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

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Introduction

Mining activity is very important in Bolivia since colonial times. Nowadays it has been reactivated, especially gold mining, due to rise in metal prices.

Artisanal and small-scale mining activities are abundant in the protected areas of Apolobamba, department of La Paz, which is located near the border with Peru. Several rivers occur in this area. The most important are the river Yacu, in the border with Peru, that drains to the Pataquite and the Mapiri river, that is affluent to the Amazonas river.

In the northern part of this area gold is mined from veins. Here mercury is used as a recovery agent to obtain the Hg-Au amalgam. This manipulation with mercury causes an important environmental impact in the area. Otherwise, in the south part of the Mapiri basin gold is in placer-type deposits and it is obtained by mechanical techniques without the use of mercury.

The present work is a preliminary study of the contamination of the Mapiri river basin in the Apolobamba area, which drain to the Amazonas river. The present study also aims to do a preliminary evaluation of the efficacy in gold recovery of amalgamation method in this area.

In the head of this basin, located at more than 4000 m above sea level. According to Hentschel et al (1999) about 15 tones of Hg are discharged in the environment in Bolivia every year.

Another additional problem to use of mercury to gold recovery is the price that is increasing a very high rates due to the low production of this element to do an amalgamation with gold as a recovery processment. They led to an intense environmental pollution, mainly related to mercury and recovery processment. They led to an intense environmental pollution, mainly related to mercury contamination of soils and water.

Veins, that constitute the primary gold deposits, are hosted in mica schists and shales. Quartz veins often also contain sulphides as pyrite, sphalerite, galena,arsenopyrite, chalcopyrite and sulphosalts and telurides.

Discussion and Conclusions

The artisanal gold mining activities in the northern part of the Mapiri river basin use mercury to the gold recovery processment. They lead to an intense environmental pollution, mainly related to mercury and arsenic contents. Mercury pollution is due to the use of this element to do an amalgam with gold as a recovery technique.

Tailings from Chojlaya also are rich in heavy metals as Pb, Cd, Cu and Zn. These contents produce contamination of soils and water.

Vegetation of the area is very effective in capturing Hg, Pb, Cu, Cd, Zn, As and other heavy metals after recovery processment. They can reach up to high values (eg. 4.4 ppm in Viscachani).

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 4.56 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%, Cu ranges from 140 to 228 ppm, Zn from 194 to 794 ppm, Cu from 88 to 1052 ppm and Hg from 181 to 187 ppm (Table 2). These contents also contribute to environmental pollution.

After processing, tailings still contain important amounts of gold suggesting that the amalgamation method is not effective to gold recovery. In some places silver sulphides are abundant, then Ag concentration is not high in economic contents. The Ag content should be investigated and take into account when exploitation.

More research should be done to quantify other possible metals that could be of economic interest, as silver. In addition, an alternative method to the use of mercury should be investigated to be used mercurygold in these exploitations, according to the sustainability concept.

Analytical methods

The content of several metals were measured by means of XRF (X, Au, Cu, Zn, Cd, Pb, Hg) in tailing samples from the different gold mining sites in the ACTLABS laboratory.

In addition mercury concentrations in water and in vegetation close to the processing areas were determined by means of atomic spectrometry with Zeeman effect (LUMEX RA-915 Equipment) in the Universidade de Castilla-La Mancha. The concentration of mercury was also determined in the air along the study area with a portable LUMEX RA-915 Equipment.

Results

Graph of the measurement in situ with the LUMEX portable spectrometer of the Hg content in the air along the road from Ulla Ulla to Viscachani.

Table 1: Content in Au, Hg and As of tailings from the Apolobamba protected area.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Location</th>
<th>Type</th>
<th>Cr</th>
<th>Ni</th>
<th>Cu</th>
<th>Zn</th>
<th>As</th>
<th>Se</th>
<th>Mo</th>
<th>Cd</th>
<th>Hg</th>
<th>Pb</th>
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<tr>
<td>M1</td>
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<td>1.05</td>
<td>75</td>
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<td>M2</td>
<td>Tailings/Head Tachi</td>
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<td>122</td>
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<td>M3</td>
<td>Tailings/Head Tachi</td>
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<td>1346</td>
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<tr>
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Sampling

We have sampled several mining sites from this area, in particular the ones known as Viscachani, Virgen del Rosario, Flor de Mayo and Chojlaya, located in the proximity of the head areas of the Mapiri river and the head of the Taqui river. Also we exploited in the proximity of the locality of Mapiri, in the south of the apolobambas were sampled.

All these mining sites were in activity during the present sampling campaign. The processing of gold takes place near the mines, where the mines also live.

Geology

In the Apolobamba protected area gold occurs as primary and secondary deposits. In the northern part of the Mapiri river basin gold occurs in hydrothermal quartz veins of Paleozoic age. The area is abundantly covered by quaternary sediments. In other cases as in the Chachis river and in the southern part of the Mapiri river basin, gold occurs in place-type deposits, where it is free, but it occurs in very small particles.

Veins, that constitute the primary gold deposits, are hosted in mica schists and shales. Quartz veins often also contain sulphides as pyrite, sphalerite, galena,arsenopyrite, chalcopyrite and sulphosalts and telurides.

References


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