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Protracted erosion and climate change create an illusion of Cenozoic uplift for the Scandinavian Caledonides

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Although plate tectonic theory explains the active formation of mountain ranges by collision of lithospheric plates (orogeny), the long-term evolution of the topography that is produced remains poorly understood. The north Atlantic Caledonian orogeny was initiated during Silurian time (443-417 Ma) as the result of the continent-continent collision of Laurentia and Baltica. During the Late Palaeozoic and the Mesozoic the Caledonian range was affected by rifting processes forming sedimentary basins on the continental shelves of northern Europe. On the basis of previous interpretations of sedimentary and morphological evidence, it has been thought that the high topography of the Caledonian range in western Scandinavia was eroded close to sea level by the Late Mesozoic, with the present high topography being explained by a range of proposed tectonically-driven, virtually deformation-free uplift mechanisms operating during the Cenozoic. Here we report new geophysical, thermochronological and stable isotope data, together with a reassessment of previous evidence, which support a model for the evolution of the topography of the Scandinavian Caledonides involving protracted erosion and accompanying isostatic rebound of the original orogen rather than active tectonic uplift in the Cenozoic. We argue that evidence previously used to infer recent uplift is more effectively explained by our model which incorporates the transient effects of Cenozoic climatic change. Our analysis emphasizes the importance of differentiating the morphological, sedimentological and structural signatures of recent active tectonics from the effects of long-term erosion and isostatic rebound in understanding the evolution of regions of high topography.