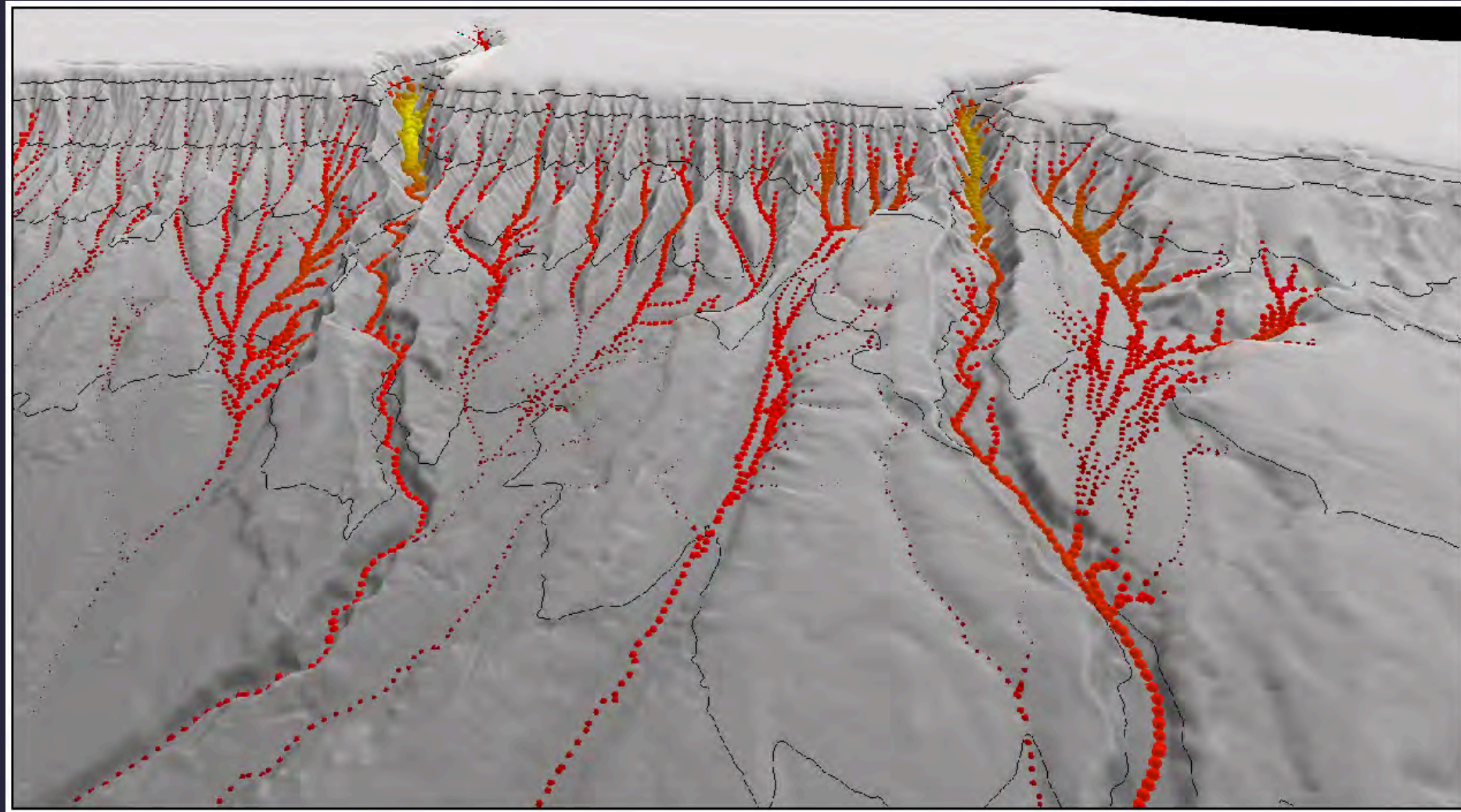


USGS Projects Along ENAM



Danny Brothers
USGS Coastal and Marine Geology
Woods Hole, MA



GeoPRISMS Relevant Projects (*people involved*):

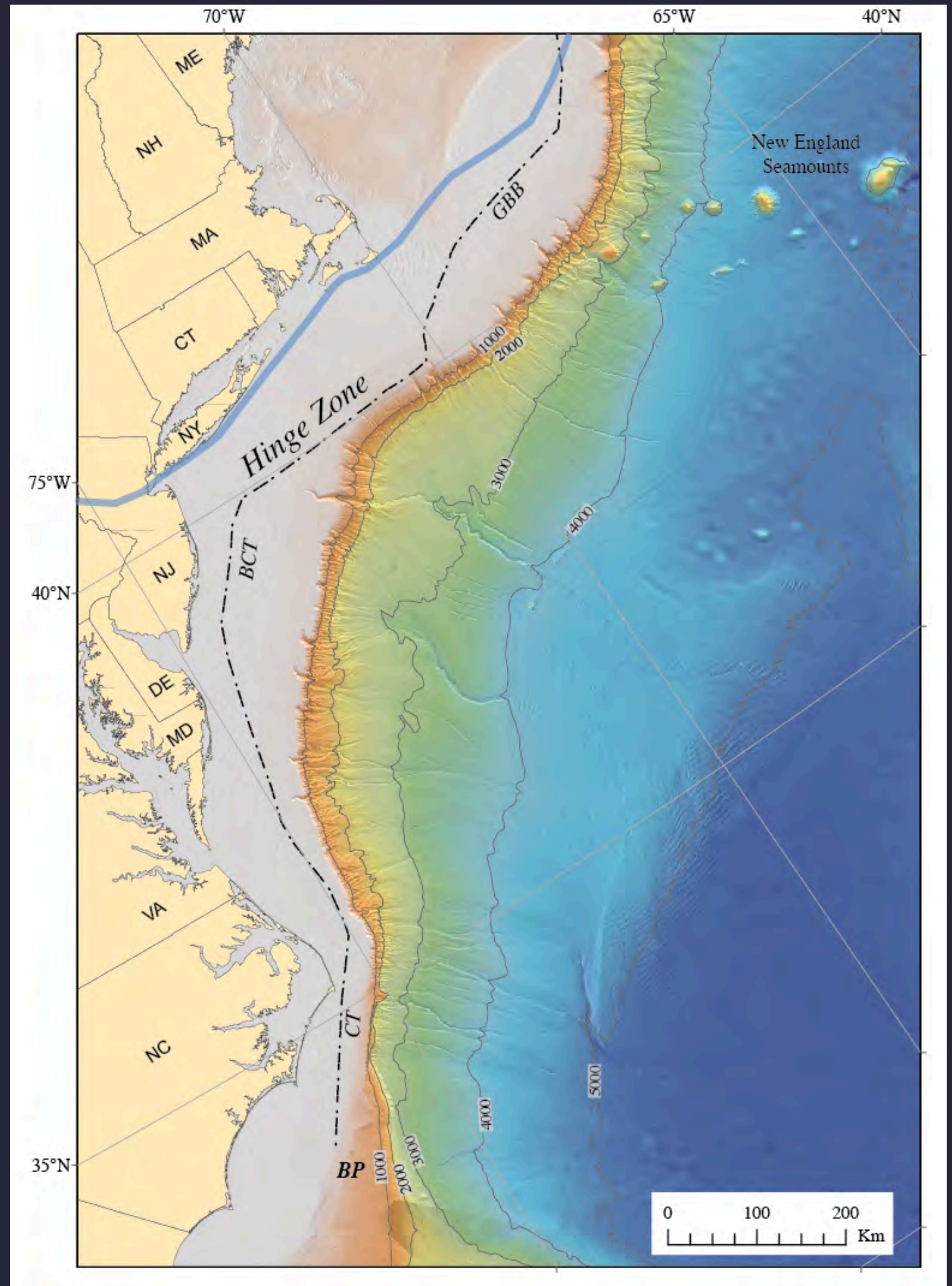
1. Margin-scale seafloor morphology (*Brothers, ten Brink*)
2. Submarine canyon morphology and seascape evolution (*Brothers, Chaytor, ten Brink, Twichell*)
3. Submarine landslide occurrence, causes and associated geohazards (*Chaytor, Brothers, ten Brink, Twichell*)
4. Stratigraphic architecture of Southern New England margin (*Brothers, Chaytor, ten Brink*)
5. Seismicity and seafloor compliance studies of Southern New England margin (*USGS: ten Brink, Brothers, Chaytor; WHOI: Collins, McGuire*)
6. Extended Continental Shelf/Law of the Sea (*Hutchinson, Chaytor*)

1. Margin-scale seafloor morphology

Swath Bathymetry Data Integration

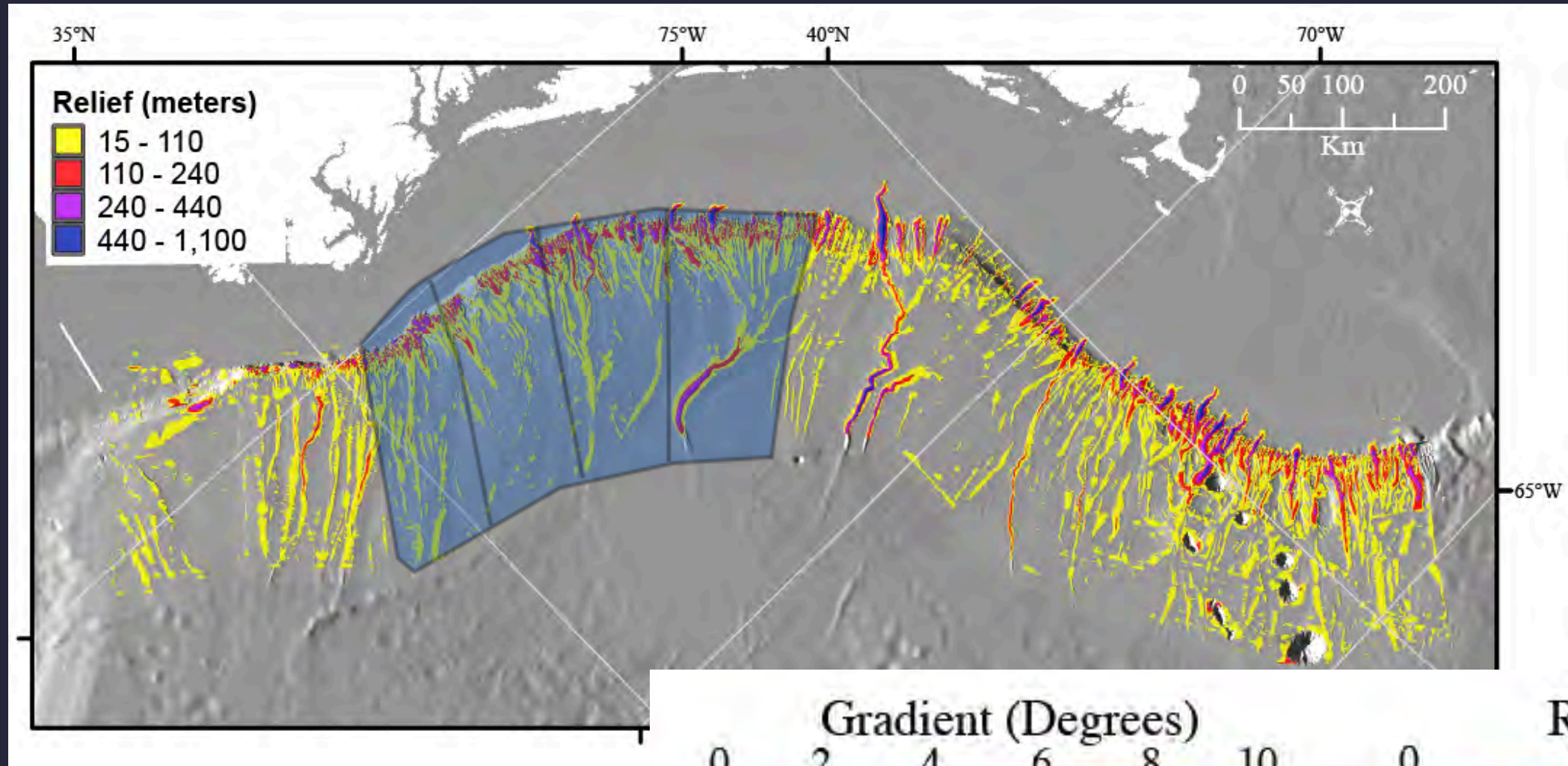
- Mosaic of multibeam swath bathymetry data from 26 cruises. Final DEM is 616,000 km² at 25-100 m resolution.
- Nearly complete coverage between the shelf break to below the 4,000 m isobath

Characterize the mesoscale shape of the margin, identify variation and understand what processes are responsible.



