

Understanding the composition and distribution of a multi-layered salt-prone stratigraphy, and it's role in rift basin development:
Insights from the Slyne and Erris basins, offshore NW Ireland

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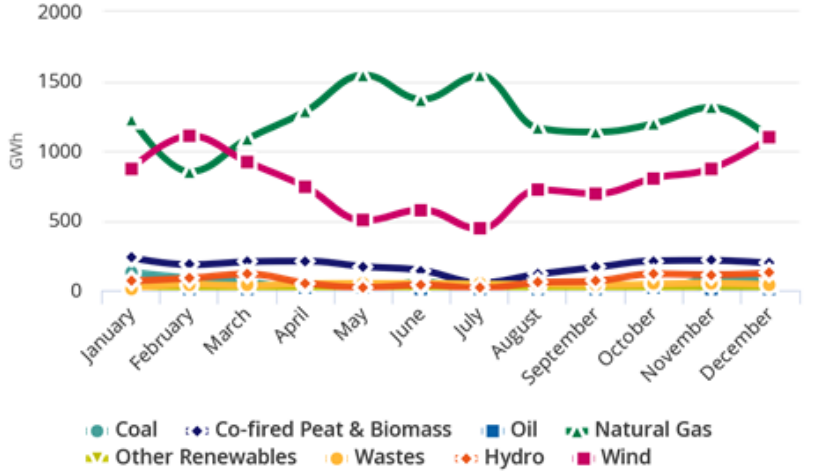
Photo © Patryk Sadowksi

Research Rationale

- Salt tectonics poorly understood offshore Ireland
  - Salt proven in several wells
  - Salt plays key role in gas discoveries on Irish Atlantic margin (excellent seal)
  - Regional distribution and composition uncertain
- Societal impact
  - Future gas discoveries (energy security)
  - Possible CO_2 storage sites (climate change)
  - Relevance to mining onshore (critical metal supply)

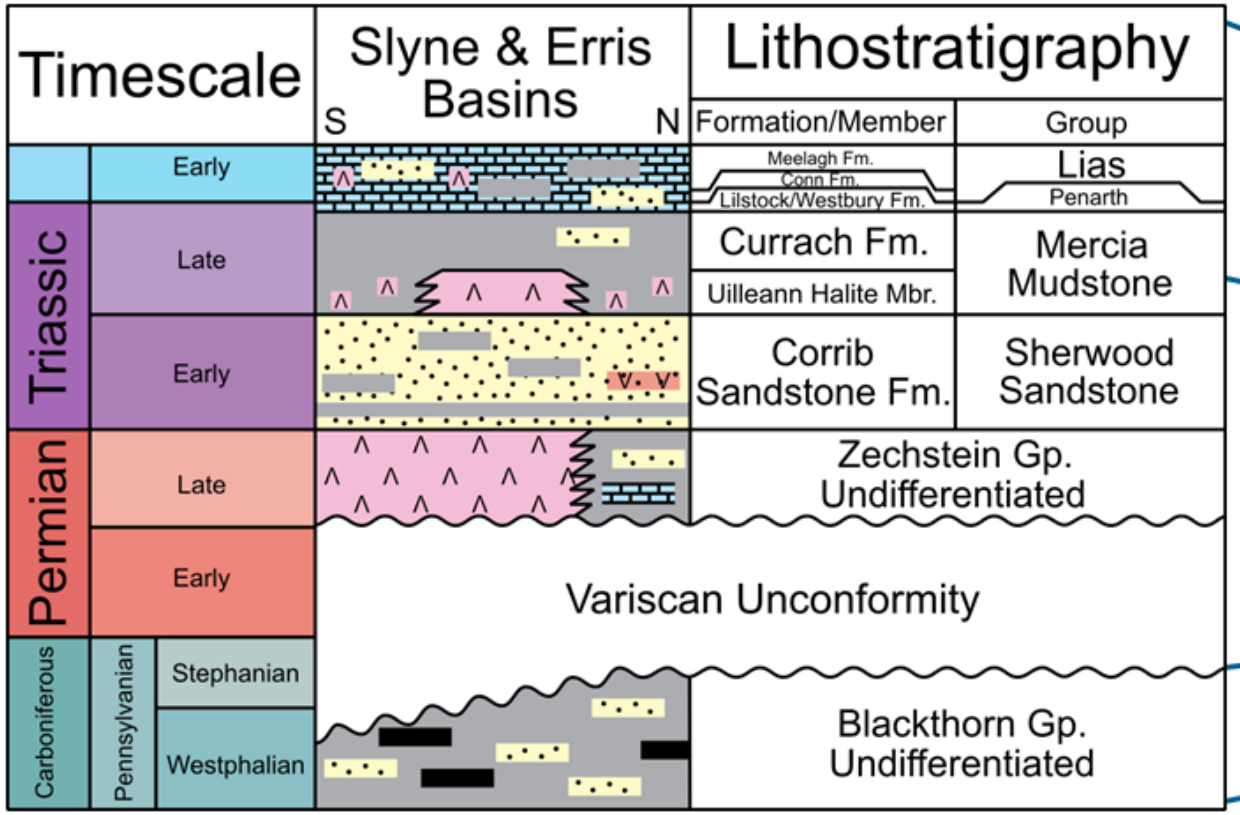


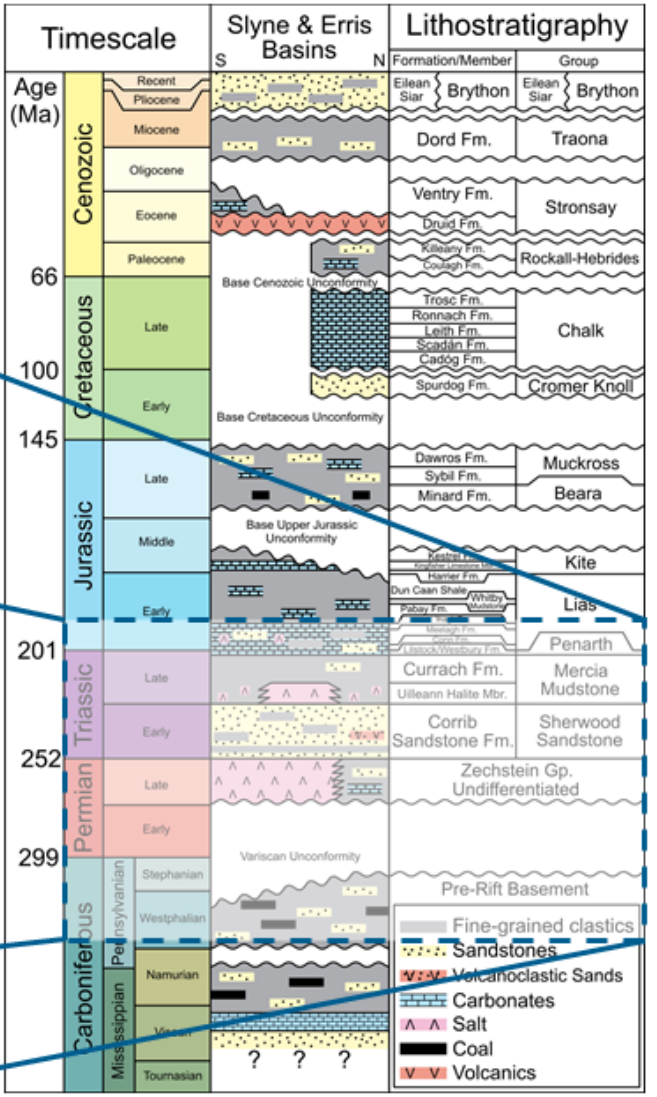
Electricity generation in Ireland by fuel type in 2019 (SEAI, 2020)



Salt on the Irish Atlantic margin

- Two main layers proven to date:
  - Upper Triassic **Uilleann Halite Member** (part of Currach Fm.)
  - Upper Permian **Zechstein Group**
- Salt also encountered locally in Mississippian and Lower Jurassic





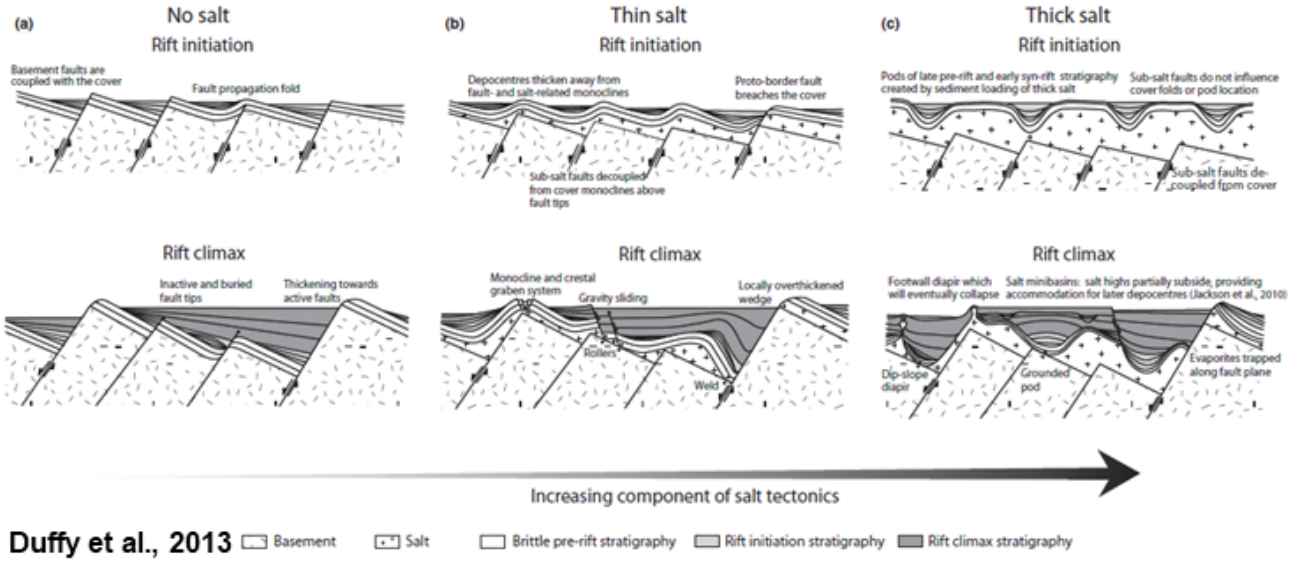
Mapping the distribution of salt

Well Data

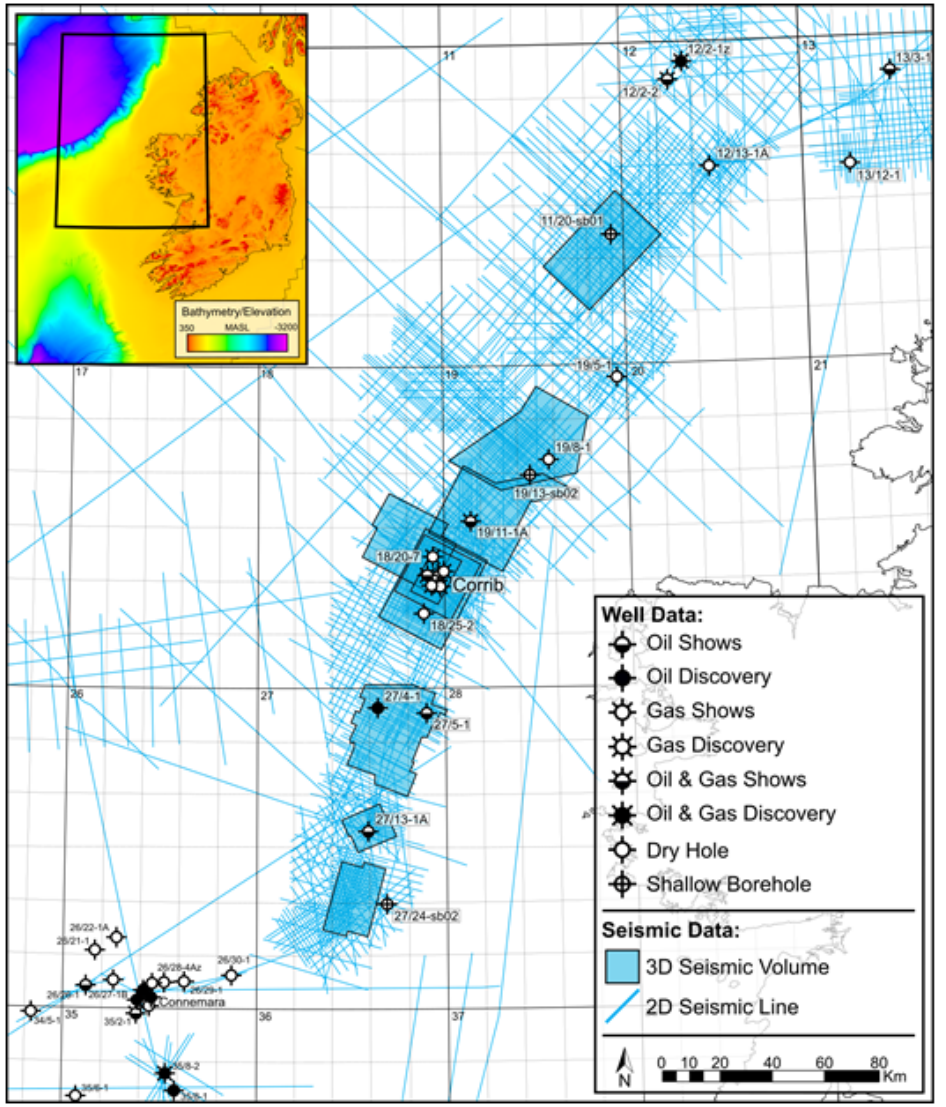
- Few well penetrations
- Average of 55 km separation per penetration in Permian section

