INSTITUTO DE PESQUISAS TECNOLÓGICAS

RARE EARTHS

Sandra Lúcia de Moraes
Andre Luiz Nunis da Silva
Joao Ricardo Filipini da Silveira
Maciel Santos Luz
Célia Aparecida Lino dos Santos
Fabián Andree Cerda Pastrián

Rare Earths

Technical document submitted to the Technological Research Institute of the State of São Paulo (IPT).

São Paulo
2025

Sumário

01

Rare Earths in Brazil

This e-book aims to make the discussion about rare earth elements accessible, explaining their strategic importance for the future of industry, technology, and sustainability. Led by the Institute for Technological Research (IPT), under the direction of Sandra Lúcia de Moraes and the expertise of researcher André Nunis, this material aims to inform, engage, and inspire the general public about one of Brazil's most valuable assets. Based on reliable sources, market data, and scientific evidence, the content offers a complete overview of the current situation and future opportunities.

Here we will show what rare earth elements are, their potential, the challenges they face, and the innovation they are experiencing in Brazil.

02

What are Rare Earth elements?

Rare earth elements are a group of 17 chemical elements from the periodic table, known as the lanthanides, in addition to scandium and yttrium. Despite the name, they are not scarce elements and can be found in different parts of the globe. Their extraction is challenging and requires technical knowledge and rigorous environmental control.

These elements possess unique electronic and magnetic properties, making them essential for advanced technologies. Their special characteristics allow for applications in various strategic sectors, from high-tech industries to the global energy transition.

The importance of these elements has grown exponentially in recent decades, keeping pace with the development of more efficient and sustainable technologies. Mastering knowledge about rare earth elements therefore represents not only a scientific advantage, but also an economic and geopolitical one.

1

Permanent magnets

Elements such as Neodymium (Nd), Praseodymium (Pr), Dysprosium (Dy), and Terbium (Tb) are fundamental to the manufacture of permanent magnets, also known as supermagnets, used in wind turbines, electric vehicles, and hard drives.

2

Catalysts

Cerium (Ce) and Lanthanum (La) are widely used in automotive catalysts, petroleum refining, and industrial emissions control.

3

Iluminação

Európio (Eu), Térbio (Tb) e Ítrio (Y) são essenciais para lâmpadas fluorescentes, LEDs e displays coloridos de alta definição.

4

Baterias

Lantânio (La) é um elemento que pode ser utilizado nos eletrodos de baterias recarregáveis.

03

Brazil in the Global Scenario

With approximately 21 million tons in reserves, Brazil occupies a strategic position in the global rare earth mineral landscape. This significant amount of resources places the country second only to China in terms of geological potential, representing a unique opportunity for economic and technological development.

21M

TONS

Estimates of Brazilian rare earth reserves place the country in a privileged position on the global stage.

2º

WORLD RANKING

Brazil's position in terms of total reserves is second only to China.

20%

MAPPED AREAS

Percentage of areas with potential for occurrence that have already been mapped using modern geophysical techniques.

Major Brazilian Deposits

Carbonatites

Located primarily in Araxá (MG) and Catalão (GO), these deposits are rich in light rare earth elements such as Lanthanum (La), Cerium (Ce), and Neodymium (Nd). They have great potential for large-scale commercial exploration.

Ionic Clays

Found in regions such as Minaçu (GO) and Poços de Caldas (MG), they exhibit a significant concentration of heavy rare earth elements, including Dysprosium (Dy) and Terbium (Tb), elements of high strategic and economic value.

Phosphates

Deposits like Morro do Ferro are associated with uranium and thorium minerals, which adds complexity to their exploration but offers potential for integrated resource exploitation.

Despite this enormous potential, Brazil still faces the challenge of developing a complete production chain. Currently, t**he country is beginning to export concentrates and investing in new mineral processing technologies**, without yet capturing the added industrial value that could be generated by transforming these resources into high-tech products.

04

The role of IPT in Scientific Leadership

The Institute for Technological Research (IPT) plays a fundamental role in structuring the national rare earth technology chain. With a tradition of excellence and innovation, the institute positions itself as a protagonist in the development of solutions that enhance the use of these strategic resources for Brazil.

