AN OVERVIEW OF

CRITICAL AND STRATEGIC MINERALS POTENTIAL OF BRAZIL

2024 EDITION

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FOREWORD

Alexandre Silveira
Ministry of Mines
and Energy

"The mining sector is crucial in the new global agenda, strenghthening the energy transition and sustainable socioeconomic development. In this context, Brazil presents itself as a significant player, with the potential to lead the changes towards a low-carbon energy matrix. The Brazilian government is committed to creating a fertile field for development guided by environmental, social, and corporate governance standards dedicated to mining activities.

Through our potential in critical minerals and rare earths, our country is taking all effort into increasing the role of leading a fair, inclusive, and balanced global energy transition. This is evident in our 88% clean and renewable electric power matrix, our production of biofuels, and our commitment to environmental, social, and corporate governance standards. The Brazilian government is dedicated to fostering an environment that encourages the growth of the mining sector, emphasizing its role in achieving a just and sustainable energy transition on a global scale."

Vitor Saback
National Secretary of
Geology, Mining and
Mineral Transformation

"The current mining activity in Brazil generates several opportunities for the country and the global effort to transition to clean and renewable energy sources. The country has a vast territory with diverse geological settings and mineral systems, combined with other aspects such as constantly improving infrastructure, availability of clean energy, legal security, and a growing commitment to socio-environmental principles. These factors place the country's mining industry in a privileged position regarding competitiveness and sustainability. The main priorities of the Ministry of Mines and Energy for attracting investments focus on improving regulations and procedures, expanding the availability of areas for research and production, creating instruments that facilitate access to financing, improving public governance, and strengthening government institutions in the sector. The information generated about the potential of mineral resources that stimulate investments in research and mineral production, combined with public policies that promote the rational and sustainable use of mineral resources, will result in the proper use of Brazilian natural resources, expanding job creation and income generation."

Inácio C. Melo Neto
President-Director
of the Geological
Survey of Brazil

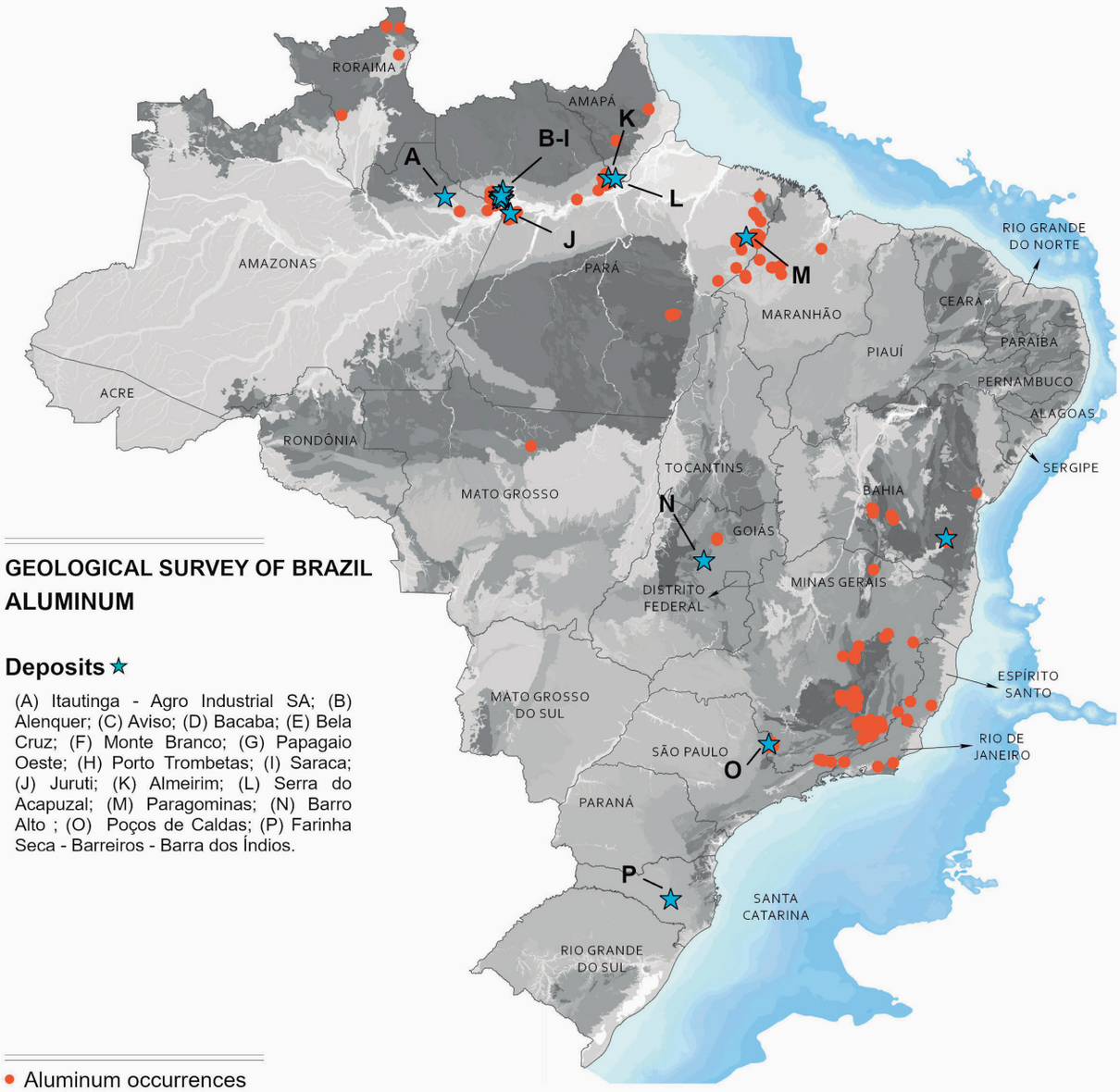
"We are at a crucial moment where mining is not merely an economic sector, but a key asset in the transition to cleaner and sustainable energy sources. The Geological Survey of Brazil (SGB), by showcasing the vast geological potential of the territory referred in this publication, puts the country in a prominent position in supplying essential minerals for green technologies, such as those used in electric vehicle batteries and renewable energy systems. Our researches provide security to Brazil's commitment to sustainability and responsible mining practices."

Francisco Valdir Silveira
Director of Geology and
Mineral Resources

"The geoscientific information consolidated in this second edition of the "An overview of critical and strategic minerals potential of Brazil" highlights the country's potential for producing minerals essential for the energy transition and food security. This publication presents data on the availability of aluminum, copper, chromium, gold, graphite, lithium, nickel, phosphate, platinum, potassium, tungsten, uranium, zinc, and Rare Earth Elements. Such data is crucial for the productive sector and the formulation of public policies, contributing to strategic planning for a global supply chain of critical minerals."

SUMMARY

ALUMINUM



GEOLOGICAL SURVEY OF BRAZIL
ALUMINUM

Deposits ★

(A) Itautinga - Agro Industrial SA; (B) Alenquer; (C) Aviso; (D) Bacaba; (E) Bela Cruz; (F) Monte Branco; (G) Papagaio Oeste; (H) Porto Trombetas; (I) Saraca; (J) Juruti; (K) Almeirim; (L) Serra do Acapuzal; (M) Paragominas; (N) Barro Alto ; (O) Poços de Caldas; (P) Farinha Seca - Barreiros - Barra dos Índios.

● Aluminum occurrences

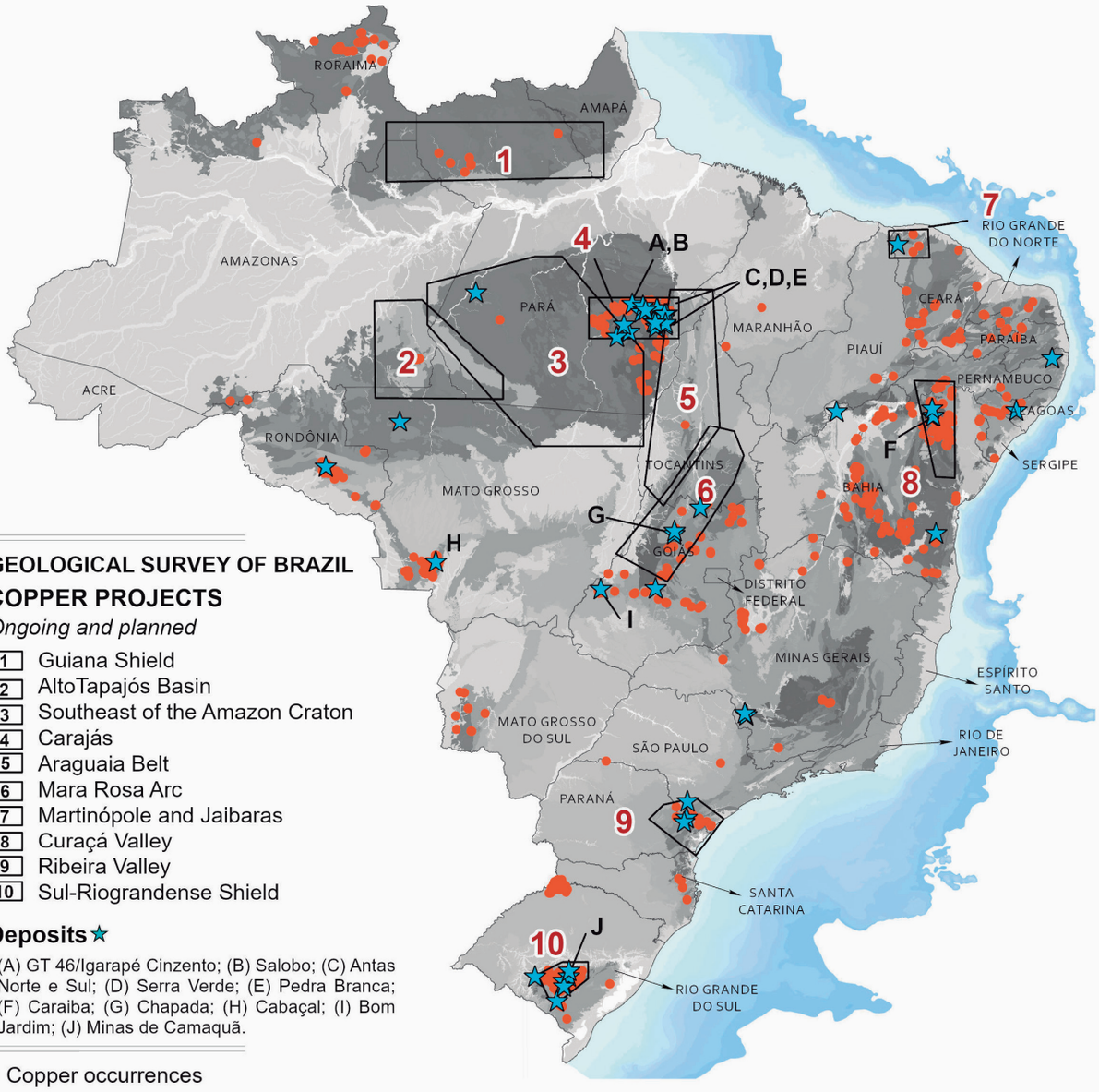
HIGHLIGHTS

- The Pará State, in the north of Brazil, holds the largest bauxite reserves in the country, historically accounting for over 90% of the Brazilian's production. The state of Minas Gerais follows with 7% of the production, while the states of São Paulo, Santa Catarina and Goiás collectively hold 3%. Relevant bauxite occurrences are also found in the states of Bahia, Maranhão and Amapá. In Pará, key extraction and processing companies include Mineração Rio do Norte, Mineração Paragominas and Alcoa. In the Center of Brazil, Companhia Brasileira de Alumínio (CBA) and Terra Goyana are significant players.
- The bauxite formation found in Pará is characterized by thick lateritic profiles on siliciclastic rocks of the Cretaceous period. In Minas Gerais, bauxite occurrences are associated with metasedimentary rocks in the Quadrilátero Ferrífero and granulitic rocks in the southeast. Bauxite in the state of Goiás originates from the alteration of Neoproterozoic anorthosites of the Barro Alto Mafic-Ultramafic Layered Complex.
- The evolution of the lateritic/bauxitic cover of the Amazon was polyphase and controlled by chemical and physical processes in humid equatorial climates. São Paulo hosts bauxite deposits over amphibolites, dolerites and granites, while the deposits in the southern region come from alkaline rocks, basalts, diabase, and syenites in a subtropical climate.
- Before the discovery of deposits in northern Brazil, bauxite in alkaline rocks, especially in Poços de Caldas (Minas Gerais), was the primary source of aluminum, accounting for 65% of national production until the 1970s. Pará's dominance in bauxite production reflects changes in the industry and the allocation of resources over time.

Selected Aluminum deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resources	Grades (Al)	Status
Porto Trombetas	Al (Bauxite)	Mineração Rio do Norte S.A.	600 Mt	49.5 %	Operating
Juruti	Al (Bauxite)	Alcoa Alumínio S.A.	558.1 Mt	34.25 %	Operating
Paragominas	Al (Bauxite)	Norsk Hydro do Brasil Ltd.	249.7 Mt	82.4 %	Operating
Barro Alto	Al (Bauxite)	Terra Goyana	180 Mt	56%	Operating
Bela Cruz	Al (Bauxite)	Mineração Rio do Norte S.A.	55.86 Mt	50.2 %	Operating
Almeirim	Al (Bauxite)	MSL Minerais S.A.	46 Mt	57.4 %	Inactive
Poços de Caldas	Al (Bauxite)	Alcoa Alumínio S.A.	50 Mt	46%	Operating

COPPER



GEOLOGICAL SURVEY OF BRAZIL

COPPER PROJECTS

Ongoing and planned

1. Guiana Shield
2. AltoTapajós Basin
3. Southeast of the Amazon Craton
4. Carajás
5. Araguaia Belt
6. Mara Rosa Arc
7. Martinópole and Jaibaras
8. Curaçá Valley
9. Ribeira Valley
10. Sul-Riograndense Shield

Deposits ★

(A) GT 46/Igarapé Cinzento; (B) Salobo; (C) Antas Norte e Sul; (D) Serra Verde; (E) Pedra Branca; (F) Caraiba; (G) Chapada; (H) Cabaçal; (I) Bom Jardim; (J) Minas de Camaquã.

