

Rationale:

- Salt is proven throughout the Slyne and Erris basins and plays a crucial role in the petroleum system of these basins, acting both as an excellent sealing lithology and driver in the formation of hydrocarbon-bearing structural traps (e.g. Corrib gas field).
- To date very little work has been done to understand the controls on salt distribution both in these basins and across the greater Irish Atlantic margin.
- Salt will likely play a significant part in future gas discoveries in the greater Corrib area and understanding the timing and style of salt movement will be crucial to exploration success.
- The Slyne and Erris basins have the most numerous and data-rich well penetrations of both Permian and Triassic salt offshore Ireland.
- Salt bodies represent one of the best storage methods for sequestered CO₂ and understanding their composition and distribution aids in determining their suitability for future CC&S initiatives.

The Slyne and Erris Basins

- A pair of contiguous rift basins off the north-western coast of Ireland.
- Formed through a multiphase evolution involving Permian, Early Jurassic and Late Jurassic rifting, with periods of uplift during the end Middle Jurassic, Early Cretaceous and Cenozoic.
- Two layers of salt are present in these basins:
 - Upper Permian Zechstein Group
 - Upper Triassic Uilleann Halite Member (Currach Formation)
- The Zechstein Group is thickest and most salt-prone in the Slyne Basin and southern Erris Basin, with the salt content decreasing in the northern Erris Basin. This distribution is likely controlled by faults which were active during the Late Permian, such as the basin-bounding fault in the central and southern Slyne Basin, and the large faults to the east of Corrib.
- The Uilleann Halite is restricted to the northern Slyne and southern Erris basins, and represents a marine influence in that area during the Late Triassic, possibly sourced from the Rockall Basin to the northwest.

