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Environmental and human health risks due to mining activity in the soils and plants of the Remance mine, Panama

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Abstract

The Remance gold mine, in Veraguas (central Panama), had its last mining operation in 1999, using the cyanidation process for Au separation. As a result of this activity, three waste tailings were exposed to the weather, in addition to mine dumps and the open pit mining areas. Currently the area is inhabited by peasants who develop subsistence agriculture and livestock. Therefore, the objective of this study has been to evaluate the environmental and human health risks that this area represents. The total concentrations of potentially toxic elements (PTEs) such as As, Cu, Zn, Ba, Sb and Hg were determined in mining process areas, surrounding soils and edible and inedible plants in the area; in addition to the cyanide species and the enzymatic activity by dehydrogenase (DHA) in soils. The accumulated contamination index (PLI) and potential ecological risk (RI) were calculated, the carcinogenic (CR) and non-carcinogenic (HQ) risk to human health represented by

soils and edible plants was estimated.

Regarding the degree of contamination, it is observed that the contamination is considerable in the tailings and the sediments of the pithead, and it spreads to the surroundings mainly in the sediments of the streams and their terraces, and, to a lesser degree, to the soils around it, showing that the main route of dissemination is through runoff; the same trend is followed by the potential ecological risk, being extreme in the sediments of the pithead, serious in the tailings and terrace sediments, high in the stream sediments and medium in the surrounding soils. The enzymatic activity by DHA tells us that the health of the surrounding soils is better than that of the stream sediments and terrace sediments, but less than in other sites affected by mining activity in Spain. Cyanide species are linked to DHA and this in turn is favoured by organic matter (OM). On the other hand, it was observed that cyanide elutes from the tailing's piles in a complex cyanide way, favouring the transport of PTEs associated with it to the stream sediments.

Regarding the risks to human health in soils, As and Cu concentrations exceed the limits for non-carcinogenic and carcinogenic risk in both children and adults, with the residential scenario being the worst scenario, and for adults also the agricultural scenario. In edible plants such as rice, corn, cassava and tea leaves, Sb exceeds the limit for non-carcinogenic risk, and Cu and As for carcinogenic risk. Due to the potential ecological and human health risks that the area represents, actions must be taken to reduce them.

Keywords: potentially toxic elements (PTEs), gold mine, risk assessment, edible plants, human health.