

Fate, transport, and bioremediation of Chromium in soil-groundwater system at Rania-Khan Chandpur site, India

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Multiple chromite ore processing residue (COPR) dump hotspots lying at Rania and Khan Chandpur villages in the proximity of tanneries industries in Kanpur district of U.P., India and subsequent Chromium contamination to the soil-water system, which requires exigent attention as a part of regulatory obligations to safeguard the collapsing ecosystem services and human health. The aim of this research is to perform field-laboratory-numerical modeling studies to understand the fate, transport, and provide remediation of Chromium in soil-water system at Rania-Khan Chandpur villages. We prepared the surface elevation model using high-resolution LiDAR and IfSAR data from remote sensing survey. We estimated the hydraulic and transport properties using undisturbed COPR and soils cores. We performed solute transport and soil-water quality modeling and analysed soil microbiome using metagenomic analysis. We found that stratification of chromate leachate continues to move with underlying advective flow in a narrow stretch (~500 m width) towards south-west in Khan Chandpur village. This is corroborated with extreme Cr concentrations (>10mg/L) in 95% monitoring wells located in Khan Chandpur and with the site hydrology. We found that Rania is hydrogeologically different than the Khan Chandpur village, where multiple chromate plumes are active and its mobility is due to diffusive fluxes, which is reflecting moderate Cr concentrations (<10 mg/L) in ~35-40% monitoring wells. We observed high soil moisture drives in such a way that little surface leachate is imbibed into deeper zones, thus deep soils are safe as we move away from the COPR dump site. We found the vegetation biodiversity is comparatively high in area where soils are safe. 16S rRNA sequencing data reveals that COPR has an active microbiome, but structurally distinct from soil microbial communities. In this talk, I will describe some of our key contributions related to monitoring of Cr-mobility, soil-water quality in and around Rania-Khan Chandpur site, and some of our ongoing work and potential future applications.