



CPRM
Geological Survey of Brazil

**New drivers to leverage the
mining industry in Brazil**

Eduardo Ledsham
May-2017

***EU-Latin America Dialogue on
Raw Materials***

MINISTÉRIO DE
MINAS E ENERGIA



Brazil: global player in the mining industry.

- Top three producer of Nb, Fe, bauxite, graphite, and kaolin and an important exporter of Sn, Ni, Mg, Mn, Cr, Au. There is abundant potential for much more.
- Gold, diamond and base metals production is rising, based on new discoveries and mining development.
- Most of the deposits are open pit with tremendous potential to develop underground projects.
- Brazil has the best quality iron ore in the world.
- Brazil has a solid professional and workforce, with knowledge and skills acquired during last decades and a track record of developing and operating competitive mining projects.

New investments should move Brazil into the 5 top producers

	Brazil	Canada	Australia
Area (10^6 km^2)	8,5	9,1	7,7
Precambrian shield (10^6 km^2)	3,6	1,2	2,5
Productivity Au kg/km ²	0,9	3,4	5,7
Exploration Expenditure, 2012-2016 (US\$ B)	2,6	9,0	8,4

Source: Arantes; Mackenzie 1195; SNL/MEG 2017

CPRM - The Geological Survey of Brazil:

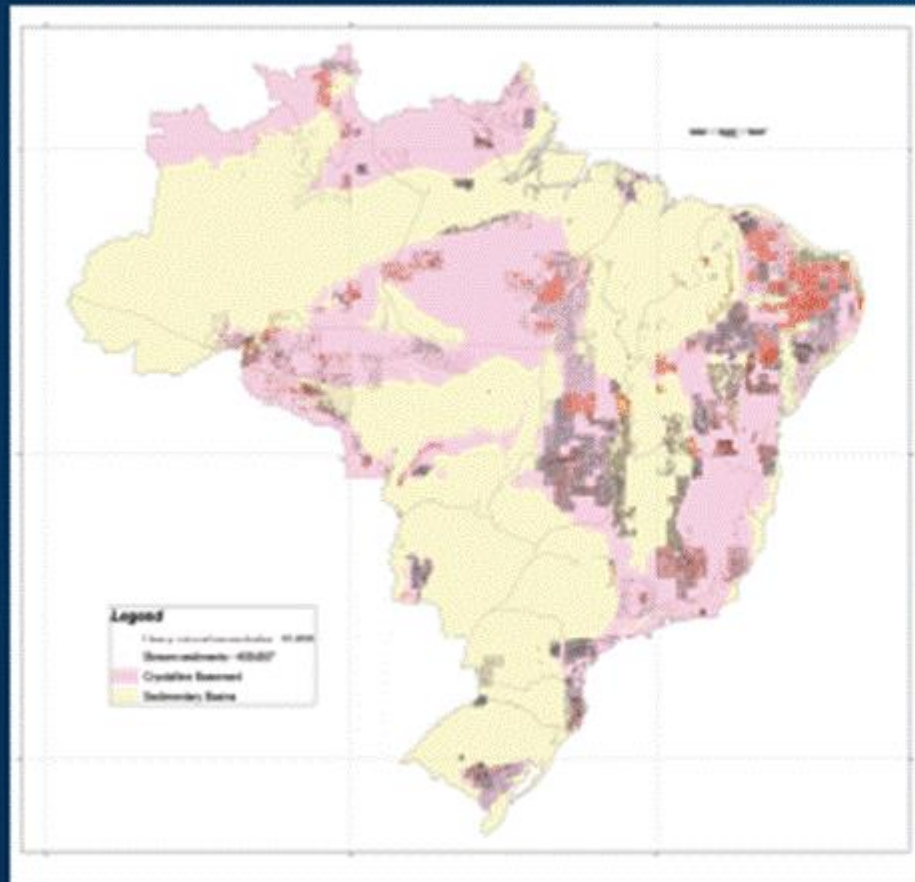
New drivers to leverage the mining in Brazil

- Top priorities adding value to society:
 - Generation of opportunities for mining investments
 - Management of surface and subsurface water resources
 - Mapping to mitigate land risks
- Continuous government investments in geological, geochemical and airborne geophysical survey in new frontiers
- New technologies, including high-resolution airborne geophysical survey over the main mineral districts
- Free-access to all CPRM database: geology, geochemistry, geophysics and mineral resources
- Adding value to the mineral exploration sector, establishing new concepts and ideas
- Farm out of all CPRM mineral assets - PPI program

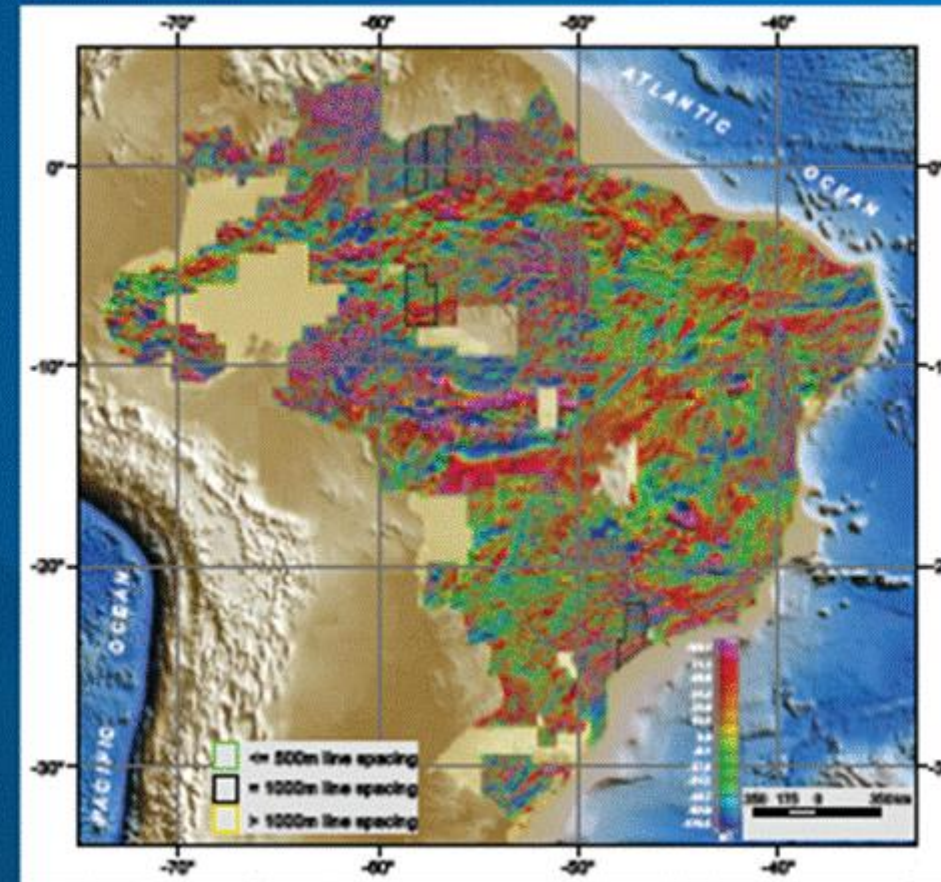
CPRM: Creating Value and Generating Opportunities

