

COPPER IN PERU: FACTS AND CHALLENGES

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(1) INGEMMET

(2) EXPLOANDES

(3) ALTURAS MINERALS

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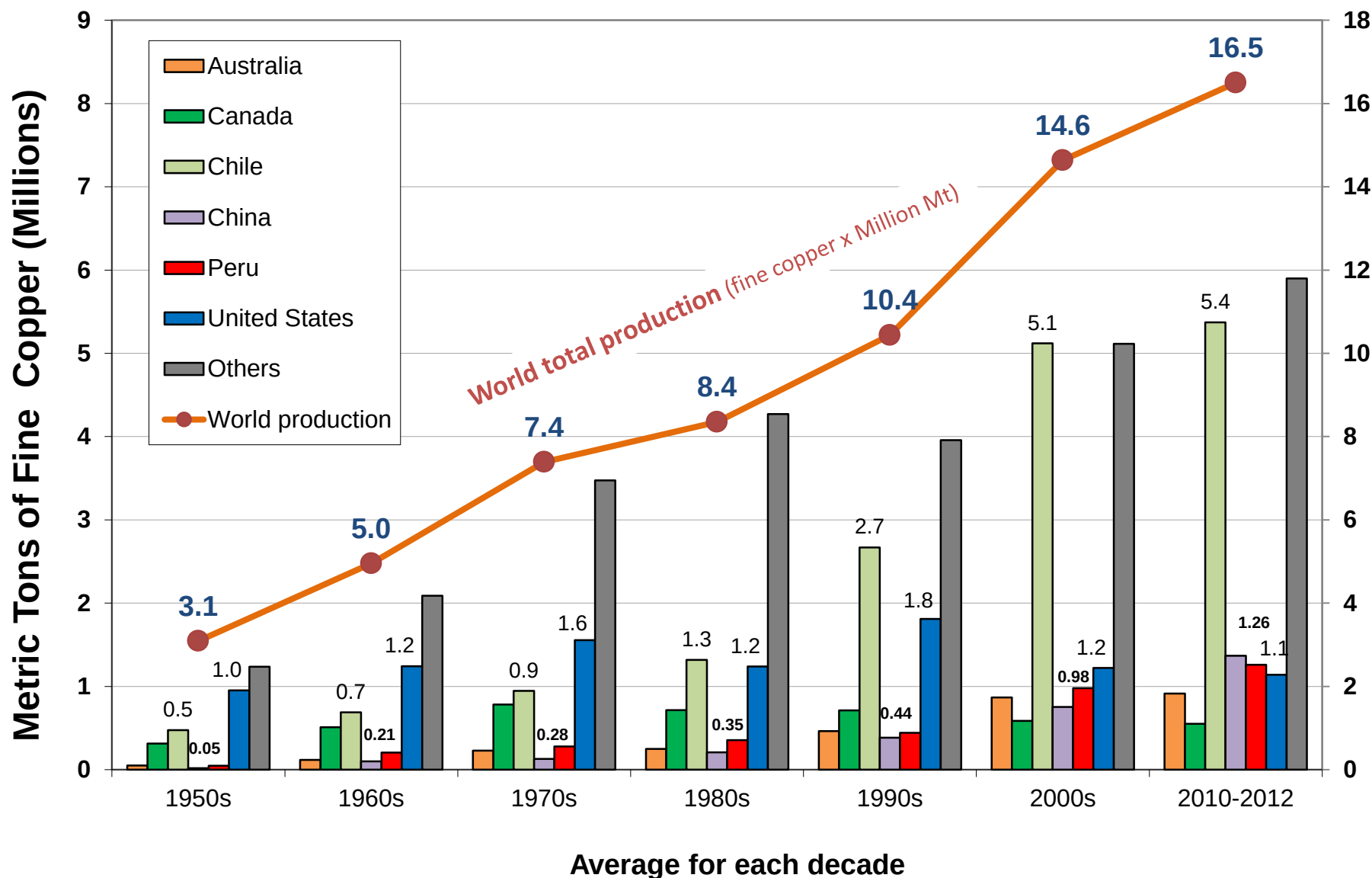
Content

- Statistical facts
- Peruvian copper belts
- Deposit types and metal contents in the main porphyry belts
- Geological models of the main porphyry belts in Peru
- Facts and challenges

Statistical Facts

Worldwide Copper Production Trends

(average for each 10 years)



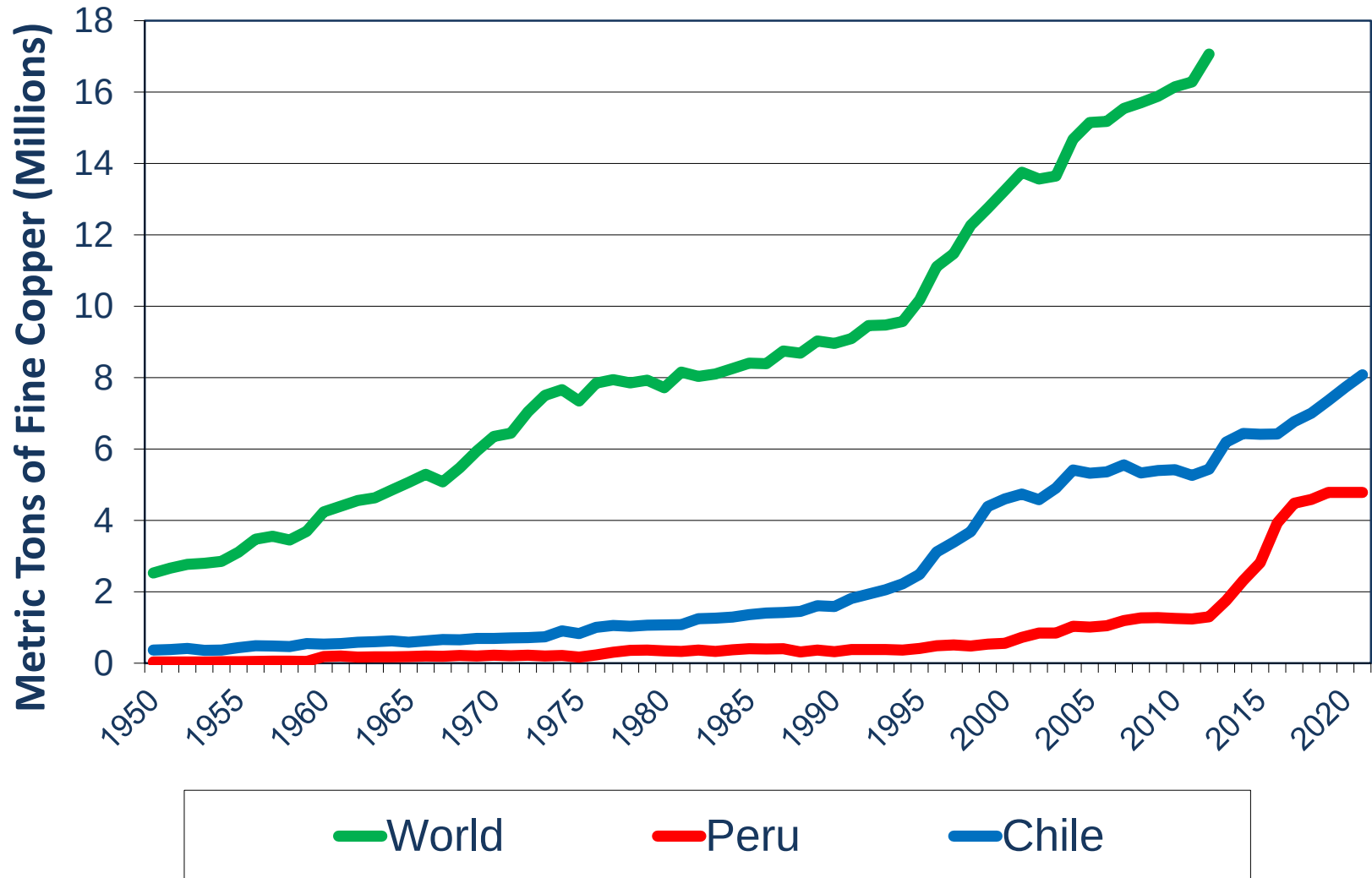
Sources: Global Copper Production from <http://minerals.usgs.gov/ds/2005/140/ds140-coppe.pdf>

