Limitations of soft-sediment deformation structures as indicator for paleo-earthquakes in formerly periglacial and glaciated areas

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During the last years many studies focused on soft-sediment deformation structures (SSDS) to identify past seismic events. However, in regions that were affected by glaciations and periglacial processes like northern and central Europe, the use of SSDS as paleo-earthquake indicator is challenging. Interpretations require great care. Earthquakes are only one possible trigger mechanism of many that can cause liquefaction and/or fluidization of sediments, which leads to the formation of e.g. sand volcanoes, clastic dykes, flame structures, or ball-and-pillow structures.

SSDS triggered by seismic shaking are so-called seismites. Originally the term ‘seismites’ was used by Sailacher (1969) and only referred to sediment beds that were deformed by earthquake-related shaking. Pleistocene seismites are described from former glaciated areas in Germany, Denmark, Sweden, Poland, Latvia, and Lithuania.

However, ice-sheet loading, glaciotectonism as well as freeze and thaw processes in periglacial environments are also potential trigger mechanisms causing the formation of similar looking types of SSDS, which can be easily mistaken for seismites. Therefore, it is important to use a set of clear criteria to recognize seismites in the field.

Extensive studies of Pleistocene sediments in northern Germany have shown that deformation bands are a suitable indicator for paleo-fault activity. Deformation bands that are developed close to the tip line of a fault in combination with e.g. sand volcanoes, clastic dykes, flame structures, or ball-and-pillow structures is the most robust indicator for paleo-earthquakes.

References