● Copper occurrences

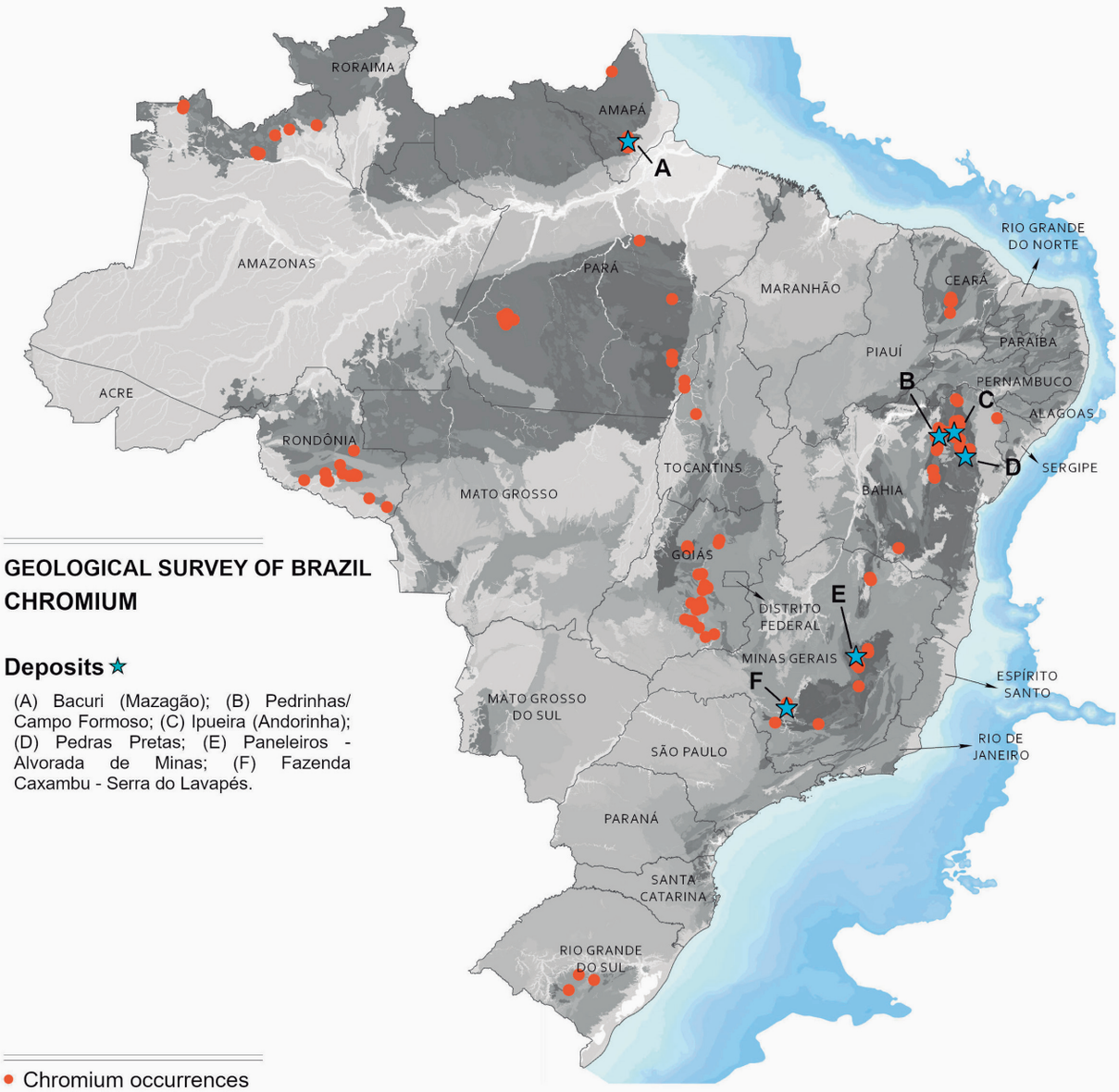
HIGHLIGHTS

- Unlike the rest of the world, where copper is mainly exploited from porphyry-type deposits, Brazil has around 30 copper deposits and advanced prospects, mostly distributed in the Magmatic Segregation / IOCG (36%), IOCG (26%) and VMS (13%), which account for 74% of the total. Added to the magmatic segregation deposits of mafic-ultramafic complexes, the total reaches 85%. Only one porphyry-type deposit has been described in Brazil, the Chapada deposit, in northern Goiás State.
- Brazil's copper mineral potential lies almost entirely in Precambrian domains. Most of the Brazilian copper deposits are located in the Carajás Mineral Province, which is also the mineral province with the largest amount of metallic copper in the country, with an estimated total of 27.34 Mt endowment. In Carajás, most of the deposits are of the IOCG type, but the Brazilian copper deposits are also classified as Volcanic Massive Sulfides, Porphyries, SEDEX, and Sediment-hosted.
- 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, being a province with potential for discoveries for this mineral good in the porphyry copper and VMS models.
- The Goiás Magmatic Arc has an active copper mine and potential for discoveries of medium to small metamorphosed porphyry copper, as well as VMS deposits.
- The Vale do Curaçá Cupriferous District has cataloged deposits of magmatic segregation. Recent work has identified alterations and characteristics of IOCG-type mineralization in this province, which tends to increase the potential for discoveries of medium to large deposits.
- Brazil consumes around 3% of the world's copper concentrate production.

Selected Copper deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resources	Grades (Cu)	Status
Salobo	Cu-Au-U	Vale S.A.	1,148.4 Mt	0.61 %	Operating
Chapada	Cu-Au	Lundin Mining Corp	1,101.1 Mt	0.23 %	Operating
Furnas	Cu-Au	Ero Copper.	550 Mt	0.71 %	Unexploited
Gameleira (Pojuca, Grota Funda)	Cu-Au	Vale S.A.	535 Mt	0.57 %	Unexploited
Cristalino	Cu-Au-U	Vale S.A.	379 Mt	0.66 %	Operating
Sossego	Cu-Au-U	Vale S.A.	315 Mt	0.78%	Operating
Santa Rita (Mirabela)	Ni-Cu-Co	Atlantic Nickel	255.1 Mt	0.18 %	Operating
Alemão	Cu-Au-U	Vale S.A.	230 Mt	1.26 %	Operating
Igarapé Bahia	Cu-Au	Vale S.A.	219 Mt	1.4%	Closed
Caboclo dos Mangueiros	Ni-Cu-Co	Bahia Nickel	200 Mt	0.13 %	Unexploited
Saúva	Cu-Au	Lundin Mining Corp.	179 Mt	0.32%	Exploration
Alvo 118	Cu-Au-U	Vale S.A.	170 Mt	1%	Unexploited
Serrote da Laje	Cu-Au	Mineração Vale Verde Ltda	119.2 Mt	0.50%	Operating
Jaguar	Ni-Cu-Co	Centaurus	109.2 Mt	0.07 %	Feasibility
Boa Esperança	Cu-Co	Ero Copper	59.28 Mt	0.81%	Feasibility
Cabaçal	Cu-Au-Ag	Meridian Mining	52.9 Mt	0.3%	Interrupted
Breves	Cu-Au-Ag	Vale S.A.	50 Mt	1.22 %	Unexploited
Pedra Verde	Cu	Pedra Verde	44.23 Mt	0.9%	Interrupted
Caraíba	Cu	Ero Copper	34.60 Mt	0.60%	Interrupted

CHROMIUM



GEOLOGICAL SURVEY OF BRAZIL
CHROMIUM

Deposits ★

(A) Bacuri (Mazagão); (B) Pedrinhas/ Campo Formoso; (C) Ipueira (Andorinha); (D) Pedras Pretas; (E) Paneleiros - Alvorada de Minas; (F) Fazenda Caxambu - Serra do Lavapés.

● Chromium occurrences

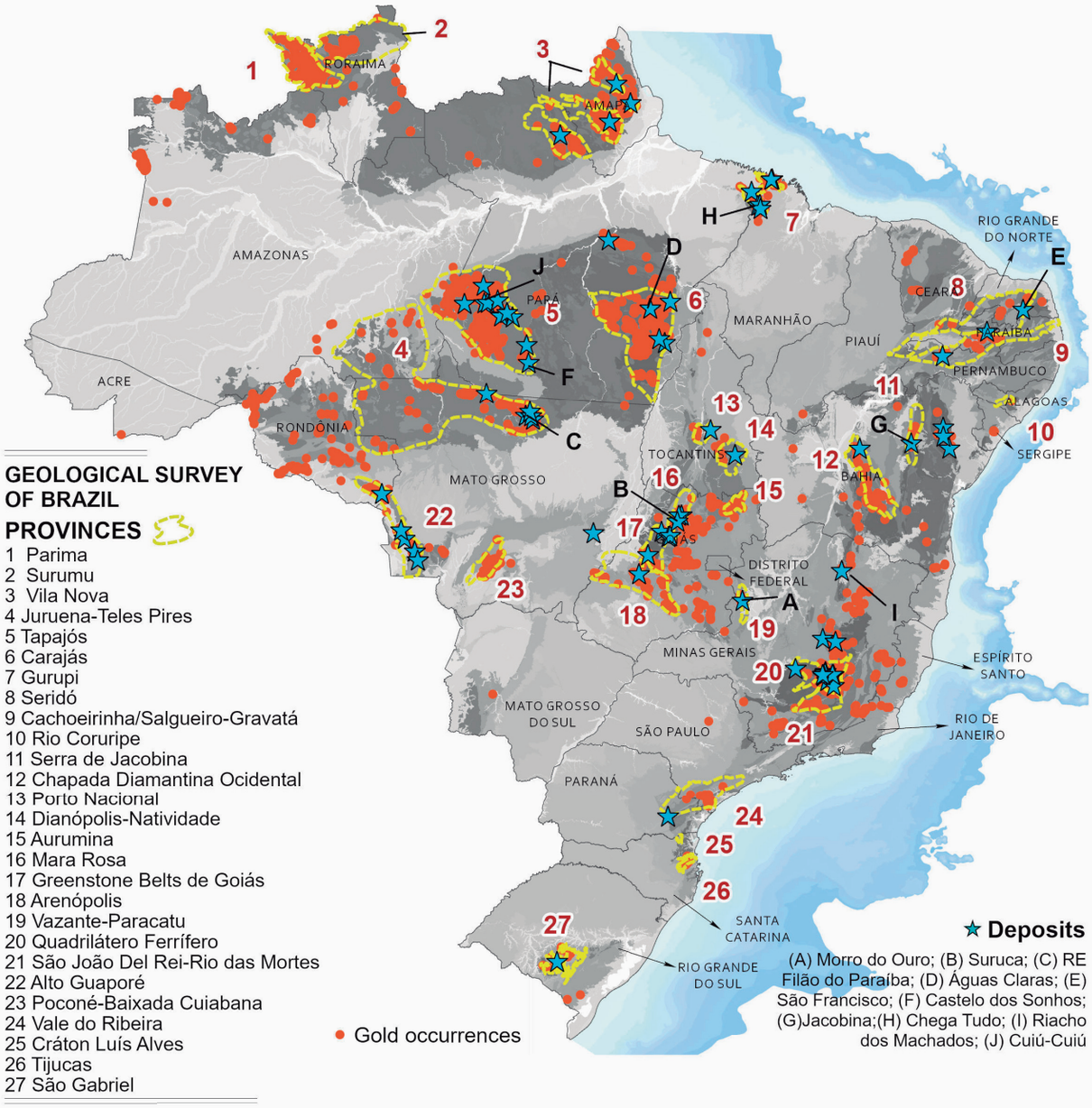
HIGHLIGHTS

- Although global chromite resources exceed 12 billion tons, chromium is often considered a critical mineral due to the concentration of the world's reserves in Kazakhstan and South Africa, which account for 95% of the total resources. Chromium still needs a substitute in stainless steel and superalloys. Brazil, on the other hand, is the only chromium-producing country in the Americas, holding 0.11% of the world's reserves.
- Most of the economic chromite deposits in Brazil result from the magmatic segregation of mafic-ultramafic complexes (stratiform type) hosted in Precambrian continental rocks. Although deposits formed by the reaction between basaltic magmas and ultrabasic rocks are known in Brazil - commonly associated with obducted ophiolitic complexes (podiform type), they have yet to prove their economic importance.
- The primary Brazilian stratiform chromite deposits are found in the mafic-ultramafic complexes of Campo Formoso, Vale do Jacurici and Pedras Pretas (state of Bahia, localities of Campo Formoso, Andorinha, Ipueira, Medrado, Santa Luz and Piritiba), making up 95% of the national reserves, with an estimated total of 4.54 Mt of contained metal.
- In Minas Gerais (3% of national reserves) the stratiform deposits of Serro, Alvorada de Minas (including Paneleiros), and Piumhi (Lavapés) stand out. Production of raw chromium ore in Minas Gerais comes exclusively from small open-pit mines, with an annual output of less than 10,000 tons.
- The Bacuri (Mazagão) mafic-ultramafic stratiform complex, in the Amapá state, has estimated reserves of 8.8 Mt of chromite ore (ROM) (~3% of Brazil's resources).
- Other geological provinces have deposits containing chromite associated with PGE mineralization. These include the Carajás Province (Luanga and Cateté mafic-ultramafic complexes) and the Borborema Province (Tróia).
- Podiform chromite occurs in the Morro Feio, Cromínia, and Abadiânia deposits in Goiás. It is also found in the Araguaia Belt at Morro Grande and in the Complexo Quatipuru, in addition to various mineralogical, chemical and mineral occurrences in other provinces. Examples include Bodocó (Faz. Esperança) deposits in the Borborema Province.
- FERBASA holds 95% of the country's chromite resources and is the only integrated producer of ferrochrome in the Americas and the leading producer of ferroalloys in Brazil. Mining had a total production of 513,788 thousand tons in 2022. The company produces the following metal alloys: High carbon ferrochrome, Low carbon ferrochrome, Ferrosilicon chrome, Ferrosilicon 75, and inoculants, totaling 301.6 thousand tons of ferroalloys in 2022.

