AN OVERVIEW OF CRITICAL AND STRATEGIC MINERALS POTENTIAL OF BRAZIL

2026 Edition

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2026 Edition

DISCLAIMER

This document has been prepared by the Geological Survey of Brazil and presents an evaluation of Brazil's potential for selected critical minerals. Comprehensive data, such as reserves, resources or production, has been gathered from several sources to conduct this analysis. For the global ranking of mineral commodities, we primarily adopted data published in the Mineral Commodity Summaries 2025 (https://doi.org/10.3133/mcs2025). This document may be provided by third parties for informational purposes only and shall not be relied upon third parties as a specific professional recommendation.

The Geological Survey of Brazil does not endorse or assume responsibility for any external data included in this report. The complete list of references for each mineral deposit is shown in the address https://sgb.gov.br/pdac/ and can be downloaded in the "Mineral Resources" section.

Foreword

In a global context of growing demand for critical minerals, essential to the energy transition and to emerging industrial value chains, Brazil has a unique opportunity to affirm its sovereignty over mineral resources and advance to a new level of development. Beyond acting as a reliable supplier to international markets, the country can design policies aimed at internalizing value, generating wealth domestically, and strengthening its national industry. Under our administration, in 2025, we marked a historic milestone with the establishment of the National Mineral Policy Council (CNPM), a body that provides modern, integrated, and strategic governance for the sector, supported by broad interministerial coordination. It is within this framework that Brazil defines the future direction of its mining sector, by expanding geological knowledge, ensuring regulatory predictability, and upholding strict social and environmental standards. These efforts are further reinforced by unique competitive advantages, including Brazil's mineral diversity, a clean energy matrix, and favorable climatic conditions, which together enhance the competitiveness, resilience, and security of mineral projects in the country.

Alexandre Silveira
Ministry of Mines and Energy

Ana Paula Lima Vieira Bittencourt
National Secretary of Geology, Mining and Mineral Transformation

The concept of friend-shoring has never been more relevant. In a context where mineral security goes beyond geology, Brazil presents itself as a friendly, democratic, and transparent nation, fully prepared to integrate reliably into global value chains. The country has moved beyond being merely a promise and has consolidated itself as an expanding reality. We are witnessing the steady advancement of new mines and mature-stage projects, particularly in Rare Earths, Graphite, Nickel, and other strategic minerals, responding to the growing demand for essential inputs for energy transition technologies. Our focus has been on creating the conditions for mining activities and their industrial transformation to take place within Brazilian territory. This publication reflects a high-level technical effort to map concrete and viable opportunities. Brazil has already begun its mineral revolution and stands ready to expand partnerships and investments.

Brazil holds a prominent position in the global mineral sector due to its vast geological potential and geodiversity. In this context, the Geological Survey of Brazil plays a crucial role in producing and disseminating high-quality technical information on critical and strategic minerals essential to low-carbon technologies, such as electric vehicle batteries and renewable energy systems. Its research strengthens the resilience and security of global mineral supply chains and supports sustainable investment decisions aligned with recognized environmental, social, and governance standards. The combination of abundant mineral resources, infrastructure, legal certainty, and a predominantly clean energy matrix reinforces Brazil's status as a competitive and reliable destination for responsible mining, fostering economic growth and employment generation.

Vilmar Medeiros Simões
President-Director of the Geological Survey of Brazil

Francisco Valdir Silveira
Director of Geology and Mineral Resources

The Geological Survey of Brazil (SGB -CPRM) is pleased to present the 2026 edition of An Overview of Critical and Strategic Minerals Potential of Brazil. This updated publication reflects the continued efforts of the SGB-CPRM to expand and integrate geoscientific knowledge in support of mineral development and public policies. This edition highlights major milestones, including the new Geological Map of Brazil and the PlanGeo for Geological Mapping and Mineral Resources, which establish strategic guidelines for the systematic expansion of geological knowledge and mineral resource assessment nationwide. These initiatives strengthen Brazil's geoscientific base and support long-term planning for the mineral sector. The publication also presents recent advances and future perspectives in geophysical and geochemical surveys, essential for reducing exploration risk and improving the identification of mineral potential areas. With an expanded coverage of critical and strategic commodities, this edition reinforces Brazil's role in global supply chains related to the energy transition, technological innovation and food security.

Contents

1 Introduction

By Izaac Cabral Neto (izaac.cabralneto@sgb.gov.br) and Maisa Bastos Abram (maisa.abram@sgb.gov.br)

Brazil stands out internationally due to its vast continental and marine territory, extensive geological and climatic diversity, and significant availability of critical minerals and natural resources, producing 96 different mineral commodities (Table 1.1). Despite being classified as a developing economy, the country has a robust industrial base, a consolidated mineral regulatory framework, and well-established technical institutions, positioning it as a strategic actor in global agendas related to sustainable development, the energy transition, and food security.

Brazil also benefits from a uniquely clean energy matrix, with approximately 50% of total energy consumption derived from renewable sources[2], notably hydropower, biomass, wind, and solar energy. This characteristic provides a competitive advantage in the production of mineral and industrial goods with lower carbon intensity, reinforcing the country's role in the global energy transition.

Mining is a historically significant sector of the Brazilian economy, contributing substantially to gross domestic product (GDP), the trade balance, and employment. In 2024, the sector generated revenues of USD 49.7 billion and accounted for 47% of the country's trade surplus[1]. Brazil ranks among the world's leading producers and reserve holders of strategic minerals such as niobium, iron ore, nickel, graphite, vanadium, lithium, and rare earth elements, supporting key global supply chains.

In parallel, the modernization of the mining sector has advanced through regulatory improvements, strengthened environmental, social, and governance (ESG) practices, and enhanced transparency, including the public availability of geological and mineral data by institutions such as the Geological Survey of Brazil (SGB-CPRM). National policies aim to attract foreign investment, foster public–private partnerships, and deepen mineral value chains, promoting value addition, innovation, and regional development. SGB-CPRM has strengthened initiatives to structure and make available a portfolio of mineral assets and targets for potential market opportunities, supporting new investments and partnerships and contributing to the expansion of Brazil's critical and strategic mineral supply.

Within this context, the publication An Overview of Critical and Strategic Minerals Potential of Brazil consolidates key geoscientific information on the country's mineral potential, with emphasis on critical and strategic minerals. It provides up-to-date data on production, reserves, national programs, and thematic studies, serving as a technical reference to support analysis, planning, and decision-making by public authorities, industry, academia, and other stakeholders.

[1] INSTITUTO BRASILEIRO DE MINERAÇÃO. IBRAM Yearbook – Mining in Brazil: base year 2024 (in Portuguese). Brasília: IBRAM, 2025. Available at: https://ibram.org.br/wp-content/uploads/2025/10/IBRAM_Anuario_IBRAM_Mineracao_do_Brasil_WEB.pdf. Accessed on: 26 Dec. 2025.
[2] EMPRESA DE PESQUISA ENERGÉTICA. BEN 2025: summary report – reference year 2024. Rio de Janeiro: EPE, 2025. Available at: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-885/topico-767/BEN_S%C3%ADntese_2025_EN.pdf. Accessed on: 18 dec. 2025.

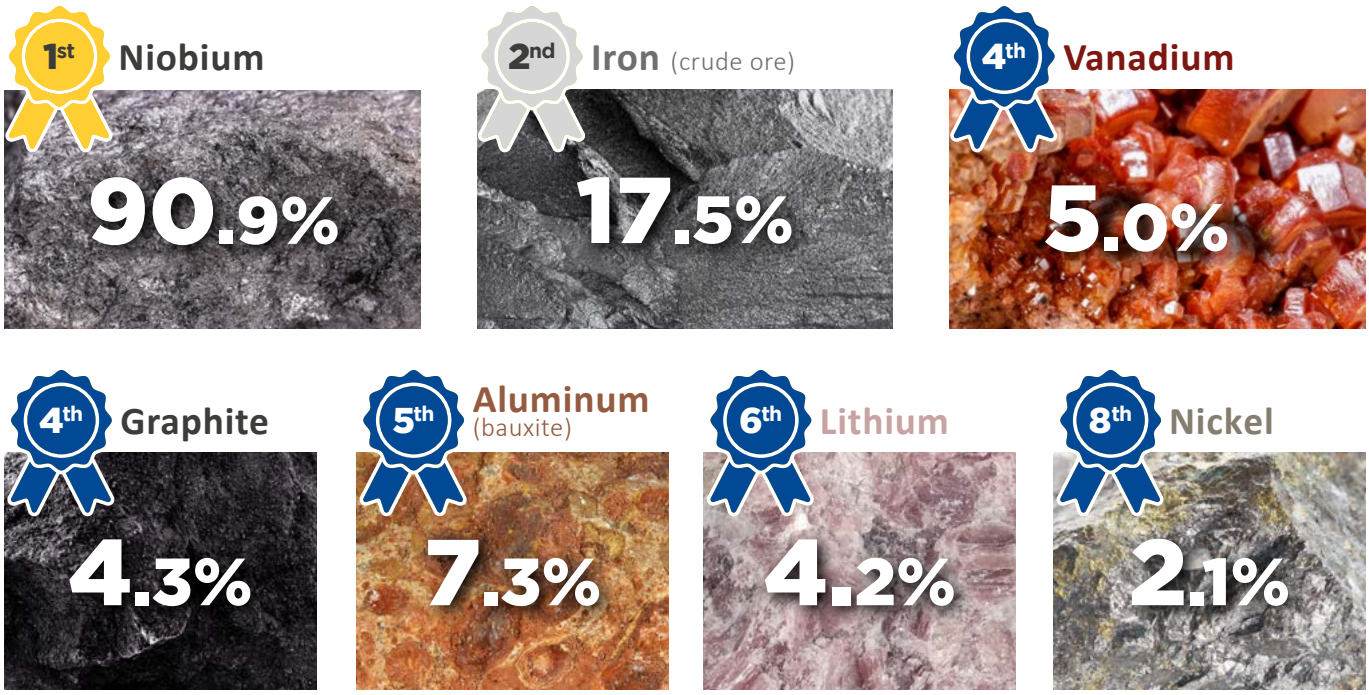
Table 1.1: Mineral commodities produced in Brazil, 2023-2024[1].

#	Mineral Commodities	#	Mineral Commodities
1	Abrasives	49	Marble
2	Agalmatolite	50	Mica
3	Agate	51	Mineral water
4	Amethyst	52	Molybdenum
5	Apatite (phosphate)	53	Monazite sands
6	Barite	54	Nepheline syenite
7	Basalt	55	Nickel
8	Bauxite	56	Niobium
9	Bentonite	57	Opal
10	Beryllium (beryl)	58	Peat
11	Calcareous shells	59	Phosphate rock
12	Calcite	60	Phyllite
13	Carnallite	61	Platinum Group Metals (PGM)
14	Cassiterite (tin ore)	62	Potash (potassium-bearing rocks)
15	Chromite	63	Pyrophyllite
16	Chrysoberyl (alexandrite)	64	Quartz
17	Clay (ceramic)	65	Quartzite
18	Clayey sand	66	Rare earth elements (REE concentrates)
19	Cobalt	67	Refractory clays
20	Columbite-tantalite	68	Rock crystal (quartz)
21	Copper	69	Rock salt
22	Crushed stone	70	Rutile
23	Diamond	71	Saltpeter (natural nitrate)
24	Diatomite	72	Sand
25	Dolomite	73	Sandstone
26	Emerald	74	Sapropelite
27	Feldspar	75	Scheelite (tungsten ore)
28	Fluorite	76	Sea salt
29	Garnet	77	Serpentinite
30	Gibbsite	78	Silicon (metallurgical grade)
31	Gneiss	79	Sillimanite
32	Gold	80	Slate
33	Granite	81	Specialty clays
34	Graphite	82	Spodumene (lithium ore)
35	Gravel	83	Steatite (soapstone)
36	Gypsum	84	Sulfur
37	Ilmenite	85	Talc
38	Industrial sand	86	Tantalum
39	Iron ore	87	Tin ore
40	Itabirite (iron ore)	88	Titanium ore
41	Jasper	89	Topaz (incl. imperial topaz)
42	Kaolin	90	Tourmaline
43	Kyanite	91	Tungsten
44	Lepidolite	92	Uranium
45	Limestone	93	Vanadium
46	Lithium	94	Vermiculite
47	Magnesite	95	Zinc
48	Manganese	96	Zircon

2 Highlights of Brazil's Mineral Production and Reserves in a Global Context

By Izaac Cabral Neto (izaac.cabralneto@sgb.gov.br)

2.1 Brazil's Mineral Production (Global Ranking)



2.2 Brazil's Ore Reserves (Global Ranking)

U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 7 jan. 2026.

3 The New Geological Map of Brazil: 20 Years of Updated Geological Cartography

By Frank Gurgel Santos (frank.santos@sgb.gov.br), Vladimir Cruz de Medeiros (vladimir.medeiros@sgb.gov.br) and Patrick Araújo dos Santos (patrick.santos@sgb.gov.br)

In 2025, the SGB-CPRM released a new edition of the Geological Map of Brazil (Fig. 3.1), consolidating recent advances in basic geological mapping. This product integrates and synthesizes geological knowledge generated by multiple mapping and mineral research projects carried out across the Brazilian territory over the past two decades (Fig. 3.2), resulting in an updated representation of Brazil's geology. The PDF map (1:5M scale) and vector files (1:2.5M scale) are available for download on the GeoSGB portal (https://geosgb.sgb.gov.br), and Institutional Repository of Geosciences – RIGeo (https://rigeo.sgb.gov.br/handle/doc/25601).

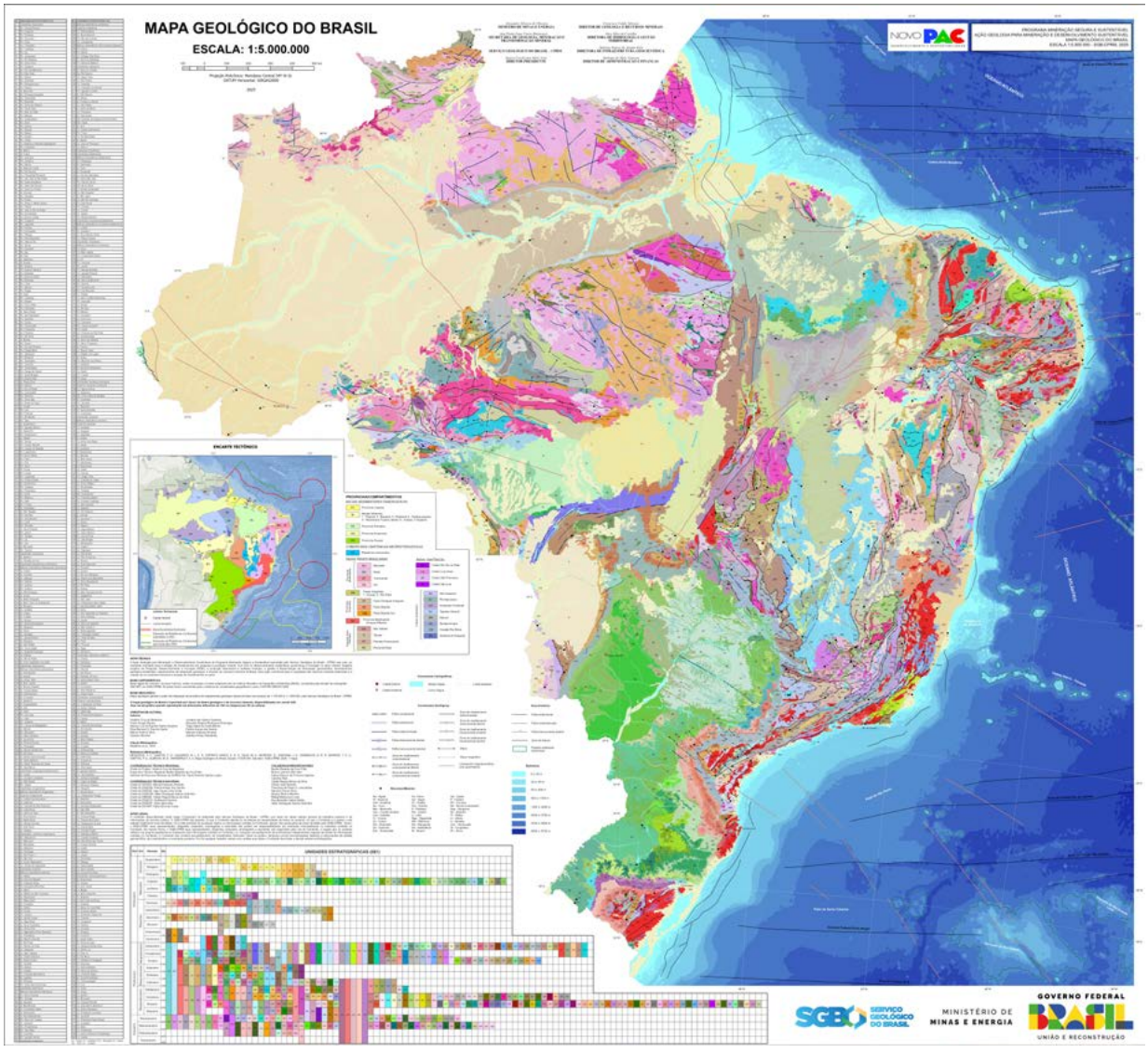


Fig. 3.1: New Geological Map of Brazil[1] (available at https://rigeo.sgb.gov.br/handle/doc/25601).

More than a cartographic product, the new Geological Map of Brazil is a strategic tool for attracting investment to the Brazilian mineral sector and stimulating research and mineral exploration initiatives aligned with sustainable development. In a global context marked by growing demand for critical and strategic minerals essential to the energy transition and low-carbon technologies, the map positions Brazil as a key player in the emerging mineral geoeconomy.

By providing a robust scientific foundation on Brazil's geological framework and mineral potential, the new map strengthens conditions for investment, supports the identification of new exploration frontiers, and reinforces

Brazil's role as a global supplier of technologically essential mineral resources such as lithium, nickel, copper, rare earth element (REE), and graphite. The release of this product reaffirms the commitment of the SGB-CPRM to scientific excellence, public data transparency, and the advancement of the Brazilian mineral sector.

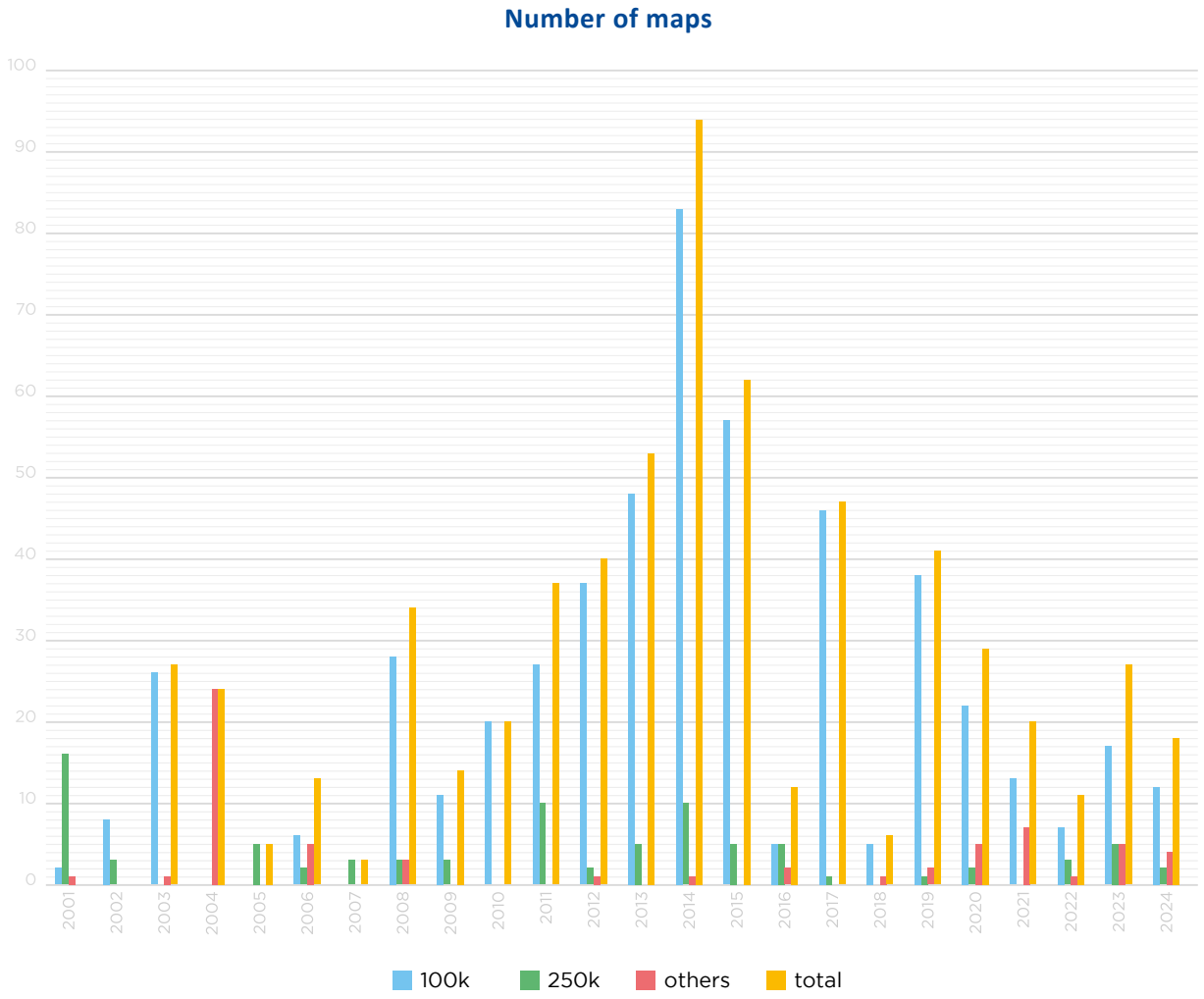


Fig. 3.2: Geological maps production by SGB-CPRM over the last 20 years, grouped by year and work scale.

Overall, the map depicts Brazil's geological framework, comprising Precambrian cratons surrounded by Neoproterozoic-Cambrian mobile belts and partially overlain by Phanerozoic sedimentary basins. In northern Brazil, the Amazon Craton hosts major mineral provinces containing significant reserves – including world-class deposits – of iron, copper, gold, manganese, nickel, tin, lead, and zinc, highlighting its potential for critical minerals essential to the global energy transition. The São Luís and São Francisco cratons likewise rank among Brazil's key geotectonic entities, containing important deposits of iron, copper, gold, nickel, vanadium, uranium, and manganese. Brazilian pegmatite provinces are emerging as new exploration frontiers, notable for lithium, tantalum, and beryl occurrences. Similarly, Brazil's alkaline provinces show important phosphate and niobium deposits and strong potential for REE deposits, increasingly relevant to low-carbon technologies. The Brasília and Ribeira belts host significant niobium and REE mineralizations – strategic resources for high-technology industries – whereas the Tocantins Province offers promising potential for copper and nickel sulfide systems. In northeastern Brazil, the Borborema Province stands out for its deposits of gold and tungsten, as well as critical minerals such as lithium and graphite. Brazil's Phanerozoic sedimentary basins play a central role in energy, food, and water security, hosting most of the country's industrial minerals, agricultural inputs, construction aggregates, and energy-related mineral resources. These basins also form some of Brazil's most important groundwater reservoirs.

[1] MEDEIROS, V. C.; SANTOS, F. G.; QUADROS, M. L. E. S.; SANTO, E. B. S. E.; SILVA, M. A.; MOREIRA, G.; SANTANA, J. S.; DOMINGOS, N. R. R.; BARROS, T. S. C.; SANTOS, P. A.; ALMEIDA, M. E.; WANDERLEY, A. A. *Geological map of Brazil, scale 1:5,000,000*. Salvador: Serviço Geológico do Brasil, 2025. 1 map, color. Available at: https://rigeo.sgb.gov.br/handle/doc/25601. Accessed on: 19 jan. 2026.

4 Geological Mapping in Brazil: Current Status and Decennial Planning (PlanGeo 2025–2034)

By Lúcia Travassos da Rosa-Costa (lucia.costa@sgb.gov.br), Marcos Vinícius Ferreira (marcos.ferreira@sgb.gov.br), Marcelo Esteves Almeida (marcelo.esteves@sgb.gov.br), Patrick Araújo dos Santos (patrick.santos@sgb.gov.br) and Vladimir Cruz de Medeiros (vladimir.medeiros@sgb.gov.br)

The systematic geological mapping of the Brazilian continental territory is one of the core responsibilities of the SGB-CPRM, which has historically prioritized mapping at the 1:250,000 and 1:100,000 scales. The former is essential for regions with limited geological knowledge and access, particularly in the Amazon, while the latter is regarded the minimum scale for assessing mineral potential and supporting studies on the mineral favorability of geological targets of interest.

The coverage of geological mapping carried out up to 2025 shows that approximately 50% of the Brazilian continental territory is mapped at the 1:250,000 scale, while 28% has been mapped at the 1:100,000 scale (Fig. 4.1). When considering the Precambrian shields, areas that received greater attention in the geological cartography programs, the coverage reaches 70% and 44% at the 1:250,000 and 1:100,000 scales, respectively.

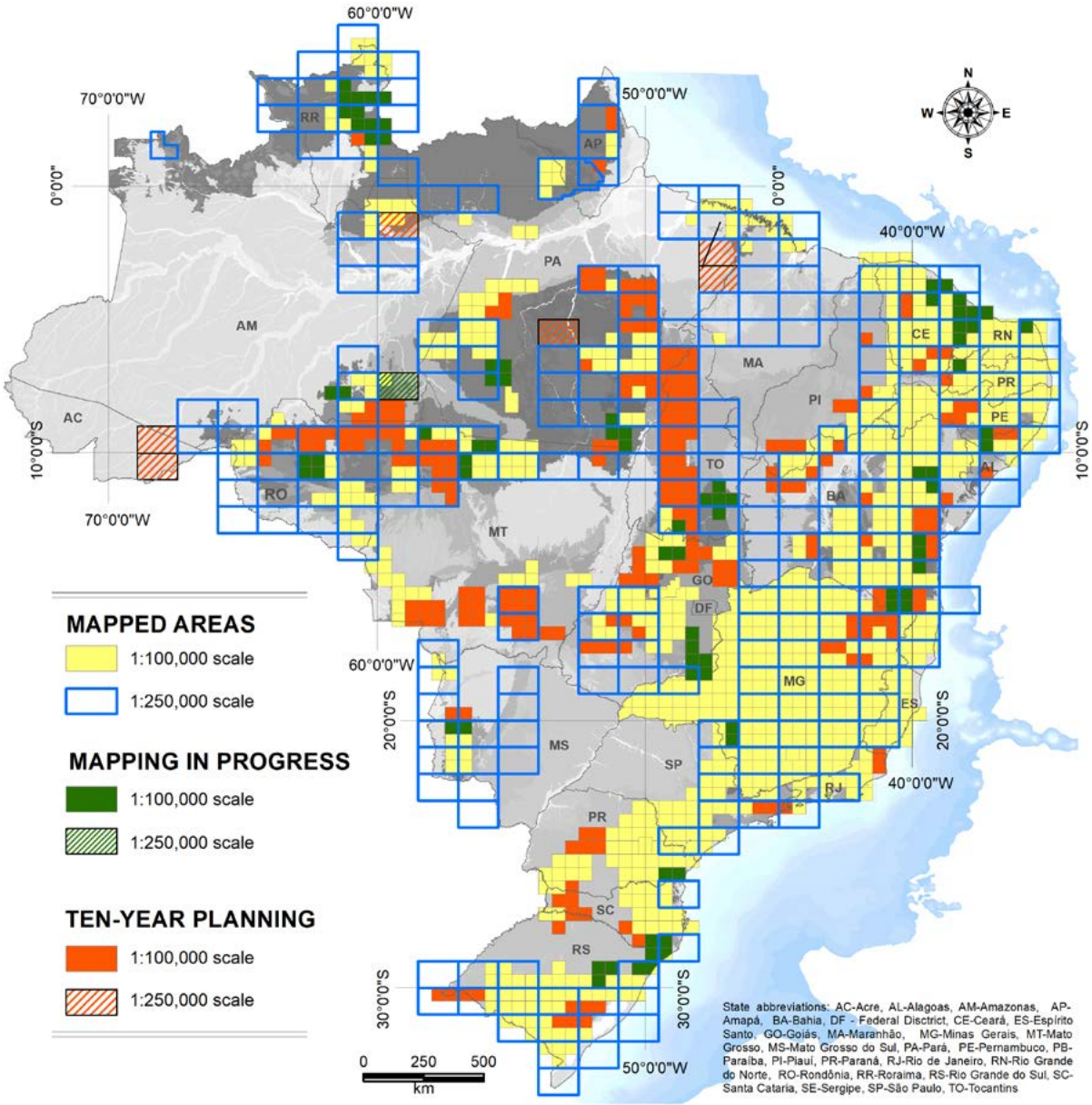


Fig. 4.1: Mapped areas, mapping in progress, and the ten-year geological mapping plan in Brazil.

The expansion of Brazil's geological mapping coverage is fundamental for attracting investments in mineral exploration. Geological, geophysical, and geochemical surveys constitute an indispensable triad for reducing exploration risk and supporting the discovery of new mineral deposits. It is also important to emphasize that geological mapping extends beyond its applications in mineral exploration, serving as a foundational knowledge base for a wide range of activities, such as water-resource research and management, studies of landscape-evolution processes, geodiversity assessments, land-use planning, and territorial management, as well as teaching and research in geosciences.

Given the recognition of the strategic importance of geological mapping for the country, the Brazilian Ministry of Mines and Energy issued Normative Ordinance No. 72/GM/MME (March 13, 2024), which formally established the PlanGeo (Decennial Plan for Basic Geological Mapping and Mineral Resource Surveys). This plan defines the guidelines and directives for ten-year planning of geological mapping execution and mineral resources research carried out by the SGB-CPRM.

Building on this directive, the Decennial Basic Geological Mapping Plan was launched in 2025[1]. Its development involved representatives from the governmental, private, and academic sectors, who contributed through a public consultation process.

The prioritization of areas to be mapped was based on geological interest, with blocks distributed across mineral provinces and mining districts, as well as in regions that remain immature from an exploratory standpoint but hold potential for new mineral discoveries. Although the Precambrian shields were prioritized in the planning, the sedimentary basins were also included, with the goal of advancing the understanding of their tectono-stratigraphic framework and the mineral potential of these important geological targets, which cover extensive areas of the Brazilian territory.

Three implementation scenarios were considered for PlanGeo - Decennial Basic Geological Mapping Plan 2025-2034, based on the perspective of increasing the operational capacity of the SGB-CPRM during the period. This capacity depends directly on the expansion of human and financial resources fostered by the federal government, but it also requires the formation of profitable partnerships with other interested parties, notably Brazilian universities, state geology and mining institutions, and mineral research and exploration companies. In the most optimistic execution scenario, the systematic mapping of over 1 million km² at a scale of 1:100,000 and approximately 234,000 km² at a scale of 1:250,000 is scheduled. This would represent an additional mapped area coverage of approximately 15% of the national territory.

In 2026, systematic geological mapping projects are underway at different stages of execution, distributed throughout all regions of the country. The projects include geological targets located in the Amazon and São Francisco cratons, in the Borborema and Tocantins provinces, and in the Paraná Basin.

These areas were prioritized due to their potential for critical and strategic minerals, such as Cu, REE, Li and graphite, essential for the development of green technologies to enable the global energy transition. Phosphate and potash were also prioritized to reduce Brazil's external dependence on fertilizer imports, strengthen the agricultural sector, and ensure the population's food security.

[1] ROSA-COSTA, L. T.; FERREIRA, M. V.; ALMEIDA, M. E.; SANTOS, P. A.; MEDEIROS, V. C. (eds.). *PlanGeo 2025–2034*: decennial plan for geological mapping (in Portuguese). Brasília, DF: Geological Survey of Brazil, 2024. Available at: https://rigeo.sgb.gov.br/handle/doc/24990. Accessed on: 27 jan. 2026.

5 Mineral Resources Research in Brazil: Decennial Planning (PlanGeo 2026–2035)

By Izaac Cabral Neto (izaac.cabralneto@sgb.gov.br), Maisa Bastos Abram (maisa.abram@sgb.gov.br), Rogério Celestino de Almeida (rogerio.almeida@sgb.gov.br) and Marcos Vinícius Ferreira (marcos.ferreira@sgb.gov.br)

Investments in basic geological and mineral resources research are essential to support Brazil's strategic planning and long-term development, providing knowledge that reduces exploration risks and supports informed public policies in the context of the energy transition and sustainable development.

The PlanGeo - Decennial Plan for Basic Geological Mapping and Mineral Resource Surveys, prepared by the SGB-CPRM, aims to generate pre-competitive geological knowledge in support of the country's strategic and economic development. The Plan follows the schedule established by the Ministry of Mines and Energy, and is aligned with national strategic planning instruments.

