Impact of U-mining tailings on water resources in Mailu-Suu (Kyrg)

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From 1946 till 1968, uranium ore was mined and processed in the region of Mailu-Suu (Kyrgyz Republic). The residual waste rock and tailing material (~3 Mio. m^3) has been provisionally deposited in the Mailu-Suu valley in close vicinity of rivers and instable slopes, and may be eroded and mobilized through landslides and floods.

Findings presented here are dealing with the contamination state of the local water resources, based on 55 samples including seepage, ground and surface water. Analytical methods comprise IC, ICP-OES, ICP-MS for determining the hydrogeochemistry, γ- and α-spectrometry characterizing the radiology of the sampled water.

Results and Discussion

Aggravated by the complex and unclear hydrogeological situation, this study reveals local infiltration and extensive contamination of river and shallow quaternary aquifer by uranium and other contaminants. Major pollution source seems to be seepage water leaking from tailings with up to 36 mg/L U and the tributary river Kulmin-Say containing 170 µg/L with a flow rate of ~10 L/s. More than half of the samples fail the chemotoxic WHO-guideline for drinking water for U (15 µg/L). Pollutants transport downstream (N→S) is evident in both shallow aquifer and Mailu-Say river. Hydrochemical fingerprints and multivariate statistics reveal their interconnection and allow genetical clustering of groundwater samples of uncertain origin.

In sampled water, uranium is not present in radioactive equilibrium relative to the uranium-radium decay chain. The activities of uranium strongly predominante relative to their daughter nuclides indicating transport processes of dissolved uranium, likely as carbonylated species. The measured mass and activity concentrations of uranium fit well considering that 1 µg U of natural isotopic composition corresponds to 12.45 Bq of U-238. Combining all data, the radiation dose of one example well possibly used for drinking purposes is estimated to exceed the EU guideline value of 0.1 mSv/a.

Conclusions and Outlook

Radiocuclides and other contaminants from U-mining activities have affected the water resources in Mailu-Suu and may be transported down to the Fergana Basin (Uzbekistan). Beyond design of a monitoring network and awareness rising of the local populatioon, future investigations focus on the transport pathways and behaviour of uranium, incl. the role of deep aquifers with flooded U-mines and the characterization of solid and dissolved U-species.

Isotopic constraints on picritic magmatism, Iceland

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New Sr, Nd, Pb and Hf isotope data are presented for a suite of 19 picritic samples from Iceland; Os and He isotope data for the same samples are presented by Brandon *et al.* (2007). The samples display compositions typical for neogene magmatism in Iceland; $^{87}Sr/^{86}Sr$ =0.70290–0.70318, $^{143}Nd/^{144}Nd$ = 0.51230–0.51315, $^{206}Pb/^{204}Pb$ = 18.05–18.97, $^{207}Pb/^{204}Pb$ = 15.43–15.52, $^{208}Pb/^{204}Pb$ = 37.71–38.53, $^{176}Hf/^{177}Hf$ = 0.28315–0.28333. The samples span the spectrum from depleted to enriched samples (La/Sm_N = 0.31-1.83) and have isotopic and trace element signatures characteristic for Icelandic compositions with negative $\Delta^{207}Pb$ (-0.3 – -3.5, excl. 1 sample), positive $\Delta^{208}Pb$ (3.2 – 31.2, excl. 3 samples) and positive ΔNb (0.01–0.37).

Typical correlations are observed between various isotope systems (e.g. Sr-Nd, Pb-Nd, Pb-Pb etc.) and are consistent with the involvement of multiple source components. Of particular note are correlations between decreasing $^3He/^4He$ and $^{187}Os/^{188}Os$ and increasing $^{176}Hf/^{177}Hf$, and increasing $^3He/^4He$ and $^{187}Os/^{188}Os$ with increasing $^{206}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$. These correlations indicate that the enriched component(s) of the Icelandic system, with radiogenic Pb isotope signatures indicative of high time-intergrated U/Pb and Th/Pb, are also characterised by a non-radiogenic high $^3He/^4He$ signature. These observations are inconsistent with the high $^3He/^4He$ signature being the result of incorporation of an U+Th-poor component from the upper mantle (e.g. depleted lithosphere, olivine-rich domains) as these should also be expected to have non-radiogenic Pb isotope systematics.

In detail, two groups of data can be seen in plots of He, Pb and Hf isotopic compositions, with a subordinate group from the SW region of the western rift zone having high $^3He/^4He$ for a given $^{206}Pb/^{204}Pb$. This provides evidence for the contribution of at least three components to magmatism in Iceland, and may suggest a spatial variation in these components beneath Iceland.

Reference

Brandon, A.D., Graham, D.W, Waight, T. and Gautason, B., (2007). *This volume.*