Stress transfer and Quaternary faulting in the northern Alpine foreland

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We investigate the relationship between seismicity and the faulting behaviour of major faults in the Northern Alpine foreland region. This will be done interdisciplinary by means of seismology (exact and precise hypocentre determination, fault plane solution, and stress estimation) and neotectonics (remote sensing, near-surface geophysics, and geological field studies).

Our focus is on three areas: the Albstadt Shear Zone (ASZ), the Molasse basin/Oberschwaben (MB) and the southern half of the Upper Rhine Graben (URG). High-resolution seismicity studies (hypocenters, fault planes, stresses) will help to understand the surficial expression of faults and long-term slip rates. Overall, the study will reveal how the deformation is distributed and if the reactivation of faults is preferred over the formation of new ones in this structurally complicated and highly populated area.

The seismology work will be based on recordings from the AlpArray network (which is densified with 15 additional mobile stations from KIT), the KIT KABBA datacenter and the state earthquake surveys. This comprehensive database offers a unique chance to study the local seismicity in details. Based on hypocenters, fault planes and lithostatic pressure we will determine state of stress in the study region.

The discrepancy between the tectonic morphology and the absence of seismicity will be studied by neo- and active tectonic studies that will focus on young landscapes (post-glacial) and also the youngest fault deposits.

All research themes are closely related to SPP 4D-MB and AlpArray. We closely cooperate thematically with research themes 1, 2 and 3 and include as well links to most of the activity fields. Especially, we work together with project "Quantifying crustal fluid flow .." by Luijendijk and von Hagke, as their sample areas north of the Lake of Constance fall into our research area Oberschwaben, and we will do there neotectonic assessments to link those to low-temperature thermochrono-meters to map the timing and rate of exhumation to tectonic activity and rates. Thematically and methodologically, the Grützner et al. project in the Slovenia/Italia region is also closely related to our work in southern Germany. Outside the SPP, we have established diverse international cooperations with IRSN (France) and the LGRB for the URG area, and for Oberschwaben with the Univ. of Berne/ Switzerland.
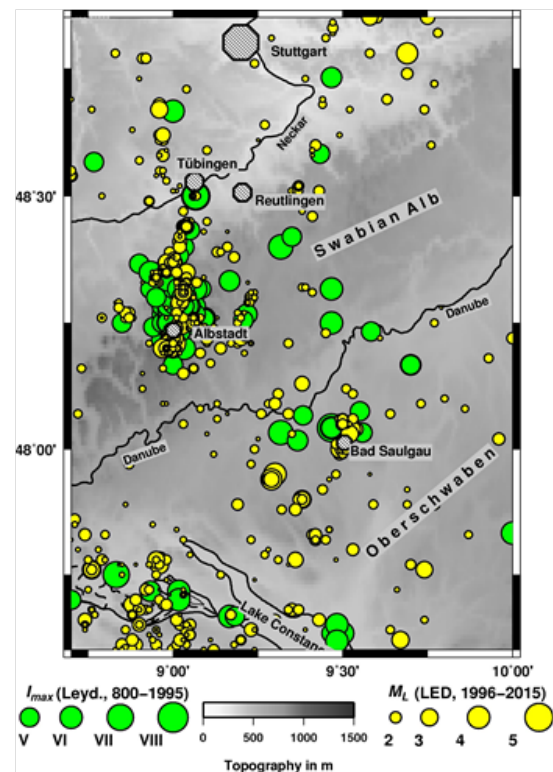

Figure 1: Historic seismicity (Leydecker catalogue, 2011) and instrumental seismicity (since 1996, Landeserd-bebendienst BW, Brüstle & Stange, Jahreszusammen-stellungen,http://lgrbbw.de/erdbeben/jahresbulletins) on the Swabian Alb with the Albstadt shear zone and in the Molasse Basin / Oberschwaben.

