

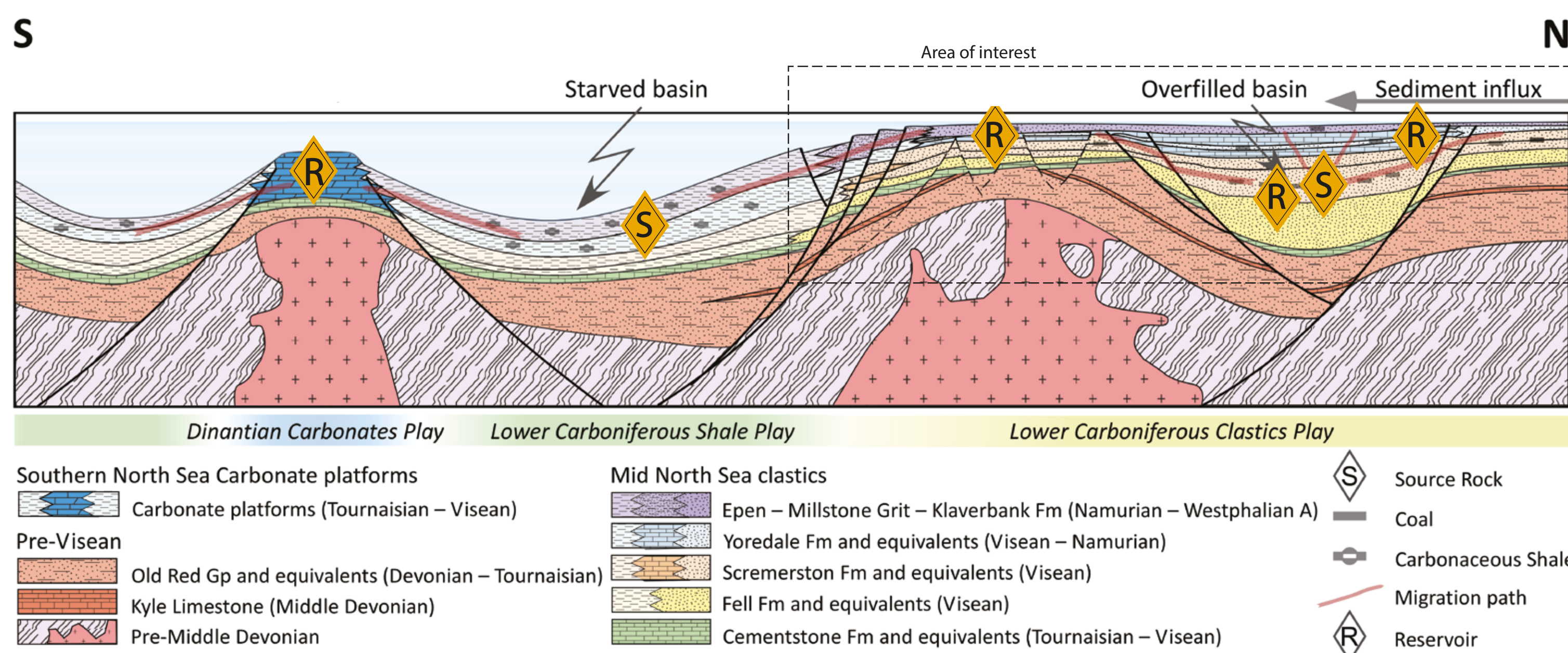
Lower Carboniferous

A virtually untested play

The Visean and Namurian deposits in the northern Dutch offshore have significant hydrocarbon potential:

- EBN's analysis indicates the presence of traps, source and reservoir rocks in the study area.
- 20 structures have been identified on the Base Permian Unconformity (BPU) depth map, all 4-way or fault dip closures. Provisional P50 GIIP's add up to ~75 BCM (unrisked).
- The Lower Carboniferous clastics play is established in the UK part of the southern North Sea, with fields producing from Namurian and Visean reservoirs (e.g. Breagh field development).
- From well reviews it is concluded that the play is virtually untested in the Dutch northern offshore.

Play elements of the Lower Carboniferous plays



Reservoir

- Visean and Namurian reservoir rocks are present throughout the study area (fig. 3 & 4).
- Abundance and thickness of reservoir-quality sands increase from Breagh (well 42/13-2) towards the northeast (fig. 3).