Peruvian Historic Copper Production from <http://www.minem.gob.pe/estadistica.php?idSector=1&idEstadistica=5818>

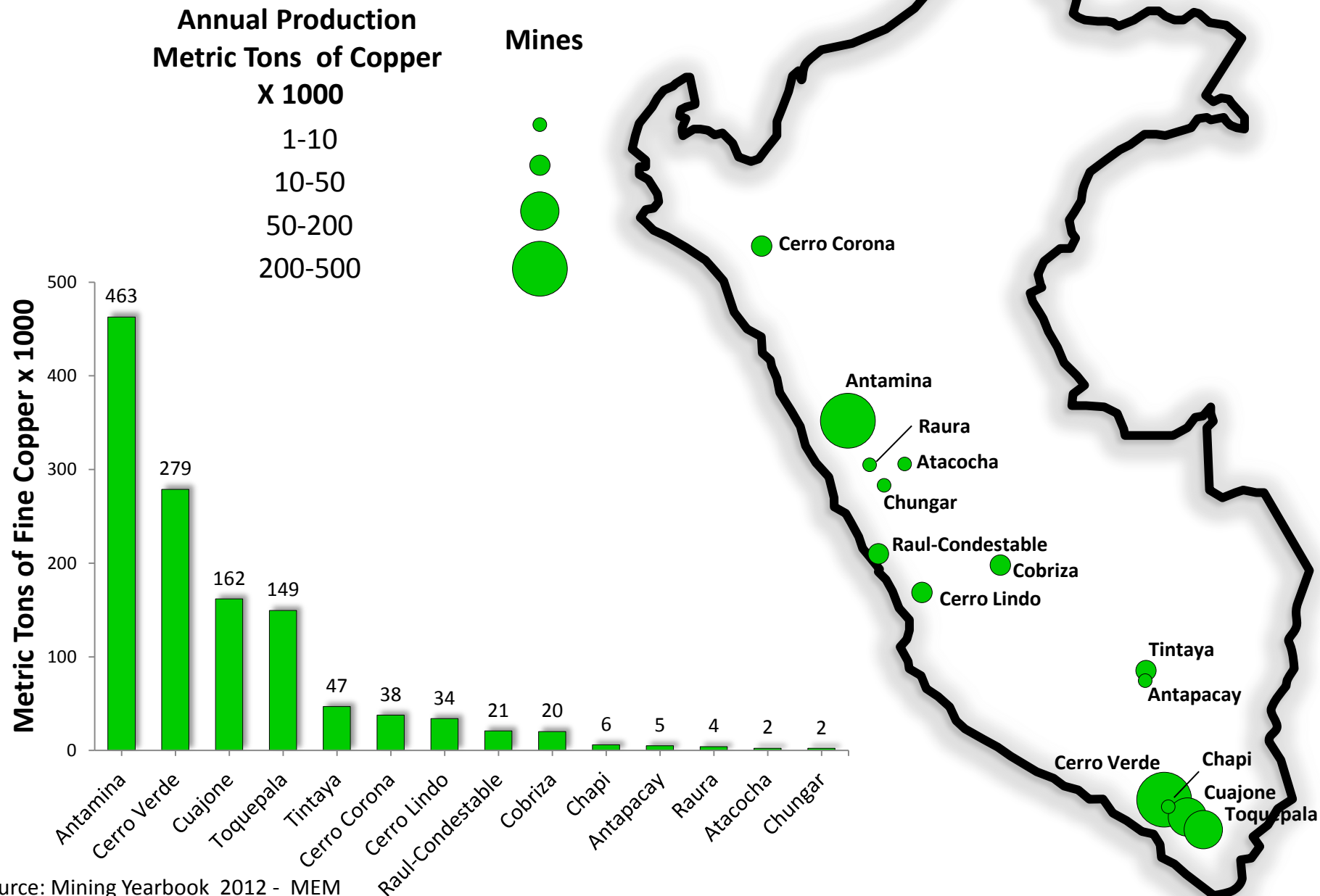
Chilean Historic and Forecast Copper Production from <http://www.cochilco.cl>

Peru and Chile Copper Production to 2021

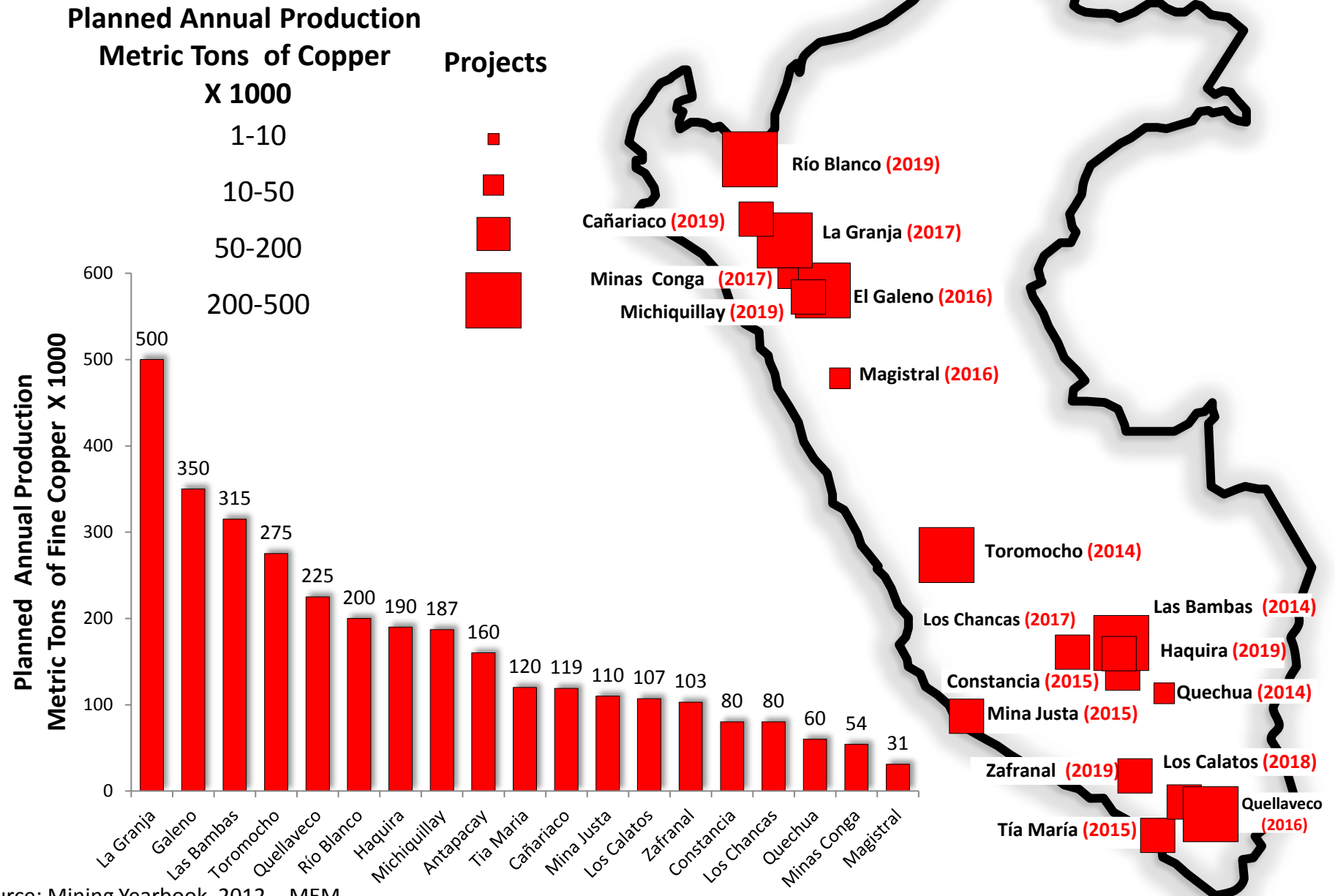
(actual + forecast)



Copper Mines in Peru - 2012



Future Copper Producers in Peru



Copper Exploration Projects



Projects with
resources > 1 MMT



Projects with
resources < 1 MMT



Prospects

Source: Mining Yearbook 2012 - MEM

Reserves and Resources from Annual Reports of Mining Companies

Ore Mineral Deposits Data Base from <http://geocatmin.ingemmet.gob.pe/geocatmin/>

