Comparison of δ^{53}Cr ratios between geogenic and anthropogenic chromium in Central European waters

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$^{53}Cr/^{52}Cr$ isotope ratios can be used to distinguish between geogenic and anthropogenic sources of chromium in surface waters and groundwaters. Often, a multiple-tracer approach is needed. Since 2011, we have monitored Cr concentrations and δ^{53}Cr values in seven different areas of the Czech Republic, Central Europe. At two sites, we sampled first-order streams on ultrabasic (serpentinite) bedrock. At five sites, we sampled shallow groundwater in the vicinity of Cr-processing industrial operations. Water samples were complemented with globally distributed minerals and whole-rock samples. Sofar, we have isotopically analyzed 110 samples. Mean Cr concentrations were 6500 ppb in industrial waters, and 20 ppb in geogenic waters. The range of δ^{53}Cr values increased from minerals/rocks to geogenic and industrial waters. The δ^{53}Cr of solid samples was close to 0 per mil, with isotopically slightly heavier Cr in some serpentinites (+1.1 per mil). The range of δ^{53}Cr of geogenic waters was 4.0 per mil (from -0.1 to +3.9 per mil). The range of δ^{53}Cr of anthropogenic waters was 4.6 per mil (from +1.2 to + 5.8 per mil). In general, Cr in anthropogenic waters was isotopically heavier than Cr in geogenic waters. None of the industrial waters had a δ^{53}Cr close to 0 per mil. Sofar, we have not observed C-isotope indices of natural attenuation of the anthropogenically polluted groundwaters.

Fluvial sediments: Assessment of contamination by trace metals respecting natural variability

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According to the latest studies, proper assessment of trace metal contamination levels in fluvial sediments of different rivers necessarily requires individual approaches for each river, according to the local geological proveniences and individual river sedimentation dynamic characteristic.

Such special approach includes sampling respecting floodplain architecture, use of different normalisation elements for each trace metal (e.g., Al, Ti, Rb, Fe) to eliminate highly possible dependence of natural lithogenic background values on lithofacies and finally also use of sufficient method for contamination level assessment.

In this study, comparison of trace elements contamination level (Pb, Zn, Cu, Cr and Ni) of floodplain sediments of five different rivers in Czech Republic (the Berounka, the Jizera, the Morava, the Ohře and the Ploučnice) was done. Floodplain sedimentary profiles were obtained from hand drilled cores, elementary analysis was done by energy dispersive X-ray fluorescence (ED XRF) and by inductively coupled plasma mass spectrometer (ICP MS); cation exchange capacity measurement (CEC) was used for determination of expandable clay mineral content.

Regional lithogenic background values were obtained from “safe” parts of profiles (uniform facies, i.e. no sandy strata, unaffected by reductimorphic processes, unpolluted) and were further used for revelation of potential post-depositional trace elements migrations within profiles and also for determination of anthropogenically contaminated layers.

Elimination of potential influences of lithofacies and also elimination of different provenience influences was allowed by using of carefully chosen normalisation elements for trace elements in the rivers (e.g., Rb normalisation was used for all trace metals in the Morava River sediments or in the case of the Jizera River, Ti normalisation was used for Pb, Zn, Cr and Ni and Rb normalisation for Cu).

The only exception was the upper part of the Ohře River, where no normalisation element was yet established, due to the different proveniences influence and hence simple normalisation could not be used.

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