

## Economic Viability and Global Market Competitiveness of Specific Minerals *Graphite Geoeconomic Profile*

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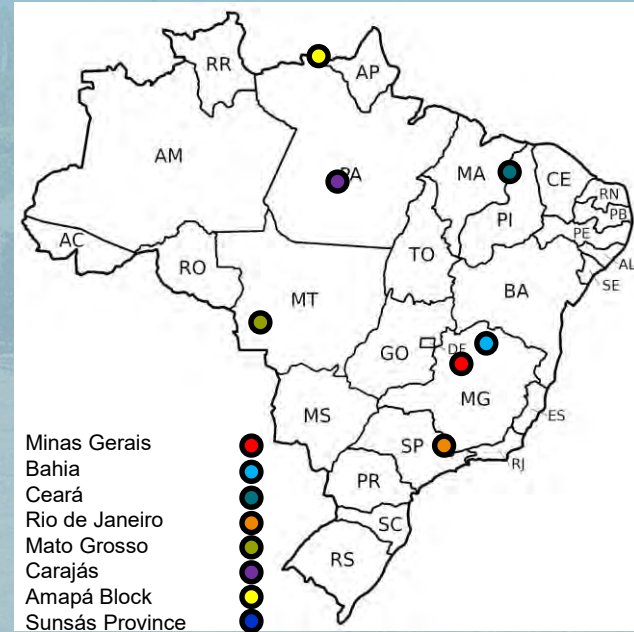
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# Graphite

- Brazil contains world-class graphite type deposits, being the third largest producer of this mineral good and holding the fourth largest global reserve of flake type graphite.
- The main deposits are found in Minas Gerais, Bahia, Ceará, Rio de Janeiro and Mato Grosso. In addition, there is great potential for graphite in the Amazon Craton, in the Carajás areas, in the Amapá Block and in the Sunsás Province.
- Venular graphites in Brazil were found in the graphite district of Araçoiaba - Baturité, in Ceará. In this example the graphite is hosted in Paleoproterozoic paragneisses of the Ceará Group.