PlanGeo - Decennial Plan for Mineral Resource Surveys 2026–2035 defines as central priorities strategic and critical minerals for the energy transition – such as lithium, copper, rare earth elements, and nickel – as well as minerals essential to food security, with emphasis on potassium, phosphate, and agrominerals. Its scope includes the review and expansion of thematic projects, the strengthening of sustainability- and mineral-economics-related studies – particularly those focused on circularity and impact mitigation – and the provision of technical support for strategic planning.

In its full scenario, the portfolio comprises 259 projects and the delivery of 520 products (maps, GIS files, technical reports, databases, scientific articles) over the 2026–2035 period. The methodological approach prioritizes advanced, state-of-the-art geophysical and geochemical techniques. Target areas are defined based on geological potential, excluding areas subject to legal restrictions (national parks, Indigenous lands, and forest reserves). The final version of the Plan incorporates the results of the public consultation conducted online between May 1 and June 15, 2025.

The Plan will be subject to biennial review and updating to account for changes in the geopolitical context and mineral market conditions. Among the proposed innovative budgetary initiatives is the "Expansion of the Subsurface Exploratory Frontier," which seeks to apply geophysical data to the investigation of deep crustal domains and to improve predictive models for new mineral discoveries (see chapter 7).

PlanGeo 2026–2035 is publicly available[1] through the SGB-CPRM's institutional repository and mineral resources platform (https://www.sgb.gov.br/recursos_minerais), ensuring transparency, broad access, and coordination among government, industry, academia, and other stakeholders.

[1] ABRAM, M. B.; CABRAL NETO, I.; ALMEIDA, R. C.; FERREIRA, M. V (eds.). *PlanGeo 2026–2035*: decennial plan for mineral resources research (in Portuguese). Brasília, DF: Geological Survey of Brazil, 2025. Available at: https://rigeo.sgb.gov.br/handle/doc/25649. Accessed on: 26 dec. 2025.

6 SGB-CPRM Geochemical Survey: Expansion, Recovery and Dissemination Program

By Daliane Bandeira Eberhardt (daliane.eberhardt@sgb.gov.br) and Eduardo Duarte Marques (eduardo.marques@sgb.gov.br)

Global demand for critical and strategic minerals, driven by the energy transition and technological development, is intensifying the need for reliable geoscientific information to support mineral exploration and territorial planning. As easily accessible resources become increasingly scarce, strengthening national geochemical knowledge is essential to identify new exploration targets, reduce geological uncertainty, and improve environmental and land-use decision-making.

In this context, geochemistry plays a fundamental role by providing systematic information on the spatial distribution of chemical elements at regional and local scales. These data support a wide range of applications, including:

I. Regional geological and metallogenic mapping;

II. Mineral prospectivity and favorability modeling;

III. Identification of geochemical anomalies associated with critical and strategic minerals;

IV. Environmental baseline characterization and monitoring;

V. Soil and sediment quality assessment;

VI. Support for hydrogeological and land-use studies;

VII. Territorial planning and sustainable resource management.

To consolidate and expand this information infrastructure, the SGB-CPRM created the Geochemical Survey Expansion, Recovery, and Dissemination Program to recover, update, standardize, and disseminate the national geochemical database. The program focuses on digitizing historical sample collections and analytical results, incorporating new surveys, expanding territorial coverage across all metallogenic provinces, and public dissemination of georeferenced data and maps through the Institutional Repository of Geosciences (RIGeo) and the SGB-CPRM Geoportal.

Since its inception, the program has made significant progress, achieving data consistency and releasing 188 geochemical projects up to November 2025, totaling 162,587 samples available for download. These include rock, stream sediment, soil, panned concentrate, gold grain, and drill-hole data, representing a substantial advance in the integration and standardization of national geochemical information (Fig. 6.1). This consolidated database enables new geological interpretations and increases efficiency in the identification of areas favorable for the occurrence of critical and strategic minerals.

In parallel, a wide range of geochemical studies has been published over the last five years, including geochemical atlases, thematic and regional prospecting reports, and integrated geology–geophysics–geochemistry studies. These works emphasize the generation of multi-element anomaly maps, the definition of anomaly thresholds, the application of exploratory statistics, and the use of GIS-based 2D and 3D modeling to improve target definition. Methodological advances, such as studies on grain-size effects in stream sediments, have contributed to more robust interpretations by reducing analytical bias and minimizing false anomalies. Thematic projects focused on lithium and pegmatite potential further illustrate the strategic role of a high sampling density regional geochemical survey (1 sample/10 km²) and high-quality chemical analysis in identifying prospective areas.

Fig. 6.1: The SGB-CPRM Geoportal (available at https://geoportal.sgb.gov.br/geoquimica) highlights the spatial distribution of the compiled projects and their respective sample types.

6.1 Geochemical Studies Published in the Last 5 Years

- Geochemical Atlases- consolidation of soil/rock/sediment geochemical data, thematic maps (elemental spatial distribution), regional anomaly identification, exploratory statistics, granulometric normalization, and map generation to support mineral prospecting and environmental studies.
- Thematic or Regional Geochemical Reports- prospecting reports based on map sheets showing metallogenic anomalies in stream sediments, including upstream/downstream flow direction interpretation, integration with local geology to prioritize follow-up sampling areas, anomaly threshold establishment, and element ratio plots (e.g., Cu/Zn, Pb/Zn) with anomaly maps.
- Geology-Geophysics-Geochemistry Integration Studies- multi-dataset integration to improve the resolution of structural interpretations and correlate geophysical and geochemical anomalies, using GIS overlays, 2D/3D modeling, and favorability maps.
- Methodological Studies on Grain Size Effects in Stream Sediments (2023)- comparison of sampling methods and granulometric fraction effects on elemental results, evaluation of sampling biases, recommendations for analytical fractions in prospecting, and statistical corrections for more robust geochemical interpretations (avoiding false positives/negatives).
- Mineral Resource Evaluation and Metallogenic Province Studies- synthesis of regional data to understand crustal evolution and metallogenic controls, creation of multi-element anomaly maps, and proposals for mineral interest areas. For example: Roosevelt Group / ARIM (2020), available at https://rigeo.sgb.gov.br/handle/doc/20421.
- The Thematic Projects *Lithium* and *Pegmatite Potential Assessment (2021-2026)*- series of reports evaluating lithium potential through integrating pegmatite, stream sediment (sampling and chemical analysis) and mineralogical data, with mapping of Li-Cs-Rb anomalies, correlation with known pegmatite fields, and identification of prospective areas using multi-element indices and regional comparison patterns.

7 National Geophysical Programs

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Global demand for strategic minerals, hydrocarbons, and carbon-free energy is outpacing the rate of new discoveries. This trend reflects the depletion of shallow, easily identifiable resources and underscores the need for deeper exploration. Advancing subsurface knowledge of the national territory is therefore essential to reveal new exploration targets, reduce geological uncertainties, and strengthen energy security in the context of the global energy transition.

In this context, geophysics emerges as an indispensable tool, enabling the characterization of the subsurface from shallow to deep levels. These data support a wide range of applications, including:

I. Multi-scale geological mapping;

II. Mineral prospectivity and favorability modeling;

III. Assessment of emerging energy resources, such as geothermal energy and natural hydrogen;

IV. Hydrocarbon exploration support;

V. Hydrogeological mapping;

VI. Identification of reservoirs for carbon capture, utilization, and storage (CCUS);

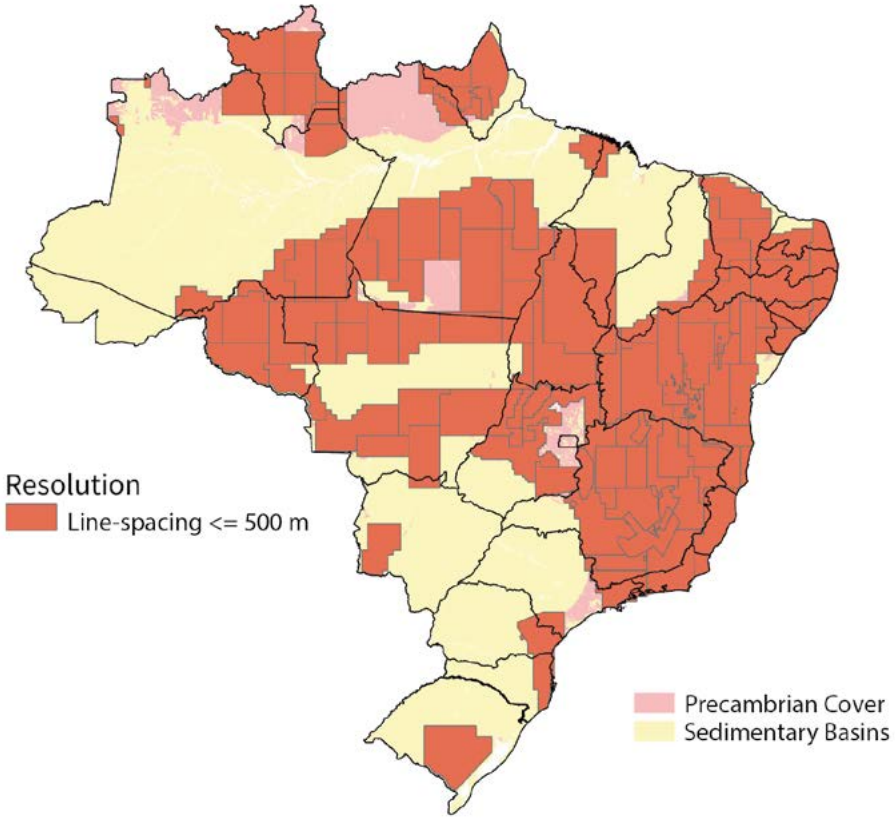
VII. Land-use and territorial planning.

Since the early 1970s, the SGB-CPRM has been the primary institution responsible for acquiring airborne geophysical surveys in Brazil. Between 2004 and 2014, SGB-CPRM invested approximately USD 183 million in airborne geophysical data acquisition. Additional surveys were conducted by other institutions, including the Companhia Baiana de Produção Mineral (CBPM), the Companhia de Desenvolvimento Econômico de Minas Gerais (CODEMIG), the National Agency of Petroleum, Natural Gas and Biofuels (ANP), and the state governments of Goiás, Bahia, and Minas Gerais. As a result, approximately 51% of Brazil's territory is currently covered by airborne gamma-ray spectrometry and magnetometry surveys with line spacing of 500 m or less. When considering only the crystalline basement, this coverage reaches approximately 86% (Fig. 7.1).

Despite this significant progress, large portions of the country remain uncovered by these traditional geophysical methods. Therefore, the resumption of systematic airborne geophysical surveys is imperative to achieve full national coverage. Moreover, the integration of new technologies and methodologies, such as time-domain electromagnetic (TDEM) surveys and gravimetry, is essential to enhance the potential for identifying new exploration targets.

Recognizing the strategic importance of geophysical data for national development, the SGB-CPRM launched the Deep Earth Exploration of Brazil Program (DEEP Brazil) in 2025. The program is based on the systematic acquisition of geophysical data through both airborne and ground-based surveys, with the objective of assessing Brazil's deep subsurface potential for natural resources and supporting long-term resource and energy planning.

a) Airborne Geophysical Projects



b) Ternary Map

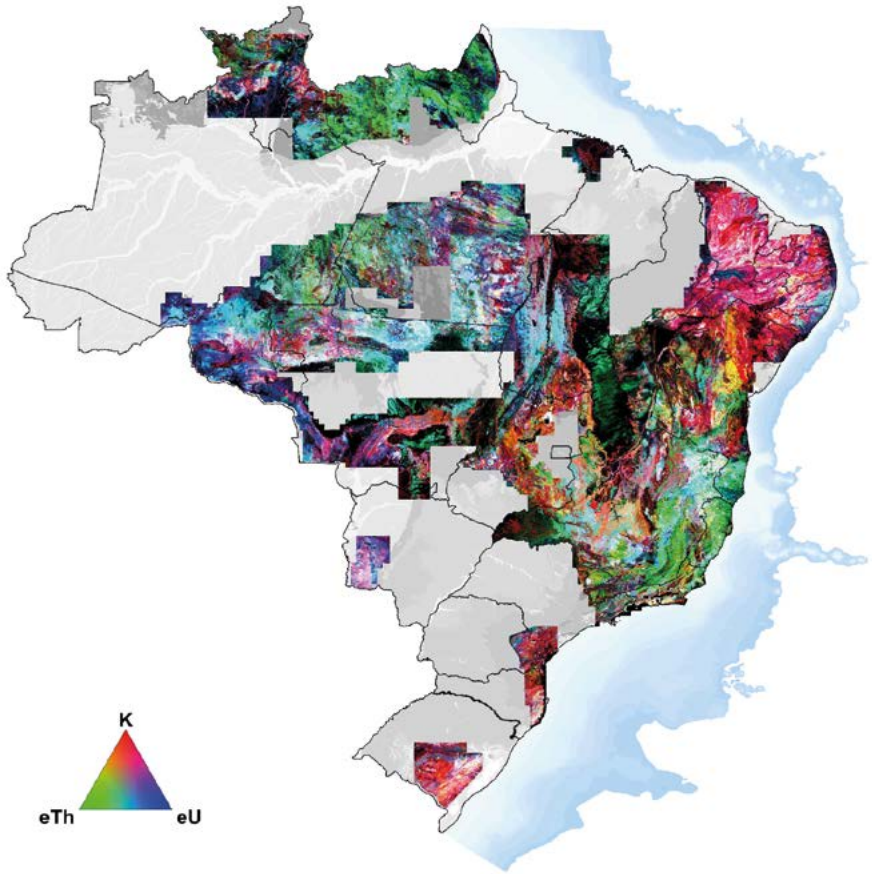


Fig. 7.1: a) Coverage of Brazil by airborne magnetometry and gamma-ray spectrometry surveys with flight-line spacing of less than 500 meters, and b) Integrated ternary gamma-ray map of Brazil.

In 2025, the DEEP Brazil Program achieved significant progress across both airborne and ground-based operations. The public tender for airborne geophysical data acquisition was completed and the first survey contract signed, representing an investment of approximately USD 2 million. Ground-based campaigns advanced in parallel. To date, 122 long-period magnetotelluric stations have been deployed, covering about 340,000 km² (~4% of Brazil 's territory and ~8% of the non-Amazonian biomes), with results disseminated through technical–scientific events and peer-reviewed publication. In addition, 1,835 ground gravity stations were acquired, covering approximately 96,000 km², including nearly 70% of the available area (without legal access restrictions) in the state of Rondônia on a 5 km grid. Table 7.1 and Fig. 7.2 summarize the current acquisition status and spatial coverage of the DEEP Brazil Program.

Table 7.1: Summary of geophysical datasets acquired within the DEEP Brazil Program up to 2025.

GEOPHYSICAL METHODS	NUMBER OF STATIONS OR LINEAR KILOMETERS	AREA (km²)	STATION OR LINE SPACING
Airborne Geophysics: magnetometry, radiometry and strapdown gravimetry	42,889	20,329	250 m
Magnetotellurics	122	340,000	50 km
Ground Gravity	1,835	96,000	5 km

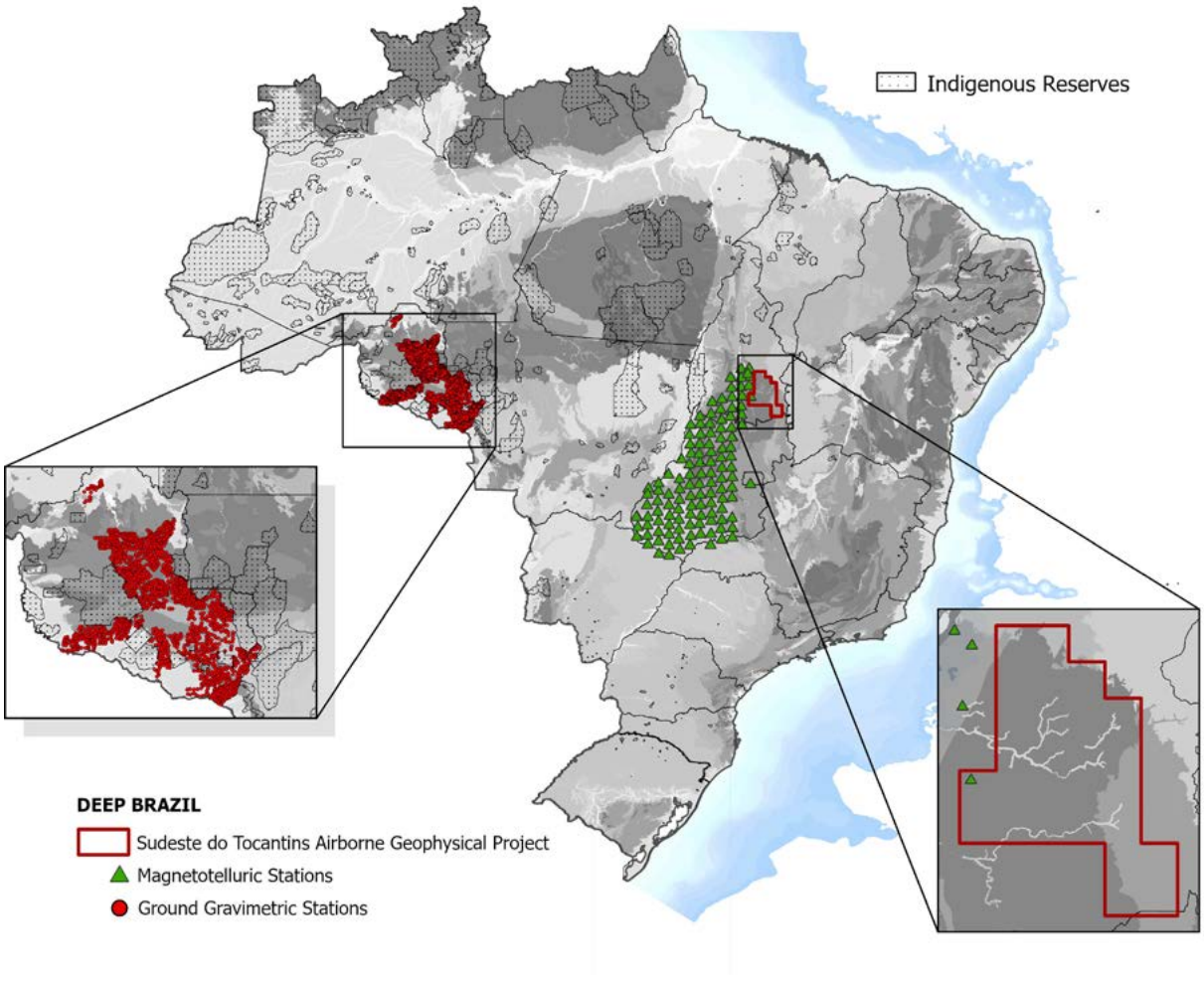


Fig. 7.2: Geophysical datasets acquired within the DEEP Brazil Program up to 2025.

Through the continued expansion and integration of these datasets, the DEEP Brazil Program is establishing a robust geophysical framework for deep exploration in Brazil, strengthening subsurface knowledge, reducing exploration risk, and enhancing the country's capacity to support sustainable development.

The program's expansion strategy is built on active engagement with government agencies, research institutions, and industry partners. Future survey areas will be prioritized through collaborative planning, balancing national strategic interests with private-sector exploration needs. This approach not only optimizes public investment but also creates shared value, reducing exploration risk for companies while building a comprehensive geophysical knowledge base that strengthens Brazil's position in global critical mineral and energy supply chains.

Scan the QR code for more details about the DEEP Brazil Program

8 Geoscientific Knowledge Index of Brazil

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The availability of public, pre-competitive geoscientific datasets reduces geological risk and supports industry in identifying priority areas for mineral exploration. In Brazil, a country of continental scale, understanding the distribution and quality of this information is essential for guiding investment decisions and supporting public policy.

As part of a national geoscientific assessment, the SGB-CPRM developed the Geoscientific Knowledge Index (GKI), a methodology designed to measure the density of geoscientific knowledge across the Brazilian continental territory. The index is based on georeferenced datasets that are publicly available through the SGB portal, reflecting data availability up to 2025. Scaled from 1 to 10, the GKI quantifies the coverage and density of geoscientific information, enabling consistent regional comparisons.

The GKI is calculated using a weighted sum that reflects the relative contribution of key public geoscientific domains:

$$GKI = (2 \times GEI) + (0.5 \times GII) + GPI + GCI + MRI$$

Where:

GEI – Geology Index: systematic geological mapping produced by the SGB-CPRM at scales ranging from 1:25,000 to 1:2,500,000.

GII – Geological Integration Index: thematic and integrative geological products derived from regional geological mapping, including geophysical–geological integration and state-level geological compilations.

GPI – Geophysics Index: geophysical survey datasets weighted by spatial resolution and data quality, including airborne geophysics (radiometrics and magnetics), ground gravity, magnetotelluric, hyperspectral, and seismic surveys.

GCI – Geochemistry Index: regional geochemical survey datasets derived from rock samples, stream sediment, heavy mineral concentrate, and soil sampling.

MRI – Mineral Resources Index: technical reports and mineral prospectivity maps produced by the GSB, documenting mineral occurrences and resource assessments.

In the calculation of the GKI, all geoscientific domains were assigned an equal weight of 1, with two exceptions. The Geology Index (GEI) was assigned a weight of 2, as geological mapping provides the primary framework for the use of other geoscientific datasets. The Geological Integration Index (GII) was assigned a weight of 0.5, as it represents derivative products compiled from existing geological maps. This reduced weighting avoids over-representing areas that are already covered by geological cartography.

By integrating these datasets into a single spatial framework (Fig. 8.1), the GKI enables both visual and quantitative identification of areas with higher concentrations of geoscientific data, as well as regions where knowledge gaps persist.

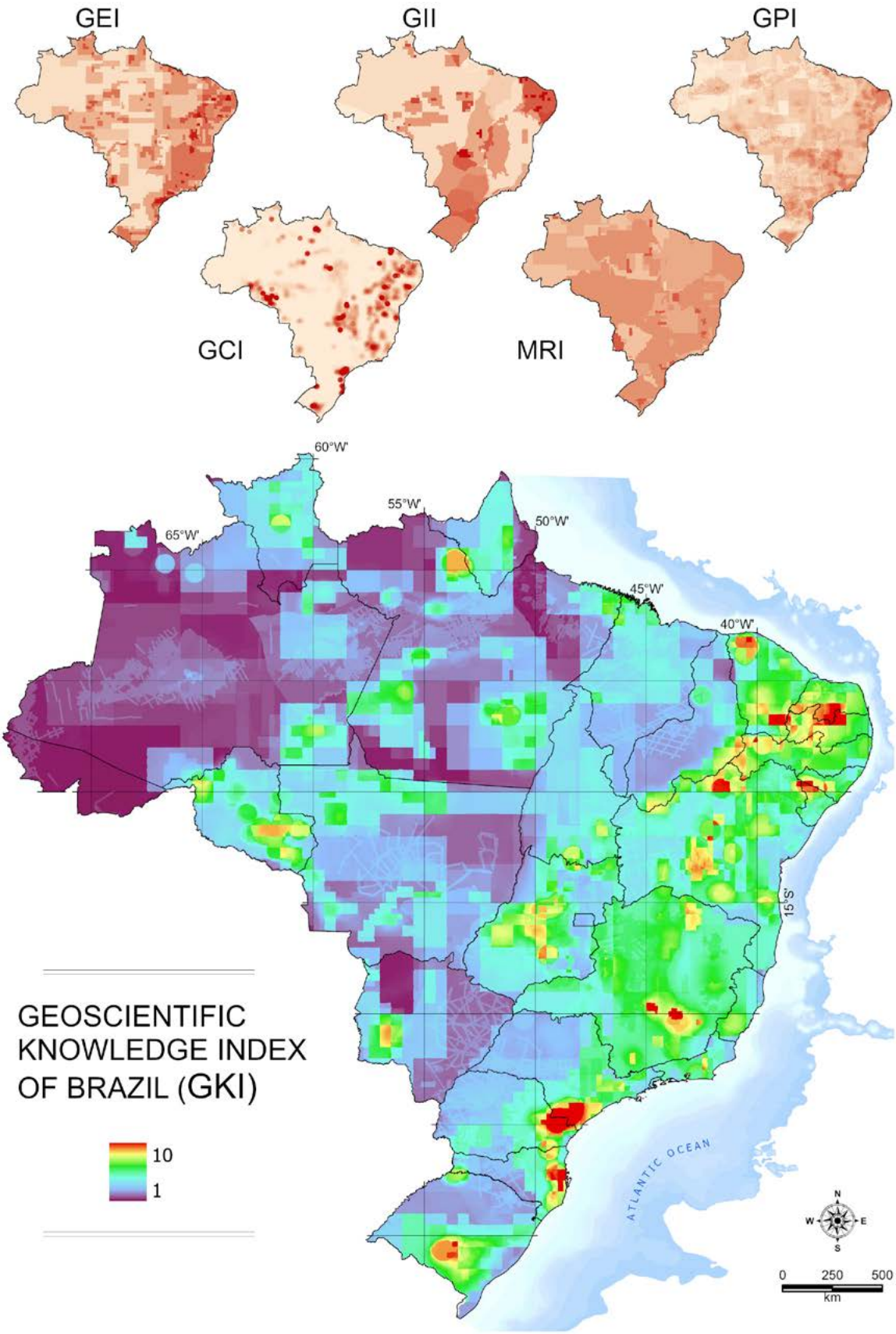

Fig. 8.1: Map illustrating geoscientific knowledge levels across Brazil.

9 Commodity Summaries

9.1 Aluminum

By Roberto Loreti Júnior (roberto.loreti@sgb.gov.br)

Global bauxite reserves total approximately 29.0 billion metric tons (Gt), with Guinea holding the largest reserves at 7.4 Gt, followed by Australia (3.5 Gt), Vietnam (3.1 Gt), Indonesia (2.8 Gt), Jamaica (2.0 Gt) and Brazil (1.6 Gt)[1]. In terms of production, in 2024, Guinea leads globally with 130.0 million metric tons (Mt) of bauxite mined in 2023, followed by Australia (100.0 Mt), China (93.0 Mt), Indonesia (32 Mt), and Brazil (31.8 Mt). The state of Pará, in northern Brazil, hosts the country's largest bauxite reserves and has historically accounted for more than 90% of the Brazilian production. Minas Gerais follows with 7% of the output, while the states of São Paulo, Santa Catarina and Goiás collectively account for the remaining 3%.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]
1.62 Gt of bauxite	13	31.8 Mt of bauxite	Reserves 5th (9.3%) Production 5th (7.3%)

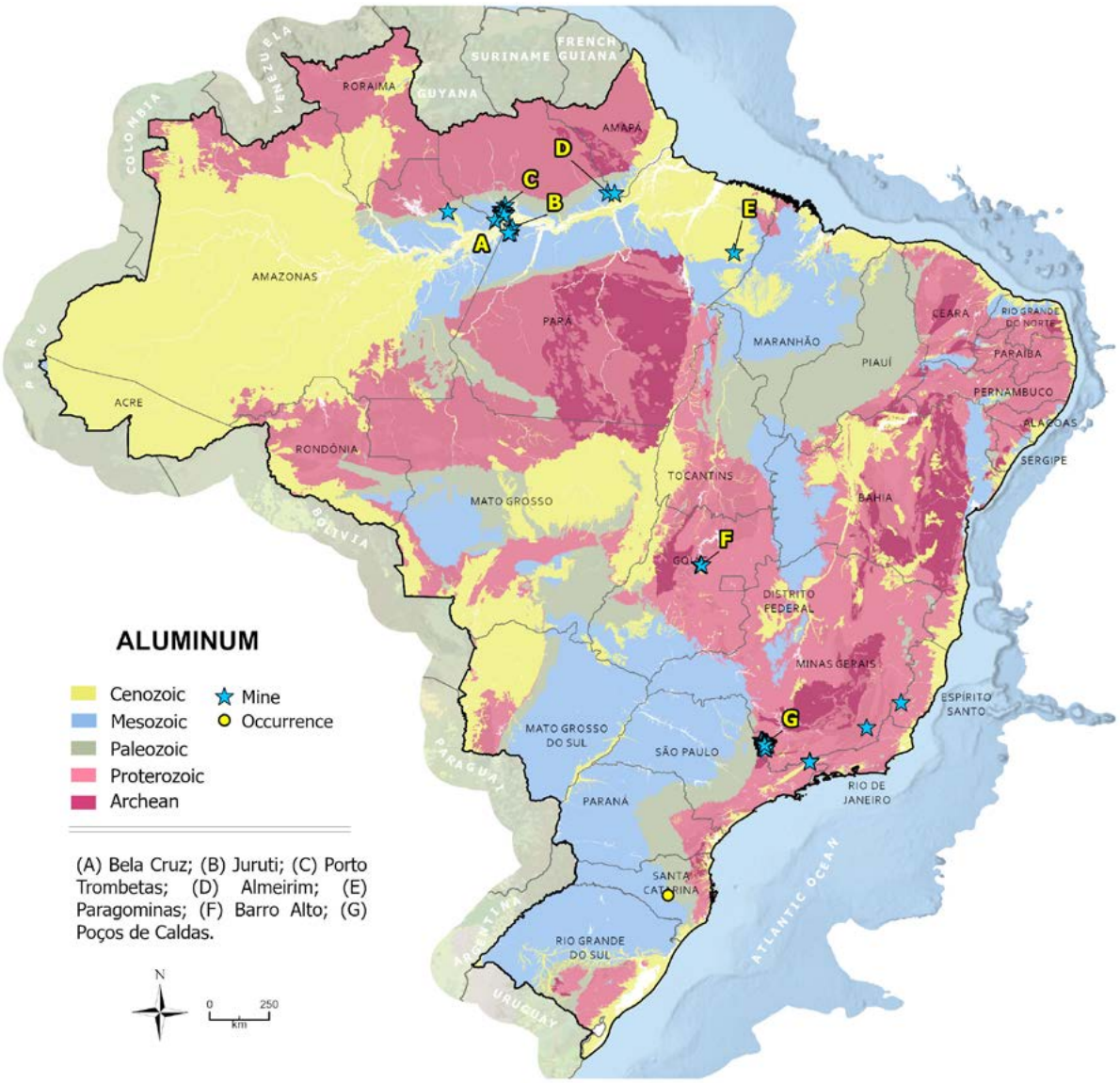

Fig. 9.1: Selected Brazilian aluminum occurrences and mines.

Highlights

- In Pará, the main mining and processing companies include Mineração Rio do Norte (MRN), Mineração Paragominas and Alcoa. MRN has announced a new project, Novas Minas, comprising five new plateaus – Rebolado, Escalante, Jamari, Barone and Cruz Alta Leste – located in the municipalities of Oriximiná, Terra Santa and Faro. In central Brazil, Companhia Brasileira de Alumínio (CBA) and Terra Goyana are significant players. Relevant bauxite occurrences are also reported in the states of Bahia, Maranhão and Amapá.
- The evolution of the lateritic-bauxite cover of the Amazon is polyphase and controlled by chemical and physical weathering processes under humid equatorial conditions. These conditions are responsible for Brazil's main bauxite reserves, concentrated in the region between Pará and Amazonas. In northeastern Pará, thick lateritic profiles have developed over Cretaceous siliciclastic rocks, particularly in the Paragominas region.
- In Minas Gerais, bauxite occurrences are associated with the alteration of metasedimentary rocks in the Quadrilátero Ferrífero and of granulitic rocks in the southeastern part of the state. In Goiás, bauxite originated from the alteration of Neoproterozoic anorthosites of the Barro Alto Mafic-Ultramafic Layered Complex.
- Before the discovery of major deposits in northern Brazil, bauxite hosted in alkaline complexes, particularly at Poços de Caldas (Minas Gerais), was the country's primary source of aluminum, accounting for 65% of national production until the 1970s. The subsequent dominance of Pará in bauxite production reflects changes in the industry development and the allocation of resources over time.

Table 9.1: Selected aluminum deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Al)	STATUS
Porto Trombetas	Al (Bauxite)	Mineração Rio do Norte	600	49.5	Operating
Paragominas	Al (Bauxite)	Norsk Hydro do Brasil	249.7	82.4	Operating
Juruti	Al (Bauxite)	Alcoa Alumínio	558.1	34.2	Operating
Barro Alto	Al (Bauxite)	Terra Goyana	180	56	Operating
Bela Cruz	Al (Bauxite)	Mineração Rio do Norte	55.9	50.2	Operating
Almeirim	Al (Bauxite)	MSL Minerais	46	57.4	Closed/ Exhausted
Poços de Caldas	Al (Bauxite)	Alcoa Alumínio	50	46	Operating

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.
[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

9.2 Chromium

By Geysson de Almeida Lages (geysson.lages@sgb.gov.br)

The world has more than 12 Gt of shipping-grade chromite, but 95% of it occurs in Kazakhstan and southern Africa. This strong supply concentration, combined with chromium's non-substitutability in stainless steel production, underscores its critical importance. Brazil holds ~3.9 Mt[1] of shipping-grade chromite, ranking seventh worldwide[2].