Seismic Data

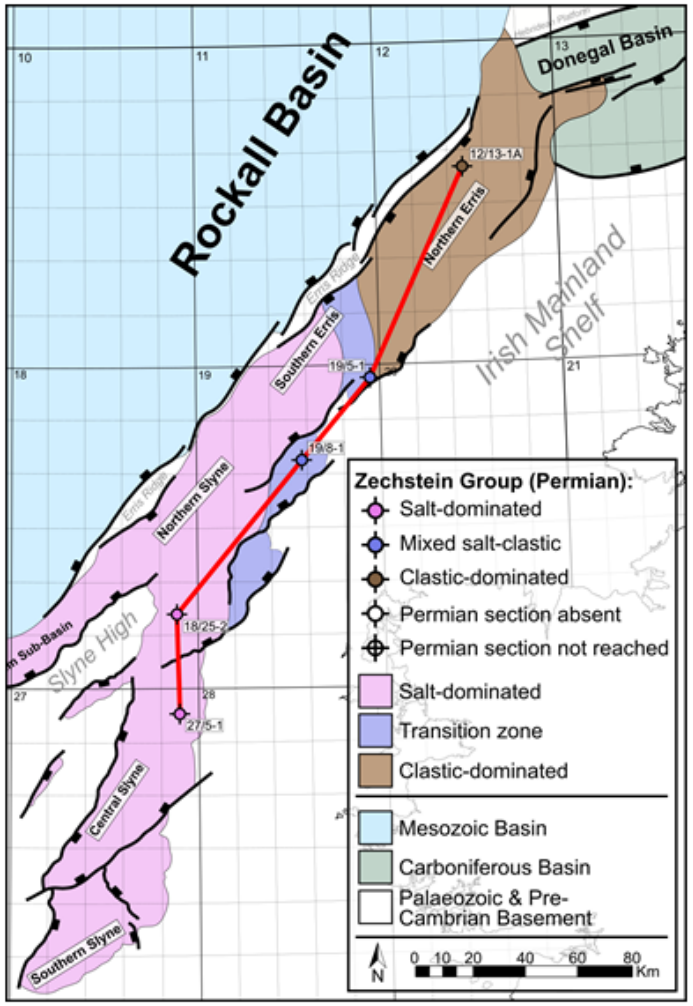
- Salt acts as décollement and will mechanically detach sub- and supra-salt sections