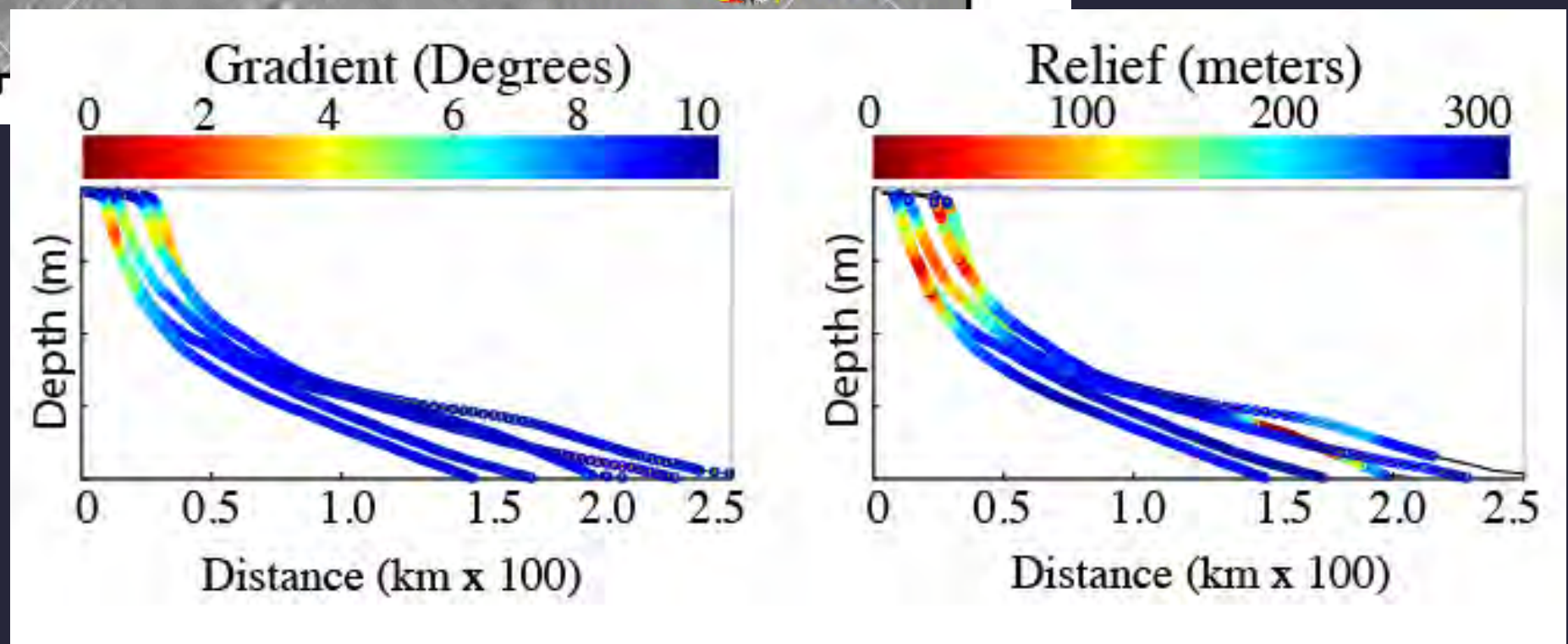
Example from the US Mid-Atlantic Margin

Canyon/Channel Relief



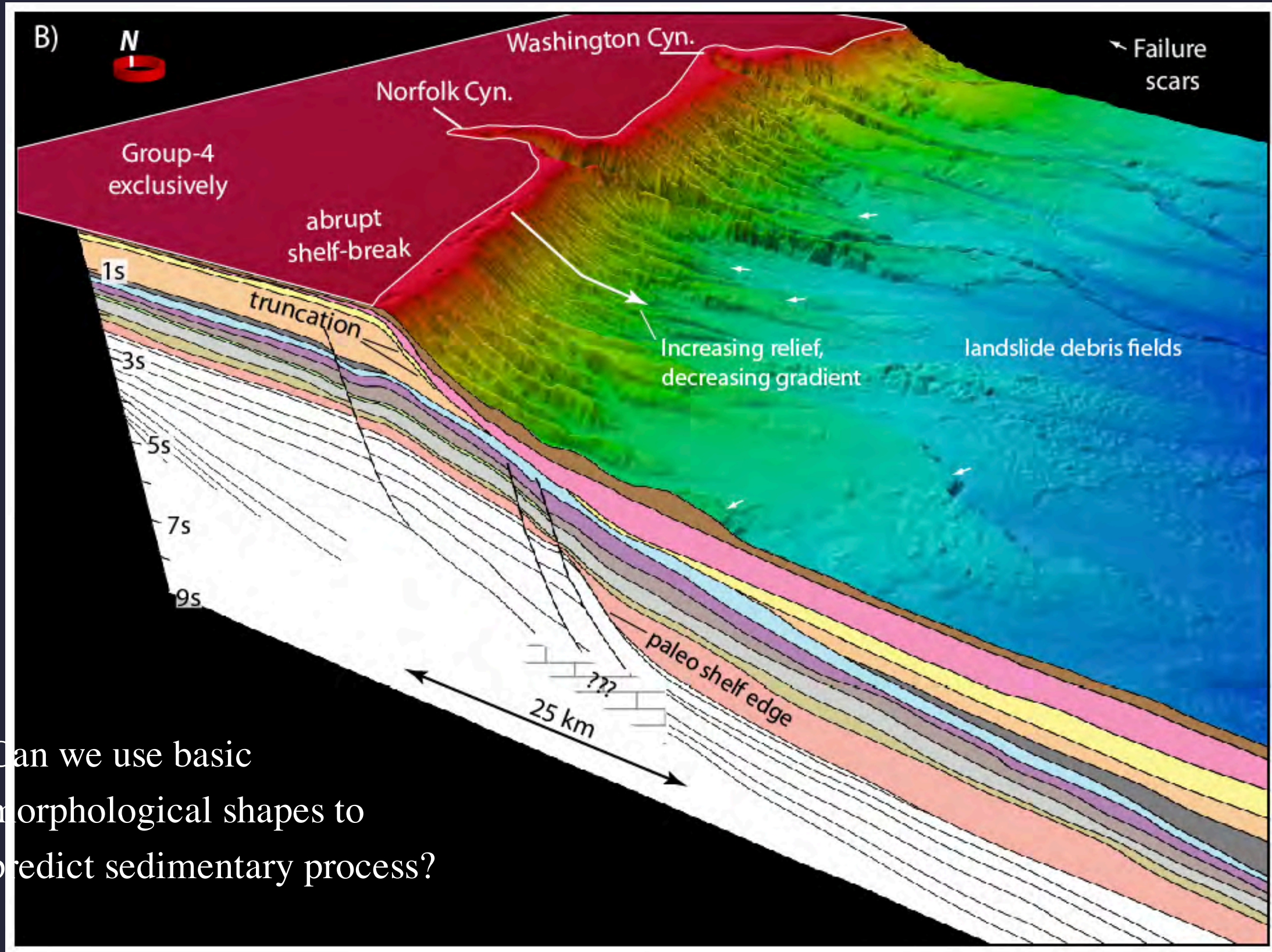
Expand on earlier studies by O'Grady et al. (2000), Schlager et al. (2001), Goff (2001), Pratson and Haxby (1997), etc

Categorize morphology based on average shape and canyon relief



Comparison to subsurface data

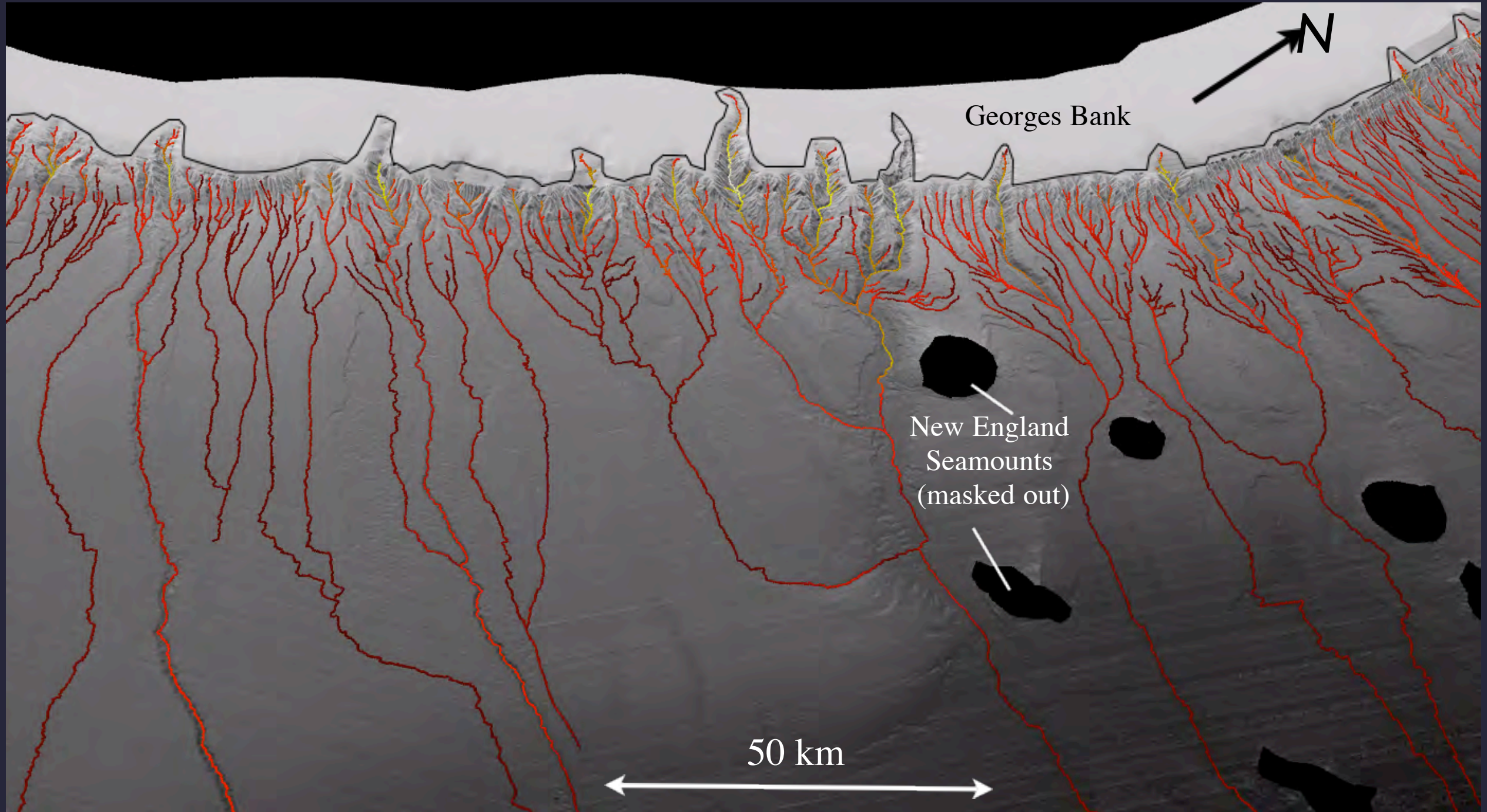
Try to understand which components of the morphology are due to Quaternary sedimentary processes versus inherited physiography.



Can we use basic morphological shapes to predict sedimentary process?