Source and charge

- Lower Carboniferous Scremerston coals are the most promising source rocks in the northern part of the study area (fig. 5 & 6).
- In the southern part charge may occur from Lower Carboniferous basinal shales and laterally from Upper Carboniferous Westphalian coals.

Seal and trap

- Numerous fault and dip closures at BPU level, below Silverpit shales and Zechstein salt, which are proven regional seals (fig. 7).
- Fault dip closures are dependent on juxtaposition sealing across faults (fig. 8).
- Presence of intra Lower Carboniferous seal(s) would provide large upside.

Visean and Namurian well results in the study area

Well	Trap	Reservoir	Seal	Charge	Conclusion
Namurian Well results					
A11-01	Absent (3D)	Present	Present	Weak gas shows	Invalid test
A15-01	Absent (2D)	Inconclusive	Lower Rotliegend volc.	Gas in Zechstein (16% N ₂)	Invalid test
B17-04	Absent (2D)	Tight (high depth: 4600 m)	Present	Mature source rock in well	Invalid test
E06-01	Doubtful (3D)	Only 17 m, possibly part of Yoredale	Present	No shows	Invalid test?
E09-01	Inconclusive	Inconclusive	Present	Present, 85% N ₂	Invalid test
E12-02	Absent (3D)	Probable	Present	Gas shows	Invalid test
E12-03	Present	Present	Present	Present, 33% N ₂	Positive
E12-04	Present	Present	Present	Present, 65% N ₂	Positive
Visean well results					
A14-01	Absent (2D)	Present	Doubtful (thin intra-formation shale)	Gas shows	Invalid test
A16-01	Probable (2D)	Present	Present, thin	No shows	Negative/ invalid
B10-01	Absent (2D)	Present	Present	No shows	Invalid test
E02-01	Absent (3D)	Present	Doubtful (Chalk)	Doubtful shows	Invalid test
E02-02	Absent (3D)	Present	Present, thin	No shows	Invalid test
E06-01	Doubtful (3D)	Present	Present	No shows	Invalid test

Figure 1. Well results for the Visean and the Namurian.

Figure 2. Diagram illustrating the structural geology and play elements of the Visean and Namurian in the Mid North Sea area. The Elbow Spit Platform is an example of a high (C), while the North Elbow Low is an example of an overfilled basin (D). South of the study area carbonate platforms are present on intra-basinal highs such as the Groningen High (A) (Kombrink et al. 2010; Van Hulten 2012). In between the highs basins were present where subsidence exceeded sedimentation (B).

