APPENDIX 2 Data Examples

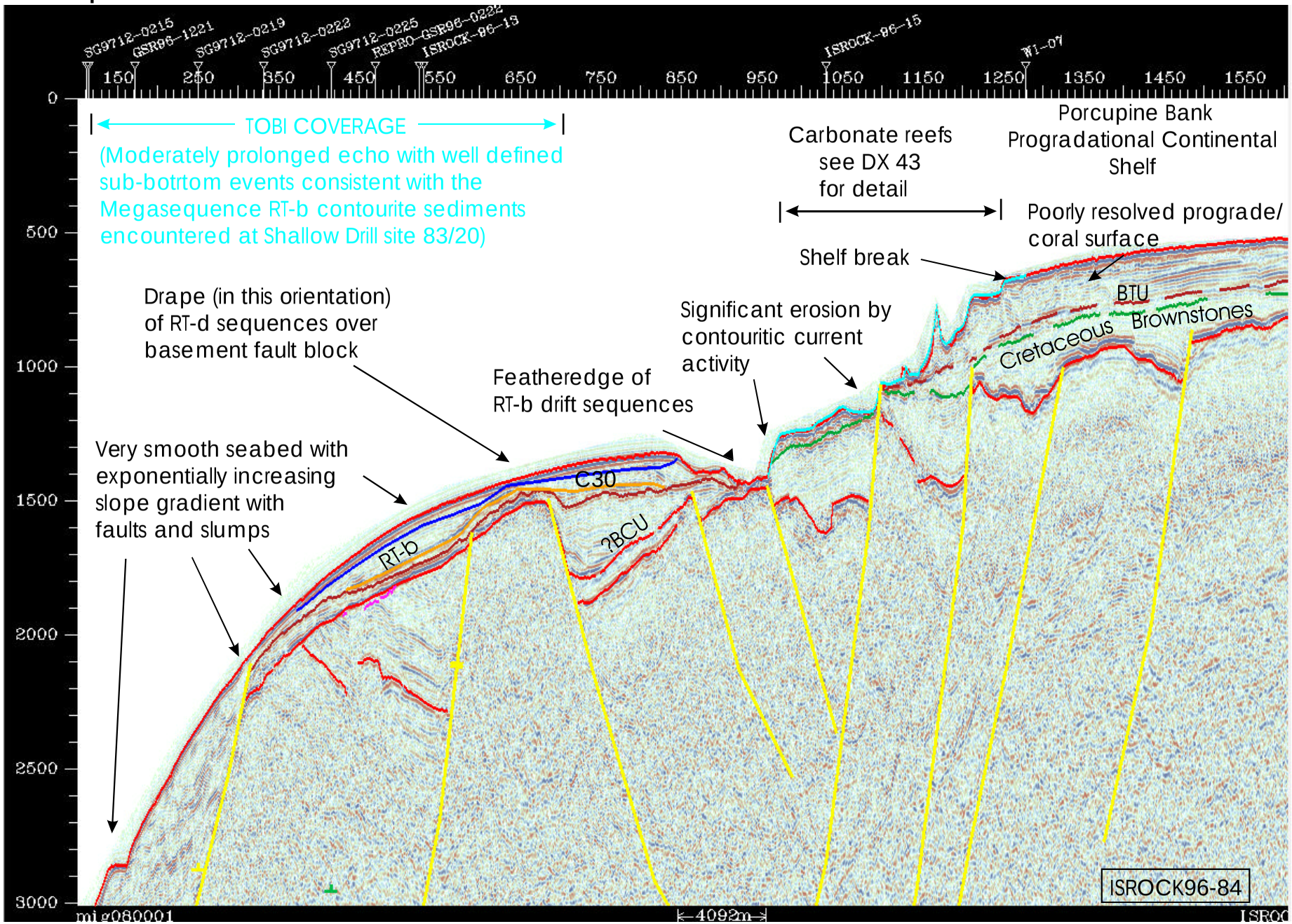
1. Example of contourite deposition and erosion influenced by underlying structural control.
2. Fault bounded sediment wedge exhibiting wavy, contorted or sub-parallel to chaotic reflection geometry.
3. Example of major sediment slide feature down slope into Rockall Trough.
4. Regional overview of Porcupine Bank Continental Shelf, Continental Slope and Rockall Tough Basin environments
5. Megasequence RT-b exhibits wedge/lens shaped external reflection geometry with parallel to subparallel internal reflectivity showing large-scale onlap onto the C20 sequence boundary surface.
6. Faulted and slumped slope showing the complicated stratigraphic relationships between the Shelf, Upper and Lower Slope, and Basinal environments.
7. Sequence boundary definition of model proposed by M. Stoker, BGS, on western slope off Slyne – Erris.
8. Stratigraphic, structural and geotechnical diversity apparent on the slope and base of slope environment characteristic of the NE Rockall Trough region.
9. Landmark plot of P.I.P. commercial 2D seismic database showing the high proportion of the data necessarily selected for the interpretation of the Study.
10. Complexity of megasequence boundaries in NW Rockall Trough.
11. Detail of basin Floor Thick (BFT) development beneath C30 event.
12. Example of notched Upper Slope on eastern margin of the Rockall Trough (western Porcupine Bank).
13. Shallow drilling site 11/20-sb01 projected on to nearest PIP commercial 2D seismic line.
14. Detail of the 11/20-sb01 location.
15. Shallow drilling site 16/28-sb01 showing important Tertiary and Upper Mesozoic stratigraphic relationships.
16. Shallow drilling site 83/20-sb01 showing fault controlled nature of the distinctive Cretaceous ‘plateau capping’ of older “Brownstones” beneath overlying “Greenstones”.
17. Shallow drilling site 83/24-sb01, -02 that encountered Upper Cretaceous rocks above an Upper Jurassic veneer resting upon steeply dipping Palaeozoic strata beneath the prominent (composite) angular unconformity.
18. Differing vintages of commercial 2D seismic from the PIP database have been used to correlate shallow drill sites 83/20 and 83/24.
19. Stratigraphic relationships indicate significant interplay of contouritic erosion, deposition followed by more erosion/deposition cycles from lower Cretaceous (KL) to present poorly resolved veneer of Megasequence RT-a sands existing at seabed.
20. Detail of massive slumped bodies overlying truncated Megasequence RT-c and older units.
21. Detail of faulted mass movement/slumped units with overlying ?contouritic sediments and notched progradational continental slope within influence of deep seated (Erris) fault.
22. Regionally extensive mass movement/slumped sediment body at foot of slope apparently of Megasequence RT-b age.
23. Slumped mass of 15km width.
24. Typical profile of ‘notched’ upper slope and progradational shelf.
25. Base of slope mass movement of relatively thinned Cenozoic section down onto Rockall Trough basin floor.
26. Complex stratigraphic relationships amongst huge mass flow deposits comprising Megasequence RT-c (and ?older/younger) in NE Rockall Trough area.
27. Apparent dip and strike profiles through and body of major RT-b aged mass slump body

28. Palaeo-high at BTU underlying present bathymetric high of unknown origin.
29. Deformed and undulating/hummocky slope bathymetry related to underlying fault deformation.
30. Faulted structural relationship to slope canyon location.
31. Relationships of upper – middle slope canyon, shelf progrades and contourites.
32. Rugged slope of N. Macdara Basin.
33. Orthogonal and perpendicular views across canyon axis in N. Macdara Basin.
34. Profiles through upper (top) and middle slope canyons illustrating the infilled nature of the canyon system upslope.
35. Illustrating the similarities but also the differences and pitfalls in interpretation and mapping of morphological features using just TOBI alone.
36. Good correlation of TOBI interpretation and mapping with that from the widely spaced commercial 2D seismic database.
37. Relationship of progradational shelf sediments and carbonate mound environment with faulting on upper slope.
38. Showing deformation within Megasequences RT-a to –c and relationships to contourite depositional systems.
39. Probable gas at Base Tertiary Unconformity (BTU) surface identified by subtle amplitude bloom above faulted older Mesozoic sequences in mid – upper slope environment.
40. Possible gas (masked areas) leaking up flanks of slope canyon and from eroded, tilted Upper Cretaceous sandstones.
41. Presumed shallow gas hazard possibly linked to deeper seated faulting.
42. Example of linked fault pattern cutting Megasequences RT-a to RT–d and older showing effect on seismic reflection continuity and imaging.
43. Detail of structural influences to carbonate reef and pinnacle reef development.
44. Detail of solitary pinnacle reef associated with recent faulting amongst far smaller carbonate growths.
45. Correlation of Upper Cretaceous (KU) ‘Greenstones’ and Lower Cretaceous (KL) ‘Brownstones’ from the 83/20-sb01 location.
46. Classic example of a biohermal/coral mound specifically located along a minor fault zone near the SE Rockall Bank Shelf break.
47. Proposed “case study” areas for further area specific work.
48. Major faulting in NE Rockall.
49. SW Rockall seismic stratigraphy.
50. Prograding shelfal megasequences truncating older RT-c and RT-d.
51. Unclear interface at distal portion of Gullwing/Erris base-of-slope wedge.

Data

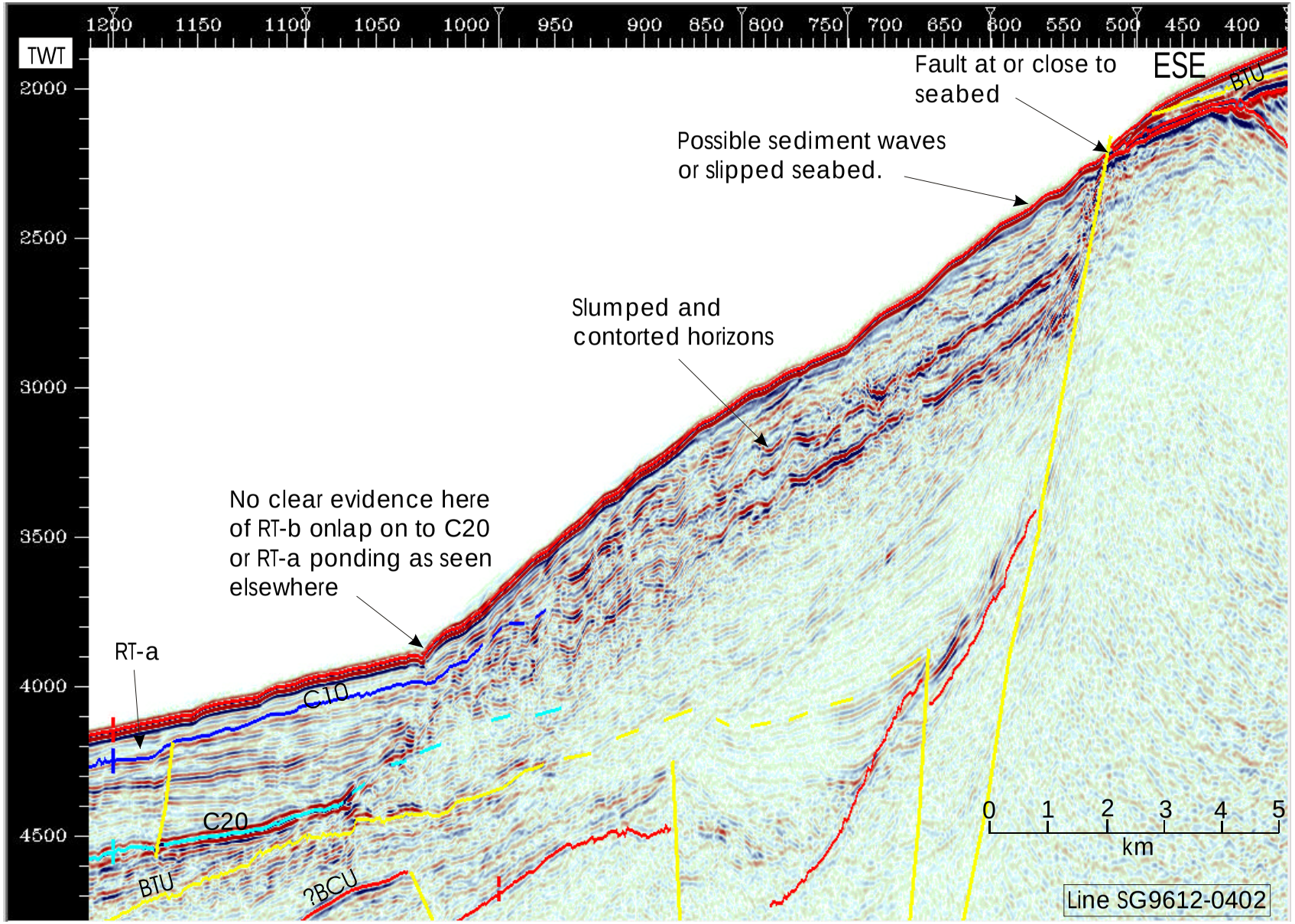
Example 1

Example of contourite deposition and erosion influenced by underlying structural control.



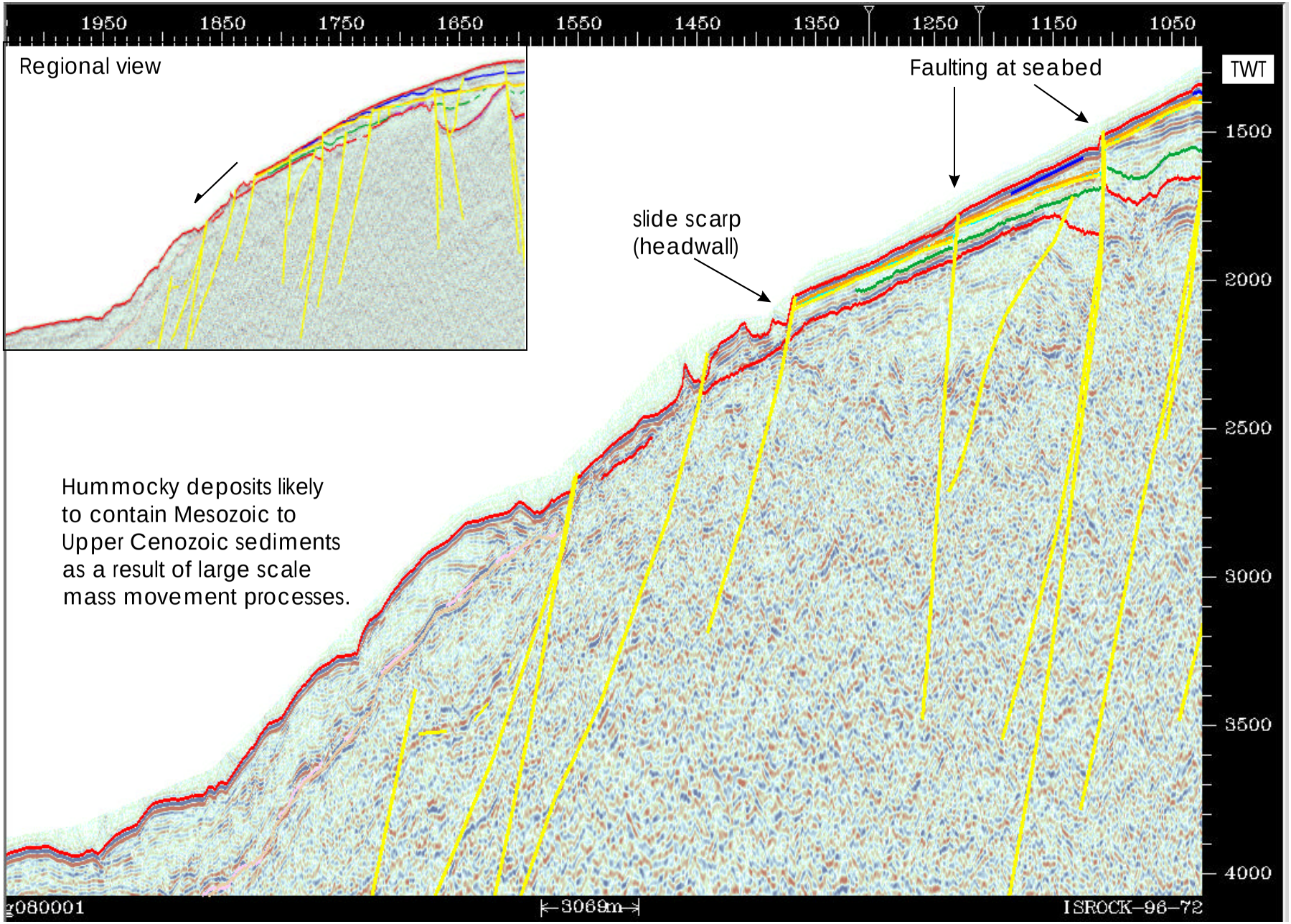
Data Example 2

Fault bounded sediment wedge exhibiting wavy, contorted or sub parallel to chaotic reflection geometry. This is interpreted as the result of mass movement processes (slumping). Alternatively, the upper limit (?RT-a and RT-b) results from contouritic deposition since apparent wave forms at seabed are clearly visible at the updip end. Example is from the western margin of N Brona Basin.



Data Example 3

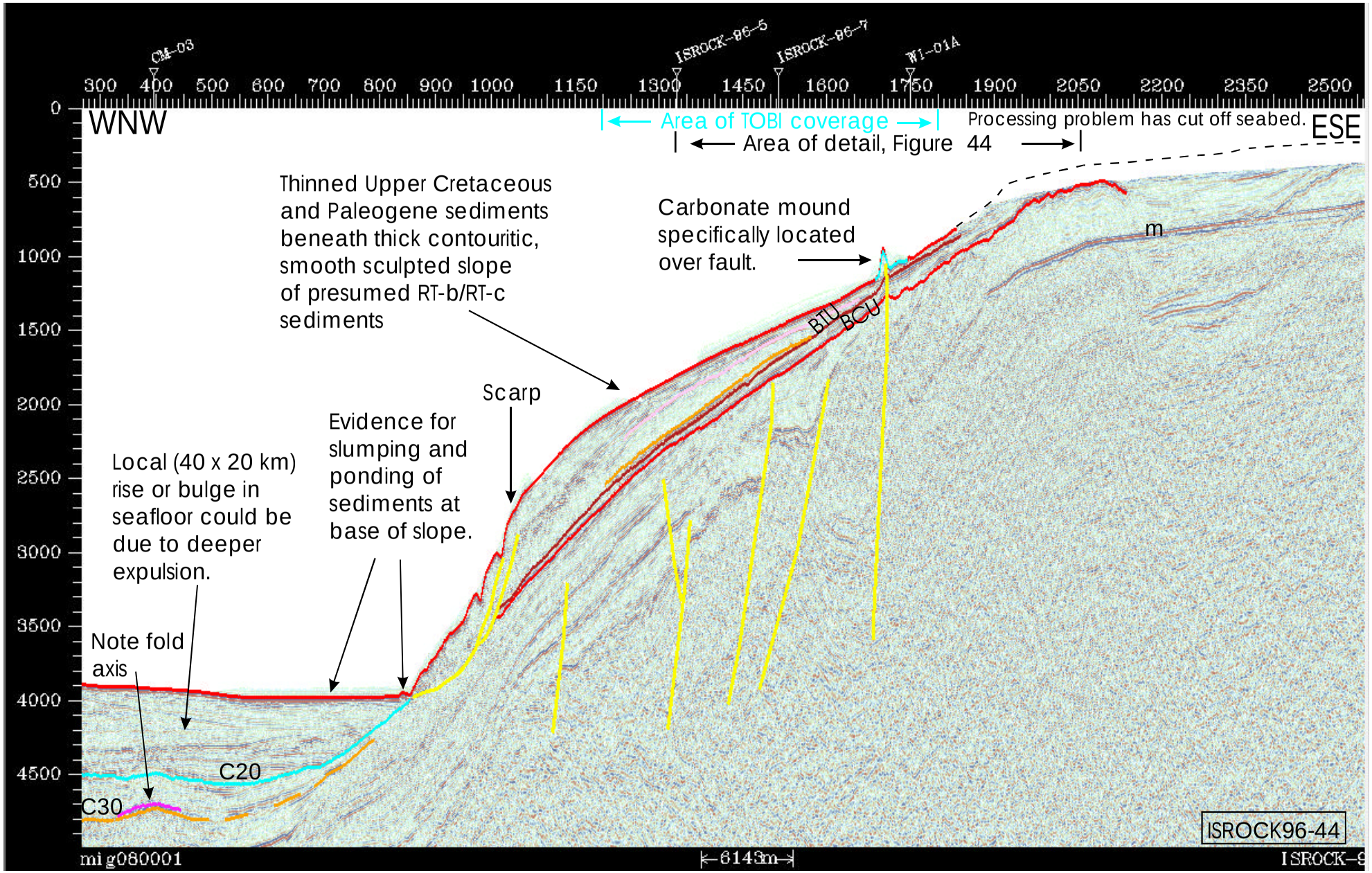
Example of major sediment slide feature down slope into Rockall Trough. The catastrophic failure seems likely to have been induced by deeper seated faulting. Alternatively the downslope, apparently onlapping mass may in fact be a contourite deposit climbing the slope below an area of active erosion.



Data

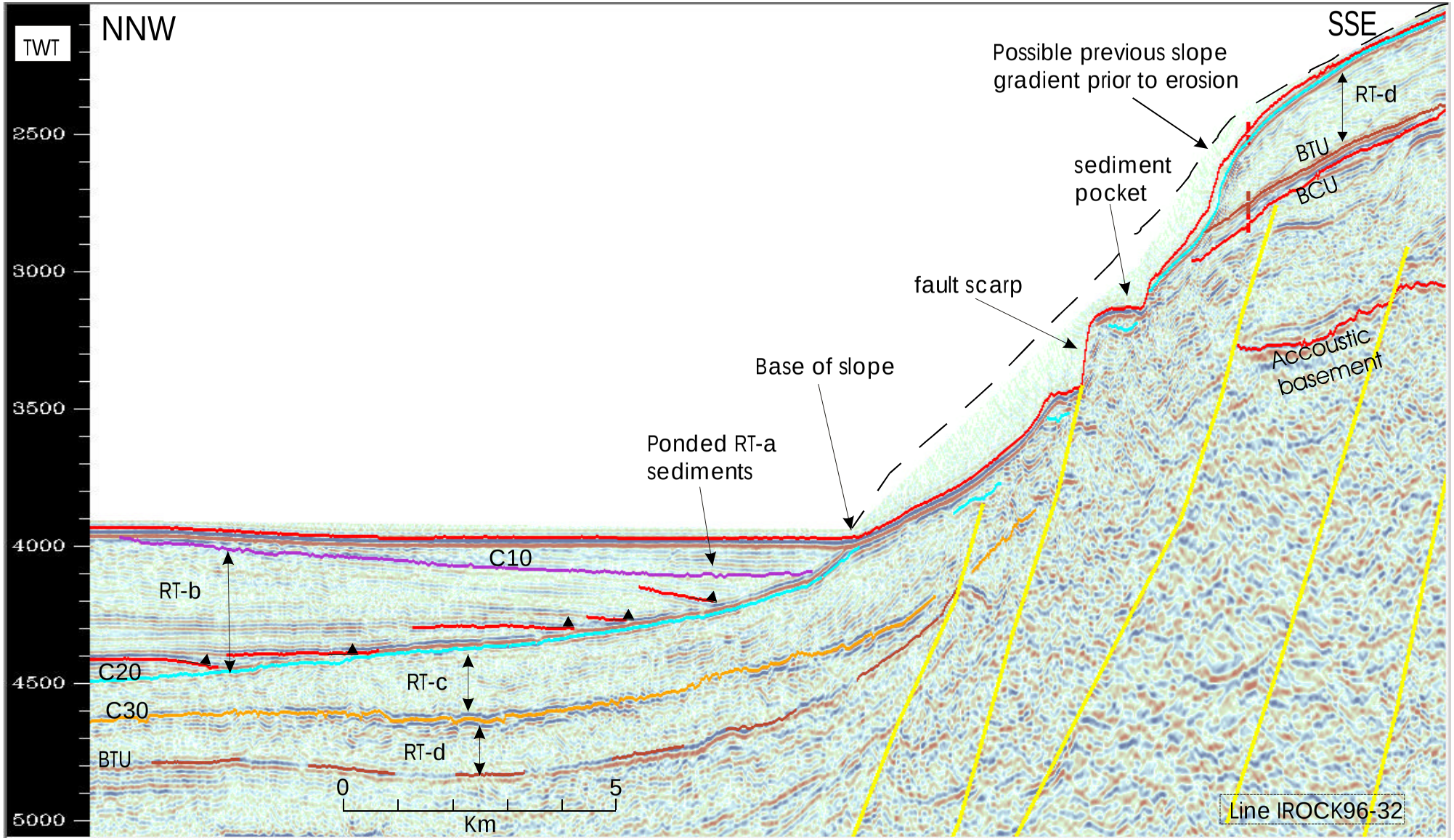
Example 4

Regional overview of Porcupine Bank Continental Shelf, Continental Slope and Rockall Trough Basin environments.



