PDAC MARCH 3-6 2024 THE WORLD'S PREMIER MINERAL EXPLORATION & MINING CONVENTION

SGB GEOLOGICAL SURVEY OF BRAZIL

MAIN TECHNICAL APPROACHES IN GEOLOGY AND MINERAL RESOURCES

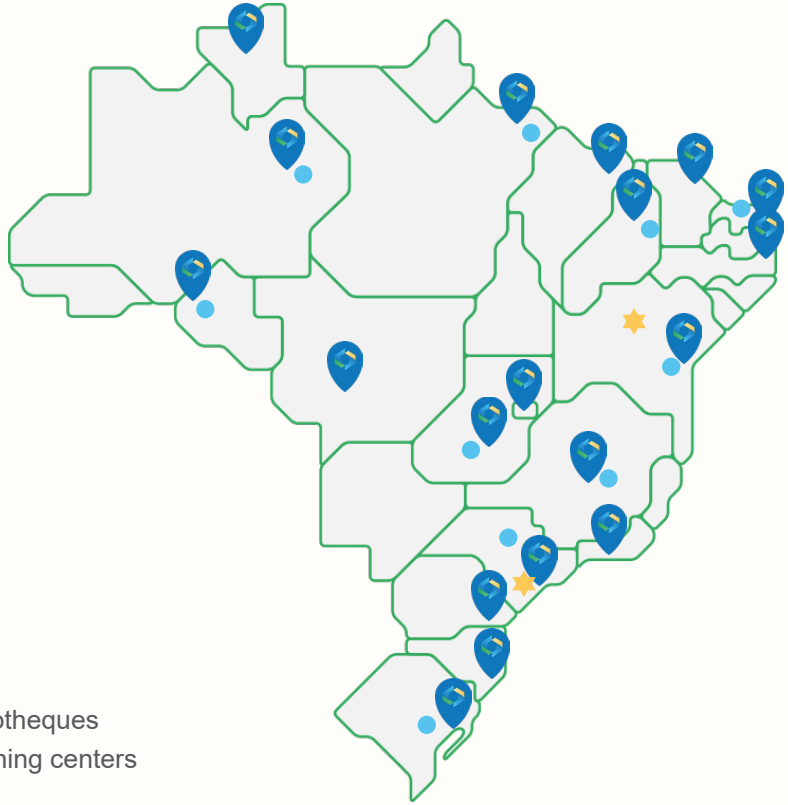
BRAZILIAN OPPORTUNITIES

WHO WE ARE

We are a state institution with **Geological Survey** attributions, under the auspices of the Ministry of Mines and Energy.

Our mission is to **generate and disseminate geoscientific knowledge with excellence, contributing to the improvement of the quality of life and sustainable development in Brazil.**

WHERE WE ARE



- Lithotheques
- Training centers

HEADQUARTER

Brasília

ADMINISTRATIVE OFFICE

Rio de Janeiro

8 REGIONAL OFFICES

Belém, Belo Horizonte, Goiânia, Manaus, Porto Alegre, Recife, Salvador e São Paulo

3 SUPPORT OFFICES

Fortaleza, Porto Velho e Teresina

7 REPRESENTATIVE OFFICES

Curitiba, Criciúma, Natal, Roraima, Cuiabá, São Luís, Palmas

MAIN AREAS OF EXPERTISE

Geology

Mineral Resources

Geological Hazard

Surface and Groundwater

SGB GEOLOGICAL SURVEY OF BRAZIL

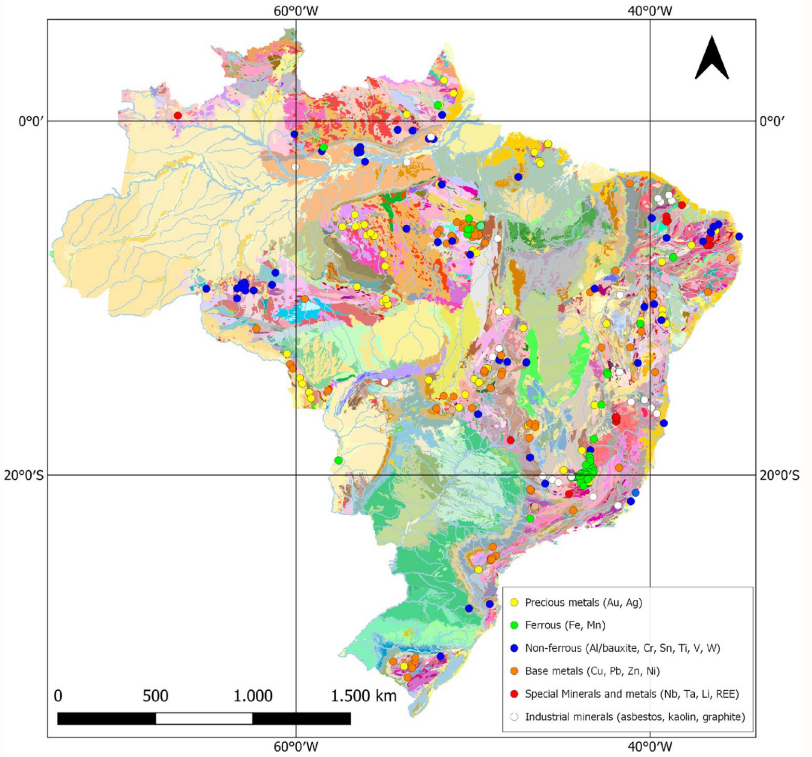
576 Researchers

- 134 PhD
- 366 MsC

BRAZILIAN GENERAL GEOLOGICAL CONTEXT

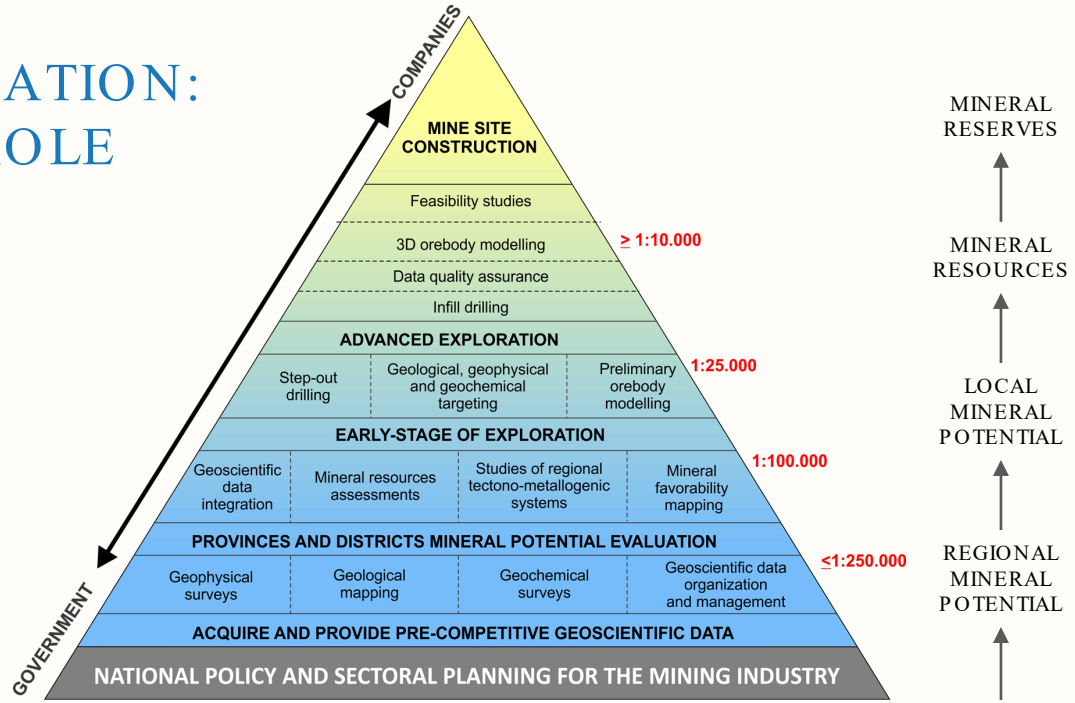
Diversity of geological and tectonic settings

- Granite -greenstone Au, Ni, Fe, Mn, Cu, Pb, Zn
- Magmatic arcs and associated basins Cu, Au, Mo, W
- Mobile belts Au, Ag, graphite
- Continental rifts Sn, Cu, Au, Ni, Zn, Bi, U, REE
- Ophiolites and mafic -ultramafic plutons Ni, Co, Cr, Ti, V, Cu, PGE
- SLIP Silicic Large Igneos Provinces Au, Cu, Mo, W, Sn, Bi, U, REE
- Intracratonic sedimentary basins P, K, coal, U
- Intraplate alkaline magmatism REE, U, P



