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Soft-sediment deformation structures in Late Pleistocene alluvial-aeolian sediments caused by GIA induced seismicity along the Osning Thrust (northern Germany)

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Historic sources report that northern Germany was affected by significant earthquakes during the last 500 years (Leydecker 2009), but the only modern study so far on earthquake related soft-sediment deformation structures was carried out by Hoffmann and Reicherter (2012) for the Baltic Sea coast area of northeastern Germany.

We present new data on seismically triggered soft-sediment deformation structures in Pleniglacial to Late Glacial alluvial fan and aeolian sand-sheet deposits of the upper Senne (Münsterland Embayment) and link this soft-sediment deformation directly to Late Glacial earthquakes generated along the Osning Thrust, which is one of the major fault systems in Central Europe. The reactivation of the Mesozoic Osning Thrust was an effect of glacial isostatic adjustment during the Pleniglacial to Late Glacial (Brandes et al., 2012). Young tectonic activity in this area is indicated by the 1612 Bielefeld earthquake (Vogt & Grünthal 1994). The analysed soft-sediment deformation structures are exposed in two sand pits in the vicinity of the Osning Thrust and include a complex fault and fold pattern, clastic dykes, sand volcanoes, sills, irregular intrusive sedimentary bodies, flower- to antler-like dewatering structures, flame structures, and ball-and-pillow structures. There is a distinct variation of the soft-sediment deformation style parallel to the trend of the Osning Thrust. In the northwestern part of the study area, close to Oerlinghausen there is a wide range of structures developed that is mainly related to fluidization processes. In contrast, in the southeast only flower- to antler-like dewatering structures and normal fault-arrays occur. This might indicate that the epicentre of the Late Pleniglacial to Late Glacial seismic event was close to Oerlinghausen.

It is the first time in northern Germany, that fluidization and liquefaction features can be directly related to a fault. The occurrence of seismicity in the Late Pleniglacial to Late Glacial together with the 17th century seismicity indicates ongoing crustal movements along the Osning Thrust and sheds new light on the seismic activity of northern Germany. The association of soft-sediment deformation structures implies that the Late Glacial earthquake had a Richter magnitude of at least 5.

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