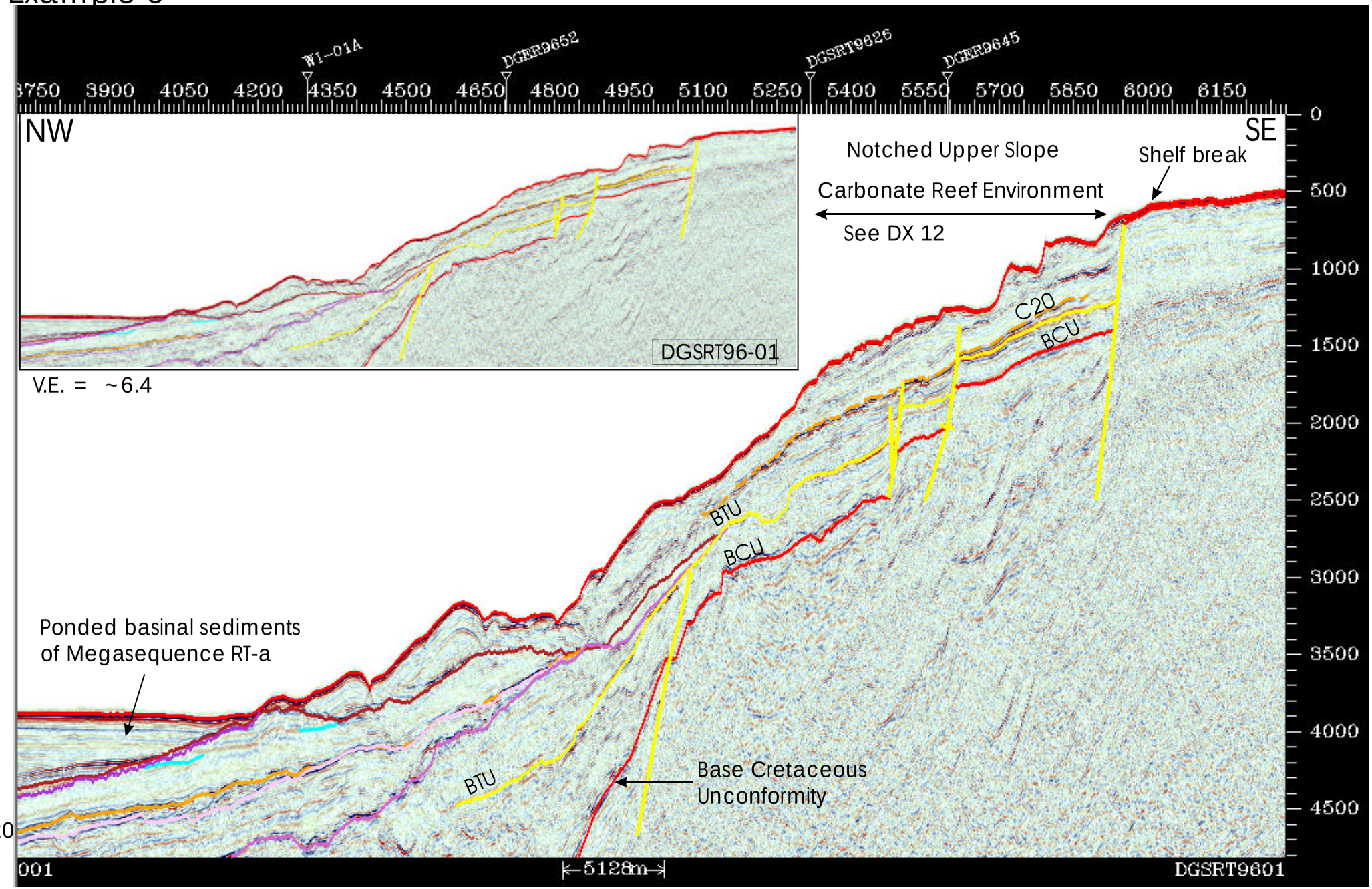
Data Example 5

Megasequence RT-b exhibits wedge/lens shaped external reflection geometry with parallel to subparallel internal reflectivity showing large scale onlap onto the C20 sequence boundary surface. Significant erosion by bottom currents is indicated along the steeper part of the faulted slope. Example is from northern Macdara Basin.



Data Example 6

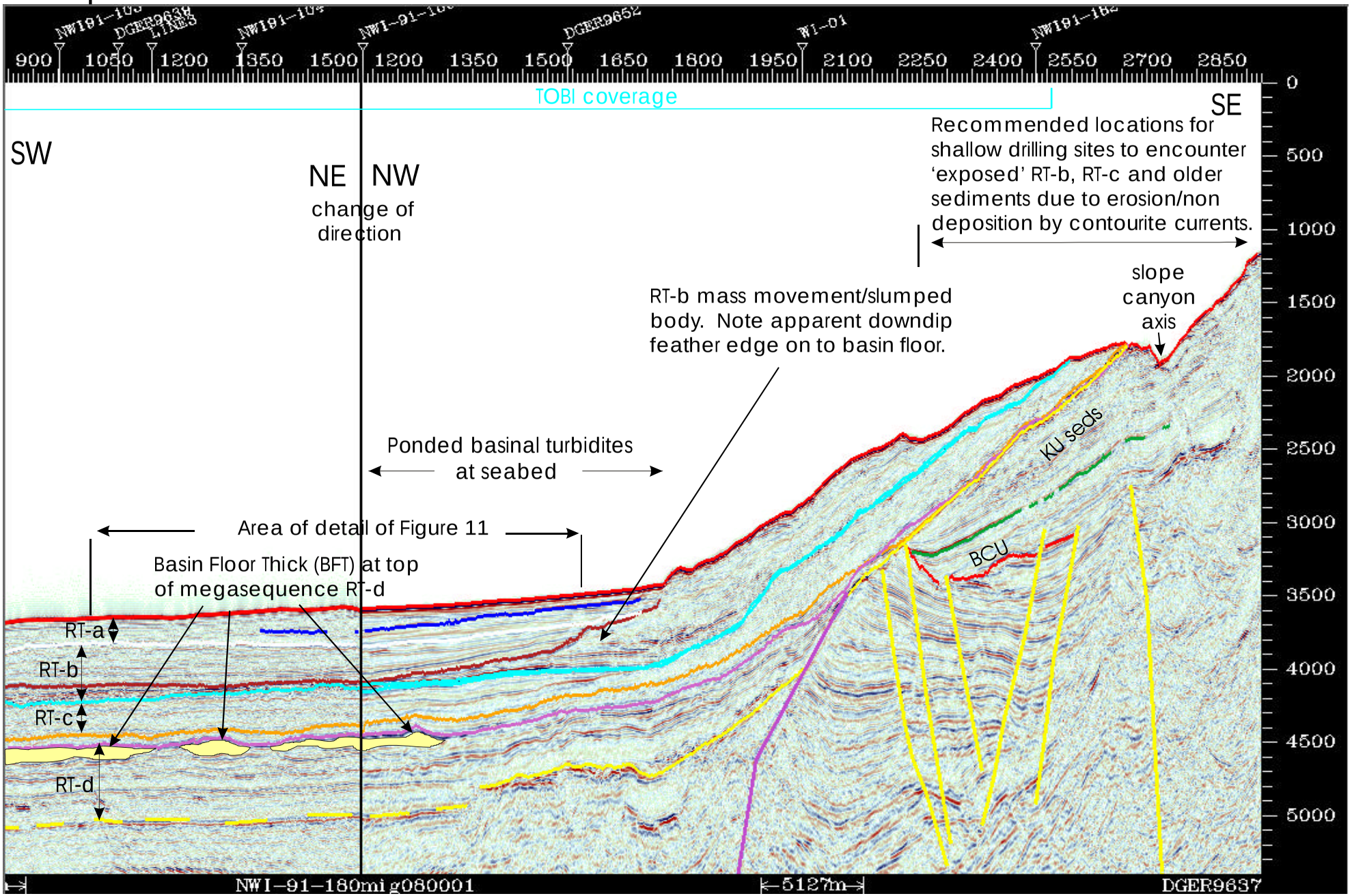
Faulted and slumped slope showing the complicated stratigraphic relationships between Shelf, Upper and Lower Slope environments. Strong onlap of Megasequence RT-a is evident but reflector C10 is difficult to discern.



Data

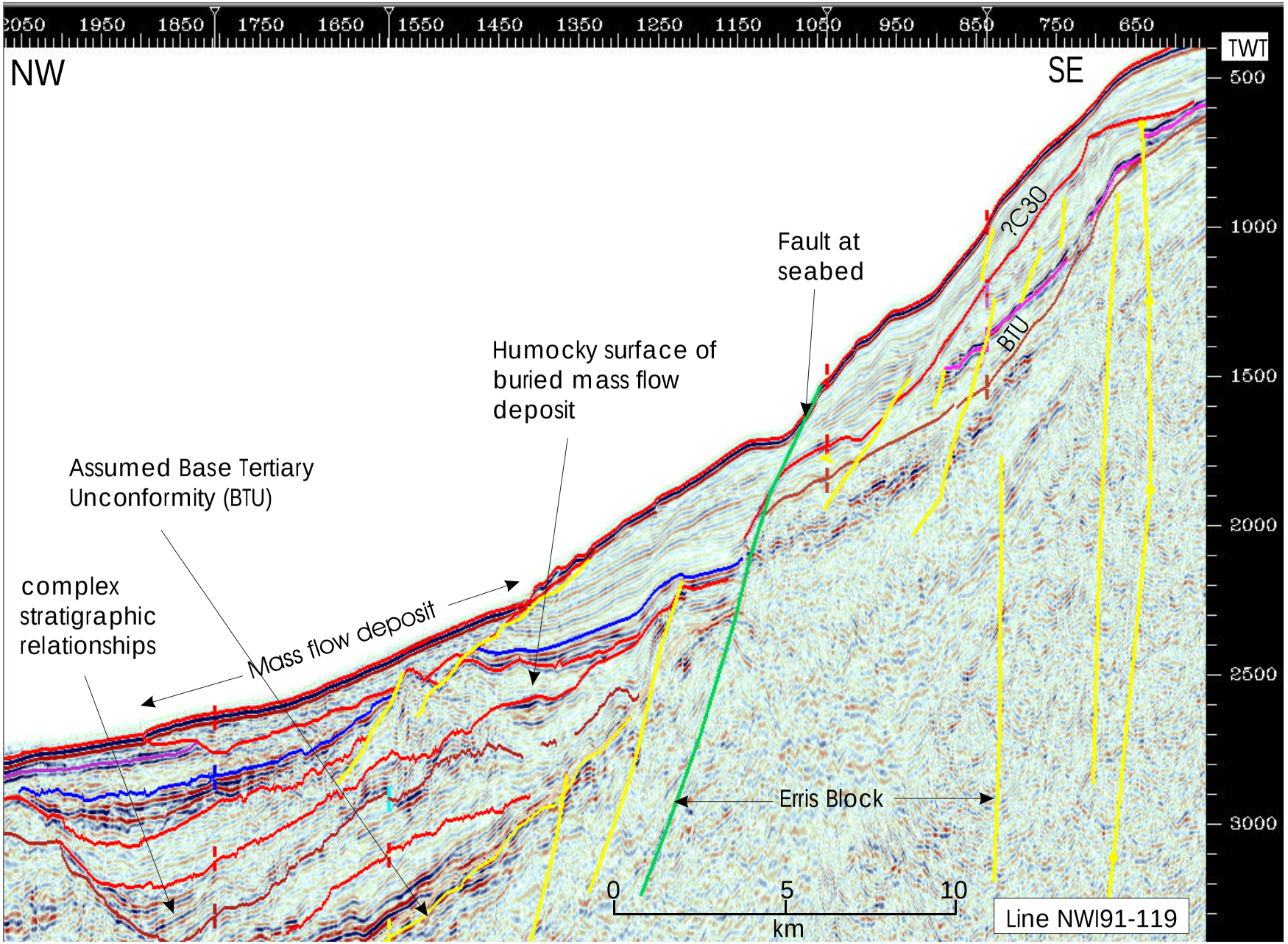
Example 7

Sequence boundary definition of model proposed by M> Stoker, BGS, on western slope of Slyne/Erris.



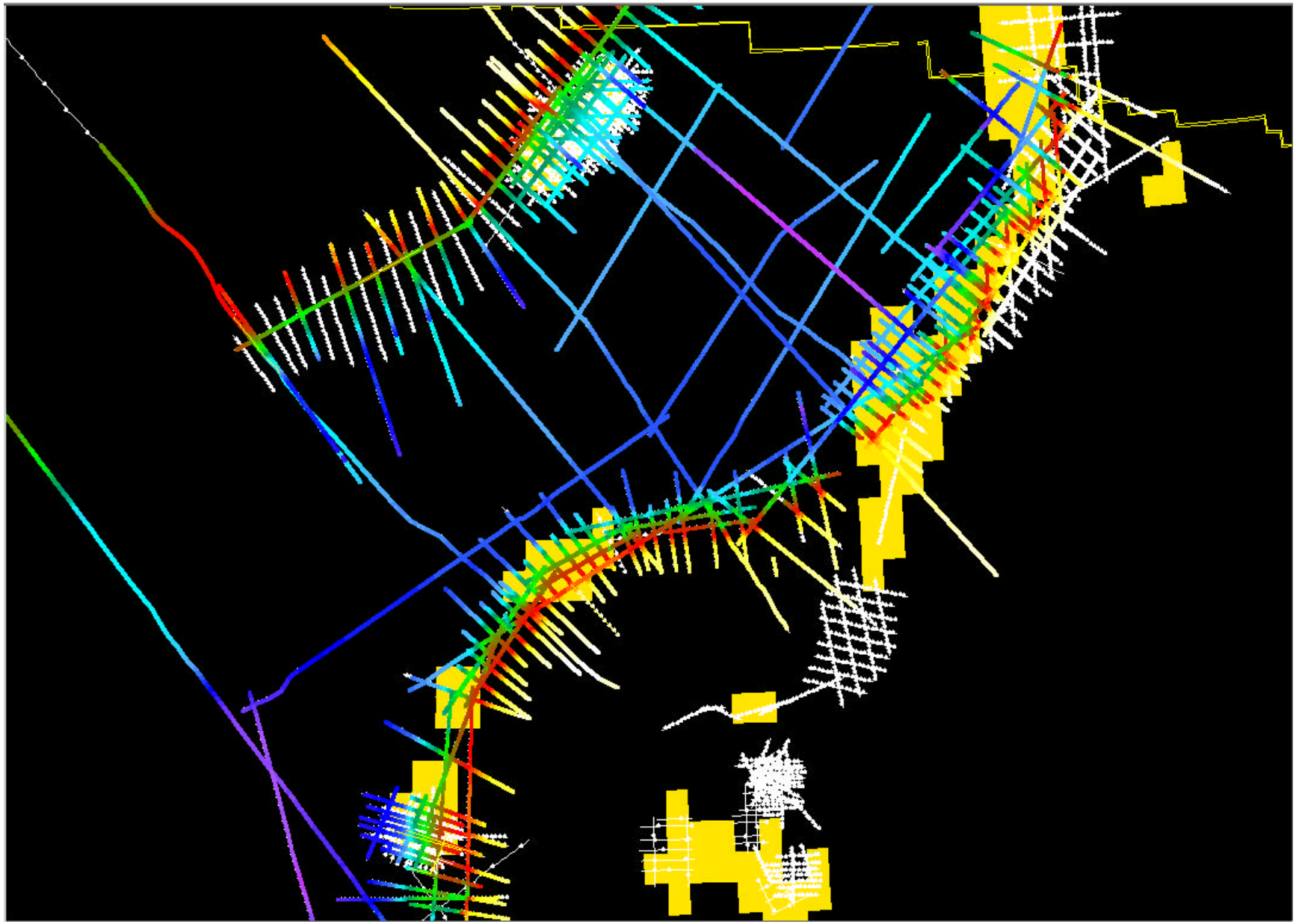
Data Example 8

Stratigraphic, structural and geotechnical diversity apparent on the slope and base of slope environment characteristic of the NE Rockall Trough region.



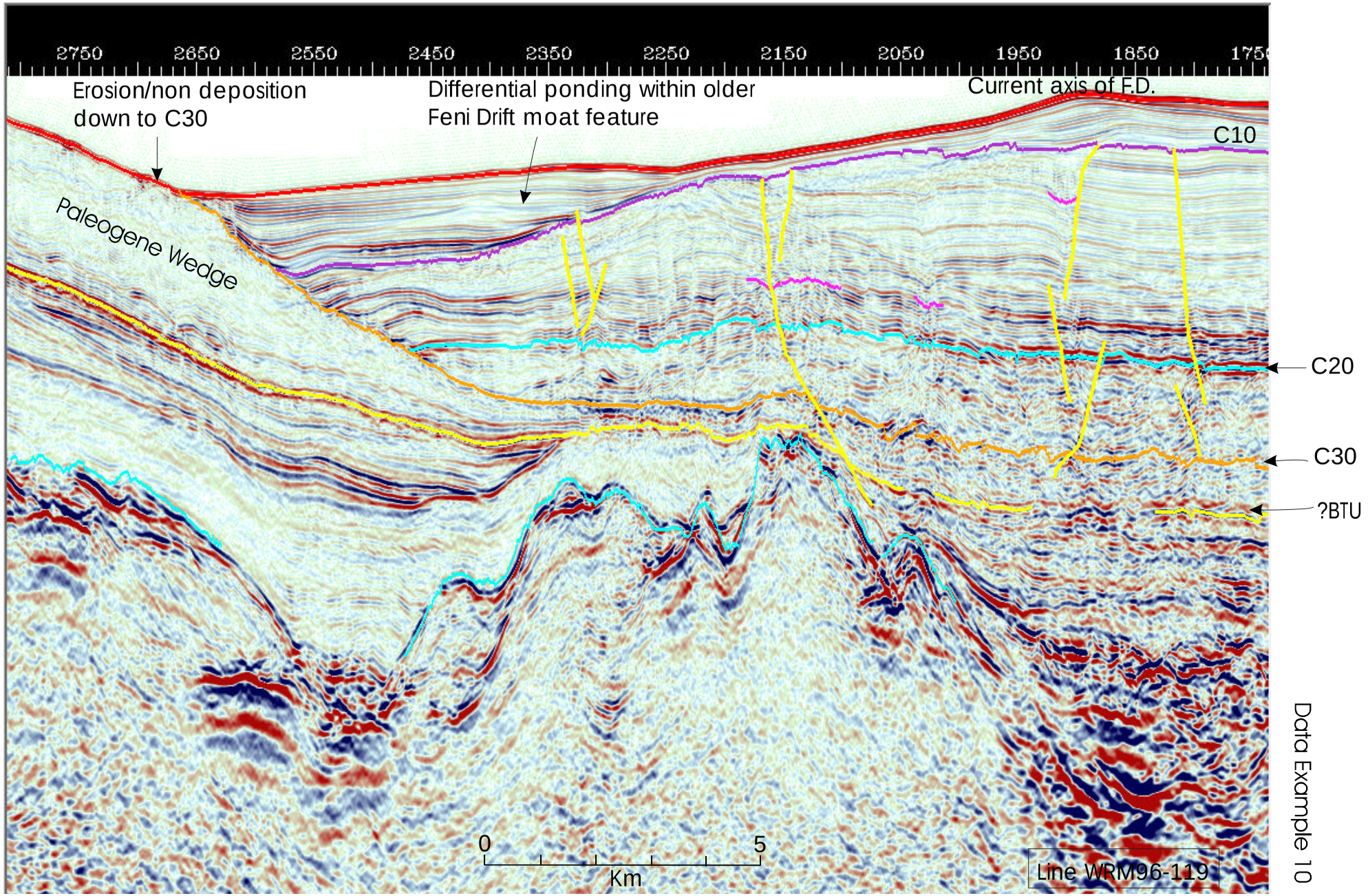
Data Example 09

Landmark map of PIP 2D seismic database showing the high proportion of the data necessarily selected for interpretation of the study region. Picked horizon is seabed; yellow is Licenced acreage.



Data Example 10

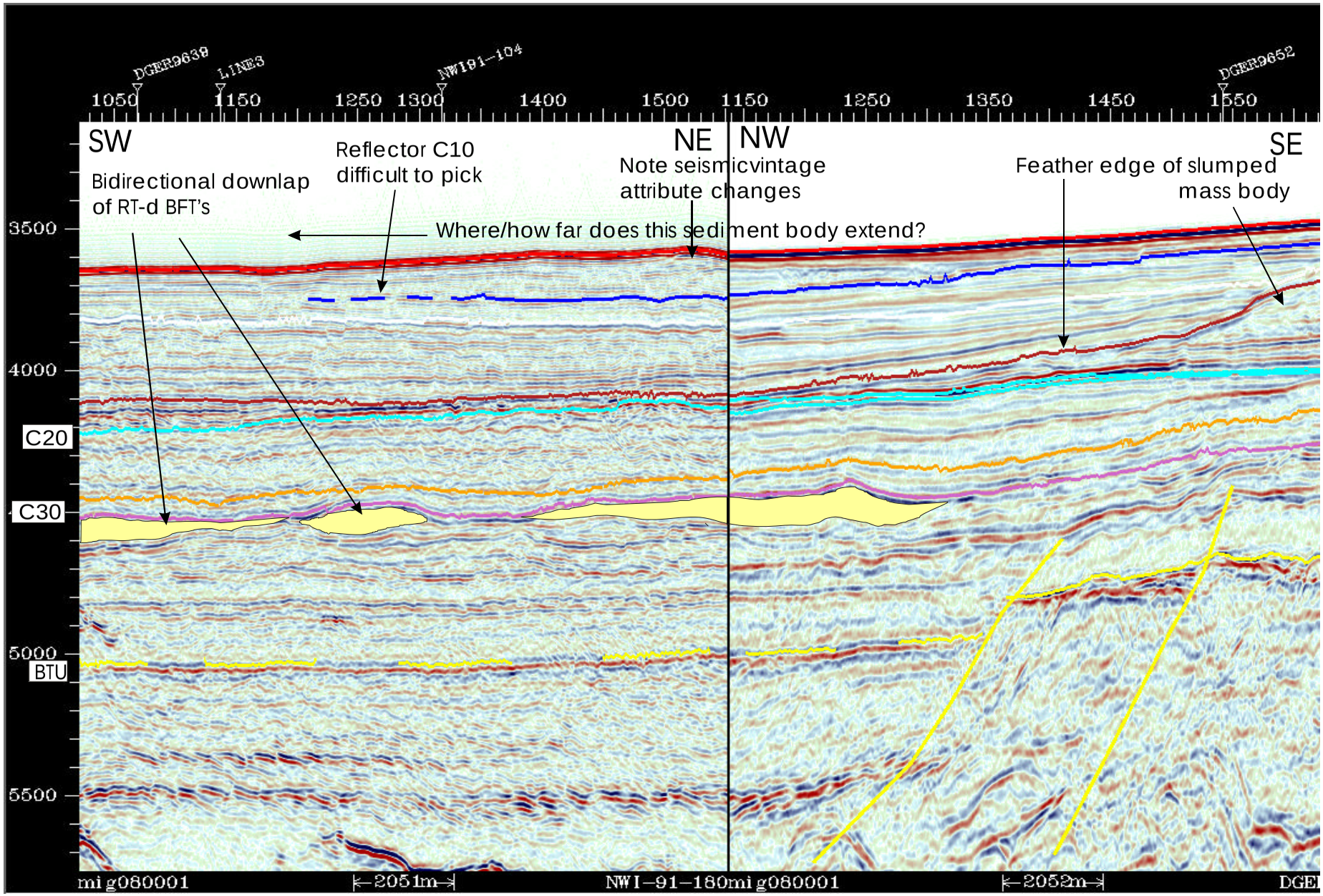
Complexity of megasequence boundaries in NW Rockall Trough. Seismic character suggests the thick basinal package. Note ponding influence of base of slope irregular high.



Data Example 10

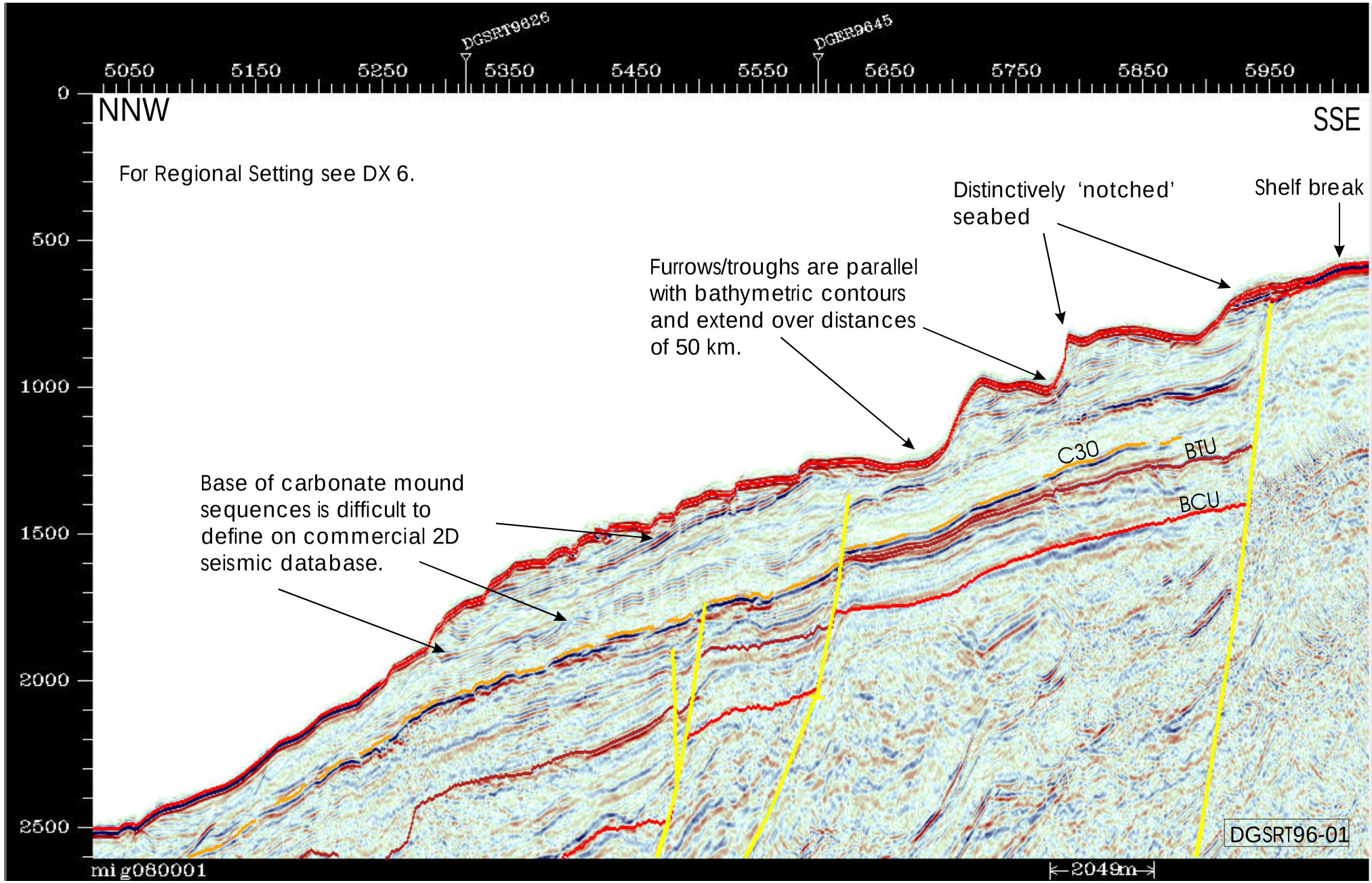
Data Example 11

Detail of Basin Floor Thick (BFT) development beneath C30 event and the feather edge of the RT-b aged large slumped mass. For location see Data Example 7.