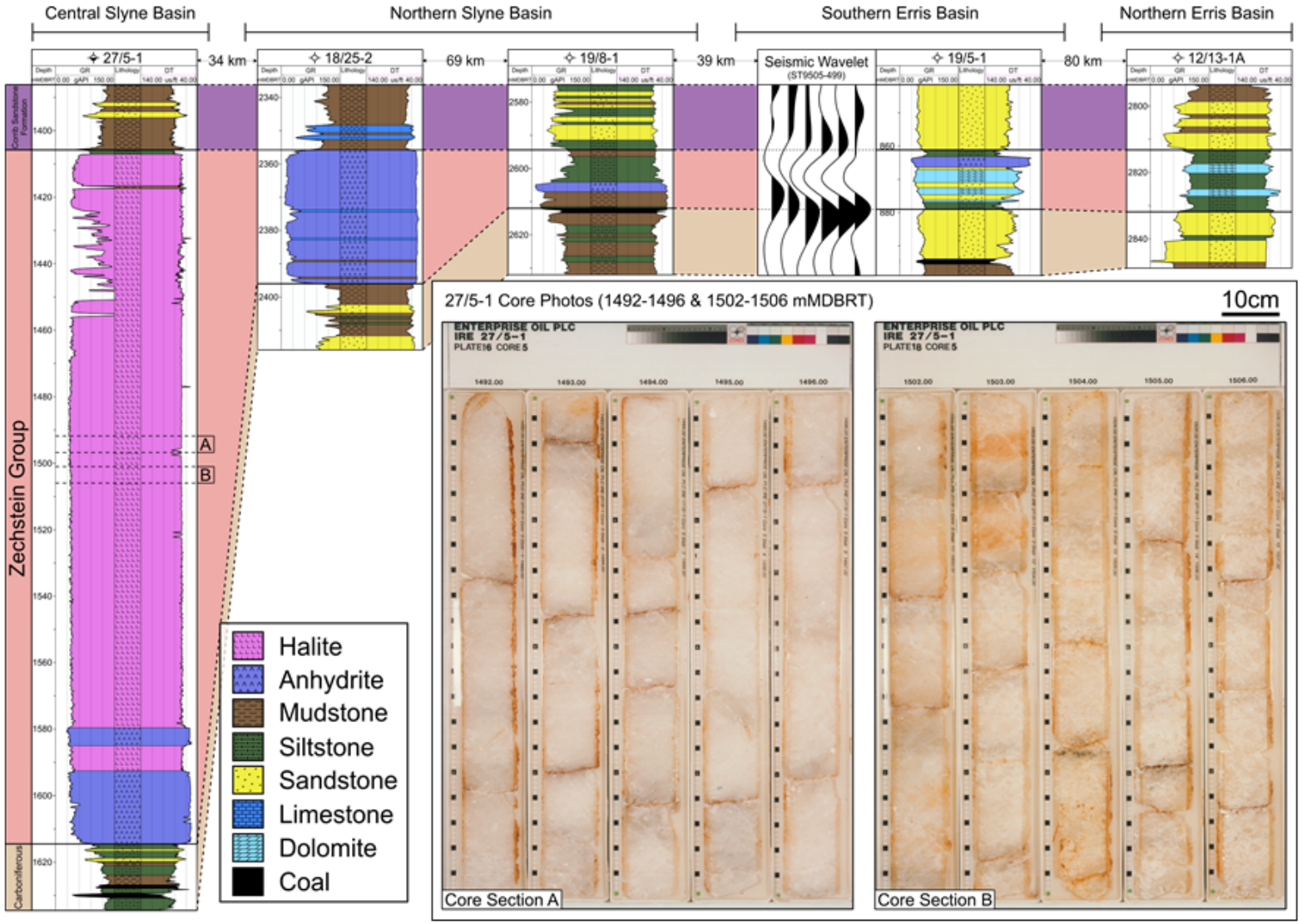


Duffy et al., 2013

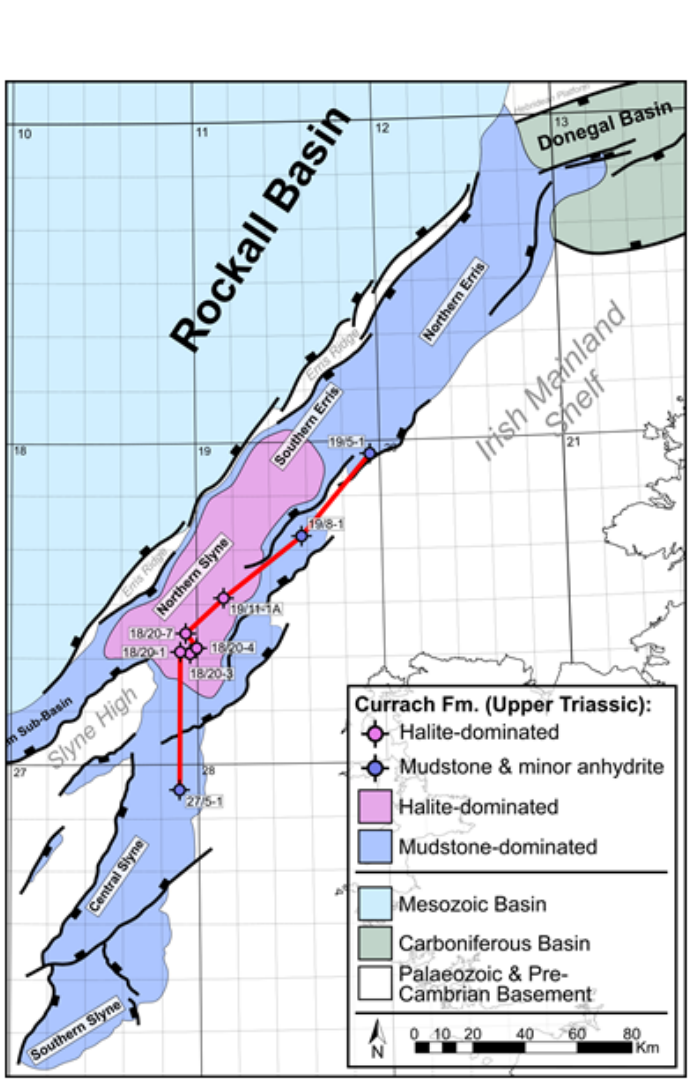


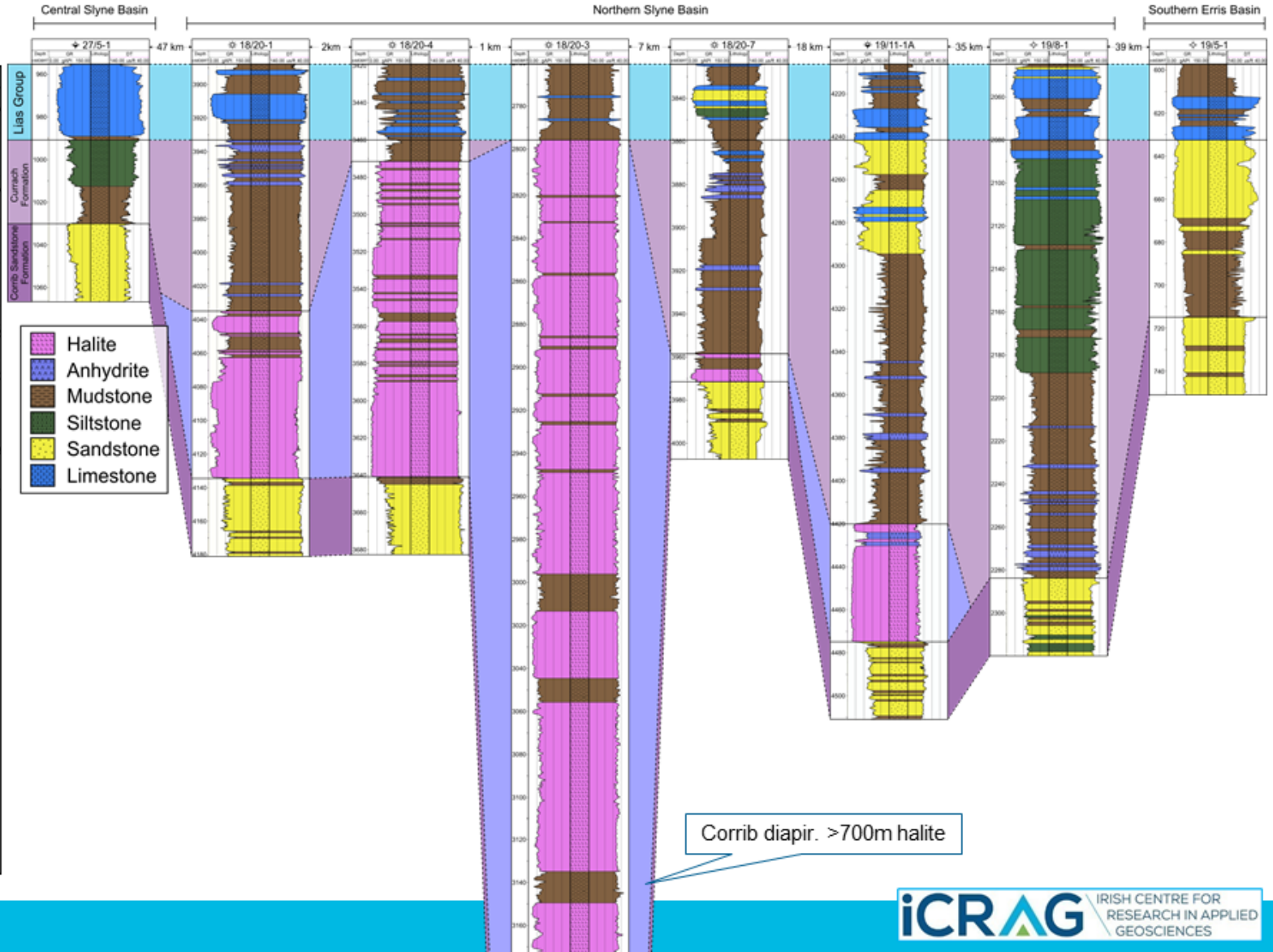
Zechstein Group Well Data





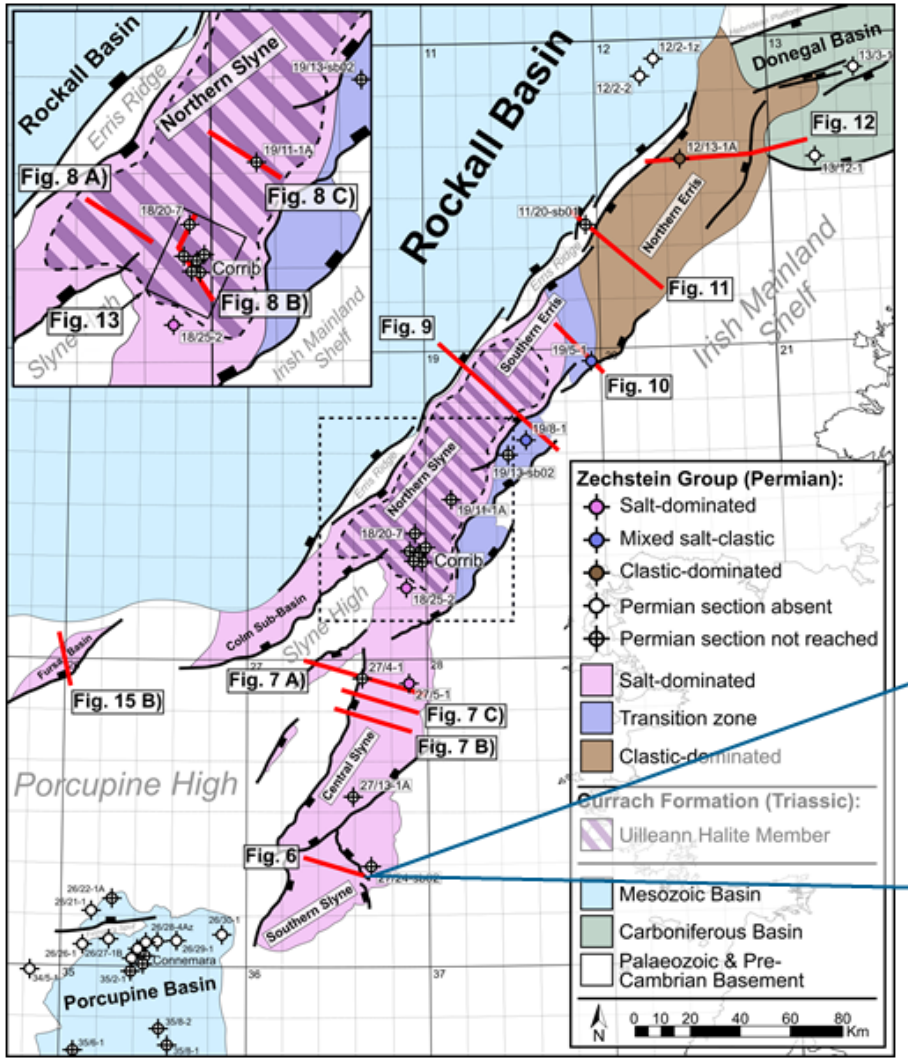
Currach Formation Well Data

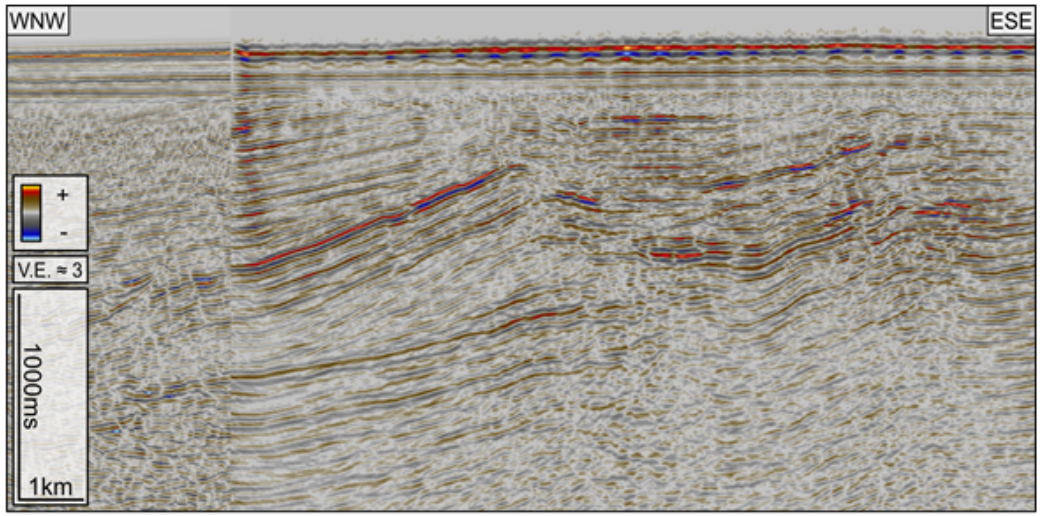




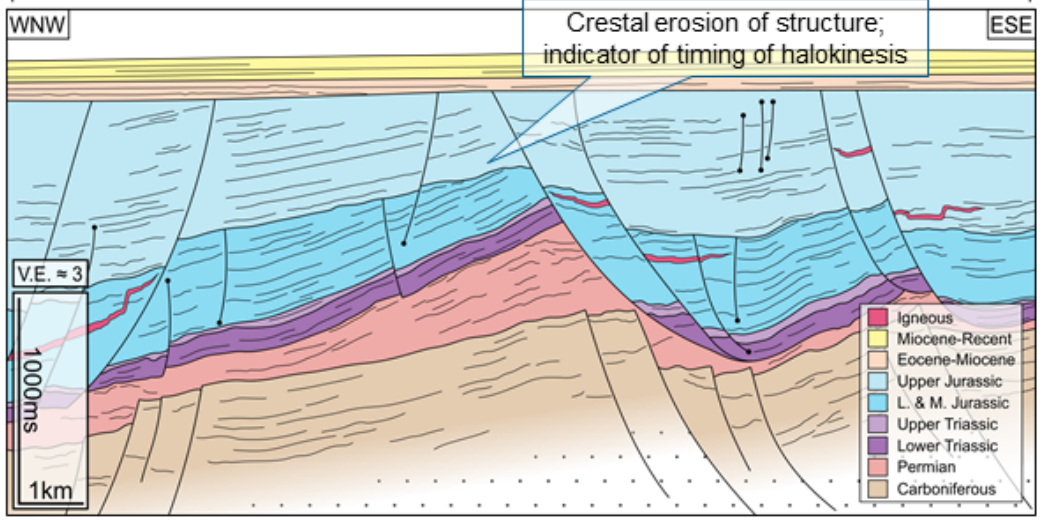
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Southern Slyne: Reactive diapirs

