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Gobierno de Chile

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World Community of Geological Surveys

AGI american geosciences institute
connecting earth, science, and people

GEOSCIENTIFIC INFORMATION FOR A DIVERSIFIED MINING IN CHILE: BEYOND CU & AU

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The role of geological survey organizations to advance critical mineral research; February 12th, 2021

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CONTENT (18 slides)

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- Chile
- SERNAGEOMIN

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- SIGEX portal

III. Critical Minerals (CM) in Chile
- How are we doing?
- "ChilePolimetalico" initiative
- Oportunities

IV. Mineral Potential maps

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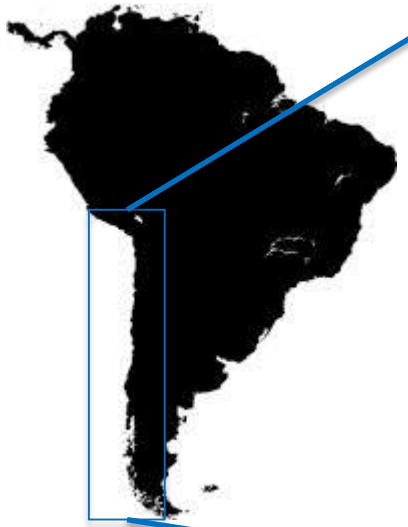
I) Overview

General facts about Chile



Population

18,8 million (@ 2018)

Geographic data

- 756,950 km^2
- 4,329 km (18° S – 55° S)

GDP 2019

USD 305,556 million (**Mining: 10%**)

per capita income USD 14,897

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Sources: COCHILCO, Central Bank of Chile, National Statistical Institute

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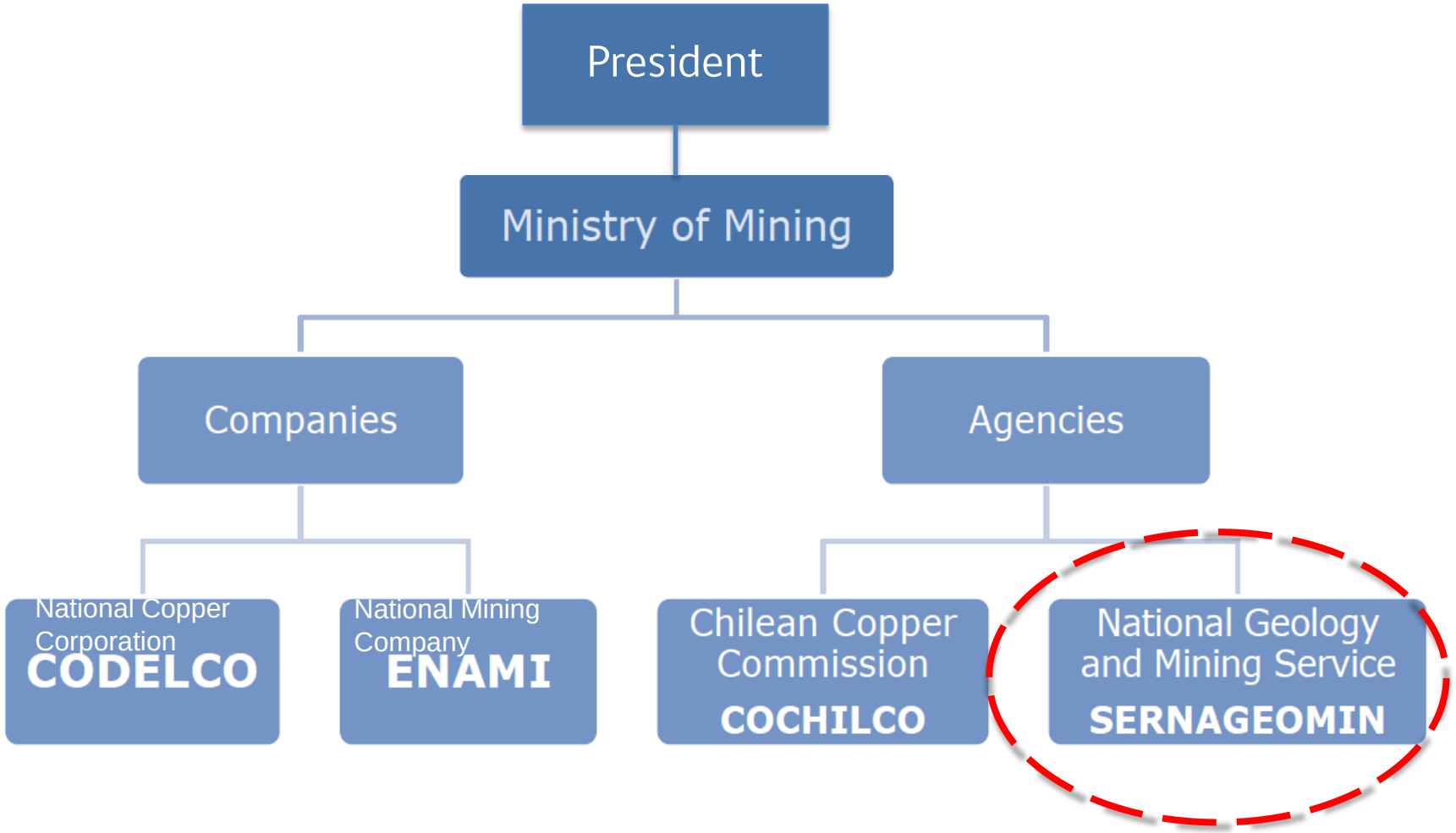
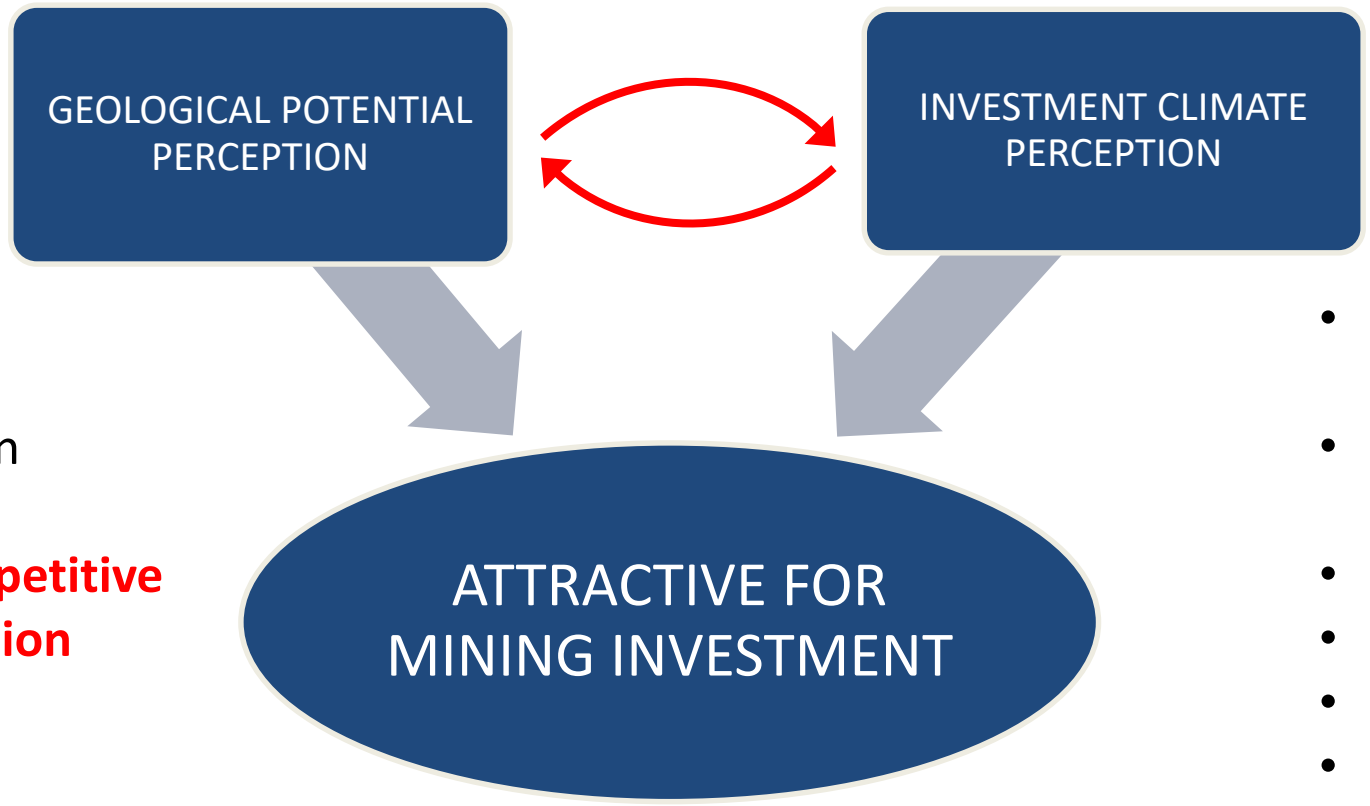
Public Institutions related to the Geology and Mining Sector