Selected Chromium deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resources	Grades (Cr_2O_3)	Status
Pedrinhas (Campo Formoso)	Cr	FERBASA	10.31 Mt	29.8 %	Operating
Ipueira (Andorinha)	Cr	FERBASA	2.70 Mt	37.82 %	Operating
Pedras Pretas	Cr	Magnesita Mineração S.A.	1.11 Mt	40.01 %	Operating
Tróia (Curiu, Esbarro, Cedro, Trapiá, Santo Amaro)	Cr-Pd-Pt-Au	ValOre Metals	17.9 Mt	0.846%	Feasibility
Paneleiros - Alvorada de Minas	Cr	Cromita Piumhiuense Ltda.	0.71 Mt	20.07 %	Operating
Bacuri (Mazagão)	Cr	Mineração Vila Nova Ltda.	0.39 kt	44.28 %	Operating

GOLD



GEOLOGICAL SURVEY OF BRAZIL

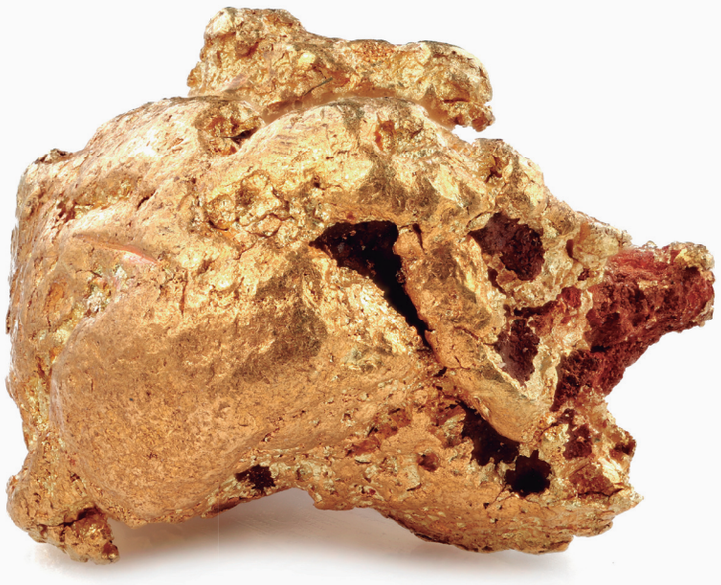
PROVINCES

1 Parima
2 Surumu
3 Vila Nova
4 Juruena-Teles Pires
5 Tapajós
6 Carajás
7 Gurupi
8 Seridó
9 Cachoeirinha/Salgueiro-Gravatá
10 Rio Coruripe
11 Serra de Jacobina
12 Chapada Diamantina Ocidental
13 Porto Nacional
14 Dianópolis-Natividade
15 Aurumina
16 Mara Rosa
17 Greenstone Belts de Goiás
18 Arenópolis
19 Vazante-Paracatu
20 Quadrilátero Ferrífero
21 São João Del Rei-Rio das Mortes
22 Alto Guaporé
23 Poconé-Baixada Cuiabana
24 Vale do Ribeira
25 Cráton Luís Alves
26 Tijucas
27 São Gabriel

● Gold occurrences

★ Deposits

(A) Morro do Ouro; (B) Suruca; (C) RE Filão do Paraíba; (D) Águas Claras; (E) São Francisco; (F) Castelo dos Sonhos; (G)Jacobina;(H) Chega Tudo; (I) Riacho dos Machados; (J) Cuiú-Cuiú



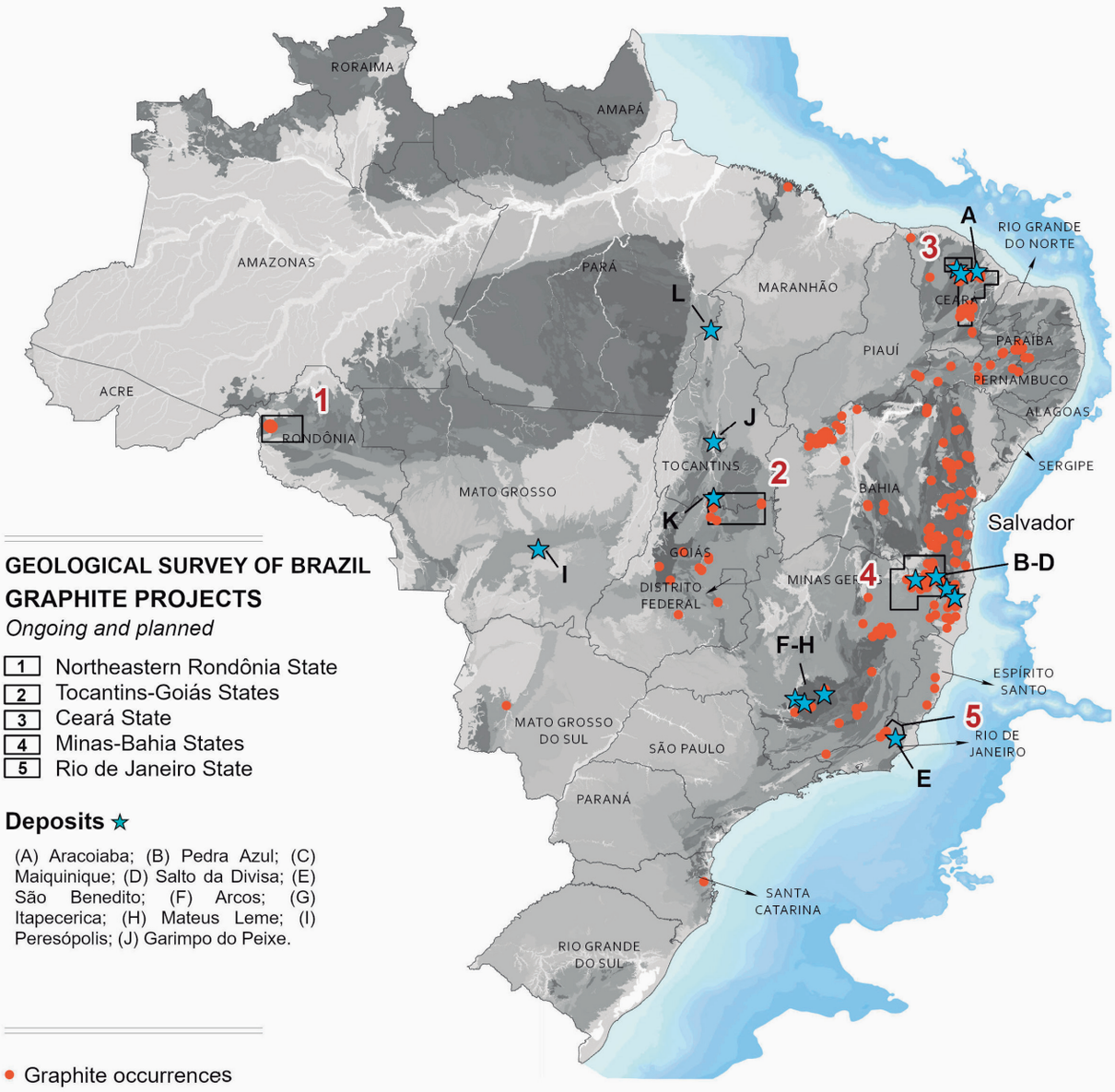
HIGHLIGHTS

- Over the past 120 years, industrial mining projects have boomed and spread throughout Brazil, culminating in more than 80 mines producing approximately 2000 tons of gold;
- Brazil currently has four world-class mines: Cuiabá, Morro do Ouro, Crixás and the Morro Velho mine. The Morro Velho mine, which closed in 2003, must also be considered world class;
- The Amazonian Craton (especially the Carajás, Tapajós and Juruena-Teles Pires provinces), the Gurupi Belt and the Goiás magmatic Arc represent the current frontier of new discoveries, with great potential for the future development of industrial gold mining;
- Although the state of Minas Gerais remains the country's main gold producer (home to the two largest gold mines in Brazil), the Amazon region in particular has become the new gold-frontier and is beginning to consolidate as a key player in the field;
- The diversity of metallogenic environments for gold deposits and the vast geographic size of the country suggest the possibility of major mining developments in the short and medium term;
- The gold deposits found in the states of Minas Gerais, Bahia, Mato Grosso, Goiás and Maranhão are the main primary gold deposits explored by major industrial or artisanal mining companies.

Selected gold deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resources	Grades (Au)	Status
Morro do Ouro	Au-Ag	Kinross	578.02 Mt	0.4 g/t	Operating
Volta Grande (norte e sul)	Au	Belo Sun	196.35 Mt	0.95 g/t	Feasibility
Suruca	Au-Zn	Lundin Mining Corp.	147.5 Mt	0.53 g/t	Feasibility
Águas Claras	Au-Cu	Vale S.A.	95 Mt	2.43 g/t	Interrupted
Castelo dos Sonhos	Au	Tristar Company	79.1 Mt	0.97 g/t	Feasibility
Tocantinzinho	Au	G Mining Ventures Corp.	51.13 Mt	0.9 g/t	Exploration
Jacobina (Canavieiras Sul, Norte e Central, Morro do Vento, João Belo, Serra do Córrego)	Au-U	Pan American Silver	42.47 Mt	2.26 g/t	Operating
Cuiú-Cuiú (Moreira Gomes, Central)	Au	Cabral Gold	41.4 Mt	0.86 g/t	Pre-feasibility
Crixás (Serra Grande)	Au	AGA Mineração (AngloGold Ashanti)	38.35 Mt	2.95 g/t	Operating
Cachoeira	Au	Gold Mining Inc.	37.35 Mt	1.12 g/t	Intermittent Operation
Córrego do Sítio	Au	AGA Mineração (AngloGold Ashanti)	35.84 Mt	3.8 g/t	Operating
Amapari - Tucano	Au	Tucano Gold	35.19 Mt	1.61 g/t	Interrupted
Posse-Mara Rosa	Au	Hochschild Mining	32.1 Mt	1.1 g/t	Feasibility
Aurizona Mineração	Au	Sandstorm/ Equinox Gold	30.8 Mt	1.78 g/t	Operating
São Jorge	Au	Gold Mining Inc.	28.81 Mt	1.55 g/t	Intermittent Operation
CentroGold	Au	Oz Minerals	28 Mt	1.9 g/t	Pre-feasibility
Cuiabá	Au	AGA Mineração (AngloGold Ashanti)	27.73 Mt	5.77 g/t	Operating
Cipoeiro	Au	Jaguar Mining	27.83 Mt	1.9 g/t	Exploration
Fazenda Maria Preta (C1 Santa Luz)	Au	Equinox Gold	23.84 Mt	1.81 g/t	Interrupted

GRAPHITE



GEOLOGICAL SURVEY OF BRAZIL

GRAPHITE PROJECTS

Ongoing and planned

1. Northeastern Rondônia State
2. Tocantins-Goiás States
3. Ceará State
4. Minas-Bahia States
5. Rio de Janeiro State

Deposits ★

(A) Aracoiaba; (B) Pedra Azul; (C) Maiquinique; (D) Salto da Divisa; (E) São Benedito; (F) Arcos; (G) Itapecerica; (H) Mateus Leme; (I) Peresópolis; (J) Garimpo do Peixe.

● Graphite occurrences

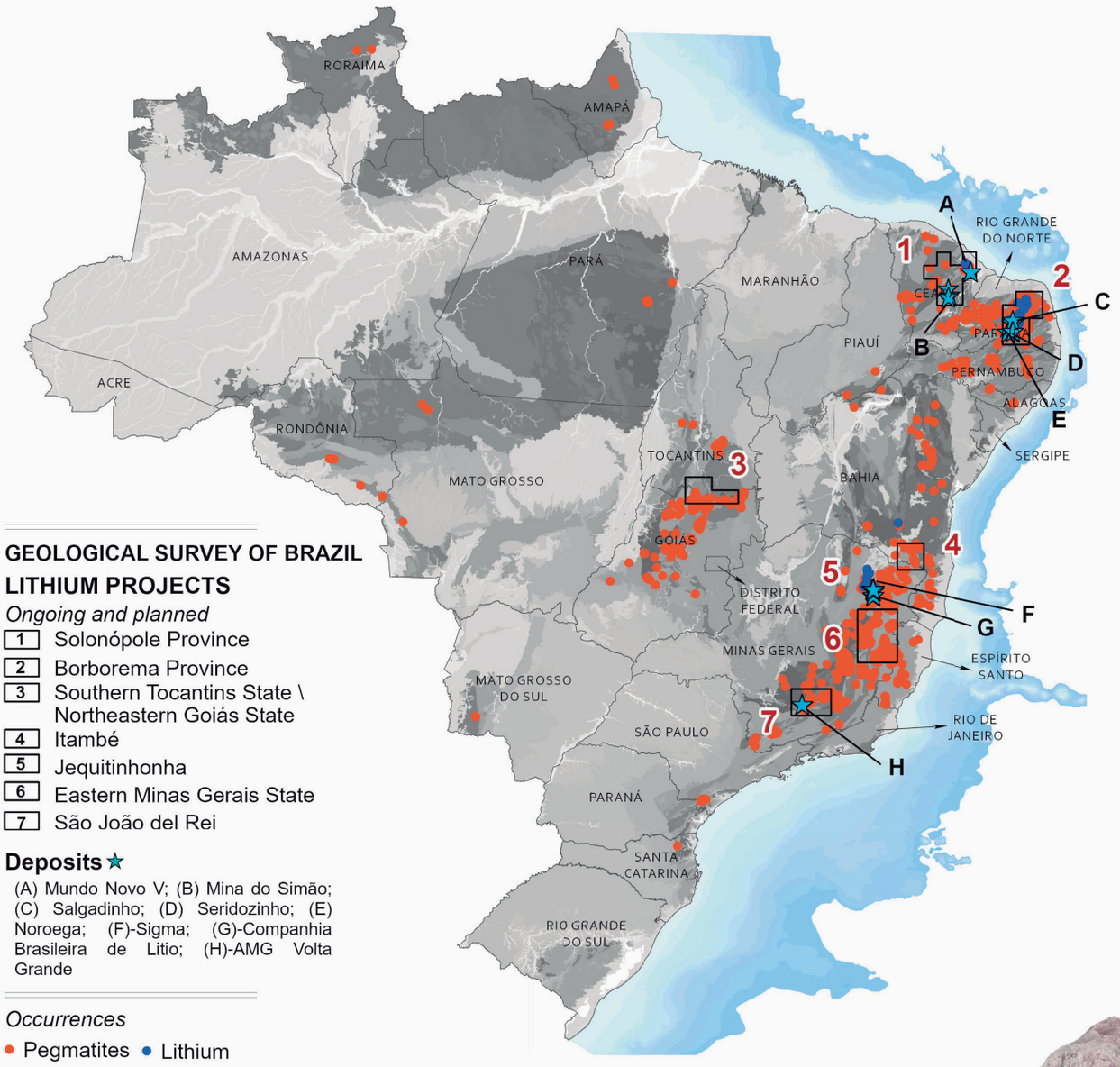
HIGHLIGHTS

- Brazil has significant potential for the production of graphite, a mineral widely used in various industries, such as the production of world-class batteries and the manufacture of electronic components. Brazil has many graphite-producing regions, particularly in the Bahia-Minas Province, which is considered one of the largest graphite-producing regions in the world;
- Brazilian graphite occurrences are mainly confined to metamorphic environments. Metamorphism - and consequently the rock-forming temperature and pressure - is considered the primary variable in the analysis of graphite potential because it regulates the degree of crystallization and ore grade;
- Considering the potential, Brazil's graphite production still needs to be improved and there is room for growth in the industry. The Brazilian government has shown interest in developing the country's graphite production, and investment in the sector is expected to increase in the coming years;
- In the long-term, Brazil offers attractive prospects for graphite exploration and growth due to the increasing demand for the mineral on the market, coupled with its position as the world's third largest graphite producer and the second largest producer of high quality flake graphite used in electric vehicles.