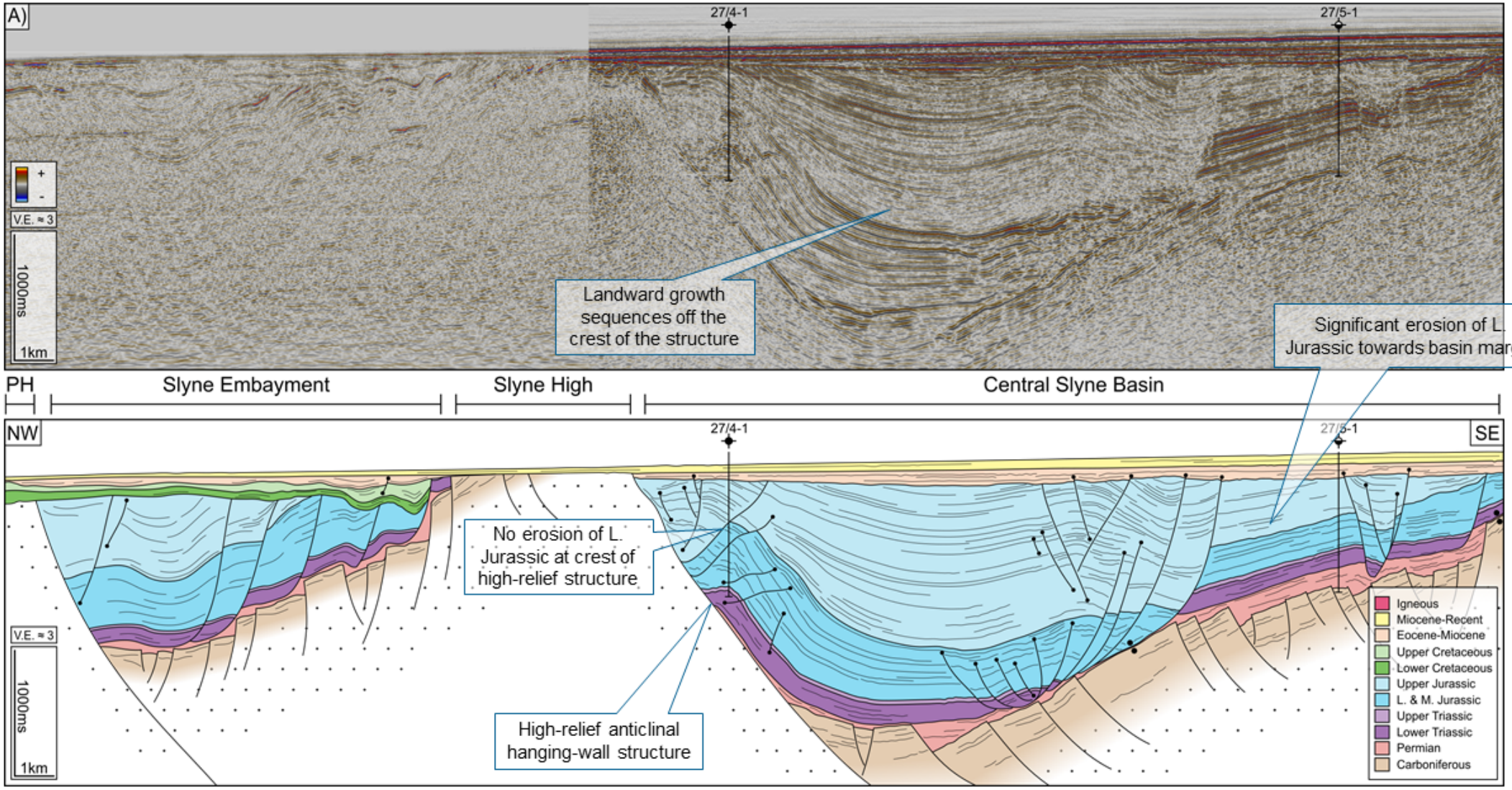




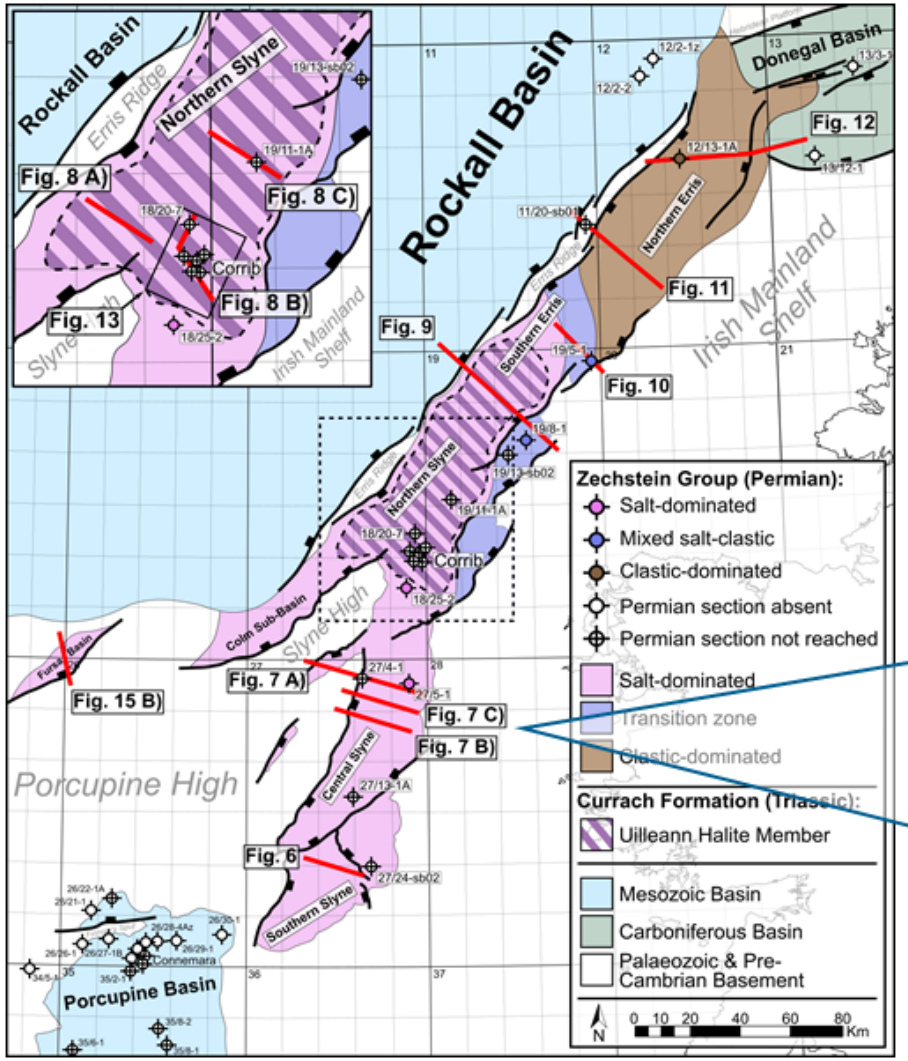
Southern Slyne Basin



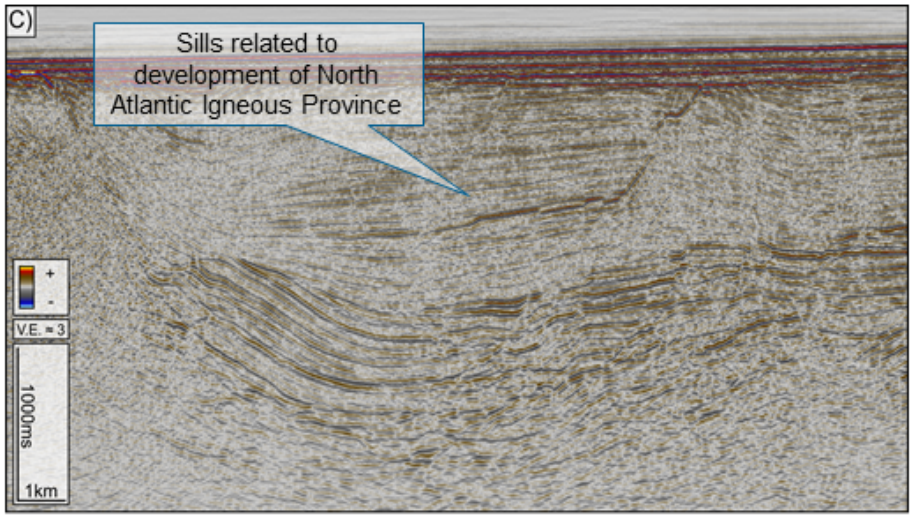
Central Slyne: Complex Hanging-Wall Geometries



