



Human impact on fluvial sediments: distinguishing regional and local sources of heavy metals contamination

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Industrial pollution can provide a useful tool to study spatiotemporal distribution of modern floodplain sediments, trace their provenance, and allow their dating. Regional contamination of southern Moravia (the south-eastern part of the Czech Republic) by heavy metals during the 20th century was determined in fluvial sediments of the Morava River by means of enrichment factors. The influence of local sources and sampling sites heterogeneity were studied in overbank fines with different lithology and facies. For this purpose, samples were obtained from hand-drilled cores from regulated channel banks, with well-defined local sources of contamination (factories in Zlín and Otrokovice) and also from near naturally inundated floodplains in two nature protected areas (at 30 km distance).

The analyses were performed by X-ray fluorescence spectroscopy (ED XRF), ICP MS (EDXRF samples calibration, $206\text{Pb}/207\text{Pb}$ ratio), magnetic susceptibility, cation exchange capacity (CEC), and 137Cs and 210Pb activities. Enrichment factors (EF) of heavy metals (Pb, Zn, Cu and Cr) and magnetic susceptibility of overbank fines in near-naturally (near annually) inundated areas allowed us to reconstruct historical contamination by heavy metals in the entire study area independently on lithofacies. Measured lithological background values were then used for calculation of EFs in the channel sediments and in floodplain sediments deposited within narrow part of a former floodplain which is now reduced to about one quarter of its original width by flood defences. Sediments from regulated channel banks were found stratigraphically and lithologically "erratic", unreliable for quantification of regional contamination due to a high variability of sedimentary environment. On the other hand, these sediments are very sensitive to the nearby local sources of heavy metals. For a practical work one must first choose whether large scale, i.e. a really averaged regional contamination should be reconstructed, or whether more or less qualitative information on local point sources is searched for. The profiles from regulated river reaches are highly prone to local sources and due to the stratigraphic chaos and post-depositional mobilization of heavy metals, which we revealed using $206\text{Pb}/207\text{Pb}$ ratio; such profiles were further excluded from an evaluation of regional contamination. Overbank fines in the study area (middle and lower reach of the Morava) are only weakly but whole-regionally contaminated (maximal EFs are 1.3-2 for Pb and Zn, 1.2-1.7 for Cu, 1.1-1.2 for Cr and 2-4 for magnetic susceptibility). Regulated river channel sediments, which reflect the actual contamination from local sources, produced apparent EFs ranging from 0.3 to 15 for heavy metals and 0.4-21 for MS, with the highest values obtained downstream from the most relevant point source in the study area, shoe-making and related chemical industry in Zlín and Otrokovice.