Copper Mines and Projects in Peru

Actual and Planned
Annual Production
Metric Tons of
Fine Copper X 1000

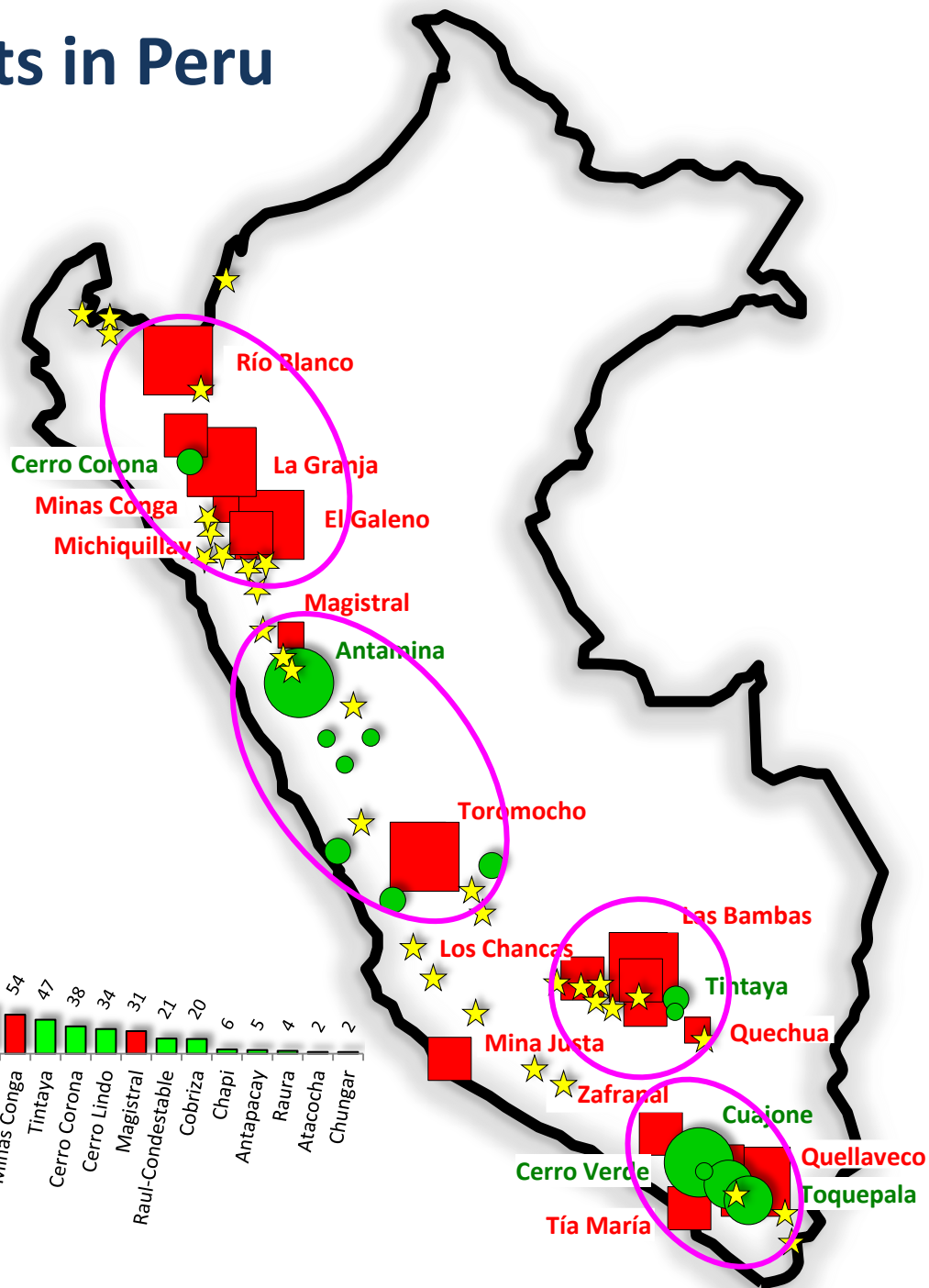
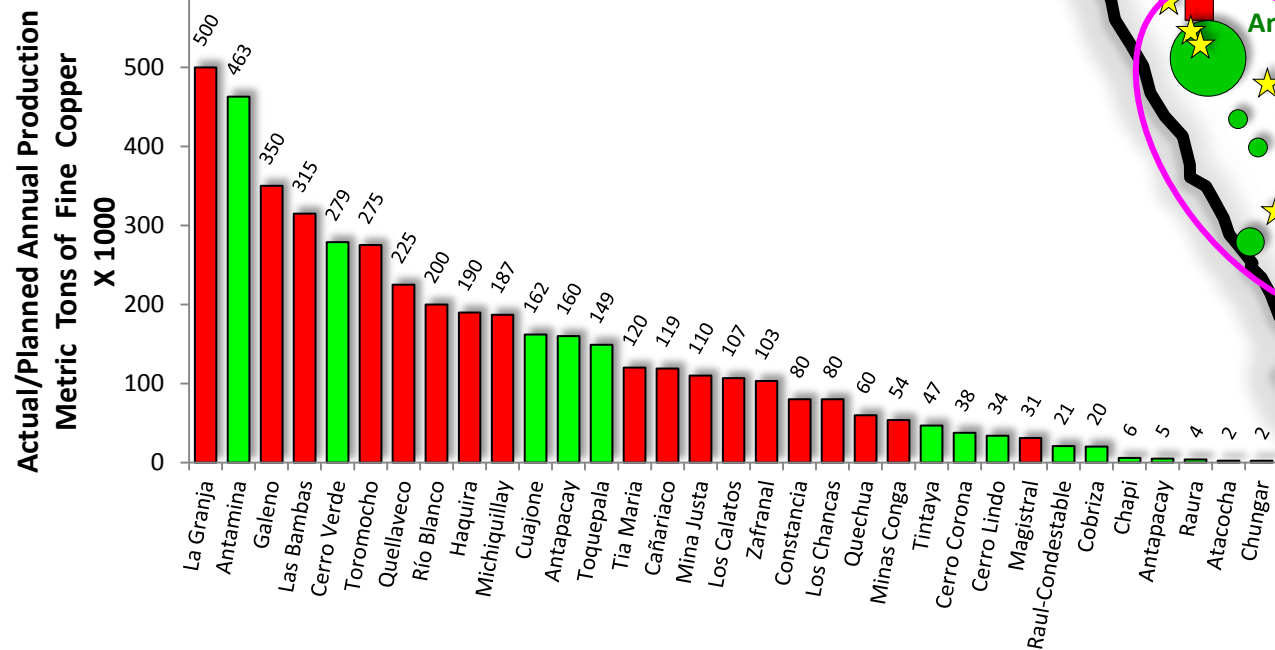
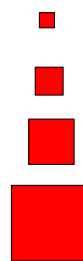
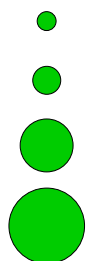
Mines Projects

