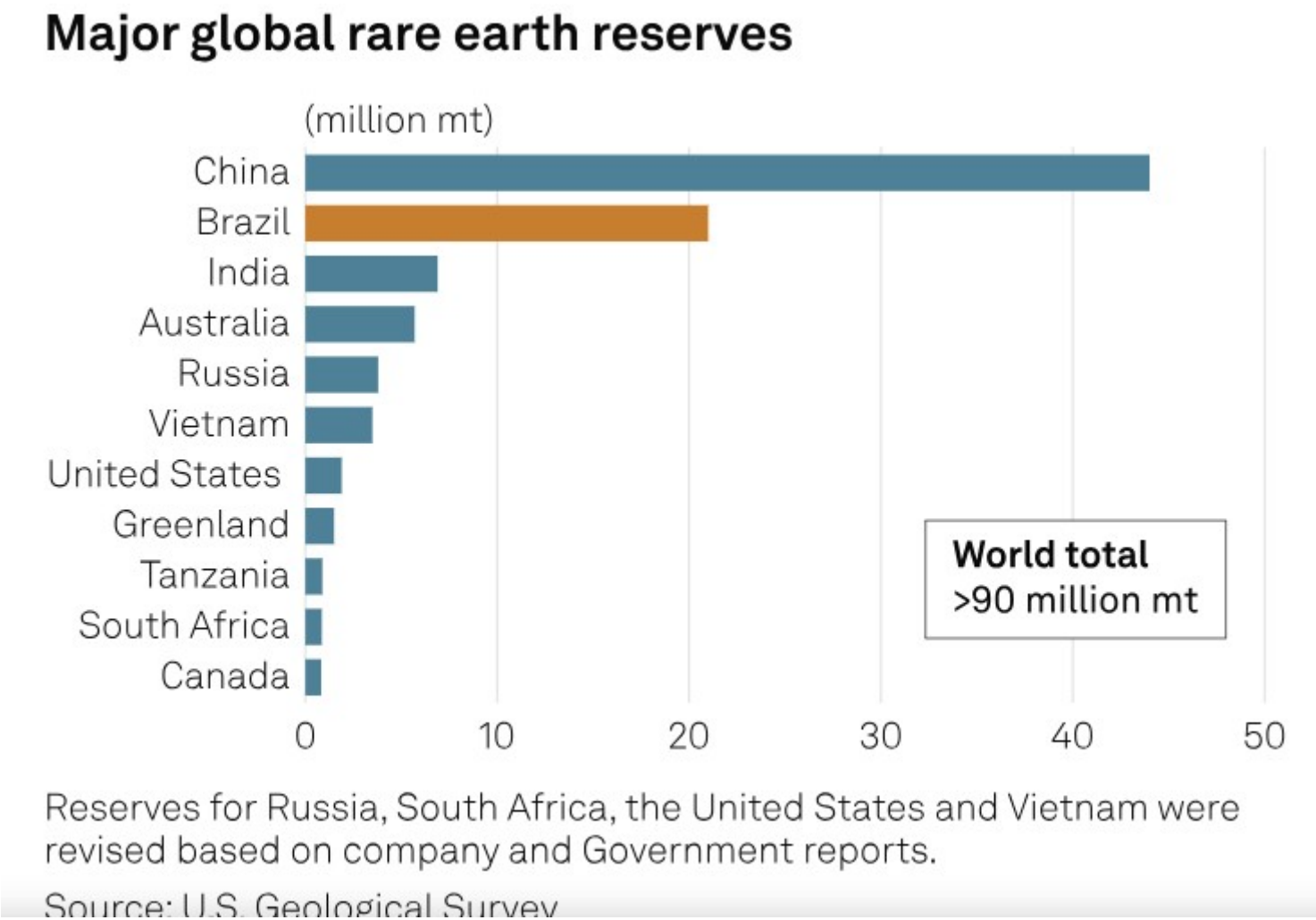
Challenges and Opportunities in the Rare Earth magnets supply chain in Brazil: 2026

Fernando JG Landgraf
Universidade de São Paulo, Brazil

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In 2025, according to the US Geological Service has the second largest reserves in the world.



To understand the miners language we need to define some acronymes:
MREC: Mixed Rare Earth carbonates : the RE concentrate that is sold by the mines
TREO: total Rare Earth oxides
MREO: the amount of “magnetic Rare Earth oxides” (Nd+Pr+Dy+Tb)