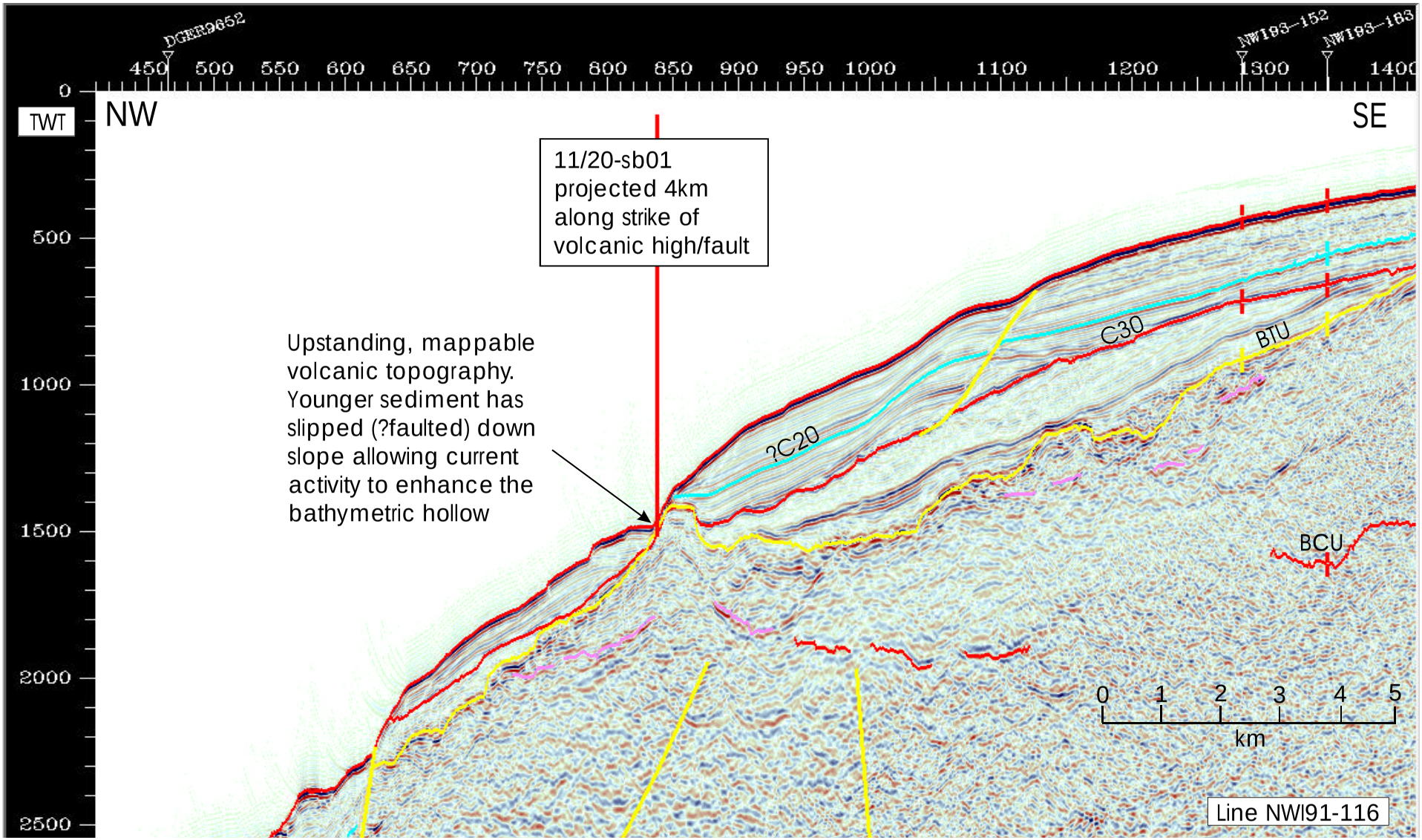
Data Example 12

Example of notched Upper Slope on eastern margin of the Rockall Trough (Western Porcupine Bank). The area shown corresponds with similarly distinctive seabed features attributable (via correlation with TOBI and sampling data) to carbonate mound development. Note proximity of carbonate growth to presence of faulting in the shallow section.



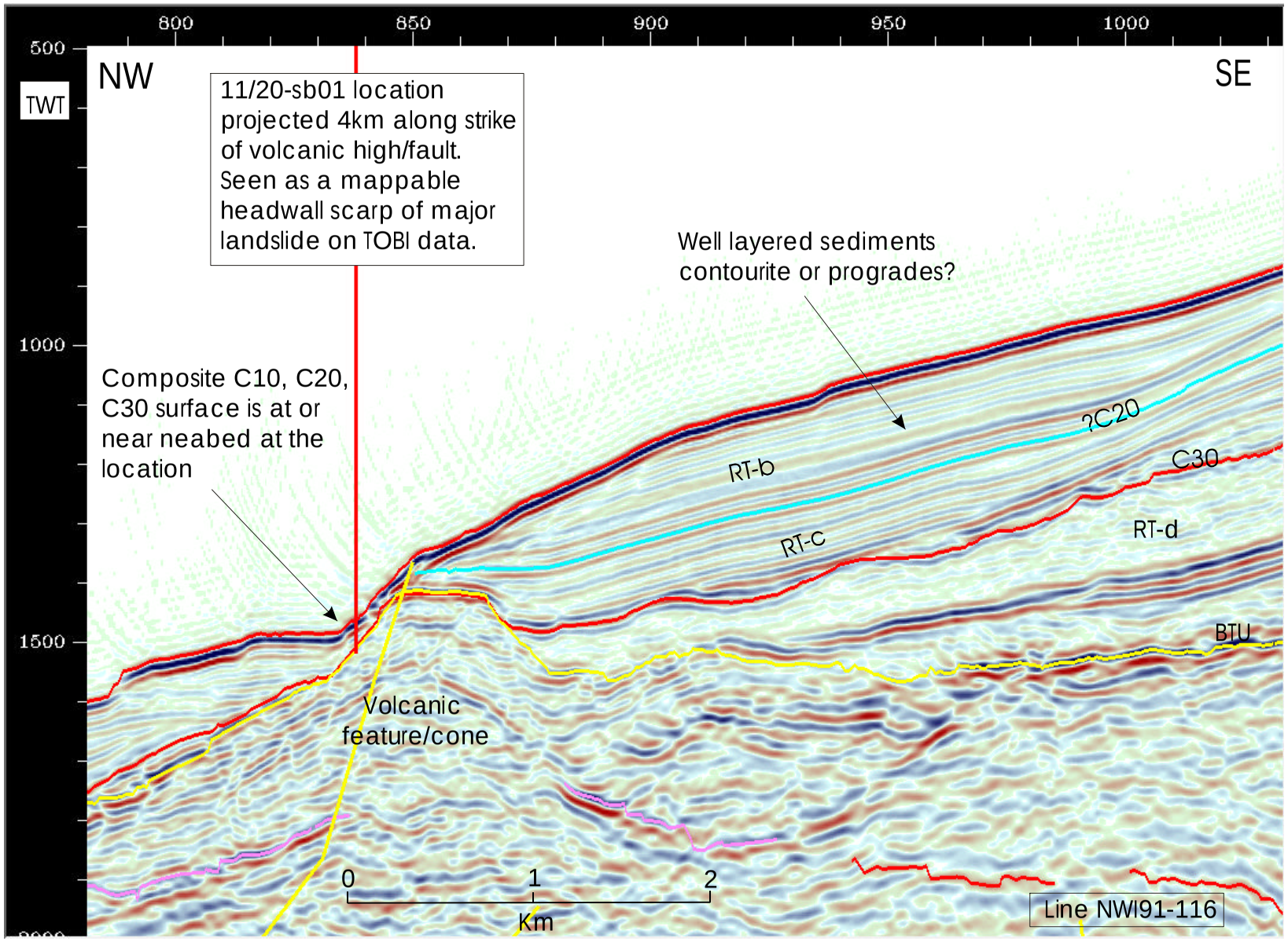
Data Example 13

Shallow drilling site 11/20-sb01 projected on to nearest PIP commercial 2D seismic line. The pre-C30 RT-d micritic carbonate is interpreted as being injected along joints and cracks of faulted submarine tuffaceous flows. It correlates to the distinctive, seismically transparent RT-d lensoid package seen elsewhere.



Data Example 14

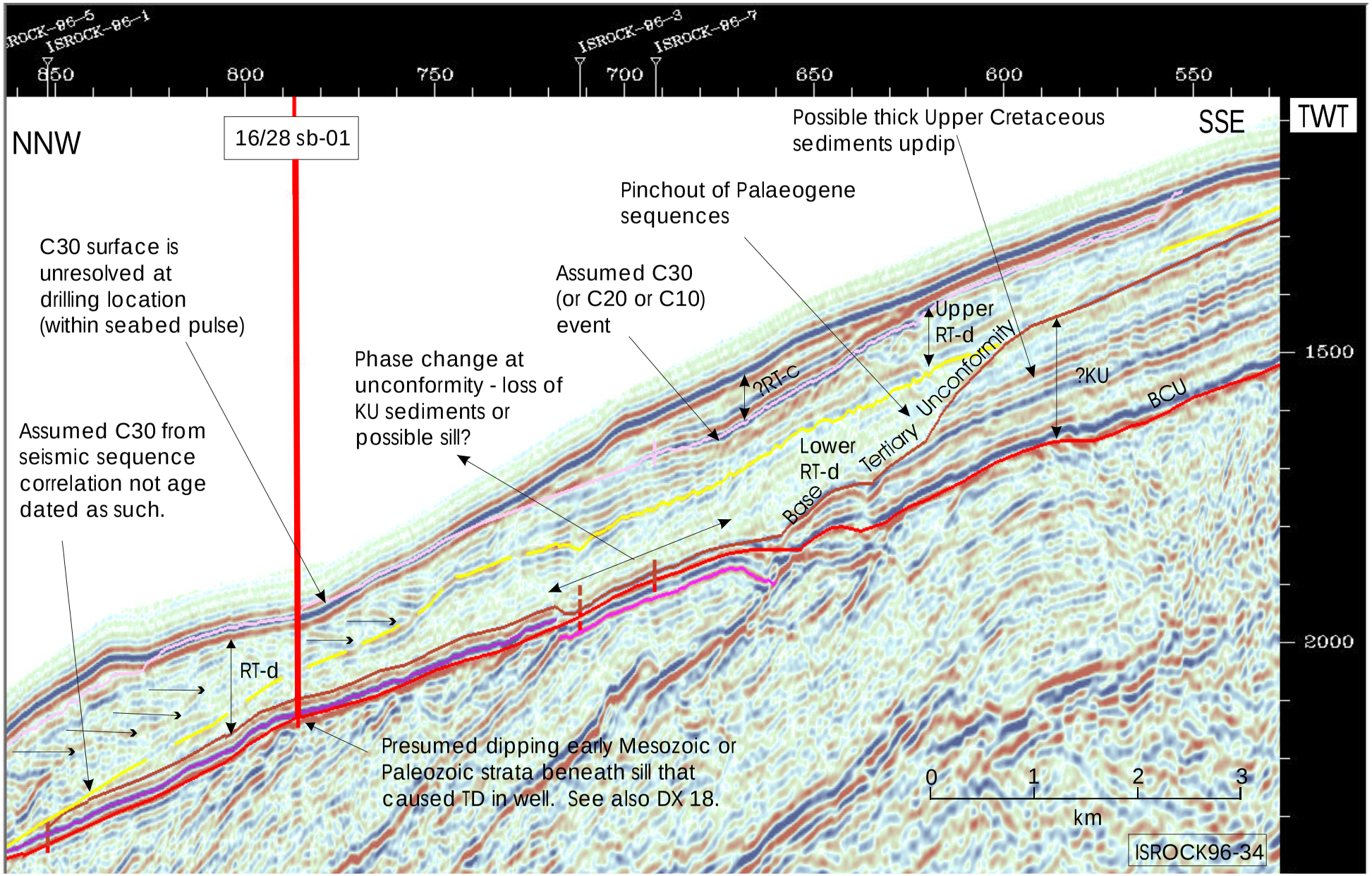
Details of the 11/20-sb01 location. It remains unknown whether the transparent (RT-d) or the overlying Megasequence RT-c was sampled at the location.



Data Example 15

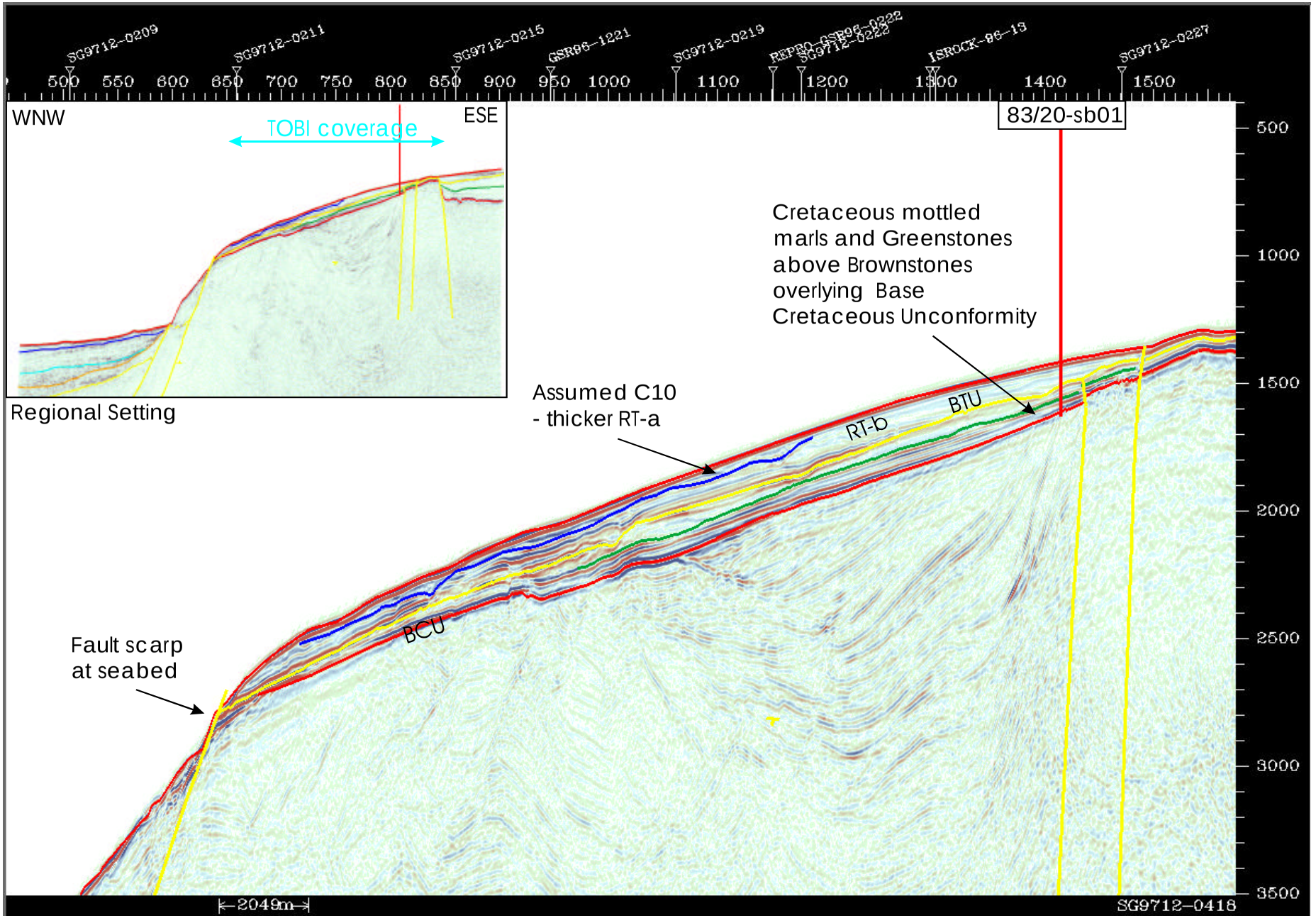
Shallow drilling site 16/28-sb01 showing important Tertiary and Upper Mesozoic stratigraphic relationships. The location lies in the upper portion of a canyon system identified on TOBI and seismic data. Note strongly downlapping reflections of sequence age dated as RT-d.

BCU = major unconformity



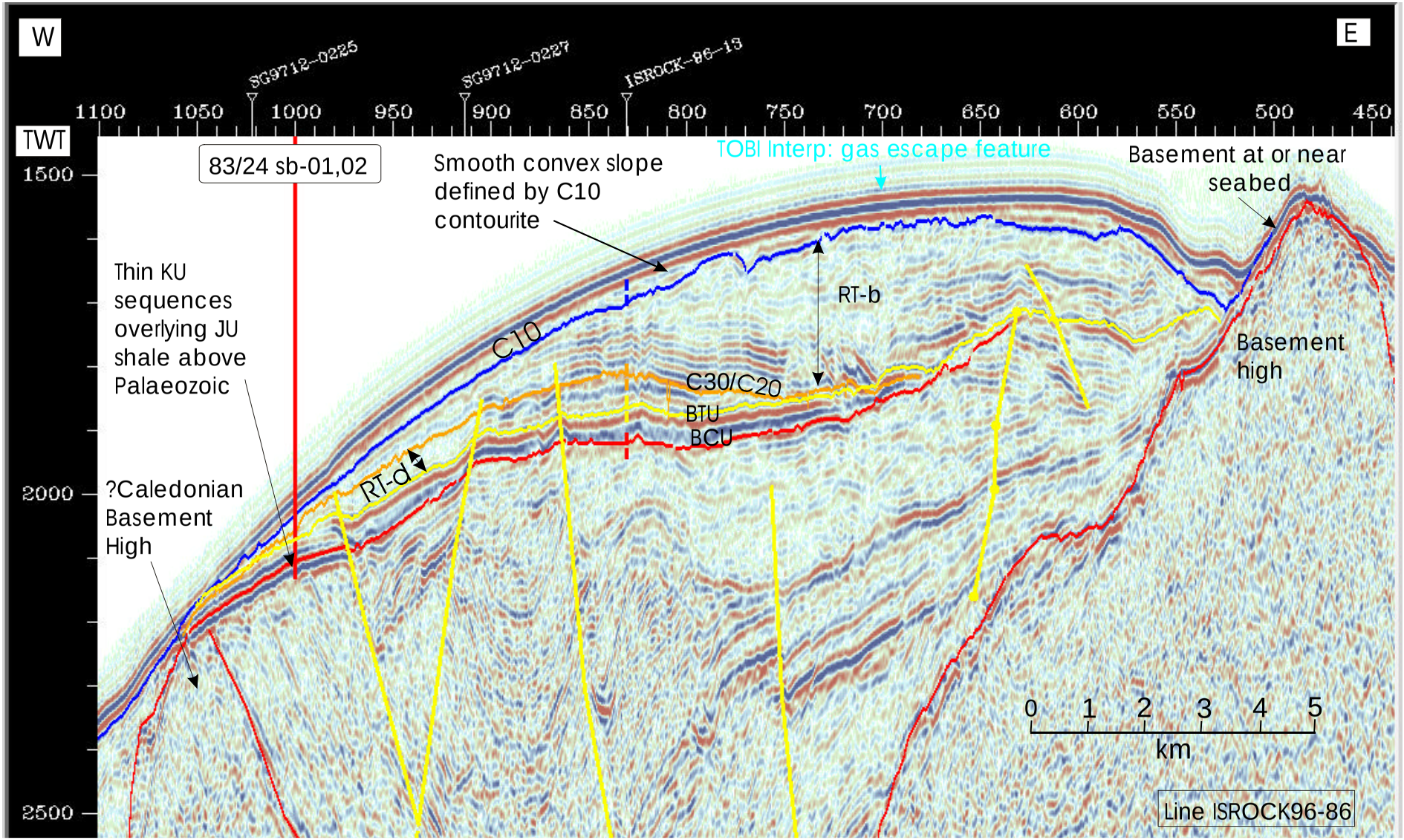
Data Example 16

Shallow drilling site 83/20-sb01 showing fault controlled nature of the distinctive Cretaceous 'plateau capping' of older Brownstones beneath 'Greenstones' resting upon folded, older Mesozoic strata (Kimmeridgian at location). The Base Tertiary Unconformity (BTU) is sub-parallel to that of the Base Cretaceous Unconformity (BCU) surface. The BTU is a composite surface since neither C30 nor C20 are present with Megasequence RT-b overlying the Upper Cretaceous beneath a veneer of RT-a at the seabed.



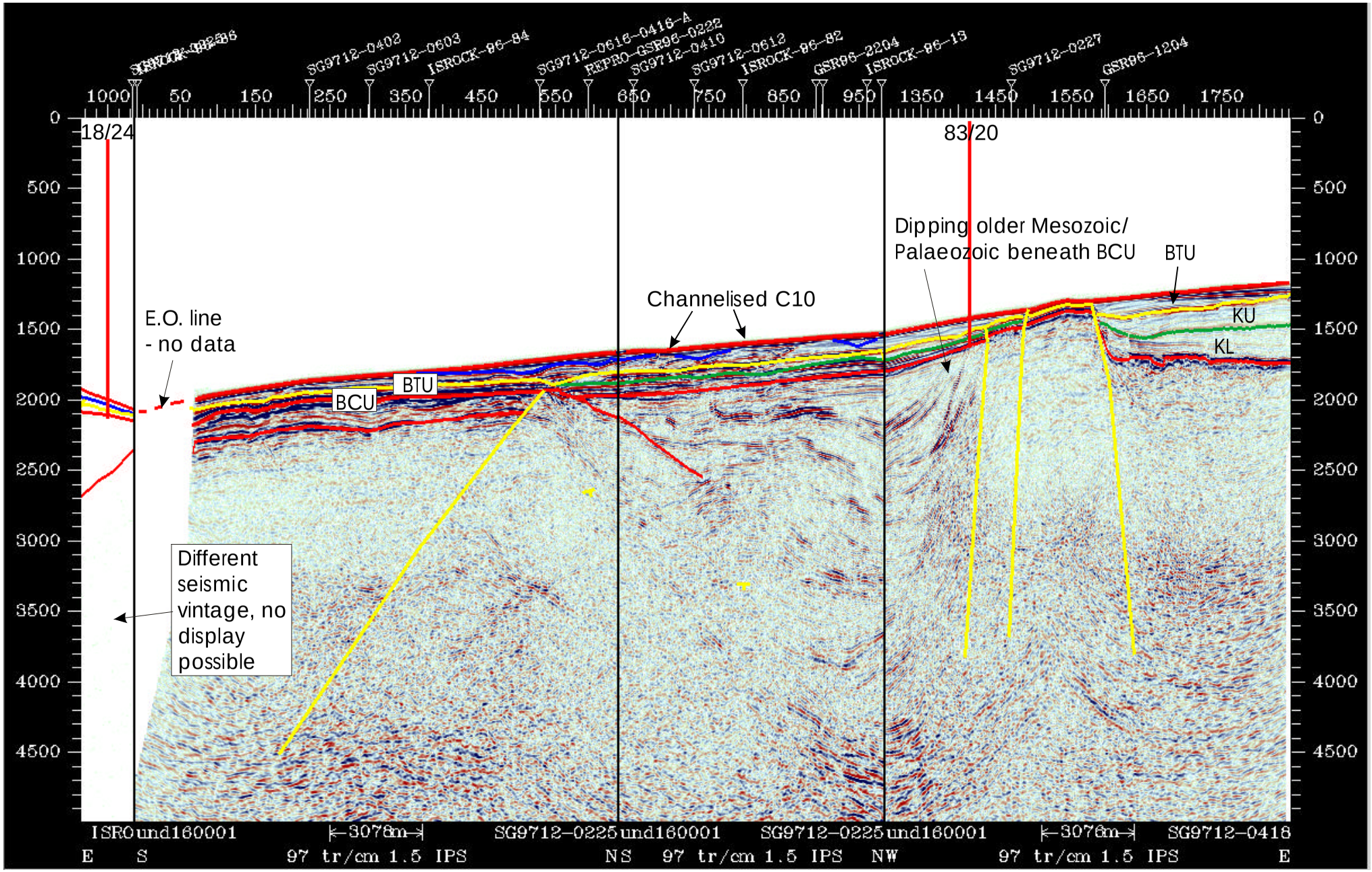
Data Example 17

Shallow drilling site 83/24-sb01,02 that encountered Upper Cretaceous rocks above an Upper Jurassic veneer resting upon steeply dipping Palaeozoic strata beneath the prominant (composite) angular unconformity. Note thick RT-c sequence updip and composite C10/C20 surface beneath sand grade contourite sequence encountered at seabed.



