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Origin and behavior of contamination of Lake Neusiedl with PAH and PFAS

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Lake Neusiedl is the largest endorheic lake in Central Europe, straddling the Austrian–Hungarian border. The lake has an area of 315 km^2, 52% of which is covered by a reed belt representing the second largest contiguous reed population in Europe. The lake's drainage basin has an area of about 1,120 km^2 and is strongly impacted by intensive agricultural production and urban settlements, especially in the catchment of the main inflow River Wulka. On average, the lake's surface lies 115.45 m above the Adriatic Sea and the lake is no more than 1.8 m deep. Due to its chemical composition Lake Neusield can be characterized as soda lake with typical pH values of 9.0-9.3 in the open lake.

In this contribution, we present results from investigations on selected PAH (Benzo(a)pyrene, Fluoranthene) and PFAS (PFOS and PFOA) in the lake with specific focus on sediment associated transport and legacy processes. We apply a holistic approach, by combining emission modelling, targeted monitoring, adsorption and mobilization experiments as well as a lake's mass balance. We describe the current state of contamination of River Wulka and the lake, we identify the main emission pathways into both river and lake and we shed light on the complex environmental behavior within the coupled system lake - reed belt.

While PFOA and PFOS emissions into the river are dominated by effluents from waste water treatment plants, atmospheric deposition on the lake surface adds a significant contribution to the contamination of the lake. On the contrary, agricultural erosion is the dominant pathway of the contamination of river and lake for Benzo(a)pyrene, Fluoranthene. Our results show that the reed belt at the entrance of River Wulka to the lake acts as a significant sink for these substances due to suspended solid sedimentation.

Persistent chemicals entering the lake may undergo different fates. They may concentrate in water, because in this peculiar lake evaporation exceeds precipitation. They may also be stored in the sediments of the reed belt, from where they might be later re-mobilized. The fate of Benzo(a)pyrene and Fluoranthene is clearly dominated by the latter processes. While these processes cannot be neglected for PFOS and PFOA as well, PFOA shows a strong enrichment in the lake water. The behavior of PFOS is even more complex. Though highly persistent, its removal from the lake water cannot be explained by suspended solid associated transport to and

sedimentation in the reed belt. It is removed from the lake water through degradation or conversion to metabolites to a significant extent as well.