# Graphite

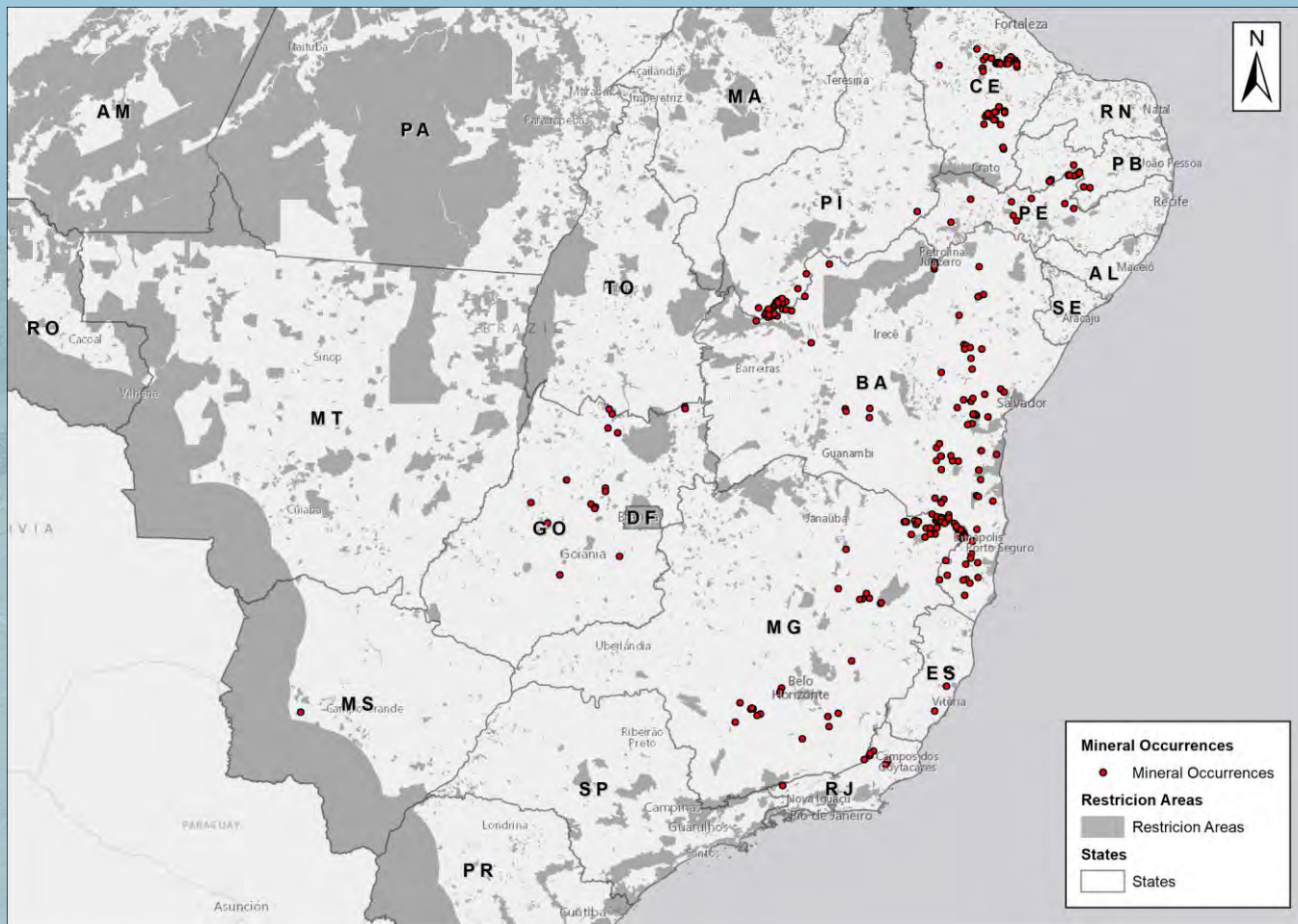
## Mineral Rights

States	Mineral Rights			Total
	Available	Exploitation	Exploration	
Bahia	5	9	206	220
Ceará	10	8	50	68
Goiás			3	3
Mato Grosso			1	1
Mato Grosso do Sul			2	2
Minas Gerais	5	68	95	168
Pará			3	3
Pernambuco	2		3	5
Piauí			6	6
Rio de Janeiro	3		2	5
São Paulo			12	12
Tocantins			3	3
<b>Total</b>	<b>25</b>	<b>85</b>	<b>386</b>	<b>496</b>

## Occurrences, Deposits and Mineral Production Units

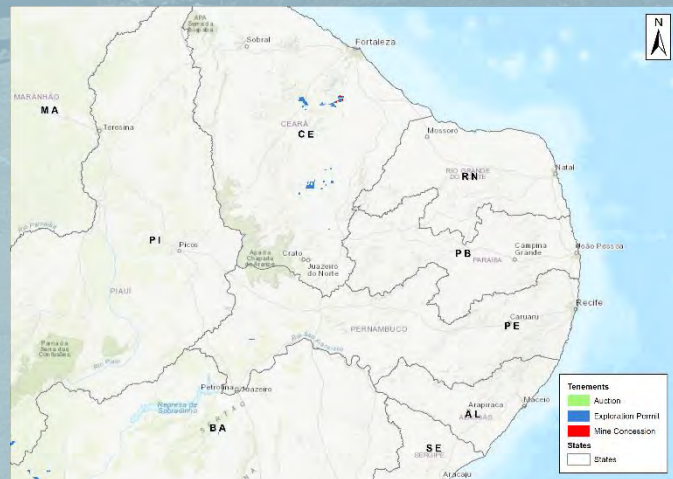
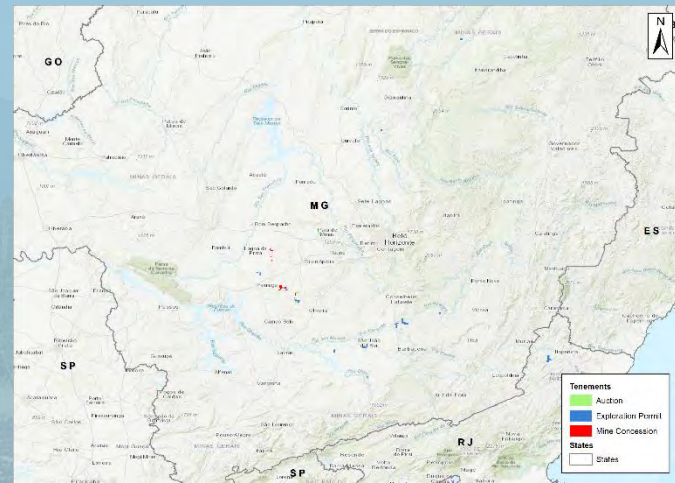
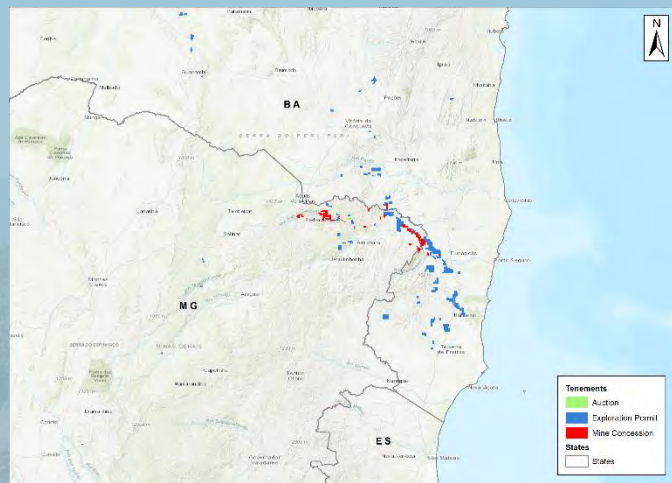
States	O, D, MPU
Bahia	96
Ceará	70
Espírito Santo	3
Goiás	16
Maranhão	2
Mato Grosso do Sul	1
Minas Gerais	122
Paraíba	10
Pernambuco	14
Piauí	41
Rio de Janeiro	8
Rio Grande do Norte	2
Santa Catarina	1
Tocantins	1
<b>Total</b>	<b>387</b>

