

Detachment Faulting, Successive Incision and Controls on Supradetachment Basin Formation at the Mid-Norwegian Rifted Margin

'The Frøya High Turtleback'

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Our research

Detachment fault systems that record displacements in the order of 10s to 100s of km are poorly understood compared smaller faults. We investigate the Mid-Norwegian rifted margin through the interpretation of 2D and 3D seismic reflection data (Figs. 1 and 2), where the Klakk and Main Møre Fault Complexes (KFC and MMFC) form the outer necking breakaway complex and the western boundary of the Frøya High. The central Frøya High contains a remnant of a metamorphic core complex¹, which we recognize as an extension parallel turtleback-structure (Fig. 3). The turtleback is flanked by a supradetachment basin, whose location corresponds to the crustal taper break associated with the outer necking domain of rifted marginsⁱⁱ. We attribute turtleback exhumation to Late Jurassic-Early Cretaceous detachment faulting along the KFC and MMFC. The supradetachment basin links the Frøya High Turtleback with the core complex previously interpreted for the Gossa Highⁱⁱ in the south, near where the MMFC incises the Slørebotn detachment.

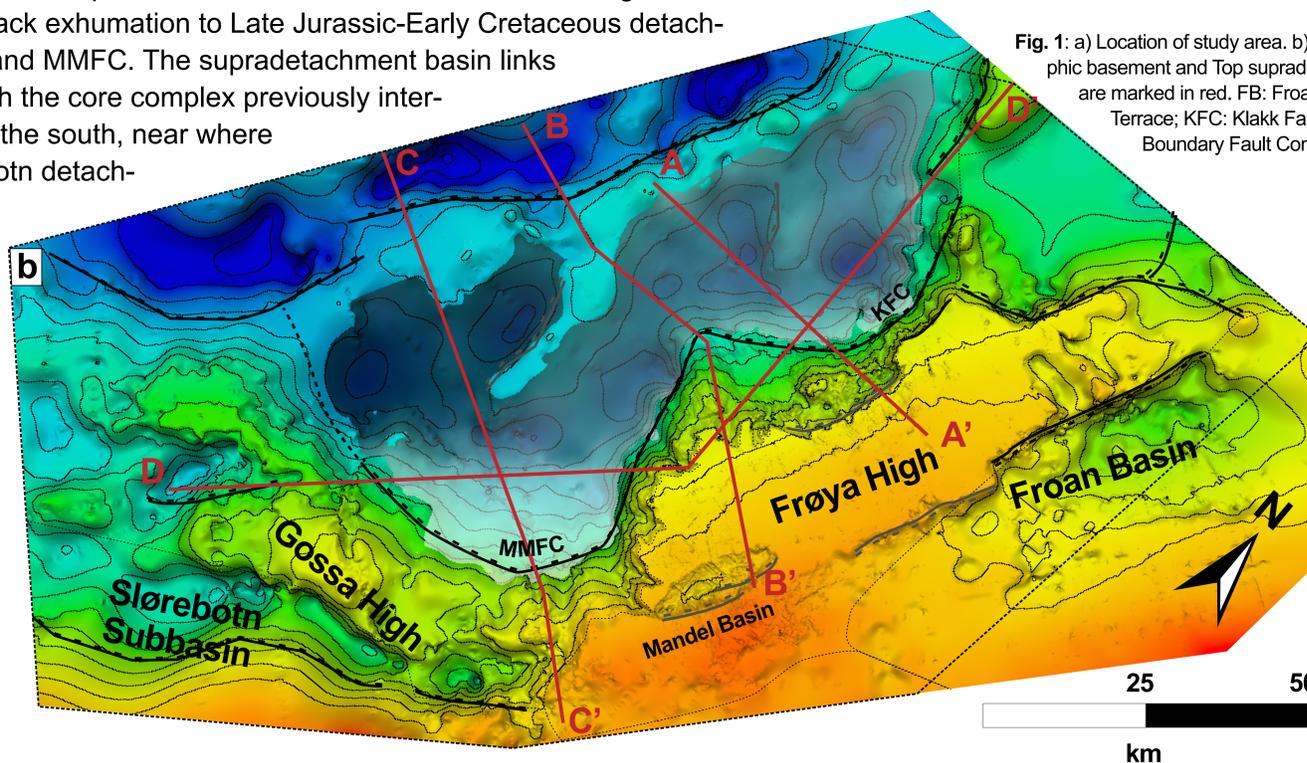
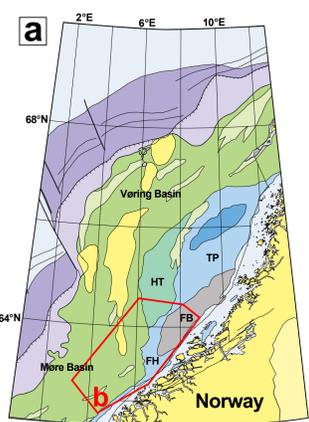
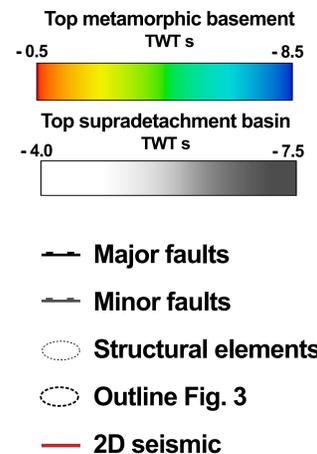
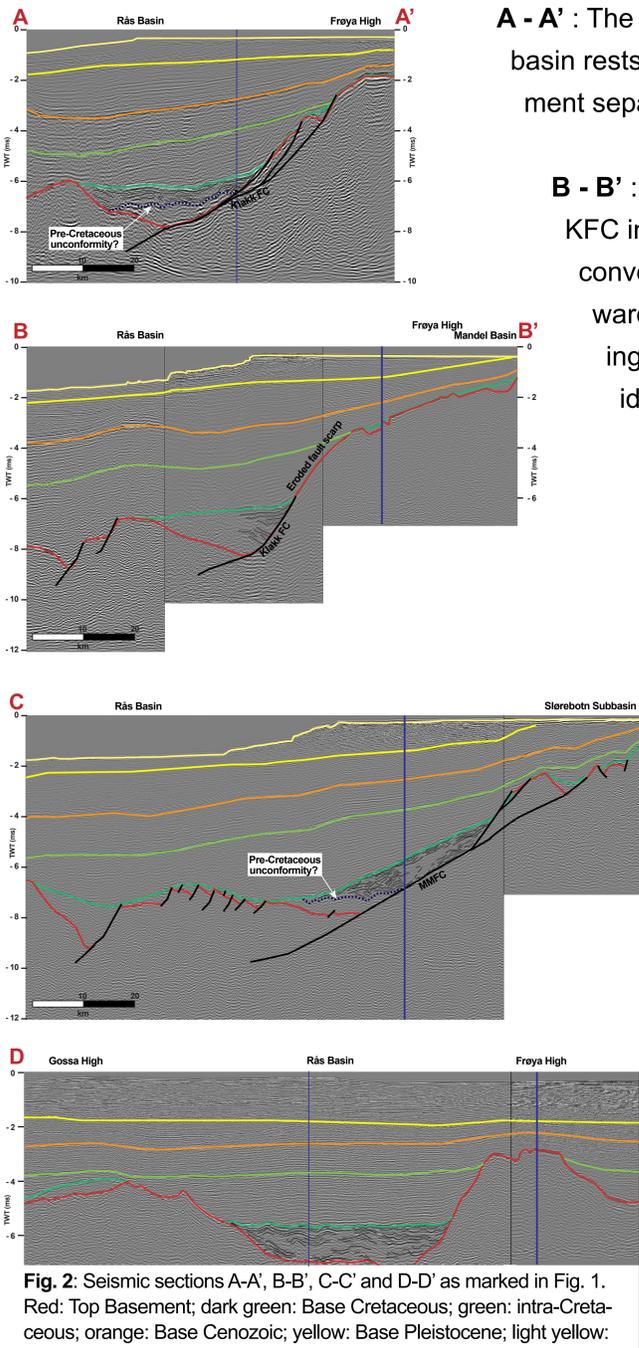


Fig. 1: a) Location of study area. b) Time-structure map of Top metamorphic basement and Top supradetachment basin(s). Seismic sections are marked in red. FB: Frøya Basin; FH: Frøya High; HT: Halten Terrace; KFC: Klakk Fault Complex; MMFC: Main Møre Boundary Fault Complex; TP: Trøndelag Platform.



