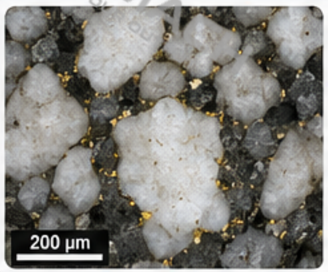
# Gold Ore Processing Route Selection

## KEY DECISION FACTORS

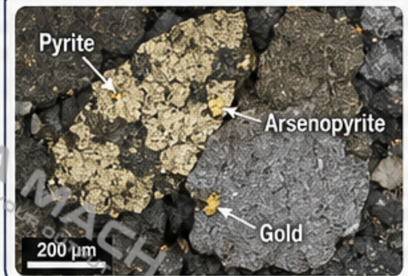
- Mineralogy
- Gold Occurrence
- Liberation
- Sulfide Association
- Permeability
- Metallurgical Testwork

### 1. FREE-MILLING GOLD

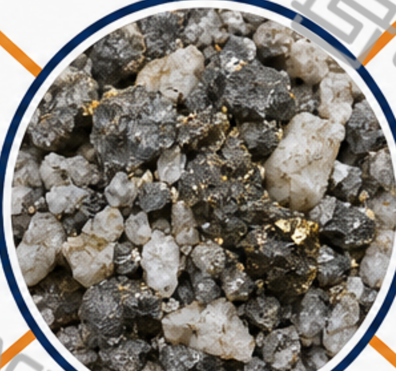



Gold occurs as liberated or partly liberated particles in quartz-rich ore. Suitable for conventional recovery after comminution using gravity and cyanidation.

### 2. SULFIDE-ASSOCIATED GOLD

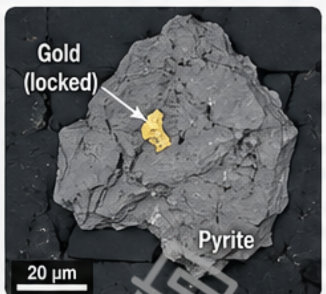



Gold is associated with sulfide minerals such as pyrite and arsenopyrite. Route selection requires sulfide-related recovery options, including flotation and/or roasting.



CRUSHED / GROUND GOLD ORE

### 3. REFRACTORY GOLD




Gold is finely disseminated or locked within sulfide grains. Locked gold may not be recovered by conventional comminution and cyanidation alone. Additional treatment such as oxidation, bio-oxidation, or roasting may be required.

### 4. AMENABLE OXIDIZED GOLD

Gold occurs in oxidized, weathered ore with iron oxides and clays. Route selection depends on oxide behavior, permeability and leach response to cyanidation or alternative leaching.

**No single flowsheet is suitable for all Gold Ore.**

Route selection depends on ore characteristics and metallurgical response.

# Free-Milling Gold Ore Processing

Typical flowsheet for free-milling gold ores using gravity and/or cyanide leaching routes.

### 1. CRUSHED ORE

Prepared by primary and secondary crushing.

### 2. GRINDING / CLASSIFICATION

Size reduction to liberate gold from host minerals.

### 3. GRAVITY RECOVERY

Recovery of coarse, liberated gold where applicable.

### 4. CYANIDE LEACHING

Dissolution of gold into solution.

### 5. ACTIVATED CARBON RECOVERY

Gold is adsorbed onto activated carbon for later elution.

## TWO COMMON CIRCUIT CONFIGURATIONS

### A. CIL CIRCUIT (Carbon-in-Leach)

Leaching and carbon adsorption occur within the same circuit.

Leach Tanks

CIL Tanks (Carbon-in-Leach)

Loaded Carbon Screen

Elution

Electrowinning

Regenerated carbon returned to CIL tanks

### B. CIP CIRCUIT (Carbon-in-Pulp)

Leaching and carbon adsorption occur in separate stages.

Leach Tanks

Carbon Adsorption (CIP Tanks)

Loaded Carbon Screen

Elution

Electrowinning

Regenerated carbon returned to CIP tanks

The most suitable route depends on mineralogy, gold occurrence, liberation, ore characteristics and testwork results.