# Graphite – Mineral Occurrences and Restriction Areas





# Graphite – Mineral Rights



# Graphite

## Resources & Reserves

Municipality	State	Reserves (in thousand tons)					
		Measured		Indicated		Inferred	
		Ore	C	Ore	C	Ore	C
Baturité	Ceará	17,333	1,040	0	0	0	0
Itapiúna	Ceará	576	22	113	3	0	0
Eunápolis	Bahia	1,467	14	0	0	0	0
Guaratinga	Bahia	3,136	313	5,727	572	0	0
Itabela	Bahia	0	0	0	0	0	0
Itagimirim	Bahia	0	0	0	0	0	0
Maiquinique	Bahia	6,901	641	6,183	575	10,306	958
Almenara	Minas Gerais	22,199	1,329	11,712	650	42,207	1,688
Cachoeira de Pajeú	Minas Gerais	218	43	0	0	0	0
Córrego Fundo	Minas Gerais	1,501	15	0	0	0	0
Itapecerica	Minas Gerais	4,542	600	347	46	0	0
Jordânia	Minas Gerais	751	49	2,623	172	2,422	159
Mateus Leme	Minas Gerais	4,793	602	4,965	623	6,227	780
Pedra Azul	Minas Gerais	11,756	925	3,0291	2,188	29,240	2,004
Salto da Divisa	Minas Gerais	61,007	3,082	7,158	357	0	0
São Francisco de Paula	Minas Gerais	0	0	19	1,980	60	6

Reserves =  $360 \times 10^3$  ton (flake)

Other indentified resources =  $3.400 \times 10^3$  ton (flake)