Free access database

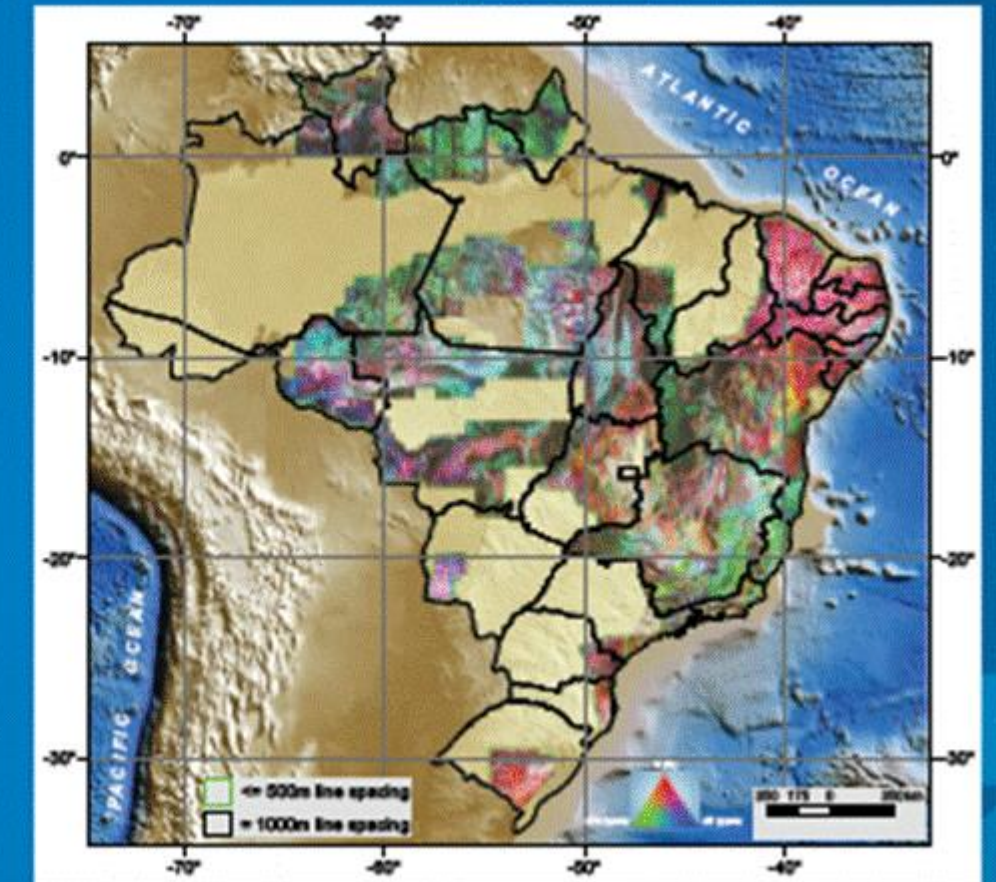
MAP OF GEOCHEMICAL SAMPLING



MAGNETOMETRIC MAP



GAMMA-RAY SPECTROMETRY MAP



✓ Free-access geological and mineral resources database (<http://geobank.cprm.gov.br>):

- 409,607 Stream Sediment Samples
- 51,280 Heavy Mineral Concentrates
- 87% of the Precambrian Shields covered with 500 meters spacing-lines (mag + gamma)

CPRM: Creating Value and Generating Opportunities

Leveraging the knowledge of the main mineral provinces

CPRM
Serviço Geológico do Brasil

BRASIL
GOVERNO FEDERAL

Brazil

Geological Survey Under the Spotlight

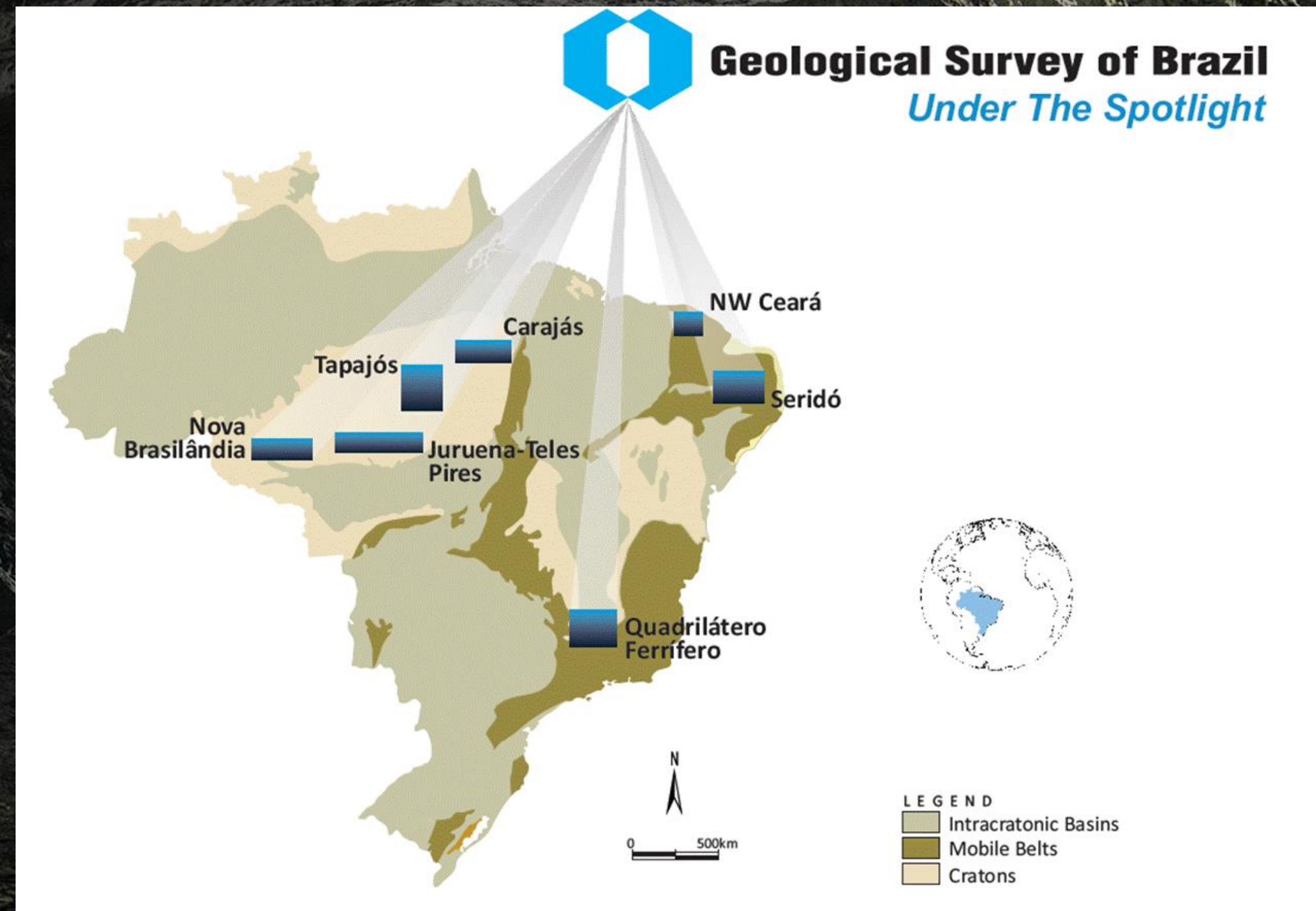
SGB-CPRM
Focus on Development Of Brazilian Mineral Sector