Seismic sections



A - A' : The northernmost supradetachment basin rests on rider blocks and Top Basement separated by the KFC.

B - B' : The fault scarp defined as the KFC in the turtleback area has a convex upwards geometry hinting towards a footwall rollback and a 'rolling hinge' type model. Must be validated by depth conversion.

C - C' : The southernmost supradetachment basin rests on rider blocks and top Basement separated by the MMFC.

D - D' : The main supradetachment depocenters flank the turtleback structure of the Frøya High.

Fig. 2: Seismic sections A-A', B-B', C-C' and D-D' as marked in Fig. 1. Red: Top Basement; dark green: Base Cretaceous; green: intra-Cretaceous; orange: Base Cenozoic; yellow: Base Pleistocene; light yellow: seabed. Seismic data courtesy: NTNU-NPD-Schlumberger Petrel Ready Database

Preliminary conclusions

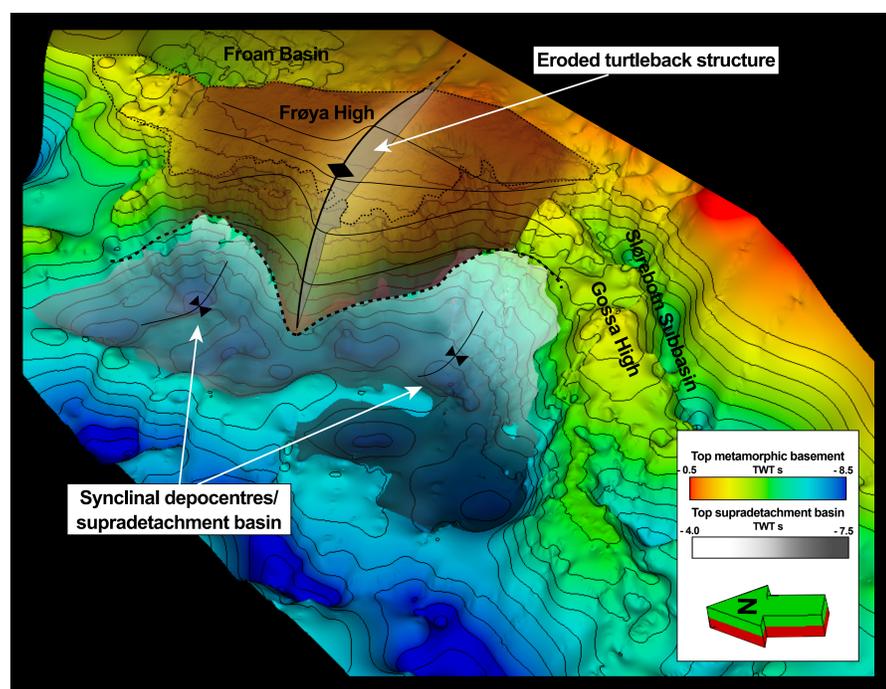


Fig. 3: Enlarged section from Fig 1 in 3D view. Our theorized turtleback metamorphic core complex geometry marked in brown.

- The 'Frøya High Turtleback' is flanked by recess depocenters accommodating a supradetachment basin that became located above the crustal taper break in the southernmost Vøring and northern Møre basin
- Supradetachment basin configuration was likely controlled by localized isostatic uplift, lateral linkage and successive incision of large-magnitude normal faults. The relative importance of these processes is under investigation by us
- The pre-rift structural template and crustal heterogeneity facilitated differential supradetachment basin configuration during and after Late Jurassic-Early Cretaceous rifting

References

¹Muñoz-Barrera, J. M., Rotevatn, A., Gawthorpe, R. L., Henstra, G. A. & Kristiansen, T. B. (2020) The role of structural inheritance in the development of high-displacement crustal faults in the necking domain of rifted margins: The Klakk Fault Complex, Frøya High, offshore mid-Norway. *Journal of Structural Geology*, 140

²Osmondson, P. T. & Péron-Pinvidic, G. (2018) Crustal-Scale Fault Interaction at Rifted Margins and the Formation of Domain-Bounding Breakaway Complexes: Insights from Offshore Norway. *Tectonics*, 37, 935-964.



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