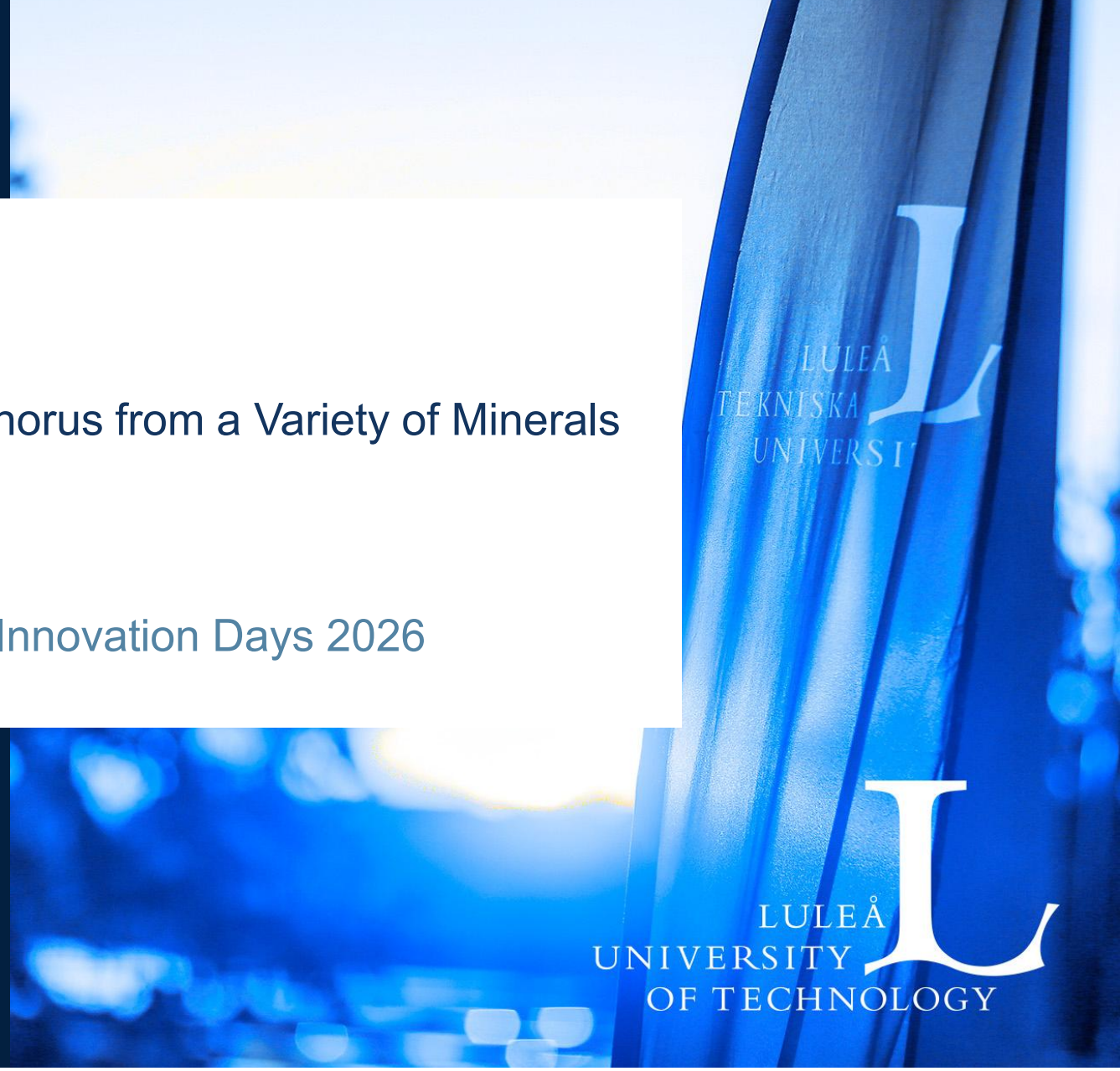
OPTIREEP

Recovery of REE and Phosphorus from a Variety of Minerals

Adam Isaksson

Swedish Mining Research & Innovation Days 2026



CAMMCRM
CENTRE OF ADVANCED MINING AND METALLURGY CRITICAL RAW MATERIALS

VINNOVA
Sweden's Innovation Agency

Swedish Metals & Minerals
impact innovation

LKAB

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OPTIREEP facts

FUNDED BY
Impact Innovation – Swedish Metals and Minerals
(initiated by the Swedish Energy Agency, Formas & Vinnova)

