

Mercury pollution from the artisanal mining in Yani gold district, Northern Bolivia

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Artisanal gold mining is the main economic activity in the Yani district, Northern Bolivia. In this area abundant orogenic gold deposits constituted by quartz veins hosted in paleozoic turbiditic series that contain either free gold or associated with pyrite. Gold is recovered in processing plants by gravimetric methods using shaking tables in several communities of this district. Previously, miners ground the mineral in ball mills together with mercury. The present study aims to evaluate the effect of mercury used in the gold recovering process to the environment and human health in the Yani district. The assessment was based on the analysis of human hair, sediments and water from the river nearby the processing plant and drinking water from the fountain that supplies these communities. 47 samples of hair from miners and other people from the Yani and Señor de Mayo communities were obtained in 2014 and 52 samples in 2015. All were analysed to evaluate the mercury exposure in these places. The results from the 2014 sampling show a wide range of Hg concentration in hair, especially in Señor de Mayo, with values up to 136 $\mu\text{g/g}$ THg. However, in 2015 among the 43 residents in Señor de Mayo, 29 (67%) exhibit concentrations higher than 2 $\mu\text{g/g}$ THg, with an average value of 5.36 $\mu\text{g/g}$ THg. On the other hand, in Yani only 40% have concentrations above 2 $\mu\text{g/g}$ THg, with an average value of 2.34 $\mu\text{g/g}$ THg. The content in Hg in most of the hair samples exhibit values above the tolerable limits established by the US Environmental Protection Agency (1 $\mu\text{g/g}$ Hg) and the World Health Organisation (WHO, 2 $\mu\text{g/g}$ Hg). These high Hg concentrations are found not only in miners but also in the other members of the community, in spite of low fish consumption in this area. Part of the hair was analysed before and after cleaning. Usually in the second case the content of Hg is reduced, but still show high Hg levels, then probably the atmosphere is polluted with Hg and population is exposed to Hg vapour. The average of Hg contents in hair from Señor de Mayo is double than in Yani. This can be explained because in the former the processing plant is located much closer to the community.

The THg concentration in water from the river vary from 0.12 to 0.22 $\mu\text{g/g}$ THg and from the drinking water display values around 0.22 $\mu\text{g/g}$ THg, both below the tolerable limits indicated by the WHO. THg levels in sediments collected in river near the processing plant of Señor de Mayo and Yani show high Hg concentrations, 2.4 and 5.9 $\mu\text{g/g}$, respectively, which represent a serious environmental risk.

Most of the obtained values of mercury concentration in hair indicate a high level of pollution. The miners of these areas should find out alternative methods for gold recovery.

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