Selected Graphite deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resources	Grades (CG)	Status
Mina de Salto da Divisa	Graphite	Nacional de Grafite Ltd.	232.6 Mt	25%	Operating
Mina Itapecerica	Graphite	Nacional de Grafite Ltd.	209.59 kt	9.79 %	Operating
Porto Nacional	Graphite	Porto Nacional	49.7 Mt	5.3 %	Early exploration
Peresópolis	Graphite	Peresópolis	40 Mt	12%	Early exploration
Mina Maiquinique	Graphite	Extrativa / Grafite do Brasil	33.3 Mt	9.6 %	Operating
Santa Cruz	Graphite	South Star Mining Corp.	14.9 Mt	2.29 %	Exploration
Mina Mateus Leme	Graphite	Grafita MG Ltd.	91.67 kt	14%	Operating
Mina de Pedra Azul	Graphite	Nacional de Grafite Ltd.	19.07 kt	12.59 %	Operating
Mina São Benedito	Graphite	São Benedito	2.09 kt	57.43 %	Interrupted

LITHIUM



Selected Lithium deposits and resource estimates.

Deposit	Commodity	Owner	Resource estimates	Grades (Li_2O)	Status
Salinas Project (Colina, Fog's Block)	Li	Latin Resources	70.3 Mt	1.27%	Feasibility
Nezinho de Chicão	Li	Sigma Lithium	26.7 Mt	1.49 %	Feasibility
Barreiro	Li	Sigma Lithium	25.08 Mt	1.38 %	Feasibility
Volta Grande	Li-Ta-Nb	AMG	20.29 Mt	1.06 %	Producing
Xuxa	Li	Sigma Lithium	17.41 Mt	1.55 %	Producing
Bandeira	Li	Lithium Ionic	13.72 Mt	1.40 %	Feasibility
Murial	Li	Sigma Lithium	5.56 Mt	1.14 %	Feasibility
Cachoeira	Li	CBL	4.5 Mt	1.40 %	Producing
Outro Lado (Galvani)	Li	Lithium Ionic	2.97 Mt	1.46 %	Feasibility
Lavra do Meio	Li	Sigma Lithium	2.27 Mt	1.09 %	Feasibility

HIGHLIGHTS

- In Brazil, lithium is mainly found in the form of lithium-cesium-tantalum (LCT) pegmatite deposits.
- The primary ore mineral is spodumene, followed by amblygonite, petalite, and lepidolite.
- In 2022, reported production reached 2,200 tonnes of contained lithium, a 29% increase over 2021 production[1].
- Active mines and advanced exploration projects are concentrated in the state of Minas Gerais.
- The launch of Minas Gerais' "Lithium Valley Brazil" initiative in May 2023 has caught the attention of the market. The initiative aims to accelerate project development for the lithium supply chain and demonstrates a receptive approach to global investment.
- Companhia Brasileira de Lítio – CBL reported 4.5 Mt of mineral resources (measured + indicated) and a capacity to produce 45 ktpa (kilotonnes per annum) of high-quality spodumene concentrate @5.5% Li_2O at its operating Cachoeira Mine in the Middle Jequitinhonha region, Minas Gerais.
- In the same region, Sigma Lithium reported[2] mineral resource (measured + indicated) estimates of 77 Mt @1.43% Li_2O and reserves (proven + probable) of 54.8 Mt @1.44% Li_2O on its Grota do Cirilo property. Sigma achieved its first production in 2023, with five shipments. The annual run-rate production reached 270 kt (37 kt Lithium Carbonate Equivalent, LCE), with plans to expand to 766 kt (104 kt LCE) over the next two years.
- Atlas Lithium plans to achieve the initial production and sales of lithium concentrate at its Neves project in the Middle Jequitinhonha region by Q4 2024, with an expected production of approximately 150 ktpa[3].
- Lithium Ionic reported[4] mineral resources (measured + indicated) of 16.69 Mt @1.41% Li_2O at the Bandeira and Outro Lado deposits, with a 20-year mine life producing 220 ktpa of SC5.5. The definitive feasibility study is expected in Q1 2024.
- Latin Resources announced[5] the JORC Mineral Resource Estimate (MRE) for its Salinas project in the state of Minas Gerais, indicating a total of 70.3 Mt @1.27% Li_2O. Production is expected to commence in the second half of 2026, with an expected output of 405 to 525 ktpa of SC5.5 and 159 ktpa of 3% Li_2O spodumene tails concentrate products.
- Although the state of Minas Gerais is the main player in lithium exploration, there are also potential areas in northeastern Brazil (e.g., the states of Ceará, Rio Grande do Norte and Paraíba) where more than a hundred Li-bearing pegmatite bodies have been identified.
- On March 1, 2023, Oceana Lithium reported[6] the discovery of high-grade near-surface lithium mineralization within the "N Green" permits at its Solonópole lithium project in the state of Ceará. The permits cover a series of pegmatite outcrops that returned high grade lithium rock chip results of up to 4.25% Li_2O over 500 m of outcropping pegmatite.
- Greenfield areas include the regions of Southern Tocantins-Northern Goiás and Itambé (Southern Bahia).
- The Geological Survey of Brazil – CPRM has conducted research projects in key lithium areas to promote the development of the mineral industry. Completed projects in the Middle Jequitinhonha (Minas Gerais) and Borborema Pegmatite Provinces in northeastern Brazil have identified new targets for lithium mineralization. The results, including maps, charts, technical reports and scientific papers, are available to the public (https://rigeo.cprm.gov.br and http://www.sgb.gov.br/litio/index.html). Two ongoing projects are located in Eastern Minas Gerais and Solonópole Province (Ceará).

1 U.S. Geological Survey, 2023, Mineral commodity summaries 2023: U.S. Geological Survey, 210 p., https://doi.org/10.3133/mcs2023.
2 https://ir.sigmalithiumresources.com/ar-tr-grota-do-cirilo-2023-06-12/
3 https://www.atlas-lithium.com/wp-content/uploads/2023/12/12.9.23-Corporate-Overview.pdf
4 https://www.calameo.com/read/007217922c183cc9a848a?page=1
5 https://www.investi.com.au/api/announcements/lrs/19629c02-e62.pdf
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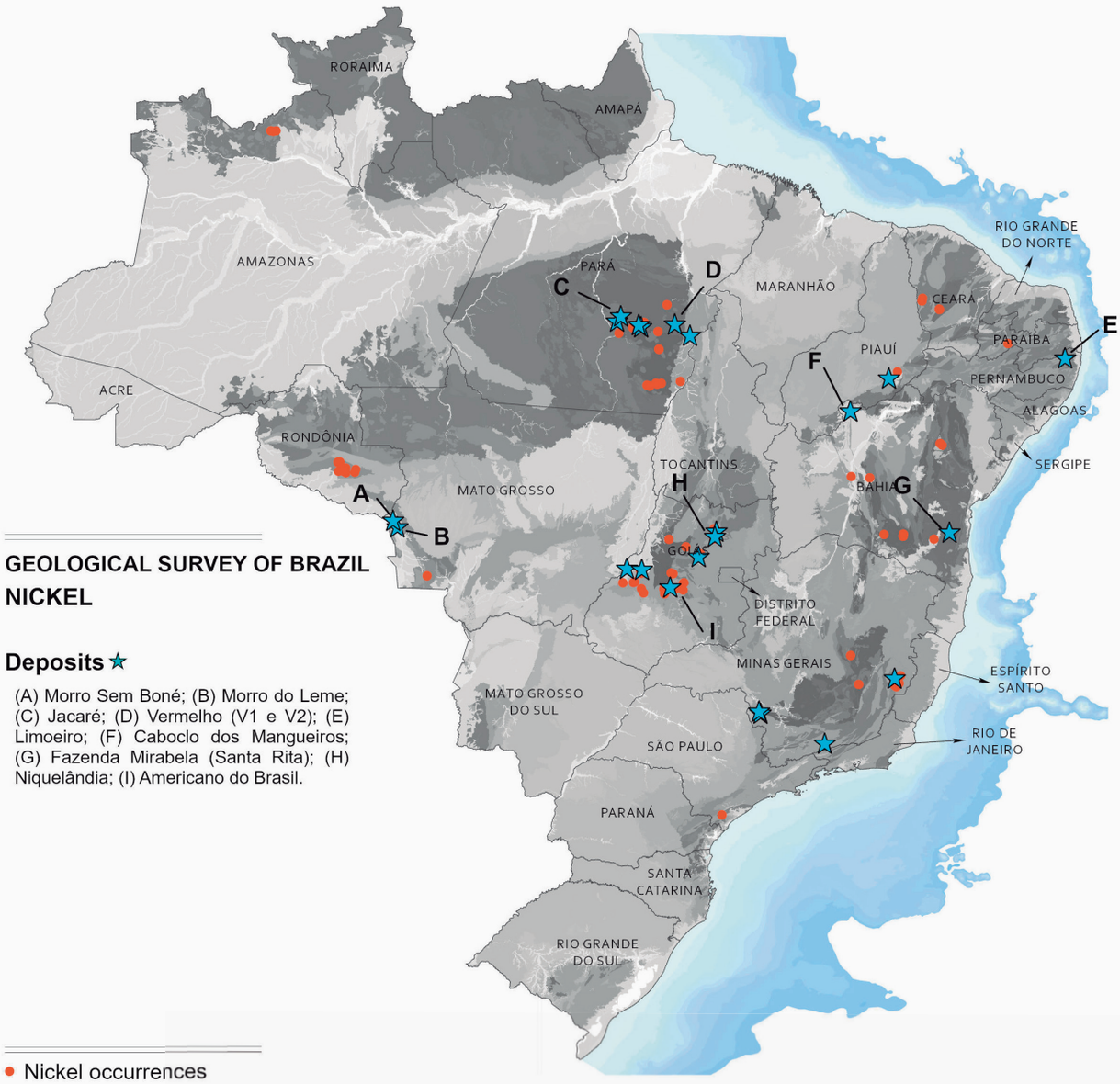
NICKEL



GEOLOGICAL SURVEY OF BRAZIL
NICKEL

Deposits ★

(A) Morro Sem Boné; (B) Morro do Leme; (C) Jacaré; (D) Vermelho (V1 e V2); (E) Limoeiro; (F) Caboclo dos Mangueiros; (G) Fazenda Mirabela (Santa Rita); (H) Niquelândia; (I) Americano do Brasil.

● Nickel occurrences

HIGHLIGHTS

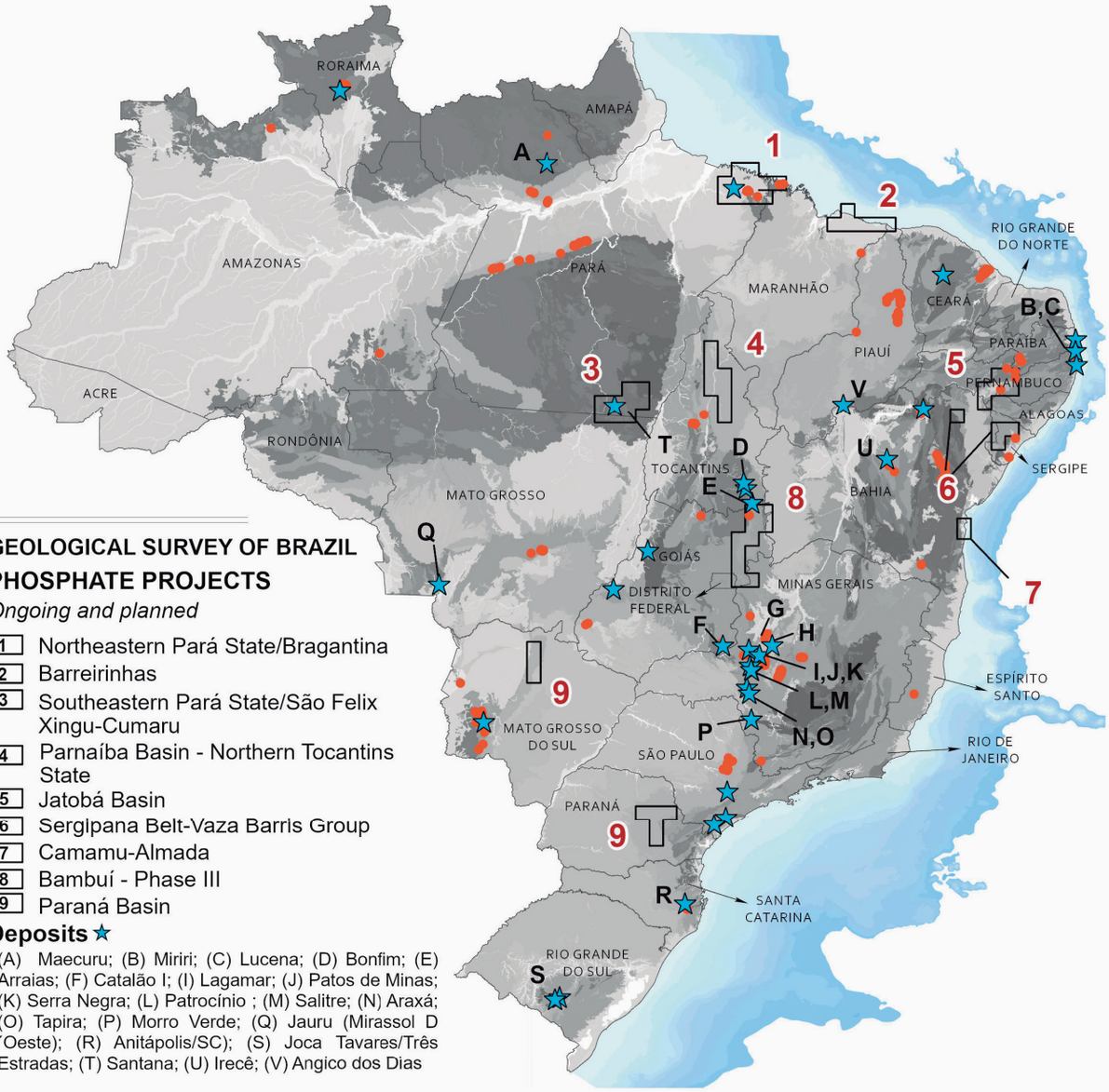
- The Brazilian nickel industry is competitive and robust, producing Class I and II nickel as one of the top 10 nickel producers in the world. It includes five mining operations (Onça-Puma, Niquelândia, Barro Alto, Codemin and Santa Rita) of sulfide and laterite ore;
- Brazil has significant nickel reserves and resources, approximately 16% of the world's declared reserves (16 Mt) and 6% of the world's nickel resources (USGS, 2022). Nickel deposits in Brazil are of both the lateritic and sulfide types, with the former predominating. Several exploration projects are in various stages of development (see table below). Three mines operate at costs below the world average (Barro Alto, Niquelândia, and Santa Rita);
- In addition, three companies produce stainless steel with nickel in Brazil: Aperam, Villares Metals, and Gerdau. They produced almost 330 kt of stainless steel in 2020, which corresponds to an estimated 13 kt of nickel consumption;
- Cobalt is usually an important by-product in many Ni deposits. Brazil has not produced cobalt since 2016, but the production recorded from 2010 to 2016, which accounted for 408 tons, was from nickel sulfide ores. However, cobalt is reported as a secondary commodity in at least 8 Ni deposits in Brazil, spread across lateritic and sulfide ore operations and projects;
- Hydroelectric power accounts for the majority of Brazil's electricity generation, about 66 percent in 2020. Access to low-cost, low-emission hydroelectricity in Brazil gives nickel producers a competitive advantage in terms of operating costs and carbon footprint.

