GeoZentrum Nordbayern

Tectonic stylolites as a valuable stress archive - New insights from Late Cretaceous stress development

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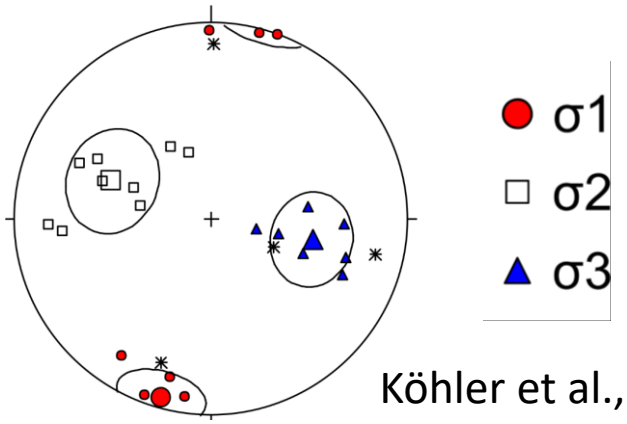
Aims

Previous paleostress analysis, based on fault-slip inversion raised further questions.

E.g. we observed a transitional stress field where no principle stress axis is oriented vertically.



Köhler et al., in prep.

- Can we reconstruct stress development during one tectonic event?
- What is the absolut compressional stress?
- Is stress in one outcrop homogeneous?

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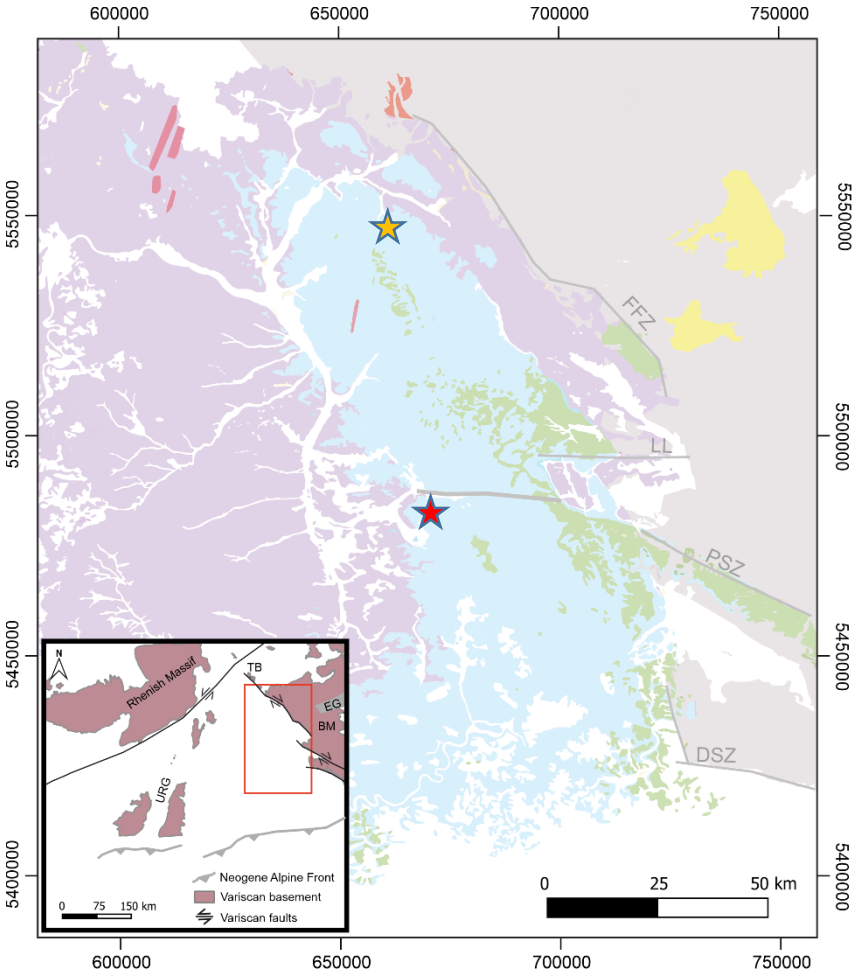
Study area – SE Germany



Stratigraphy
- Quaternary, undiff.
- Miocene
- Paleogene
- Cenozoic volcanism
- Cretaceous
- Jurassic
- Triassic
- Pre-Mesozoic/Basement

Abbrevations
DSZ Danube shear zone
EKFZ Eisfeld-Kulmbach fault zone
FFZ Franconian fault zone
HFZ Hersbruck fault zone
LL Luhe Line
PSZ Pfahl shear zone

- Outcrop – this study
- Outcrop – Köhler et al., in prep.

