

A Program for Supplanting Mercury in Artisanal and Small-Scale Gold Mining (ASGM)

Caelen Burand
Mercury Free Mining and University of Arizona



MERCURY FREE MINING

Eradicating Mercury for the
Health of Our World



**ALLIANCE FOR
RESPONSIBLE MINING**

What is ASGM?

Defined:

ASGM is a mining sub-sector. It is often informal, uses rudimentary methods, and/or has low rates of throughput. Mining is usually the best or only income source available.

By the numbers ASGM:

- Directly employs 20 million people in 80+ nations (1)
 - Twenty times more than the industrial mining sector
 - Can contribute to all 17 UN SDG's (1)
- Produces ~415 tonnes Au/yr (5)
- Releases 38% of anthropogenic mercury pollution (6)

Why is this Relevant?

- Mercury amalgamation is a widespread method for recovering gold. It can be the only tool available for miners to earn an income.
- Mercury is a potent neurotoxin. Global mercury pollution is creating a "global health crisis" (2).
- Five decades of global efforts to supplant mercury have yielded little progress (3).

Flaws of Prior Programs:

- Approaches are top-down and seek "silver bullets"
- Often consider only individual components of ASGM and not the whole system (3).

Mercury abatement success stories:

- Processes connecting miners to markets valuing sustainability (4).
- Miners will often adopt mercury-free methods when such methods also increase gold production (3).

This Investigation

Proposes and pilots a program for improving access to reliable information on mercury alternatives.

Program Goals:

- Provide reliable information regarding more effective, mercury-free methods of recovering gold
- Designed to be scalable and open source for widespread implementation after piloting

Objective: Develop a scalable program for reliably identifying optimal mercury-free ore processing

Proposed Program & Pilot Results

Step 1: Rally consumer-facing support for improved sourcing methods

Gemological Institute of America (GIA) supports pilot



Headlines of press-release and popular media article. Broad support is necessary for integrated supply chain to support miners when adopting mercury-free methods.

Step 3: Deploy robust sampling

Four stages of review produced a practical method of sampling which maximized quality