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]
3.9 Mt of contained Cr_2O_3	5	530 kt of contained Cr_2O_3	Reserves 7th (0.6%) Production 6th (3.0%)

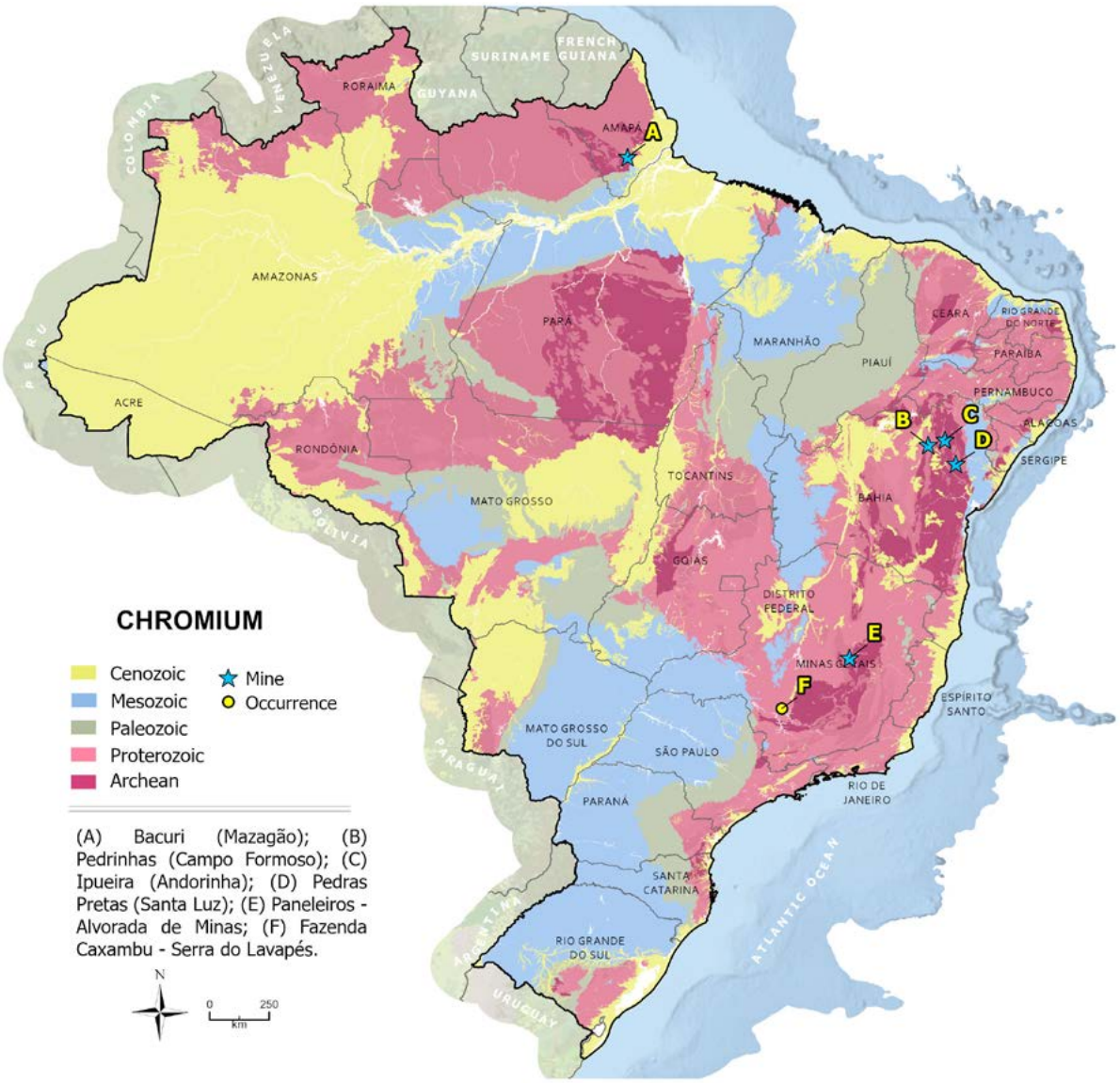

Fig. 9.2: Selected Brazilian chromium occurrences and mines.

Highlights

- Brazil remains the only chromite-producing country in the Americas. In 2024, it produced ~530 thousand metric tons (kt) of chromite ore, placing it 6th globally and contributing for about 3% of world output[2].
- Stratiform deposits hosted in the mafic-ultramafic complexes of Campo Formoso, Vale do Jacurici, and Pedras Pretas account for ~80% of national reserves (~4.84 Mt of contained metal). Key mines include Pedrinhas (10.31 Mt at 29.8% Cr_2O_3), Ipueira (2.70 Mt at 37.82%), and Pedras Pretas (1.89 Mt at 40.01%).
- New drilling in the Bacuri (Mazagão) Complex has revised resources to 3.39 Mt at 34.74% Cr_2O_3, representing a tenfold increase over the 2024 estimate. The complex now accounts for about 7% of Brazil's chromite resources.
- Smaller stratiform deposits at Serro, Alvorada de Minas (Paneleiros), and Piumhi (Lavapés), in Minas Gerais State, represent ~3% of the national reserve base. Paneleiros has 0.87 Mt at 20.07% Cr_2O_3 and is currently in operation, whereas the Fazenda Caxambu deposit in Serra do Lavapés remains undeveloped.
- Chromite associated with platinum group elements occurs in the Luanga and Cateté complexes (Carajás Province) and in the Tróia Suite (Borborema Province). The Tróia Project contains 17.9 Mt grading ~0.846% Cr_2O_3 and is currently at the feasibility stage.
- Podiform chromite, of limited economic importance, is found in Goiás State (Morro Feio, Cromínia, Abadiânia). It also occurs in the Araguaia Belt at in the Morro Grande and Quatipuru Complex, as well as in small occurrences such as the Gararu Project in Sergipe State.
- Companhia de Ferro Ligas da Bahia (Ferbasa) controls about 95% of Brazil's chromite resources. Its main operations-Coitezeiro (Campo Formoso) and Ipueira (Vale do Jacurici) – use both open-pit and underground mining methods and supply an integrated ferrochrome plant.

Table 9.2: Selected chromium deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Cr_2O_3)	STATUS
Pedrinhas (Campo Formoso)	Cr	Ferbasa	10.31	29.8	Operating
Bacuri (Mazagão)	Cr	Mineração Vila Nova	3.39	34.74	Operating
Ipueira (Andorinha)	Cr	Ferbasa	2.7	37.82	Operating
Pedras Pretas (Santa Luz)	Cr	RHI Magnesita	1.89	40.01	Operating
Paneleiros – Alvorada de Minas	Cr	Cromita Piumhiense	0.87	20.07	Operating
Fazenda Caxambu – Serra do Lavapés	Cr	Fazenda Caxambu – Serra do Lavapés	N/A	N/A	Unexploited

N/A – Not available.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 Dec. 2025.
[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025

9.3 Copper

By Rafael Bittencourt Lima (rafael.bittencourt@sgb.gov.br) and Francisco Sene Rios (francisco.rios@sgb.gov.br)

Brazil holds an estimated 79 Mt of copper reserves, equivalent to approximately 7.7% of global reserves[1], positioning the country as the sixth largest holder of copper reserves worldwide. In 2024, Brazil's beneficiated copper production amounted to 384 kt of contained copper, representing about 1.7% of global production, derived from a total run-of-mine (ROM) output of approximately 88 Mt. Copper production was concentrated mainly in the states of Pará, Goiás, Bahia, Alagoas, and Mato Grosso.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[1,2]
79 Mt of copper	8	384 kt of copper	Reserves 6th (7.7%) Production 18th (1.7%)

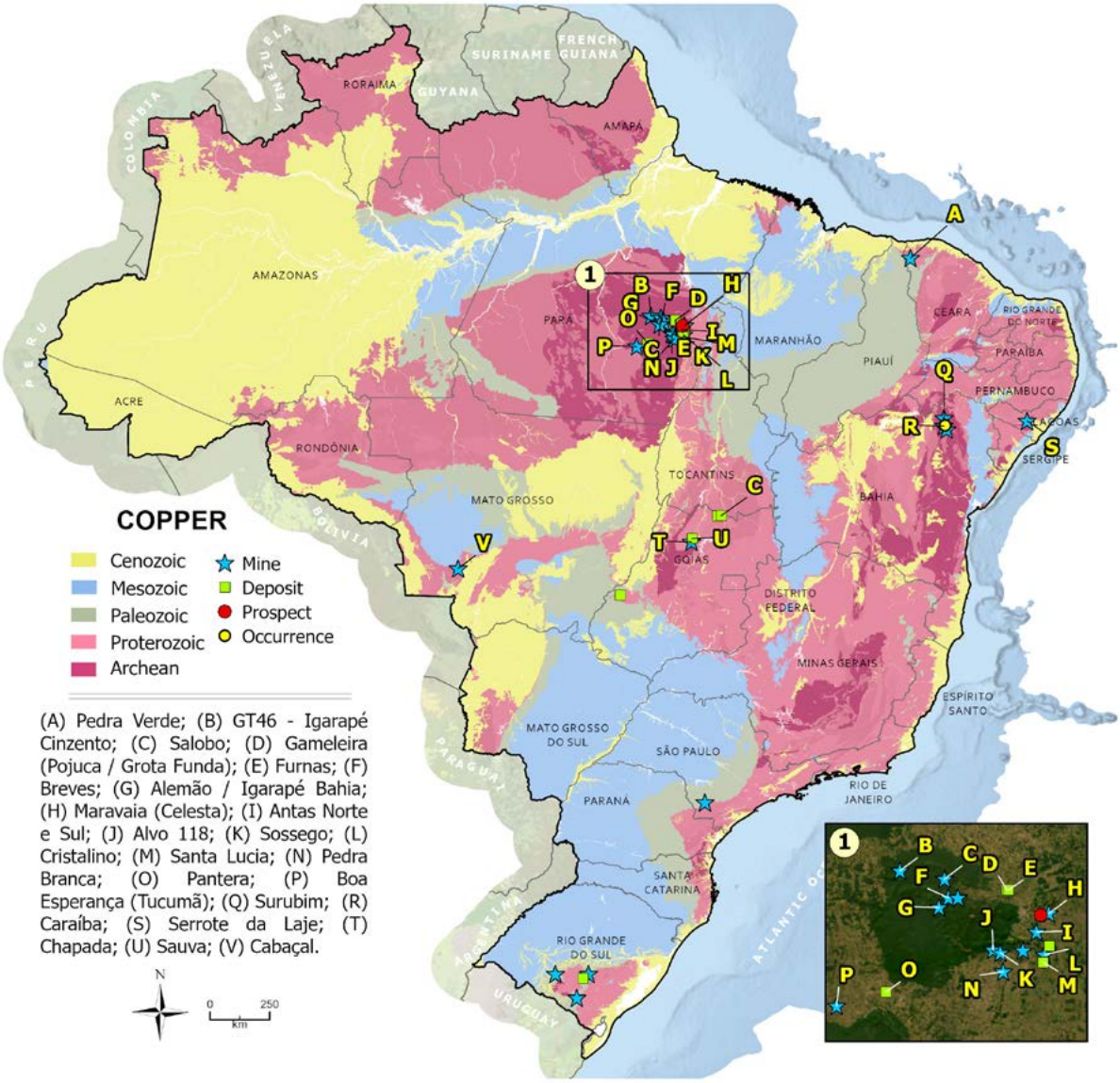

Fig. 9.3: Selected Brazilian copper prospects, occurrences, deposits, and mines

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.

[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 Dec. 2025.

[3] LIMA, R. B. (org.). *Panorama nacional do cobre*. São Paulo: Serviço Geológico do Brasil, 2024. (Informe de Recursos Minerais. Série minerais estratégicos; 10). Available at: https://rigeo.sgb.gov.br/handle/doc/25334. Accessed on: 13 jan. 2026.

Highlights

- Unlike the rest of the world, where copper is mainly exploited from porphyry-type deposits, Brazil has around 46 copper deposits and advanced prospects, mostly distributed among magmatic segregation/iron oxide-copper-gold (IOCG) systems (36%), IOCG deposits (26%), volcanic massive sulfides (VMS) deposits (13%), which together account for 74% of the total. Including magmatic segregation deposits hosted in mafic-ultramafic complexes, the total reaches approximately 85%. To date, only one porphyry-type deposit has been described in Brazil, the Chapada deposit, located in northern Goiás State.
- Brazil's copper mineral potential lies almost entirely in Precambrian domains. Most of Brazilian copper deposits are located in the Carajás Mineral Province, which is also the mineral province with the largest amount of contained copper in the country, with an estimated total of 27.34 Mt endowment. In Carajás, most of the deposits are of the IOCG type, although copper mineralization is also represented by VMS, porphyry, sedimentary exhalative (SEDEX), and sediment-hosted deposits[3].
- The Juruena – Teles Pires Mineral Province has the second highest potential. It comprises 7.23% of copper contained in two VMS-type deposits; the largest of which is called Cabaçal. This province is also considered prospective for new additional discoveries within both the porphyry copper and VMS deposit models.
- The Goiás Magmatic Arc has an active copper mine and shows potential for the discoveries of small to medium-sized metamorphosed porphyry copper deposits, as well as VMS systems.
- The Vale do Curaçá Cupriferous District has cataloged deposits of magmatic segregation. Recent work has identified alteration patterns and features characteristic of IOCG-type mineralization, suggesting an increased potential for the discovery of medium to large-sized deposits in this province.
- Brazil consumes around 3% of the world's copper concentrate production.

Table 9.3: Selected copper deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Cu)	STATUS
Salobo	Cu–Au (IOCG)	Vale	1,148.4	0.61	Operating
Furnas	Cu–Au (IOCG)	Ero Copper	550	0.71	Feasibility
Alemão / Igarapé Bahia	Cu–Au	Vale	219	1.40	Feasibility/ Interrupted
Gameleira (Pojuca / Grota Funda)	Cu–Au	Vale	535	0.57	Feasibility
Cristalino	Cu–Au	Vale	379	0.66	Feasibility
Sossego	Cu–Au (IOCG)	Vale	315	0.78	Operating
Chapada	Cu–Au	Lundin Mining	754.9	0.23	Operating
Alvo 118	Cu–Au	Vale	170	1.00	Feasibility
Caraíba (Céu Aberto + Pilar UG)	Cu	Ero Copper	53.8	1.54	Operating
Breves	Cu–Au–Ag	Vale	50	1.22	Feasibility
Serrote da Laje	Cu–Au	Mineração Vale Verde	119.2	0.50	Operating
Saúva	Cu–Au	Lundin Mining Corp	179	0.32	Exploration
Boa Esperança (Tucumã)	Cu–Co	Ero Copper	59.3	0.81	Operating
Pedra Verde	Cu	N/A	44.2	0.90	Interrupted
Pantera	Cu–Au	OZ Minerals	20.8	1.70	Exploration
Pedra Branca	Cu–Au (IOCG)	OZ Minerals	18.1	1.60	Installation
Cabaçal	Cu–Au–Ag	Meridian Mining	52.9	0.32	Exploration
Maravaia (Celesta)	Cu–Au (IOCG)	Lara Exploration, Tessarema and North	2.1	4.20	Operating
Surubim	Cu	Ero Copper	8.7	0.88	Operating
Antas Norte e Sul	Cu–Au	OZ Minerals	1.5	0.50	Interrupted
Santa Lúcia	Cu–Au (IOCG)	OZ Minerals	0.12	2.10	Exploration
GT-46 / Igarapé Cinzento	Cu–Au	Vale	N/A	N/A	Exploration

N/A – Not available.

9.4 Gold

By Evandro Klein (evandro.klein@sgb.gov.br)

Global gold reserves total approximately 64 kt, with Australia holding the largest reserves at 12 kt, followed by Russia with 12 kt, South Africa with 5 kt, Indonesia with 3.6 kt, Canada with 3.2 kt, China with 3.1 kt, and the United States with 3 kt. Brazil holds 2.4 kt in gold reserves, ranking as the nineth-largest reserve holder globally. In terms of production, China leads globally with 380 metric tons (t) mined in 2024, followed by Russia at 310 t and Australia at 290 t. According to the USGS[3] Brazil produced approximately 70 t of gold in 2024, ranking as the world's thirteenth-largest producer.

ORE RESERVES[1]	ORE RESOURCES[2]	OPERATING MINES[2]	PRODUCTION[1]	WORLD RANKING[3]	
2.4 kt of contained gold	4.5 kt of contained gold	24	76.8 t (mines) 5.5 t (artisanal)	Reserves Production	9th (3.7%) 13th (2.1%)

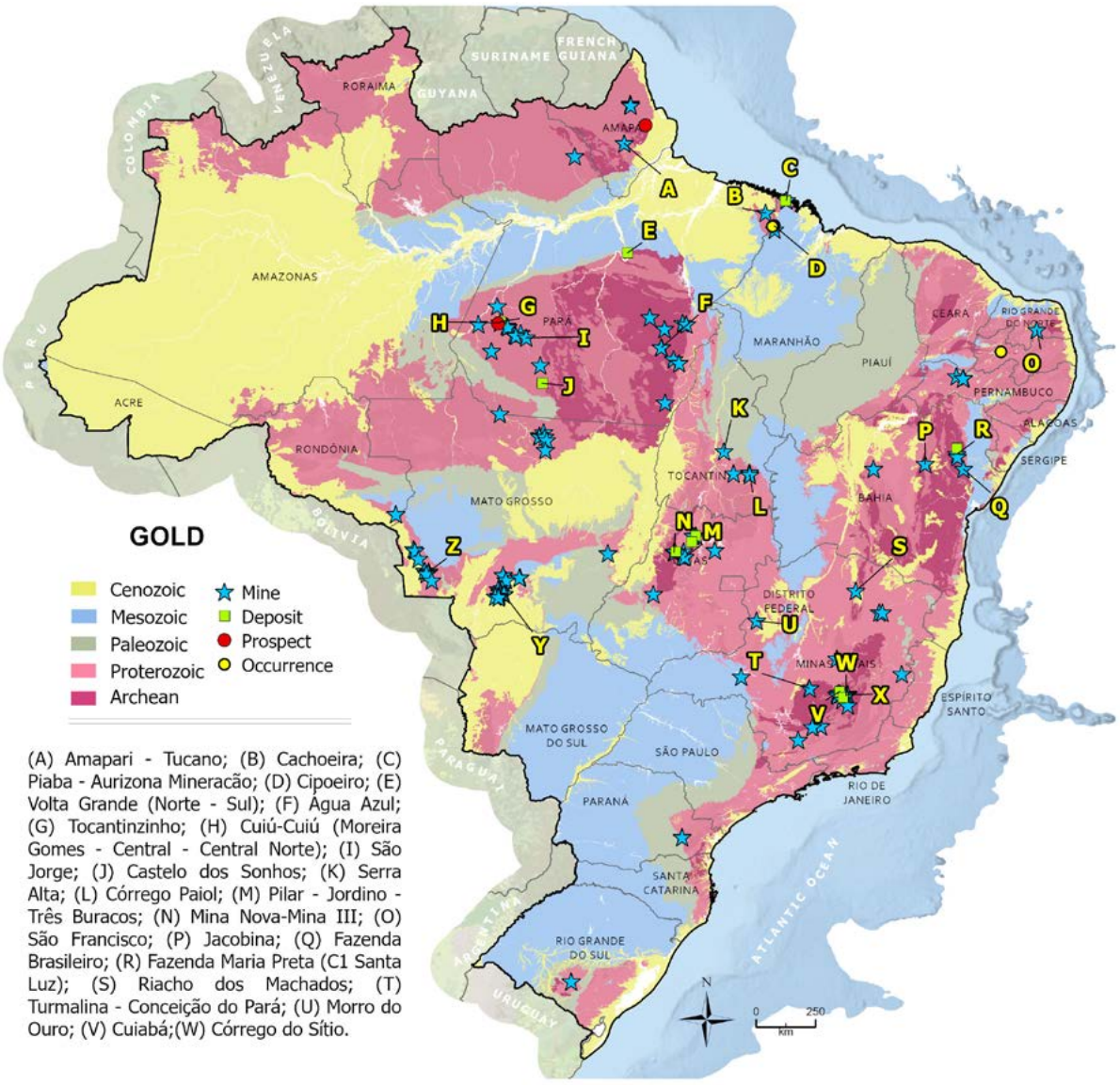

Fig. 9.4: Selected Brazilian gold prospects, occurrences, deposits, and mines.

Highlights

- Gold mining in Brazil is carried out by junior and large national and multinational companies and has been instrumental in establishing the country as one of the world's leading producers.
- Over the past 120 years, industrial mining projects have rapidly expanded across Brazil, leading to the operation of over 80 mines and the production of approximately 2,000 tons of gold.
- Brazil is home to at least 26 gold-bearing provinces and 112 districts.
- These provinces and districts host several operating gold mines with endowment (resources + past production) exceeding 155 tons of gold (>5 Moz): including the orogenic deposits of Morro do Ouro, Cuiabá, Crixás (Mina Nova-Mina III), Fazenda Brasileiro, Córrego do Sítio, Caeté Complex, and the closed Morro Velho mine, and the modified paleoplacer of Jacobina.
- Several IOCG (iron oxide-copper-gold) deposits also contain >5 Moz gold (e.g., Salobo, Chapada, Furnas), and a number of Au-Ag and Au-Ag-Cu magmatic-hydrothermal deposits (epithermal and granite-related) account for more than 230 t of contained gold.
- While Minas Gerais remains the nation's primary gold producer, housing Brazil's two largest gold mines, a number of districts and provinces of the Amazon Craton outside Carajás (e.g., Tapajós and Vila Nova) have emerged as new frontiers, further strengthening Brazil's position in the gold industry.
- The Amazon Craton—including the Carajás, Vila Nova, Tapajós, and Juruena-Teles Pires provinces—the Gurupi Belt-São Luís Craton, the Goiás Magmatic Arc, and the Borborema Province represent key frontiers for discoveries, offering significant potential for the future growth of industrial gold mining.
- Advances in remote sensing and geological mapping technologies have enabled the identification of new exploration targets in the states of Pará, Amazonas, and Roraima, which hold substantial potential for uncovering undiscovered gold resources.
- The primary gold deposits being explored by major industrial and artisanal mining companies are located in the states of Minas Gerais, Bahia, Mato Grosso, Goiás, and Maranhão.
- Furthermore, expanding operations and modernization efforts in regions such as Tocantins (Monte do Carmo, Almas deposits) and Rio Grande do Norte (São Francisco mine – currently Aura's Borborema Project) highlight the vast potential for sustainable exploration and future growth.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.
[2] GEOLOGICAL SURVEY OF BRAZIL. *Ouro Brasil project*. [*S. l.*]: Geological Survey of Brazil, [20--]. Unpublished (unconstrained) data.
[3] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

Table 9.4: Selected gold deposits in Brazil (including some polymetallic deposits) and their respective endowment (resource + past production).

DEPOSIT	COMMODITY	OWNER	ENDOWMENT (t Au)	STATUS
Serrote da Laje-Caboclo	Cu-Au	Mineração Vale Verde	13	Operating
Amapari-Tucano	Au	Tucano Gold	102	Interrupted
Fazenda Brasileiro	Au	Equinox	183	Operating
C1-Santa Luz	Au	Equinox	81	Operating
Jacobina	Au	Pan American Silver	345	Operating
Fazenda Nova	Au	N/A	22	Interrupted
Mina Nova-Mina III	Au	Anglogold Ashanti	227	Operating
Chapada	Cu-Au	Lundin	173	Operating
Posse (Mara Rosa)	Au-Ag	Hochschield Mining	44	Operating
Pilar	Au	Pilar Gold	102	Operating
Piaba	Au	Equinox	124	Operating
Cipoeiro-Chega Tudo	Au	G. Mining Ventures	112	Unexploited
Ernesto-Pau a Pique	Au	Aura Minerals	30	Operating
Paraíba	Au-(Cu-Ag)	P.A. Gold	42	Operating
Araés	Au-Ag	Erro Copper	27	Operating
Fazenda Salinas	Au	Salinas Gold	46	Operating
Riacho dos Machados	Au	Equinox	43	Operating
Córrego do Sítio	Au	Anglogold Ashanti	182	Interrupted
Cuiabá-Lamego	Au	Anglogold Ashanti	568	Operating
Caeté complex	Au	Jaguarmining	216	Operating
Turmalina complex	Au	Jaguarmining	64	Operating
São Sebastião (Pitangui)	Au	Iamgold	25	Unexploited
Morro do Ouro	Au-Ag	Kinross	621	Operating
Salobo	Cu-Au	Vale	555	Operating
Água Azul	Au	Bemisa	38	Operating
Tocantinzinho	Au	G.Mining Ventures	69	Operating
Cuiu-Cuiu	Au	Cabral Gold	37	Operating
Palito	Au-Cu	Serabi	28	Operating
Coringa	Au-Ag	Serabi	17	Operating
Castelo de Sonhos	Au	Tristar	78	Unexploited
São Jorge	Au	Goldmining	44	Unexploited
Volta Grande	Au	Belo Sun	210	Feasibility
Cachoeira	Au	Goldmining	43	Unexploited
Tabiporã	Au-Ag	Mineração Tabiporã	17	Operating
São Francisco	Au	Aura Minerals	77	Operating
Bloco Butiá	Au	Amarillo Gold	26	Interrupted
Paiol	Au	Aura Minerals	32	Operating
Serra Alta	Au	Hochschield Mining	41	Feasibility

N/A – Not available.

9.5 Graphite

By Débora Rabelo Matos (debora.matos@sgb.gov.br)

Brazil is one of the world's most promising countries for natural graphite production, combining large geological resources, high-quality flake graphite, and significant growth potential. In a global market dominated by China and increasingly affected by supply-chain constraints, Brazil has emerged as a strategic high-quality flake graphite supplier, ranking as the fourth-largest global producer[2].

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]	
199.3 Mt of graphite	5	52.2 kt of graphite	Reserves	2th (25.5%)
			Production	4th (4.3%)

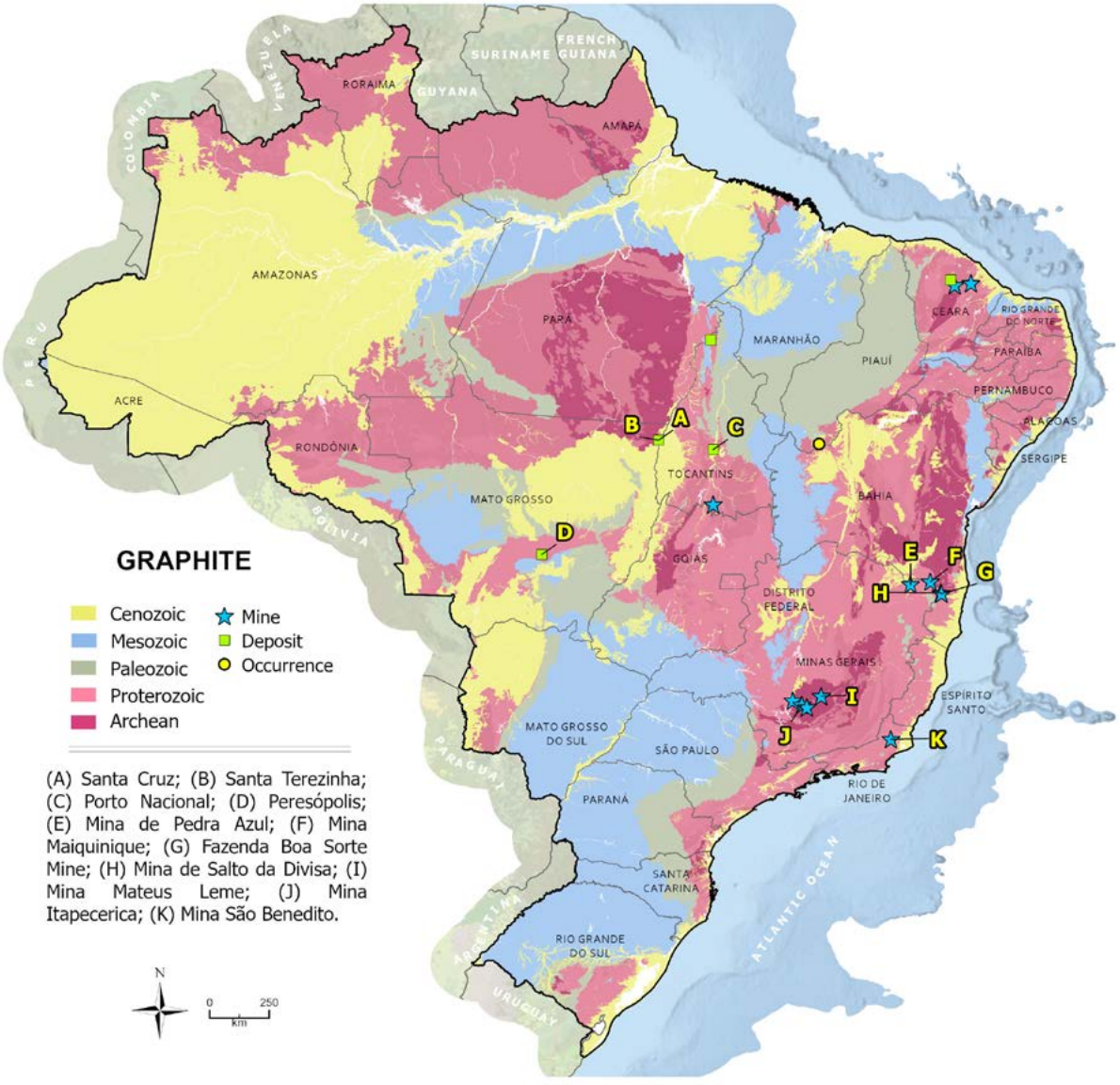

Fig. 9.5: Selected Brazilian graphite occurrences, deposits, and mines.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 - base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.

[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

Highlights

- Global supply constraints, China's export controls, and strategic investments by the United States and allied countries are reshaping the graphite market, increasing the importance of reliable producers such as Brazil.
- The country hosts a mature production hub in the Bahia–Minas Graphite Province, alongside several underexplored provinces—including Central Ceará Domain, the Amazon Craton, and the Araguaia, Paraguay, and Brasília belts—positioning Brazil among the few nations capable of expanding natural graphite supply outside Asia.
- Brazil holds one of the world's largest and highest-quality natural graphite endowments, with production concentrated in the Bahia–Minas Province and substantial untapped potential in multiple Proterozoic mobile belts across the country.
- Metamorphic grade and pressure–temperature conditions are the primary geological controls on graphite crystallinity and flake quality, directly influencing suitability for high-value applications such as lithium-ion batteries.
- In the country, graphite mineralization is mainly associated with Proterozoic metamorphic belts, where pressure–temperature conditions and organic-rich sedimentary protoliths control graphite crystallinity and industrial quality.
- Organic-rich metasedimentary protoliths, formed during Paleoproterozoic and Neoproterozoic oxidation events, represent a critical precursor for economically viable graphite mineralization in Brazil.
- The start-up of new operations, including the Santa Cruz Mine (Bahia State), signals a new growth phase for the Brazilian graphite sector.
- Over the long term, Brazil offers exceptional opportunities for exploration, mine development, and downstream integration, supported by rising demand from the electric vehicle, energy storage, and advanced materials industries.

Table 9.5: Selected graphite deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% cg*)	STATUS
Itapecerica Mine	Graphite	Nacional Grafite	209.59	9.79	Operating
Mateus Leme Mine	Graphite	Grafita MG	91.67	14	Operating
Peresópolis Deposit	Graphite	Lucra Minerals	40	12	Early exploration
Mina Maiquinique	Graphite	Extrativa / Grafite do Brasil	33.3	9.6	Operating
Porto Nacional Deposit	Graphite	Di Castro's Construtora	49.7	5.3	Early exploration
Pedra Azul Mine	Graphite	Nacional Grafite	19.07	12.59	Operating
São Benedito Mine	Graphite	São Benedito	2.09	57.43	Interrupted
Fazenda Boa Sorte Mine	Graphite	Graphcoa	21.68	2.86	Operating
Salto da Divisa Mine	Graphite	Nacional Grafite	232.6	0.25	Operating
Santa Terezinha Deposit	Graphite	Mineração de Calcário Montevidiu	7.5	6.33	Early exploration
Santa Cruz	Graphite	South Star Mining Group	14.9	2.29	Exploration

*Carbon graphite grade.

9.6 Iron

By Ana Paula Justo (ana.justo@sgb.gov.br)

According to the USGS[1], Brazil produced approximately 440 Mt of crude (run-of-mine) iron ore in 2024 (~280 Mt Fe content), representing ~17.5% of global output and ranking as the world's second-largest producer after Australia. USGS estimates[1] ~200 Gt of global declared iron ore reserves, with Brazil holding ~34 Gt (~15 Gt Fe; ~17% of the total), ranking third behind Australia and Russia. Brazil's National Mining Agency reports[2] significantly higher reserves of 58.2 Gt @ 40.5% Fe (proven and probable), reflecting differences in national classification systems and reporting standards.

