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Lake Biel sediment record during the last 7500 years and impact of the Aare river deviation in 1878 AD.

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Lake sediments are excellent archives of environmental and climate changes as well as human impact on lake- and river-systems. Lake Biel is a medium-sized peri-alpine lake (Switzerland) with a maximum depth of 74 m and lies at 429 m asl. Our study focuses on the south-west basin, where the lake sedimentation was naturally mainly controlled by autochthonous sedimentation, and is now, since the artificial Aare river deviation through the Hagneck canal in 1878 AD, under the strong influence of water and sediment input from its catchment.

A 10.05-m-long composite sediment sequence, cored in 2011 at 52 m water depth, was built from two cores retrieved with an Uwitec system. The cored sedimentary sequence begins in 1975 and spans the last 7500 years, as dated by seven 14C analyses and 210Pb/137Cs activity profiles. Magnetic susceptibility and density were measured with a Geotek MSCL at 0.5 cm resolution, granulometry with a CILAS grain sizer every 10 cm and X-ray fluorescence measurements were carried out using an Avaatech core scanner at 1-cm resolution.

Lake Biel sediment record is subdivided in four main units. The lowest Unit A (651-1005 cm; 7355 to 5075 BP), with dark greyish clayey silty laminated layers and sedimentation rates between 0.10 to 0.29 cm/yr, shows stable low values for almost all proxies, excepted for allochtonous elements which increase between 7000-6000 BP. By analogy with Unit C facies (see below), Unit A is interpreted as influenced by the Aare river which probably flew into the south-west basin at that time. Unit B1 (651-343 cm, 5075 to 2036 BP) has lower sedimentation rate (0.10 cm/yr), high Ca/Ti ratio, light sediment color, constant clayey silty grain size and varying elemental profiles which point to the dominant influence of autochtonous lake processes influenced by climate. From the beginning of Unit B2 (343-147 cm, 2036 to 1878 AD) sediment grain size increases which possibly reflects a human influence over the lake system. The greatest sedimentary change occurs in the upper part of the record with a 20 times increase in sedimentation rate (2.63 cm/yr) happening at the beginning of Unit C (147-0 cm, 1878 to 1975 AD). Unit C is initiated with a 3-cm-thick sand layer and comes with a sharp increase of allochtonous elements and a proportional decrease of Ca. These changes are interpreted as directly caused by the Aare deviation and subsequent river bed erosion in the channel. From 1900 AD, when a dam was built at the end of the Hagneck canal, sedimentation rate stabilizes at $\sim$1.1 cm/yr. Overall, the Lake Biel record reveals the magnitude of sedimentary changes happening in a lake system when it shifts from a relatively closed basin to a river-influenced basin.

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