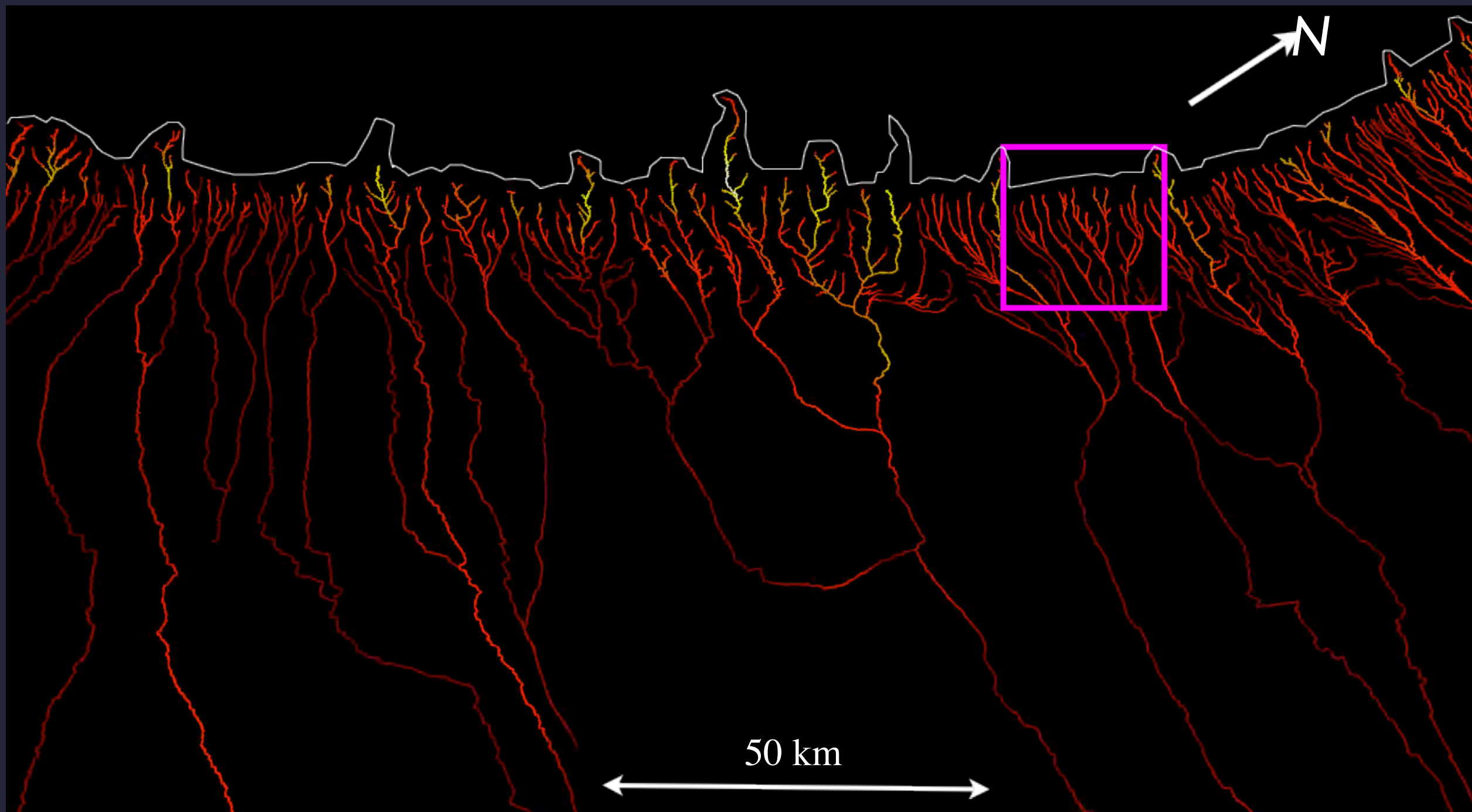
2. Submarine canyon morphology and seascape evolution

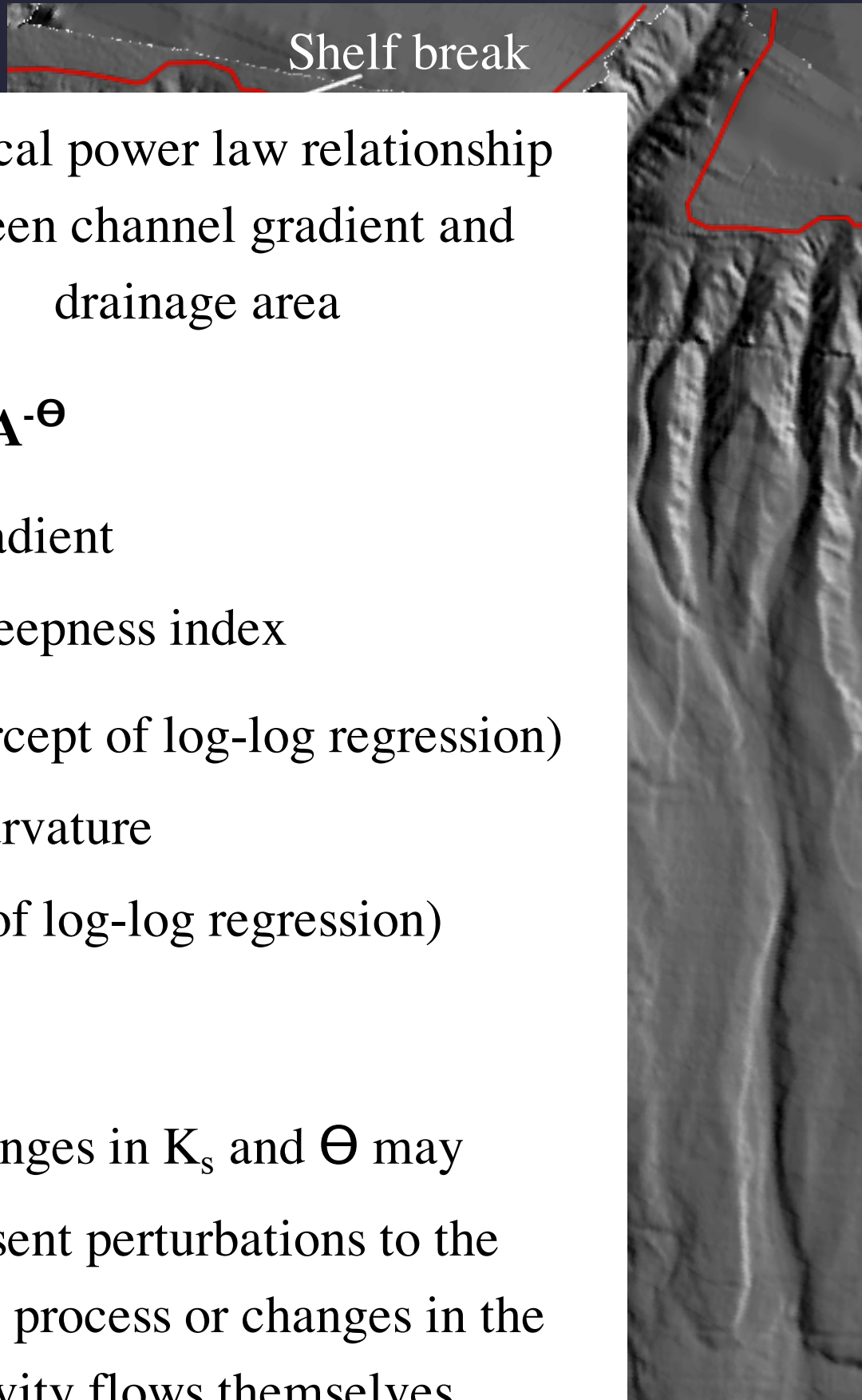
Submarine canyons are highly sensitive to environmental change --> morphology is a function of the frequency and shear stress imposed by turbidity flows



Can morphology tell us anything about the mechanics and down-slope evolution of the flows themselves?

Extract geomorphic information from each canyon w/ head on upper slope





Empirical power law relationship
between channel gradient and
drainage area

$$S = K_s A^{-\Theta}$$

S = Gradient

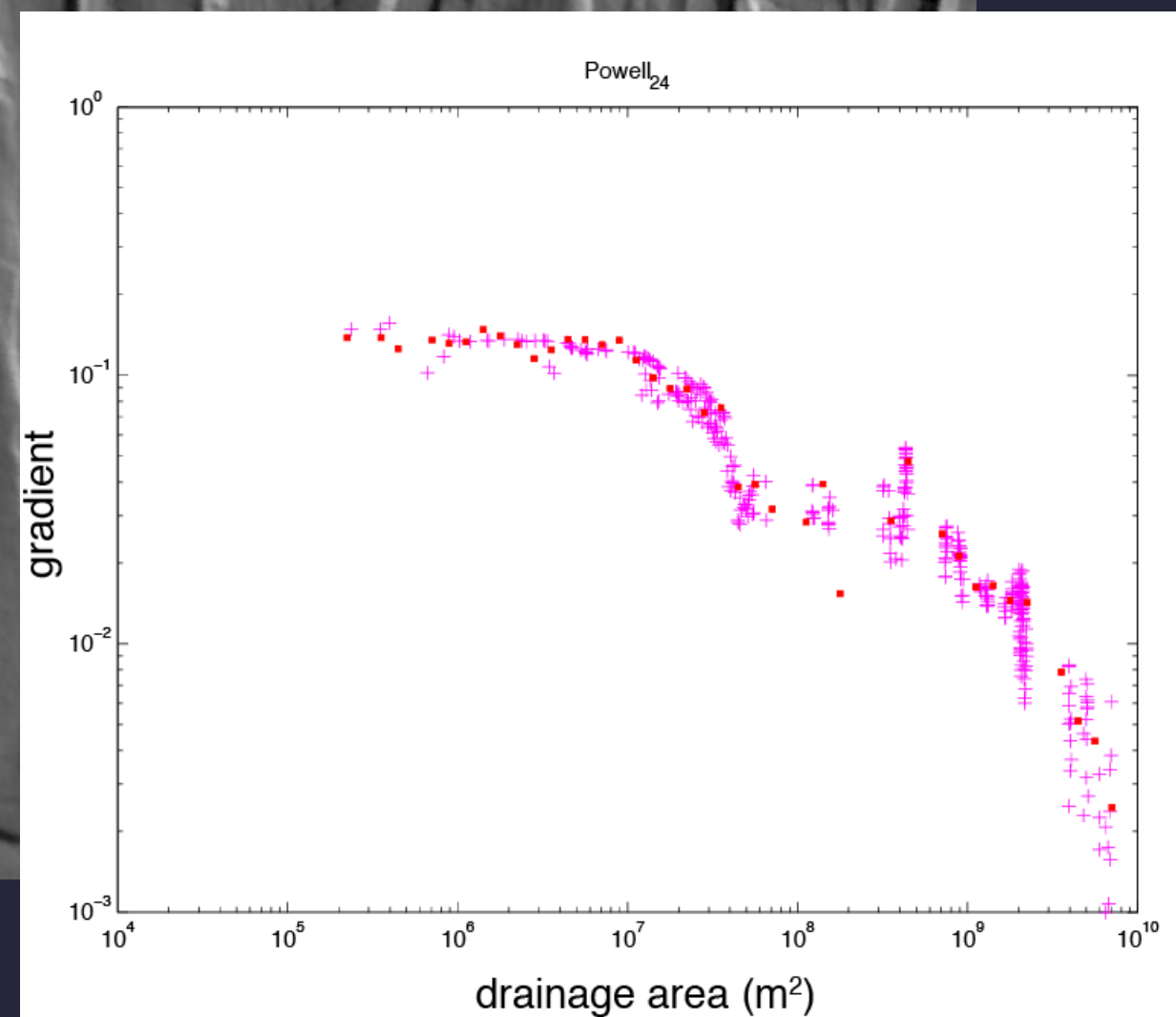
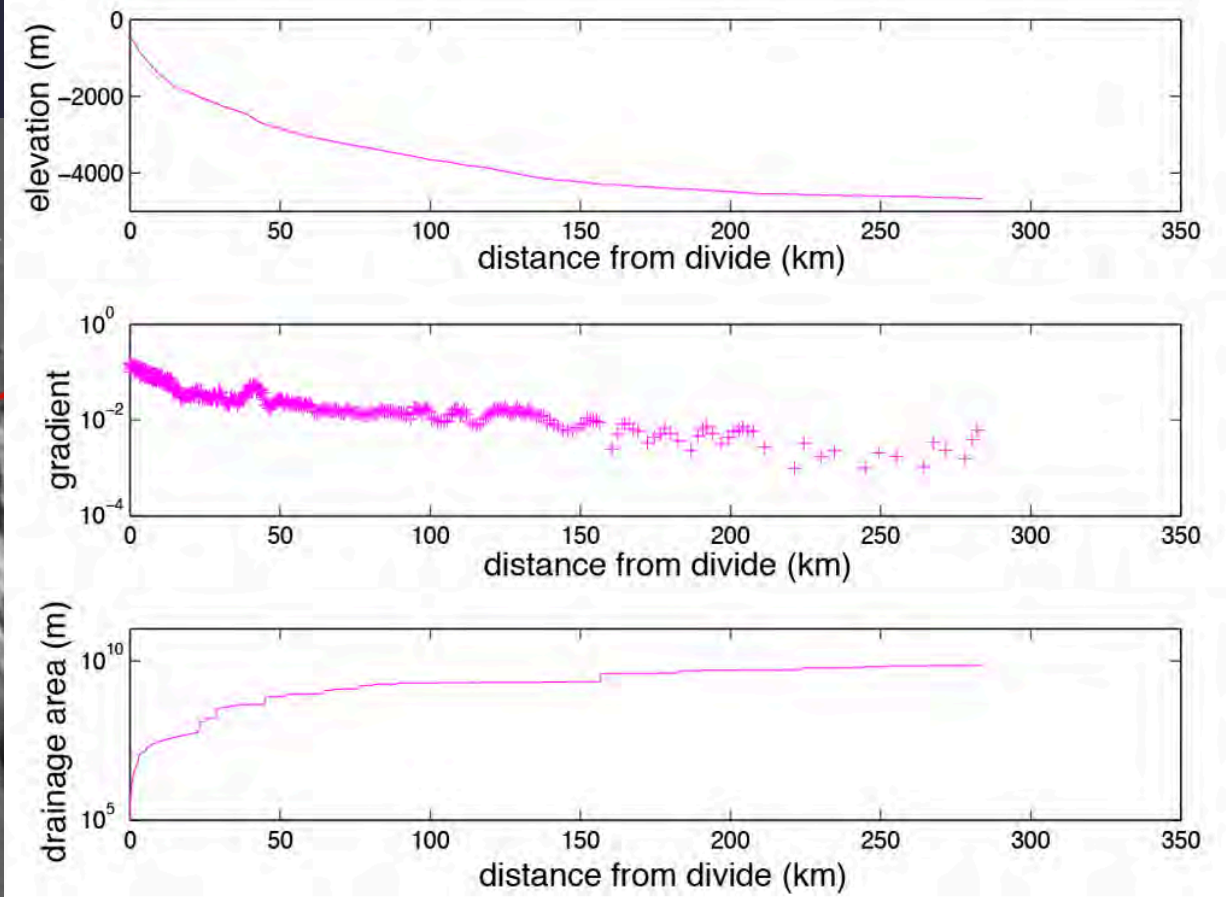
K_s = Steepness index

