



Maturity data record inversion of the Sorgenfrei-Tornquist Zone of the eastern North Sea

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The dynamic analysis of major tectonic inversion structures is generally founded on structural and stratigraphic observations and may be predicted by numerical models of compressional basin inversion. Here we show that the dynamics of an inversion zone can be constrained by using thermal maturity data such as present day borehole temperature, vitrinite reflectance, AFT and general stratigraphic information in deep boreholes in combination with basin modelling software.

Basin formation in the eastern North Sea was initiated during the Paleozoic and ensuing episodic rifting took place during the Mesozoic followed by thermal subsidence and localized inversion during the late Mesozoic and early Cenozoic. The Sorgenfrei-Tornquist Zone (STZ) is a very prominent structural feature (strike slip zone) roughly separating the Fennoscandian area from the North Sea Basin. Change of regional trans-tension to trans-pressure 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. Also predicted is a different style of inversion - relaxation inversion - which occurs once compression ceases. The relaxation 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.

In the present study we have analysed and modelled wells on the inversion axis of the STZ and in the marginal troughs and the results show that wells influenced by the STZ inversion axis was subject to deep erosion during the late Cretaceous, and that no Cenozoic erosion is required. Furthermore, two deep geothermal test wells with excellent temperature and maturity data located in the marginal trough SW of the STZ allow no Cenozoic erosion following the inversion-induced late Cretaceous subsidence. 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 data from wells in the area require Cenozoic erosion other than what could be explained by Quaternary glacial erosion, which is well documented in the geological record.