II) Precompetitive Geoscientific Data

Investment in mineral exploration



- Historical Production
- Recent discoveries
- Historical investment in exploration
- **Availability of Precompetitive Geoscientific Information (PGI)**

- Political and social stability
- Respect for current legislation
- Mining Regulation
- Environmental regulation
- Tax regime
- Infrastructure

VALUE of the PGI for Exploration

- ✓ Reduce RISKS
- ✓ Reduce COSTS
- ✓ Improves and catalyzes **geological knowledge**

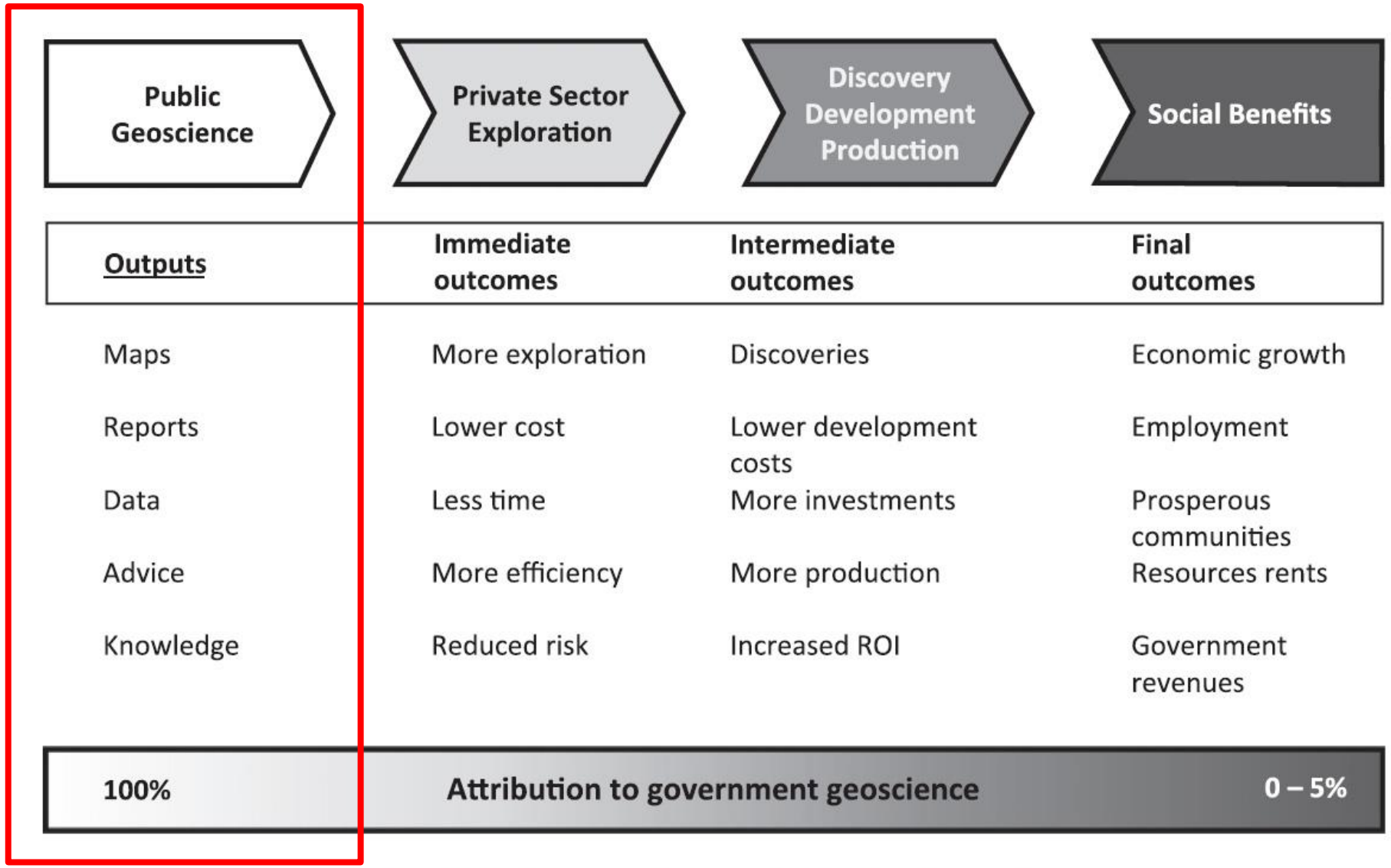
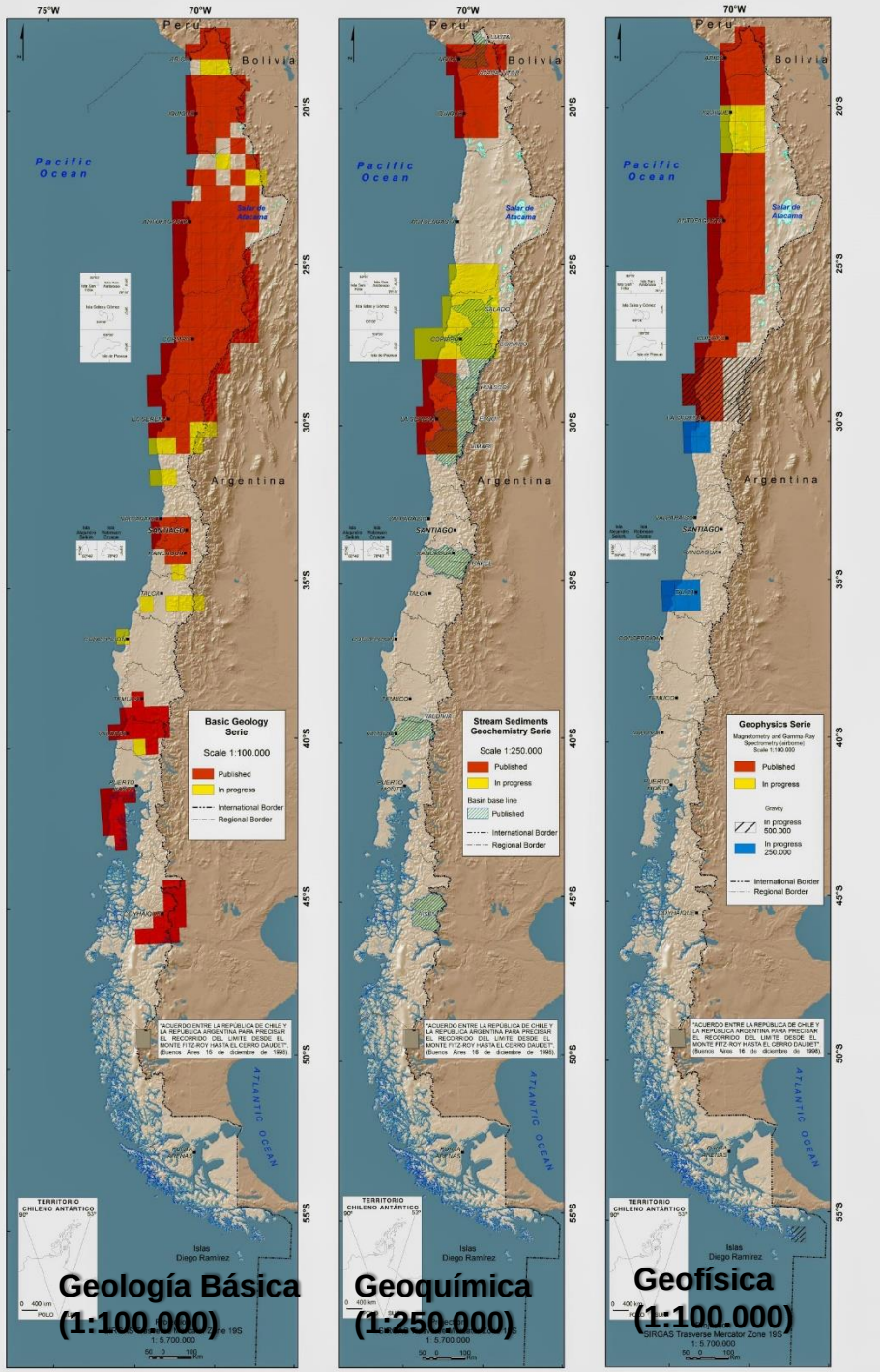


