Chromium isotopes inform plume and background conditions in Mojave Desert groundwater

KATHLEEN SCHEIDERICH[1*], JOHN IZBICKI[2]

[1] U.S.Geological Survey, Hydro-Eco Interactions, Menlo Park, CA 94025 (*correspondence: kscheiderich@usgs.gov)

[2]U.S.Geological Survey, CA Water Science Center, San Diego, CA 92101

Chromium isotopes ($\delta^{53}Cr$) in groundwater were analysed from ~100 wells near the site of a point source of anthropogenic hexavalent Cr (Cr(VI)) contamination in the Mojave Desert, ~100 km north of Los Angeles. The contaminant plume, defined by the current regulatory estimate of Cr(VI) background of 3.1 µg/L, may extend ~12 km north from the source and cover as much as 20 km^2. The $\delta^{53}Cr$ data are part of a larger study intended to refine understanding of the occurrence of naturally occurring Cr(VI) and extent of anthropogenic Cr(VI). The study area is low in Cr and is divided into three subareas, distinguished by the general character and depositional provenance of geological material. The eastern (upgradient) subarea contains coarse-grained, alluvial deposits interspersed with fine-grained, brown clays containing Mn oxides. Older alluvium in the western subarea contains more (although still generally low) Cr, and is underlain by weathered bedrock containing higher Cr concentrations. The northern subarea comprises generally finer-grained lacustrine deposits. Although the Cr isotopic compositions of these solid materials have not yet been ascertained, groundwater samples show distinct regional trends in $\delta^{53}Cr$ composition, ranging from -0.2‰ (plume source) to values as high as +3.2‰ in water drawn from the brown clays. The eastern subarea, containing the plume and upgradient wells, has an average $\delta^{53}Cr$ value of +1.4 ± 0.7‰. The western subarea is the most variable, with an average of +1.3 ± 0.9‰, while the northern, down-gradient subarea has an average $\delta^{53}Cr$ value of +0.75 ± 0.3‰. Regional variations in groundwater $\delta^{53}Cr$ may be partially attributable to substrate age, texture, or mineral composition, while variations due to redox transformations of plume Cr are also apparent.