

-**OGA Frontier exploration competition**

linked to future exploration licensing rounds in order to stimulate further offshore oil and gas exploration activity in the UKCS.

-Mid North Sea High and Rockall

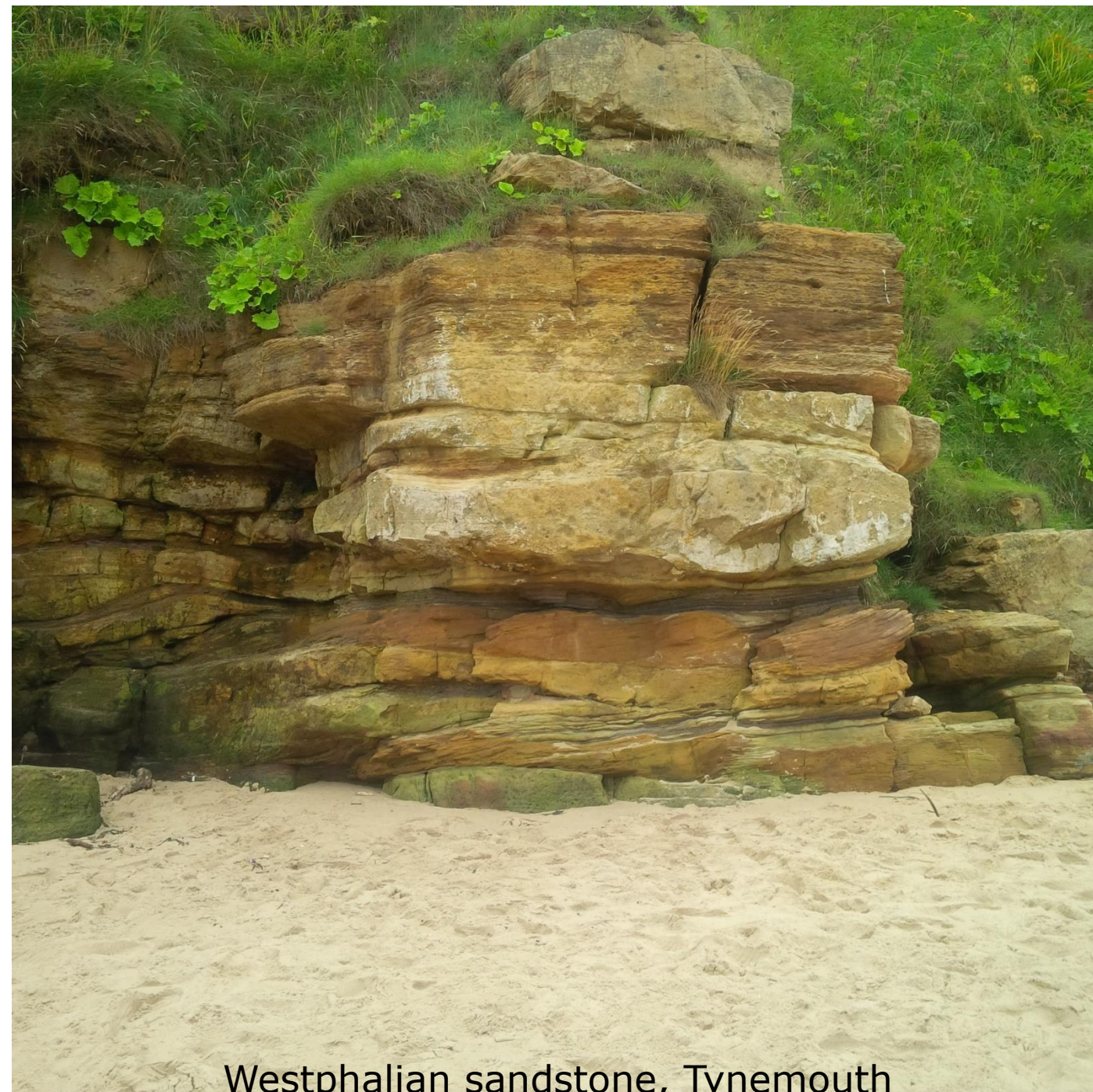
-**free data package** which was available for download

-**The competition was in two phases:**

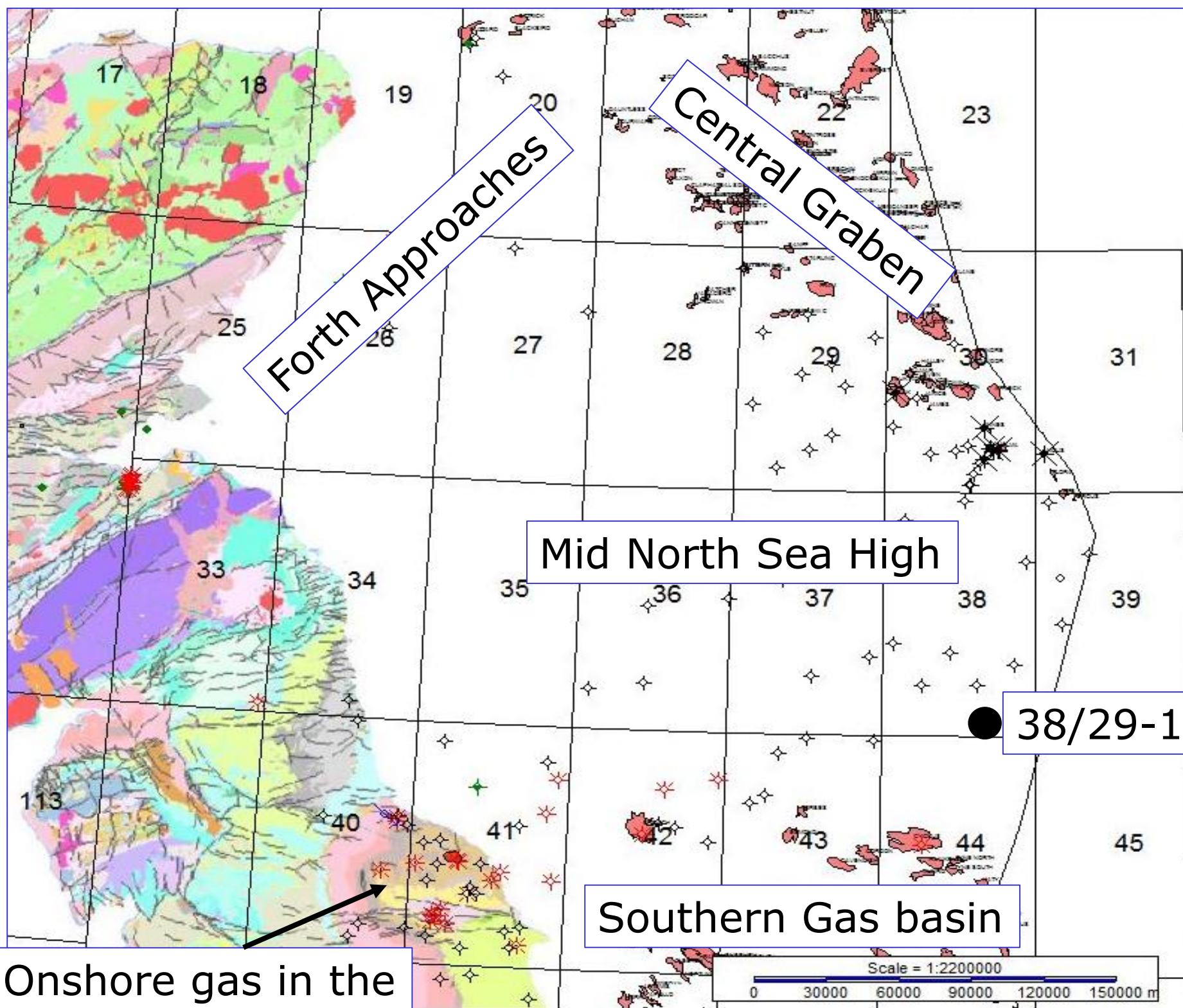
-A small number of applicants were awarded 'seed funding' to carry out initial analysis.

-The successful candidate from the first phase would then be awarded further funds to develop their work into a final product for use by the OGA.

GWL awarded funding for both phases for a study of the Mid North Sea High



Westphalian sandstone, Tynemouth



Vast area between the Central Graben and the Southern Gas Basin

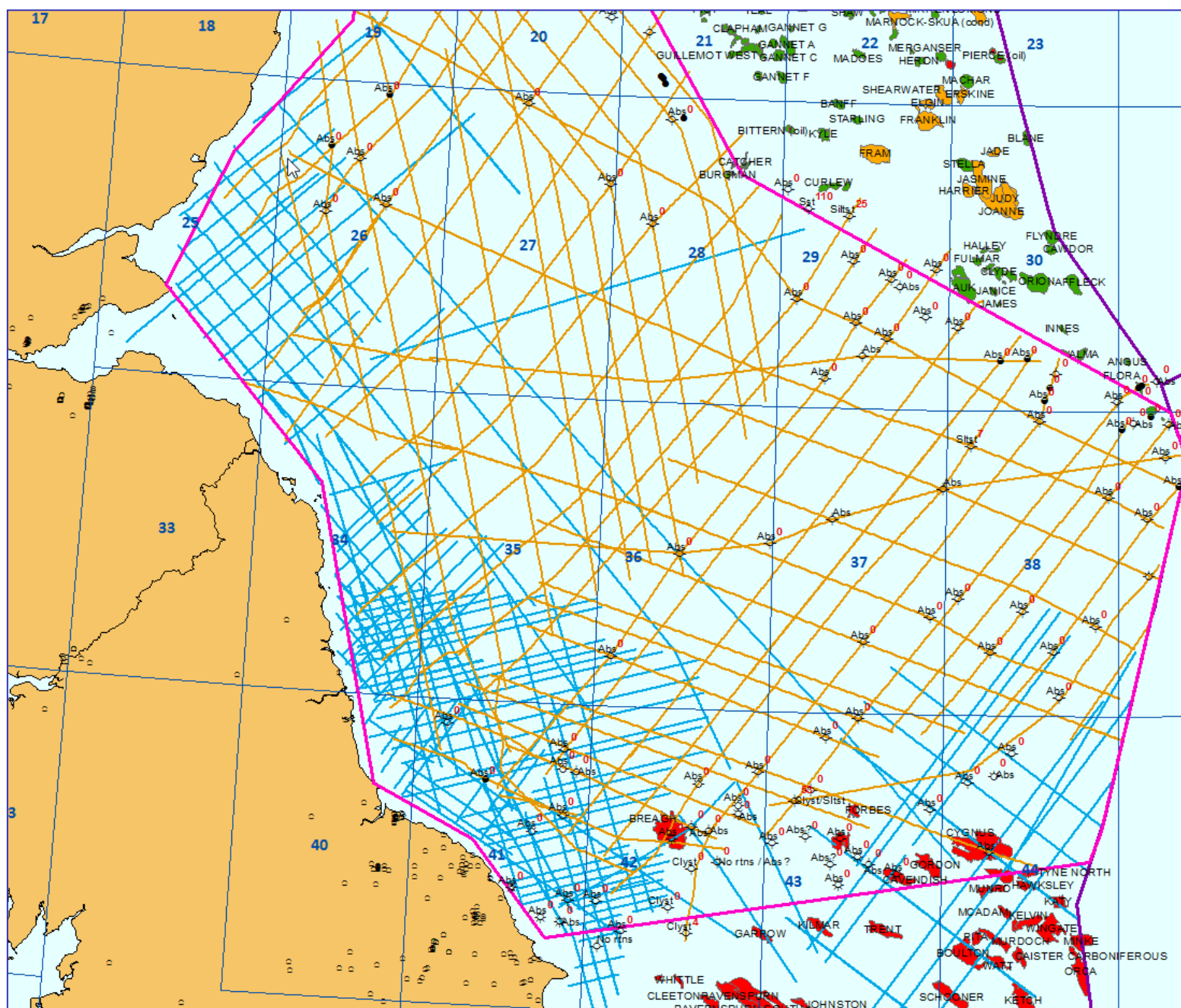
ca 80,000 km²

First well in the UK sector was drilled in Quad 38 in 1964-65

Written off because of the lack of mature source rocks-especially lack of Westphalian Coals

