

# Development of river water and sediment quality at remediated uranium mining and milling legacy sites (“WISMUT Project”) in Germany

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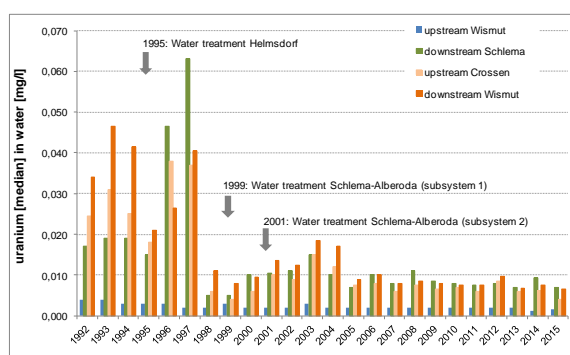
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**Introduction:** In the Eastern part of Germany, mining of metals like Ag, Pb, Zn, Sn, W, Bi and Co has been carried out since the Early Middle Ages. It was followed by large-scale uranium mining and milling between 1946 and the German reunification in 1990, by the Soviet-German company SDAG Wismut. Since 1991, the by then federal-own company Wismut GmbH has been significantly mitigated the environmental impacts of the uranium production legacy sites. The WISMUT Environmental Project was launched. Key elements were (and continue to be) dismantling of industrial structures, flooding of mines, clean-up of contaminated sites, coverage of waste rock piles and safeguarding of radioactive tailings. The commissioning of powerful water treatment plants in the late nineties contributed essentially to the decrease of surface water and sediment-borne pollutions. The development of the environmental parameters is reflected by results gained within the WISMUT Environmental Monitoring Program.

**Methods:** Within its monitoring program, Wismut GmbH operates appr. 100 surface water and 18 suspended sediment investigation points. Location of the points allows studying of the impact of controlled discharges into rivers (e. g. from water treatment plants) as well as of diffuse discharges (e. g. as seepage from tailings management facilities and waste rock dumps). The time series of monitoring data (25 years) give answer on pollution before, during and after remediation of the objects and sites. In water, the dissolved phase as well as the total content are analysed. For the investigation of suspended matter, sediment traps have been installed. Key analytical parameters along the water and sediment path are uranium and radium (nuclide Ra-226). In addition to this, arsenic, iron, manganese, nickel and zinc are site-specifically of interest. The monitoring is aimed to control the parameters against water and sediment quality standards set in German regulations as well as in the EU Water Framework Directive.

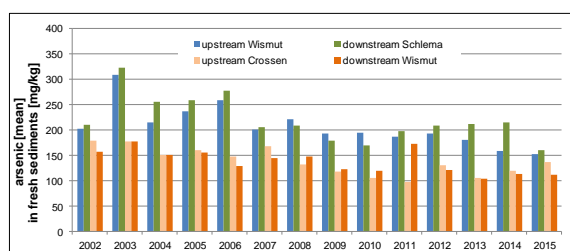
**Results:** The Zwickauer Mulde, one of the biggest rivers passing the WISMUT area, is affected by the sites Schlema-Alberoda (former complex mining site) and Crossen (former ore processing site). Past the German reunification the river section inside of the both sites offered considerably high uranium

concentrations. Figure 1 illustrates the decrease of uranium concentrations in the aquatic phase after commissioning of the water treatment plants at both sites. The differently coloured columns indicated the situation up- and downstream to each site.



**Fig. 1:** Uranium in water of Zwickauer Mulde (data: Wismut GmbH)

Since beginning of water treatment, also investigation of the suspended sediments is part of the WISMUT Monitoring Program. From Figure 2 it can be learned, that arsenic and some other elements are found in significant concentrations already in the Zwickauer Mulde before the river passes the WISMUT sites. This is caused by its geogenic background occurrence and by other industrial activities outside of WISMUT.



**Fig. 2:** Arsenic in suspended sediments (fraction <63 µm) of Zwickauer Mulde (data: Wismut GmbH)

**Conclusions:** Implementation of the WISMUT Environmental Monitoring Program has accompanied the significant improvement of the water and sediment quality in former uranium production areas in Eastern Germany. Study of the big amount of environmental data allows understanding the distribution processes of pollutants along watercourses.