GEOSCIENTIFIC KNOWLEDGE GENERATION: THE GOVERNMENT ROLE

- Integrated national geoscientific dataset
- Regional studies of mineral resources to identify areas with high potential to host ore deposits
- Continuous programs of systematic geological mapping and geoscientific data acquisition

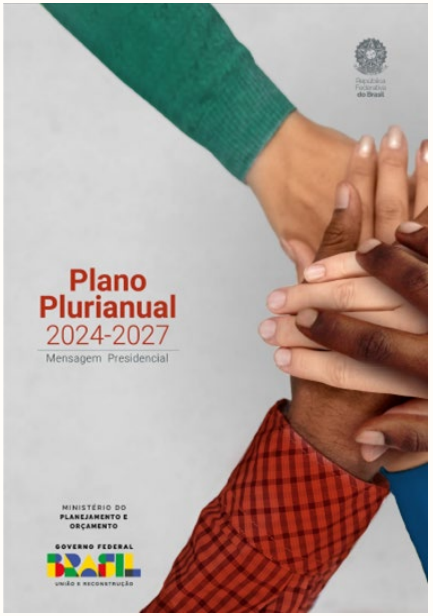


*Inspired by Geoscience Australia (2014)

POLICIES AND PLANNING FOR THE MINING INDUSTRY

Long -term Nacional Mining Plan (2011-2030)

Preparatory studies for the long-term Nacional Mining Plan (2022-2050)



Medium -term Government Plan Plurianual Plan 2024-2027

PLURIANUAL PLAN 2024-2027

SAFE AND SUSTAINABLE MINING PROGRAM

GENERAL GOAL: Create, in the Brazilian mining sector, an environment oriented towards sustainability, energy transition, public safety and attractiveness for investments .

FEDERAL BODIES INVOLVED: MME, ANM, INB S/A, Geological Survey of Brazil

LINKED WITH SUSTAINABLE DEVELOPMENT GOALS - SDGS

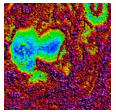
THEMATIC AXES

- COMPETITIVENESS OF THE BRAZILIAN MINING SECTOR
- MINERALS FOR THE ENERGY TRANSITION
- MINERAL RESOURCES FOR FOOD SECURITY

TECHNICAL PROGRAMS OF THE GEOLOGICAL SURVEY OF BRAZIL IN THE "SAFE AND SUSTAINABLE MINING PROGRAM 2024-2027"

Geological Mapping

Geochemical Survey



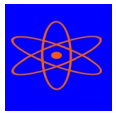
Airborne Geophysical Survey

Mineral Resources Potential of Metallogenic Provinces and New Exploration Frontiers

Regional Scale Geological-Geophysical Integration

Geoscientific Database

Minerals for Energy Transition



Radioactive Minerals

Mineral Resources for Food Security

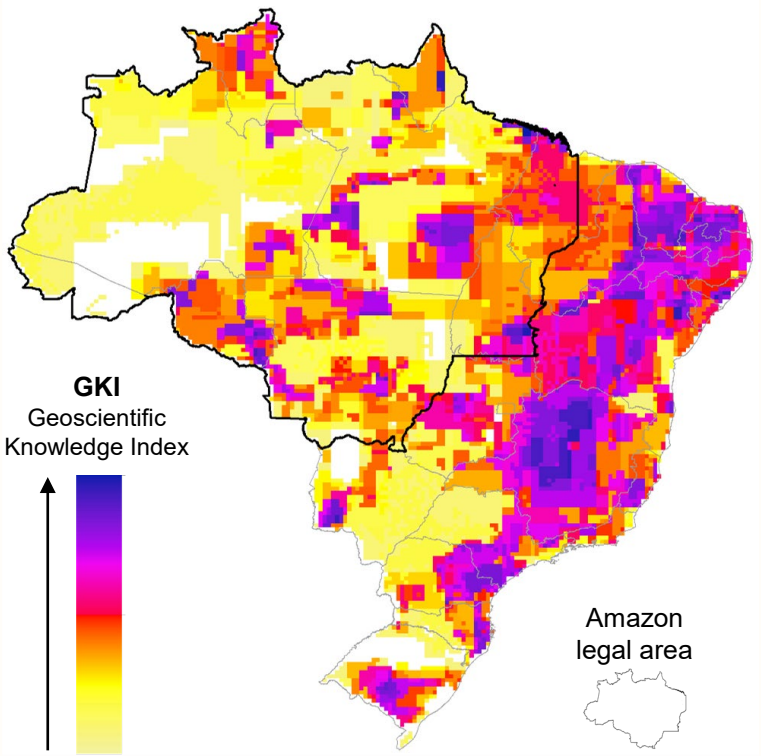
Mineral Asset Management

Industrial Minerals and Rocks

Mineral Intelligence

GEOSCIENTIFIC KNOWLEDGE IN BRAZIL

- Pre-competitive geoscience information to grow prospectivity;
- Reveal new opportunities;
- Reduce exploration risk and drive industry investment.



Queiroz et al. 2022

GEOLOGICAL MAPPING PROGRAM

Amazon legal area

% Mapping coverage Brazil

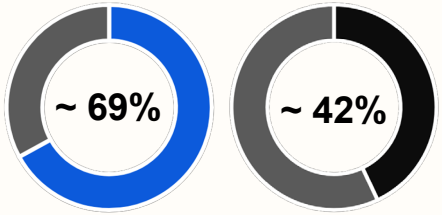
~ 49%

~ 27%

1:250 k

1:100 k

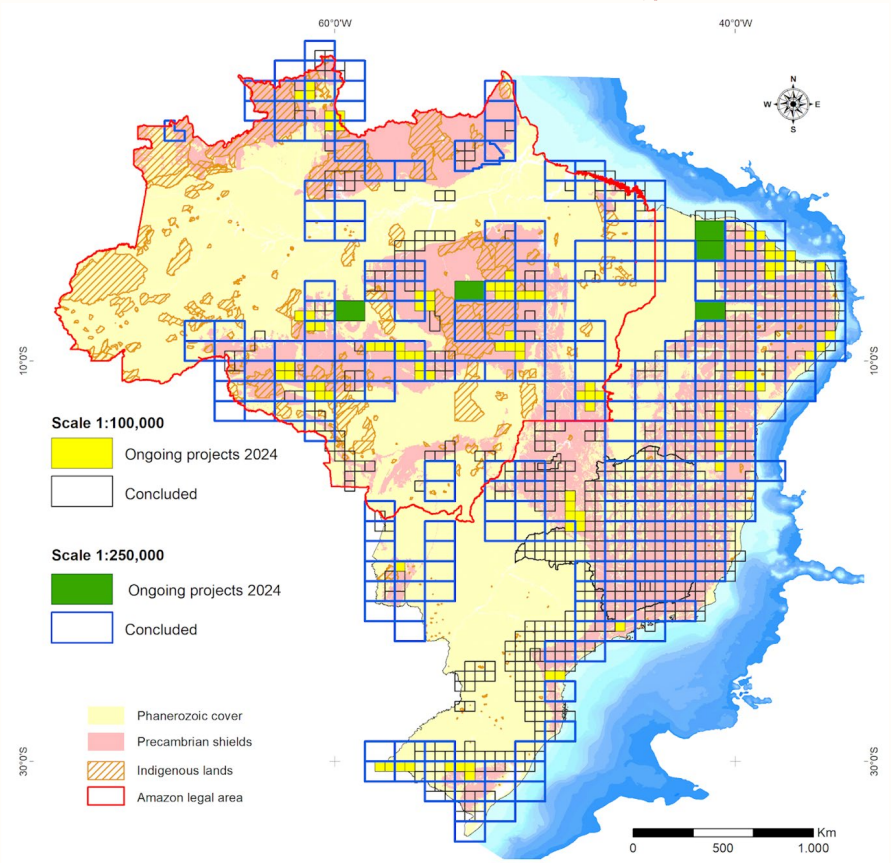
% Mapping coverage Precambrian shields



1:250 k

1:100 k

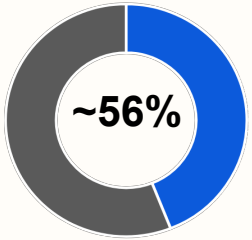
- Support to mineral exploration, academic studies, water resources research, and land management occupation .
- Priority for Precambrian Shields and areas of high mineral potential