1-10

10-50

50-200

200-500



Peruvian Copper Belts

Main Porphyry Belts, Mines and Projects in Peru

Actual and Planned Annual
Production in Metric Tons of
Fine Copper
X 1000

0

1-10

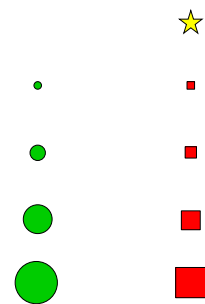
10-50

50-200

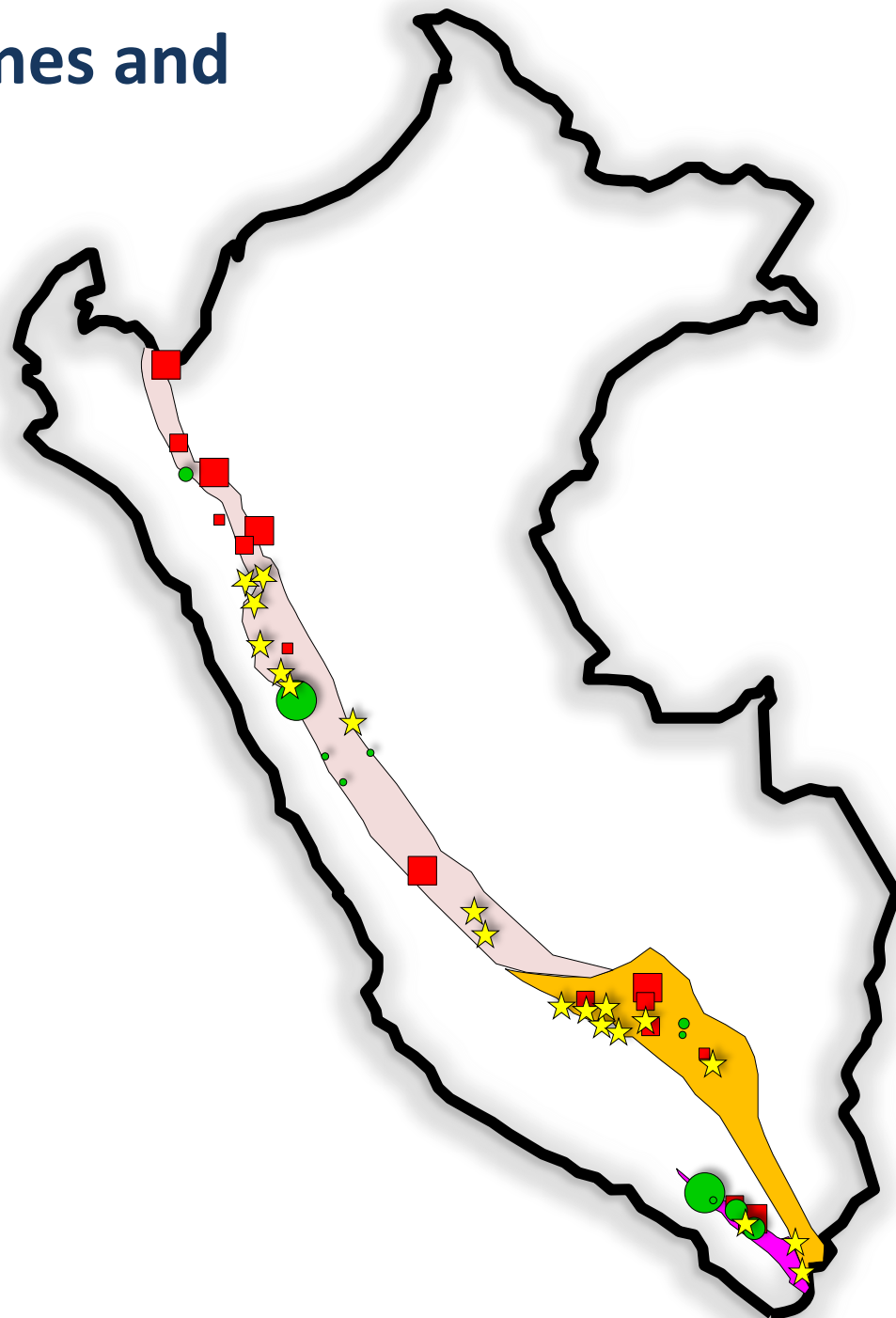
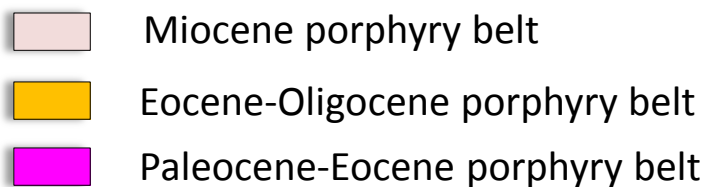
200-500

Mines

Projects



Metallogenic belts



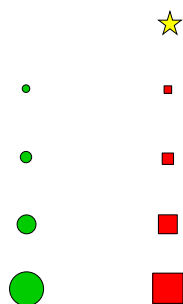
Other Copper Belts in Peru

Metric Tons of
Fine Copper X 1000

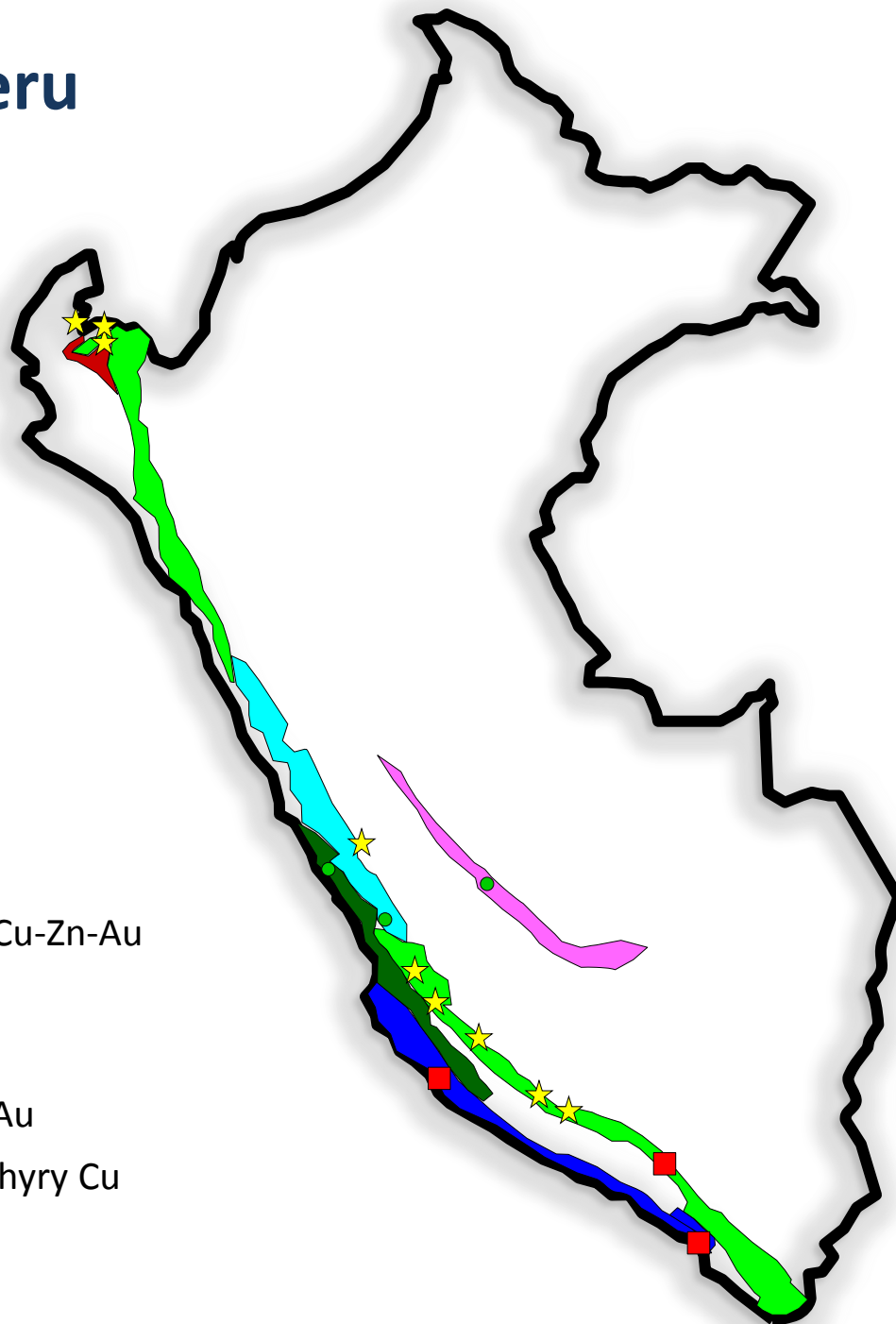
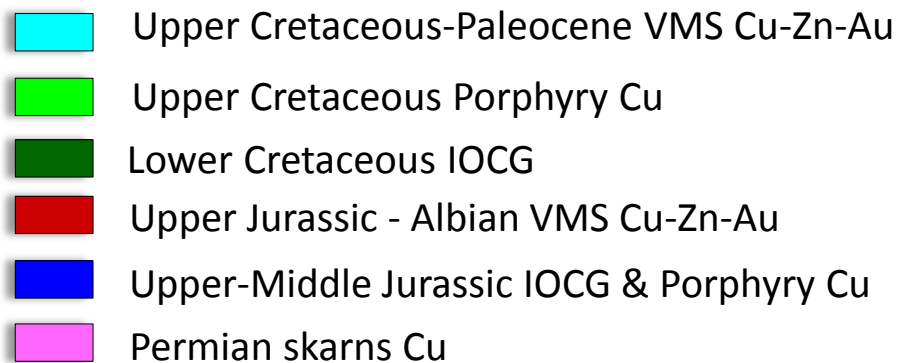
0
1-10
10-50
50-200
200-500