ORE RESERVES[2]	OPERATING MINES	PRODUCTION[2]	WORLD RANKING[1]	
58.2 Gt (crude ore)	109	447.2 Mt of iron ore (average 62.2% Fe)	Reserves	3rd (17%)
			Production	2nd (17.5%)

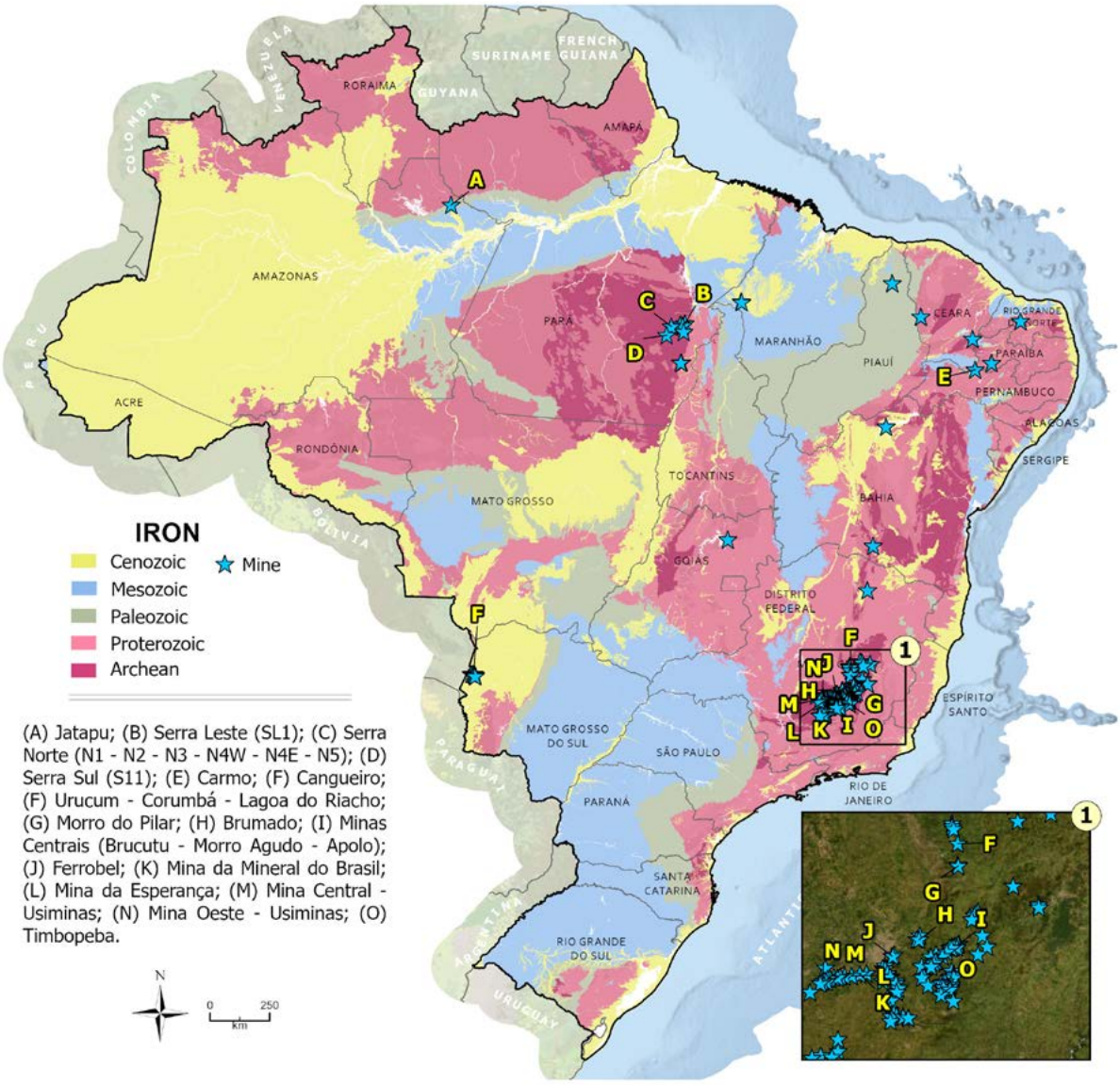

Fig. 9.6: Selected Brazilian iron ore mines.

[1] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

[2] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.

Highlights

- Iron ore is Brazil's leading mineral commodity, accounting for 56% of mining revenue in 2024 (USD 28.8 billion) and underpinning national industrial and logistics infrastructure. It is the main driver of the mineral trade surplus, representing 55.9% of mineral exports in 2025 (USD FOB 39.20 billion from 432.61 Mt), with the extractive segment generating USD 28.96 billion and China absorbing 67.48% of export value.
- Brazil's iron resources are concentrated in two world-class provinces—Carajás and the Quadrilátero Ferrífero—reflecting distinct metallogenic settings. The main ore systems comprise Archean–Paleoproterozoic BIFs, enriched Paleoproterozoic itabirites, locally Neoproterozoic stratiform iron (often associated with Mn), and magmatic Fe in alkaline–carbonatitic complexes later modified by lateritization.
- In the Carajás Province, giant oxide-facies BIF-hosted deposits underpin world-class operations including Serra Norte and Serra Sul (S11D). These systems exemplify large-tonnage, high-grade iron provinces where hypogene hydrothermal and supergene upgrading processes have produced ores commonly exceeding 66% Fe with characteristically low concentrations of deleterious elements for steelmaking applications.
- In the Quadrilátero Ferrífero, iron production is based on extensive itabirite-hosted deposits in long-established districts such as Alegria, Brucutu, Conceição, and Cauê. These ores evolved from Archean BIFs transformed into itabirites during Paleoproterozoic tectonometamorphism and later upgraded by supergene enrichment, generating friable to compact ore types exploited by large-scale, logistics-intensive operations.
- Beyond the main hubs, the Urucum Massif (state of Mato Grosso do Sul) is a key iron–manganese center hosted in Neoproterozoic stratiform sequences. Additional production and advanced projects occur at Caetité (Bahia State) and Piripiri (Piauí State), while magnetite is recovered as a byproduct at Jacupiranga (São Paulo State) and within integrated alkaline–carbonatitic operations at Araxá (Minas Gerais State).
- Recent trends focus on productivity and sustainability through dry processing, tailings reprocessing, and circular-economy integration between mining and steelmaking. Exploration targets underexplored cratonic areas and lateritic profiles, while competitiveness is sustained by scale, consistent ore quality, and integrated rail–port logistics.

Table 9.6: Selected iron ore deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Fe)	STATUS
Itabira (Conceição and Minas do Meio mines)	Fe	Vale	1,498.1	45.82	Operating
Minas Centrais (Brucutu, Morro Agudo mines and Apolo project)	Fe	98.6% Vale and 1.4% China Baowu Steel Group Corporation	4,021	43.68	Operating
Mariana (Fazendão, Alegria, Fábrica Nova and Capanema mines)	Fe	Vale	9,066.2	41.29	Operating
Vargem Grande (Sapecado, Galinheiro, Tamanduá, Horizontes and Abóboras mines)	Fe	Vale	8,900.4	40.44	Operating
Paraopeba (João Pereira, Segredo, Mar Azul, Capão Xavier and Viga mines)	Fe	Vale	5,325.6	41.72	Operating
Serra Norte (N4W, N4E and N5 mines, Gelado tailings dam ore, and N1, N2 and N3 projects)	Fe	Vale	3,286	65.65	Operating
Serra Leste	Fe	Vale	880.8	57.97	Operating
Serra Sul (S11D and S11C orebodies)	Fe	Vale	4,414.3	65.44	Operating
Serra do Rabo (S43P, S44P, S45E, and S45W deposits)	Fe	Vale	578.8	66.04	Exploration, FEL 2 (Prefeasibility)

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Fe)	STATUS
Minas-Rio: Serra do Sapo, Itapanhoacanga, Serra da Serpentina (Conceição do Mato Dentro)	Fe	85% Anglo American Minério de Ferro Brasil and 15% Vale	5,784.9	32.73	Operating
Casa de Pedra, Engenho e Fernandinho(1)	Fe	CSN Mineração	3,985	38.85	Operating
Minas Miguel Burnier and Varzea dos Lopes(2)	Fe	Gerdau Açominas and Grupo Avante(2)	476	65	Operating
Projeto Colomi	Fe	Colomi Iron Mineração	5,000	N/A	Pre-Feasibility Study
Complexo Baratinha	Fe	Bemisa Holding	300	N/A	Operating
Corumbá	Fe-Mn	3A Mining	100	N/A	Operating
Projeto Ferro Verde (Fazenda Mocó)	Fe	Brazil Iron Mineração	1,700	N/A	Operating
Florália High-Purity Iron Project	Fe	Max Resource Corp	50- 70	55- 61	Feasibility
Jambeiro, Passabem and Canavial	Fe	Centaurus Metals	237	28.7	Development
Fazenda Almas (MIG- Mineração Guanhães)	Fe	MIG Mineração Guanhães (Grupo SM Metais)	20	N/A	Operating
Fazenda Santa Maria (MIB- Mineração Ibirité)	Fe	MIB- Mineração Ibirité (Grupo SM Metais)	30	N/A	Operating
Fazenda Segredo	Fe	MML- Metais Mineração (Grupo SM Metais)	25	N/A	Operating
Mina de Ferro do Amapá	Fe	Cadence Minerals PLC DEV Mineração ~35-36% (option to increase to 49%)	471.8	39	Pre-Feasibility Study
Mina Pedra de Ferro	Fe	Bamin- Bahia Mineração	674	40.5	Operating
Mina Ponto Verde	Fe	SAFM Mineração	400	40- 44.5	Operating
Morro do Pilar	Fe	MOPI- Morro do Pilar Minerais	1,640	N/A	Feasibility
Pitombeiras	Fe-Ti-V	Jangada Mines PLC	8,142	46.05	Development
Planalto Piauí	Fe	Bemisa Holding	1,600	N/A	Feasibility
Sul Americana de Metais (SAM) Projeto Bloco 8 (antigo Vale do Rio Pardo + blocos 5, 7 e 13)	Fe	Sul Americana de Metais (Hornbridge Holdings)	10,530.4	18.14	Development
SRN- Minério de Ferro	Fe	SRN Mineração	800	23	Exploration

N/A – Not available.

9.7 Lithium

By Izaac Cabral Neto (izaac.cabralneto@sgb.gov.br)

In Brazil, lithium occurs predominantly in LCT (Li–Cs–Ta) pegmatite deposits. Spodumene is the main ore mineral, while amblygonite, petalite, and lepidolite occur as subordinate lithium-bearing phases. Brazilian production in 2024 totaled ~26 kt of Li_2O[1].

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]	
642.5 kt of contained lithium oxide	3	25,979 t of contained lithium oxide	Reserves	8th (1.3%)
			Production	6th (4.2%)

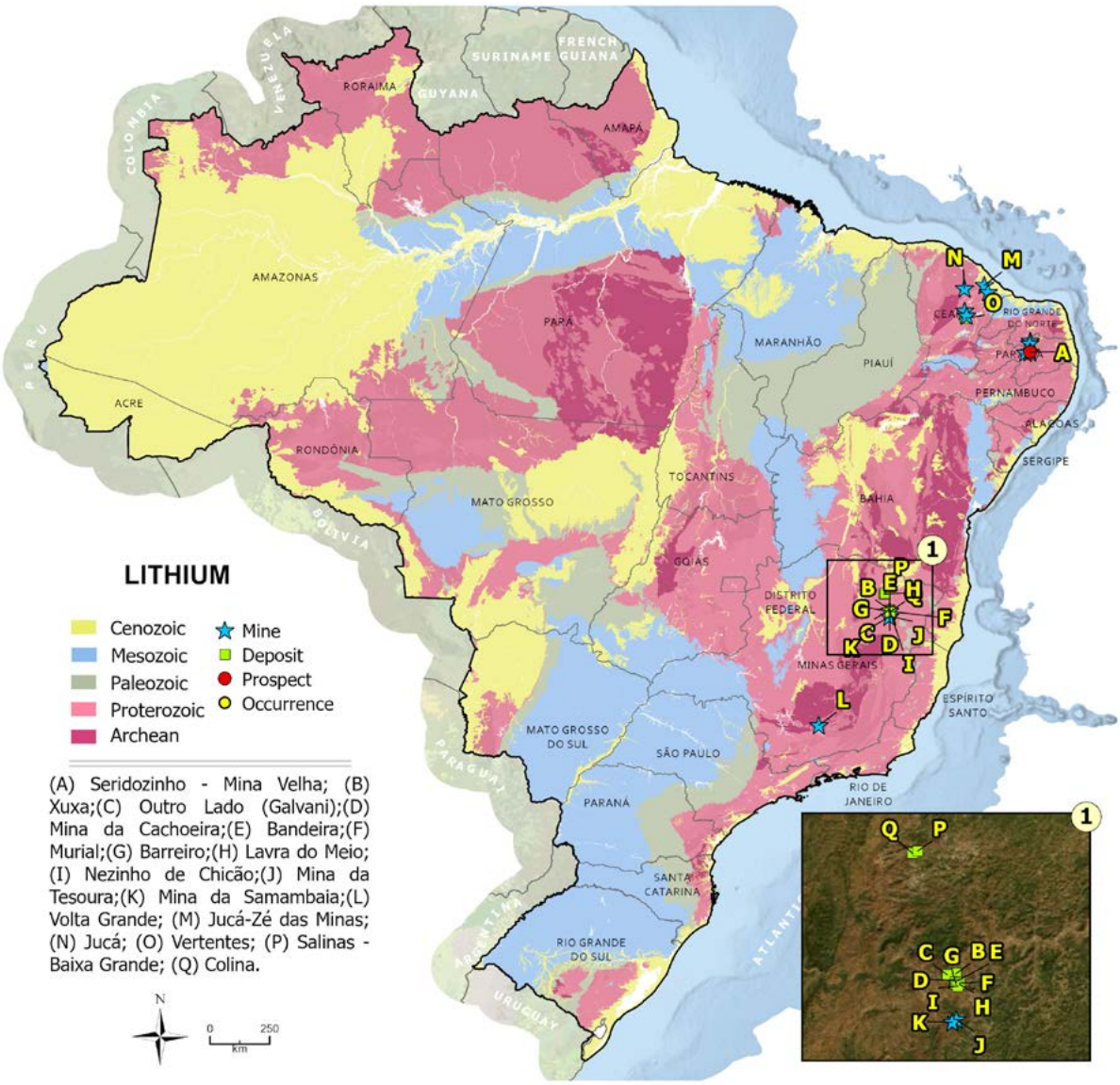

Fig. 9.7: Selected Brazilian lithium prospects, deposits, and mines.

Highlights

- Brazilian lithium reserves, active mines, and advanced exploration projects are mainly concentrated in the Eastern Brazilian Pegmatite Province and the São João del Rei Pegmatite Province, both in the state of Minas Gerais.
- In 2024, the total value of Brazil's lithium-product exports decreased by 39.5% compared with 2023, totaling USD 302.6 million[1], largely reflecting a sharp decline in prices, as the FOB price of exported spodumene concentrate fell by 60%, from USD 2,105.37/t in 2023 to USD 827.60/t in 2024.
- Investments in lithium mineral exploration in Brazil totaled approximately USD 25.3 million in 2024, distributed mainly across the states of Minas Gerais (79.4%), Rio Grande do Norte (11.8%), Paraíba (2.9%), Ceará (2.5%) and Bahia (2.0%)[1].
- AMG Brasil increased spodumene concentrate production from 90 to 130 thousand tons per year (ktpa) and plans a new plant to produce 15–16 tons per year (tpa) LCE (lithium carbonate equivalent), with ~USD 185 million in investments by 2028.
- Atlas Lithium completed Phase 1 of the Neves Project (Minas Gerais), estimating 150 ktpa of spodumene concentrate; Phase 2 may expand capacity to 300 ktpa. The Clear and Salinas projects remain at the exploration stage.
- Lithium Ionic advanced the Bandeira Project (Minas Gerais), designed for a 14-year mine life with 178 ktpa of spodumene concentrate (5.5% Li_2O), and continues development of the Baixa Grande Project.
- Lithium Ionic announced on May 6, 2025, an updated mineral resource estimate for its Bandeira Lithium Project (Minas Gerais). See Table 9.7.
- The Colina Project (Minas Gerais), owned by PLS (Pilbara Minerals), presented a preliminary economic assessment estimating 499 ktpa of spodumene concentrate (5.2% Li_2O)[1], with operations expected to begin in 2026.

Table 9.7: Selected lithium deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES* (Mt)	GRADE (% Li_2O)	STATUS
Nezinho do Chicão[4]	Li	Sigma Lithium	38.3	1.41	Feasibility
Bandeira[3]	Li	Lithium Ionic	27.27	1.34	Feasibility
Barreiro[4]	Li	Sigma Lithium	25.6	1.36	Feasibility
Xuxa[4]	Li	Sigma Lithium	14.7	1.55	Producing
Volta Grande[8]	Li	AMG	20.29	1.06	Producing
Murial[4]	Li	Sigma Lithium	14.6	1.28	Unexploited
Salinas – Baixa Grande[7]	Li	Lithium Ionic	6.52	1.11	Unexploited
Mina da Cachoeira[6]	Li	CBL	4.5	1.4	Producing
Lavra do Meio[4]	Li	Sigma Lithium	4.2	1.17	Unexploited
Itinga – Outro Lado[5]	Li	Lithium Ionic	2.97	1.46	Unexploited

*Measured plus indicated resources.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 Dec. 2025.
[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.
[3] LITHIUM IONIC CORP. Lithium Ionic reports updated mineral resource estimate at its Bandeira Lithium Project, Minas Gerais, Brazil; significantly increases global mineral resources in the Lithium Valley. *Lithium Ionic News Release, Toronto*, ON, 6 may 2025. Available at: https://www.lithiumionic.com/_resources/news/nr-20250506.pdf. Accessed on: 13 jan. 2026.
[4] SIGMA LITHIUM CORPORATION. *Technical report on the Grota do Cirilo Lithium Project*: Araçuaí and Itinga regions, Minas Gerais, Brazil. São Paulo: Sigma Lithium Corporation, 2025. Report date: 31 Mar. 2025. Effective date: 15 Jan. 2025. Prepared by SGS Canada Inc. Available at: https://ir.sigmalithiumcorp.com/wp-content/uploads/2025/11/Sigma-NI-43-101-MASTERVERSION-v30.03.25-23h43.pdf. Accessed on: 13 jan. 2026.
[5] LITHIUM IONIC CORP. *Itinga – Outro Lado*: project overview. [*S. l.*]: Lithium Ionic Corp., [202-]. Available at: https://www.lithiumionic.com/projects/itinga-outro-lado. Accessed on: 13 jan 2026.
[6] COMPANHIA BRASILEIRA DE LÍTIO. *Nossas operações*. São Paulo: CBL, [202-]. Available at: https://www.cblitio.com.br/nossas-opera%C3%A7%C3%B5es. Accessed on Jan. 13, 2026.
[7] LITHIUM IONIC CORP. Lithium Ionic reports 32% growth in updated mineral resource estimate at Baixa Grande – Salinas, Minas Gerais, Brazil. Toronto, ON: Lithium Ionic Corp., Jan. 14, 2025. PDF. Available at: https://www.lithiumionic.com/_resources/news/nr-20250114.pdf. Accessed on: 13 jan. 2026.
[8] AMG ADVANCED METALLURGICAL GROUP N.V. AMG Advanced Metallurgical Group N.V. announces increased lithium and tantalum mineral resources at Mibra Mine. Amsterdam: AMG, 3 apr. 2017. Available at: http://hugin.info/138060/R/2092860/796776.pdf. Accessed on: 13 jan. 2026.

9.8 Magnesium

By Ioná de Abreu Cunha (iona.cunha@sgb.gov.br) and Monique Ellen Matos Santos (matosmoniquesantos@gmail.com)

Brazil maintains favorable geological endowment and operational conditions for the supply of magnesite and magnesium-derived products. Brazilian magnesite reserves are estimated at approximately 200 Mt, while recently reported primary production is ~1.8 Mt per year.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[1]	
200 Mt of magnesium oxide content	9	1.8 Mt of magnesium oxide content	Reserves	6th (2.6%)
			Production	3rd (8.2%)

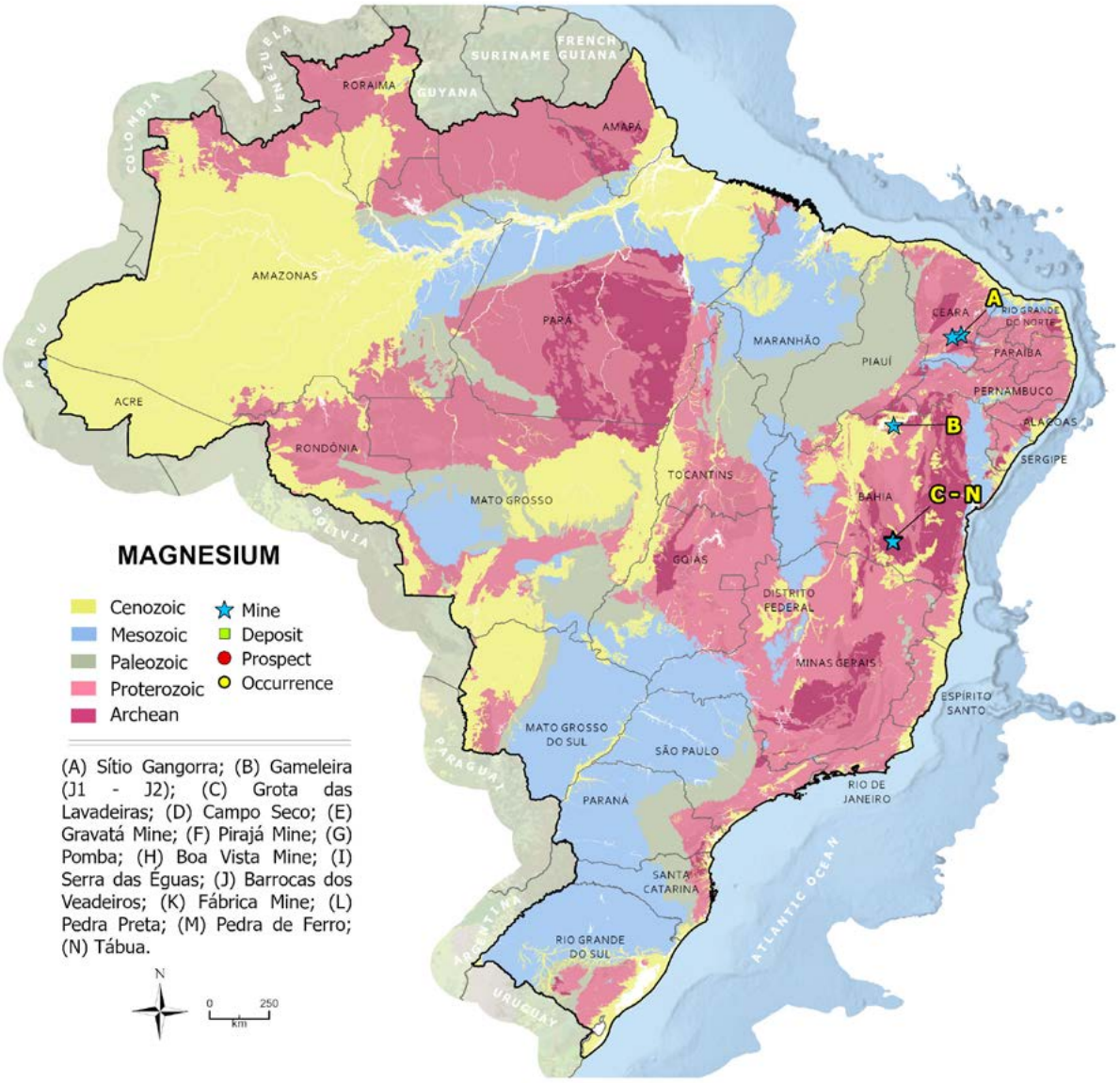

Fig. 9.8: Selected Brazilian magnesite mines.

Highlights

- Magnesite production in Brazil exhibits a high degree of geographic concentration, as Bahia and Ceará dominate national output and define the core of the country's magnesite supply base.
- The state of Bahia represents Brazil's principal magnesite (magnesium ore) province, based on reserve size, ore quality, and level of industrial development. The Brumado-Serra das Éguas district constitutes the country's largest and most strategically significant magnesite operation, hosting high-grade deposits suitable for the production of sintered magnesia and other refractory-grade materials critical to metallurgical applications.
- In the state of Ceará, magnesite mining is largely confined to the Iguatu-Jucás area, with the majority of concessions and ongoing projects under Refranor's operation. Recoverable magnesite reserves total approximately 19.5 Mt, comprising 16.4 Mt of sparry magnesite and 3.1 Mt of medium-grained magnesite.
- Four major companies dominate Brazil's magnesite industry: Magnesita (RHI Magnesita), the leading producer, responsible for more than 90% of national production; Ibar Nordeste (specializing in magnesium oxide products); Refranor; and Xilolite.
- The steel industry remains the dominant consumer of magnesite in Brazil, accounting for about 80% of processed consumption. Demand is therefore closely tied to steel production, while additional markets include specialty cements, foundry, glass, and chemical and agro-industrial applications.

Table 9.8: Selected magnesite deposits in Brazil.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES	GRADE (% Mg)	GROSS PRODUCTION (Mt)	STATUS
Pomba Mine	Magnesite	RHI Magnesite	N/A	44.65	750.3	Producing
Pedra Preta Mine	Magnesite	RHI Magnesite	N/A	45.60	615.9	Producing
Pedra de Ferro Mine	Magnesite	RHI Magnesite	N/A	44.80	N/A	Producing
Gravatá Mine	Magnesite	RHI Magnesite	N/A	44.85	N/A	Producing
Barrocas dos Veadeiros	Magnesite	RHI Magnesite	N/A	45.36	N/A	Producing

N/A – Not available.

[1] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

9.9 Manganese

By Evilarde Carvalho Uchôa Filho (evilarde.uchoa@sgb.gov.br)

Brazil ranks as the fourth-largest holder of manganese reserves worldwide, behind South Africa (560 Mt), Australia (500 Mt) and China (280 Mt), and ahead of major producers such as Gabon (61 Mt) and India (34 Mt). In 2024, Brazil was the seventh-largest producer globally, slightly below Ghana, Gabon, South Africa, Australia, and China.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]	
228 Mt of contained manganese	2	537.5 kt of contained manganese	Reserves	4th (15.8%)
			Production	7th (3.0%)

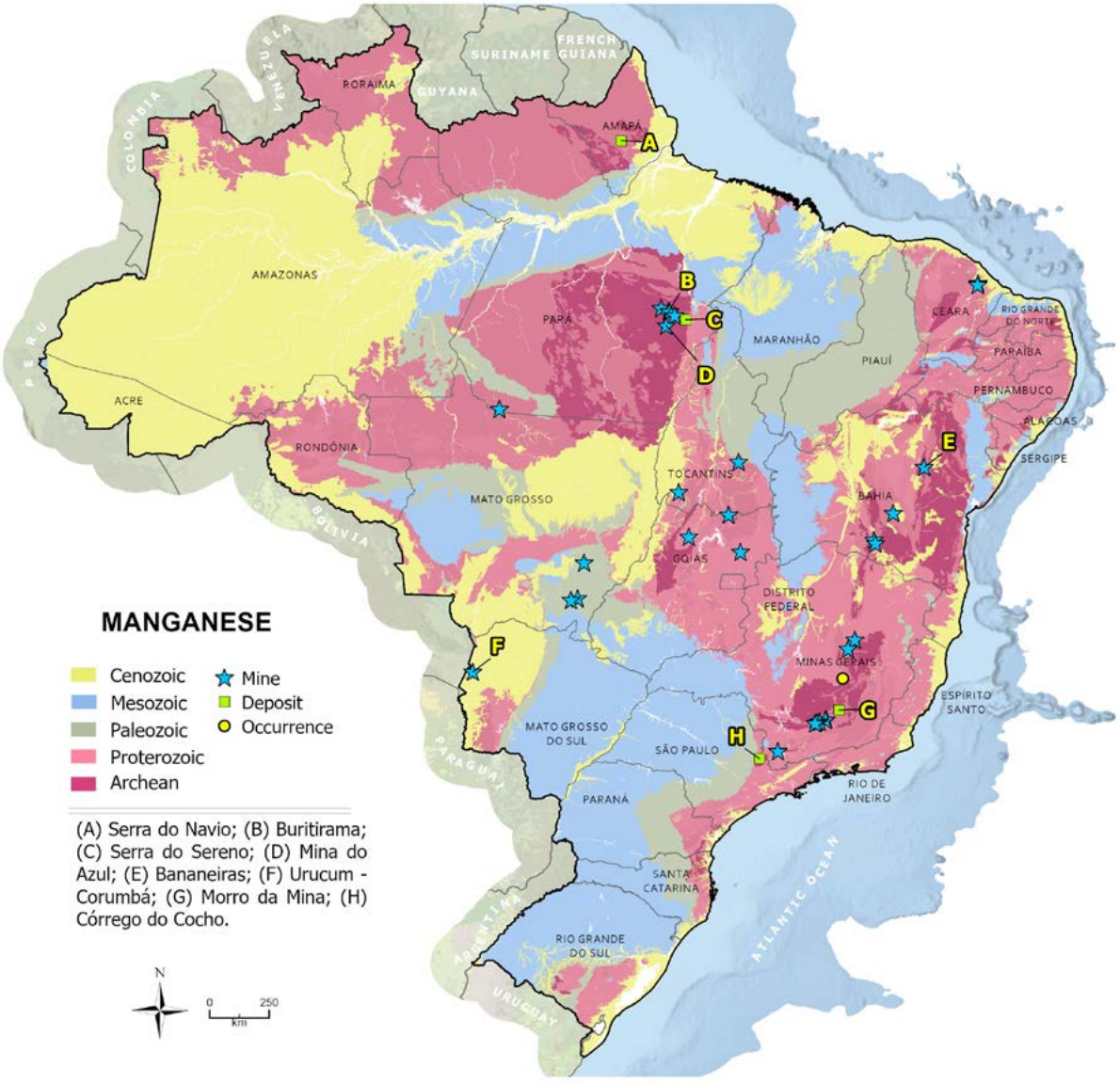

Fig. 9.9: Selected Brazilian manganese occurrences, deposits, and mines.

Highlights

- Brazil's manganese reserves are concentrated in the states of Amapá, Bahia, Ceará, Mato Grosso do Sul, Minas Gerais, and Pará. The Carajás Mineral Province in Pará represents the country's main manganese-producing district, hosting the Azul and Buritirama mines, which account for a substantial share of national production and reserves. Azul is the Brazil's largest manganese mine, with high-grade ore (>40% Mn) and estimated reserves of ~65 Mt, while Buritirama Mine holds ~100 Mt of reserves with grades ranging from 40% to 54% Mn. In Mato Grosso do Sul, the Urucum Mine is another key asset with 34.5 Mt of reserves with an average grade of 46% Mn.
- Brazil's manganese deposits occur in a wide range of geological settings, most of which are Paleoproterozoic in age. These include Paleoproterozoic greenstone belts (e.g., Serra do Navio), banded iron formations (e.g., Morro da Mina), continental shelf siliciclastic–carbonate sequences (e.g., Azul and Buritirama), black-shale–hosted Mn-carbonate systems (e.g., Lagoa do Riacho), and Neoproterozoic siliciclastic–carbonate sequences (e.g., Urucum). Supergene enrichment is critical for the formation of high-grade manganese ores and represent a key factor in the economic viability of major Brazilian deposits, including Azul, Buritirama, and Urucum.
- The steel industry remains the primary consumer of Brazil's manganese production, mainly for alloy manufacturing. However, the transition toward low-carbon energy systems is steadily increasing demand for manganese in electric vehicle battery technologies. Additionally, the agricultural sector has increased its use of manganese-based fertilizers. Supported by abundant high-grade reserves, established mining infrastructure, and strengthening international demand, Brazil is strategically positioned to expand its role as a competitive and increasingly influential player in the global manganese market.

Table 9.9: Selected manganese deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Mn)	STATUS
Buritirama	Mn	Mineração Buritirama	100	25-47	Interrupted
Mina do Azul	Mn	Vale	65	47	Producing
Urucum	Mn	LGH Mining	34.5	46	Producing
Córrego do Cocho	Mn	Mineração Itapira	20	23	Unexploited
Serra do Sereno	Mn	Vale	6.5	40	Unexploited
Morro da Mina	Mn	Nexus Ligas	30	N/A	Producing
Serra do Navio	Mn	Indústria e Comércio de Minérios (ICOMI)	18.5	N/A	Closed/ Exhausted
Lagoa do Riacho	Mn	Libras Ligas do Brasil	N/A	23	Producing
Bananeiras	Mn	Zeus Mineração	N/A	N/A	Early Explorartion

N/A – Not available.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025.
Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025
[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025.
Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

9.10 Molybdenum

By Alan Pereira da Costa (alan.costa@sgb.gov.br)

Molybdenum in Brazil occurs in several deposit types. The main ones include: polymetallic skarn deposits in the Seridó Mineral Province (states of Rio Grande do Norte and Paraíba); uranium-related mineralization in Minas Gerais and Santa Catarina; pegmatite-hosted byproducts occurrences in Bahia; granite-hosted deposits in Santa Catarina, Rio Grande do Sul and Roraima; and epithermal deposits in Pará, notably associated with the Salobo (Cu-Au) and Breves (Cu) deposits.