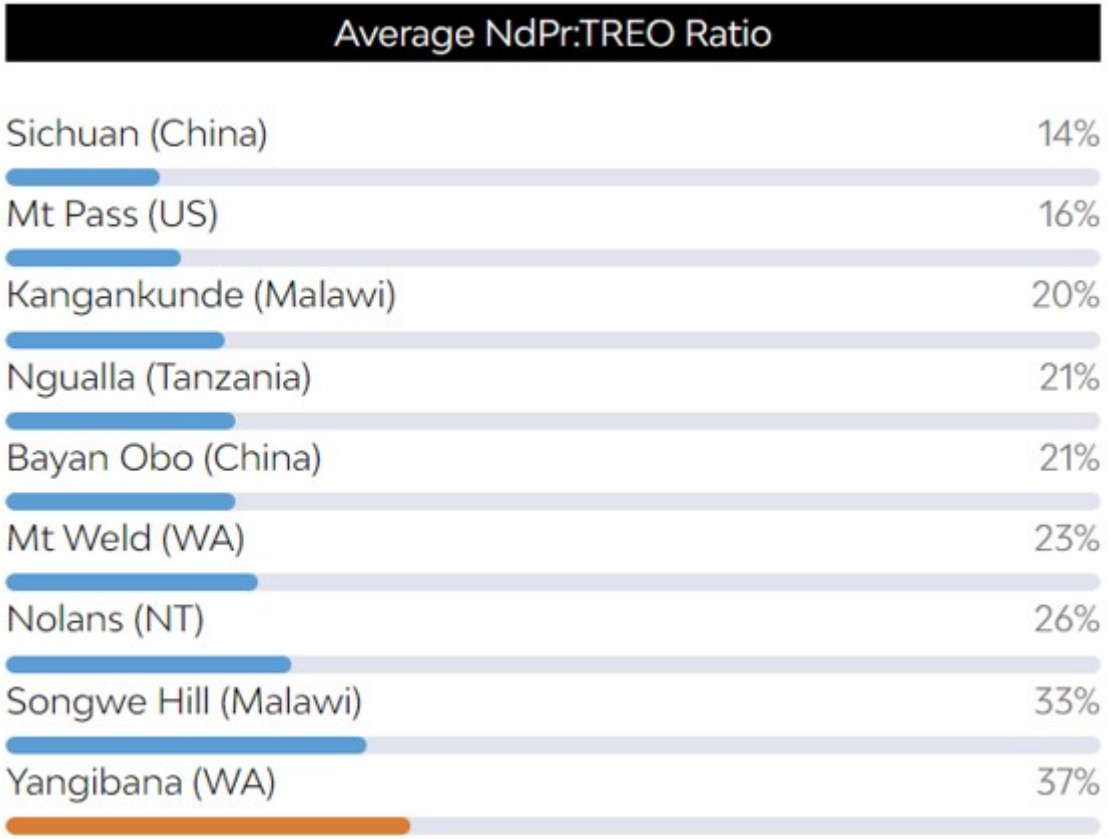
1 kg of NdFeB magnet has about 30%Nd = 0.3kg
0.3kg Nd comes from 0.35kg of Nd_2O_3
0.35kg of Nd_2O_3 comes from 0.49kg of $Nd_2(CO_3)_3$
Assuming $Nd_2(CO_3)_3$ as 24% of total MixedRECarbonate
Fot each kg of magnet we need 2 kg of MREC

Reserves are only the potential.

RE Carbonate production is what matters.

If RE magnets demand is 150.000tpy

This means that the demand for total TRE Carbonate is around 300.000tpy



Aclara
27%
Meteoric
29%
Viridis

MREC gross estimates

If Europe needs **20.000tpy of RE Magnets**,
the demand for mixed carbonate (**MREC**) from miners is **40.000tpy**

If USA needs 30.000tpy of RE Magnets, it corresponds to 60.000tpy of MREC

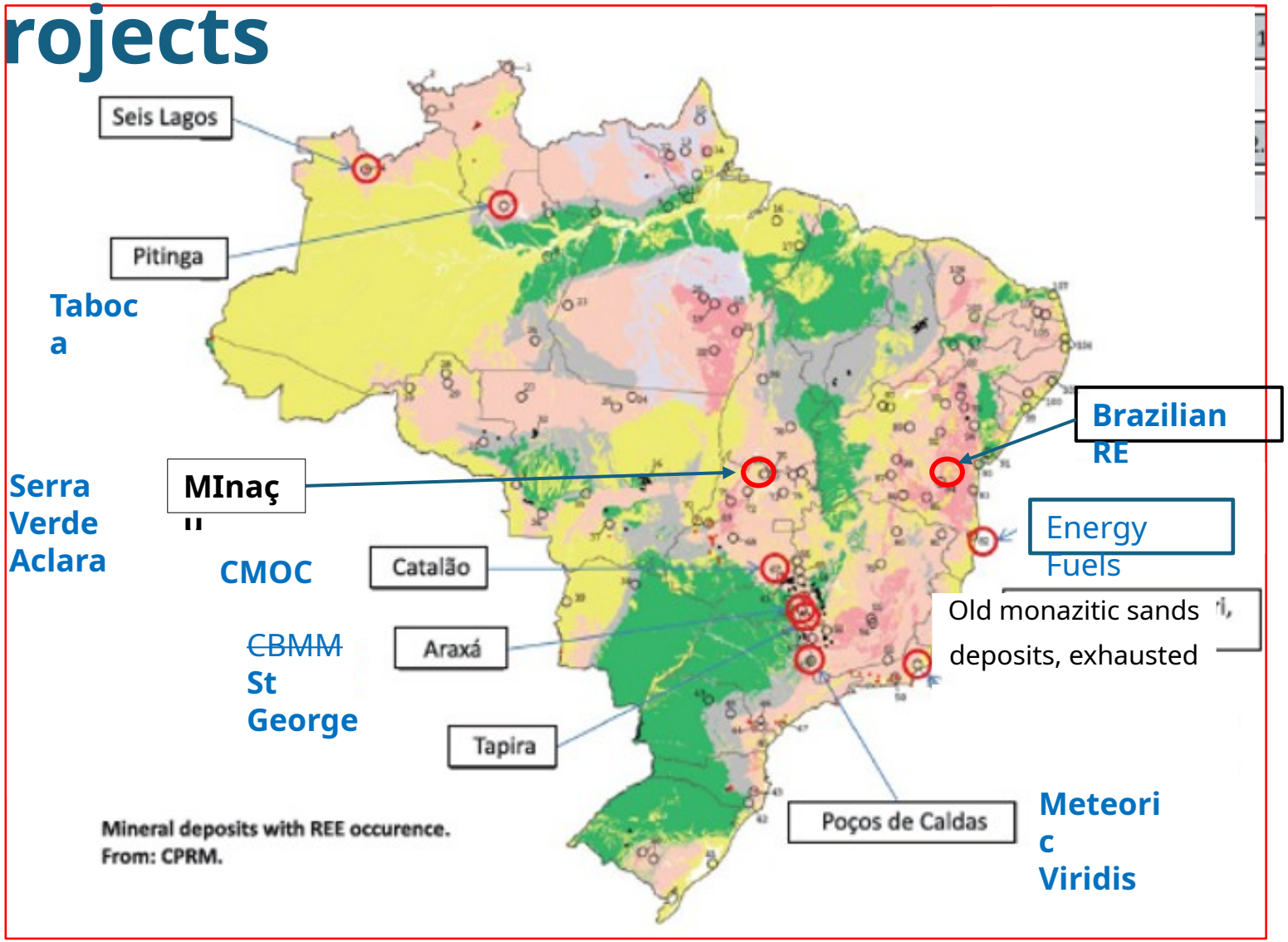
Mountain Pass mine (USA) produces 45.000tpy of MREC, so the US is nearly served. But Montain Pass does not have the heavy RE.

