

# Metals Circularity

REE and other metals from Industrial Waste & End of Life

Kiril Mugerman – June 2025

# Forward looking statement

Our presentation contains “forward-looking statements” not based on historical facts. Forward-looking statements express, as of the date of this presentation, our estimates, forecasts, projections, expectations and opinions as to future events or results. The forward looking statements that are contained in this presentation are based on various assumptions and estimates by the Corporation and involve a number of risks and uncertainties. As a consequence, actual results may differ materially from results forecast or suggested in these forward-looking statements and readers should not place undue reliance on forward-looking statements. We caution you that such forward-looking statements involve known and unknown risks and uncertainties, as discussed in the Corporation's filings with Canadian Securities Administrators. Various factors may prevent or delay our plans, including but not limited to, contractor availability and performance, weather, access, mineral prices, success and failure of the exploration and development carried out at various stages of the program, and including as regards the commercialization of any of the technology, general business, economic, competitive, political and social conditions. The Corporation expressly disclaims any obligation to update any forward-looking statements, except as required by applicable securities laws.

Developing **clean technologies** to extract **critical & strategic metals**

Sourcing from primary ores, mine tailings and industrial waste

Founded in **2008**

> **\$23M** investments in R&D since 2015

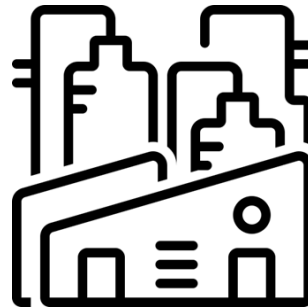
**Growing IP Portfolio**

**Technology licensing model - Royalties**

## Strong Technical Team



## Demo Plant Under Construction



## Analytical & Piloting Facilities



## Key drivers:

- Global need to develop more sustainable production of metals
- Provide secure and diversified supply chain
- Distribute the environmental impact of the project over a wider range of products

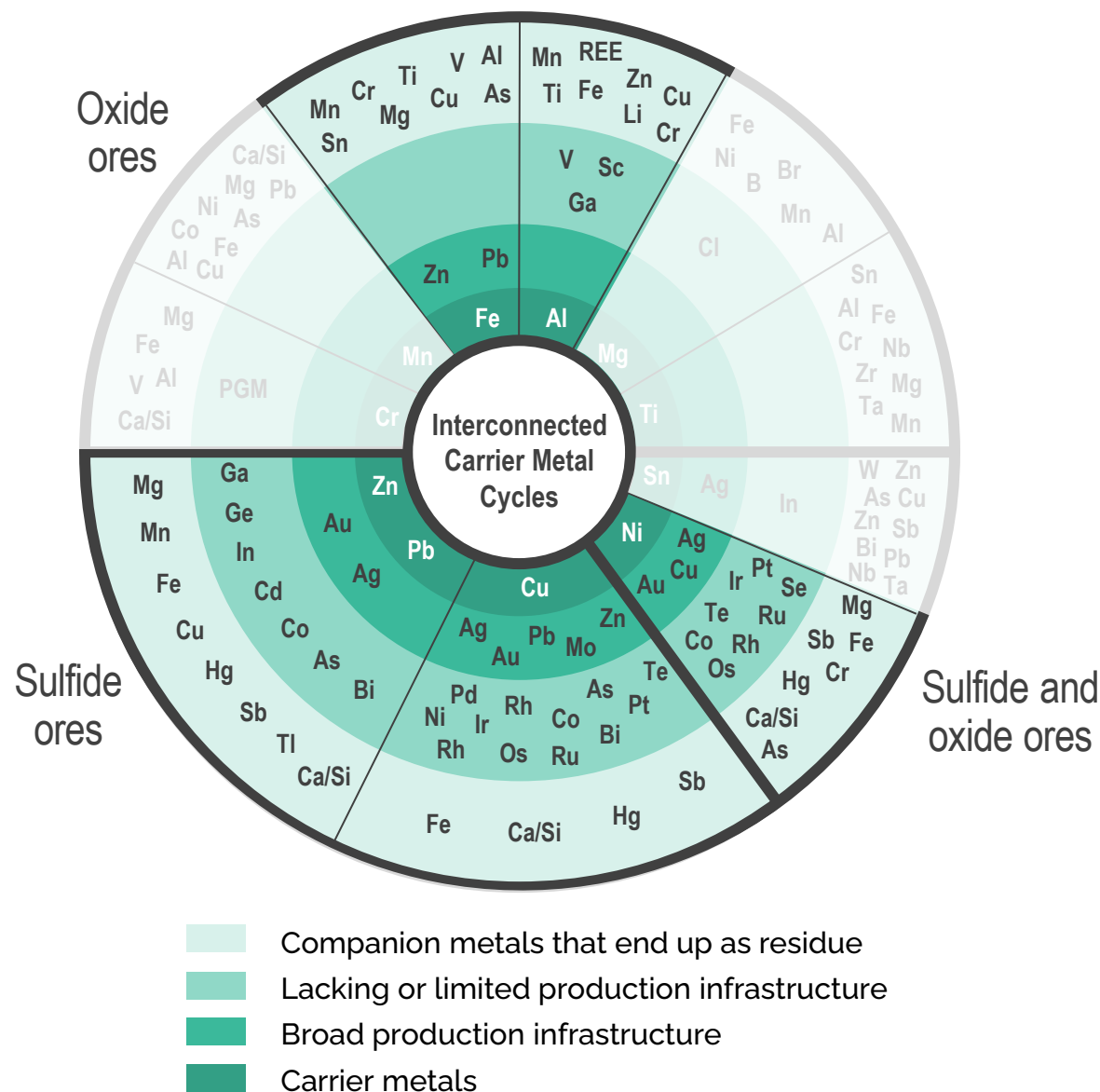
## Strategy:

