Characterization of gold ores - the basis of gold traceability

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Funded by InnoSuisse – Swiss Innovation Agency
SWITZERLAND AND ITS GOLD MARKET

Economical importance
Switzerland is the most important hub for gold of the world:

60 – 70 % of the worldwide produced gold is refined in Switzerland

Political challenges
2013: Report investigated by Public Eye: Togolese Gold from Burkina Faso
2015: Recordon Postulat: Trade in gold produced in violation of human rights
Current: Responsible Business Initiative of the Swiss Coalition for Corporate Justice

Scientific perspective
Determine the origin of the gold by a scientific approach:

PROOF OF ORIGIN
VALIDATE THE DECLARED PROVENANCE OF DORE BARS
FOCUS OF THIS PRESENTATION

CONTEXT:
Artisanal and small scale mining (ASM)

AIMS:
- to characterize «gold ore»
- to distinguish between gold from vicinous mining sites
- to distinguish different metallurgical processes

METHODS:
Field work, Traditional mineralogical approaches, Isotope studies (MC-ICP-MS), Chemical composition (XRF, ICP-OES), Scanning electron microscope (SEM)
**GOLD OPERATING CHAIN (ASM)**

Step 1: enrichment on sluices

Step 2a: amalgamation

Step 2b: gravimetric table

Step 3: doré bars

Studied mining sites:
- Fortuna
- Boca Inambari
- Sol Naciente
- Hueypethue
- La Rinconada
- Ananea
TRACERS OF ORIGIN FOR PROVENANCE STUDIES: Pb-ISOTOPES
TRACERS OF METALLURGICAL PROCESSES

- Industrial mines (yellow) and its closed by ASM (brown)
- red: due to refining process?
POSSIBILITIES AND LIMITS

Validate the declared provenance of gold using analytical methods (isotopes and bulk chemical composition)

- **YES**
  - Direct supply chain: Distinction at local, supra-regional, international level
  - Addition of metals, hiding the isotopic signature
    - Other isotopes, Chemical composition, inclusions and microstructure of the gold

- **NO**
  - Signature too close, distinction between industrial and artisanal mining is not possible
    - Tracers of metallurgical processes
  - Complex mixing of different sources
    - Determination of a regional signature and not of a single mine
CONCLUSIONS

Geochemical and mineralogical approaches are promising for determining the provenance of gold.

- The present results must be further developed taking into account variations related to time and space.

The gold market is very complex, an easy solution for the traceability of gold does not exist.

- It is necessary to formulate specific challenges, in order to find concrete solutions based on geochemical and mineralogical approaches.
Thank you for your attention!

With the support of

- Better Gold Initiative BGI (Thomas Hentschel, Nils Krauer, Victor Hugo Pachas)
- Swiss Embassy in Lima, Peru (Christoph Sommer)
- Geological Museum in Lausanne, Switzerland (Nicolas Meisser)
- EDANA, He-Arc, Neuchâtel (Carole Baudin)