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Sediment geochemistry and seismic stratigraphy of an Alpine lake in southern Bavaria (Walchensee, Germany)

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The lake Walchensee is located in the Northern Calcareous Alps, ∼60 km SSW of Munich. It is surrounded by up to 1800 m high mountains, has an area of 16.3 km^2 and is up to 189.5 m deep. The lake basin is located on a fault zone and was shaped by glacial erosion during the last glacial periods. Since AD 1924, the height difference between Walchensee (801 m asl) and nearby Kochelsee (599 m asl) is used for production of hydroelectric power and, thus, the lake was converted to a reservoir for the power plant. Since that time, three streams in the vicinity were redirected to stabilize the lake level with the consequence of enlarging the originally small natural catchment area substantially. These anthropogenic changes resulted in increased eutrophication of the former oligotrophic lake and in a massive increase of the sedimentation rate.

A 55 cm long sediment core was recovered from the deepest basin of Walchensee to study the impacts of these anthropogenic disturbances on the lake's sediments. This gravity core was dated with ^{137}Cs and investigated with isotopic and geochemical methods. The homogeneous lower part of the core is interpreted as a thick turbidite possibly triggered by human activities during the construction of the power plant. Only the uppermost 23.5 cm, covering the last 80 years, are laminated and show a generally increasing but varying Ca contents, decreasing $\delta^{13}C_{org}$ values (around -30‰) and δ^{15}N values close to 0‰ . We interpret this as varying influx of detrital carbonates from the artificial inflows of the lake, microbially mediated carbon sources and substantial amount of N-fixing cyanobacterial remains in the sediment organic matter, respectively.

A detailed 3.5 kHz reflection seismic grid acquired in April 2009 registered the complete sediment infill of the lake basin all the way down to the underlying moraine/bedrock substrate. A large variability of sediment thickness was recorded throughout the lake with a maximum of ∼24 m in the deepest basin. Additionally, multiple and contemporaneous slide deposits and correlated homogenous layers of several meter in thickness were recorded in the seismic sections, that are the results of slope instabilities likely triggered by earthquakes. Future research activities at Walchensee are intended to focus on the recovery of longer sediment cores from selected sites to study the basin history, its paleoenvironmental development and regional tectonic activities.