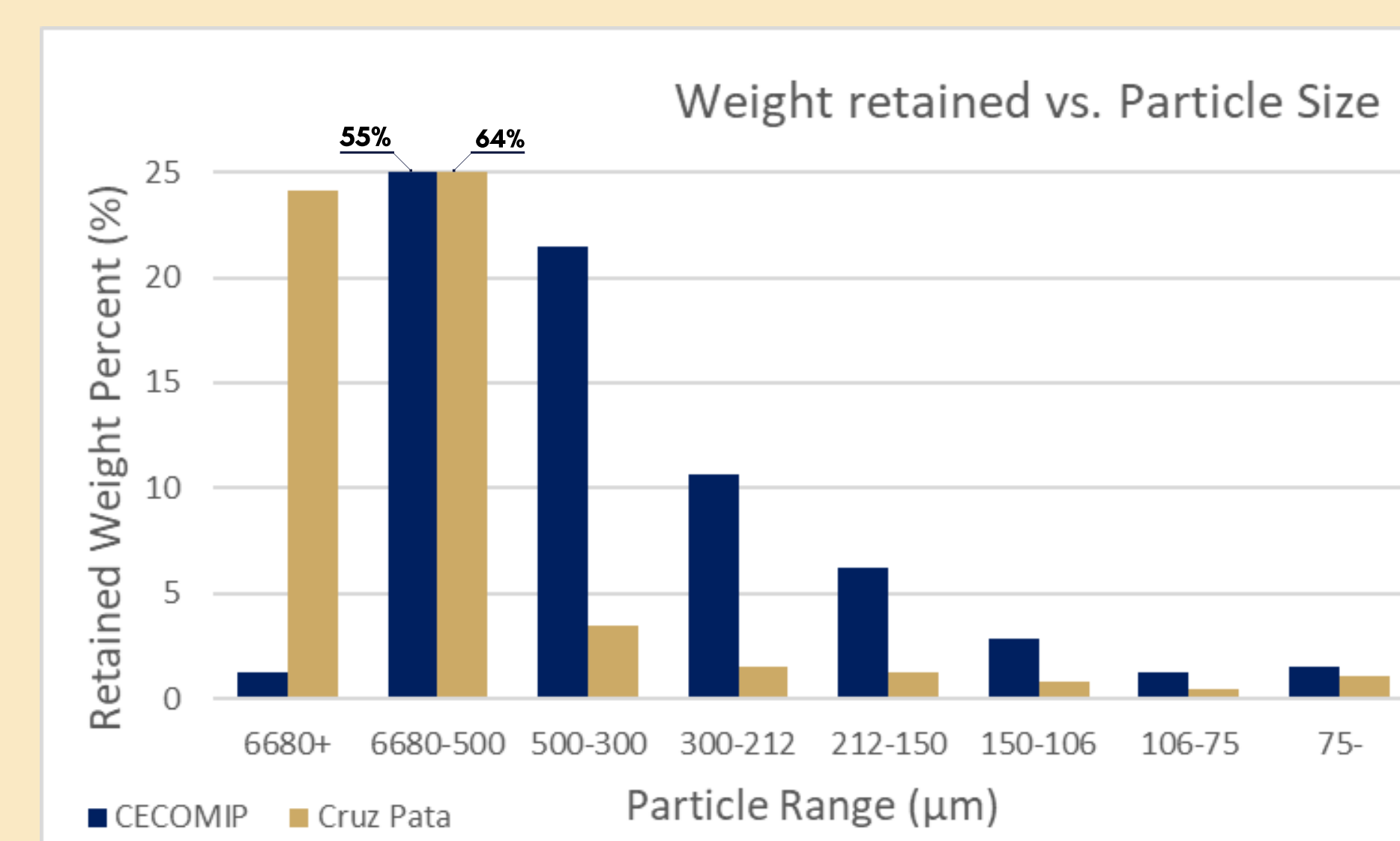
CECOMIP miners sample tailings from their sluices shown in step 2



Quartering and sampling of concentrated ores at Cruz Pata Chiquimas

Step 5: Analyze geometallurgical parameters. Calculate KPI's.

Fluvial/glacial ore with grain size and shape heterogeneity. Gold is "platelet-like".



Example grain size distribution showing notable differences in particle size between sites although ~1 km apart

Step 2: Partner with ASGM operations and identify wants and needs

CECOMIP and Cruz Pata Chiquimas in Puno District Peru want less dangerous methods to recover gold.