- Target bulk minerals and metals with strong established markets to decrease tailings volume
- Leads to grade enrichment for the critical metals present
- Recyclability of reagents allows for a near zero waste operations



# Metal extraction associations

- Critical metals are present in association with other minerals in various deposits
- Grades not high enough to have justified extraction in the original mine design
- Innovative & disruptive methods could allow extraction in certain cases
- Secondary sources such as mine tailings become an important source



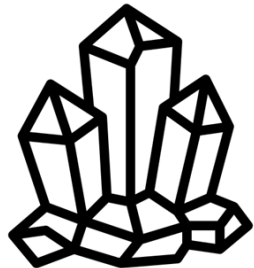
# Business Model with a Global Opportunity

**Growing demand for  
Critical Metals**

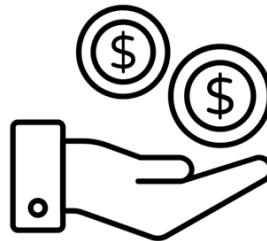
**Mining Waste – A  
sustainability issue &  
a major resource**

**Geomega's Technology  
for Waste Valorization**

**Sustainable  
Supply of CSM**



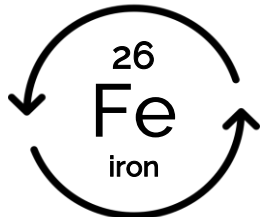
**Royalties to  
Geomega**



**Revenues to Mining  
Companies**



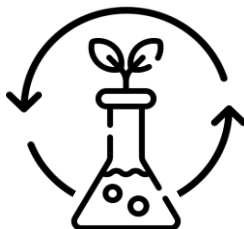
# Geomega's approach & its Core Technologies



Recovery & Valorization of bulk metals (Fe, Ca, ...)



Critical Metals Extraction & Refining (REE, Nb, Ti, Sc, ...)



Reagent Recycling



Process Heat Recovery

**Processing  
secondary feeds**



## **End-of-life**

**NdFeB magnet scraps (TRL – 7 to 8)**



## **Industrial**

**Bauxite residues (TRL - 5 to 6)**



## **Mining**

**Sulphide tailings (TRL – 3 to 4)**



- Demonstration plant construction ongoing
- Patent pending (provisional PCT application)
- Targeting to license to Western magnet manufacturers
- A growing strategic market

**Capacity:**

1.5 tonnes of magnet/day

**Location:**

Saint-Hubert, QC, Canada

## Financing from several organisms:

**\$3M**

**TECHNO**  
CLIMAT



**Québec**



**\$3M**



Natural Resources  
Canada

Ressources naturelles  
Canada

**Canada**

**\$2M**

**NGen**

- Long lead items procurement complete
- Majority of equipment received
- Remaining items arriving Q3/2025
- Electrical installation ongoing
- Piping design, build and installation – Q3/Q4
- Permitting ongoing
- Pre-commissioning Q4
- Commissioning to start once permits issued