**No single flowsheet is suitable for all Gold Ore.**

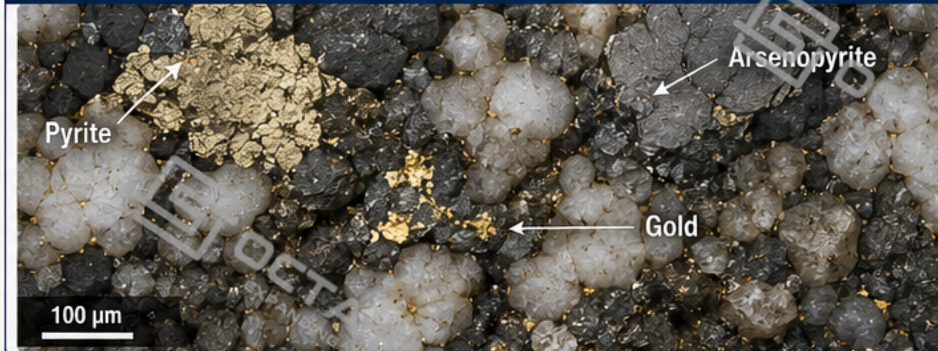
Metallurgical testwork is essential to confirm the appropriate processing route.

# Sulfide-Associated Gold Ore Processing

## KEY DECISION FACTORS

- Mineralogy
- Gold Occurrence
- Liberation
- Sulfide Association
- Permeability
- Metallurgical Testwork

## MICROSCOPIC GOLD ASSOCIATED WITH SULFIDE MINERALS




In sulfide-associated gold ores, gold occurs mainly as microscopic particles locked within or along the boundaries of pyrite and arsenopyrite, commonly with quartz.

Liberation of gold is typically limited; recovery usually requires concentration of the sulfide minerals.

### 1. CRUSHING

Size reduction to liberate sulfide-bearing particles.

### 2. GRINDING / CLASSIFICATION

Fine grinding and classification to improve particle liberation.

### 3. FLOTATION

Float sulfide minerals that carry microscopic gold.

### 4. SULFIDE-RICH CONCENTRATE

Concentrate containing pyrite, arsenopyrite and associated gold.

### 5. FURTHER TREATMENT

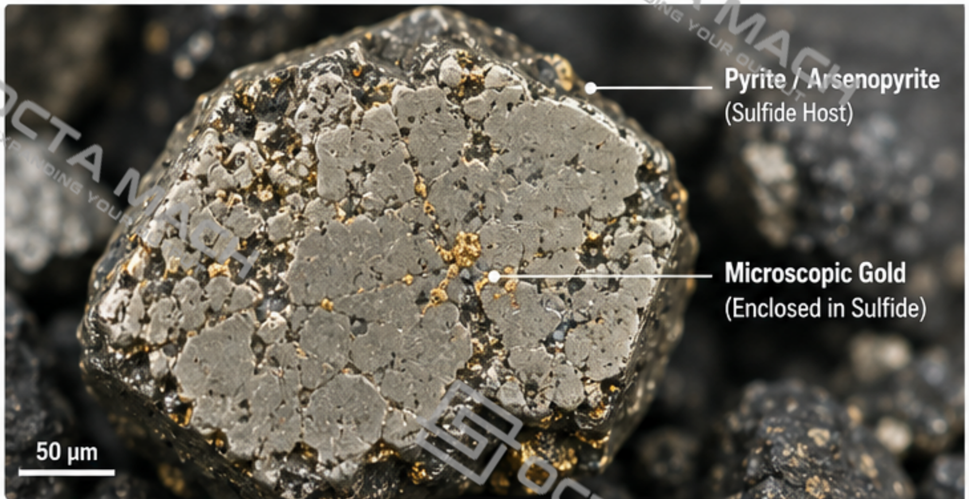
Concentrate treatment, oxidation or alternative downstream recovery options.

**Flotation concentrates gold-bearing sulfide minerals; it is not automatically required for every Gold Ore.**

Route selection depends on mineralogy, sulfide association, liberation and metallurgical response.

# Refractory Gold Ore — Locked Gold

Gold is physically enclosed within sulfide minerals and is not accessible by conventional leaching.



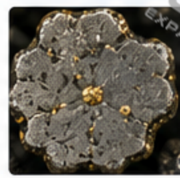

## What is Locked Gold?

Gold occurs as ultra-fine particles trapped within sulfide minerals such as pyrite and arsenopyrite.

Locked gold requires additional liberation and/or chemical treatment to become accessible for leaching.

### Locked Gold vs. Liberated Gold (Illustrative)

**Locked Gold**



Gold enclosed inside sulfide mineral grain.

Not accessible to leach solution.

**Liberated Gold**

Gold exposed on particle surface or in open pores.

