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The mountains of South Norway and East Greenland reached their present elevation long after Atlantic break-up

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We have undertaken a regional study of the thermo-tectonic development of East Greenland (68–75°N) [1,2] and of southernmost Norway (58–60°N) [3] based on integration of apatite fission-track analysis (AFTA), stratigraphic landscape analysis and the geological record onshore and offshore [4].

In southern East Greenland, voluminous plateau lavas erupted onto a largely horizontal plain near sea level at breakup of the NE Atlantic at the Paleocene–Eocene transition. Subsidence and burial continued until a late Eocene uplift phase led to formation of a regional erosion surface near sea level (the Upper Planation Surface, UPS). A late Miocene phase led to formation of the Lower Planation Surface (LPS) by incision below the uplifted UPS, and a Pliocene phase led to formation of fjords and valleys below the uplifted LPS and to peaks reaching 3.7 km asl (Fig. 1A).

Figure 1: Elevated plateaux formed by erosion to base level followed by uplift. A: Across Palaeogene basalt, East Greenland, 70˚N. B: Across pre-Cambrian rocks, South Norway, 60˚N.

The Norwegian margin also experienced Eocene subsidence and burial, but end-Eocene uplift of the NW European margin led to the formation of a major unconformity along the entire margin and to progradation of clastic wedges from Norway towards the south. The AFTA data from Norway define uplift and erosion which began in the early Miocene when samples that are now near sea level cooled below palaeotemperatures of ~60°C, but they do not resolve end-Eocene effects. The Miocene palaeotemperatures correspond to burial below rock columns that reach well above the present-day landscape. This implies that the early Miocene land surface lay well above the level of the present landscape, and that Miocene erosion to sea level formed the dominant, sub-horizontal, elevated plateau of southernmost Norway (Hardangervidda; Fig. 1B). A Pliocene tectonic phase lifted the surface to its present elevation of about 1.2 km asl.

Our analysis shows that the elevated plateaux on both margins formed in three main steps after opening of the NE Atlantic: (1) initial subsidence and burial. (2) A first phase of uplift leading to formation of low-relief surfaces by erosion to sea level. (3) One or two phases lifting the erosion surfaces to their present elevation. We conclude that the mountains of South Norway and East Greenland reached their present elevation long after Atlantic break-up.

References:

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