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Pollutant fates in fluvial systems: on need of individual approach to each case study

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To outline the pollutant fates in fluvial systems it is necessary to combine two main kinds of knowledge: sedimentation and erosion patterns of each individual river with spatio-temporal resolution higher than in most fluvial geomorphology/sedimentology studies and timing and way how the pollutants have entered the fluvial system. Most of these aspects are commonly neglected in environmental geochemistry, a domain to which pollution studies apparently belong. In fact, only when these two main components are established (at least in a qualitative manner), we can start reading (interpretation) of the fluvial sedimentary archives, e.g., decipher the way how the primary pollution signal has been distorted during passing through the fluvial system. We conducted empirical studies on Czech rivers impacted by pollution (by risk elements). We learnt how individual (site-specific) are the main processes responsible for the primary pollution input, spread through each fluvial system and inevitable secondary pollution (“lagged pollution improvement signal”).

We will discuss main features of the story on pollutant fates in three different fluvial systems, which have not been impacted by “hard” river engineering and still undergo natural fluvial processes: 1. the Ohre (the Eger) impacted by production of Hg and its compounds, historical mining of Pb and more recent U ore processing, 2. the Ploucnice impacted by U mining, and 3. the Litavka, impacted by Pb-Zn(-Sb) mining and smelting.

The Ohre is specific by most pollution having been temporarily deposited in an active channel, only minor reworking of older fluvial deposits diluting pollution during downstream transport, and pollution archives existing practically only in the form of lateral accretion deposits. The deposits of archive value are rare and can be revealed by detailed study of historical maps and well-planned field analysis, best using portable analytical instruments (XRF).

The Ploucnice is specific by only transient deposition in a channel belt and subsequent secondary pollution via physical mobilisation, most pollution storing in the floodplain in a surprisingly heterogeneous manner - in hotspots with a size comparable to fragments of abandoned channels (from a few to few tens of metres). The hotspots are hence best revealed by well-designed field analysis using portable instruments (gamma spectrometry or XRF).

The Litavka is specific because most pollution is in its floodplain in the form of anthropogenic alluvium, a very thick vertical accretion body of “artificial” material added to the river system in the amount exceeding its normal transport capacity. That situation favours secondary pollution by chemical mobilisation of pollutants under low river discharges revealed by geochemical analysis.

Our case studies show that simple “rules” such as continuous decay of pollutant concentrations downstream from the pollution source, existence of a continuous blanket of polluted overbank fines in floodplain, simple change of the pollution extent with growing distance from the river channel and as a consequence of extreme floods, or simple recipes such as low-density sampling to trace point pollution sources are too simplistic to be applicable in real polluted fluvial systems. Each river system represents a nearly unique combination of individual geomorphic processes, and each pollution has been specific by the mode how it entered the fluvial system. We will not offer “magic tools” in our contribution. In literature we can find all pieces we need for the jigsaw puzzle - pollutants fates in fluvial systems. The question is why so rarely researchers put them together. We would like to encourage them to do so.