



The Glueckstadt Graben: structure and evolution caused by salt movements, and its relation to other Triassic subsidence centers within the Central European Basin System

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The Central European Basin System (CEBS) is one of the basins strongly affected by salt tectonics. One significant stage of the strong salt movement occurred during the Triassic. At the same time, the largest Triassic subsidence took place in the different sub-basins surrounding the Ringkoebing-Fyn High such as the Horn Graben, the Danish Basin and the Glueckstadt Graben. The evaluation of the diverse deformation patterns in the sedimentary cover and their relations to salt structures shows that major salt movements occurred at the beginning of the Keuper, when the Glueckstadt Graben was affected by extension. The internal seismic pattern of the Keuper, lithostratigraphic data, and palynological investigations (Trusheim, 1960) indicate that Permian salt extruded onto the paleosurface and was dissolved and redeposited within the Keuper strata. The Early Jurassic extension and related normal faulting documented in the Lower Saxony Basin and within the Pompeckj Block (Kockel, 2002) may have also affected the Glueckstadt Graben. Thick Jurassic sediments are only observed around salt structures and are thinning with increasing distance from salt walls or salt stocks. Parts of the Jurassic were eroded in Late Jurassic-Early Cretaceous times. The Upper Cretaceous strata have an almost constant thickness and their parallel reflections pattern indicates a quiet tectonic setting with very minor salt movements in the Late Cretaceous. Renewed salt flow during the Paleogene-Neogene caused rapid subsidence along the marginal parts of the Glückstadt Graben. The thick Paleogene-Neogene strata within the marginal troughs may also be related to a regional component of tectonic subsidence, contemporary with the rapid subsidence in the North Sea. A 3D modelling approach has been used to determine salt distribution

at certain paleo-levels. In addition, the whole model has being isostatically compensated for every stratigraphic level. The reconstruction of the initial salt thickness takes into account that the Permian salt partially extruded during the Keuper and was redeposited due to superficial dissolution. The initial salt thickness varies from 1300 m at the flanks of the basin up to 3000 m within the central part and demonstrates a clear NNE-SSW trend of the basin. The regional trend of the restored initial salt distribution points to a westward continuation of the Permian salt basin. Seismic and borehole data as well as 3D numerical modelling allow the following conclusions: Triassic extensional faults have been identified at the salt base below salt walls and diapirs. The fault activity most likely controlled the location and orientation of the NNE-SSW elongated salt walls, and the formation of the salt walls was triggered by active extensional faults in the Keuper. The GG was not inverted during the Late Cretaceous and Tertiary, when up to 4,5 km of sediments were eroded during inversion of the Lower Saxony Basin (Petmecky et al, 1999) and along the southern margin of the NE German basin (Scheck et al., 2002). In contrast to other parts of the CEBS, the growth of almost N-S-striking salt walls and normal faulting indicate E-W directed extension in the Tertiary. The initial thickness of the Permian salt regionally controlled the structural style of the basin. Where the salt was thick, salt diapirs and walls formed. Where the salt was relatively thin, simple salt pillows and shallow anticlines developed. According to the 3D structural model, the formation of the deep Central Triassic Glueckstadt Graben and the subsequent Jurassic-Cenozoic marginal troughs was strongly controlled by the development of salt structures through time. The centre of sedimentation moved from the central part of the original Graben towards its margins due to gradual withdrawal of Permian salt. In this sense, the Glueckstadt Graben was formed at least partially as a “basin-scale rim syncline” during post-Permian times.

References Baldschuhn R, Binot F, Fleig S, Kockel F (2001) Geotektonischer Atlas von Nordwest-Deutschland und dem deutschen Nordsee-Sektor. Geologisches Jahrbuch Reihe A Heft 153. Kockel F (2002) Rifting processes in NW-Germany and the German North Sea Sector. *Geologie en Mijnbouw* 81:149-158. Petmecky S, Meier L, Reiser H, Littke R (1999) High thermal maturity in the Lower Saxony Basin: intrusion or deep burial?. *Tectonophysics* 304:317-344. Scheck M, Bayer U, Otto V, Lamarche J, Banka D, Pharaoh T (2002) The Elbe fault System in North central Europe - a basement controlled zone of crustal weakness. *Tectonophysics* 360:281-299. Trusheim F (1960) Mechanism of salt migration in North Germany. *Bull. AAPG* 44:1519-1540. Ziegler P A (1990) Geological Atlas of western and central Europe, 2nd Edition. Shell Internationale Petroleum Mij B V, and Geological Society London.