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Episodes of subsidence and uplift of the conjugate margins of Greenland and Norway after opening of the NE Atlantic

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We have undertaken a regional study of the thermo-tectonic development of East Greenland (68–75°N) and of southern Norway (58–64°N). We take advantage of the general observation that that the effects of uplift often are reflected more clearly onshore than offshore, and of the specific condition that the mountains of southern East Greenland expose thick basalts that were extruded onto a largely horizontal lava plain near sea level during breakup of the NE Atlantic at the Paleocene–Eocene transition. It is thus clear that the present-day elevation of these basalts up to 3.7 km a.s.l. were reached after breakup.

Our results based on apatite fission-track analysis (AFTA) data from East Greenland reveal a long history of post-Palaeozoic burial and exhumation across the region and show that the terrains of Palaeozoic and older rocks were buried below a 2–3 km-thick cover prior to a series of Mesozoic events of uplift and exhumation. The AFTA results from southern Norway reveal events of Mesozoic uplift and exhumation that are broadly simultaneous with those in Greenland.

Volcanic and sedimentary rocks accumulated on the subsiding, East Greenland margin during and following breakup and then began to be exhumed during late Eocene uplift that preceded a major, early Oligocene plate reorganization in the NE Atlantic. The Norwegian margin also experienced Eocene subsidence and burial. Our AFTA data from southern Norway show evidence of an event of midCenozoic uplift and exhumation that overlap with the early Oligocene onset of progradation of clastic wedges towards the south and with the formation of a major, late Eocene unconformity along the NW European margin.

The uplift event at the Eocene–Oligocene transition that affected wide areas in the NE Atlantic domain was followed by two regional events of uplift and incision of the East Greenland margin in the late Miocene and Pliocene whereas the Neogene uplift of southern Norway began in the early Miocene and was followed by the Pliocene phase that also affected East Greenland. In East Greenland, the end-result of the three events of Cenozoic uplift and exhumation are two elevated erosion surfaces of Palaeogene and Neogene age. In southern Norway, a similar stepped landscape (the Palaeic relief) is also of Cenozoic age.

In Greenland, definition of the chronology of events benefits from the availability of AFTA data from boreholes onshore where the plateau surfaces truncate Palaeogene basalts, and thus make it possible to date these surfaces and correlate them with offshore unconformities. In Norway, these factors are lacking, but the overall similarity of the onshore landscapes and Cenozoic cooling history and of the offshore sedimentary section to those in Greenland, suggests that the landscapes along these conjugate margins developed in similar fashion. This implies that the mountains of Norway also reached their present elevation in the late Cenozoic, long after Atlantic breakup.