In addition to possessing state-of-the-art laboratory infrastructure, IPT stands out for its ability to connect different sectors, promoting partnerships between industry, academia, and government. This integrated approach allows for the construction of a robust and dynamic innovation ecosystem, capable of transforming scientific knowledge into practical and commercially viable applications.

Advanced Research

Development of innovative methodologies for the characterization and processing of rare earth elements, with a focus on sustainability and efficiency.

Pilot Plants

Implementation of laboratory facilities for oxide reduction, development of NdFeB metal alloys and corrosion protection, with support from CBMM, WEG, Embrapii, Finep, Fapesp, CNPq and BNDES.

Performance Tests

Development of new methodologies for chemical characterization of rare earth elements, alloying elements and impurities, and corrosion resistance.

Technology Transfer

Establishing partnerships with the productive sector for knowledge transfer and joint development of proprietary technologies.

Strategic Leadership

IPT fosters an innovation ecosystem based on technological expertise. Its vision integrates scientific development, sustainability, and industrial competitiveness, creating the foundation for Brazil to advance in the rare earth value chain.

Technical Excellence

In our laboratories, we develop high-yield metallurgical routes with reduced environmental impact. Our solutions encompass the development of mineral beneficiation processes, extractive metallurgy, the development of metal alloys and protective coatings against corrosion — contributing decisively to the technical and economic viability of national production.

05

The Rare Earth Production Chain

The complexity of the rare earth production chain represents one of the greatest challenges to global progress in this strategic sector. Each stage requires specific technologies, specialized knowledge, and significant investments, which explains the current concentration of production in a few countries.

Geological Prospecting and Characterization

This initial stage requires advanced technologies such as aerogeophysics, remote sensing, and geochemistry. Accurate mapping of the deposits determines the economic and technical feasibility of the entire project.

Extraction and Processing

In ionic clay deposits, for example, the process occurs via leaching. This phase requires rigorous control to minimize environmental impacts and maximize the recovery of elements.

Chemical Separation

Considered challenging, it requires multiple solvent extraction or ion exchange steps to isolate elements with extremely similar chemical properties.

Metallurgy

Transformation of oxides into metals by electroreduction or calciothermal reduction. Processes that demand high energy consumption and precise control of operational parameters.

Production of Metal Alloys and Powders

Steps that require strict control of chemical composition and microstructural formation. Characteristics that contribute to the magnetic properties of magnets.

Magnet Production

This stage includes grain orientation, pressing, heat treatment, machining, and protective coating against corrosion. After these steps, the material can be magnetized and is ready for technological applications.

Investments in Mineral Research in Brazil (2023)

In 2023, investments in the mineral exploration authorization phase totaled R$ 31.2 million, representing a 67.4% increase compared to 2022. These resources were mainly applied in Bahia (72.5%), Minas Gerais (12.7%), Goiás (8.3%), and Amazonas (5.7%), distributed across 370 mining processes. Investment allocation was concentrated in infrastructure (50.0%), geophysical prospecting (16.3%), drilling (11.8%), geology (6.2%), and chemical analysis (3.2%).

The progress of rare earth projects is noteworthy, with, as of December 31, 2023:

- 7 processes in the mining rights application phase;
- 1 process in the mining application phase;
- 28 processes in the mining concession phase.

Among the brownfield projects, the start of operations at the ionic clay deposit of rare earth elements (REEs) in Pela Ema (Minaçu – GO), by Serra Verde Pesquisa e Mineração Ltda., stands out. Major rare earth research projects include initiatives from companies such as Meteoric Resources, Rainbow Rare Earths/Mosaic, Bemisa, Viridis Mining, Brazilian Rare Earths, Equinox Resources, Appia Rare Earth & Uranium, Aclara Resources, Alvo Minerals, Mineração Taboca, Canada Rare Earth Corp, Resouro Strategic Metals, Foxfire Metals, Uranio Energy Fuels, and Mineradora Tabuleiro/Umyne, distributed across several Brazilian states.

Source: National Mining Agency – Mineral Summary 2024 (base year 2023).

06

IPT Initiatives and Success Stories

In addition to the milestones already mentioned, the Institute for Technological Research (IPT) is consolidating itself as a center of excellence, whose work transcends academic research to directly impact the industrial and economic development of the country.