Lynas (Australia) produced Around 30.000tpy of MREC

Summing up the most important Brazilian miners estimates we reach 20.000tpy MREC

Brazilian mining projects

In blue, nine on-going projects, in different stages





RE from Ionic Clay

- The main RE ores are monazite, bastnasite, xenotime and ionic clays. The only developed ionic clay deposits reside in China and Myanmar. Up to now.
- Southern China became famous for Ionic clay, for several reasons:
  - It has been the major source of heavies like Dy and Tb
  - Although their RE content is low, barely above 1000 ppm, it is easy to concentrate
  - So easy that illegal mining spread rapidly, in the 1990´s
  - The enviromental impact of those uncontrolled mining was harsh
  - Chinese government has been able to controle it, recently.

Ionic clay in Brazil

- RE containing Ionic clay has been identified in Brazil in the last ten years.
- Today maybe ten projects are been developed.
- One has already reached production, Serra Verde.
- The challenge is the fraction of RE that can be recovered by leaching. The total content may be good, but the amount that can be extracted may not.

Rare Earth extraction from Ionic clay

- Although China and Mianmar extraction brought a very bad image to the process, it can be much better done!
- There is an unavoidable mining impact (large áreas).
- it does not need crushing, which is energy spending step
- The leaching can be done with ammonium sulphate (no need for acids), which is not a bad contaminant
- The leaching can be done in closed batches, with water in closed circuit
- RE carbonate precipitation and ammonium recovery can be done with low impact.

