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Fault-growth by segment-linkage over time - an example from Permian normal faults in the NW German Basin

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Extensional fault systems commonly develop from individual segments with isolated sub-basins to zones of interacting fault systems. During extension, normal faults grow by the linkage of initially-isolated segments, and thereby coalesce through breached-relay structures. Thus, these formerly individual segments subsequently form parts of the larger more-recent fault surface, and can be identified by the analysis of the fault morphology, and by fault-slip measurements.

In this study we focus on the development of fault-slip in space and time. We show an example of fault analysis from Permian normal faults, interpreted from a high-quality depth-migrated 3-D reflection seismic survey, which is located in the NW German Basin. We interpret a syn-sedimentary Permian graben fault in 3-D and analyse it in terms of slip-direction, segment linkage and relay structures using seismic interpretation and modelling tools.

The analysed fault extends over a length of nearly 10 km. We determine the slip of two Permian horizons, parallel to fault-strike. The slip changes strongly along strike, which points to several former fault segments characterised by displacement maxima and overlap zones. Fault-growth over time is also demonstrated by the different scales of segment length, ranging from few 100 metres to several kilometres. Attribute maps, which visualize the fault topography, do also highlight overlap zones, and therefore support the results of slip-measurements.

Clarifying the spatial and temporal development of the graben faults observed in the study area in terms of lithology and reactivation of older structures will yield the input for modelling studies, and finally allow comparison with natural data sets at different scales.