Selected nickel deposits and resource estimates.

Deposit	Commodity	Owner	Resource estimates	Grades (Ni)	Status
Jacaré	Ni-Co	Anglo American	306.6 Mt	1.28 %	Feasibility
Santa Rita (Fazenda Mirabela)	Ni-Cu-Co	Atlantic Nickel	255.1 Mt	0.54 %	Producing
Caboclo dos Mangueiros	Ni-Cu-Co	Bahia Nickel	200 Mt	0.2 %	Exploration
Vermelho (V1 and V2)	Ni-Co	Horizonte Minerals	148.9 Mt	1.05 %	Exploration
Onça-Puma	Ni	Vale S.A.	134 Mt	1.47 %	Producing
Araguaia (Serra do Tapa, Pau Preto)	Ni-Co	Horizonte Minerals	132.26 Mt	1.26 %	Feasibility
Luanga	Pd-Pt-Au-Ni	Bravo Mining	118.1 Mt	0.11 %	Feasibility
Jaguar	Ni-Cu-Co	Centaurus Metals	109.2 Mt	0.87 %	Feasibility
Piauí Níquel	Ni-Co	Brazilian Nickel Ltda.	98.8 Mt	0.74 %	Feasibility
Barro Alto	Ni	Anglo American	75.8 Mt	1.25 %	Producing
Morro do Engenho	Ni-Co-Sc	SGB-CPRM	65.95 Mt	1.07 %	Exploration
Niquelândia (WAVE)	Ni-Co	Wave Nickel Brasil	55 Mt	0.94 %	Producing
Santa Fé	Ni-Co-Sc	SGB-CPRM	45.56 Mt	1.17 %	Exploration
Morro Sem Boné / Morro do Leme	Ni	Anglo American	40.29 Mt	1.79 %	Feasibility
Itapitanga	Ni-Co	Centaurus	40 Mt	0.95 %	Exploration
Limoeiro	Ni-Cu-Pt	Nexa Resources S.A.	35 Mt	0.25 %	Feasibility
CODEMIN (Niquelândia)	Ni	Anglo American	11.9 Mt	1.21 %	Producing
Fortaleza de Minas (O'Toole)	Ni-Cu-Co	Fortaleza de Minas	6.6 Mt	2.2 %	Interrupted
Americano do Brasil	Ni-Cu-Co	Prometálica Mineração Centro Oeste S.A.	3.09 Mt	1.12 %	Interrupted

• U.S. Geological Survey, 2022, Mineral commodity summaries 2022: U.S. Geological Survey, 202 p., https://doi.org/10.3133/mcs2022

PHOSPHATE



GEOLOGICAL SURVEY OF BRAZIL

PHOSPHATE PROJECTS

Ongoing and planned

1. Northeastern Pará State/Bragantina
2. Barreirinhas
3. Southeastern Pará State/São Felix Xingu-Cumaru
4. Parnaíba Basin - Northern Tocantins State
5. Jatobá Basin
6. Sergipana Belt-Vaza Barris Group
7. Camamu-Almada
8. Bambuí - Phase III
9. Paraná Basin

Deposits ★

(A) Maecuru; (B) Miriri; (C) Lucena; (D) Bonfim; (E) Arraias; (F) Catalão I; (I) Lagamar; (J) Patos de Minas; (K) Serra Negra; (L) Patrocínio ; (M) Salitre; (N) Araxá; (O) Tapira; (P) Morro Verde; (Q) Jauru (Mirassol D ´Oeste); (R) Anitápolis/SC); (S) Joca Tavares/Três Estradas; (T) Santana; (U) Irecê; (V) Angico dos Dias

● Phosphate occurrences

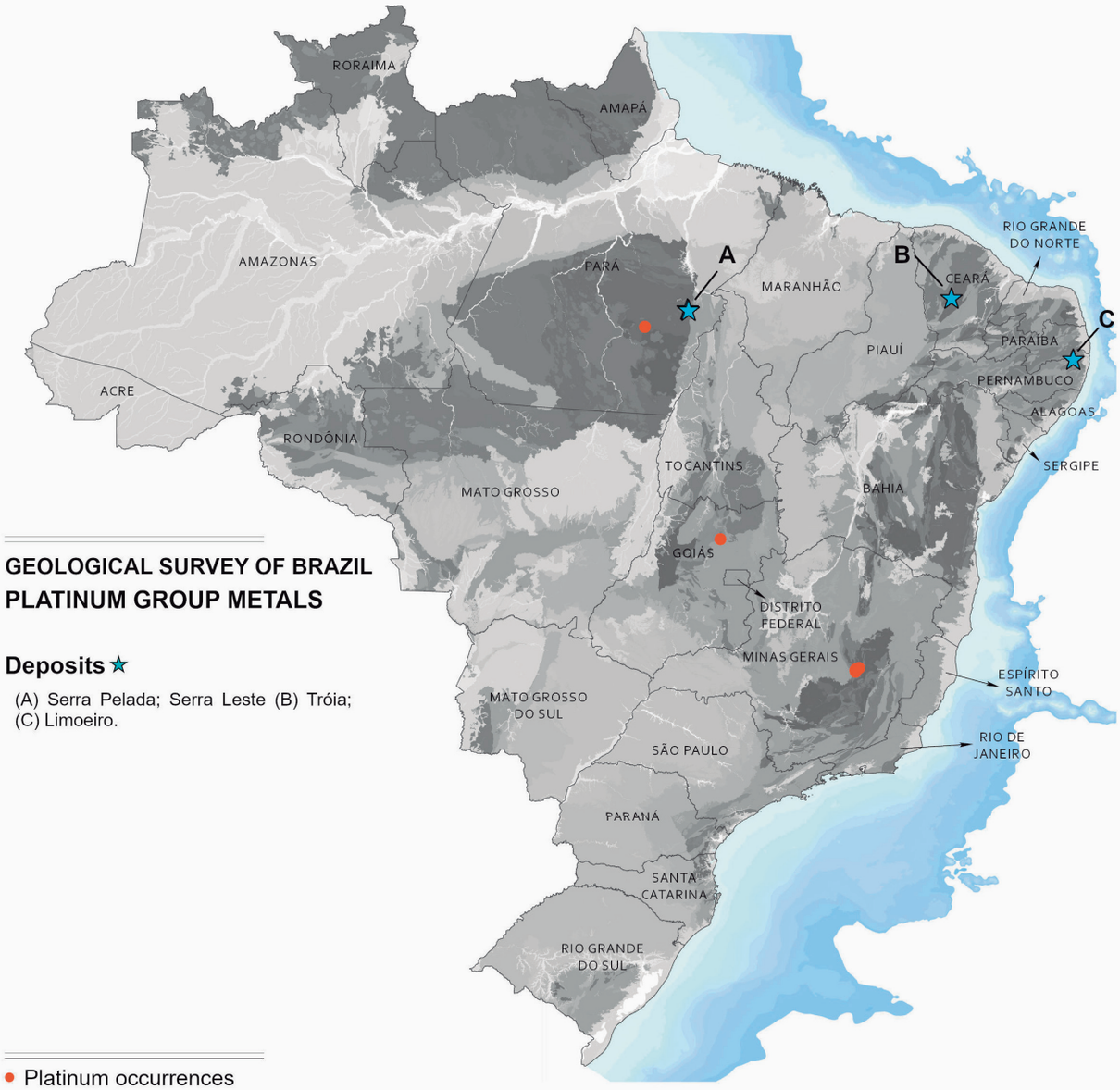
HIGHLIGHTS

- Brazil has great potential for the occurrence of igneous and sedimentary phosphate deposits. Only 20% of Brazilian reserves are associated with sedimentary rocks, despite the large number of different potential basins. The majority of deposits are associated with residual enrichment processes of carbonatite-alkaline bodies with the development of thick weathering mantles (almost 80%). Brazil also has unexplored potential for AMCG-related deposits;
- Only seven igneous deposits (Tapira, Araxá, Catalão I, Catalão II, Salitre, Cajati, and Angico dos Dias) are in production. The main mines are related to the Alto Paranaíba Province, world-class igneous deposits. The Santana (Pará - PA) and Três Estradas (Rio Grande do Sul) projects, which are more recent discoveries of igneous deposits, are in the process of going into operation;
- Sedimentary reserves in production are associated with the Neoproterozoic deposits of Patos de Minas (Minas Gerais State - MG), Arraias (Tocantins and Goiás States), Irecê (Bahia State), Ressaca (Mato Grosso do Sul) and Pratápolis (Minas Gerais) some with inconclusive expansion potential. The Neoproterozoic Jauru deposit (Minas Gerais) is a potential sedimentary resource discovered by the Government and now under feasibility studies by BEMISA;
- The Miriri Project (Paraíba and Pernambuco States) is a Cretaceous sedimentary deposit opportunity offered by the Geological Survey of Brazil. It corresponds to a phosphate deposit with a total area of 7,752.84 hectares and 114.7 million tons with an average grade of 4.19% P_2O_5;
- The Itataia phosphorus-uranium deposit is the second largest uranium reserve in Brazil, associated with a complex geological evolution in metasedimentary rocks, hydrothermal influence and a paleokarst stage;
- The Gavião Project is a new igneous phosphate area in the pre feasibility phase. The production estimated is 120 kt of DANF phosphate, with an average content of 5% P_2O_5;
- Brazil also has aluminous phosphate reserves, such as the Sapucaia mine (Pará State), which uses a calcination process to promote phosphorus solubility and is used as a thermophosphate fertilizer. In addition to this mine, five new nearby targets with expansion potential have been identified: Boa Vista, Serrote, Serrotinho, Caeté and Tracuá.

Selected phosphate deposits and resource estimates.

Deposit	Commodity	Owner	Resource estimates	Grades (P_2O_5)	Status
Tapira	P_2O_5-Nb-Ti	Mosaic	699,9 Mt	8.6 %	Producing
Serra do Salitre	Ti-P_2O_5-Nb	Eurochem + Mosaic	609.4 Mt	9,55%	Producing
Mata da Corda	P_2O_5-Ti	Nexon Mineração S.A.	520 Mt	3.5 %	Exploration
Beberibe	P_2O_5	Lepanto Mineração	390 Mt	15%	Exploration
Anitápolis	P_2O_5	IFC (Mosaic)	320 Mt	6.41 %	Exploration
Jauru (Mirassol D´Oeste)	P_2O_5-Fe	BEMISA	314 Mt	5%	Planned
Serra Negra	P_2O_5-Ti	Mosaic + Eurochem	228 Mt	10%	Exploration
Rocinha	P_2O_5	Mosaic	226 Mt	13%	Producing
Maecuru (Maicuru)	Ti-P_2O_5-REE	Mosaic	200 Mt	15%	Exploration
Catalão I	P_2O_5-Nb-Ti-U	Mosaic + CMOC	150.9 Mt	10.5 %	Producing
Fazenda Ipanema	P_2O_5-Fe	Fazenda Ipanema	120 Mt	6.07 %	Exploration
Miriri	P_2O_5	CPRM	114.73 Mt	4.19 %	Producing
Fazenda Itataia	U-P_2O_5	Indústrias Nucleares do Brasil	79.5 Mt	11%	Feasibility
Três Estradas	P_2O_5	Aguia Resources Ltd.	83.21 Mt	4.11 %	Planned
Arraias	P_2O_5	Itafos	79.0 Mt	4.9 %	Producing
Mina Cajati	P_2O_5	Mosaic	69.2 Mt	5.1 %	Producing
Serra da Capivara (Santana)	P_2O_5	Itafos	60.4 Mt	12%	Planned
Lucena	P_2O_5	Aguia Resources Ltd.	55 Mt	6%	Exploration
Morro Verde (Pratápolis)	P_2O_5	Mineração Morro Verde	40 Mt	10%	Producing
Juquiá (Registro)	P_2O_5	Socal Mineração S.A.	18 Mt	10%	Producing
Bonfim	P_2O_5	Dusolo/FENGRO	18 Mt	6%	Interrupted

PLATINUM GROUP ELEMENTS



GEOLOGICAL SURVEY OF BRAZIL
PLATINUM GROUP METALS

Deposits ★

(A) Serra Pelada; Serra Leste (B) Tróia; (C) Limoeiro.

