Retreat of the Rhine Glacier from Lake Constance: Sedimentological and geochemical evidences from a deep lake-basin drillhole

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The modern basin of trinational Lake Constance, between Switzerland, Germany, and Austria, represents the underfilled northern part of a glacially overdeepened trough. It is over 400 m deep and reaches well into the Alps at its southern end. The overdeepening was formed by the numerous glacial advance-retreat cycles of the Rhine Glacier throughout the Middle to Late Quaternary. A seismic survey of Lake Constance revealed a Quaternary sediment fill of over 150 m thickness under the modern lake floor in a maximal water depth of >250 m. This sedimentary sequence represents at least the last glacial cycle with ice-contact deposits at the base on top of the Molasse bedrock overlain by glaciolacustrine to lacustrine sediments. During the successful field test of a newly developed mid-size coring system (“HIPERCORIG”), the longest core ever taken in Lake Constance was recovered with an overall length of 24 m. The drill core, taken in a water depth of 200 m, consists of a nearly continuous succession of lacustrine sediments including over 12 m of pre-Holocene sediment at the base. The entire core was petrophysically and geochemically analyzed, sedimentologically described, and 14 lithotypes were identified. In combination with a 14C- and OSL-based age-depth model, the core was divided into three main chronostratigraphic units. The basal age of ~13.7 ka BP places the base of the section back into the Bølling-Allerød interstadial whereas the overlying strata represent a complete Younger-Dryas and Holocene section.

The sediments offer a high-resolution insight into the evolution of Paleolake Constance from a cold postglacial to a more productive warm Holocene lake. The Late Glacial sections are dominated by massive, m-thick sand beds reflecting episodic sedimentation pulses. They are most
likely linked with a subaquatic channel system that is still apparent in today's lake bathymetry despite the Holocene drape. This channel system was fed from a Late Glacial river from the north; provenance analysis of the initially unexpected sands together with hydrologic considerations will document whether this inflowing high-discharge river represented a local catchment (i.e. northern lake shore) or an Alpine signal (i.e. from the south) provided by the Rhine glacier. Tentative pore water hydrogeochemical and isotope analyses indicate a still active flow system at depth. The overlying Holocene section reveals a prominent, several cm-thick double-turbiditic event layer representing the most distal impact of the "Flimser Bergsturz", the largest known rock slide of the Alps that occurred over 100 km upstream the Rhine River at ~9.5 ka BP. Furthermore, lithologic variations in the Holocene section document the varying sediment load of the Rhine and of the endogenic production representing a multitude of environmental changes.