Onshore geology can be extrapolated offshore

Onshore gas in the Cleveland Basin



Seismic:

Orange: OGA seismic

Blue: Legacy 2D

Wells:

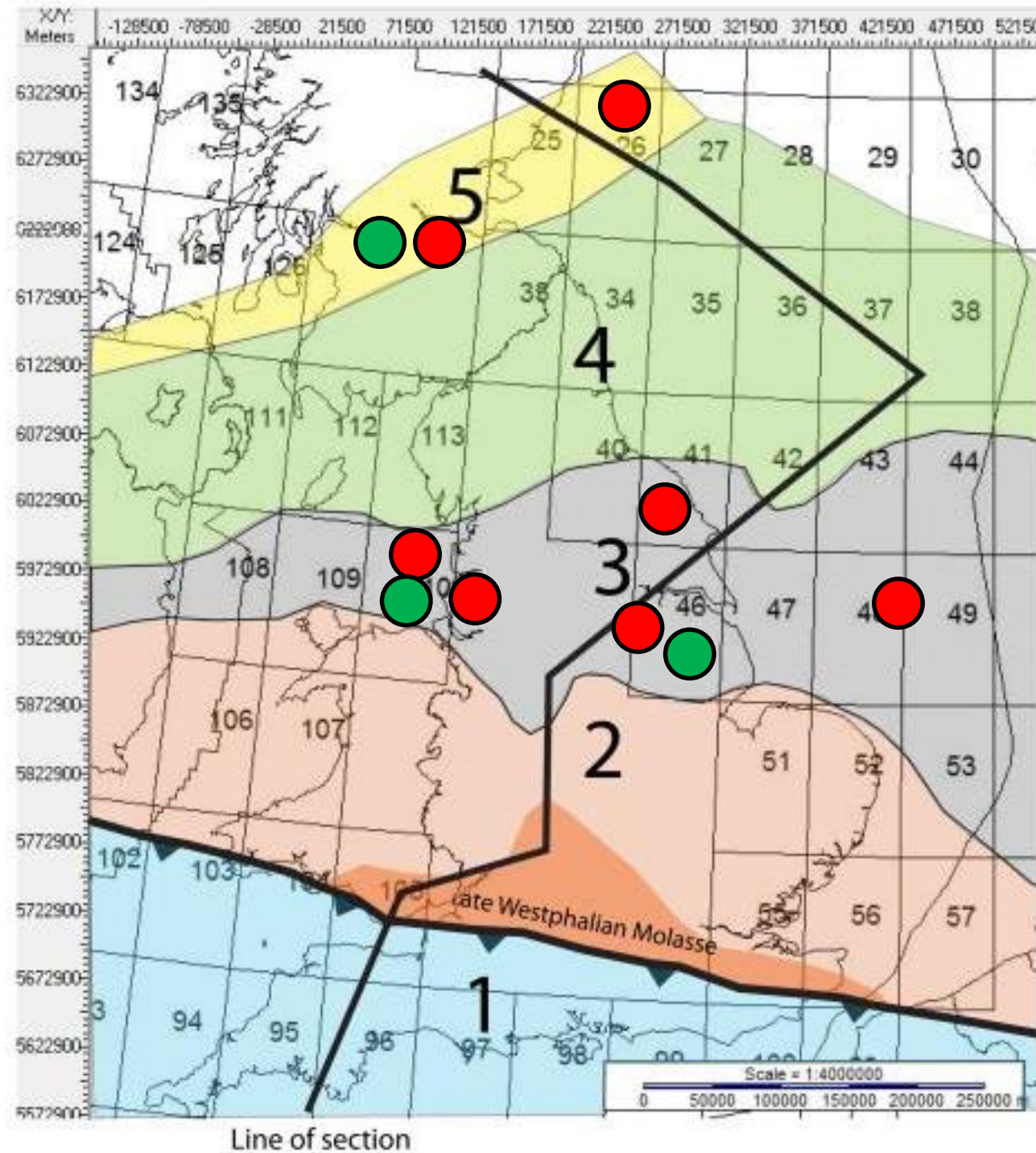
113 LAS and scanned reports & logs

Source rock & fission track data

Potential Fields:

Gravity and Magnetic data

- Interpret key seismic horizons across the study area,
- Produce a tectonic model of the area based on new seismic, wells and potential fields data.
- Review well data and document well reports and data availability, especially the availability of geochemical, fission track and borehole temperature data.
- basin modelling using 1D models of key wells plus a 3D Trinity model
- focus on Carboniferous source rocks



● Gas ● Oil

Zone 5: Midland Valley and Forth Approaches
Narrow and deep strike slip basin with deltaic clastic fill

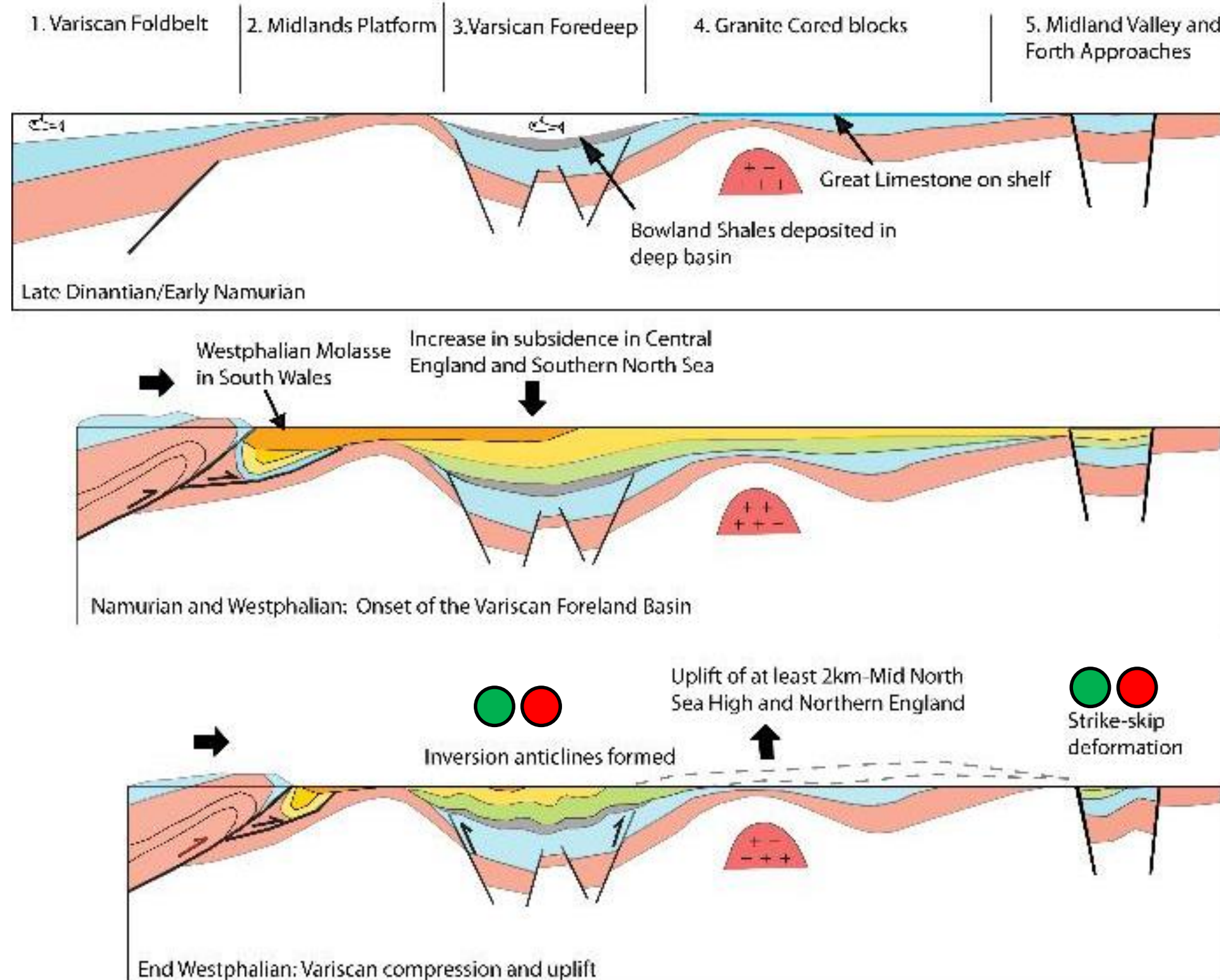
Zone 4: Granite cored blocks of the Mid North Sea High and Northern England: Delta top throughout the Carboniferous

Zone 3: Variscan foredeep: Lower Carboniferous rifts overlain by a thick sequence of deltaic clastics. Increase in subsidence in the Upper Carboniferous. Contains the Bowland Shales and the thickest Westphalian Coal Measures

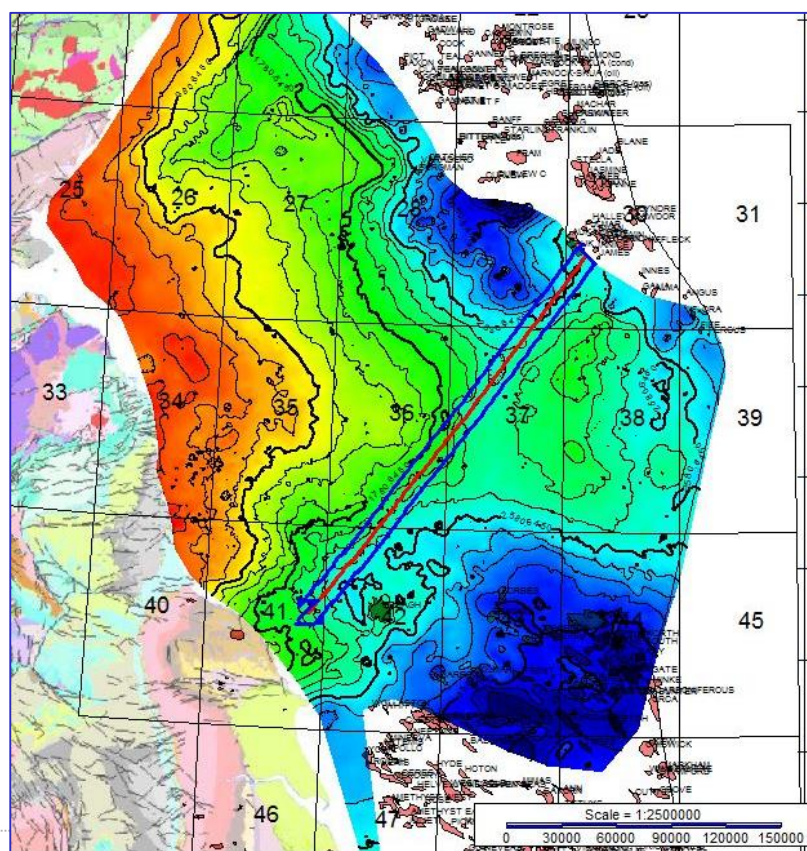
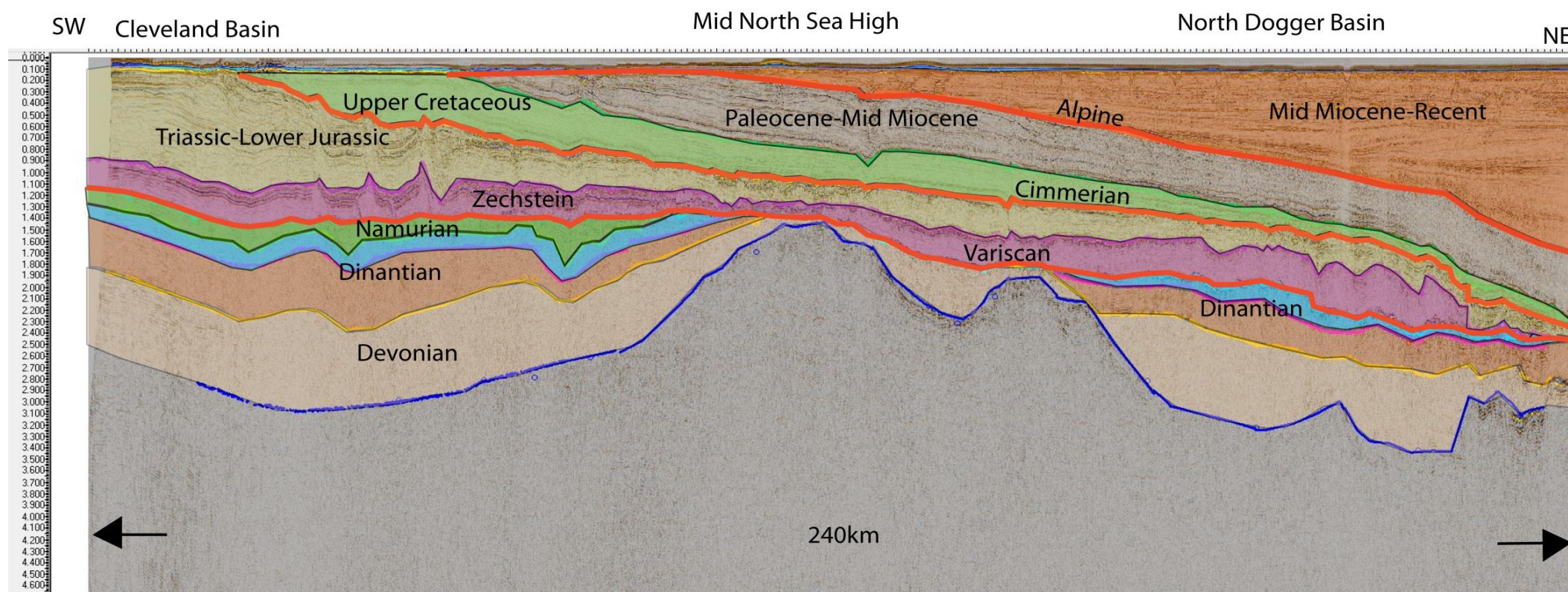
Zone 2: Midlands Platform: Precambrian, Lower Palaeozoic and Devonian High

