



Quaternary layer anomalies around the Carlsberg Fault zone mapped with high-resolution shear-wave seismics south of Copenhagen

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The Carlsberg Fault zone is located in the N-S striking Höllviken Graben and traverses the city of Copenhagen. The fault zone is a NNW-SSE striking structure in direct vicinity to the transition zone of the Danish Basin and the Baltic Shield. Recent small earthquakes indicate activity in the area, although none of the mapped earthquakes appear to have occurred on the Carlsberg Fault. We examined the fault evolution by a combination of very high resolution onshore shear-wave seismic data, one conventional onshore seismic profile and marine reflection seismic profiles. The chalk stratigraphy and the localization of the fault zone at depth was inferred from previous studies by other authors. We extrapolated the Jurassic and Triassic stratigraphy from the Pomeranian Bay to the area of investigation. The fault zone shows a flower structure in the Triassic as well as in Cretaceous sediments. The faulting geometry indicates strong influence of Triassic processes when subsidence and rifting prevailed in the Central European Basin System. Growth strata within the surrounding Höllviken Graben reveal syntectonic sedimentation in the lower Triassic, indicating the opening to be a result of Triassic rifting. In the Upper Cretaceous growth faulting documents continued rifting. This finding contrasts the Late Cretaceous to Paleogene inversion tectonics in neighbouring structures, as the Tornquist Zone.

The high-resolution shear-wave seismic method was used to image structures in Quaternary layers in the Carlsberg Fault zone. The portable compact vibrator source EIViS III S8 was used to acquire a 1150 m long seismic section on the island Amager, south of Copenhagen. The shallow subsurface in the investigation area is dominated by Quaternary glacial till deposits in the upper 5-11 m and Danian limestone below. In the shear-wave profile, we imaged the 30 m of the upward continuation of the Carlsberg Fault zone. In our area of investigation, the fault zone appears to comprise normal block faults and one reverse block fault showing the complexity of the fault zone. The observed faults appear to affect both the Danian as well as the Quaternary successions. We conclude that such investigations are critical for judgment regarding whether or not faults in the study area affect recently deposited strata and if the zone is tectonically active.