**Site visit on Friday June 20th**

## Competitive edge

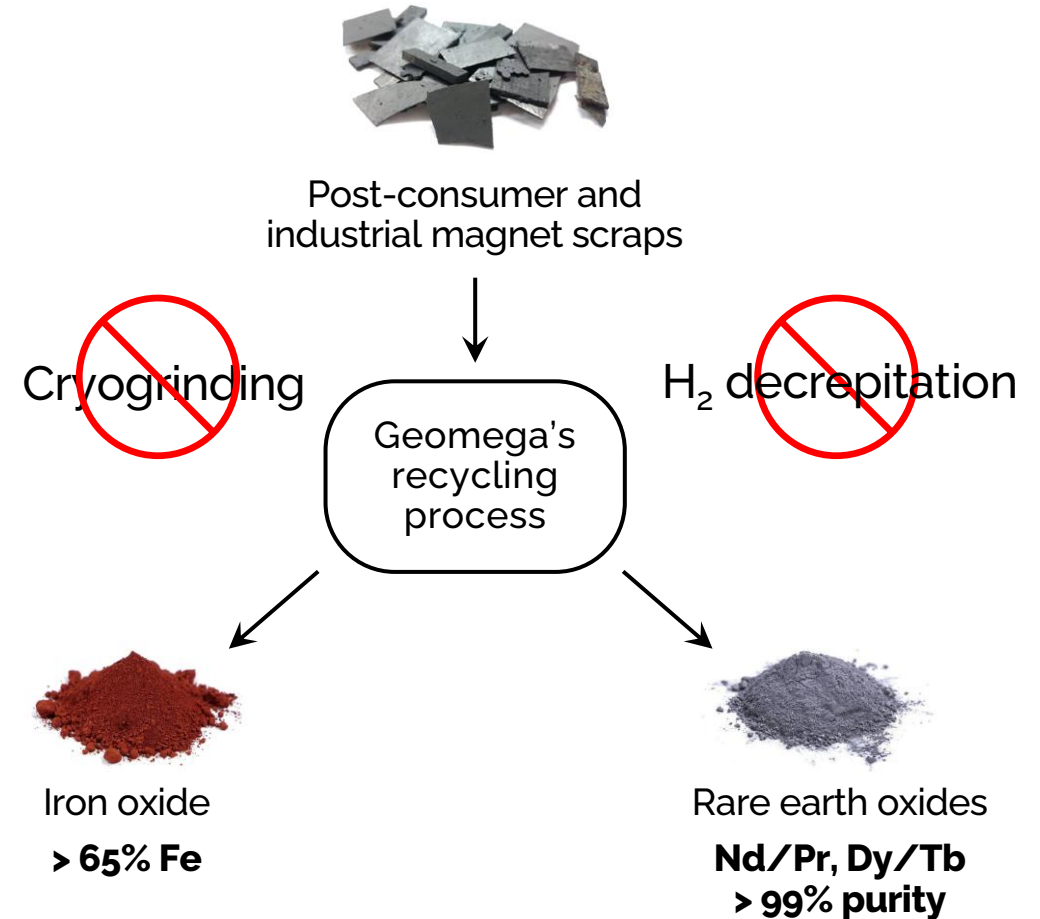
### versus other magnet recycling approaches:

Process chemistry and design:

- Readily available, non-aggressive main reagent
- Closed-loop reagent recycling
- Feed agnostic (coated scrap, swarf, etc.)
- Targeting low OPEX to give more purchasing power
- Use of standard equipment
- Over 90% REE recovery

## Challenges

- Limited (but growing) EOL supply
- Growing competition for supply
- Growing supply of swarf outside of China
- An important but a limited supply of REE



**Processing  
secondary feeds**



**End-of-life**

NdFeB magnet scraps (TRL – 7 to 8)



**Industrial**

Bauxite residues (TRL - 5 to 6)