Zone 1: Variscan Foldbelt. Devonian-Carboniferous basins inverted in Upper Carboniferous

Tectonic evolution of the Variscan Foreland in the British Isles



Seismic interpretation



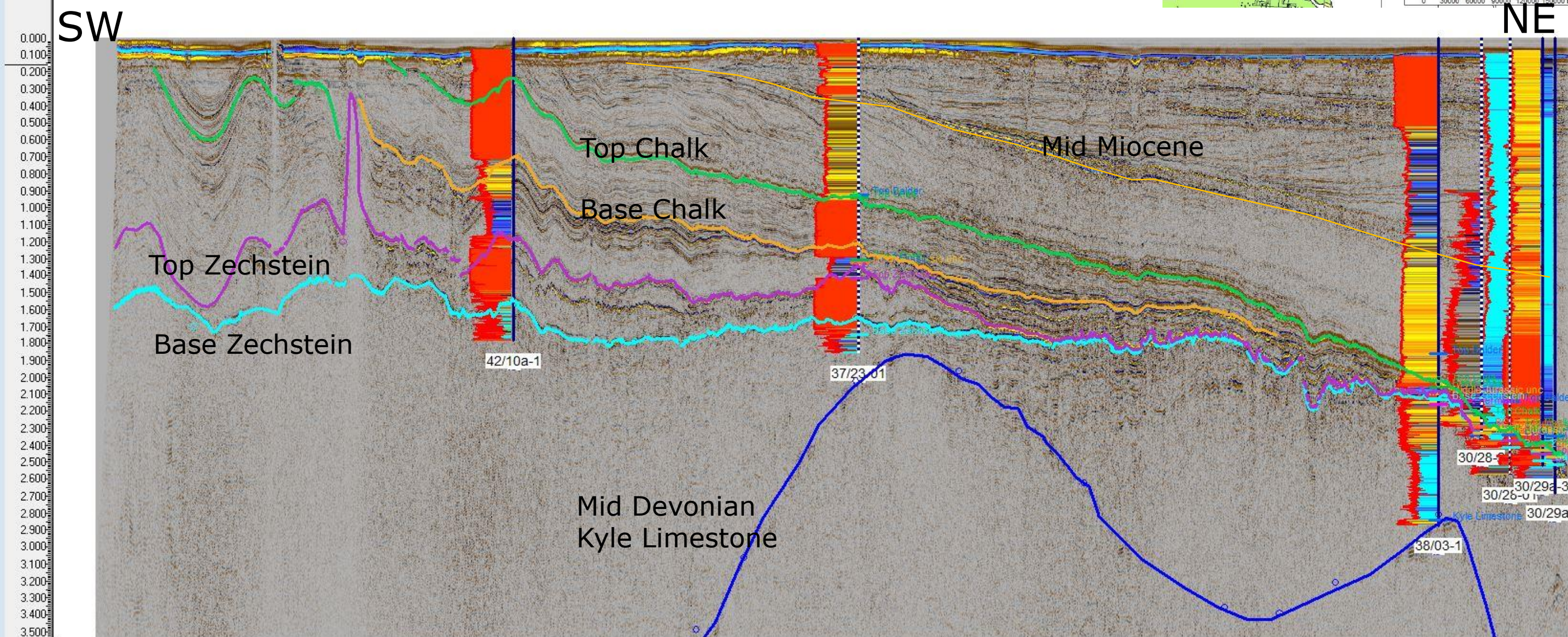
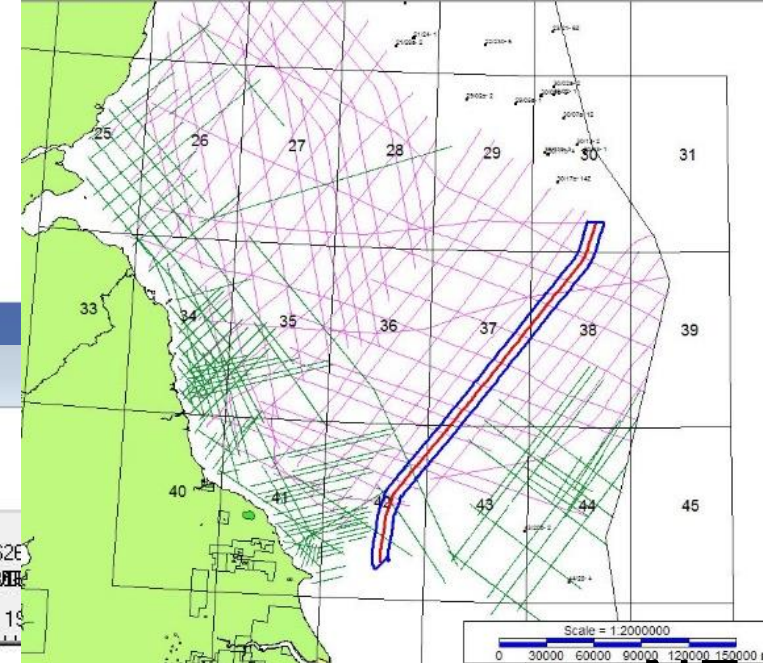
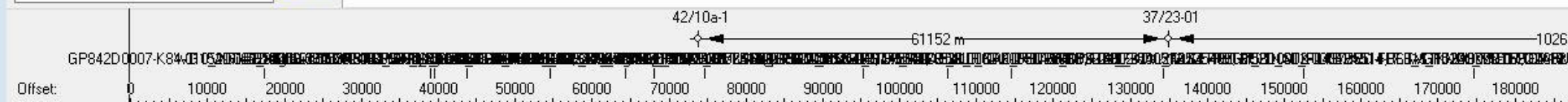
Interpreted horizons in time and depth

Mid Miocene	Alpine
Top Chalk	
Middle Jurassic Unconformity	Cimmerian
Top and Base Zechstein	Variscan
Base Westphalian	
Top Dinantian	
Top Scremerston Coal Group	
Top Devonian	
Top Mid Devonian Kyle Limestone	



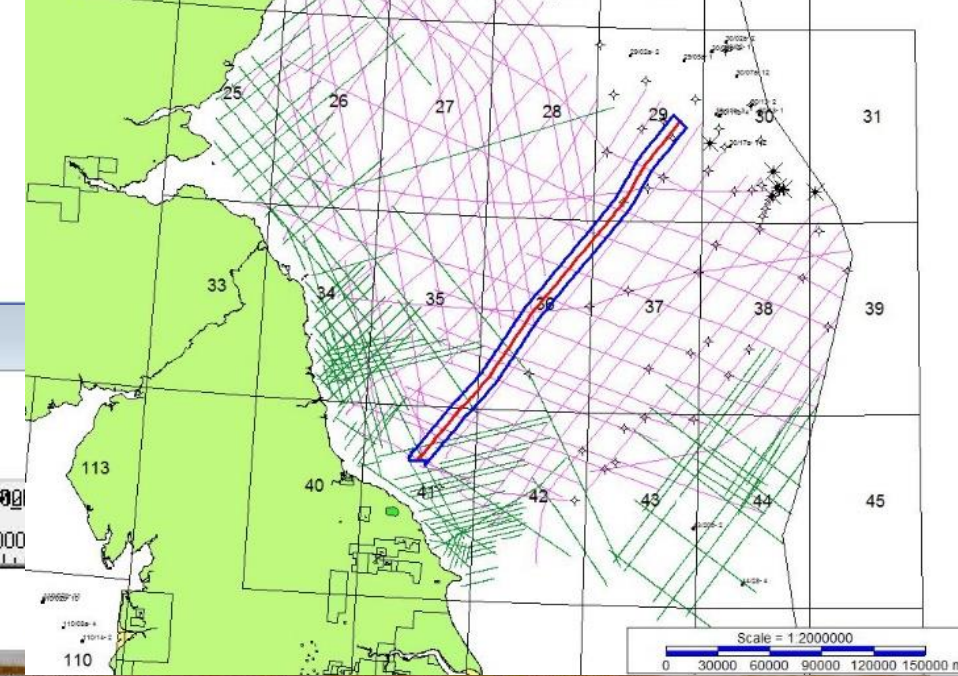
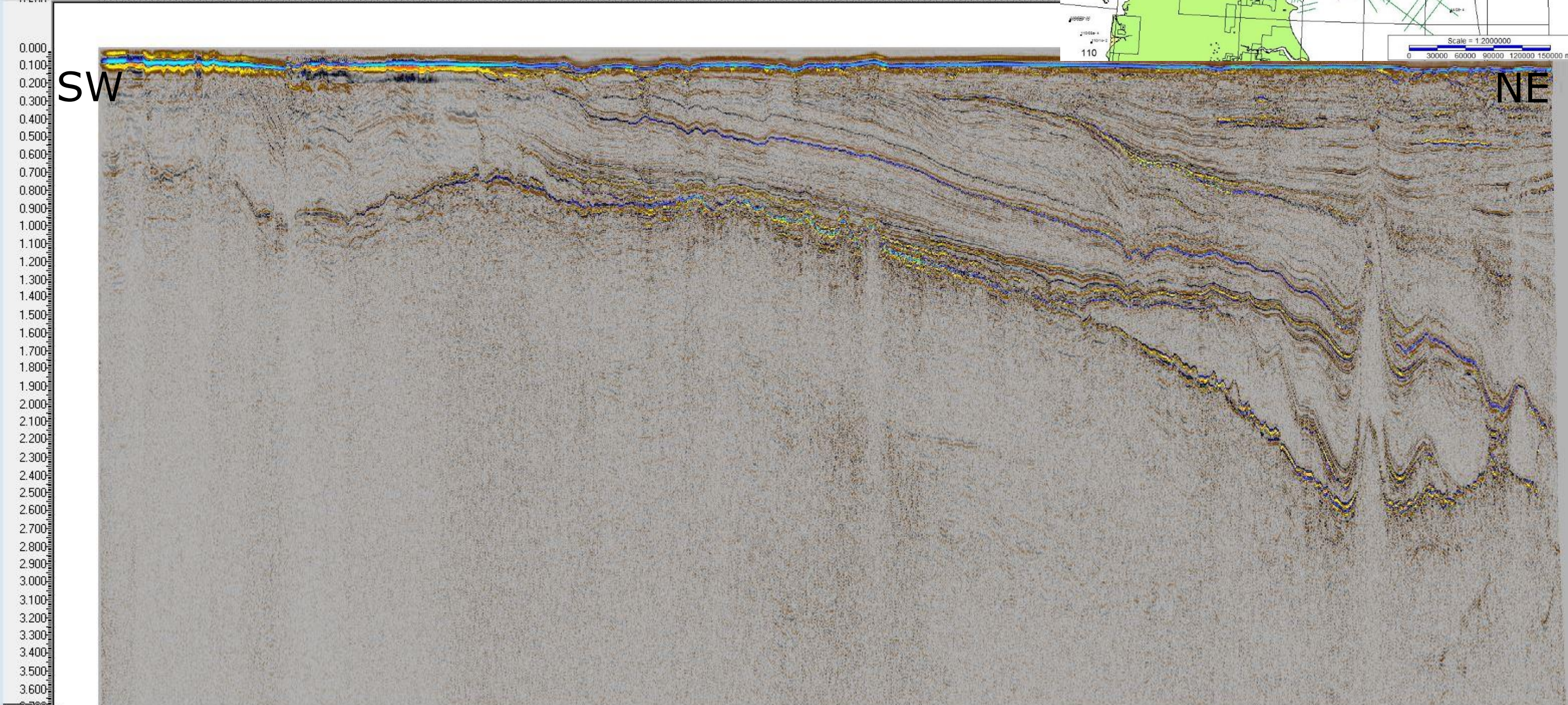
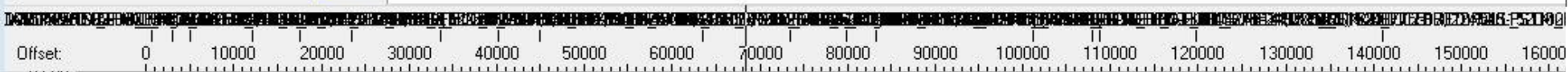
2015 line across the central part of the study area

