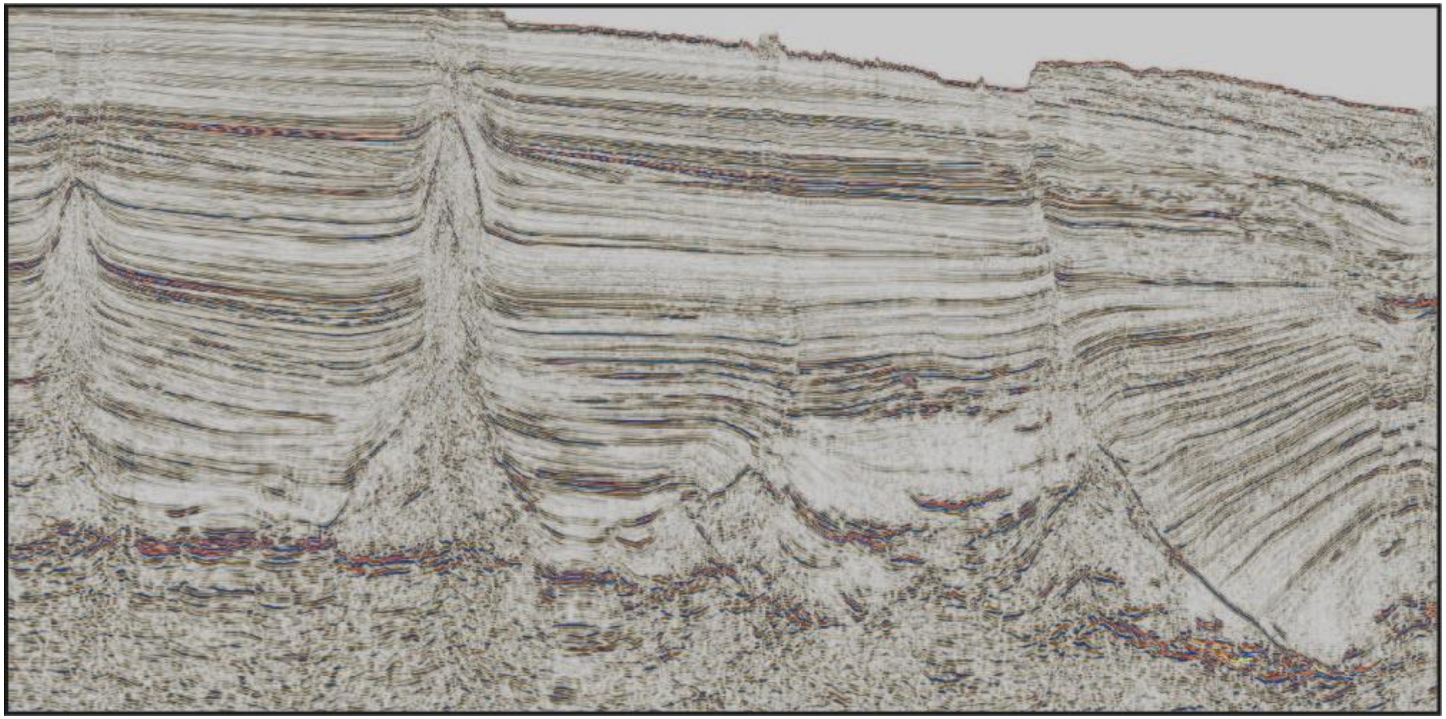
3D seismic imaging reveals salt-magma interactions in the Santos Basin, offshore Brazil



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Rationale

- Salt layers / structures common in many basins
- Magmatism common in many basins

But what happens when salt and magma interact?

