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Paleoseismological investigation of northern Germany

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Seismicity in northern Germany is rare, but historic earthquakes with intensities of up to VII occurred in this region during the last 1200 years (Leydecker, 2011). In the last 40 years, ongoing seismic activity was also instrumentally detected. Recent earthquakes were recorded e.g., east of Hamburg and in the Halle/Leipzig area. Many of the historic and recent earthquakes occur at major Cretaceous reverse faults. A possible trigger mechanism is the release of lithospheric stress changes due to glacial isostatic adjustment in response to the decay of the Weichselian ice-sheet in the Late Pleistocene (Brandes et al., 2015). The occurrence of recent seismicity and the long record of historic earthquakes require a re-evaluation of the seismicity in northern Germany.
In this project, seven major fault zones in northern Germany (Aller Valley Fault, Elbe Lineament, Gardelegen Fault, Halle Fault, Harz Boundary Fault, Osning Thrust and Steinhuder Meer Fault) were analysed for evidence of neotectonic activity and paleo-earthquakes. Sand and gravel pits, within an area of up to 20 km around the major basement faults, were analysed for paleoseismological evidence. Indications of neotectonic activity were found at the Aller Valley Fault, the Harz Boundary Fault, the Osning Thrust, the Steinhuder Meer Fault and at a small fault near Halle. Indicators are deformation bands and soft-sediment deformation structures, which formed in unconsolidated Pleistocene sediments. The deformation bands follow the trend of the major basement faults. Therefore, they are regarded as strong indicators of movements along subsurface faults that developed due to earthquakes above and along basement faults.
Information about the timing of faulting was derived from luminescence dating (IRSL and OSL) of syntectonic sediments. High resolution shear-wave seismic and geoelectric (ERT) profiles were used to analyse the near-surface geometry of the faults. Subsequently, numerical simulations of GIA related changes in Coulomb failure stress were carried out to investigate the reactivation potential of the Harz Boundary Fault, where Lateglacial activity was observed that is likely caused by the decay of the Weichselian ice-sheet.

References

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