

METALLOGENIC MAP OF SOUTH AMERICA

1:5.000.000

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ASSOCIATION OF IBEROAMERICAN GEOLOGICAL AND MINING SURVEYS (ASGMI)



<https://asgmi.org/>



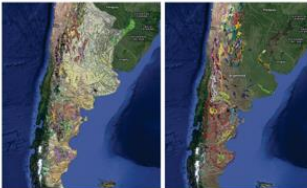
-  INTERNATIONAL COOPERATION
-  GEOCHEMISTRY
-  GEOLOGICAL HERITAGE
-  MUSEUMS NETWORK
-  MINING ENVIRONMENTAL LIABILITIES
-  ARTISANAL AND SMALL SCALE MINING
-  **METALLOGENY AND MINERAL RESOURCES**
-  GEOLOGICAL HAZARDS
-  HYDROGEOLOGY
-  GEOGRAPHICAL INFORMATION SYSTEM
-  REGIONAL GEOLOGY AND GEOLOGICAL MAPPING
-  COMMUNICATION
-  MARINE GEOLOGY

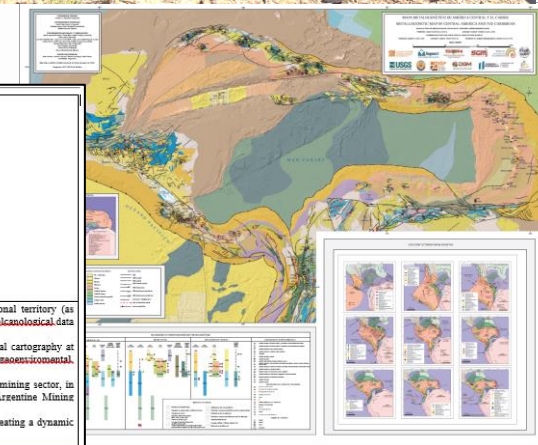
Group of Experts on Metallogenics and Mineral Resources (GEMET)

Objective: to become a reference nucleus in the knowledge of the mineral resources of Ibero-America, contributing to the enhancement of the mining potential of the region through the development and dissemination of basic and specialized information on the subject.

The Geological Surveys of Latin America have assumed the commitment to provide complete and consistent information on non-fuel mineral resources. Its ordering and analysis constitute a tool of great value for mining exploration and the evaluation of the potential of mineral resources not yet discovered.



																
	<p><i>(Segemar, Geological and Mining Survey of Argentina, 2020) ²³</i></p> <ul style="list-style-type: none"> • SEGEMAR is responsible for generating geological-mining and geological hazards information of national territory stipulated by Law 24.224 (93), and constitute the repository of geological, mining, geo-environmental and volcanological of the Argentine Republic. • Within SEGEMAR, the Institute of Geology and Mineral Resources, (IGRAM) performs regional geological cartography at different scales and thematic charts (geochemistry, geophysics, metallotectonic mining, industrial minerals, neoesotomental, land use planning and geological hazards). • Within SEGEMAR, the Institute of Mining Technology (INTEMIN) supports technological update of the mining sector, in particular small and medium-sized companies and provides laboratory services to other areas of the Argentine Mining Geological Survey. • Argentina is member of One Geology (international initiative of the geological surveys of the world for creating a dynamic digital geological map data) WMS & Accreditation 															
Mineral Production	<table> <tr> <th>Mineral</th><th>Production</th><th>World Ranking</th></tr> <tr> <td>Copper</td><td>102.56 t</td><td>20</td></tr> <tr> <td>Gold</td><td>60.17 t</td><td>14</td></tr> <tr> <td>Silver</td><td>987.57 t</td><td>10</td></tr> <tr> <td>Lithium Carbonate Eq.</td><td>3.515 t</td><td>3</td></tr> </table>	Mineral	Production	World Ranking	Copper	102.56 t	20	Gold	60.17 t	14	Silver	987.57 t	10	Lithium Carbonate Eq.	3.515 t	3
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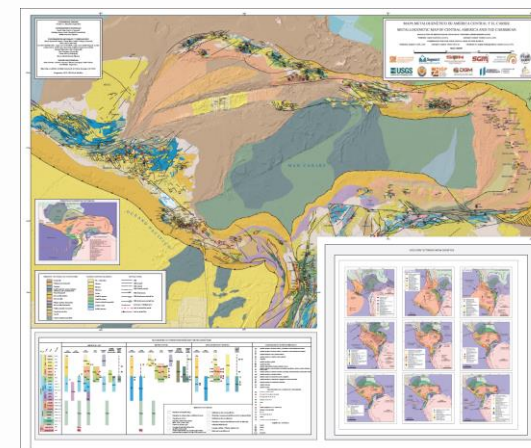


