Large to Small Faults Within the Galicia 3D Seismic Volume

RICE

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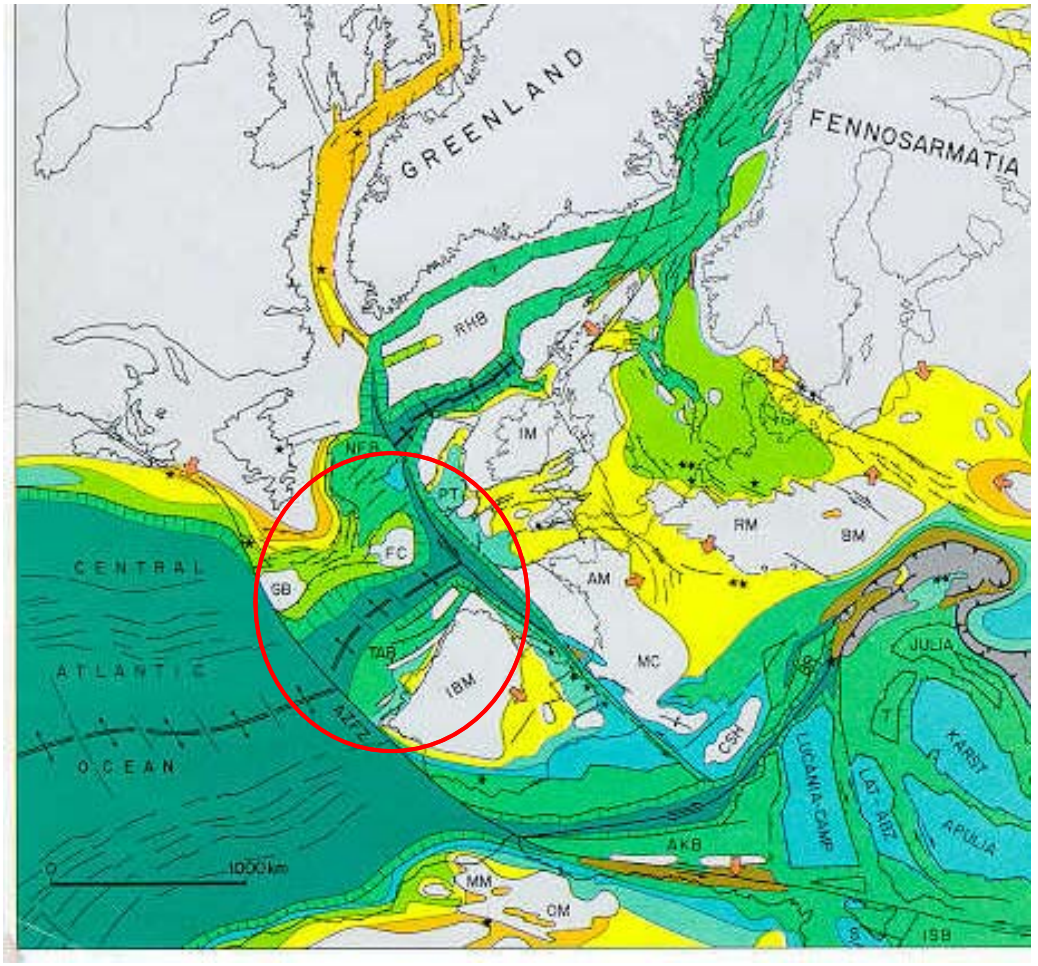
REPSOL

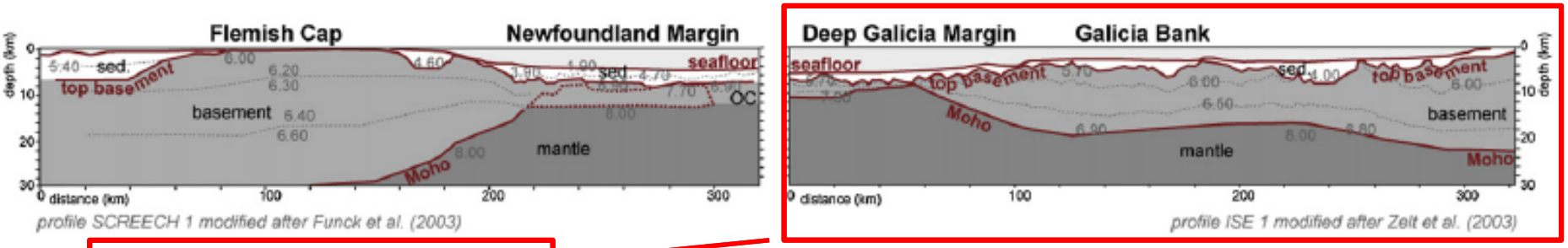
13 December 2015

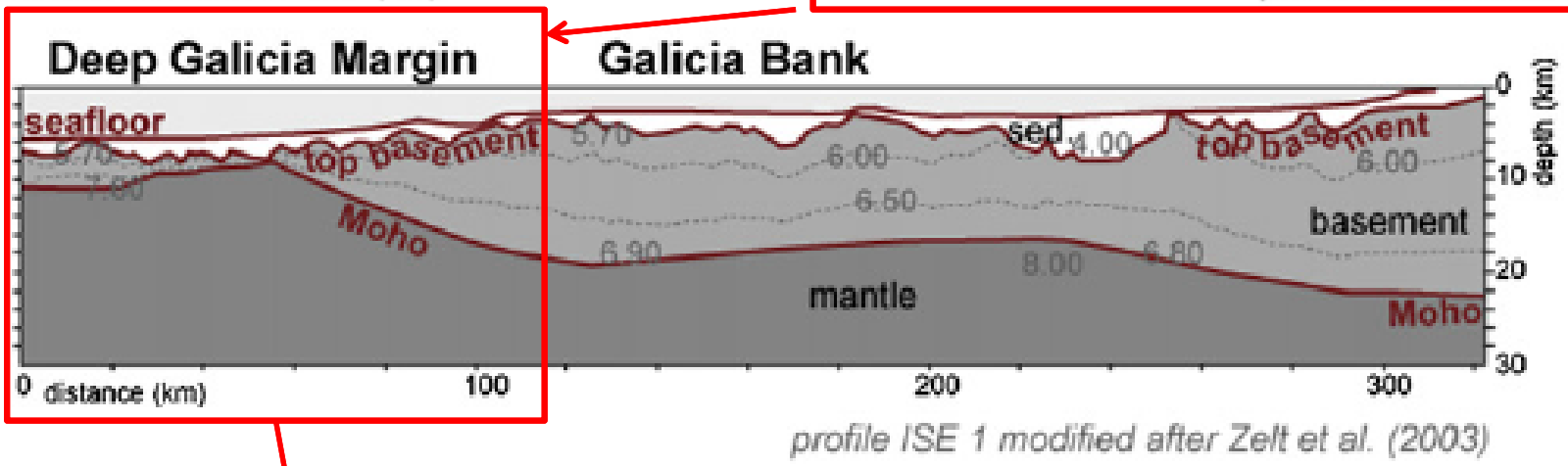
Iberia and Newfoundland were separated during Middle Triassic to Lower Cretaceous.

The Deep Galicia basin formed the final part of the breakup, between Late Jurassic to Aptian/Albian time.



