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Environmental pollution produced by gold artisanal mining in the Mapiri river basin, Apolobamba, Bolivia

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Mining activity is very important in Bolivia since colonial times. Today it has been reactivated, especially gold mining, due to rise in metal prices. Artisanal and small-scale mining activities are abundant in the protected area of Apolobamba, near the border with Peru. Here mercury is used to recovery gold by obtaining an Hg-Au amalgam. This manipulation with mercury causes an important environmental impact in the area.
The present work is a preliminary study of the contamination of the Mapiri river basin in the Apolobamba area. In the head of this basin, located at more than 4000 m above sea level, gold is mined from hydrothermal gold deposits of Paleozoic age. We have sampled several mining sites from this area, in particular the ones known as Viscachani, Flor de Mayo and Chojlaya, located in the proximity of the head area of the Mapiri river basin. These mining sites were in activity during the present sampling campaign.
Different metals were measured by means of XRF (Se, As, Cu, Zn, Cd, Pb, Hg) in tailing samples from the different gold mining sites. In addition mercury concentrations were measured in water and in vegetation close to the processing areas by means of atomic absorption spectrometry with Zeeman effect (LUMEX RA-915 Equipment).
Tailings are mainly constituted by quartz with minor contents of clay minerals and sulphides. The most abundant sulphides are galena and arsenopyrite. Chalcopyrite, sphalerite, pyrite and sulphosalts also occur in minor amounts, as well as minor secondary minerals. Gold content, after recovery with mercury, is high, between 4.56 ppm and 10.35 ppm.
The Hg content of the tailings ranges from 149 to 1027 ppm. Lixiviable mercury from these samples ranges between 30.10 and 859.94 ng l-1. Water released from the tailings contains between 0.1 and 5.7 ppb of Hg. Studied vegetation typical of the area has high Hg contents, between 162 and 219 ppm.
In addition there is a high arsenic content in all the studied tailings, except in those from the Viscachani mining site, where concentrations of this element ranges from 456 ppm to 18540 ppm. The Pb content usually ranges from 337 to 939 ppm. The Chojlaya mining site tailing has exceptionally high values of heavy metals: Pb content is between 2.26 and 3.27 wt.%, Cd ranges from 160 to 228 ppm, Zn from 194 to 794 ppm, Cu from 847 to 1052 ppm and Se from 105 to 187 ppm. These contents also contribute to an environmental pollution.
In conclusion the gold mining activities in the Mapiri river basin produce and intense environmental pollution, mainly related to mercury and arsenic contents in the proximity of these mining activities. After processing, tailings still contain important amounts of gold suggesting that the amalgamation method is not effective to gold recovering.

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