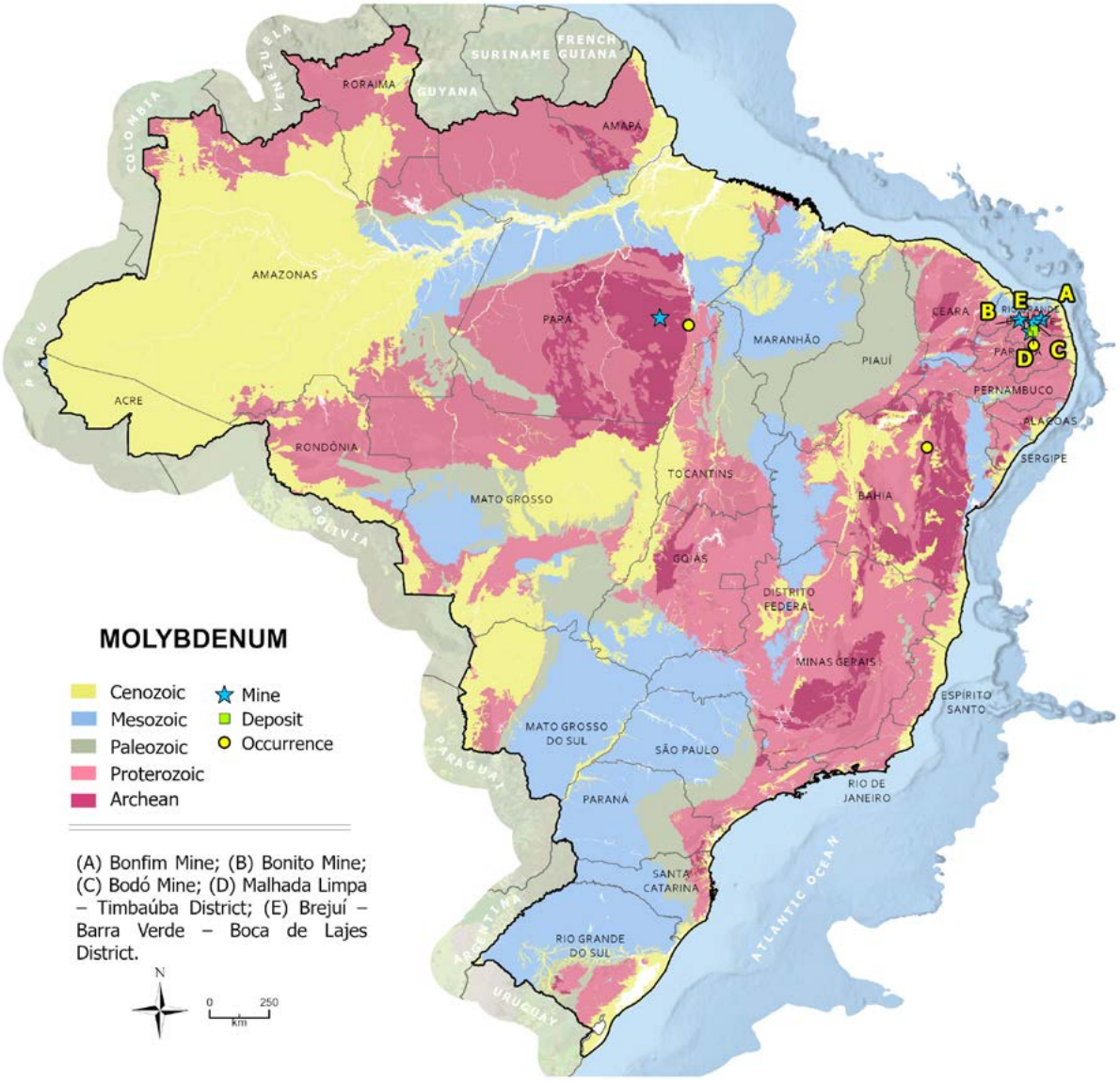

Fig. 9.10: Selected Brazilian molybdenum occurrences, deposits, and mines.

Highlights

- Brazil has no officially recorded molybdenum production between 2010 and 2025, and its reserves are considered minor. Nonetheless, informal production of molybdenite concentrate does occur, particularly in the Carnaíba region in Campo Formoso, Bahia, where molybdenite is extracted on a small scale as a by-product of emerald and green beryl mining.
- In the Seridó Mineral Province, molybdenum is mainly associated with polymetallic skarn mineralization of the W–Mo, W–Au–Mo–Bi–Ta and W–Mo–(Cu) types. Notable deposits include Brejuí, Barra Verde, Bodó, Timbaúba, Malhada Limpa, Bonfim, and Bonito, where molybdenum is recovered as a by product from processing tailings. A strong structural control is observed in many of these deposits, characterized by shear zones that play a fundamental role in the concentration of molybdenum. The mineralization is linked to Neoproterozoic-Cambrian magmatic–hydrothermal systems that control the formation and distribution of the skarns in the area.
- The SGB-CPRM has conducted studies[3] in the Seridó Mineral Province, covering areas in the states of Rio Grande do Norte and Paraíba. These investigations identified areas with high potential for tungsten, molybdenum, copper, and gold mineralization through the development of prospectivity maps, contributing significantly to improving geological knowledge and to enhancing the mineral potential of the region.

Table 9.10: Selected molybdenum deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	ESTIMATED RESOURCES	GRADE	ORE / GANGUE MINERALS	RE–OS AGE (Ma)[1]
Bodó Mine[1,4,6]	W–Mo	9 Mt	2.0 wt.% WO_3; 0.002–0.1 wt.% Mo	Garnet, epidote, diopside, calcite	510
Brejuí – Barra Verde – Boca de Lajes District[1,4,6]	W–Mo–(Cu)	11 Mt	1.0 wt.% WO_3; 0.001–1.0 wt.% Mo	Garnet, epidote, calcite, diopside, pyrite, chalcopyrite, molybdenite	554
Bonito Mine[2,4]	W–Mo	4.0 Mt	0.7 wt.% WO3; 0.001–1.0 wt.% Mo	Garnet, diopside, epidote, calcite, pyrite, molybdenite	N/A
Malhada Limpa – Timbaúba District[4,6]	W–(Mo–Cu–Au)	5.5 Mt	0.5 wt.% WO_3; 0.1 wt.% Mo	Vesuvianite, garnet, diopside, epidote, calcite, pyrite, chalcopyrite, malachite, molybdenite	N/A
Bonfim Mine[1,2,3,5]	W–Mo–Au–Bi–Te	0.3 Mt; 105 koz Au	4.8 wt.% WO_3; 8–40 g/t Au; 0.05–0.4 wt.% Mo	Bismuthinite, pyrite, chalcopyrite, pyrrhotite, molybdenite	524

N/A – Not available.

[1] HOLLANDA, M. H. B. M.; SOUZA NETO, J. A.; ARCHANJO, C. J.; STEIN, H.; MAIA, A. C. S. Age of the granitic magmatism and the W–Mo mineralization in skarns of the Seridó Belt (NE Brazil) based on zircon U–Pb (SHRIMP) and molybdenite Re–Os dating. *Journal of South American Earth Sciences*, v. 79, p. 1-11, 2017. DOI: 10.1016/j.jsames.2017.07.011.

[2] OLIVEIRA, C. G.; DANTAS, E. L.; SOUZA, V. S.; RODRIGUES NETO, L.; DANTAS, R.; SILVA, J. C. Contribution to the metallogenetic framework of the Seridó Mineral Province (in Portuguese). in: SEMINÁRIO DAS PROVÍNCIAS METALOGENÉTICAS BRASILEIRAS, 1., 2013, Currais Novos. Proceedings [...]. Currais Novos, RN: CPRM, 2013. p. 329-366.

[3] COSTA, A. P.; CAVALCANTE, R.; DANTAS, A. R.; OLIVEIRA, R. G.; MELO, S. C.; LAGES, G. A. *Areas of relevant mineral interest (ARIM)*: crustal evolution and metallogeny of the Seridó Mineral Province, Rio Grande do Norte and Paraíba states (in Portuguese). Recife: CPRM, 2023. Available at: https://rigeo.sgb.gov.br/handle/doc/23861. Accessed on: 13 jan. 2026.

[4] COSTA, A. P.; CAVALCANTE, R.; DOMINGOS, N. R. R.; MELONI, R. E.; MARQUES, E. D.; SILVA, G. F.; NASCIMENTO, M. A. L.; TOLEDO, P. I. F.; CAMARA, H. C. F. Prospectivity maps for polymetallic skarn and orogenic gold mineralization in the Rio Piranhas–Seridó Domain, Borborema Province (NE Brazil): an aid to exploration targeting. *Journal of the Geological Survey of Brazil*, v. 9, n. 1, 2026. DOI: 10.29396/jgsb.2026.v9.n1.4.

[5] ANGELIM, L. A. A.; NESI, J. R.; TORRES, H. H. F.; MEDEIROS, V. C.; SANTOS, C. A.; VEIGA JUNIOR, J. P.; MENDES, V. A. *Geology and mineral resources of the state of Rio Grande do Norte*: explanatory notes of the geological and mineral resources maps of the State of Rio Grande do Norte (in Portuguese). Recife: CPRM; SEDEC-RN; FAPERN, 2006. Scale 1:500,000.

[6] SILVA, G. F.; SILVA, A. D. R.; SOUZA GAIA, S. M. (eds.). *An overview of critical and strategic minerals potential of Brazil*. Brasília: Geological Survey of Brazil, 2024. 35 p.

9.11 Nickel

By Lila Costa Queiroz (lila.queiroz@sgb.gov.br)

In 2025, Brazil ranked among the world's ten largest nickel producers and was the leading producer of nickel and stainless steel in Latin America. The country's production is supported by four operating mines (Onça Puma, Codemin, Barro Alto, and Santa Rita) as well as several projects at different stages of exploration and development. Brazilian nickel production is derived from both sulfide and laterite deposits, yielding Class I and Class II nickel.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]	
11.4 Mt of contained nickel	4	67.5 kt of contained nickel	Reserves	3rd (12.3%)
			Production	8th (2.1%)

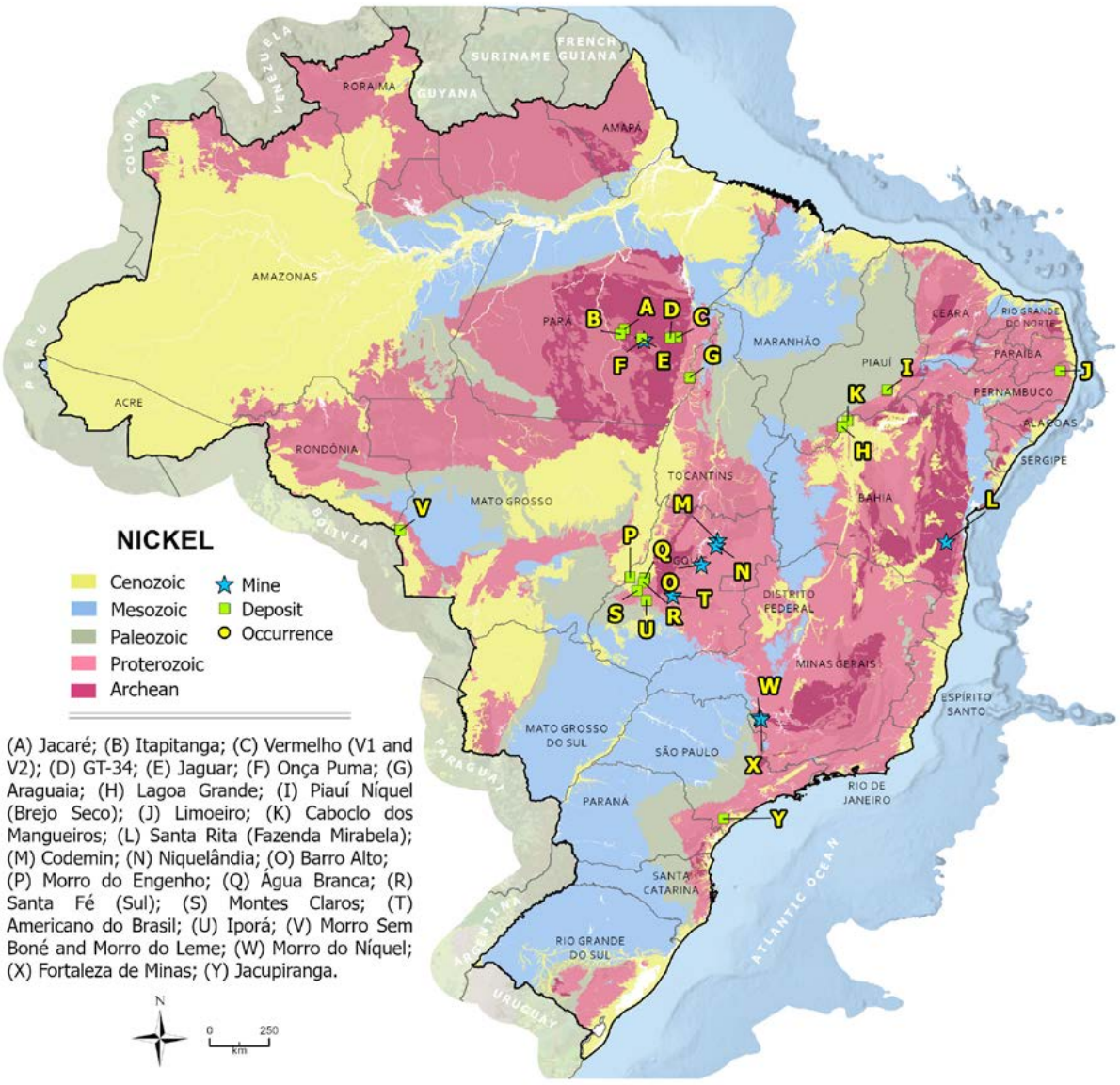

Fig. 9.11: Selected Brazilian nickel deposits and mines.

Highlights

- Brazil hosts the world's third-largest nickel reserves, representing approximately 12% of global declared reserves, behind Indonesia and Australia[2].
- The Brazilian nickel sector is vertically integrated, with the country acting as both a significant exporter and a major domestic consumer. Downstream, Brazil hosts a consolidated stainless-steel industry led by Aperam, Villares Metals, and Gerdau.
- In the refining segment, Jervois plans to restart the São Miguel Paulista electrolytic refinery, located in São Paulo, in 2026, with commercial production targeted for 2027. The facility is designed to produce approximately 10 ktpa of refined nickel and 2 ktpa of cobalt, re-establishing the only electrolytic nickel–cobalt refinery in Latin America.
- The state of Pará hosts the country's largest producing asset, Vale's Onça Puma complex, along with advanced projects such as Centaurus Metals' Jaguar sulfide project, the Luanga EGP (Bravo), and the Araguaia and Vermelho projects (Horizonte Minerals; currently halted). Several of these projects have the potential to enter production in the short to medium term, applying diverse processing routes, including HPAL (high-pressure acid leaching), heap leaching, and flotation, with increasing emphasis on battery-grade nickel and cobalt.
- In 2025, MMG acquired 100% of Anglo American's nickel assets in Brazil, including the Barro Alto and Codemin operations in Goiás and key deposits in Pará and Mato Grosso. This portfolio contains approximately 5.2 Mt of contained nickel in resources, forming a world-class ferronickel package with a long remaining mine life and significant growth potential[3].
- Bahia is emerging as a high-potential sulfide province, hosting several metallogenetic belts. Atlantic Nickel operates Santa Rita, the only Class I nickel mine in Brazil. Recent CBPM exploration identified the Lagoa Grande Mafic–Ultramafic Complex, a cluster of intrusions hosting multiple Ni–Cu–Co magmatic sulfide deposits with an estimated 405 Mt of undeveloped nickel resources, within the same metallogenetic province as the advanced Caboclo dos Mangueiros Project[4]. Another key discovery is the Umburana mafic–ultramafic system, identified by Ero Copper in 2022 in the Curaçá Valley, where nickel mineralization occurs in ultramafic rocks[5].
- In the state of Piauí, the Piauí Nickel Project has initiated early-stage production of a high-purity nickel–cobalt mixed hydroxide precipitate (MHP), an intermediate product suitable for electric vehicle battery cathode precursors, as well as traditional stainless-steel and alloy markets.
- In Goiás state, the SGB-CPRM is preparing a tender process for two nickel–cobalt assets—Morro do Engenho (Montes Claros de Goiás) and Santa Fé de Goiás—with a likely auction in 2026. Both projects have approved final exploration reports and completed economic valuation studies, and may help attract new private investment to strengthen Brazil's nickel pipeline for stainless-steel and energy-transition markets.
- Overall, Brazil's large and diversified resource base, competitive cost structure, low-carbon hydroelectric energy matrix, established downstream industry, and growing refining capacity position the country as a globally competitive and strategically important long-term supplier of nickel to both stainless-steel and energy-transition markets.

Table 9.11: Selected nickel deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Ni)	STATUS
Jacaré	Ni, Co	Anglo / MMG	306.6	1.28	Feasibility
Onça Puma	Ni	Vale	142.5	1.45	Operating
Araguaia	Ni, Co	Horizonte Minerals	132	1.27	Feasibility
Vermelho (V1 and V2)	Ni, Co	Horizonte Minerals	148.9	1.04	Feasibility
Santa Rita (Fazenda Mirabela)	Ni, Cu, Co	CBPM / Appian Capital	255	0.54	Operating
Jaguar	Ni, Cu, Co	Centaurus Metals	138.2	0.87	Feasibility
Morro Sem Boné and Morro do Leme	Ni	Anglo / MMG	65	1.65	Feasibility
Barro Alto	Ni	Anglo / MMG	79.3	1.28	Operating
Santa Fé (Sul)	Ni, Co	Companhia Níquel Santa Fé / Mineradora Invi	61.5	1.5	Interrupted
Piauí Níquel (Brejo Seco)	Ni, Co	Brazilian Nickel	99	0.84	Development
Morro do Engenho	Ni, Co, Sc	SGB-CPRM	67.24	1.07	Feasibility
Montes Claros	Ni	Companhia Brasileira de Alumínio (CBA)	52.5	1.27	Feasibility
Lagoa Grande	Ni, Cu, Co	CBPM	405	0.16	Exploration
Niquelândia	Ni, Co	Companhia Brasileira de Alumínio (CBA)	55	0.94	Interrupted
Água Branca	Ni, Co, Sc	SGB-CPRM	39.73	1.14	Feasibility
Caboclo dos Mangueiros	Ni, Cu	CBPM / Bahia Nickel	200	0.2	Feasibility
Itapitanga	Ni, Co, Sc	Centaurus Metals	40	0.95	Exploration
Iporá	Ni, Co	Companhia Niquel Santa Fé / Mineradora Invi	13.6	1.5	Feasibility
Jacupiranga	Ni	Mosaic Fertilizantes P&K	13	1.4	Exploration
Codemin	Ni	Anglo / MMG	11.9	1.2	Operating
Limoeiro	Ni, Cu, Pd, Pt	Companhia Brasileira de Alumínio (CBA)	35	0.25	Feasibility
Americano do Brasil	Ni, Cu	Prometálica Mineração Centro Oeste	N/A	N/A	Interrupted
Fortaleza de Minas	Ni, Cu, Co, Au, PGE	Extrativa Metalurgia	N/A	N/A	Interrupted
GT-34	Ni, Cu	Vale	N/A	N/A	Feasibility
Morro do Níquel	Ni	Comercial Lilian	N/A	N/A	Interrupted

N/A – Not available. For the expanded table access https://bit.ly/4bF8OXN

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.
[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.
[3] MMG LIMITED. *Project Apex*: investor presentation. Melbourne: MMG, 2025. Available at: https://www.mmg.com/wp-content/uploads/2025/02/Project-Apex-Investor-Presentation_EN.pdf. Accessed on: 27 dec. 2025.
[4] SOUZA, L. F. C. C.; FERREIRA FILHO, C. F. Os depósitos de Ni-Cu-Co do Complexo Lagoa Grande, BA: um cinturão de intrusões máficas-ultramáficas mineralizadas na borda NW do Cráton do São Francisco. in: SIMPÓSIO BRASILEIRO DE METALOGENIA, 6., 2025, Salvador. *Anais* [...]. Salvador: ADIMB; UFBA, 2025. p. 106.
[5] ERO COPPER. News release. Vancouver, BC: Ero Copper, 2022. Available at: https://erocopper.com/site/assets/files/6333/2022-09-29-ni-occurrence-nr_vf2.pdf. Accessed on: 27 dec. 2025.

9.12 Niobium

By Jonatas de Sales Macêdo Carneiro (jonatas.carneiro@sgb.gov.br) and Gustavo de Assunção Mello (gustavo.mello@sgb.gov.br)

Brazil produced 105,821 t of contained niobium in 2023[1], led by Minas Gerais State with 90,372 t (85%) and Goiás with 15,449 t (15%). Globally, Brazil ranked as the world's largest niobium producer, accounting for approximately 91% of total world output, and holds about 94% of global reserves[2].

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]	
14.1 Mt of contained Nb_2O_5	4	144 kt of Nb_2O_5 concentrate	Reserves	1st (94.1%)
			Production	1st (90.9%)

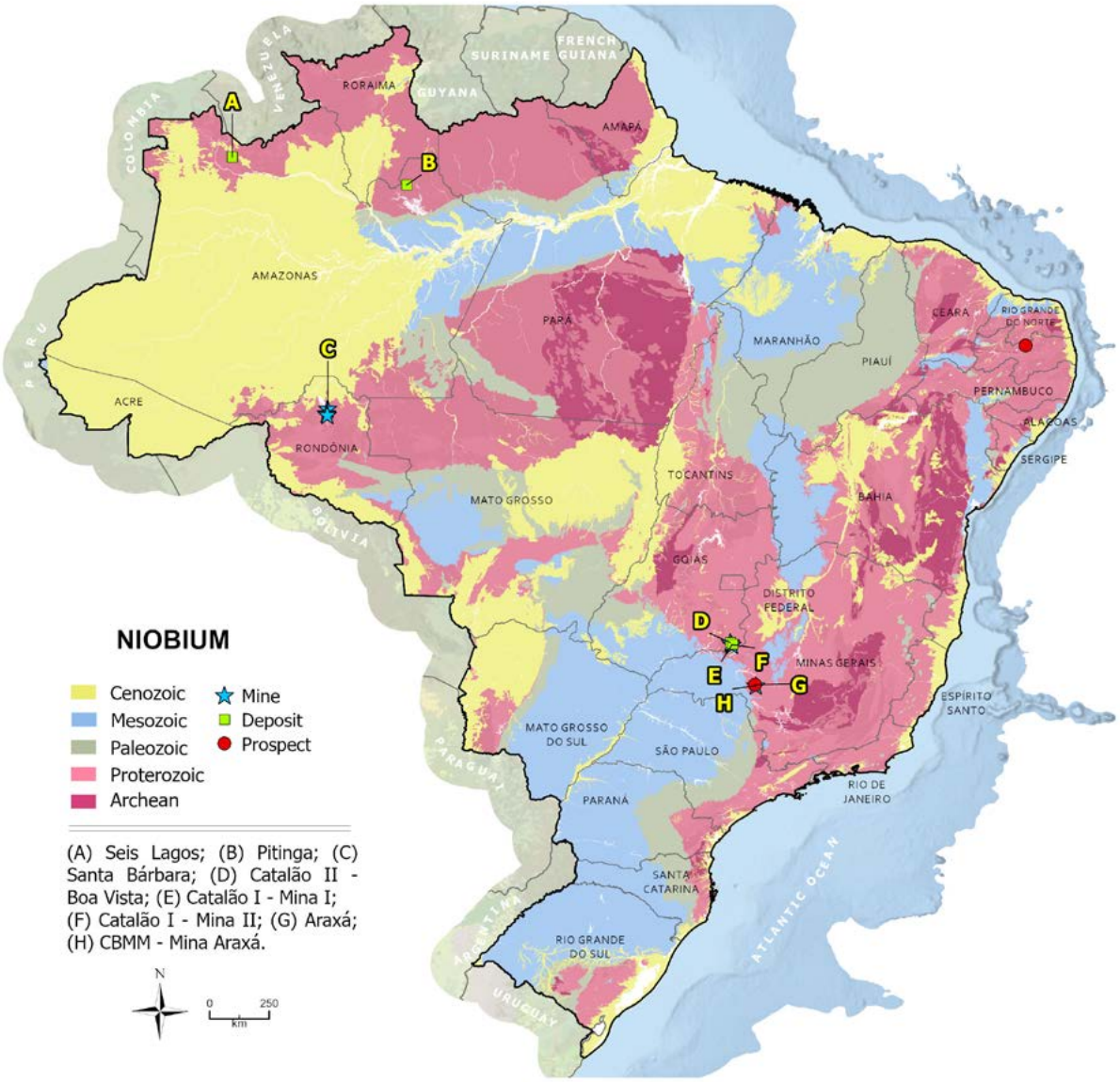

Fig. 9.12: Selected Brazilian niobium prospects, deposits, and mines.

Highlights

- Brazilian production is highly concentrated in the states of Minas Gerais and Goiás, where world class alkaline–carbonatite complexes host pyrochlore as the principal ore mineral. Although pyrochlore is magmatic in origin, industrial recovery is typically most effective in the supergene (weathered) profiles developed over these complexes, where lateritic alteration upgrades and homogenizes mill feed.
- In Minas Gerais, the Araxá district (CBMM) is the flagship operation and the mainstay of world supply. In Goiás, the Catalão district (CMOC) complements Araxá as the other major production center. In 2024, CMOC Brazil reported record production of 10,024 t of niobium, reinforcing its position as the world's second largest producer and contributing about 11% of global output.
- Metallogenetically, Brazil's main niobium endowment reflects deep-sourced alkaline–carbonatitic magmatism that concentrates Nb in pyrochlore bearing carbonatites and related lithotypes, followed by intense tropical weathering that generates thick lateritic profiles and residual enrichment of refractory Nb phases. This combined magmatic–supergene architecture explains the exceptional tonnage, grade continuity, and long mine lives of Araxá and Catalão.
- Outside the carbonatite districts, niobium is produced in lesser quantities as a byproduct of cassiterite operations, notably at the Pitinga mine (Amazonas State) and in the state of Rondônia (e.g., the Santa Bárbara operation). Niobium also occurs in pegmatite hosted columbite sources and associated alluvial concentrations, particularly in Rondônia and Pará, which contribute minor volumes relative to the main carbonatite producers.
- Looking ahead, Brazil's most prominent underdeveloped niobium frontier is Seis Lagos (Amazonas), a large pyrochlore-bearing carbonatite system that remains undeveloped. Together with continued optimization at Araxá and Catalão, this reinforces Brazil's long-term strategic advantage in critical and high-performance metals and supports a resilient position in global supply chains.

Table 9.12: Selected niobium deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Nb)	STATUS
Araxá	Nb (pyrochlore)	CBMM	896	1.49	Operating
Pitinga	Nb (pyrochlore and columbite) byproduct of Sn (cassiterite)	CNMC	515	0.2	Operating
Boa Vista (Catalão II)	Nb (pyrochlore)	CMOC	26	0.95	Operating
Mine I (Catalão I)	Nb (pyrochlore)	CMOC	13	0.95	Operating
Mine II (Catalão I)	Nb (pyrochlore)	CMOC	5.9	1.13	Operating
Seis Lagos	Nb (pyrochlore)	SGB-CPRM	1.15	2.99	Unexploited
Santa Bárbara	Nb (columbite) byproduct of Sn (cassiterite)	ERSA/CSN	N/A	N/A	Operating

N/A – Not available.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Brazilian Mineral Yearbook*: main metallic commodities 2024 (in Portuguese). Brasília, DF: ANM, 2025. 26 p. Year-base 2023. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/anuario-mineral/anuario-mineral-brasileiro/anuario-mineral-brasileiro-principais-substancias-metalicas-2024. Accessed on: 26 jan. 2026.
[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

9.13 Phosphate

By Tamara Reginatto Manfredi (tamara.manfredi@sgb.gov.br) and Ioná de Abreu Cunha (iona.cunha@sgb.gov.br)

Brazil remains highly dependent on imported fertilizers, with approximately 86% of agricultural phosphorus sourced externally and total fertilizer imports reaching 41–44 Mt in 2024[1], while domestic production supplied only 7 Mt. Brazil hosts relevant phosphate deposits and significant potential for new discoveries, approximately 80% of the deposits are associated with residual enrichment processes of carbonatite–alkaline complexes. Only ~20% of Brazil's reserves derive from sedimentary settings, despite the existence of numerous potential basins.

ORE RESERVES[2]	OPERATING MINES	PRODUCTION[2]	WORLD RANKING[3]	
4.85 Gt of phosphate rock	12	7 Mt of phosphate rock	Reserves	7th (2.2%)
			Production	7th (2.2%)

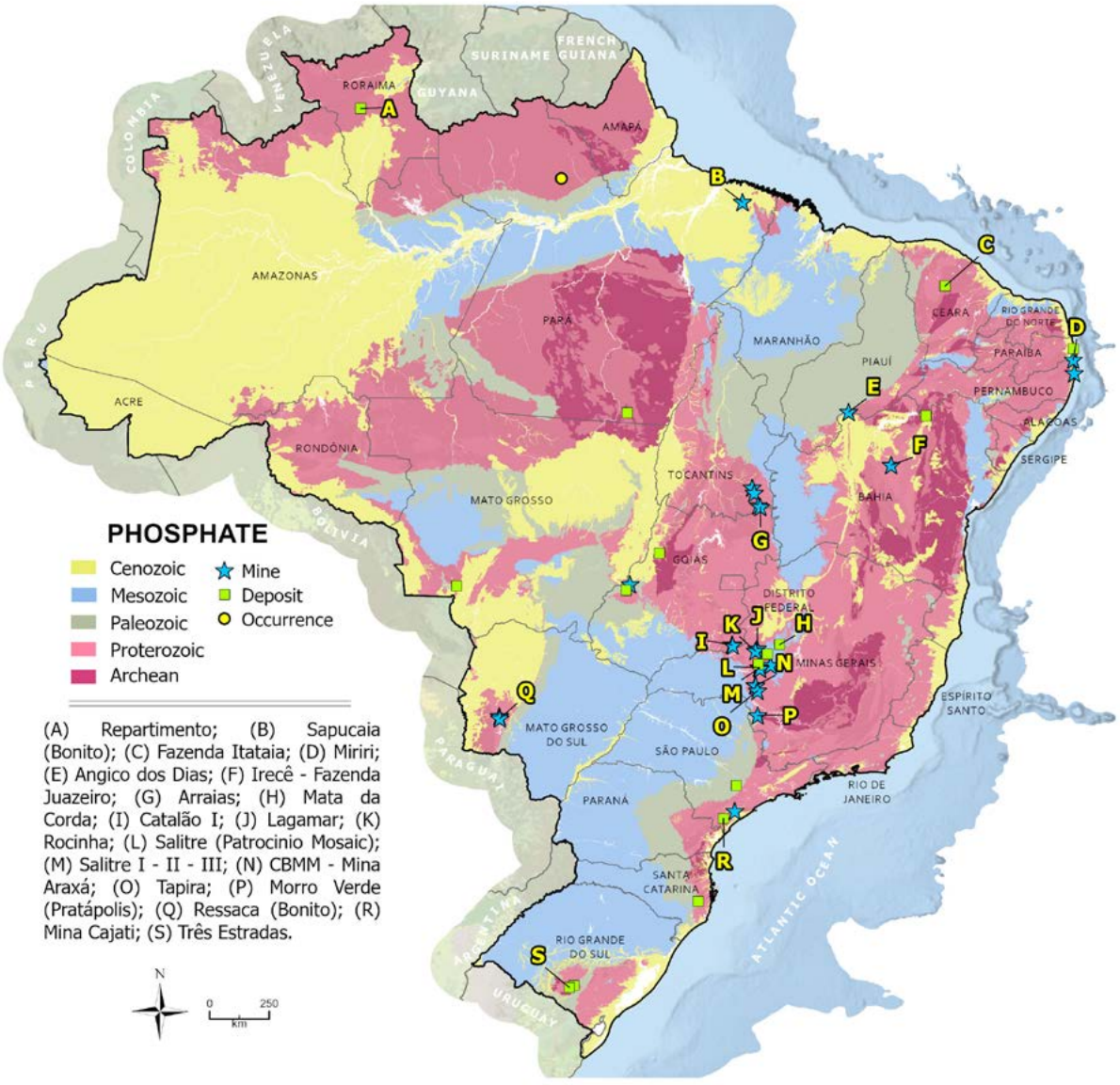

Fig. 9.13: Selected Brazilian phosphate occurrences, deposits, and mines.

