Restoration of Surface water bodies contaminated by mercury. State of the art of available methods and applicability in the French Guiana context

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While many techniques are available to manage mercury pollution (Hubé and Merly, 2014; Colombano, 2011 & 2012; Hubé and Colombano, 2012), their adaptability to the climatic, geographical and economic context of the country is to be assessed.

A study was conducted in French Guiana to evaluate the techniques applicable to the restoration of mercury-impacted surface water bodies.

Most of the remediation techniques developed and used for industrial sites remediation find their limit for use in the case of artisanal mines in Guyanese context due to:

- strong total tonnages but with significant dissemination (existence and location of potential hot spots poorly known),
- large water mass flows in quantities, high flows,
- low concentrations of mercury (<100 µg / L),
- the remoteness of the sites, and their difficult access.

The restoration of the quality of water bodies therefore essentially involves better management of the exploitation of alluvial mines. It is therefore necessary to reduce the "leakage" of water loaded with suspended matter (and associated mercury) from the mines to the rivers. For that, a better management of the extraction must be applied by all the miners whatever the size of their exploitation.

This restoration will only be effective if the resumptions of exploitation are limited. As they result in remobilization of mercury used during the first exploitation by rainwater and process water. These waters can be loaded with mercury metal in the form of micro-droplets and mercury-rich particles. Remobilized mercury levels may be important during this step. It is therefore essential to restrict this release. This release being of mechanical origin (digging), it is necessary either to reduce the water flow of the treatment, or to contain the drained water, mainly during the start of the new exploitation.

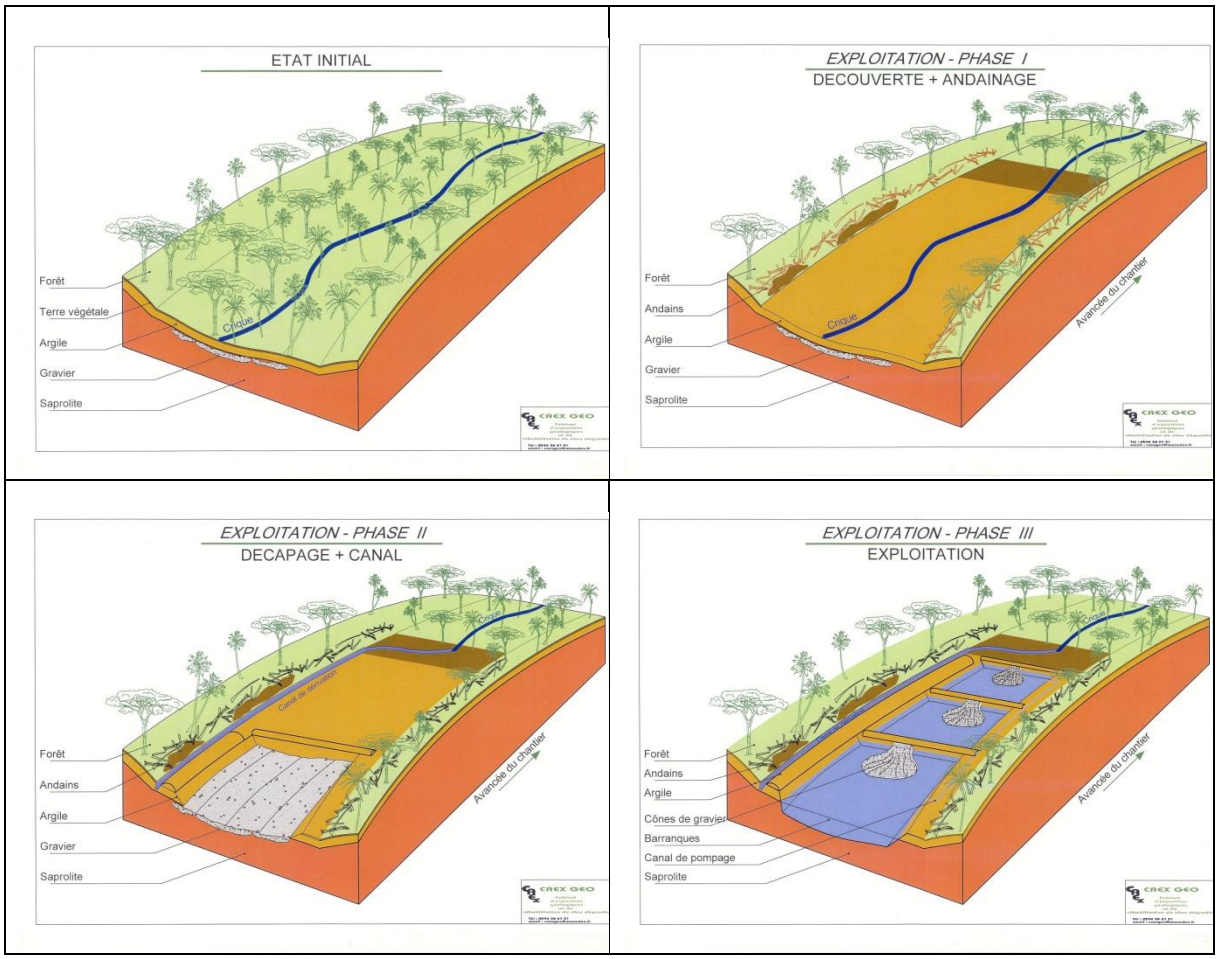
Better management of exploitation and post-exploitation