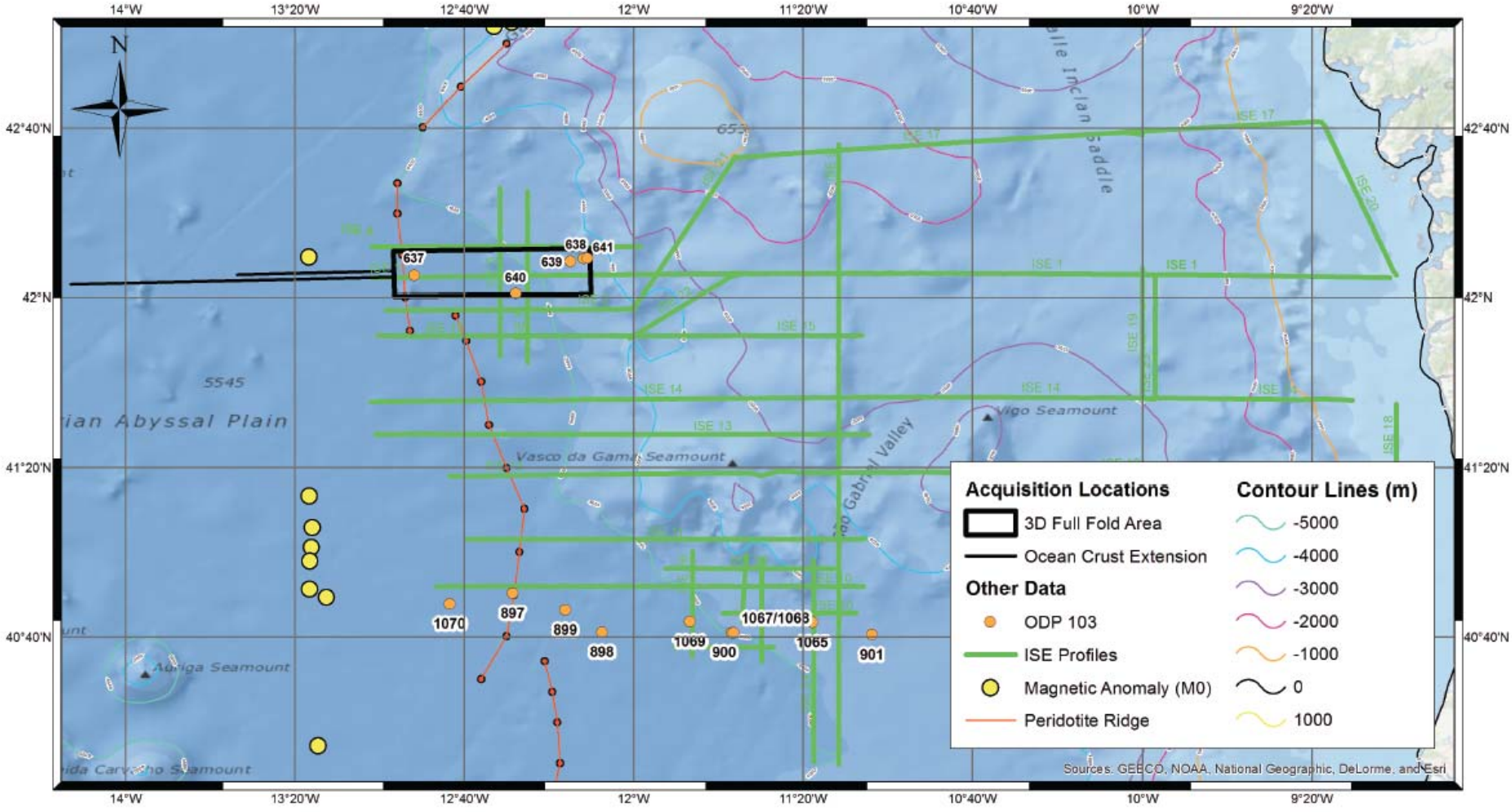
Ziegler 1988





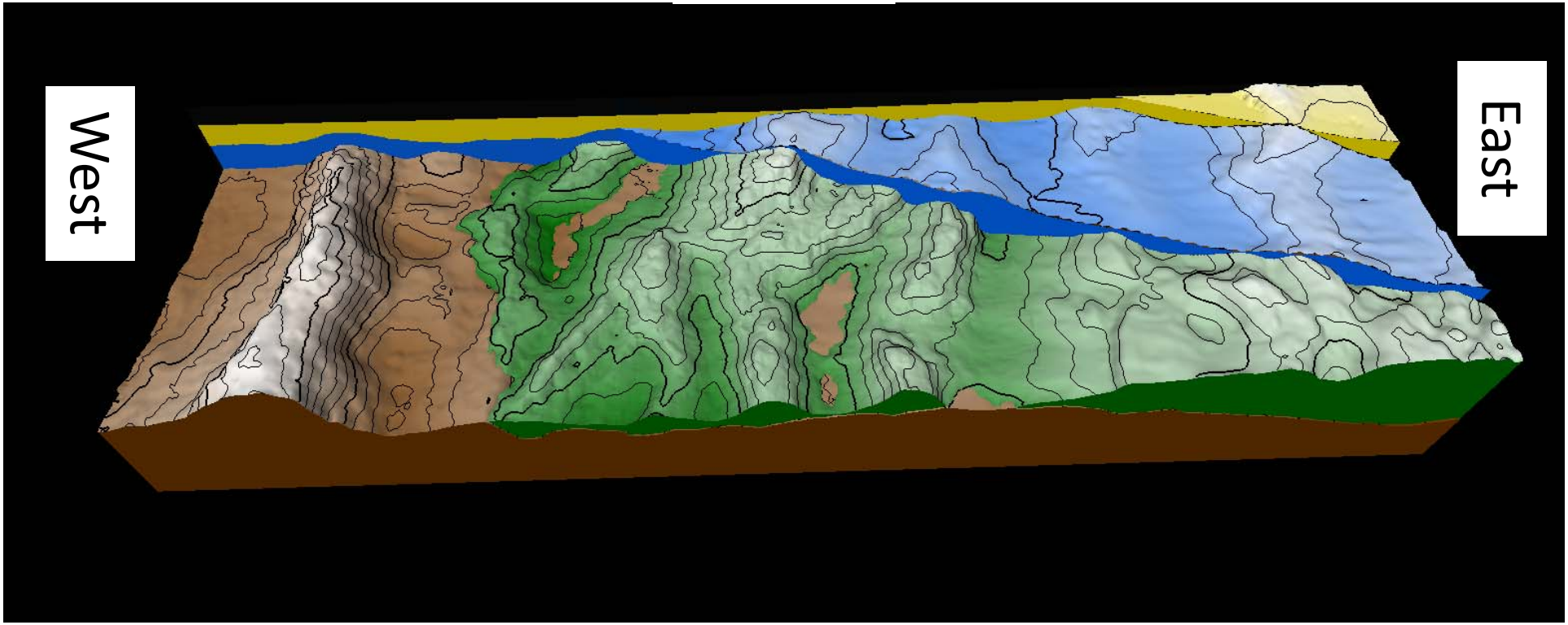
Peron-Pinvidic et al. (2013)