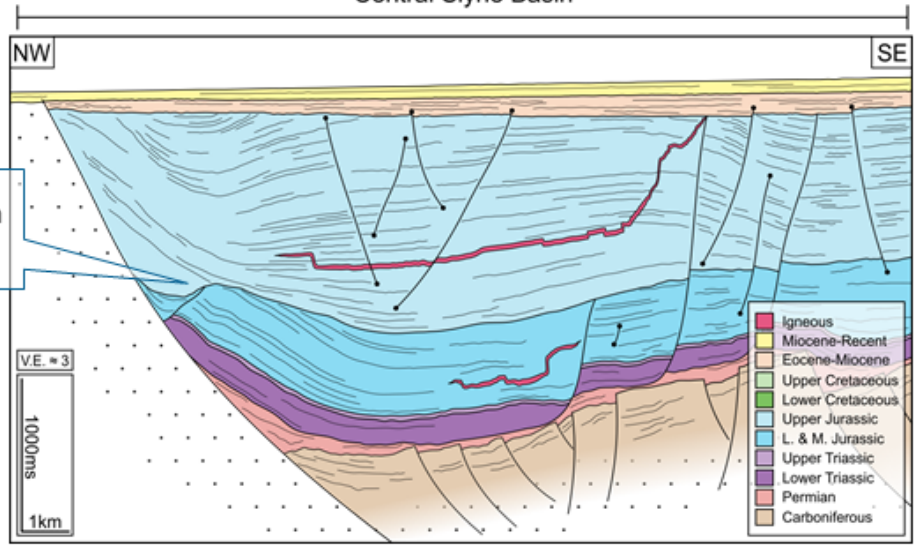
Central Slyne: Along-strike variation



Along-strike erosion at lower-relief location relative to previous structure

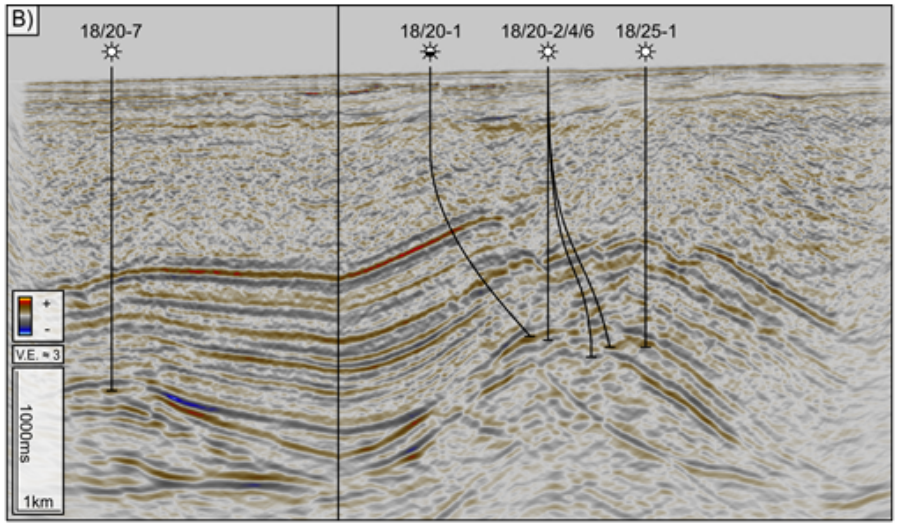


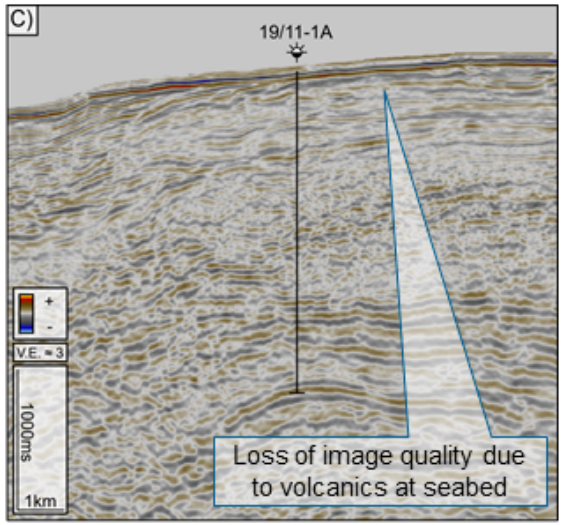
Central Slyne Basin

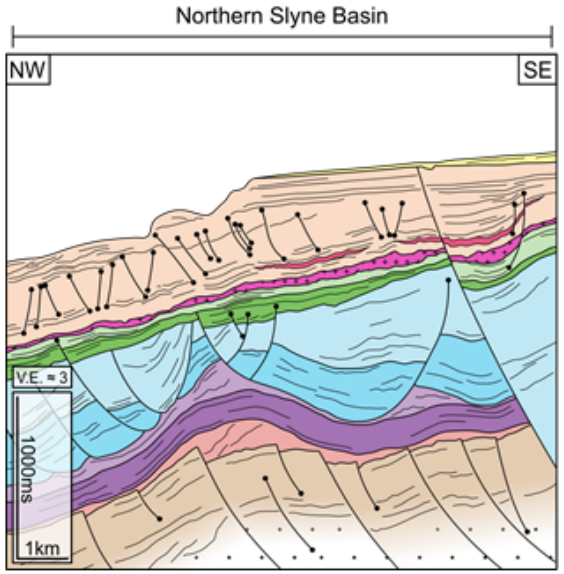


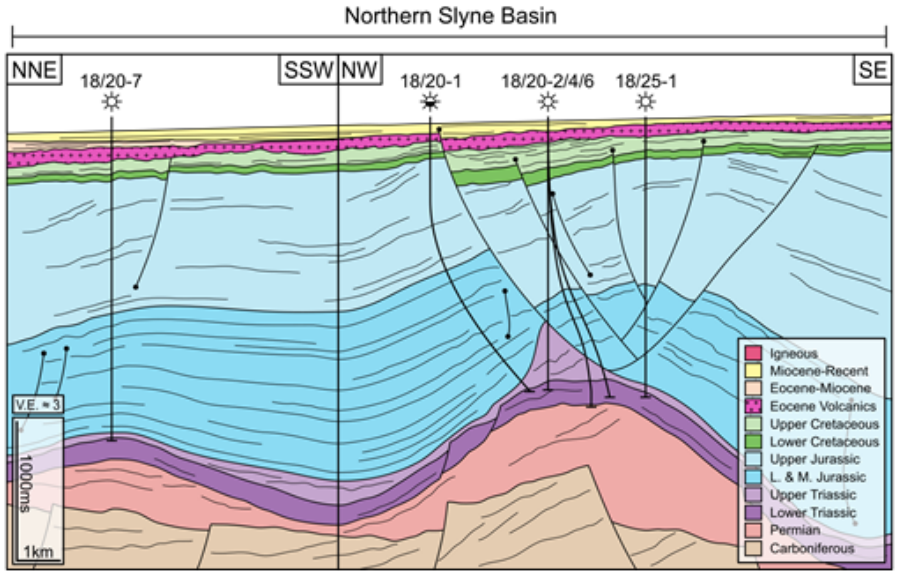
Northern Slyne: Salt pillows

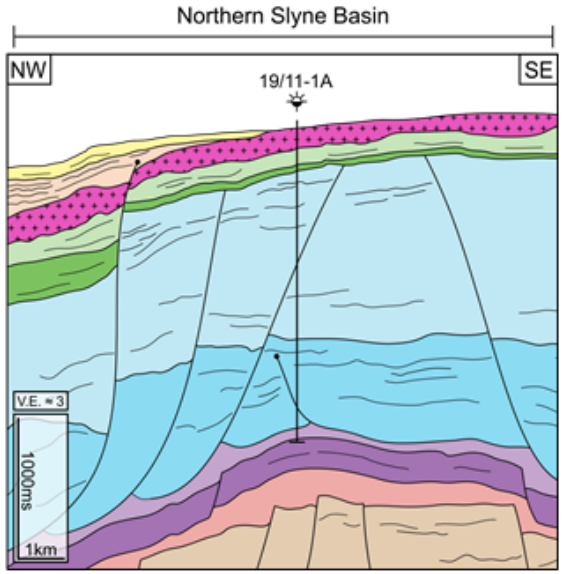
Seismic data confidential



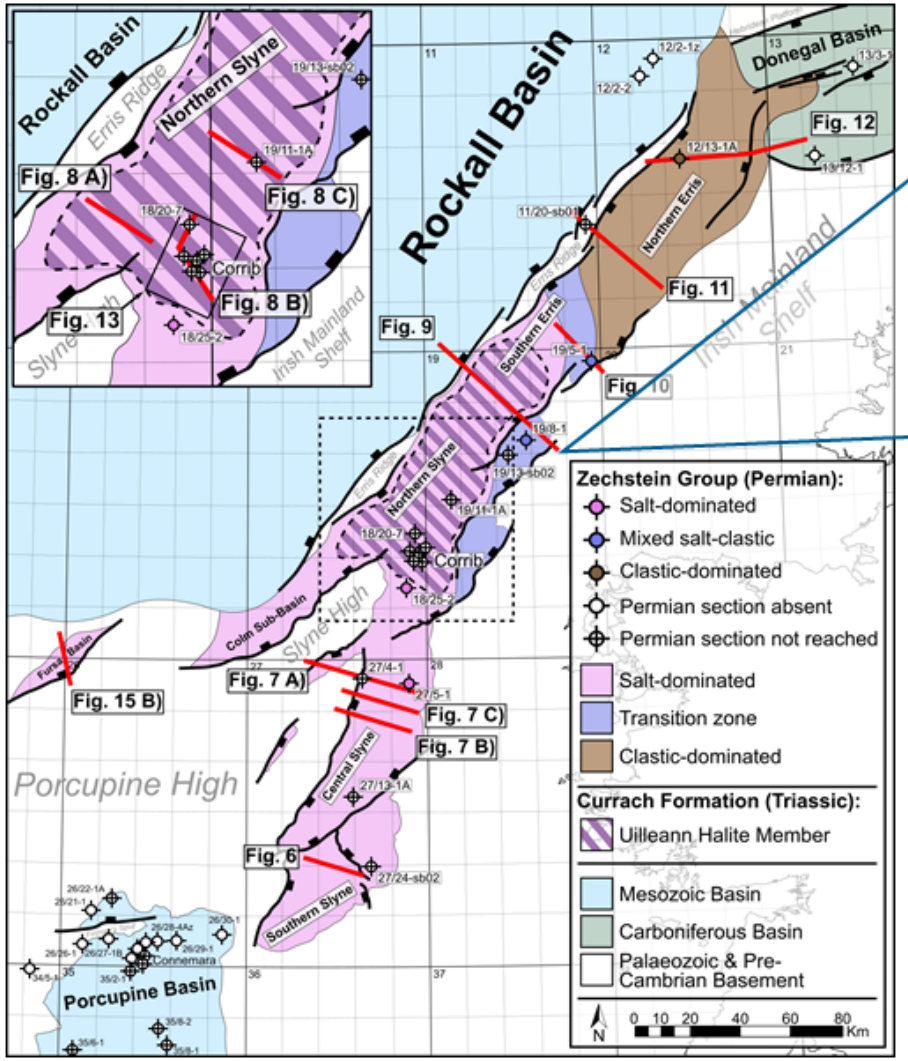


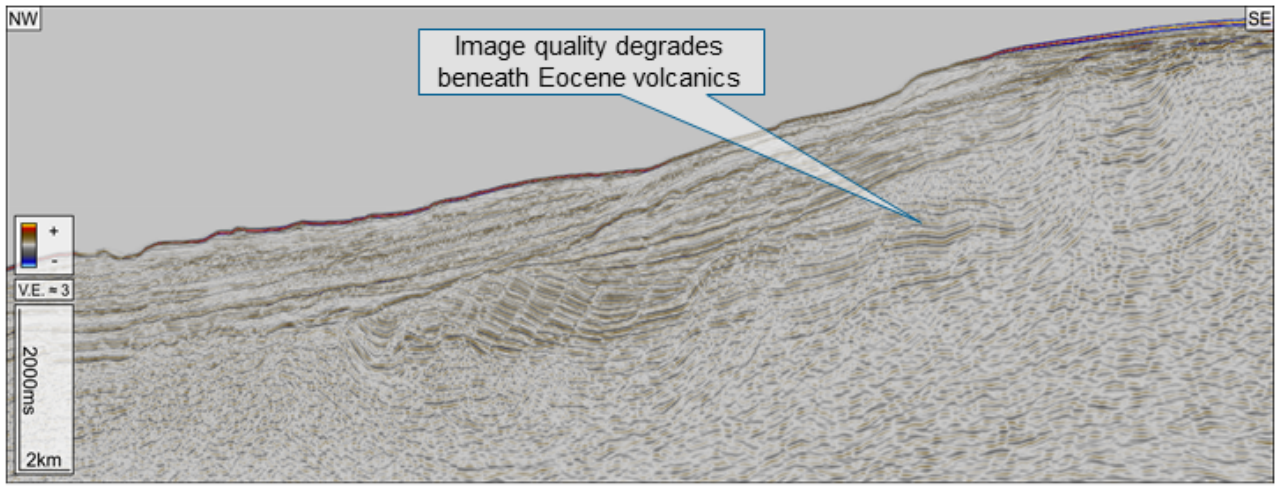


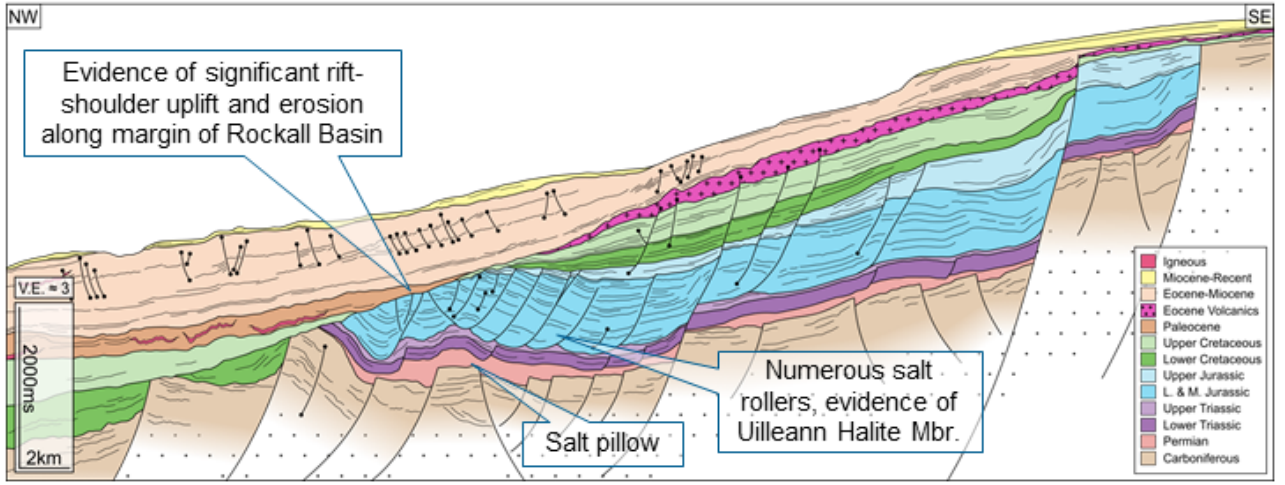




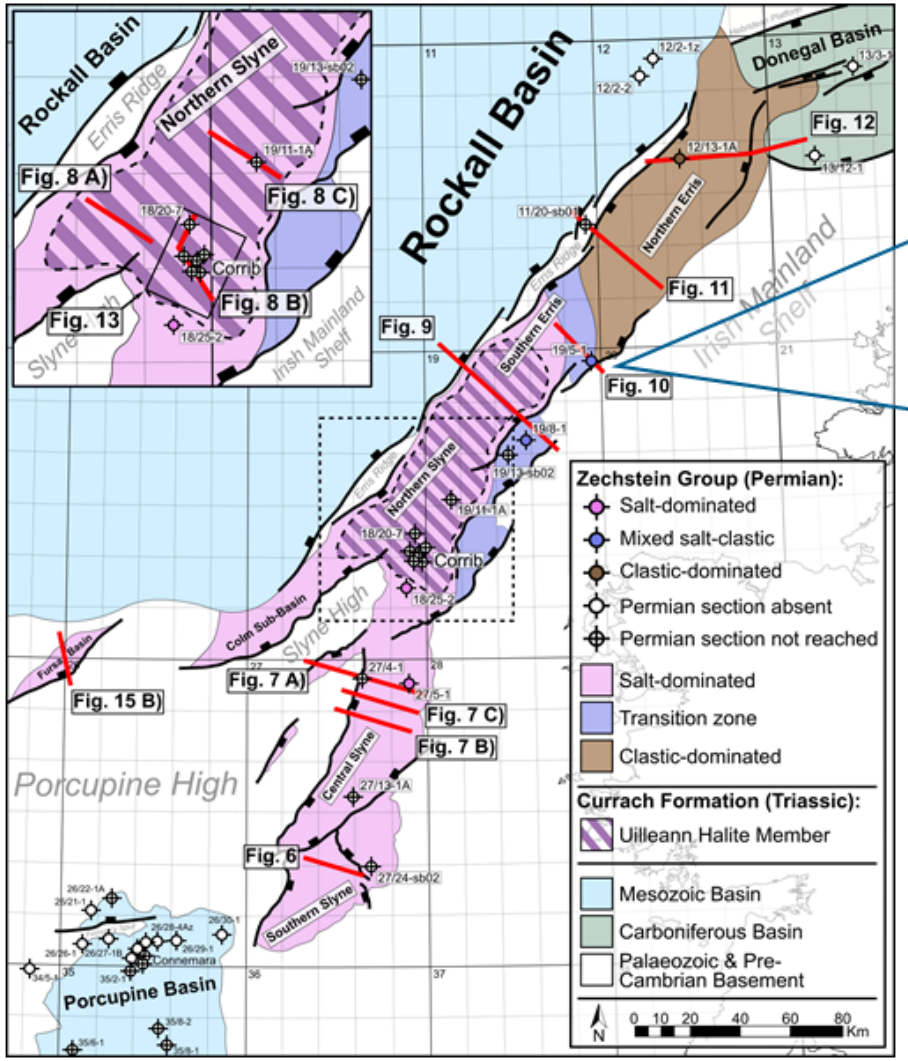
Southern Erris: Influence of the neighbouring Rockall Basin