Sustainable Processes

Development of innovative technologies to reduce emissions during rare earth processing, significantly reducing environmental impact.

Life Cycle Assessment

Implementation of advanced methodologies for complete life cycle analysis of metallurgical processes, identifying critical points and opportunities for improvement in terms of efficiency and sustainability.

Technology Transfer

Establishing strategic partnerships with private companies for the transfer of knowledge and technologies developed in IPT laboratories, accelerating industrial application.

National and International Participation

The IPT (Institute for Technological Research) has expanded its presence in this area through strategic partnerships with national and international institutions, such as its participation in the REGINA Project - Rare Earth Global Industry and New Applications, INCT PATRIA, INCT MATERIA, MagBras, among others.

This activity allows the institute not only to share its knowledge, but also to absorb best practices and establish partnerships that strengthen Brazil's position in the rare earth field.

Scientific Production

The publication of technical studies in high-impact journals and the generation of intellectual property in cooperation with industry demonstrate IPT's commitment to open innovation and the dissemination of knowledge. This work has generated international recognition and attracted strategic partnerships to Brazil.

National Policy for Rare Earths

IPT has been actively collaborating in the development of a proposed National Policy for Rare Earths, seeking to align economic development, national security, and environmental preservation. This initiative represents a crucial step towards structuring the sector in a strategic and sustainable way in the long term.

07 Challenges and Opportunities

Brazil faces the challenge of overcoming its tendency to export raw materials without adding value, thus missing out on the greatest economic and technological opportunities associated with these strategic assets.

Main Challenges

Initial Investment and Operating Costs

The high cost of implementing complete industrial plants, developing technologies, and processing rare earth elements represent significant barriers for new entrants into the market.

Scale and Demand

The small scale of initial production and the lack of a consolidated domestic demand hinder the economic viability of ventures in their initial phases.

Environmental Risks

The presence of radioactive elements such as thorium and uranium in some repositories requires strict safety and control protocols, increasing operational complexity.

Great Opportunities

Import Substitution

Developing national capacity to supply strategic inputs to sectors such as automotive, defense, and aerospace, thereby reducing external dependence.

Proprietary Technology

Creating innovative technological solutions with export potential, transforming Brazil from an importer to an exporter of advanced technology.

Centers of Expertise

Establishing regional centers of excellence in critical minerals, generating skilled jobs and stimulating technological development.

Global Positioning

Consolidating Brazil as a reliable and sustainable supplier in global value chains, especially in a context of seeking supplier diversification.

> "A country's true wealth lies not only in possessing natural resources, but in its ability to transform them into high value-added products, generating knowledge, skilled jobs, and technological expertise."

08

Geopolitics and Sustainability

Rare earth elements have transcended their purely industrial role to become a geopolitical asset of paramount importance. China's control of over 85% of global refining has created significant vulnerabilities in international supply chains, exposing strategic weaknesses in several countries.

Sustainability as a Differentiating Factor

Sustainability should be the central pillar of Brazil's strategy for rare earth elements, not only as an environmental requirement, but also as a competitive advantage in a global market that is increasingly demanding regarding the responsible origin of materials.

Environmental Restoration

Implementation of advanced techniques for the recovery of degraded areas, transforming environmental liabilities into productive and sustainable assets.

Community Integration

Developing projects that benefit local communities, promoting social participation and fair distribution of the benefits generated by mining activity.

