# Unexpected low mercury levels in sediments and fish from lakes down-water from a gold mining area in Peru

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## Background

- Artisanal and small-scale gold mining (ASGM) is believed to be one of the largest sources of mercury (Hg) to the aquatic environment
- In Peru, ASGM is expanding since the 1970s, and was estimated to have used 30 tonnes Hg in year 2005 alone (1)
- The region of Madre de Dios (Peru) hosts most of the country's ASGM, which has led to public health awareness regarding Hg levels in fish for human consumption. Nevertheless, the fate of Hg releases to the environment from regional ASGM is still not well constrained

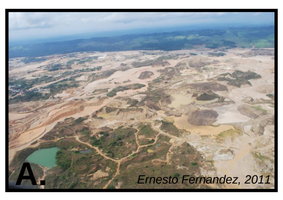



**Figure 1.** ASGM in Madre de Dios, Peru (a) An aereal photograph of mining area Huaypetue (b) ASGM dredge operating in the Malinowski River

## Study area and hypothesis

- We investigated sediments and fish from three oxbow lakes located ~50 km down-water from a ASGM area, and ~20 km from Puerto Maldonado, the town where most regional gold shops and amalgam burners are located
- If a significant fraction of the Hg used by ASGM has been emitted to the atmosphere through amalgam burning, this should result in increased Hg concentrations in the lake sediments

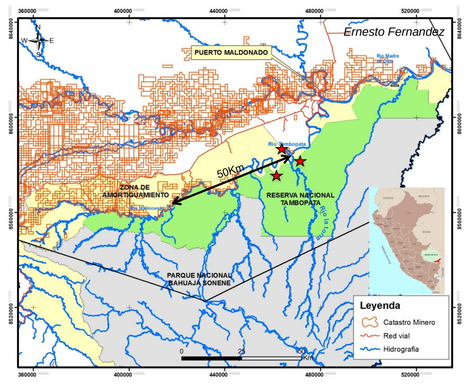


**Figure 2.** Location of study lakes (Cocococha, Tres Chimbadas, and Sachavacayoc), and regional ASGM area in region Madre de Dios, Peru




**Research question: Can we find Hg from ASGM in sediments and fish from down-water lakes?**

## Conclusions

- We found no clear evidence of Hg influence from ASGM in the Hg deposition in sediments of the study lakes
- Although Hg levels above guidelines were detected in predator fish species, our findings seem to reflect unpolluted conditions







## Results

### ❖ Mercury content in fish

- Hg was detected in all analyzed samples.
- 25% of total samples (*huasaco*, *corvina*, and white *piraña*) exceeded USEPA guidelines for human consumption (0.3ppm)
- Biomagnification was confirmed (Figure 2)

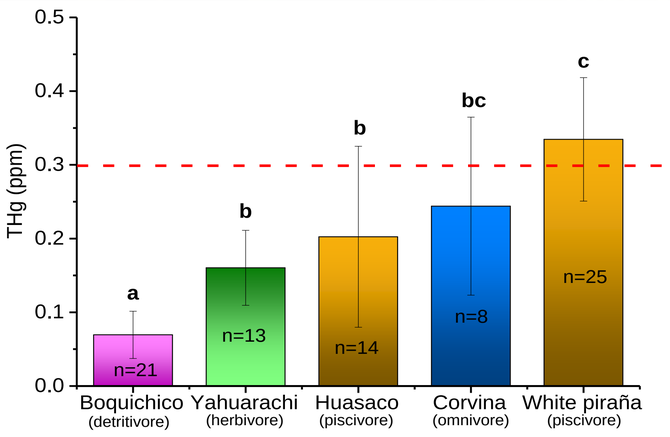


**Figure 2.** Average mercury levels in five fish species (n=81) from the three oxbow lakes located down-water of a mining area in Madre de Dios, Peru. Values compared to guidelines for mercury in fish (0.3 ppm). Letter *a*, *b*, and *c* indicate a significant difference (0.05 significance level, one-way ANOVA)