GEOLOGICAL MAPPING PROGRAM

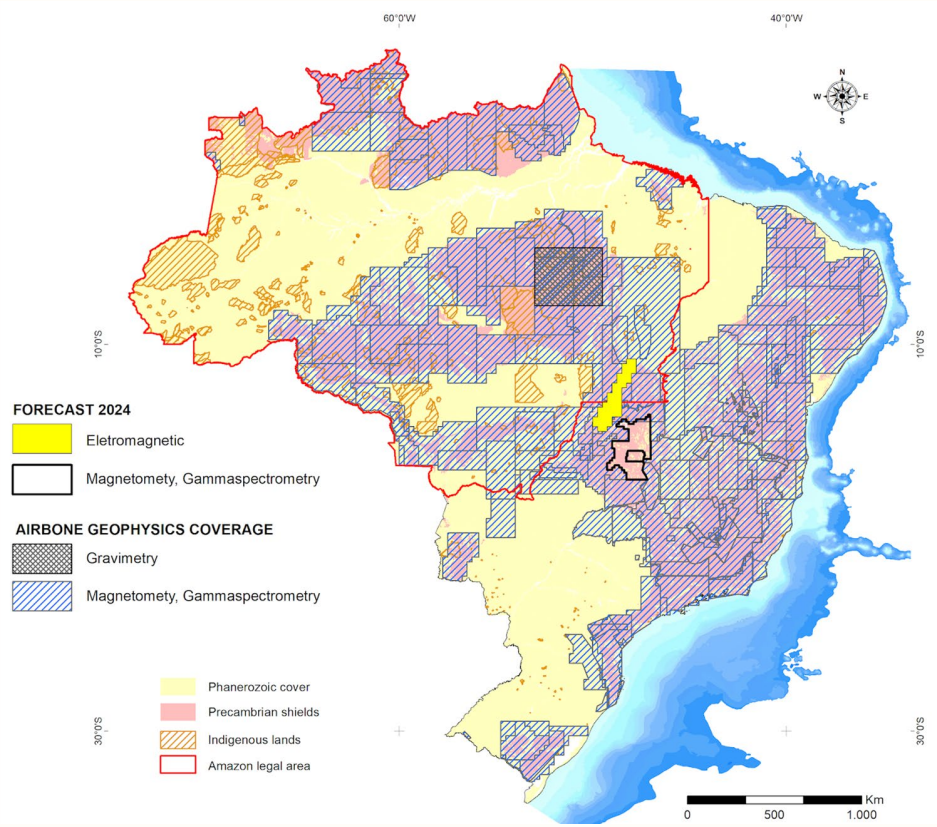
**** Flight line spacing:** 1,000 – 100 m*

% Magnetometric and radiometric coverage
Brazil

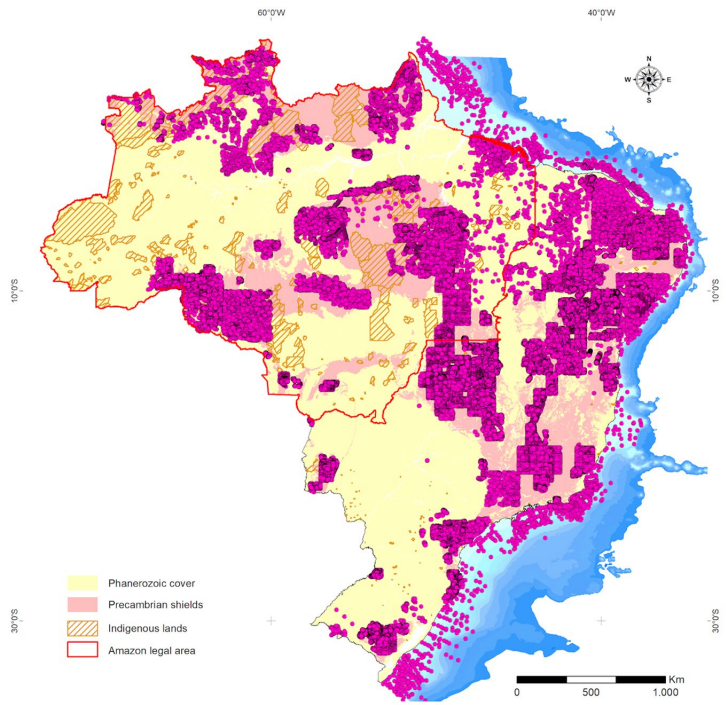


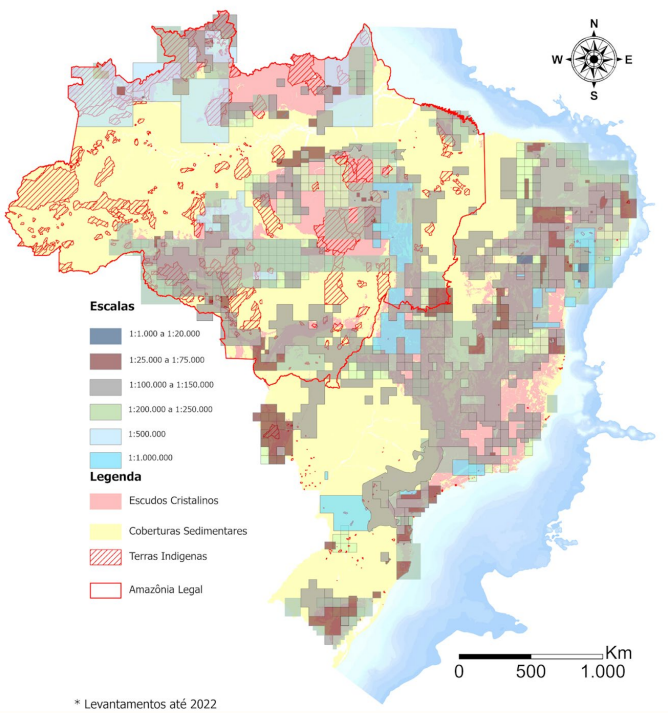
% Magnetometric and radiometric coverage
Precambrian shields

- Airborne magnetometric and radiometric surveys conducted between 2003 -2016
- Priority for Precambrian Shields and areas of high mineral potential
- Support to internal projects (geological mapping and prospective studies), academic studies and attract private investments in mineral research .
- Open -access database



GEOCHEMICAL SURVEY



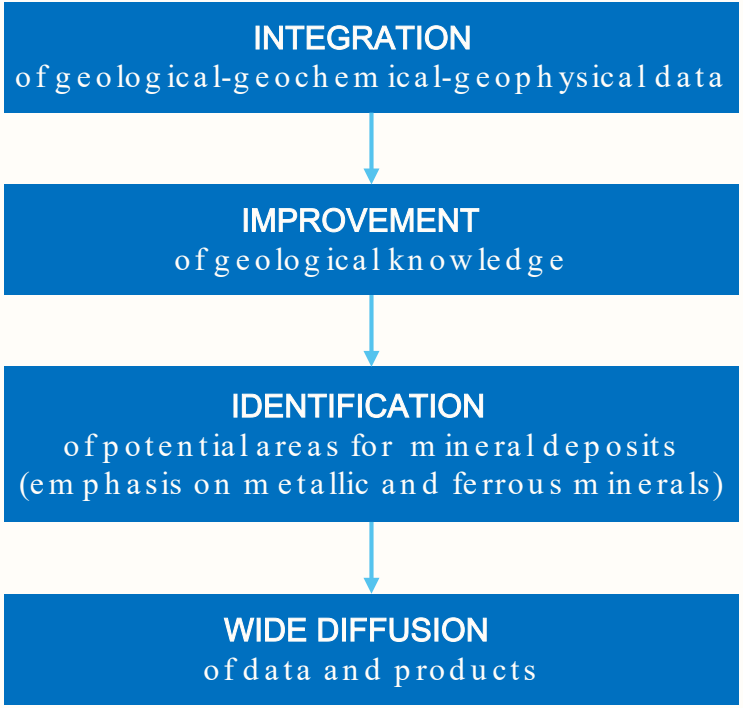


60 % of the Brazilian Territory with coverage at different scales (1:1.000.000, 1:500.000, 1:250.000,00, 1:100.000, etc).