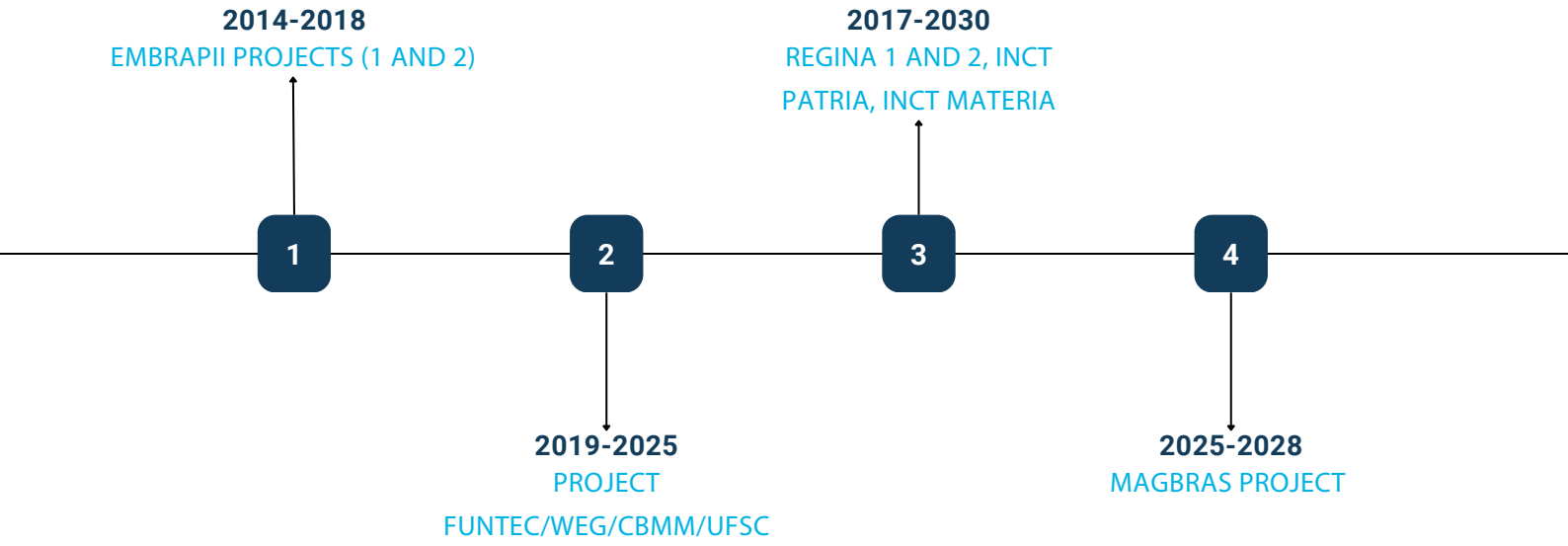
Circular Economy

Establishing recycling programs for products containing rare earth elements, such as magnets, motors, and electronic devices, creating alternative supply streams.

09

IPT at the forefront of the development of the rare earth magnet production chain

The trajectory of IPT in the development of the rare earth supply chain in Brazil involves expanding the scale of operations of the Institute for Technological Research (IPT), consolidating its position as one of the protagonists in the country's transition to a higher value-added and technologically intensive economy.



The specialist's work

The work of researchers André Nunis, Célia dos Santos, João Ricardo, Maciel Luz, and Fabián Pastrián will be decisive in positioning the country among the leaders in metallurgical innovation applied to rare earths. Their work has focused on developing more efficient and environmentally responsible processes, with the potential to revolutionize how these materials are processed globally.

Advances in low-environmental-impact pyrometallurgical processes represent a significant contribution to the technical and economic viability of national rare earth production, paving the way for the advanced industrialization of the sector.


HOSOKAWA ALPINE

09

IPT at the forefront of the development of the rare earth magnet production chain

> "Our goal is to contribute to Brazil positioning itself not only as a supplier of raw materials, but also as a producer of advanced technological solutions based on rare earth elements, generating skilled jobs and promoting national economic development."
> Sandra Moraes.

1. Reduction of Rare Earth Oxides (2014–2016)

In this project, IPT partnered with CBMM (a major global producer of niobium) to develop a technology capable of converting rare earth oxides, especially neodymium and praseodymium oxide (known as didymium), into their corresponding metals. The method used was an electrochemical process, carried out in an electrochemical reactor specifically designed to reduce the oxides by removing oxygen, resulting in the production of high-purity metals.