Accessible to leaching.

**Key Point**

The challenge is mineral liberation and gold exposure, not just breaking the rock.

## TYPICAL PROCESS LOGIC FOR REFRACTORY GOLD ORES

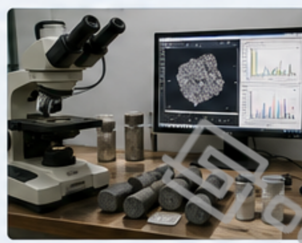
**1 Crushing**

Size reduction to prepare the ore for grinding.

**2 Grinding**

Further size reduction to liberate gold from sulfide minerals.

**3 Mineralogical / Metallurgical Assessment**



Determine gold deportment, liberation level, and required treatment strategy through testwork.

**4 Flotation and/or Pretreatment Where Required**

Concentrate sulfide minerals and/or apply pretreatment as indicated by testwork. (Options depend on specific ore.)

**5 Leaching / Recovery**

Gold is leached from treated material and recovered using an appropriate recovery method.

**Refractory behavior is metallurgical, not simply a measure of rock hardness.**

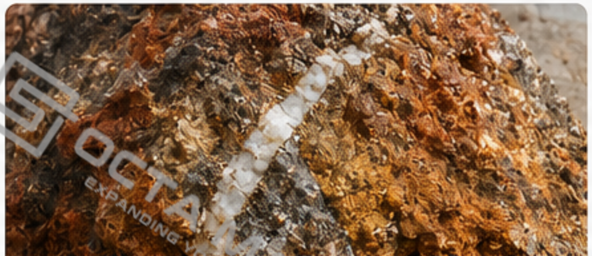
**Further grinding alone may not solve locked-gold recovery.**

**Important**

Each refractory ore is different.
The appropriate flowsheet must be based on comprehensive testwork and evaluation.

# Oxidized Gold Ore Processing — Where Applicable

Processing approach depends on ore characteristics, testwork results and project objectives.



**Weathered / Oxidized Gold-Bearing Ore**
Iron oxides, limonite, clay and other alteration minerals may be present.

## KEY FACTORS FOR ROUTE SELECTION

**Permeability**
Controls solution flow through ore in heap leach operations.

**Clay Content**
High clay can reduce permeability and may require agglomeration.

**Gold Liberation**
Degree of gold exposure affects leaching rate and recovery method.

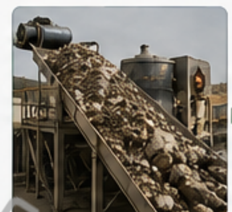
**Leach Response**
Oxidized gold may respond differently to heap or tank leaching.

**Metallurgical Testwork**
Testwork confirms the most suitable processing route for the ore.

**Route selection must be based on testwork, ore variability and project constraints.**
Operational considerations, environmental conditions and economics also influence the final decision.

## ROUTE A: HEAP LEACHING ROUTE (Where Applicable)

**1 Crushing / Sizing**



Reduce ore to appropriate size to achieve permeability and stacking stability.

**2 Agglomeration Where Required**

Improve ore permeability and prevent fines migration using binders where necessary.

**3 Heap Leaching**

Leach solution percolates through the heap to dissolve gold.

**4 Pregnant Solution**

Gold-bearing solution (collected as pregnant solution) is sent to recovery circuit.

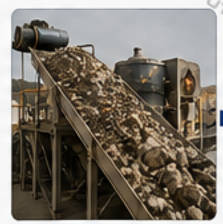
**5 Gold Recovery**

Gold is recovered from the pregnant solution using an appropriate method.

Heap leaching can be an effective option for suitable oxidized ores with good permeability and leach response.
It is not appropriate for all oxidized gold ores.

## ROUTE B: TANK LEACHING ROUTE (Where Applicable)

**1 Crushing**



Initial size reduction to prepare ore for grinding.

**2 Grinding**

Liberate gold by reducing particle size to the target range.

**3 Tank Leaching**

Gold is dissolved in tanks using a leaching solution.

Tank leaching may be preferred when permeability is poor, clay is high, or faster kinetics are required.

**OXIDIZED GOLD ORE DOES NOT AUTOMATICALLY MEAN HEAP LEACHING.**
The most appropriate processing route must be confirmed by metallurgical testwork and engineering evaluation.

**Testwork First**
Comprehensive metallurgical testing is essential to determine leach response, permeability, agglomeration need, and the most suitable processing route.