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East Greenland: A classic example of an elevated, passive continental margin shaped long after rifting and breakup

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The Atlantic margin of East Greenland shares the characteristics of many elevated, passive continental margins around the world: Elevated plateaux (large-scale, low-relief and high-level landscapes) at 2 km or more above sea level (a.s.l.) cut by deeply incised valleys, Mesozoic-Cenozoic rift systems parallel to the coast, and a transition from continental to oceanic crust further offshore. Other examples of such margins are found in SE Australia, Brazil and Norway.
Breakup of the North Atlantic occurred at the Palaeocene–Eocene transition. The geological record in the Kangerlussuaq–Blosseville Kyst area (68–70°N) in SE Greenland shows that the area underwent short-lived uplift immediately prior to breakup followed by km-scale subsidence during the eruption of basalts, with no evidence for crustal upwarping at this time. The earliest basalts erupted partly in a marine environment, and there are marine incursions in the uppermost of the flood basalts. These Palaeogene lavas make up Gunbjørn Fjeld which is the highest summit in Greenland (3.7 km a.s.l.), and the present topography is thus the result of post-rift uplift.
We have mapped the plateaux surfaces over a wide area in SE Greenland and find that they are erosion surfaces that truncate both Palaeogene basalts and older rocks. Consequently, these surfaces (or peneplains) are post-basalt in age, and we suggest that they formed by fluvial erosion towards the base level of the adjacent sea during the opening of the North Atlantic. The present topography thus formed in two steps: first by erosion to form a peneplain near sea level and second by uplift to form a high plateau. The present topography has developed by incision of this high plateau, initially by rivers and later by glaciers below the uplifted peneplain.
Many apatite fission-track (AFT) studies have been published from East Greenland, and we present new results from 100 samples from the Kangerlussuaq area. Both published and new AFT data reveal that regional, Cenozoic cooling of the margin started at the Eocene – Oligocene transition. Post-rift subsidence and burial of the margin therefore lasted for about 20 Myr until uplift of the margin at the Eocene-Oligocene transition (c. 35 Ma). Uplift and erosion at this time affected margins around the North Atlantic and because it also correlates in time with a major plate reorganisation in the region, we suggest that it was related to plate tectonic forces. Because the regional cooling starting at 35 Ma coincides in space with the post-basalt peneplain we find that the peneplain along the margin was the end-result of this episode of uplift and erosion. The new AFT data from SE Greenland also show that the peneplain was uplifted to its present elevation in the late Neogene, and thus that the shaping of the present topography began several tens of millions of years after breakup.

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