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

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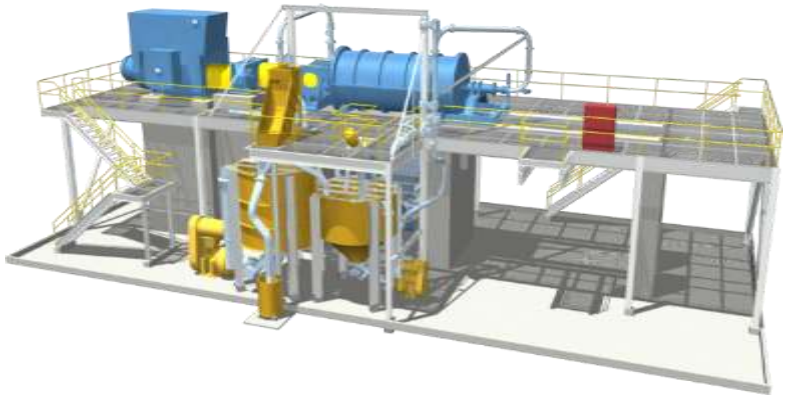
Outline

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

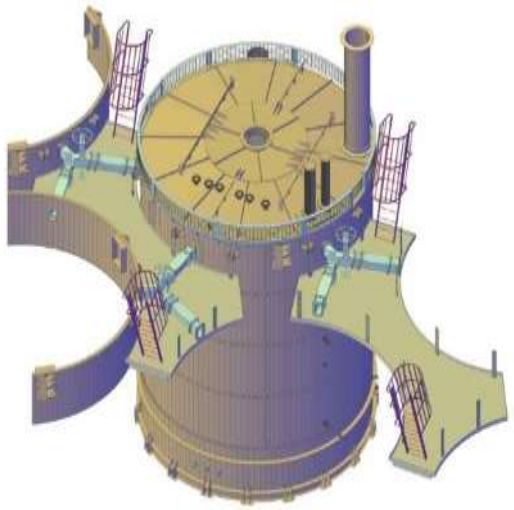
1. Albion Process™ Technology

Albion Process™

The Albion Process is a combination of mechanical and chemical liberation

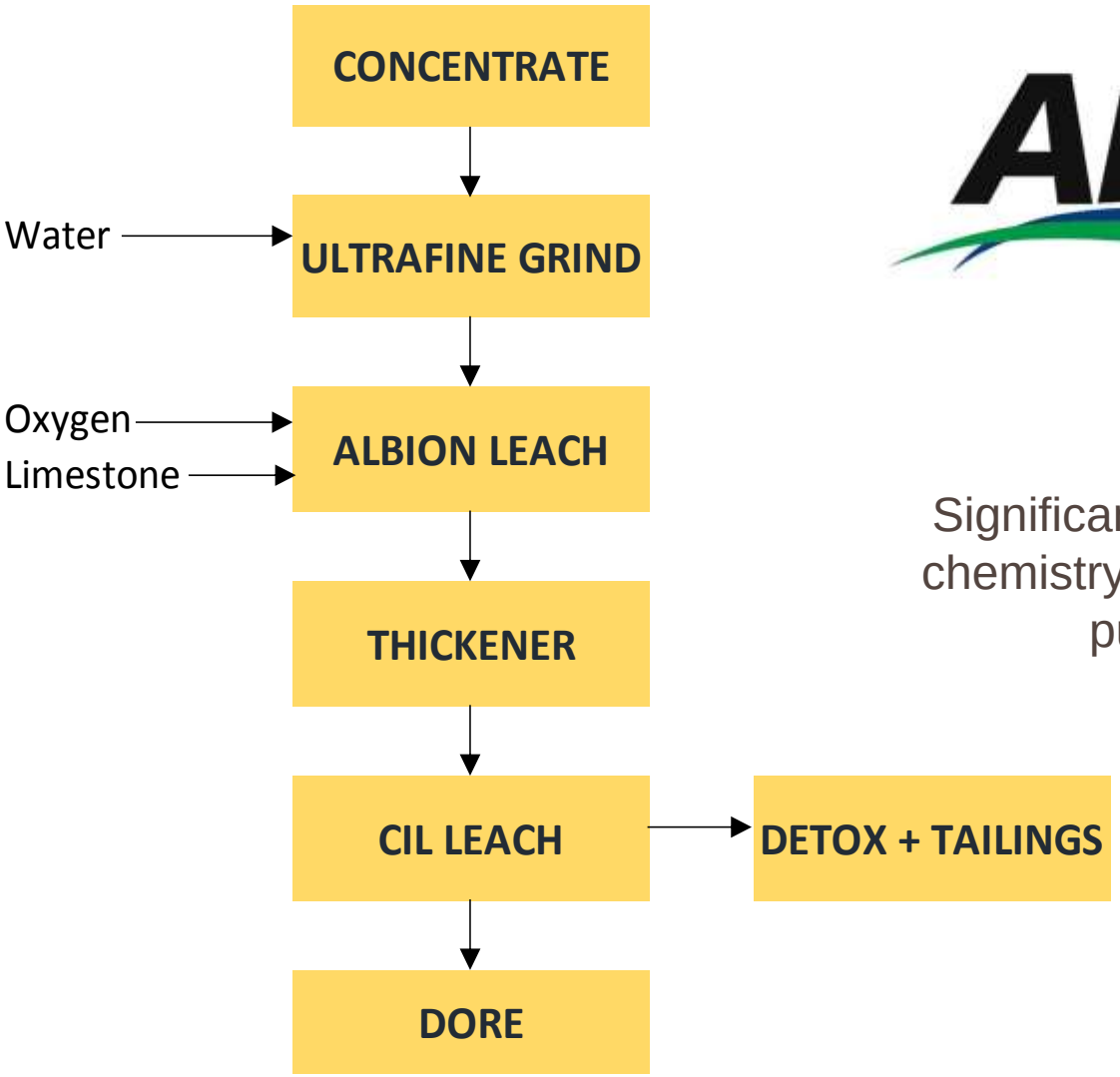


- **Ultrafine grinding:**
  - *IsaMill™ stirred mill:*
  - *FeS_2 = 80 % passing 10 microns*
  - *$CuFeS_2$ = 80 % passing 12 – 18 microns*
  - *$Ni_9Fe_9S_{32}$= 80 % passing 10 – 14 microns*
  - *ZnS = 80 % passing 16 – 20 microns*