Mines

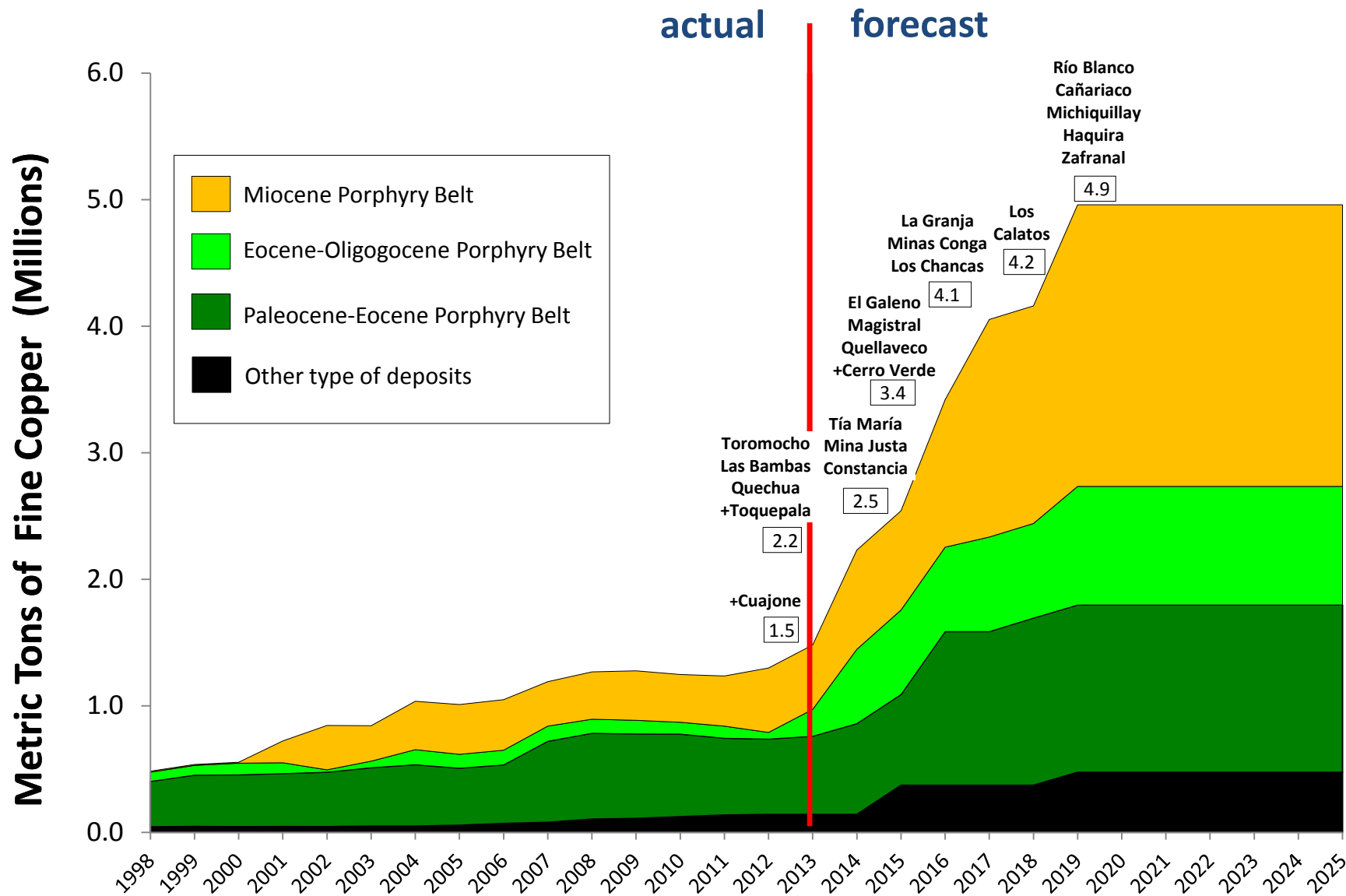
Projects



Metallogenic belts



Peruvian Copper Production 1998-2025



Deposit Types in the Main Porphyry Belts in Peru

Deposit Types

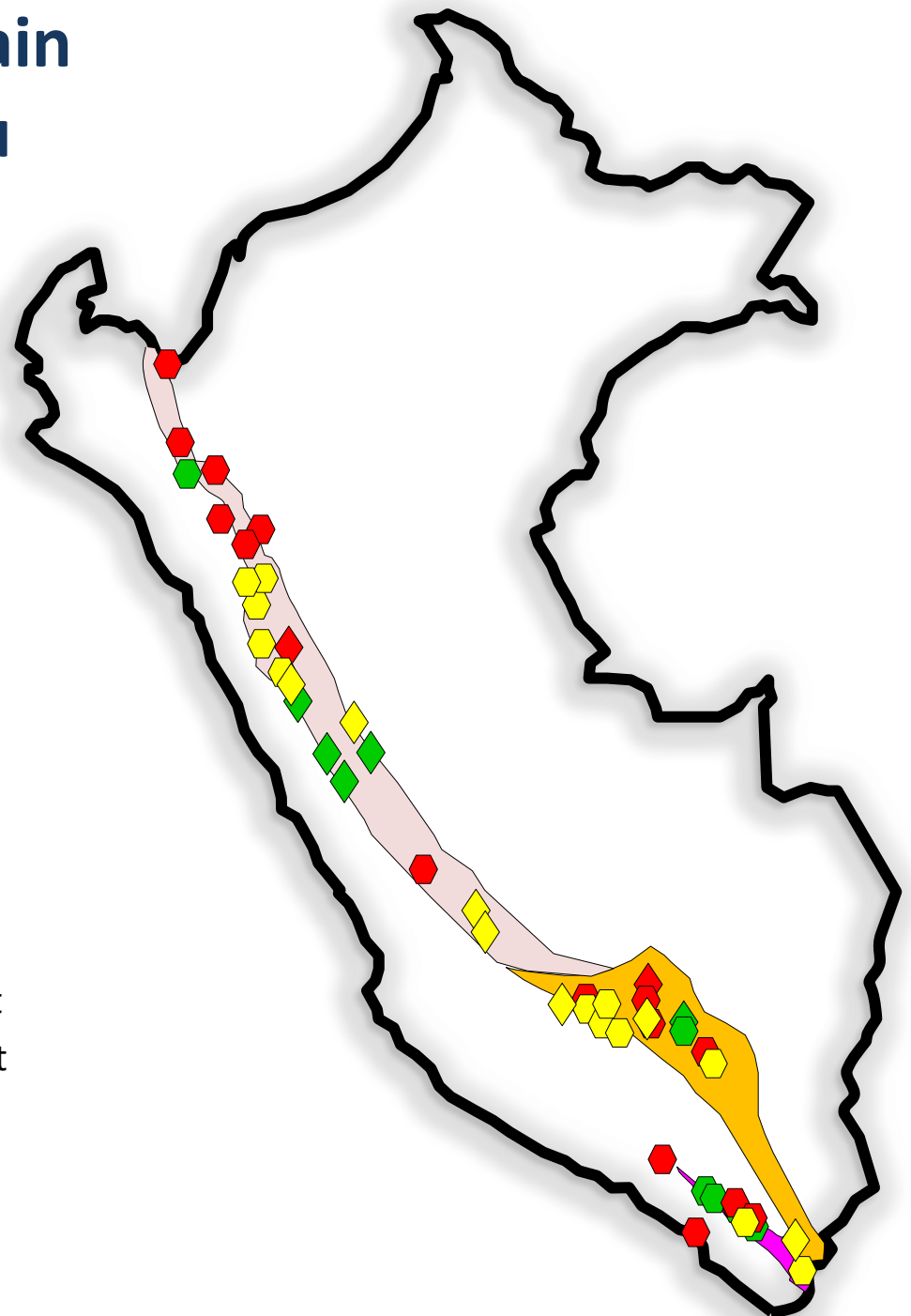
- Porphyry
- ◇ Skarn
- △ Other

State

- Mines
- Future Producers
- Exploration projects

Metallogenic belts

- Miocene porphyry belt
- Eocene-oligocene porphyry belt
- Paleocene-Eocene porphyry belt