PERIOD
2025-2028

TOTAL BUDGET
8.25 MSEK

VINNOVA FUNDING
4.2 MSEK

PARTNERS
Industrial in-kind
LKAB foundation (PhD student)

PART OF
CAMM-CRM – Centre of Advanced Mining and Metallurgy
Critical Raw Materials at Luleå University of Tehcnology

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Project partners and contribution

Luleå University of Technology
Coordinator / Project leader

Process Metallurgy
Hydrometallurgical studies. PhD student focusing on the speciation of e.g. F, Si, P.

Ore Geology
Characterization of feed material.

Chemistry of Interfaces
Chemical speciation via NMR.

Luossavaara-Kiirunavaara AB (LKAB)

Industrial partner, produces ferrous products for steelmaking.

Has tailings that are beneficiated to an apatite concentrate, the feed material for REE and phosphorus extraction.

LKAB Minerals

Industrial partner with a process to produce phosphoric acid and REE from apatite concentrate.

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REE and phosphorus
– why do they matter?

CRITICAL APPLICATIONS

REE are essential for magnets used in wind turbines, robotics etc.

EUROPEAN SUPPLY RISK

The EU heavily relies on imports.

STRATEGIC IMPORTANCE

REE and phosphorus are critical raw materials under the European Critical Raw Materials Act.

PHOSPHORUS

A crucial nutrient for agriculture.

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REEMAP

Transforming mine tailings into critical raw materials and valuable products

1 THE PROCESS

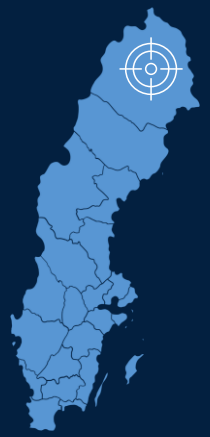
Feedstock: apatite concentrate from mine tailings generated during magnetite beneficiation.

Converts apatite into phosphoric acid and an REE product.

By-product: gypsum of commercial value.

2 ORIGIN

Developed for apatite tailings from Malmberget.



3 POTENTIAL

Adaptable to multiple mines and varying apatite grades.

Handle feeds containing other phosphorus and REE-bearing minerals (e.g. monazite, allanite)

Enable extraction of critical raw materials from streams previously considered waste.

THE REEMAP PROCESS IN BRIEF

Mine tailings (magnetite beneficiation) → Apatite concentrate → REEMAP (hydrometallurgical process) → Phosphoric acid + REE product + Gypsum (by-product)

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Purpose and goals

PURPOSE

Reduce the import dependency on REE and phosphorus in Sweden and Europe.

Generate knowledge in processing of raw materials with varying quality and mineralogy.

RESEARCH FOCUS

Influence of raw materials and process conditions.

Improve recovery, separation and purity.

Develop innovative process steps.

Provide a basis for industrial implementation.

OUTPUTS

Results disseminated in five scientific publications.

Results also becoming part of a PhD thesis.

Mid-term seminar of PhD student.

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Project execution

EXPERIMENTAL STUDIES

FEEDSTOCK

Production and characterization of apatite concentrates.

Varied feeds used.

PRE-TREATMENT

Mineral-specific pre-treatment.

LEACHING

Optimized leaching with examination of element distribution.

SEPARATION & PURIFICATION

Innovative separation and purification of products.

REAGENT REGENERATION

Reagent regeneration.

ENVIRONMENTAL ANALYSIS

Environmental assessment.

MODELLING SUPPORT

Thermodynamic modelling supports the planning and evaluation of results.

PhD PROJECT

- Time period: 2026-2029
- Focus on elemental speciation in hydrometallurgical steps.
- Assessing interaction between mineral properties and chemical system.