- **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



ALBION PROCESS™

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

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

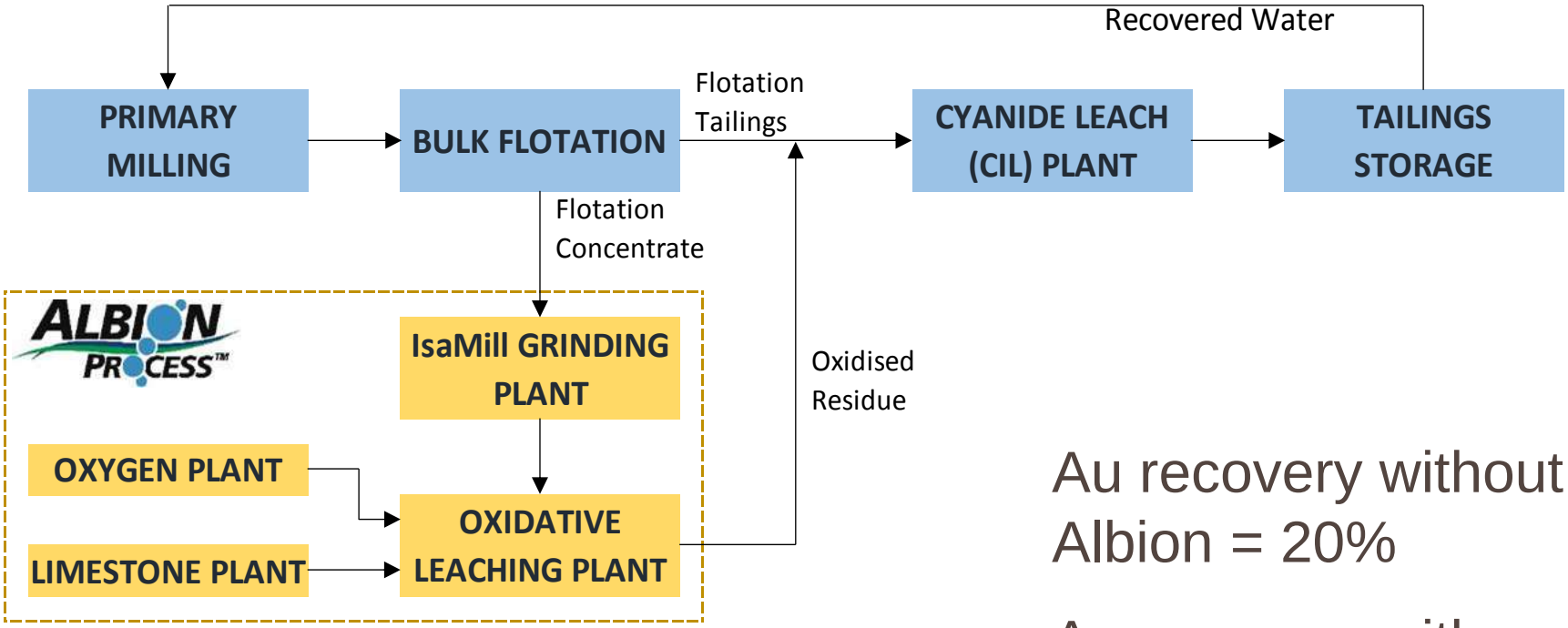
GPM Gold – The success of a technology

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