- Jurassic limestones
- Affected by Late Cretaceous shortening

Key out crop of the previous study where we observed transitional stress is marked with he yellow star. The outcrop for this study is positioned further south.

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Stylolite Clou

- Roughness in tectonic stylolites is anisotropic with respect to stress

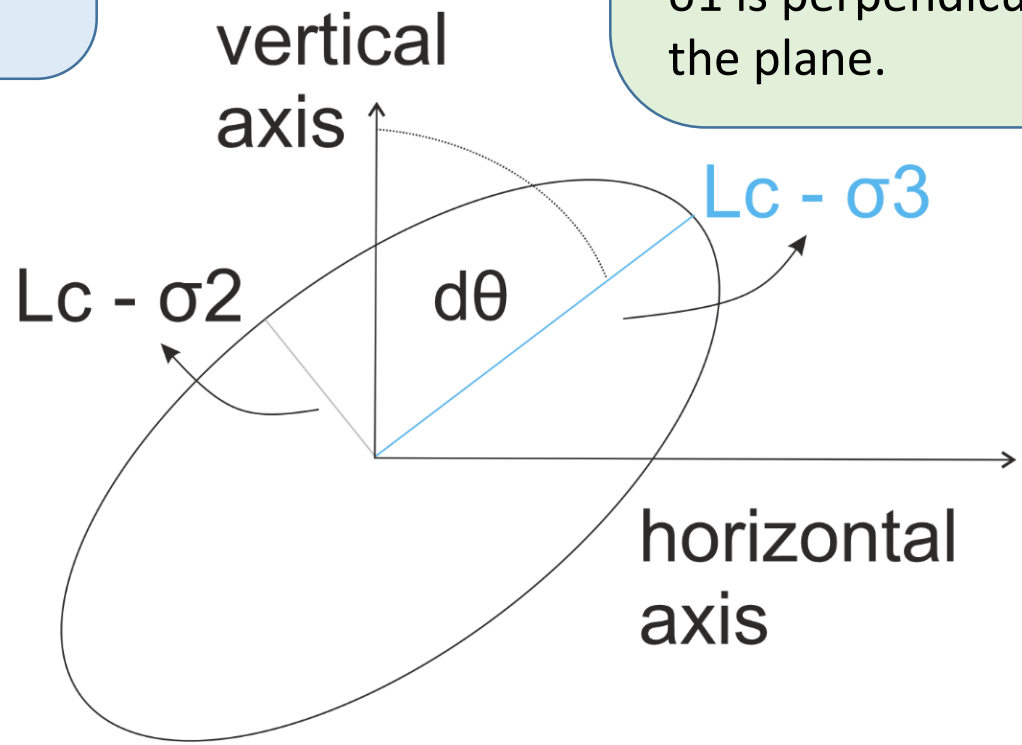
➢Orientation of complete stress tensor is preserved

- Roughness depends on stress

➢Absolut stress is preserved

Schmittbuhl et al. 2004
Ebner et al. 2010
Beaudoin et al. 2016

Roughness analysis leads to an ellipse. The long axis is direction of σ3 and the short axis in direction of σ2.
σ1 is perpendicular to the plane.