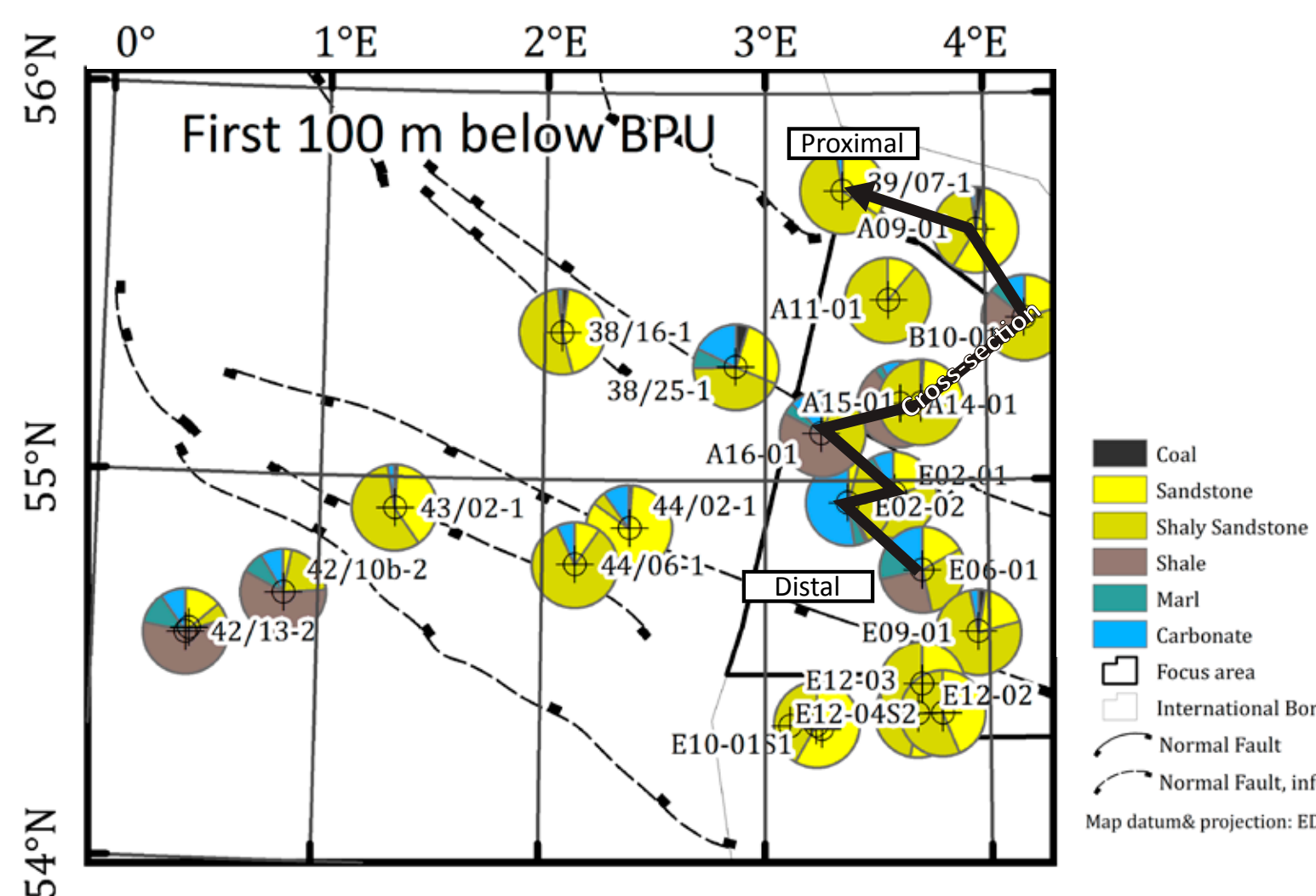


Figure 3. Lithological statistics of the first 100m below BPU. Chances of encountering sandstone in the Visean or Namurian directly below the BPU are good.