Fig. 1. PGI value chain and its intermediate and final outcomes. Modified from Duke (2010).

1) National Mapping Program

- ✓ Rate of publication of Regional Geology maps (1:100M) increaes **from 3 to 8 per year**.
- ✓ First coutry-scale **geophysical** initiative (Mag, Grav, espectro.)
- ✓ First stream sediments **geochemistry** program

Program	Scale	Coverage Chile cont. [%]
Regional Geology	1: 1 MM	100 %
	1: 250 M	87 %
	1: 100 M	**40 %**
	1: 50 M	4 %
Geochemistry	**1: 250 M**	**9 %**
Geophysics	**1: 100 M**	**19 %**

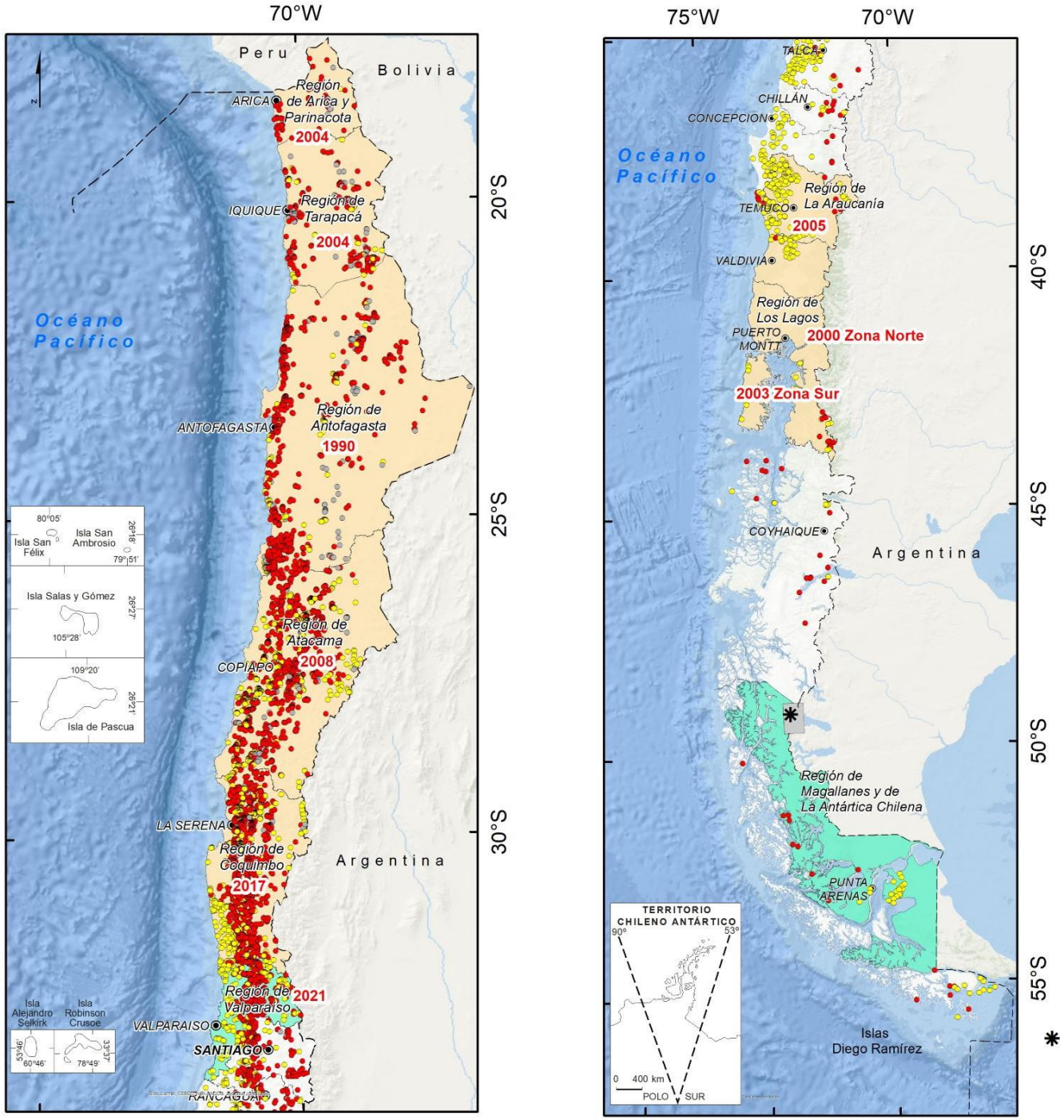


NMP Advances (2020). Red: published charts; Yellow: work *in progress*.

II) Precompetitive Data from SNGM

2) Mineral Resources

- ✓ **Metallogenic Maps**
  - 1:100,000 & 1:500,000 scale (XX % coverage)
  - Metallic Mineral resources
  - Industrial Rocks and Minerals resources
  - Identification of Metallogenic Belts



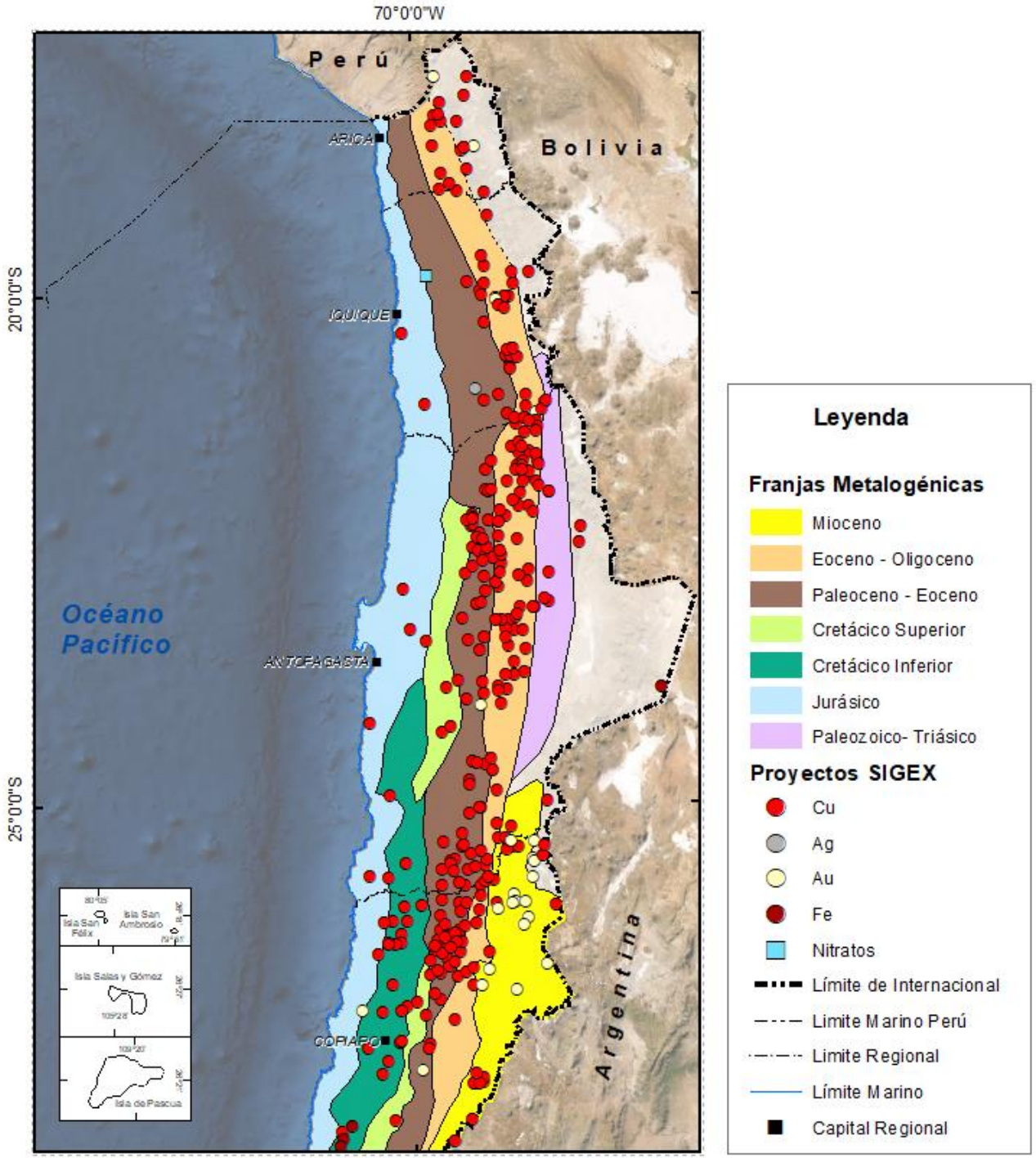
✱ "ACUERDO ENTRE LA REPÚBLICA DE CHILE Y LA REPÚBLICA ARGENTINA PARA PRECISAR EL RECORRIDO DEL LIMITE DESDE EL MONTE FITZ-ROY HASTA EL CERRO DAUDET". (Buenos Aires 16 de diciembre de 1998).

