The Albion Process™ at the GPM Gold Project – The success of a technology

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www.albionprocess.com
GPM Gold – The success of a technology

Outline

1. Albion Process™ technology
2. Performance of the Albion Process™ at GPM
3. Review of global installations
4. The Future for Refractory Gold Projects
1. Albion Process™ Technology
Albion Process™

The Albion Process is a combination of mechanical and chemical liberation

• Ultrafine grinding:
  – IsaMill™ stirred mill:
    – FeS$_2$ = 80 % passing 10 microns
    – CuFeS$_2$ = 80 % passing 12 – 18 microns
    – Ni$_9$Fe$_9$S$_{32}$ = 80 % passing 10 – 14 microns
    – ZnS = 80 % passing 16 – 20 microns

• Oxidative Leaching:
  – Atmospheric pressure leach
  – Gold Applications – pH = 5.5 (“Neutral Albion Leach”)
  – Conventional baffled tank (Modular)
  – Sulphate solutions - no chlorides
  – Supersonic oxygen injection
Gold Albion Process Flowsheet

Significant detail of Albion Process chemistry and design is available in published literature.
Albion Process™ - Low Process Risk

All components of the technology are well demonstrated:

IsaMill
  - > 130 IsaMills in operation globally
  - 17 mills in gold re-grind applications

Atmospheric Leach
  - 6 operating Albion Process Oxidative Leach Pants
  - Zinc, lead, gold and copper plants
  - 700,000 tpa of sulphide concentrate currently processed

Oxygenation System
  - >520 HyperSparge units installed in Albion Process and other oxidative leach applications
  - Extremely successful at high utilisation of oxygen of 90+%, above design
2. GPM Project - Albion Process™ Plant Performance
GPM Gold – The success of a technology

The GPM Gold Project

• Armenian gold project, owned by GeoProMining LLC
• Open cut mine - 1 Mtpa ROM, 14.5 Mt reserves
• Historical grinding & flotation plant (1976) + CIL plant (1997)
• Oxide ores exhausted 2012, gold now refractory in pyrite
GPM Gold – The success of a technology

Refractory gold plant installed 2012

- Albion Process™ technology installation
- BFS and Pilot Plant completed 2011 by Core Resources
- Gold recoveries of 95%+ (up from 20% recovery without Albion Process™ treatment).
- Low skill workforce
- Plant tolerates highly variable throughput, sulphur grades and climate
- 100,000 tpa concentrate, producing 120,000 ozpa gold
- Plant production at up to 130% of nameplate design
GPM Albion Process™ Plant Performance

Process Plant Overview

Au recovery without Albion = 20%
Au recovery with Albion = 95-98%
GPM Albion Process™ Plant Performance

3 years of stable gold recoveries

![Graph showing gold recovery over time with stable performance.](chart.png)
GPM Albion Process™ Plant Performance

Variable Sulphur Grades (<10% to >30%)
Variable Throughput (100 – 350 tpd)
GPM Albion Process™ Plant Performance

Better than Pilot Plant

![Graph showing % Gold Recovery vs % Sulphide Oxidation with data points for GPM Pilot Plant, GPM Plant Data Nov 14, and GPM Plant Data April 15.]
GPM Ramp Up – Relative McNulty Curve

Series 1-2 Performance

% of design production rate

Months since end of 6-month commissioning

- Series 1
- Series 2
- Series 3
- Series 4
- GPM Gold Production
3. Albion Process™ - Global Installations
Albion Process™ Installations

- 6 Albion sites
- 11 ZipaTank
- 400+ HyperSparge
GPM Gold Project – Albion Process™ Plant

Commodity – Gold
Location – Armenia
Client – GeoProMining

Refractory pyrite concentrate
120,000 ozpa gold
Commissioned March 2013

Application: Recovery of precious metals from a refractory arsenic bearing deposit within the setting of a soviet era mining complex
Las Lagunas Tailings – Albion Process™ Plant

Commodity – Gold
Location – Las Lagunas, Dominican Republic
Client – Panterra

Complex arsenopyrite/gold tailings
80,000 ozpa gold
Commissioned in 2012

Application: Albion Process required to recover gold from complex matrix in tails dam (80% recovery, up from 35%), and leave arsenic minerals inert.
Copper Project – Albion Process™ Plant

Commodity – Copper
Location – Africa
Client – Confidential

Copper Concentrate
10,000 tpa copper cathode
>99 % copper recovery
Commissioning late 2017

Application: Recovery of copper and cobalt from low and medium grade concentrates in the African region
Asturiana de Zinc – Albion Process™ Plant

Commodity - Zinc
Location – Spain
Client – Glencore

Bulk lead/zinc concentrate
4,000 tpa zinc cathode
>99 % zinc recovery
Commissioned 2010

Application: Recovery of zinc from a bulk concentrate as electrowon cathode with lead and silver in residue for smelting
Nordenham – Albion Process™ Plant

Commodity - Zinc
Location – Germany
Client – Glencore

Bulk lead/zinc concentrate
35,000 tpa zinc cathode
>99 % zinc recovery
Commissioned 2011

Application: Recovery of zinc from a bulk concentrate as electrowon cathode with lead and silver in residue for smelting
MRM – Albion Process™ Plant

Commodity - Zinc
Location – Australia
Client – Glencore

Bulk lead/zinc concentrate
150,000 tpa of cleaned zinc concentrate
Commissioned 2014

Application: Selective oxidation of galena in a bulk concentrate to chemically liberate lead from zinc
4. The Future for Refractory Gold Projects
# The Future for Refractory Gold Projects

## Demonstrated Alternative

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<thead>
<tr>
<th>Feature</th>
<th>Albion Process™</th>
<th>POx</th>
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<tbody>
<tr>
<td>Demonstrated high recoveries</td>
<td>✔</td>
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<tr>
<td>Demonstrated in current operations</td>
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<tr>
<td>Guaranteed by technology provider</td>
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<tr>
<td>Lower capital costs</td>
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<td>Simple equipment + low skills requirement</td>
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<tr>
<td>Short commissioning and ramp up period</td>
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<tr>
<td>Can treat high carbonate material</td>
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<td>Tolerates variable feed rate and quality</td>
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<td>High availability and low maintenance</td>
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Albion Process – Project Development

Study phase well defined and understood

- Scale up now well understood, less sample and testwork required to define process.
  - Phase 1 – Amenability testwork and Class 5 Engineering Study (+/- 40%)
  - Phase 2 – Further batch testwork and Class 4 Engineering Study
  - Phase 3 – Feasibility study
- Piloting can be conducted if client requires, but not required for process guarantees.
- Study management can be provided by Core Resources (GT’s laboratory and marketing partner).
- Basic engineering conducted by Glencore Technology.

Flexible project delivery model

- Can work direct to client or through engineering companies
Albion Process – Technology Access

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www.albionprocess.com

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Thank You.