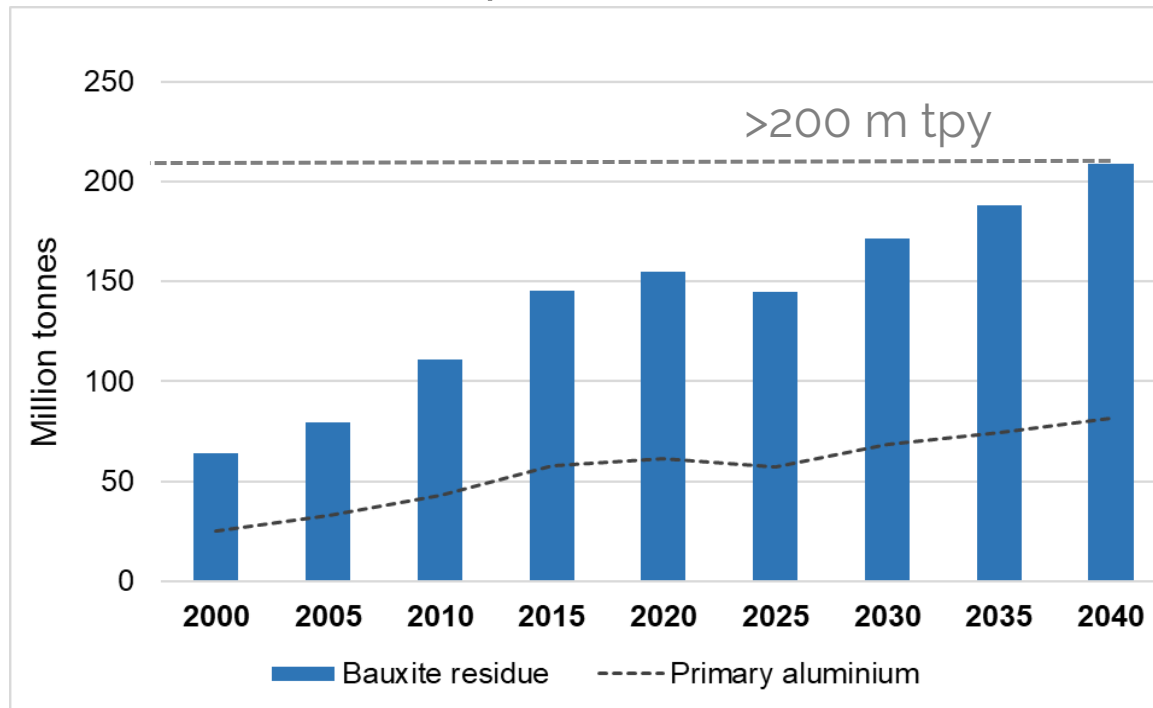


**Mining**

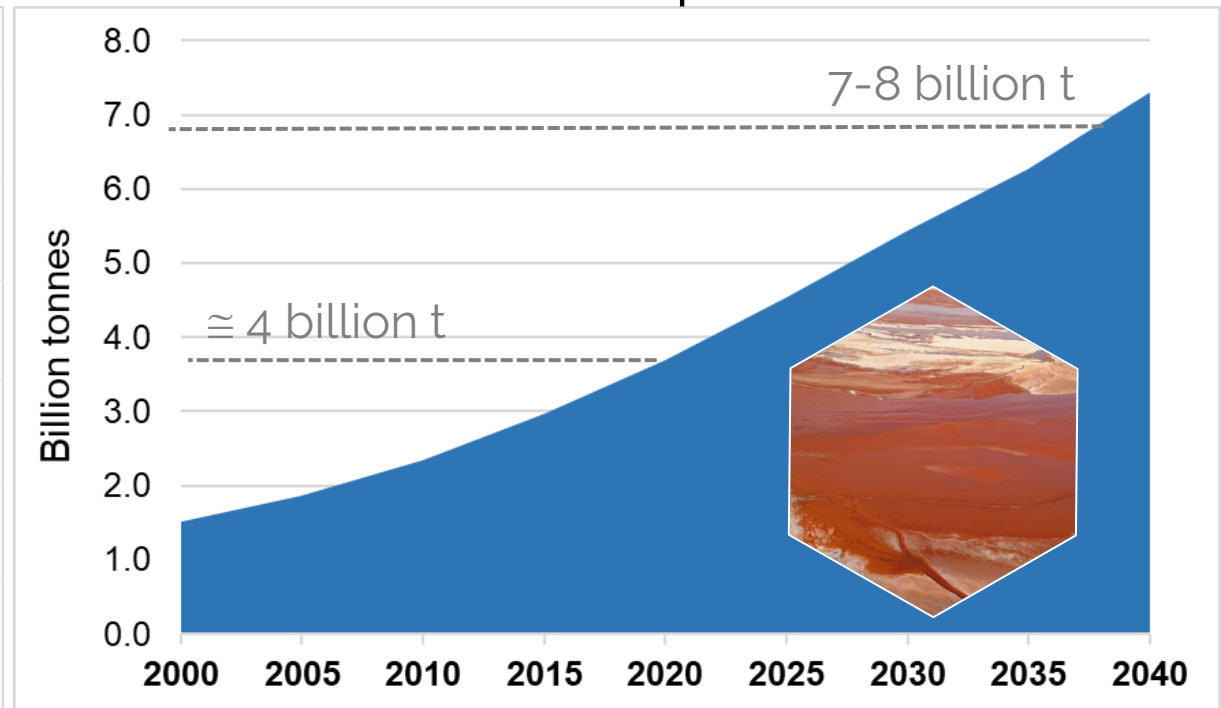
Sulphide tailings (TRL – 3 to 4)