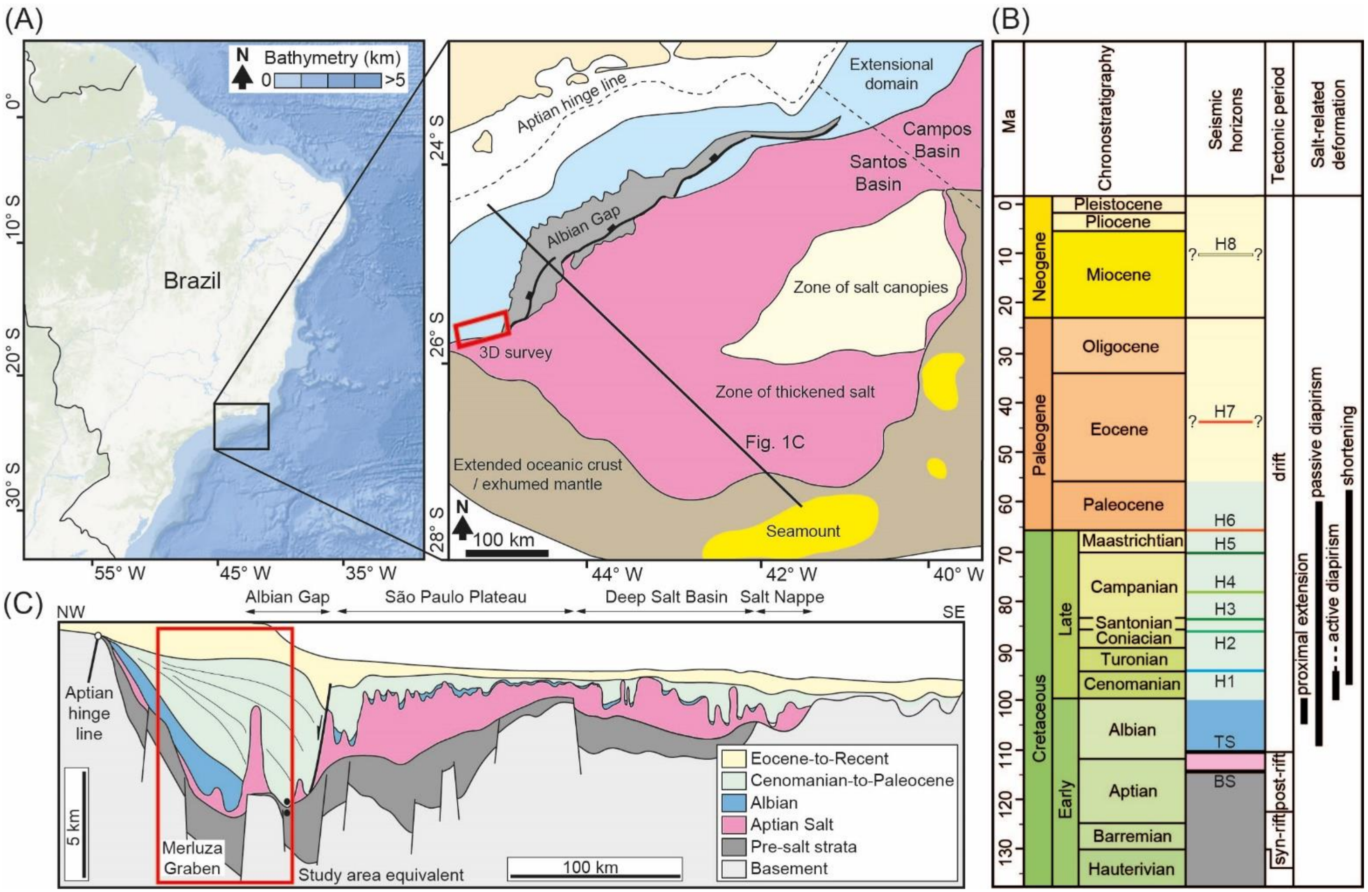
Few studies explored salt-magma interactions, leaving many questions:

- **Can salt dehydration / melting impact magma emplacement mechanics?**
  → Probably, at small scales: Schofield et al. 2014
- **Does dehydration / melting of salts alter magma chemistry (and thus rheology)**
  → Probably: e.g., Li et al., 2009; Heimdal et al., 2019
- **Can heat from magma promote salt movement?**
- **Does the presence of crystallised intrusions limit salt movement?**