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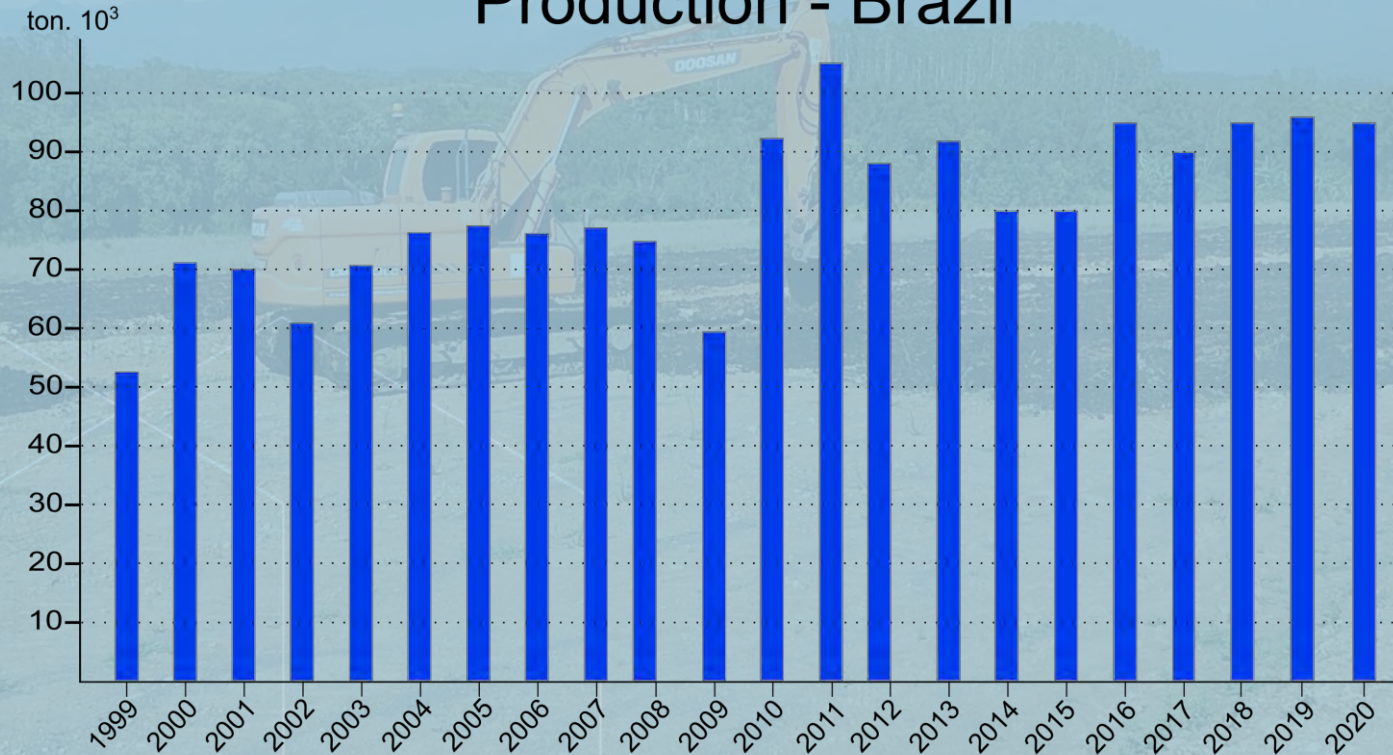
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# Graphite

## Production - Brazil



Source: (USGS, ROBINSON, JR.; HAMMARSTROM; DONALD, 2017; U.S. Geological Survey, Mineral Commodity Summaries, 2018/2019/2020)

# Graphite

## CFEM

States	R\$ thousand
Bahia	192
Minas Gerais	48,813
Pará	1
<b>Total</b>	<b>49.006</b>

Counties	R\$ thousand
Carmo da Mata - MG	2,076
Itapecerica - MG	11,029
Maiquinique - BA	192
Mateus Leme - MG	122
Pedra Azul - MG	23,269
Salto da Divisa - MG	12,317
São Geraldo do Araguaia - PA	1
<b>Total</b>	<b>49,006</b>



# Graphite

## *Mining Companies*

### Nacional de Grafite Ltda.

- Operating since 1939 - in its three plants (Itapecerica, Pedra Azul and Salto da Divisa), all located near important deposits in the state of Minas Gerais, Brazil - Nacional de Grafite processes the ore, generating about 80,000 tons per year of graphite with different characteristics and market specifications.



Plant - Pedra Azul-MG



# Graphite

## *Mining Companies*

- **Grafite do Brasil** (ex-Extrativa Metalquímica): started its exploitation and processing activity of high quality natural crystalline graphite in 2002, in the south of Bahia in the municipality of Maiquinique. Production capacity:  $\pm 20,000$  tons/ year.
- **Grafita MG Ltda.:** small production of amorphous graphite in Mateus Leme, near Belo Horizonte - MG
- **Mineração Grafite Pedra Azul Ltda.:** small production of amorphous graphite near Belo Horizonte - MG

## *New Projects*

- **Buxton Mineradora:** will own the only spherical graphite production unit in Brazil, which indicates technological pioneering, operating in the lithium-ion battery market.
- **South Star Mining:** acquired Grafite Brasil, Santa Cruz Project - Capim Grosso - BA



# Graphite

## *Potential new entrants*

- Brasil Grafite Mineração Ltda - southeast of Bahia
- Cbg Mineração S A - north east of Minas Gerais and southeast of Bahia
- Cia de Ferro Ligas da Bahia Ferbasa - northwest of Bahia
- Columbia Exploração Mineral Ltda. - northeast of Minas Gerais and southeast of Bahia
- Companhia Baiana de Pesquisa Mineral CBPM - Bahia
- G 4 Esmeralda – northwest of Bahia
- Lara do Brasil Mineração Ltda. - Ceará
- Magnesita Refratarios S.A - northeast of Minas Gerais and southeast of Bahia
- Nacional de Grafite Ltda - center and northest of Minas Gerais and southest of Bahia
- Valter Monaco Conceicao Filho - north east of Minas Gerais
- Viva Companhia de Mineração S A - northeast of Minas Gerais and southeast of Bahia