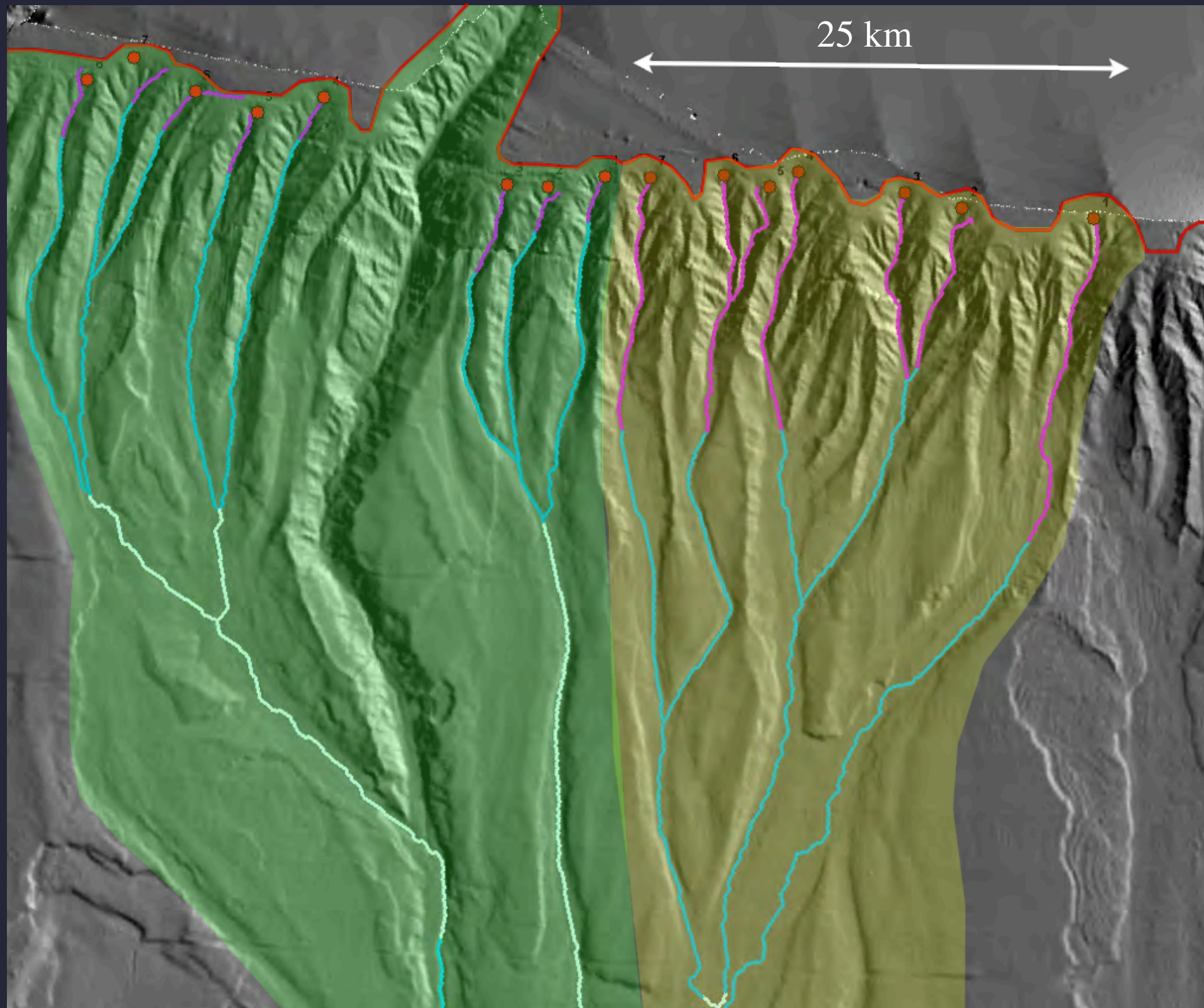
(y-intercept of log-log regression)

Θ = Curvature

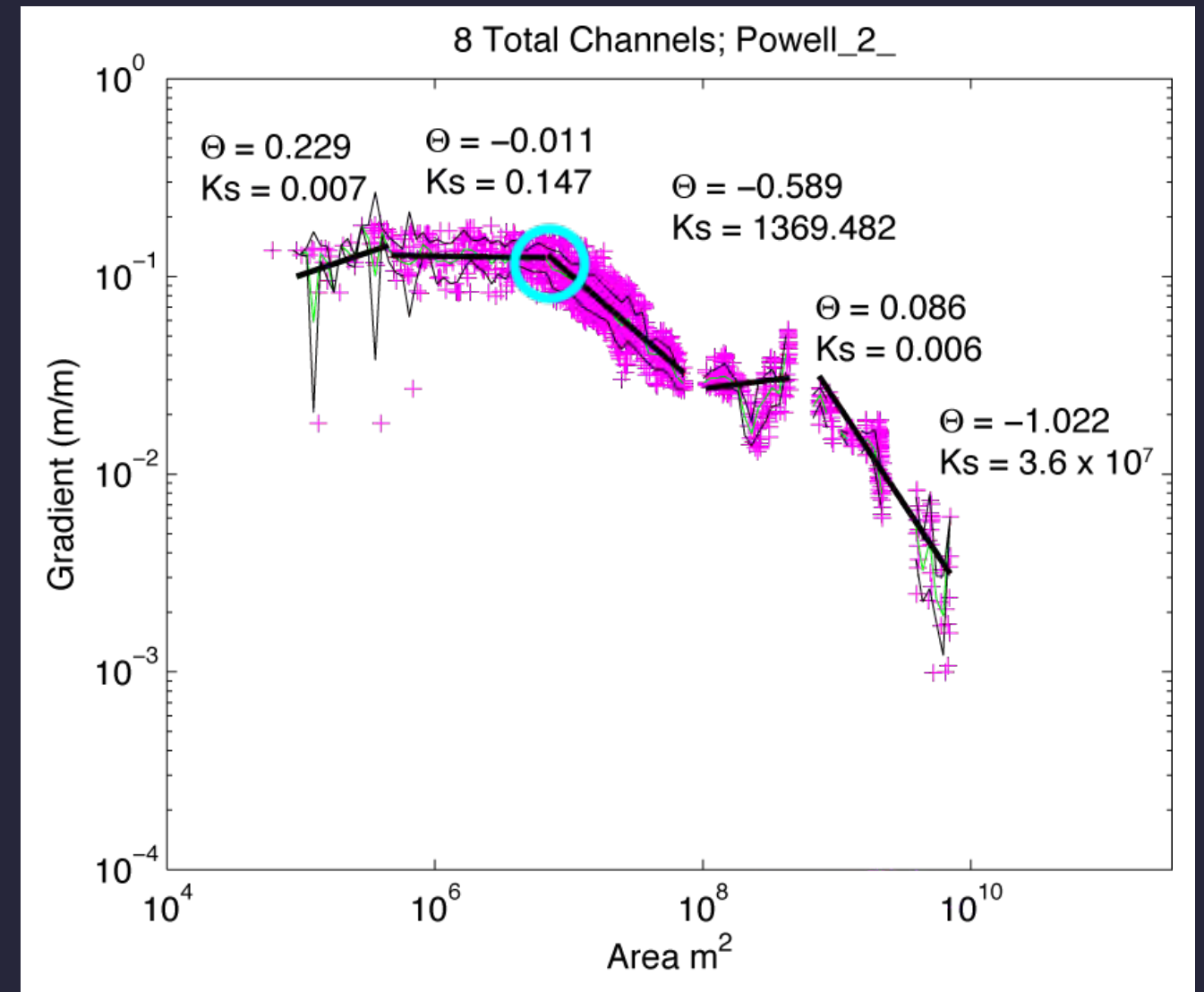
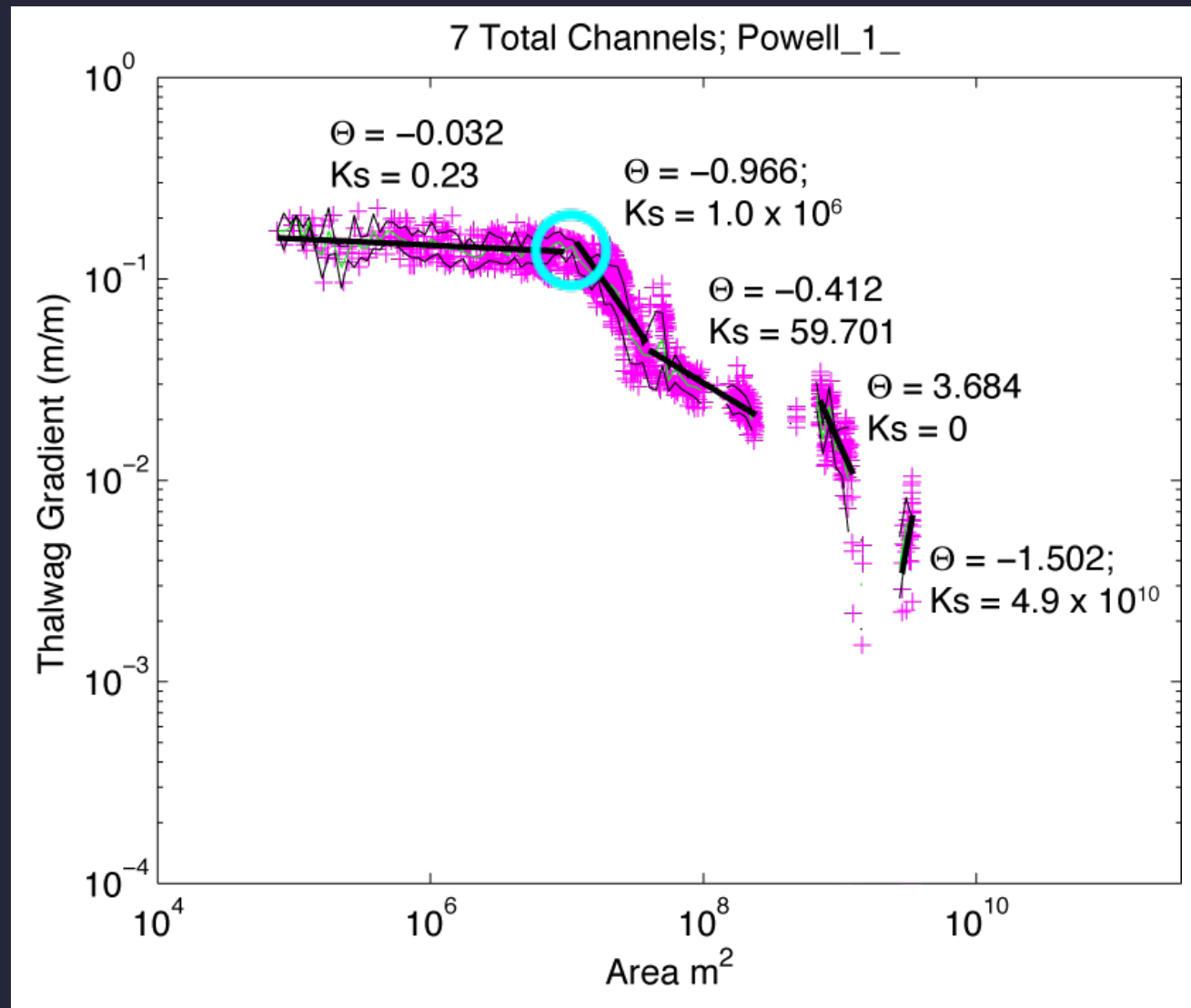
(slope of log-log regression)