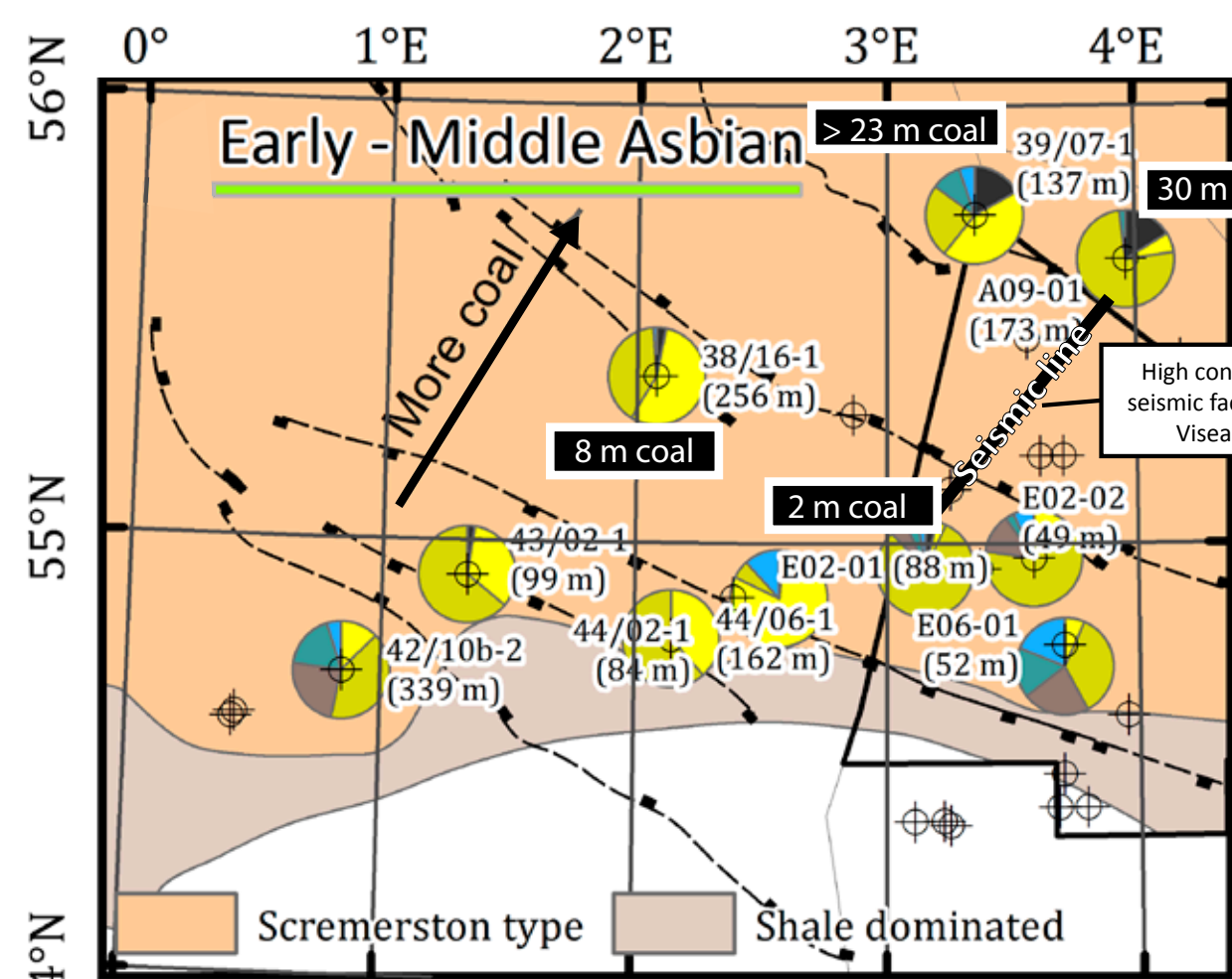


Figure 5. Palaeogeographic chart and lithological statistics for the Early-Middle Asbian. Coal content increases towards the North. UK palaeogeography after Kearsey et al. (2015, 2017), UK structures after Arsenikos et al. (2015). Legend in fig. 3.