Aim

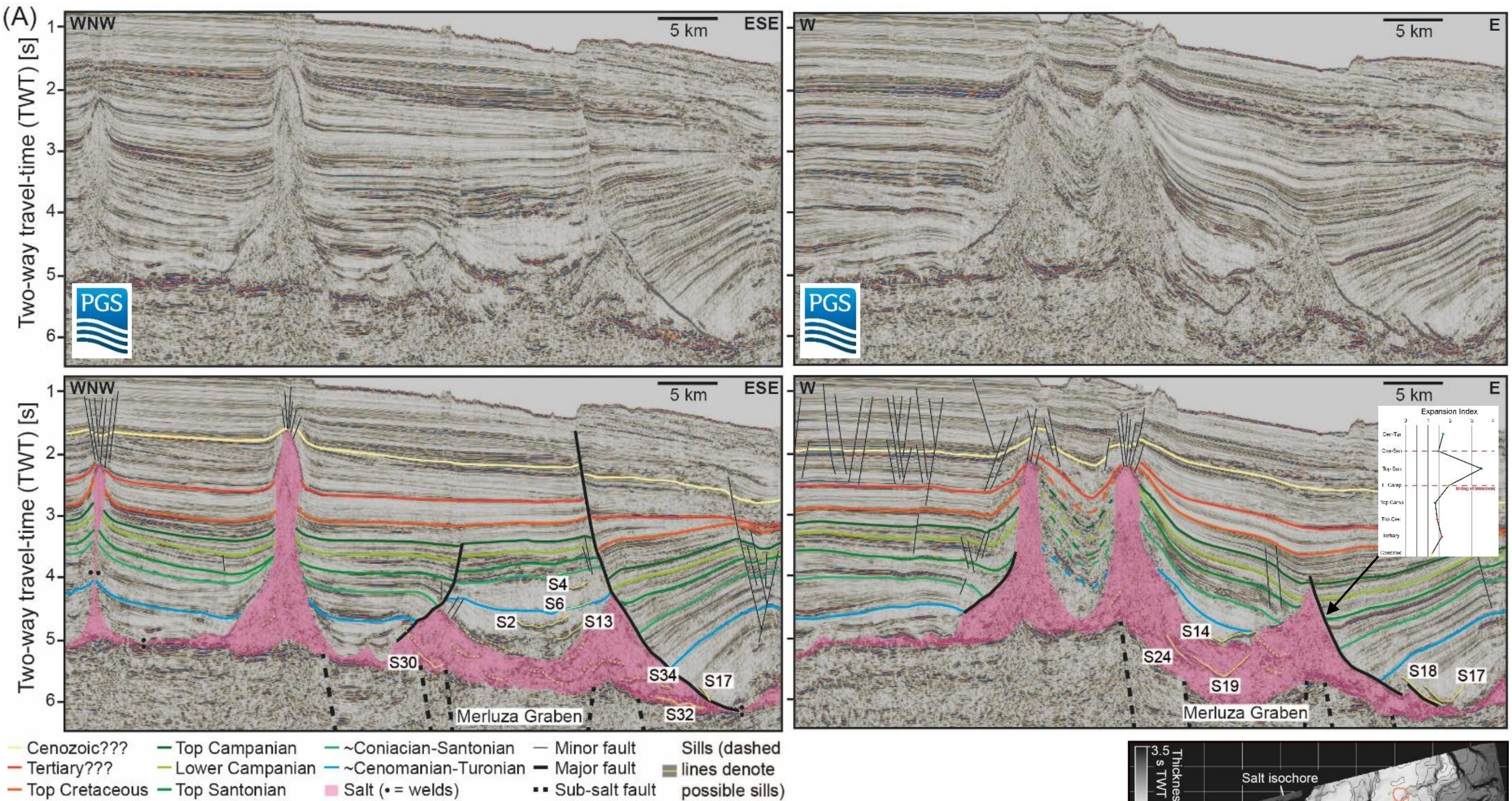
To test how magma emplacement may impact salt tectonics, by quantifying the structure and evolution of salt bodies and an associated sill-complex in the Santos Basin, offshore Brazil

Geological context:



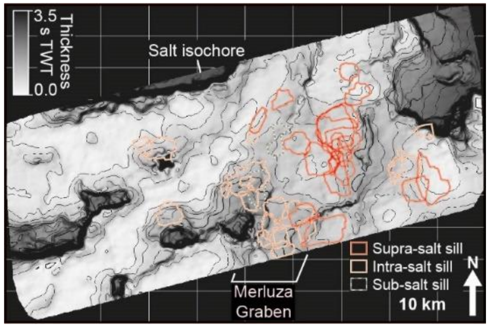
- Late Aptian salt
- Halite-dominated but anhydrite / bittern salts too
- Peak salt movement = Albian-Cenoman. gravity-driven salt-rollers / diapirism
- Cenoman.-Neogene contraction squeezed diapirs but minor extension persisted above Merluza Graben

