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Styles of extension offshore Mid-Norway and implications for mechanisms of Late Jurassic-Early Cretaceous rifting

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Interpretation of long-offset seismic reflection data from the Jurassic-Cretaceous rift offshore Mid Norway reveal structural styles that resemble those reported from well-studied magma-poor margins. A comparison of parts of the magmatic Mid-Norway margin with magma-poor margins is justified in our view, because thinning of crystalline crust to thicknesses of 10 km or less appears to have preceded breakup and associated Eocene magmatism with 50-100 million years.

Low- to moderate-angle domain boundary faults that separate platform , terrace and subbasin areas from the deep Møre and Vøring basins display geometries consistent with large magnitudes of extension (10-30 km) and denudation of high-density lower crust in dome-shaped culminations that reside in the footwalls. The Møre margin was demonstrably affected by at least two modes of extensional faulting in Late Jurassic-Early Cretaceous time, leading to incision and warping of an extensional detachment in the Slørebotn Subbasin area. Extension led to the exhumation of a metamorphic core complex that became eroded in Early Cretaceous time and overstepped and buried after the Cenomanian. A ramp-flat detachment geometry also characterises the southern part of the Bremstein Fault Complex, which defines the boundary between the Trøndelag Platform and the Halten Terrace. The domain boundary faults were main agents in the production of the areas of strongly thinned crust that evolved into deep post-rift basins. Locally, domain boundary faults are interpreted to cut the Moho.

Under the northern Møre and southern Vøring basins, the domain boundary faults are commonly flanked at depth by arrays of rotated fault-blocks with associated deep half-graben basins, that cannot be restored back to normal crustal thickness. The fault-blocks are underlain by a basal reflector band (BRB). Locally, the BRB appears as cut by block-bounding faults. Correlation with a 3D density model of the Mid-Norway rifted margin indicates that the BRB corresponds to the Moho in part of our sections, whereas northwestwards, it appears to be located on top of high-density bodies (3100 kg/m^3). The high-density bodies may represent magmatic underplate, high-grade metamorphic lower crust or, alternatively, serpentinized mantle. Low-angle normal faults located northwest of the rotated fault-block arrays are associated with warping of the BRB, and under the deepest parts of the basins, rotated strata appear to rest directly upon the BRB, indicating complete separation of the crystalline basement above a fundamental extensional shear zone. Large-magnitude extension of the Mid-Norway margin did not, however, lead to breakup in Late Jurassic-Early Cretaceous time, and exhumation of serpentinized mantle to the palaeo-seafloor cannot be demonstrated under the Møre and Vøring basins. Evolution of an extensional shear zone along the crust-mantle boundary, and serpentinization of mantle below syn- and post-rift strata may, however, have taken place under the most highly stretched parts of the basins.