What is the influence of pre-existing structures on regional intraplate tectonic stress fields?
A case study of the central German platform

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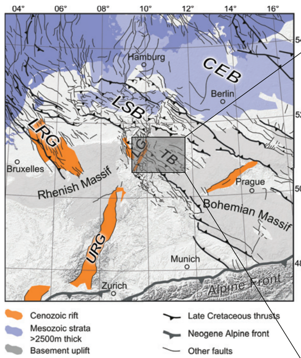
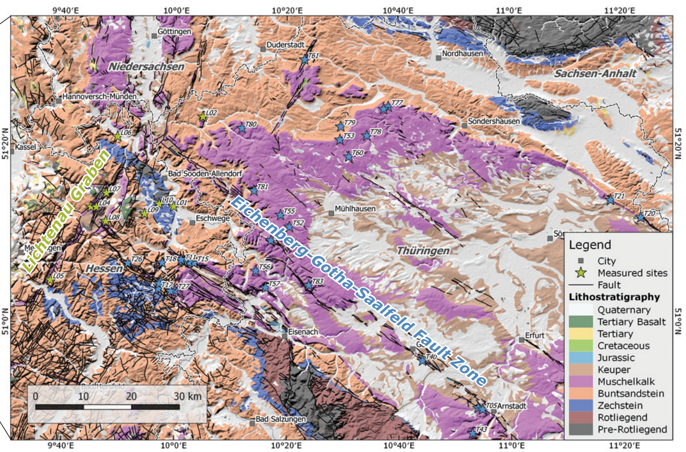
1. Geological setting





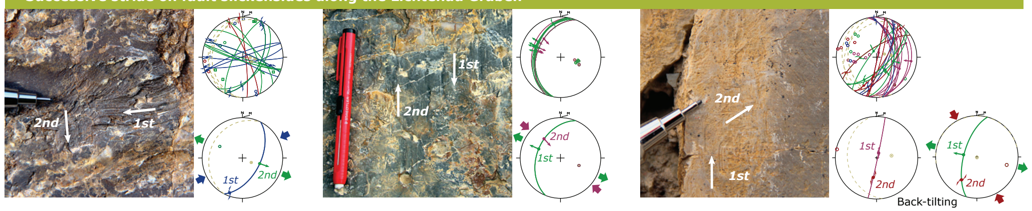
Geological setting of the study area within the regional tectonic framework of Central Europe.
CEB, Central European Basin; LSB, Lower Saxony Basin; LRG, Lower Rhine Graben; URG, Upper Rhine Graben; LG, Lichtenau-Leinetal Graben; TB, Thuringian Basin.

The study area is located in the central German platform and highlights two prominent structures: the N030-striking Lichtenau Graben and the N120-striking Eichenberg-Gotha-Saalfeld Fault Zone.

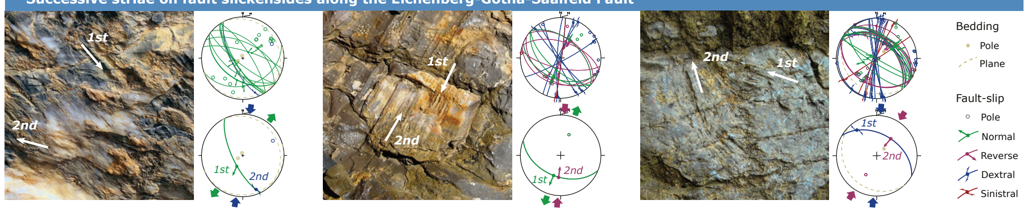
2. Kinematic change indicators

Here, the succession of reactivations along the Lichtenau Graben and the Eichenberg-Gotha-Saalfeld Fault Zone is addressed based upon field observations of kinematic change indicators on fault slickensides, fracture pattern analysis through stereographic projection and stress tensor inversion of fault-slip data collected mostly from the mid-Triassic Muschelkalk limestone.
The age of affected rocks indicates that the succession of fault reactivation belongs to post mid-Triassic events.
According to the fracture patterns, normal and sinistral strike-slip faults are dominant features along the N030-striking Lichtenau Graben, whereas most fractures along the N120-striking Eichenberg-Gotha-Saalfeld Fault Zone indicate normal and reverse motion. The successive striae on the fault slickensides provide evidence for relative binary chronologies of fault reactivations.