**Every new tonne of aluminum metal results in about **4 to 5 tonnes** of bauxite residue<sup>1</sup>.**

BR production<sup>2</sup>



Global stockpile size<sup>2</sup>



- <sup>1</sup> International Aluminium Institute, 2022. Sustainable bauxite residue management guidance.
- <sup>2</sup> 2.55 t<sub>BR</sub>/t<sub>Al</sub> and 3% usage rate



## The Problem

## The Solution

≈4 Bt stockpiled

>175Mt produced /yr

Caustic residue

Large disposal area

Significant NaOH loss

Loss of value  
(Up to 400\* USD/t)

**Mitigating BR  
Challenges**

**Sustainable  
and Profitable  
Valorization**

• Iron Product (+65% Fe elem.)

• Na & Ca Product

• Mixed Al and Si product,  
MAS (low Na)

• CM\* concentrates (REE/Sc,  
Ga, Ti/V)

• Aluminium product (optional)

**Volume Reduction**

\*CM = Critical metals



\* Between 100 to 400 USD/t value depending on the bauxite ore used



## Advantages

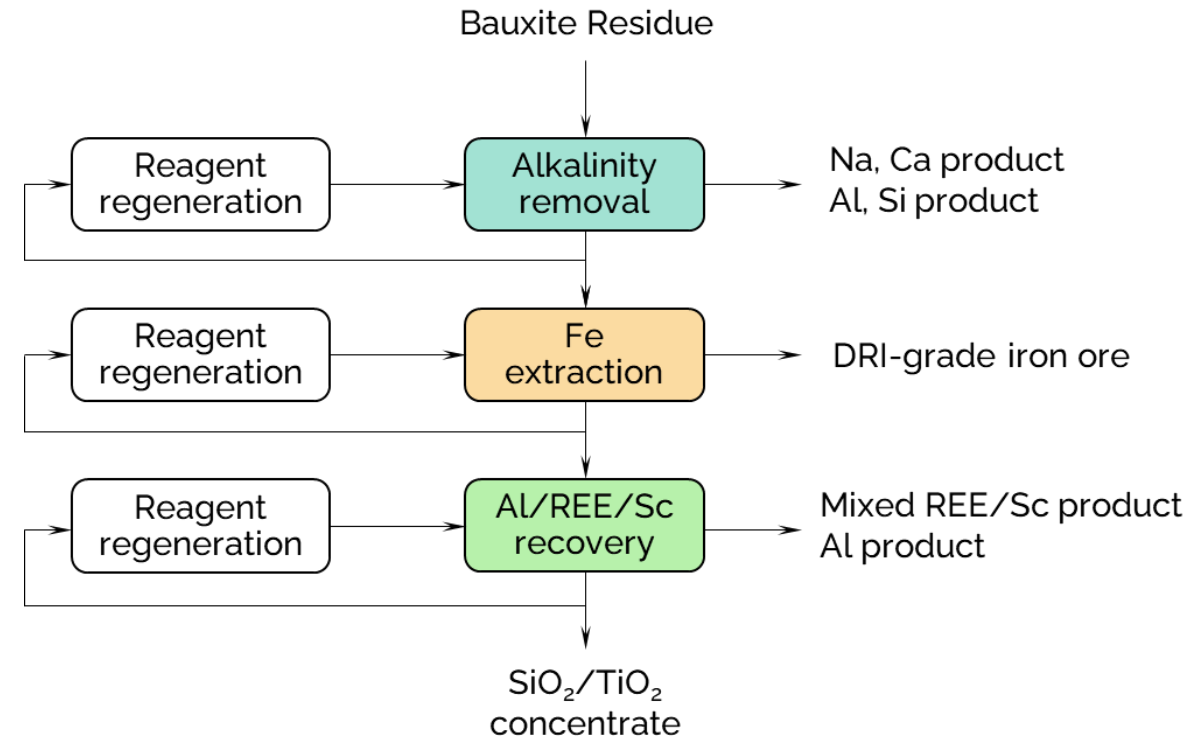
- Significant volume reduction (>80%)
- Maximize revenue
- Distribute environmental impacts and costs
- Mitigate market price fluctuations (Sc/REE)

