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Ecological long term effects in the Hungarian Szamos and Tisza River after the Baia Mare Spill (Romania)

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1. Introduction

After the accident in the Arul gold processing company of Baia Mare in January 2000 approx. 100 000 t of cyanide-contaminated mud from gold leaching processes entered the Theiss river via the Szamos river. The eco-toxicity of these extremely high cyanide concentrations were immediately observed through high fish mortality rates in the river. Additionally, heavy metals, which are associated with the gold ores and therefore with the spilled mud, entered the Szamos river and, subsequently, the Theiss. In March 2000 during extreme spring flooding a re-mobilisation in combination with a re-suspension of sediments in the river areas took place. Approx. 3 months after this flood water, surface sediment, and depth profile sediment samples from 13 sites along the Szamos and Theiss rivers (longitudinal profiles) were investigated. To get information about the ecological long term effects in February 2002 a detailed sediment campaign has been done and 2003 natural Biofilms and macro zoobenthos have been investigated.

2. Material and methods

For the determination of the dissolved trace element concentration the taken surface water samples have been filtered in the field (0.45µm) and have been stabilized with HNO_3. The taken surface sediments were stored in plastic boxes and the sediment cores, taken with a Mondsee corer had been discriminated according to visible layers bevor storing in plastic bags under nitrogen atmosphere (Kraft et al 2003). For the sample transport cooling boxes have been used.

The macrozoobenthos (chironomid larves) were collected ca. 100m below the confluence of the Szamos and Tisza and stored in polypropylen tubes on site (Woelfl et al 2004).

Biofilms have been collected from natural supports like stones or wood with a ceramic tweezers. Attached sediment or particles wer washed our with filtered river water. The samples were stored in PTFE vials and frozen in lquid nitrogen transported into the laboratory (Mages et al. 2004).

For getting information about the main bounding characteristics of the trace elements in the sediments the sequential leaching procedure after (Jacob et al. 1990).

For the trace element determination after the sample preparation ICP OES, ICP MS and TXRF Systems have been used.

3. Results

The results definitively show that mining industry activities influence the elemental water quality of the Theiss river downstream of the confluence with the Szamos. By interrupting the inlet in the Tisza lake over the period during which the mud wave passed, the extreme inputs of heavy metals to the lake sediments could have been avoided.

For several elements like Cu, Cd, Pb and Zn the detected total concentration in the sediment fraction less than 20 µm of Szamos and Tisza river exceeds the investigated regional background value for more than 8 times.

During the March 2000 spring flood, the heavy metals were distributed on a large surface in the flooded region and were also deposited as surface sediment in the Tisza lake, although these are in a form that may be regarded as an uncritical increase.

In the confluence area of the Szamos and Theiss rivers, eco-toxicity of the sediments was proven to create long term effects in agreement with investigations of the Environment Department of Rheinlandpfalz from July 2000.

The calculated sediment bioaccumulation factors for the Tisza sediment are low compared to literature data. This may indicate al low bioavailability of trace metals in the Tisza sediment. For example Zn anc Cu are only 2-2.5 times bioaccumulated in Chironomus sp. compared to literature data which are 10-20 times higher.

For several elements like Cu, Cd and Zn detailed results of the sequential leaching procedure and the biofilms have shown that depending on the bioavailability of the trace element accumulation rates in the biofilms up to 1000 higher in comparison to natural accumulation rates and gives first information about the ecological risk.

4. Literature

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