Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.22153

Bioaccessibility of As in “Minette” oolitic iron ores and associated soils: implications for soil policy

PROF. VALERIE CAPPUYNS[1], HANNES CLAES[1], RUDY SWENNEN[1], ROMAIN MEYER[2], TIMO SEEMANN[3], HELGE STANJEK[3], SVEN SINDERN[3] AND POL TOCK[4]

[1]KU Leuven
[2]Service géologique du Luxembourg
[3]RWTH Aachen University
[4]Environment Agency Luxembourg

Presenting Author: valerie.cappuyns@kuleuven.be

Soil quality guidelines are often based on total concentrations of contaminants in soil. However, total element concentrations in soils are often poor predictors of toxicity and health risks. Incorporating bioaccessibility/-availability into risk assessments allows to consider location-specific physico-chemical and geological conditions. The Grand Duchy of Luxembourg is currently developing a soil legislation, which also includes ecological and health risk of soils.

Minette iron ores are the world largest Fe-ore deposits formed during the last 500 Myrs. They are often responsible for a diffuse, geogenic As-contamination. Still, the risk associated with these elevated As-concentrations received little attention. In the present study, the oral bioaccessibility of As was assessed for Minette oolitic iron ores and associated soils from Luxembourg based on the in vitro Solubility/Bioavailability Research Consortium (SBRC) method, combined with a mineralogical and chemical characterization of the Minette samples. Twenty five representative samples, from different lithologies, and with total As-concentrations in the range 40-247 mg/kg were selected. The results showed an average gastric bioaccessibility of 7.8±4.0 mg/kg (~10% of the total As-concentration), with a maximum of 18 mg/kg. Bioaccessibility of As in Minette rocks and soils is controlled by lithology, mineralogy and total Ca-content. Soils and ooid grainstones with an Fe-oxide or clayey matrix are characterized by average gastric bioaccessible As-concentrations of <6 mg/kg. Gastric As-bioaccessibility is highest in Fe-bearing calcite-cemented bioclastic grainstones (~12 mg/kg). For all samples the maximal bioaccessible As remains below the threshold for significant adverse (non–)carcinogenic health effects. These results contrast with what is expected from total As-concentrations. The low bioaccessibility of As should be taken into account when developing soil quality guidelines in the region where Minette ooilitic iron ores and soils occur. Considering bioaccessibility can help to avoid disproportionate risk management strategies. Furthermore, this study illustrates the importance of cross-disciplinary collaboration between geo- and health scientists in health risk assessment.