Key seismic sections

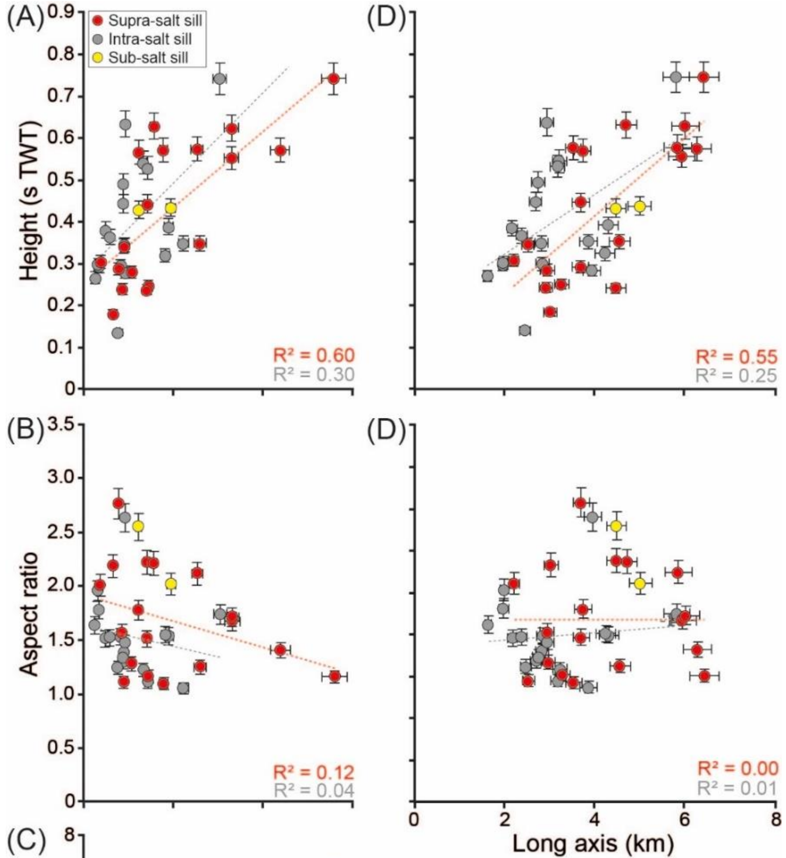


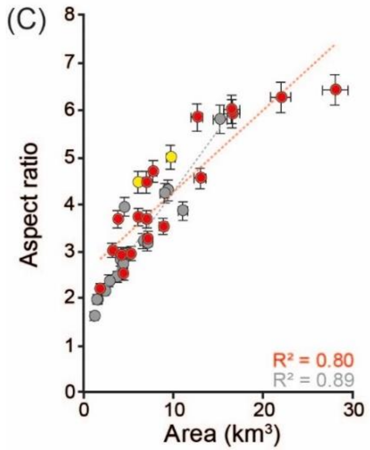
- >30 sills identified above, within, and below salt structures