Deposits Types in Other Belts in Peru

Deposit Types

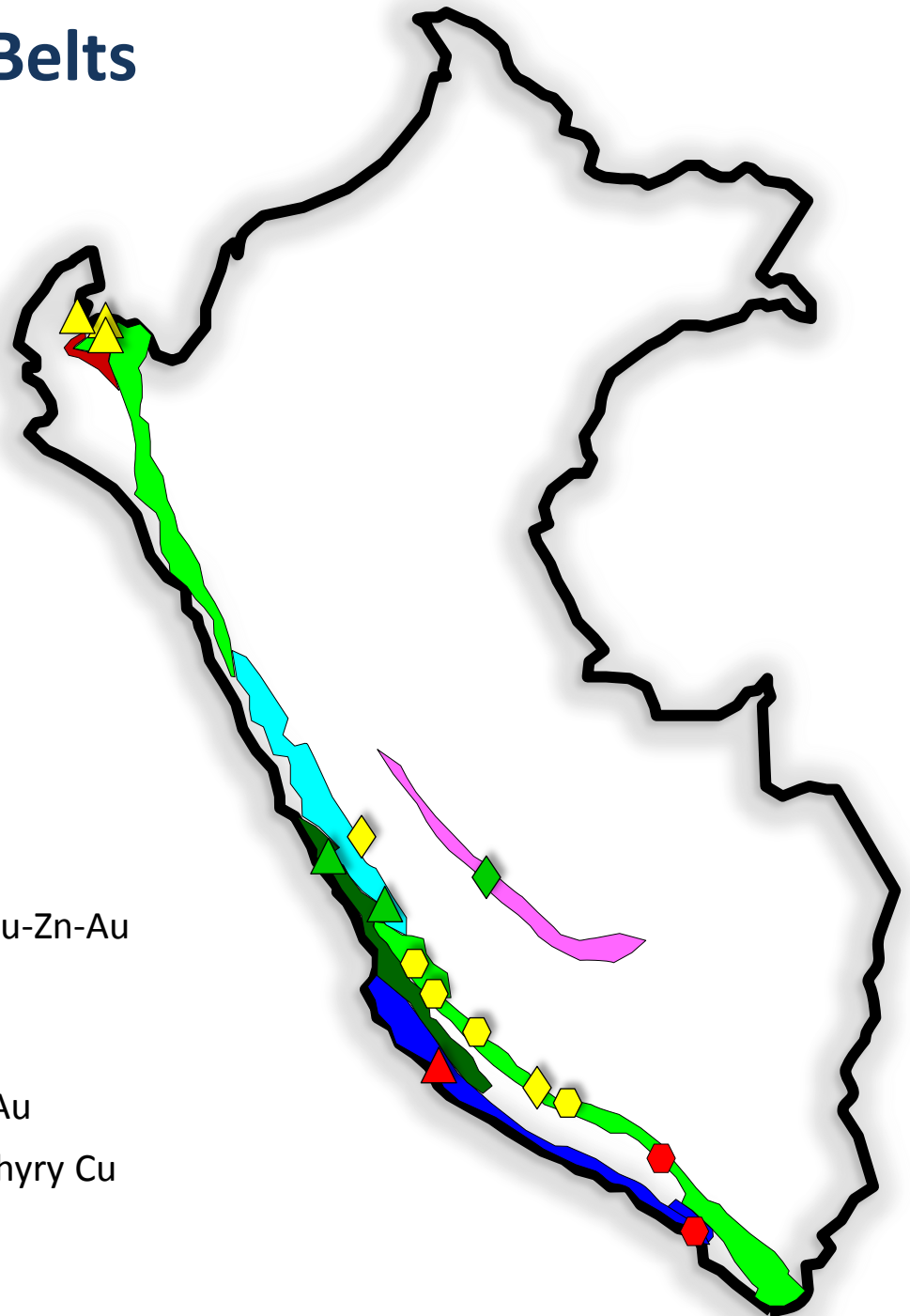
- ⬡ Porphyry
- ⬠ Skarn
- ⬡ Other

State

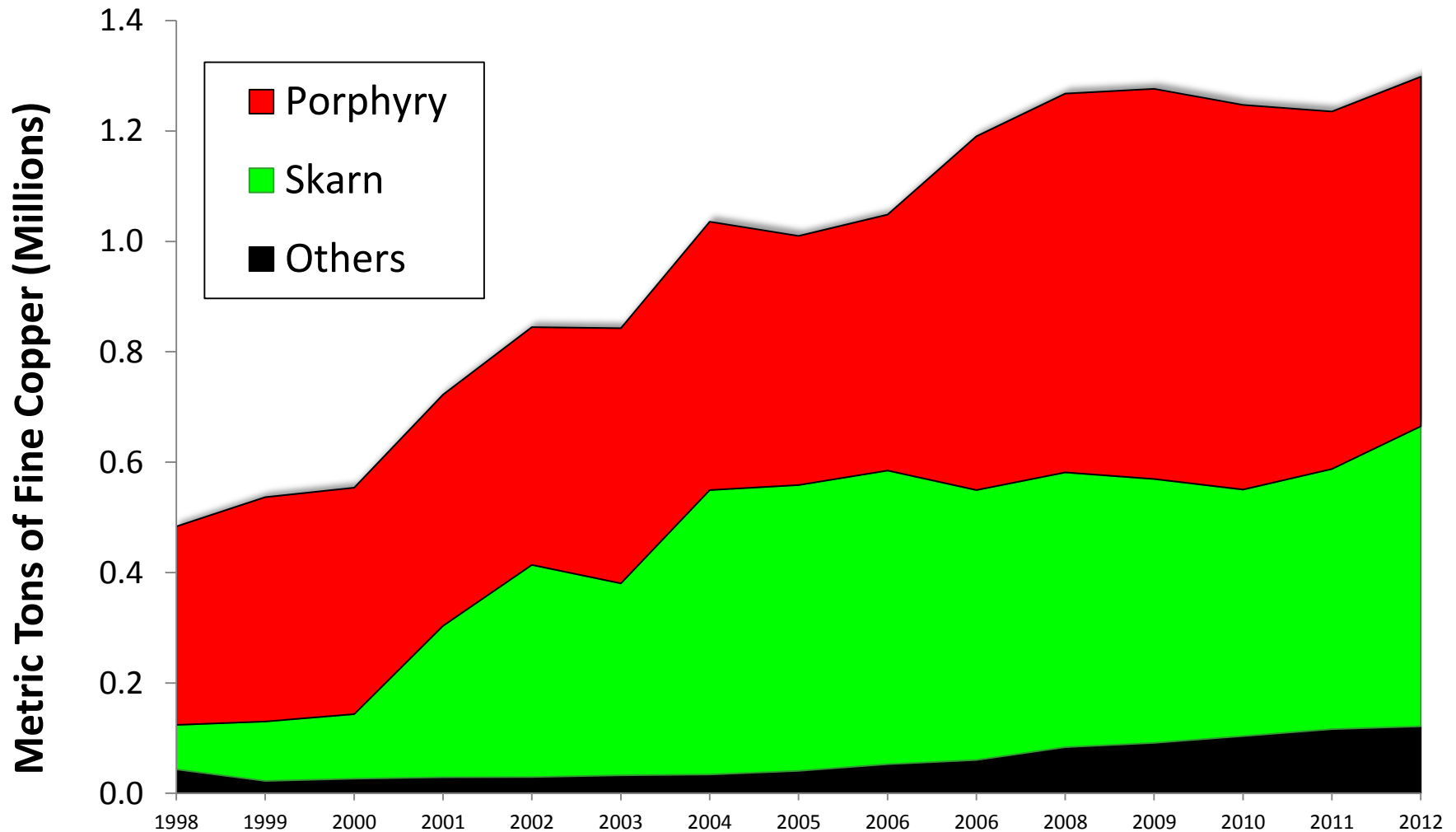
- Mines
- Future Producers
- Exploration projects

Metallogenic belts

- Upper Cretaceous-Paleocene VMS Cu-Zn-Au
- Upper Cretaceous Porphyry Cu
- Lower Cretaceous IOCG
- Upper Jurassic - Albian VMS Cu-Zn-Au
- Upper-Middle Jurassic IOCG & Porphyry Cu
- Permian Skarns Cu



Peruvian Copper Production by Deposit Types



Historic Cumulative Copper Production in Peru

Total Production in Peru

28 MMT (100%)

Production from main porphyry belts

23 MMT (82%)

Other Cu belts: 2 MMT (7%)