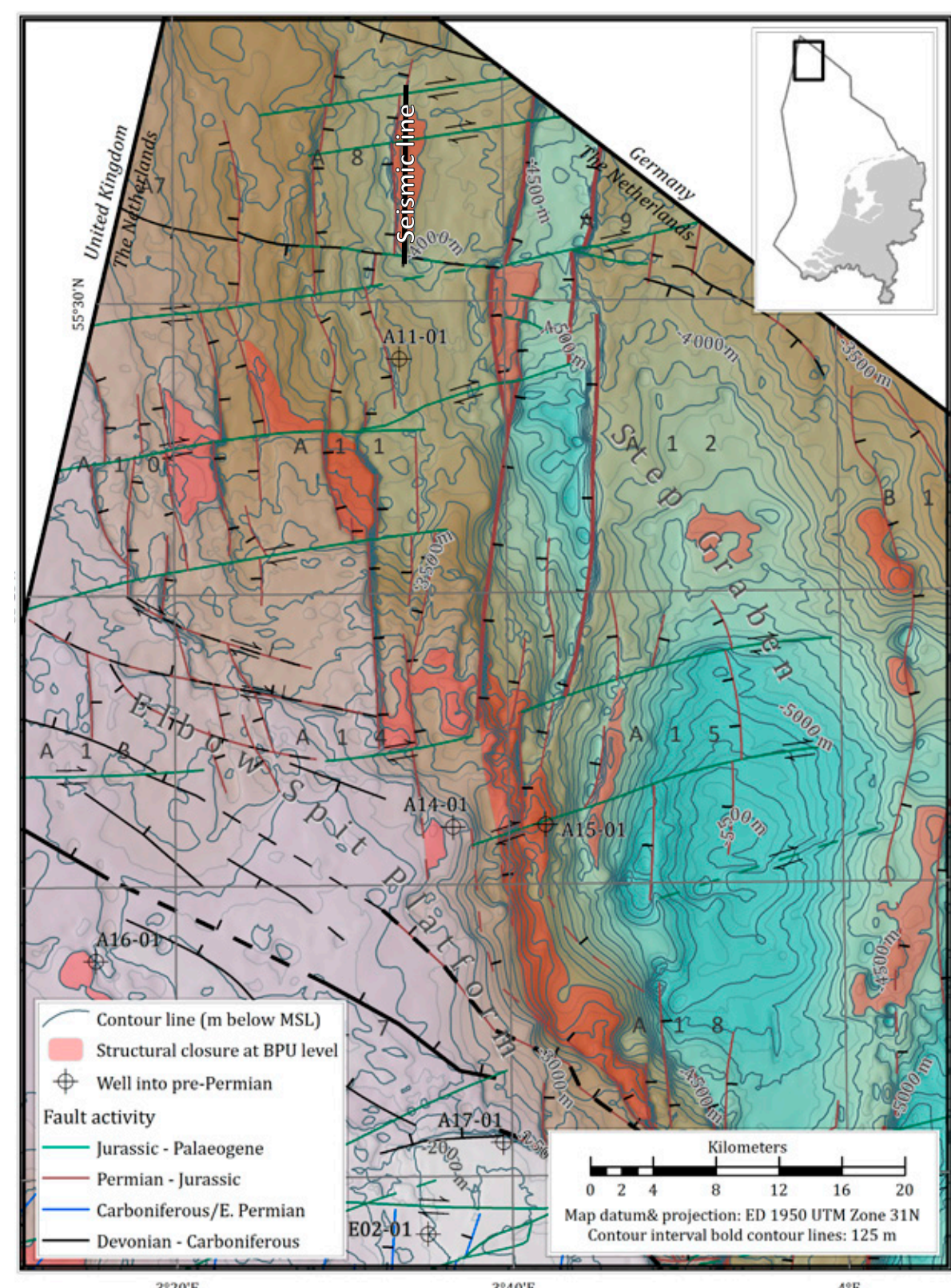


Figure 7. Structures at BPU level in the A quadrant, illustrating the types of structures that may form traps for hydrocarbons. The figure should not be regarded a detailed assessment of the prospectivity of the area.