Highlights

- Brazil hosts a diverse set of phosphate deposits across igneous, sedimentary, and supergene environments, ranging from consolidated operations to early-stage exploration targets.
- Brazil's long-term phosphate reserves are dominated by alkaline-carbonatite provinces. In July 2025, the SGB-CPRM launched studies in the Alto Paranaíba Igneous Province, targeting key complexes such as Araxá, Tapira, Serra Negra, and Salitre, along with the Mata da Corda units.
- Neoproterozoic sedimentary basins (e.g., Arraias, Irecê, Patos de Minas, Ressaca, Pratápolis) remain regionally important and are adopting new beneficiation technologies to improve recovery and reduce environmental impacts.
- Galvani announced ~USD 250 million in investments in Bahia to expand phosphate mining and fertilizer production. The Irecê Project (USD 108 million), expected to start in 2026, aims to make Bahia self-sufficient and supply up to 30% of North and Northeast demand, while ~USD 90 million will double capacity at the Luís Eduardo Magalhães industrial complex.
- The Três Estradas Project (Águia Fertilizantes) reported 2025 JORC-compliant updates and is projected to supply ~300 ktpa of natural phosphate, pending approval. Similar carbonatite targets in southern Brazil (Santa Clara, Porteira, Mato Grande, and Passo Feio) show promising geophysical and P_2O_5 indications, highlighting further discovery potential in both weathered and hard-rock zones.
- The Miriri Phosphate Project (NE Brazil) spans 6,112 ha with an estimated resource of 114 Mt. Awarded to Elephant Mineração in the 2024 public tender (Auction No. 4/2024), it holds strategic importance for Brazil's fertilizer supply chain.
- The Santa Quitéria Project (Ceará State, Brazil), under environmental licensing, is an integrated phosphate-uranium complex expected to produce 1.05 Mt per year of phosphate fertilizers and 220 ktpa of dicalcium phosphate, meeting ~25% of North and Northeast Brazil's demand.
- Sectoral trend (2025-2026): rising production capacity, technological upgrades, regional deposits diversification, and greater vertical integration are enhancing resilience in Brazil's phosphate supply chain, despite continued reliance on imports.

[1] ASSOCIAÇÃO NACIONAL PARA DIFUSÃO DE ADUBOS. Recursos. [*S. l.*]: ANDA, 2025. Disponível em: https://anda.org.br/recursos. Acesso em: 22 jan. 2025

[2] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.

[3] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025..

Table 9.13: Selected phosphate deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% P_2O_5)	STATUS
Barreiro- Complexo Araxá	P_2O_5-Nb-REE-U-Ba	Codemi/Mosaic	460	15.1	Producing
Rocinha	P_2O_5	Fosfatados Centro	415	12.5	Interrupted
Tapira	P_2O_5-Nb-Ti	Mosaic	432.5	9.0	Producing
Maecuru	Ti- P_2O_5-REE	Vale	200	15	Unexploited
Morro Preto Sul	P_2O_5-Nb-REE	CMOC	228	8.6	Feasibility
Mata da Corda	P_2O_5-Ti	Terra Brasil Direitos Minerarios	520	3.5	Unexploited
Serra do Salitre (Eurochem)	P_2O_5	Eurochem	350	4.5	Producing
Jauru (Mirassol D´Oeste)	P_2O_5-Fe	BEMISA	314	5.0	Planned
Santana (PA)	P_2O_5	Itafós	87	12.0	Planned
Mina Ouvidor/ Chapadão	P_2O_5- Nb	CMOC	80.0	10.4	Producing
Fazenda Ipanema	P_2O_5-Fe	N/A	117	6.1	Unexploited
Catalão I	P_2O_5-Nb-Ti-U	Mosaic	65.5	10.4	Producing
Irecê/Fazenda Juazeiro	P_2O_5	Galvani	40	15.0	Producing
Miriri	P_2O_5	Elephant Mineração	114	4.2	Unexploited
Morro Verde (Pratápolis)	P_2O_5	Morro Verde (Ore Investiments)	50.6	9.2	Producing
Arraias	P_2O_5	Itafos	91	4.9	Interrupted
Morro Preto Norte	P_2O_5-Nb-REE	CMOC	61	7.3	Feasibility
Anitápolis	P_2O_5	Mosaic	53	8.2	Unexploited
Três Estradas	P_2O_5	Aguia Resources	74.7	4.1	Feasibility
Cajati	P_2O_5	Mosaic	55.7	5.4	Producing
Lucena	P_2O_5	Aguia Resources	55	4.4	Unexploited
Angico dos Dias	P_2O_5-REE	Galvani	12.5	15.4	Producing
Juquiá (Registro)	P_2O_5	Mineração Juquiá	18	10.0	Unexploited
Ressaca (Bonito)	P_2O_5	Edem	11.5	14.0	Producing
Taipas	P_2O_5	Rialma Fertilizantes	25	5.0	Planned
Fazenda Itataia	U- P_2O_5	Galvani	8.9	11.0	Feasibility
Sapucaia/Boa Vista (Bonito)	P_2O_5	Viso Fertilizantes (Grupo Scheffler)	4	21.0	Producing
Mundo Novo	P_2O_5-Nb-REE	EDEM/Summit Minerals	2.5	8.8	Feasibility
Mandacaru (CE)	P_2O_5	Harvest Minerals	4.38	4.5	Producing
Joca Tavares	P_2O_5	Aguia Resources	2.75	4.4	Unexploited
Bonfim	P_2O_5	FENGRO/DuSolo	1.16	8.2	Unexploited
Serrote da Batateira	P_2O_5	CBPM	0.66	11.0	Unexploited
Lagamar	P_2O_5	Galvani	Exhausted	N/A	Exhausted
Repartimento	P_2O_5-REE	N/A	3.5	3 to 5	Unexploited

N/A – Not available.

9.14 Platinum Group Elements

By Felipe Grandjean Costa (felipe.costa@sgb.gov.br)

Platinum group elements (PGE) – Pt, Pd, Rh, Ru, Os, Ir – are extremely rare, around 30 times rarer than gold. Their exceptional catalytic properties make them vital for clean-energy technologies like green hydrogen. Since 1900, about 90% of global supply has come from South Africa and Russia, placing PGE at the center of many nations' critical minerals strategies.

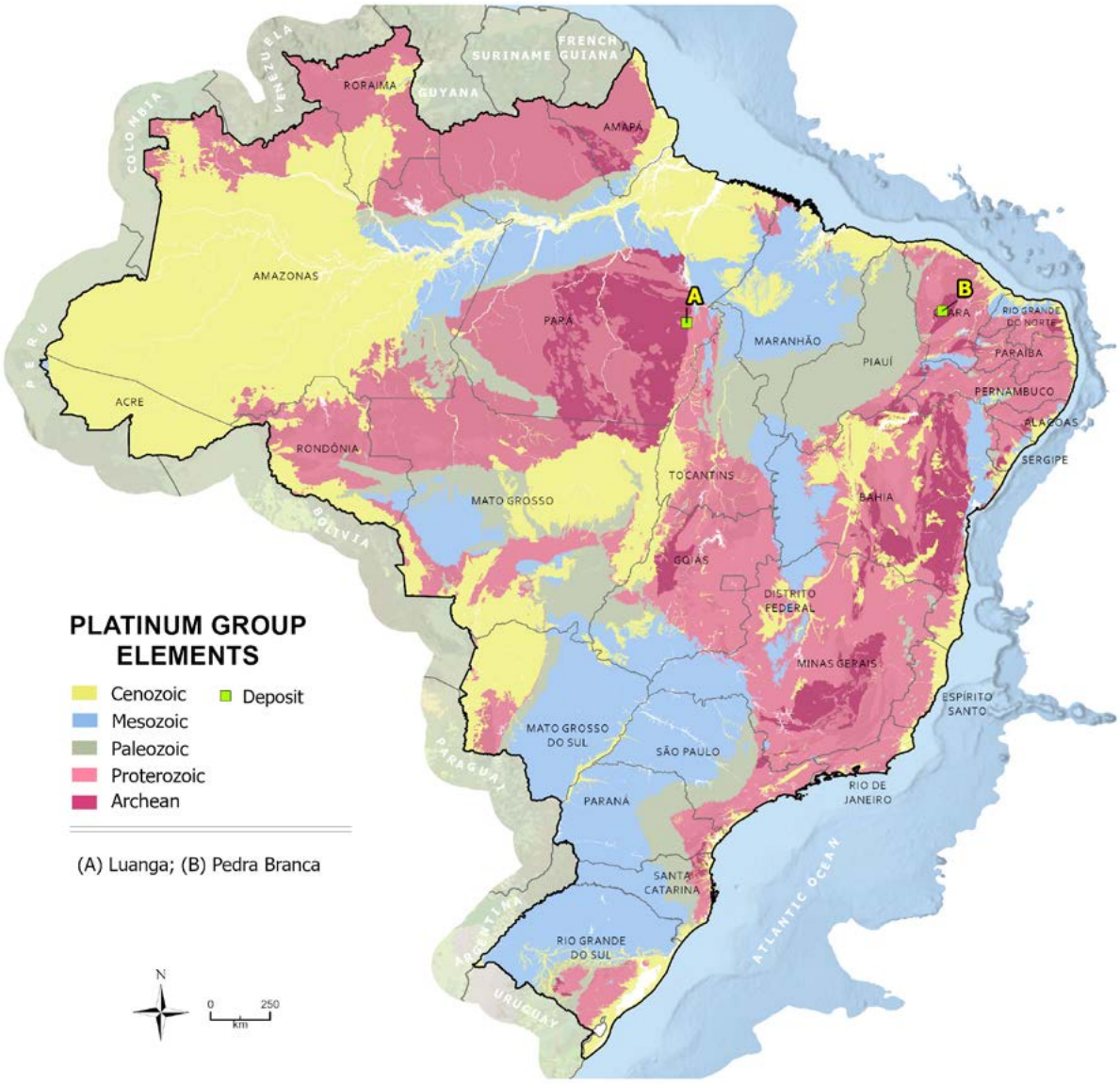

Fig. 9.14: Selected Brazilian platinum group elements deposits.

Highlights

- Brazil has no operating PGE mines yet, but the Pedra Branca and Luanga deposits are in advanced exploration and are likely future producers.
- Like other global PGE deposits, Brazilian occurrences are hosted in layered mafic–ultramafic complexes.
- The Luanga deposit (Carajás Province) is the largest PGE deposit in South America, with 236 Mt (measured+indicated+inferred) at 2.04 g/t PdEq (palladium equivalent; grades: 0.98 Pd, 0.62 Pt, 0.09 Rh, 0.12 Ni, and 0.05 Au). High-grade zones occur in sulfide-rich harzburgites, orthopyroxenites, and minor chromitites.
- The Luanga intrusion is Neoarchean (~2.76 Ga), similar to other Carajás intrusions (e.g., Lago Grande, Serra da Onça, Puma, Fafá, Jacaré).
- The Pedra Branca deposit (NE Brazil) has 63.6 Mt (inferred) at 1.08 g/t 2PGE+Au (0.68 Pd, 0.36 Pt, 0.04 Au), hosted in disrupted chromitite layers of the Tróia–Pedra Branca complex (~2.04 Ga), comparable in age to South Africa's Bushveld Complex.
- Large igneous complexes are unlikely to be found in Brazil, but many small Precambrian intrusions in the Borborema Province and the São Francisco Craton remain underexplored.
- Economic PGE grades also occur in Brazilian Ni–Cu sulfide deposits (Limoeiro, Mirabela), komatiites (Fortaleza de Minas), some gold deposits (Serra Pelada, Buraco do Ouro), and IOCG (iron oxide-copper-gold) systems (Jatobá), though generally at lower concentrations.
- All Brazilian PGE mineralization is Precambrian; none has been found in Mesozoic sills, though Norilsk-type models suggest potential.
- Brazil's geology is favorable for new PGE discoveries, and rising demand for clean energy metals may drive further exploration.

Table 9.14: Selected PGE deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE	STATUS
Luanga	Pd-Pt-Rh-Ni-Au	Bravo Mining	236.0	0.98 g/t Pd; 0.62 g/t Pt; 0.09 g/t Rh	Exploration
Pedra Branca	Pd-Pt-Au	ValOre Metals	63.6	0.68 g/t Pd; 0.36 g/t Pt	Exploration

N/A – Not available.

9.15 Potash

By Marcelo Batista Motta (marcelo.motta@sgb.gov.br)

Updated estimates indicate that Brazil holds 2.68 Gt of resources, containing approximately 565.6 Mt of K_2O, with an average grade of 21.12%. Lower Cretaceous and Permo-Carboniferous evaporites are the main hosts of potassium mineralizations in Brazil.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]
225 Mt of contained K_2O	1	398 kt of contained K_2O	Reserves minor Production minor

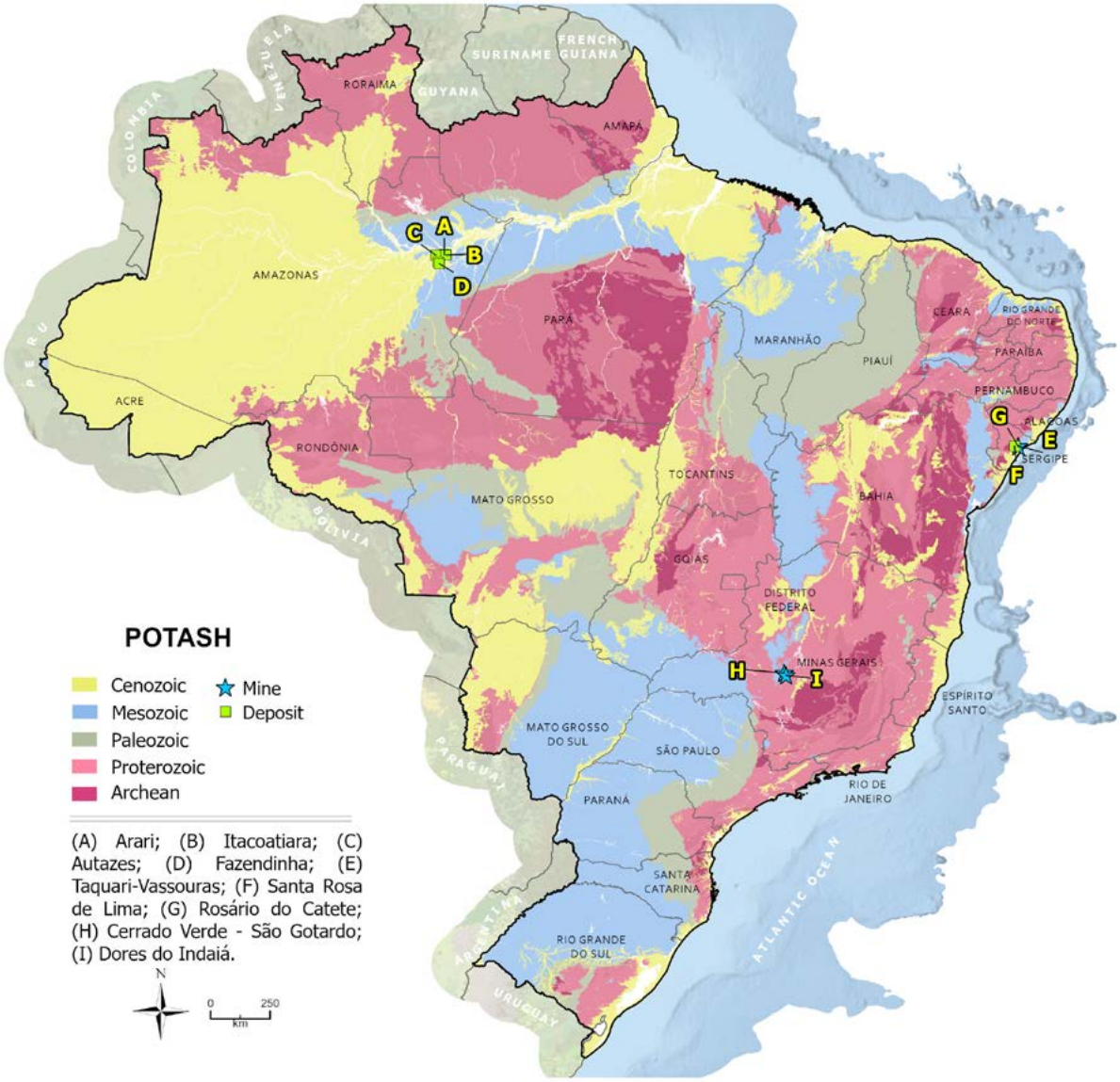

Fig. 9.15: Selected Brazilian potash deposits and mines.

Highlights

- Taquari-Vassouras Mine produced 102.26 kt of K_2O in the second quarter of 2025, with an average grade of 21.12%. This represents a 44.14% increase compared to the 71.4 kt of K_2O produced in the same period of 2024.
- In the Sergipe Basin, Mosaic previously mined deposits in the Taquari-Vassouras and Santa Rosa de Lima regions with sylvinite as the main potash ore and remaining reserves estimated[2] at 2.3 Mt of K_2O. In Rosário do Catete, carnallite deposits contain ore reserves of about 11.5 Gt, including approximately 2.5 Gt of KCl (8.3% contained KCl) and 1.95 Gt of i*n situ* K_2O.
- In the Amazon Basin, reserves in the municipalities of Itacoatiara and Nova Olinda do Norte are held by Petrobras, while the Autazes deposit belongs to Potássio do Brasil, a subsidiary of Brazil Potash Corp. Together, these reserves total 1.79 Gt of KCl (30.40% average grade), or approximately 1.13 Gt of K_2O. With the necessary permits, Potássio do Brasil has begun preliminary work on the site of the future industrial plant, which will process 8.5 Mt of ore to produce 2.4 Mt/year of KCl, equivalent to 1.52 Mt/year of K_2O.
- Potássio do Brasil has identified three other potential targets in Novo Remanso, Itacoatiara and São Sebastião do Uatumã with resources estimated at over 1.2 Gt of KCl with an average grade of 30%, equivalent to approximately 950 Mt of K_2O.
- A SGB-CPRM publication on the Amazonas Basin identified four sub-basins containing a total of 2.4 Gt of ore, equivalent to 1.5 Gt of KCl with a inferred grade of 30%, or 947.5 Mt of K_2O. In the Abacaxis evaporitic sub-basin, two evaporitic layers with potassium and sulfate salts—each 5 m thick—were detected.
- Basins with characteristics similar to the Amazonas and Sergipe basins are being evaluated under the Brazilian government's critical minerals program, covering 9 onshore and 13 offshore basins. Detailed studies are underway in the Sergipe Basin and in a new exploratory front in the Parnaíba Basin, using data from the National Agency of Petroleum, Natural Gas, and Biofuels (ANP).
- Glauconite (6-10% K_2O) is being studied in Brazil as an alternative potassium source. In this segment, FASA - Fertilizantes da Amazônia is conducting research in Apuí (Amazonas), while Kalium Mineração, with 220 Mt of verdete/glauconite reserves and an additional 2.5 Gt of potential ore, is seeking partnerships for its venture. Verde Agritech, based in São Gotardo (Minas Gerais), processes ore averaging 9.28% K_2O, yielding a final fertilizer product with 22% K_2O.

Table 9.15: Selected potash deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% K_2O)	STATUS
Autazes	K	Potássio do Brasil	767	30.7	Installation Permits
Arari	K	Petrobras	545	32.7	Feasibility
Fazendinha	K-salt	Petrobras	478	27.8	Feasibility
Itacoatiara	K	Potássio do Brasil	263	19	Feasibility
Dores do Indaiá	K	Kalium Mineração	220	10.6	Exploration
Cerrado Verde	K	Verde Agritech	253	9.2	Exploration
Santa Rosa de Lima	K	Petrobras	55.2	24.6	Exploration
Taquari-Vassouras	K	VL Mineração	25.5	15	Operating
Sub-bacia Taquari Vassouras Carnalita	K	Petrobras / VL Mineração	14.4	6.6	Exploration

N/A – Not available.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. Brazilian Mineral Summary 2025: base year 2024 (in Portuguese). Brasília: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 27 dec. 2025.

[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025* (in Portuguese). Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 27 dec. 2025.

9.16 Rare Earth Elements

By Lucy Takehara Chemale (lucy.chemale@sgb.gov.br), Guilherme Iolino Troncon Guerra (guilherme.guerra@sgb.gov.br) and Victória Frazão Siqueira (vicfs@usp.br)

Since 2014, the United States Geological Survey (USGS) has consistently reported Brazilian REE reserves in the range of 21–22 Mt, based on the Brazilian Mineral Summary (2013), which incorporated mineable reserves from the Araxá district—approximately 14 Mt associated with CBMM and 8 Mt with CODEMIG. These reserves have positioned Brazil as the second-largest holder of global REE reserves[1]. In parallel, the Brazilian Mining Agency (ANM) recently reported[2] 11.4 Mt of proved and probable REE reserves. Notwithstanding this revised national estimate, Brazil maintains its second-place ranking in the USGS global reserve assessment for 2025[1].

ORE RESERVES[2]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[1]	
11.4 Mt of rare-earth-oxide equivalent	1	20 t of rare-earth-oxide equivalent	Reserves	2nd (23.3%)
			Production	minor

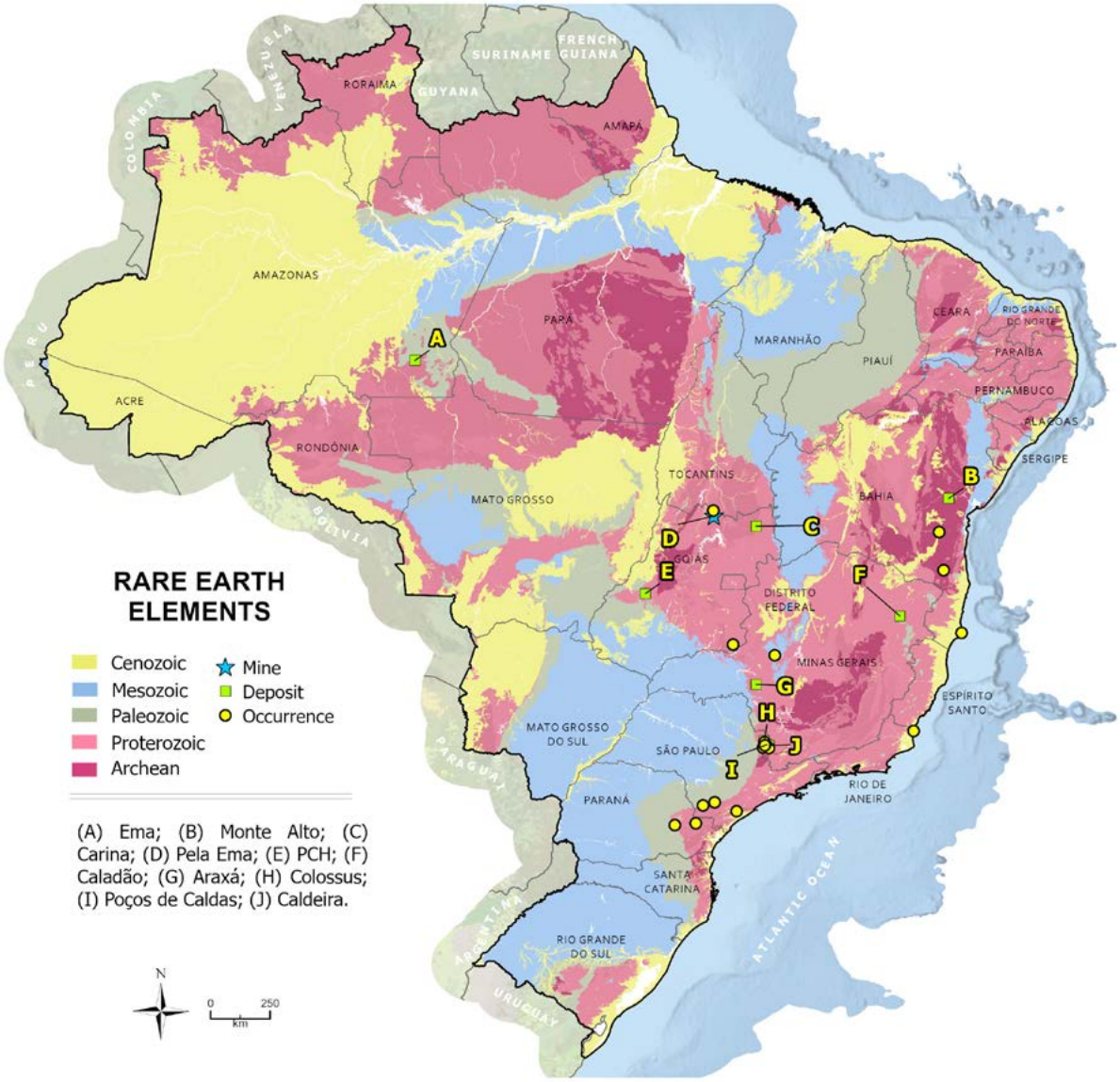

Fig. 9.16: Selected Brazilian rare earth elements deposits and occurrences. Occurrences represent early-stage prospects, deposits correspond to projects with published mineral resource estimates (MRE), and Pela Ema (Serra Verde Project) is highlighted as the sole producing mine.

Highlights

- Brazil hosts the world's second-largest rare earth elements (REE) reserves, estimated at approximately 21 Mt, accounting for nearly 23% of the global REE resources[1] (including 11.4 Mt, or 13,9%, of proved and probable REE reserves[2]). Despite this significant geological endowment, Brazil has not reported substantial REE production. Nonetheless, mineral exploration activities have intensified in recent years, particularly focused on ion-adsorption clay (IAC)-type deposits. These efforts have yielded highly encouraging results and are contributing to a reassessment of Brazil's potential role in the global REE supply chain.

- In 2024, Brazil initiated industrial-scale REE production from IAC-type deposits. The Serra Verde Mining Company, located in the Minaçu region in the state of Goiás, commenced production at the Pela Ema deposit, becoming the country's first producer of rare earth oxides from IAC-type ores. Phase I production is projected at approximately 5,000 tonnes of total rare earth oxides (TREO), with capacity expansion planned for Phase II. The deposit hosts officially documented reserves of roughly 350 Mt of ionic clays, with an average REO+Y grade of 0.15% (SVPM, 2016).

- Most REE projects currently underway in Brazil remain at exploration or early development stages. While several projects are still advancing through drilling campaigns and laboratory-scale analyses, others have progressed to preliminary metallurgical testing, environmental licensing procedures, and early technical and economic evaluations. A defining characteristic of the current exploration landscape is the predominance of IAC–type deposits, which represent the principal target of recent exploration activities nationwide.

- A systematic compilation of publicly available information—including mining databases, company technical disclosures, and stock exchange filings—identified 62 REE projects distributed across Brazil and spanning multiple stages of development. This inventory encompasses early-stage prospects, advanced exploration projects with published drilling, geochemical, and metallurgical data, and several projects reporting formal mineral resource estimates (MRE). At present, Serra Verde remains the only REE operation in production.

- Brazil is progressively advancing toward the consolidation of an integrated domestic REE value chain, supported by coordinated actions involving government agencies, research institutions, and industry stakeholders. Key initiatives include programs supported by the Ministry of Science, Technology and Innovation (MCTI), such as INCT Terras Raras and Regina, as well as advances in national rare earth oxide separation technologies, the establishment of the Rare Earth Refining, Recycling, and Innovation Center (CR), and the MagBras program, which aims to develop domestic capabilities in rare earth alloys and permanent magnet manufacturing.

Table 9.16: Selected REE deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (TREO)	RESERVES	STATUS
Poços de Caldas[13]	REE	Mineração Terras Raras S.A.	3,961.55	37,748 ppm	N/A	Exploration
Caldeira[7]	REE	Meteoric Resources NL	1,498	2,413 ppm	103 Mt @ 4,091 ppm	Exploration
Ema[10]	REE	Brazilian Critical Minerals	943	716 ppm	N/A	Exploration
Pela Ema[3]	REE	Serra Verde Pesquisa e Mineração	911	1,200 ppm	350 Mt @ 1,500 ppm	Operating
Colossus[9]	REE	Viridis Mining	493	2,590 ppm	200.6 Mt @ 2,640 ppm	Exploration
Carina[8]	REE	Aclara Resources	298	1,452 ppm	165.4 Mt @ 1,723 ppm	Exploration
Caladão[6]	REE	Axel REE Limited	233	2,143 ppm	N/A	Exploration
Monte Alto IAC[11]	REE	Brazilian Rare Earths	104.1	1,105 ppm	N/A	Exploration
PCH Project[12]	REE	Appia Rare Earth & Uranium	52.8	2,841 ppm	N/A	Exploration
Araxá[5]	REE	St George Mining	40.6	4.13%	N/A	Exploration
Araxá[14]	REE	CBMM/ CODEMIG	17.22	2.78%	N/A	Inactive

N/A – Not available; TREO - total rare earth oxides.

[1] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.
[2] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 Dec. 2025.
[3] https://core.ac.uk/outputs/322489758/
[4] https://minedocs.com/25/Serra-Verde-Geology-082016.pdf
[5] Measured + Indicated + Inferred Resource - https://cdn-api.markitdigital.com/apiman-gateway/ASX/asx-research/1.0/file/2924-02931020-6A1258237&v=undefined
[6] Inferred Resource - https://wcsecure.weblink.com.au/pdf/AXL/03001812.pdf
[7] Measured + Indicated + Inferred Resource - https://wcsecure.weblink.com.au/pdf/MEI/03012856.pdf. Probable reserve of 103 Mt with grade of 4091 ppm
[8] Indicated + Inferred Resource - https://cdn.prod.website-files.com/67b9c5dc15db73b34fcf2bce/690dfe2a4ac3bfeec08486e6__NI43-101_Technical-Report_ACLARA_Carina-Project_251105.pdf. Probable reserve of 165 Mt with grade of 1723 ppm
[9] https://wcsecure.weblink.com.au/pdf/VMM/03015586.pdf. Probable reserve of 201Mt with grade of 2640 ppm
[10] Indicated + Inferred Resource - https://braziliancriticalminerals.com/announcements/6803971
[11] Inferred Resource - https://webservices.weblink.com.au/article.aspx?articleID=I2kEBzvJ1nPYCrKx2KfWNOvcxoyDTQLSBQVktJHpFWY=
[12] Indicated + Inferred Resource - https://appiareu.com/wp-content/uploads/2024/04/PCH-Project-2024-NI-43101-Technical-Report-for-Appia-FINAL-1.pdf
[13] Indicated + Inferred Resource - https://mtr.net.br/wp-content/uploads/2017/10/exec-RPA.pdf
[14] https://www.gov.br/anm/pt-br/centrais-de-conteudo/anm/sumarios/sumario-mineral-2013/view

9.17 Silicon

By Said Abdallah (said.abdallah@sgb.gov.br)

Silicon is abundant in the Earth's crust and increasingly demanded by high-technology industries. In 2023, global quartz trade totaled USD 1.33 billion, with Brazil accounting for 9.28% of worldwide exports. Recent market expansion, particularly in 2024, underscores Brazil's strategic role due to its abundant natural quartz resources and significance within the global supply chain.