Line WG152D0002-00017B561-PSTM_FINAL_FILTERED-FULL_STK-249775436, Amplitudes

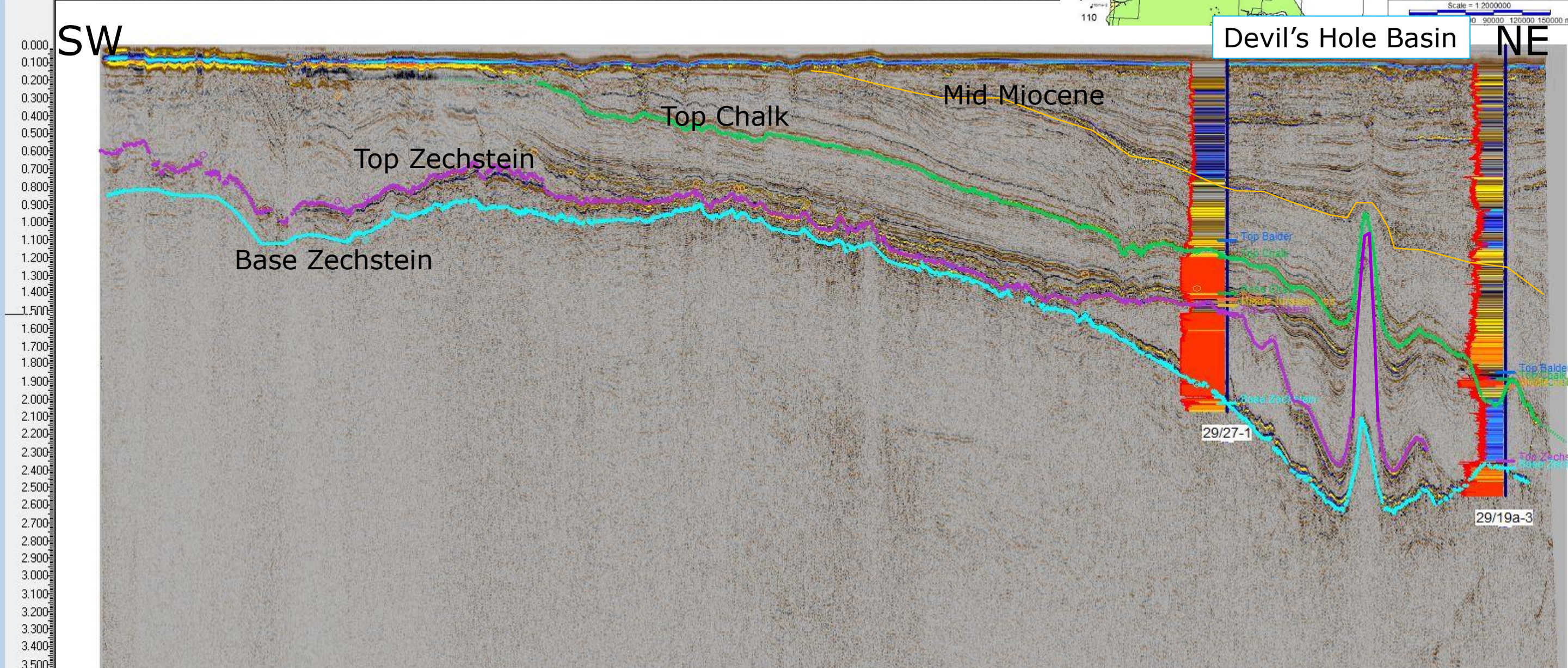
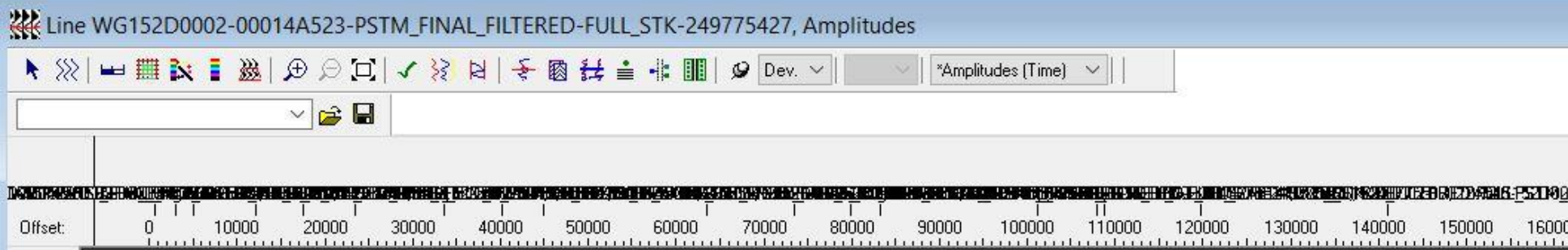
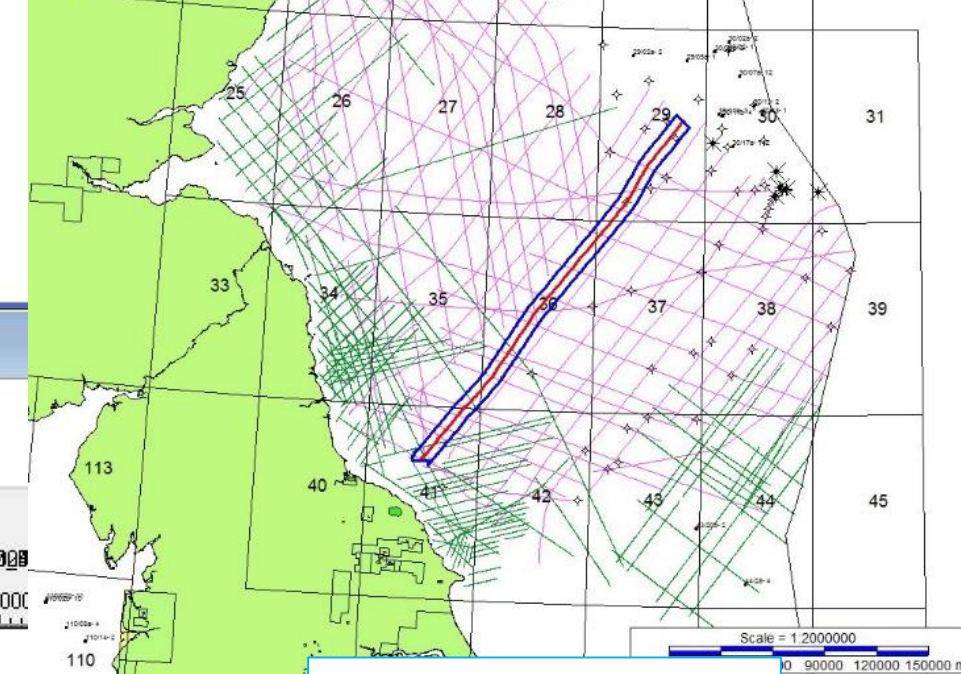


2015 line across the central part of the study area

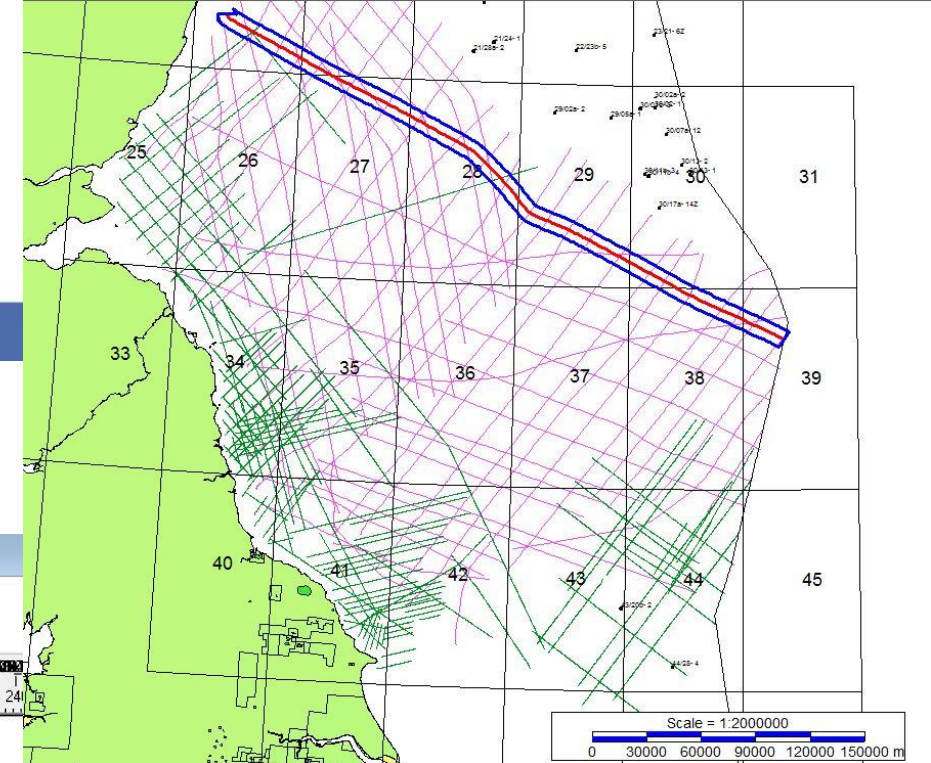
Line WG152D0002-00014A523-PSTM_FINAL_FILTERED-FULL_STK-249775427, Amplitudes