Galicia 3D Seismic Acquisition



Brian Jordan

North



South

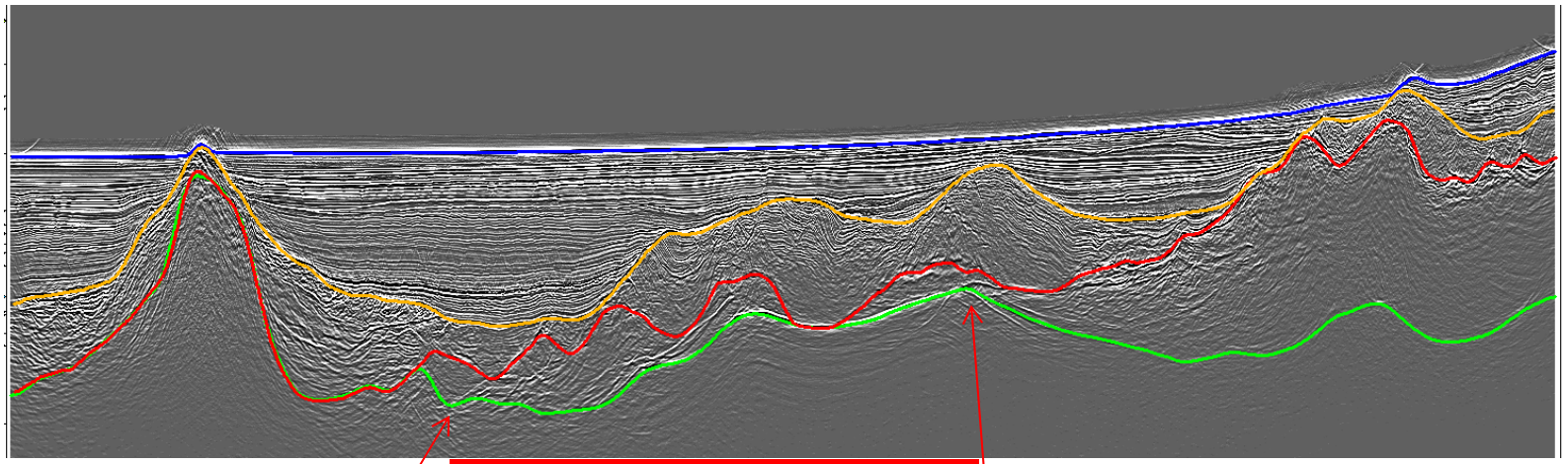
Brian Jordan

68 km by 20 km
PSTM
Depth Conversion

Large scale faulting

Inline 320 – PSTM – 4X

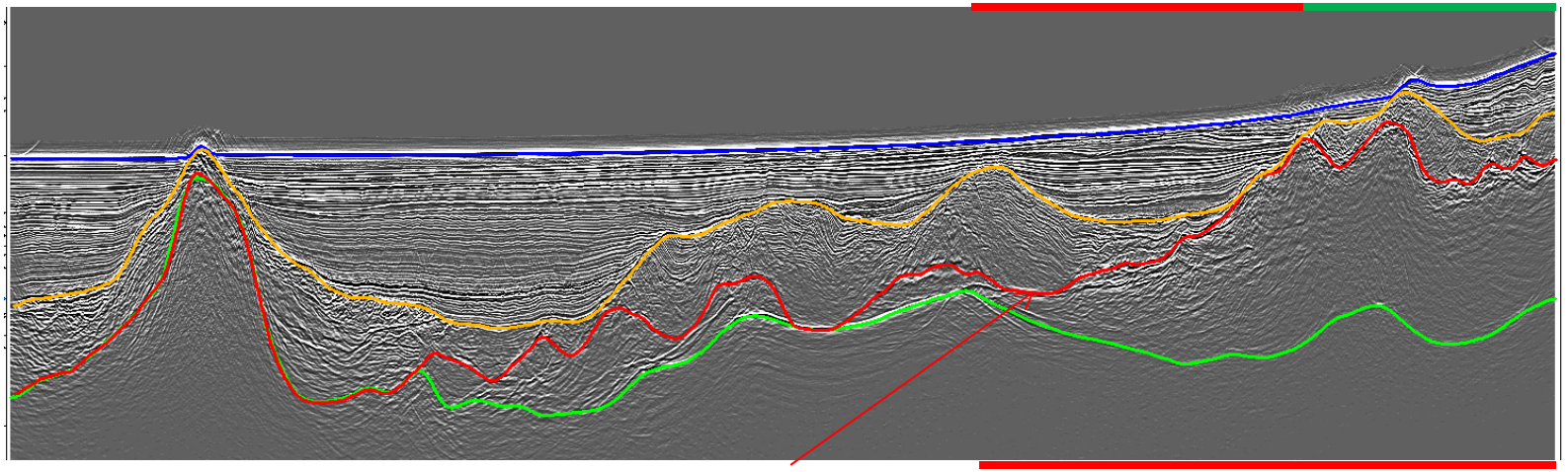
W E



S-termination S-decollement S-breakaway

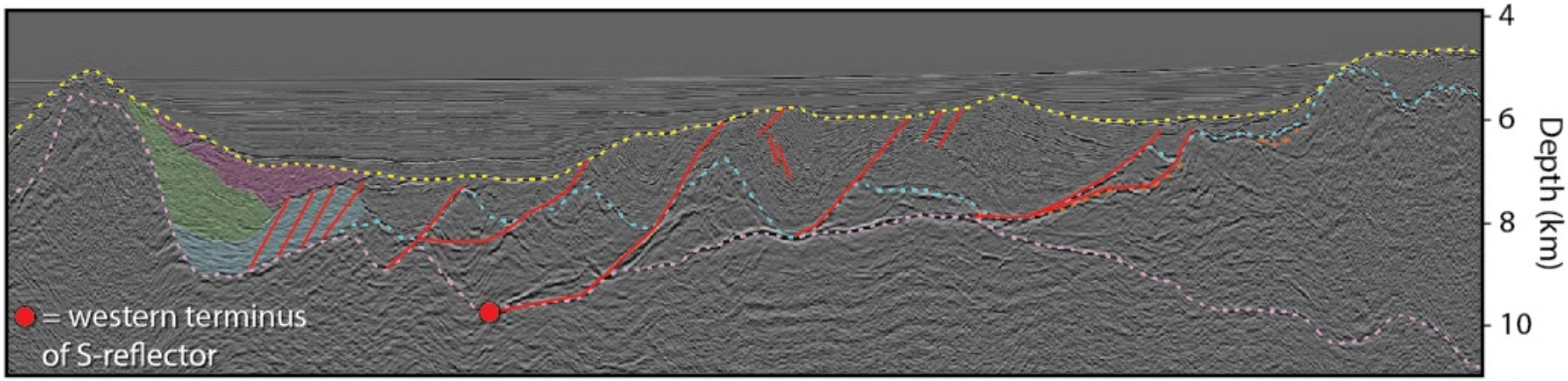
W E

Normal fault East of S Galicia Bank



Normal fault East of S Moho diving toward Galicia Bank

West East



VE = 2
Inline 270
PSTM and Depth Conversion

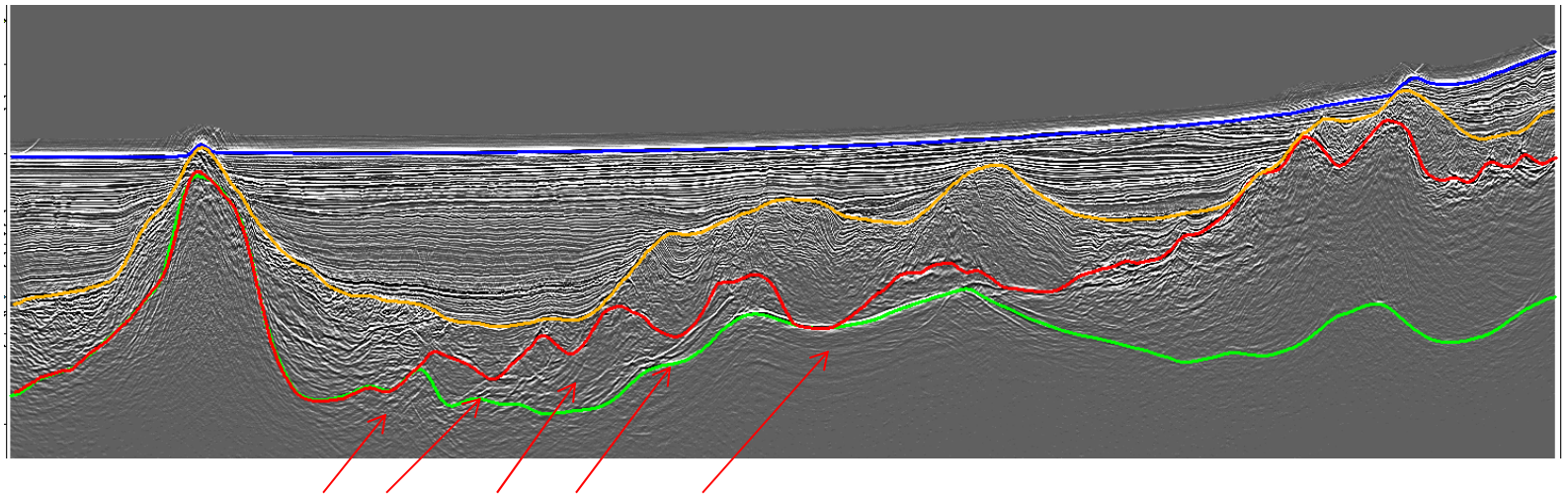
Jordan, Sawyer, et al., EGU2015

The S fault is roughly 25 km (E-W), is very low angle to the West, and the fault forms the Continental Crust above and Serpentinite/Peridotite upper mantle.

Intermediate scale faulting

Inline 320 – PSTM – 4X

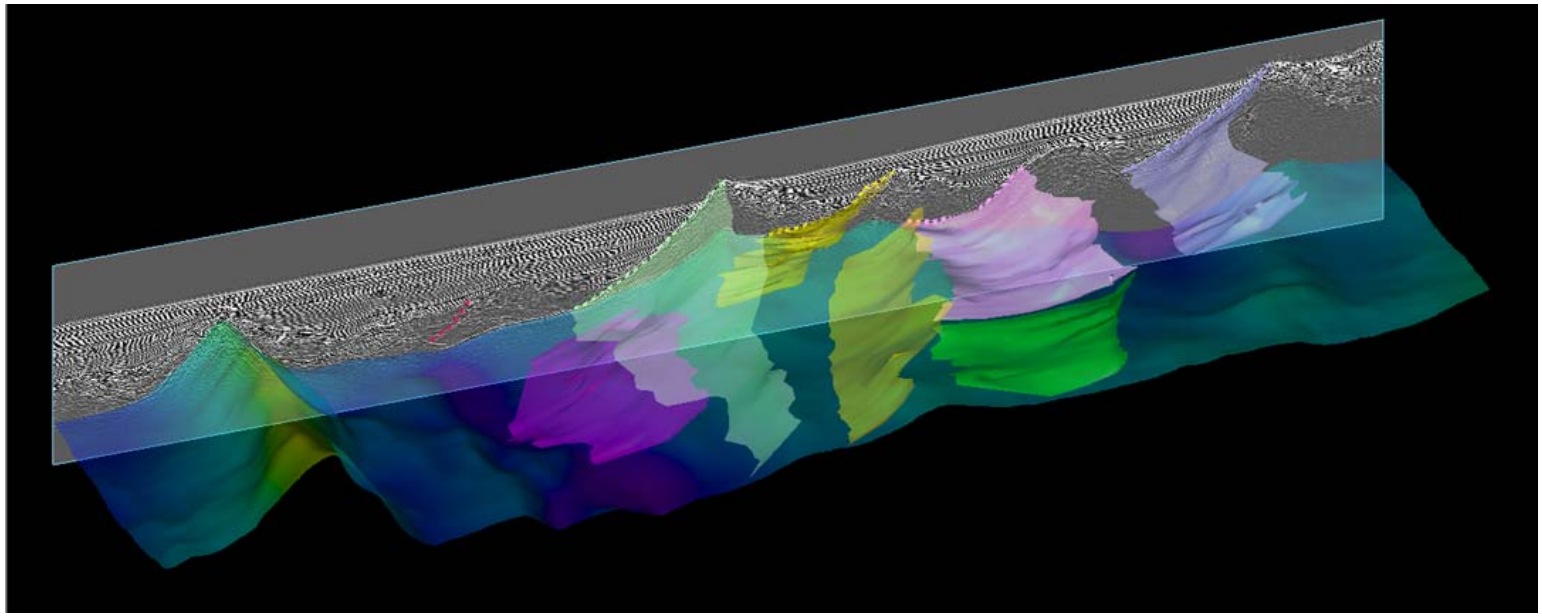
W E



Normal faults soling onto the S decollement

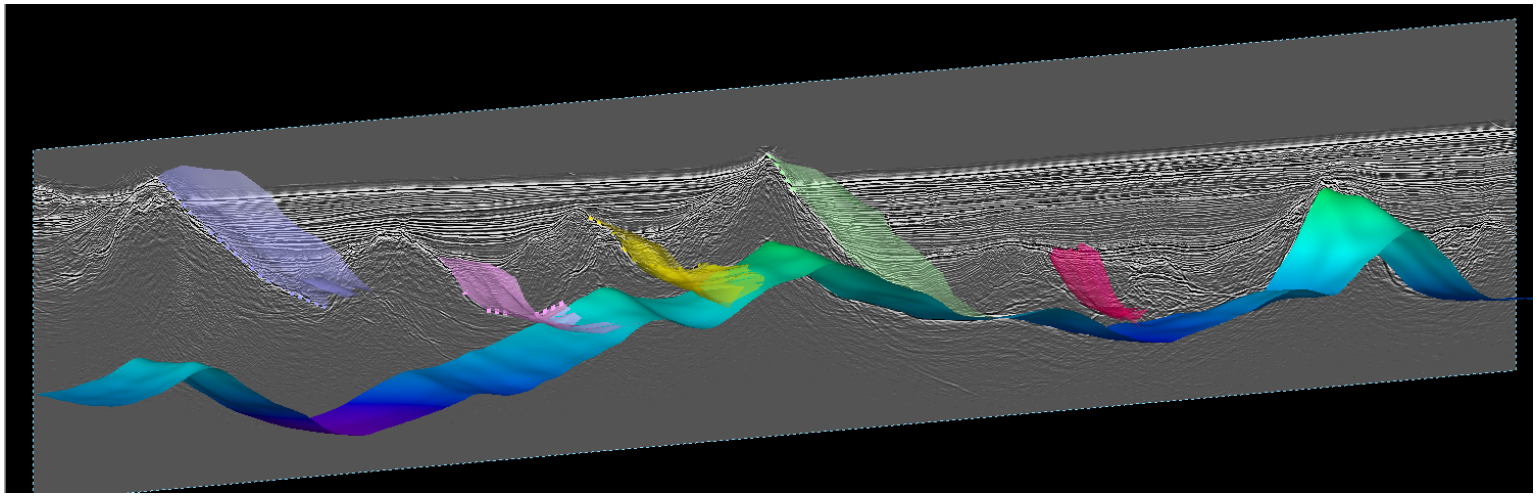
The intermediate faults are dipping to the West, they are spaced about 4-8 km apart, they sole onto the S decollement, and the faults cut the pre and syn sediment.