# Graphite

## *Market*

- **Portable Energy:** Brazilian producers of graphite supply inputs on the national and world market in the production of batteries and energy accumulators.
- **Steel:** Brazilian steel production, around 40 M t/year, uses graphite as fuel. Uses in the steel industry: refractories, foundry, carbon aditice, eletrodos, escória espumante.
- **Refractories:** Brazil stands out in the production of refractories with the company Magnesita S.A, a large supplier in the refractory products worldwide market.
- **Abrasives:** Automobile manufacturers.
- **Agriculture:** The use of graphite as a seed lubricant has been developing rapidly in the country.
- **Polymers:** Fire retardant and other applications
- **Graphene:** New technological routes that are emerging suggest broad prospects for the expansion and verticalization of the Brazilian production of graphite.



# Graphite

## *Typical Substitute and Competitor*

- Petroleum Coke

## *Typical Consumers*

- |                 |              |
|-----------------|--------------|
| • ArcelorMittal | • Marubeni   |
| • Autometales   | • Matsushita |
| • C. Lorraine   | • Maxion     |
| • Denaven       | • Rima       |
| • Duracell      | • Schulz     |
| • Eurerf        | • Sony       |
| • Eveready      | • Spectrum   |
| • Graphitas     | • Sudametal  |
| • Magnesita     | • Sumitomo   |
| • Matsushita    | • Teksid     |
| • Fras-Le       | • Thyssen    |
| • Gerdau        | • Tupy       |
| • James Durans  | • Vesuvius   |
| • Mahle         | • WHB        |



# Graphite

## *Important Scientific and Technological Initiatives*

- **MacGraphe:** Operated by Mackenzie University, MacGraphe was opened in 2016. It is a scientific and technological center that develops research and rent services in the area of nanomaterials and nanotechnologies directed to the two-dimensional materials.
- **CODEMGE:** invests in a project in partnership with UFMG and CDTN – the MGgrafeno Project, which has as its main objectives the development of a technology for the production of high-quality, low-cost graphene, in a reproducible and scaled manner.
- **UCSGRAPHENE:** first Latin America graphene industrial plant, in production since march/ 2020. It has been developed and is operated by the UCS (Caxias do Sul Catholic University). It counts with the expertise developed in 15 years of research in the nanomaterials area.



# Government Policies

## *Important points*

- **Pro-Strategic Minerals:** Decree 10.657, of March 24th, 2021 - Institutes the Policy to Support the Environmental Licensing of Investment Projects for the Production of Strategic Minerals. It provides qualification under the Investment Partnership Program of the Presidency of the Republic and creates the Interministerial Committee for the Analysis of Strategic Minerals Projects.
- Art. 2 The mining investment projects may be qualified in the Pro-Strategic Minerals Policy, upon request of the project holder, according to the following criteria:
  - I - mineral good of which the Country depends on importation in high percentage for the supply of vital sectors of the economy;
  - II - mineral good that is important due to its application in high technology products and processes; or
  - III - mineral good that holds comparative advantages and that is essential to the economy by generating a surplus in the Country's foreign trade.

# Government Policies

## *Important points*

- Resolution n° 2, of June 18th, 2021 - Defines the list of strategic minerals for the country, in accordance with the criteria mentioned in art. 2 of Decree n° 10.657, of March 24, 2021.

I - Mineral assets on which the country depends on imports in high percentage to supply vital sectors of the economy: 1.sulfur; 2. phosphate ore; 3. potassium ore; and 4. molybdenum ore.

II - Mineral assets that are important for their application in high-technology products and processes: 1.**cobalt** ore; 2. copper ore; 3. tin ore; 4. **graphite** ore; 5. platinum group ores; 6. **lithium** ore; 7. niobium ore; 8. **nickel** ore; 9. silicon ore; 10. thallium ore; 11. tantalum ore; 12. **rare earth** ore; 13. titanium ore; 14. tungsten ore; 15. uranium ore; and 16. vanadium ore.

III - Mineral assets that have comparative advantages and that are essential to the economy because they generate a surplus in the country's trade balance: 1. aluminum ore; 2. copper ore; 3. iron ore; 4. **graphite ore**; 5. gold ore; 6. manganese ore; 7. niobium ore; and 8. uranium ore.





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