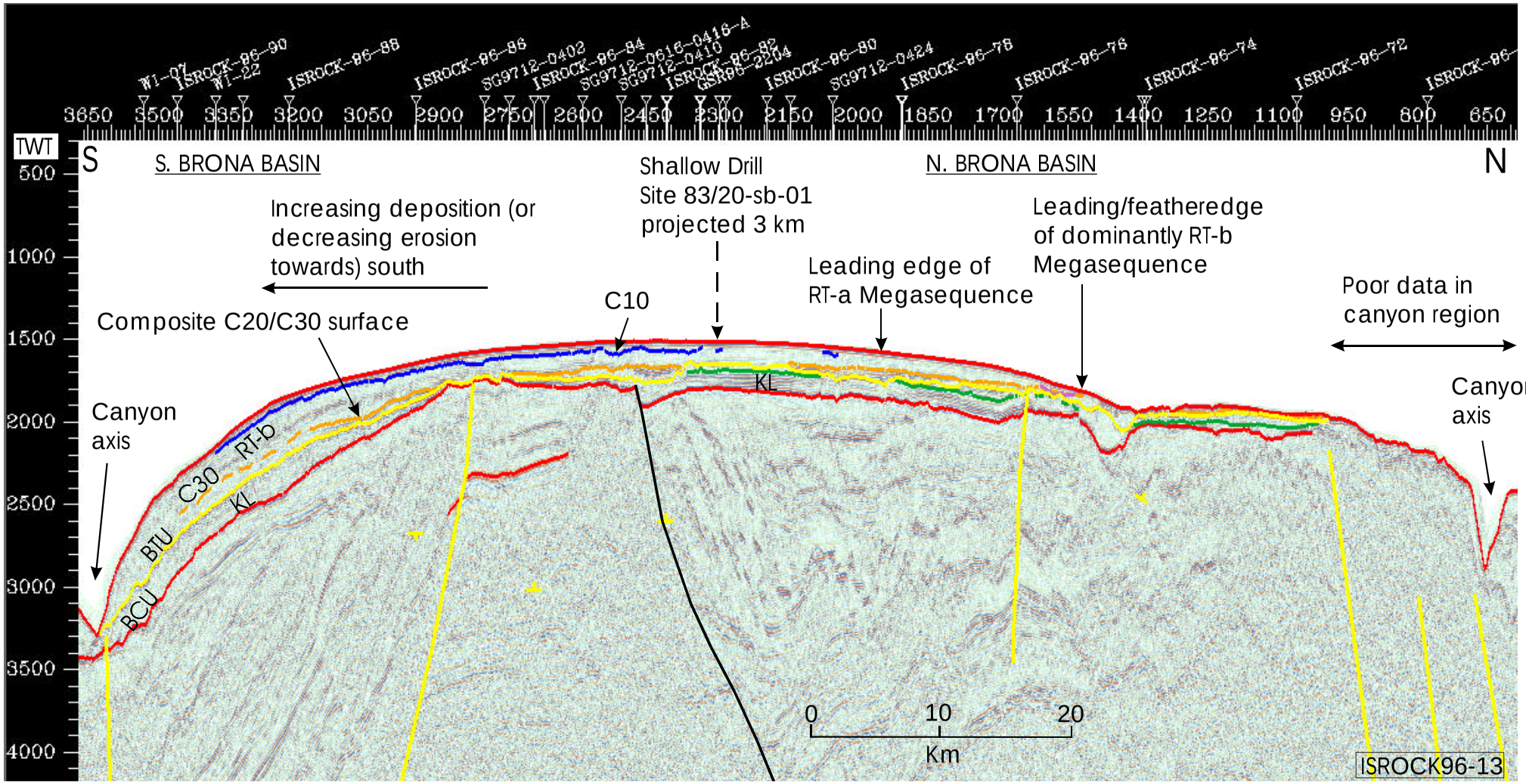
Data Example 18

Differing vintages of commercial 2D seismic from the PIP database have been used to correlate shallow drill sites 83/20 and 83/24. Closest seismic 'loop' is shown tying the two locations that are 27 km apart. Note fault controlled disposition of Cretaceous "Green/Brownstones".



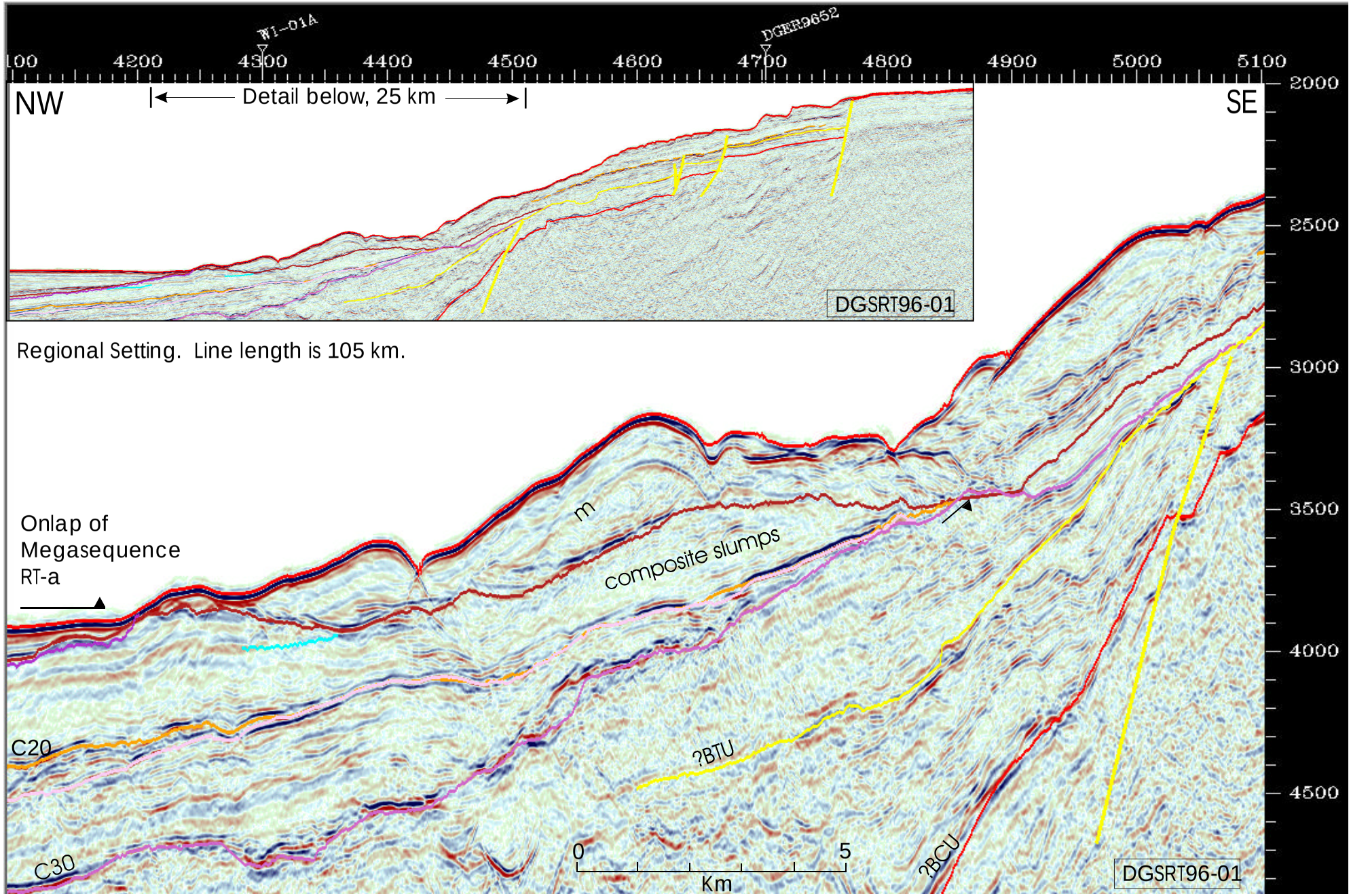
Data Example 19

Stratigraphic relationships indicate significant interplay of contouritic erosion, deposition followed by more erosion/ deposition cycles from Lower Cretaceous (KL) to present poorly resolved veneer of Megasequence RT-a sands existing at seabed. The Paleogene Megasequences RT-c and RT-d are noticeably thin/absent..



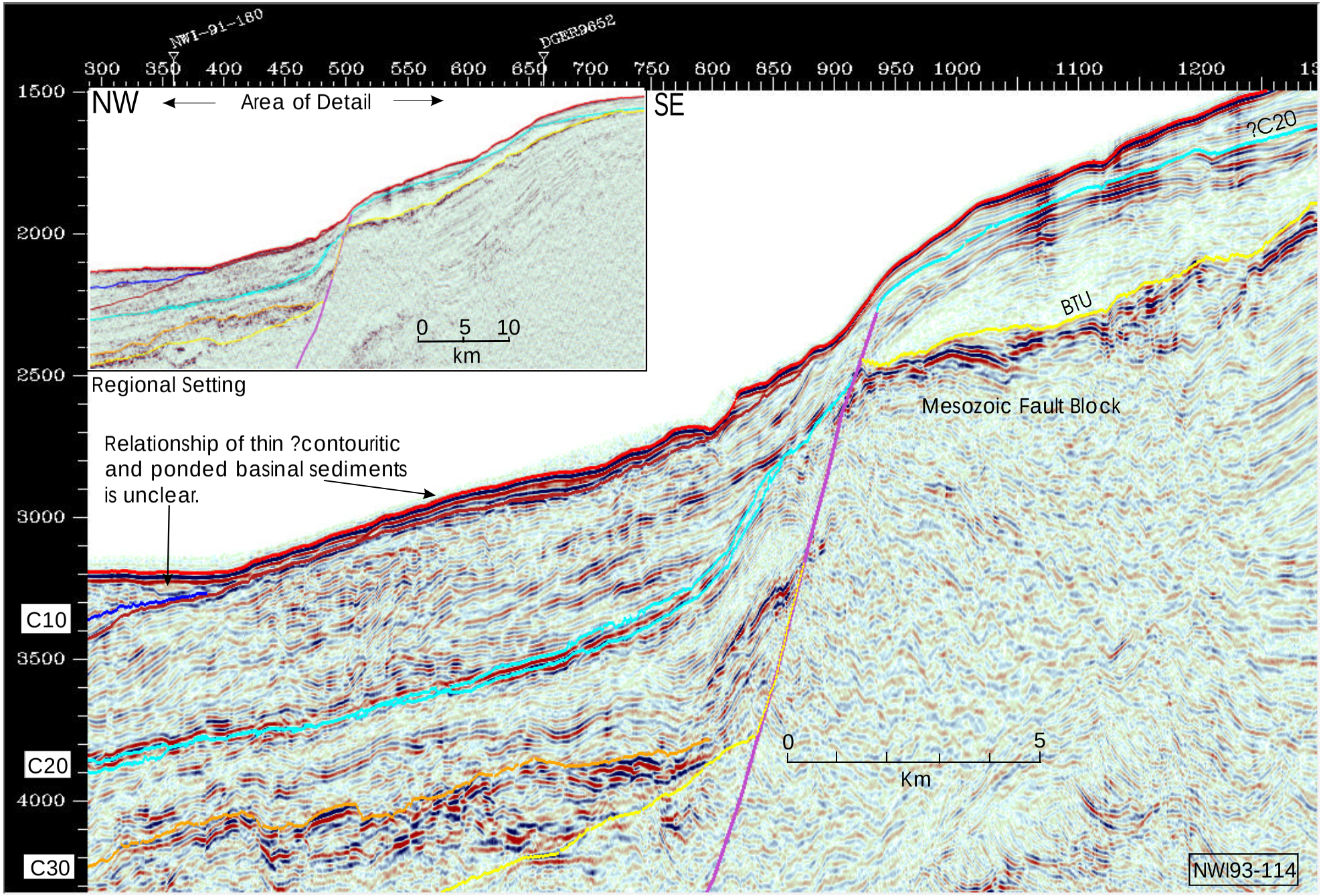
Data Example 20

Detail of massive slumped bodies overlying truncated megasequence RT-c and older units. Stratigraphic units are poorly constrained here. m = acquisition ghost.



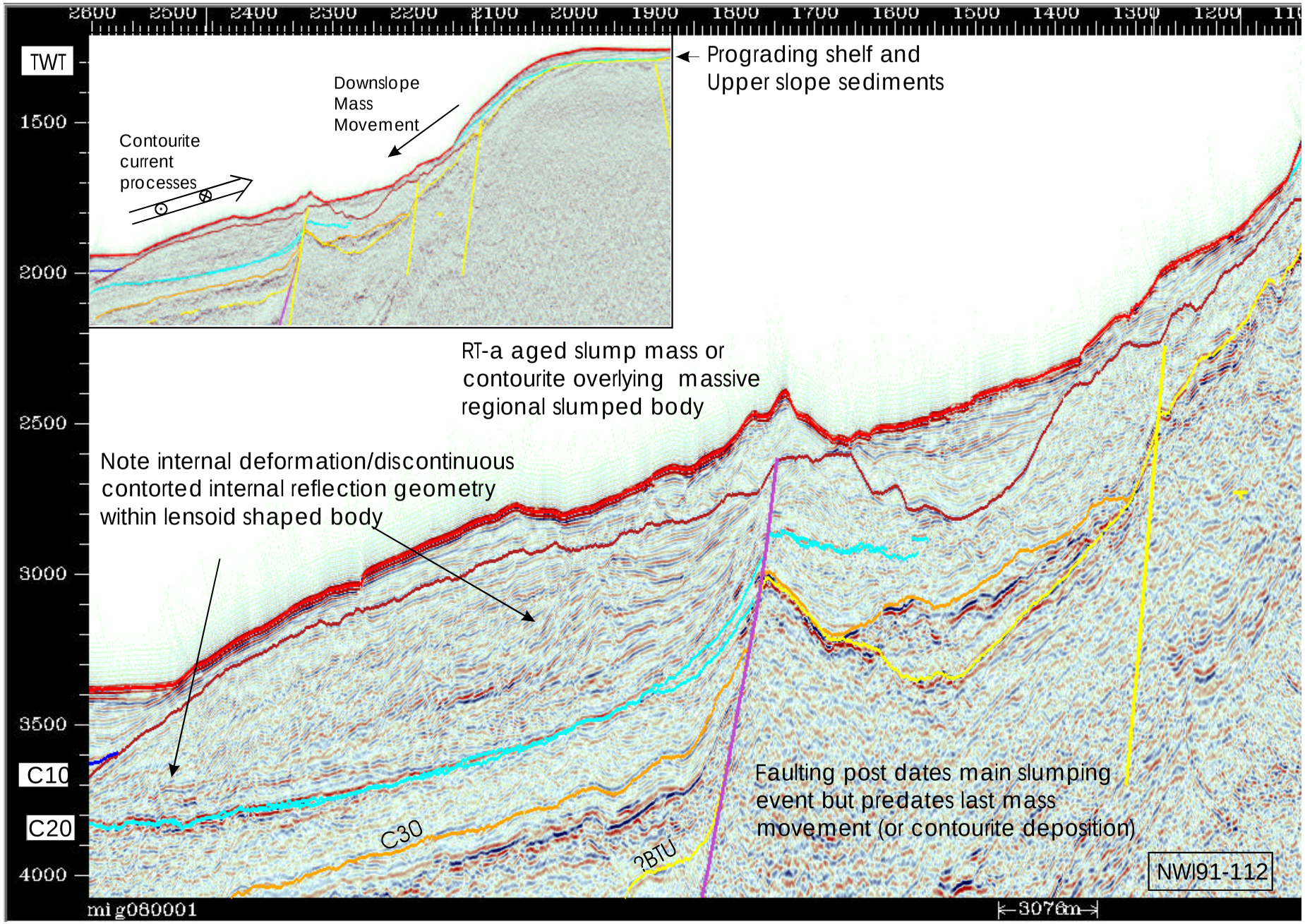
Data Example 21

Detail of faulted mass movement/slumped units with overlying ?contouritic sediments and notched progradational continental slope within influence of deep seated (Erris) fault.



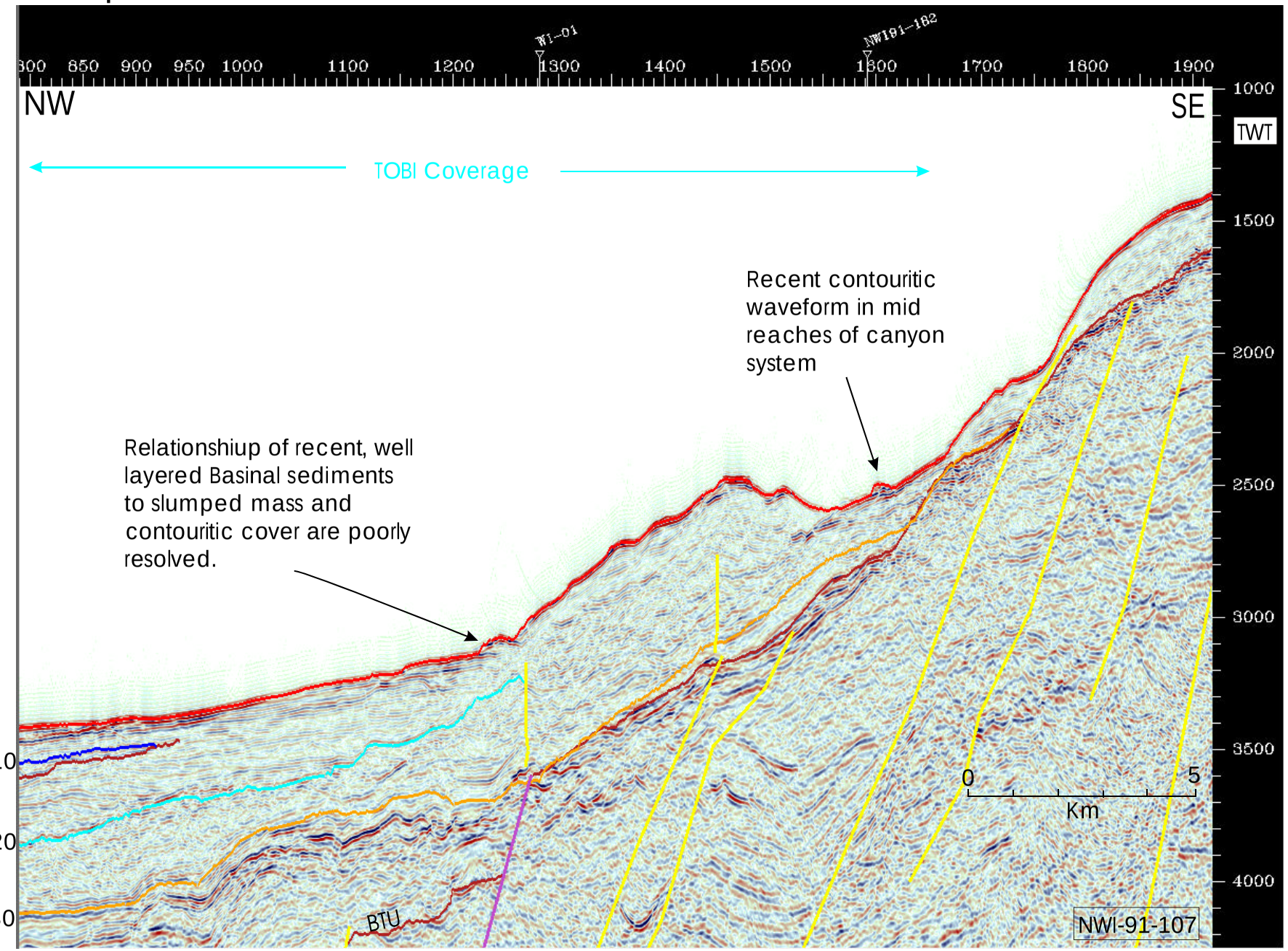
Data Example 22

Regionally extensive mass movement/slumped sediment body at foot of slope apparently of Megasequence RT-b age. Age relationships between the body and the prograding upper slope are complex, see text, as are the important depositional and erosional processes of along slope contourites.



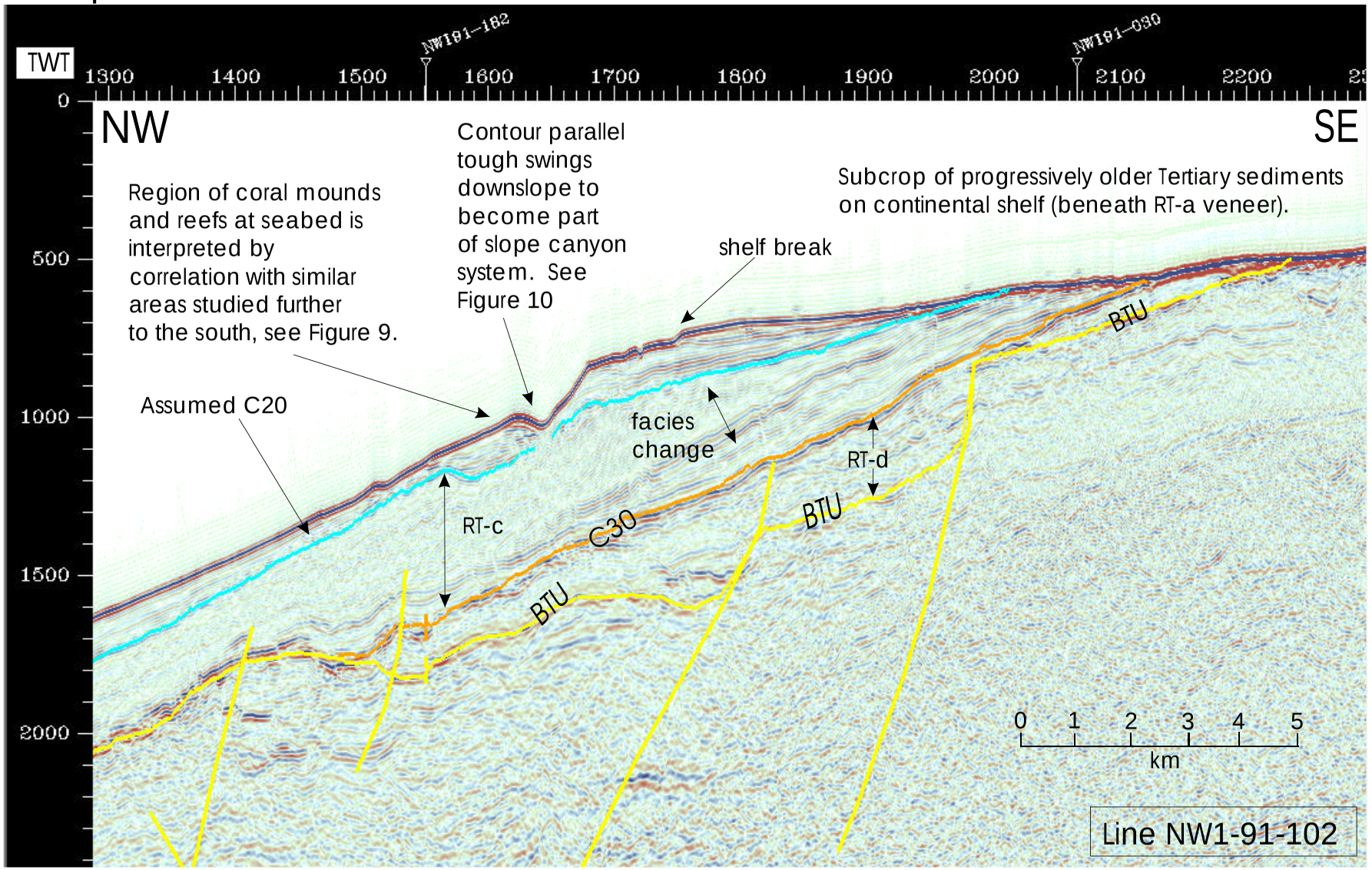
Data Example 23

Poorly resolved slumped mass of 15 km width covered by contouritic sediments.