GROUP OF EXPERTS ON METALLOGENICS AND MINERAL RESOURCES (GEMET)

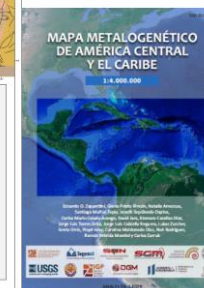
PROJECTS:

Metallogenetic Map of Central America and the Caribbean (1:4,000,000)

✓ Finalized



<https://asgmi.org/mapa-metalogenetico-de-america-central-y-el-caribe-mapa-en-pdf-y-memoria/>



Update of the Metallogenetic Map of South America (1:5,000,000)

✓ Completion date: December 2022



Map of Critical Minerals of Latin America

✓ Estimated completion date: March 2024

METALLOGENIC MAP OF SOUTH AMERICA

1:5.000.000

Introduction

Metallogenetic Map of South America (1:5,000,000). 1st Ed. 1985 - Commission for the Geological Map of the World (CGMW)

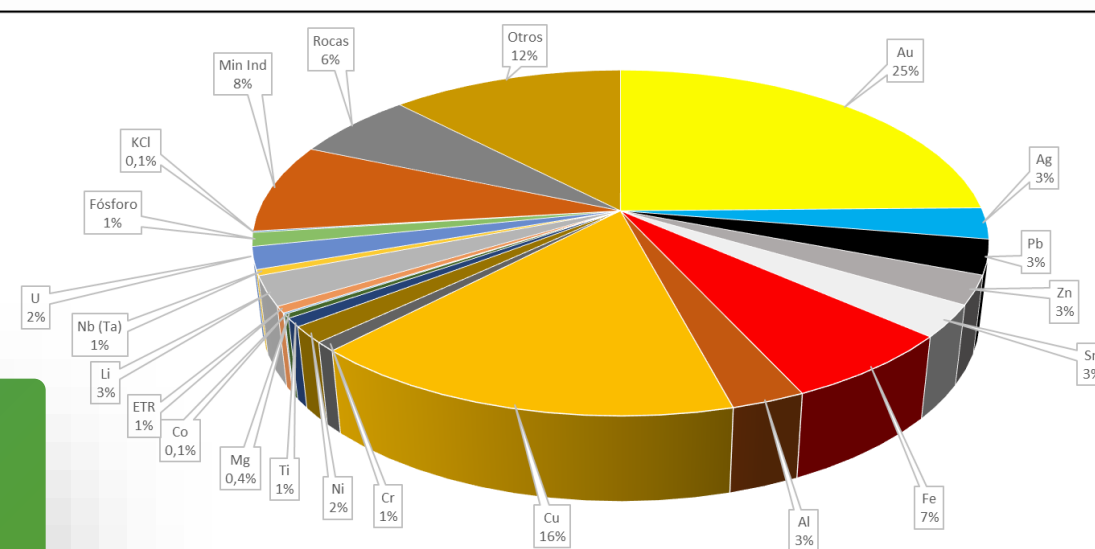
Metallogenetic Map of South America (1:5,000,000). 2nd Ed. 2005 - Commission for the Geological Map of the World (CGMW)/
Association of Ibero-American Geological and Mining Surveys (ASGMI)

Update of the Metallogenetic Map of South America (1:5,000,000). 2022 - Association of Ibero-American Geological and Mining Surveys (ASGMI)

Participants: Geological Surveys of Venezuela,
Brazil, Colombia, Ecuador, Peru, Chile,
Argentina and Uruguay

