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Mantle plume related dynamic uplift and plate kinematics: The NE Atlantic case with global implications.

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At present a pronounced residual depth anomaly (RDA), centred on Iceland, is characterizing the bathymetry of the NE Atlantic region. For the oceanic lithosphere this anomaly represents a <500 to >2500 m elevation difference compared to 'normal' oceanic lithosphere. The observed depth anomaly has since Cochran and Talwani (1978) been ascribed to a 200 -300 km thick moderate thermal anomaly beneath the oceanic lithosphere, the existence of which today has been proven by a sizable low velocity zone on seismic tomography data. The sub-lithosphere low velocities are, however, not limited to the oceanic domain, but also underlie the adjacent continental lithosphere, thus causing a similar magnitude anomalous elevation of the continental shelves and landmasses. The thermal anomaly is presumed to relate to the arrival of the Iceland mantle plume demonstrated by excess Paleocene and Early Eocene magmatism and the formation of the North Atlantic Volcanic Province (NAVP), and subsequent volcanic margin formation. The present width of the RDA compares with the size of the regions that experienced excess magmatism during rifting and breakup, which implies that the sub-lithospheric thermally anomalous body was emplaced in Paleocene time, but still resides in the area.

This presentation aims to describe the temporal and spatial development of uplift based on combining plate kinematic modeling with models of lithospheric and plume body thickness development through Late Cretaceous-Paleocene extension, and subsequent seafloor spreading. The model prediction of uplift compares well with descriptions of erosional episodes and depositional sequences off Greenland, in the Northern North Sea, off mid-Norway and in the SW Barents Sea, and represents a mechanism that explains the present elevation of East Greenland as well as western Norway.

In a global perspective the close correlation between Large Igneous Provinces (LIP's), the arrival of known mantle plumes and formation of volcanic margins demonstrates that the NE Atlantic case likely can be used as an analogue for most areas associated with LIP's. The plume scenario represents a logic explanation for the co-existence of magma-rich and magma-poor margins along the same and spatially continuous break-up of large continents. The crucial points are timing and strain rates. Simple time dependent modelling demonstrates that magma-poor margins may exist in plume affected regions, while magma-rich margins depend on elevated asthenosphere temperatures.