Influence of humic substances on the transport of indium and gallium in porous media

YASMINE KOUHAIL[1], ISHAI DROR[1], BRIAN BERKOWITZ[1]

[1]Department of Earth and Planetary Sciences, Weizmann Institute of Science, Rehovot 7610001, Israel

Indium and gallium are widely use in modern industry, mostly for the production of semiconductors. With the increasing demands for these trace metal elements, which have low abundances in the Earth's continental crust, together with supplies that are dominated by only a few countries, a supply risk is expected in the future. Moreover, mining exploitation and poor recycling of the metals from technological products can lead to environmental pollution. Due to these reasons, indium and gallium are considered as Technology-Critical Elements.

Only a few studies on the aqueous geochemistry of indium and gallium have been published, and regarding their transport in porous media, only one study has been published.[1] Natural colloids are known to impact the transport and fate of metals in porous media. In our study, we investigated the impact of humic substances on the transport of indium and gallium in quartz sand. We performed laboratory saturated column experiments under controlled conditions (pH 6.3 ± 0.3, electrolyte with an ionic strength of 4.93 mM with a composition similar to rainwater). The impact of different extracts of organic matter on the transport and retention of indium and gallium was investigated as well as the impact of flow rate and concentration of organic matter. Indium and gallium were shown to be more mobile in the presence of humic substances. Indium and gallium were more retained in quartz sand in the presence of Aldrich humic acid, AHA, than in the presence of Suwannee river fulvic acid, SRFA, (C/C_{0max} = 0.44 for AHA vs C/C_{0max} = 0.98 for SRFA and C/C_{0max} = 0.54 for AHA vs C/C_{0max} = 0.72 for SRFA for gallium). However, gallium was shown to be retained more than indium in the presence of humic substances by a factor up to 10, and tailing was observed on the breakthrough curves of gallium, indicating weaker interactions of gallium with sand compared to those of indium.

References

1. Ringering *et al.* (2019) J. Hazard. Mater. **363**, 394-400.