Data Example 24

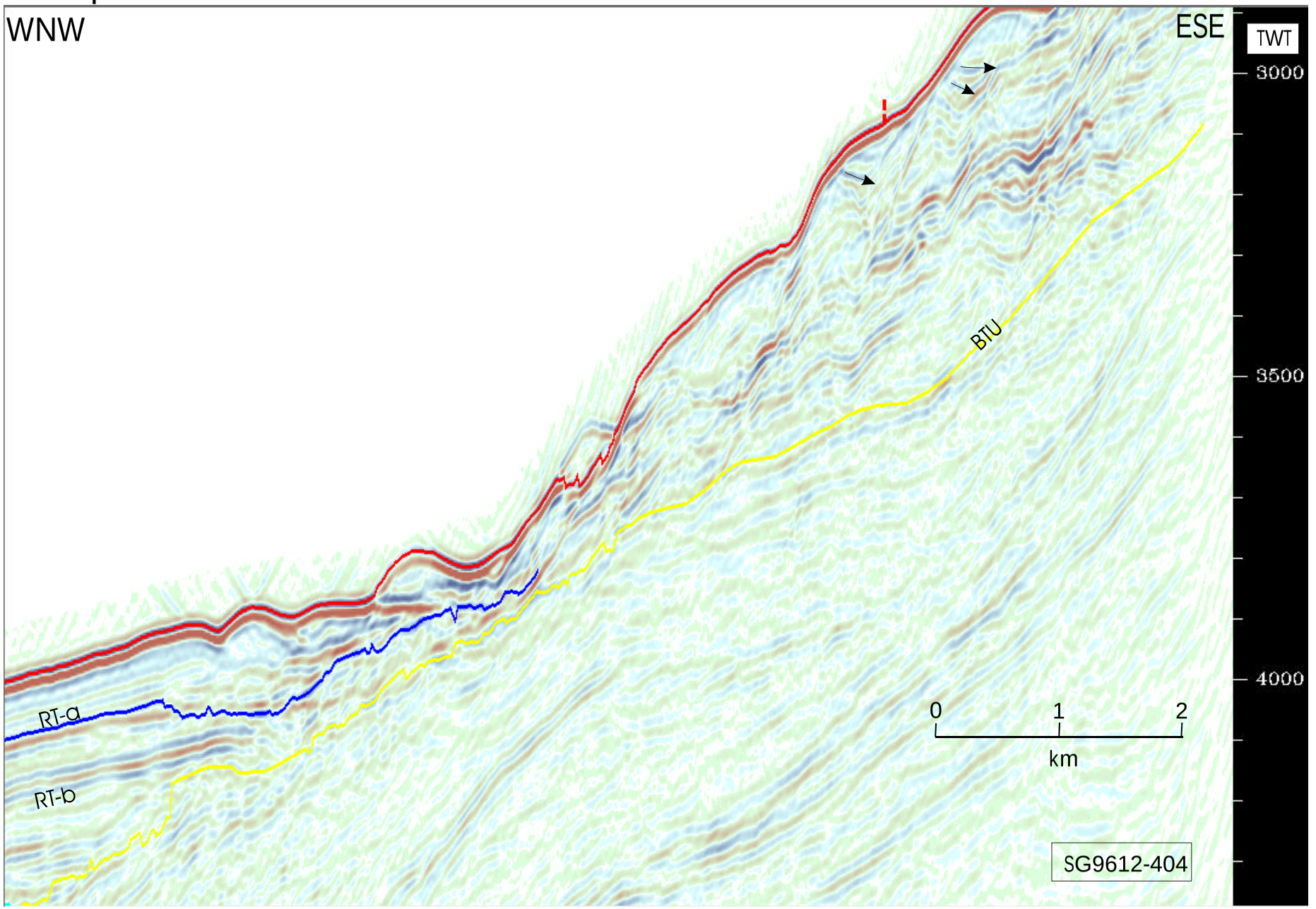
Typical profile of 'notched' upper slope and progradational shelf. If correct, correlation of seismic events suggest considerable throw during post BTU - pre C30 times



slump_SG404

Data Example 25

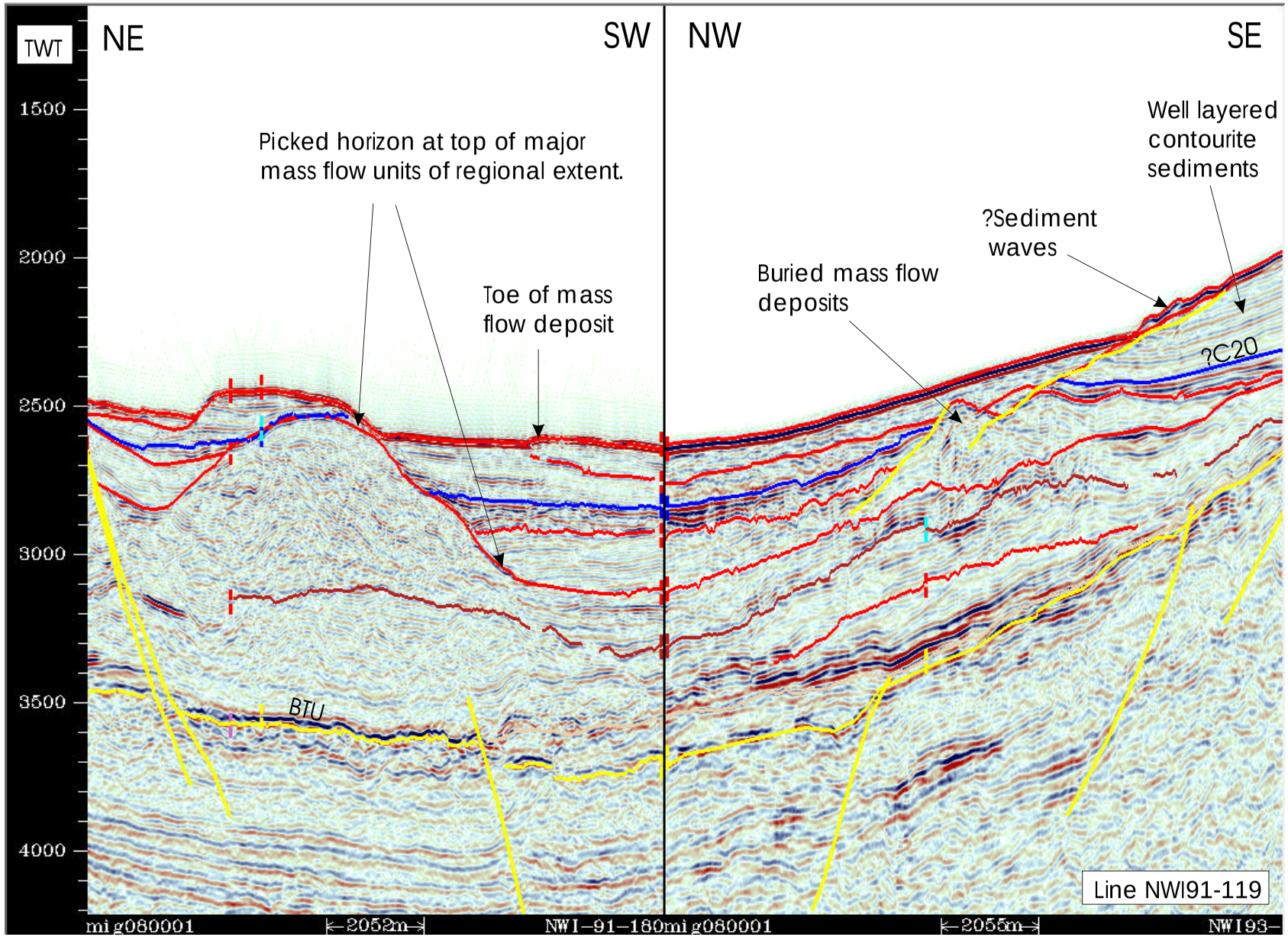
Base of slope mass movement of relatively thinned Cenozoic section down onto Rockall Trough basin floor. Yellow is base Tertiary picked horizon. Note conspicuous hummocky topography and internal geometries of the various Cenozoic sequences. Uppermost unit on slope is probably contourite emphasising difficulties in distinguishing mass movement from depositional/erosional processes due to oceanographic current actiivity.



Data Example 25

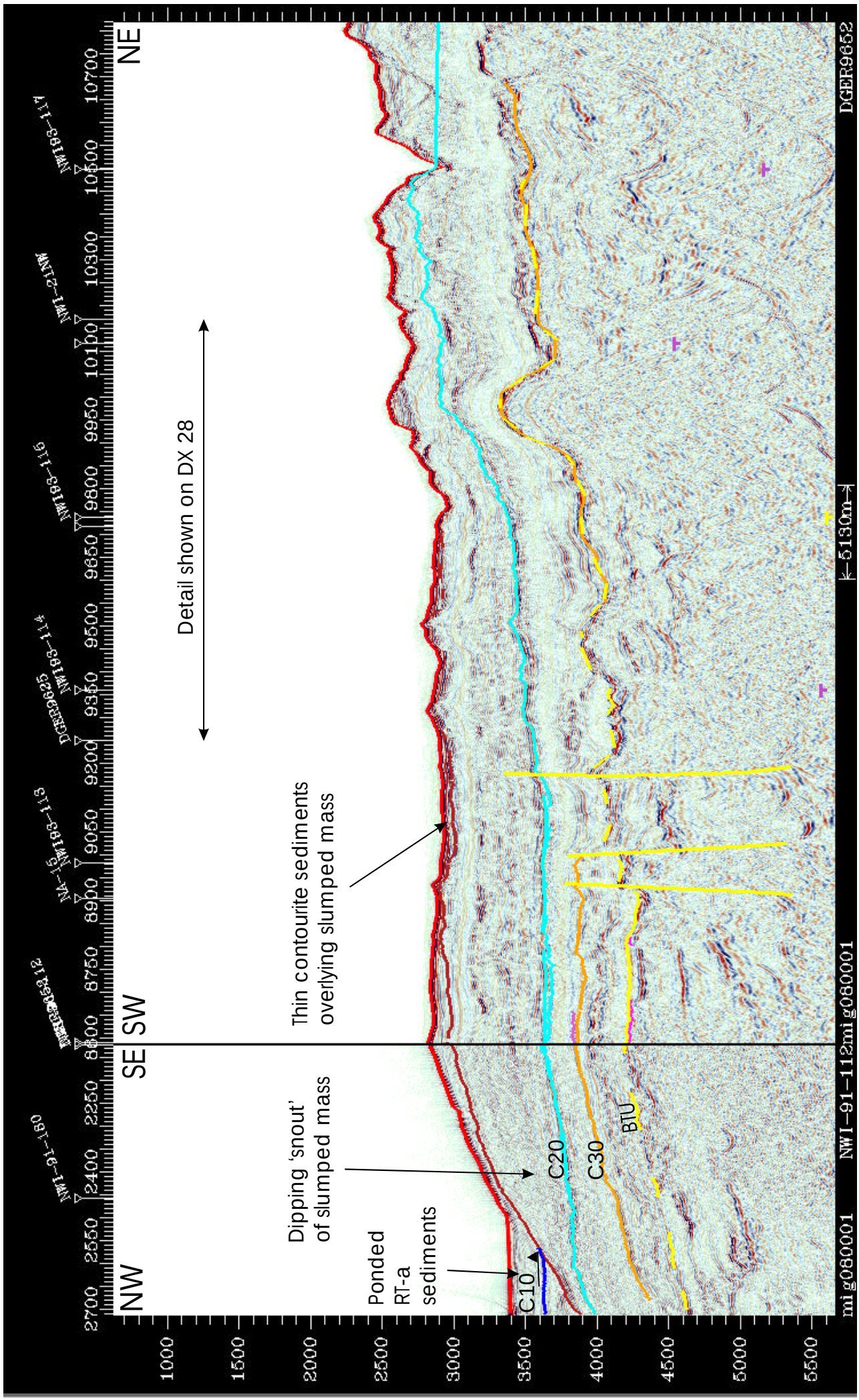
Data Example 26

Complex stratigraphic relationships amongst huge mass flow deposits comprising Megasequence RT-c (and ?older/younger) in NE Rockall Trough area.



Data Example 27

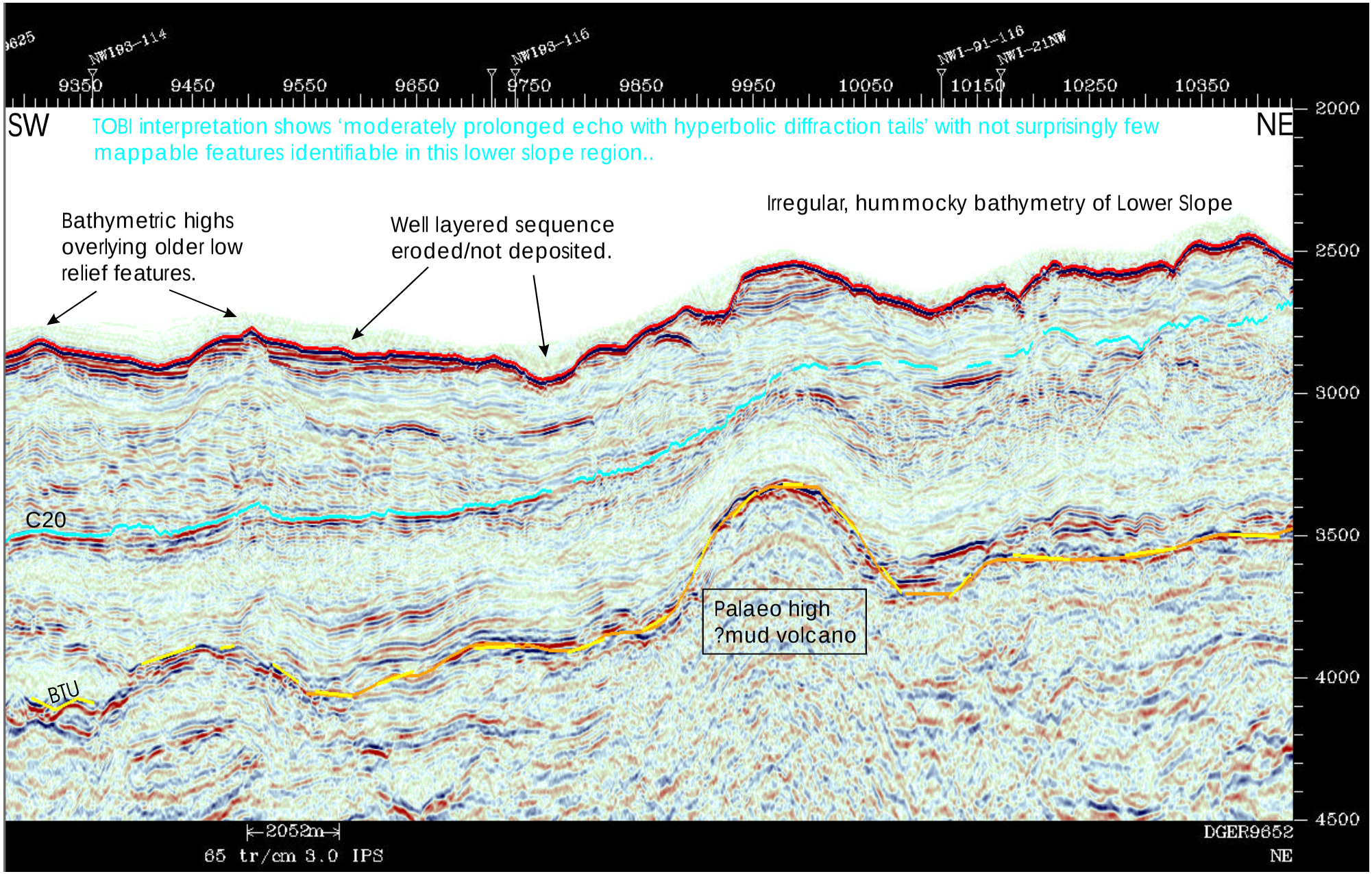
Apparent dip and strike profiles through flank and body of major RT-based mass slump body. Note irregular upper and internal relief. Internal reflection geometries range from discontinuous sub-parallel to wavy, slumped or chaotic.



slump_snout

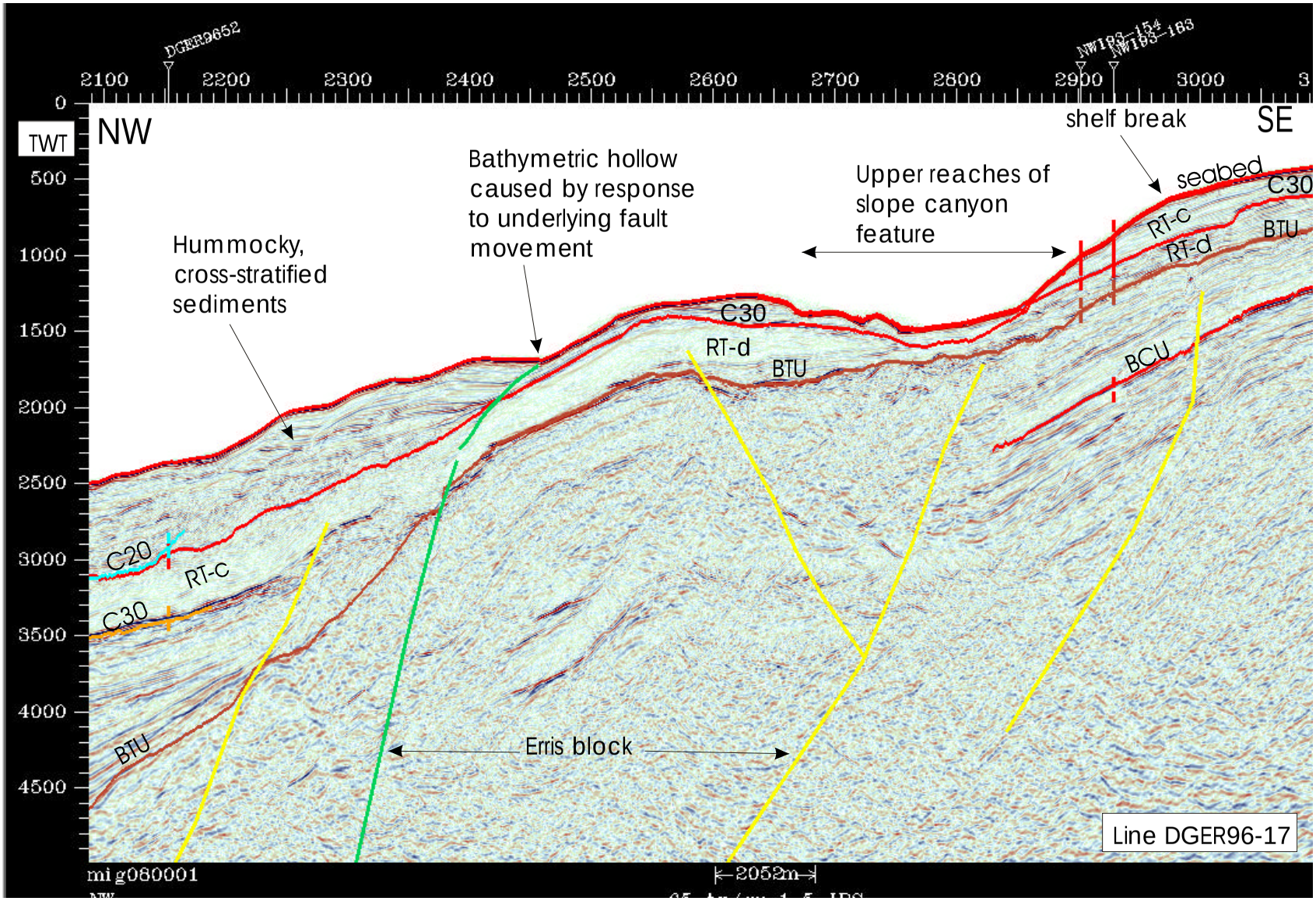
Data Example 28

Palaeo-high at BTU underlying present bathymetric high of unknown origin. Several other seabed highs are also underlain by apparent older local highs.



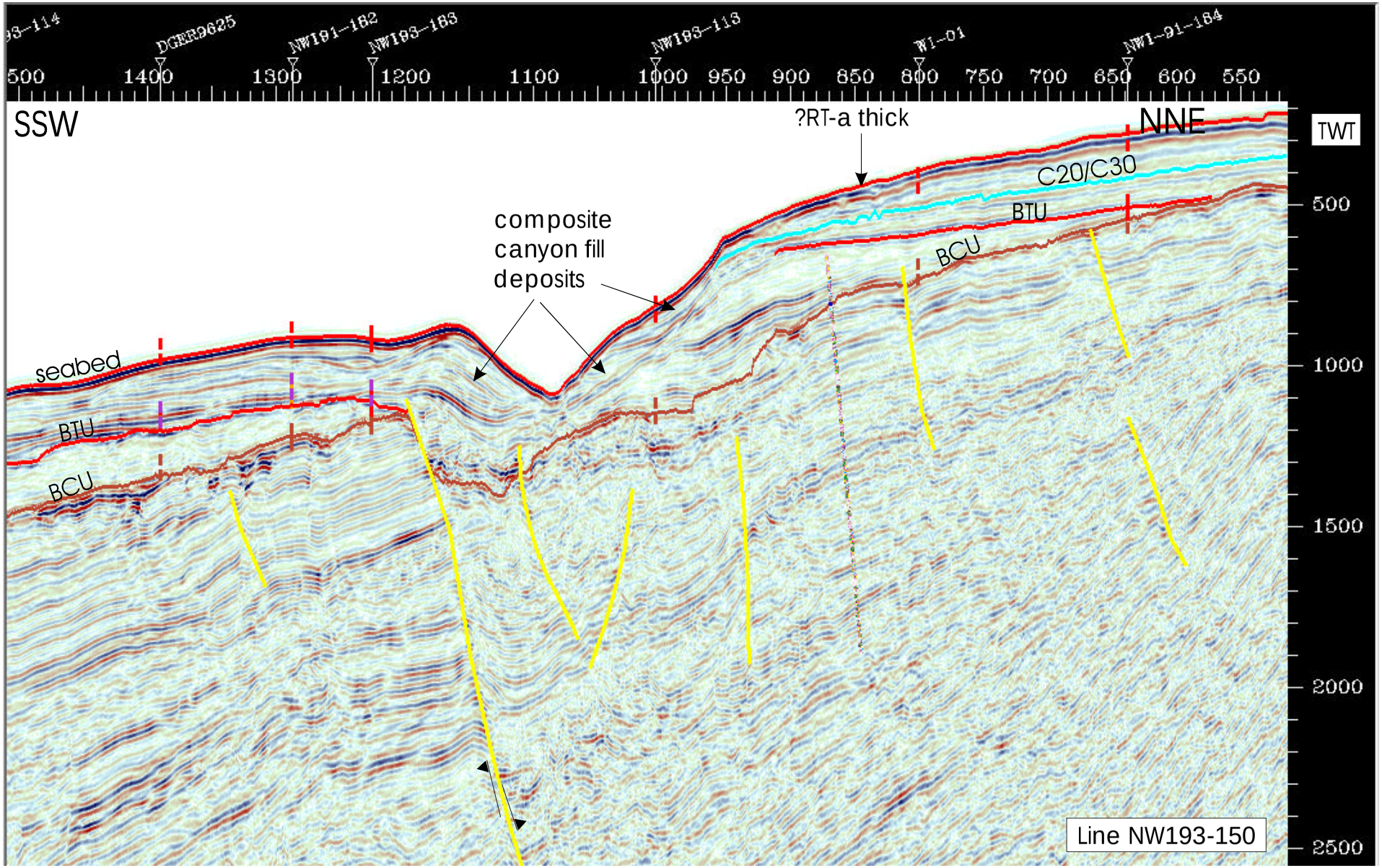
Data Example 29

Deformed and undulating/hummocky slope bathymetry related to underlying fault deformation. Note transparent RT-d megasequence pinches out updip at canyon feature.