SGB-CPRM Programs:

- Program I**
Geological Geophysical Integration and Predictive Mapping of Brazilian Shields
- Program II**
Basic Geological Mapping
- Program III**
Mineral Potential Assessment of the Brazilian Volcano-sedimentary Sequences
- Program IV**
Crustal Evolution and Metallogeny of the Brazilian Mineral Provinces
- Program V**
Thematic Projects

Project Areas:

- Carajás**
Fe, Ni, Cu, Au, Ni, As, PGE, Pb, Zn, Ag, Mo, W, Sn, Co, Se, Te
- Tapajós**
Au, As, Cu, Se, W
- Quadrilátero Ferrífero**
Fe, Au, Ni, Sn, As, U
- Alta Floresta**
Au, As, Cu, Zn, Pb, Co, Ag
- Borborema (Seridó)**
W, As, Fe, Pb, Ti, Co, Cu, PGE, Ni, Zn
- Nova Brasilândia**
Zn, Pb, As
- NW Ceará**
Cu, Pb, Zn, Ni
- Gurupi**
As



Brazil and One geology – First Country to provide data available

Integrated System – Geology, Geochemistry, Geophysics



GeoSciML - Cronológico



GeoSciML - Litológico

Brazil and One geology

Integrated System – Thematic Analysis

Thematic analysis

Filter by lithology

▸ Gabbroic rock

▸ Fragmental igneous material

▾ ▸ Igneous rock

▾ ▸ Acidic igneous rock

▾ ▸ Dacite

▸ Granitoid

▾ ▸ Quartz rich igneous rock

▾ ▸ Rhyolitoid

▸ Basic igneous rock

▾ ▸ Doleritic rock

▸ Exotic composition igneous rock

▸ Fine grained igneous rock

▸ Fragmental igneous rock

▸ Glass rich igneous rock

▸ Intermediate composition igneous rock

▸ Phaneritic igneous rock

▾ ▸ Porphyry

▾ ▸ Ultrabasic igneous rock

▸ Ultramafic igneous rock

▸ Intermediate composition igneous material

▸ Rock

▸ Sedimentary material

▸ Unconsolidated material

Filter by age

▸ Fanerozóico

▾ ▸ Precâmbrico

▸ Arcaico

▾ Hadeano

▾ ▸ Proterozóico

▸ Mesoproterozóico

▸ Neoproterozóico

▸ Paleoproterozóico

Choose a color:

Portrayal

Reset

ONE

Providing geoscience data globally

IGNEOUS ACID ROCKS

Service title : CPRM EN Bedrock and Age

Abstract : The 1:1M DIGMap data covering the whole of the Brazil is available in this WMS service for all uses - including commercial use subject to the conditions in the Access Constraints section. It is being served as a contribution to the OneGeology initiative (www.onegeology.org). The data is returned in GeoJSON, v3 format using SRS-CRS dictionary values in most cases where applicable. For information about more of the Geological Survey of Brazil's maps and data that are available digitally please visit <http://www.cprm.gov.br>

Owner : Geological Survey of Brazil

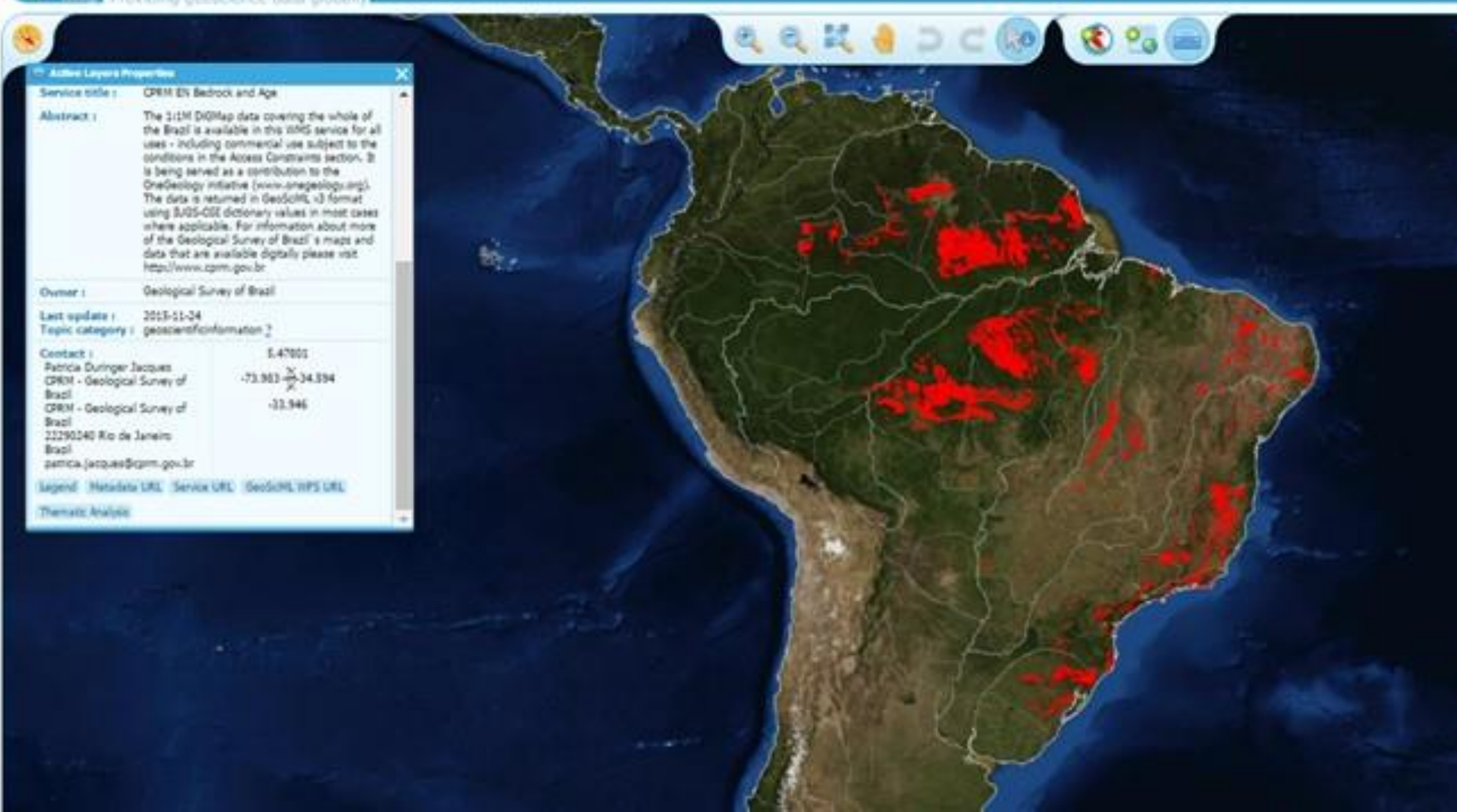
Last update : 2013-11-24

Topic category : geoscientificinformation ?