Total mineral deposits: **1,654**

Percentage distribution of mineral deposits by
commodities



METALLOGENIC MAP OF SOUTH AMERICA

1:5.000.000

Main characteristics of the map

Scale → 1:5,000,000

Area → about 15 million square kilometers

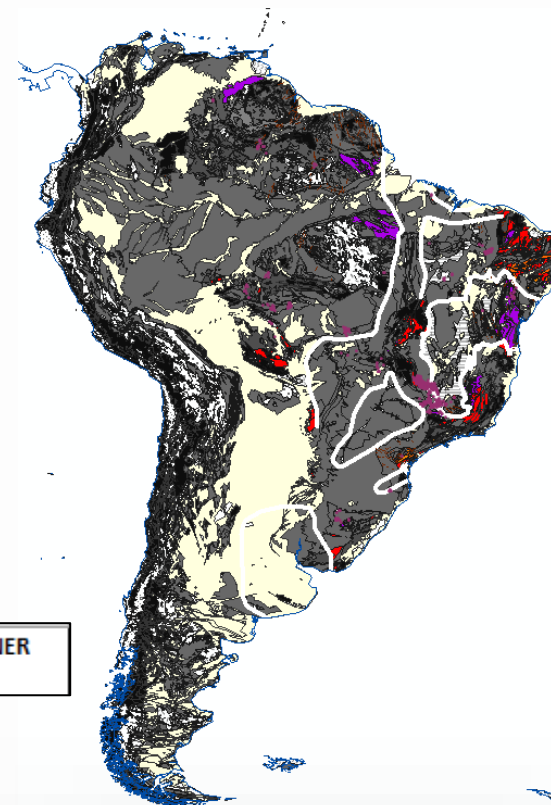
Metallic and industrial mineral deposits → 1,654

Classification of mineral deposits → genetic criteria

Base map → geotectonic

XSIMEXMIN

NUMERO	PAIS	NOMBRE	LATITUD	LONGITUD
Characteristics of the mineral deposit	MORFOLOGIA	MENA	GANGA	
	TAMANO	EDO_DP	GRUPO_DP	EDAD_MINER
	COMMODITY_1	COMMODITY_2	COMMODITY_3	ASOC_COM
Commodities	REC_TOT	LEY_1	LEY_2	LEY_3
	UNIDAD_GE_NOMBRE	UNIDAD_GE_CLASIF	UNIDAD_GE_EDAD	
Host rock	ROCA_ENCAJ_NOMBRE	ROCA_ENCAJ_LITO	ROCA_ENCAJ_edad	



Geotectonic base map

- Deposits associated with mafic and ultramafic intrusions in tectonically stable areas
- Deposits associated with mafic and ultramafic intrusions in tectonically unstable areas
- Deposits associated with alkaline rocks and systems
- Deposits associated with mafic continental volcanism
- Pegmatites
- Deposits associated with granites
- Porphyry type deposits
- Metasomatic deposits (including greisens and skarns)
- Deposits associated with intermediate to acid volcanics and subvolcanics in a continental domain
- Deposits associated with submarine volcanism and volcanosedimentary marine sequences (it includes massive sulfides and Sedex mineralizations)
- Deposits associated with clastic sediments
- Deposits associated with carbonate sediments
- Deposits associated with chemical sediments
- Deposits associated with biogenic sediments
- Deposits associated with dehydration and metamorphic segregation fluids
- Deposits associated with metamorphic crystallization
- Residual deposits
- Placer deposits