390,035 geochemical samples available in GeoSGB (https://geosgb.sgb.gov.br)

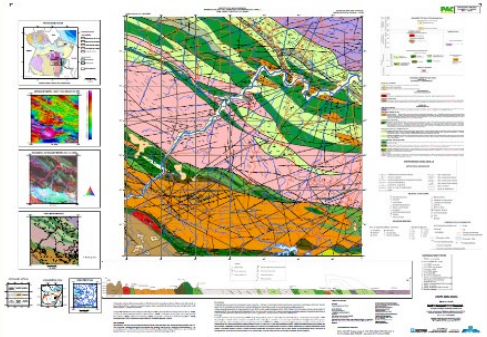
INTEGRATED STUDIES IN MINERAL PROVINCES AND AREAS OF HIGH POTENCIAL TO NEW DISCOVERIES

- Systematic geological mapping
- Prospective geochemical surveys
- Terrestrial geophysical surveys
- Geological-geophysical-geochemical integration
- Metallogenetic studies in potential targets
- Mineral favorability evaluation
- Application of geotechnologie (e.g. predictive mapping, 3D modeling)

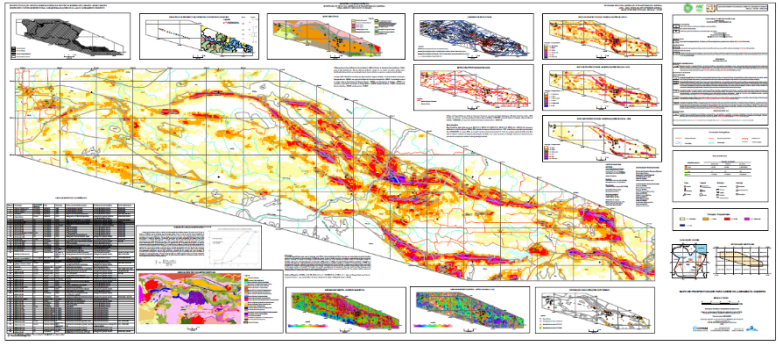


INTEGRATED STUDIES IN MINERAL PROVINCES

Geological mapping 1:100,000

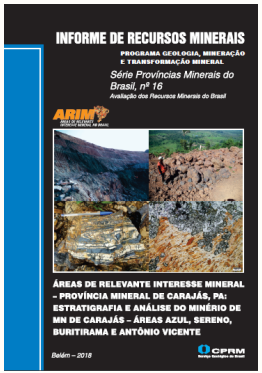


Favorability map of Cinzento Belt (Cu-Au IOCG deposits)

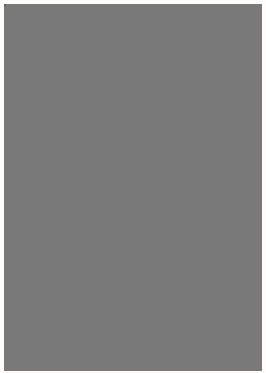


e.g. outcomes of Carajás Project

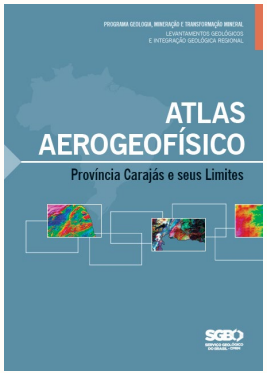
Stratigraphic controls of Mn mineralization



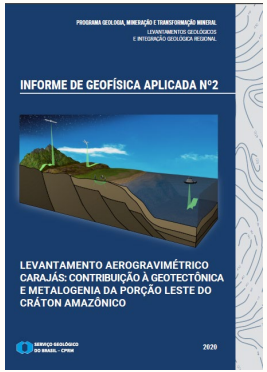
Geochemical Atlas



Geophysical Atlas



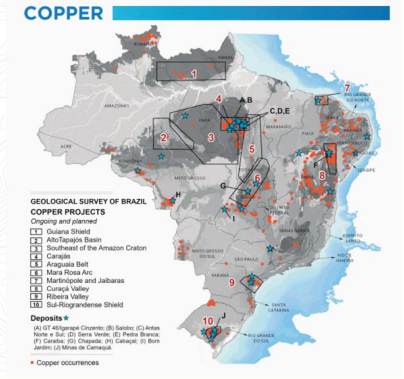
Gravimetric airborne data supporting geotectonic and metallogenetic interpretations

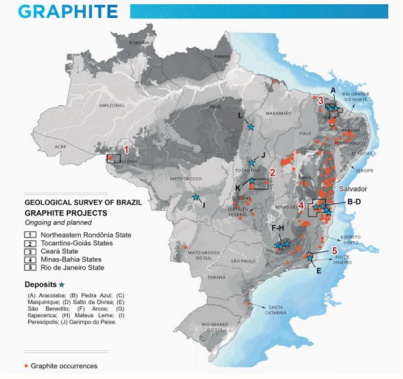


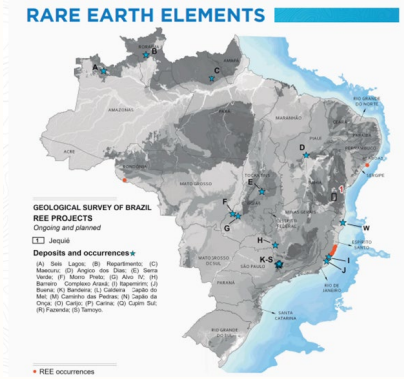
Predictive lithological mapping through machine learning

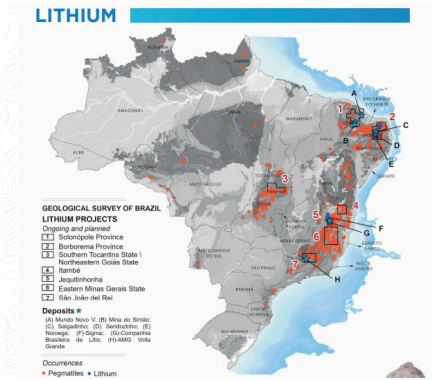
CRITICAL MINERALS FOR ENERGY TRANSITION

ONGOING PROJECTS





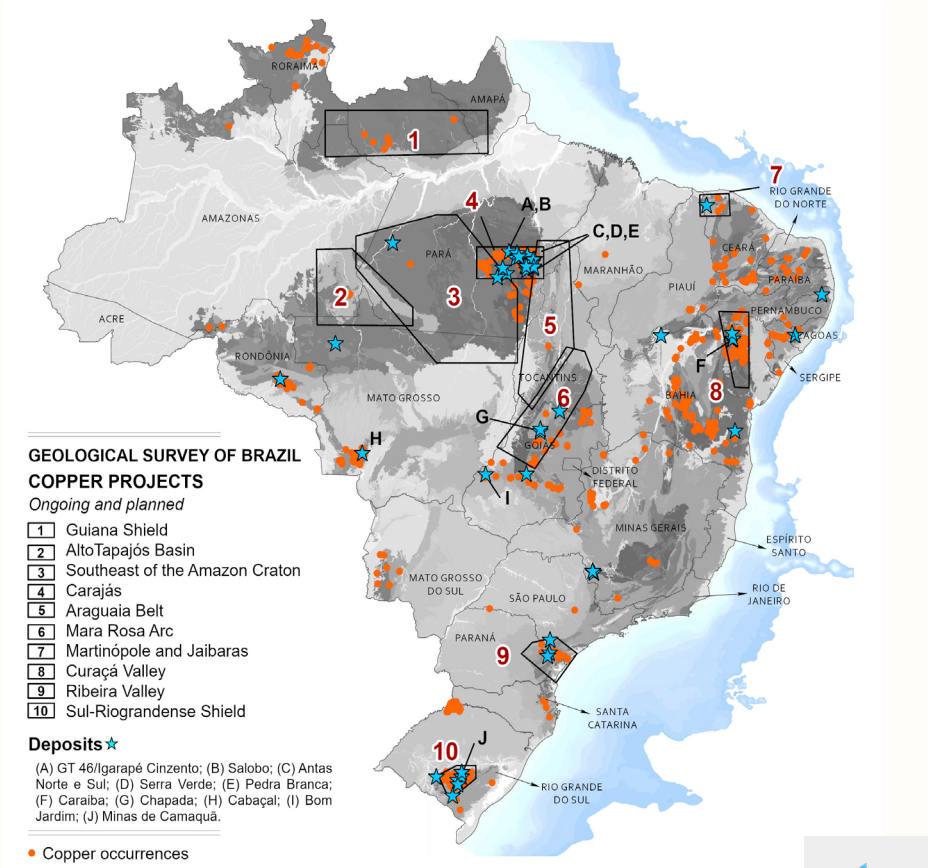




- Multi -scale mineral potential modeling (continental-provinces-districts-deposits favorability maps
- Integration of different dataset (geological-geophysical-geochemical)
- Review/proposition of metallogenetic models
- Identification of footprints or exploration guidelines for deposits and mineral systems
- Evaluation of non-conventional resources