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Legend : Metadata URL Service URL GeoJSON/JSON URL

Thematic Analysis



Brazil and One geology

Next Steps

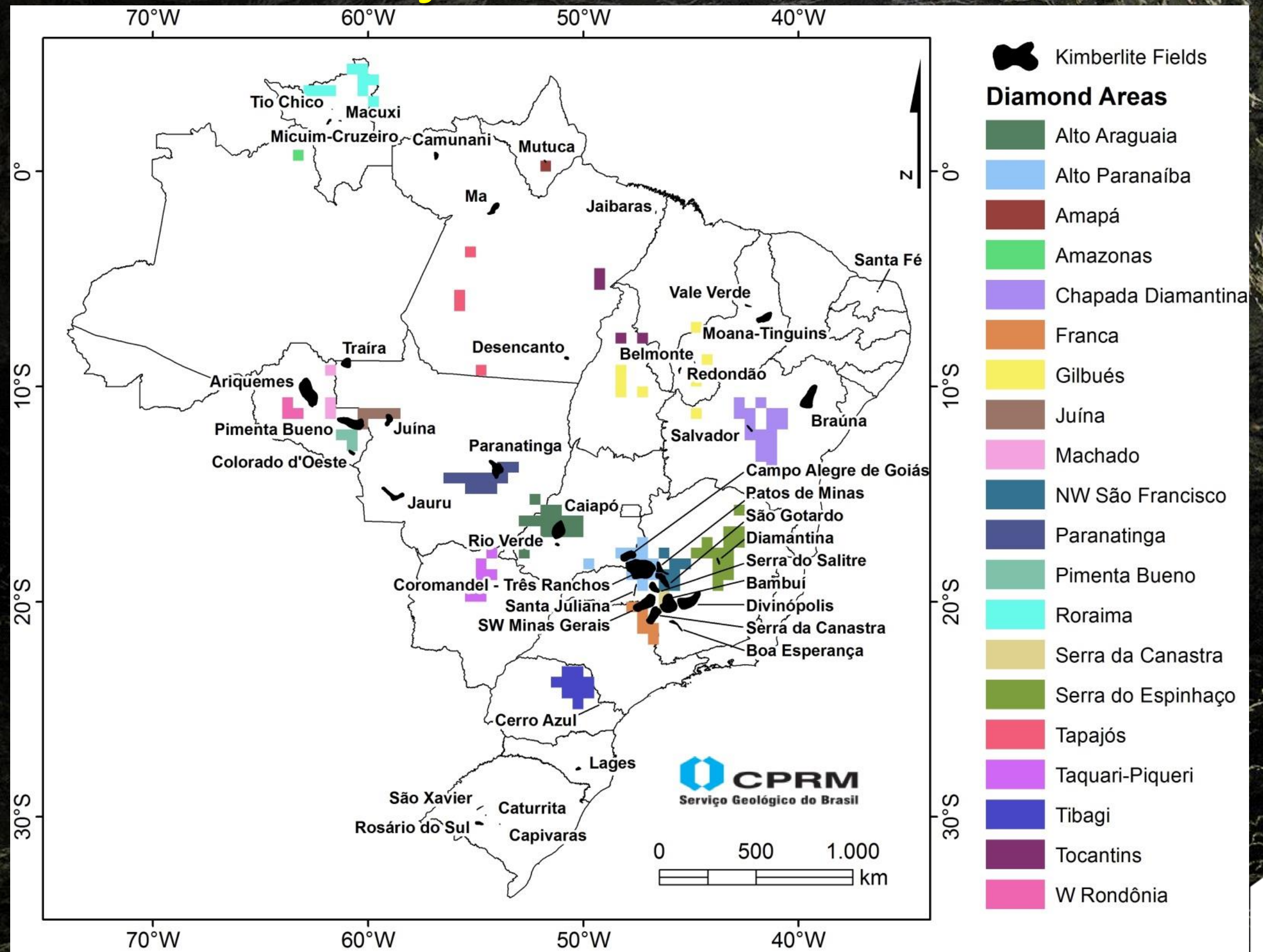
Transfer the knowledge to others
Geological Surveys in South America