2. Production of the NdFeB Magnetic Alloy (2016–2018)

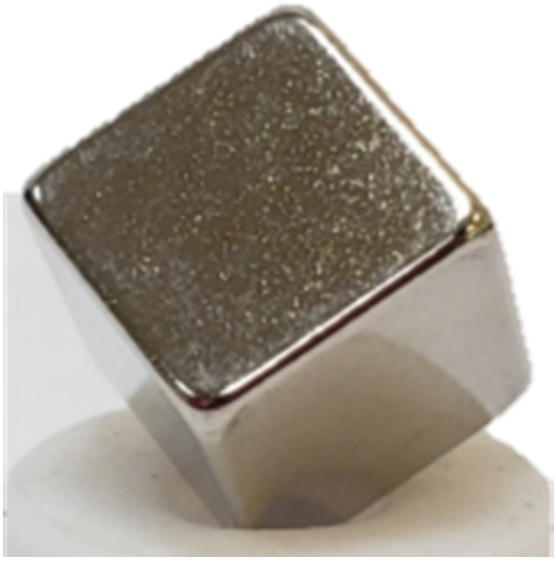
Following up on the previous project, IPT and CBMM advanced in the development of the next stage of the production chain, focused on obtaining neodymium-iron-boron (NdFeB) magnetic alloys. The method employed was StripCasting, a rapid solidification technique that produces the metallic alloy directly in the form of thin strips. The result was mastery of the main parameters necessary to manufacture these magnetic alloys, essential in the production of high-performance permanent magnets, widely used in electric motors and wind turbines.

09

IPT at the forefront of the development of the rare earth magnet production chain

3. Production of Magnets from Didymium Oxide (2019–2025)

In this extensive project coordinated by IPT, in partnership with UFSC, CBMM, and the electric motor manufacturer WEG, the entire production chain of rare-earth permanent magnets is being developed. Supported by BNDES, the project involves everything from the pilot-scale electrochemical reduction of oxides to the final processing of magnets on a laboratory scale. The stages include hydridation, dehydration, grinding, compaction, sintering, machining, magnetization, and coating for corrosion protection.



4. National Institute of Science and Technology – INCT-Processing and Applications of Rare Earth Magnets for High Technology Industry (P.A.T.R.I.A.) (2017–2024)

Coordinated by USP and with the active participation of IPT and several other Brazilian institutions (UFSC, IPEN, CETEM, CDTN and UFCAT), this national research institute aimed to consolidate the technology and scientific expertise for the production of rare earth permanent magnets in the country. It encompassed everything from the concentration and separation of oxides and the development of magnets using different techniques to the development of chemical characterization techniques for rare earths, promoting the training of specialized human resources and strengthening the national scientific infrastructure in this field.

09

IPT at the forefront of the development of the rare earth magnet production chain

5. REGINA Project - Rare Earth Global Industry and New Applications – Brazil–Germany Cooperation (Phase 1: 2017–2020)

Coordinated by UFSC, the REGINA project had its first phase dedicated to technical and scientific cooperation between Brazilian institutions (including IPT and UFSC) and research centers in Germany. The objective was to promote the exchange of knowledge and technical training to strengthen and accelerate the development of technologies associated with the rare earth magnet production chain.

6. Rare Earth Global Industry and New Applications Project - REGINA – Supply Chain Sustainability (Phase 2: 2025–2028)

Once again coordinated by UFSC, the second phase of the REGINA initiative, in addition to maintaining international technical cooperation, aims to study the sustainability of rare earth magnet production, with emphasis on reducing environmental impacts, circular economy, life cycle analysis, and the social viability of the Brazilian production chain.

09

IPT at the forefront of the development of the rare earth magnet production chain

7. MagBras Project – From Mine to Magnet (2025–2028)

Its objective is to develop in Brazil the complete production chain of rare earth permanent magnets (NdFeB) on a pilot scale, from the mine to the coated magnet. This project is developed in partnership with the SENAI Institutes for Innovation in Laser Processing, CIT SENAI, SENAI Institute for Innovation in Manufacturing Systems, SENAI Institute for Innovation in Advanced Manufacturing, Technological Research Institute of the State of São Paulo (IPT), Mineral Technology Center (CETEM) and Federal University of the State of Santa Catarina (UFSC), as well as partner companies WEG, MOSAIC, VALE, SCHULZ, STELLANTIS, VECO, ZEN, NANUM, METEORIC, VIRIDION, ST.GEORGE, ACLARA, RESOURO, BEMISA, TUPY, BORBOREMA, GREYLOGIX, EION, STROKMATIC, WALBERT, TABOCA, STEINERT, ARCELOR MITTAL, BBX, APPIA RARE EARTH, INTEGRA LASER, MODERNA and LEAN 4.0, with the support of the MOVER Program – SENAI National Department (SENAI DN) and FUNDEP – Research Development Foundation, managed by the Support Foundations FIPT, FACC and FEESC.