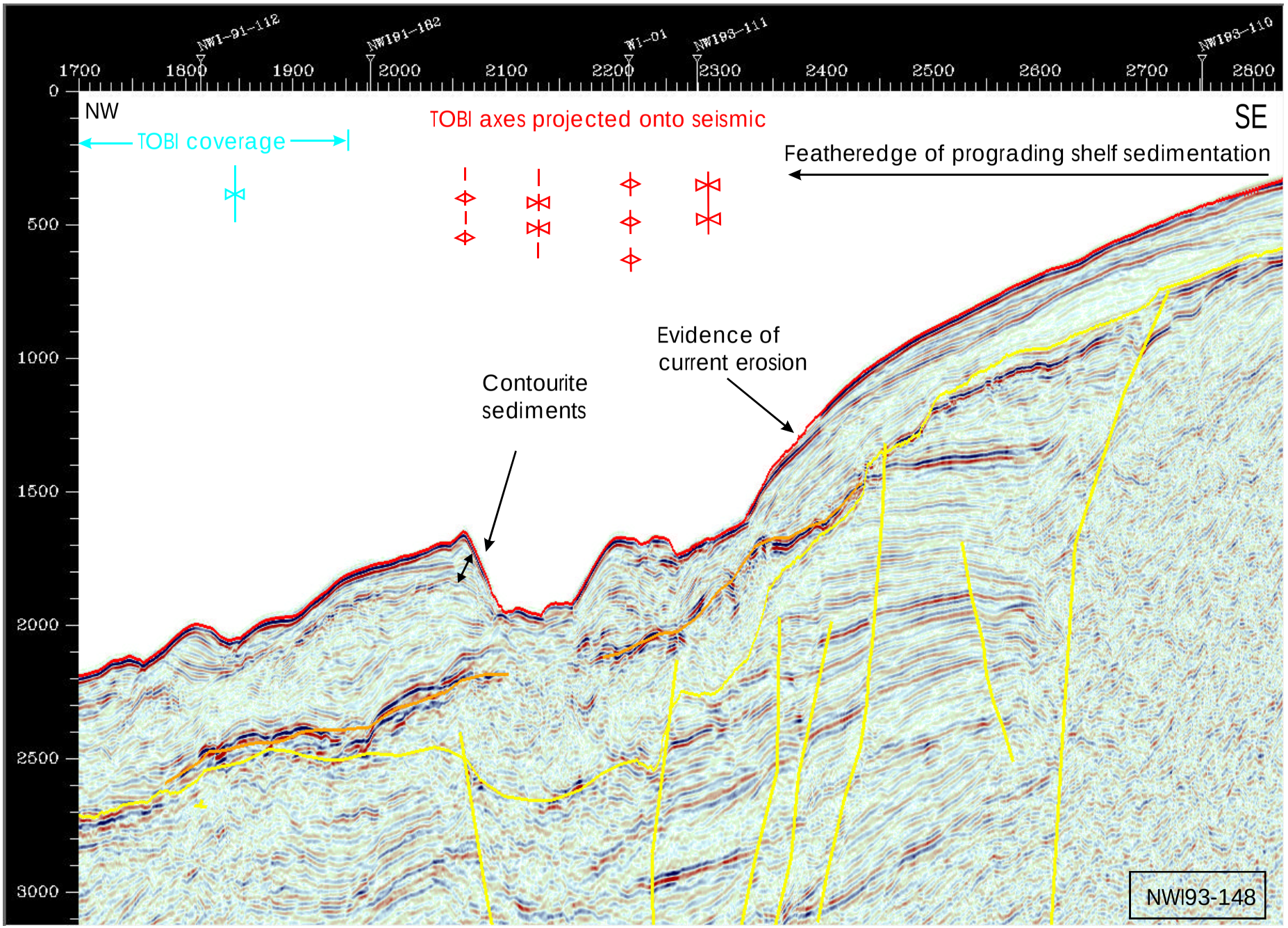
Data Example 30

Faulted structural relationship to slope canyon location. Majority of canyon features appear related to underlying structure - not always as clearly defined as in this example from south of the Eris basin.



Data Example 31

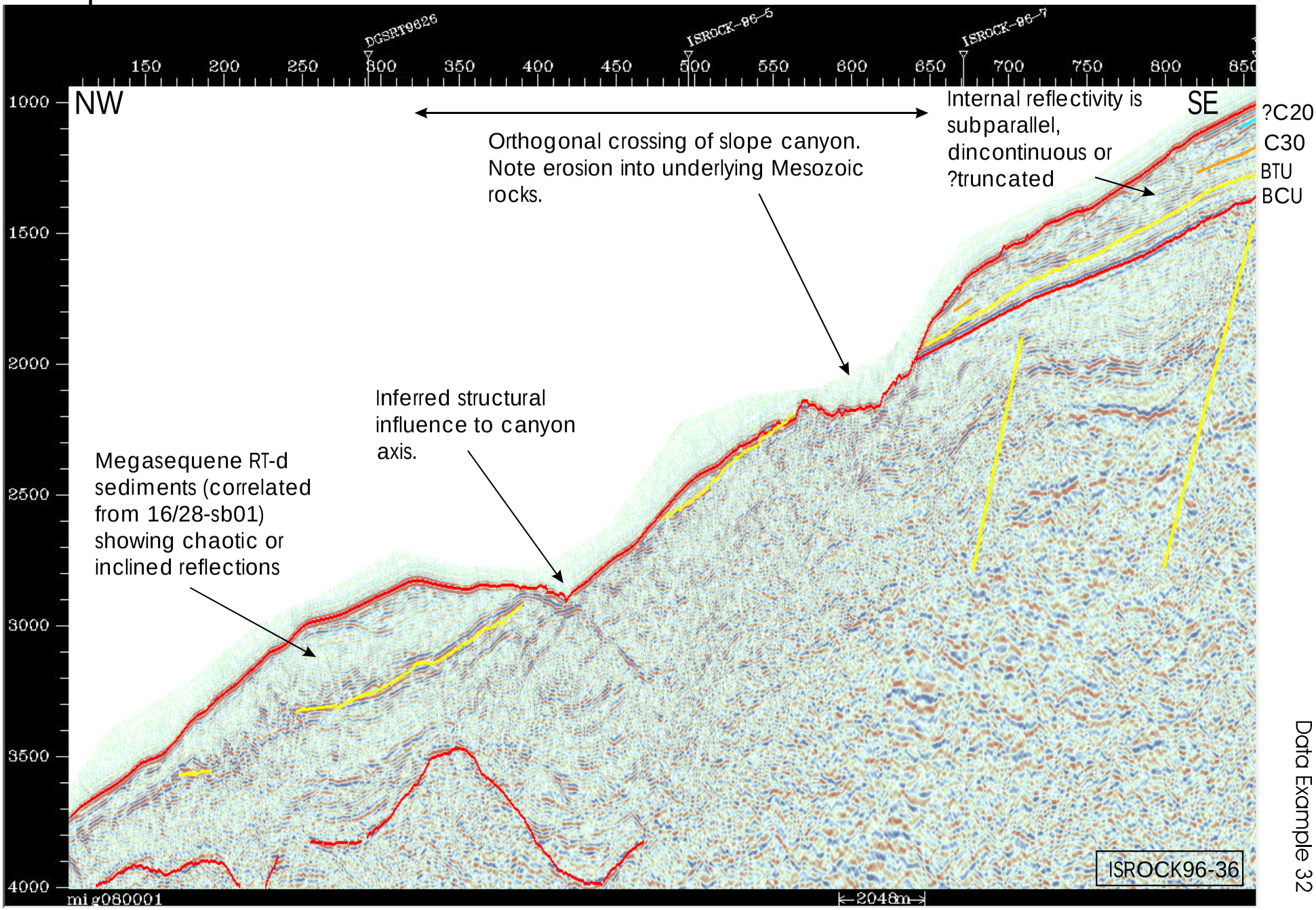
Relationships of upper to middle slope canyon with shelf prograde and contourites.



Data

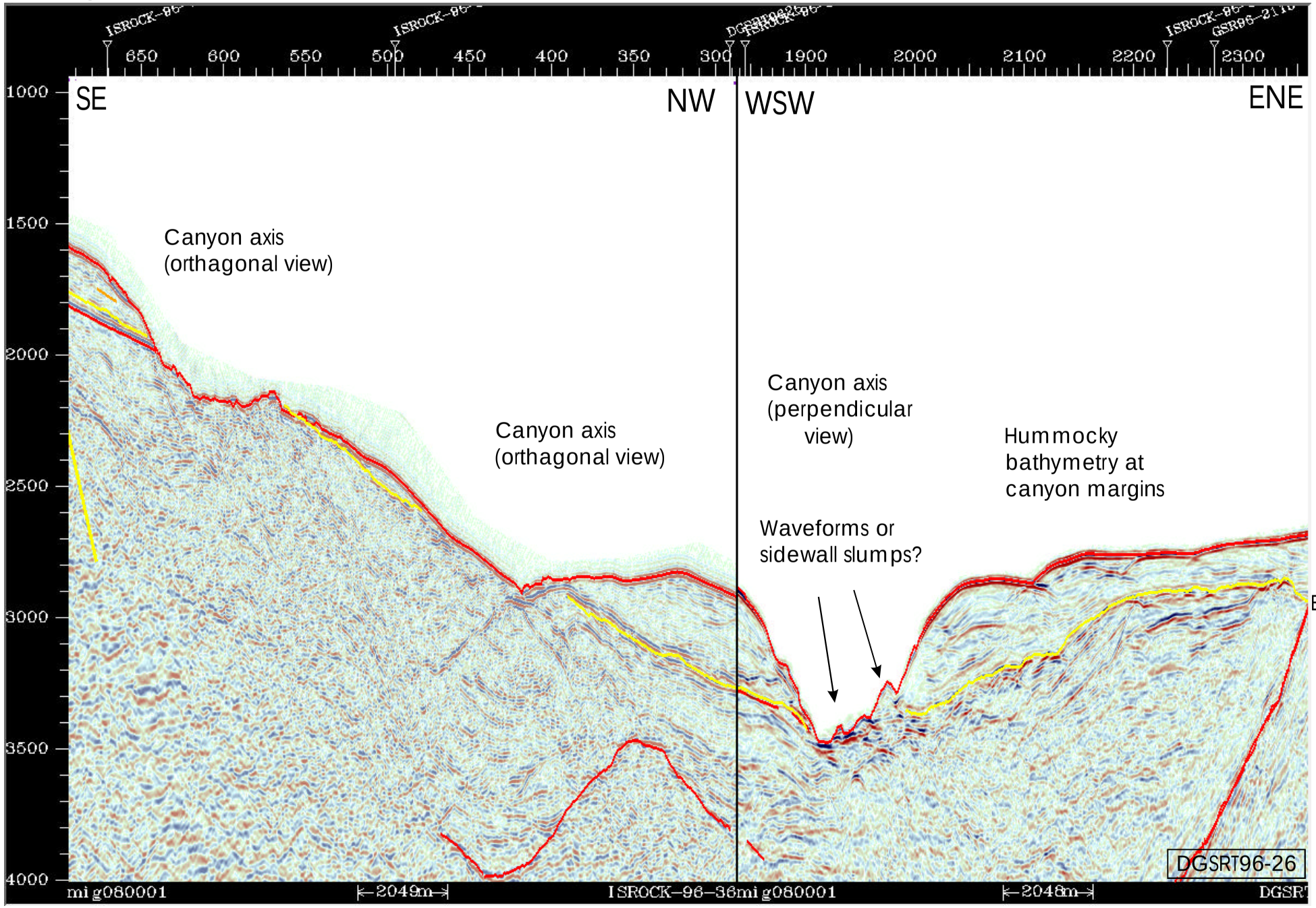
Example 32

Rugged slope of N. Macdara Basin. Note differences in internal reflectivity of Megasequences on canyon flanks.



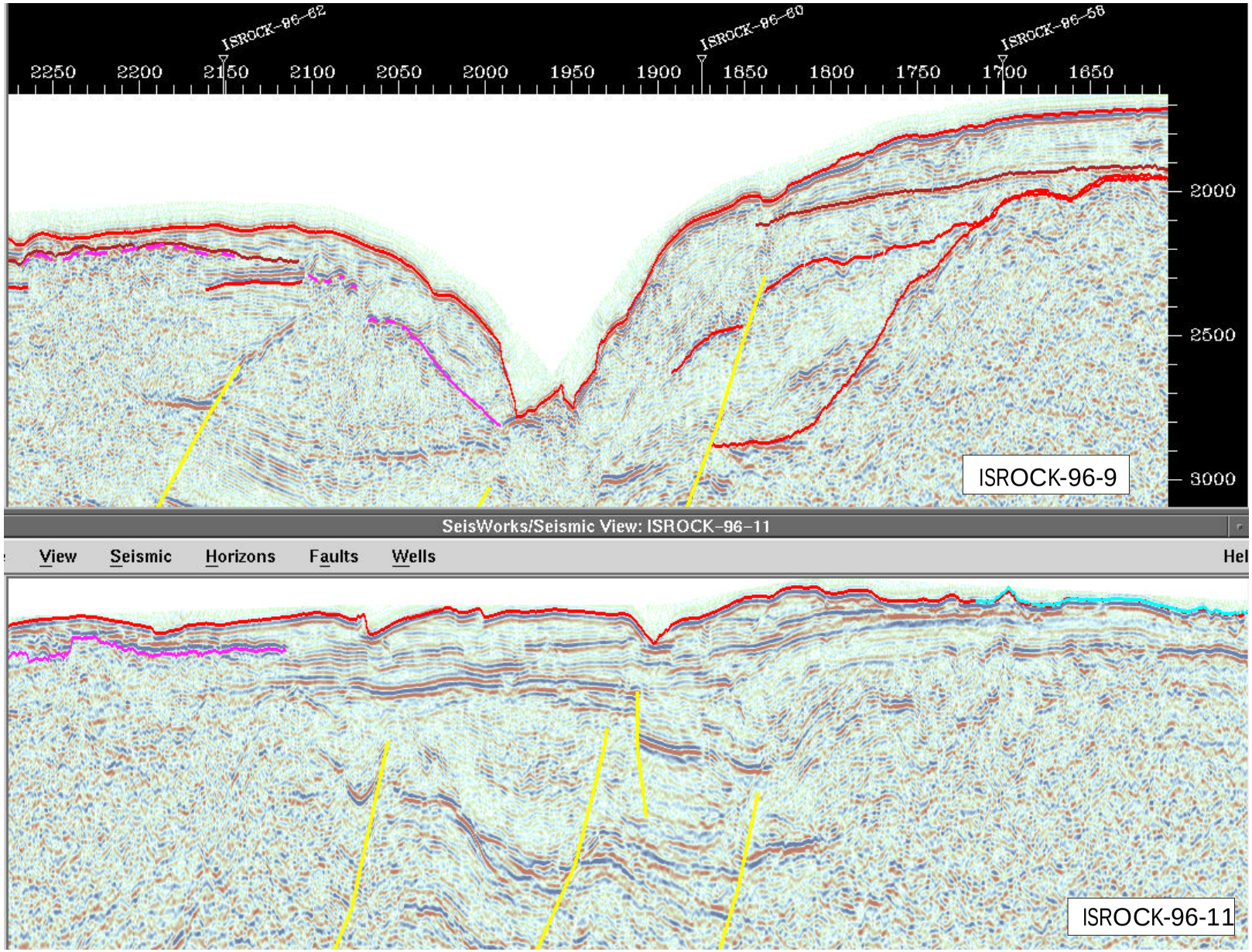
Data Example 33

Orthogonal and perpendicular views across canyon axis in N. Macdara Basin. Steep gradient of canyon thalweg drops 1000m over 12.5 km downslope.



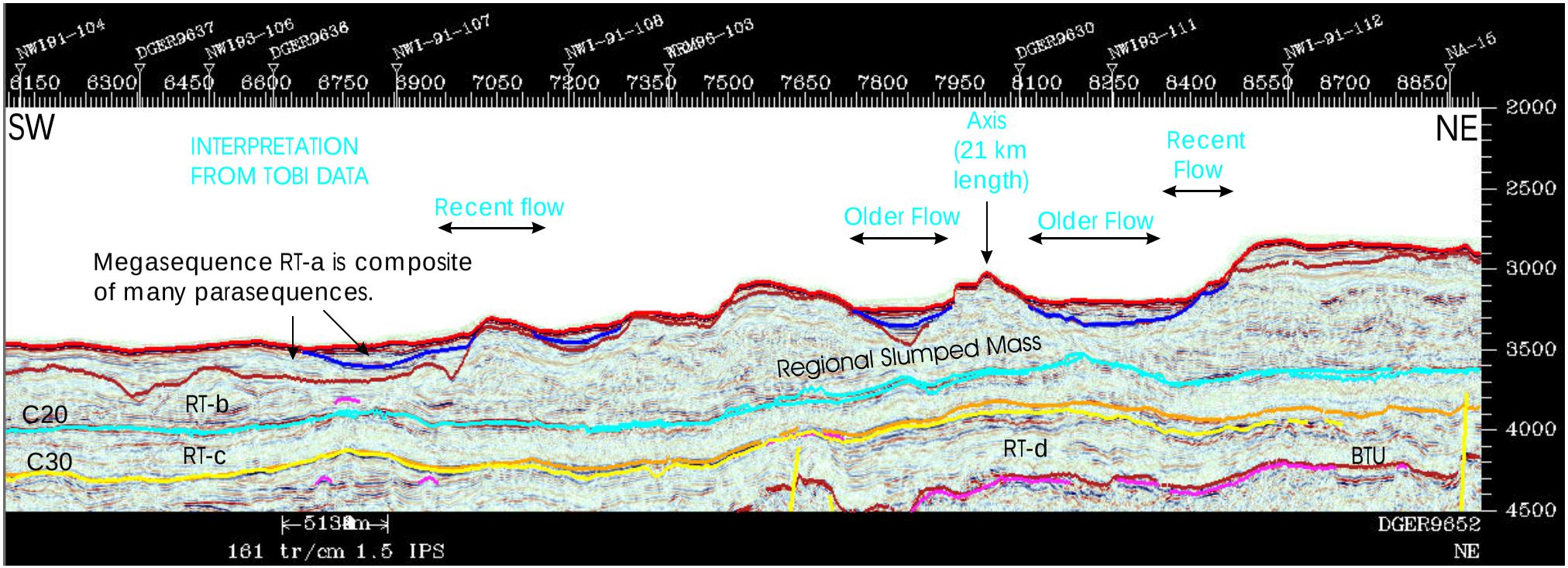
Data Example 34

Profiles through middle (top) and upper slope canyons illustrating infilled nature of the canyon systems upslope. Canyon profiles are 7.5 km apart.



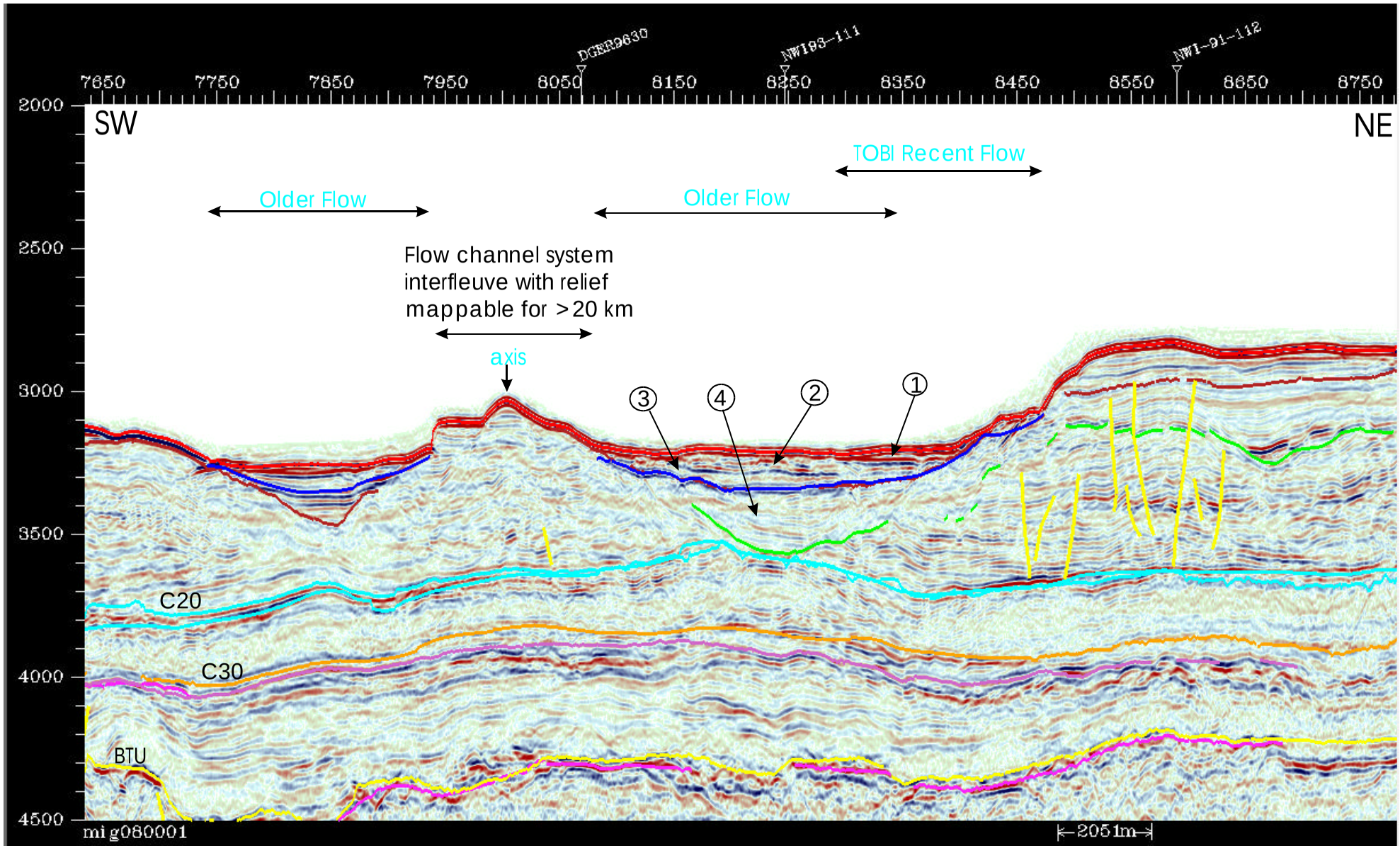
Data Example 35

Illustrating the similarities but also the differences and pitfalls in interpretation and mapping of morphological features using just TOBI alone. Major features tie with seismic evidence in the north but become progressively blurred further south where the 'Recent Flow' appears coincident with an older, protruding slump mass as per the highlighted axis that is mappable over more than 20 km. See also Figure 10 for detailed example of differences in stratigraphic interpretation. Careful detailed integration of the seismic-sonar database is a fundamental recommendation of this report.



Data Example 36

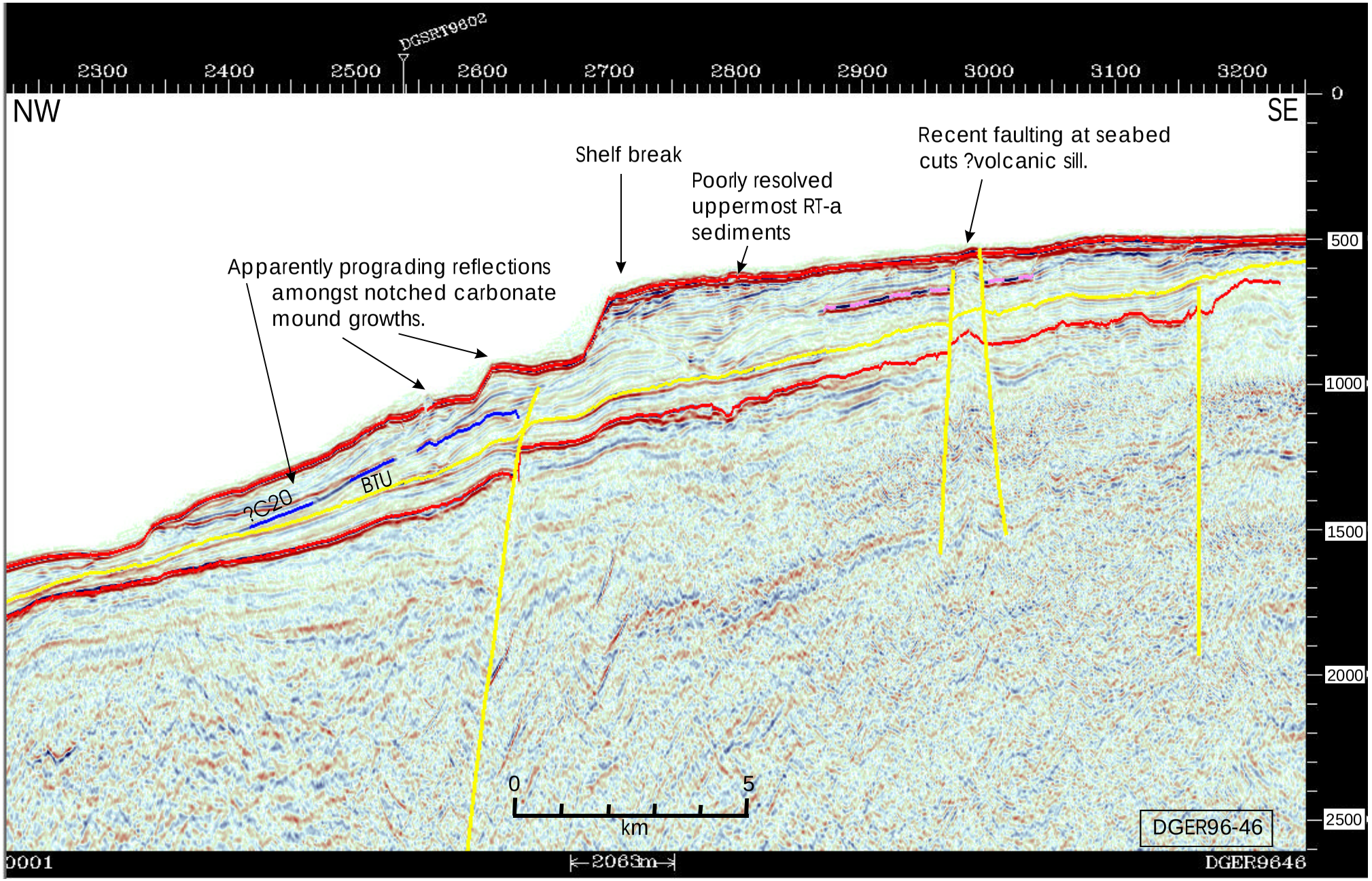
Good correlation of TOBI interpretation and mapping with that from the widely spaced commercial 2D seismic database. Downslope, distal positions of the (here) RT-a aged slope canyon system are clearly imaged with evidence of three or four phases of cut and fill by mass debris flow processes.