Other non-Cu belts: 3 MMT (11%)

Million Metric Tons
of Fine copper

Mines

< 1



1-3



3-5



5-7



Metallogenic belts



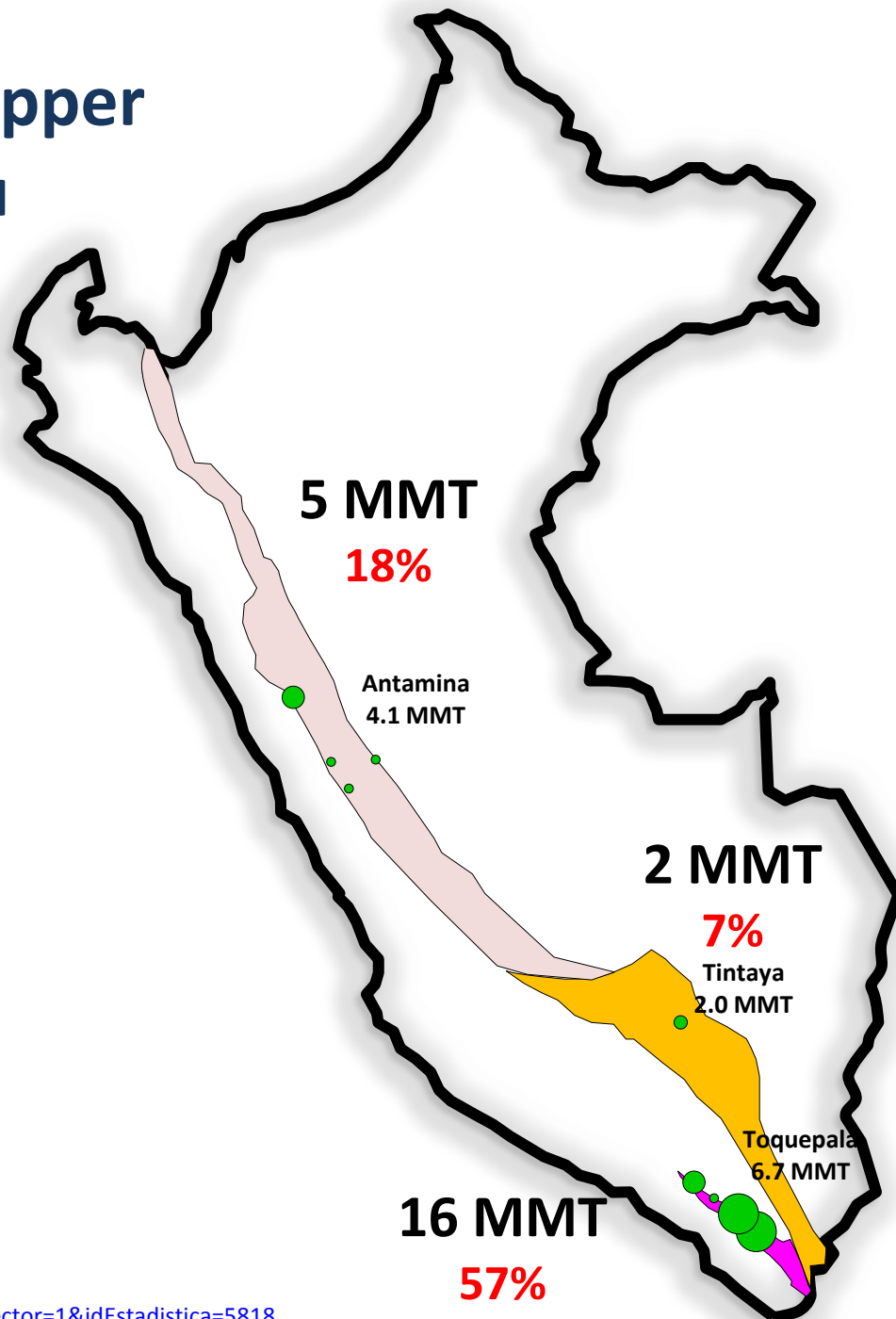
Miocene porphyry belt



Eocene-oligocene porphyry belt



Paleocene porphyry belt



16 MMT
57%

2 MMT
7%
Tintaya
2.0 MMT

Antamina
4.1 MMT

Toquepala
6.7 MMT

Sources: Belts from Metallogenic Map of Peru 2011- INGEMMET

Historic Copper Production from <http://www.minem.gob.pe/estadistica.php?idSector=1&idEstadistica=5818>

Copper Resources and Reserves in the Main Porphyry Belts in Peru

Total reported resources in Peru

218 MMT (100%)

Resources from porphyry belts

192 MMT (88%)

Other Cu belts: 11 MMT (5%)

Other non-Cu belts: 15 MMT (7%)

