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Shear-wave reflection seismics as bridge between georadar and deeper subsurface surveying - a case study for quick-clay landslides in Sweden

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As part of a joint project studying clay-related landslides in Nordic countries, we successfully tested the use of shear-wave reflection seismics to survey shallow structures that are known to be related to quick-clay landslide processes. Co-sponsored via the Society of Exploration Geophysicists (SEG) program 'Geoscientists Without Borders (GWB)', several international groups apply a suite of applied geophysical and geotechnical methods to understand structural and physical conditions and the conditioning of this type of liquefaction.
For this purpose, three 2D profiles were recorded in Frastad, southern Sweden, above the main slide plane area. Using a 120 m long streamer of 120 SH-geophones at 1 m spacing, and the ELVIS micro-vibrator as source, shear-wave data of very high quality were gathered, allowing a vertical resolution of 1 m and less. The longest profile along a paved road shows clear internal structuring of the up to 50 m thick marine sediments as well as strong undulations of top basement underneath. Different sedimentary sequences can be distinguished, and the quick clay sequence is interpreted in 15-20 m depth, which correlates well with the height of the most recent scarp. The sedimentary shear wave velocities suggest extremely low values of 100-120 m/s, which geotechnically prohibits building areas. In addition, test measurements on a stubble field showed the first time that the suppression of Love waves is not only restricted to paved surfaces and may also be achieved if reflection contrasts and low dispersion allow a suitable data processing. This opens new possibilities for a wide range of applications and specialized equipment adaptions with respect to reflection seismic surveying. In addition, the gap between structural data from georadar and P-wave seismic can be closed.