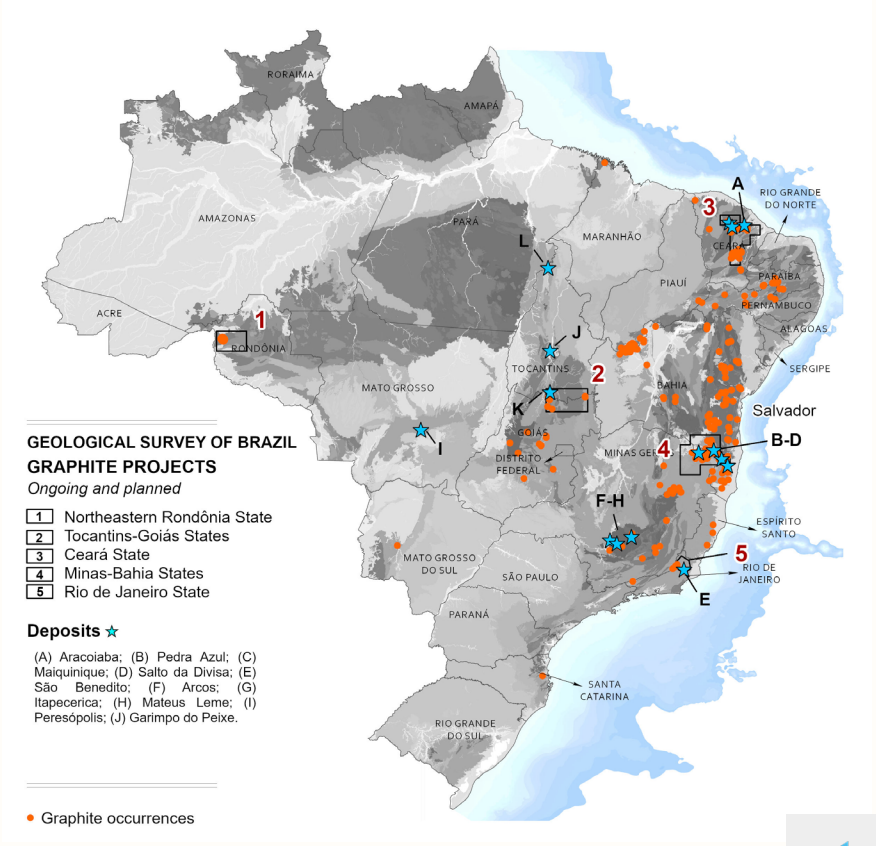
COPPER

- Brazil has around 30 copper deposits and advanced projetcs
- Mainly IOCG, Magmatic Segregration and VMS deposits, minor participation of Porphyry System
- Brazil's copper mineral potential lies almost entirely in Precambrian domains (Carajás, Juruena-Teles Pires, Vale do Curaçá, Goiás Magmatic Arc)



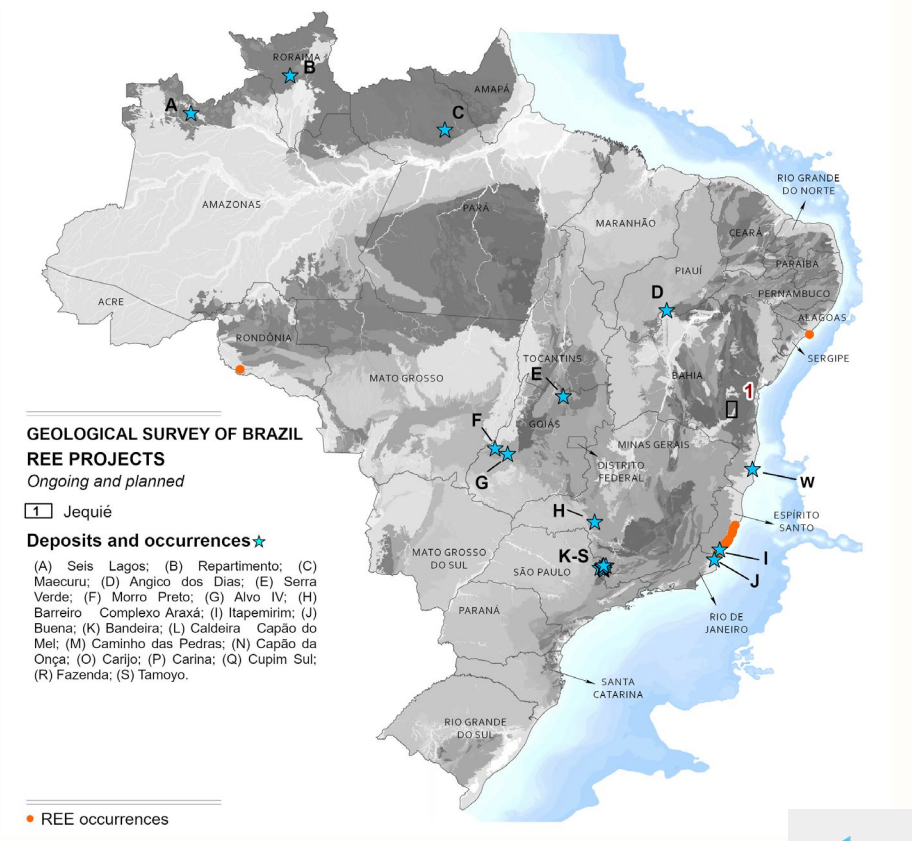
GRAPHITE

- Brazil has significant potential for the production of graphite, a mineral widely used in various industries
- Graphite occurs mainly confined to metamorphic environments
- Occurs mainly as “Flake,” with minor reserves declared of “disseminated” type
- The Brazilian government has an interest in developing the country’s graphite production, and investment in the sector is expected to increase.



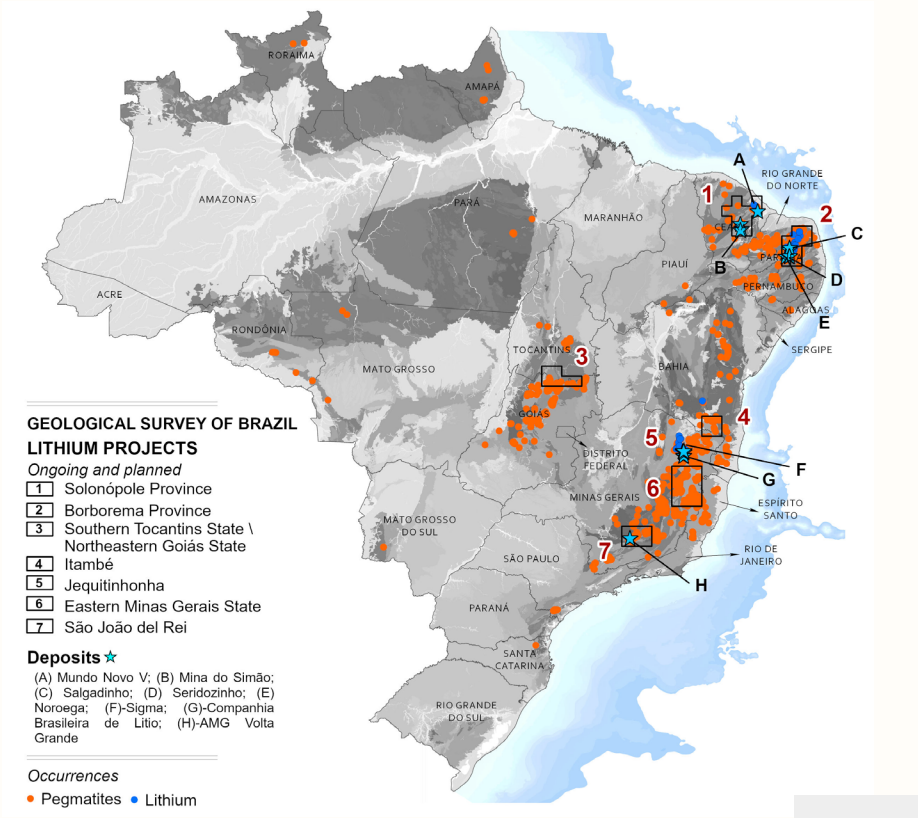
RARE EARTH ELEMENTS

- Brazil is the third country with the largest Rare Earth Elements (REE) reserves (USGS, 2023)
- Total Produced REE 903 t (Fundação Gorceix, 2022)
- Most REE deposits in alkaline-carbonatitic intrusions
- A relevant deposit of IAD type/supergenic in central Brazil (300 Mt @ 0.15% TREO+Y)
- An increase in the REE production are expected for the coming years, with new operations beggining.



