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Cenozoic uplift and subsidence in the North Atlantic region: Geological evidence revisited

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Abstract

The topographic evolution of the "passive" margins of the North Atlantic during the last 65Myr is the subject of extensive debate. The various geological, geomorphological and geophysical methods for studies of uplift and subsidence have each their limitations.

We have compiled a database of studies of topographic changes in the North Atlantic region during the Cenozoic (65-0 Ma), based on published results, with focus on sign, time and amplitude (where possible) of these changes. Our compilation, based on reflection seismic studies, AFTA (apatite fission track analysis), VR (vitrinite reflectance) trends, maximum burial, sediment supply studies, mass balance calculations and extrapolation of seismic profiles to onshore geomorphological features indicates that a first major phase of regional uplift occurred in the late Palaeocene-early Eocene (ca 60-50 Ma). This uplift was probably related to the break-up of the North Atlantic between Europe and Greenland, since the timing of uplift propagated northward. It was preceded by a phase of middle Palaeocene uplift and over-deepening of some basins of the North Sea and the surrounding areas and followed by a regional increase in subsidence in the offshore marginal areas of Norway, the northern North Sea, the northern British Isles and west Greenland in the Eocene (ca 57-35 Ma). The Oligocene and Miocene (35-5 Ma) were characterized by a regional tectonic quiescence, with only localized uplift. Its timing suggests a possible causal relation to compressional tectonics and changes in spreading dynamics (a change in spreading direction between Norway and Greenland, cessation of sea-floor spreading in the Labrador Sea and a jump of the spreading ridge north of Iceland), which may have been further enhanced by climatic and eustatic sea-level changes. The second major phase of regional uplift that affected all marginal areas of the North Atlantic occurred in the Plio-Pleistocene (5-0 Ma). The importance of a tectonic component for this uplift is inconclusive but erosion-driven glacio-isostatic compensation is likely to have been an important factor.