### ❖ Mercury accumulation in sediments

- C:N ratios (mean=8) in lake sediment cores indicated that there is a limited input from the catchment. For this we assume that the main input of Hg to the lakes is direct atmospheric deposition to the lake surface (Figure 3)
- Mean Hg concentrations in Cocococha and Tres Chimbadas were close to background levels (72 and 77 µg $kg^{-1}$, respectively).
- In Cocococha, variation on Hg concentrations over the last ~150 years were relatively stable, with no obvious increase in recent years.
- The increasing trend of Hg in Tres Chimbadas started much earlier than 1960-70s (assuming a similar sedimentation rate in both lakes)
- The trends of Hg and organic matter (OM) were highly correlated in Tres Chimbadas. However, the last increase of OM ( ~8cm depth). which should have occurred at about the same time as the ASGM started, is not accompanied by a corresponding increase in Hg (i.e. there is actually an effective decrease in Hg at that point in time).

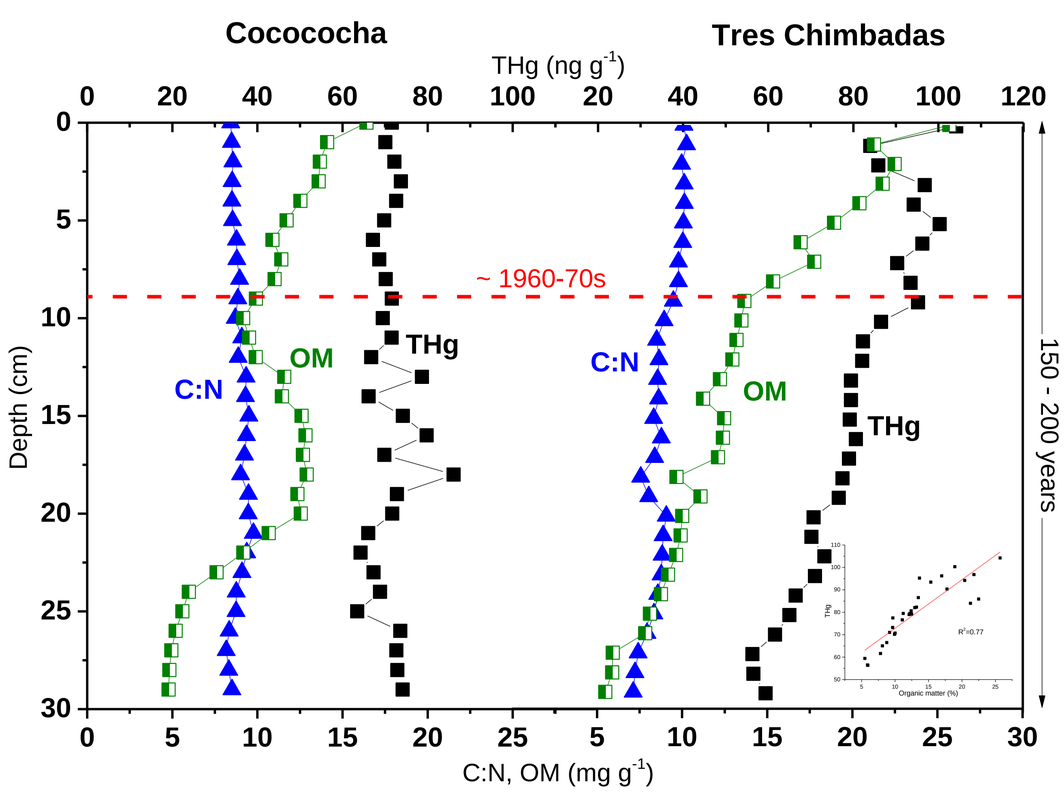


**Figure 3.** Down-core variations over the last 150-200 years in sediments from oxbow lakes Cocococha and Tres Chimbadas. Depth corresponding to years 1960-70s in indicated. THg=Total mercury, OM=organic matter, and C:N=carbon:nitrogen ratio

## References and sponsorship

(1) Telmer y Veiga (2009) Mercury Fate and Transport in the Global Atmosphere. In Mason, R. & Pirrone, N. (Eds), Mercury Fate and Transport in the Global Atmosphere: Emissions, Measurements and Models (pp. 131-172).

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