Learn about the MagBras project.

8. National Institute of Science and Technology – INCT-MATERIA- Advanced Rare Earth Materials: Innovations and Applications" (2025–2030)

The INCT-MATERIA, coordinated by UFAM and with the participation of IPT and other ICTs, aligned with the Sustainable Development Goal (SDG) and the National Action Plan, will promote research on rare earth materials essential for energy transformation and storage, focusing on three axes: Rare earth magnets, complex rare earth ceramics, concentrates, and metallurgical routes.

10

Biographies

Sandra Lúcia de Moraes

Technical Director of the Materials Unit

She is a Researcher and Technical Director of the Advanced Materials Unit at the Technological Research Institute of the State of São Paulo - IPT - Brazil. She holds a degree in Chemical Engineering from the Oswaldo Cruz Higher School of Chemistry (2000), a Master's degree in Mineral Engineering from the University of São Paulo (2004), and a PhD in Sciences (2014) from the same institution. She worked as a visiting researcher (2009) at Michigan Technological University (USA), in the Department of Chemical Engineering with Professor S. Komar Kawatra's team, conducting research on the pelletizing process. She has experience in research in the area of mineral processing, industrial techniques for solid waste recovery, and agglomeration processes. She is a member of the Board of Directors of the Brazilian Association of Metallurgy and Mining (ABM). She serves as a member of the Mining and Agglomeration Technical Committees at the Brazilian Association of Metallurgy and Mining (ABM). She is a member of the Editorial Board of the International Journal of Mineral Processing and Extractive Metallurgy. She is a reviewer for the following journals: Minerals Metallurgical Processing Journal, Mineral Processing Extractive Metallurgy Review Journal, Society for Mining, Metallurgy, and Explorations (SME), Powder Technology, and Journal of Materials Research and Technology. Her research interests lie in developing innovative projects aimed at providing technological solutions applicable to industrial processes and products in the areas of mineral processing, metallurgy, and materials.

10

Biographies

Andre Luiz Nunis da Silva

Technical Manager of the Metallurgical Processes Laboratory

Graduated in Chemical Engineering from the State University of Campinas (2008), he holds a master's degree (2012) and a doctorate (2022) in Sciences from the Department of Chemical Engineering at the Polytechnic School of USP. Currently, he works as a researcher at the Technological Research Institute of the State of São Paulo and as technical manager of the Metallurgical Processes Laboratory. He has experience in the areas of Chemical Engineering and Metallurgy, focusing on chemical, electrochemical and pyrometallurgical processes.

Joao Ricardo Filipini da Silveira

Researcher at the Metallurgical Processes Laboratory

He holds a bachelor's and master's degree in Metallurgical and Materials Engineering, both from the Polytechnic School of the University of São Paulo. During his master's studies, supervised by Professor Fernando Landgraf, he studied the mathematical modeling of the magnetic properties of materials. In 2014, he joined IPT and, after working for two years in reduction processes, began working on the development of magnetic alloys and the strip-casting process. He is currently pursuing a doctorate at the Polytechnic School of USP under the supervision of Professor Marcelo Martorano, focusing on the mathematical modeling of the rapid solidification of alloys.

10

Biographies

Maciel Santos Luz

Researcher at the Metallurgical Processes Laboratory

Holds a Bachelor's degree in Chemistry (2009) and a PhD in Sciences in the area of Analytical Chemistry (2013), both from the University of São Paulo (IQ-USP). Works as a Professor at the Oswaldo Cruz Faculties and as a Researcher at the Technological Research Institute of the State of São Paulo (IPT). Has experience in the area of Analytical Chemistry with emphasis on optical methods of analysis, aiming at the development of analytical methods for elemental analysis in different matrices, such as metallic alloys, slags, ores, ceramics, petrochemical products, biological and environmental samples, among others. Works with flame and graphite furnace atomic absorption spectrometry (F AAS/GF AAS), inductively coupled plasma atomic/optical emission spectrometry (F AES/ICP OES), triple quadrupole mass spectrometry with inductively coupled plasma (TQ ICP-MS), wavelength dispersive X-ray fluorescence spectrometry (WD XRF) and elemental analyzers (ONH and CS). He also studies sample preparation through acid decomposition in open and closed systems with microwave-assisted digestion furnaces, alkaline fusion, emulsion, pressed and fused pellets, extraction, and direct sampling of solids. His main interest is to contribute to scientific and technological work investigating the influence of chemical elements on the properties of materials, human health, the environment, food, and chemical, biological, and metallurgical processes, among others.