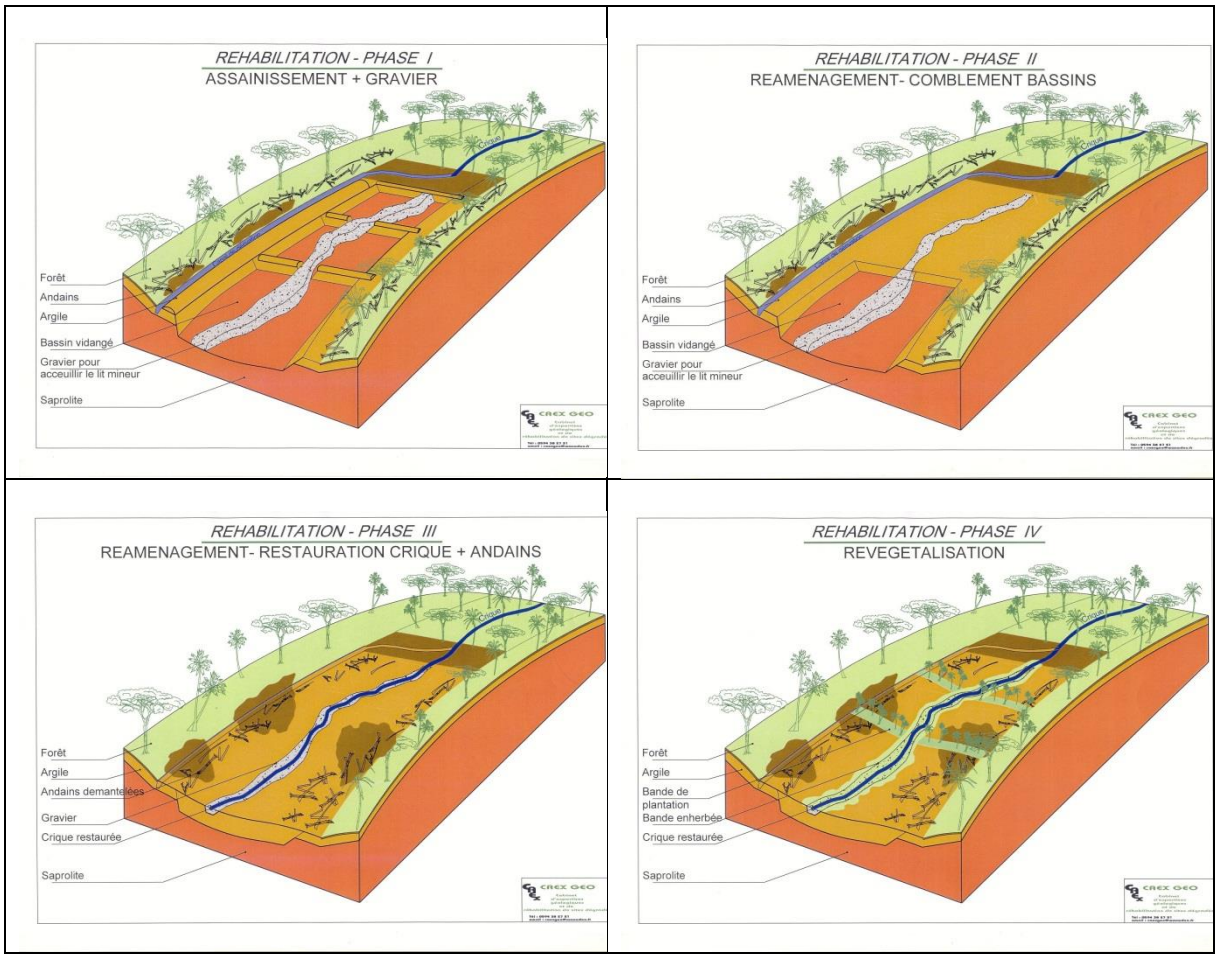
This study has established key advice for improving current mines management practices:

- For the exploitation phase:

- Studies have shown the important contribution of suspended matter to the river at the opening of the sites (Guédron, 2008). It would be preferable that these openings are done outside the rainy seasons to limit leaching.
- Another solution to put in place during the operation is to reduce the flow by limiting the number and the capacity of the pumps and the number of shovels.
- Compliance with good practices to protect the environment as soon as a mine starts (FEDOMG, 2005 published the Charter of Mining Operators in Guyana). Frequently encountered faults are:
    - The pumps are often oversized compared to the capacities of the sluices. A decrease in the flow of water should make it possible to increase the recovery rate of gold and to reduce the problem of water management;
    - The size and shape of the trailing ponds should be properly sized to favor the sedimentation of the particles with or without the addition of a material that can promote settling to be identified locally.
    - Test different materials likely to trap Hg that are adapted to the Guyanese context, easy to implement and cheap (charcoal type).

– For closure and rehabilitation phase
- For a better restoration of the sites, it is important to prepare it from the start as shown below to ensure a better recovery of the vegetation, and also to avoid erosion of the banks and thus the transfer of the suspended matter to the river.





Management of the sites of the various phases of exploitation until the phases of rehabilitation (Source : CAEX-REAH).

Revegetation of the sites

The exploitation of alluvial deposits entails:

- degradation of the vegetation cover,
- soil erosion and,
- pollution of rivers.

The interest of revegetating a site is important because the establishment of a vegetation cover will limit soil erosion and therefore limit the transfer of particles (and associated mercury) to rivers.

The goal is the "creation of an artificial plant cover to recreate the conditions allowing a return of natural dynamics". In the context of Guyana, it has been shown that it is important to set up fast-growing, nitrogen-fixing species that provide the necessary shade for plant cover similar to the surrounding forest. The choice of species must be made by considering endemic species and avoiding invasive species.

It is necessary to set up a nursery chain to meet the needs for revegetation.

The impact of this revegetation on suspended matter is well demonstrated, however, its impact on the evolution of residual mercury and its possible mobility remain little known.

Merly, C., and Hube, D. (2014). Remediation of Mercury-Contaminated Sites. Project No. SN-03/08. Available at https://docplayer.net/18898131-Remediation-of-mercury-contaminated-sites.html.

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Hubé D., Colombano S. 2012. Gestion des pollutions mercurielles associées aux sites à électrolyse au mercure : état de l'art, pratiques et perspectives en matière de dépollution des sols et des eaux mercurielles. Rapport BRGM/RP-60878-FR, 116p.

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