The most important ionic clay projects in Brazil

1. Serra Verde
2. Aclara
3. Meteoric
4. Viridis
5. A non ionic: Brazilian Rare Earths

There are others, less developed

Ionic clays

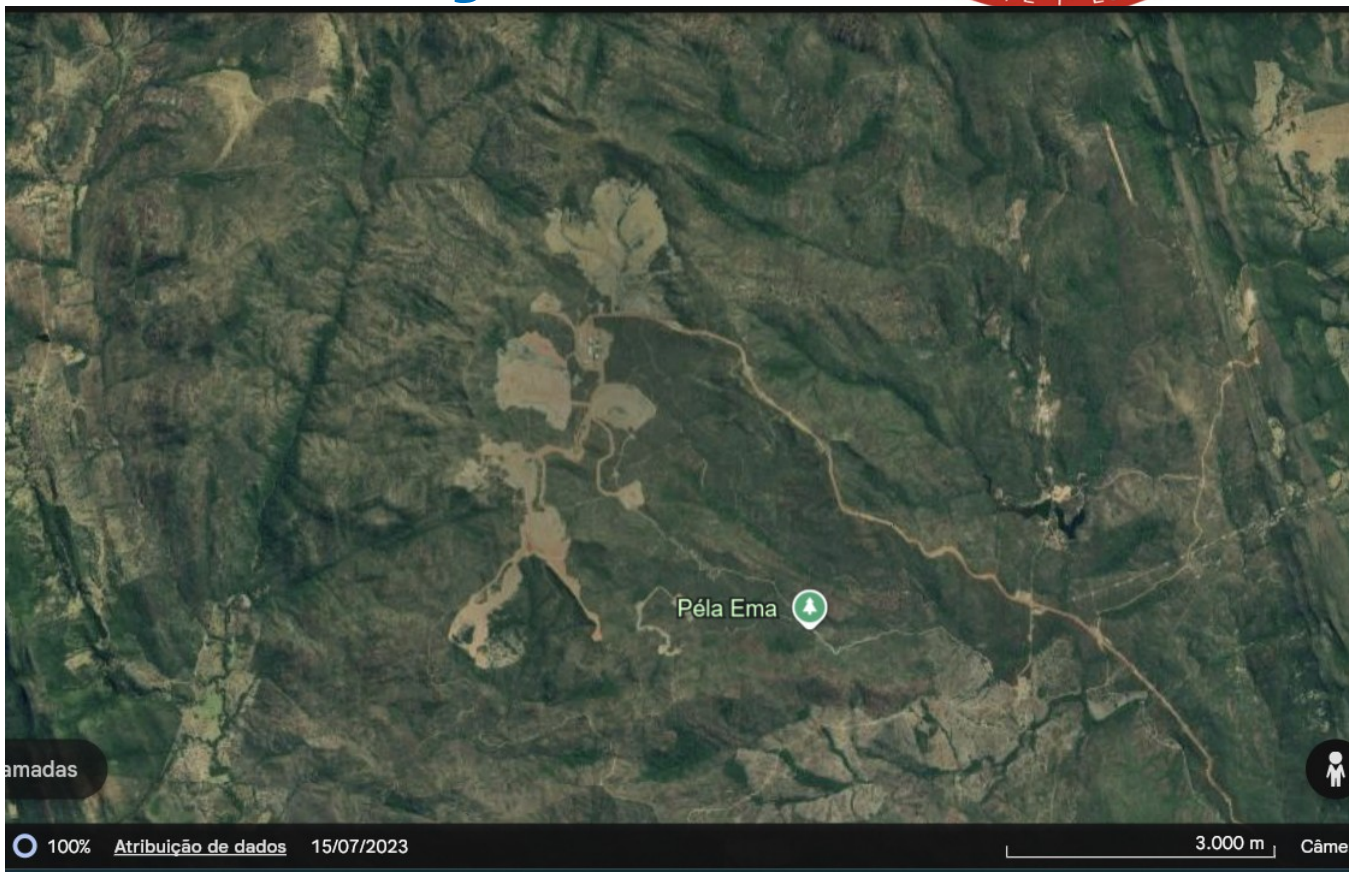
	Bayan Obo	Mountain Pass	Lynas	XunWu (JiangXi)	Serra Verde	Meteoric	Aclara	Viridis
source	D.K.	D.K.	D.K.	D.K.	Announc.	Report	report	report
country	China	USA	Australia	China	Brazil	Brazil	Brazil	Brazil
MREC (tpy)	100,000?	45,000	12,000	n.d	5,000	12,300	4,265	n.d.
Nd+Pr %	24,7	16,3	23,8	40,7	n.d.	29	27	23.3
Dy+Tb %	0,2	Tr.	0,2	8,0	n.d.	0.8	3.9	1.3

Serra Verde Mineração

- Serra Verde was a Denham Capital portfolio company, American based, until last month.
- Now it owned by USA Rare Earth, who bought it for 2.3 billion dollars
- They plan to deliver 5.000tpy of RE concentrate, in Phase 1

Serra Verde Mineração





Serra Verde Mineração

Drilling started in 2010
Operation approval in 2023
First delivery Jan 2025




Camadas
3D
100%
Atribuição de dados
800 m
Câmera: 5.702 m
13°29'33"S 48°30'51"W 813 m

US backs Serra Verde's Brazilian rare earth project with $465M funding

Bloomberg News | November 7, 2025 | 7:52 am Critical Minerals Latin America USA Rare Earth



Pela Ema rare earths plant construction. (*Image courtesy of Serra Verde.*)

