Microplastics in lacustrine sediments – the example of Lake Biel, Switzerland

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Introduction: Since the beginning of the second half of the 20th century the worldwide plastic production increased from 1.5 Mt/year to more than 320 Mt in 2015 [1]. Microplastics end up in freshwater bodies and in the marine environment, and are even found in remote places such as the Arctic [2]. In undisturbed lake sediments, only selected investigations have been conducted until now (e.g. [3]). Lake Biel is one of the three large lakes in the Jura region of Switzerland with a length of 15 km and a width of up to 4.1 km. The lake has a catchment area of about 8,305 km². Water remains in the lake for an average of 58 days. The rivers Aare and Zihl/Thielle flowing from Lake Neuchâtel are the main tributaries. The aim of this study is to trace the input of microplastic particles since the beginning of the plastic production in the 1950s. That allows estimating the annual deposition and increase of microplastics in undisturbed lacustrine sediments. Moreover, it is another piece of the puzzle to solve the question of current or future risks that can come from microplastics in sediments..

Methods: For this study a 110 cm long sediment core (diameter: 5.9 cm) has been retrieved with a lead-loaded gravity corer from the middle of Lake Biel in Switzerland (lake bottom at 53.1 m below water surface). Samples were taken every 1 cm for the chronostratigraphy, every 2 cm for the microplastic investigation. The anthropogenic radionuclides (^{137}Cs) measured by means of γ-spectrometry allows a relative age estimation. For measuring the microplastic concentration, the organic matter was digested using a reagent composed of equal volumes of 10 M KOH and 30 % H_2O_2, followed by neutralization with formic acid. Then, the microplastic particles were isolated from remaining matrix by density floatation using 1.6 g/mL potassium formate solution and pressure filtration on aluminium oxide filters. Analysis was done by visual inspection and Fourier-transform infrared spectroscopy (µFT-IR).

Results: The depth distribution of ^{137}Cs reveal the historical fallout peaks of the nuclear weapon testing period from 1945 to 1963, the release of the Mühleberg nuclear power station into the Aare and thus into Lake Biel in the middle of the 1970s and the Chernobyl accident of 1986. The sedimentation rate was calculated to 1 ± 0.1 cm per year.
The preliminary results of microplastic analysis of each 2 cm (ca. 2 years) reveals that only few fibers and plastic fragments are deposited. The frequency of particles increase particularly towards the top over the past years. The detailed µFT-IR analysis will be presented at the conference.

Discussion: This is the first time that a core from Lake Biel has been investigated for ^{137}Cs concentrations and correlated with microplastic occurrence. In the undisturbed sediments microplastic particles could be detected (esp. fibers and particles), however, only few were counted. This might be due to the fact that only 20 g per sample could be used for microplastic investigations. Therefore, more sediment is necessary for future investigations. The finding of higher particle concentrations in recent years should be supported by further investigations.

References:

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