Environmental impacts of ophiolitic alteration products as natural and anthropogenic contamination sources: An example of Iranian ophiolitic massifs

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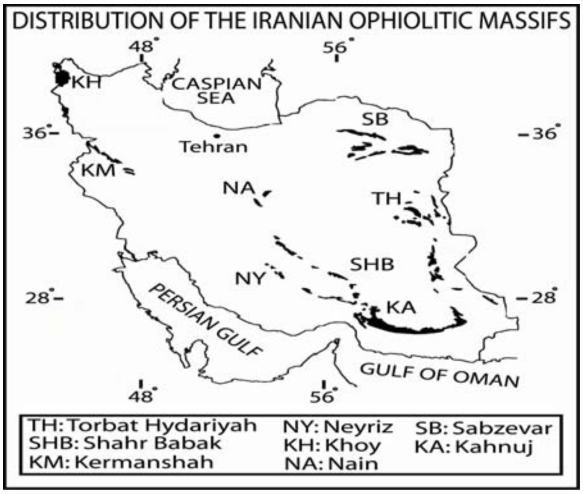
Ophiolites, in an advanced state of alteration, are one of the most important sources of toxic minerals and elements that may introduce toxic materials into the ecosystem. In Iran, the ophiolitic massifs have large extension and major cities and villages such as: Nain, Kermanshah, Neyriz, Khoy, Sabzevar, Shahrbabak, Torbat Hydariyah and Kahnuj are located over or downstream of drainages of ophiolitic massifs. These polluting sources are threatening the downstream environment through the streams, so that people are highly exposed to the poisoning of ophiolitic alteration products. In order to determine and estimate the environmental impacts of certain elements, some samples of surface and ground-water, from various rock types in these massifs have been investigated. According to microscopic studies and geochemical analysis, massifs are mainly enriched in Serpentine, Talc, Chromite and Sulfide. The average concentrations of Cr, Ni, Co, Fe, Mn, Ag, Au, Hg, Pt and As are several times higher than the admissible level for drinking water. This anomalously high concentration indicates that these elements have been leached from ophiolitic massifs provenance.



Keywords

Ophiolites; alteration; water analysis; contamination; Iran

Can kinetics tell us more? Cr(VI) binding to organic adlayers at silica/water interfaces studied by second harmonic and sum frequency generation

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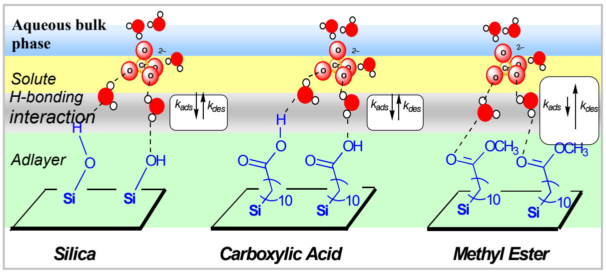
Hexavalent chromium in the environment poses a significant health threat as a groundwater pollutant. Binding of such toxic metal species at geosorbent surfaces is controlled by adsorption, desorption and redox processes. Thus, a detailed kinetic and thermodynamic understanding of these processes is needed for predicting the transport of Cr(VI) released into the environment.

In this work, second harmonic and sum frequency generation are used to investigate Cr(VI) interaction with ester- and carboxylic acid-functionalized silica/water interfaces. Direct surface-specific measurements show that Cr(VI) binds to ester- and carboxylic acid functionalized surfaces. Cr(VI) adsorption rate constants increase in the order ester < carboxylic acid ~ silica, desorption rate constants increase in the order carboxylic acid ~ silica < ester, while the thermodynamic binding parameters for all three interfaces are identical. This suggests that thermodynamic parameters are insensitive to the differences in Cr(VI) binding between silica-rich soils and organic-rich soils. In contrast, kinetic parameters can differentiate among the chemistries of the three surfaces. These studies indicate that kinetic parameters should be explicitly incorporated into transport models when scaled up for real world applications.



Proposed Cr(VI) binding mechanisms to silica, carboxylic acid, and methyl ester surfaces. Cations are omitted for clarity. The thermodynamic parameters (K_{eq}) are identical for the three cases, while the rate constants k_{ads} and k_{des} show clear differences in methyl ester adlayer, which, in contrast to the SiOH and -COOH surface groups, is non-ionizable and can only accept H-bonds.