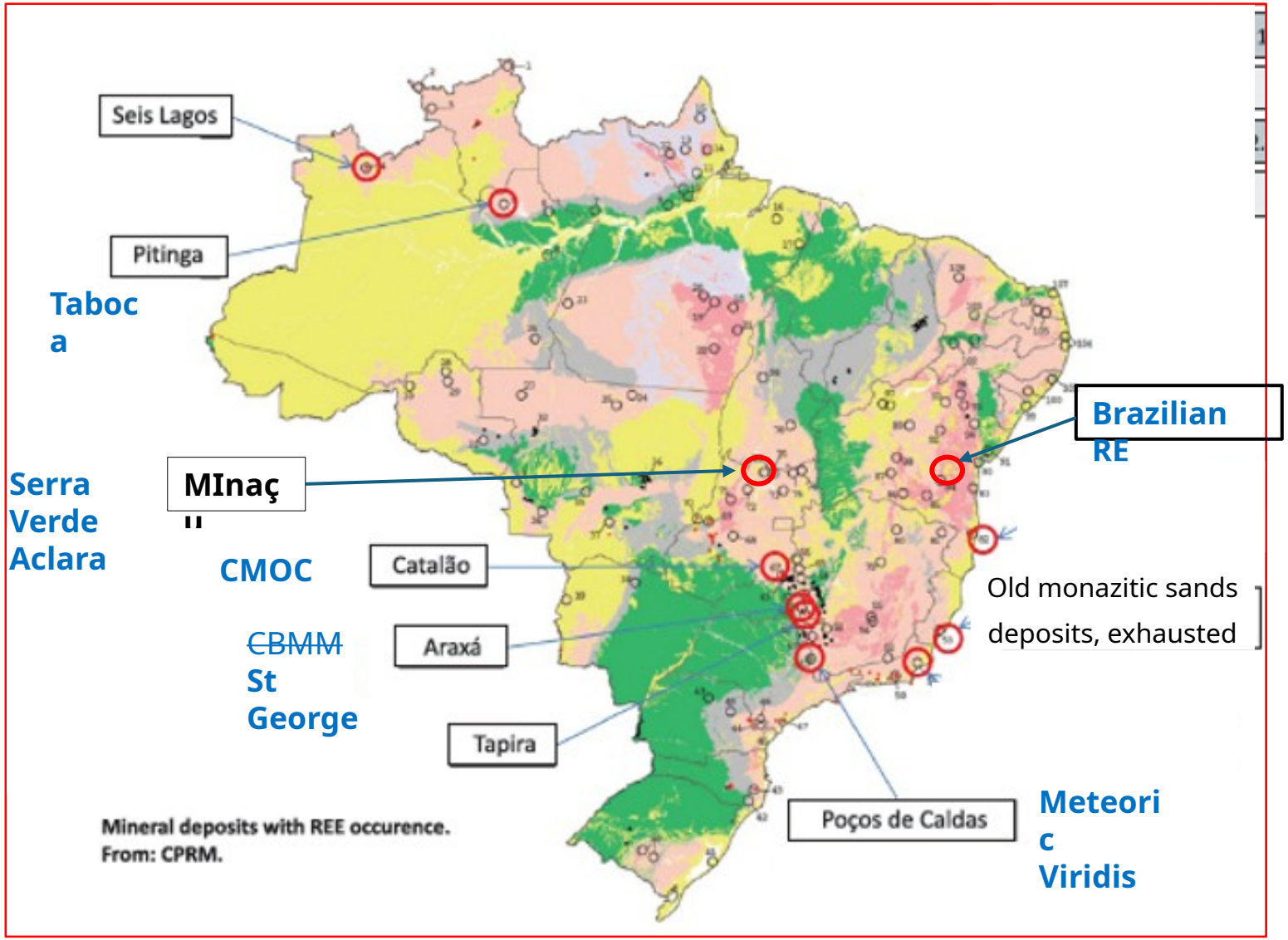
funding from the US International Development Finance Corporation,

The firm aims to ramp up output to between 4,800 and 6,500 metric tons of total rare earth oxides by early 2027.

2. Aclara Carina Project

- Is a Toronto Stock Exchange listed company
- 58% owned by Hochschild Group, a 50 Years old Peruvian group Strong in gold mining
- Two RE projects, one in Chile and one near Serra Verde
- Aclara has incorporated a U.S .based subsidiary, Aclara Technologies Inc., to develop its own rare earths separation capabilities.

In blue, on-going projects, in different stages





Aclara concentration pilot plant



- Built by ANSTO for Aclara in Chile, has benn brought to Brazil to fine tune the concentration of Carina ionic clay.

https://www.youtube.com/watch?

Aclara's Pre Feasibility Study

ACLARA ANNOUNCES FILING AND RESULTS OF PRE-FEASIBILITY STUDY FOR ITS FLAGSHIP CARINA PROJECT

TORONTO, ON, November 6, 2025

Significant Production of HREEs and Light Rare Earths (LREEs)

- Average annual production[1] of 4,265 tonnes rare earth oxides ("REO") contained in an MREC product with very high content of DyTb and NdPr of 4.1% and 27.5%, respectively.
- Average annual production[1] of magnetic elements as well as other strategic HREEs contained in the MREC product:
    - 149 tonnes Dysprosium (Dy) and 25 tonnes of Terbium (Tb);
    - 1,170 tonnes Neodymium and Praseodymium (NdPr); and
    - Other strategic HREE: 170 tonnes of Samarium (Sm), 171 tonnes of Gadolinium (Gd), 10 tonnes of Lutetium (Lu) and 1,098 tonnes of Yttrium (Y).