- ✓ **Mineral Deposits Database (*SIA-YACIMIENTOS*):**
  - ~ 10,000 entries

3) Exploration Data repository

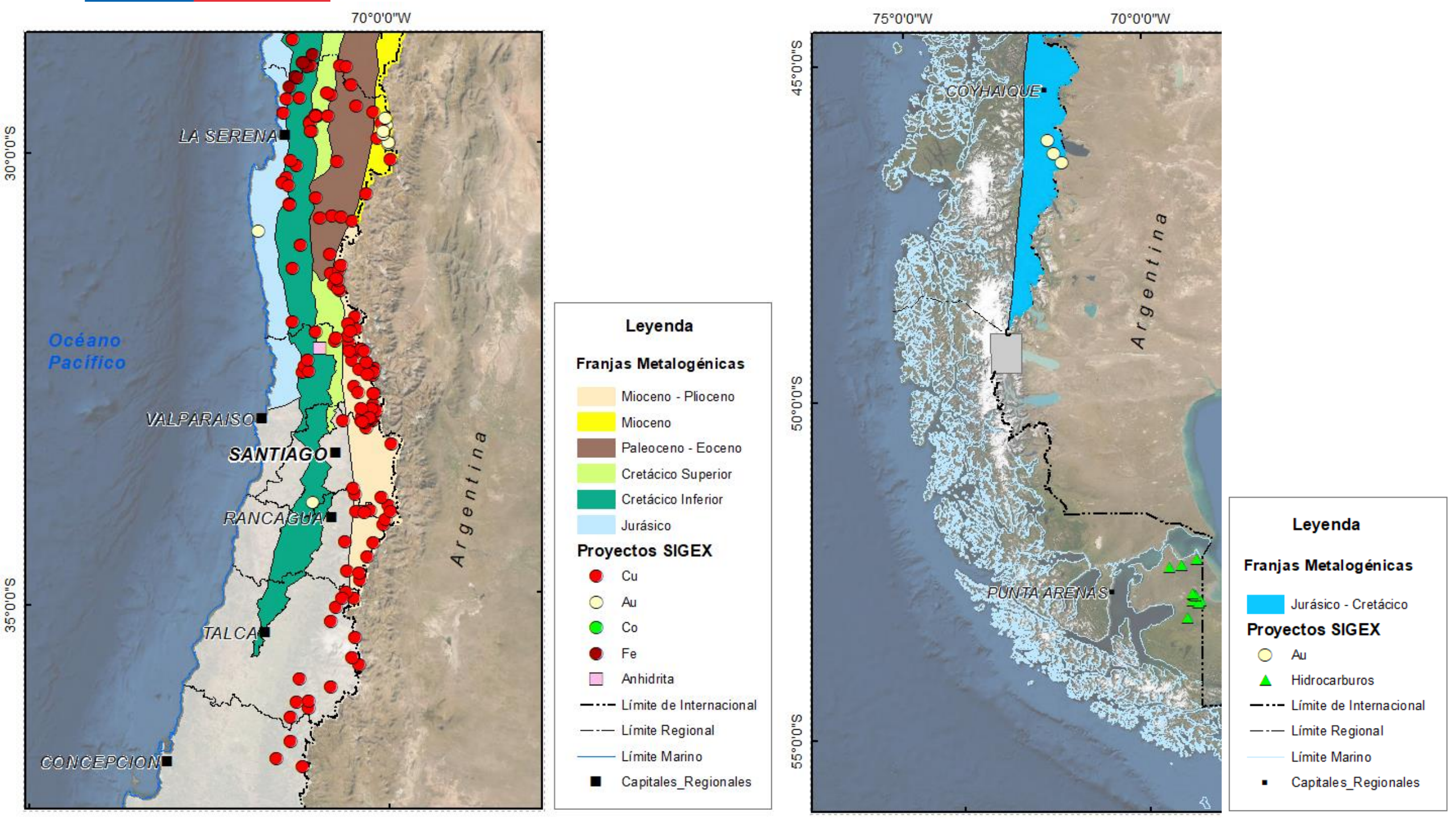
SIGEX

Exploration Geological Information System



web portal that makes available all the basic geological information generated in the exploration projects developed in Chile (geological maps, geochemical and geophysical data, drilling information, among others) that sernageomin requests from mining companies.

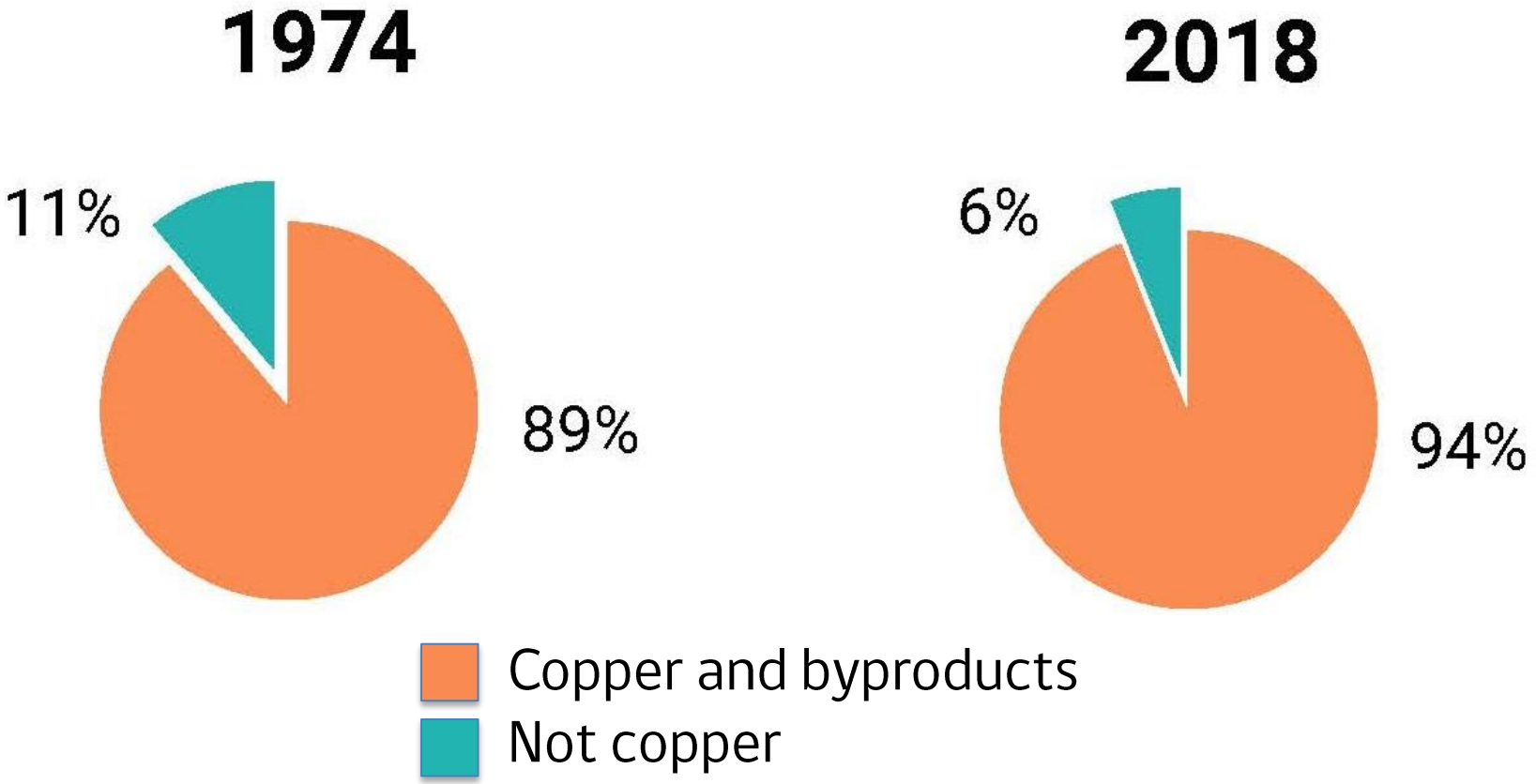
- ✓ Trends of exploration


70°0'0"W
30°0'0"S
35°0'0"S
LA SERENA
VALPARAISO
SANTIAGO
RANCAGUA
TALCA
CONCEPCION
Océano Pacífico
Argentina
Leyenda
Franjas Metalogénicas
Mioceno - Plioceno
Mioceno
Paleoceno - Eoceno
Cretácico Superior
Cretácico Inferior
Jurásico
Proyectos SIGEX
Cu
Au
Co
Fe
Anhidrita
Límite de Internacional
Límite Regional
Límite Marino
Capitales_Regionales
75°0'0"W
70°0'0"W
45°0'0"S
50°0'0"S
55°0'0"S
COYHAIQUE
PUNTA ARENAS
Argentina
Leyenda
Franjas Metalogénicas
Jurásico - Cretácico
Proyectos SIGEX
Au
Hidrocarburos
Límite de Internacional
Límite Regional
Límite Marino
Capitales_Regionales

III) Critical Minerals in Chile

How are we doing?