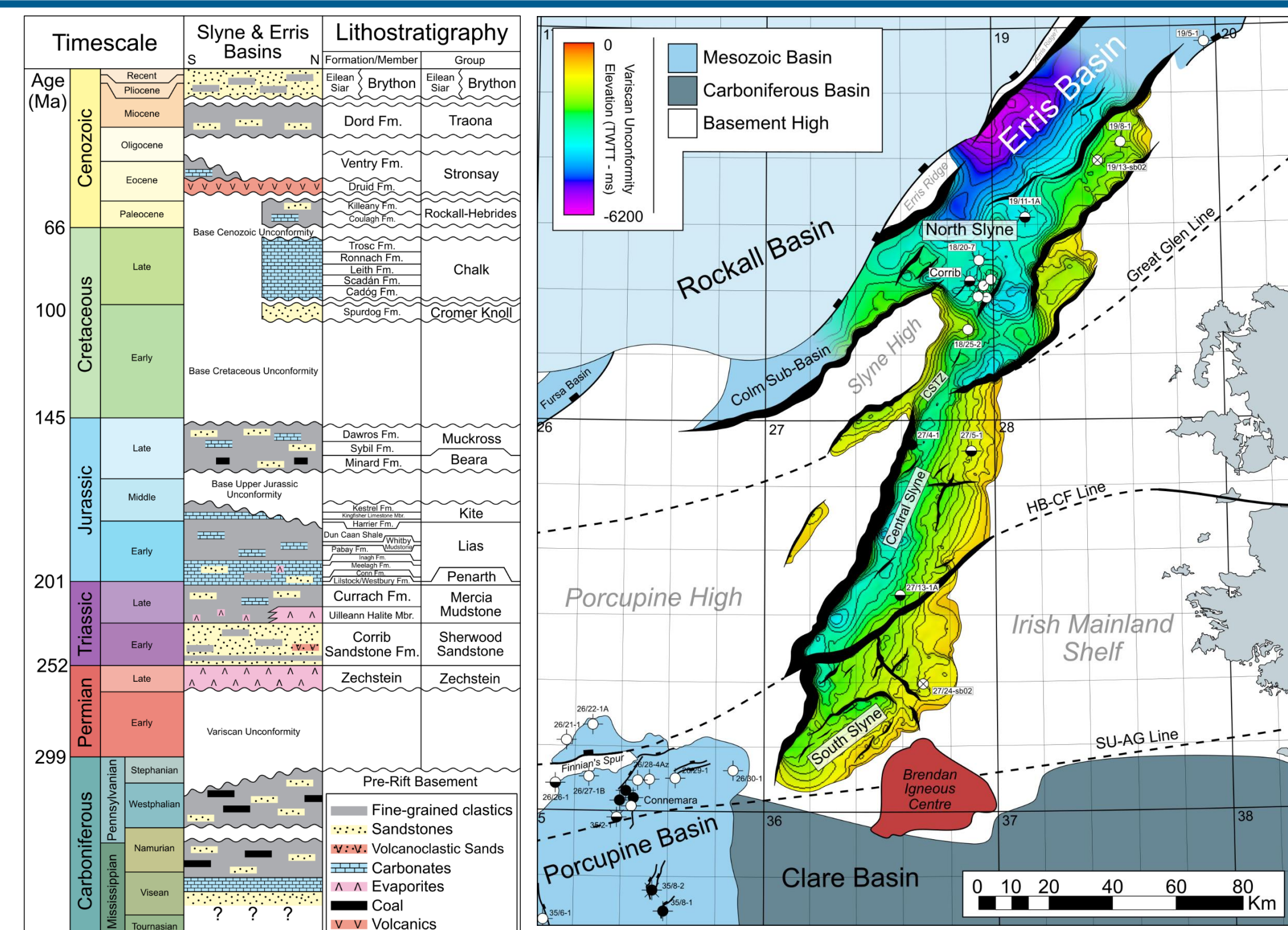


Figure 1: Slyne & Erris chronostratigraphic chart.

Figure 2: Variscan Unconformity (Top Carboniferous) structure map of the Slyne and southern Erris Basin.

Salt composition:

- The Zechstein Group in the Slyne and southern Erris basin is composed of relatively clean salt (mostly halite and anhydrite) with minor interbedded mudstone and carbonate stringers.
- The Uilleann Halite Member composed of halite, with the proportion of halite increasing towards the base of the Upper Triassic section. This halite is interbedded with several mudstone stringers. When the member is not developed, the Currach Formation typically has infrequent metre to sub-metre stringers of halite and anhydrite at the base of the section.

Timing of salt movement:

- Salt movement is recorded during pre-rift, syn-rift and post-rift stages of basin development. These include:
 - Lower Jurassic growth sequences observed in a withdrawal syncline around Corrib (not shown).
 - Erosion of salt-cored structural highs at the Base-Upper Jurassic Unconformity (Figure 5).
 - Onlap on the flanks of rising salt-cored structures during the deposition of the Oxfordian Minard Formation (Figure 4).
 - Continued growth of salt-cored folds such as the Corrib structure during the Cretaceous and Cenozoic (Figure 7).
- Salt structures which form early often continue to develop e.g. the crest of the structure above the large salt roller in Figure 5, which has both a thinned Lower and Middle Jurassic section beneath the Base-Upper Jurassic Unconformity, and a thinned Upper Jurassic section beneath the Base-Cenozoic Unconformity.

