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Evolution of the Lower Saxony Basin and the Bramsche Massif

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The Lower Saxony Basin (LSB), Germany, is one of several sedimentary basins within the Central European Basin system. In the southwestern part, anomalously high maturity of organic matter has been observed reaching 4.5% VRr in Upper Jurassic and Lower Cretaceous sedimentary rocks. This area coincides with a magnetic and a positive gravimetric anomaly. This observation has been interpreted as the effect of an igneous body which intruded during Early Late Cretaceous times at a depth of about 5 km (Bramsche Massif) and heated the overlying sedimentary rocks. In recent years, numerical modelling using stratigraphic, sedimentological, and maturity data from several wells east and west of the Bramsche Massif suggested a different interpretation involving deep burial during Early Cretaceous times followed by Late Cretaceous/Tertiary uplift, probably related to inversion of specific local, fault-limited subbasins.

The objective of this project was to determine parameters (geochemical and maturity data, fission track data, fluid inclusion data) which elucidate the temperature history of this basin, in particular in the western-central part. The results of the petrological and geochemical observations acted as calibration parameter for modelling.

Based on numerical simulations of burial history the following conclusions are obtained: Coalification is pre-kinematic with respect to the inversion and reflects the former accumulation settings. Basin inversion caused uplift and erosion of 1300 to 7300 m of sedimentary rocks. Erosion occurred during Coniacian or post-Coniacian times.

The zircon fission track data provide evidence for widespread (hydro)thermal activity during i) the Permian, probably related to the rifting and crustal thinning of the Southern Permian Basin and ii) the Upper Jurassic respectively Lower Cretaceous related to more local extension in the LSB itself. The apatite fission track ages indicate one major cooling event in the mid Cretaceous ($\sim$89-72 Ma) reflecting the time of inversion of the LSB. Apatite fission track ages from borehole samples which are recently within the upper part of the APAZ indicate that a continuous cooling during the Tertiary must be taken into account which was followed by a young heating of the sedimentary sequences until present.

A thermal influence of a magmatic intrusion in the study area is not evident from the modelling approach and the fission track data. Thus, the theory of an igneous Cretaceous intrusion as cause for the coalification pattern appears not to be supported by these results.