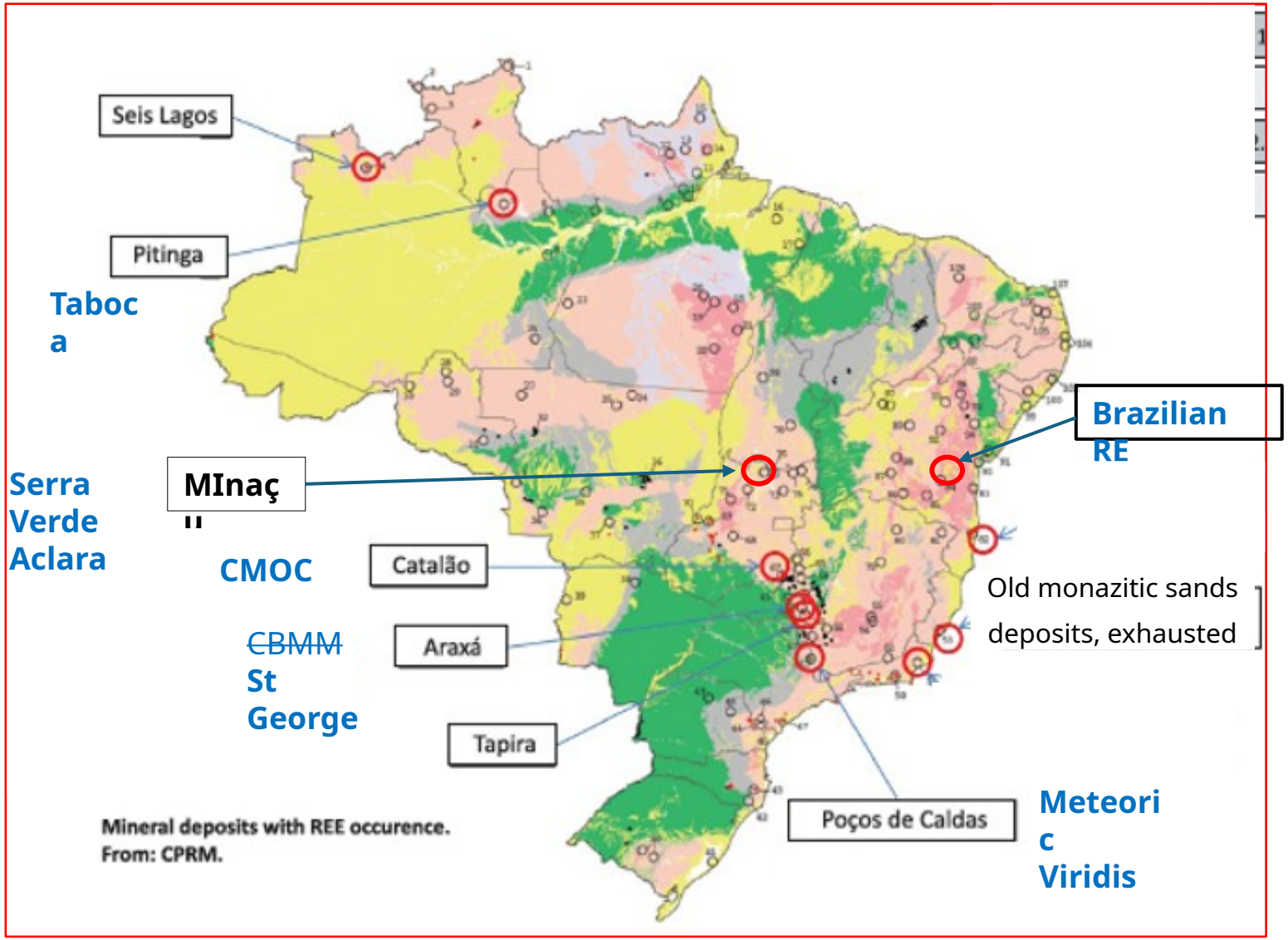
Commissioning is estimated to commence in H2 2028 with initial production and ramp-up through 2029. The Company is evaluating the possibility of expediting the schedule to begin initial production by mid-2028 depending on offtake agreements and access to financing.

3. Meteoric Caldeira Project

- An Australian mining company,
- The Prefeasibility Study projects the production of 26,000tpy of MREC, resulting in 4,200tpy of MREO
- They claim potential for the world's lowest-cost source of rare earths.

https://www.youtube.com/watch?v=Xmx3dlJ2wKw

Meteoric is in Poços de Caldas





Meteoric Caldeira Project



Meteoric pilot plant

- Meteoric installed a ANSTO designed pilot plant in Poços de Caldas in November 2025.
- The pilot plant is designed to process 25 kilograms of ore per hour, producing around 2 kilograms of mixed rare earth carbonate (MREC) each day.
- They have support from local Universities in geology and leaching.

Meteoric Schedule

1 Submission of the Caldeira EIS

Complete

May 2024

- Comprehensive research and community consultation from mid-2023
- Includes favourable feedback from a Social Diagnosis and Stakeholder Survey of the Caldeira Project conducted by EcoDue Ambiental in December 2023

2 Preliminary License Approval (LP)

November 2025

- Initial license designed to evaluate social and environmental feasibility
- The principal document supporting the LP was the EIS and Meteoric has strong confidence in receiving approval with the majority of key milestones already being achieved to date

3 Installation License Approval (LI)

June 2026

- Key license to commence detailed construction of the project
- The principal document supporting the LI application is the Environmental Control Plan (PCA) which is **being drafted in parallel with the analysis by EPA of the LP application**
- ANM approvals to add REEs (PAE and RRR) and CDM approval to convert to ML

Key requirement for FID and commencement of construction

4 Operating License Approval (LO)

2028

- Short, audit style process during which the regulatory authorities (SEMAD) confirm that the project is in compliance with the conditions set out in the Installation License

4. Viridis Colossus Project

- Also an Australian mining company.
- By Jan 2024 they had more than 400 holes
- They have an estimate of 4.000ppm of RE
- 30% of which is MRE Magnetic Rare Earth (Nd+Pr+Dy+Tb)
- Average recovery of the MRE is more than 60%
- They announced May 22 the operation of a concentration pilot plant

