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Modelling the Tectonic History of Sedimentary Basins by Integration of 3D Backstripping and Thermal Subsidence

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The subsidence history of sedimentary basins is controlled by a number of different driving forces namely fault-controlled tectonic movements, thermal subsidence, and sedimentary load. Existing studies on the subsidence in sedimentary basins tend to focus on the quantification of only one or two of these mechanisms, and have mostly been carried out in 2D. However, for an overall and precise restoration of the subsidence history of a basin system all components have to be considered and a 3D approach is needed, especially if salt is present within the sedimentary succession.

In this study we present a new modelling concept for geohistory analysis in which 3D backstripping (Scheck et al., 2003) is combined with the pure shear model of McKenzie (1978) to account for the amount of thermal subsidence stored in a basin. Extraction of all three subsidence components allows us (1) to determine of the amount of initial fault-controlled subsidence and the nature of the syn-rift basin geometry, (2) to study the trend of the post-rift subsidence history of the basin infill and the evolution of basin topography, and (3) to detect areas where basement structures might have been reactivated after rifting.

The restoration of paleo-topographic surfaces provides a new means to estimate paleo-waterdepths and depositional environments, whereas the determination of negative basement subsidence (= uplift) may be used as indicator for potential post-rift basin inversion. In addition, integrating the mathematical concepts of the uniform stretching model of McKenzie (1978) in the modelling approach gives the possibility to evaluate pure shear as a potential driving mechanism for the formation of the considered sedimentary basin. Having been successfully applied to the South Atlantic Kwanza Basin the modelling concept is here elucidated using a 3D model of the Northeast German Basin System (NEGB).

References:

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