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Extensional faulting, crustal taper and the long-term topography of the Scandinavian passive margin

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A long-term control on topography, drainage, landscape formation and sediment routing patterns becomes set during the main phases of crustal thinning at passive margins. The role of large-magnitude faults is critical, not only in the definition of severely thinned (hyperextended) areas, but in the localization of long-term uplifted areas in the adjacent continent.

Recent models for the tectonic evolution of passive margins emphasize their polyphase evolution. Particularly important is the reduction of the thickness of the crystalline crust along extensional detachment faults with several tens of kilometers of displacement. Most of the reduction occurs in the so-called necking zone, where the crustal thickness is reduced from 30 down to less than 10 km. The necking zone can be narrow or wide, depending on the configuration of very large-magnitude, 'top-basement′ normal faults and how they link laterally to define the seaward crustal thinning gradient, or taper, of the crystalline crust. The 3D distribution of these faults, their growth and linkage and the resultant 3D architecture of the necking zone are not well understood at passive margins. The well-imaged Norwegian margin does, however, provide some insight into the structures that defined the crustal taper.

In the Møre region offshore Norway, two Jurassic-Cretaceous, very large-magnitude normal faults linked laterally to produce a very sharp crustal taper that decided 1) the location of a hyper-extended area that developed into the very deep Møre Basin, 2) the reactivation of onshore faults that straddle the base of alpine ranges developed in their footwalls and 3) the preservation or rejuvenation of high topography inboard of the faults for tens of millions of years. A gentler crustal taper is preserved in the Trøndelag Platform area, where crustal thinning was facilitated by 2-3 large-magnitude normal faults, each with a displacement magnitude less than the detachment faults offshore Møre. The onshore response in this area is more subdued.

We present interpretations of seismic sections that reveal the style and geometry of faults with tens of kilometers displacement. Based on these sections we can show how faulting and erosion interacted to produce the final geometry of the crustal taper, and how the onshore and offshore evolution of the margin became linked through the post-rift phase.