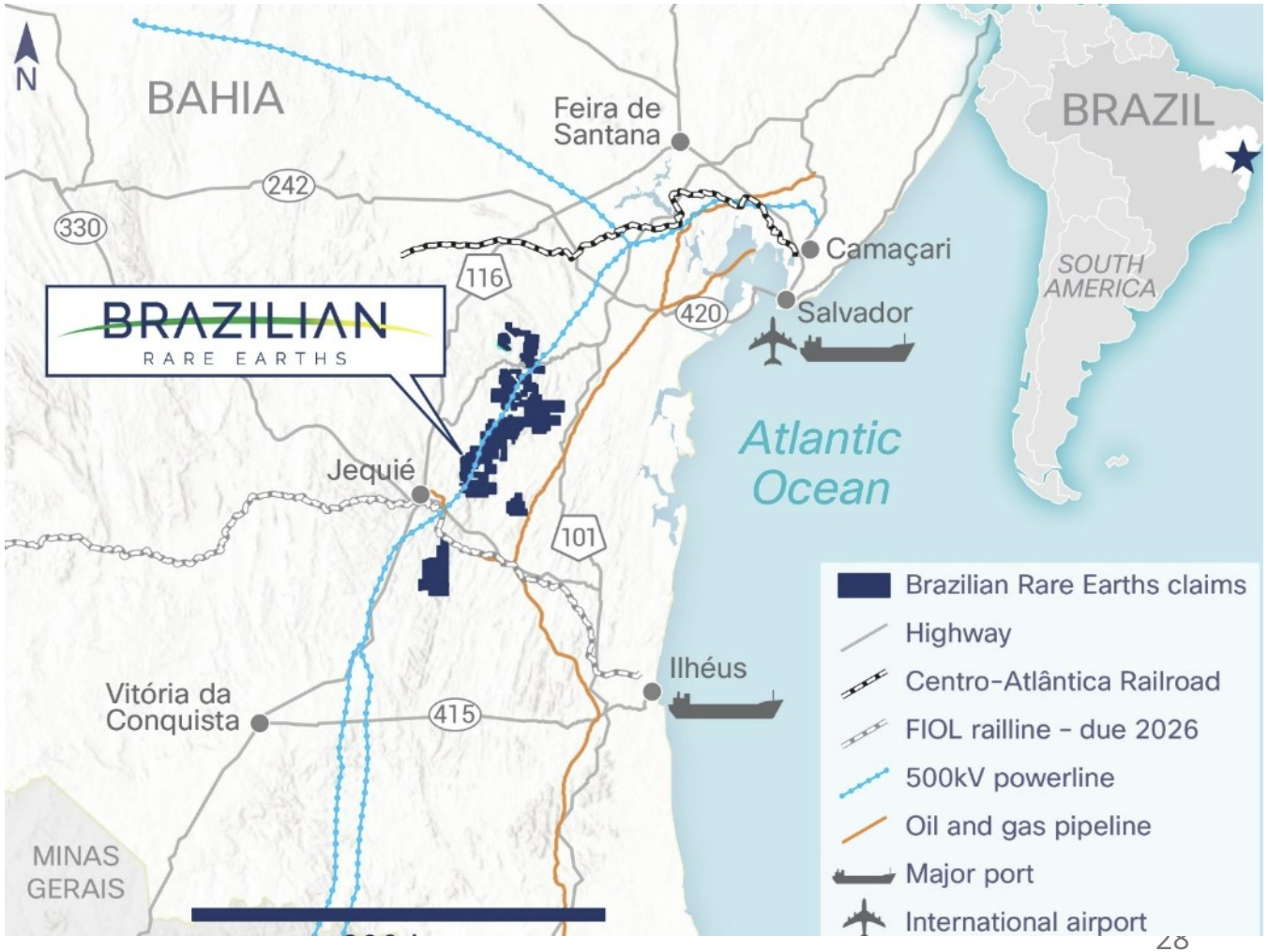
Viridis schedule

Regulatory progress was a key focus during the period. On 28 January 2025, the Company lodged its Environmental Impact Assessment ('EIA') and Environmental Impact Report ('RIMA') with the Environmental Agency of Minas Gerais ('FEAM'), a major step in securing the Preliminary License ('PL') necessary for full-scale development.

PreFeasibilty study assumes 9,500 tpy of REO, with 25% MREO
Estimated CAPEX of U$ 350M

5. Brazilian Rare Earths (BRE)

More recente Project.
Ore is Monazite
7% Nd+Pr
1% Tb+Dy



BRE and Carester sign 10-year Heavy Rare Earth Offtake and Partnership to deliver BRE's Rare Earth Separation Plant

October 09, 2025 08:30 ET | Source: Brazilian Rare Earths Follow

Supply offtake agreement will support up to 150 tpa of separated dysprosium and terbium (DyTb) oxide production at Caremag, Carester's plant.

Engineering and technical services agreement: Carester will provide engineering, construction and commissioning services for BRE's planned integrated rare earth separation plant at the Camacari Petrochemical Complex in

company	market value (U$ M) Nov 07 2025
Lynas	13600
MP	10400
Serra Verde	
n.d.	
Aclara	390
Meteoric	314
Viridis	87
Braz RE	424

From mining to separation

The RE separation have had extrordinary developments in 2025

- Lynas improved their separation plant in Malaysia
- Their new Project in Texas is under study.
- Silmet, in Estonia, has a capacity of 3.000tpy of RE oxides. They have a deal with Meteoric.
- MP received large investment to advance refining capacity
- Solvay announced a plant that can reach 30% of European demand by 2030
- The facility will source rare earths and recycled materials from a diverse range of suppliers and mining partners (Brazil, Canada and Australia), as mandated by the Critical Raw Materials Act.
- Caremag (joint venture of Carester and JOGMEC) plans to process 5.000t of MREC. It has na off-take deal with Brazilian RE.
- Aclara announced a refining plant in Louisiana, USA.