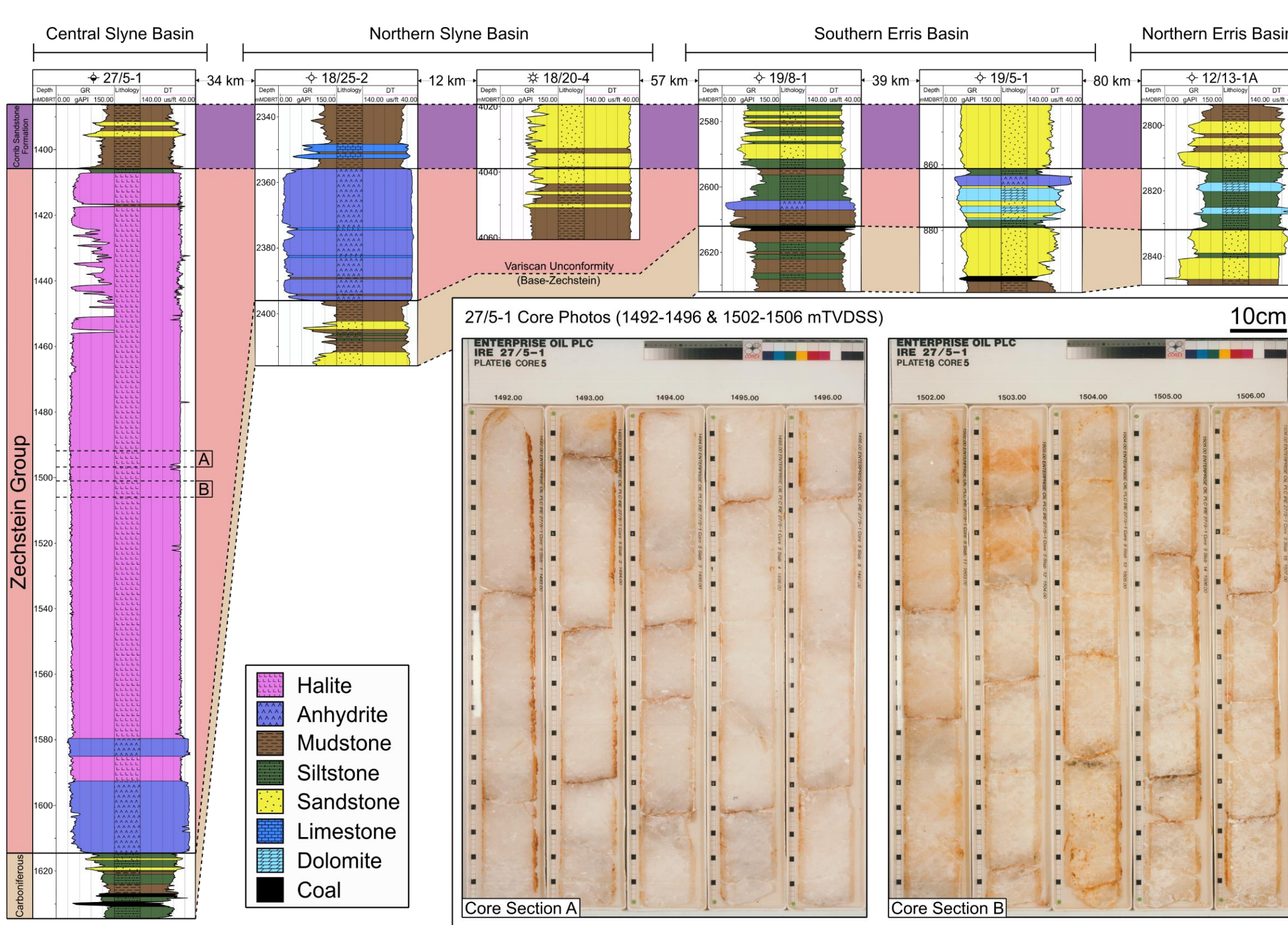


Figure 3: Lithological well correlation of the Zechstein Group through the Slyne and Erris basins. The Zechstein Group is more salt-prone in the Slyne Basin and southern Erris Basin, with the salt content decreasing in the northern Erris Basin (e.g. well 12/13-1A). The Zechstein Group in the southern Erris Basin appears more salt-prone on seismic sections (undrilled at present), with salt content decreasing towards the low-strain basin margins (e.g. wells 19/5-1 and 19/8-1).

