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Major phases of salt tectonics within the Central European Basin System

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The Central European Basin System (CEBS) covers the area of the Southern and Northern Permian basins and contains up to 12 km of Permian to Cenozoic deposits. Initiated in the Early Permian, the Central European Basin System accumulated Lower Permian clastics overlain by significant amount of Upper Permian (Zechstein) salt. Post-Permian differentiation of the basin system was controlled by variable regional stress conditions including Late Triassic extension, a Mid-Late Jurassic-Early Cretaceous regional erosional event, Early Cretaceous transtension and Late Cretaceous–Early Tertiary compression. These tectonic phases not only provoked regional shifts in subsidence and erosion but also triggered the mobilisation of the Zechstein salt which had an important impact on sedimentation and the subsequent deformation of Mesozoic and Cenozoic strata within the CEBS. Salt rise strongly influenced the Meso-Cenozoic structural evolution in terms of mechanical decoupling of the sedimentary cover from its basement. Consequently, the CEBS displays a wide variety of salt structures (walls, diapirs and pillows) with structural amplitudes of up to 9 km. This makes it a classical site to study the interaction of salt movements, deposition and tectonics.

A combined approach of subsidence analysis and seismic interpretation has been used to unravel the mechanisms controlling basin evolution and the related salt pathways. Subsidence analysis includes 3D backstripping with salt redistribution in response to the changing load conditions in the salt cover. The results of 3D modelling of salt movements and seismic data indicate that the primary initiation of salt movements occurred during the Triassic. The Triassic regional extensional event initiated a phase of salt movements within the Triassic depocenters of the Central European Basin System, such as the Glueckstadt Graben, Horn Graben, the Fjerritslev Trough and the adjacent Himmerland Graben of the Norwegian-Danish Basin, and the Polish basin. The Early Triassic (Buntsandstein) and the Late Triassic (Middle–Late Keuper) extensional events triggered strongest salt movements within the central part of the Glueckstadt Graben. During the Late Jurassic–Early Cretaceous, major erosion regionally truncated the study area. The magnitude of Late Jurassic-Early Cretaceous erosion is declining towards the margins of the basin system. In the Late Jurassic-Early Cretaceous, an increased intensity of salt movement influenced the Central Graben, the Lower Saxony Basin and the Pompeckj Block. This phase of growth of salt structures is mostly related to Late Jurassic-Early Cretaceous extensional/transtensional tectonics. The late Early Cretaceous–early Late Cretaceous is characterized by a tectonic quiescence without strong salt movements. A further regional phase of salt tectonics was triggered by Late Cretaceous-Early Tertiary inversion affecting almost the entire Central European Basin System in terms of renewed salt movements. At that time, thick-skinned tectonics affecting the basement is observed along the Elbe Fault System where compressional deformations are localized. In contrast, a thin-skinned character of salt movements is prevailing towards the north from the areas of strain localization in the basement. Post-inversion Cenozoic subsidence was accompanied by salt movements, related either to diapiric rise due to regional shortening and/or to local almost E–W directed extension. The Tertiary phase of salt movements was especially prominent within the marginal troughs of the Glueckstadt Graben.