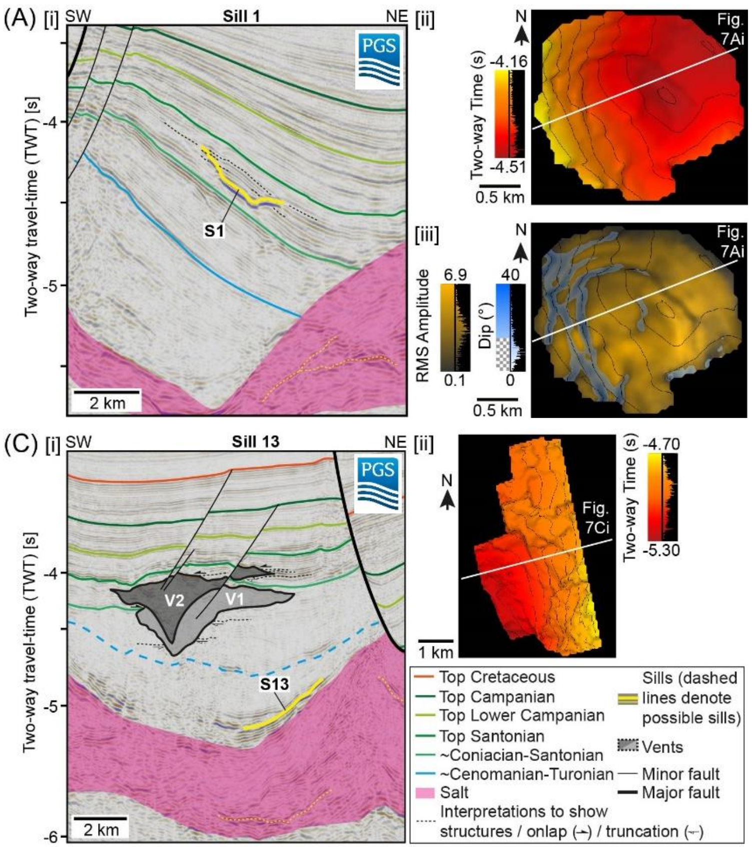
- Sills focused above Merluza Graben, away from diapirs