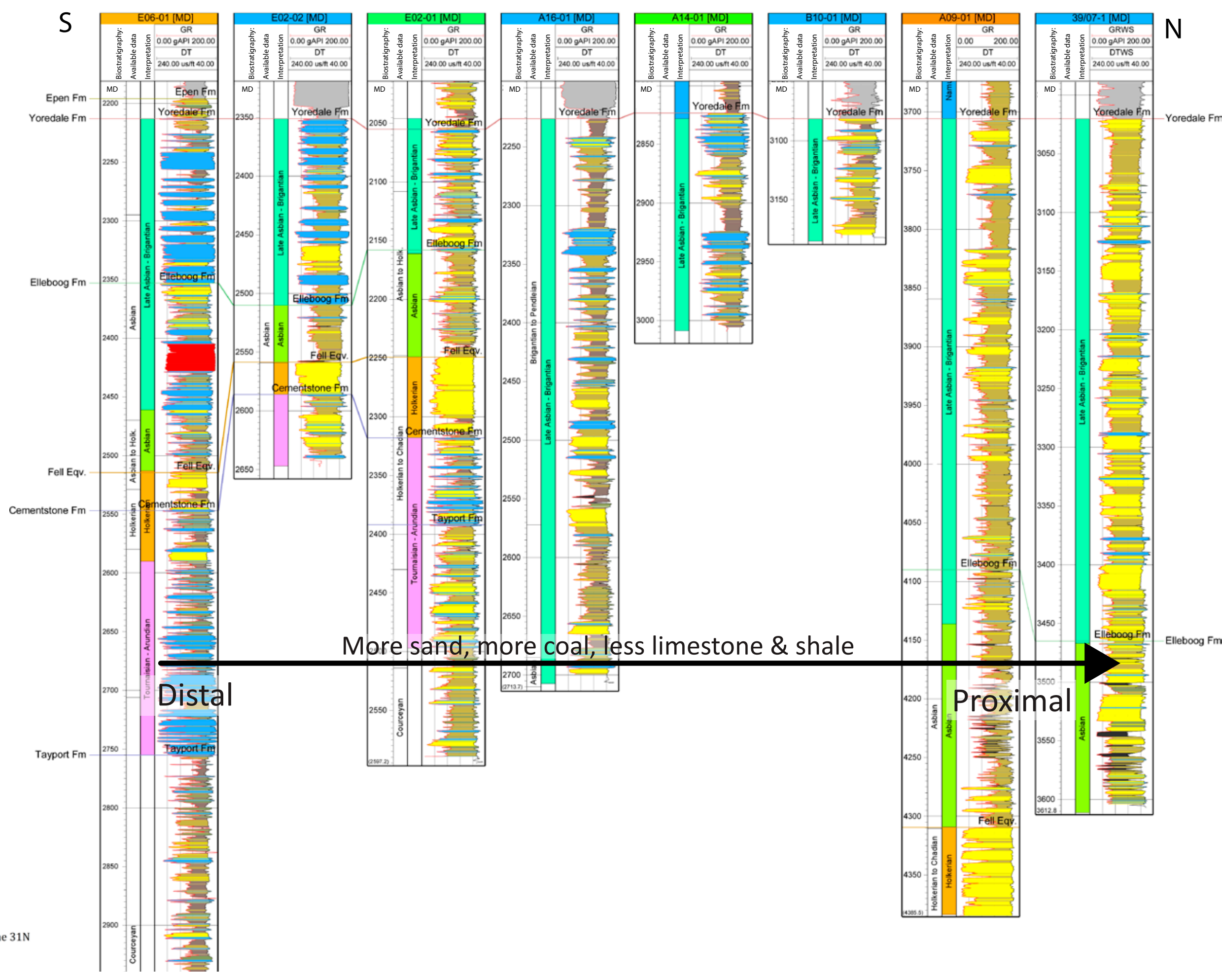


Figure 4. Well Correlation Panel, Visean, Dutch offshore illustrating the lithological trend. Location and legend in fig. 3.

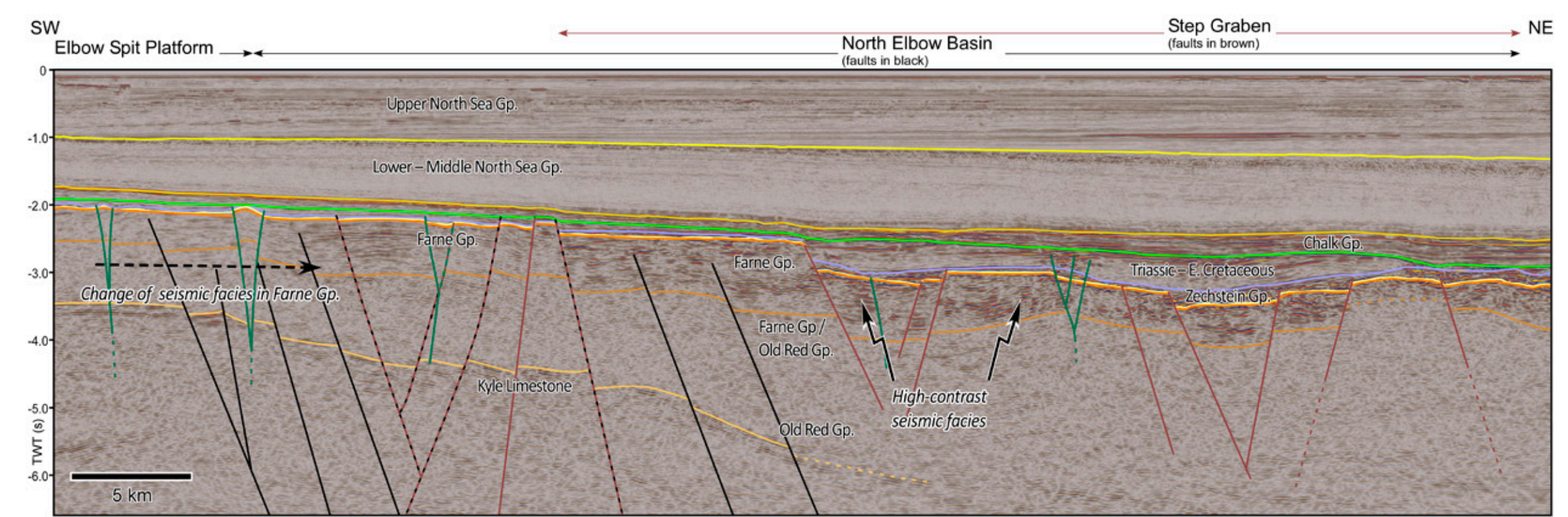


Figure 6. Seismic section across the North Elbow Basin. The Visean Elleboog Formation has a high contrast seismic facies that is likely caused by the presence of coals. Location in fig. 5. Public seismic line NSR32294.