ORE RESERVES	OPERATING MINES	PRODUCTION	WORLD RANKING	
Not available	3	3,178 kt of quartz	Reserves	Not available
			Production	Not available

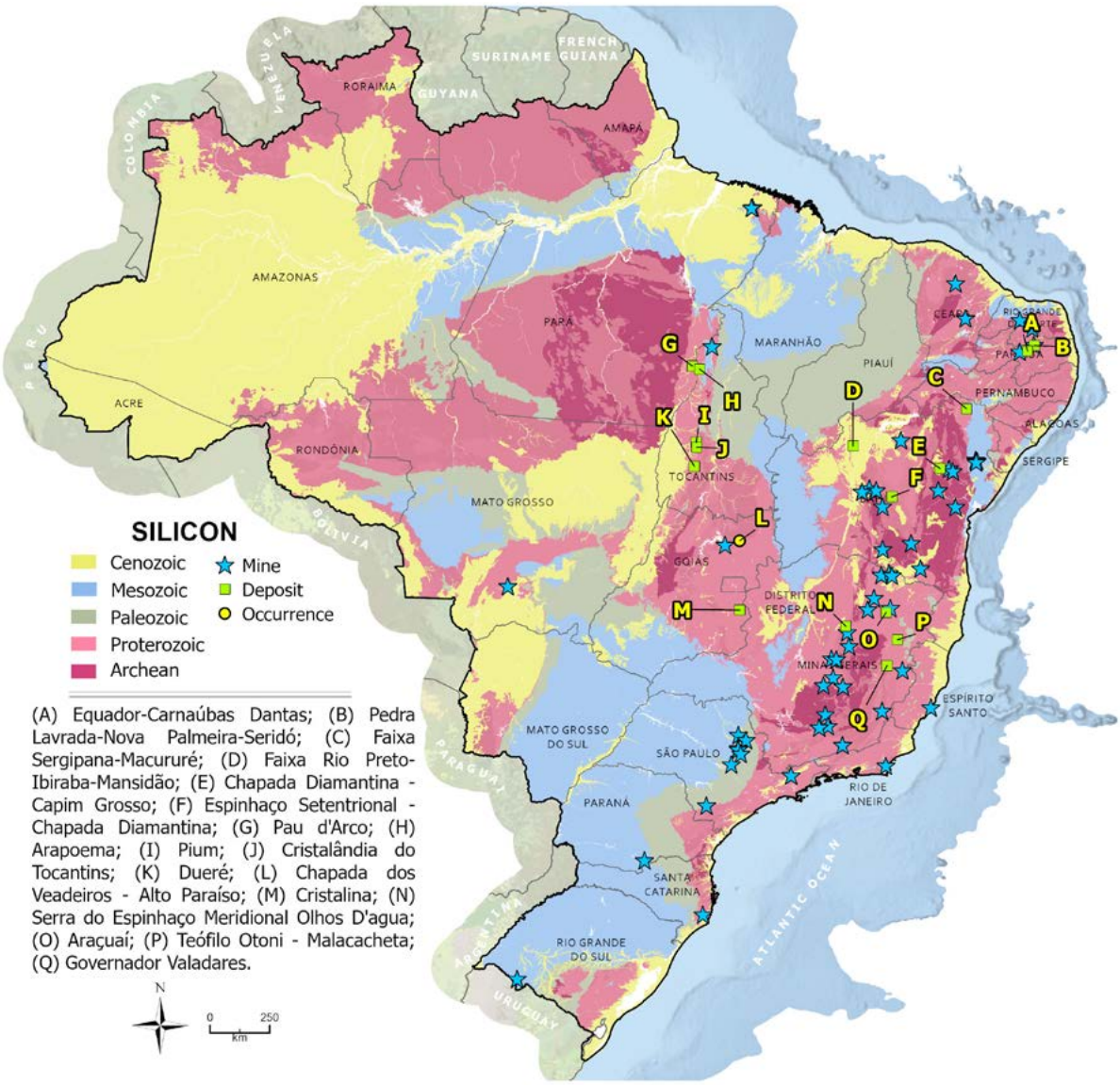

Fig. 9.17: Selected Brazilian silicon occurrences, deposits, and mines.

Highlights

- Quartz crystal production in Brazil is led by Minas Gerais, followed by Bahia, Tocantins, Ceará, Mato Grosso, and Paraíba. Only crystal and piezoelectric quartz are considered, excluding industrial silica sands.
- Based on silicon metal output in 2022, Brazil's quartz production is estimated at ~3.18 Mt, assuming all silicon is sourced from quartz (both hyaline and milky varieties).
- In 2024, quartz production reached a historic 174 Mt of ROM, generating approximately USD 8.7 million in gross mineral production value.
- Brazil holds a strong position in the global quartz market, but its national reserves remain poorly assessed. Major deposits are in the states of Pará, Minas Gerais, Bahia, Paraíba, Tocantins, and Goiás, mainly in Neoproterozoic and Mesoproterozoic metamorphic and metasedimentary rocks.
- In Brazilian quartz deposits, two main mineral systems are recognized:
  - Ductile-domain systems, characterized by monomineralic quartz veins and pegmatite swarms with predominant north–south regional trends, especially in the Araguaia and Brasília belts.
  - Brittle-domain systems, associated with fractures and faults, including quartz infill in Riedel-type T fractures.
- Key prospective areas include:
  - The central-northern São Francisco Craton (in the states of Bahia and Minas Gerais) hosts extensive, long-exploited quartz prospects with strong short-term research and development potential.
  - The Eastern Pegmatitic Province of the Araçuaí Belt (Governador Valadares region) is notable for dense swarms of mineralized pegmatites.
  - The Serra do Espinhaço Meridional (Central-Northern Minas System) extends ~300 km and including key areas such as Diamantina and Morro do Chapéu.
- Significant quartz mineralization also occurs in northeastern Brazil, particularly within the Riacho do Pontal, Rio Preto and Sergipana belts in the states of Bahia and Sergipe, as well as the Borborema–Seridó System in Ceará.
- High-purity silica and large quartz crystals occur in the Pequizeiro and Couto Magalhães formations (Tocantins Group, Araguaia Belt) and in the Paranoá Group (Cristalina and Chapada dos Veadeiros, Goiás).
- The Homerun Project in Belmonte (in the state of Bahia) hosts 25.56 Mt of Measured and 38.35 Mt of Inferred high-purity quartz resources grading >99.6% SiO_2, positioning it as a strategic long-life source of premium silica in Brazil.
- Brazil does not yet control the full silicon value chain, remaining a raw material supplier while importing high value-added products (e.g., battery and electric vehicle components).
- Accumulated investments total ~USD 18.9 million in mineral exploration and ~USD 95.6 million in mining. Minas Gerais (~USD 87 million) and Bahia (~USD 16.7 million) are the main investment destinations.

9.18 Sulfur

By Cimara Francisca Monteiro (cimara.monteiro@sgb.gov.br)

USGS estimates 2024 global sulfur production at approximately 85 Mt, led by China (19 Mt), the United States (8.2 Mt), and Russia and Saudi Arabia (7.5 Mt each). Petrobras, Brazil's primary elemental sulfur producer, forecast approximately 180 kt of production in 2024. COMEX STAT data indicate that Brazil exported 6.8 kt of sulfur and imported 2.4 Mt in 2024. Quantifying sulfur resources and reserves is challenging due to inconsistent reporting standards and because sulfur recovery often occurs at petroleum refineries and gas-processing facilities located far from extraction sites, sometimes in different countries.

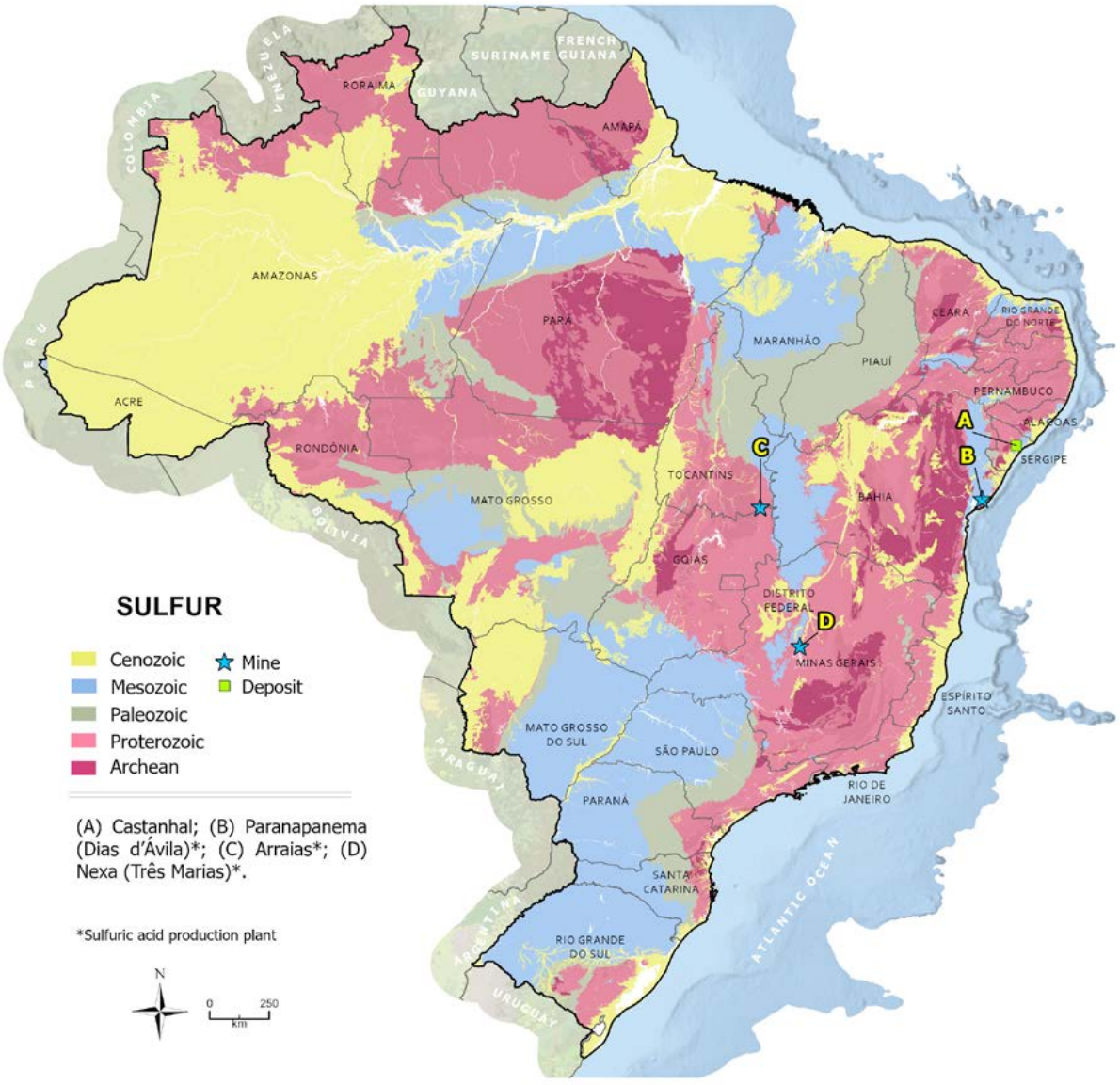

Fig. 9.18: Selected Brazilian sulfur deposits and sulfuric acid production plants.

Highlights

- Sulfur is formed by precipitation in volcanic fumaroles, salt domes and evaporitic sequences. It also occurs as sulfates associated with carbonates and clays in evaporitic environments, and as sulfides in volcanogenic, hydrothermal and sedimentary deposits.
- Approximately 90% of the sulfur available on the global market is a byproduct of oil and natural gas refining, obtained through the Claus process, which converts hydrogen sulfide gas into elemental sulfur. About 93% of this sulfur is used in the production of sulfuric acid, primarily for manufacturing phosphate fertilizers. Sulfur is also used in the production of chemicals such as hygiene and cleaning products, cellulose, sugar bleaching agents, insecticides, fungicides, pharmaceuticals and rubber vulcanization, among other applications.
- Petrobras is the only company in Brazil that produces sulfur in both liquid and solid forms, processing acid gas from hydrodesulfurization (HDT or HDS) units. In December 2024, Petrobras began operating the Atmospheric Emissions Reduction Unit (SNOX) at the Abreu e Lima Refinery (RNEST), located in Ipojuca, Pernambuco. The SNOX unit is the first emissions reduction system in the refining sector in Brazil and the Americas that is capable of converting sulfur oxides (SOx) and nitrogen oxides (NOx) into sulfuric acid. In the first quarter of 2025, refining capacity increased by 12%, and a doubling of current capacity is projected by 2029. Petrobras also produces sulfur at all of its other refineries.
- In the form of sulfuric acid, Brazil has several producers, including Galvani, Mosaic CMOC, Nexa Resources, Paranapanema, Itafós, Elekeiroz and AngloGold Ashanti. Throughout 2025, Yara Fertilizantes suspended sulfuric acid production at its plants in Cubatão and Paulínia, in the state of São Paulo.
- Global sulfur resources from evaporites, volcanic deposits, and fossil fuels total ~5 Gt. Gypsum and anhydrite sulfur is nearly unlimited, while coal, oil shale, and organic-rich shales contain ~600 Gt of sulfur contained, though cost-effective extraction is needed.
- Between January and December 2025, sulfur prices increased by more than 130%, driven by a reduction in global supply following the shutdown of Gazprom units in Russia, which caused the country—traditionally a major exporter—to become a net importer.

9.19 Tantalum

By Frank Gurgel Santos (frank.santos@sgb.gov.br)

The state of Amazonas, in the north of Brazil, holds the largest tantalum production in the country, accounting for over 85% of the national output. The state of Rondônia follows with 10% of the production, while the states of Minas Gerais and Pará together account for less than 3%[1].

ORE RESERVES[2]	OPERATING MINES[1]	PRODUCTION[2]	WORLD RANKING[2]	
40 kt of contained tantalum	8	210 t of contained tantalum	Reserves	3rd (10.3%)
			Production	4th (10.1%)

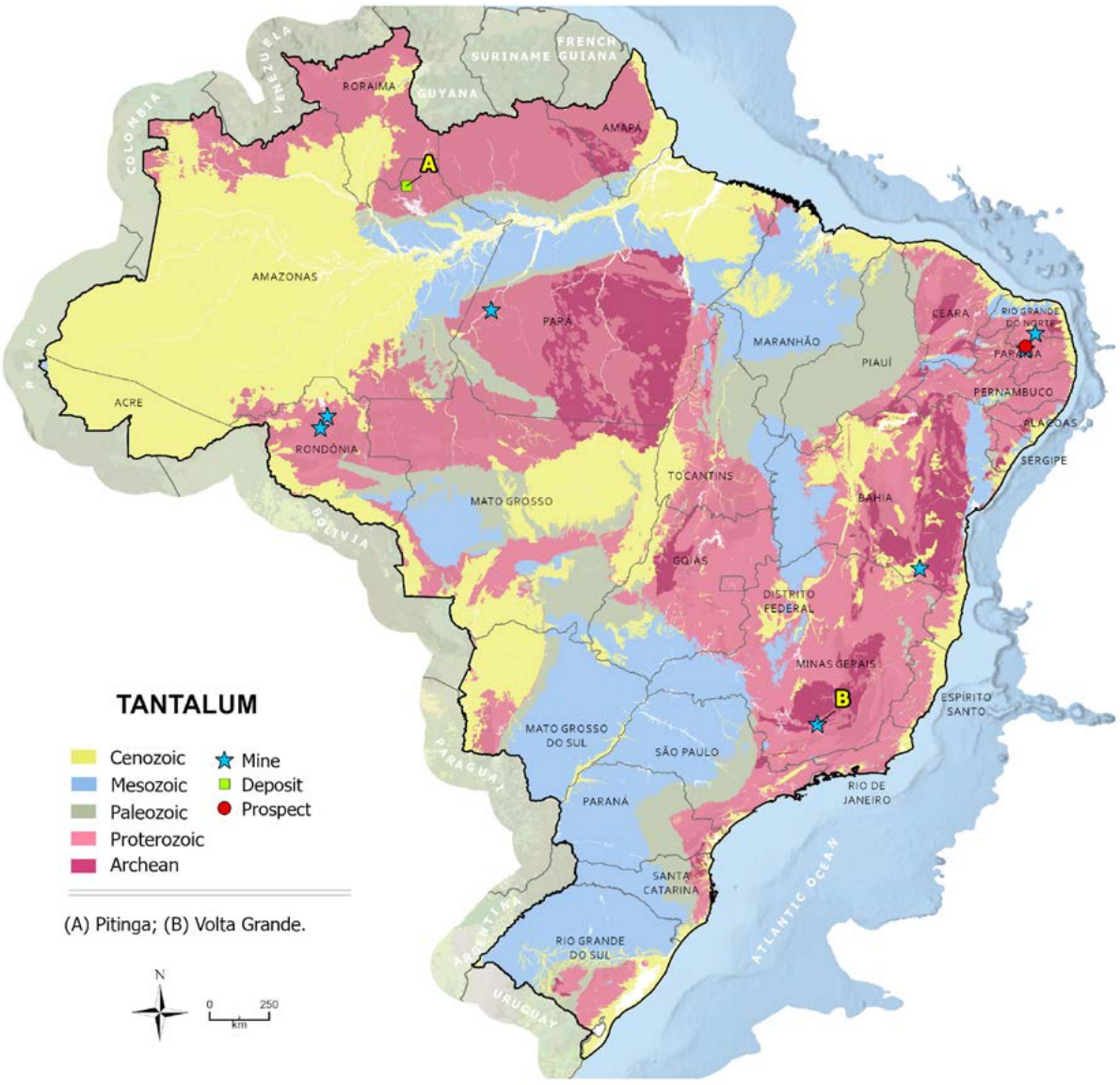

Fig. 9.19: Selected Brazilian tantalum prospects, deposits and mines.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.

[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

Highlights

- In Brazil, tantalum is primarily hosted in peraluminous granitic pegmatites (columbite-tantalite) and in peralkaline–syenitic systems. Modern operations commonly recover it as a by product of lithium and tin ores, as well as from the processing of other critical metals.
- Tantalum-bearing pegmatites are typically granitic and result from advanced fractional crystallization of peraluminous magmas, producing enrichment in lithium, tin, niobium, and rare earth elements.
- Mineração Taboca, in the state of Amazonas, is Brazil's principal producer, recovering niobium and tantalum as byproducts of primary tin ore processing.
- The state of Minas Gerais ranks third in national production, sourcing ore from the Eastern Brazilian Pegmatite Province. Processing facilities capable of isolating tantalum oxide from associated by products include AMG Brasil and Boston Metal do Brasil.
- Relevant tantalum occurrences in the states of Rio Grande do Norte, Paraíba, and Ceará are hosted in columbite-tantalite–bearing pegmatites of the Borborema Province, where extraction commonly occurs through small-scale and artisanal operations.
- Brazil remains one of the world's leading producers of tantalum minerals, chiefly from columbite-tantalite ("coltan") concentrates, where niobium–tantalum coexistence enables joint recovery.

9.20 Tin

By Gustavo de Assunção Mello (gustavo.mello@sgb.gov.br) and Said Abdallah (said.abdallah@sgb.gov.br)

Brazil produced approximately 16,600 t of contained tin in 2024[1], led by the state of Amazonas with 8,600 t (52%), followed by Rondônia with 4,500 t (27%) and Pará with 3,500 t (21%). Globally, Brazil ranked as the fifth-largest tin producer in 2024, accounting for 9.7% of total world output, and holds approximately 10% of global reserves, also ranking fifth[2].

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]	
735.4 kt of contained tin	8	16.6 kt of contained tin	Reserves	5th (10%)
			Production	5th (9.7%)

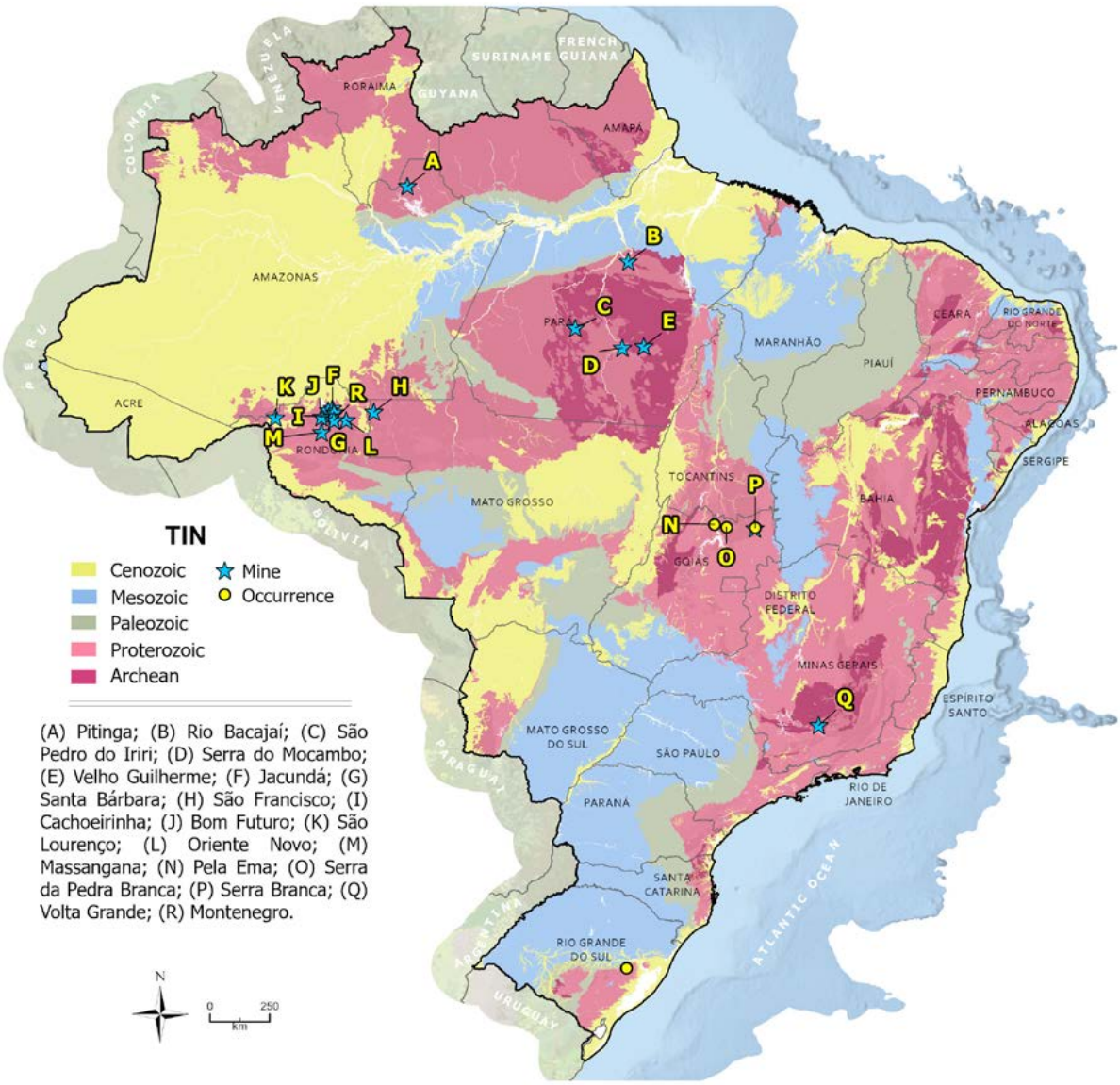

Fig. 9.20: Selected Brazilian tin deposits and occurrences.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed: Jan 6, 2026.

[2] U.S. GEOLOGICAL SURVEY. *Mineral Commodity Summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 6 jan. 2026.

Highlights

- Over recent decades, Brazil's tin production has been concentrated in the Amazon region, particularly in the states of Amazonas and Rondônia, complemented by smaller operations in the states of Pará and Minas Gerais. Between 1970 and 2023, cumulative production reached approximately 850,000 t of concentrate, consolidating Brazil as a significant global producer.
- The world-class Pitinga deposit (Amazonas State) is a granite-related system hosted by fractionated plutons, with polymetallic Sn–Nb–Ta–U–Zr mineralization. Cassiterite occurs disseminated and in greisen/stockwork zones formed by late-magmatic albitization and greisenization. The district also includes cassiterite-bearing alluvial deposits, intensively mined during the 1980s and 1990s and now exhausted.
- The Rondônia Tin Province has produced cassiterite since the 1950s through artisanal and small- to medium-scale operations, with deposits in anorogenic granites (veins, greisens, stockworks) and secondary eluvial and alluvial deposits formed by supergene reworking.
- Cassiterite mining in the state of Pará is conducted mainly by artisanal and small-scale operations targeting alluvial deposits. Within the São Félix do Xingu and Itaituba regions, tin mineralization is associated with granitic suites, with cassiterite occurring within stockworks and greisenized zones and reconcentrating into alluvial placers that have been mined historically.
- Production in Minas Gerais is concentrated within the São João del Rei Pegmatite Province, which hosts zoned LCT-type pegmatite deposits. Cassiterite occurs as disseminations and veinlets, associated with columbite–tantalite, niobium oxides, and lithium minerals, enabling co-production of critical minerals.
- Key exploration targets include the Goiás Tin Province, underexplored Amazon Craton areas like Surucucus (Roraima State), and pegmatite districts in Minas Gerais and Bahia, where cassiterite occurs in geochemically favorable granitic and pegmatitic systems.

Table 9.17: Selected tin deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Sn)	STATUS
Pitinga	Sn-Nb-Ta-U-Zr	Mineração Taboca	522.1	0.11	Producing
Bom Futuro	Sn	Meridian	61.0	0.6	Exploration
Volta Grande	Li-Ta-Nb-Sn	AMG	24.5	0.03	Producing
Rio Bacajaí	Sn	Matapi	N/A	N/A	Exploration
São Pedro do Iriri	Sn	COOGER	N/A	N/A	Intermittent production
Velho Guilherme	Sn	Brasilca	N/A	N/A	Intermittent production
Serra do Mocambo	Sn	Min. São Francisco	N/A	N/A	Intermittent production
Jacundá	Sn	Estanho de Rondônia	N/A	N/A	Intermittent production
Santa Bárbara	Sn	Estanho de Rondônia	N/A	N/A	Producing
São Francisco	Sn	Veeiro	N/A	N/A	Producing
Cachoeirinha	Sn-Nb	Metalmig	N/A	N/A	Producing
São Lourenço	Sn	Min. São Lourenço	N/A	N/A	Producing
Oriente Novo	Sn	Metalmig	N/A	N/A	Intermittent production
Montenegro	Sn	Metalmig	N/A	N/A	Producing
Massangana	Sn	CEMAL	N/A	N/A	Producing
Pela Ema	Sn	Serra Verde	N/A	N/A	Exploration
Serra da Pedra Branca	Sn	Min. Pedra Linda	N/A	N/A	Intermittent production
Serra Branca	Sn	ACLARA	N/A	N/A	Exploration

N/A – Not available.

9.21 Titanium

By Roberto Loreti Júnior (roberto.loreti@sgb.gov.br)

In 2024, China remained the world's leading producer and consumer of titanium mineral concentrates, accounting for approximately one-third of global ilmenite production[1]. Mozambique and South Africa were also among the principal producers of titanium mineral concentrates. China's imports of titanium mineral concentrates were about 4.4 Mt (gross weight), representing a 27% increase compared with to 2022. As of September 2024, Mozambique (49%), Norway (10%), and Vietnam (7%) were the leading sources of titanium mineral concentrates imported by China.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[1]	
38 Mt of titanium dioxide	1	20 kt of titanium dioxide	Reserves	6th (6.8%)
			Production	minor

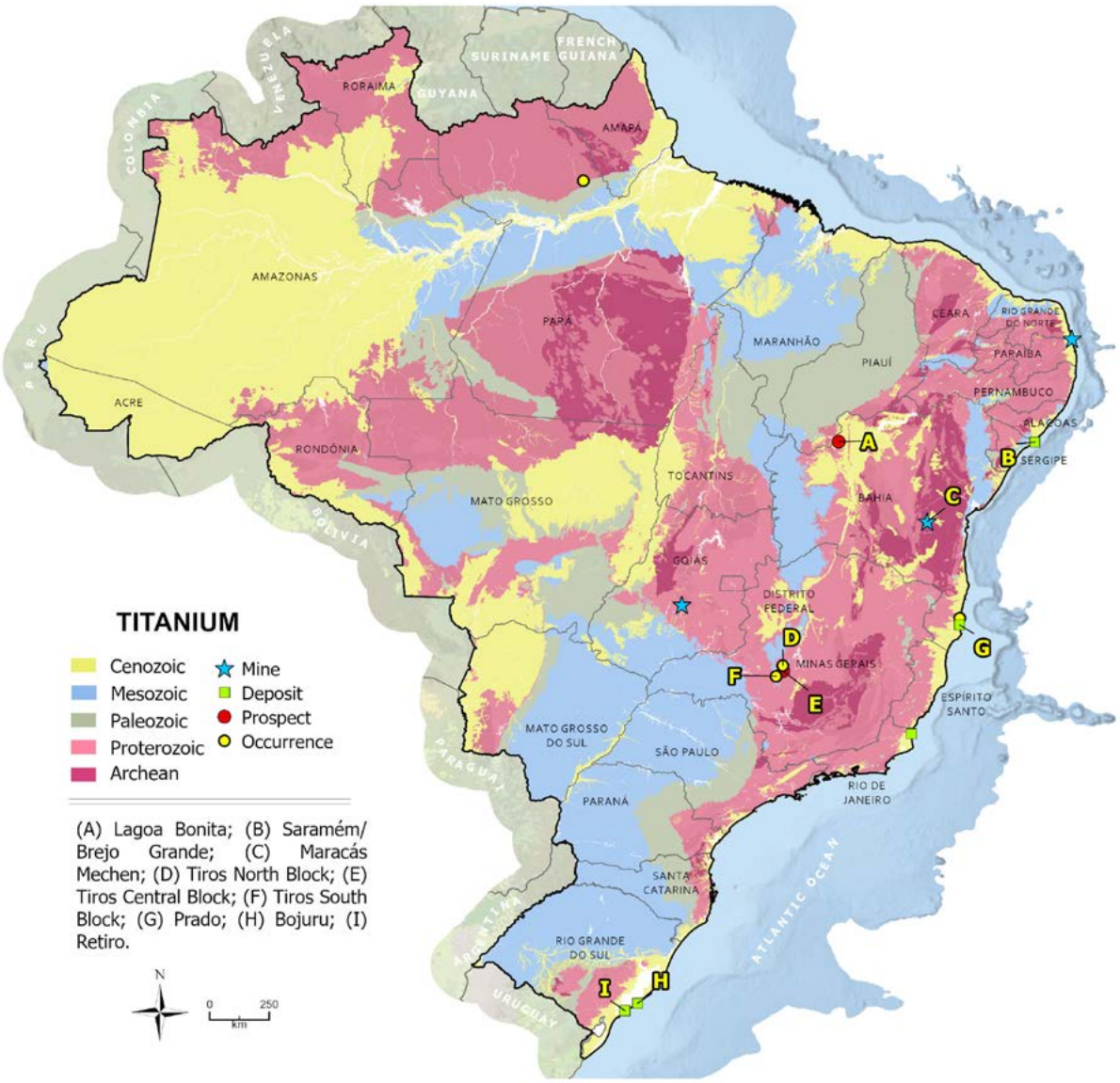

Fig. 9.21: Selected Brazilian titanium prospects, occurrences, deposits and mines.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral Summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 6 jan. 2026.

Highlights

- Brazil's ilmenite production is dominated by Largo Inc.'s Maracás Menchen mine (state of Bahia), with titanium in ilmenite and vanadium in titaniferous magnetite within cyclic magnetite and magnetite-pyroxenite layers. The titanium mineralization occurs in ilmenite, which forms a secondary oxide phase.
- The Maracás Menchen deposits are hosted in the Rio Jacaré mafic-ultramafic intrusion of the Archean São Francisco Craton, which comprises the Contendas-Mirante Complex and the Gavião and Jequié blocks. The Rio Jacaré intrusion is a linear, sheet-like body composed predominantly of gabbro, striking approximately north-south, with a length of 70 km and an average width of 1.2 km.
- The Tiros Project (Minas Gerais State) is an undeveloped high-quality titanium and REE deposit, with 1.9 Gt averaging 3,900 ppm TREO, 1,100 ppm MREO, and 12% TiO_2. An ultra-high-grade zone contains 136 Mt at 8,860 ppm TREO, 2,320 ppm MREO, and 23% TiO_2.
- As of January 2024, the proven and probable mineral reserves of the Maracás Menchen mine were estimated at 101 Mt grading 0.56% V_2O_5 and 7.52% TiO_2. The announced production capacity of the concentrate plant is 120 ktpa. Titanium concentrate production for 2024/2025 has not been disclosed.
- Other ilmenite targets in Brazil include placer deposits (Retiro, Bujuru, Saramém, Prado) and Fe-Ti-V mafic-ultramafic complexes, notably Campo Alegre de Lourdes and Lagoa Bonita in northern Bahia.
- Former ilmenite-producing deposits at Mataraca, in the state of Paraíba, and Buena, in the state of Rio de Janeiro, are exhausted.

Table 9.18: Selected titanium deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	STATUS
Tiros	Ti, REE	Resouro Estrategic Metals	1,900	Exploration
Maracas Mechen	Ti, V	Largo	307.63	Operating
Bojuru	Ti, Zr	Rio Grande Mineração	250	Exploration
Retiro	Ti, Zr	Rio Grande Mineração	250	Exploration
Saramém / Brejo Grande	Ti, Zr, REE	Backshore	120.7	Exploration
Prado	Ti, Zr, REE	Energy Fuels	N/A	Exploration
Lagoa Bonita	Ti, V	CBPM	23.8	Feasibility

N/A – Not available.

9.22 Tungsten

By Rogério Cavalcante (rogerio.cavalcante@sgb.gov.br)

Global tungsten production reached approximately 81,000 t in 2024, dominated by China (67,000 t; 83%), followed by Vietnam (3,400 t) and Russia (2,000 t). World reserves total approximately 4.6 Mt, with China holding 2.4 Mt (52%). Historical Brazilian production reached approximately 2 ktpa of scheelite concentrate during peak periods, though current commercial production has been significantly reduced due to international market price fluctuations. In Brazil, tungsten reserves are found primarily as scheelite and wolframite, hosted in skarn and greisen systems, respectively, with average WO_3 grades ranging from 0.7% to 2.0%.