West



East

East

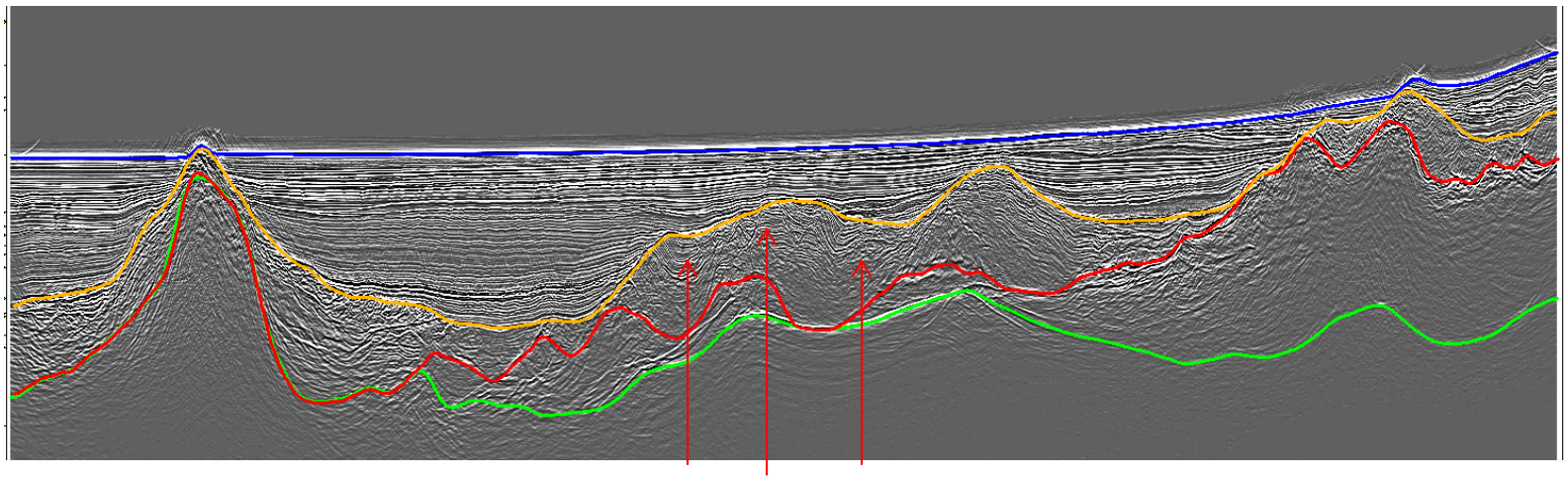


West

Fine scale faulting

Inline 320 – PSTM – 4X

W E

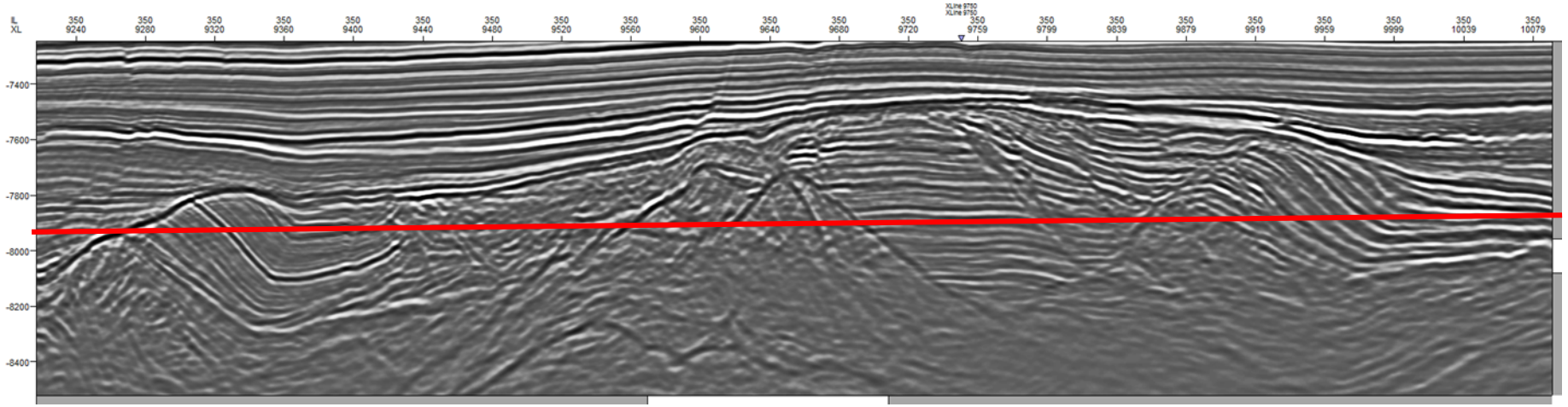


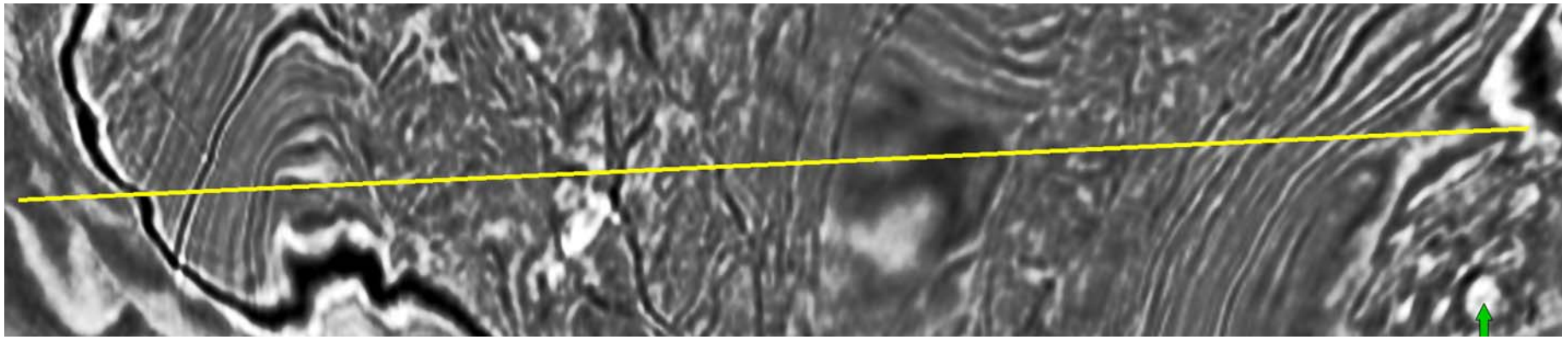
Example of very fine scale normal faulting in pre- and syn-rift sediment

The fine scale faults are generally within the pre- and syn-rift sediments, are in scales of 1-2 km fault blocks, and are complex 3D seismic structure.

W East-West extent of 11 km E

Inline #350 – Red line is the 7884 TWT (ms).



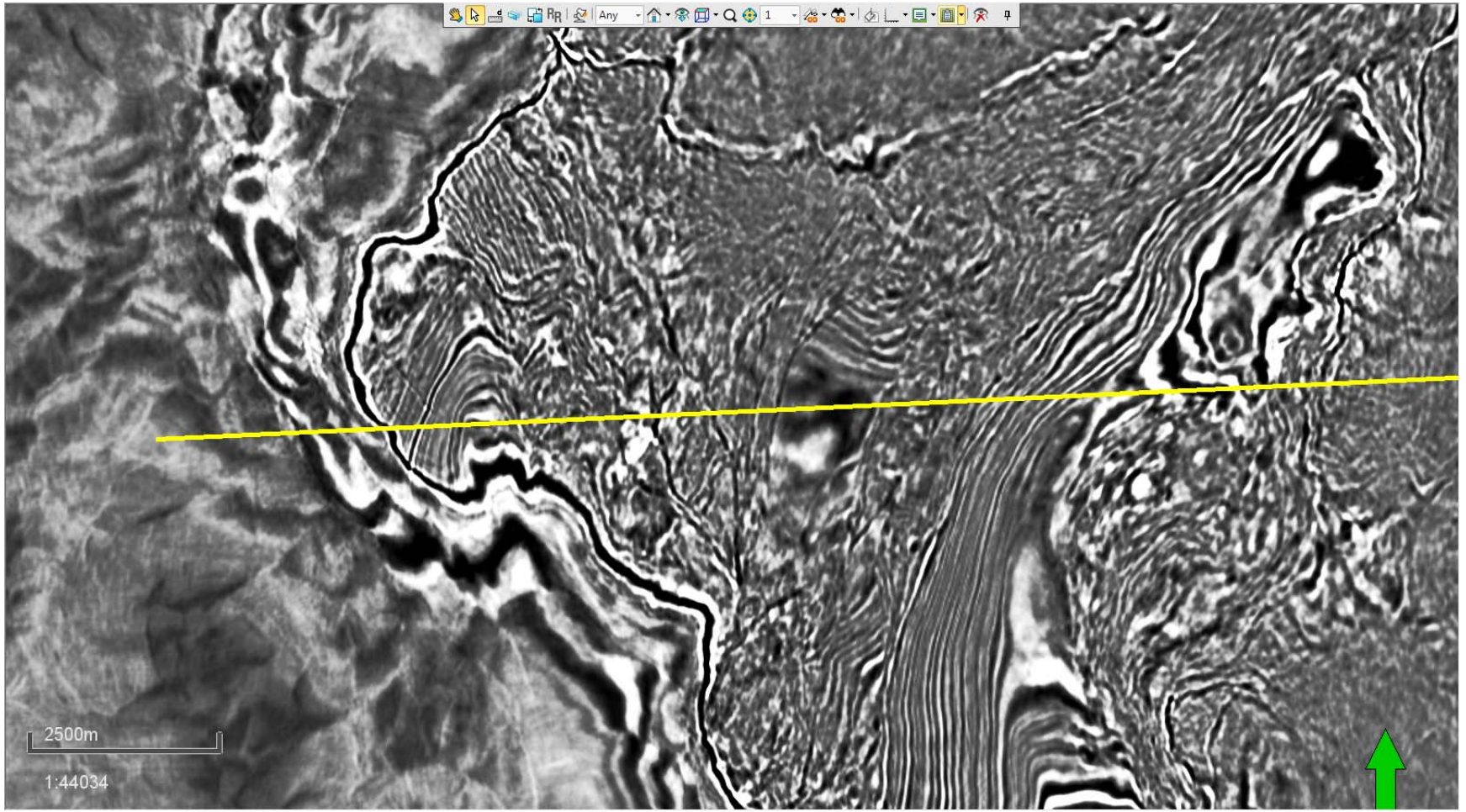


Time Slice #7884 – Yellow line is the Inline 350 location.