CPRM: Creating Value and Generating Opportunities

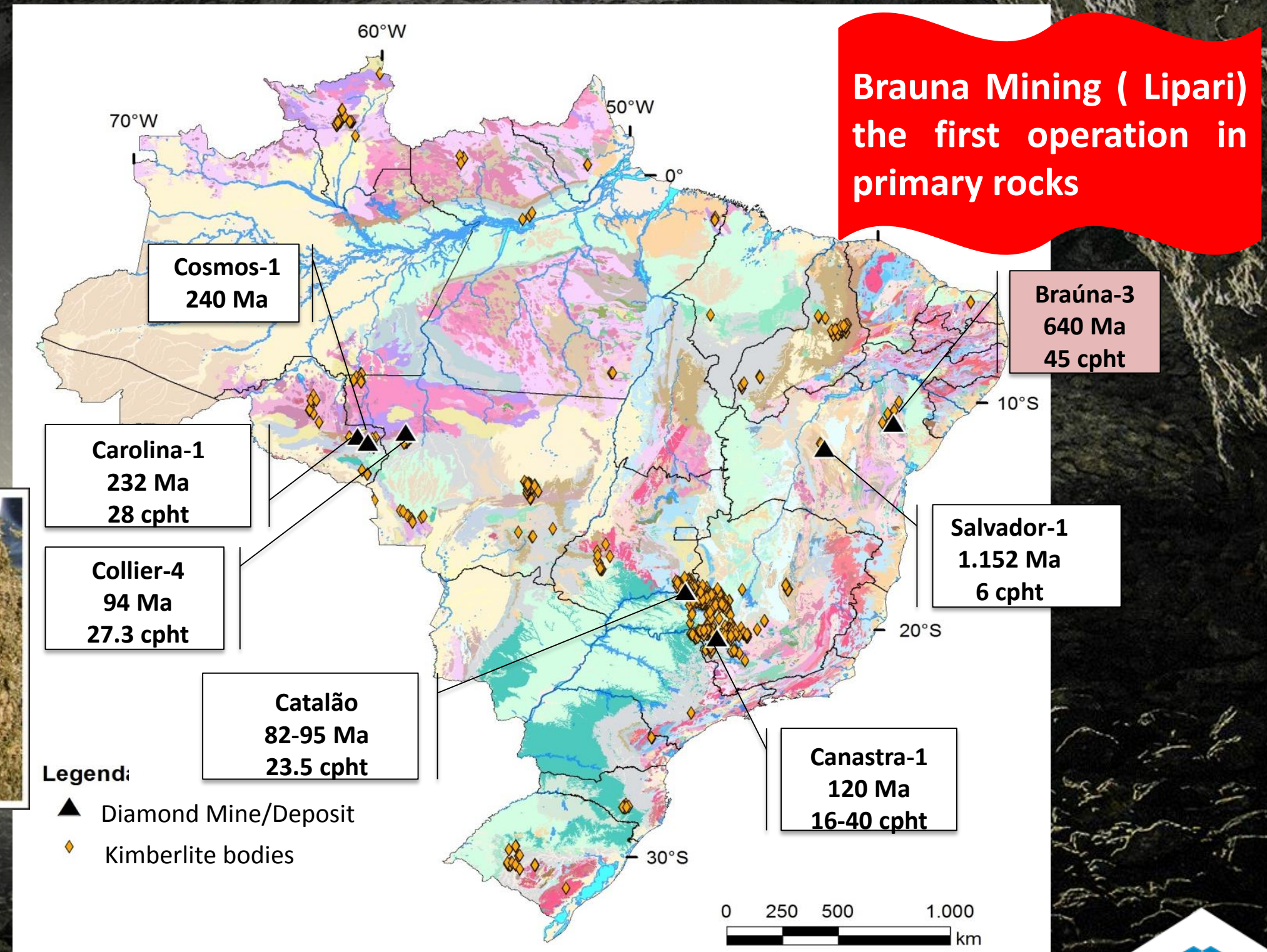
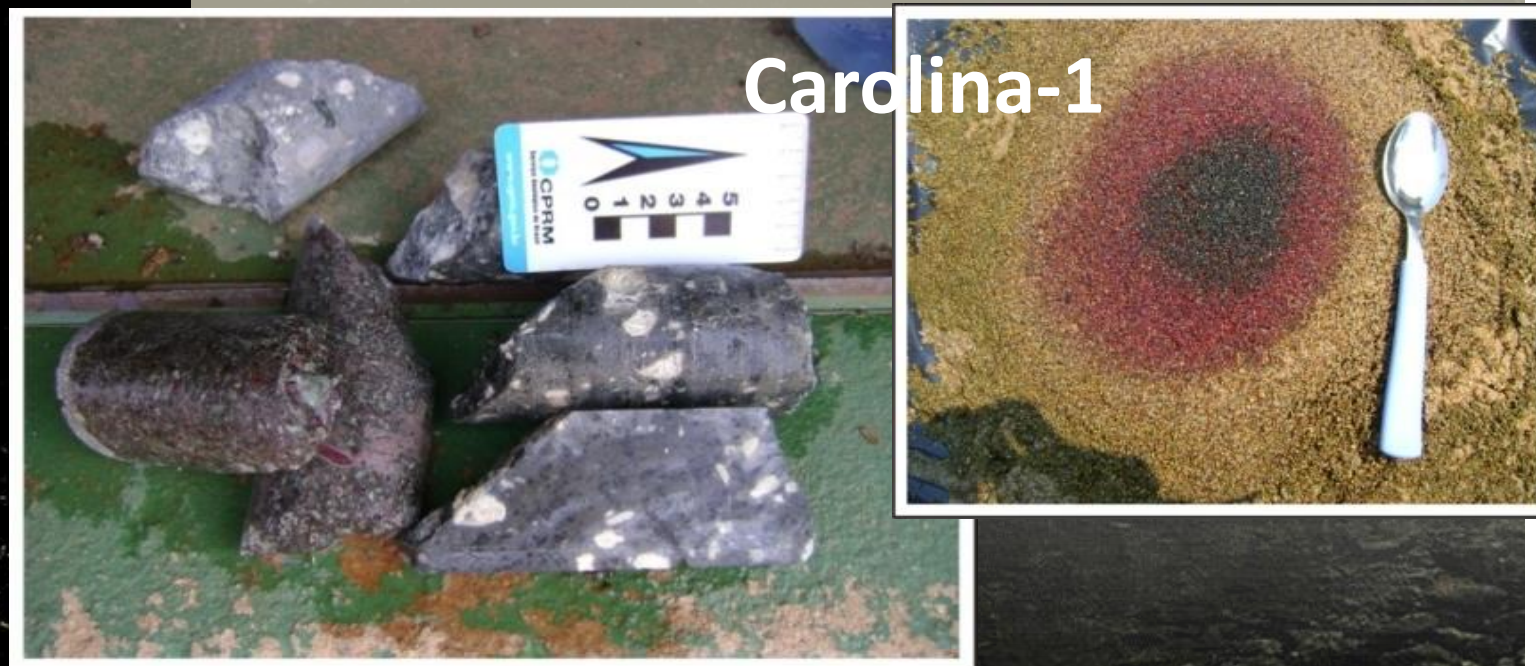
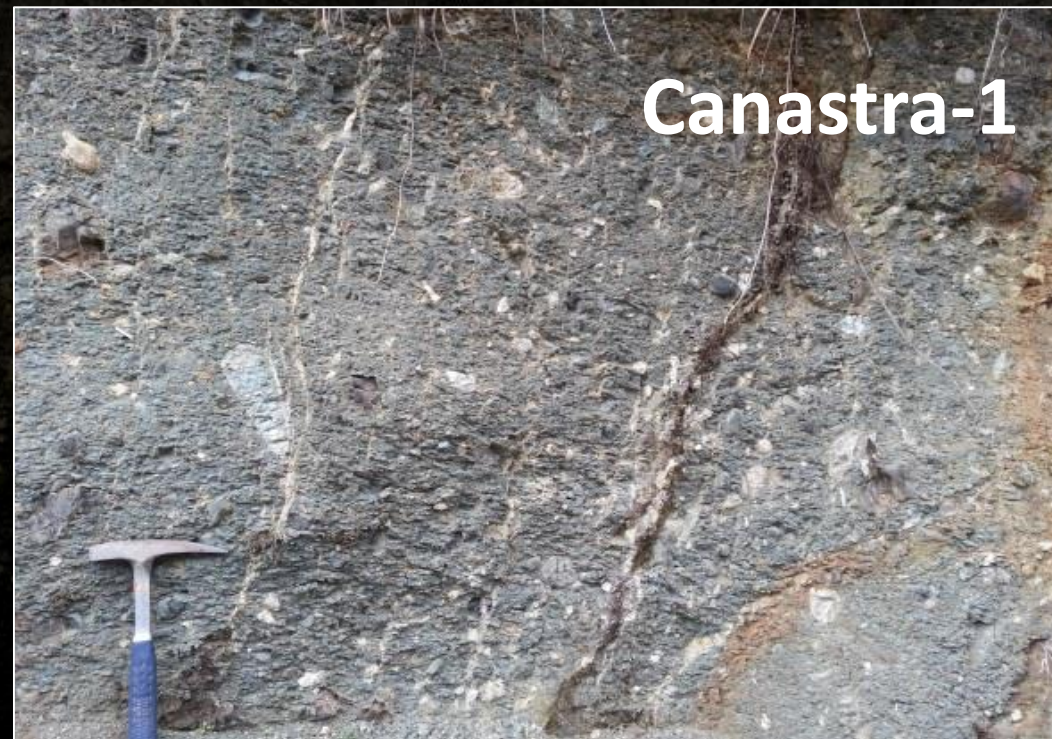
Diamond Brazil Project - Concluded

- Integration of government and private companies data and information generated during the last three decades:
 - 1.344 kimberlites and associated rocks (116 added by CPRM)
- Nine new targets identified.
- Brauna Mining (Lipari) opened a window of opportunities: the first mining operation in primary rocks.
- Drilling and intensive sampling will identify new bodies like Lipari.