Data

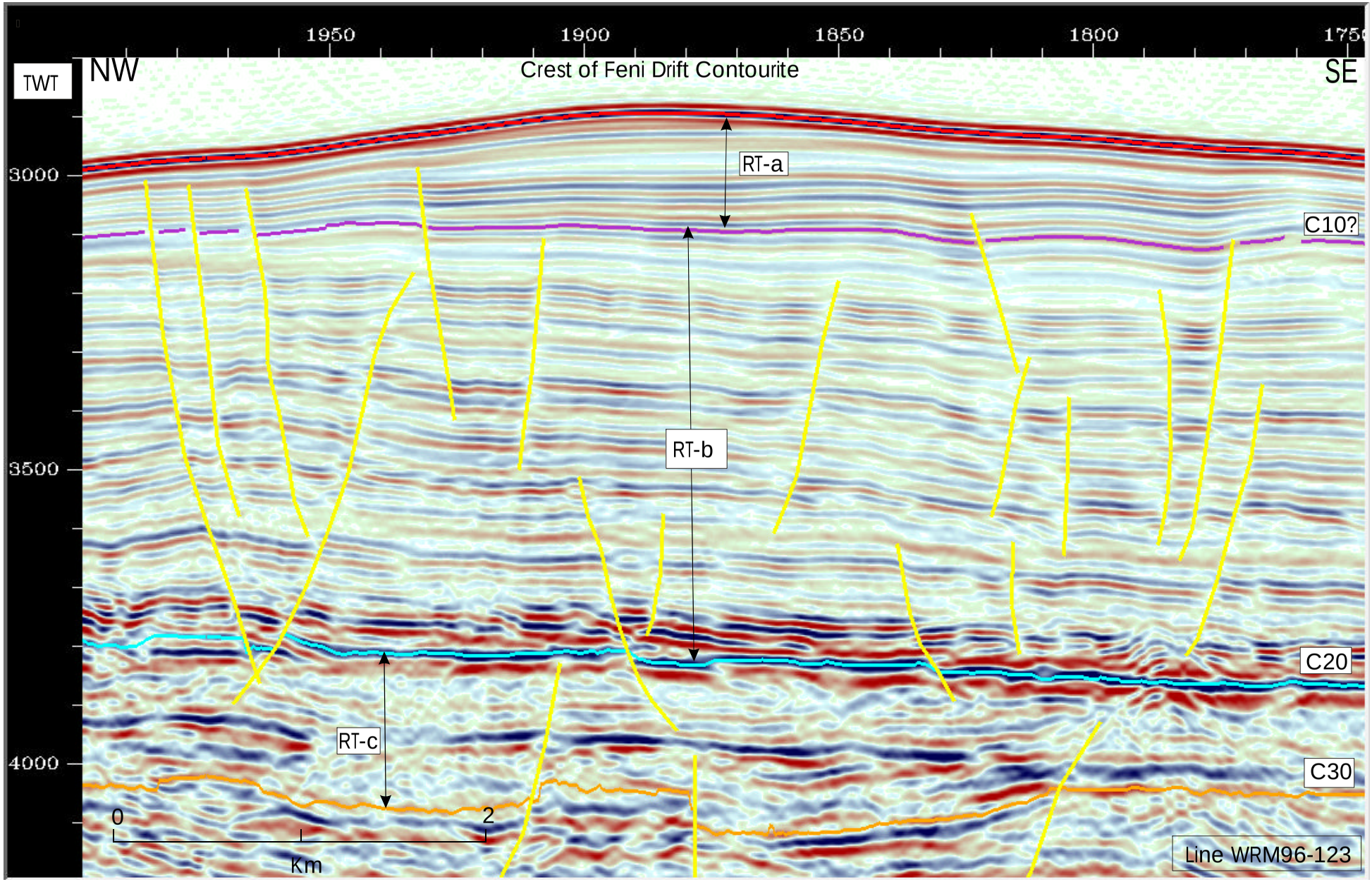
Example 37

Relationship of progradational shelf sediments and carbonate mound environment with faulting on upper slope.



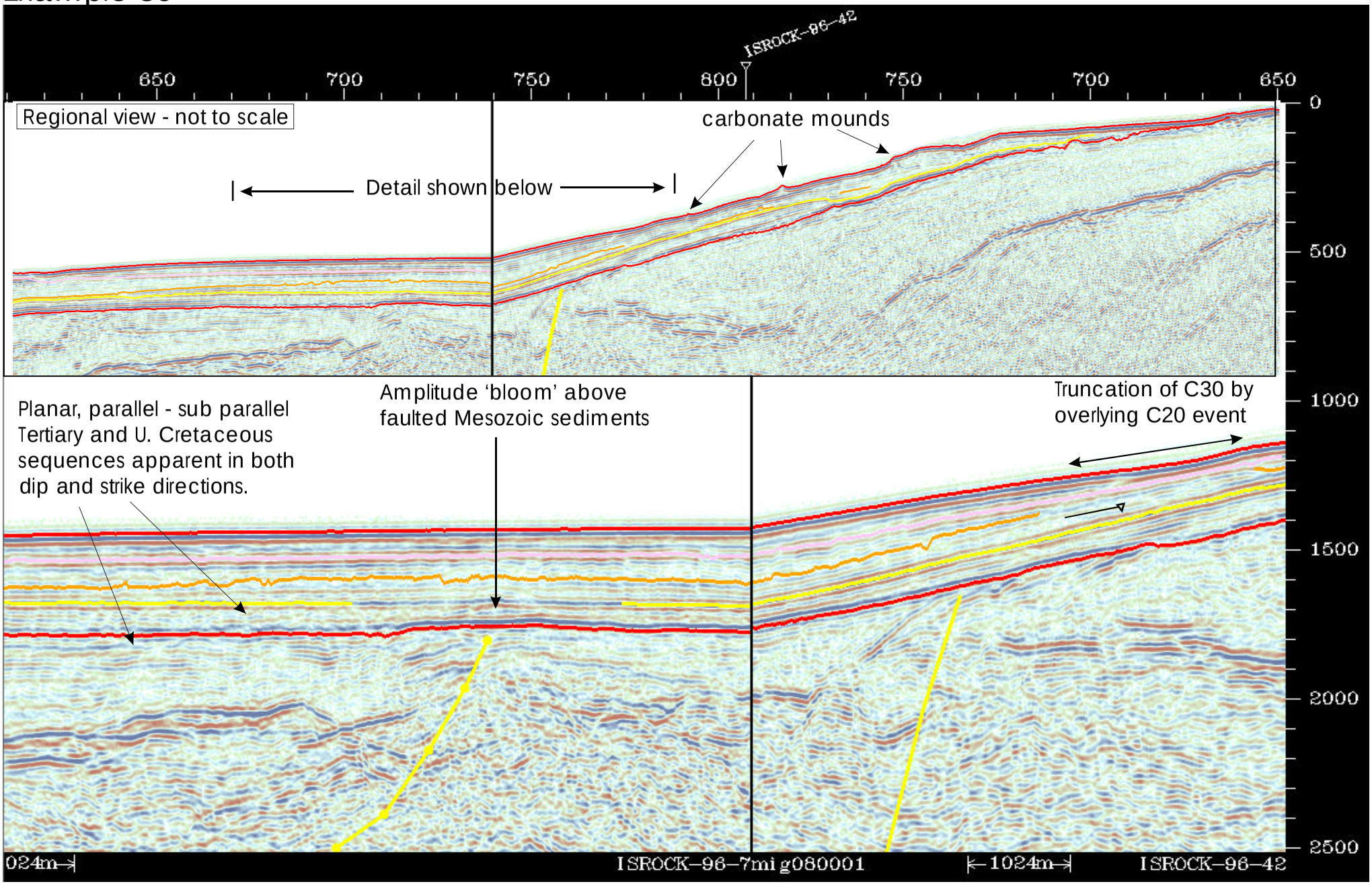
Data Example 38

Showing deformation within megasequences RT-a to -c and relationships to contourite depositional systems. Fault geometry is typically polygonal in map view and is related to active expulsion of pore fluids from sediment dewatering and other migrating phenomena.



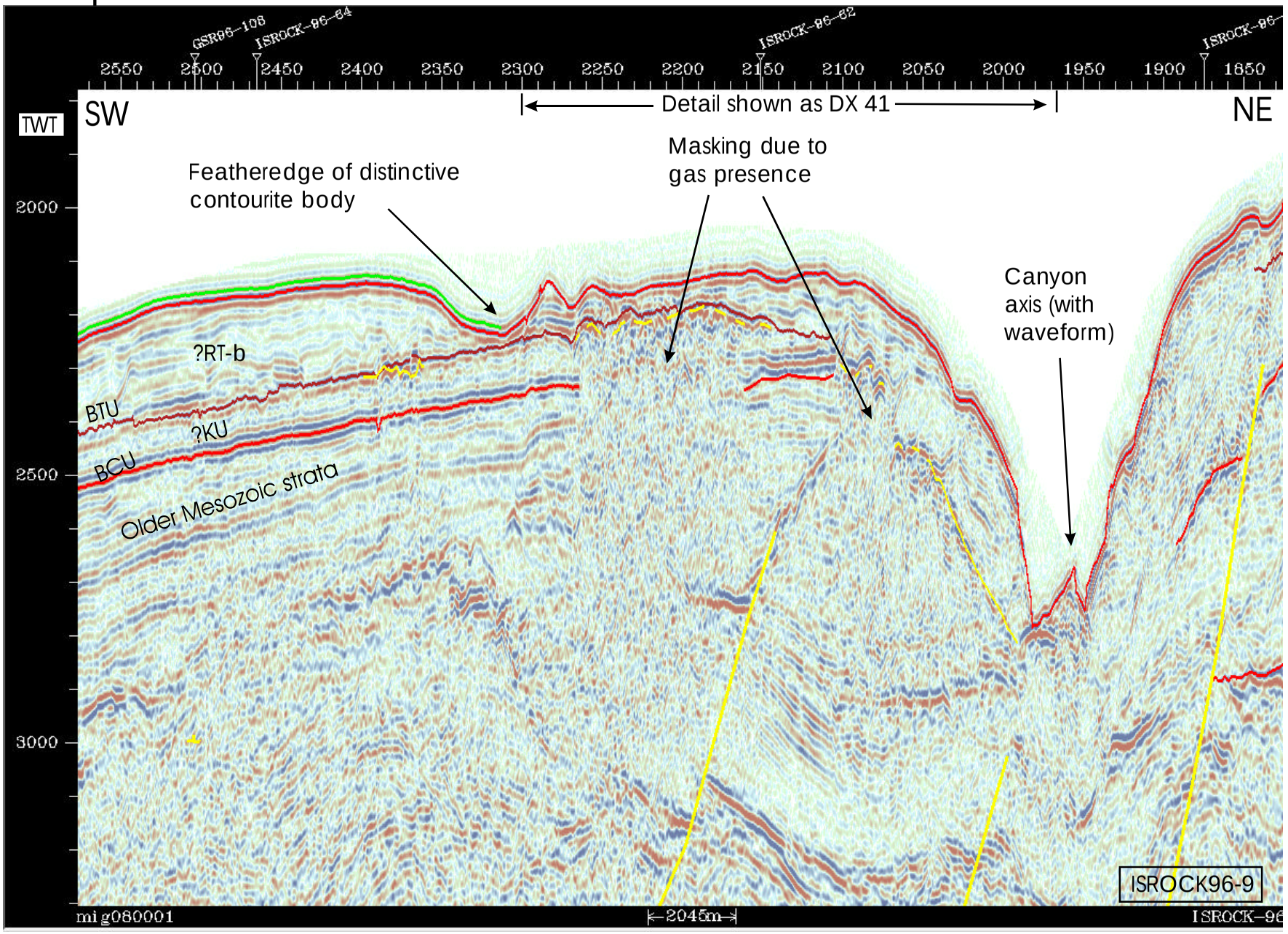
Data Example 39

Probable gas at Base Tertiary Unconformity surface (BTU) identified by subtle amplitude bloom above faulted older Mesozoic sequences in mid - upper slope environment.



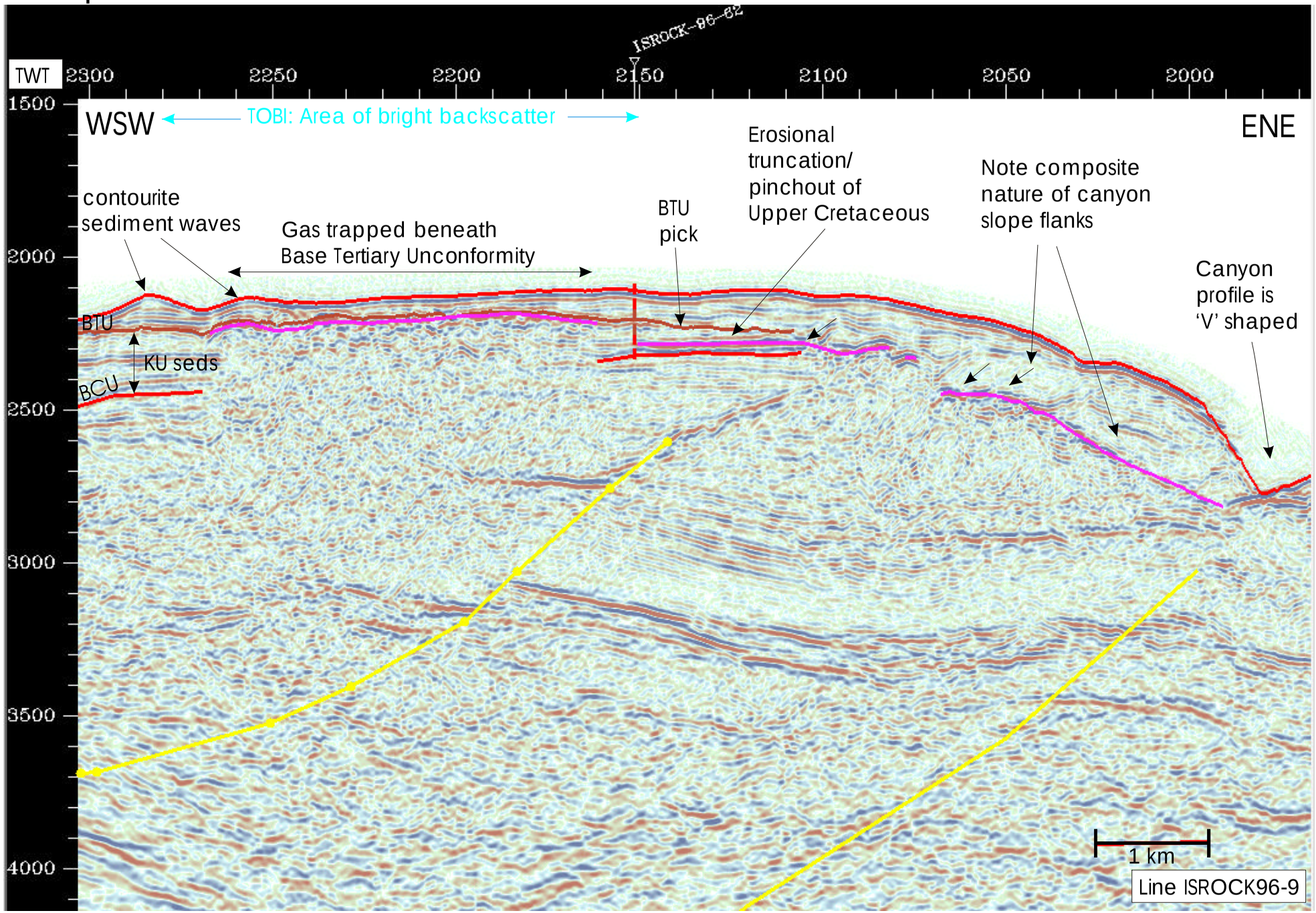
Data Example 40

Probable shallow gas (marked areas) leaking up flanks of slope canyon and from eroded high cut into tilted Cretaceous sandstones. TOBI pinger data also shows linked diffractions in the subsurface.



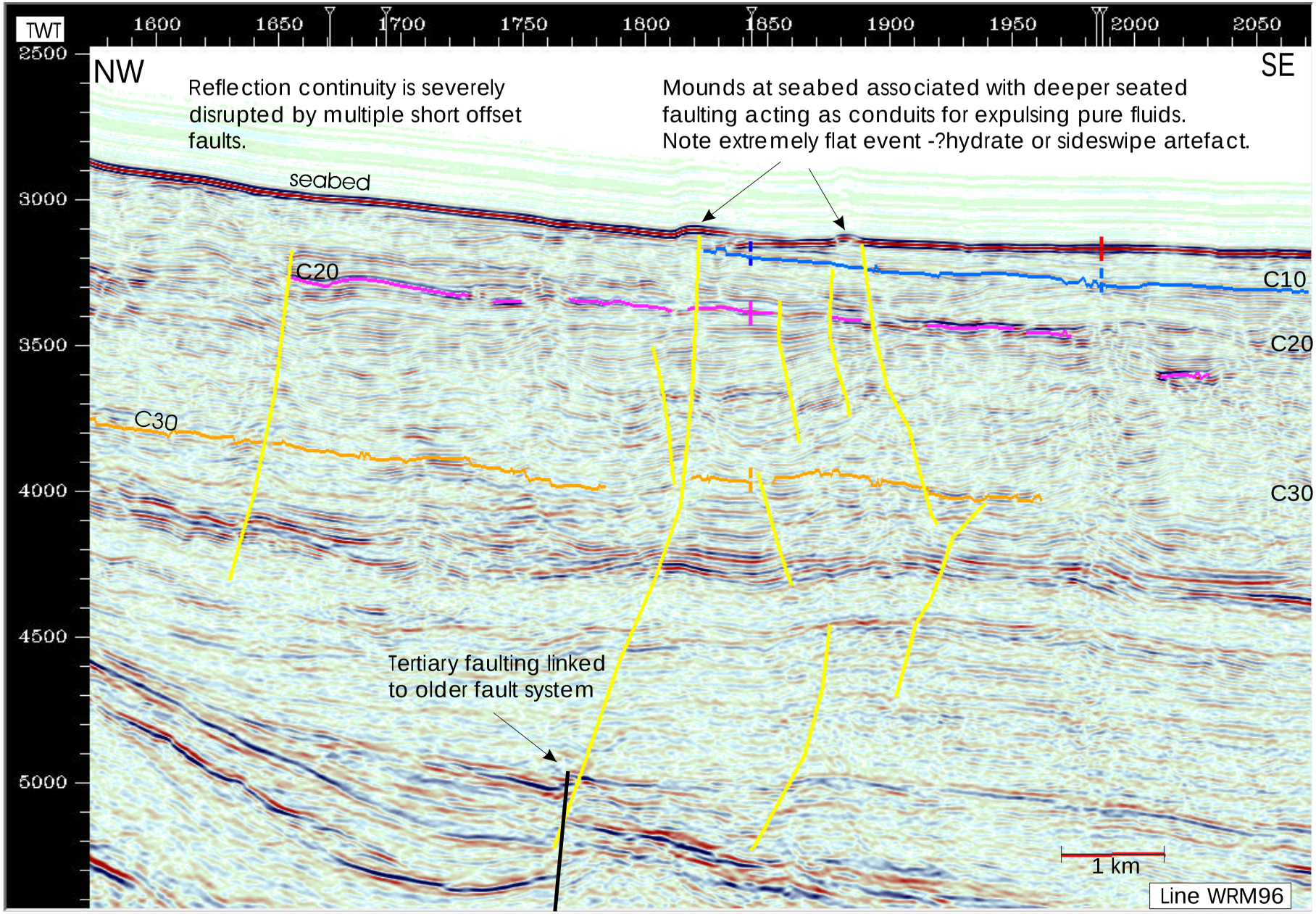
Data
Example 41

Presumed shallow gas hazard possibly linked to deeper seated faulting.



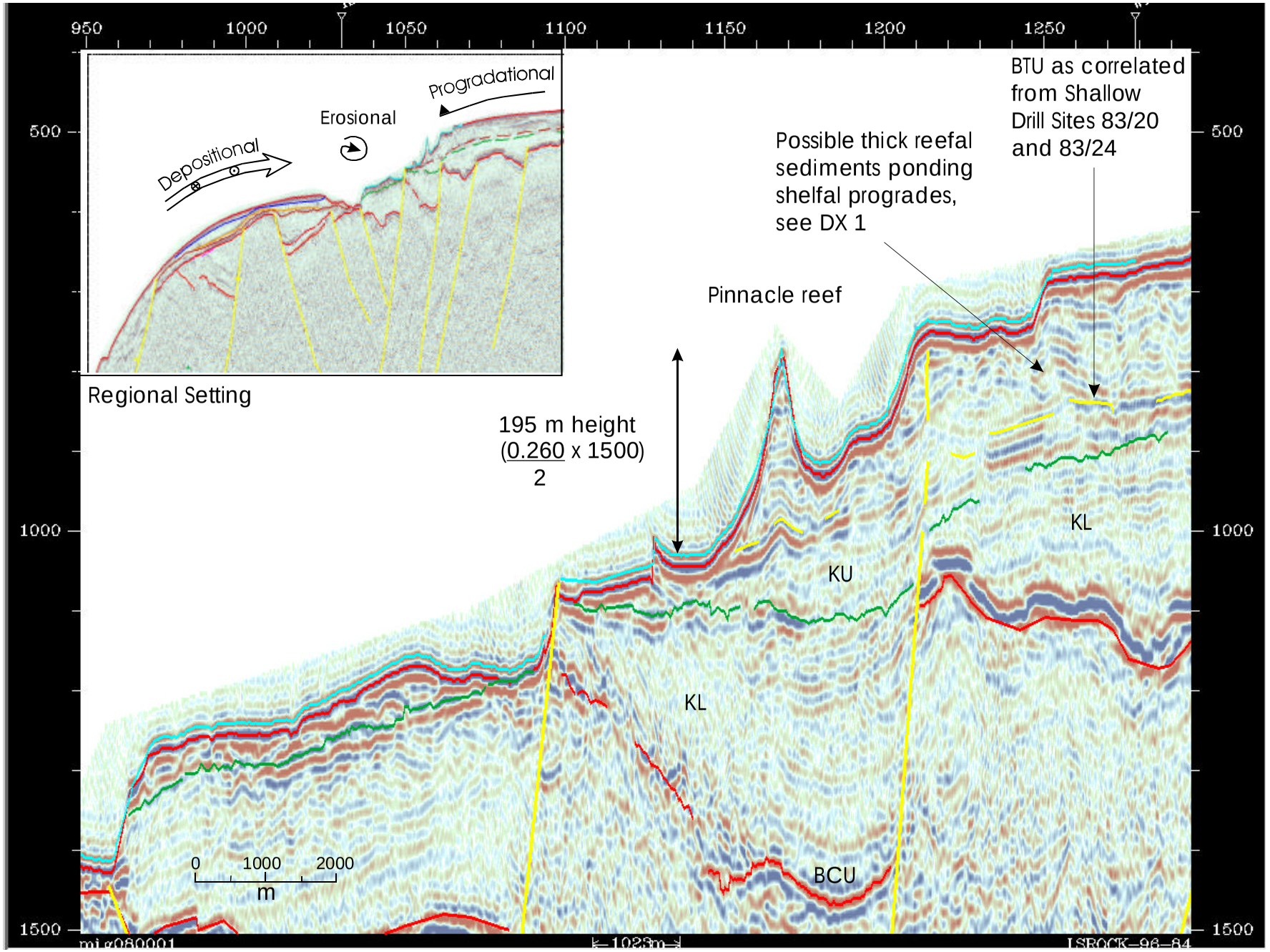
Data Example 42

Example of linked fault pattern cutting megasequences RT-a to -d and older showing effect on seismic reflection continuity and imaging. Pore fluids and probably gas in solution migrate or are dynamically expulsed through the dynamic system. Only a few of the many faults are interpreted here. Elsewhere it is known that structures of this kind often exhibit strikingly polygonal elements in map view.