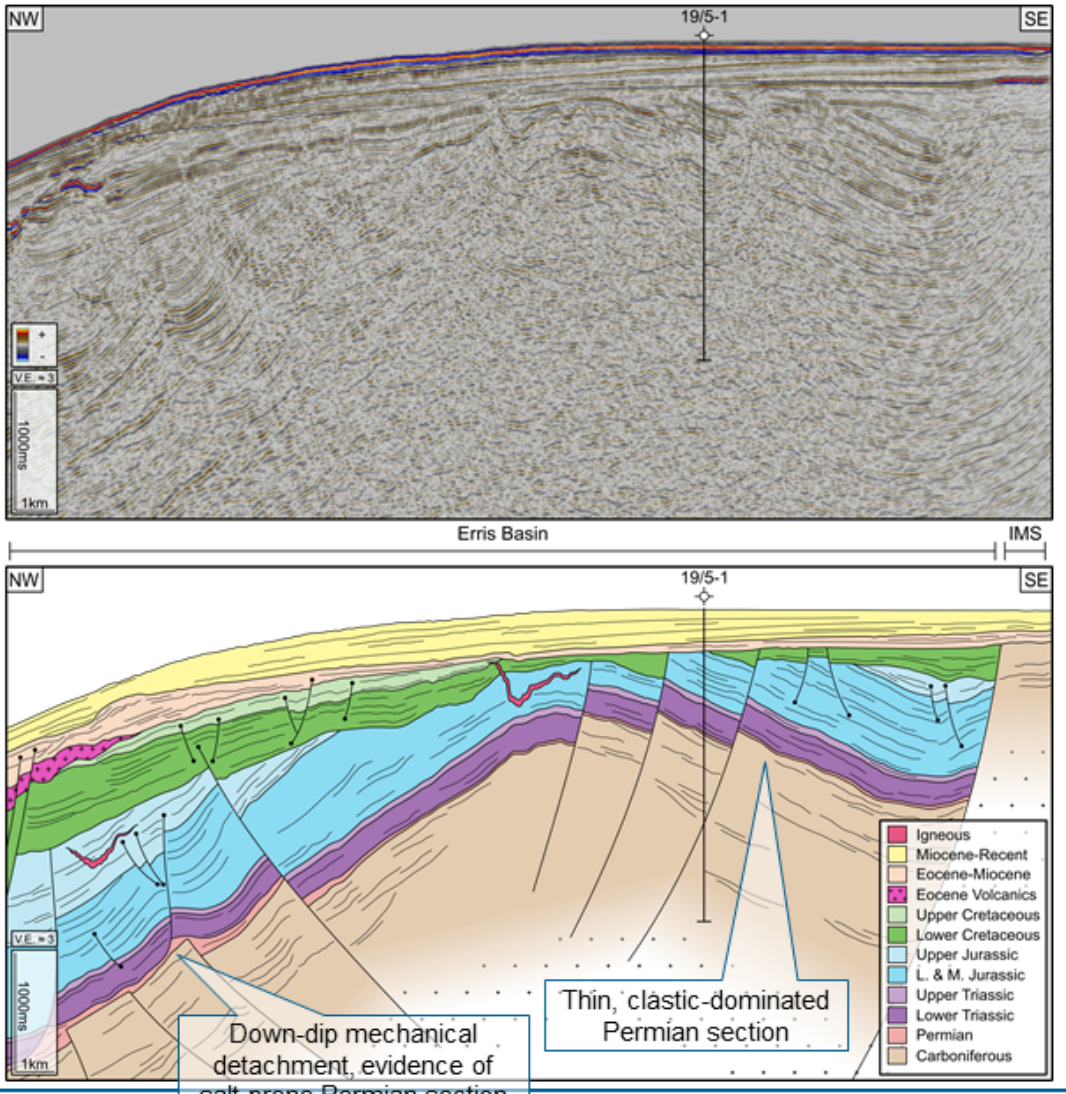




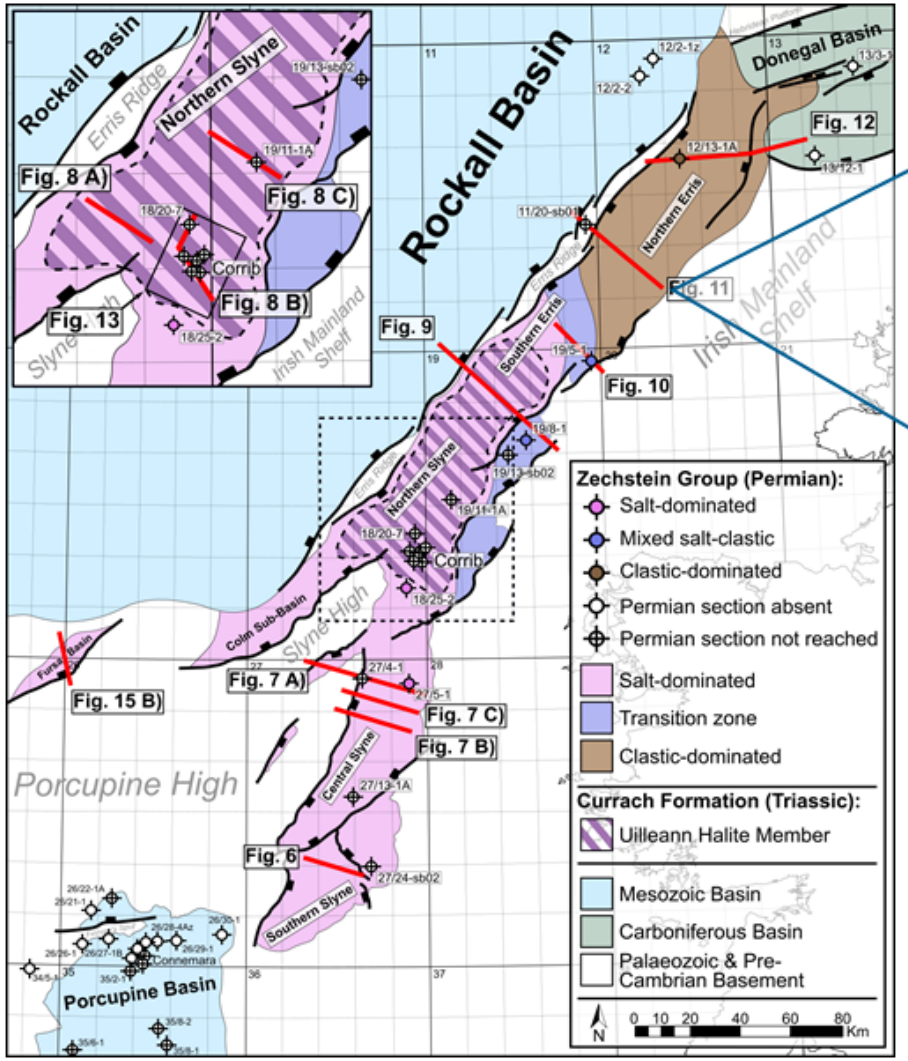


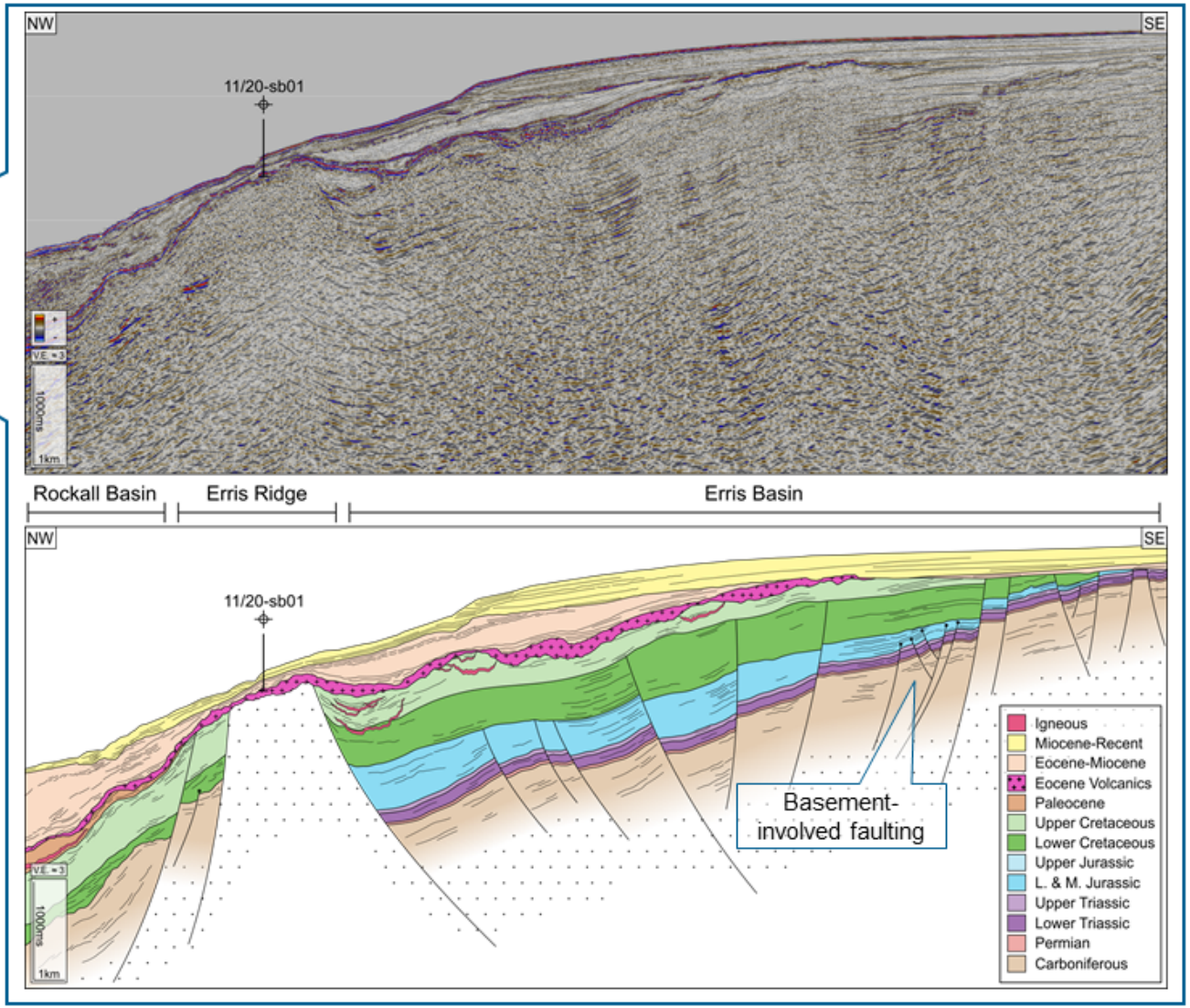
Southern Erris: Transition to clastic dominated