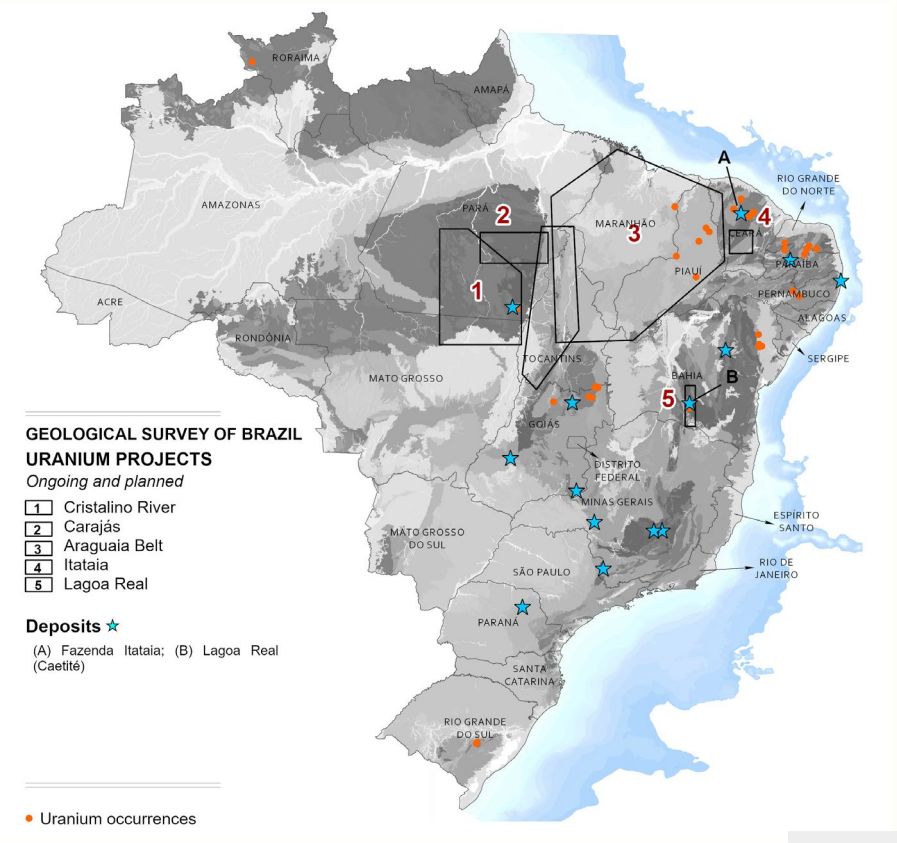
LITHIUM

- Lithium in Brazil occurs in Lithium-Cesium-Tantalum (LCT) pegmatite deposits
- In 2022, reported production reached 2,200 tonnes of contained lithium, a 29% increase over 2021 production (USGS, 2023)
- 7th largest reserve (Fundação Gorceix, 2022)
- 5th largest world's producer (Fundação Gorceix, 2022)
- Although Minas Gerais State leads the national production, there are several other potential areas (e.g., the states of Ceará, Rio Grande do Norte and Paraíba).



URANIUM

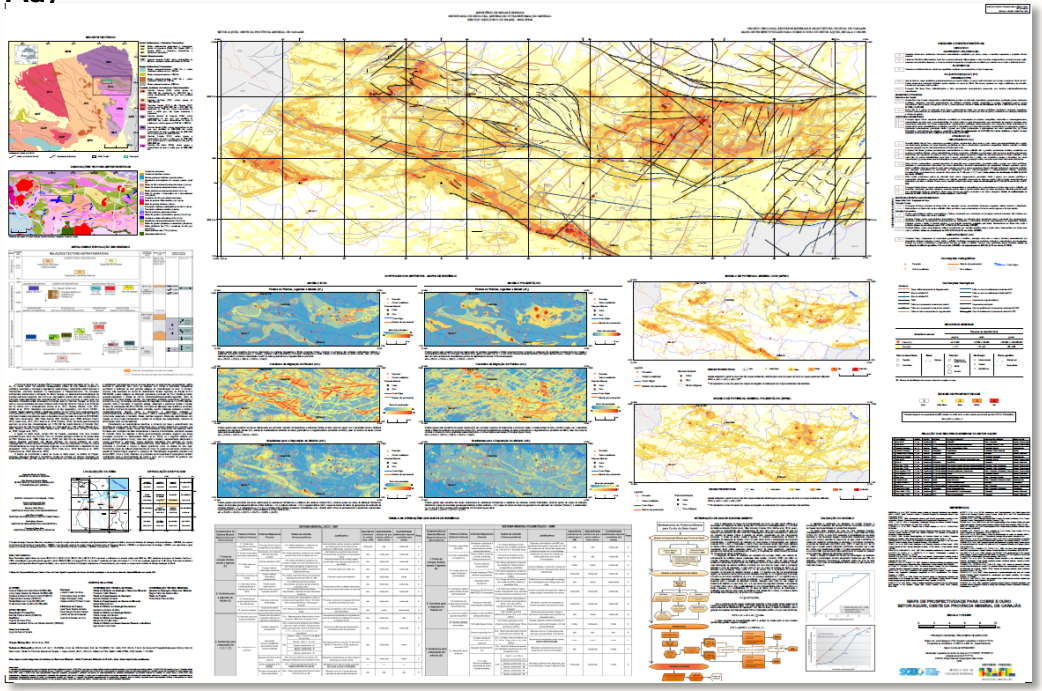
- Brazil currently has one of the largest uranium reserves in the world, with approximately 280 kt of contained uranium (U_3O_8), and the country has the potential to have one of the three largest reserves in the world
- Currently, only one operation in Caetité/Lagoa Real (production capacity of about 400 tons of U_3O_8/year)
- Several deposit types: Metasomatic (Lagoa Real), Archean Paleoplacer (Serra das Gaivotas), Paleoproterozoic Unconformity (Cristalino) and Associated with Phosphate (Itataia)
- 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.



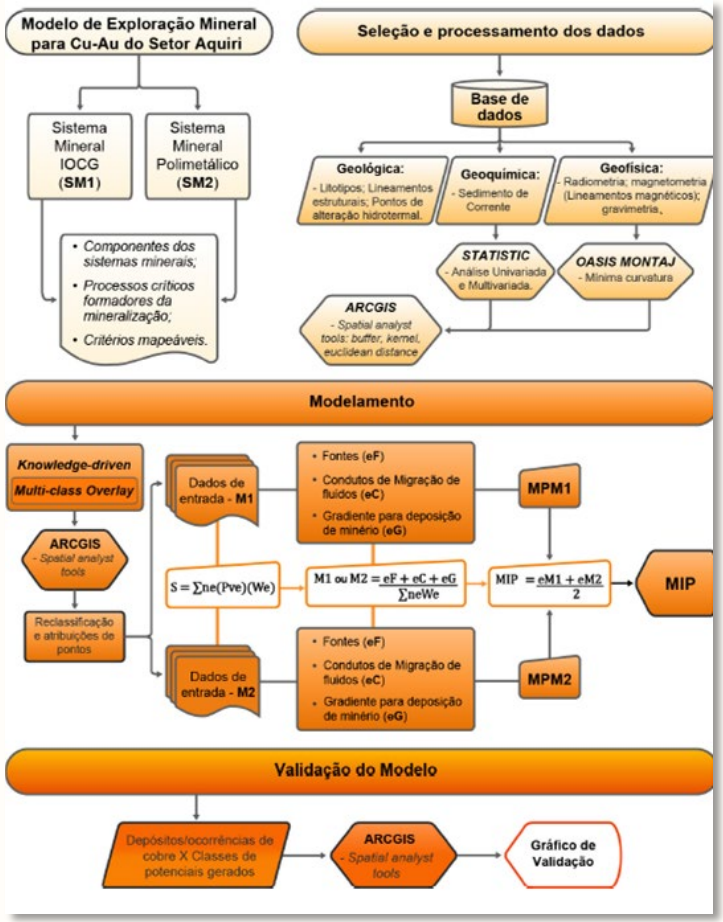
MINERAL POTENTIAL MODELING

COPPER

Favorability map of Aquiri area, Carajás Province (Cu - Au)



Silva et al. (2023)