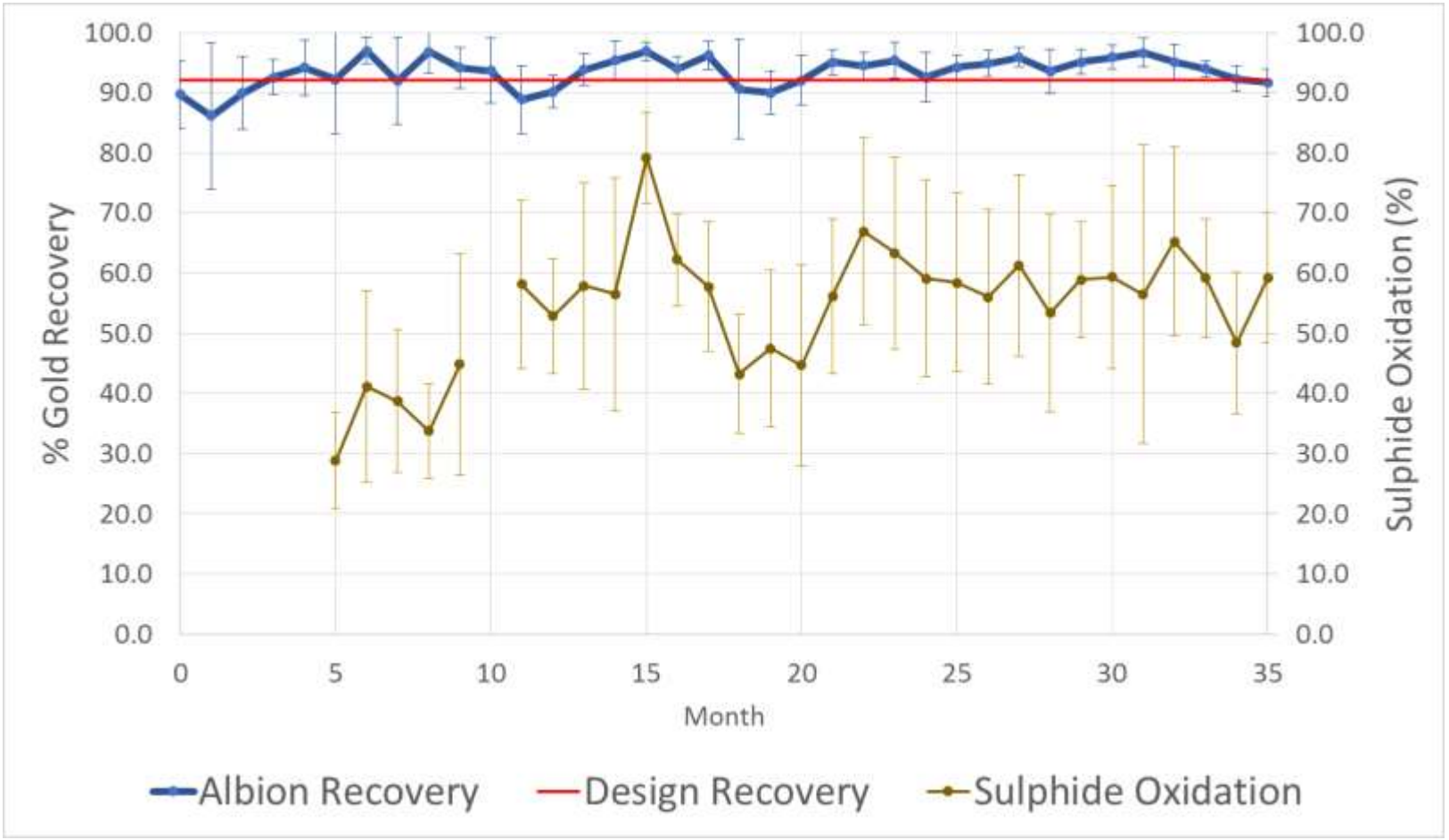
Process Plant Overview



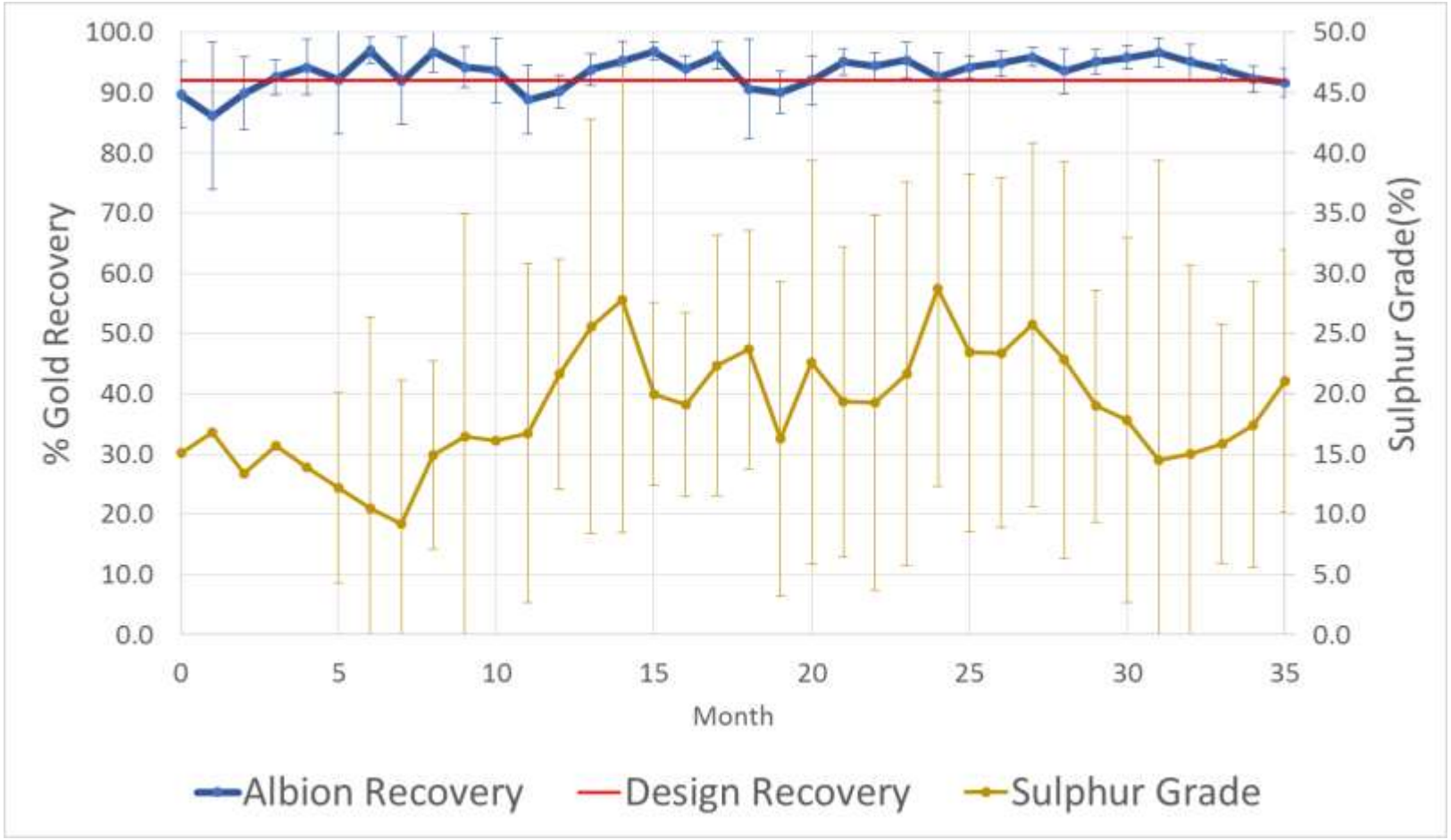
Au recovery without Albion = 20%