- Mining exports
- Diversification of the mineral supply



source: Chile Polimetálico – Alta Ley

III) Critical Minerals in Chile
ChilePolimetalico initiative

Public– Private initative

ALTALEY®

CHILEPOLIMETÁLICO

https://chilepolimetalico.cl/

"strategic maps for the diversification of Chilean mining"

Goal: Identification of Gaps and definition of an Action Plan to enable a diversified mining Industry, generating the **bases of a national strategy** for the diversification of the Chilean mining with a polymetallic perspective, beyond copper.

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III) Critical Minerals in Chile
ChilePolimetalico initiative

In Chile, CMs are defined as required for **low carbon technologies** (energetic revolution) and its ocurrence/concentration for extraction

ELEMENT	SOLAR TECHNOLOGY	WIND TECHNOLOGY	ELECTRIC VEHICLES AND ENERGY STORAGE	CHILE CATEGORY
Mo		☑		WORLD-CLASS PRODUCER
Ag	☑			
Fe	☑	☑	☑	MINOR PRODUCER
Si	☑		☑	
Mn		☑	☑	PAST MINOR PRODUCER
Pb	☑	☑	☑	
Zn	☑	☑		
Se	☑			
Te	☑			
Co		☑	☑	MIDDLE SIZED PROJECTS
Ti			☑	
Nd, Dy, Pr		☑	☑	
Ge	☑			POTENTIAL RECOVERY FROM CONCENTRATES
Ga	☑			

source: Chile Polimetálico – Alta Ley

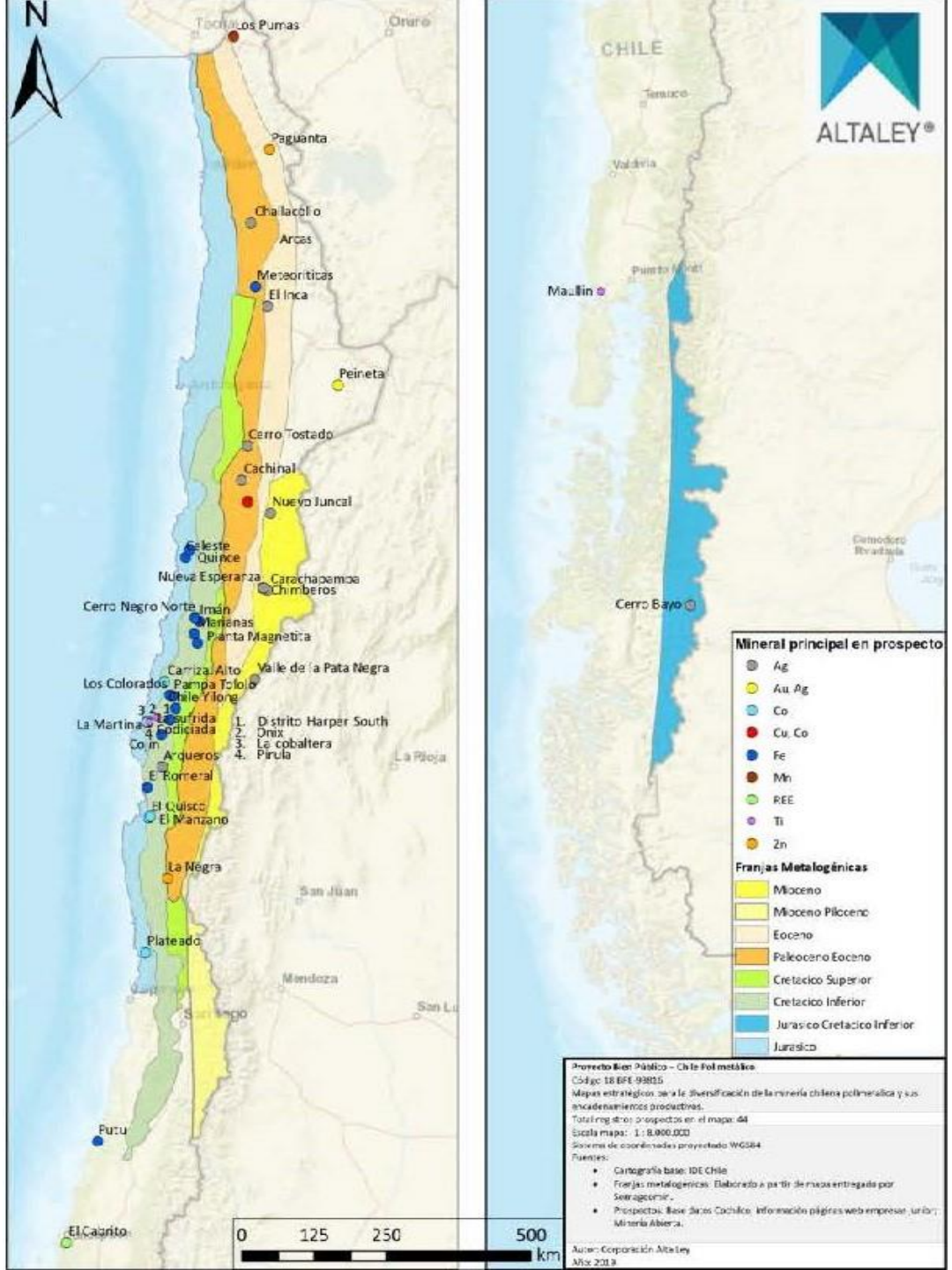
III) Critical Minerals in Chile
Opportunities

1. Potential development of **"multi-element" mining projects** from small to medium-scale natural mineral deposits with the presence of copper and/or other CM that make the business viable.
2. Recovery of CM from **mining waste or anthropogenic deposits**, that is, production of elements with commercial value from tailings, waste, slags, foundry powders, anode mud, etc.
3. Recovery of CM from **environmental remediation** projects for alternative post-mining land use.
4. Exploitation of **polymetallic deposits from the seafloor** of the Chilean coast.