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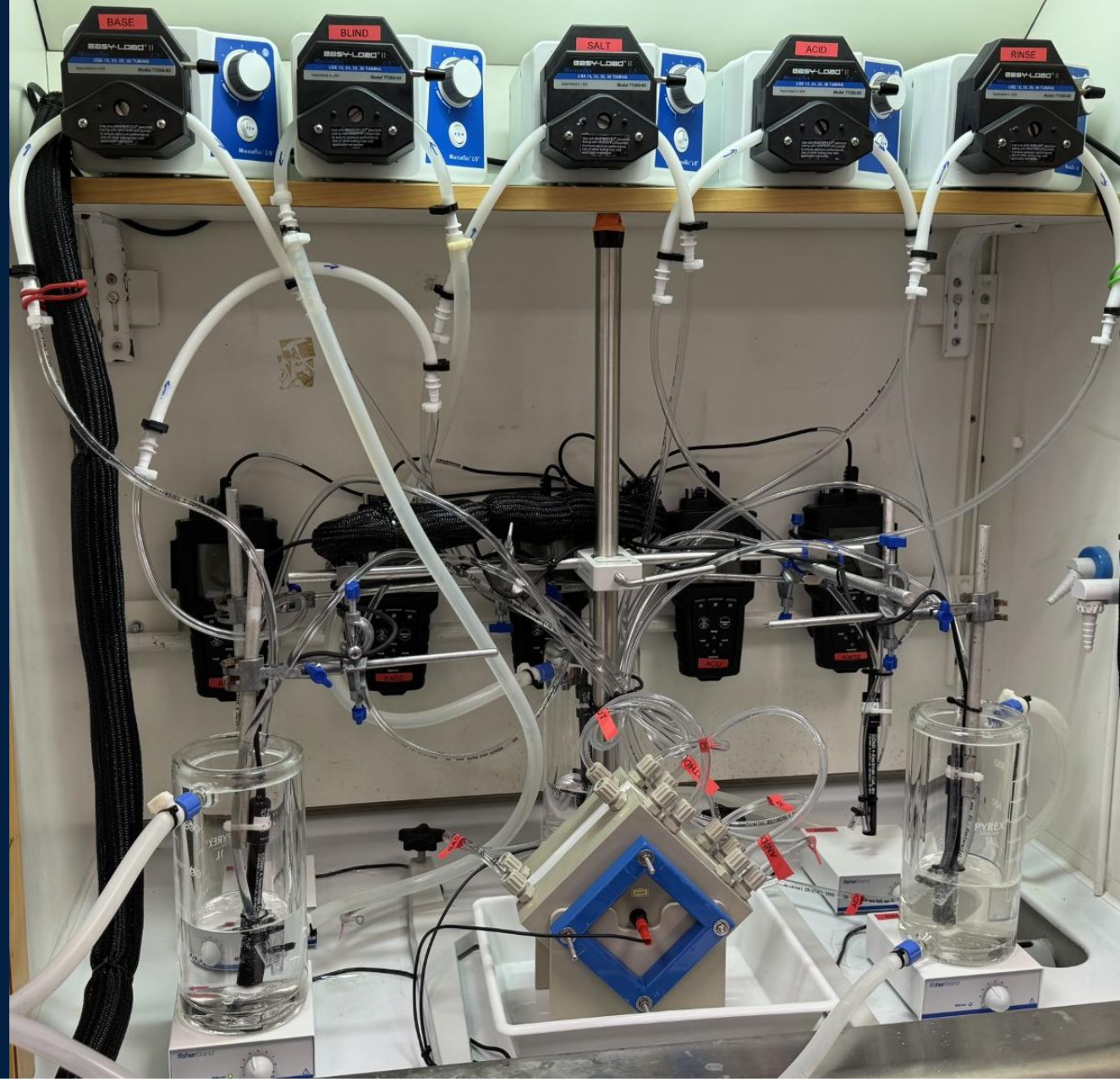
Experimental insight

SEPARATION & PURIFICATION

Refining of phosphoric acid using electrodialysis.

Electrodialysis separates ions using membranes positioned in an electric field.

Green technique using fossil-free electricity instead of fossil chemicals.



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