Geophysical Research Abstracts
Vol. 14, EGU2012-4508, 2012
EGU General Assembly 2012

Pb and Zn and the onset of Anthropocene in floodplain sediments: How and why to quantify weak contamination?

T. Matys Grygar (1), T. Novakova (1,2), V. Lukešová (3), M. van der Perk (4), H. Middelkoop (4), and M. G. Macklin (5)

(1) Institute of Inorganic Chemistry AS CR, Institute of Inorganic Chemistry AS CR, Rez, Czech Republic (faramira@centrum.cz), (2) Charles University in Prague, Faculty of Science, Albertov 6, 128 43 Prague, Czech Republic, (3) Czech University of Life Sciences in Prague, Faculty of Agrobiology, Food and Natural Resources, Kamýcká 129, 165 21 Prague 6, Czech Republic, (4) Utrecht University, Faculty of Geosciences, Department of Physical Geography, Heidelberglaan 2, 3508 TC Utrecht, the Netherlands, (5) University of Wales, Institute of Geography and Earth Sciences, Aberystwyth, SY23 3DB Ceredigion, U.K.

In our laboratory we work on the quantification of heavy metal pollution in fluvial sediments of which sedimentological description, facial assignment, post-depositional stability and dating are incomplete or missing. Without such fundamental knowledge the only robust information is apparently the absolute concentration of heavy metals. Due to local geochemical differences and heavy metal sorting by fluvial transport and pedogenesis, the actual level of anthropogenic contamination is usually considered inconclusive when the enrichment factor EF<2. However, such small EF is expected to have marked the onset of Anthropocene, i.e. early industrialization impact by a collective human action, measurable already in regions without heavy industry. That onset provides a local or regional isochron, which allows identifying “industrially impacted” floodplain sediments, their spatial distribution, dating, and calculating mean aggradation rate. Such valuable knowledge justifies why we work with such complex systems.

In floodplain sediments, accurate dating is usually missing when only sediment from cores with a small diameter is available. We cannot do extensive OSL, while 210Pb and 137Cs dating can cover decades to a century and 14C datable material is rather rarely caught. Small-scale sedimentological features in floodplain soils are mostly destroyed by bioturbation. There are no large outcrops like sand pits in most of the studied floodplains and hence their architecture is unknown. Erosional banks are exposed to a variety of chemical and sedimentological disturbances and are covered by levee sediments of variable thickness, which devaluates them as sediment archives. We often hardly know the past river channel network, which complicated even simple facial assignment of the sediments from a drill core. The river style (number of channels and their lateral stability) has been changed due to human action in the studied period (it is a common activity in the Anthropocene) but these changes are rather rarely covered by sufficiently detailed maps. We must hence make an unpleasant choice: either study those few rivers of which complete information has already been gathered, or work on any river but simplify our task and search for only "simple" and robust information, which is the EF of overbank fines during the last several centuries. The EF for each sediment sample is a perfectly defined numerical value for a given heavy metal.

We propose how to select suitable floodplain profiles and quantify their EF due to human action in weakly (the Jizera, Czech Republic) and heavily contaminated watersheds (the Geul, the Netherlands). Our work is based on hand drilled cores, which suffer from all above mentioned problems. However, their description can still be done by simple technical means (EDXRF) and implementation of a well established knowledge on floodplains and environmental geochemistry. Our tools are correlation of more cores, their basic lithological description (Al/Si and Rb depth profiles), use of element proxies of reductimorphic processes (Fe/Al and Mn/Al depth profiles) and other kinds of post-depositional chemical mobilization (specific behaviour of Pb and Zn), and carefully done normalization to conservative elements (Fe, Rb or Ti). This approach is based on our previous extensive study of floodplain sediments of the Morava River (Czech Republic).