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Erosion and filling of glacially-overdeepened troughs in the Northern Alpine Foreland as recorded in a deep drill core from Northern Switzerland

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As the major weather divide in Europe, the Alps represent one of the most interesting areas for understanding past climate change and its impact on continental environments. However, our knowledge of the Quaternary environmental history of the region is still rather limited, especially for the time preceding the last glaciation of the Alps. Geological and geophysical studies in the Wehntal, 20 km northwest of Zurich, Switzerland, in 2007 and 2008 have revealed the existence of a glacially overdeepened trough cut into Miocene molasse bedrock, which is today filled with $\sim$90 to 180 m of Pleistocene sediments. In March 2009, a 93.6 m long sediment core (NW09/1) has been drilled east of the famous mammoth-site Niederweningen. This record is one of the very few sites in the northern Alpine Foreland that provides crucial insights into the timing of the erosion and infilling history of pre-Eemian glacially overdeepened troughs and also helps to understand the climate and environmental history.

Based on chronological data deduced from the nearby, but shorter, 2007 core and on new multi-proxy data, the NW09/1 record is interpreted as: 4.1 m of in-situ molasse bedrock, overlain by 3.4 m of diamictic till. These glacial deposits were deposited by a Linth glacier lobe during Marine Isotope Stage (MIS) 6 (Rissian), although, the possibility that an even older glaciation was responsible cannot currently be excluded (e.g. MIS 8, luminescence dating, pollen interpretations, and palaeomagnetic studies in progress). It is suggested that this extensive ice advance, which once covered the entire Wehntal valley, caused the final erosion of the bedrock. The till is overlain by a 29.5 m thick sequence of laminated, carbonate-rich, fine-grained siliciclastic sediments that are interpreted as proglacial lake sediments. It is supposed that this unit was deposited in a proximal setting to a calving glacier-front confirmed by the presence of numerous dropstones. The damming of this Wehntal palaeolake was most likely caused by a terminal moraine located $\sim$3 km to the northwest of the drill site. The overlying 37.9 m of fine-grained lake sediments are comparable to the former unit, but the absence of dropstones and the occurrence of multiple interstratified sand layers (up to 40 cm in thickness) indicate a more distal proglacial lake facies and thus, a melting of the feeding glacier lobe. The subsequent 9.5 m of fine-grained material are characterised by a striking drop in carbonate content (from $\sim$50 to 20 wt%), which is interpreted as a decoupling of the Wehntal catchment from the Linth glacier system that originates in a carbonate-rich hinterland. Furthermore, the top of this unit documents the gradual infilling of the palaeolake and the onset of biological productivity due to climate warming. This is also documented by occurrence of pyrite and siderite concretions. The prominent environmental change culminates in the abrupt accumulation of peat (1.8 m) during the interglacial MIS 5e (late Eemian). Afterwards, the Wehntal was recaptured by a younger palaeolake after which the peat became flooded. The resulting 4.9 m of silty sediments have carbonate contents of $\sim$25 wt% and also show post-sedimentary pyrite and siderite concretions. The source of sediment is interpreted as derived from the molassic Zurich Highlands and the Jurassic limestone of the Lägern mountain, which borders the Wehntal valley to the south. The cause of the rise in water level subsequent to deposition of the MIS 5e peat, however, has not yet been identified. Eventually, the younger palaeolake was filled, resulting in the accumulation of 0.7 m of fossil rich Middle Würmian peat ('Mammoth peat'). This peat was finally covered with 2.0 m of post-Würmian-to-recent silts and sands.