Changes in K_s and Θ may
represent perturbations to the
incision process or changes in the
gravity flows themselves





Quantify geomorphic thresholds and compare along-strike changes known sedimentary processes along the shelf edge, changes in oceanographic currents and to variations in underlying structure,

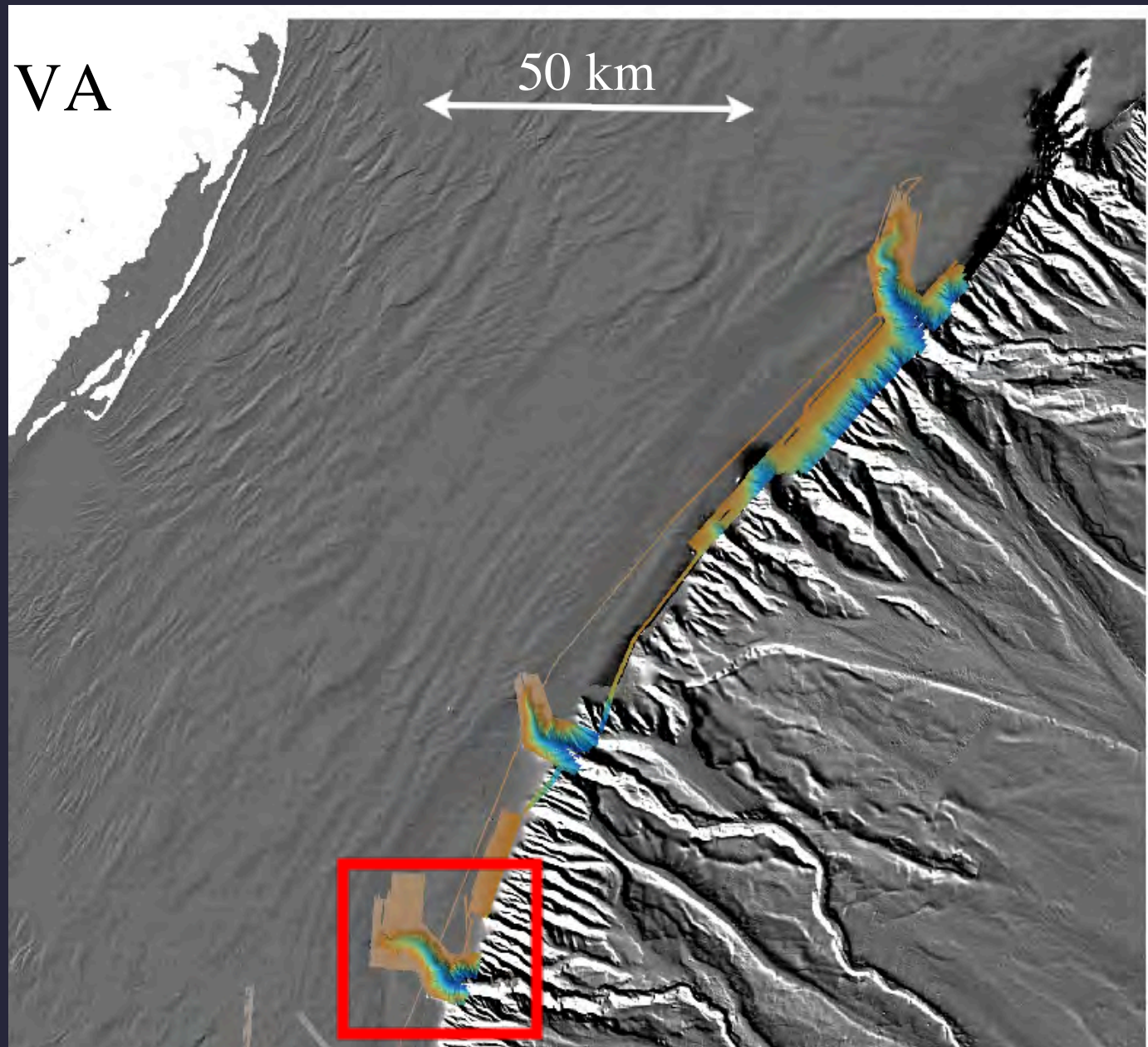


Gravity flow evolution: debris flow to turbidity flow?

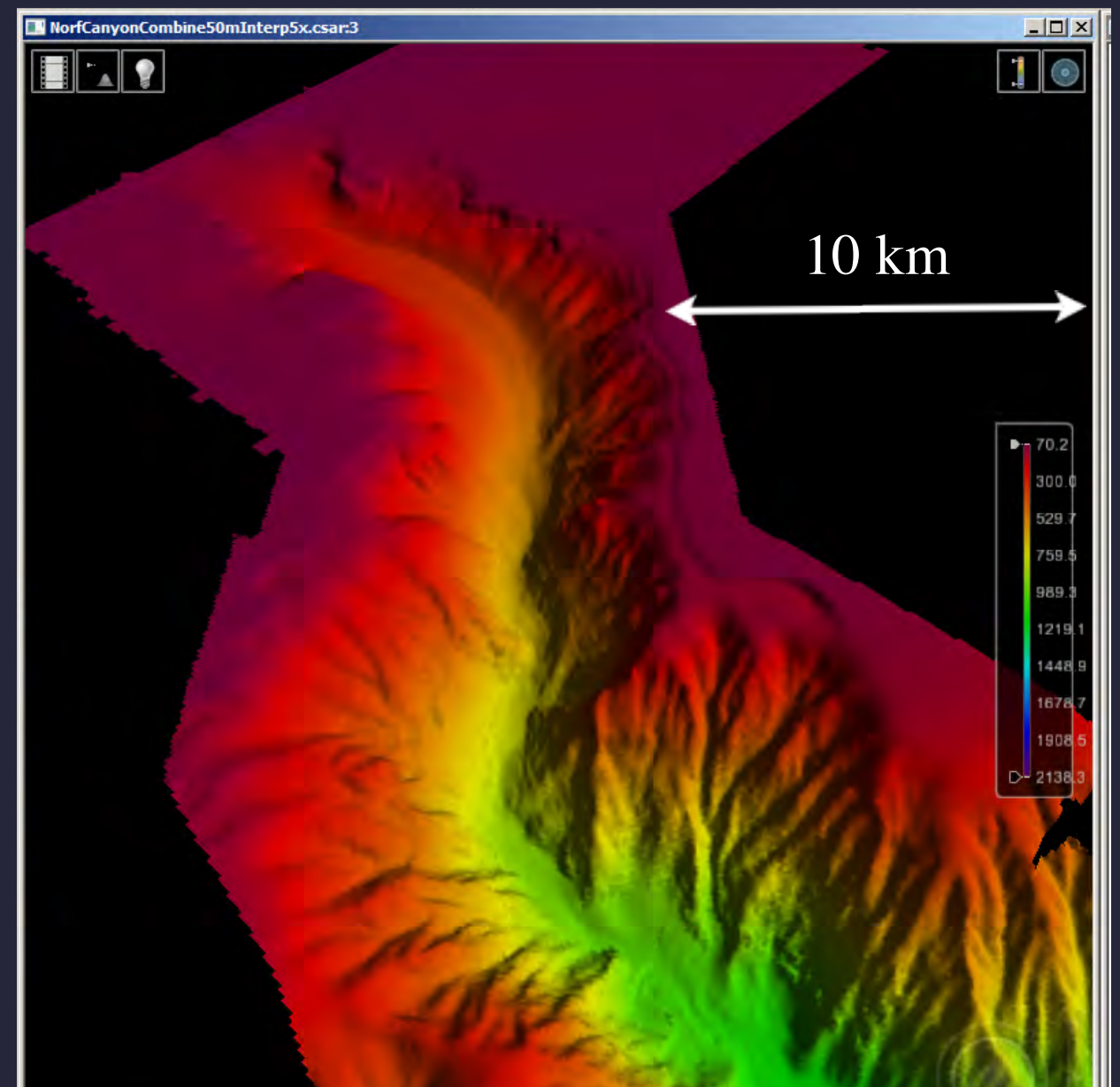
~200 Canyons analyzed thus far

June 2011 Canyon Mapping: $> 1,000 \text{ km}^2$ coverage at 10 m resolution

Fine-scale morphology, sedimentary processes, seafloor ecology
of major shelf-breaching canyons



