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Tectonic reconstruction in the eastern North Sea area using basin stratigraphy, present-day borehole temperatures, vitrinite reflectance and Apatite fission tracks

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Basin initiation in the eastern North Sea dates back at least to late Carboniferous rifting and Permo-Carboniferous magmatic activity. Ensuing episodic rifting during Triassic, Jurassic and the late Cretaceous mainly focused along the Sorgenfrei-Tornquist Zone (STZ). Change of regional trans-tension to trans-pression caused extensive inversion in Europe and along the STZ during the late Cretaceous, producing deep erosion in places along the inversion axes and simultaneous formation of loading-induced marginal troughs. These simultaneous and opposite vertical movements are founded on structural and stratigraphic observations and predicted by numerical models of compressional basin inversion. Also predicted is a different style of inversion - relaxation inversion - which occurs once compression ceases. This inversion mode involves no shortening and is characterised by gentle low-amplitude doming of a wider area with only little erosion of the inversion ridge and formation of shallow and more distal marginal troughs. It has been argued from a range of evidences that relaxation inversion provides the best explanation for the mid Paleocene inversion phase in Europe. Here we show that maturity data from deep wells along the STZ in the eastern North Sea confirm this sequence of events - late Cretaceous compressional inversion followed by mid-Paleocene relaxation inversion. We find that wells influenced by the STZ inversion axis do require deep erosion during the late Cretaceous, but that no significant Cenozoic erosion is not required. Two deep geothermal test wells with excellent data located in the marginal trough SW of the STZ allow only limited Cenozoic erosion, consistent with the low-amplitude domal relief created due to relaxation inversion. Thus, the maturity data of the wells in different tectonic settings along the STZ are consistent with existing quantitative models of inversion tectonism, and no wells require deep Cenozoic erosion.