Repsol – PSTM – May2015

North

West



East

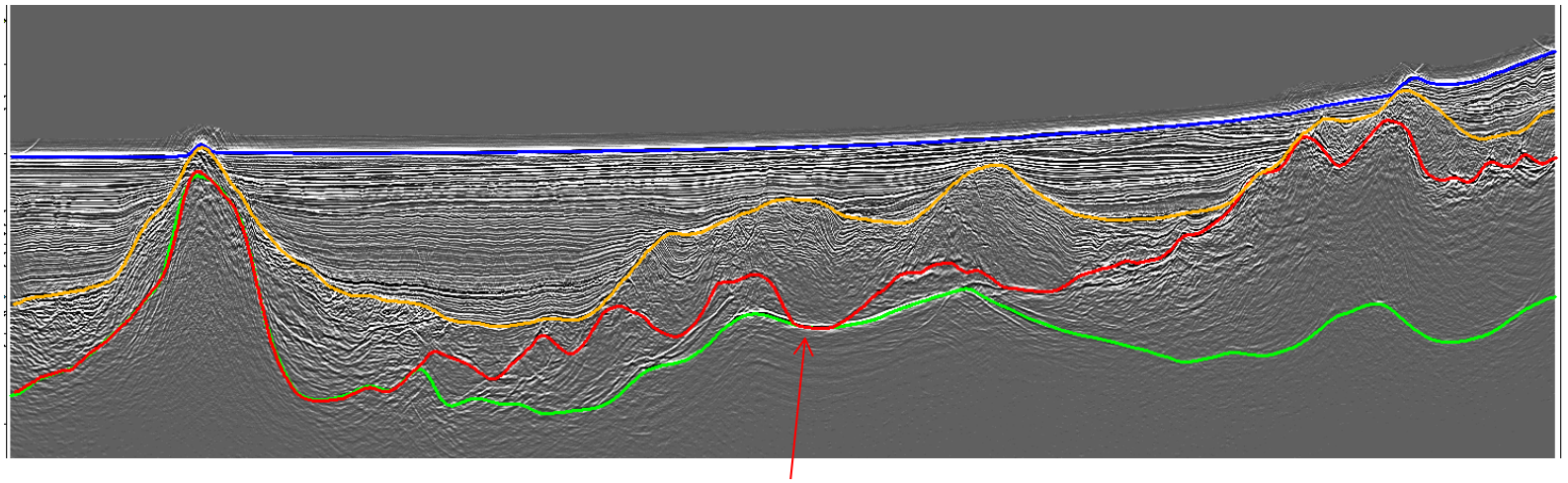
South

~18 km West to East
~10 km South to North

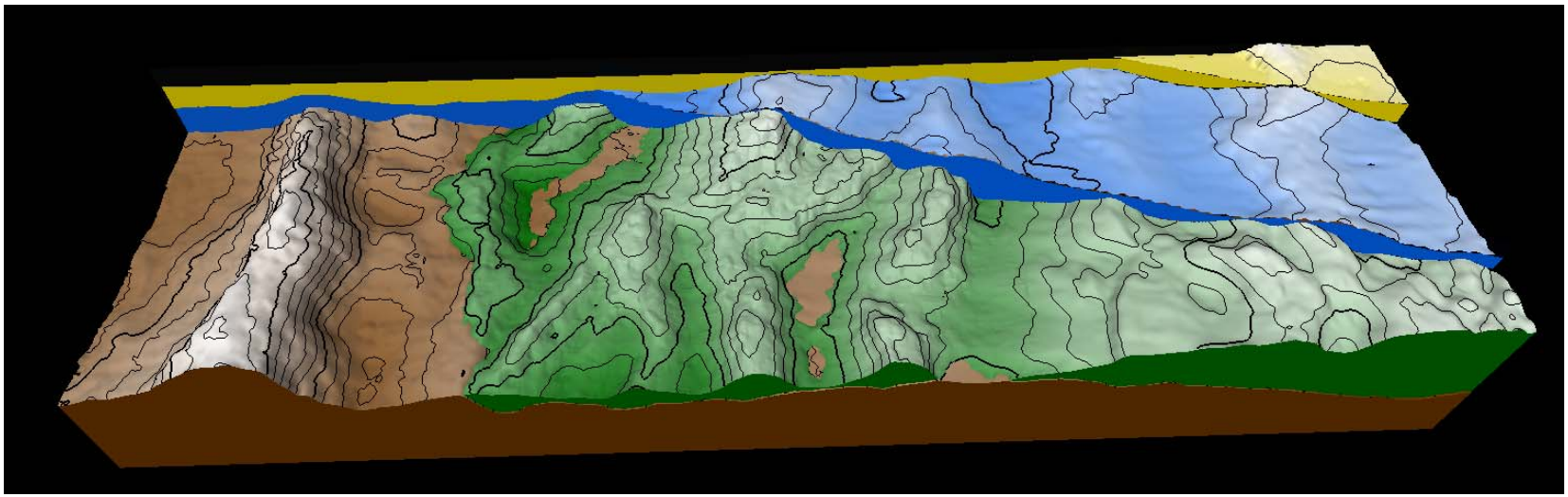
Time Slice 7884 ms
Yellow line is the Inline 350 location
PSTM in time

Inline 320 – PSTM – 4X

W E



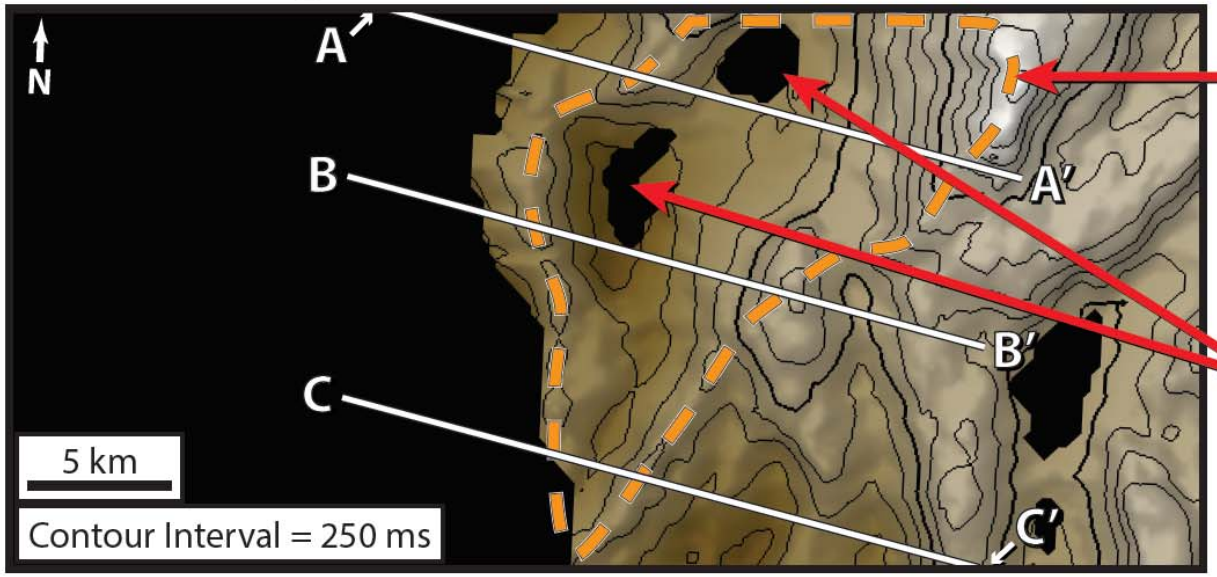
Continental crust “windows” – occasional sediment to S



Crust and Mantle Interfaces

Brian Jordan

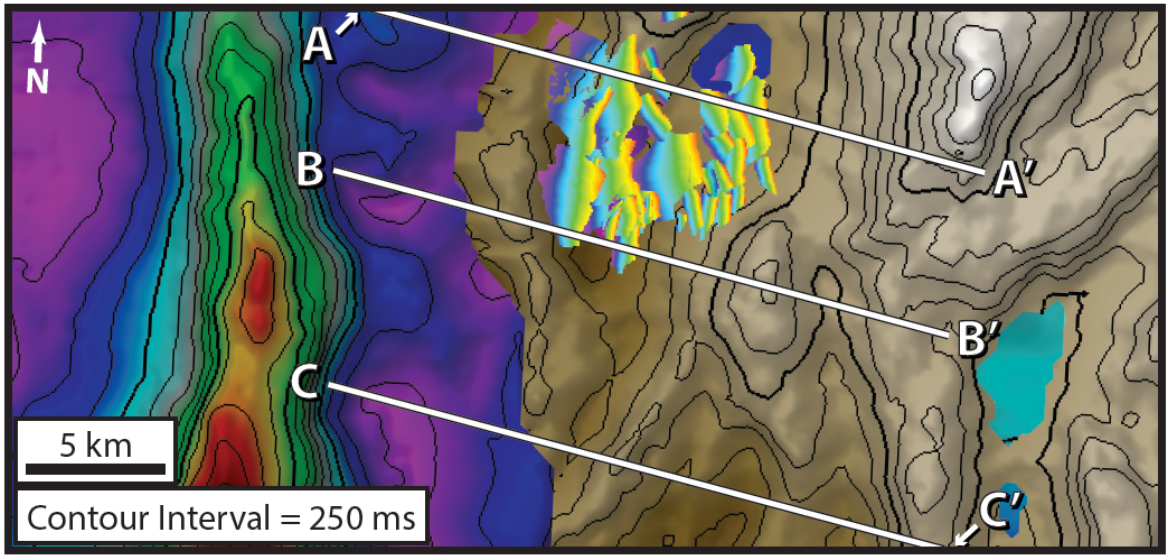
Top of Continental Crust



Outline of basin as marked on the seismic examples

Continental blocks have completely detached from each other at these 'holes'. Most extension is accomodated by the S-Reflector detachment

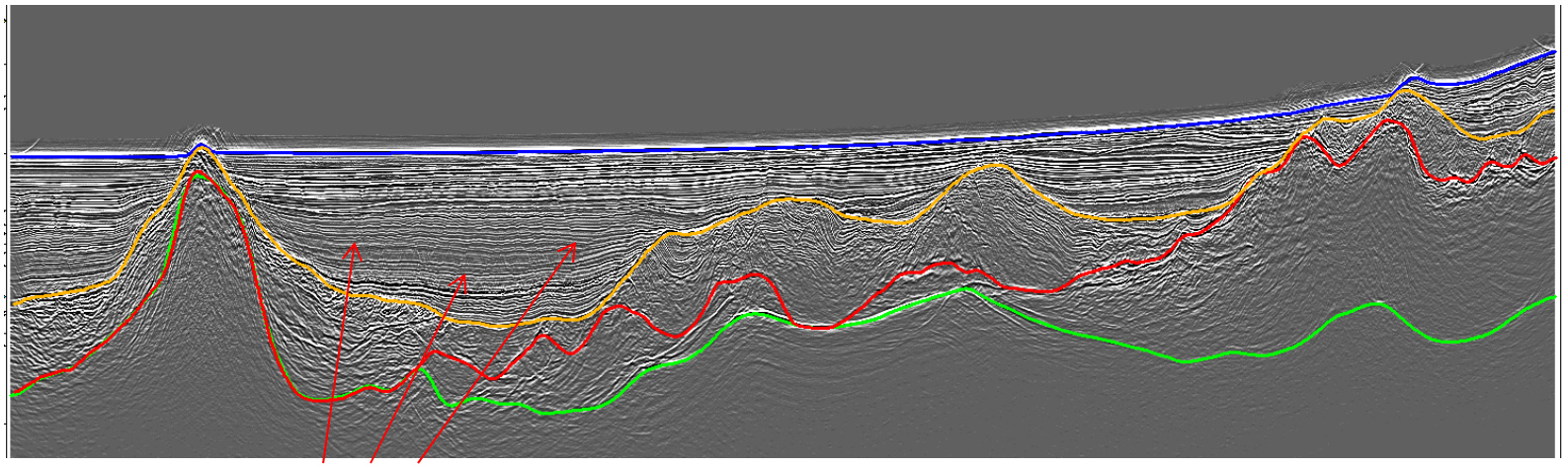
Crust/Mantle with Minor Normal Faults



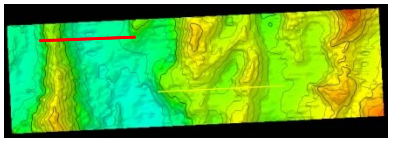
All minor normal faults interpreted within the 'Basin of Focus' (as marked on the seismic examples) occur north of the small ridge of peridotite and may have accomodated some extension along the S-Reflector.