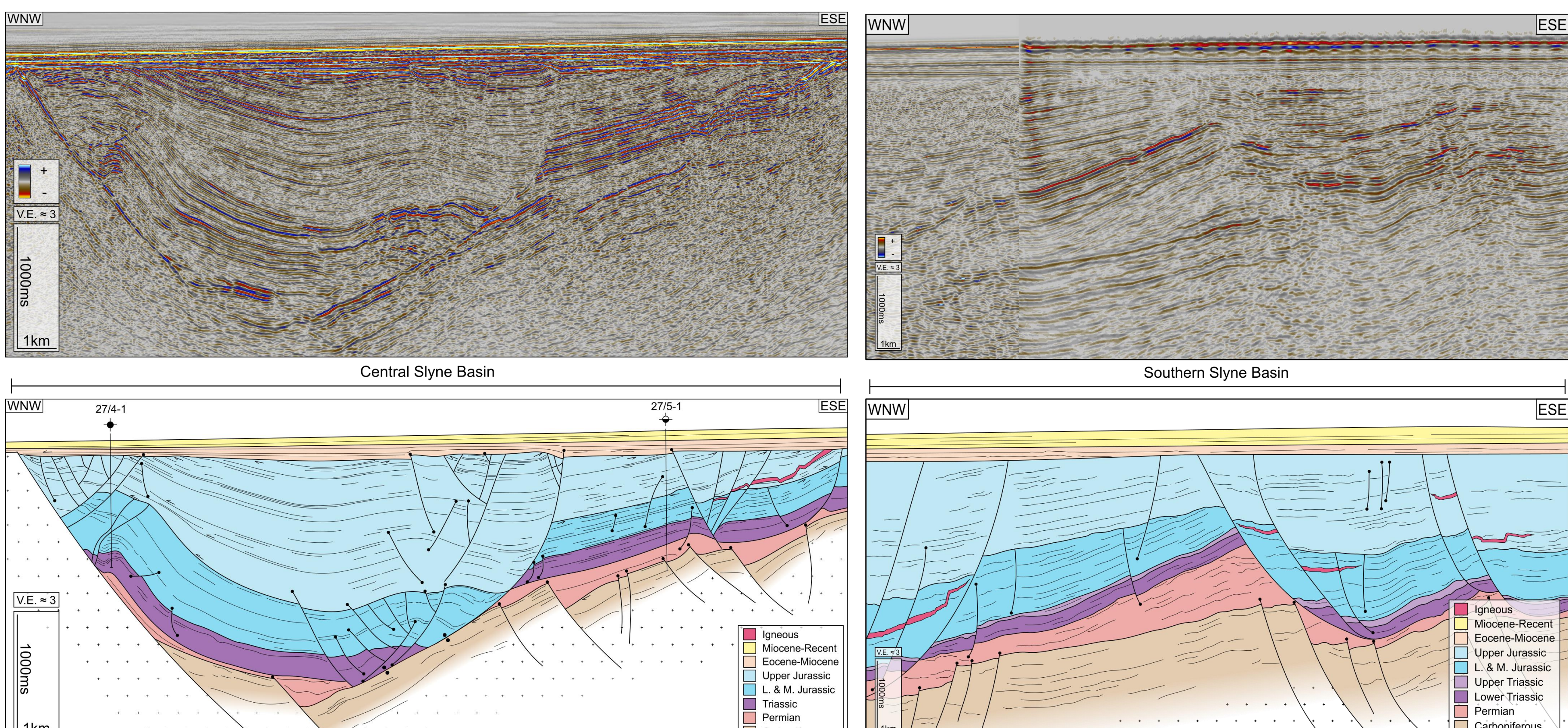


Figure 4: In-line 2650 from the 2000/08 3D seismic volume and accompanying geoseismic interpretation. The Upper Jurassic section onlaps the steeply-dipping flanks of the structure targeted by the 27/4-1 well, with this Upper Jurassic section thickening into the hanging-wall of the large listric fault to the east. Growth of the structure was likely driven by a positive feedback mechanism of active salt and syn-tectonic sediment loading.

Figure 5: Composite seismic section of 2D seismic line TK25-95-32 and crossline 3163 from the 2010/01 (SL103D) 3D seismic volume, with accompanying geoseismic interpretation. The Middle and Lower Jurassic section is severely eroded on the crest of the fault block cored by the large salt roller, with a thicker section preserved in the hanging-wall of the fault bounding the structure.

Fault-style:

- The Zechstein Group acts as the main mechanical detachment in the Slyne and Erris basins, decoupling the pre-salt Palaeozoic basement from the Mesozoic post-salt section.
- The majority of post-salt faults are listric, soling out in the Zechstein Group. In the 2000/08 3D seismic volume, only 3 of 188 interpreted post-salt faults are hard-linked (~2%).