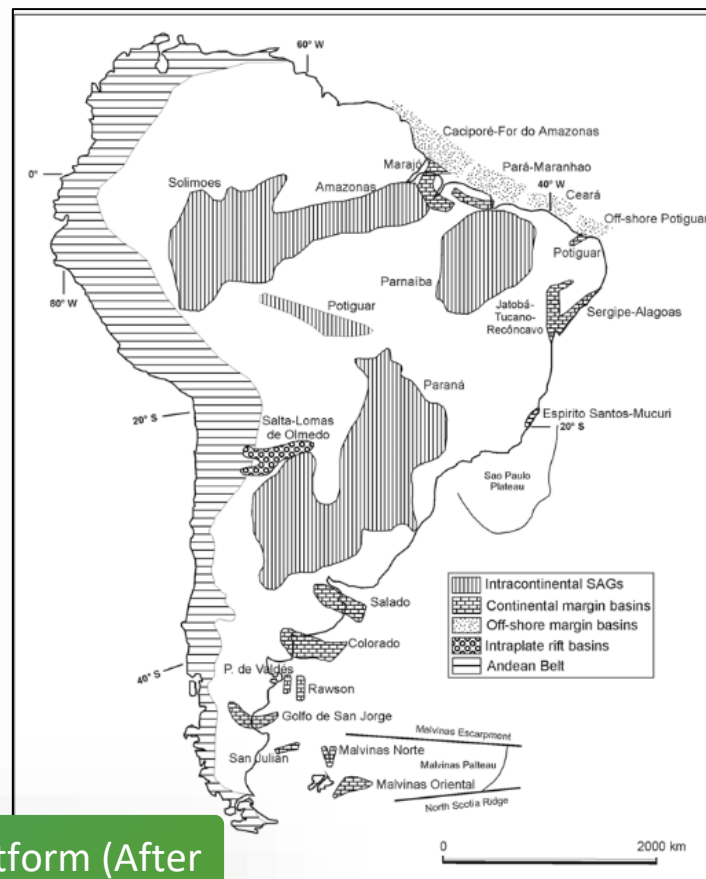
Classification of Deposits

METALLOGENIC MAP OF SOUTH AMERICA

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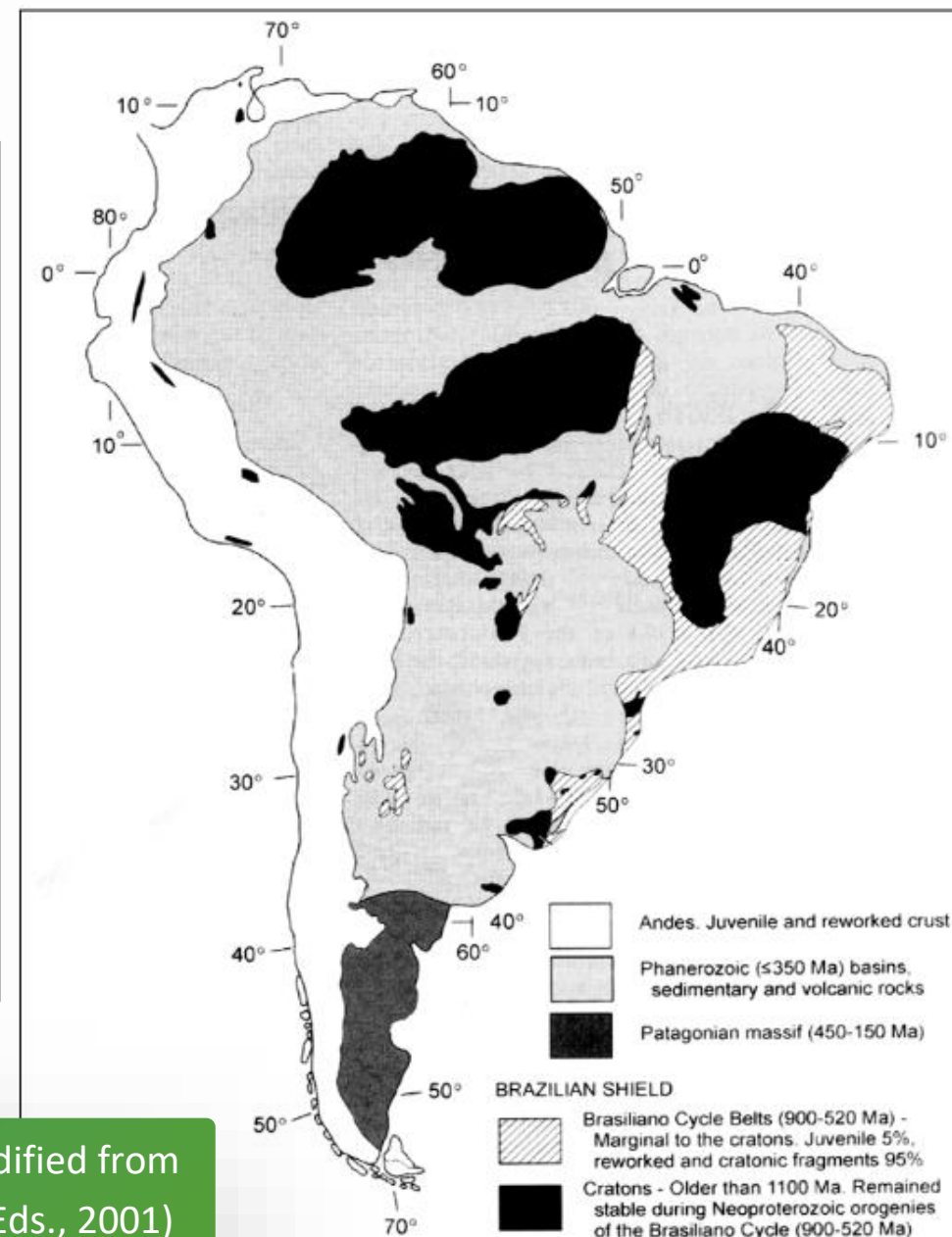
Geotectonic overview

The South American Plate consists of two main geotectonic domains: the South American Platform that covers 15 million km² and includes major Precambrian tectonic provinces, and the Andean Belt. Phanerozoic sedimentary basins developed under particular plate-tectonic regimes, small cratonic cores and marginal belts can be differentiated



Sedimentary basins in the Southamerican platform (After Milani and Thomaz filho, in Cordani et al., Eds., 2000)

Geotectonic domains in the South American Plate (modified from Hartmann and de Medeiros Delgado, in Groves et al., Eds., 2001)



METALLOGENIC MAP OF SOUTH AMERICA

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Metallogenic provinces, districts and belts

The analysis of the distribution of mineral deposits in South America shows their spatial distribution relationship within the various geological settings.