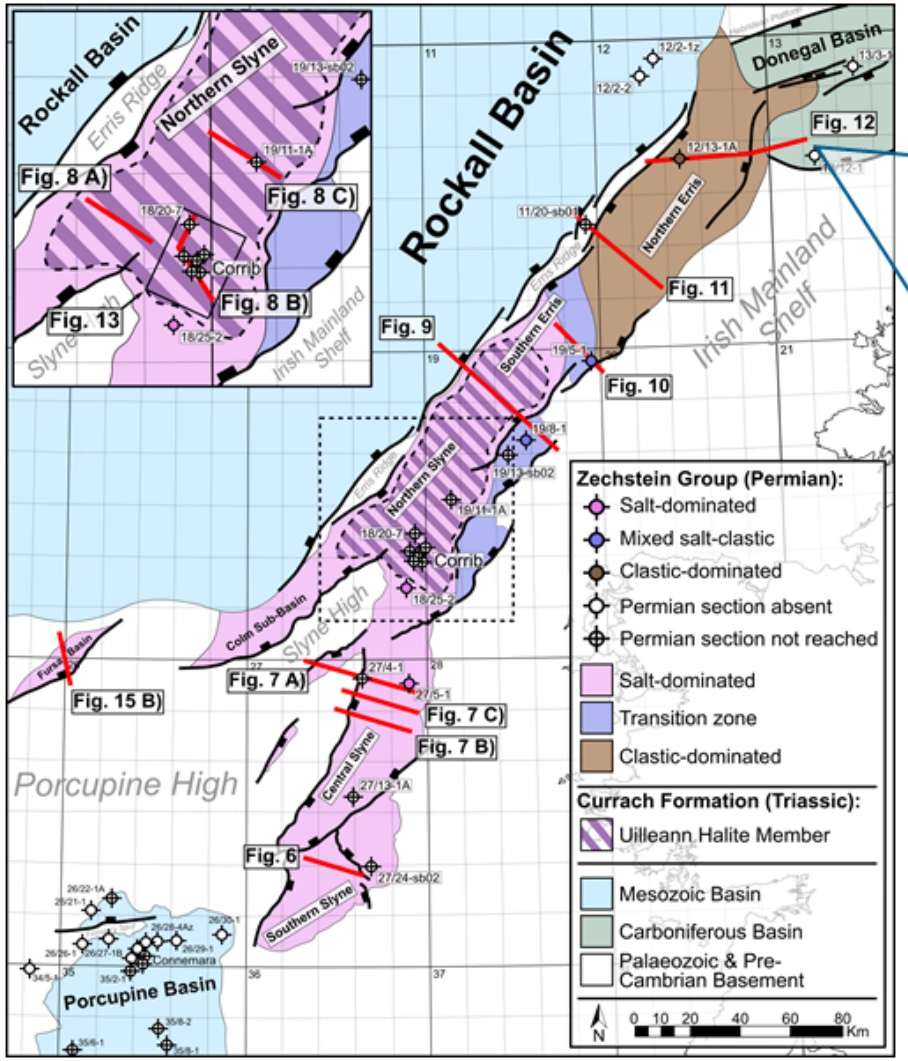


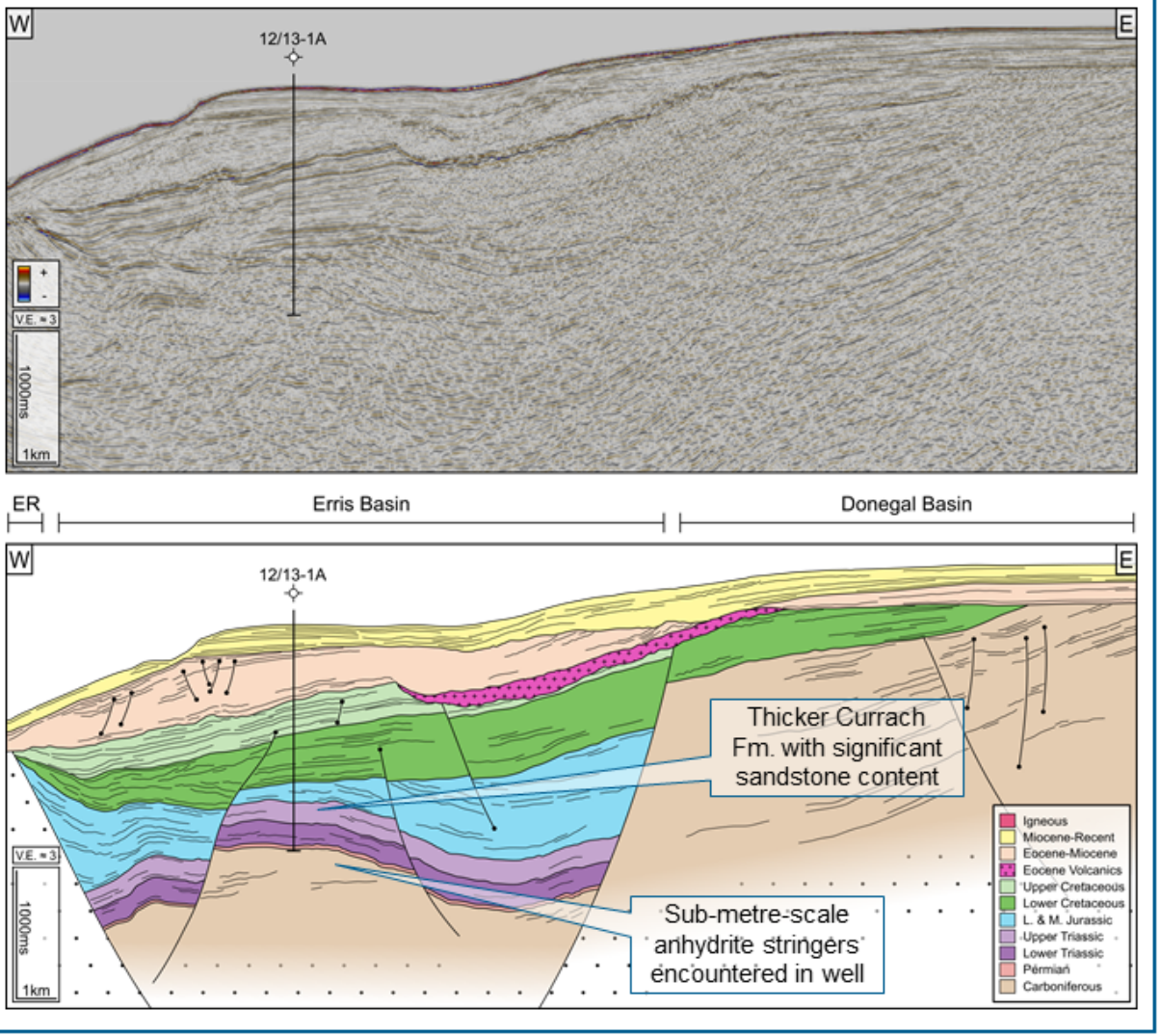
Northern Erris: Clastic-dominated, basement-involved faulting



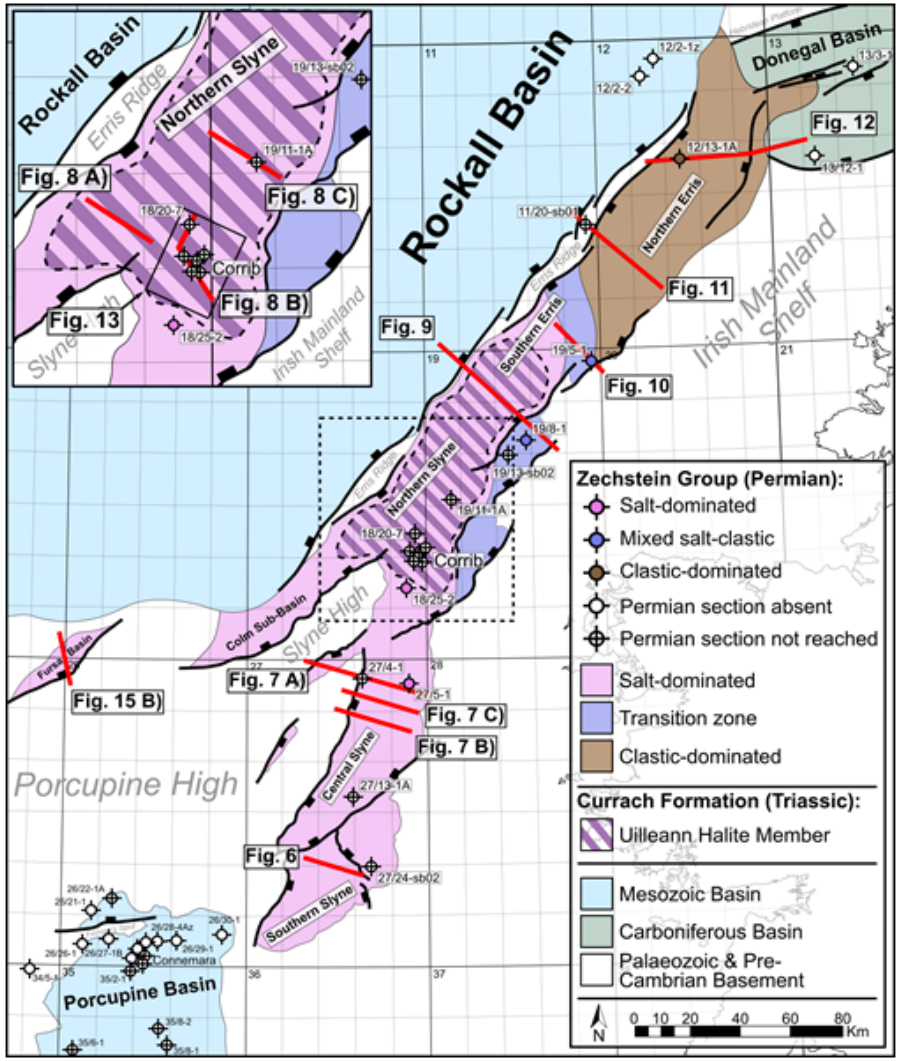


Northern Erris: Clastic-dominated, basement-involved faulting



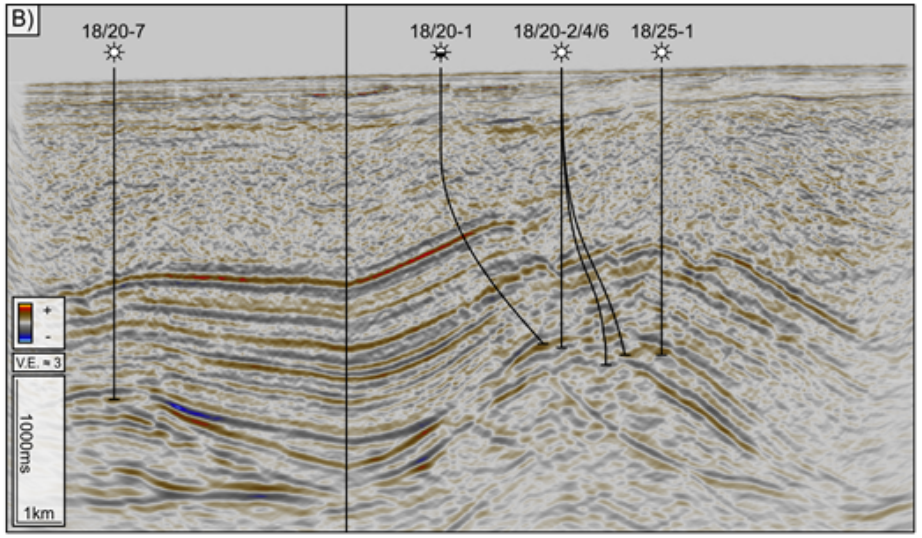


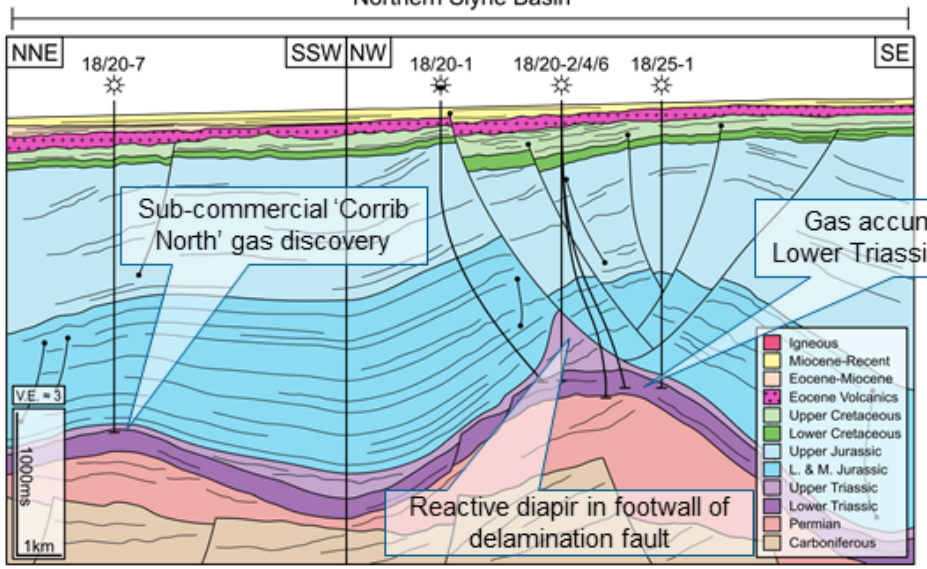
Salt Distribution: a better understanding

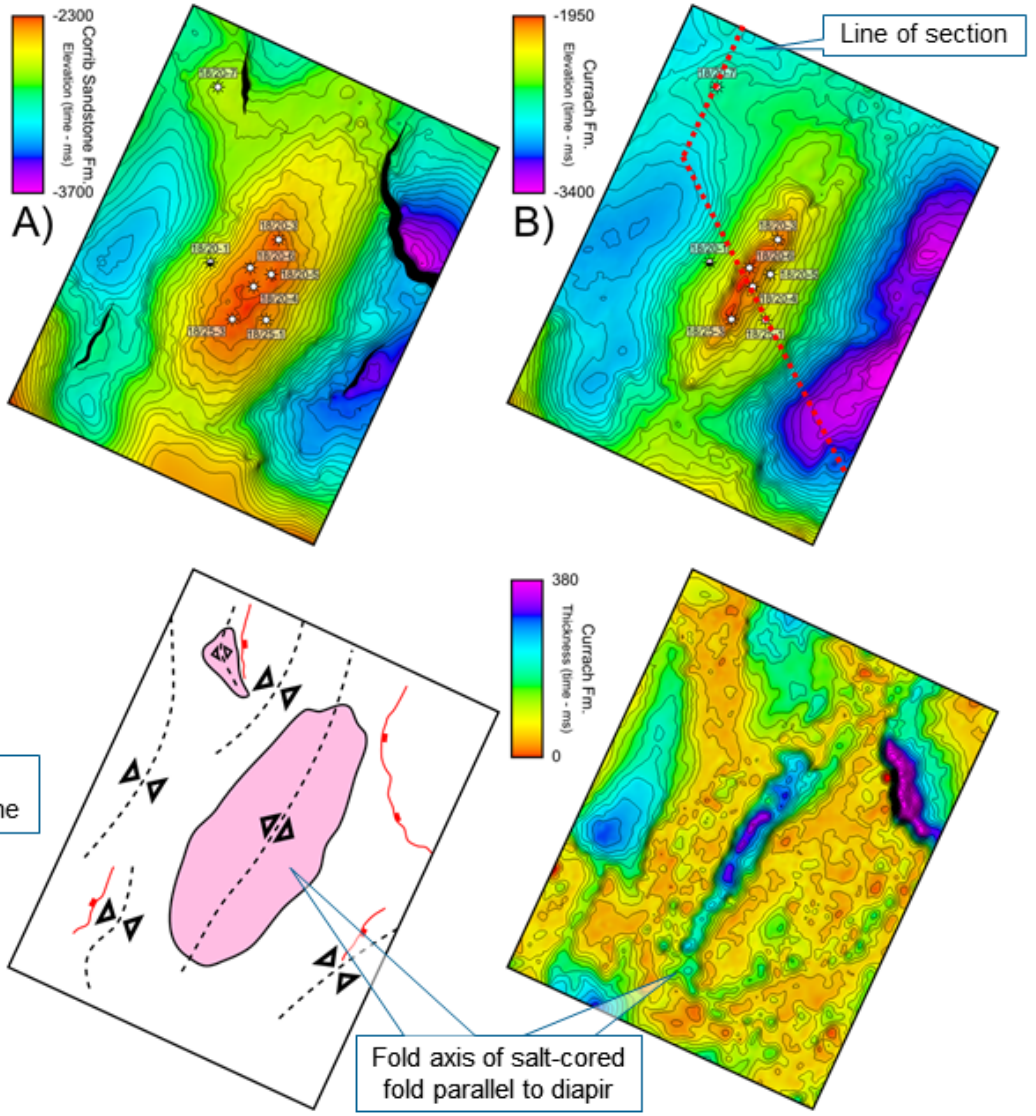


- **Zechstein Group:**
  - Salt-prone in Slyne and southern Erris basins
  - Clastic & carbonate-prone in northern Erris Basin
- **Currach Formation:**
  - Mudstone prone throughout the study area, with thin anhydrite stringers
  - Uilleann Halite Mbr. developed in the northern Slyne and southern Erris basins
- **Implications?**
  - N. Slyne and S. Erris are the most prospective areas for both gas exploration and future CO_2 storage

