Fault kinematics in the Thuringian Basin and the Flechtingen-Calvörde Block, Germany

The role of Jurassic extension tectonics in regional deformation patterns

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Introduction

Fault patterns in the Thuringian Basin (TB) and the Flechtingen-Calvörde Block (FCB) of the central German platform show similarities in terms of fault orientation and kinematic mechanisms that are mostly the result of thrust faulting during Late Cretaceous-Early Cenozoic basin inversion. Though fault and fracture patterns and their corresponding structural evolution during inversion have been subject to several scientific investigations, little is known with regard to the role of extensional dynamics during Jurassic rifting. In this study, we present a comprehensive approach to developing a unique deformation model based on a combination of structural and petrological investigations that allows for a better understanding of the extensional rifting process in the Thuringian Basin and Flechtingen-Calvörde Block, as well as in recent case studies from the Kinsmen-Broadback Fault Belt in the Canadian Shield. Our approach is based on the identification of fault orientation, fracture populations, and related kinematic mechanisms at several key locations.

A) Thuringian Basin

Fig. 6: Stereodomes of the fault slip data of the cover rocks from the Thuringian Basin separated based on consistent chronology and kinematics. Stress tensors are calculated based on the inverse method of (23) and given as the orientation of σ1 (σ1) and σ3 (σ3), with 95% and 99% confidence ellipses. Additional confidence in gray curves and the ratio of stress magnitude differences δ.

Fig. 7: Stereodome plot of a quasitriangular (hemipelagic-amphibole-biotite) fault mineralization in Upper Rötental sandstone (depth: 360.10 m - 366.07 m) (23) Schematic sketch of the respective mineralization illustrating vein opening and spatial distribution of mineralization episodes. The observed mineralization displays a typical macroscopic breakdown of deformation bands of Upper Rötental sandstone, and therefore are most likely the result of Mesozoic rifting.

Fig. 10: Opening mode of a fracture set (A) and orientation of a set of microfractures within fracture vein network (B) derived from a re-orientated core from the adjacent Altmark-Brandenburg Basin.

C) Altmark-Brandenburg Basin

Acknowledgments

Conclusions

- Structural analyses in the Thuringian Basin and the Flechtingen-Calvörde Block revealed similarities in both study areas with respect to pre-, syn-, and post-inversion tectonics. Predominantly NW-SE striking faults were locally active during Late Jurassic - Early Cenozoic extension and Late Cretaceous - Early Cenozoic compression.
- Fault patterns in the Flechtingen-Calvörde Block clearly associated with Jurassic extension tectonics are rare, as they were mostly overprinted during basin inversion (see Fig. 11), however, investigated fault and fracture sets mostly coincide with normal faults known from the Thuringian Basin and the Altmark-Brandenburg Basin that clearly predates basin inversion.
- Moreover, C14/He age dating of hematite mineralization related to normal faults in the Flechtingen-Calvörde Block revealed tectonic stretching in that area taking place during Late Jurassic - Early Cenozoic rifting (c.a. 140 Ma).

References


Fig. 11: Stereodome plot with fault slip data from the Thuringian and Flechtingen-Calvörde Basins.