Au recovery with Albion = 95-98%

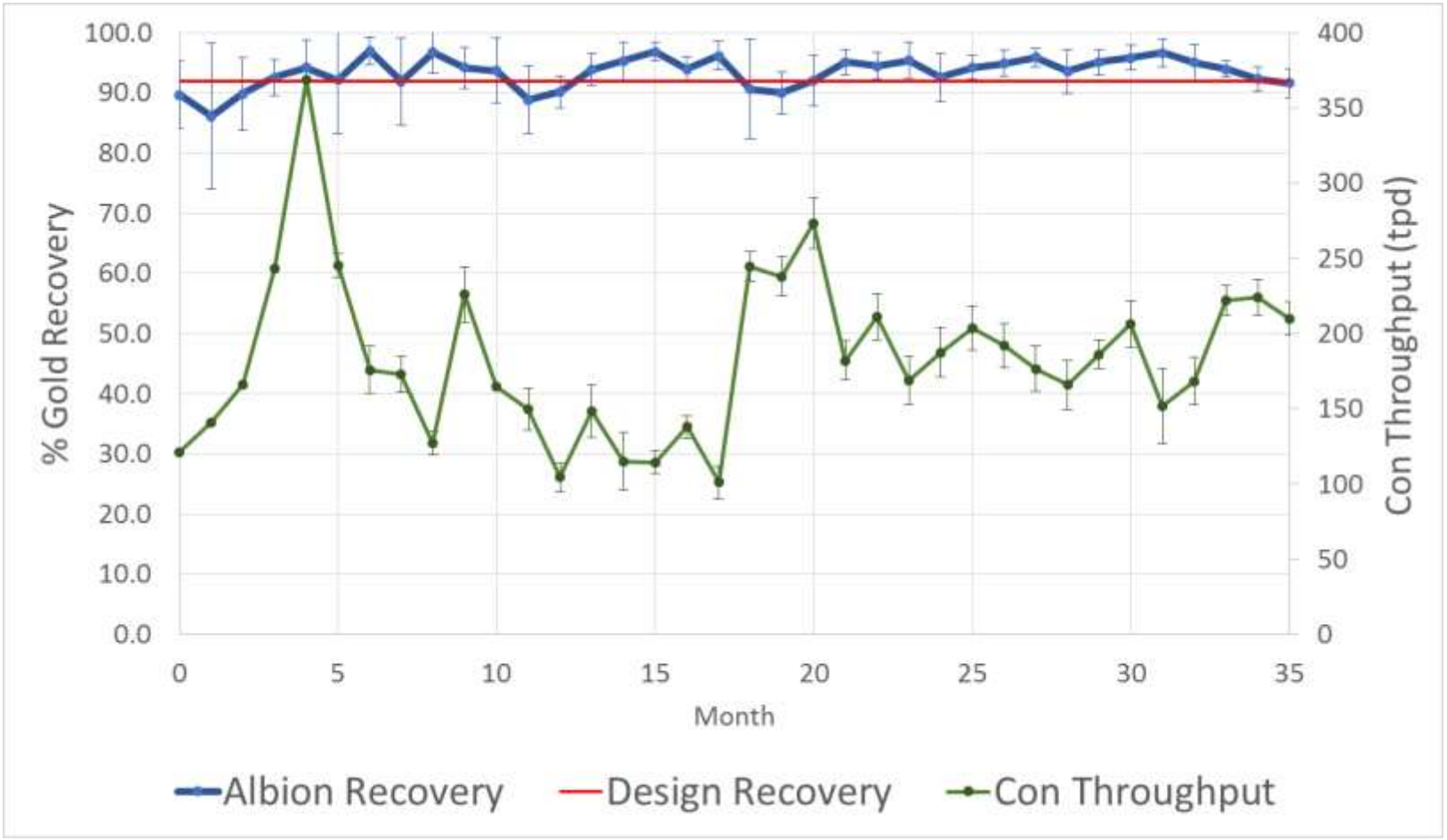
3 years of stable gold recoveries



Variable Sulphur Grades (<10% to >30%)