2015 line across the central part of the study area



2015 line across the Northern part of the study area



Line WG152D0002-00064A571-PSTM_FINAL_FILTERED-FULL_STK-249775544, Amplitudes

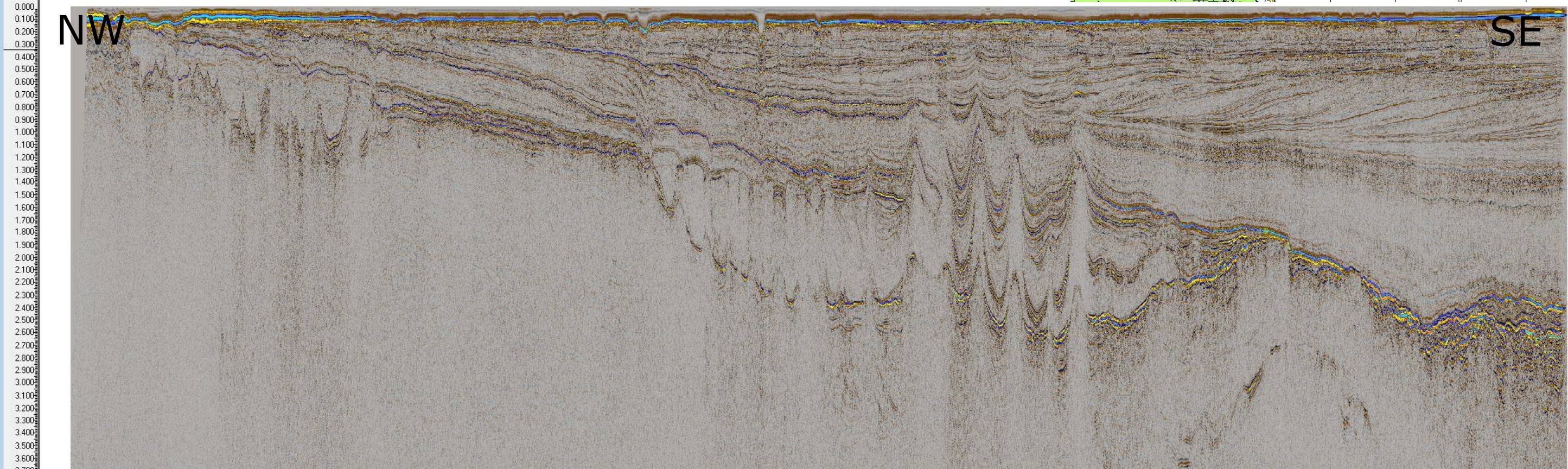
Amplitudes (Time)

Offset: 0 10000 20000 30000 40000 50000 60000 70000 80000 90000 100000 110000 120000 130000 140000 150000 160000 170000 180000 190000 200000 210000 220000 230000 240000

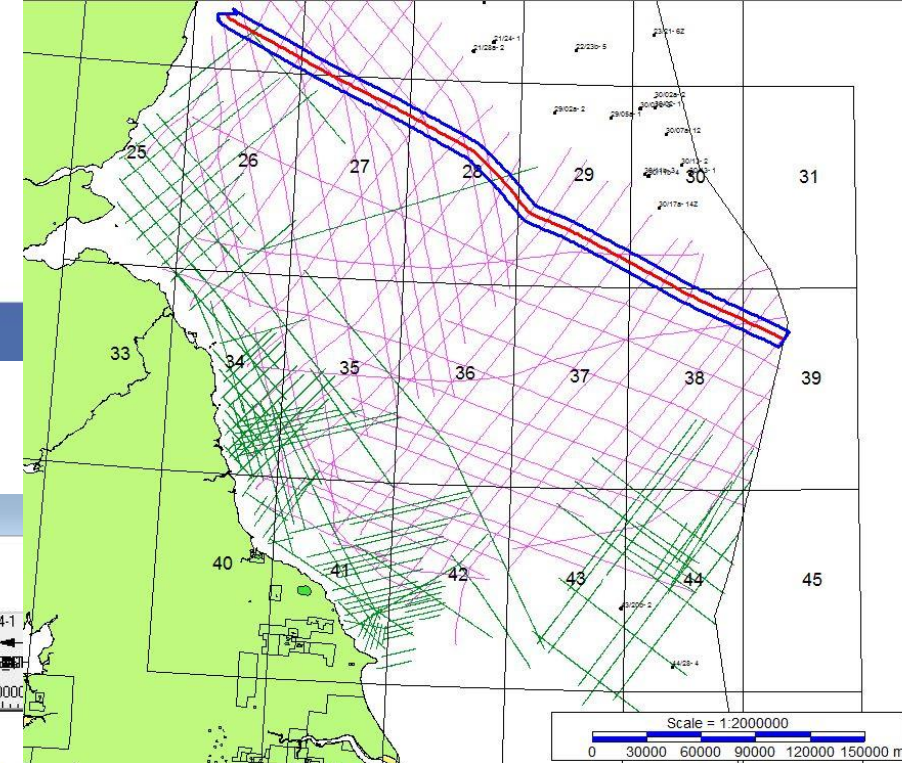
0.000 0.100 0.200 0.300 0.400 0.500 0.600 0.700 0.800 0.900 1.000 1.100 1.200 1.300 1.400 1.500 1.600 1.700 1.800 1.900 2.000 2.100 2.200 2.300 2.400 2.500 2.600 2.700 2.800 2.900 3.000 3.100 3.200 3.300 3.400 3.500 3.600 3.700