source: Chile Polimetálico – Alta Ley

III) Critical Minerals in Chile

1. Multi-element mining projects



Metallogenic Belt	Deposit type	Ore/CM
Jurassic	Stratabound	Ag
Jurassic - Early Cretaceous	Skarns, VMS, Epithermal	Zn, Pb, Ag
Early Cretaceous	IOCG, OIA, Stratabound, Skarns	Fe, Ag, P, U, Co, REE
Late Cretaceous	Porphyres and Veins	Ag
Paleocene-Eocene	Porphyres and Epithermals	Mo, Ag
Eocene-Oligocene	Porphyres	Mo
Miocene	Epithermal and porphyres	Ag
Upp. Mio - Low. Pliocene	Porphyres	Mo

source: Chile Polimetálico – Alta Ley

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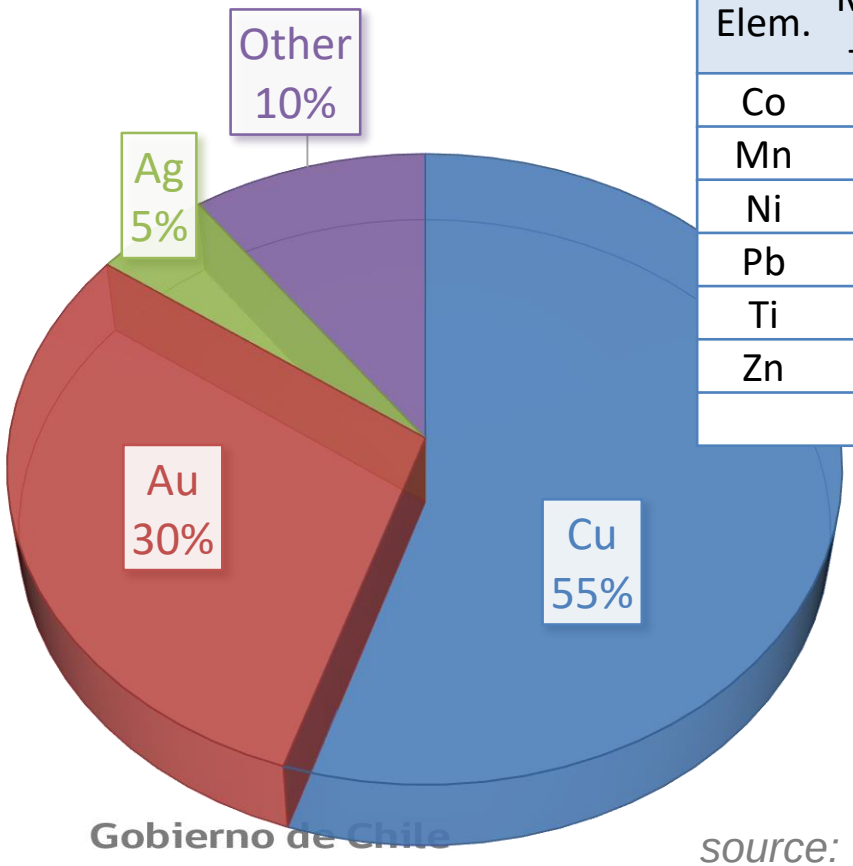
III) Critical Minerals in Chile

1. Multi-element mining projects

Metallic Deposits (2019)

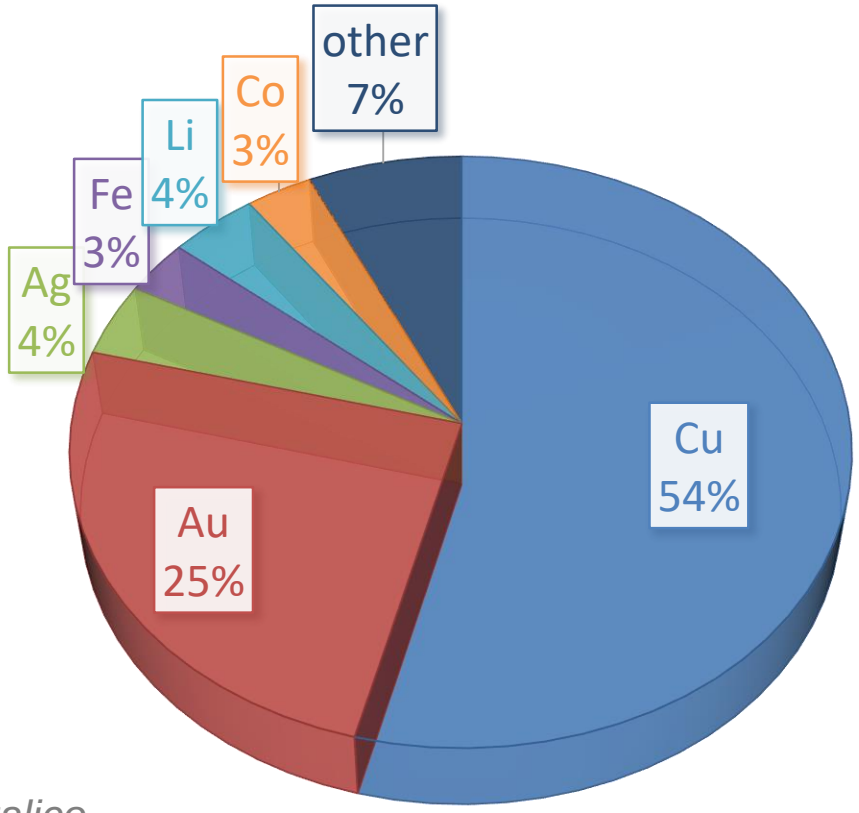
Deposits with Ore ≠ Cu, Au, Ag, Fe



Elem.	Middle -sized	small-sized	total
Co		11	11
Mn	7	68	75
Ni		1	1
Pb	4	35	39
Ti		6	6
Zn		6	6
	11	127	138