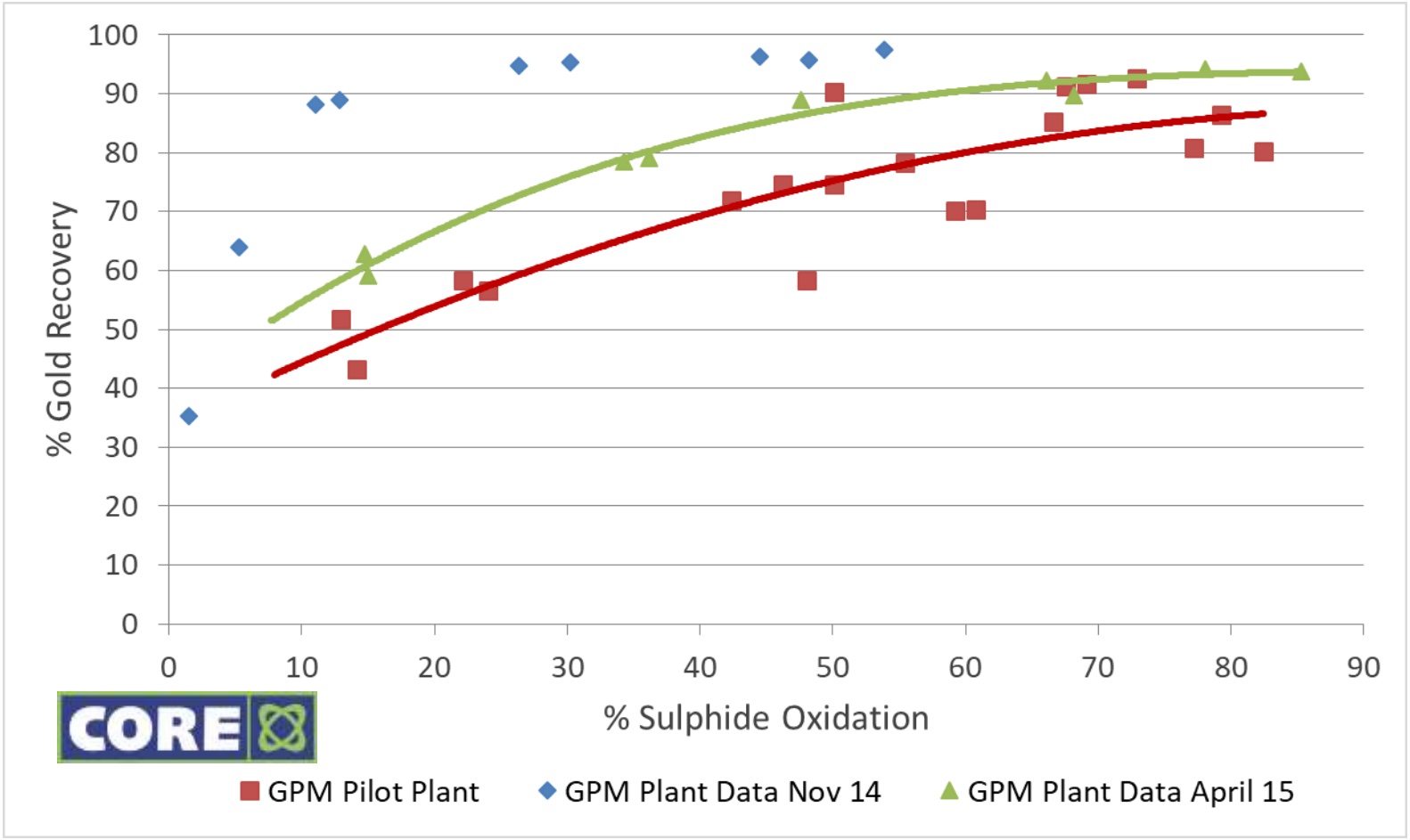


Variable Throughput (100 – 350 tpd)