NW

SE



2015 line across the Northern part of the study area

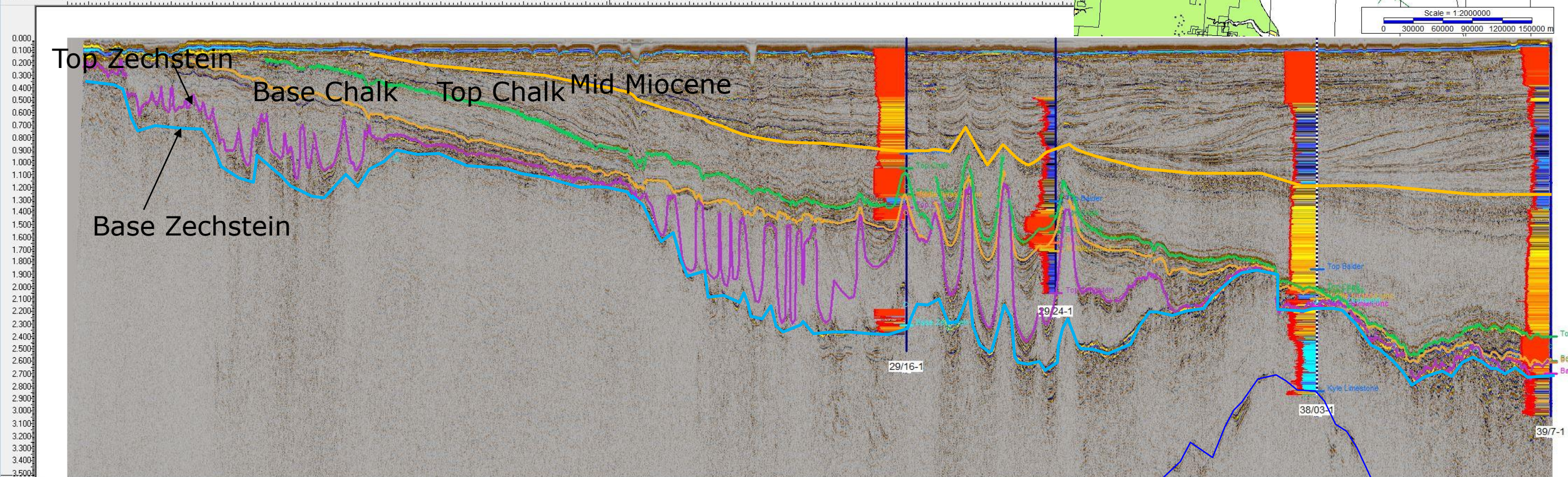


Line WG152D0002-00064A571-PSTM_FINAL_FILTERED-FULL_STK-249775544, Amplitudes

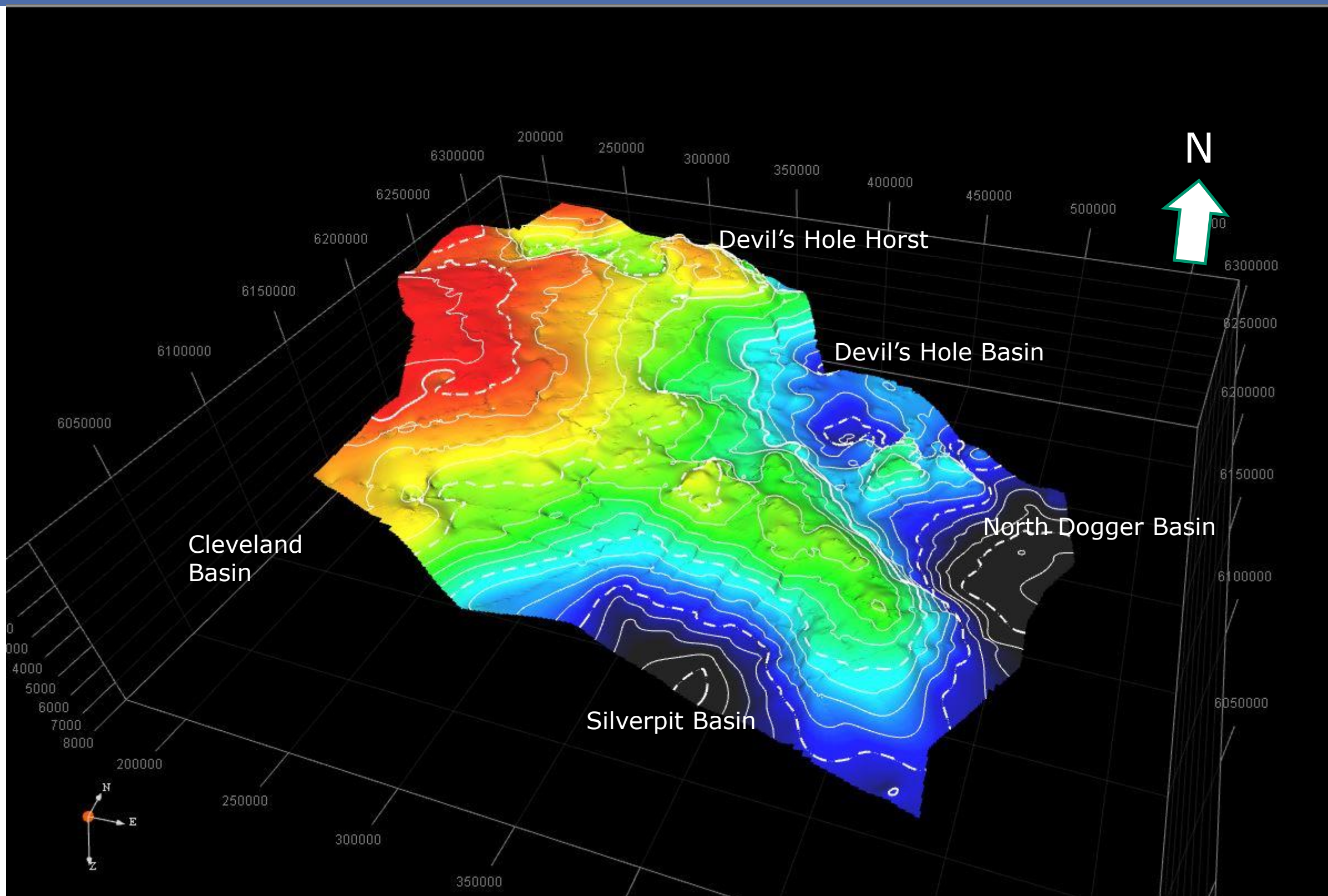
Forth Approaches basin

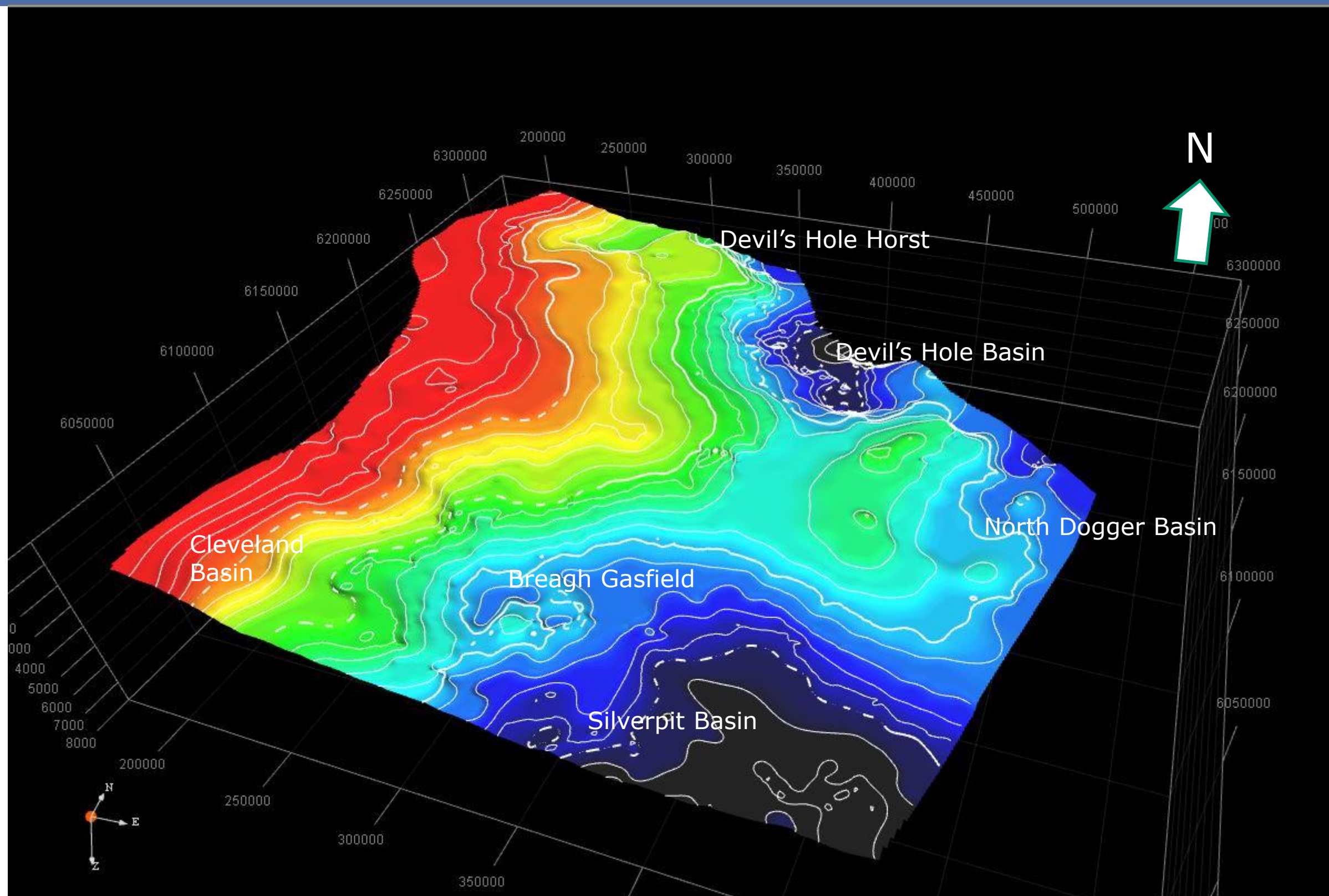
Devil's Hole Basin

Offset: 0 10000 20000 30000 40000 50000 60000 70000 80000 90000 100000 110000 120000 130000 140000 150000 160000 170000 180000 190000 200000 210000 220000 230000 240000