● Platinum occurrences

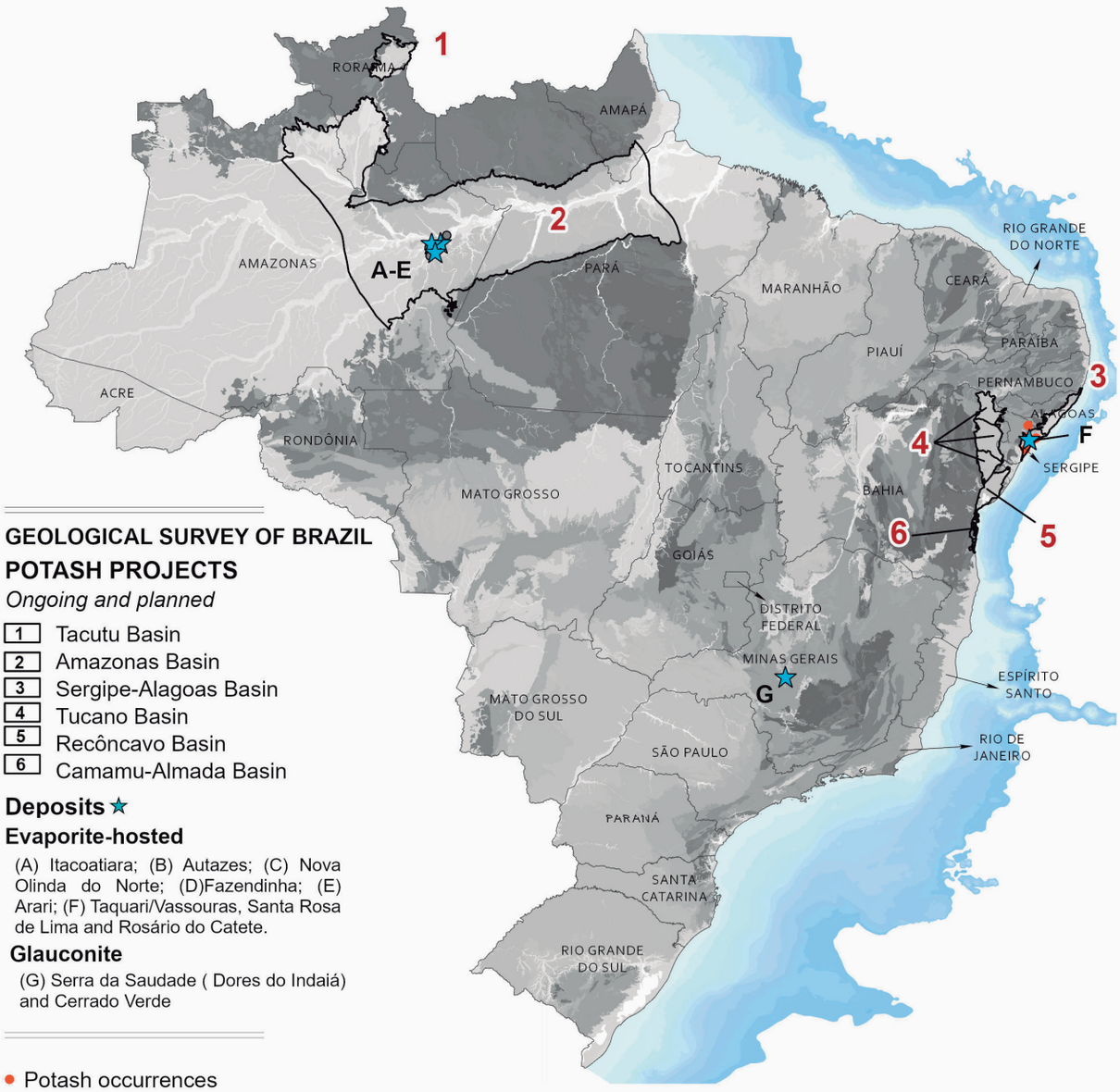
HIGHLIGHTS

- The platinum group elements (PGE) consist of platinum (Pt), palladium (Pd), rhodium (Rh), ruthenium (Ru), osmium (Os) and iridium (Ir). These are very rare metals (30 times rarer than gold) and because of their excellent physical and chemical behavior as catalysts, they are essential to climate-safe energy technologies, such as green hydrogen production. However, since 1900, about 90% of PGE production has come from South Africa and Russia, making PGE part of many countries' critical minerals strategy;
- Brazil does not yet have a PGE mine, but the Pedra Branca and Luanga deposits have very advanced exploration work and are likely to become PGE mines in the near future;
- Similar to other PGE deposits worldwide, the Brazilian PGE deposits are hosted by layered mafic-ultramafic complexes;
- The Luanga deposit in the Carajás Mineral Province is the largest PGE deposit in South America with 142 Mt at 1.24 g/t PGE+Au and 0.11% Ni. The high-grade PGE zones of the Luanga mafic-ultramafic intrusion consist of sulfide-rich harzburgites, orthopyroxenites and minor chromitites;
- The Luanga mafic-ultramafic intrusion is of Neoarchean age (ca. 2.76 Ga), similar to many other medium- to small-sized mafic-ultramafic intrusions in the Carajás Mineral Province, all of which are attractive to PGE exploration (e.g., Lago Grande, Serra da Onça, Puma, Fafá, etc.);
- In the northeast of Brazil, the Pedra Branca PGE deposit is another well explored mineralization (since the 1980's) with an inferred mineral resource of 63.5 Mt with 1.08 g/t of PGE+Au. The PGE are mainly hosted in tectonically disrupted chromitite layers of the Troia-Pedra Branca mafic-ultramafic complex. The age of this mafic-ultramafic intrusion is approximately 2.04 Ga, which is very similar to the age of the world-class PGE-bearing Bushveld igneous complex, in South Africa;
- There is no hope of finding new large igneous complexes in Brazil, but a number of small Precambrian mafic-ultramafic intrusions occur in the northeast of Brazil (Borborema Province and northern São Francisco craton), that are waiting to be explored (conduit-type intrusions? e.g., Limoeiro Ni-Cu-PGE deposit);
- Despite the Pedra Branca and Luanga PGE deposits, economic grades of PGE are also found in many Brazilian Ni–Cu sulfide deposits (e.g., Limoeiro, Mirabela) of mafic-ultramafic intrusions and komatiites (Fortaleza de Minas). In addition, some Brazilian gold deposits may also host unconventional (hydrothermal) PGE mineralization (Serra Pelada, Buraco do Ouro);
- The PGE mineralization in Brazil is all Precambrian in age and no PGE occurrences have been found in the Mesozoic basaltic sills of the Brazilian intracratonic basins. However, following the Norilsk-type deposit model, it may represent an exploration frontier;
- The geology of Brazil's major mineral provinces is quite favorable for the discovery of new PGE resources, and the increasing importance of PGE in supporting the transition to clean energy may spur new PGE exploration programs by private and governmental companies.

Selected PGE deposits and resource estimates.

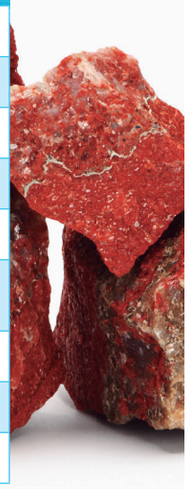
Deposit	Commodity	Owner	Estimated Resource	Grades	Status
Luanga	Pd-Pt-Au-Ni	Bravo Mining	191.2 Mt	0.67g/t (Pd) - 0.57g/t (Pt)	Exploration
Pedra Branca	Pd-Pt-Au	ValOre Metals	63.6 Mt	0.68g/t (Pd) - 0.36g/t (Pt)	Exploration
Limoeiro	Ni-Cu-Pt	Nexa Resources SA	35 Mt	0.16 g/t (Pt)	Feasibility
Serra Pelada; Serra Leste	Au-Pt	Colossus Minerals	12.37 Mt	0.25 g/t (Pt)	Feasibility

POTASH



Selected Potash deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resource	Grades (K_2O)	Status
Autazes	K	Potássio do Brasil	767 Mt	30.71 %	Feasibility
Nova Olinda do Norte	K	Potássio do Brasil	693.3 Mt	16.79 %	Feasibility
Arari	K	Petrobras	675 Mt	27 %	Feasibility
Fazendinha	K-Salt	Petrobras	487 Mt	33 %	Feasibility
Itacoatiara	K	Potássio do Brasil	263 Mt	16.4-21.7 %	Feasibility
Cerrado Verde, São Gotardo	K	Verde Agritech	253 Mt	9.2 %	Exploration
Dores do Indaiá	K	Kalium Mineração	220 Mt	10.56 %	Exploration
Santa Rosa de Lima	K	Mosaic	55.2 Mt	24.26 %	Operating
Taquari-Vassouras	K	Mosaic	9.5 Mt	14,9 %	Exploration

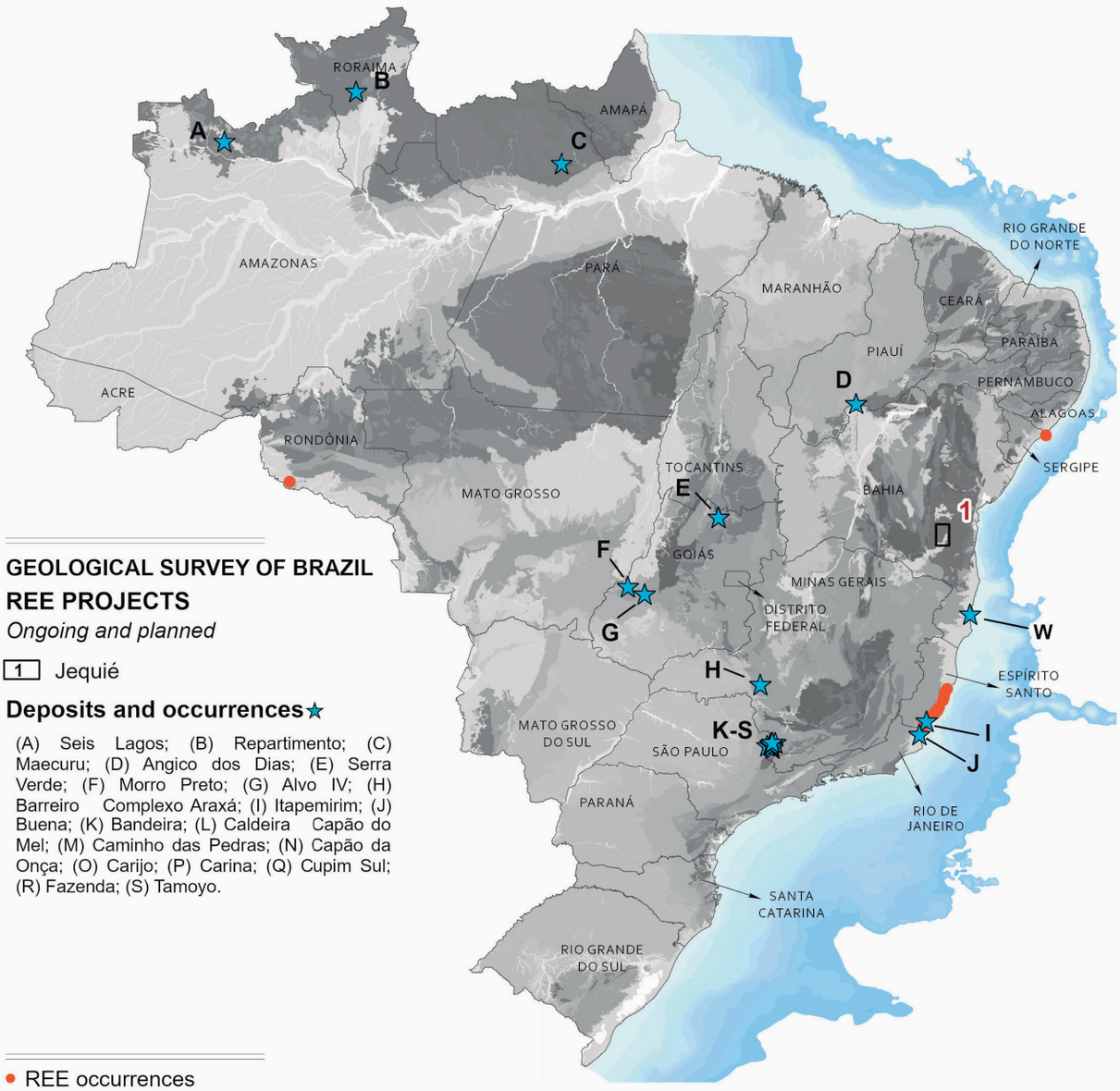


HIGHLIGHTS

- Brazil's main potential is associated with evaporite-hosted potash deposits of Lower Cretaceous and Permo-Carboniferous age. Currently, the only national productive plant is concentrated in the Taquari/Vassouras mine (Sergipe State) which produces approximately 250,000 tons of K_2O and is operated by Mosaic;
- Brazil's current measured potash rock reserves are 3.7 billion tons, with 523 million tons of K_2O equivalent (average content of 18.0% K_2O). Inferred reserves are 430 million tons, with 99 million tons of K_2O equivalent (average content of 23.0% K_2O);
- The main reserves and resources are located in the Sergipe (Northeastern Brazil) and Amazonas Basins (Northern Brazil);
- In the Sergipe Basin, it is located in the regions of Taquari/Vassouras, Santa Rosa de Lima (both silvinite, with a remaining reserve of 2.3 Mt of K_2O) and Rosário do Catete (carnalite, 12 Bt of ore with 2.5 Bt of KCl, 8.3% content, and 1.5 Bt of K_2O "in situ"), all in the state of Sergipe and owned by Mosaic;
- In the Amazonas Basin, the delineated reserves are located in the regions of Itacoatiara, Nova Olinda do Norte and Autazes (silvinita), Amazonas State, owned by Potássio do Brasil. The reserves of the three deposits located in the state of Amazonas total 1.71 Billion tons of KCl (average content 30.43%), or approximately 1.1 Billion tons of K_2O. Studies have demonstrated the technical, economic, legal, environmental and social feasibility of the project. It is currently in a consultation phase with the indigenous population;
- Three other potential resource targets evaluated by Potássio do Brasil indicate more than 1.2 Bt of KCl (30% content), that is, approximately 739.8 Mt of K_2O;
- PETROBRAS has started to sell its mining assets, which include Fazendinha-Arari and Maués-Boa Vista dos Ramos, and the cities of Nova Olinda, Autazes, Itacoatiara, Silves, Itapiranga, Maués and Boa Vista dos Ramos;
- The Geological Survey of Brazil - CPRM has carried out a re-evaluation of resources and reserves based on ANP data. It outlined four areas that could contain more than 1.5 Bt of KCl (inferred content of 30%), or 900 Mt of K_2O[1].
- Other potential basins with similar evaporite age sections remain unexplored for this commodity. Twenty-four basins have evaporite units cited in their sedimentary sequences. Among the emerging basins, 11 were mentioned in a promising way for the occurrence of evaporites, such as: Acre, Solimões, Amazonas, Tacutu, Parnaíba, Paraná, Recôncavo, Araripe, Potiguar, Sergipe-Alagoas and Parecis. Among the offshore basins, 13 stand out: Santos, Pelotas, Campos, Espírito Santo, Mucuri, Cumuruxatiba, Jacuípe, Jequitinhonha, Almada, Camamu, Pernambuco/Paraíba, Ceará and Bragança Viseu, São Luís and Ilha Nova;
- Other sources of potash are being developed in Brazil, such as glauconite-hosted potash as an alternative source of potash for the production of a slow-release fertilizer suited to Brazil's tropical climate. It promises to be a booming source of business, with grades ranging from 6 to 10% K_2O. Kalium Mineração, Harvest Minerals, Verde Agritech and Terra Brasil are mining companies focused on this market share in Brazil.

1 For more information access: https://rigeo.sgb.gov.br/handle/doc/21740

RARE EARTH ELEMENTS



GEOLOGICAL SURVEY OF BRAZIL

REE PROJECTS

Ongoing and planned

1 Jequié

Deposits and occurrences

(A) Seis Lagos; (B) Repartimento; (C) Maecuru; (D) Angico dos Dias; (E) Serra Verde; (F) Morro Preto; (G) Alvo IV; (H) Barreiro Complexo Araxá; (I) Itapemirim; (J) Buena; (K) Bandeira; (L) Caldeira Capão do Mel; (M) Caminho das Pedras; (N) Capão da Onça; (O) Carijo; (P) Carina; (Q) Cupim Sul; (R) Fazenda; (S) Tamoyo.

