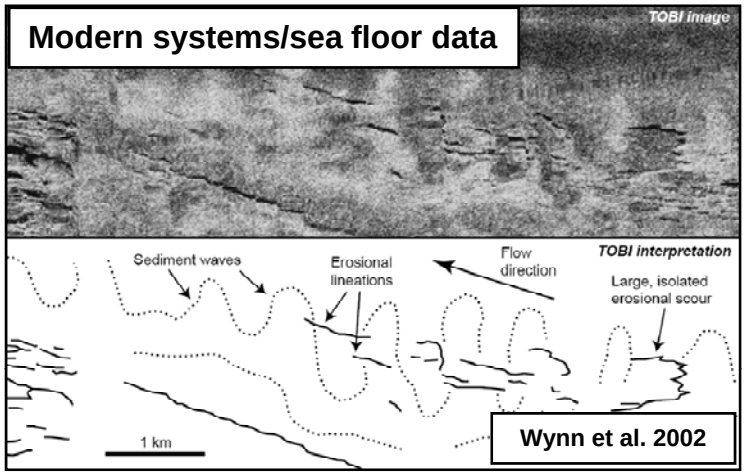
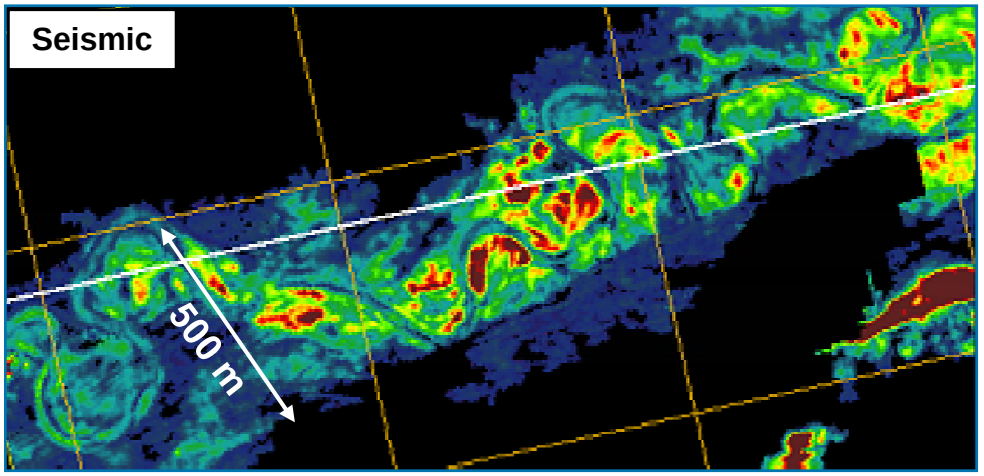
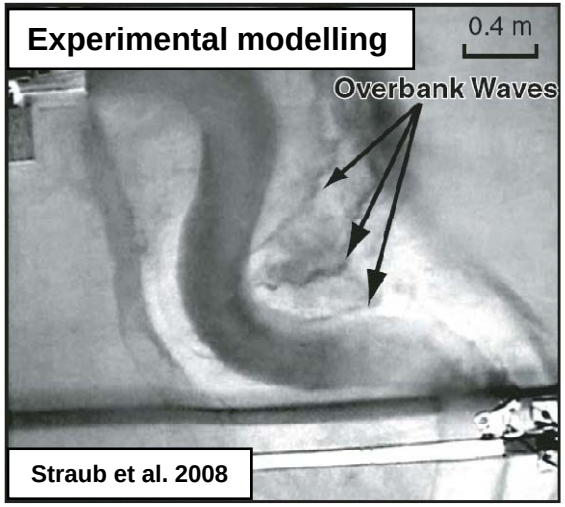
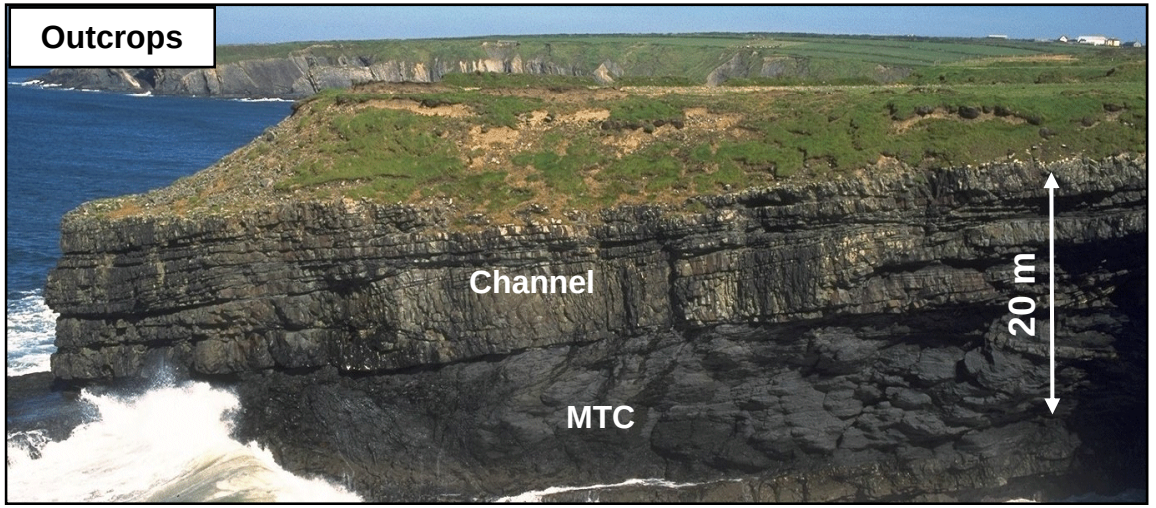
Geobody exchange between various arenas?