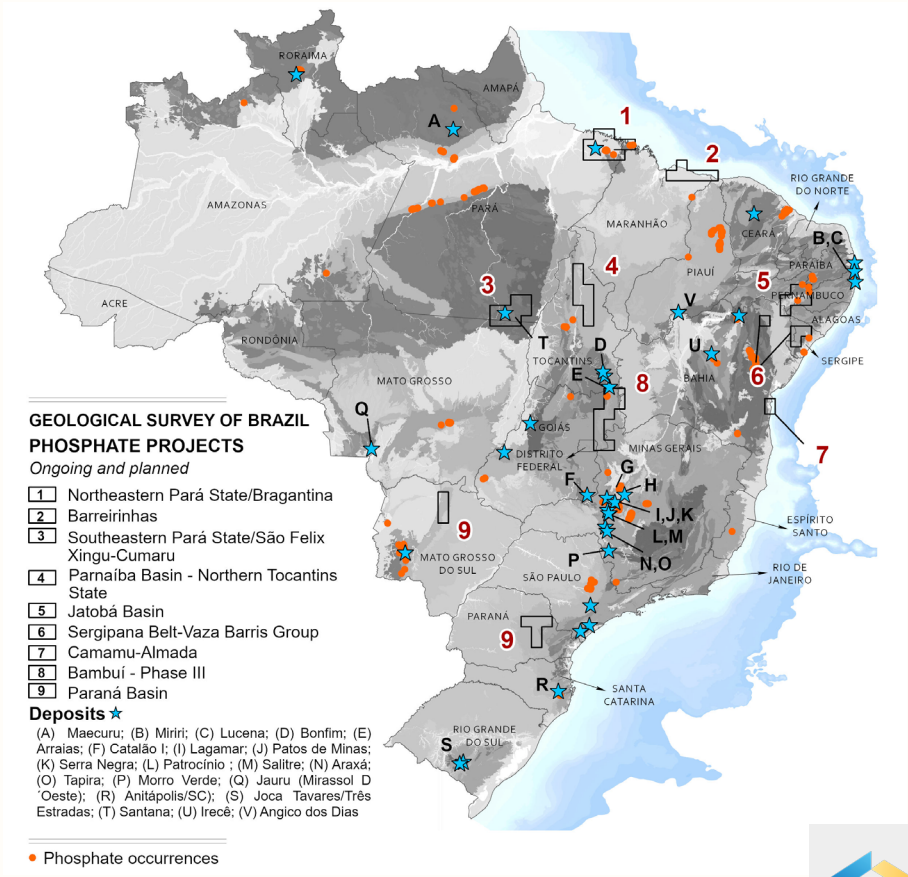


STRATEGIC MINERALS FOR FOOD SECURITY

ONGOING PROJECTS

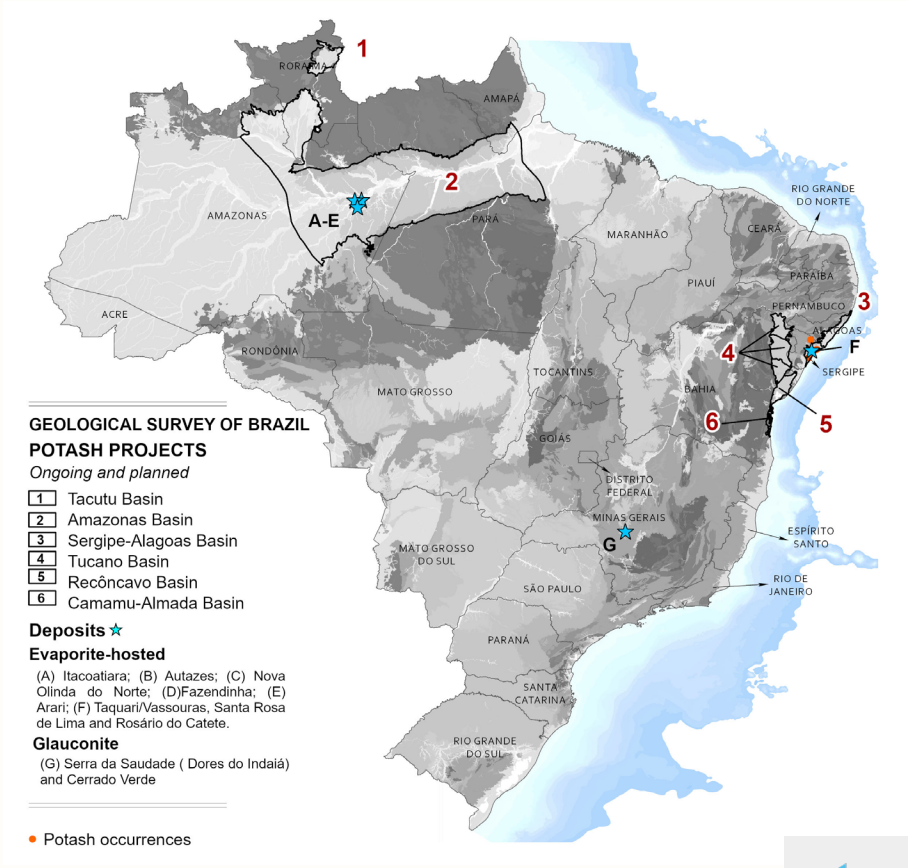
PHOSPHATE

- Brazil has the potential for the occurrence of phosphate deposits of both igneous and sedimentary origins.
- 3rd largest reserve (Fundação Gorceix, 2022)
- 3rd largest producer (Fundação Gorceix, 2022)
- Brazilian reserves are mainly associated with alkaline rocks but have unexplored potential in several basins for sedimentary phosphate
- Almost all production remains in the country for its croplands remediation (1st importer world ranking).



POTASH

- Brazil's main potential is associated with evaporite-hosted potash deposits of Lower Cretaceous and Permo-Carboniferous age.
- 12th world largest producer (255 kt, Fundação Gorceix, 2022), concentrated in Sergipe State
- 1st importer world ranking
- Other non-conventional sources of potassium are being developed in Brazil, such as glauconite-hosted potash in Minas Gerais State.



CRITICAL AND STRATEGIC MINERALS POTENTIAL OF BRAZIL

Discover the brazilian potential for critical and strategic minerals.

Explore how Brazil's mineral wealth can contribute to a low-carbon economy and food security.

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Access our PDAC hotsite: sgb.gov.br/pdac

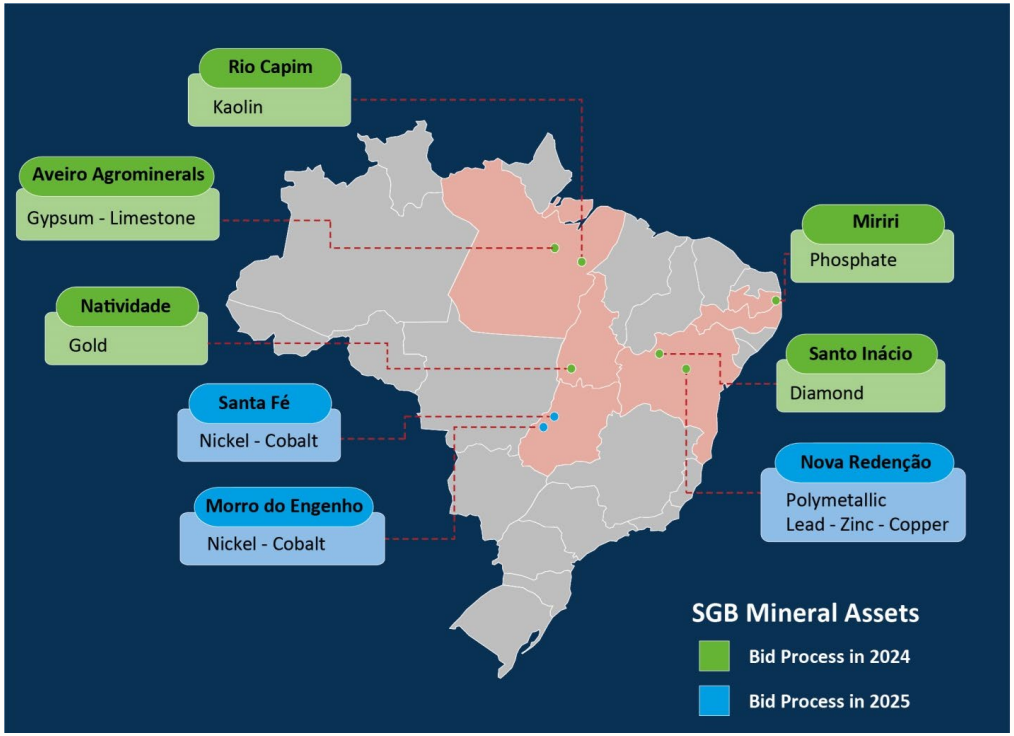
SGB GEOLOGICAL SURVEY OF BRAZIL

MINISTRY OF MINES AND ENERGY

BRAZILIAN GOVERNMENT
BRASIL
UNITING AND REBUILDING

MINING ASSETS FOR BIDDING 2024-2025

The Geological Survey of Brazil is set to auction assets from its mineral portfolio, offering new investment opportunities in the Brazilian mining sector.

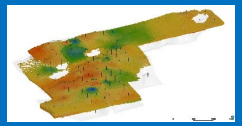


MINING ASSETS FOR BIDDING 2024-2025

The Geological Survey of Brazil is set to auction assets from its mineral portfolio, offering new investment opportunities in the Brazilian mining sector.