GOLD

Cratonic areas
Brasiliano Belts
Andean Belt
Patagonia Terrane

AGE	DEFORMATION	Ma
QUATERNARY	ANDEAN OROGENY	1.6-0
PLIOCENE		5-1.6
MIOCENE		16-5
OLIGOCENE-LOWER MIOCENE		28-16
Eocene-OLIGOCENE		43-28
PALEOCENO-EOCENO		65-43
CRETACEOUS	ANDEAN OROGENY	135-65
JURASSIC		205-135
PERMIAN-TRIASSIC		290-205
CARBONIFEROUS		355-290
DEVONIAN		355
SILURIAN	CHARNIC OROGENY	410-355
CAMBRIAN-ORDOVICIAN		438-410
NEOPROTEROZOIC	OCLOVIC OROGENY	438
MESOPROTEROZOIC	BRASILIAN OROGENY	543-438
		600-543
	GRENVILLIAN OROGENY	1000-600
		1000
		1600-1000
		1800-1600
		2000-1800
	TRANSAMAZONIAN OROGENY	2000
		2200-2000
		2500-2200
	CARAJÁS OROGENY	2600-2500
		2750-2600
		2850-2750
		3000-2850
		3500-3000
ARCHEAN		



Au Provinces, Districts and Belts in
South America

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Metallogenic provinces, districts and belts

The analysis of the distribution of mineral deposits in South America shows their spatial distribution relationship within the various geological settings.

COPPER AND MOLYBDENUM

Andean Belt
Cratonic areas

AGE	DEFORMATION	Ma
QUATERNARY	ANDEAN OROGENY	1.6-0
PLIOCENE		5-1.6
MIOCENE		16-5
OLIGOCENE-LOWER MIOCENE		28-16
EOCENE-OLIGOCENE		43-28
PALEOCENO-EOCENO		65-43
CRETACEOUS	CHANIC OROGENY	135-65
JURASSIC		205-135
PERMIAN-TRIASSIC		290-205
CARBONIFEROUS		355-290
DEVONIAN		355
SILURIAN	OCLOVIC OROGENY	410-355
CAMBRIAN-ORDOVICIAN		438-410
NEOPROTEROZOIC	BRASILIAN OROGENY	438
		543-438
	GRENVIILLIAN OROGENY	600-543
1000-600		
MESOPROTEROZOIC		1000
PALEOPROTEROZOIC	TRANSAMAZONIAN OROGENY	1600-1000
		1800-1600
		2000-1800
		2000
		2200-2000
ARCHEAN	CARAJAS OROGENY	2500-2200
		2600-2500
		2750-2600
		2850-2750
		3000-2850
		3500-3000



Cu Provinces, Districts and Belts in
South America

METALLOGENIC MAP OF SOUTH AMERICA

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Metallogenic provinces, districts and belts

The analysis of the distribution of mineral deposits in South America shows their spatial distribution relationship within the various geological settings.

TIN AND TUNGSTEN

Cratonic areas
Brasiliano Belts
Andean Belt

AGE	DEFORMATION	Ma
QUATERNARY		1.6-0
PLIOCENE		5-1.6
MIocene		16-5
OLIGOCENE-LOWER MIOCENE	ANDEAN OROGENY	28-16
EOCENE-OLIGOCENE		43-28
PALEOCENO-EOCENO		65-43
CRETACEOUS		135-65
JURASSIC		205-135
PERMIAN-TRIASSIC		290-205
CARBONIFEROUS		355-290
DEVONIAN	CHANIC OROGENY	355
SILURIAN		410-355
CAMBRIAN-ORDOVICIAN	OCLOVIC OROGENY	438-410
		438
		543-438
NEOPROTEROZOIC	BRASILIAN OROGENY	600-543
		1000-600
	GRENVILLIAN OROGENY	1000
MESOPROTEROZOIC		1600-1000
		1800-1600
		2000-1800
PALEOPROTEROZOIC	TRANSAMAZONIAN OROGENY	2000
		2200-2000
		2500-2200
	CARAJAS OROGENY	2600-2500
		2750-2600
ARCHEAN		2850-2750
		3000-2850
		3500-3000

W and Sn Provinces, Districts and Belts in South America



METALLOGENIC MAP OF SOUTH AMERICA

1:5.000.000

Metallogenic provinces, districts and belts

The analysis of the distribution of mineral deposits in South America shows their spatial distribution relationship within the various geological settings.