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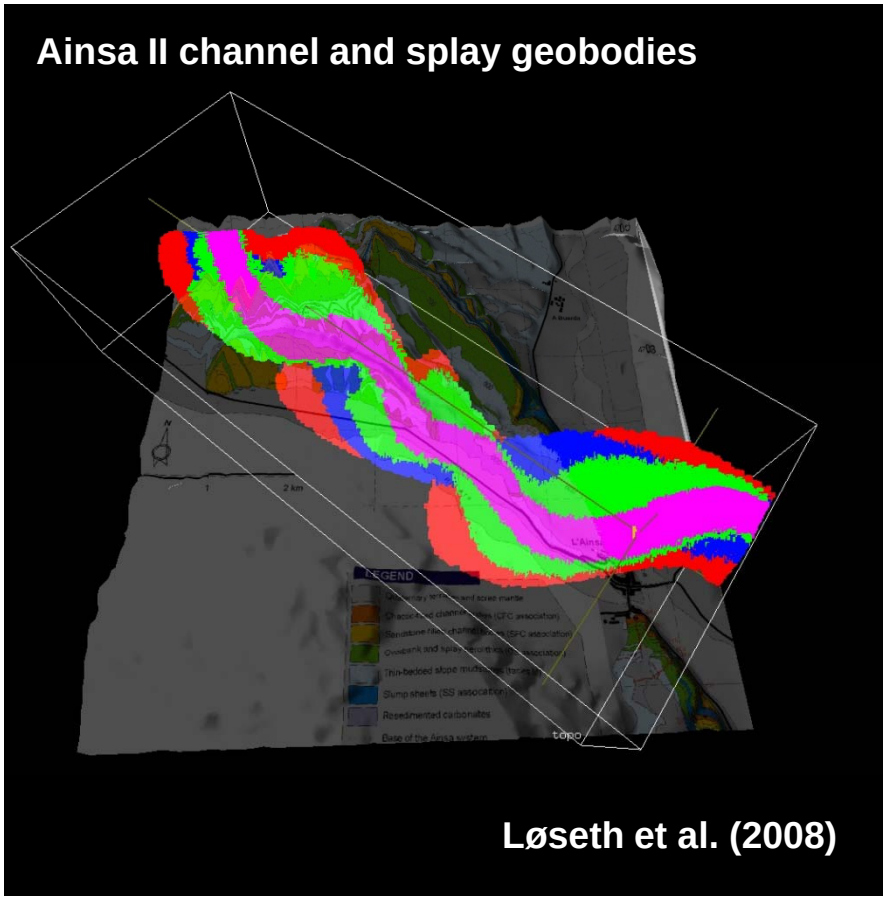
Conclusions

- Assessment of the influence of deep-water processes of architecture are demanding, whichever arena one operates on
- Outcrops are faced with the challenge of lack of 3D and direct process observation, but digital and quantitative methods narrow the gap to other arenas
- A geobody approach to process vs. architecture understanding is one useful way of attacking the challenge of bridging between arenas



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