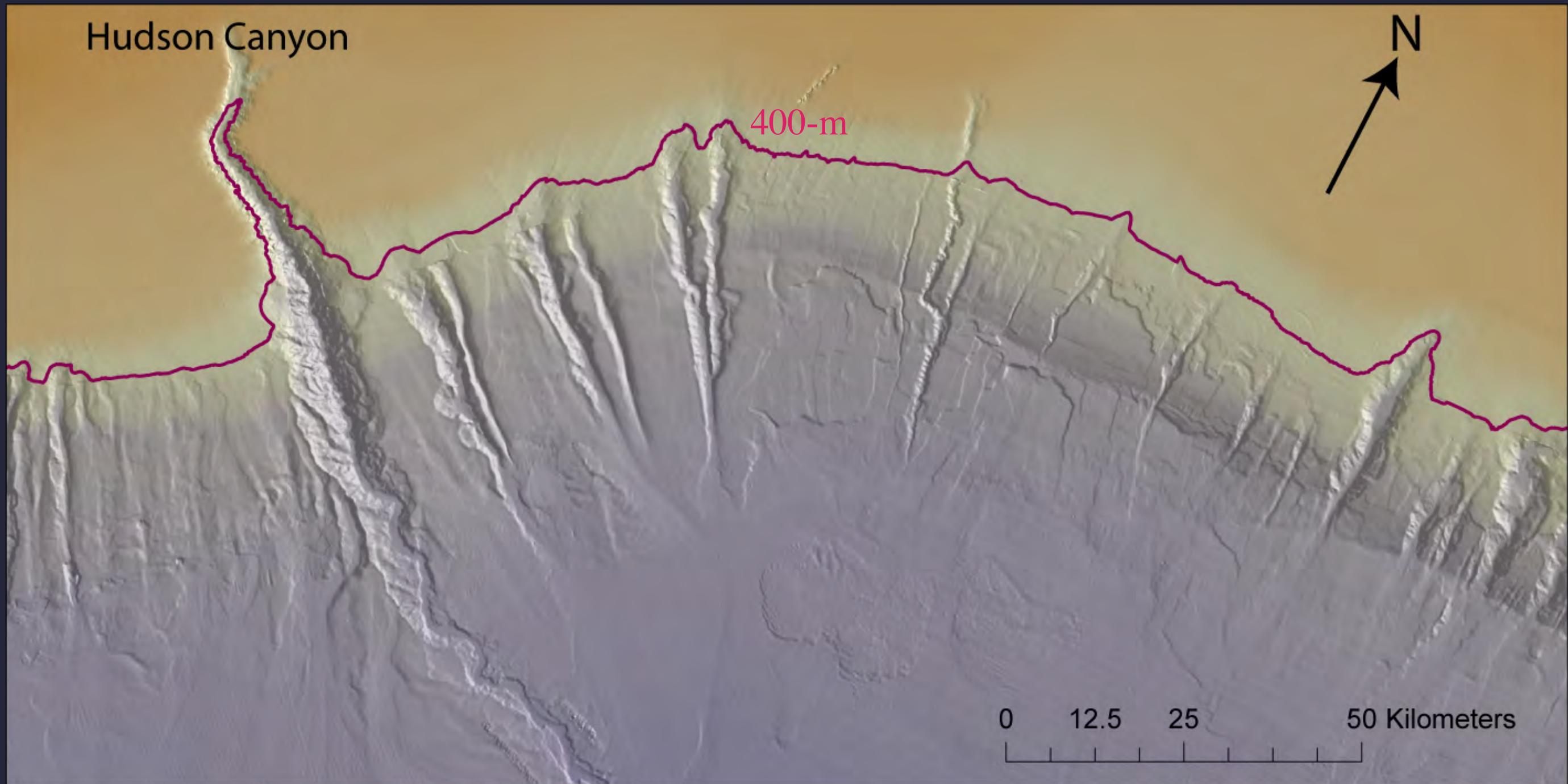
2011 US Mid-Atlantic Mapping



Norfolk Canyon

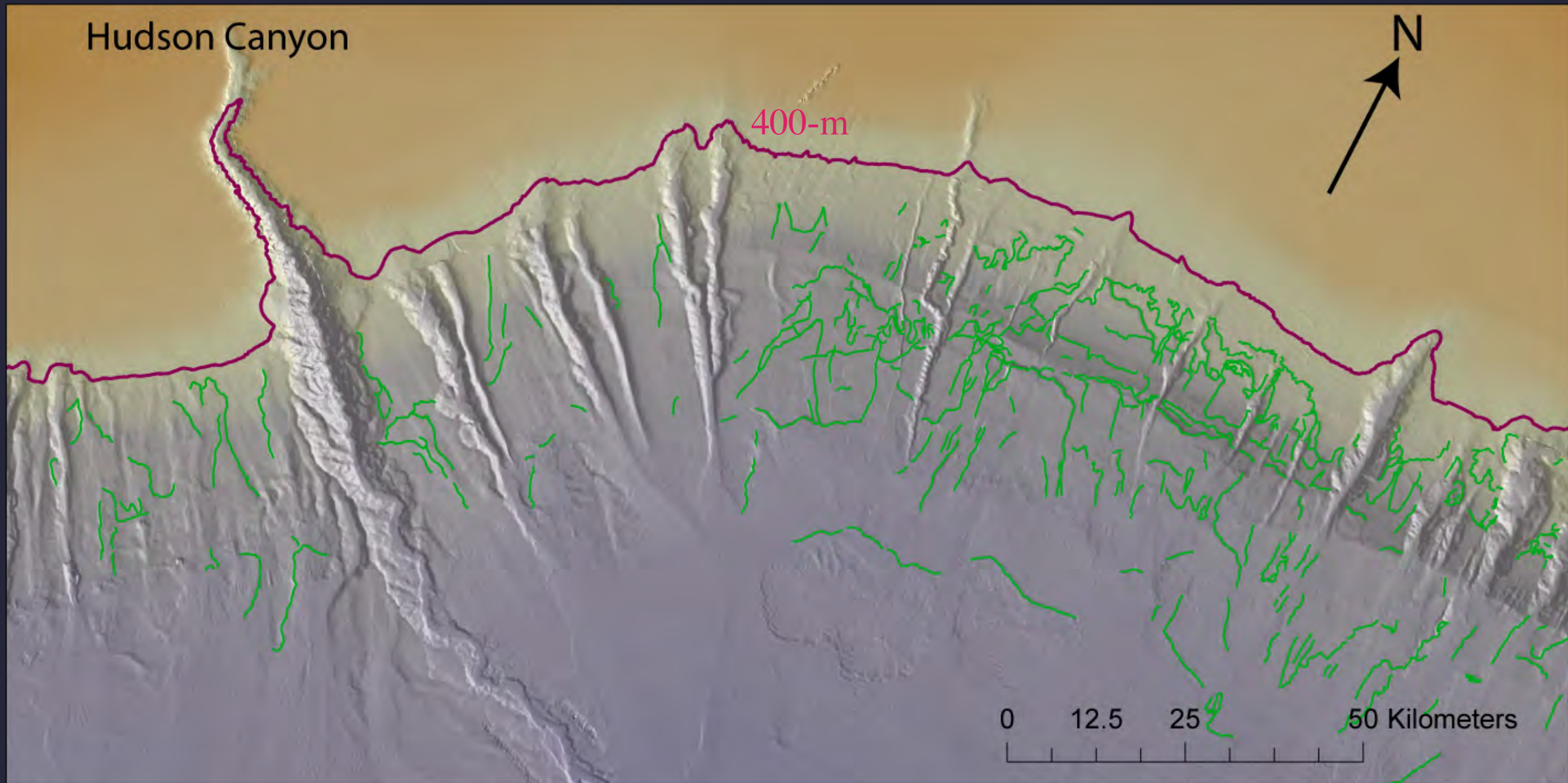
3. Submarine Landslides
&

4. Stratigraphic Architecture of Southern New England



Southern New England Slide Complex

What controls these events and when did they occur?

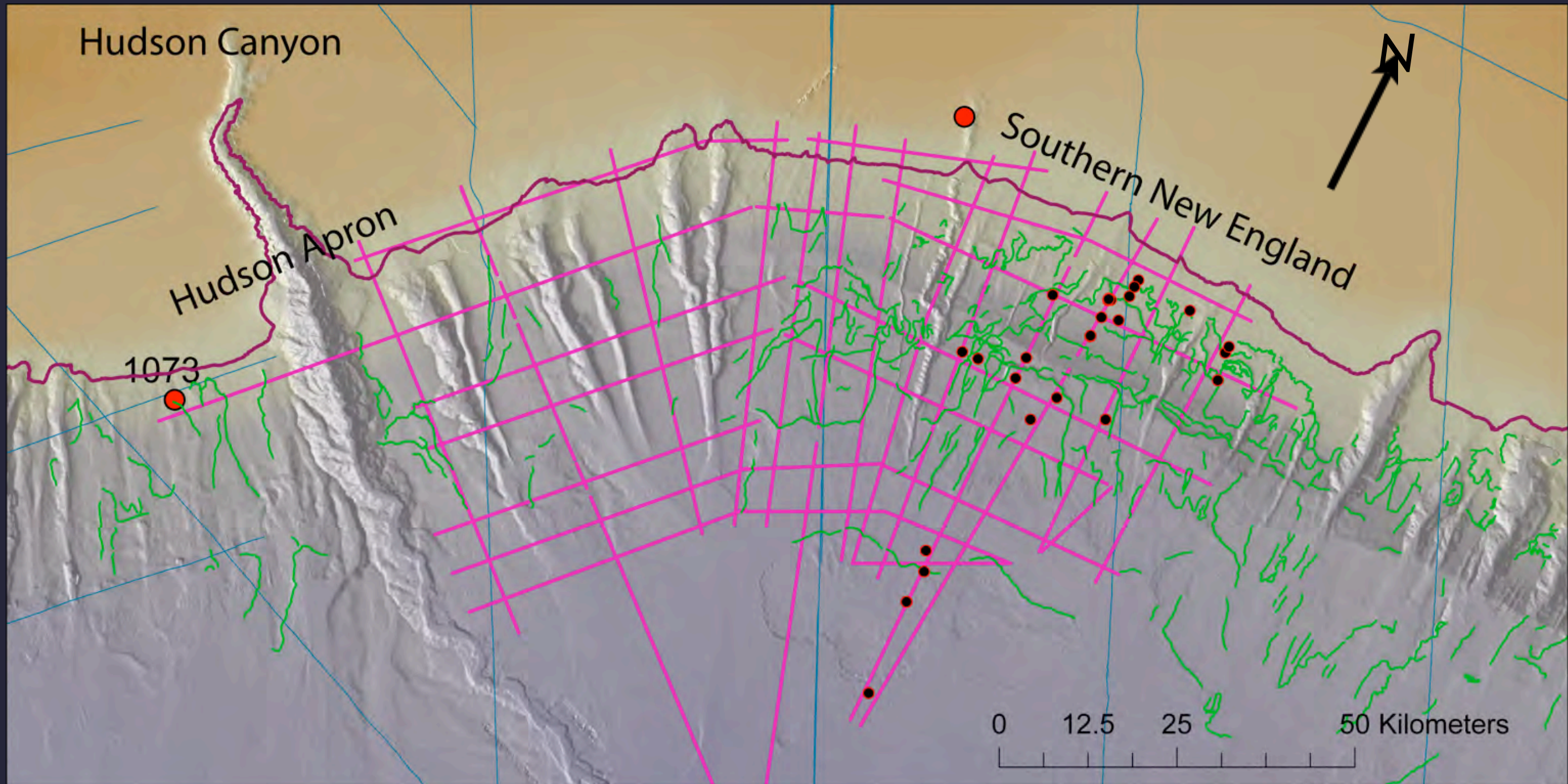


How do we explain the distribution of landslides ????