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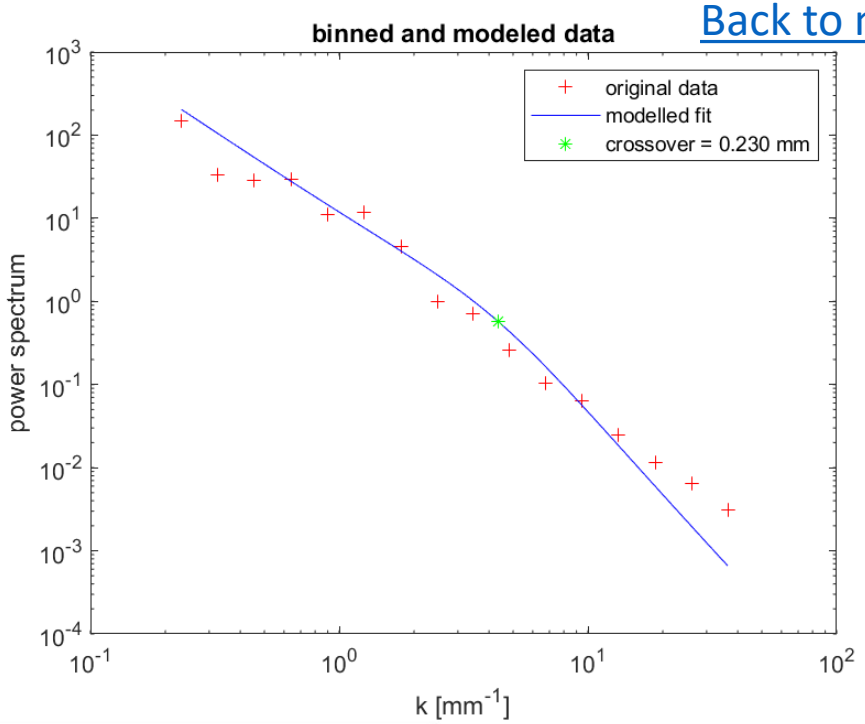
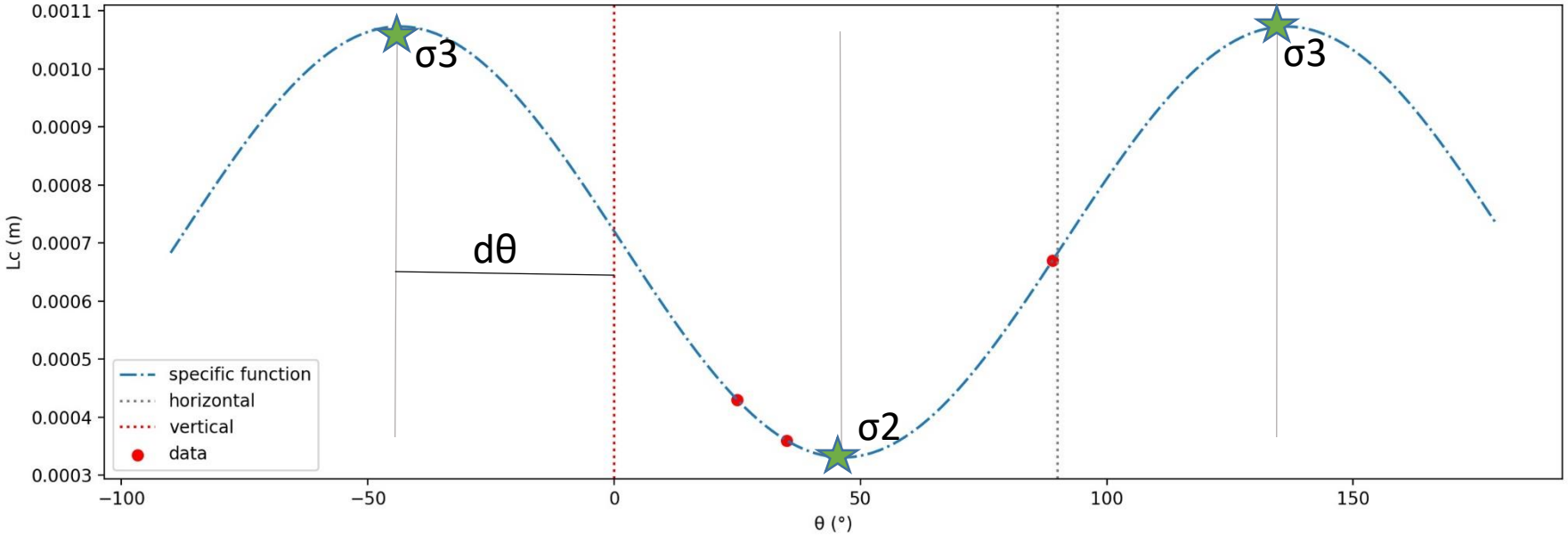
Method

- Actually seven samples (increasing)
- Measure crossover of the roughness in three direction for each sample
- Calculate specific function describing the roughness-ellipse
- dθ gives dip of the principle stress axis





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Outlook

- Use equations by Schmittbuhl et al. (2004) and Ebner et al. (2010) to calculate an absolute value σ1
- Test consistency of tectonic stylolites for one outcrop and later for a larger region

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References

- Beaudoin, Nicolas; Koehn, Daniel; Lacombe, Olivier; Lecouty, Alexandre; Billi, Andrea; Aharonov, Einat; Parlangeau, Camille (2016): Fingerprinting stress: Stylolite and calcite twinning paleopiezometry revealing the complexity of progressive stress patterns during folding-The case of the Monte Nero anticline in the Apennines, Italy. In: Tectonics 35 (7), S. 1687–1712. DOI: 10.1002/2016TC004128.
- Ebner, Marcus; Toussaint, Renaud; Schmittbuhl, Jean; Koehn, Daniel; Bons, Paul (2010): Anisotropic scaling of tectonic stylolites: A fossilized signature of the stress field? In: J. Geophys. Res. 115 (B6), S. 121. DOI: 10.1029/2009JB006649.
- Schmittbuhl, J.; Renard, F.; Gratier, J. P.; Toussaint, R. (2004): Roughness of stylolites: implications of 3D high resolution topography measurements. In: Physical review letters 93 (23), S. 238501. DOI: 10.1103/PhysRevLett.93.238501.