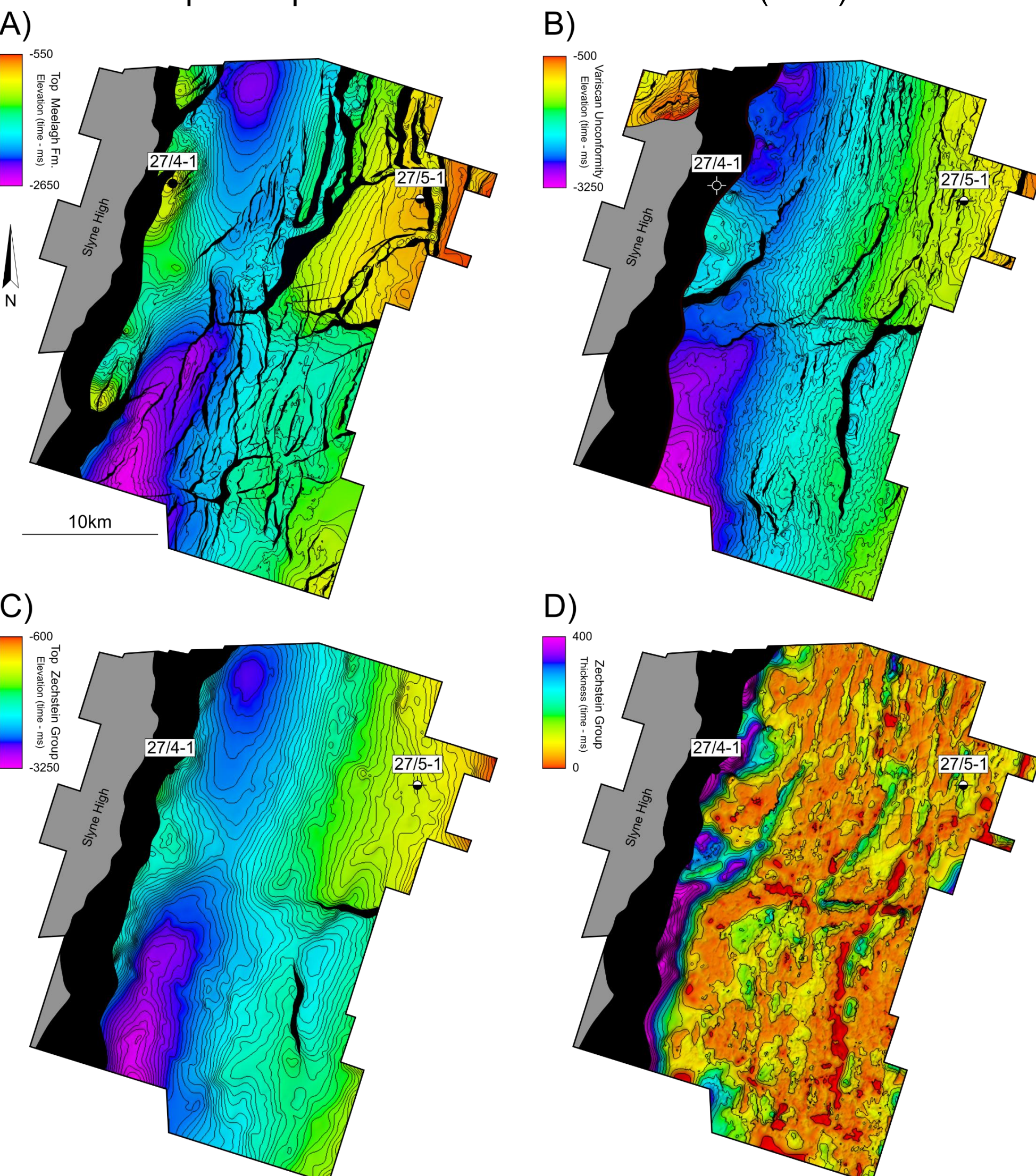


Figure 6: A) Top Triassic time-structure map. Large listric faults are formed on the low-strain side of the basin, which are slightly oblique to the main basin-bounding fault B) Variscan Unconformity time-structure map C) Top Zechstein Group [Top Salt] D) Zechstein Group thickness map (isochron). Several welds are formed across the survey, while the Zechstein Group is thickest adjacent to the basin-bounding fault.

Implications for future exploration:

- The presence of salt determines the style of faulting, with salt-prone areas experiencing thin-skinned, basement detached faulting during rifting
- Salt movement has taken place at multiple stages throughout the development of the Slyne and Erris basins. Understanding when and where is crucial to understand when traps form and how they change throughout basin development. Two examples of how this impacted hydrocarbon exploration are shown below:

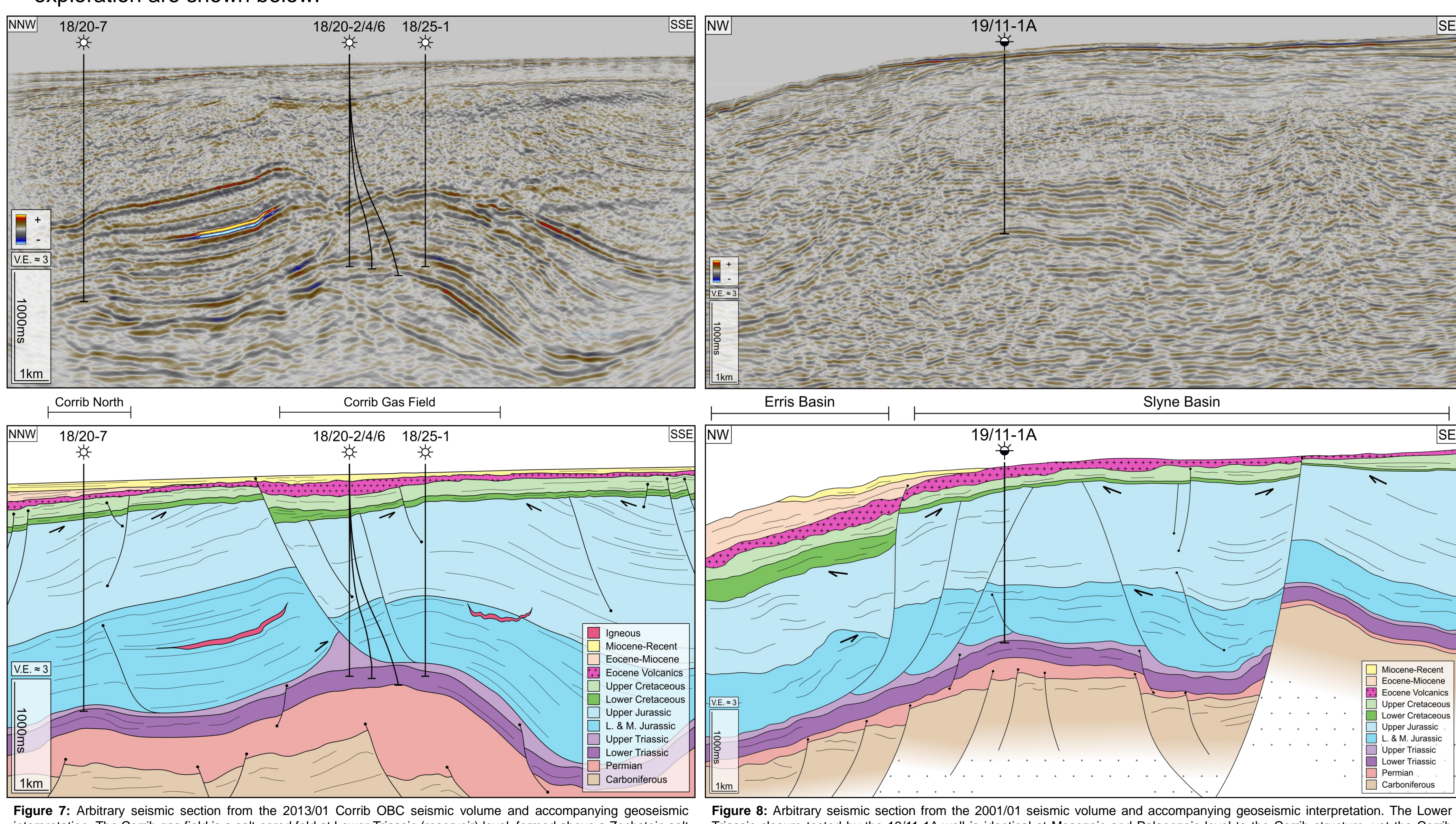


Figure 7: Arbitrary seismic section from the 2013/01 Corrib OBC seismic volume and accompanying geoseismic interpretation. The Corrib gas field is a salt-cored fold at Lower Triassic (reservoir) level, formed above a Zechstein salt pillow. A small diapir of Uilleann Halite has formed in the footwall of a major delamination fault in the Jurassic post-salt section, with a complex rollover geometry in the hanging-wall. The structural closure at the Corrib Sandstone Fm. Level is underfilled (~55% of total closure filled) due to further post-charge doming of the Zechstein during the Cretaceous and Cenozoic post-rift phases, likely driven by the development of the Rockall Basin to the northwest

Figure 8: Arbitrary seismic section from the 2001/01 seismic volume and accompanying geoseismic interpretation. The Lower Triassic closure tested by the 19/11-1A well is identical at Mesozoic and Palaeozoic level to the Corrib structure, yet the Corrib Sandstone Fm. was water wet. The pressure regime encountered is similar to Corrib, suggesting the Uilleann Halite is providing an effective seal to a valid structural closure, while gas shows in the Lower Jurassic section indicate the presence of local charge. However the dip of the post-rift unconformity (i.e. Base-Cretaceous Unconformity) dips steeply westwards due to Cenozoic post-rift thermal subsidence in the Rockall Basin, indicating the western limb of the fold closed post-charge.