Data Example 43

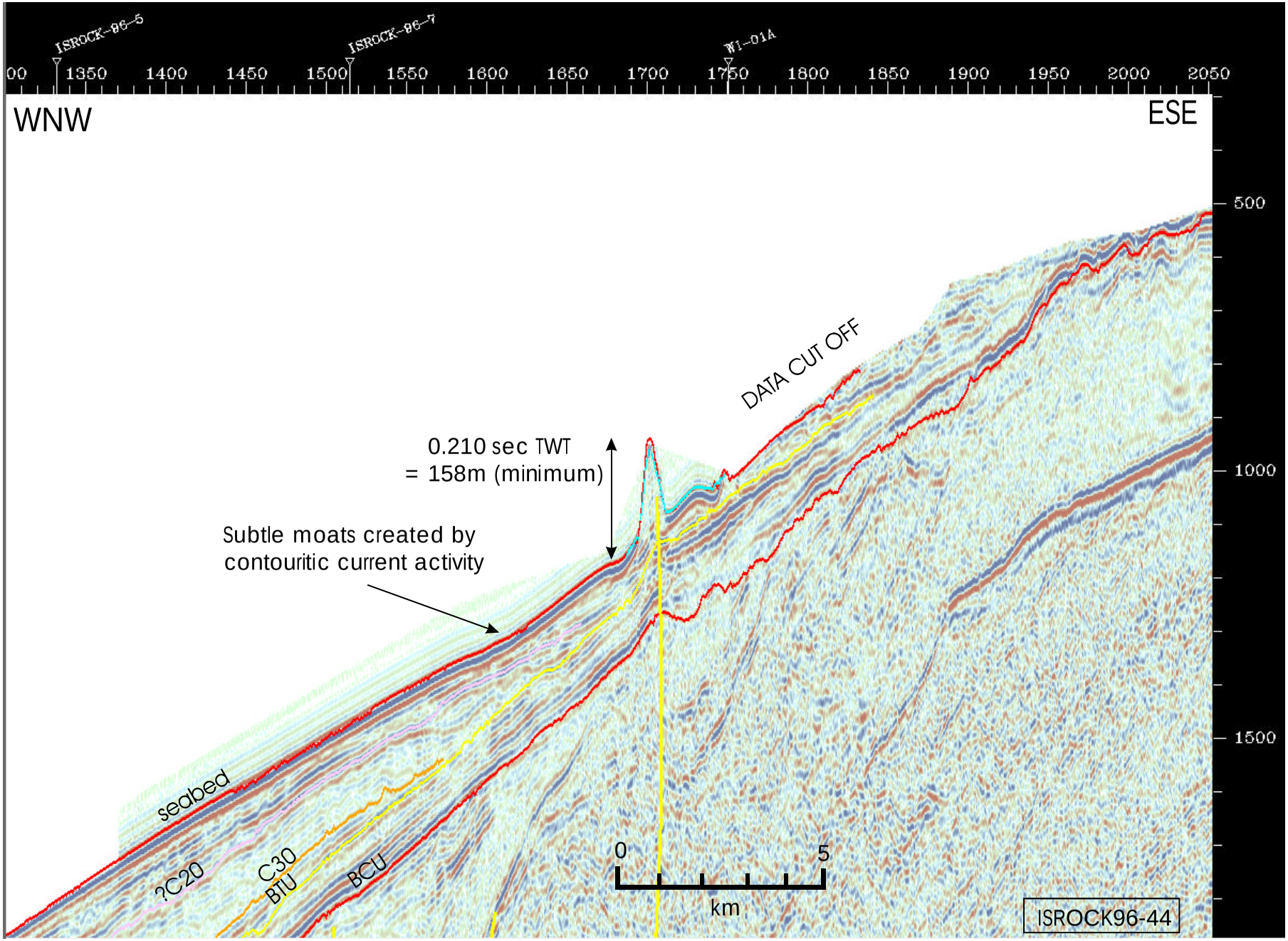
Detail of structural influences to carbonate reef and pinnacle reef development.



fault_pin_reef

Data Example 44

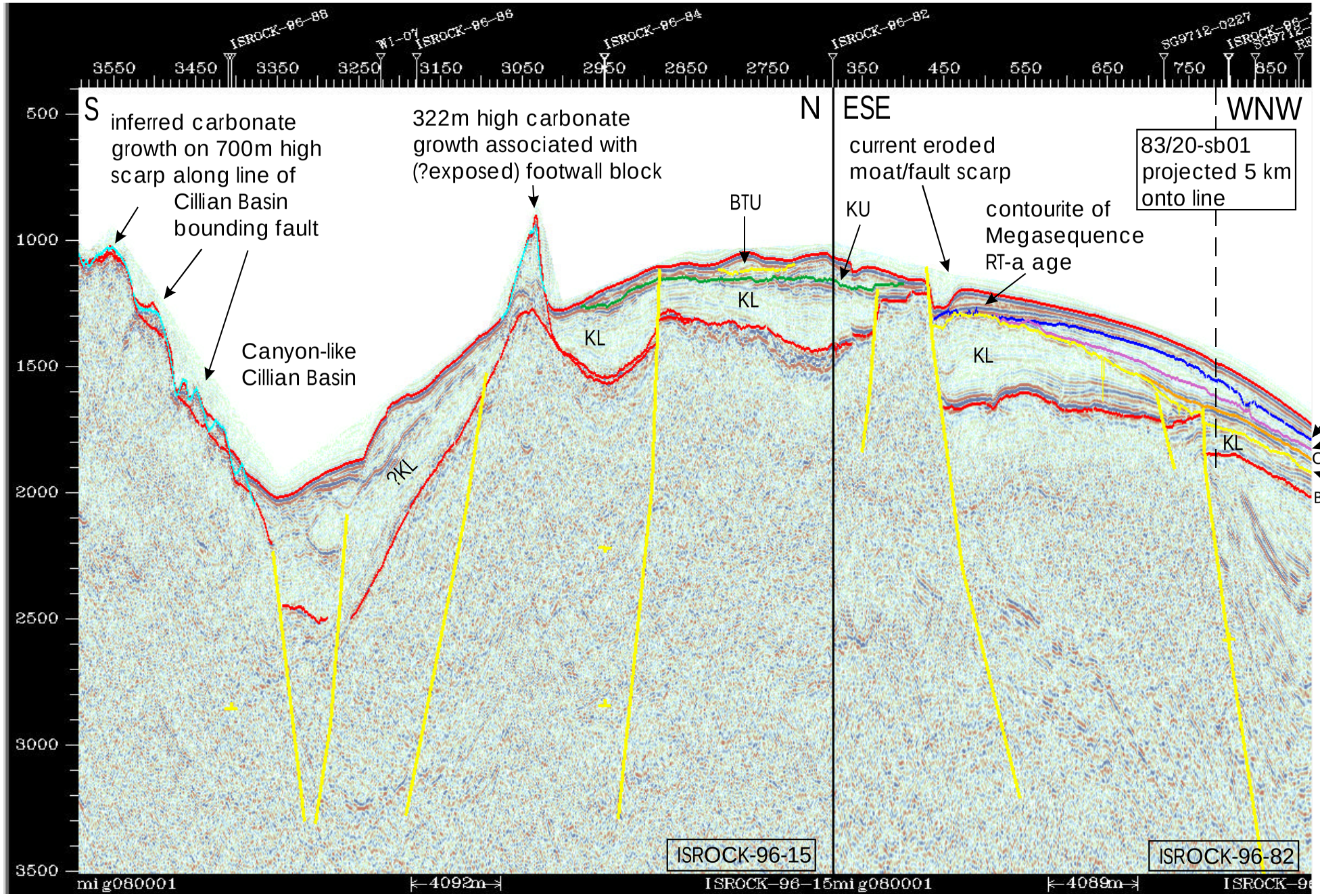
Detail of solitary pinnacle reef associated with recent faulting amongst far smaller carbonate growths.
NB Strong vertical exaggeration.



Data

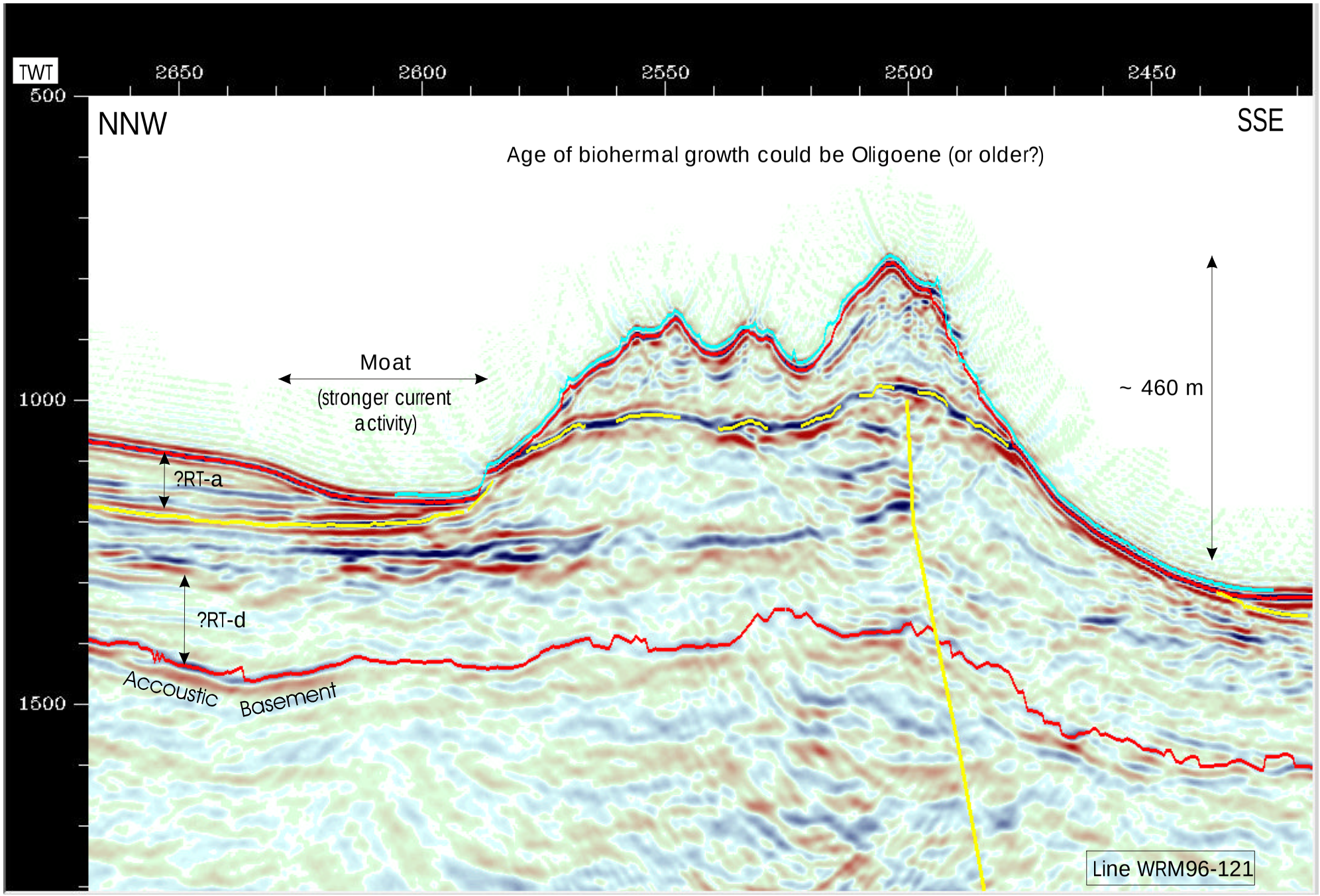
Example 45

Correlation of Upper Cretaceous (KU) 'Greenstones' and Lower Cretaceous (KL) 'Brownstones from 83/20-sb01 location.

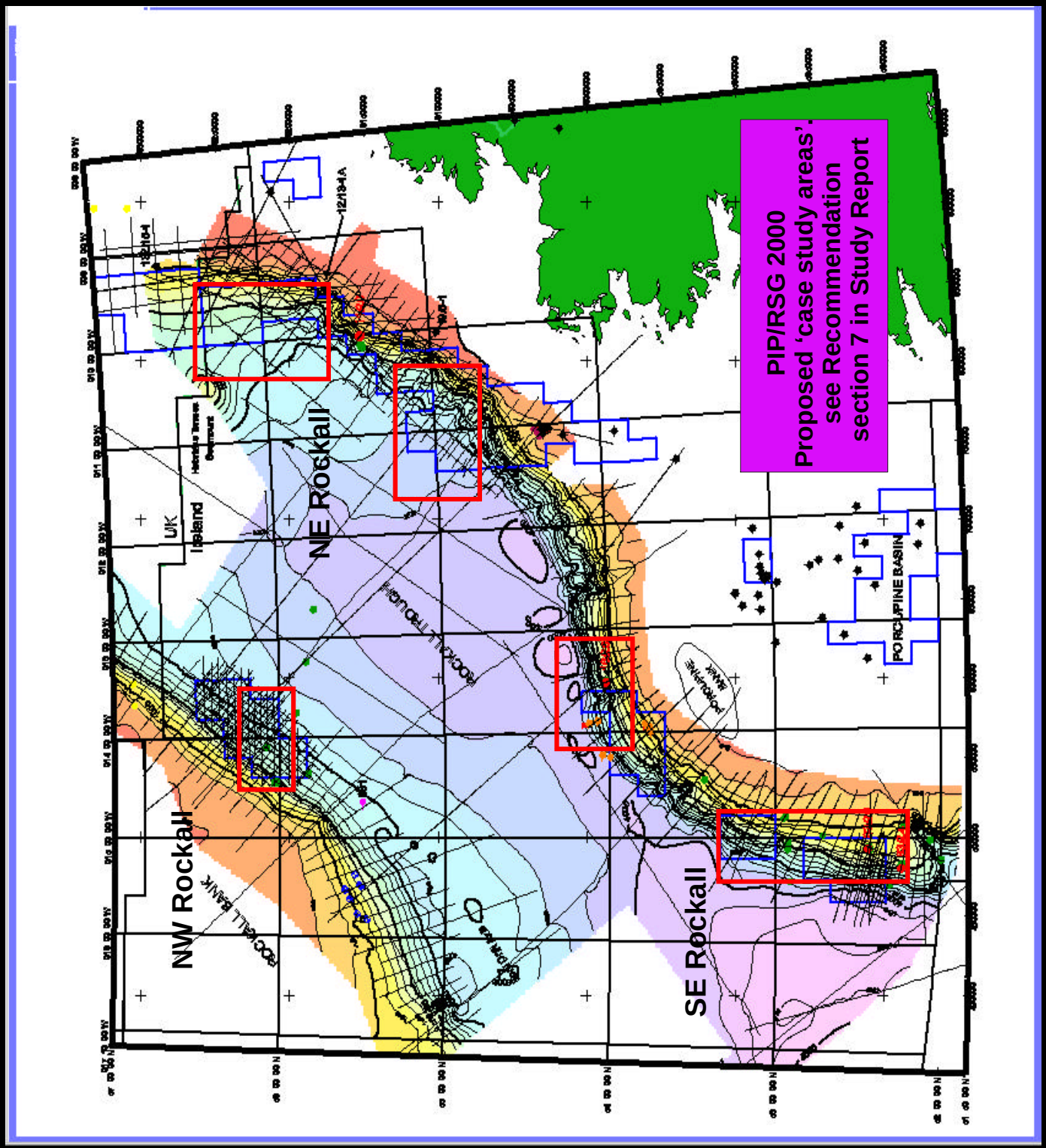


Data Example 46

Classic example of a biohermal/coral mound specifically located along a minor fault zone near the SE Rockall Bank Shelf break. At least two stages of growth are apparent as is current erosion around the flanks of the growth.

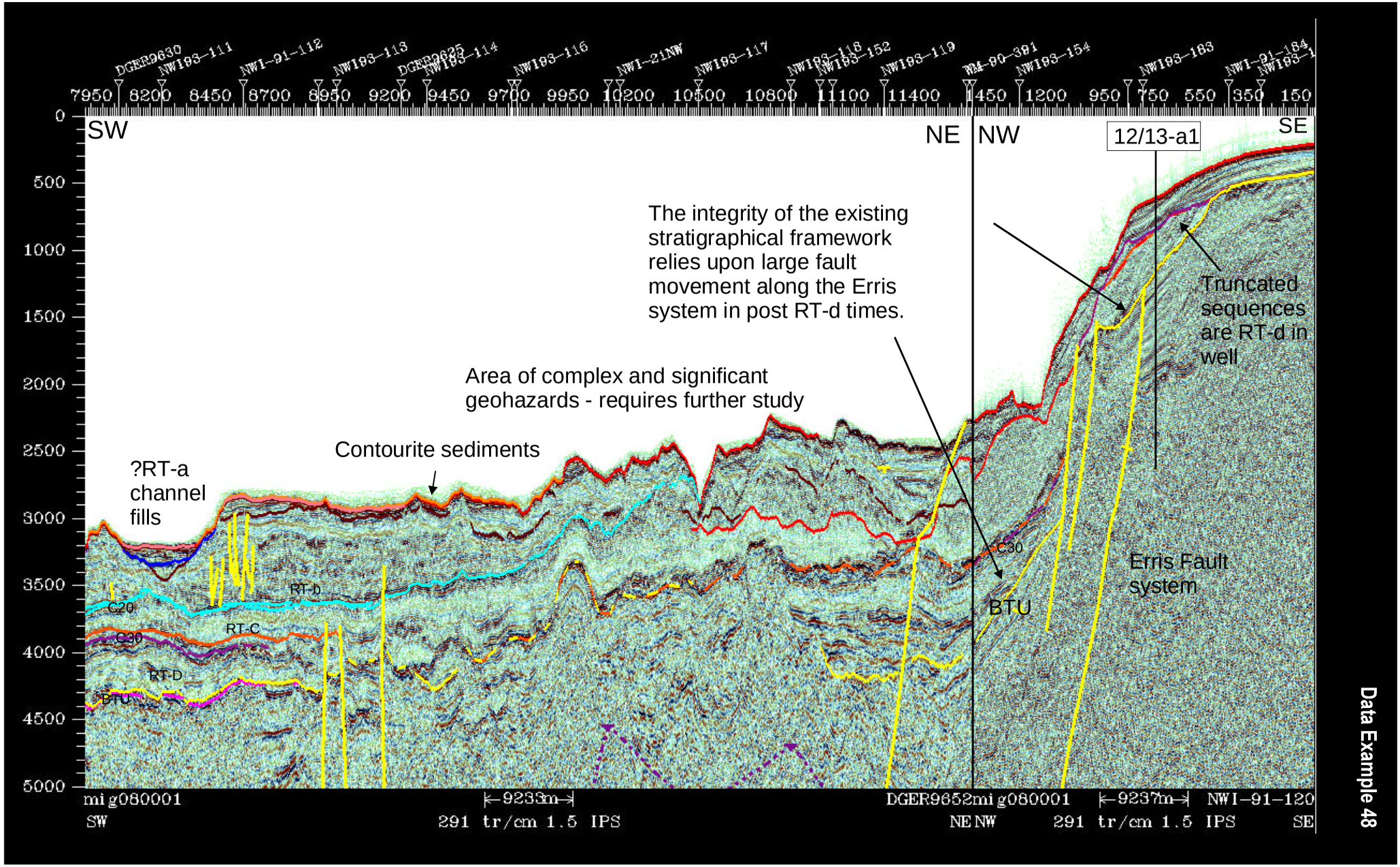


Data Example 47



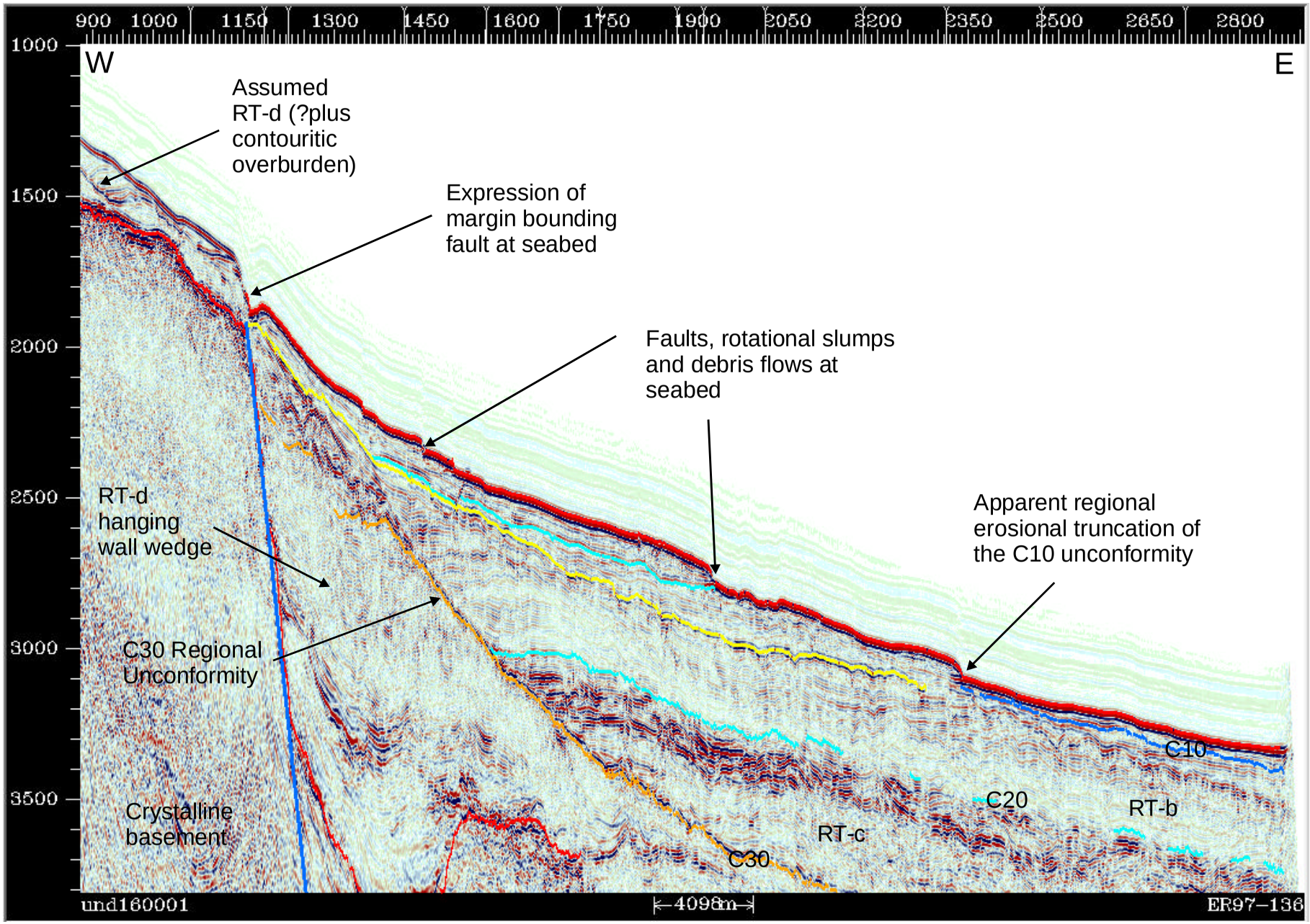
Data

Example 48 Major faulting in NE Rockall.



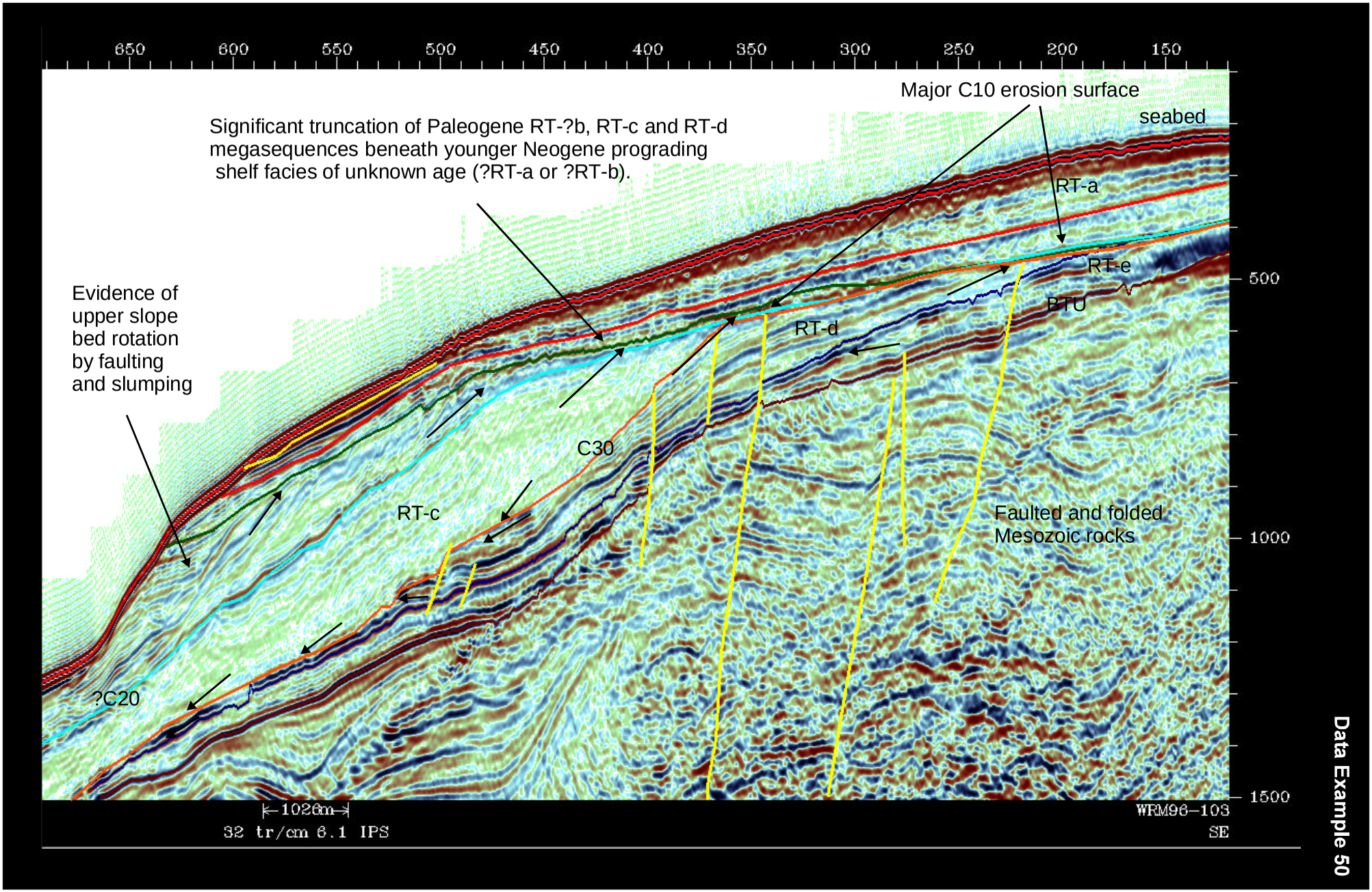
Data
Example 49

SW Rockall seismic stratigraphy



Data
Example 50

Prograding shelfal megasequences truncating older RT-c and RT-d.



Data
Example 51

Unclear interface at distal portion of Gullwing/Erris base-of-slope wedge.