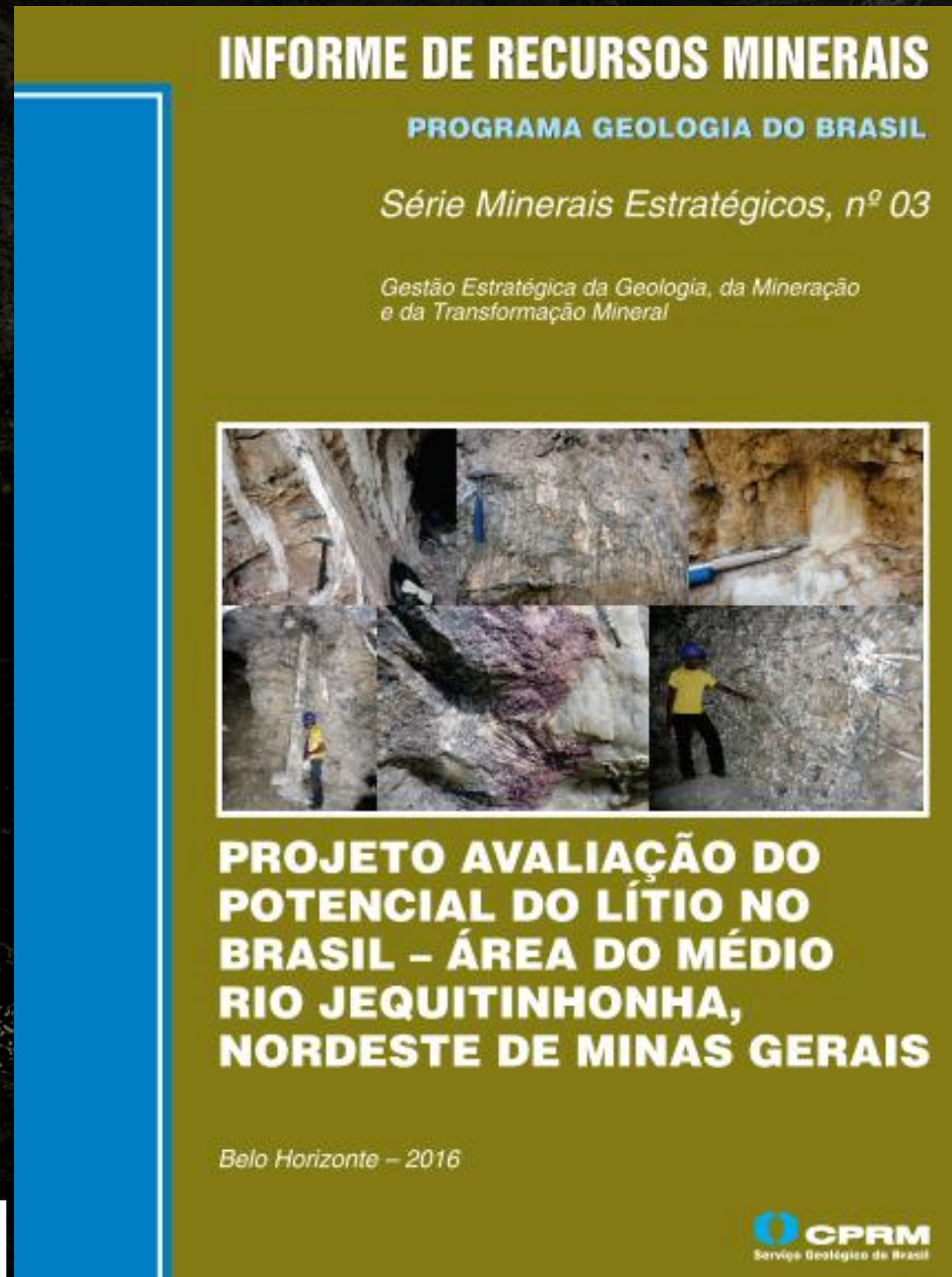
CPRM: Creating Value and Generating Opportunities

Just Lipari multiply Brazilian production sixfold in 2016



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Lithium Brazil Project - Concluded



Main results:

- Focus: Lithium-ore hosted in pegmatites
- New exploration guides and models
- New potentially fertile granites
- Generated new prospective areas with several geophysical anomalies to follow up

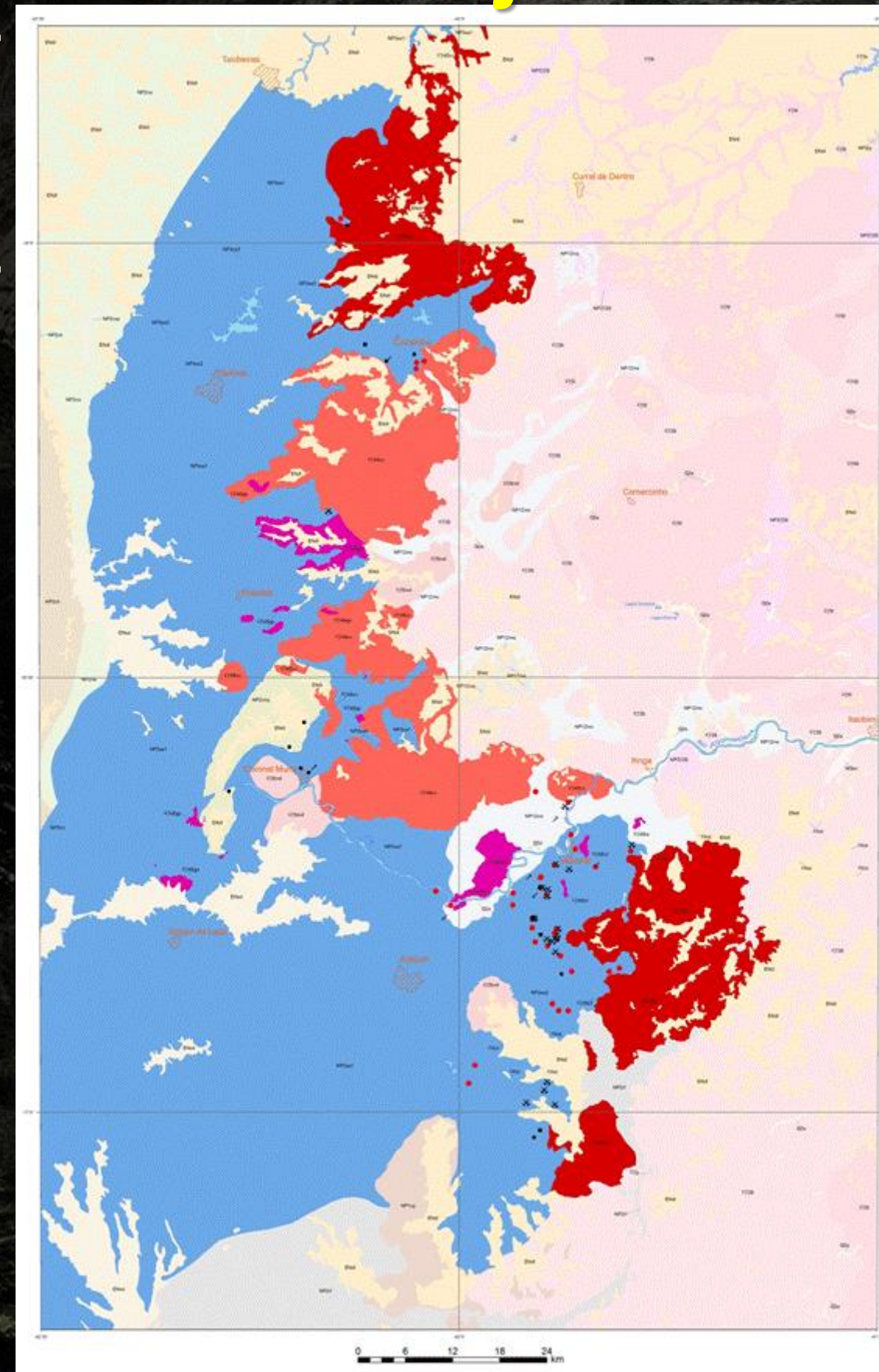
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Lithium Brazil Project - Concluded