Mid Devonian
Kyle Limestone

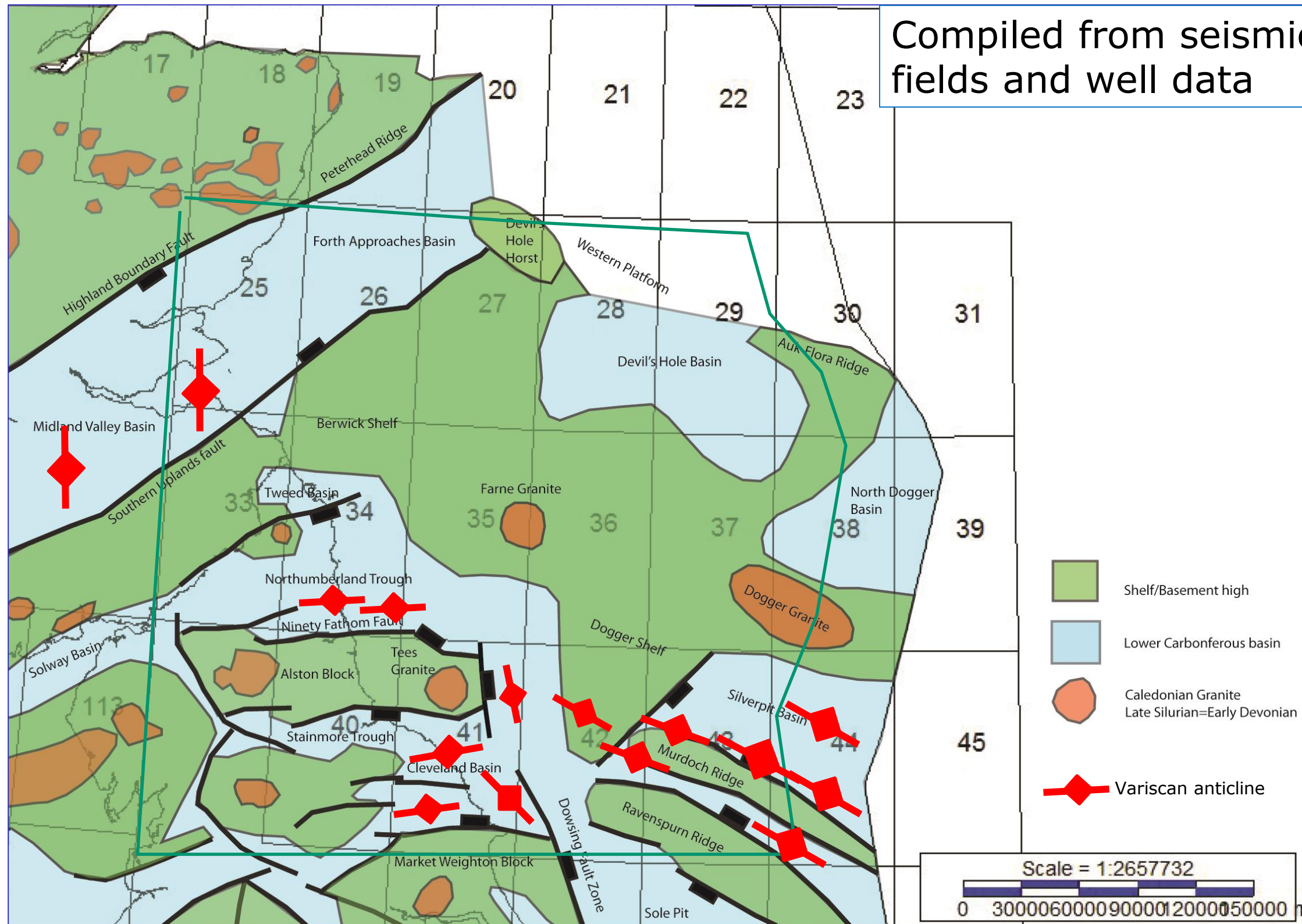




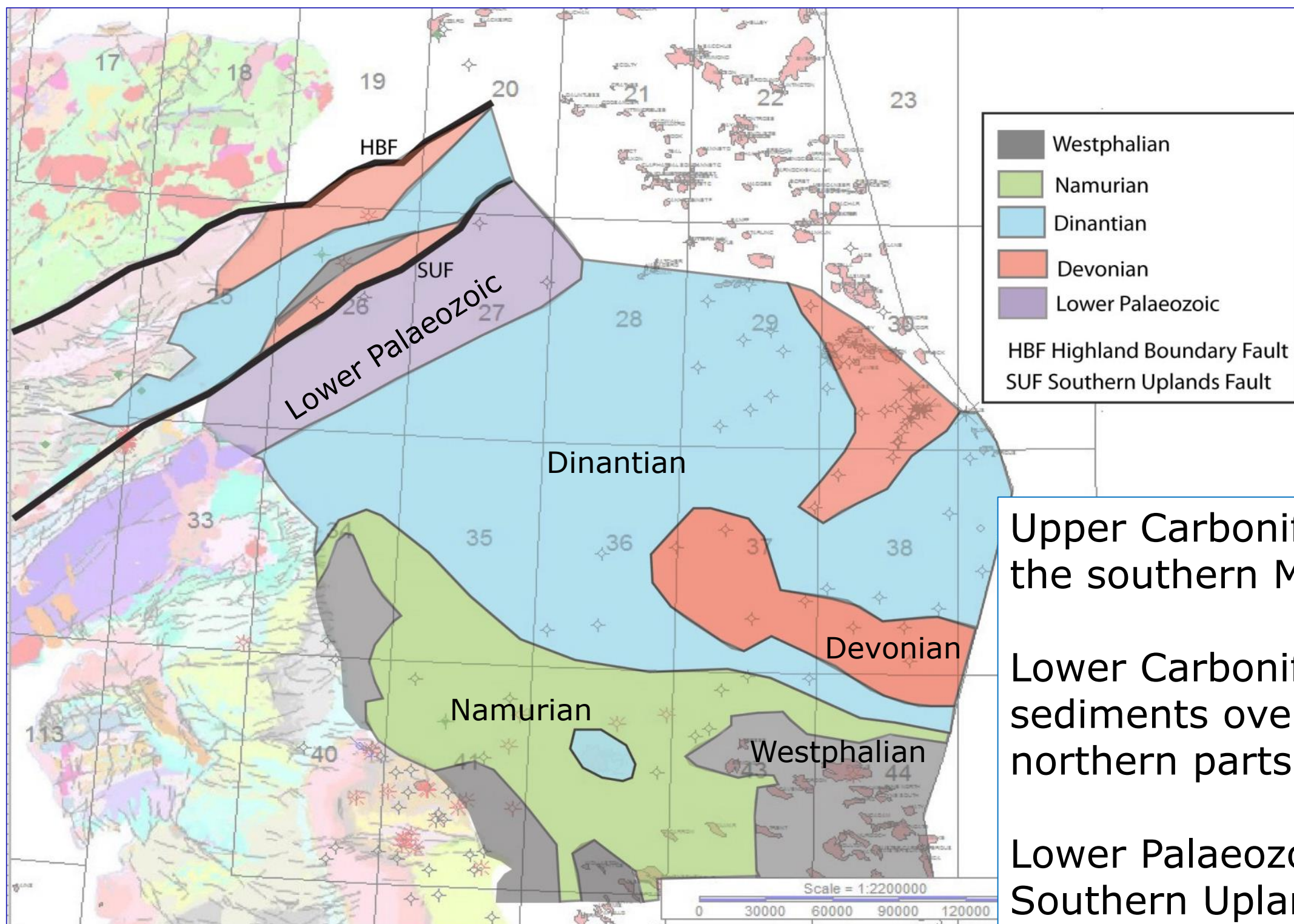
Structural elements map



Compiled from seismic, potential fields and well data



Pre-Permian subcrop map

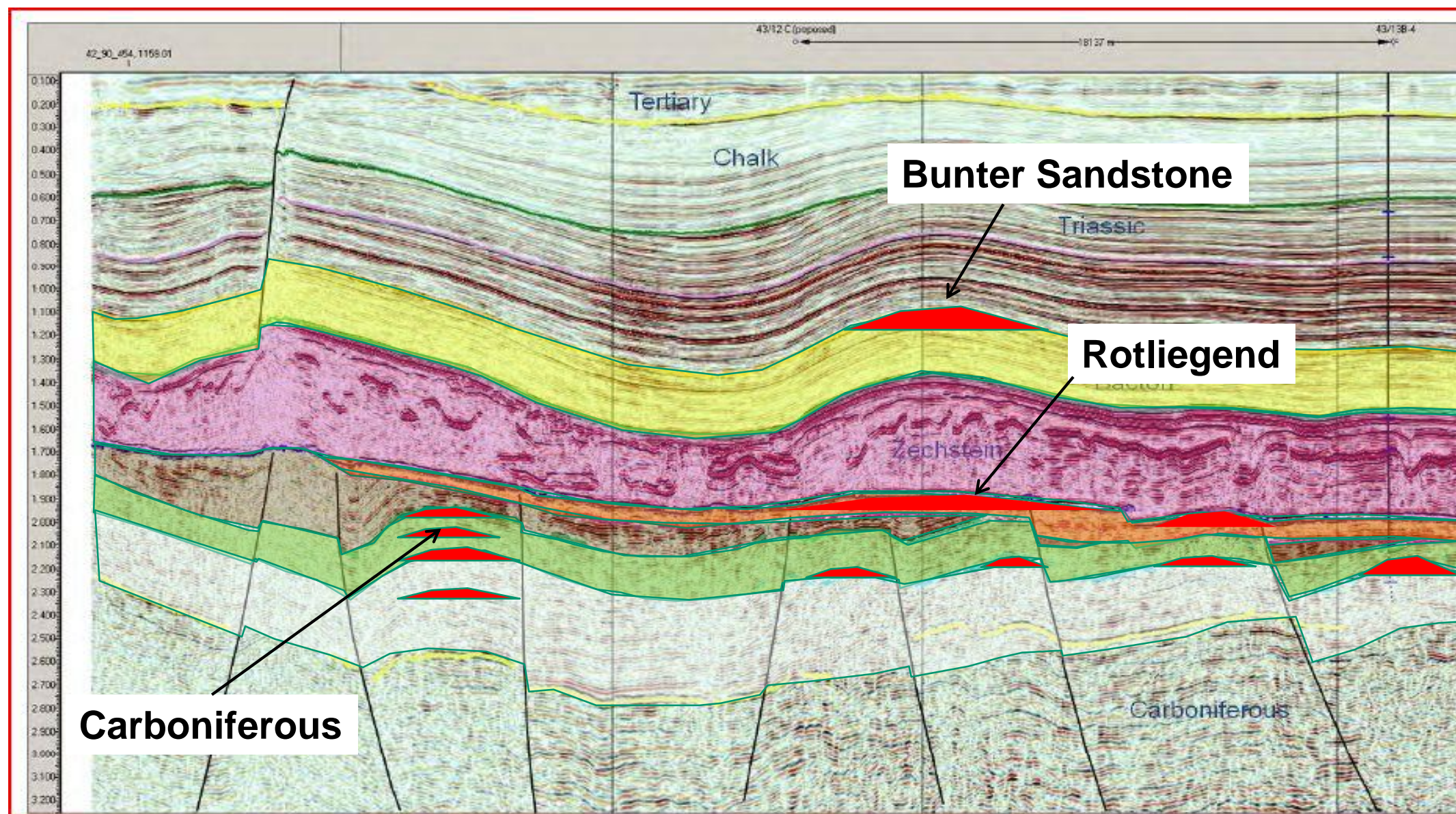


Upper Carboniferous restricted to the southern Margin of the MNSH

Lower Carboniferous Dinantian sediments over central and northern parts of the MNSH

Lower Palaeozoic extension of the Southern Uplands separates the MNSH from the Forth Approaches

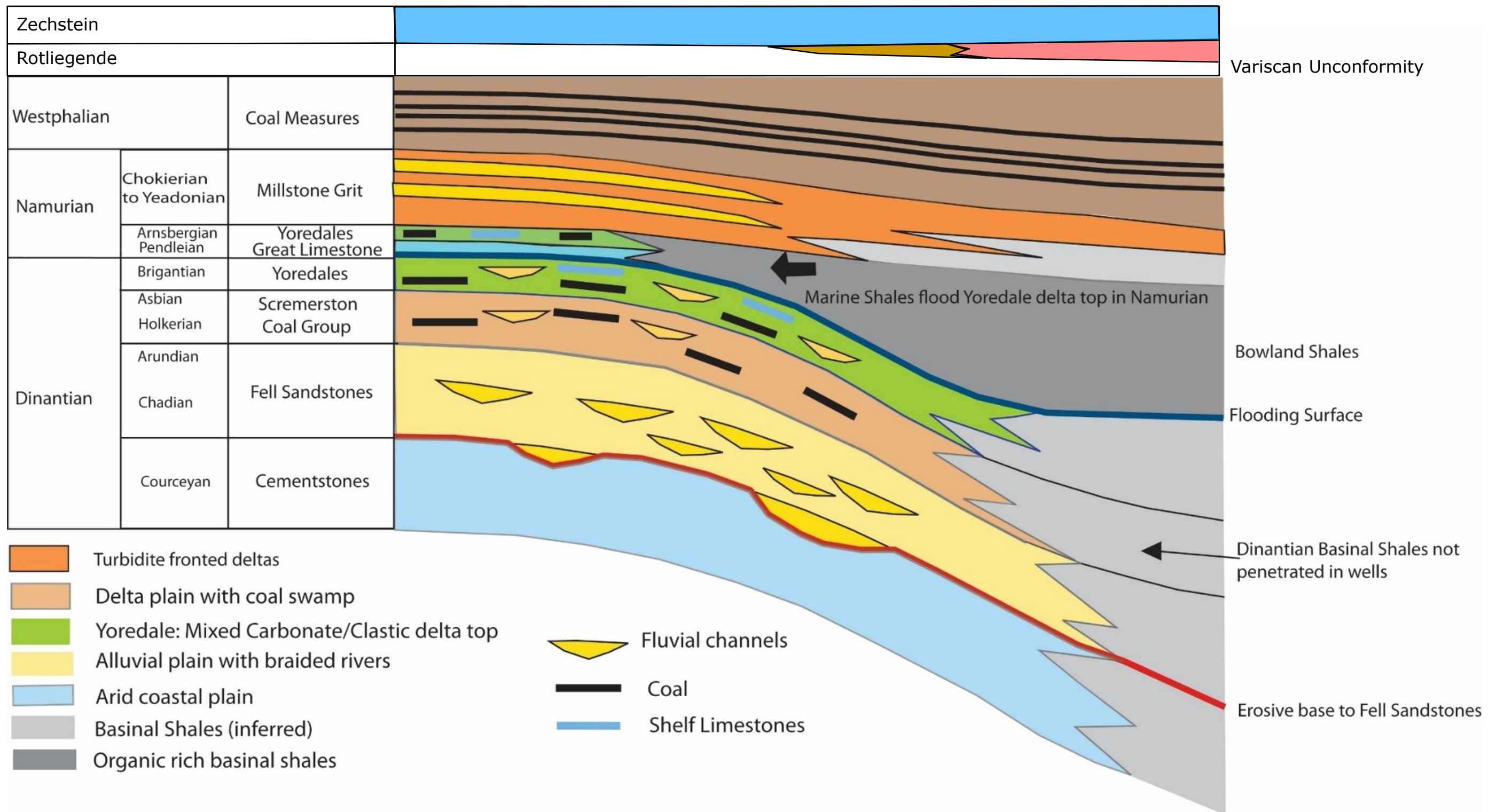
Trapping mechanisms in the gas play of the Southern North Sea



Source: Carboniferous Coals and marine mudstones
Unproved contribution from Permian marine mudstones (Kupferschiefer)

Seal: Zechstein Evaporites and intra-Carboniferous mudstones

Traps: Inversion anticlines of Variscan age subsequently modified by Tertiary Inversion
4-way closures at Base Zechstein
4-way closures at Bunter (Triassic) level



Oil production in the Auk and Argyle Fields on the northern flank of the Mid North Sea High

Gas production in the onshore Cleveland Basin (Lockton, Eskdale) and offshore stranded discoveries



Marsden Rock, South Shields



Lower Permian Rotliegende Sandstones

Gas production in the Southern North Sea

Variscan unconformity

Westphalian Sandstones:

Gas production in the Silverpit Basin
(Murdoch, Caister)

Tynemouth Priory



Gas production in Quad 43

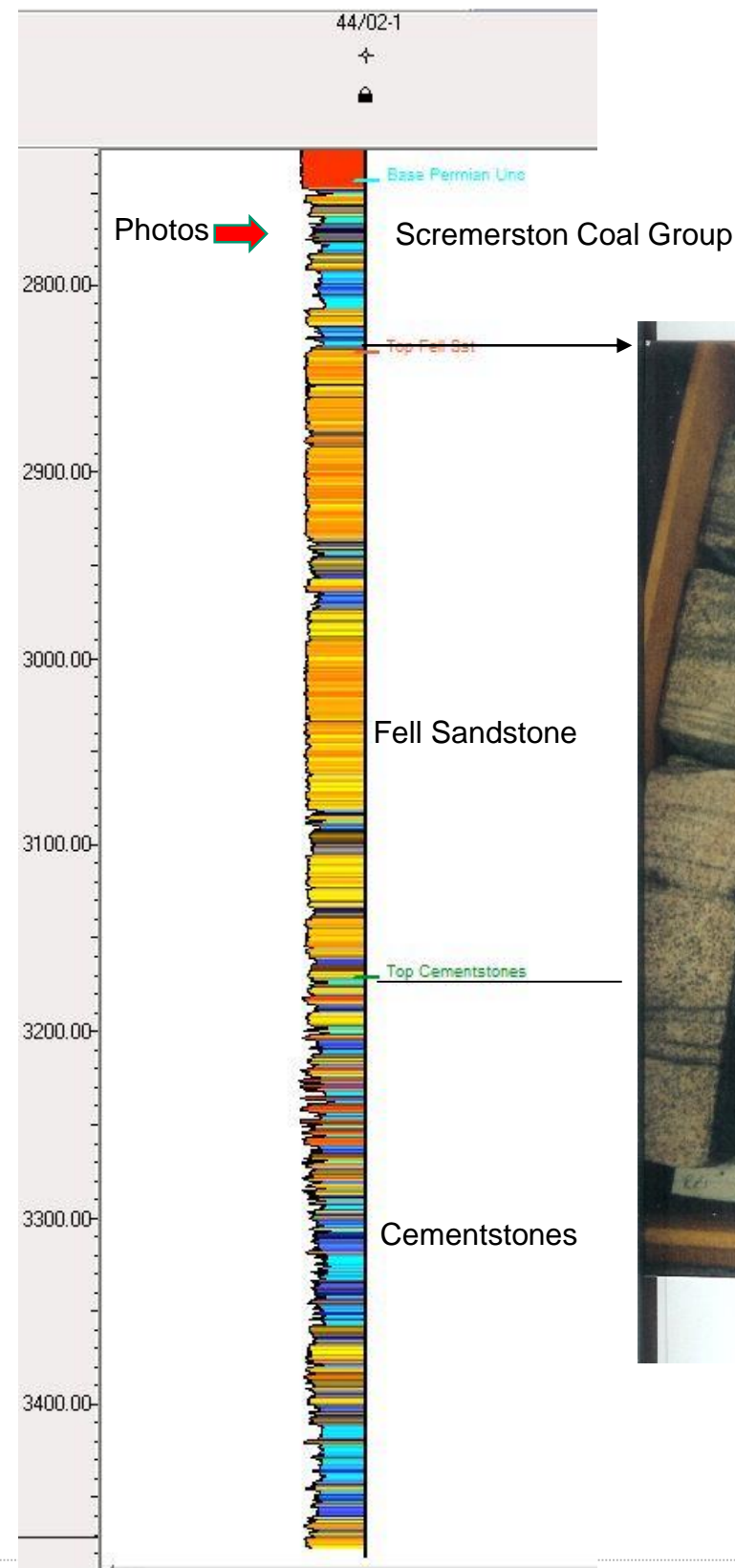
Trent Field has the main reservoir in the offshore equivalent of the Chatsworth Grit

