Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19291

Using machine learning approaches to study arsenic redistribution in groundwater

DAVID HAAF[1,2], ATHENA A. NGHIEM[2,3], PHILIPPE RENARD[4], MICHAEL BERG[2] AND LENNY H.E. WINKEL[2,5]

[1]ETH Zürich
[2]Eawag, Swiss Federal Institute of Aquatic Science and Technology
[3]ETH Zurich
[4]University of Neuchâtel
[5]ETH, Swiss Federal Institute of Technology, Zurich

Presenting Author: david.haaf@eawag.ch

Geogenic arsenic (As) contamination of groundwater poses a serious threat to human health, especially in the river deltas of South-east Asia. The potential for As exposure and its ensuing health effects is especially concerning in large and fast growing cities inside these deltas that usually rely on pumping of groundwater to meet high demands for domestic water. It was previously shown in Hanoi (Vietnam) that extensive pumping in urbanized regions can influence the regional As distribution in aquifers due to changes in groundwater flow [1]. The suggested mechanisms for such vertical and lateral redistributions, i.e., leaching of As or As-mobilizing solutes from organic-rich layers and advection of As from Holocene to Pleistocene aquifers, have been studied more in-depth in field studies at specific locations in and around Hanoi [e.g., 2,3,4,5,6]. These studies provided valuable insights into these processes; however, it is not clear (i) how transferable these mechanisms are to other areas with similar conditions beyond these specific field sites, and (ii) how generalizable these processes are for large scales.

To test the occurrence of suggested mechanisms for As redistribution on a regional scale, i.e., the greater Hanoi area, we use interpretable machine learning approaches applied to hydrochemical data available from existing studies, in combination with an improved 3D geological model and temporally resolved hydrological data. We will show here how we can use site-specific biogeochemical knowledge and hydrological information to identify different As contamination mechanisms at a larger spatial scale.

[1] van Geen, A. et al. Nature 501, 204–207 (2013)

[2] Stopelli, E. et al. Sci. Total Environ. 717, 137143 (2020)

[3] Berg, M. et al. Chem. Geol. 249, 91–112 (2008)

[4] Kuroda, K. et al. Hydrogeol. J. 25, 1137–1152 (2017)

[5] Nghiem, A. A. et al. Water Resour. Res. 55, 6712–6728 (2019)

[6] Kazmierczak, J. et al. Sci. Total Environ. 814, 152641 (2022)