Inline 320 – PSTM – 4X

W E



Faulting in post-rift sediments and polygonal faulting

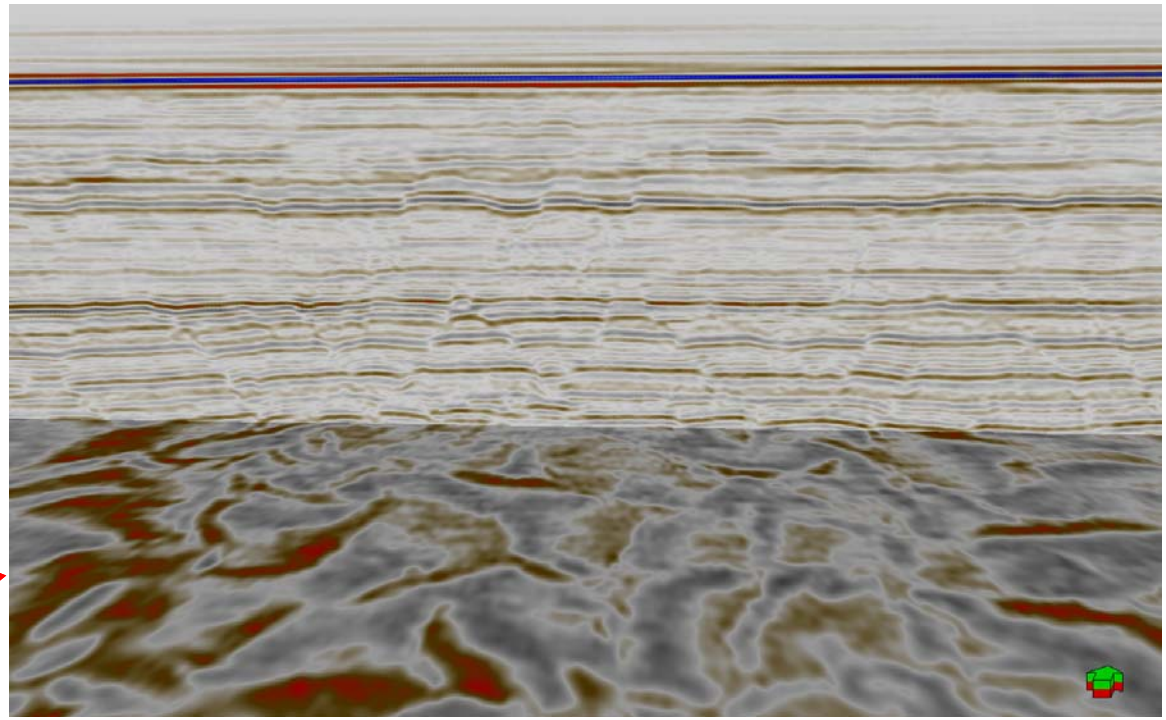


Seafloor

Inline 704

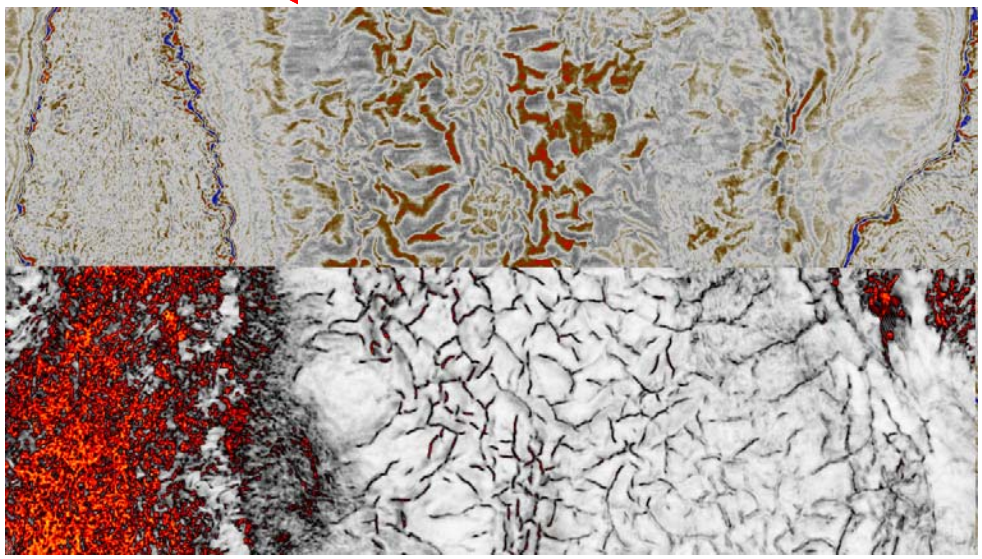
Normal faulting within post-rifting sedimentation