● REE occurrences

HIGHLIGHTS

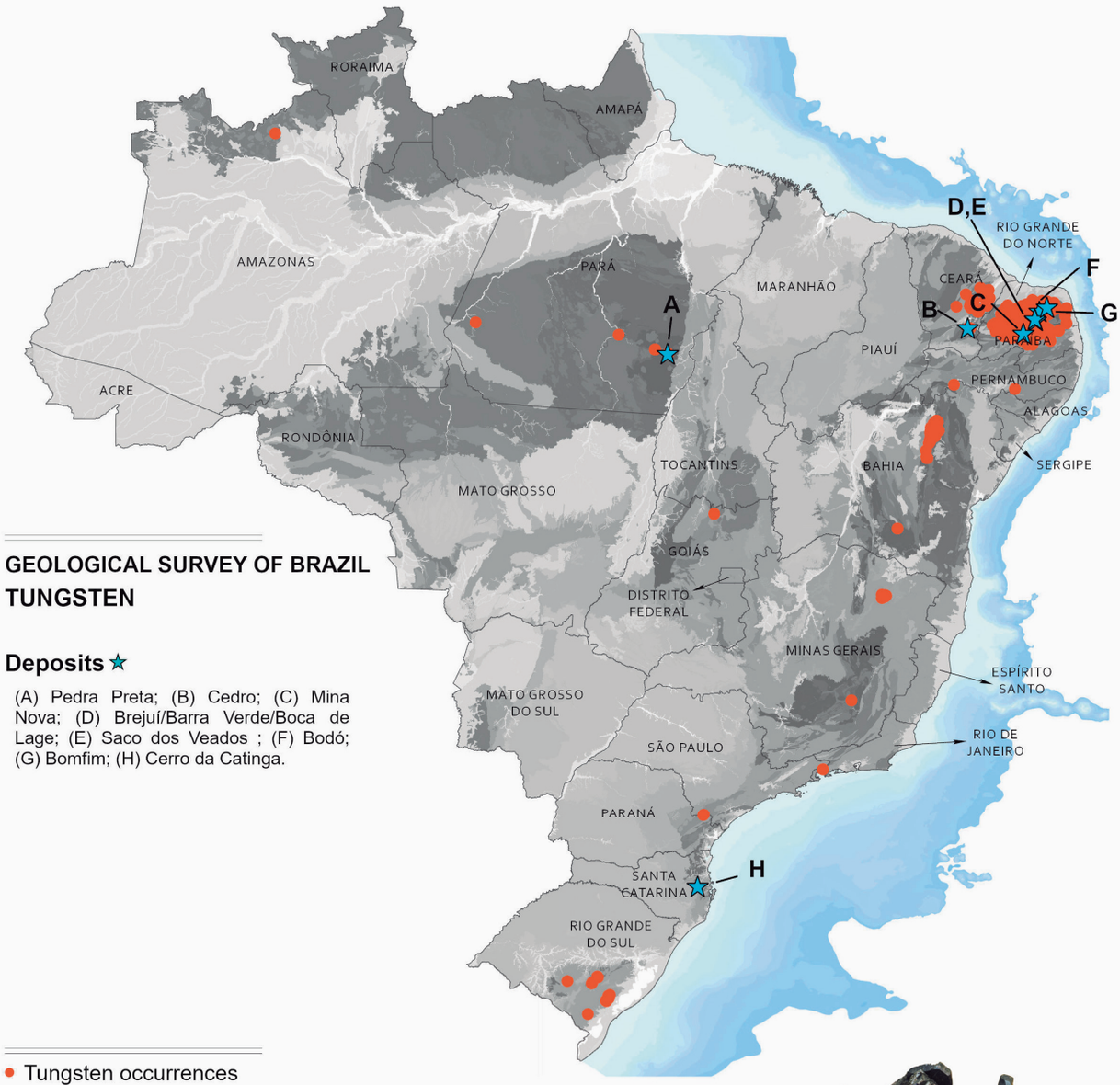
- Brazil is the third country with the largest Rare Earth Elements (REE) reserves of 21 Mt (USGS, 2023). Nevertheless, Brazil is still not so relevant in REE production on a global scale. REE production in Brazil comes mainly from monazite concentrated in paleobeach sands. In 2020, 708 t of monazite were produced and sold on the international market (Brazil Nuclear Industry, 2020);
- Most of the REE reserves in Brazil are found in alkaline-carbonatitic rocks such as Araxá, Poços de Caldas, Catalão, Tapira, Jacupiranga, and Itapirapuã; in granites such as Pitinga, Minaçu and Montividio do Norte and, to a lesser extent, in sedimentary deposits in the region of São Gonçalo do Sapucaí and São Francisco do Itabapoana. Studies in the region of Seis Lagos and Repartimento (also known as Serra do Repartimento) are inactive due to legal barriers in areas of environmental protection;
- In 2015, measured reserves were approved in the Minaçu-GO region, totaling approximately 300 Mt contained in ionic clays with a content of 0.15% REEO+Y. The operation will be carried out by the mining company Serra Grande. Construction of the mine infrastructure is well advanced and all necessary permits have been obtained;
- The largest REE deposit in Brazil in carbonatites is Araxá, with measured reserves of approximately 20 Mt, with 3.02% and 2.30% REE content. Araxá is the world's largest producer of Nb and is currently developing projects to recover REE as a by-product. The mines of Catalão, Poços de Caldas, Tapira, Pitinga, and Mata da Corda are also conducting studies for the recovery of REE as a by-product of the main ore;
- REE concentrations in paleoplacers (monazite and ilmenite association) form smaller deposits with a predominance of LREE. Continental sited (cassiterite associated), such as in Rondônia or southern Pará, are potential deposits of HREE minerals. At the Bom Futuro deposit (RO), for example, waste from cassiterite mining is sold to a Canadian rare earths company (Canada Rare Earth Corporation 2021);
- In the coming years, a possible verticalization of the REE production lines in Brazil is expected with the operations beginning in Serra Verde (GO) and Morro do Ferro/Poços de Caldas (MG), in addition to the implementation of a xenotime REE extraction plant at the Pitinga mine.

Selected REE deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resource	Grades (TREO)	Status
Minaçu (Pela-Ema)	REE-Sn-W-Nb-Ta	Serra Verde	910 Mt	0.15 %	Producing
Caldeira - Capão do Mel	REE	Meteoric Resources	409 Mt	0.27 %	Exploration
Carina	REE	Aclara Resources	168.1 Mt	0.15 %	Exploration
Seis Lagos	REE-Nb-P-Fe-Mn-Ti	SGB-CPRM	43.5 Mt	1.5 %	Without feasibility
Poços de Caldas	REE-U-Th-Mo-Zr-Al	Mineração Terras Raras S/A	3.55 Mt	3.9 %	Exploration
Catalão II	P-Nb-REE	CMOC-Mosaic	25 Mt	0.98 %	Operating
Tapira	P-Ti-Nb-REE	Mosaic	5.8 Mt	1-10 %	Operating

- INDÚSTRIAS NUCLEARES DO BRASIL. Relatório integrado. Rio de Janeiro: INB Gerência de Governança Corporativa, 2020
- U.S. Geological Survey, 2023, Mineral commodity summaries 2023: U.S. Geological Survey, 210 p., https://doi.org/10.3133/mcs2023

TUNGSTEN



GEOLOGICAL SURVEY OF BRAZIL
TUNGSTEN

Deposits ★

(A) Pedra Preta; (B) Cedro; (C) Mina Nova; (D) Brejuí/Barra Verde/Boca de Lage; (E) Saco dos Veados ; (F) Bodó; (G) Bomfim; (H) Cerro da Catinga.

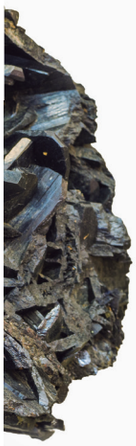
● Tungsten occurrences

HIGHLIGHTS

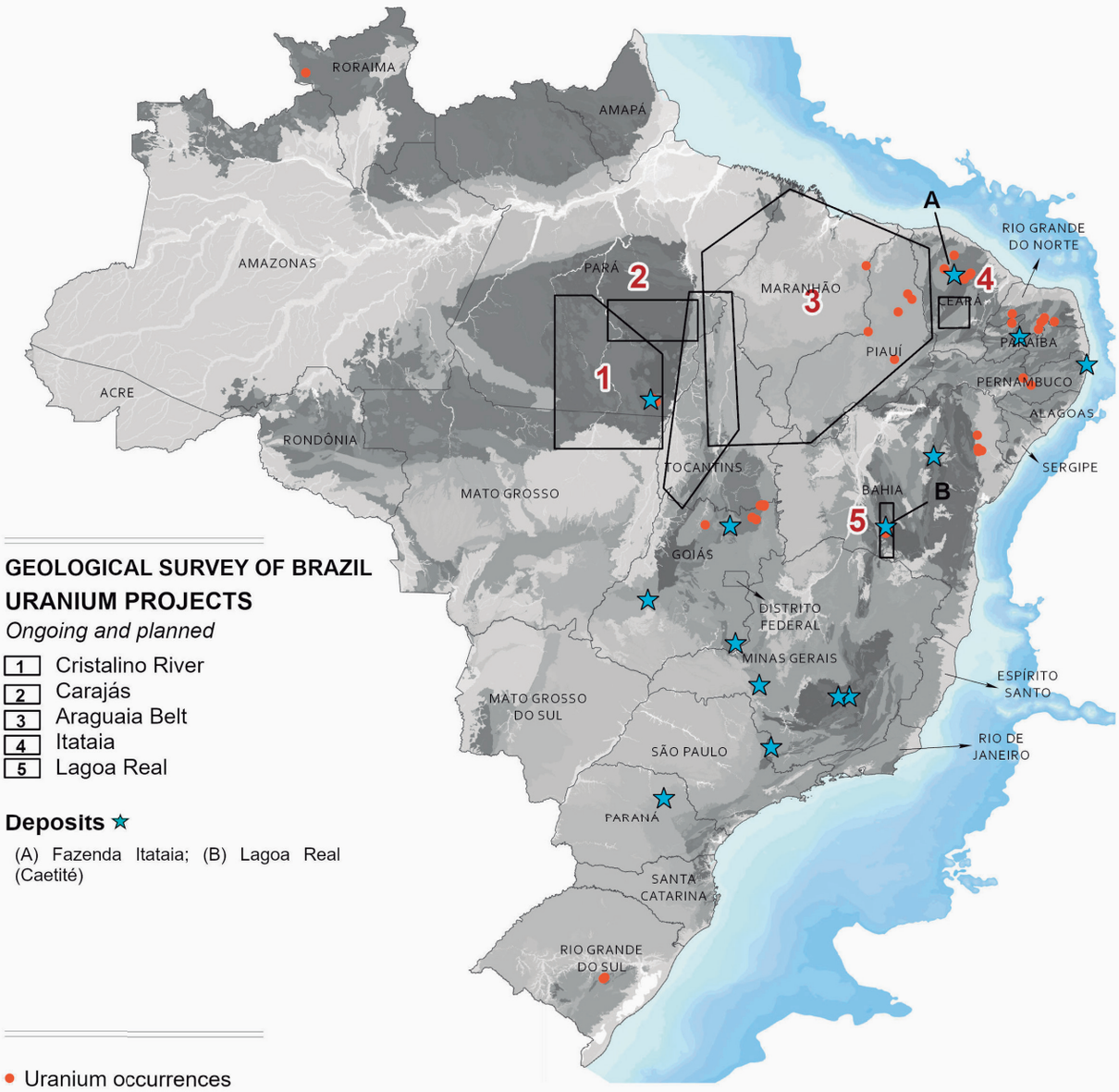
- Tungsten is exploited in Brazil through 17 mining concessions, the main ones being in the states of Rio Grande do Norte (11), Pará (2) and Rondônia (1). The mineral deposits and mining operations belong to the hydrothermal magmatic system, where the vast majority are linked to skarns (86%), while a small part is associated with veins in greisenized zones (14%). Brazil's tungsten mineral potential is mainly associated with the Neoproterozoic rocks of the Seridó Mineral Province, and subordinately with the Paleoproterozoic rocks of the Carajás Mineral Province;
- Brazil's main tungsten mineral deposits are located in the Seridó Mineral Province, where the numerous deposits/occurrences (>700) are primarily hosted in skarns with scheelite as the ore mineral. This province is the largest concentration of tungsten ore in the country and holds the largest Brazilian reserve;
- The Carajás Mineral Province has the second largest tungsten mineral potential, represented by the Pedra Preta and Serra do Bom Jardim deposits related to quartz/pegmatite veins with wolframite in greisenized zones located on the summits of Paleoproterozoic granites;
- The Ribeira Fold Belt is represented by the Itaoca tungsten deposit containing minerals from the scheelite-powellite series linked to skarns of Cambrian age;
- The rocks of the Jamari Complex in Rondônia are home to tungsten deposits (Igarapé Manteiga Mine) linked to the granites of the Rondônia Intrusive Suite from the Neoproterozoic age, with disseminated wolframite and cassiterite associated with intense greisenization processes and quartz-mica-fluorite veins.