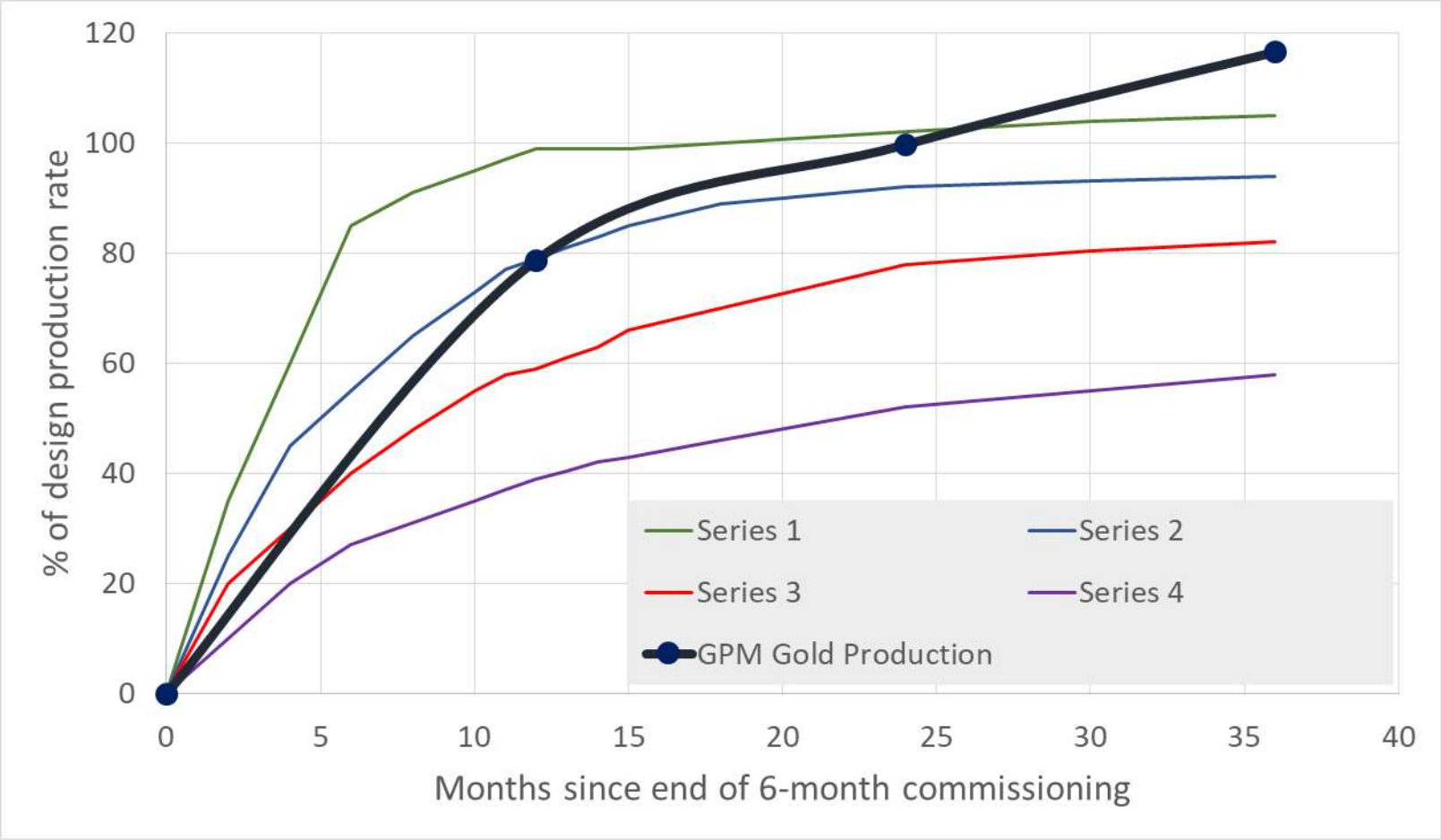
GPM Albion Process™ Plant Performance

Better than Pilot Plant



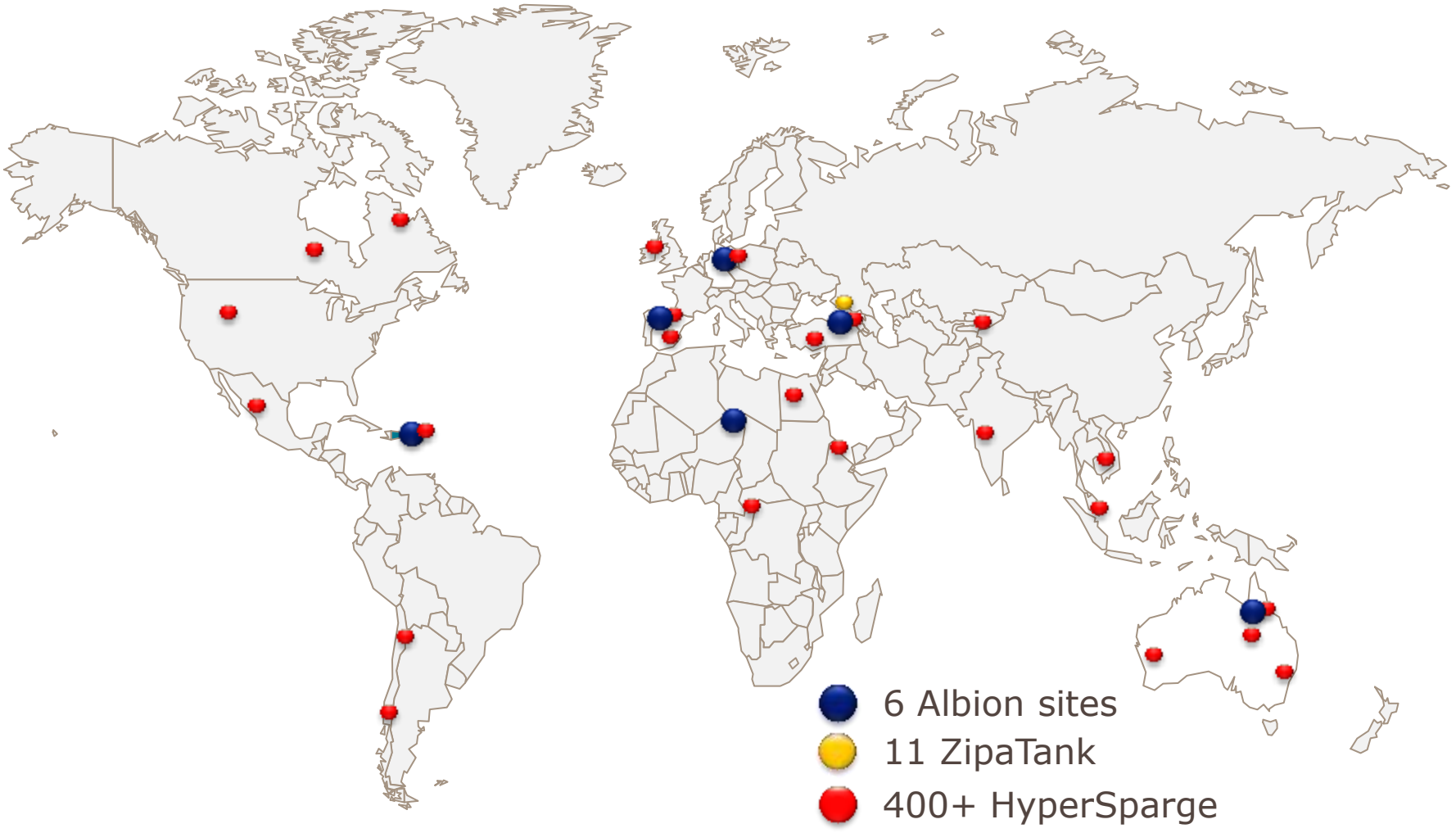
GPM Ramp Up – Relative McNulty Curve

Series 1-2 Performance



3. Albion Process™ - Global Installations

Albion Process™ Installations



GPM Gold Project – Albion Process™ Plant

Oxidative Leach Circuit

M5000 IsaMill™

Limestone Grinding 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

M5000 IsaMill™ being installed

HyperSpargers™ oxygen addition

First gold pour from Albion

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

Oxidative Leach Circuit

First Copper Cathode Production

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

Oxidative Leach Circuit

Sparging systems

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

Oxidative Leach Circuit

Sparging system

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

Oxidative Leach circuit

Off Gas Scrubber

HyperSparge system

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

Demonstrated Alternative

	Albion Process™	POx
Demonstrated high recoveries	✔	✔
Demonstrated in current operations	✔	✔
Guaranteed by technology provider	✔	✔/✕
Lower capital costs	✔	✕
Simple equipment + low skills requirement	✔	✕
Short commissioning and ramp up period	✔	✕
Can treat high carbonate material	✔	✕
Tolerates variable feed rate and quality	✔	✕
High availability and low maintenance	✔	✕

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

CORE

GLENCORE TECHNOLOGY

Albion Process – Technology Access

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GLENCORE TECHNOLOGY

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Thank You.