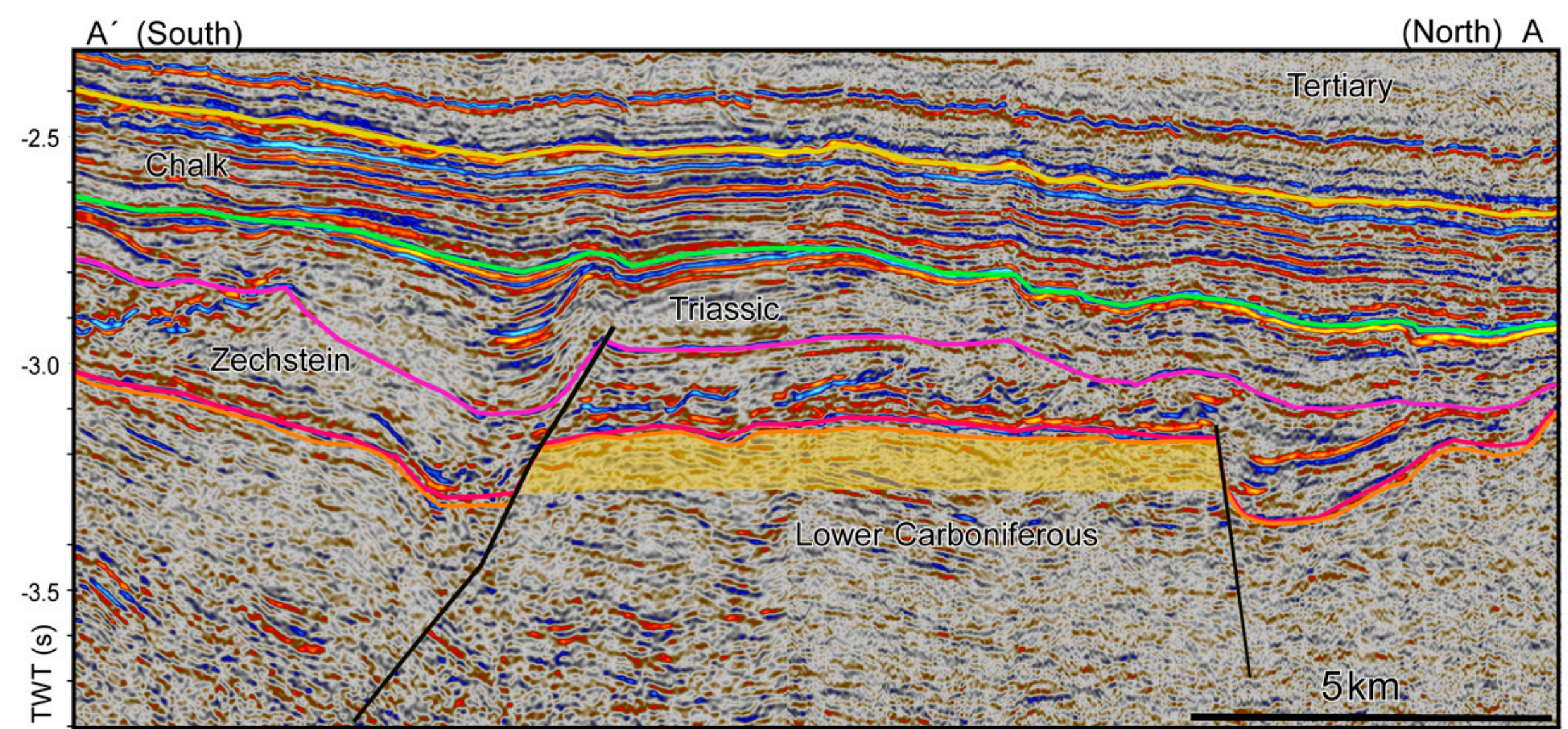


Figure 8. Example of a lead (A8-Kilimanjaro) at BPU level. Location in fig. 7.