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The history of Cesium-137 liquid emissions by Mühleberg Nuclear Power Plant (Switzerland) is recorded in Lake Biel sediments

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Lake sediments record changes happening in their upstream river catchment and regional environment which includes traces of artificial radionuclides emissions deriving from human activities. 137Cs emissions started worldwide in the early 1950's and peaked in 1963-64 due to nuclear bomb tests in the high atmosphere. A second 137Cs activity peak, due to the 1986 Chernobyl catastrophe is recorded in sediment archives from central Europe. These two events (1963/64 and 1986) serve routinely as time markers for recent lake records.

Nuclear Power Plants (NPPs) are often constructed along river course for cooling purposes. Since 1972, Mühleberg NPP (central Switzerland) lies 18 km upstream Lake Biel and releases radioactive liquid emissions into the Aare river which adds to the diffuse - above mentioned – radioactive pollution, as revealed by Albrecht et al. (1995; 1998) and recently confirmed by Thevenon et al. (2013) from Lake Biel sediments. The water of Lake Biel is used as drinking water for ca. 60'000 inhabitants and its outflowing water is further used by downstream cities lying on the Aare-Rhine course such as Basel (200'000 inhab.)

In this study, the 137Cs activity curve of a 90-cm-long sediment core (BIE10-8), retrieved in April 2010 from the central Lake Biel basin at ca. 50 m depth, and measured by gamma ray spectrometry using high resolution germanium detectors, confirms previous work and reveals a new peak for the year 1998-2000, as observed by Thevenon et al. (2013). This peak is most certainly due to Mühleberg NPP as shown by the good correlation with declared 137Cs liquid emissions indicating a significant increase in 1998-99. Decay corrected activity data, converted into 137Cs fluxes, point to water pollution by Mühleberg NPP in 1975-1985 as being similar to those linked to the catastrophic events in 1963-64 and 1986 (about 75%).
As former study showed that Lake Biel sediments scavenge only a portion of the total radionuclide in water, i.e. 30-55% for 60Co (Albrecht et al. 1999), our results indicate that the estimated quantities of 137Cs input infered from the sediment record correspond well to historic declared liquid emissions.
Overall, this study shows how lake or reservoir sediments can be used to trace back and verify the history of past liquid emissions from nuclear power plants. In the context of the Aare and Rhine course, were radionuclide liquid emissions from four NPP add-up in the same river system until the city of Basel and also further add-up downstream in Germany, it is necessary to bring new knowledge on this subject to quantify the 35-years-long exposure through river water for drinking water and irrigation to low but repeated radioactivity.

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