Time Slice 6200 m



Polygonal Faulting

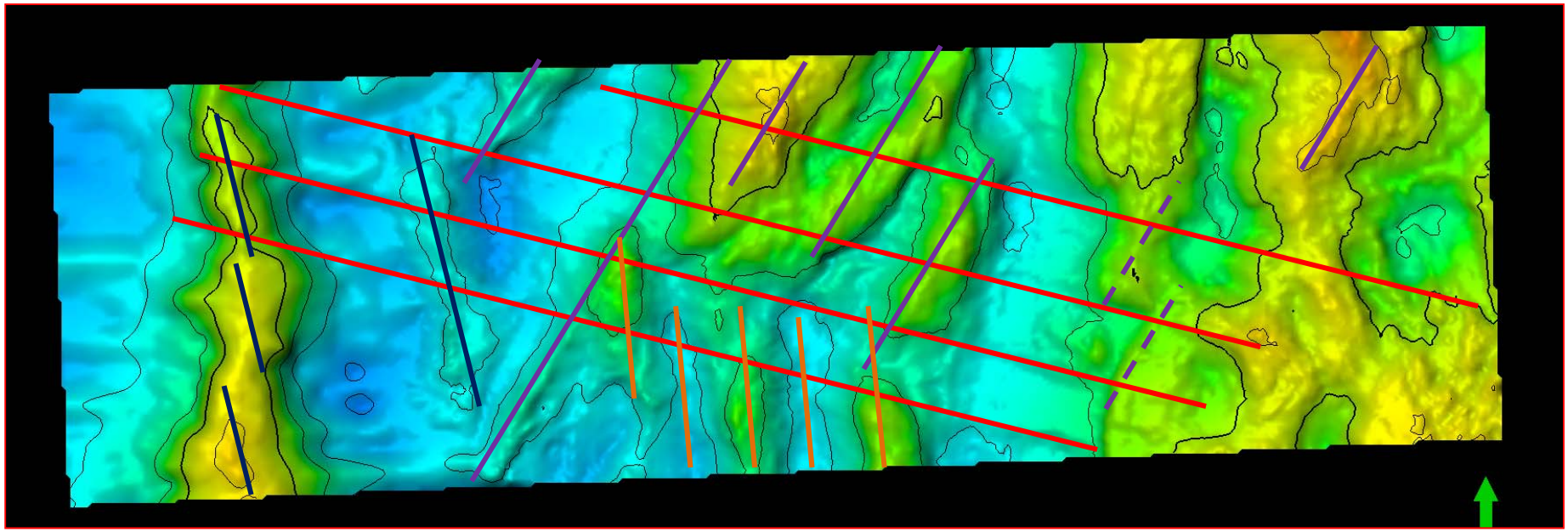
PR W



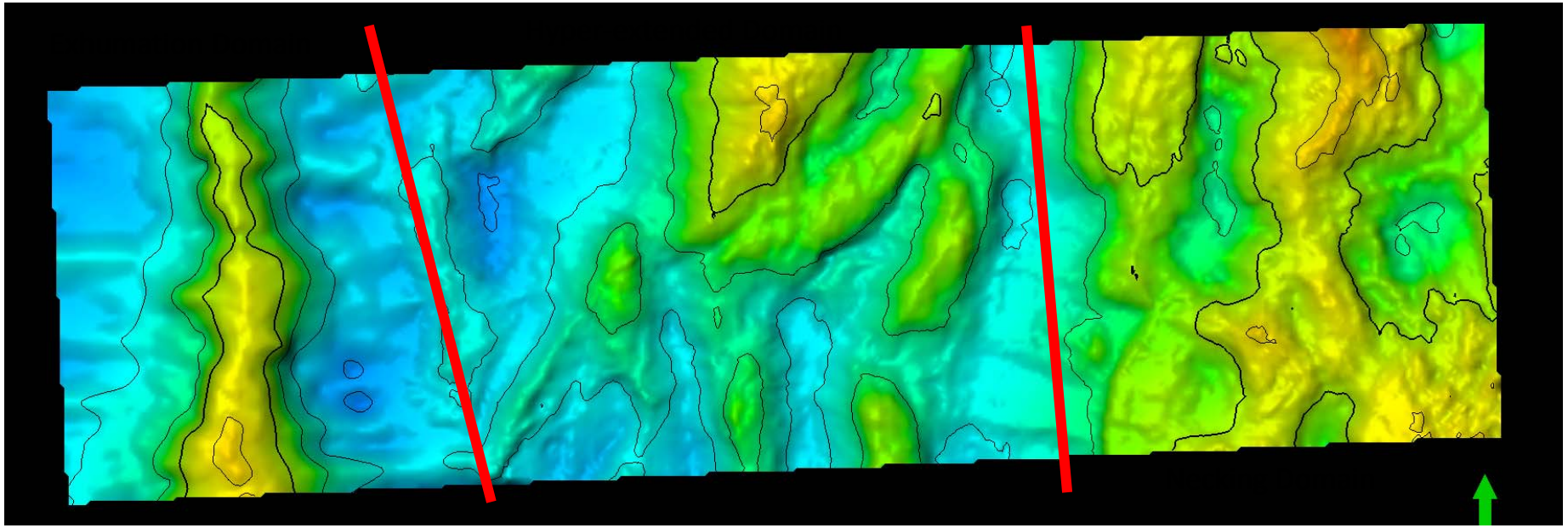
E

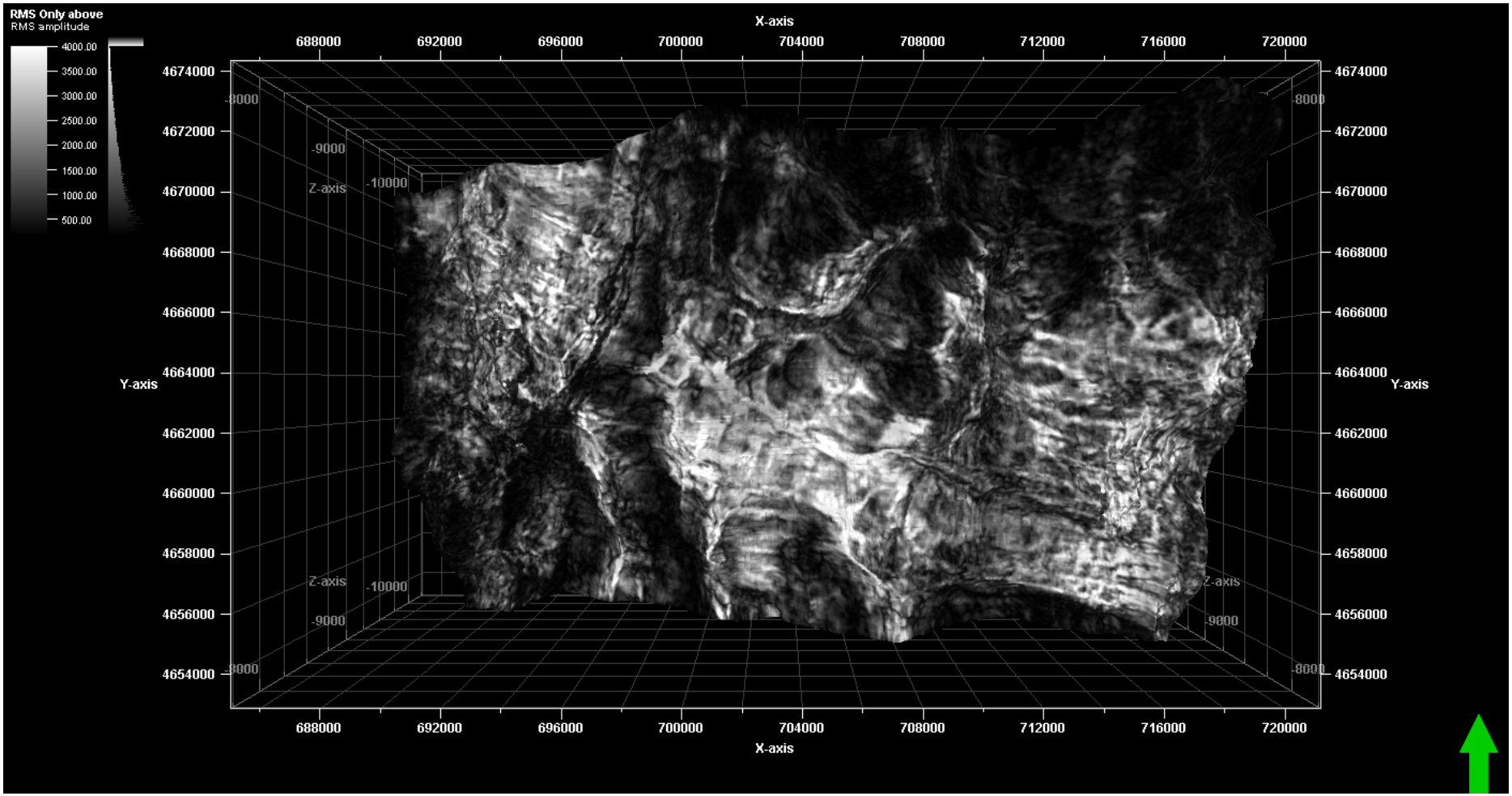
Time Slice 6200 m

Variance Attribute identifies faults



Depth converted surface is between sediments above & hard rocks below. Annotated above are likely structural fabrics.

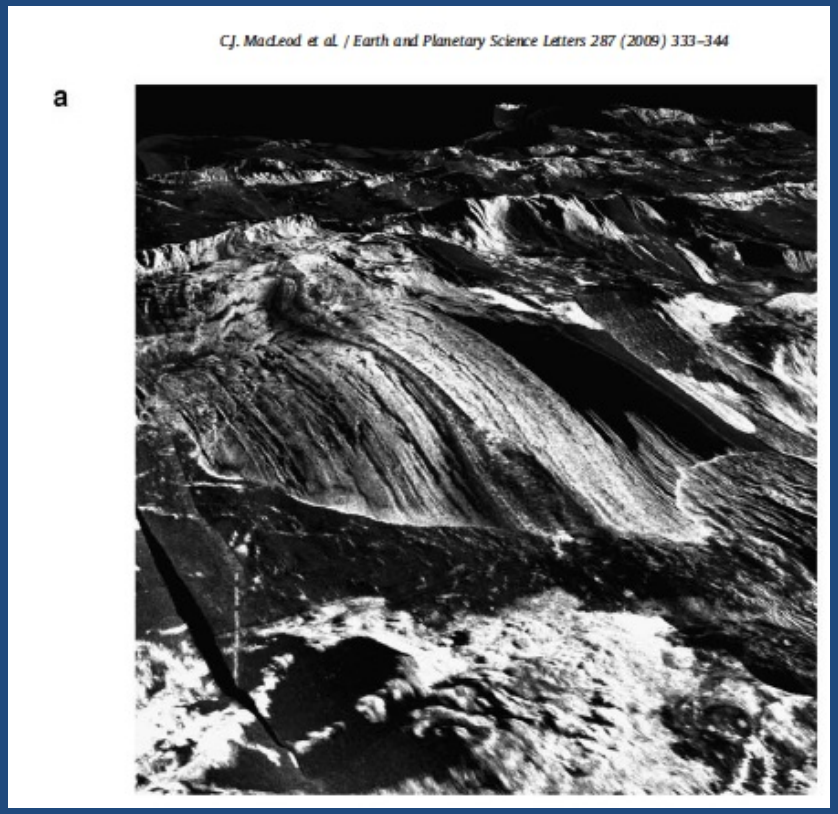




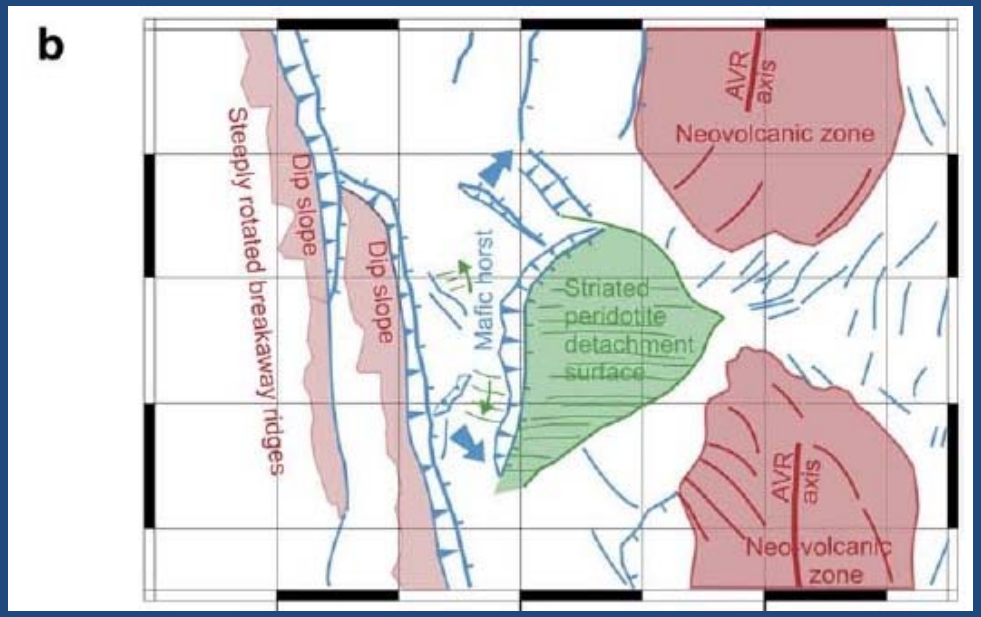
Map view of the extracted **RMS amplitudes** from the S-reflector.

Nur Koyuncu, Dale Sawyer ,and Jon Bull

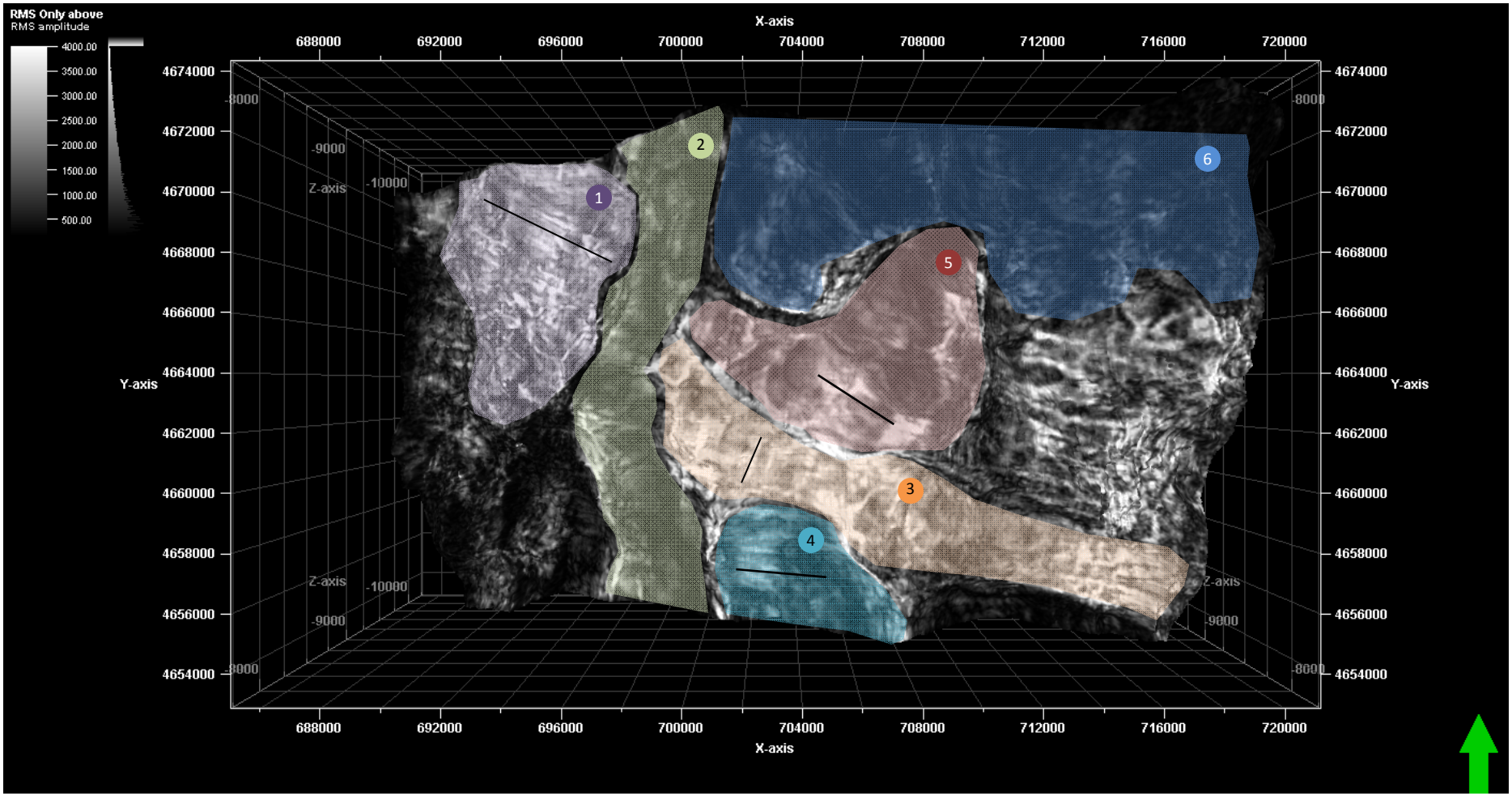
Surface is connected S reflector .
RMS amplitude on surface +/- 100 ms
Black is 0 RMS Amplitude Attribute
White is arbitrary brightness RMS Amplitude Attribute