ORE RESERVES	OPERATING MINES	PRODUCTION	WORLD RANKING	
Not available	4	500 t of contained tungsten	Reserves	Not available
			Production	Not available

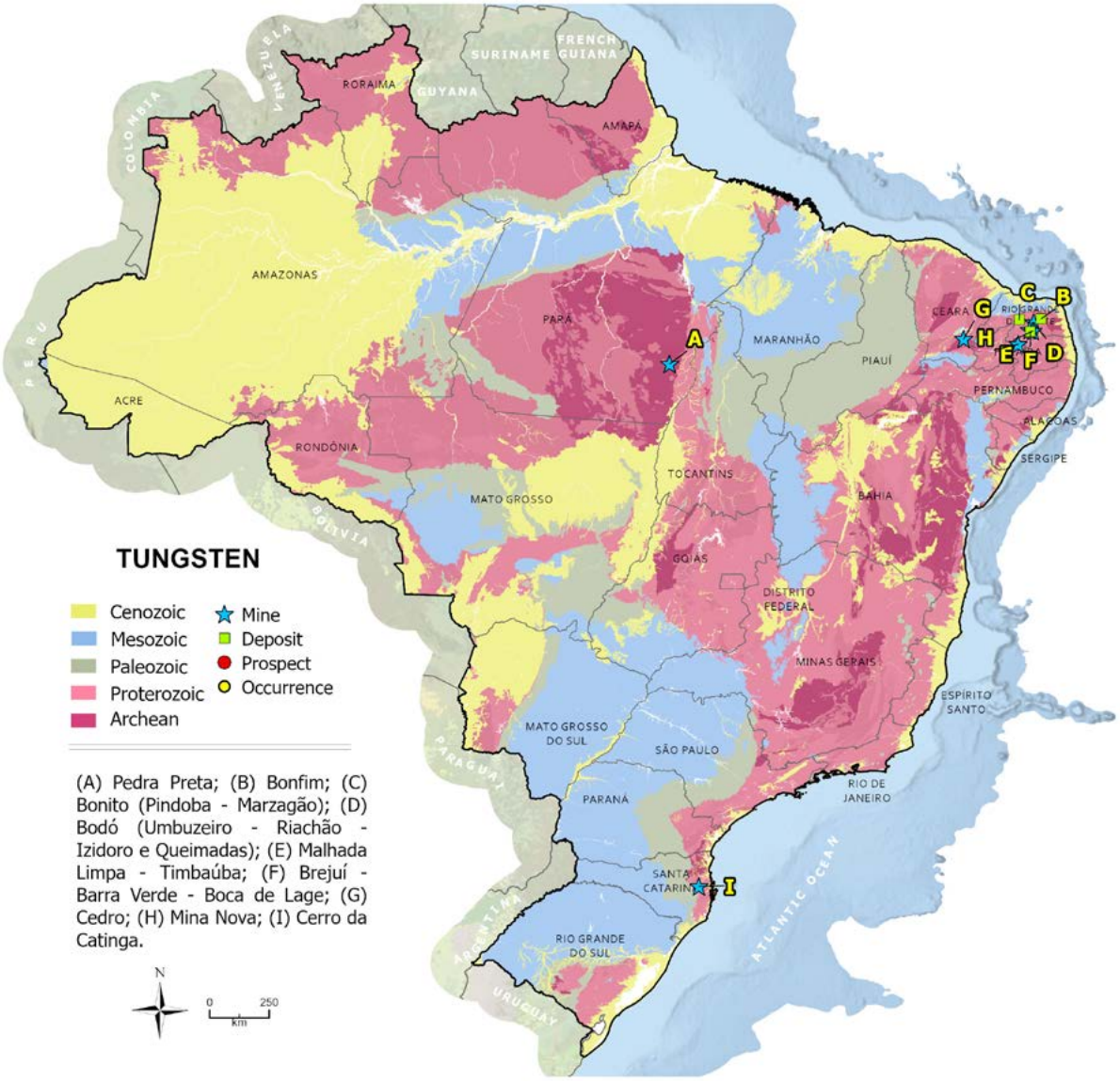

Fig. 9.22: Selected Brazilian tungsten deposits and mines.

Highlights

- Brazil's tungsten deposits, often artisanal, are mainly skarn-hosted or in greisenized veins. Key prospective areas include Neoproterozoic Jucurutu Formation (Seridó Mineral Province, states of Rio Grande do Norte and Paraíba), quartz-pegmatite veins in Paleoproterozoic Velho Guilherme granites (Carajás Mineral Province, in the state of Pará), and Neoproterozoic granitic stocks in the Jamari Complex (state of Rondônia).
- The tungsten skarn prospectivity map produced by the SGB-CPRM for the Currais Novos–Santa Luzia region in 2025 (available at https://rigeo.sgb.gov.br/handle/doc/25530) identified areas with high tungsten potential that previously had little or no record of known mineralization.
- According to market intelligence agencies[1], the global tungsten market was valued at approximately USD 1.2 billion in 2024 and is projected to grow at a compound annual growth rate of 5.0%, reaching USD 1.8 billion by 2033, driven by increasing demand from the electronics, aerospace, and medical sectors.
- Market reports[2] indicate that the adoption of clean energy technologies, such as nuclear fusion and concentrated solar power plants, is driving market growth due to the rising demand for high-purity materials capable of operating at extreme temperatures.
- The Brejuí scheelite mine in Currais Novos (Rio Grande do Norte State) has invested in new technologies through partnerships between Brazilian and German universities. These initiatives aim to reprocess mining residues accumulated over approximately 80 years, promote environmental rehabilitation, and increase scheelite production, which is currently around 15 tons per month. Ongoing studies are seeking new routes to extract tungsten from low-grade tailings[3]. The expectation is to achieve growth of 20-25% by 2026 through the combined contribution of current productions and tailings reprocessing.

Table 9.19: Selected tungsten deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES	GRADE (% WO_3)	STATUS
Brejuí / Barra Verde / Boca de Lage	W	Mineração Tomaz Salustino/Acauã Mineração/Mineração Barra Verde	11 Mt	1	Operating
Bonito (Pindoba e Marzagão)	W	Mhag Mineração	4 Mt	0.7	Interrupted
Malhada Limpa–Timbaúba	W	Malhada Limpa–Timbaúba	5.5 Mt	0.5	Interrupted
Pedra Preta	W	Mineração Pará Tungstênio	0.51 Mt	1	Operating
Bodó (Bonito)	W	Bodó Mineração	9 Mt	0.02	Interrupted
Igarapé Manteiga	W	Metalmig	0.02 Mt	1.38	Interrupted
Bonfim	W-Au	Mineração Nosso Senhor do Bonfim	0.3 Mt	0.048	Interrupted
Cerro da Caatinga	W-Sn-Mo	Cerro da Caatinga	0.61 kt	0.7	Exhausted
Cedro	W	Cedro	N/A	N/A	Operating
Mina Nova	W	Mina Nova	N/A	N/A	Operating

N/A – Not available.

[1] VERIFIED MARKET REPORTS. *Mercado -alvo global de tungstênio por tipo (5n, 6n), por aplicação (equipamentos de microeletrônica, equipamentos de fusão), por escopo geográfico e previsão*. Washington, DC: Verified Market Reports, c2025. Available at: https://www.verifiedmarketreports.com/pt/product/tungsten-target-market. Accessed on: 13 jan. 2026.
[2] MARKET DATA FORECAST. *Tungsten market report*. Hyderabad: Market Data Forecast, 2025. Last updated: January, 2026. Available at: https://www.marketdataforecast.com/market-reports/tungsten-market. Accessed on: 13 jan. 2026.
[3] TRIBUNA DO NORTE. Scheelita, rocha ornamental e caulim: mineração do RN é destaque nacional. *Tribuna do Norte*, Natal, 23. set. 2025. Natal, RN: Tribuna do Norte, 2025. Available at: https://tribunadonorte.com.br/economia/schelitta-rocha-ornamental-e-caulim-mineracao-do-rn-e-destaque-nacional. Accessed on: 19 jan. 2026.

9.23 Uranium

By Hugo José de Oliveira Polo (hugo.polo@sgb.gov.br) and Raul Eigenheer Meloni (raul.meloni@sgb.gov.br)

Brazil hosts one of the largest uranium resources in the world, with approximately 250 kt of contained uranium (reasonably assured + inferred resources), and has the potential to rank among the world's five largest resource holders. According to the definitions presented in International Atomic Energy Agency (IAEA) publications, identified resources consist of reasonably assured resources (RAR) plus inferred resources (IR) recoverable at a cost of less than USD 260/kg of U.

ORE RESOURCES[1,2] (Measured plus Indicated)	ORE RESOURCES[1,2] (Inferred)	OPERATING MINES[1,2]	PRODUCTION[3,4]	WORLD RANKING	
154.5 kt of contained uranium	96 kt of contained uranium	1	92.3 t of contained uranium	Reserves [1,2]	9th (2.34%)
				Production [3,4]	12th (0.16%)

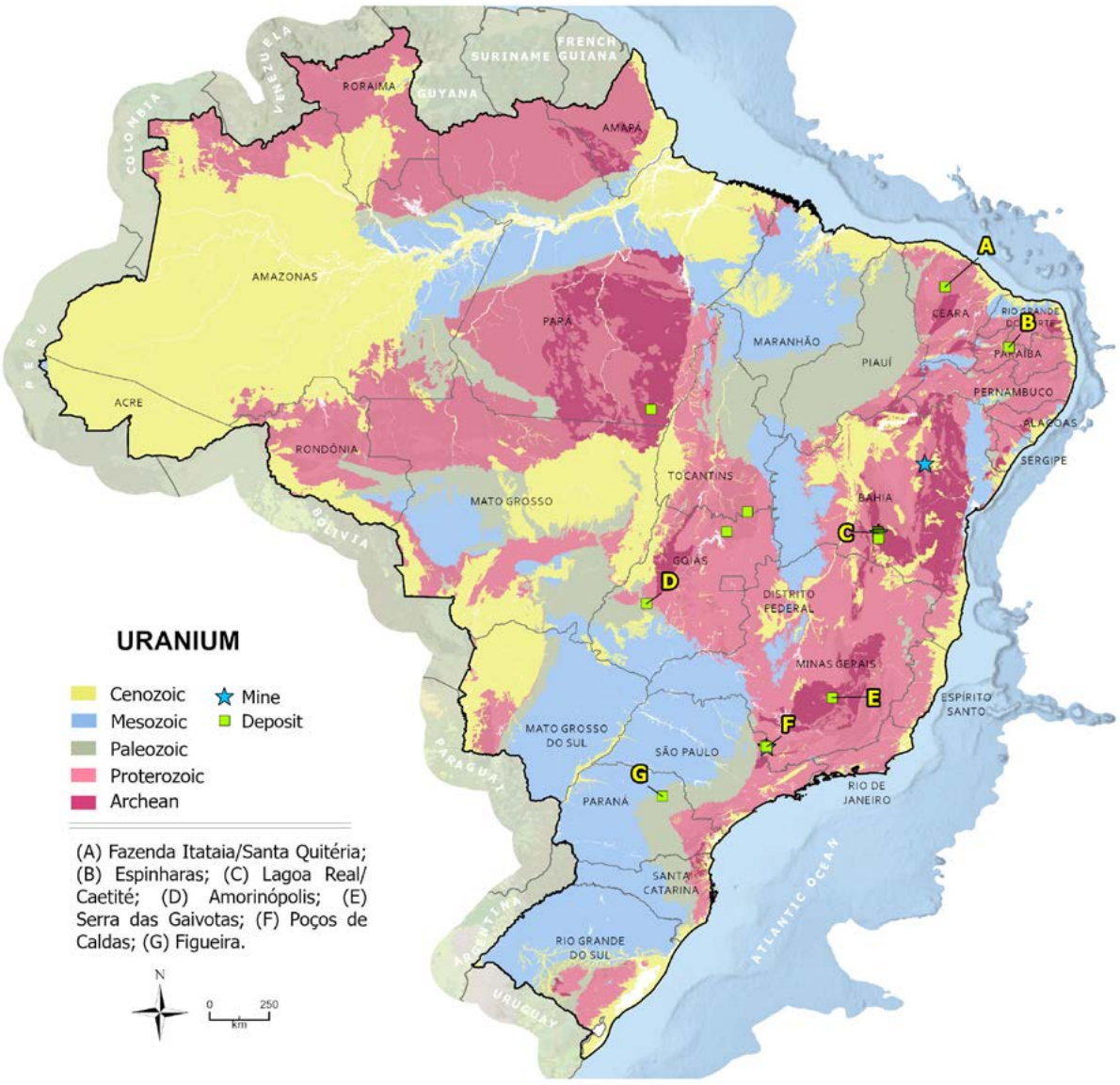

Fig. 9.23: Selected Brazilian uranium deposits and mines.

Highlights

- The Itataia and Lagoa Real deposits, discovered in the late 1970s, positioned Brazil among the top uranium-resource countries. In 2024, Brazil had the ninth largest uranium resource base in the world, despite no new discoveries since the late 1980s.
- Several uranium deposits occur in Brazil, including metasomatic (Lagoa Real and Espinharas), Archean paleoplacer (Serra das Gaivotas and Gandarela), metamorphic (Itataia) and sedimentary/sandstone (Figueira and Amorinópolis).
- The Rio Cristalino deposit, located in the south of the state of Pará, is one of the areas with the greatest potential. The SGB-CPRM will present a geological model and favorability map for this area in late 2026.
- The only uranium mine currently operating in Brazil is located in Caetité, in the state of Bahia, with estimated resources of 87 kt of uranium. Over 38 anomalies (areas of high uranium concentration) have been identified in this region, classifying it as a uranium province. This hub produces approximately 400 t of U_3O_8 per year, with potential expansion to 800 tons per year (tpa).
- Recently, the SGB-CPRM published the uranium favorability map of the Lagoa Real Province (available at https://rigeo.sgb.gov.br/handle/doc/24865), which identified numerous potential areas.
- At the country's only operation, uranium is concentrated through sulfuric acid leaching, resulting in a concentrated liquor that, after enrichment, produces the yellow cake.
- Rio de Janeiro is the only state in Brazil that requires uranium for electricity generation, as it hosts the Angra 1 and Angra 2 nuclear power plants, with Angra 3 under construction. The nominal demand is 440 tpa. However, between 310 and 340 tons of enriched uranium per year remain, depending on the operating history of the nuclear power plants. The Indústrias Nucleares do Brasil (INB) nuclear fuel plant, also located in Rio de Janeiro, supplies fuel for all Brazilian nuclear power plants.
- Law 14,514/2022 provides mechanisms to make the monopoly on uranium exploration in Brazil more flexible, greatly expanding the opportunities for private investment in the sector.
- INB, which holds all uranium deposits in Brazil, has established partnerships and put forward legal instruments to bid blocks for uranium research and mining, within its application areas.
- A review of all available information and documentation about the Pitinga deposit demonstrated that the documentation was not appropriate to support the resource statements. As results, the resources were reclassified as speculative, and their removal from Brazil's identified resources led to a significant reduction of about around 23%.

Table 9.20: Selected uranium deposits in Brazil and their respective resources.

DEPOSIT	COMMODITY	OWNER	MEASURED AND INDICATED RESOURCES (TU)	INFERRED RESOURCES (TU)	TOTAL RESOURCES (TU)	GRADES (% U_3O_8)	STATUS
Itataia / Santa Quitéria	U-P	INB – Galvani	77,337	43,502	120,840	0.05	Feasibility
Lagoa Real / Caetité	U	INB	43,688	30,162	73,851	0.20	Operating
Poços de Caldas	U	INB	16,960	5,766	22,726	0.01	Closed
Serra das Gaivotas / Gandarela	U-Au	INB	4,240	8,480	12,720	0.01	Early Exploration
Espinharas	U	INB	4,240	4,240	8,480	0.10	Early Exploration
Figueira	U-COAL	INB	5,936	848	6,784	0.10	Early Exploration
Amorinópolis	U	INB	1,696	2,544	4,240	0.02	Early Exploration
Campos Belos / Rio Preto	U	INB	424	424	848	0.02	Early Exploration
TOTAL			**154.522,56**	**95.967,31**	**250.489,87**		

[1] Nuclear Energy Agency; international atomic energy agency. *Uranium 2024*: resources, production and demand. Paris: OECD, 2025. Available at: https://www.oecd-nea.org/upload/docs/application/pdf/2025-04/7683_uranium_2024_-_resources_production_and_demand_2025-04-22_14-29-2_928.pdf. Accessed on: 13 jan. 2026.
[2] INB unpublished internal report
[3] Production estimates based on fee payments to Brazilian Mining Agency (ANM) in 2024
[4] Uranium Production by Country available at: WORLD NUCLEAR ASSOCIATION. *Uranium production by country*. London: World Nuclear Association, c2016-2026. Last updated: 20 jan. 2026. Available at: https://world-nuclear.org/information-library/facts-and-figures/uranium-production-by-country. Accessed on: 20 jan. 2026.

9.24 Vanadium

By Jocilene dos Santos Santana (jocilene.santana@sgb.gov.br)

USGS estimates[1] that 2024 global vanadium mine production totaled ~100 kt (vanadium content), led by China (70 kt; ~70%), followed by Russia (21 kt), South Africa (8 kt), and Brazil (5 kt). USGS also estimates[1] world vanadium reserves at ~18.0 Mt of V, including Australia (8.5 Mt), Russia (5.0 Mt), China (4.1 Mt), South Africa (0.4 Mt), and Brazil (0.1 Mt). ANM reports[2] Brazil's 2024 beneficiated output of 389.5 kt of concentrate containing about 11.3 kt V_2O_5.

ORE RESERVES[2]	OPERATING MINES[2]	PRODUCTION[2]	WORLD RANKING[1]	
266 kt of contained V_2O_5	1	11,279 t of contained V_2O_5	Reserves	5th (0.7%)
			Production	4th (5%)

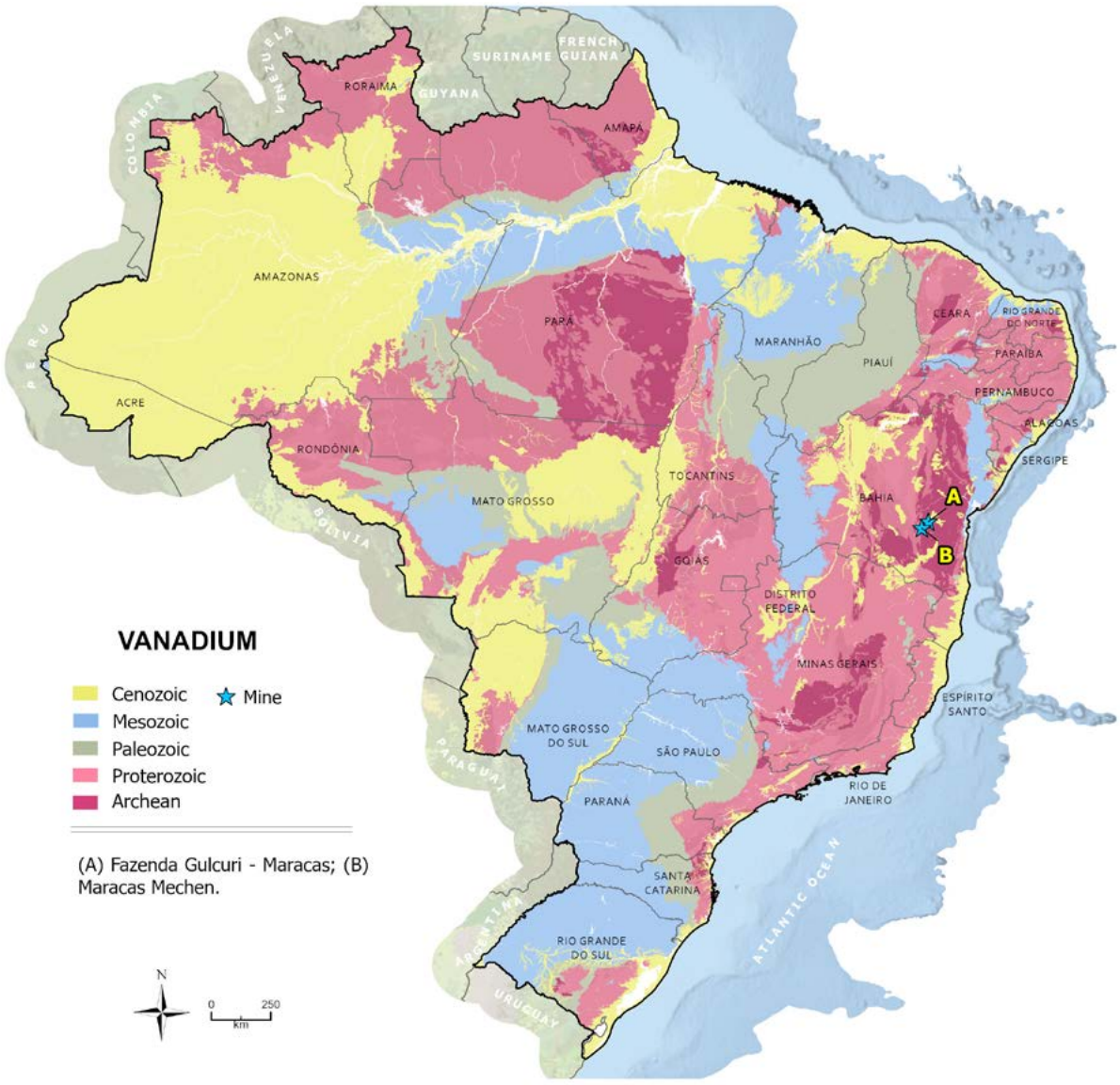

Fig. 9.24: Selected Brazilian vanadium mines.

[1] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 26 dec. 2025.

[2] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 - base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 26 dec. 2025.

Highlights

- Vanadium is regarded as a critical mineral for Brazil, and in 2024 the Northeast's critical-mineral production generated approximately USD 1.97 billion, highlighting the sector's strategic relevance. Brazil also has strong exploration potential, particularly in mafic–ultramafic and gabbro-anorthosite complexes widely distributed across the country, many of which remain insufficiently studied. Currently, production is confined to Bahia, concentrated in the Maracás area and operated by Vanádio de Maracás (Largo Resources, a Canadian company).
- Orthomagmatic Fe-Ti-V deposits can be classified into two types, according to the predominant oxide: (i) ilmenite-type deposits, associated with anorthositic complexes and hosted in high-grade metamorphic terrains; and (ii) titanomagnetite-type deposits, such as those found in Bushveld, Stillwater, Panzhihua, Campo Alegre de Lourdes, and the Rio Jacaré Sill—where the Maracás Menchen mine is located—hosted in large mafic-ultramafic complexes and stratified gabbro-anorthosite sills.
- The Maracás Menchen Mine has been in operation since 2014, with annual production ranging between 9,500 and 11,500 tons of V_2O_5 up to 2025. Mineralization occurs in the form of layers, lenses, and veins containing disseminated to massive vanadium-bearing titanomagnetite (VTM), associated with stratified mafic-ultramafic intrusions, gabbro-anorthositic intrusions, and anorthosite massifs, whose geological evolution spans from the Archean to the Paleoproterozoic.
- In southern Bahia, the Rio Piaú, Carapussê, Samaritana, and Potiraguá gabbro-anorthosite massifs, and the Lagoa da Vaca Complex stand out.
- Brazil also has significant vanadium potential in sedimentary settings. Uranium-vanadium sandstone deposits, including roll-front and tabular types, may contain 0.1–1% V. Vanadium is also found in calcrete-hosted deposits, forming at redox interfaces that concentrate uranium and vanadium minerals.

Table 9.21: Selected vanadium deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% V)	STATUS
Maracás Menchem Mine (Campbell Pit + GAN)	V-Ti	Largo	81.31	2.4	Producing
Maracás Menchem Mine (NAN)	V-Ti	Largo	35.25	2.14	Feasibility
Maracás Menchem Mine (SJO)	V-Ti	Largo	33.11	1.9	Feasibility
Maracás Menchem Mine (JAC)	V-Ti	Largo	21.16	1.74	Feasibility
Maracás Menchem Mine (GAS)	V-Ti	Largo	11.3	2.31	Feasibility
Maracás Menchem Mine (RIOCON)	V-Ti	Largo	13.27	1.63	Feasibility

9.25 Zinc

By Anderson Dourado Rodrigues da Silva (anderson.rodrigues@sgb.gov.br)

USGS estimates that 2024 global zinc reserves totaled ~230.0 Mt (Zn content), led by Australia (64.0 Mt), China (46.0 Mt), and Russia (29.0 Mt), and that 2024 mine production reached ~12.0 Mt, dominated by China (~4.0 Mt), followed by Peru (1.3 Mt) and Australia (1.1 Mt). In Brazil (2024), ANM reports[1] output of ~0.19 Mt Zn (contained in concentrates) from ~6.0 Mt of ROM ore and proved + probable reserves of ~3.2 Mt Zn.

ORE RESERVES[1]	OPERATING MINES	PRODUCTION[1]	WORLD RANKING[2]	
3.2 Mt of contained zinc	3	183 kt of contained zinc	Reserves	Not ranked
			Production	Not ranked

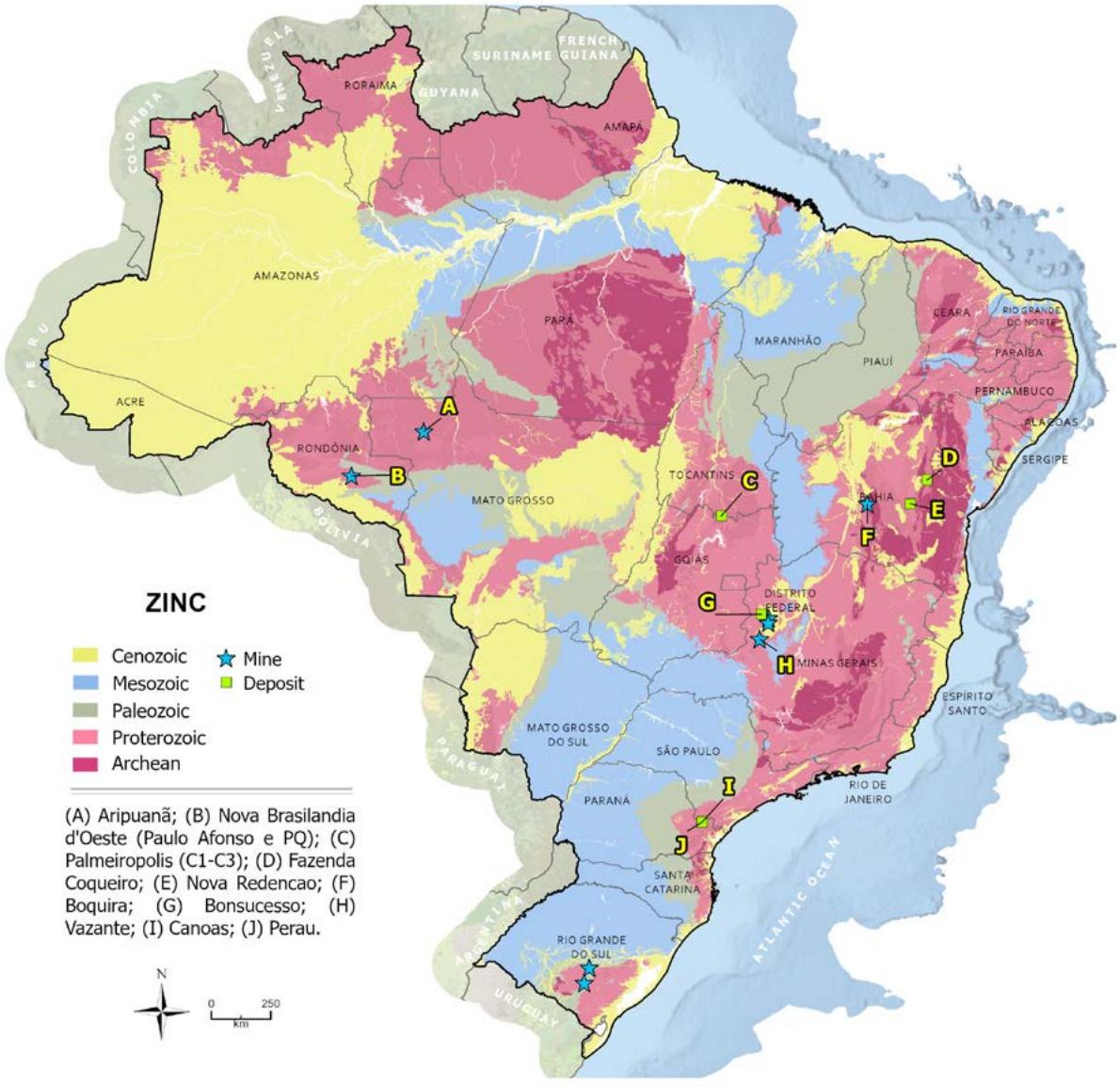

Fig. 9.25: Selected Brazilian zinc deposits and mines.

[1] AGÊNCIA NACIONAL DE MINERAÇÃO. *Mineral summary 2025 – base year 2024* (in Portuguese). Brasília, DF: ANM, 2025. Available at: https://www.gov.br/anm/pt-br/assuntos/economia-mineral/publicacoes/sumario-mineral/sumario-mineral-brasileiro-2025/sumario-2025.pdf. Accessed on: 6 jan. 2026.

[2] U.S. GEOLOGICAL SURVEY. *Mineral commodity summaries 2025*. Reston, VA: U.S. Geological Survey, 2025. Available at: https://pubs.usgs.gov/periodicals/mcs2025/mcs2025.pdf. Accessed on: 29 dec. 2025.

Highlights

- Zinc is a strategic base metal for the energy transition, playing a key role in infrastructure, renewable energy systems, corrosion protection (galvanization), and emerging zinc-based battery technologies. Brazil possesses a significant geological endowment of zinc and associated base metals, hosted in various Precambrian mineral systems.
- One of Brazil's most important zinc-producing regions is the Vazante–Paracatu Mineral Province, located in northwestern Minas Gerais. This N–S trending belt (~250 km long) comprises two main districts: the Vazante Zinc District and the Paracatu–Unaí Zn–Pb–Cu District. The Vazante District hosts the exceptional world-class Vazante silicate zinc deposit (Vazante and Extremo Norte mines). The main ore in the deposit is willemite ($ZnSiO_4$) hosted by pelite-carbonate rocks of the Vazante Group. Total resources are estimated at 19.68 Mt @ 8.79% Zn. The Paracatu–Unaí District includes the Morro Agudo mine, where zinc–lead mineralization occurs as sulfides hosted by dolomites of the Vazante Group. Total resources in the Morro Agudo area are estimated at 16.87 Mt @ 3.61% Zn and 0.58% Pb, reinforcing the province as the backbone of Brazilian zinc production.
- The Aripuanã deposit in northwestern Mato Grosso State is a large Proterozoic polymetallic VHMS system associated with bimodal volcanism, hosting 41.50 Mt at average grades of 2.4% Zn, 1.0% Pb, 0.29% Cu, 28.93 g/t Ag, and 0.45 g/t Au, ranking it among Brazil's most significant zinc-bearing polymetallic deposits.
- The Mesoproterozoic Nova Brasilândia Belt, located in northwestern Brazil, hosts zinc–lead–copper mineralization associated with gold-rich gossans. The Nova Brasilândia deposit, classified as a clastic SEDEX system with Broken Hill-type (BHT) affinity and hosting Zn–Cu–Pb mineralization, defines a polymetallic mineral district in the southern Amazon Craton, with the potential to expand Brazil's zinc resource base and contribute to increased national zinc production.
- In the Southern Ribeira Belt, spanning the states of Paraná and São Paulo, historical zinc and lead production is associated with carbonate and clastic sequences of the Lajeado Group and Perau Formation. Although currently inactive, this belt represents a favorable geological environment for renewed exploration targeting sediment-hosted Zn–Pb ± Cu ± Ag mineralization.
- In Bahia State, SGB-CPRM is advancing the Nova Redenção zinc–lead project (Andaraí region) toward a potential 2026 auction, following technical reassessment and completion of an economic valuation, positioning the asset to attract future investment in Brazil's base-metals portfolio.

Table 9.22: Selected zinc deposits in Brazil and their respective estimated resources.

DEPOSIT	COMMODITY	OWNER	ESTIMATED RESOURCES (Mt)	GRADE (% Zn)	STATUS
Aripuanã	Zn-Pb-Cu	Nexa Resources	49.56	3.18	Producing
Vazante	Zn-Pb-Ag	Nexa Resources	14.64	10.1	Producing
Nova Brasilândia d'Oeste	Zn-Cu-Pb	Mineração Santa Elina	6.2	6.84	Producing
Bonsucesso	Zn-Pb	Nexa Resources	8.49	3.78	Feasibility
Palmeirópolis	Zn-Cu-Pb	Alvo Minerals	7.6	3.4	Exploration
Fazenda Coqueiro	Zn-Pb	CBPM	4.2	6.12	Feasibility
Boquira	Pb-Zn-Ag	Metal Data	5.6	1.43	Interrupted
Canoas	Pb-Zn-Ag	Canoas	0.97	3.5	Closed
Nova Redenção	Pb-Zn-Ag	SGB-CPRM	5.2	0.5	Early exploration
Perau	Pb-Ag-Zn-Cu	Perau	0.84	1.13	Closed

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