New potential area

New potential areas:

- Northeast of Minas Gerais State
- Salinas Formation intruded by fertile granites and pegmatites
- Potential to expand Brazil lithium reserves from 0.4% to 8.0% of the world reserves (~1Mt LiO₂)



Cambrian (γ 4 Suite)

■ Fertile Granites

■ Barren Granites (with rare fertile domains)

■ Pegmatitic Granites (with rare muscovite granites)

Neoproterozoic (metasediments of Salinas Formation)

■ Favourable host Unit

⊗ Lithium mine

■ Lithium deposit

➤ Lithium small and chaotic 'mines' (i.e. digs)

● Lithium occurrence

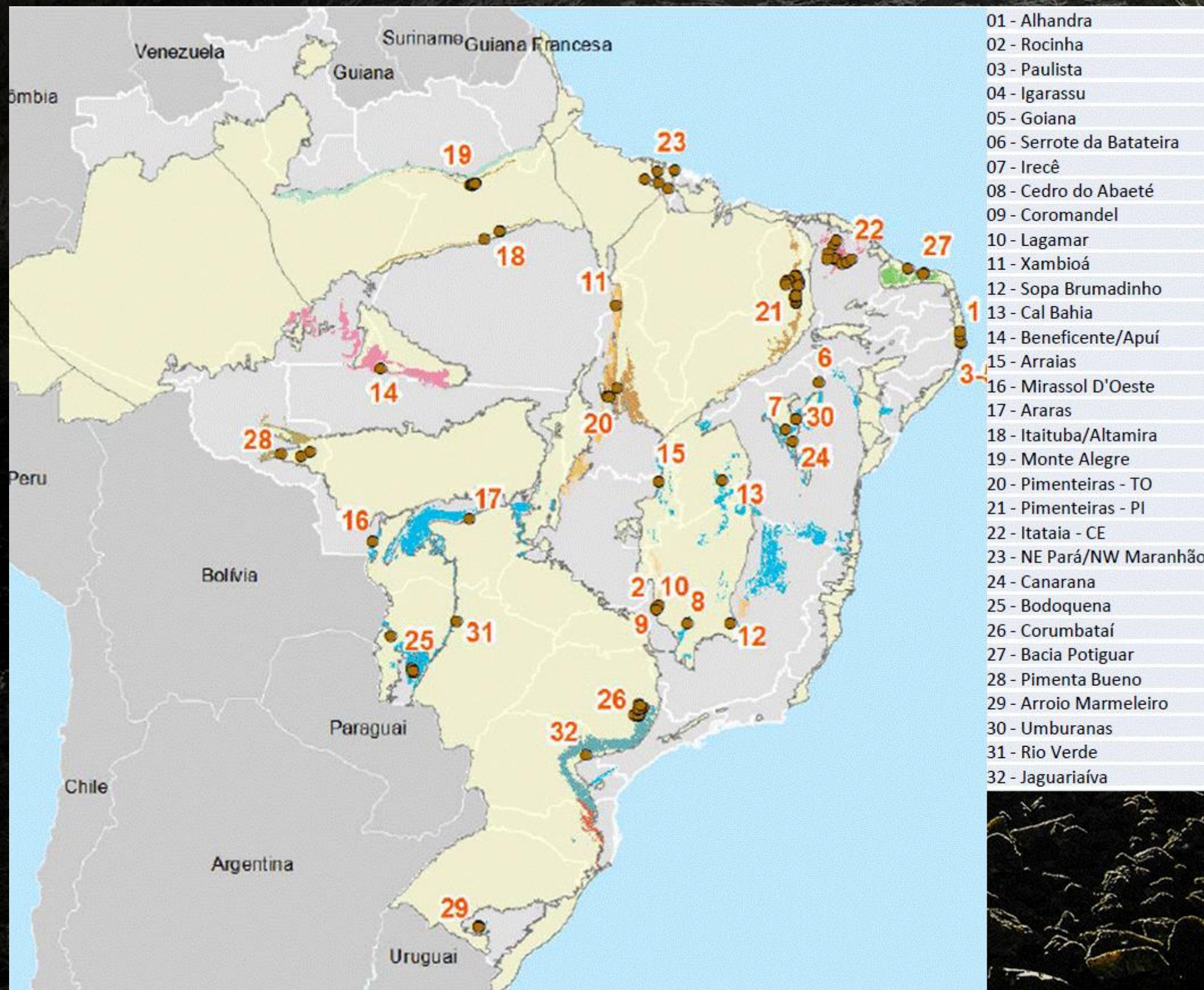
● Andalusite and/or cordierite (contact metamorphism)

New potential area

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Phosphate Brazil Project: Phase I and II concluded

- Major Brazilian phosphate mines in carbonatites.
- Potential for sedimentary phosphate still under developed.
- New targets: Small to medium size deposits close to new frontiers of the agribusiness.
- Phase III of the project in progress, to be concluded in 2018.



CPRM: Creating Value and Generating Opportunities

Technical Reports immediately published

- New discoveries or relevant facts that can generate a new opportunity is issued in the short term;
- 2016: several reports issued related to: Phosphate, kimberlites, gold, Pb-Zn-Cd, Fe-Ti-V-Co, Cu-Pb-Zn
- Portuguese and English versions available at <http://www.cprm.gov.br/publique/Recursos-Minerais/>



TECHNICAL REPORT

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DOI:

New Cu-Pb occurrence in gossan and hydrothermal breccias in the Nova Brasilândia Group, Rondônia State, Brazil: preliminary results, perspectives and interpretations

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Reference: CPRM - Geological Survey of Brazil website: www.cprm.gov.br / Geologia em Evidência/RECURSOS MINERAIS/Informe Técnico – CPRM/Edições Anteriores/ Informe 7 (06/2016): Ocorrência inédita de Cu-Pb em gossan e brechas hidrotermais no Grupo Nova Brasilândia, Estado de Rondônia: resultados, perspectivas e interpretações preliminares.

