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Oral bioaccessibility of selected metals/metalloids in fallout dust from an Iron mine in Iran

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Abstract

Dust emitted from mining, ore processing facilities, and tailing dumps not only settle in the topsoil, plant, and water, but can also have direct effects on miners working close to these operations via ingestion, inhalation or dermal contact. In this study, oral bioaccessibility of some potentially toxic elements (PTEs) of interest (As, Cd, Co, Cu, Fe, Ni, and Pb) in fallout dust samples (<250 µm) collected from outdoor and indoor iron ore processing plants of the Gol-E-Gohar (GEG) mining and industrial company (Iran) was assessed using an in vitro Unified BARGE Method (UBM). The objective was to estimate the bioaccessibility of elements and potential human exposure to PTEs along ingestion exposure pathways. Initially, the total PTE content of the fallout dust was determined using acid digestion followed by inductively coupled plasma mass spectrometry analysis. The fallout dust samples exhibited average concentrations as follows in decreasing order: Fe (380727.02 mg kg^{-1}) > Cu (236.82 mg kg^{-1}) > Co (102.51 mg kg^{-1}) > Ni (99.33 mg kg^{-1}) > As (11.46 mg kg^{-1}) > Pb (2.10 mg kg^{-1}) > Cd (0.05mg kg^{-1}). Bioaccessibility of the elements in gastric (phase I) and alkaline gastro-intestinal (phase II) decreased in the following order: Cd > Pb > Cu > As > Cr > Ni > Co > Fe and Cd > Pb > As > Cu > Ni > Co > Fe, respectively. Increasing bioaccessibility showed an inverse relationship with PTE concentration. The results, determined as the bioaccessibility factor (% BAF), indicated that considerable amounts of Cd, Pb, Cu, and As were mobilized (on average >10% BAF) during the simulated gastric and combined gastro-intestinal phases, which could be attributed to a potential risk, particularly from ingestion of fallout dusts. Daily intakes via oral exposure, calculated for an adult (70 kg, ingestion rate 50 mg dust per day), exceeded the tolerable daily intake (TDI) limits for all these elements.

In this seminar, I will discuss the oral bioaccessibility of selected PTEs in fallout dust samples collected in an iron ore mine and compare the gastric and gastro-intestinal bioaccessible fractions and consider how physico-chemical properties of dust may influence the oral bioaccessibility.

Biography

Naghmeh Soltani was born in 20 October 1983 in Shiraz, Iran. She received a bachelor's degree in geology from Islamic Azad University (Shiraz Branch, Iran) in 2007, and a master's and Ph.D. degree in economic geology and environmental geology from Islamic Azad University (Shiraz branch, Iran) and Shiraz University, Iran, in 2011 and 2017, respectively. Her current field placement is with the Medical Geology Center at Shiraz University. She is interested in medical geochemistry and medical mineralogy of potentially toxic elements and organic pollutants in environmental compartments (such as particulate matter, soil, sediment, waste material, plant, and water).



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