Selected tungsten deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resource	Grades (WO_3)	Status
Brejuí	W	Mineração Tomaz Salustino	11 Mt	0.61 %	Operating
Bodó (Bonito)	W	Bodó Mineração	9 Mt	2.0 %	Paralyzed
Bonfim	W-Au	Mineração Nosso Senhor do Bonfim	0.9 Mt	4.8 %	Paralyzed
Pedra Preta	W	Mineração Pará Tungstênio	0.51 Mt	1.01 %	Operating
Igarapé Manteiga	W	Metalmig	0.02 Mt	0.3 %	Paralyzed
Cerro da Caatinga	W-Sn-Mo	Cerro da Caatinga	0.6 Kt	1.38 %	Exhausted



URANIUM



GEOLOGICAL SURVEY OF BRAZIL

URANIUM PROJECTS

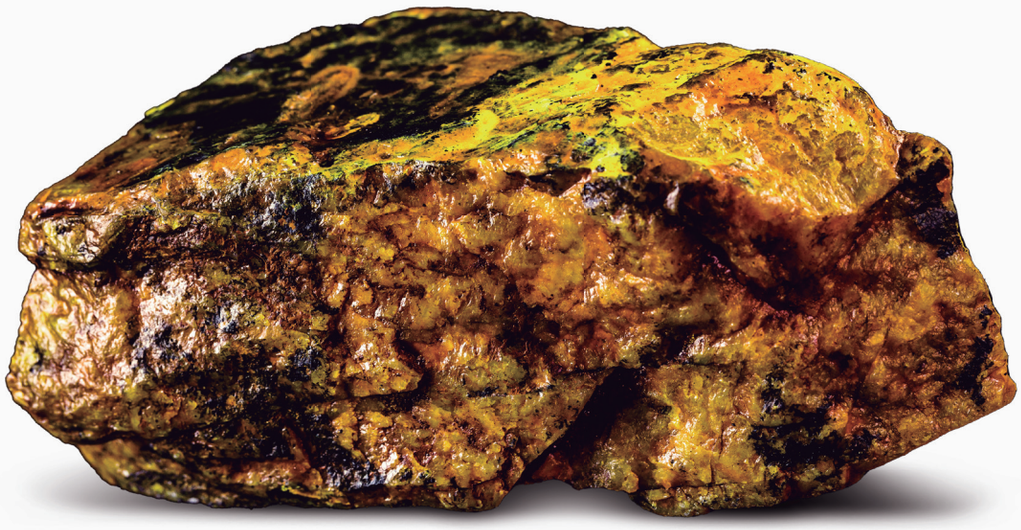
Ongoing and planned

1. Cristalino River
2. Carajás
3. Araguaia Belt
4. Itataia
5. Lagoa Real

Deposits ★

(A) Fazenda Itataia; (B) Lagoa Real (Caetité)

● Uranium occurrences



HIGHLIGHTS

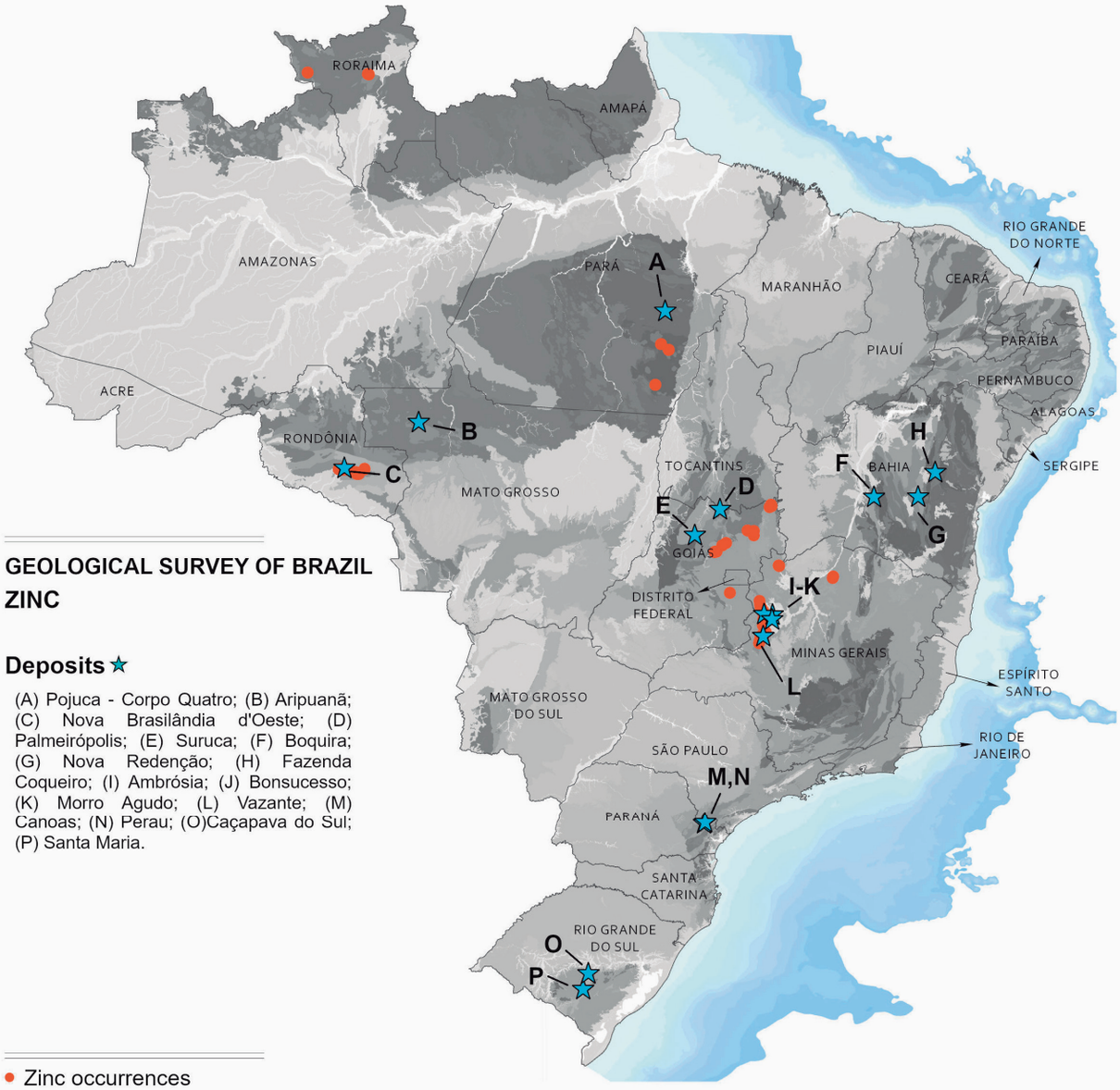
- Brazil currently has one of the largest uranium reserves in the world, with approximately 280 kt of contained uranium (U_3O_8), and the country has the potential to have one of the three largest reserves in the world.
- The Itataia and Lagoa Real deposits were discovered in the late 1970s and were responsible for Brazil ranking seventh place among countries with significant uranium resources. In 2022, Brazil had the eighth largest uranium resource in the world, although no discoveries had been made since the late 1980s. At the end of 1982, it amounted to about 160kt.
- Brazil has already identified several styles of Uranium deposits on its territory, such as Metassomatic deposits (Lagoa Real), Archean Paleoplacer (Serra das Gaivotas), Paleoproterozoic Unconformity (Rio Cristalino), associated with Phosphate (Itataia) and Sedimentary/Sandstones (Figueiras).
- The only uranium mine currently operating in Brazil is located in Caetité, in the state of Bahia, where mineral resources are estimated at 99.1 thousand tons of uranium. Over 38 anomalies (areas of high uranium concentration) have been identified in this area, which is why it is referred to as a uranium province. This hub can produce approximately 400 tons of U_3O_8/year with the potential to reach 800 tons of U_3O_8/year.
- At the country's only operation, uranium is concentrated by a sulfuric acid leaching process, resulting in a concentrated liquor that, after enrichment, produces the yellow cake.
- The only state in Brazil that requires uranium for electricity generation is Rio de Janeiro, where the Angra 1 and Angra 2 nuclear power plants are located. The nominal demand is 440 tons per year. However, between 310 and 340 tons of enriched uranium per year remain, depending on the operating history of the nuclear power plants. The INB – Indústrias Nucleares do Brasil nuclear fuel plant is also located in the state of Rio de Janeiro and provides fuel for Brazil's 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. Today, INB is the owner of all deposits in Brazil[1].

Selected Uranium deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resource	Grades (U_3O_8)	Status
Rio Cristalino	U	INB	150 Kt	0.1 %	Early Exploration
Itataia / Santa Quitéria	U-P	INB-Galvani	142.5 Kt	0.05 %	Feasibility
Lagoa Real / Caetité	U	INB	87.089 Kt	0.2 %	Operating
Poços de Caldas	U	INB	26.8 Kt	0.01 %	Reclamation
Serra das Gaivotas / Moeda	U-Au	INB	15.0 Kt	0.01 %	Early Exploration
Espinharas	U	INB	10.0 Kt	0.1 %	Early Exploration
Figueira	U	INB	8.0 Kt	0.1 %	Early Exploration

1 For more information, access https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2022/lei/L14514.htm

ZINC



GEOLOGICAL SURVEY OF BRAZIL
ZINC

Deposits ★

(A) Pojuca - Corpo Quatro; (B) Aripuanã; (C) Nova Brasilândia d'Oeste; (D) Palmeirópolis; (E) Suruca; (F) Boquira; (G) Nova Redenção; (H) Fazenda Coqueiro; (I) Ambrósia; (J) Bonsucesso; (K) Morro Agudo; (L) Vazante; (M) Canoas; (N) Perau; (O)Caçapava do Sul; (P) Santa Maria.

● Zinc occurrences

HIGHLIGHTS

- Brazil has a notable potential to become a major producer of zinc and associated base metals, such as lead, associated with a variety of Precambrian mineral systems.
- One of Brazil's leading areas for zinc and associated metals is the Vazante-Paracatu Mineral Province, located northwest of the state of Minas Gerais, which forms a north-south trending belt approximately 250 km in length. It comprises two major zinc producing districts, the Vazante Zinc District and the Paracatu-Unaí Mineral District (Zn-Pb-Cu). 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 (ZnSiO4) hosted by pelite-carbonate rocks of the Vazante Group. Total resources are estimated at 19,68Mt @ 8,79% Zn. The Paracatu-Unaí Mineral District (Zn-Pb-Cu) hosts the Morro Agudo mine, where mineralization is associated with sulfides hosted by dolomites of the Vazante Group. Total resources in the Morro Agudo area are estimated at 16.87 Mt @ 3.61% Zn, 0.58% Pb.
- In the Southern Ribeira Belt, located in the states of Paraná and São Paulo, significant Zn and Pb production records are associated with Lajeado Group and Perau Formation rocks. Lead production began in the 1940s and was primarily associated with Lajeado Group carbonates. Within the Perau Formation area, the Perau and Canoa Sediments hosted Zn-Pb (Cu-Ag). Despite the lack of current production, the region has a favorable geological environment for new and significant discoveries.
- Aripuanã is a typical VHMS (Volcanogenic Hosted Massive Sulfide) polymetallic deposit located in the northwestern corner of the state of Mato Grosso. It is associated with Proterozoic bimodal volcanism. The deposit contains up to 1,500 kt of Zn, 540 kt of Pb, and 160 kt of Cu. It also contains 835k oz of Au.
- The Mesoproterozoic Nova Brasilândia Belt, located in northwestern Brazil, hosts occurrences of zinc, lead, copper and gold-rich gossans. The recently discovered Nova Brasilândia deposit, classified as Clastic Sedex with Broken Hill Type (BHT) affinity and hosting Zn-Cu-Pb mineralization, opens the possibility of defining a new polymetallic mineral district in the southern part of the Amazon Craton. In addition to defining a new polymetallic district, this discovery has the potential to contribute to an increase in Brazilian zinc production.

Selected Zinc deposits and resource estimates.

Deposit	Commodity	Owner	Estimated Resource	Grades (Zn)	Status
Aripuanã	Zn-Pb-Cu	Nexa Resources SA	41.5 Mt	2.4 %	Planned
Vazante	Zn-Pb-Ag	Nexa Resources SA	19.68 Mt	8.79 %	Producing
Morro Agudo	Zn-Pb-Ag	Nexa Resources SA	16.87 Mt	3.61 %	Producing
Bonsucesso	Zn-Pb	Nexa Resources SA	8.49 Mt	3.78 %	Feasibility
Nova Brasilândia d'Oeste	Zn-Cu-Pb	Mineração Santa Elina	6.2 Mt	6.84 %	Producing
Boquira	Pb-Zn-Ag	Metal Data Ltda.	5.6 Mt	1.43 %	Interrupted
Nova Redenção	Pb-Zn-Ag	SGB-CPRM	5.2 Mt	0.5 %	Early exploration
Palmeirópolis	Zn-Cu-Pb	Alvo Minerals	4.6 Mt	3.9 %	Exploration
Fazenda Coqueiro	Zn-Pb	CBPM	4.2 Mt	6.12 %	Feasibility
Ambrósia Norte	Zn-Pb	Nexa Resources SA	2.16 Mt	3.85 %	Interrupted
Ambrósia Sul	Zn-Pb	Nexa Resources SA	2.15 Mt	5.12 %	Interrupted
Canoas	Pb-Zn-Ag	Canoas	0.97 Mt	3.5 %	Closed
Perau	Pb-Ag-Zn-Cu	Perau	0.84 Mt	1.13%	Closed

RELEVANT PUBLICATIONS

LITHIUM

Favorability map for lithium pegmatite of the Borborema Pegmatite Province

Avaliação do potencial de lítio no Brasil - área: Província Pegmatítica da Borborema

O “Projeto Avaliação do Potencial do Lítio no Brasil” na Província Pegmatítica Oriental do Brasil: O Serviço Geológico do Brasil fomentando a pesquisa mineral

AGROMINERALS

Mapa de avaliação do potencial agromineral do Brasil: área Tocantins

Avaliação do potencial agromineral do Brasil: eixo Manaus – Boa Vista

Soil Fertilization and Maize-Wheat Grain Production with Alternative Sources of Nutrients

PHOSPHATE

Avaliação do potencial de fosfato no Brasil: investigação na Formação Jandaíra, Bacia Potiguar, municípios de Areia Branca e Guamaré, estado do Rio Grande do Norte

Avaliação do potencial de fosfato no Brasil – áreas Monte Alegre (PA) e Monte Dourado (PA), borda norte da Bacia do Amazonas

Avaliação do potencial de fosfato no Brasil, fase III: centro-leste de Santa Catarina

Avaliação do potencial de fosfato no Brasil, fase III: bacia Sergipe - Alagoas, área sub-bacia Sergipe, estado de Sergipe

GRAPHITE

Avaliação do Potencial da Grafita no Brasil

Ocorrência de Grafita na Faixa Araguaia, norte do Estado do Tocantins, municípios de Xambioá e Araguanã.

Mapa de favorabilidade para grafita - porção centro-leste, Província grafítica Ceará Central

MINERAL POTENTIAL MODELING FOR COPPER

Mapa de prospectividade mineral Cobre: Setor Aquiri, Província Mineral de Carajás (PA)

Mapa de prospectividade para cobre-ouro skarns - área Serra da Umburana, Província Borborema

Província mineral de Carajás, PA: controles críticos das mineralizações de cobre e ouro do lineamento Cinzento

Mapa de favorabilidade para cobre: área sudeste do Cráton Amazônico, subáreas 1 e 2

URANIUM

Mapa de avaliação do potencial de urânio do Brasil: escala 1:5.000.000

Avaliação da favorabiliade para depósitos de urânio no Brasil

REE

Mapa de prospectividade para ETR-Sn (F, In)-Ta-W-U Província Estanífera de Goiás

Avaliação do potencial de terras raras no Brasil

Geologia e avaliação do potencial para fosfato e elementos terras-raras da região de Campos Novos, Roraima

GOLD

Economia Mineral do Ouro

Mapa de favorabilidade para ouro orogênico: Quadrilátero ferrífero, setor central

Mapa de favorabilidade para ouro: Lineamento Tocantinzinho - Setor Oeste

Mapa de favorabilidade para ouro Oeste de Goiás

TUNGSTEN

Áreas de relevante interesse mineral (ARIM): evolução crustal e metalogenia da província mineral do Seridó: estados do Rio Grande do Norte e Paraíba

Access our website using the QR code or the link: sgb.gov.br

Access our PDAC hotsite using the QR code or the link: sgb.gov.br/pdac

Access the full list of deposits and references: https://1sh.co/geoportal

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UNITING AND REBUILDING