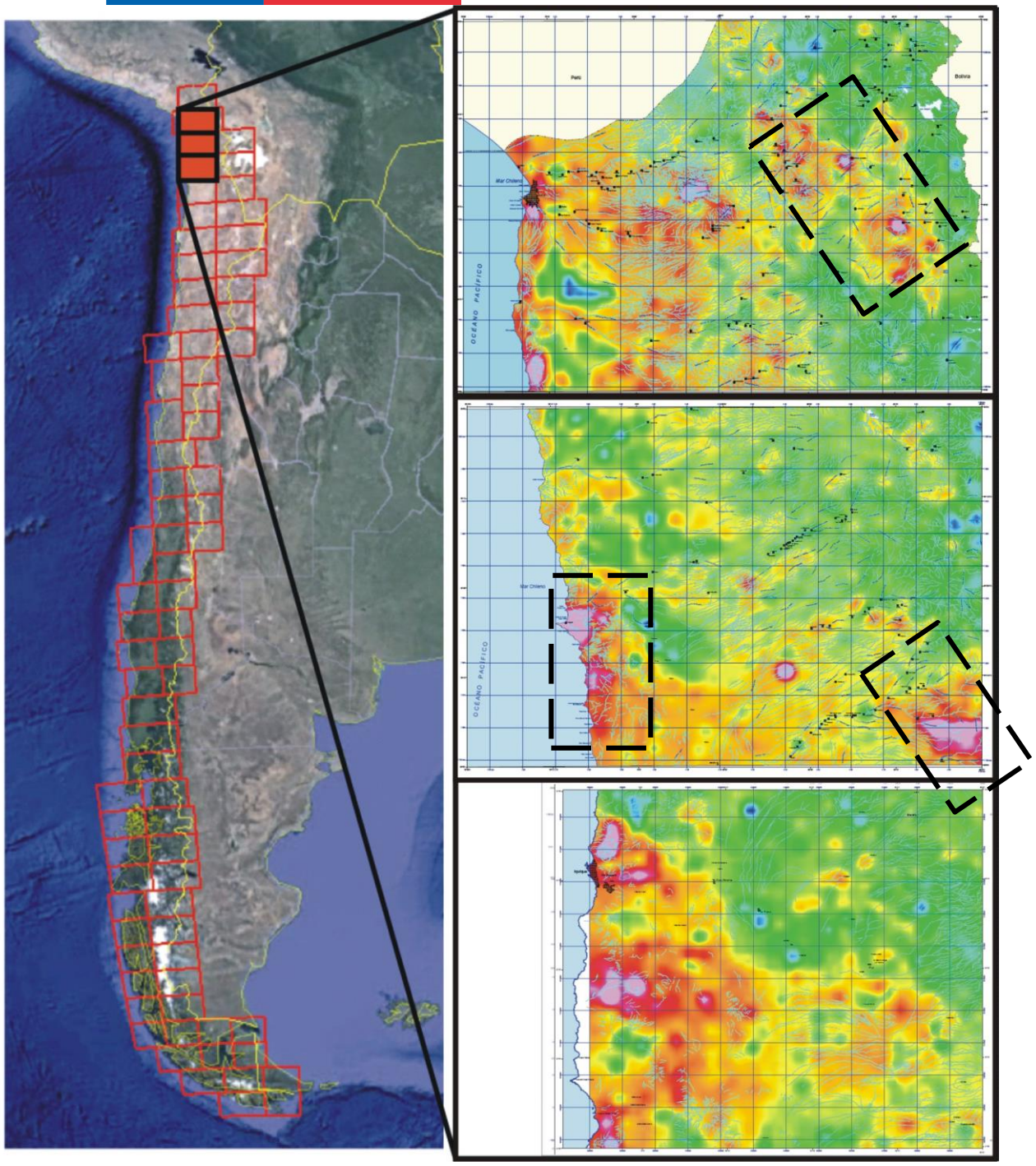
New projects & prospects (2019)

Exploration target (n = 108)



source: SERNAGEOMIN & ChilePolimetalico

IV) Mineral Potential maps: A work in progress

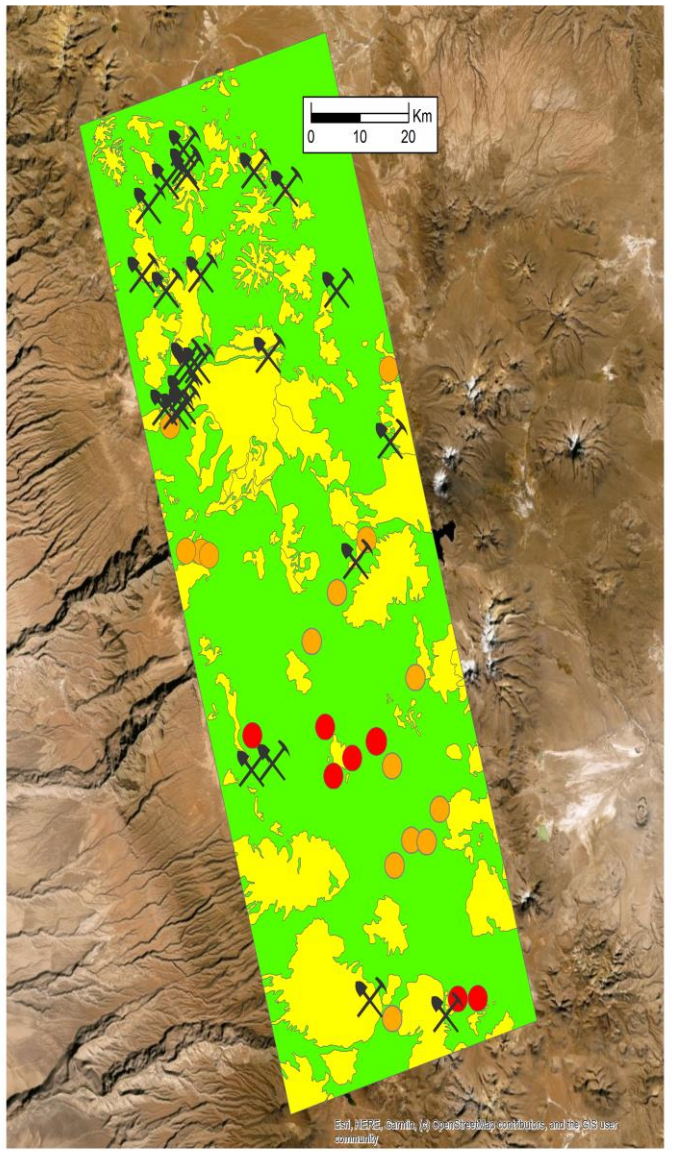


Yb (Ytterbium)

1:250.000 sheets

2300 samples

- ✓ Interpolation maps
- ✓ Regional Anomalies



Co potential map in the Arica- Parinacota region

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V) Conclusions

1. The role of Geological Surveys supporting the development of national strategies is clue in the exploration and exploitation of Critical Minerals for a sustainable development.

2. Sernageomin publish PGI and geological knowledge through different types of geological maps and studies.

3. “ChilePolimetalico” initiative is aimed to define the road map of the Critical Minerals market in Chile, pioneering on the analysis of new opportunities on the CM exploitation and definition of policies, for the future of this industry.

4. CMs in Chile are/would be mainly recovered from deposits with different principal ores (Cu, Ag, Au); focused exploration using the public geoscientific data provided by SERNAGEOMIN should yield new discovery of small/medium scale deposits, suitable for small/medium mining.

5. New and better data together with new genetic models for CM deposits are required to increase the world reserves and to satisfy the growing demand.

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GRACIAS!

www.sernageomin.cl

https://PlanNacionalGeologia.sernageomin.cl/

https://www.sernageomin.cl/sigex/

Mineral deposits DB:
http://tienda.sernageomin.cl/TiendaVirtual2/ProductDetail.aspx?pid=2863

https://chilepolimetalico.cl/