Abstract

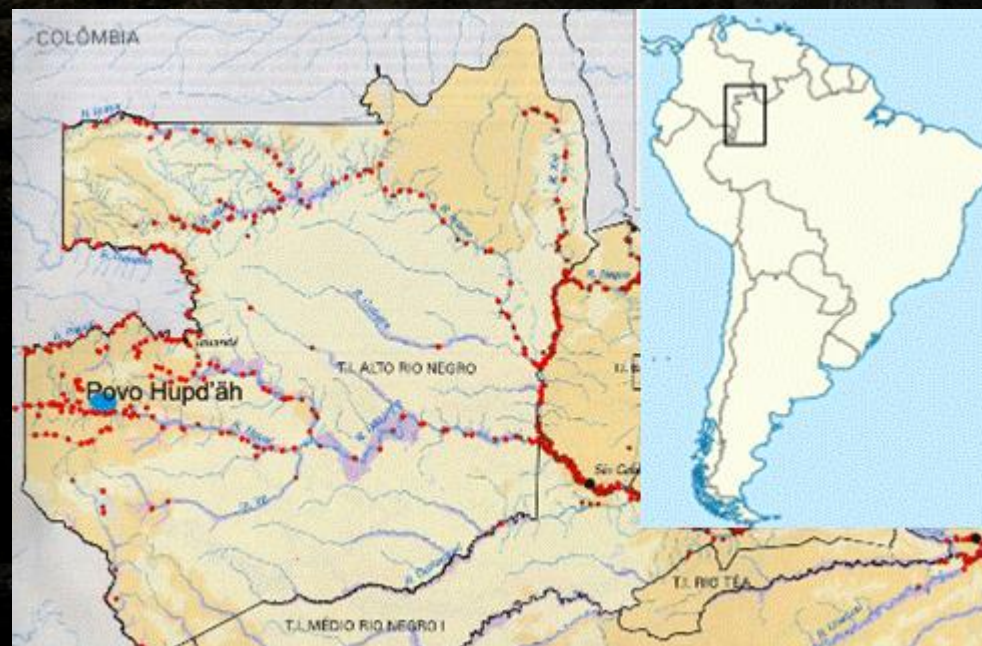
Copper- and lead-bearing breccia and gossan were found at the outskirts of Rolim de Moura town, southeastern Rondonia State, Brazil, during geological mapping. Gossans and hydrothermal breccias are hosted by the paragneisses of Nova Brasilândia Group, which, at the studied area, is composed of banded iron formation, sillimanite-biotite-muscovite gneiss, metagabbro and metatonalite, deformed and metamorphosed during the Sunsás orogeny. The hydrothermal system consists of strongly oxidized massif sulfide zones (gossans), iron oxide veinlets and stockworks, silicate breccia and quartz veins. Hydrothermal alteration was mapped continuously along a 2.5 km ESE-WNW trend. ICP OES/ICP MS chemical analyses returned values up to 1668 ppm Cu and 46.9 ppm Pb in whole-rock gossan powders. Portable XRF results yielded copper, lead and zinc grades up to 800 ppm Cu, 720 ppm Pb and 150 ppm Zn in whole-rock gossan powders. Programmed petrographic, SEM, XRD and whole-rock geochemistry studies will help to better characterize the mineralization.

Keywords: Gossan, Hydrothermal breccia, Nova Brasilândia Group, Metallogeny.

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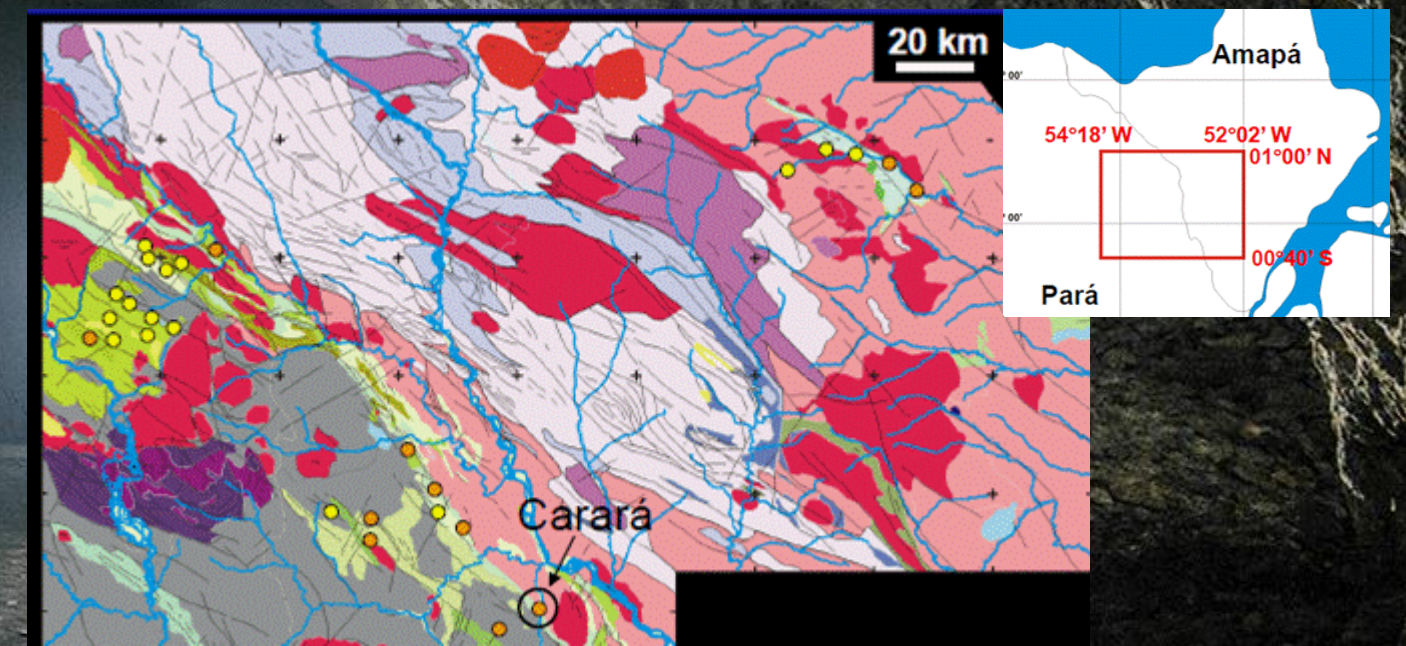
Opening New Frontiers

Cabeça do Cachorro



- Geological, geochemical and geophysics survey in progress
- Final product will support economic and environmental
- Demand generated by local communities'

RENCA



- 160 km volcanic sedimentary sequence with several plugs of granites
- 140 geochemical and geophysics anomalies to follow up
- Carará mining: 21,2 g/t Au
- Updating geological, geochemical and geophysics in progress

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Mineral Projects in the PPI Program



THE PPI – PROGRAM FOR PARTNERSHIP IN INVESTMENTS

- Priority federal government program – strong support
- Concessions of infrastructure, oil and gas and mining projects
- Attraction of new players to the Brazilian mining sector
- Bidding process expected for the second half of 2017

CPRM ASSETS

- 376 mineral rights
- 30 mining projects
- Exploration works developed between 1970 and 1990

FOUR PRIORITY PROPERTIES INCLUDED AT PPI

- Miriri Phosphate (PB-PE)
- Cu, Zn, Pb, Cd, Ag + (Au) from Palmeirópolis (TO)
- Coal from Candiota (RS)
- Copper from Bom Jardim de Goiás (GO)

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Mineral Projects in the PPI Program

Bidding Process:

- Currently concluding the data room and external audit
- Preliminary road show in progress
- Deadline to issue the bid notice: August 2017
- Data room will be opened for 70-100 days
- Main Criteria: the highest investment to conclude the PFS in two years + royalties
- Electronic trading floor: first semester 2018



Mineral deposits in intermediate to advanced exploration stages
(demands additional exploration works, mineral processing and environmental studies)



All properties drilled, with significant interceptions and inferred resources



No major social, environmental and cultural obstacles for licensing



Final exploration reports already approved by DNPM



Important for the local and regional development: priority for the country

The drivers of the new Brazilian Mining Industry



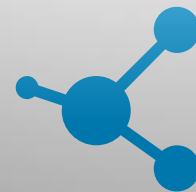
Sustainable development



Economic, social and environmental responsibility



Increase production and diversify the Brazilian mineral matrix



Technological development and innovation



Competitiveness



Regulatory stability

Brazil calls for solutions. One of the paths has already been set. It is time to walk through it. It is time to grow!

THANK YOU! – MUCHAS GRACIAS

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