CECOMIP sluices concentrating gold ores



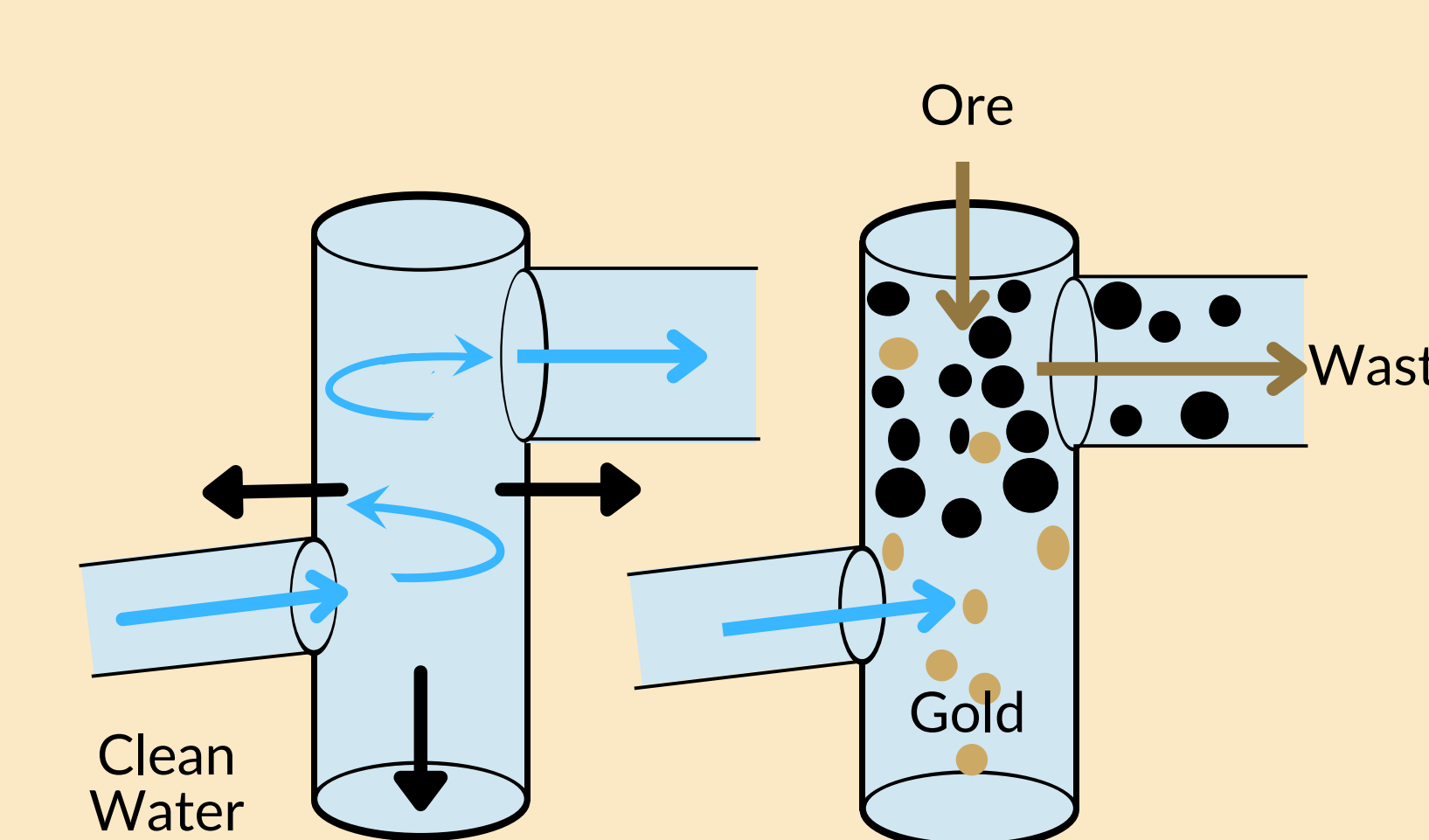
Retort and furnace for vaporizing mercury at Cruz Pata Chiquimas

Step 4: Process samples without mercury

Six methods are being evaluated; 2 sluices, 1 elutriation system, 1 adsorbent, 1 centrifuge, and 1 shaking table



Golddrop elutriation system. Diagrams showing boxed portion in detail.



Schematic diagrams of a reverse flow centrifugal elutriation system. Not to scale.

Step 6: Publish results for miners. Implement optimal processor.

Next step of the process



Golddrop system being trialed by ASGM in West Africa prior to pilot. Photo Courtesy Toby Pomeroy

What is Next?

1. Complete step 6. Review and enhance program.
 - a. Open-source methods for scaling
2. Repeat program with various gold ores
3. Develop user-friendly interface for matching ore characteristics with an optimal processing technologies.

What Have We Learned?

- Mercury-free processing research can be regarded as an in-demand service for ASGM communities
 - A "miners as clientele" model should be investigated
- It is possible to develop a standard system for identifying optimal mercury-free methods for ASGM. Increases in efficiency and scalability are to be evaluated.
- Consumer-facing markets and firms are demanding increases in sustainable sourcing and are willing to fund relevant research.

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