IRON AND MANGANESE

Cratonic areas
Brasiliano Belts
Andean Belt

AGE	DEFORMATION	Ma
QUATERNARY		1.6-0
PLIOCENE		5-1.6
MIOCENE		16-5
OLIGOCENE-LOWER MIOCENE	ANDEAN OROGENY	28-16
EOCENE-OLIGOCENE		43-28
PALEOCENO-EOCENO		65-43
CRETACEOUS		135-65
JURASSIC		205-135
PERMIAN-TRIASSIC		290-205
CARBONIFEROUS		355-290
DEVONIAN	CHANIC OROGENY	355
		410-355
SILURIAN		438-410
CAMBRIAN-ORDOVICIAN	OCLOYIC OROGENY	438
		543-438
NEOPROTEROZOIC	BRASILIAN OROGENY	600-543
		1000-600
	GRÉNVILLIAN OROGENY	1000
MESOPROTEROZOIC		1600-1000
		1800-1600
		2000-1800
PALEOPROTEROZOIC	TRANSAMAZONIAN OROGENY	2000
		2200-2000
		2500-2200
	CARAJAS OROGENY	2600-2500
		2750-2600
ARCHEAN		2850-2750
		3000-2850
		3500-3000



Fe and Mn Provinces, Districts and Belts in South America

METALLOGENIC MAP OF SOUTH AMERICA

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Metallogenic provinces, districts and belts

The analysis of the distribution of mineral deposits in South America shows their spatial distribution relationship within the various geological settings.

NIOBIUM, TANTALUM, BERYLIUM, RARE EARTHS AND LITHIUM

Cratonic areas
Alkaline Provinces

Brasiliano Belts
Andean Belt

AGE	DEFORMATION	Ma
QUATERNARY		1.6-0
PLIOCENE		5-1.6
MIOCENE		16-5
OLIGOCENE-LOWER MIOCENE	ANDEAN OROGENY	28-16
EOCENE-OLIGOCENE		43-28
PALEOCENO-EOCENO		65-43
CRETACEOUS		135-65
JURASSIC		205-135
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		2500-2200
	CARAJÁS OROGENY	2600-2500
ARCHEAN		2750-2600
		2850-2750
		3000-2850
		3500-3000



Nb-Ta-Be, REE and Li Provinces,
Districts and Belts in South America

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South America mineral's potential

The analysis of the total resources and their distribution indicates that South America includes some of the richest metallogenic provinces in the world:

- ❖ The richest Cu-Mo province in the world (Chile and Peru) 50% of the world's resources
- ❖ One of the most extensive and rich Sn provinces in the world (Bolivia). Brazil and Bolivia's combined resources are the largest in the world
- ❖ One the richest Sb belts in the world (Bolivia): 3rd largest reserve in the world
- ❖ The most important Li resources in the world (Argentina, Chile and Bolivia) 60% of world's resources
- ❖ One of the richest Borates province in the world (Argentina) — the 5th largest in the world
- ❖ The world's 4th magnesite reserve in the world (Brazil)

South American hosts some of the largest deposits in the world:

- ❖ The largest accumulation of hypogene Sn (Llallagua, Bolivia) 5% of the world's reserves
- ❖ The largest Ag accumulation (Cerro Rico de Potosi, Bolivia) 20% of world's reserves
- ❖ The largest Porphyry Cu deposit (El Teniente, Chile) 10% of the world's reserves
- ❖ The largest Nb deposit (Seis Lagos, Brazil) >90% of the world's reserves
- ❖ One of the largest Fe districts in the world (Quadrilátero Ferrífero, Brazil) 10% of world's reserve
- ❖ The largest Li accumulation (Atacama, Chile) 42% of world's reserve

Other significant commodities are:

- ✓ 30% of Au world's reserves
- ✓ 20% of Talc world's reserves
- ✓ 15% of Barite world's reserves
- ✓ 15% of Potash world's reserves
- ✓ 10% of Graphite world's reserves
- ✓ 10% of Bi world's reserves

Obrigado!

#SIMEXMIN2022