## Challenges

- Reach 1<sup>st</sup> marketable products
- Minimize processing steps
- Lower OPEX and CAPEX

## Benefits\*

- Each 1Mt plant can generate around 600 tonnes MREO+Sc
- Payback to client – up to 4 years
- Target market penetration – 10 to 20% of global annual production
- Potential sustainable large volume solution for REE supply
- To be brought online by well funded aluminum majors
- Economics driven by other metals and not volatile REE pricing



<sup>1</sup> Based on internal techno-economic assessments and royalty estimates, supported by bench and piloting studies performed on BR of 6 clients from around the world

# BR - Project development

- Advancing the technology to licensing readiness
- Full ownership of the Intellectual Property by Geomega

- One of the most versatile solutions on the market
- Technology being vetted by several major global alumina producers

## Timeline

### 2020

Initial bench-scale testwork

### 2021

R&D development co-financed by



### 2022

\$4M piloting and \$1M iron valorization projects launched, co-financed by

**RioTinto**



SUSTAINABLE DEVELOPMENT  
TECHNOLOGY CANADA

TECHNOLOGIES DU DÉVELOPPEMENT  
DURABLE CANADA

**Québec** 

### 2023

### 2024+

Pilot testwork for various clients



## **Processing secondary feeds**



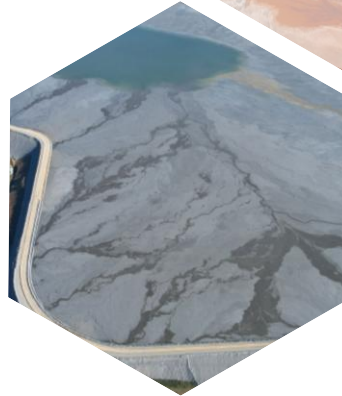
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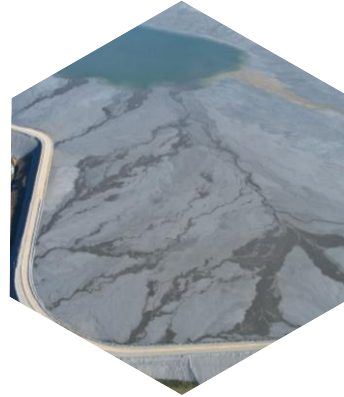


### **Mining**

Sulphide tailings (TRL – 3 to 4)

