Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.3445

Stream sediments as a contamination repository around an abandoned uranium mine, central Portugal

PAULA CARVALHO[1], ISABEL MARGARIDA ANTUNES[2], TERESA ALBUQUERQUE[3], ANTÓNIO SANTOS[4] AND PEDRO PROENÇA DA CUNHA[1]

[1]University of Coimbra
[2]University of Minho
[3]Polytechnic Institute of Castelo Branco
[4]University of Aveiro

Presenting Author: paulacscarvalho@gmail.com

In central Portugal, some abandoned uranium mines were already remediated [1]. However, some others may be responsible for potential environmental risks due to geochemical dynamics.

The abandoned Barrôco D. Frango uranium mine has an open-pit lake 50 m long and 10 m wide, and a ~40,020 m^3 mine dump. A contamination assessment was carried out along the main stream, by collecting water samples in four seasons (2016 - 2017) and stream sediments (2016). Surface waters are generally near-neutral to alkaline (5.83 - 7.55), with uranium, thorium and arsenic concentration ranges of 4.5 - 37.3 µg/L, 2.7 -11.0 µg/L and 4.8 - 39.5 µg/L, respectively. Water´s uranium concentrations tend to be higher in winter due to the dissolution of uranium minerals in dumps, while any distinction is observed with thorium. Water has arsenic and heavy metals lower than the permitted values for agricultural irrigation. However, sediments with median uranium concentration of 53.3 mg/kg (41.9 - 189 mg/kg) and thorium of 49.0 mg/kg (27.2 - 81.9 mg/kg), present moderate to considerable ecological risk (RI= 34.31 - 78.79), mainly due to arsenic concentrations (25.4 - 60.6 mg/kg).

The geochemical modeling of surface waters from downstream of mine dumps shows that arsenic occurs predominantly as arsenate $H_2(AsO_4)^-$, corresponding to the species most impacted by sorption processes [2]. Their sorption must be controlled by iron oxy-hydroxides identified in sediments by X-ray diffraction. Arsenic in sediments exceeds up to 3 orders of magnitude the trigger value [3].

Geochemical characteristics of aquatic environments affected by uranium mines are generally favorable to the arsenic adsorption in stream sediments. Climate changes and the potential release of arsenic into the water place stream sediments in the decision front line to water quality management and ecological risk assessment.

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[3] Australian and New Zealand Environment and Conservation Council (2013). ANZECC interim sediment quality guidelines. Report for the Environmental Research Institute of the Supervising Scientist. Australia.