RE Separation in Brazil?

- The Brazilian National Development Bank (BNDES) has selected ten Rare Earth projects that can ask for loans for RE mining and separation plants.
- There is a clear interest in promoting a joint-venture of Brazilian and overseas companies to invest in a separation plant n Brazil.

BNDES supports the whole value chain

NEW MINING OPERATIONS

Mineral exploration, discovery, and development of new mines.

R, D&I FOR MINERAL TRANSFORMATION AND MANUFACTURING TECHNOLOGIES

Technology, human capital development, pilot and demonstration plants.

INDUSTRIAL PLANTS

Separation, refining and manufacturing of alloys, magnets, and batteries, among others.

TRANSFORMATION AND MANUFACTURING OPPORTUNITIES

- Lithium refining
- REEs oxide separation, alloy production, and magnet manufacturing
- High purity spherical graphite
- Nickel sulfate and others applied directly to EV batteries
- Solar and electronic grade silicone, photovoltaic glass and cells
- Platinum metals group, Copper and other smelting and refining capacity

BNDES

Magnet production in Brazil?

- After RE separation again the question comes: Who will buy Nd?
- Only Magnet producers buy Nd metal
  - There are very few REPM producers in the west.
  - Vaccumschmelze is the major player in Europe
  - VAC announced it will invest U$500M to produce REPM in the US, for GM,
  - MP announced plans to produce 1.000tpy in Texas.
  - Neo inaugurated a magnet plant in Estonia, investing U$100M to produce 2.000tpy of magnets

Magnet production in Brazil?

- There are two ferrite magnet plants operating near São Paulo
- One small bonded magnet producer
- No sintered NdFeB production today

- The state of Minas Gerais invested U$20M to build a pilot plant.
- Now it is operated by CIT-SENAI, a Research institute funded by the Minas Gerais Federation of Industries

RE Magnets Pilot Plant built in Brazil

started operation in 2025

All equipment bought:

- strip caster
- jet mill
- uniaxial press
- sintering furnace
- milling machines
- electrodeposition



CIT Senai ITR, laboratório de ímãs de terras raras em MG | Credits: Senai





Photos from Jan 2024
Planned 10 tpy in stage 1
To reach 100tpy in stage 2
Using imported Nd



U$15 million are approved to fund the implementation of the magnet pilot plant.

Hartmut Nagel, November 2025, helping to put in operation equipments at the Brazilian pilot plant.

Their dream is that they will show Brazilian investors that it is possible to produce RE magnets in Brazil or, at least, to have a trained labor force able to tackle that opportunity

REPM 2027 BRAZIL

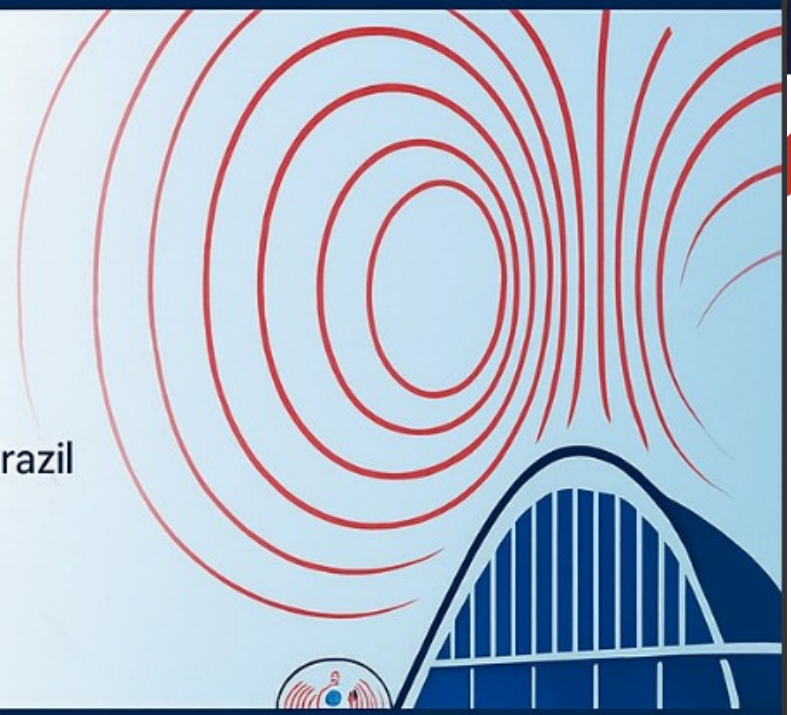
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REPM 2027

26th International Workshop on Rare Earth Permanent Magnets and Their Applications

September 5–9, 2027 - BH Centro Convention Center, Belo Horizonte, Brazil

Submit Abstract | Register Now



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Abstract Deadline
May 1, 2027

Notification of Acceptance
June 15, 2027

Early Registration
July 1, 2027

Conference Dates
Sept. 5–9, 2027



We will see how it all develops.

Thank you

f.landgraf@usp.br