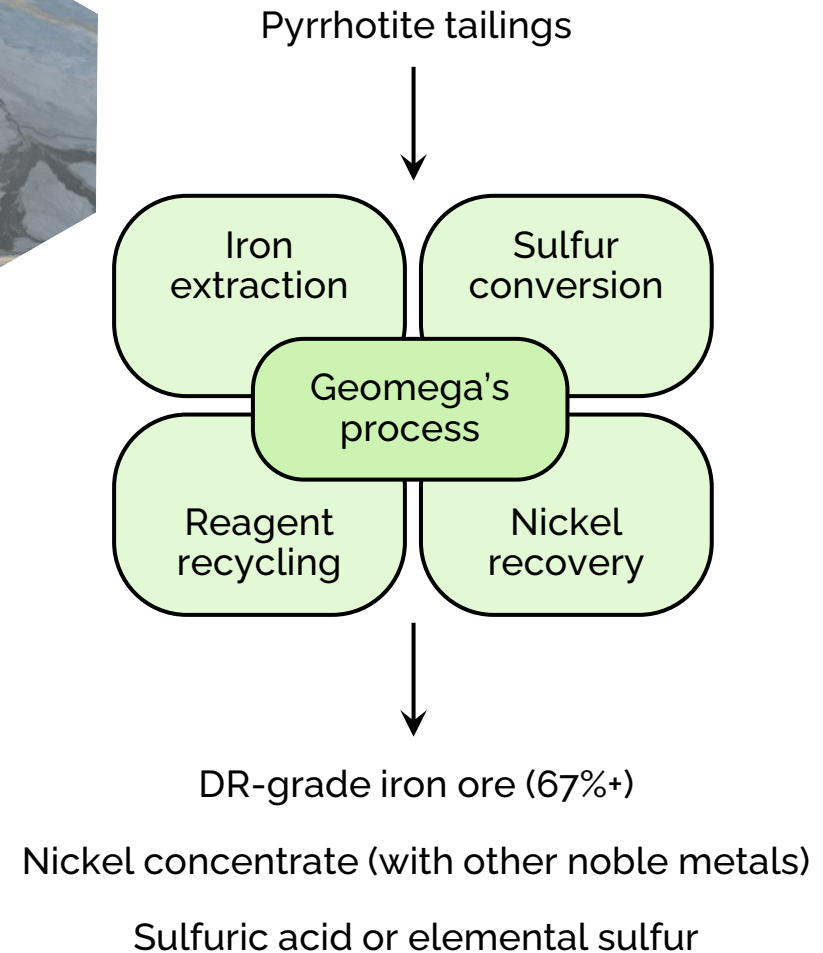
# Pyrrhotite tailings – process overview

- ❖ Over 100Mt of material stockpiled worldwide
- ❖ Limited technoeconomic potential reached by prior processing techniques



## Process chemistry and design:

- Main reagents recycling
- Iron extraction: High product purity and recovery rates
- Sulfur management: flexible commercial strategies as  $\text{H}_2\text{SO}_4$  or S elemental
- Process is economical without need for sulfur sales
- Recovery of Ni, Co concentrates
- Recovery of precious metals and PGM concentrates



# Pyrrhotite tailings - development status

- Technical maturity of different process steps between bench and piloting scales
- Process IP 100% owned by Geomega
- Applicable to sulphide tailings from other base metals mines



**One of the winners on the  
Pyrrhotite Resource Recovery Innovation Challenge  
by Vale Base Metals**



24.09.24 • Base Metals, ESG

## Vale Base Metals announces laureates of circular mining innovation challenge

Vale Base Metals is pleased to announce the laureates of the Pyrrhotite Resource Recovery Innovation Challenge, a competition aimed at enhancing the recovery of valuable metals and minerals contained in pyrrhotite.

The challenge invited researchers, innovators, and entrepreneurs to propose novel technological solutions for processing low-grade pyrrhotite tailings, a residue remaining from the mineral processing of sulphide ore. After a thorough evaluation process, three outstanding solutions have been selected as laureates, who will each be awarded a prize of C\$25,000.

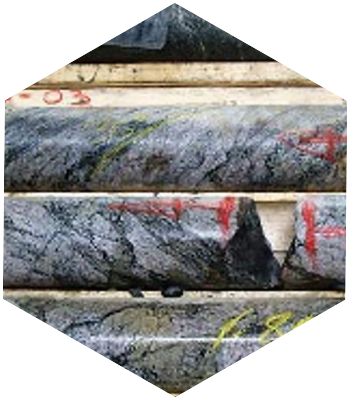
"We are thrilled to recognize these innovative solutions that not only unlock value from waste but also contribute to sustainable mining practices," said Adam MacMillan, Director of Research and Innovation for Vale Base Metals. "The ingenuity and dedication demonstrated by the laureates are truly inspiring, and we look forward to seeing the impact of their work on the future of mining."



# Can it be applied to REE deposits?

## Montviel

### REE + Nb Ferrocarbonatite



- Eliminates fine grinding and flotation
- Valorization of about 40% of overall ore into several offtake streams
- Main reagents recycling
- REO and Sc recovery (95%)
- Nb recovery (85%)
- Iron recovery (75%) as DRI product
- Iron Phosphate product for LFP batteries
- Mn/Mg salts recovery for agricultural and battery markets

## Advantages

- Improves economical benefits of the project
- Lowers the environmental footprint
- Keeps project economic even during low rare earth pricing periods

## Questions?



***Innerd***

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