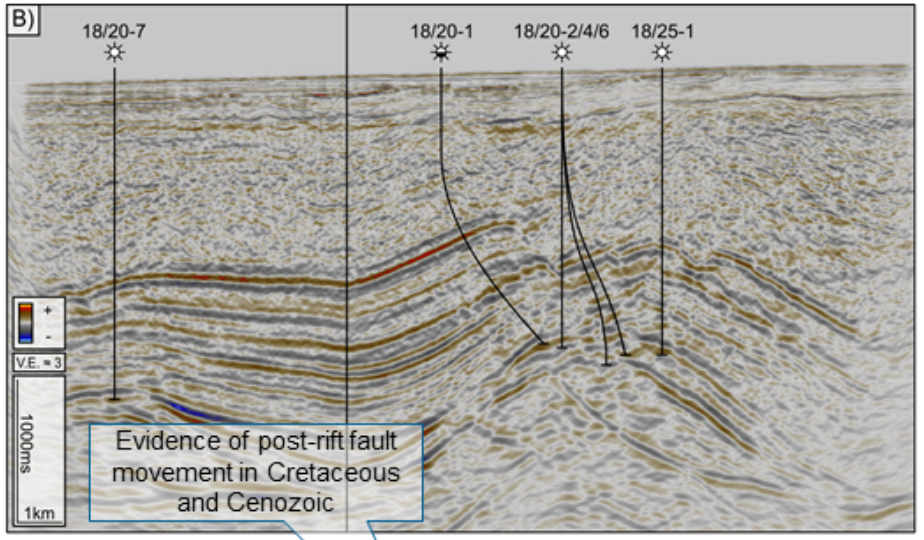
The Corrib gas field: how does it work?

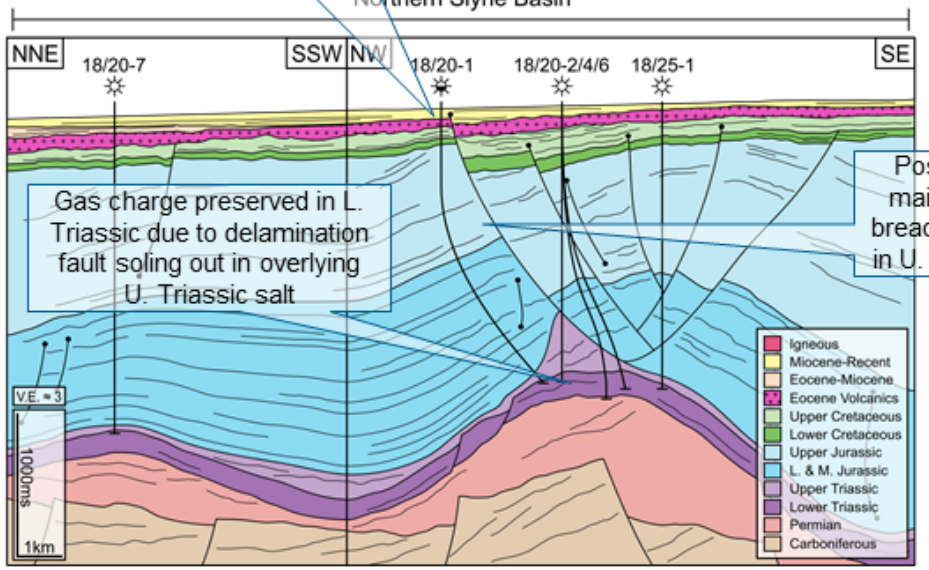


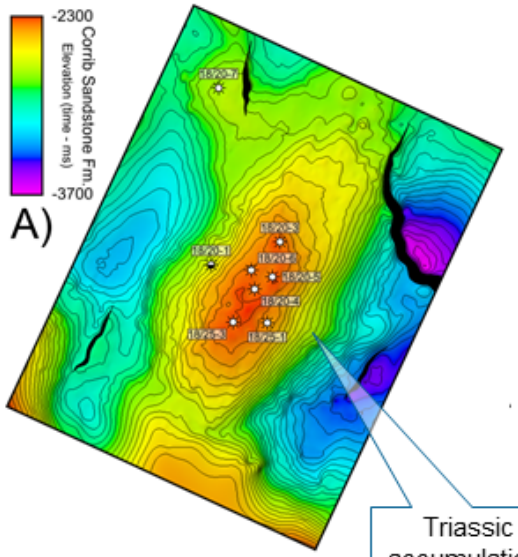


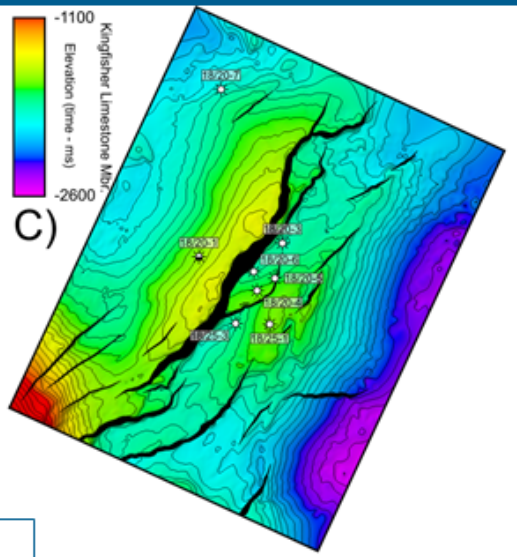


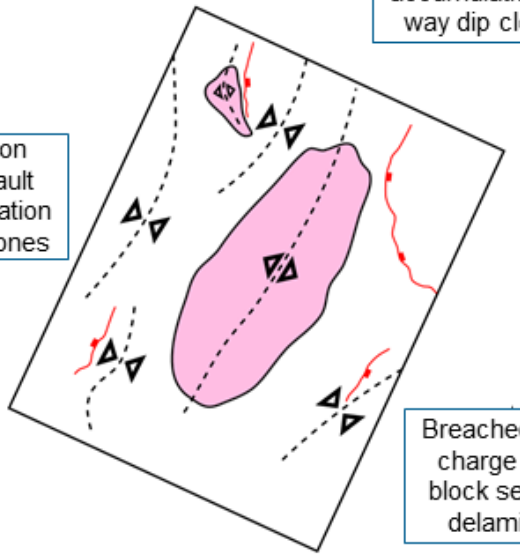
Impact of post-rift tectonics on hydrocarbon prospectivity

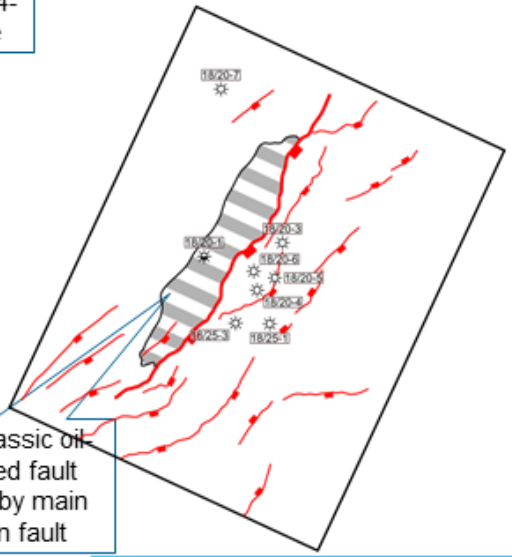






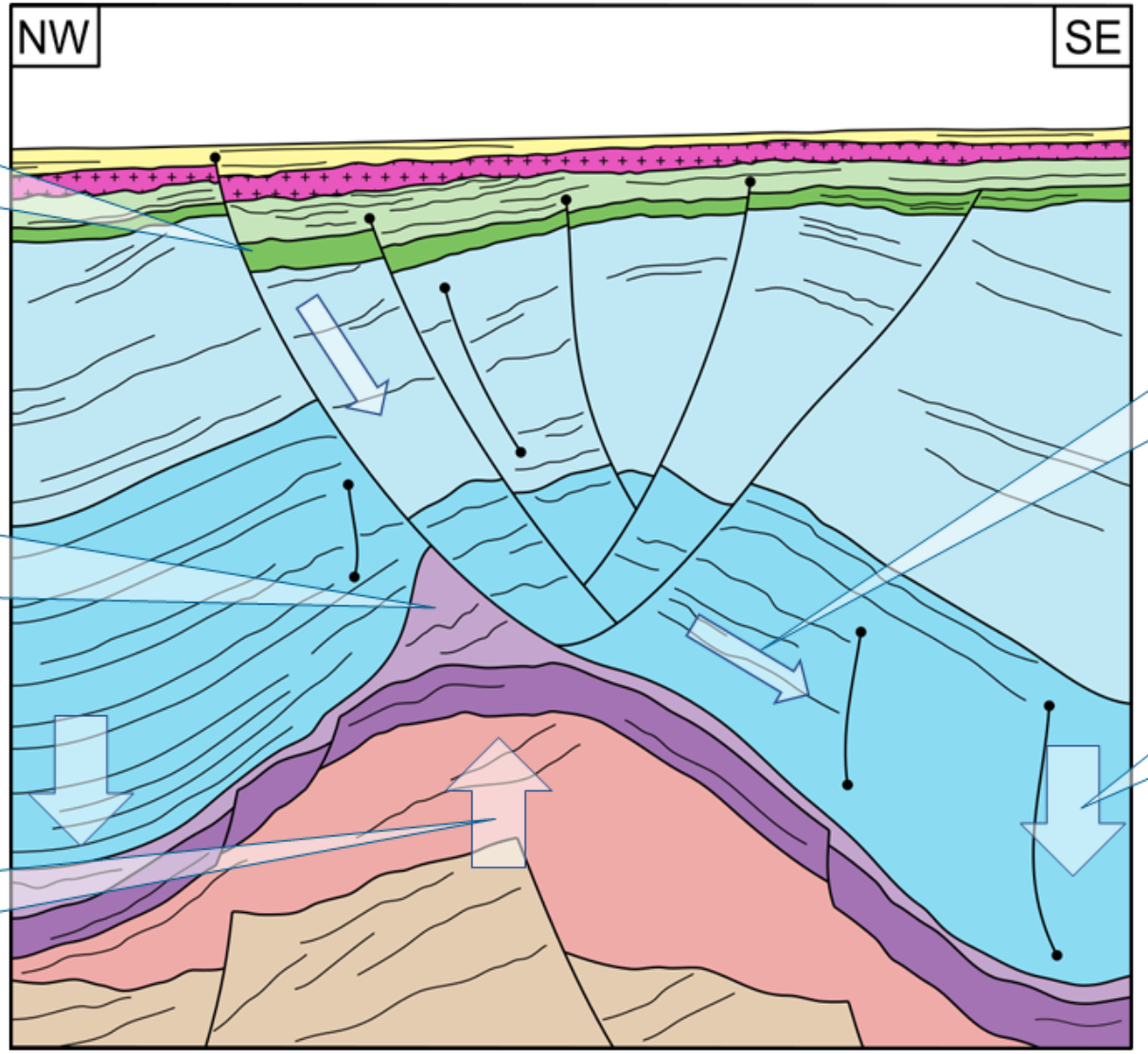






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Evolution of the Corrib structure



5. Post-rift extension during Cretaceous and Cenozoic indicates post-rift growth of salt-pillow

4. As extension continues, reactive diapir forms in footwall of main delamination fault, parallel to the axis of the salt-cored fold

1. Initial Zechstein pillow formation due to sub-salt basement faulting

2. Overburden at crest of anticline becomes unstable, delamination faults form, soling out in Uilleann Halite Mbr.

3. Additional loading in flanking synclines drives further growth of salt pillow

Conclusions

- Salt distribution better understood offshore NW Ireland
  - Northern Slyne and Southern Erris areas most prospective for gas exploration and future CO_2 storage
  - Implications for Permian paleogeography and early Atlantic rifting
- Multi-layer salt interaction driven by mechanism of positive feedback
  - Zechstein Gp. halokinesis driven by regional extension
  - Uilleann Halite Mbr. halokinesis is (predominately) reactive to the topography formed by Zechstein Gp. salt movement

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