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Tracing historical record of river contamination in deposits of modern oxbow lake; River Morava (Danube Catchment), Czech Republic

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Embankment of meandering river systems in many industrial areas results in formation of artificial oxbow lakes that may act as perennial or intermittent traps for river sediments. Their deposits can be dated using combination of historical and stratigraphic data, providing a good mean to study historical record of contamination transported by rivers. Contamination history over the last few decades is of special significance for Central and Eastern Europe as it can reflect high pollutant levels in the second half of 20th century and the subsequent improvement after the fall of the iron curtain. We studied seven ground penetrating radar (GPR) profiles and three sediment cores. Stratigraphy of the cores was inferred from visible-light spectrophotometry, X-ray radiography, grain size analysis and semi quantitative modal analysis of sandy fraction. The sediments were dated using the 137Cs mass activity and combination of stratigraphic and historical data. The cores were sampled for concentrations of heavy metals and persistent organic pollutants (POPs). Three sedimentary sequences (S1, S2 and S3) were identified. The basal sequence S1 represents river channel sediments deposited before the formation of the oxbow lake, most likely before 1930s. The boundary between the S1 and S2 sequence correlates with the level of sediment dredging from 1981 evidenced from historical data. The overlying sequences S2 and S3 represent a post-dredging sediment wedge, which progrades into the lake. 137Cs dating revealed a distinct Chernobyl 1986 peak at $\sim$150 cm depth inferring sedimen-

tation rates up to 7.7 cm per year. Sediment contamination by heavy metals and POPs abruptly increased from the pre-1930s deposits to the post-1981 deposits. The concentration levels increased 2- to 5-times for Pb, As, Zn and Cu, about 10- to 15-times for Cr, Sb and Hg, up to 34-times for Cd, and 25- to 67-times for DDTs, PCBs and PAHs. Concentrations of most contaminants remained approximately constant until late 1980s when they started to decrease slowly. The decreasing trends were most prominent for heavy metals and anthracene, less prominent for DDTs and almost absent for PCBs and most PAHs. Different temporal and spatial patterns for various contaminants make it possible to distinguish between anthropogenic point sources from local industry (anthracene, Cr, Cd), possible diffuse sources (most PAHs) and geological background (V, Co, Ni and Mo). The observed recent trends in heavy metal and POPs contamination are generally consistent with data from other Central European rivers. The roughly balanced contamination levels in sediments from the lake and the adjacent river channel suggest that the oxbow lake deposits reflect immediate levels of the contamination bound to suspended particulate matter passing through the river. The investigated oxbow lake accumulated suspended sediment from River Morava, developing a thick sedimentary body. The sediments offer a good time framework to study historical contamination of the river on a decade time scale. High sedimentation rates of up to 7.7 cm per year offer a very good stratigraphic resolution, making it possible to study contamination patterns on annual or even seasonal time scale. Continuous contamination trends can be traced back to early 1980s. The results show that stratigraphic analysis of cores has a good potential for identification of uninterrupted historical trends as well as unconformities, e.g. due to dredging. Oxbow lakes may provide an alternative to floodplains and reservoir deposits when studying river contamination history. On the other hand, oxbow lakes may represent long-term contamination stores, which are unlikely to be redistributed by river erosion and, hence, may possess significant environmental risks for the farther future.