Roaches Sandstone, North Staffordshire



Core Photos from 44/2-1 on the southern margin of the MNSH

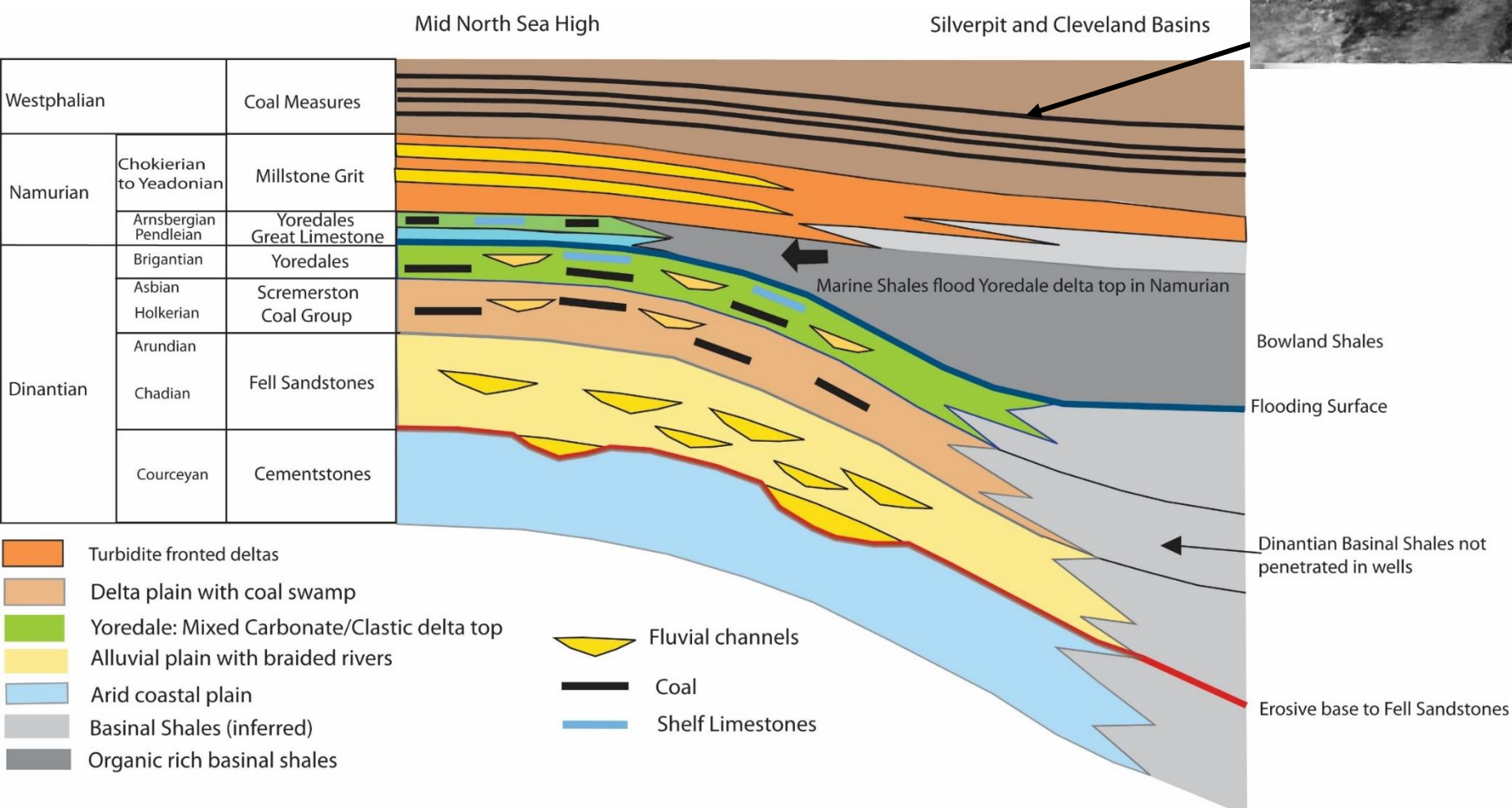
Reservoir in the Breagh field, Quad 42. 8-18% porosity



Principal Carboniferous Source Rocks: Westphalian Coal Measures

Considered to be the major source for gas
in the Southern North Sea

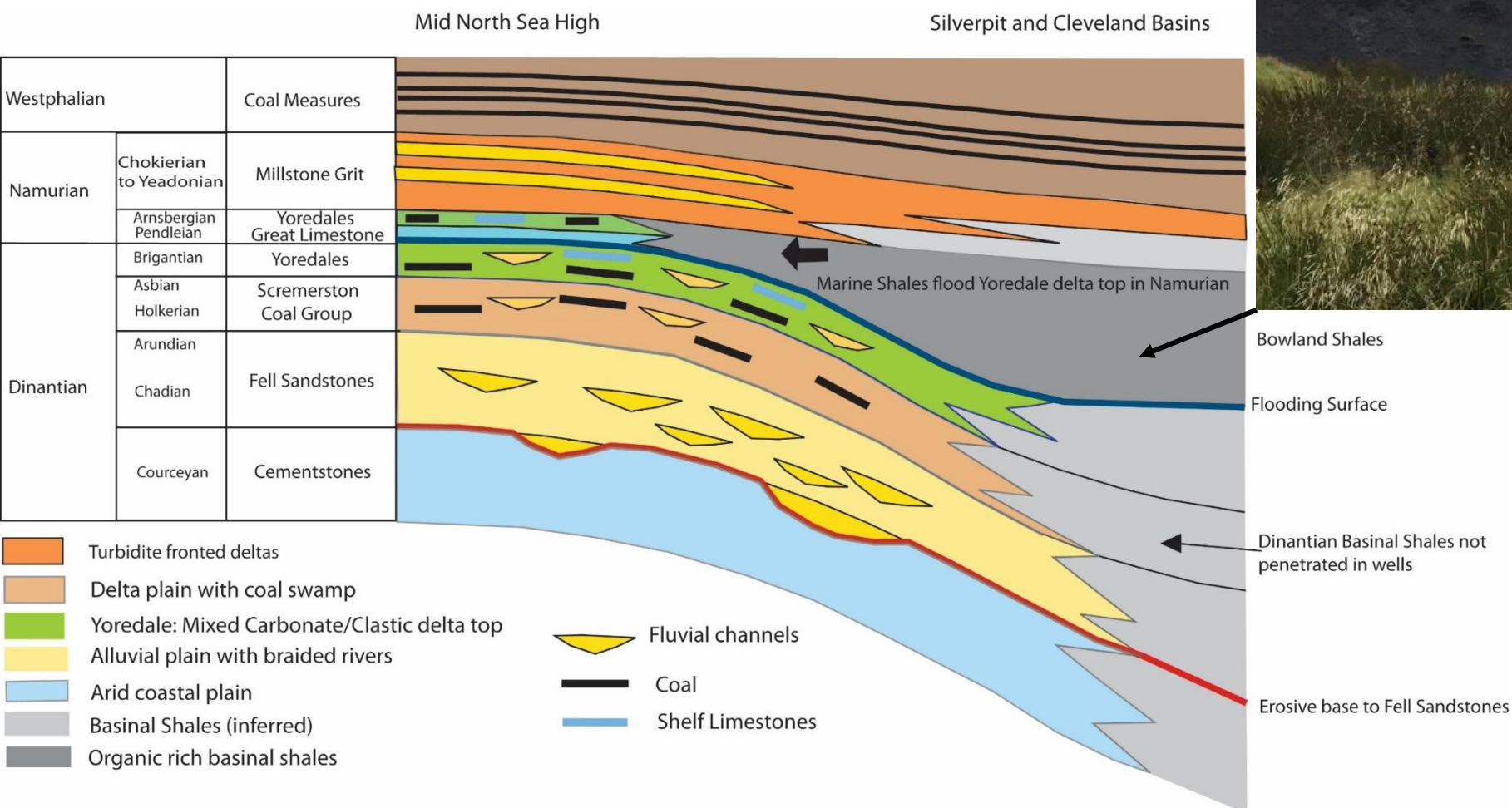
Westphalian Coal Measures
North Staffordshire



Principal Carboniferous Source Rocks Bowland Shales

Important oil source rock in East Midlands and East Irish Sea. Not considered to be a major source in the North Sea

Bowland (Edale) Shales
Castleton, Derbyshire



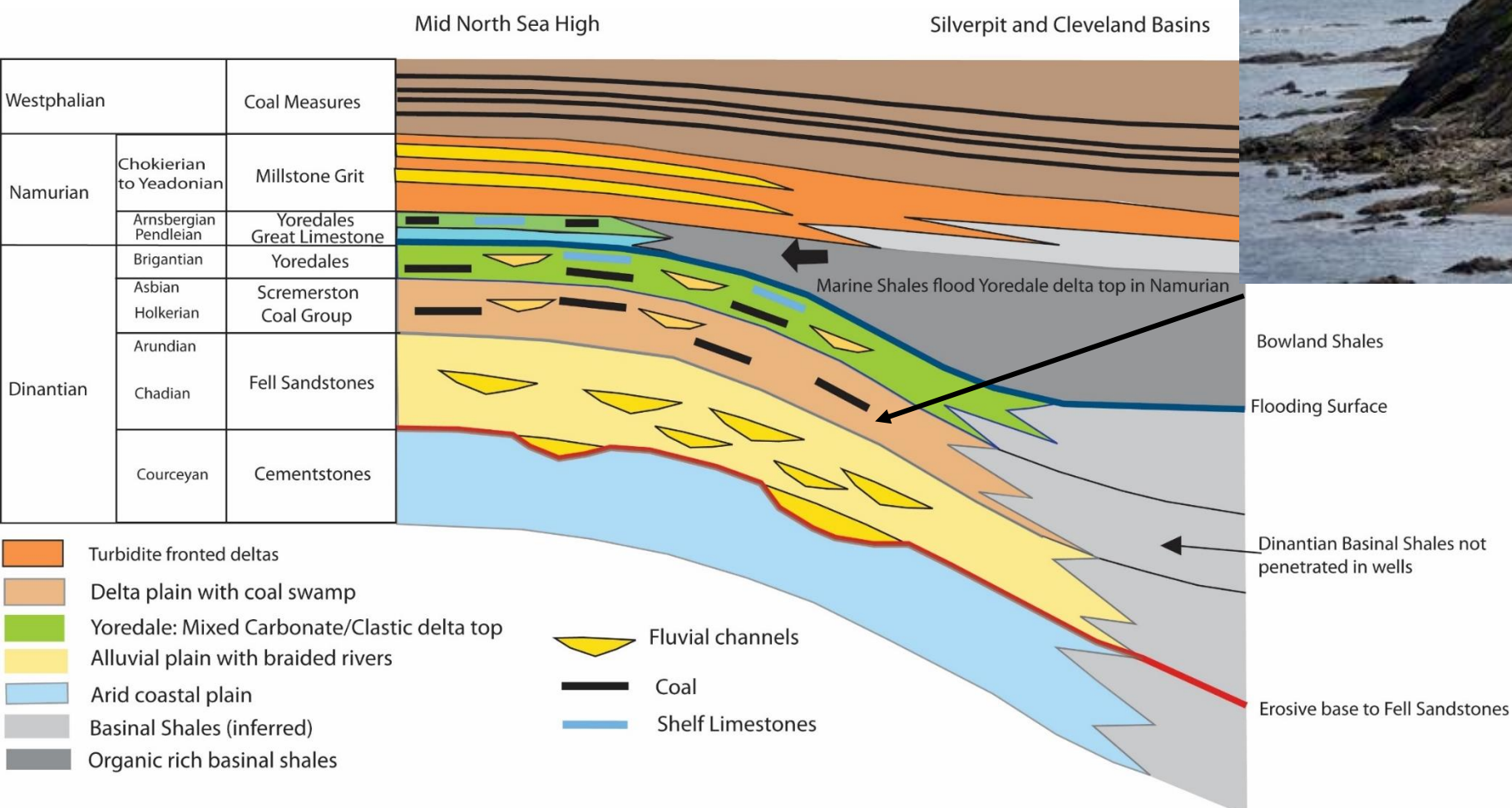
Principal Carboniferous Source Rocks: Scremerston Coal Group

Thick Coals (2-3m) and rich oil shales

First appearance of Coal Measure facies
in the Lower Carboniferous

100-300m thick

Scremerston Coal Group
Scremerston, Northumberland



Bowland (Edale) Shales at outcrop. Mam Tor, Derbyshire



Westphalian Coals are of limited extent and not gas mature in the southern part of the study area

Bowland Shales are the major source rock in the southern part of the study area

Scremerston Coal Group is the most extensive source rock and is gas mature much further north than previous studies

Oil mature over large parts of the central and northern MNSH.

Same age as the Lothian oil shales in the Midland valley

However, it is uncertain if it has the capacity to generate large volumes of oil