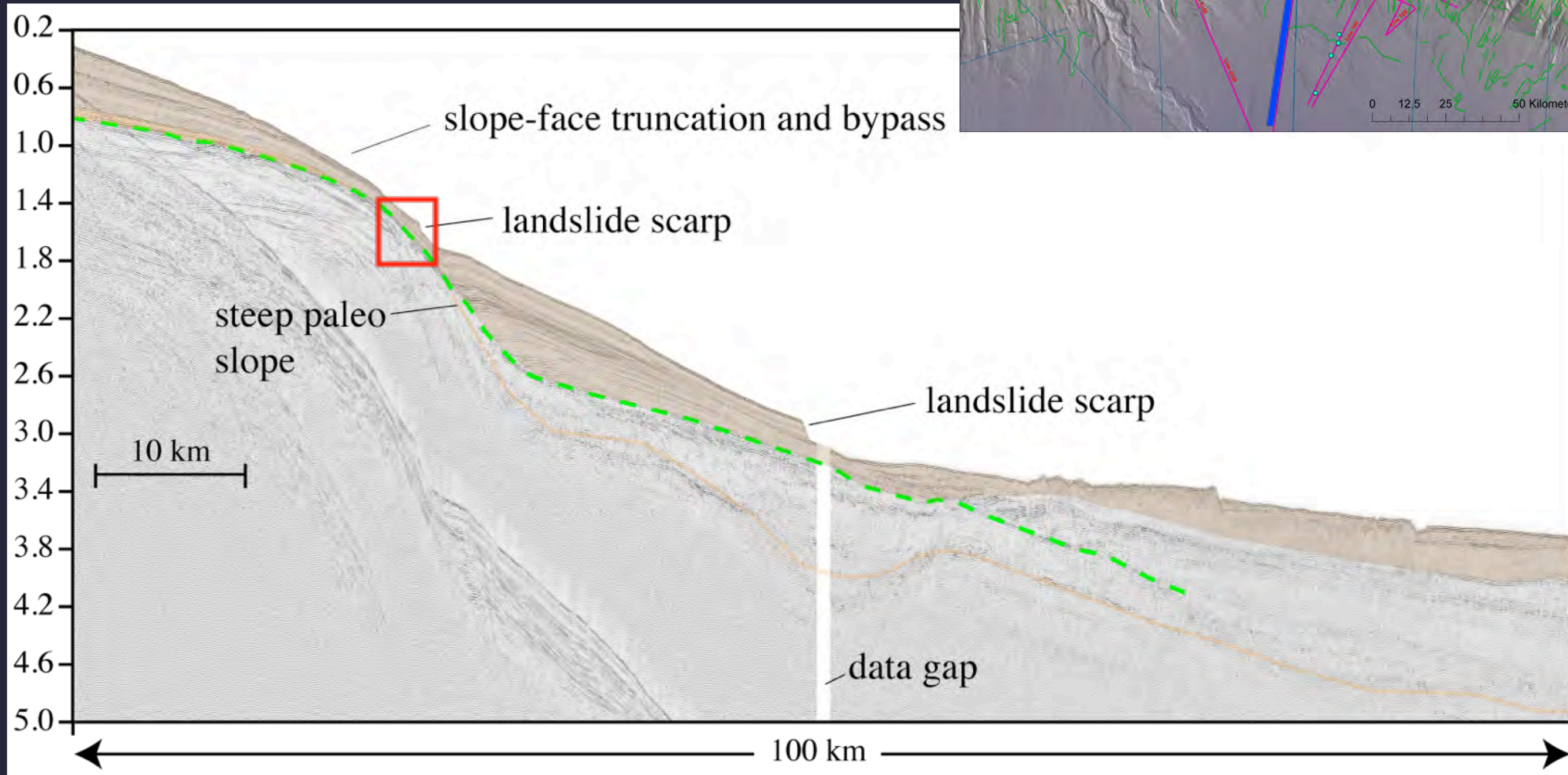
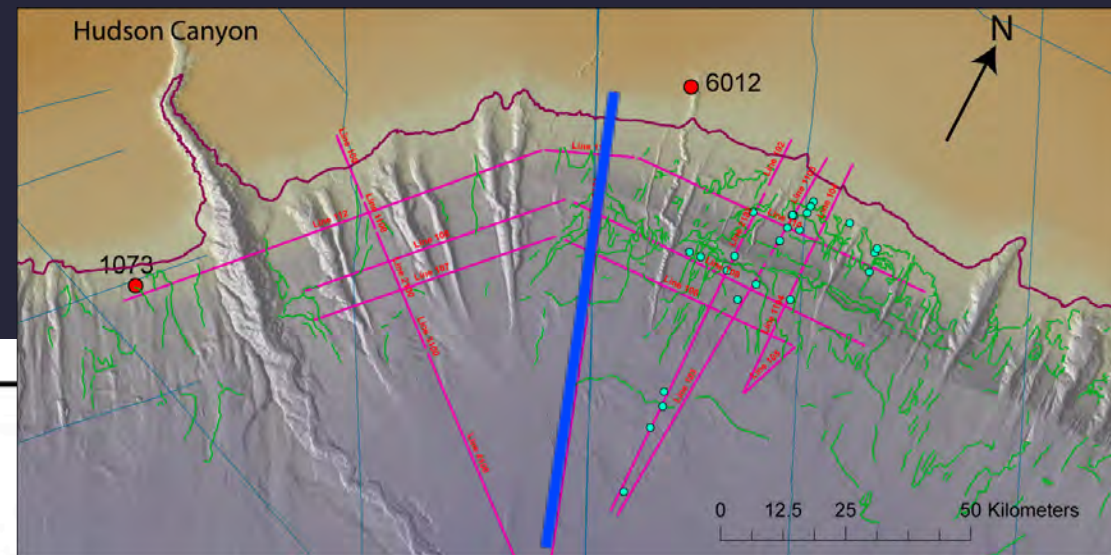
Summer 2010 and Fall 2011:

1,900 km 72-ch, high-resolution sparker MCS

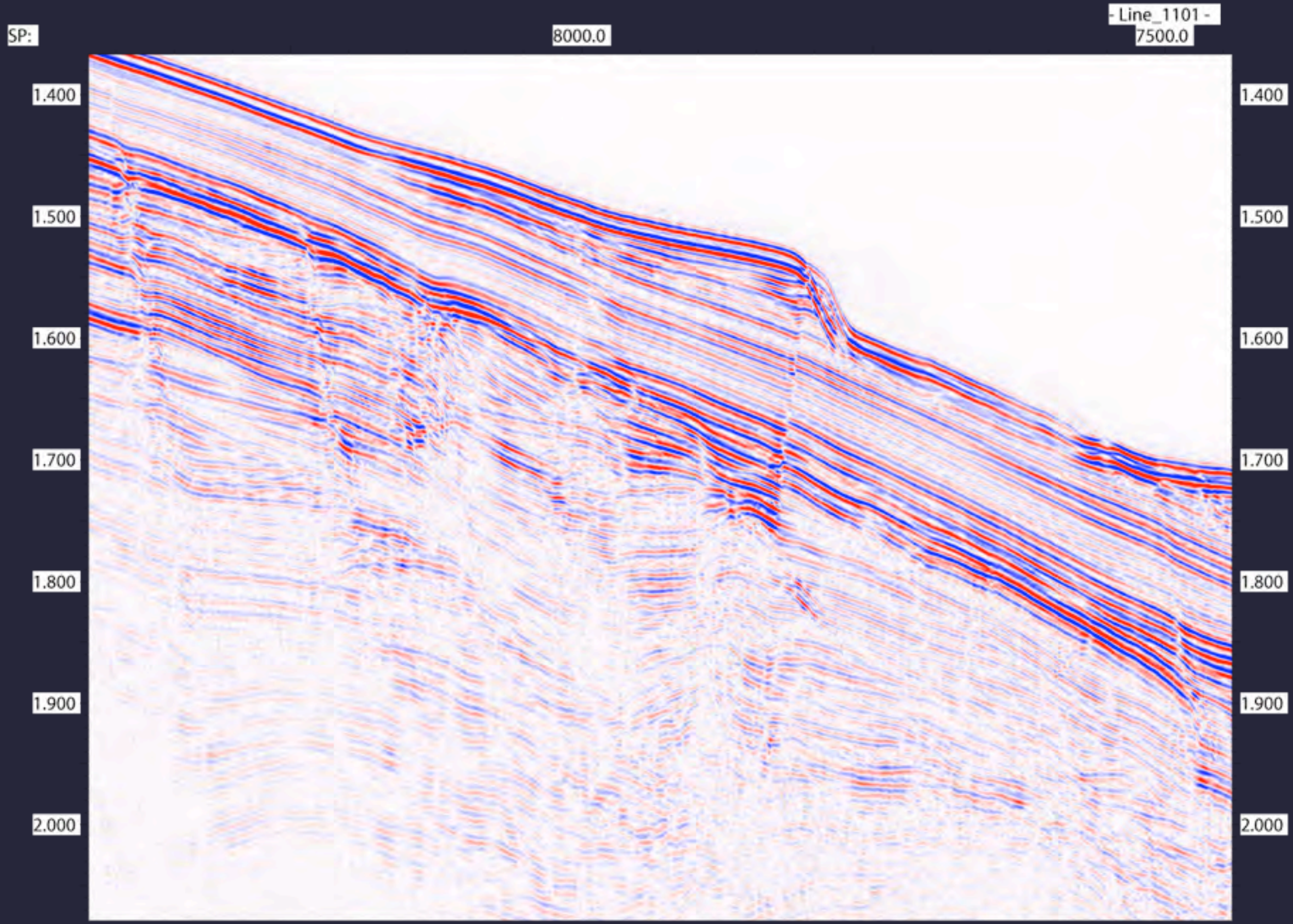
> 120 m of Piston Core



Stratigraphic architecture



USGS MCS System



Irregular, faulted layers, gas wipe-out, enhanced

SP:

