Assessment of risk to human health from simultaneous exposure to multiple contaminants in an artisanal gold mine in Serra Pelada, Pará, Brazil

Edna Santos de Souza a,⁎, Renato Alves Texeira a, Hercília Samara Cardoso da Costa a, Fábio Júnior Oliveira a, Leônidas Carrijo Azevedo Melo b, Kelson do Carmo Freitas Faial c, Antonio Rodrigues Fernandes a

a Institute of Agricultural Sciences, Federal Rural University of Amazon (ICA-UFRA), C. P. 917, Belém 66077-530, Pará, Brazil
b Department of Soil Science, Federal University of Lavras, CP 3037, Campus UFLA, 37200-000 Lavras, Minas Gerais, Brazil
c Institute Evandro Chagas, Ministry of Health, Ananindeua, Pará, 67000-030, Brazil

HIGHLIGHTS
• Contents of potentially toxic elements are measured in soil, tailings, vegetables and water.
• Contents of PTEs in soil of Serra Pelada mine are higher than background values in the natural soil of Pará.
• Potentially toxic elements pollution sources are identified using multivariate analysis.
• Non-cancer health risks from PTEs are assessed for children and adults via soil, water and vegetables ingestion.
• Contributions of the HQs via vegetables ingestion are the smallest, to both children and adults.

GRAPHICAL ABSTRACT

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Contamination of soil, water and plants caused by gold mining is of great societal concern because of the risk of environmental pollution and risk to human health. The aim of the present study was to evaluate the risk to human health from ingestion of As, Ba, Co, Cu, Cd, Cr, Ni, Pb, Se and Ni present in soil, sterile and mineralized waste, and water and plants at a gold mine in Serra Pelada, Pará, Brazil. Samples of soil, sterile and mineralized waste, water and plants were collected around an artisanal gold mine located in Serra Pelada. The mean concentrations of potentially toxic elements in the soil were higher than the soil quality reference values as defined in the legislation, which may be attributable to past mining activities. Water from the area close to the mine exhibited As, Ba and Pb concentrations exceeding the reference values established by the World Health Organization, deemed unfit for human consumption. Plants exhibited high Pb concentrations, representing a food safety risk to the population. The mean hazard index (HI) values were below the acceptable limit (1.0) established by the United States Environmental Protection Agency, although the highest HI values observed for adults and children were higher than the respective acceptable limits. Environmental contamination and risk to human health were...