Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.9594

Arsenic-enriched streambed sediment reaction on exposure to discharged phosphorus from a wastewater treatment plant

PETRA VENHAUEROVA[1], PETR DRAHOTA[1], LADISLAV STRNAD[2] AND Å ÁRKA MATOUÅ¡KOVÁ[3]

[1]Faculty of Science, Charles University
[2]Laboratories of Geological Institutes, Charles University
[3]Institute of Geology, Czech Academy of Sciences

Presenting Author: petra.venhauerova@natur.cuni.cz

One of the leading causes of As release from sediments into freshwaters is competition with phosphate. Among important P sources to freshwaters are wastewater treatment plants (WWTP), contributing 25–45 % of all P in surface waters.

We studied a small stream surrounded by soils and sediments with naturally elevated concentrations of As (>200 mg/kg) and continuous entry of small capacity WWTP. Since 2013, the WWTP discharge supplied the stream with 4–8 mg/l of P, accounting for 91–98 % of P downstream. This study revealed changes in the fractionation of As and P in the sediments due to exposure to treated wastewater. The adsorbed P fraction increased by over 70 % in the downstream samples, while the P-retention capacity decreased from 16 % to 10–12 %. In contrast, the adsorbed As fraction decreased by 45 % in the downstream samples. Solid-state speciation showed that arsenate is replaced by phosphate in the Fe (oxyhydr)oxides downstream and further mobilized into the aqueous phase. In the samples exposed to the treated wastewater, the mineralogical investigation showed newly created Fe (oxyhydr)oxide coatings significantly enriched in P (<18.2 wt % of P_2O_5), Ca (<10.9 wt % CaO) while depleted in As (<3.3 wt % As_2O_5). It seems that the stream sediment continuously releases a low concentration of As and aims to remain in equilibrium with fluctuating concentrations of discharged P by either releasing or sequestrating P in the streambed sediment.

As a local source of phosphate, wastewater treatment plants can significantly impact As fractionation in As-enriched areas and may be responsible for significant and long-term As mobilization into surface water systems.

Acknowledgments: This research was supported by the Grant Agency of Charles University (GAUK no. 790120), Czech Science Foundation (GAÄŒR no. 22-27939S), and the Center for Geosphere Dynamics (UNCE/SCI/006).