

# Dynamics of Mercury Pollution on Regional and Global Scales: Atmospheric Processes and Human Exposure

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## Mercury Pollution from Artisanal Gold Mining in Block B, El Callao, Bolívar State, Venezuela

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### Abstract

The technical and health aspects of the gold mining activity conducted by artisanal and small-scale miners in the Block B, El Callao, Bolívar State, Venezuela, were evaluated. The area, with 1731 inhabitants, is a legal mining concession of CVG-Minerven rented to small-scale mining individuals/companies. Miners extract the ore from 30-80 m deep shafts using explosives and transport it in small trucks to the Processing Centers (locally known as "molinos") to be crushed, ground, concentrated and amalgamated. There are 28 active Processing Centers in the Block B area producing about 1 to 2 tonnes Au/a. By using copper-amalgamating plates to amalgamate the whole ground ore, a large amount of mercury is lost with the tailings. The amalgam recovered from the plate is burned on a tray or a shovel. The mercury released in Block B is estimated to be between 2 and 4 tonnes/a and in all of El Callao, could reach as much as 12 tonnes/a. The level of mercury intoxication in the gold miners/millers and surrounding communities in Block B is one of the most serious in the world. A total of 165 volunteers were interviewed using UNIDO's Protocols and 105 persons were selected to perform neurophysiological tests. A total of 209 samples of urine (66 samples from women, 62 from children, 48 from millers and 33 from miners) were collected and analyzed for Hg and creatinine using a portable atomic absorption spectrometer LUMEX. The overall average of total Hg concentration in urine was 104.59 µg Hg/g creatinine with standard deviation of 378.41 µg Hg/g creatinine. About 61.7% of the sampled individuals have Hg levels in urine above the alert level of 5 µg/g creatinine, 38.3% of the individuals have Hg levels above the action level (20 µg/g creatinine), 20.6% above the maximum of 50 µg/g creatinine recommended by the World Health Organization, and 15% above 100 µg/g creatinine, which is the level where neurological symptoms are very likely. The situation with miners and millers is dramatic as 30% and 79% of the miners and millers respectively have Hg in urine above the action level and 52% of the millers have levels above 100 µg/g creatinine. In addition, about 14.6% of millers have shown extremely high mercury concentrations in urine, ranging from 1221 to 3260 µg Hg/g creatinine. This result allows the generalization that more than 90% of the sampled individuals working in the Processing Centers (millers) have Hg levels in urine above the alert level. Signs of serious intoxication and neurological damages were detected in a large majority of those directly involved in the amalgamation process as well as in innocent people living near the Processing Centers. The use of simple pieces of equipment such as sluice boxes with carpets or with a novel type of magnetic liner ("Cleangold") was demonstrated to the miners and millers. A concentrate was obtained with 2854 mg/g of fine gold. The tests also used four special amalgamating Goldtech plates that removed up to 95% of the mercury from tailings. By combining Cleangold sluices and Goldtech plates (arranged in a zigzag), it was possible to recover 15.4% of gold from tailings. Four different types of retorts were manufactured locally. All these simple techniques can reduce mercury releases and increase gold recovery.

### Introduction

Artisanal and small-scale gold mining (ASM) is an essential activity in many developing countries. The current number of artisanal gold miners is estimated to be between 10 and 15 million people worldwide (Veiga and Baker, 2004) with almost 30% of this contingent being women (Hinton et al., 2003). Since 1998, annual gold production from ASM has constituted 20 to 30% of the global production, ranging from 500 to

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