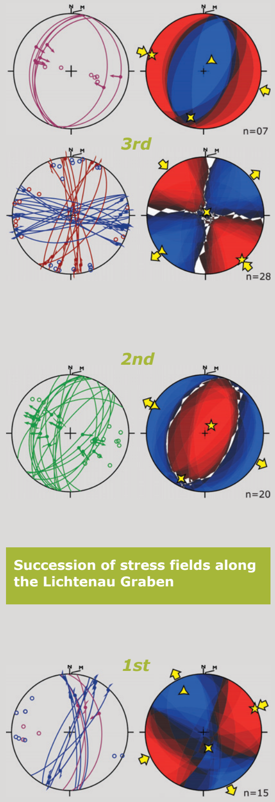
Successive striae on fault slickensides along the Lichtenau Graben

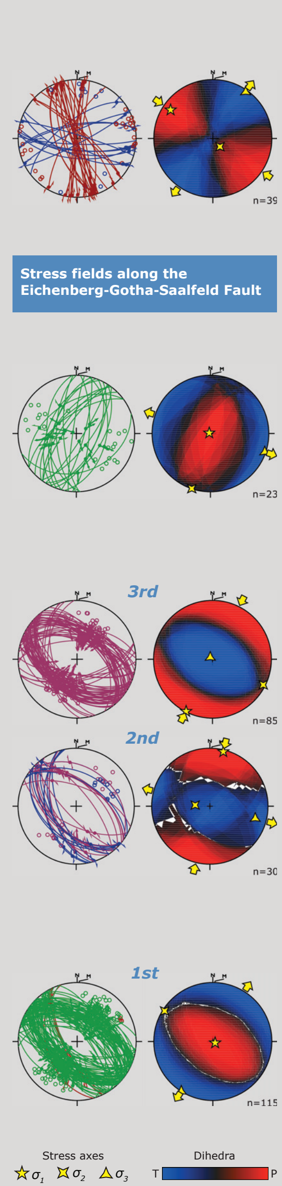


Successive striae on fault slickensides along the Eichenberg-Gotha-Saalfeld Fault



3. Succession of stress fields



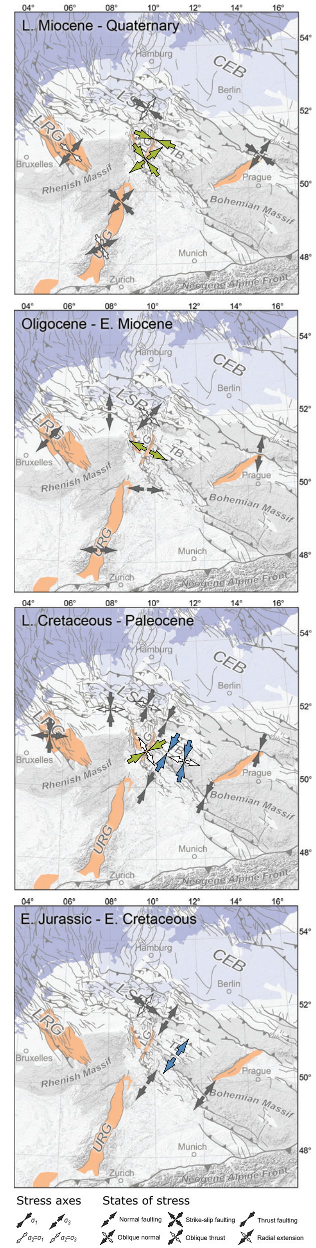


Right dihedra solution for computation of the principal stress axes from fault-slip data. T, tension dihedra; P, pressure dihedra.

Based on the binary chronologies observed on fault slickensides, a succession of stress fields could be summarized as follow:
For the N030-striking Lichtenau Graben, the fault-slip data suggest a succession of sub-horizontal principal stress axes orientated N065 σ_1, N115 σ_3 and N140 σ_1, changing from oblique thrust to normal and strike-slip faulting, respectively.
For the N120-striking Eichenberg-Gotha-Saalfeld Fault, the succession is N035 σ_3, N010 σ_1 and N030 σ_1, changing from normal to oblique thrust and reverse faulting, respectively.

A synthesis of data within the regional tectonic setting reveals consistencies and differences between the structural domains. Within this tectonic setting, the normal and reverse reactivation of NW-SE-striking faults could be attributed to the Jurassic extension and the Late Cretaceous inversion, respectively. The normal and sinistral fault reactivation along the NE-SW-striking faults could be consistent with a change in stress regime from the Cenozoic rifting to the present-day NW-SE-trending maximum horizontal shortening.

4. Regional tectonic setting



Stress field evolution of Central Europe (modified after Navabpour et al., 2017).

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Reference

Navabpour et al. (2017)
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