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Overdeepened glacigenic landforms in Lake Thun (Switzerland) revealed by a multichannel reflection seismic survey

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Recently acquired high-resolution multibeam bathymetry, in combination with a 2D multichannel reflection seismic campaign on perialpine Lake Thun (Switzerland) reveals new insights into the diverse geometry of the lake basin and a so far unknown subaquatic moraine crest with unprecedented clarity. These new data will improve our comprehension concerning the retreat phases of the Aare glacier, the morphology of its proximal deposits and the facies architecture of the subglacial units.

The overdeepened basin of Lake Thun was formed by a combination of tectonically predefined weak zones and glacial erosion during the last glacial periods. The new data indicate that below the outermost edge of a morphologically distinct platform in the south eastern part of the lake basin, a ridge structure marked by strong reflection amplitudes occurs. This structure is interpreted as a subaquatic terminal moraine crest, most likely created by a slightly advancing or stagnant grounded Aare glacier during its major retreating phase. The terminal moraine smoothly transforms downstream into well distinguishable foresets with internally recognisable layering, which dip steeply towards the deepest part of the basin, eventually transforming into bottomsets. This depositional sequence formed by the fore- and bottomsets represents ∼50% of the overall sediment volume that fills the basin and was deposited while the glacier was stagnant, interpreted to represent a rather short period of time of a few hundreds of years. This sequence is overlain by lacustrine deposits formed by late-glacial and Holocene laminated muds comprising intercalated turbidites (Wirth et al. 2011).

Little is known about the exact timing and behaviour of retreating glaciers between their recessional phase from the Alpine foreland to the deglaciation of the inner-Alpine ice cap, mostly due to the lack of well-developed moraines that indicate glacial stabilization or slight readvance. Findings from pollen analyses by Ammann (1994) hint at a completely ice-free Northern Alpine foreland during the Oldest Dryas. Radiocarbon-dated calcareous clay gyttja of late-glacial Lake Amsoldingen, located adjacent to the water outlet of Lake Thun, shows a ∼16.3 ka BP age (Lotter, 1985) while the oldest ^{10}Be exposure ages from the Grimsel area, the accumulation area of the Aare glacier, indicate ice-free conditions around 14-11.3 ka BP (Kelly et al., 2006). The deposition of the subaquatic moraine of the Aare glacier hence has to fit temporally between these age constraints, implying rather high sedimentation rates, which will be integrated in an appropriate sedimentological concept quantifying subaquatic moraine formation in a recessional overdeepened setting.