MacLeod, et al. (2009)



MacLeod, et al. (2009)

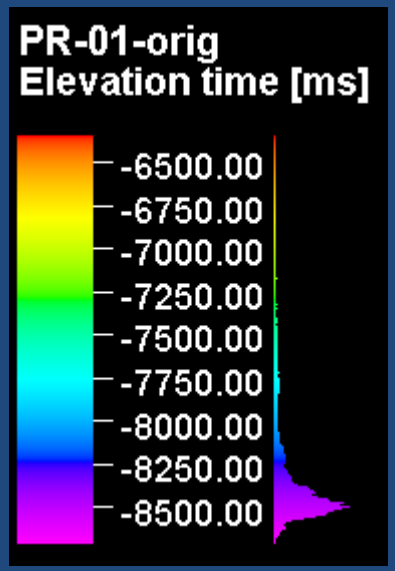


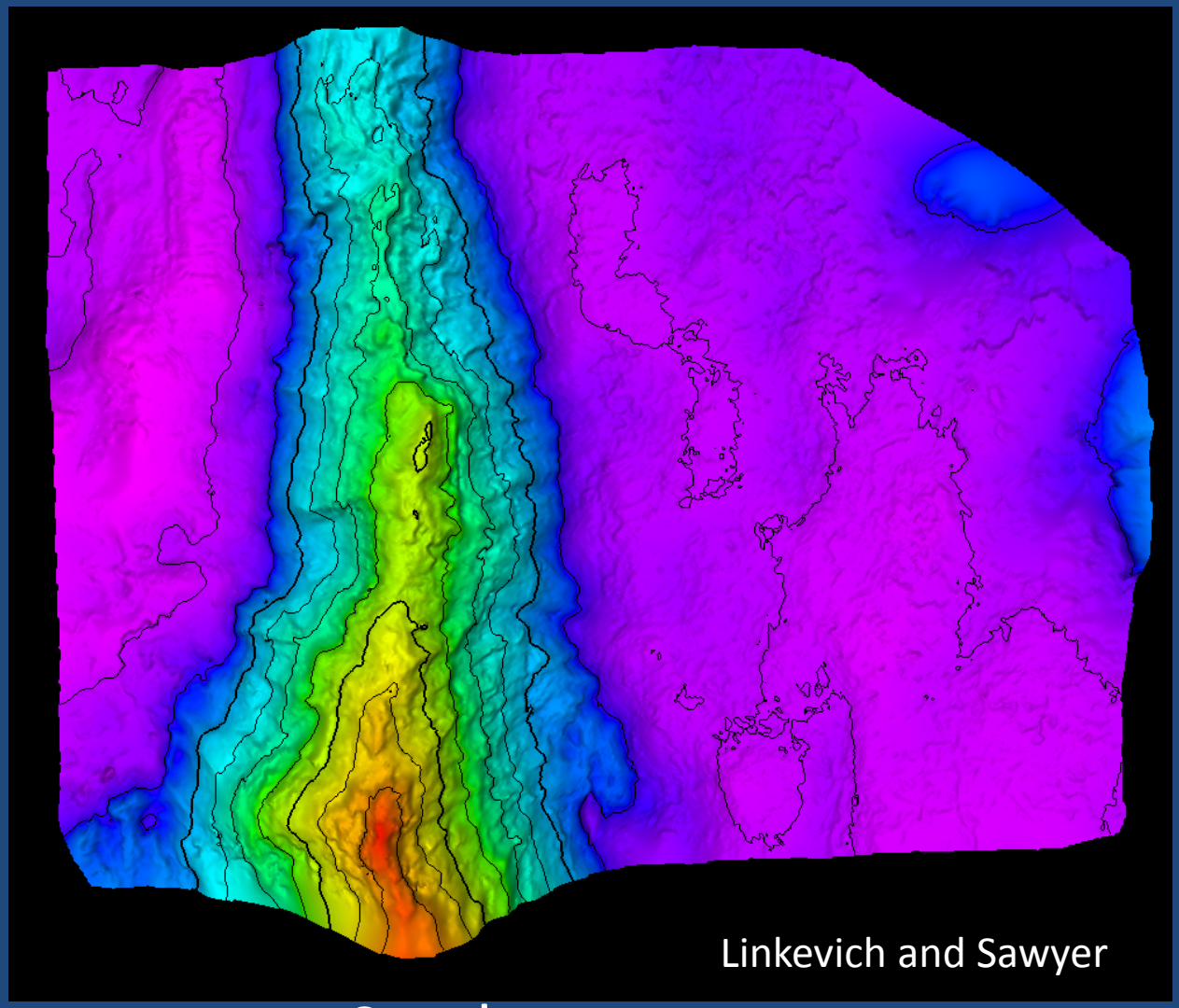
Zone separation and visible striations.
Direction of acquisition (approx. 2.83 deg)

Nur Koyuncu, Dale Sawyer ,and Jon Bull

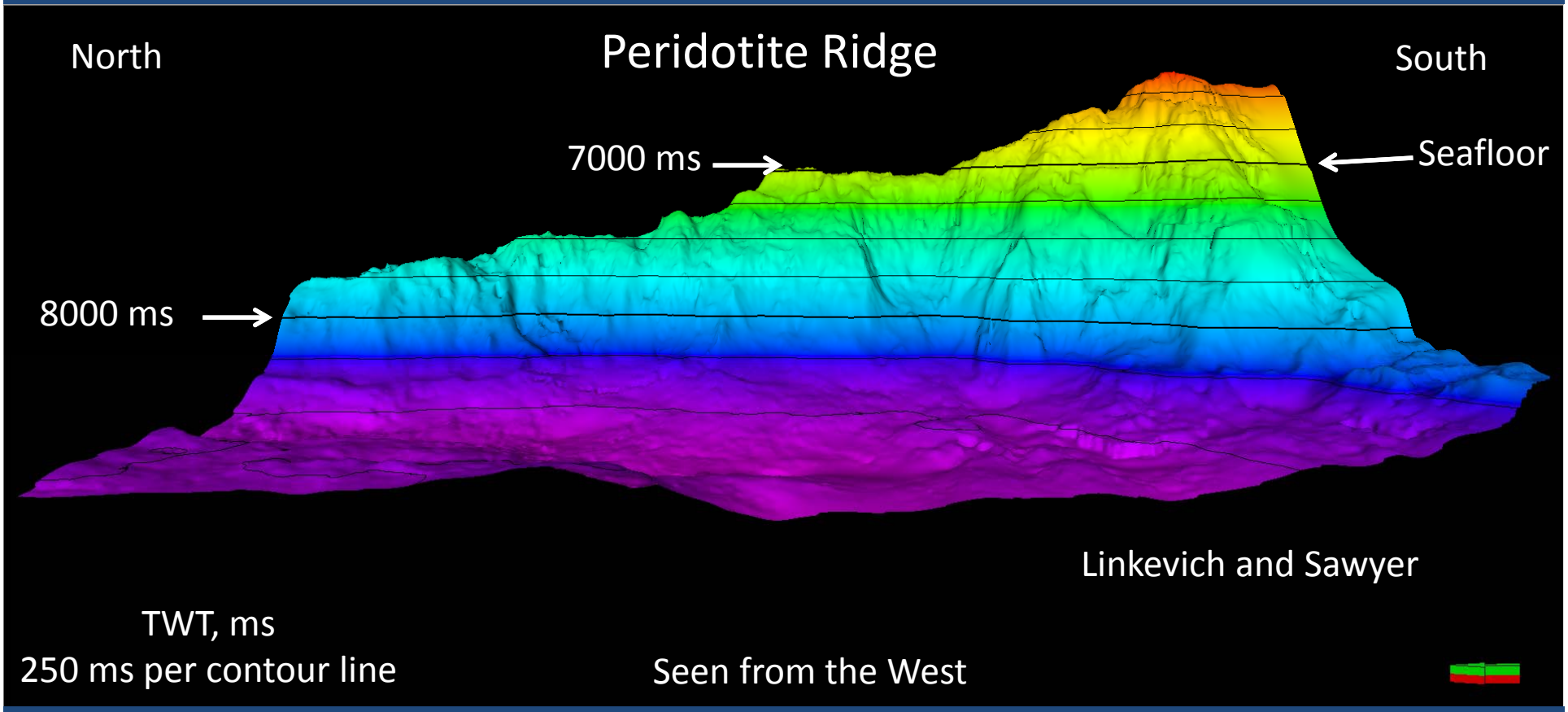
Peridotite Ridge

North





South



~3 times base width of PR from North to South

~3.5 times height of PR from North to South

~10 times mass of PR from North to South

Conclusions

1. Much of the tectonics in the Galicia 3D data volume are normal faults.
2. The largest fault is called “S,” is a low angle decollement fault, is about 25 km long (W to E), and is bounded by Continental Crust above and Serpentinized Peridotite below.
3. The intermediate faults are dipped to the West, are about 5-8 km long (W to E), the faults cut through the pre-, and syn-rift sediments , and sole on to “S.”
4. The fine scale fault blocks strike generally to South/North, in dip-line faults the fault are up to 2 km width, and they are not easy to reconstruct!

RV Marcus G. Langseth

This is a seismic research vessel owned by the NSF and operated by Columbia University.

It has now acquired four large-scale 3D seismic experiments: EPR, Costa Rica, Galicia, and New Jersey, along with many other 2D and OBS cruises.