In the first phase, one PhD will be involved in this project at KIT, in order to study the seismicity in the research areas, and to better localize hypocenters of earthquakes and related seismicity to faults.
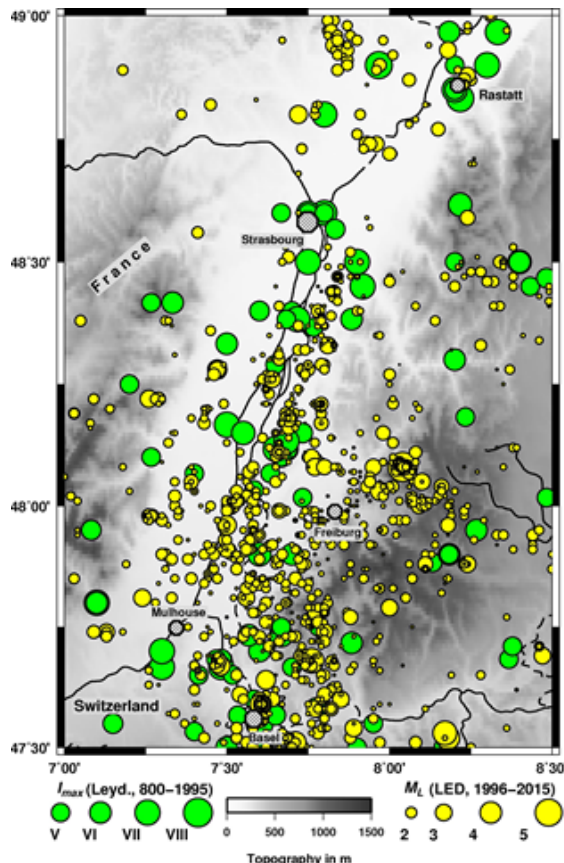

Figure 2: Historic seismicity (Leydecker catalogue, 2011) and instrumental seismicity (since 1996, Landeserd-bebendienst BW, Brüstle & Stange, Jahreszusammen-stellungen,http://lgrbbw.de/erdbeben/jahresbulletins) in the Upper Rhine Graben south of Karlsruhe.

First results of geophysical and remote sensing analyses (LiDAR data) show the presence of active faults along the eastern border fault of the URG in good relation with topographic steps (Fig. 3), where tectono-morphologic relations could be traced in the shallow subsurface by ground-penetrating radar profiling. Other promising locations in the URG near Tunsel, S of Freiburg and in Oberschwaben have been surveyed in summer 2017 and will be subject to detailed geophysical surveys in 2018.
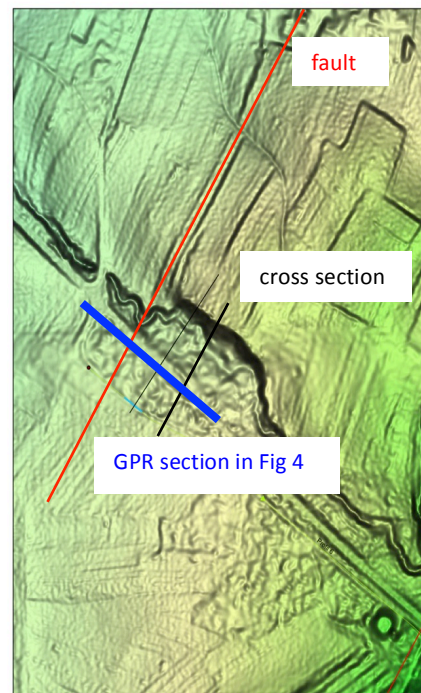

Figure 3: Eastern border fault in the URG south of Karlsruhe (Ettlingenweiler)
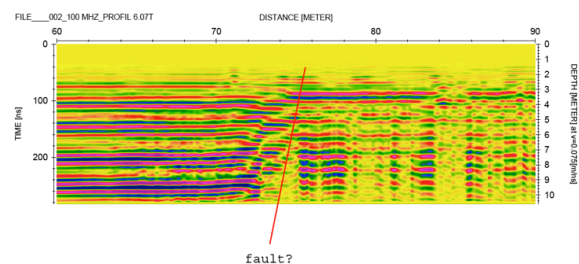
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Figure 4: Radargram of the eastern border fault in the URG, see Fig. 3 for location (W is left).