10

Biographies

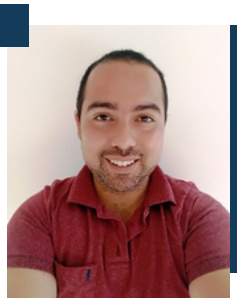
Célia Aparecida Lino dos Santos

Researcher at the Corrosion and Protection Laboratory

She holds a Bachelor's and Licentiate degree in Chemistry with Technological Specialization from UPM (Universidade Presbiteriana Mackenzie, 1990), a Master's degree in Nuclear Technology from IPEN (Instituto de Pesquisas Energéticas e Nucleares, 1997), and a PhD in Chemistry (Physical Chemistry) from IQ USP (Instituto de Química de Universidade de São Paulo, 2003). She participates as a Professor in the subject of Corrosion of Metallic Materials in the Chemical Industry in the professional master's program, area of concentration in Industrial Processes, of Technological Education (ET) at IPT (Instituto de Pesquisas Tecnológicas do Estado de São Paulo S. A). She has worked as an accredited advisor for the ET-IPT professional master's program and as a researcher at IPT since 2004. Main areas of expertise: corrosion; corrosion testing; electrochemical cells; Electrochemical techniques (polarization curves, cyclic voltammetry and electrochemical impedance spectroscopy) in aqueous media, in ethanol and in molten salts; surface treatment with emphasis on phosphating; stress corrosion and corrosion inhibitor.