Sill structure



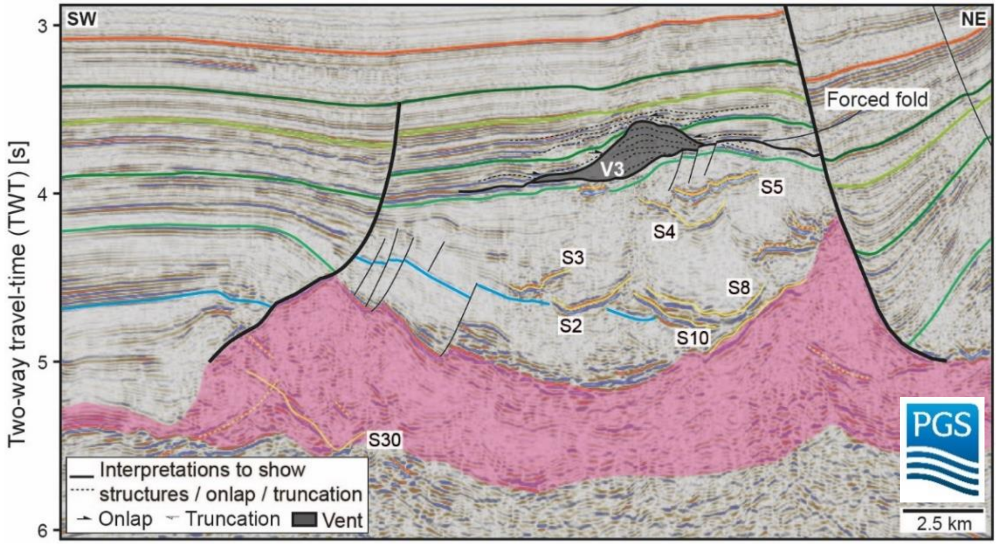


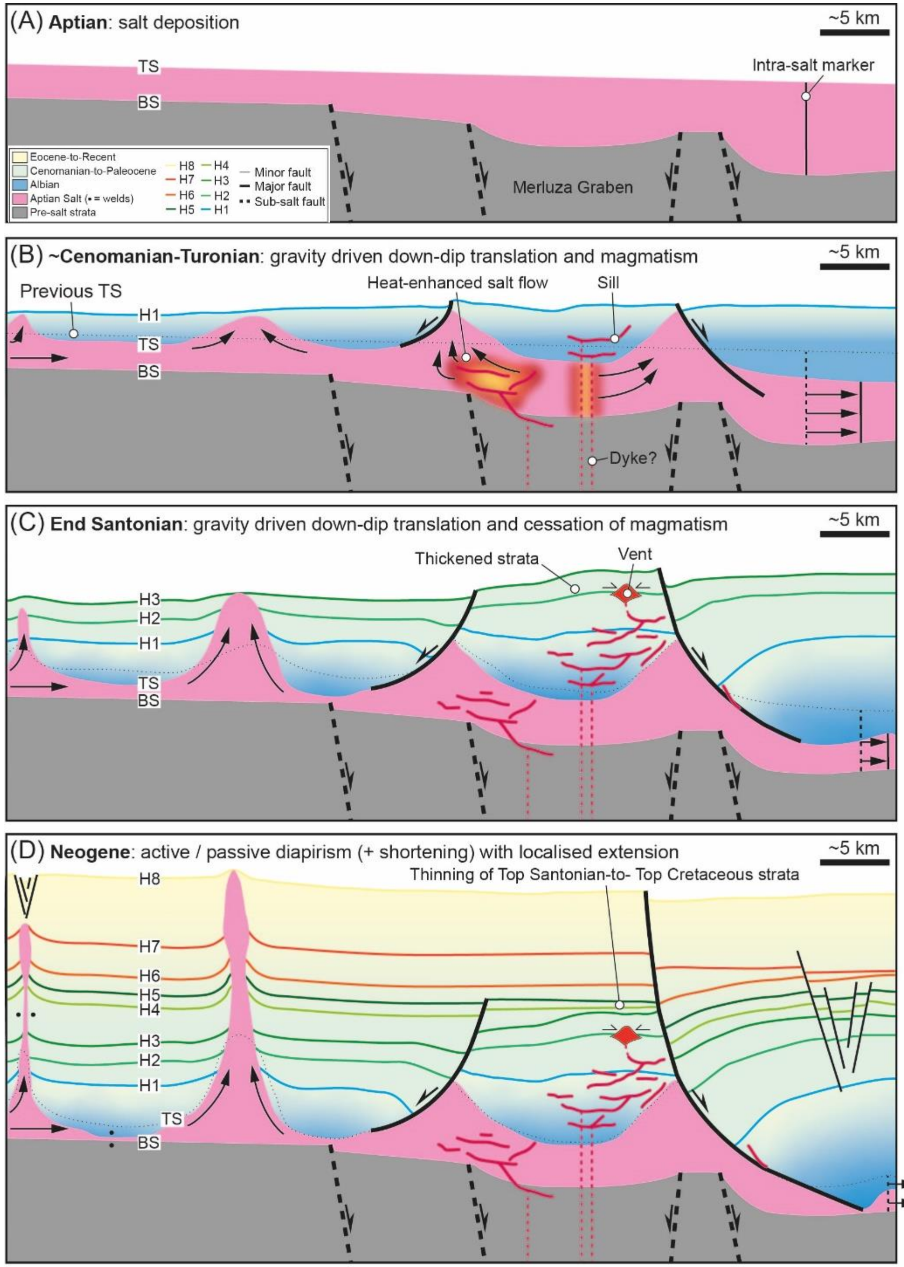


- Sill geometry varies – strata-concordant, saucer-shaped, inclined sheet
- Sills emplaced below, within, or above salt geometrically similar
- Largest sills in Cretaceous strata above salt

Timing of salt movement and sill emplacement

- Forced folds / vents allow relative timing of magmatism to be constrained
- Periodic magmatism in Cenomanian-Turonian, ending in Santonian (or later)
- Emplacement after onset of salt flow, during gravity-driven extension
- Sill emplacement ceased before Cenozoic salt movement





Observations and implications

- **Can salt dehydration / melting impact magma emplacement mechanics?**

→ No geometrical differences between sills emplaced within or outside salt
→ Sill reflections in salt are smoother than others, perhaps indicating a lack of intrusive steps (i.e. a brittle emplacement features)?

Possible implications:
→ Syn-intrusion salt behaviour may only control small-scale structures

- **Can heat from magma promote salt movement?**

→ Magmatism coincided spatially and temporally with peak salt movement (Cenomanian-Santonian salt rollers above Merluza Graben)

Possible implications:
→ Heat-enhanced salt flow may be driven by magmatism

- **Does the presence of crystallised intrusions limit salt movement?**

→ Minor post-Santonian salt rise above Merluza Graben, where sills clustered
→ Post-Santonian salt rise elsewhere more pronounced and dominated by active / passive diapirism: diapirs extend to shallower stratigraphic levels

Possible implications:
→ Mechanically strong crystallised intrusions in salt formed rigid framework, inhibiting salt movement