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Neotectonic fault structures in the Lake Thun area (Switzerland)

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Strong historic earthquakes (i.e. intensities $I_0 \geq$ V) in Switzerland are well documented by the earthquake catalogue of Switzerland ECOS-09 (e.g. Frutigen, 1729 AD, Mw=5.2, I_0=VI). Many of these strong events can be recognized paleoseismically by large subaquatic, earthquake-triggered mass movements that occur frequently in Swiss Lakes. Some of these represent the occasional occurrence of even stronger earthquakes (i.e. $M_w \sim$6.5) in the Alpine region (Strasser et al., 2013), which are expected to produce noticeable surface ruptures. However, convincing evidence for Quaternary displacements with offset surface expressions have scarcely been found (e.g., Wiemer et al., 2009). Applying a multi-disciplinary approach, this study presents potential candidates for such faults in the larger Lake Thun area at the edge of the Alps.

The overdeepened basin of Lake Thun is situated at the northern Alpine front, which extends orthogonally to the general strike direction of the Alpine nappe front. The northern shoreline is predominantly shaped by the front of the Subalpine Molasse, which is in strong contrast to the south western shore built by the structurally higher units of the Middle and Lower Penninic nappes. This pattern with obvious differences of both lake sides suggests a major fault along the lake axis and high tectonic activity during nappe emplacement, i.e. from Eocene times throughout the Late Miocene. The area is dominated today by a strike-slip stress regime with a slight normal faulting component (Kastrup et al., 2004).

As part of a multi-disciplinary study, attempting to find potential neotectonically active fault structures in the Lake Thun area, a 2D ground penetrating radar (GPR) survey was conducted. The aim of the GPR survey was to link observations from a multichannel reflection seismic survey and a multibeam bathymetric survey carried out in Lake Thun with findings in a nearby gravel quarry revealing suspicious deformation features such as rotated gravel clast as well as significantly offset horizons.

The GPR data reveal the occurrence of several morphologic depressions from gypsum cones and clearly dipping reflections. The reflection seismic data set shows prominent reflections, characteristic seismic facies and a few sets of normal and reverse faults in the north western part of the lake basin within the glacio-lacustrine deposits that may point to a transpressional strike-slip regime. A first neotectonic analysis links these prominent lake floor features with geomorphologic patterns from the surrounding landscape, pointing to a potential candidate for a fault that is active in the Quaternary period.