10

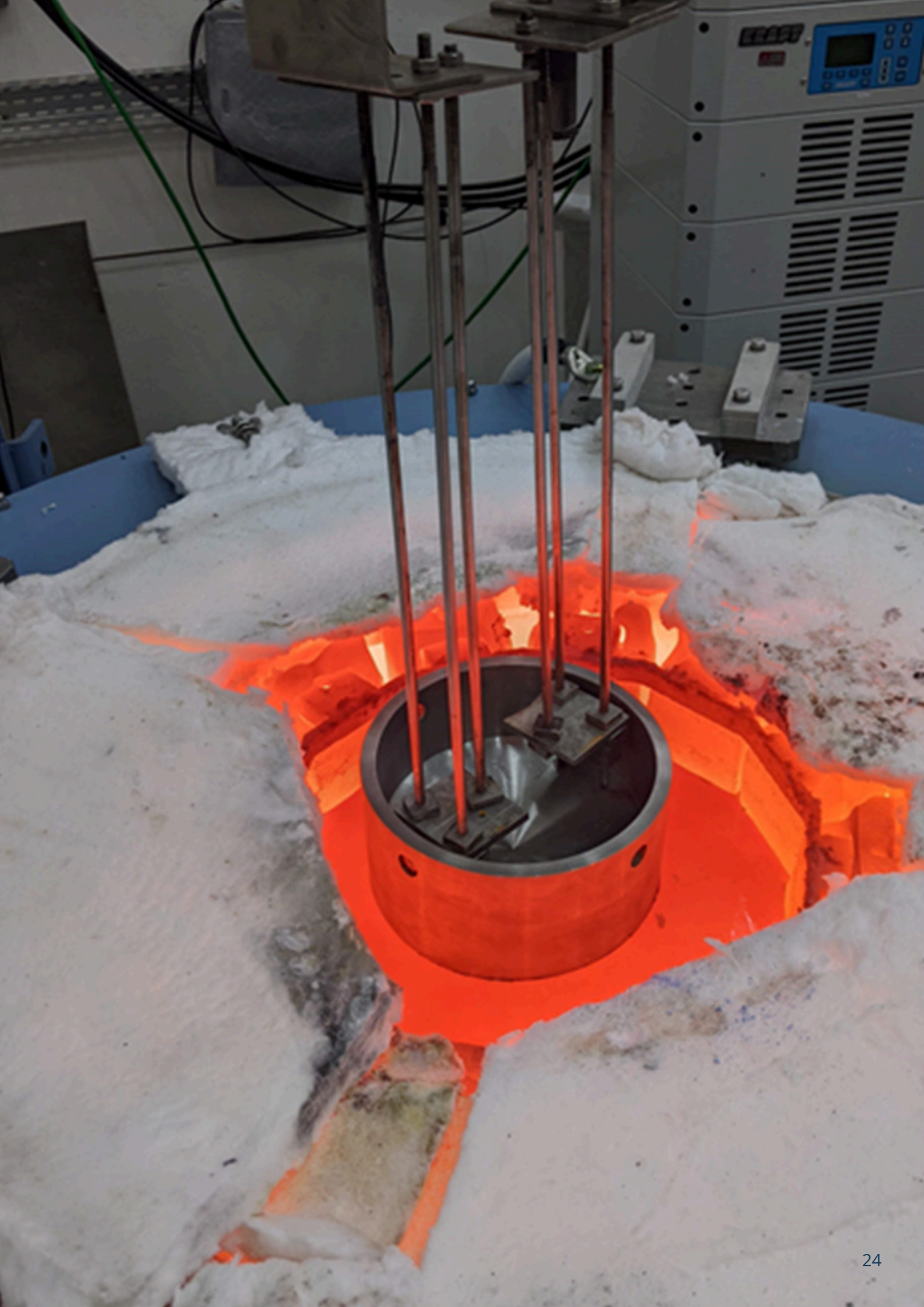
Biographies



Fabián Andree Cerda Pastrián

Researcher at the Corrosion and Protection Laboratory

Chemist with experience in the preparation, characterization, and analysis of minerals, plants, water, and soil, according to ASTM and ABTN standards. Experience in research work with universities and institutes specializing in the areas of Physical Chemistry, Electrochemistry, and Materials Science. In the field of education, I have experience teaching Chemistry at public and private universities. Graduated in Chemistry and holds a PhD in Sciences from the University of São Paulo, Brazil, specializing in Electrochemistry, synthesis, and characterization of metallic nanoparticles. I am a qualified chemist authorized to practice the profession in Brazil. Currently, I work as a Scientific Researcher at the Technological Research Institute of the Government of São Paulo (IPT), applying R&D in projects with large companies and characterizing materials.



11

Sources and References

Governmental Institutions

- Serviço Geológico do Brasil (SGB/CPRM)
- Ministério de Minas e Energia (MME)
- Instituto de Pesquisas Tecnológicas (IPT)
- Ministério da Ciência, Tecnologia e Inovações (MCTI)
- Financiadora de Estudos e Projetos (Finep)
- Banco Nacional de Desenvolvimento Econômico e Social (BNDES)
- Empresa Brasileira de Pesquisa e Inovação Industrial (EMBRAPII)

Companies in the Sector

- Companhia Brasileira de Metalurgia e Mineração (CBMM)
- Serra Verde Mineração
- Other companies in the mining and mineral processing sector

Journalistic Sources

- Money Times
- G1
- Metrópoles
- Agência Brasil

Sectoral Entities

- Instituto Brasileiro de Mineração (IBRAM)
- Instituto Nacional de Ciência e Tecnologia de Materiais (INCT-Materia)
- Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq)
- Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)

- https://www.brasilmineral.com.br/noticias/brasil-e-o-segundo-em-reservas-de-terras-raras-no-mundo
- https://www.brasilmineral.com.br/noticias/brasil-tera-dois-novos-projetos-de-oxidos

This e-book was developed based on data and information from the sources listed above, as well as interviews and direct consultations with industry experts. All content has been reviewed by qualified professionals to ensure its technical and scientific accuracy.

For more information on rare earth elements and IPT's work in this area, we recommend visiting the institute's official website and following its scientific publications in specialized journals.

www.ipt.br

/school/iptsp

ipt_oficial

+ 55 11 3767-4102
4456 / 4091
ipt@ipt.br

INSTITUTO DE PESQUISAS TECNOLÓGICAS