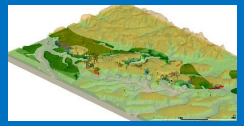
Rio Capim Project - Kaolin

- Total Resources 792.15 Mt @79.73% brightness
- Valuation concluded – Bidding in 2024



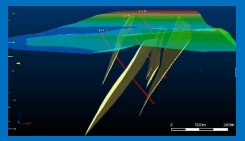
Miriri Project - Phosphate

- Total Resources 114.7 Mt @4.19% P_2O_5
- Valuation concluded – Bidding in 2024



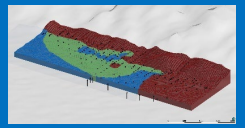
Natividade Project - Gold

- Total Resources 725 kt @1.02 g/t Au
- Valuation concluded – Bidding in 2024



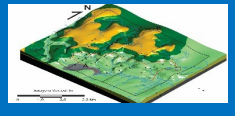
Santo Inácio Project - Diamond

- Total Resources 245 Mt @0.58 ctpht
- Valuation concluded – Bidding in 2024



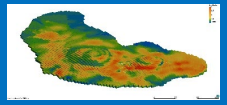
Aveiro Agrominerals Project – Limestone/Gypsum

- Total Resources 588 Mt Lim. @43% CaO / 681.43 Mt @89% Gyp.
- Valuation concluded – Bidding in 2024



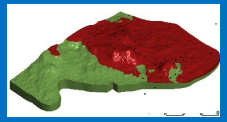
Morro do Engenho Project – Nickel - Cobalt

- Total Resources 65.95 Mt @1.07% Ni, 0.04% Co, 35.53 g/t Sc
- Valuation by independent consultancy in progress – Bidding in 2025



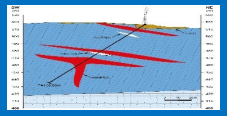
Santa Fé Project – Nickel - Cobalt

- Total Resources 45.56 Mt @1.17% Ni, 0.08% Co, 20.23 g/t Sc
- Valuation by independent consultancy in progress – Bidding in 2025



Nova Redenção Project – Polymetallic (Pb -Zn -Ag -Cd)

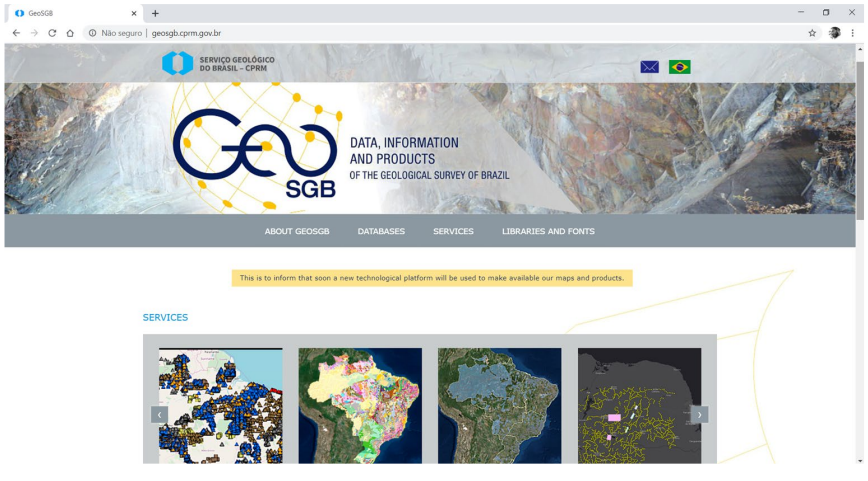
- Total Resources 3.2 Mt @2.7% Pb, 1.1% Zn, 15.4 g/t Ag, 20.1 g/t Cd
- Reassessment starting in 2024 – Bidding in 2025



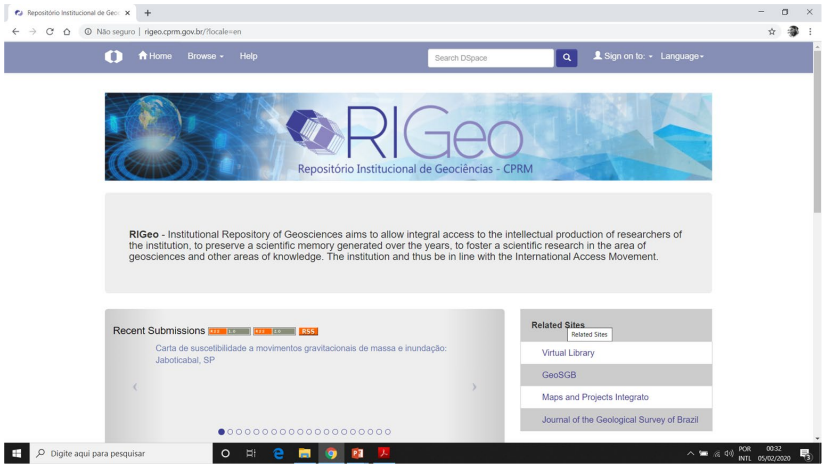
GEOSCIENTIFIC DATABASE

OPEN-ACCESS

Maps, GIS, technical reports, geophysical/geochemical/geological data, etc...



http:// geosgb.sgb.gov.br



http://rigeo.sgb.gov.br

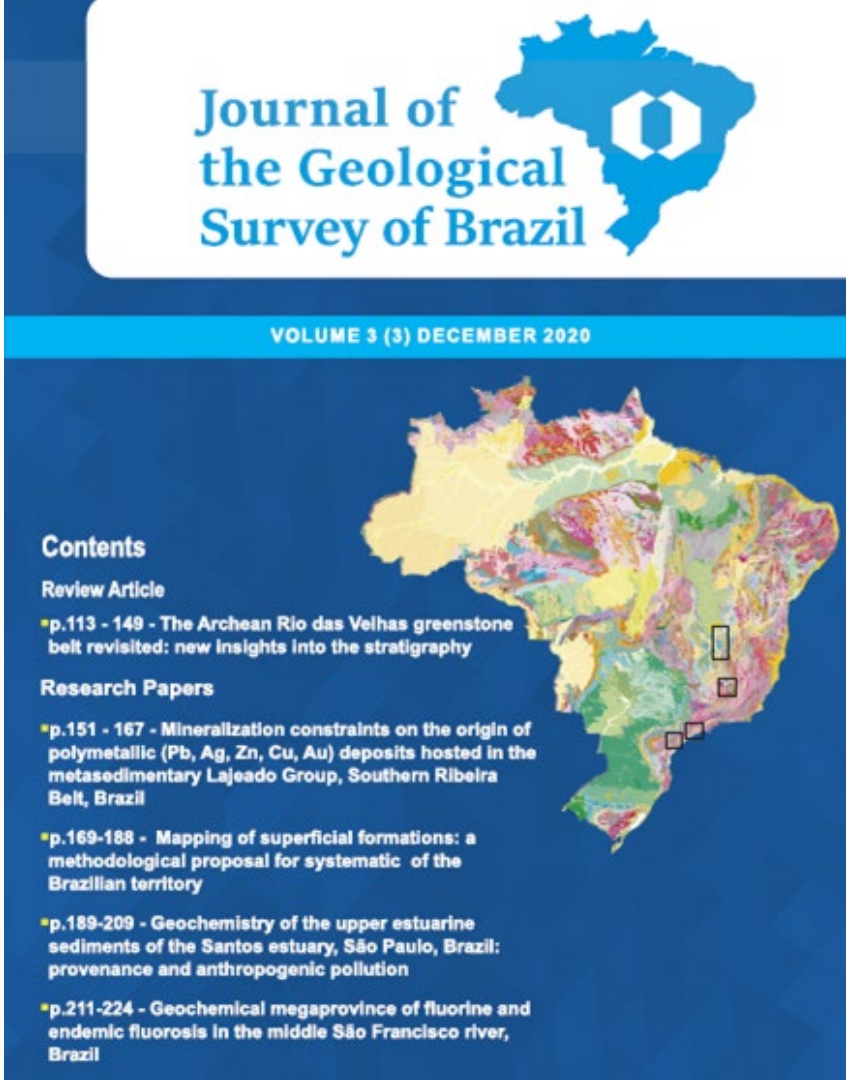
FINAL REMARKS

- **Several underexplored areas**
  to be developed
- **High potential for new discoveries**
  in main mineral provinces and districts
- **Recently discovered mineral systems**
  (e.g. Cu-Au magmatic -hydrothermal deposits in Juruena -Teles Pires Provinces)
- **Specialized workforce**
  available
- **Large pre -competitive database**
  available (public, free of charge)
- **Commited public sector**
  with the development of the mining industry

JOURNAL OF THE GEOLOGICAL SURVEY OF BRAZIL

- Peer -reviewed
- Open -access
- Published in April, August, and December

Link :
https ://jgsb.sgb.gov.br/



THANK YOU