8000.0

- Line_1101 -
7500.0

gas charged
sediment

~100 m scarp

1.400

1.400

1.500

1.500

1.600

1.600

1.700

1.700

1.800

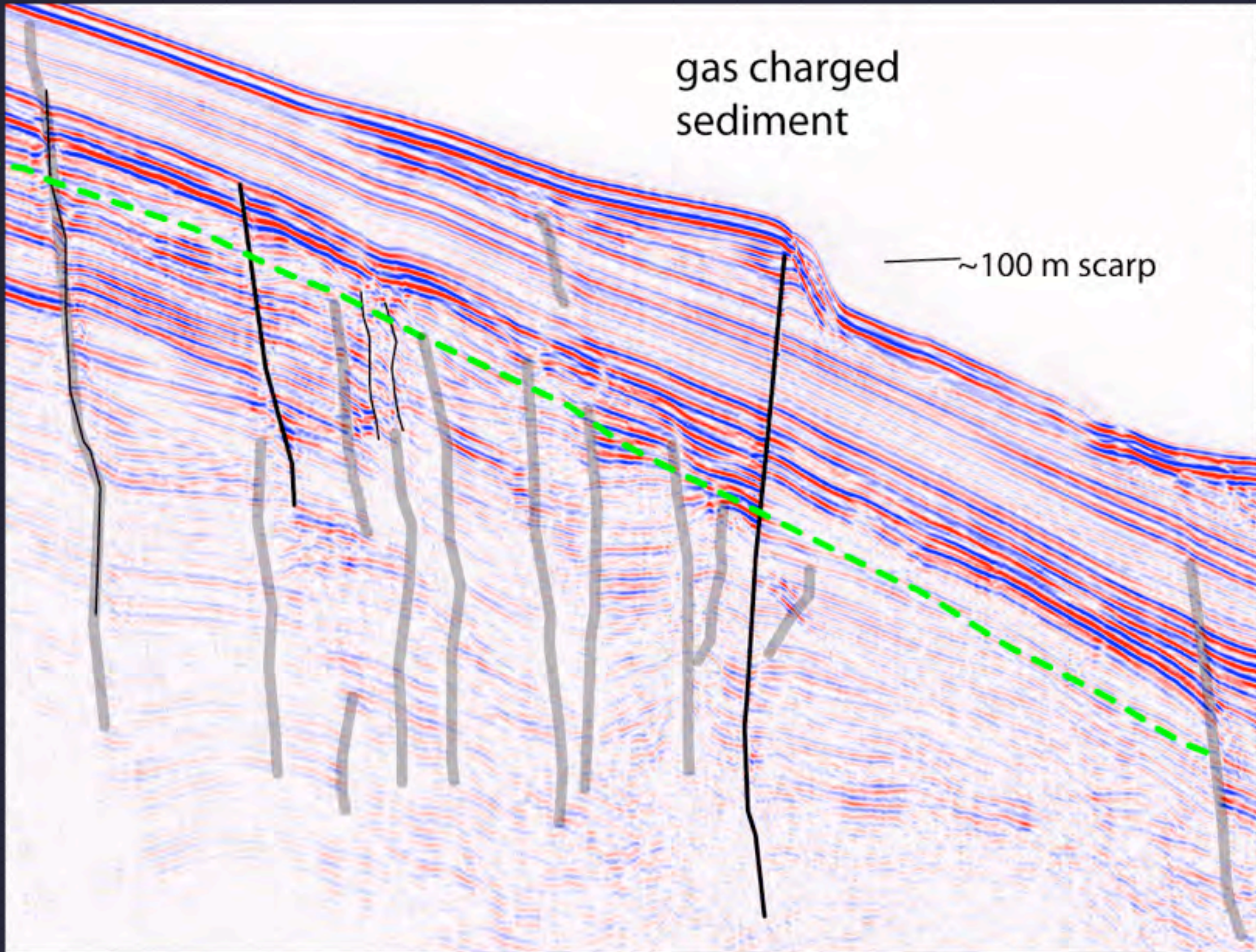
1.800

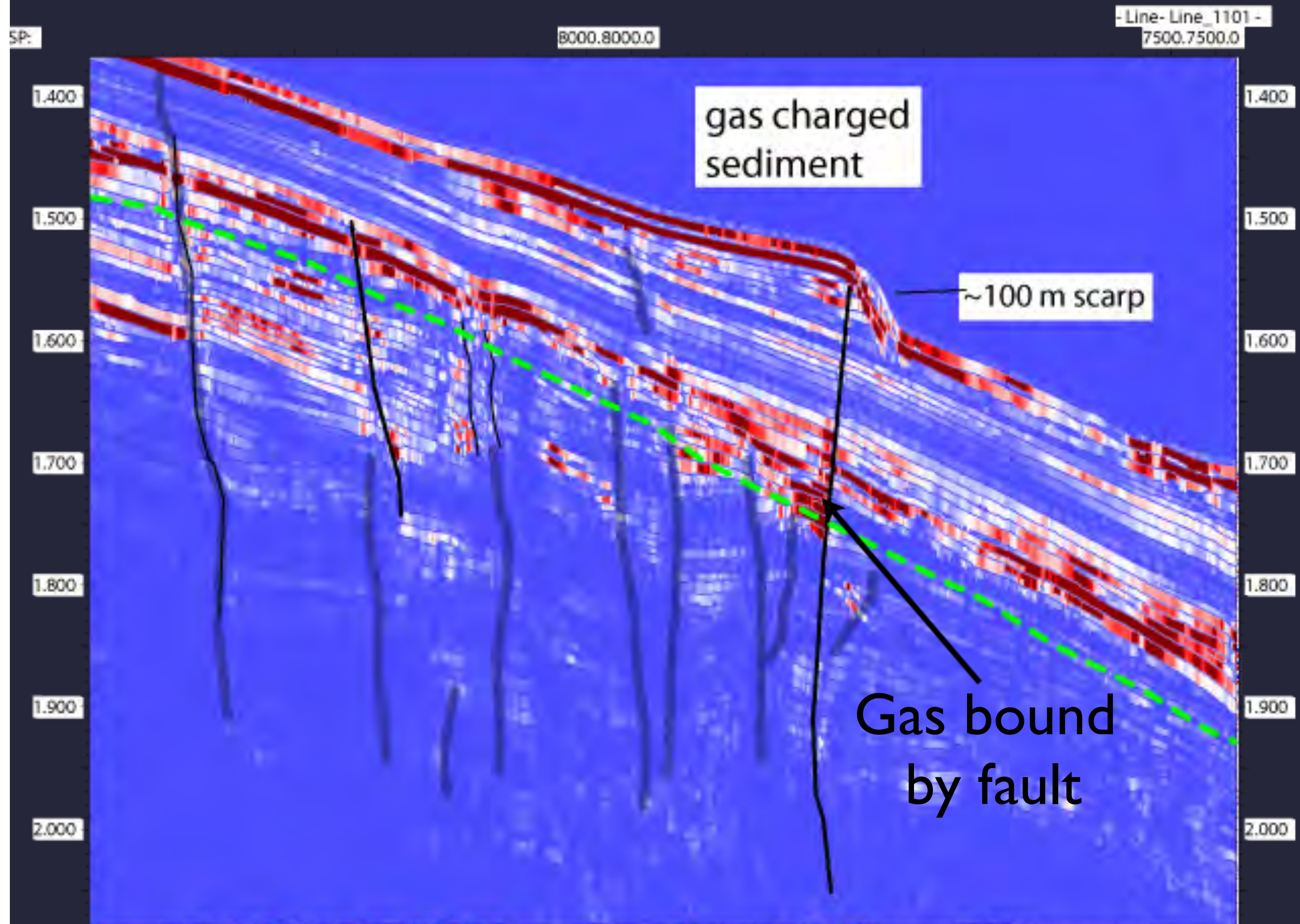
1.900

1.900

2.000

2.000





Apparent relationship between Faults, Fluids & Landslides

5. Seismicity and seafloor compliance studies of Southern New England margin

USGS/WHOI Collaboration

2012: Funded to deploy an array of broadband OBS receivers along Southern New England continental slope

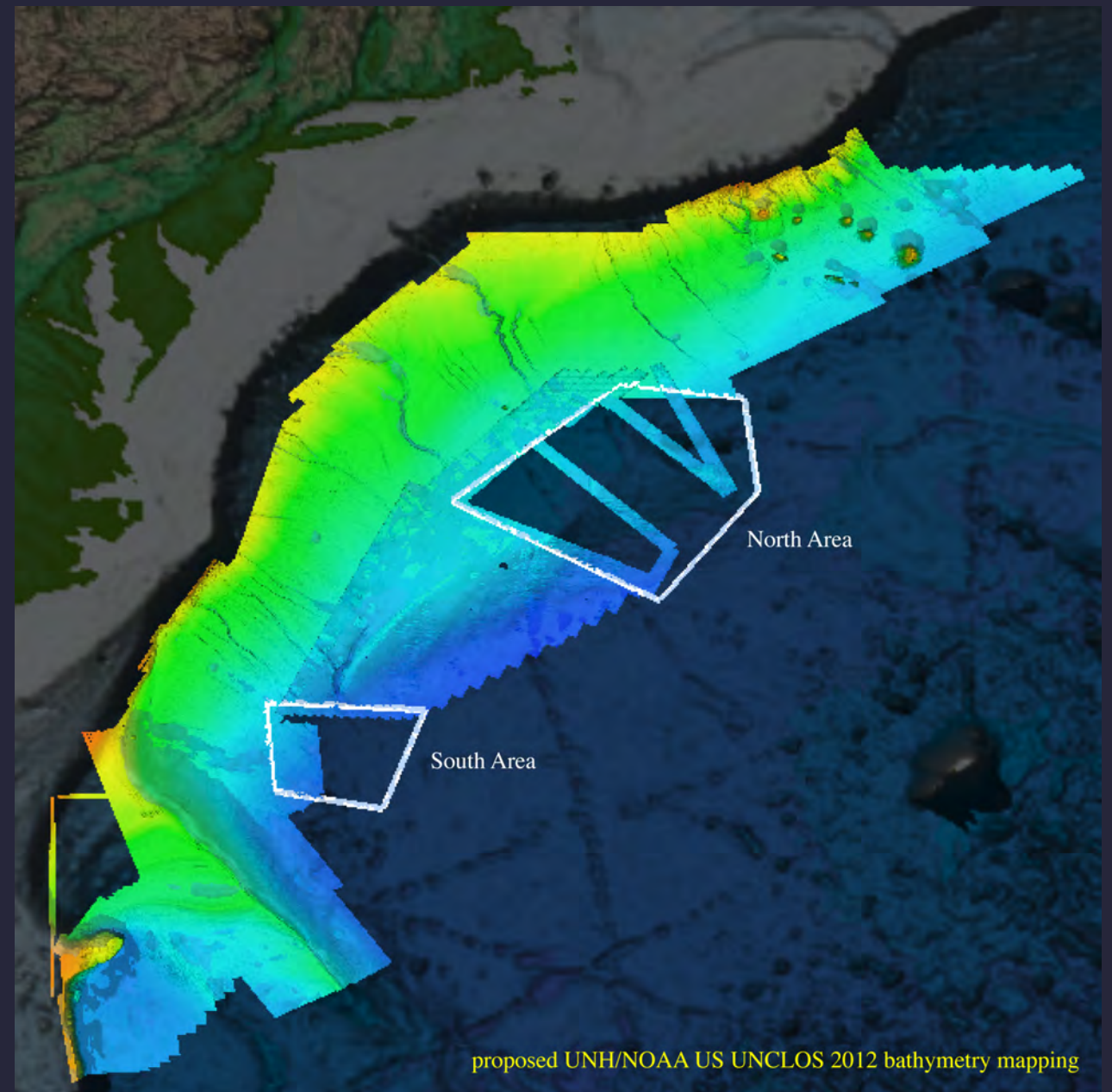


- Seismicity
- Seafloor compliance - constrain elastic parameters of the near surface sediment.

6. United Nations Extended Continental Shelf/Law of the Sea

Task to USGS and NOAA:
Establish the full extent of the US
“Continental Shelf” beyond 200
nautical miles, consistent with
international law.

“Continental Shelf”:
area of certain sovereign rights
including resources and conservation
rights to the seabed and subsoil



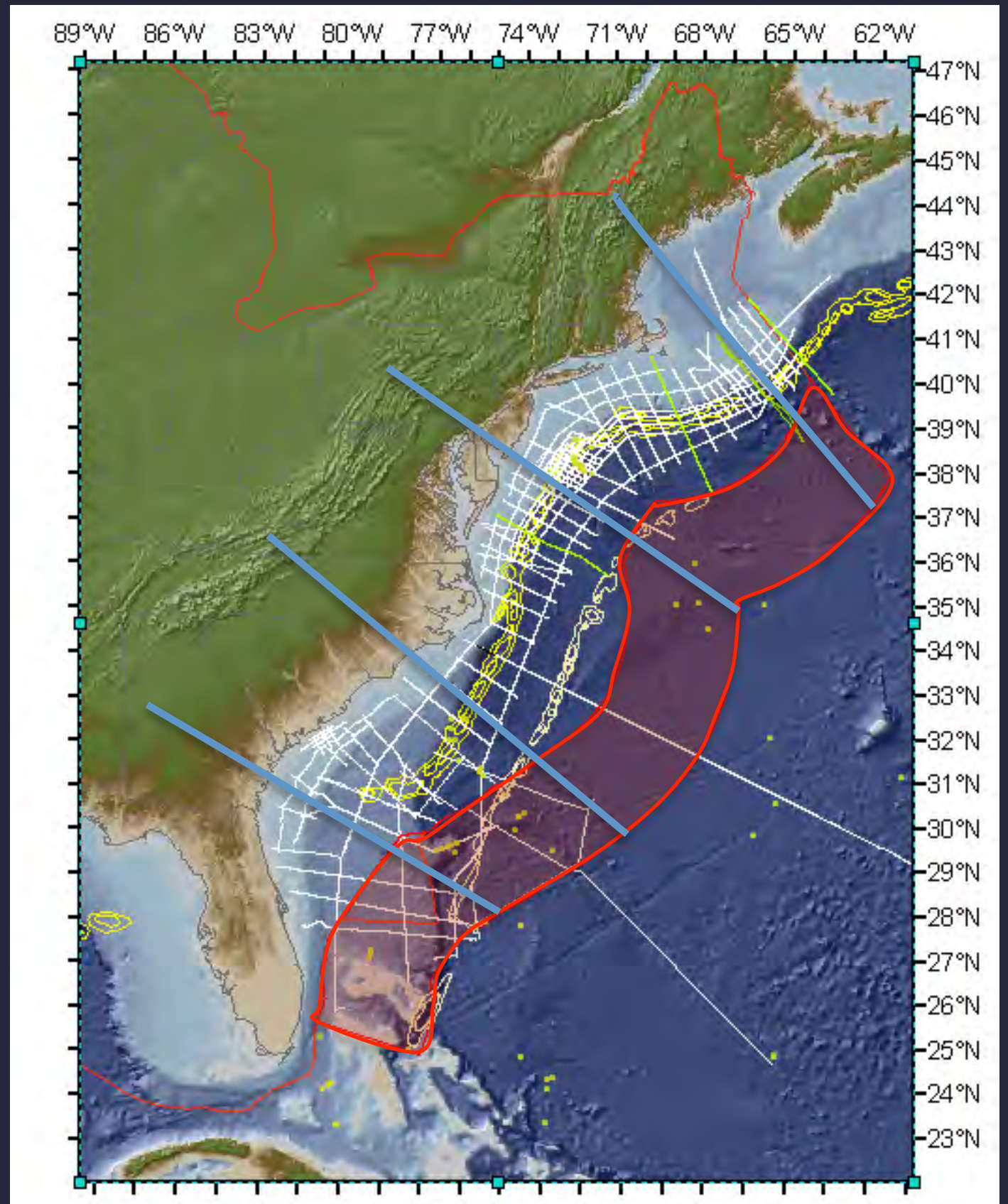
Original Plan: 2 x 40 day cruise
aboard *R/V Langseth*

MCS profiles spaced every 60 nm
beyond 200 nm limit

Coincident wide-angle refraction
on select lines

Now: Budget delays. Best case
scenario: Langseth cruise in 2013.

**Please see poster for details
or contact Debbie Hutchinson**



Law of the Sea

Additional Information:

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Meredith Westington, NOAA Office of Coast Survey

Jason Chaytor, U.S. Geological Survey

Greg Mountain, Rutgers University