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The evolution of the Thuringian Syncline (Central Germany) – an interdisciplinary approach to basin reconstruction

Alexander Malz (1), Daniel Beyer (1), Stephan Donndorf (2), Payman Navabpour (1), Thomas Voigt (1), Michaela Aehnelt (1), and Jonas Kley (3)

(1) Friedrich-Schiller-University Jena, Institute of Geosciences, Burgweg 11, D-07749 Jena, Germany (alexander.malz@uni-jena.de), (2) ERCOSPLAN Ingenieurgesellschaft Geotechnik und Bergbau mbH, Arnstaedter Straße 28, 99096 Erfurt, (3) University of Goettingen, Geoscience center, Department of Structural Geology and Geodynamics, Goldschmidtstr. 3, D-37077 Göttingen

The Thuringian Syncline is a shallow synform of mainly Triassic strata in Central Germany. In general, its lithostratigraphic units are similar to that of the North German Basin. On the top of the Paleozoic basement and Permocarboniferous red beds the evaporites of the late Permian Zechstein were deposited. The Triassic super group consists of fluvial to lacustrine sandstones, shale and evaporites of the Buntsandstein group, limestone, marls and evaporites of the marine Muschelkalk group and pelitic to sandy fluvial deposits and evaporite of the Keuper group. Some relicts of Lower Jurassic deposits still cover this succession. A number of NW-SE-trending fault zones with mostly small normal offsets characterize the recent structural configuration of the Thuringian Syncline. From regional correlations, and Lower Jurassic strata affected by normal faults, the extension most likely occurred in Late Jurassic to Early Cretaceous time. Some of these normal faults were reactivated as reverse faults during a phase of contraction in the Late Cretaceous. The unknown original offsets of the normal faults and the absence of syntectonic strata deposited during extension and contraction, however, make reconstruction of the graben inversion difficult to detect.

In this study we try to reconstruct the structural evolution of the Thuringian Syncline based on structural observations, detailed map analysis, interpolations of stratigraphic surfaces at depth, cross section balancing and fault slip data analysis. Vitrinite reflectance data are used to estimate the maximum thickness of the eroded overburden. Our study identified a deep, extended and later inverted palaeo-depression in the central part of the Thuringian Syncline. We show that the recent structural configuration cannot explain variations of the thermal maturity without deriving specific thickness variations in the eroded overburden. Taking in consideration that many Central European faults, formerly interpreted as purely extensional with small normal offsets, were later reactivated as reverse faults, can explain a significantly higher initial amount of fault-controlled subsidence. The distribution of vitrinite reflectance data indicates a scenario of structural evolution, which is consistent with similar structures of the North German Basin. Our project shows that an interdisciplinary approach can put close constraints on modelling and reconstruction of basin evolution even with incomplete stratigraphic record.