Millions Metric Tons
of Fine Copper

< 1

1-5

5-10

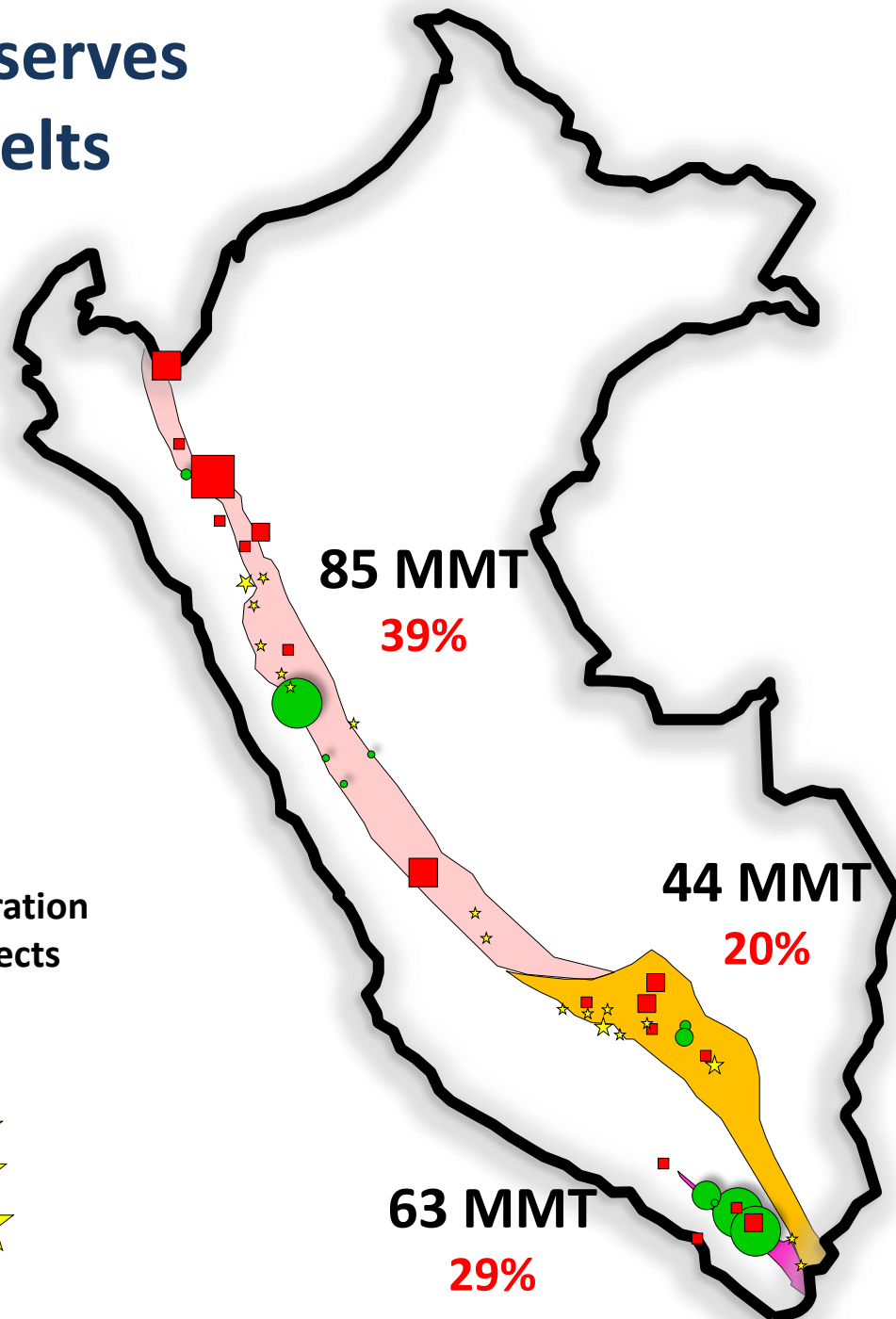
10-15

> 15

Mines

Future
Producers

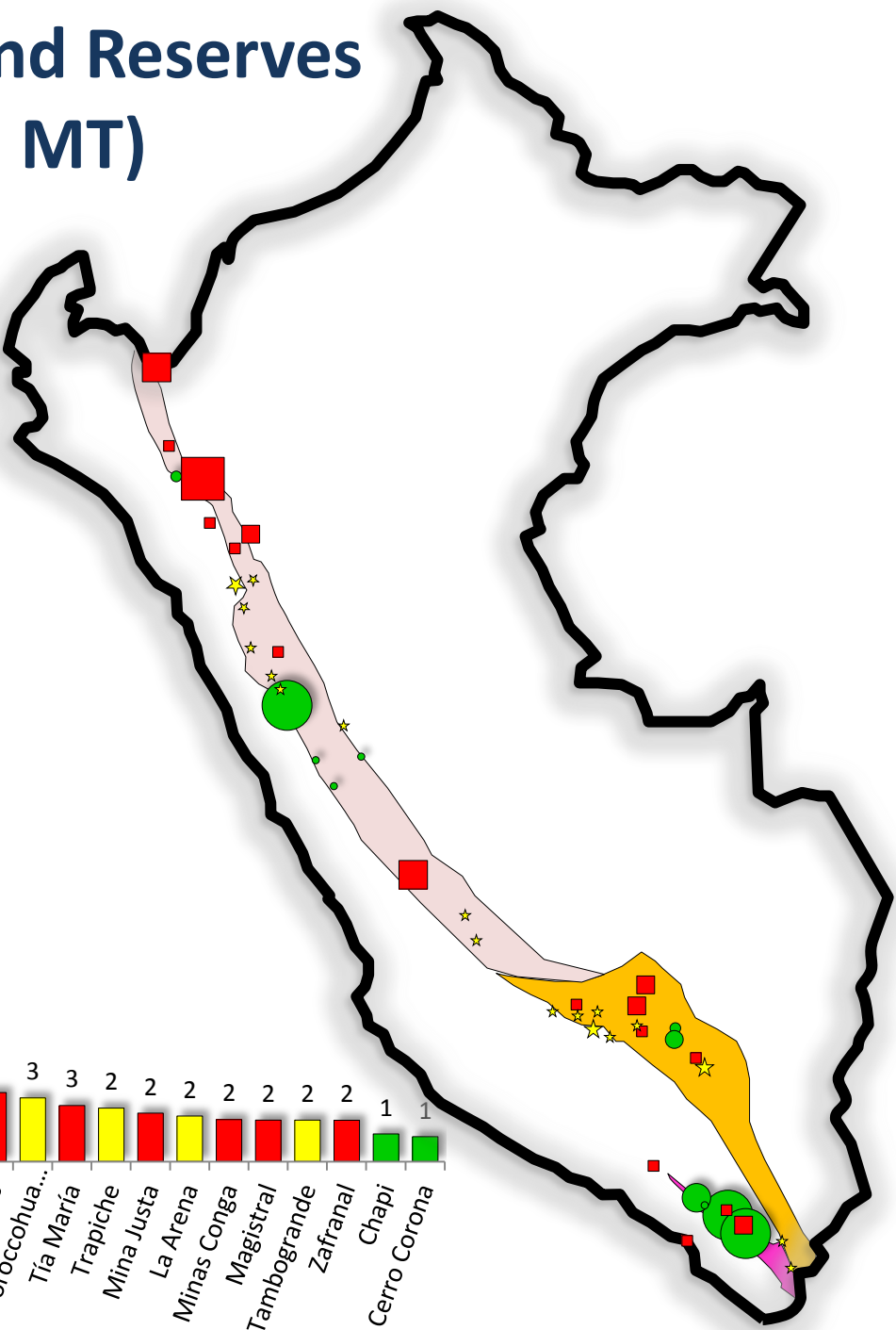
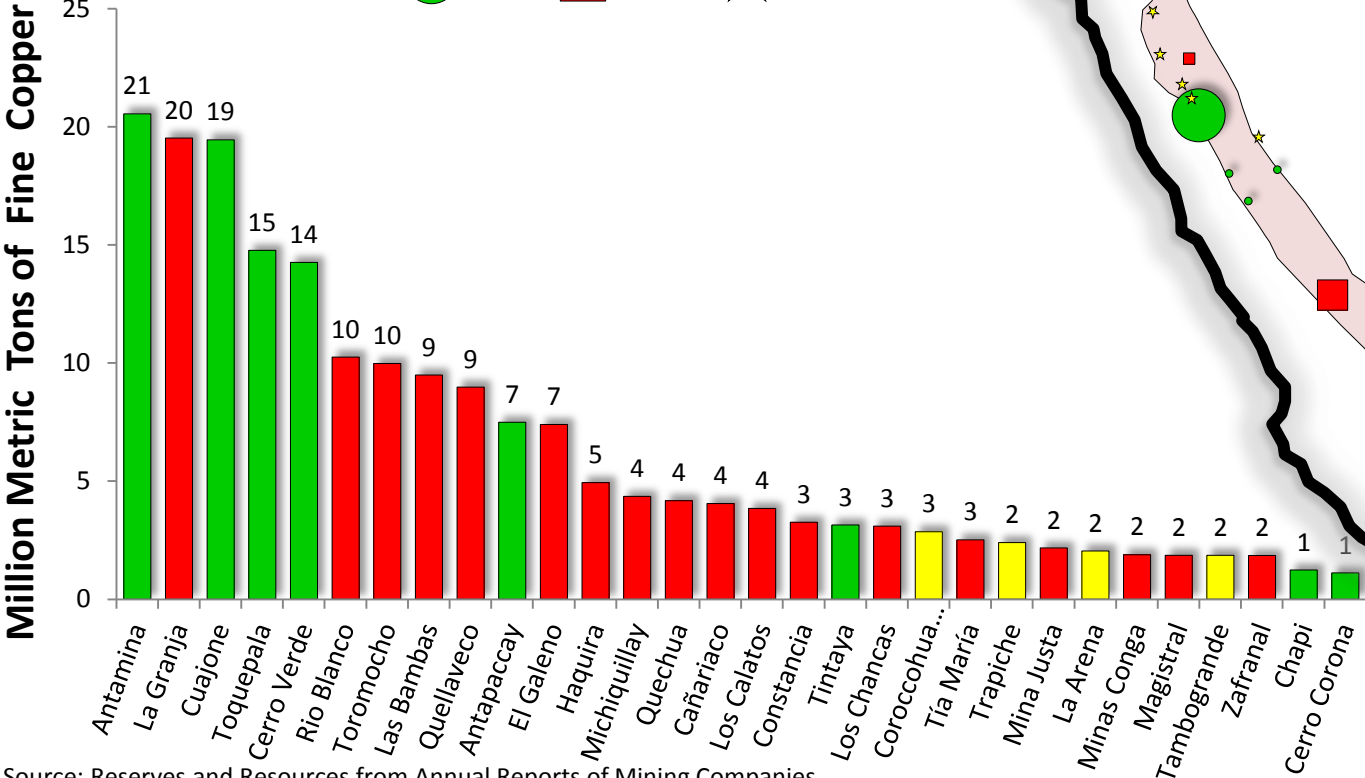
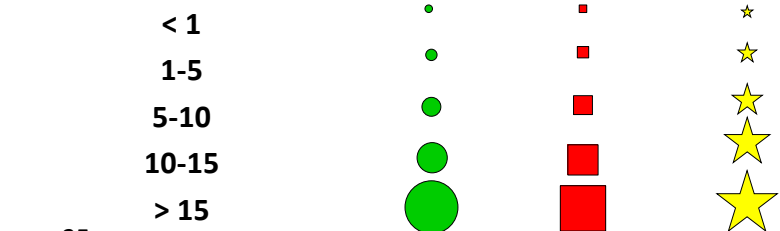
Exploration
Projects



Main Copper Resources and Reserves in Peru (> 1 Million MT)

Millions Metric Tons of Fine Copper

Mines Future Producers Exploration Projects



Source: Reserves and Resources from Annual Reports of Mining Companies

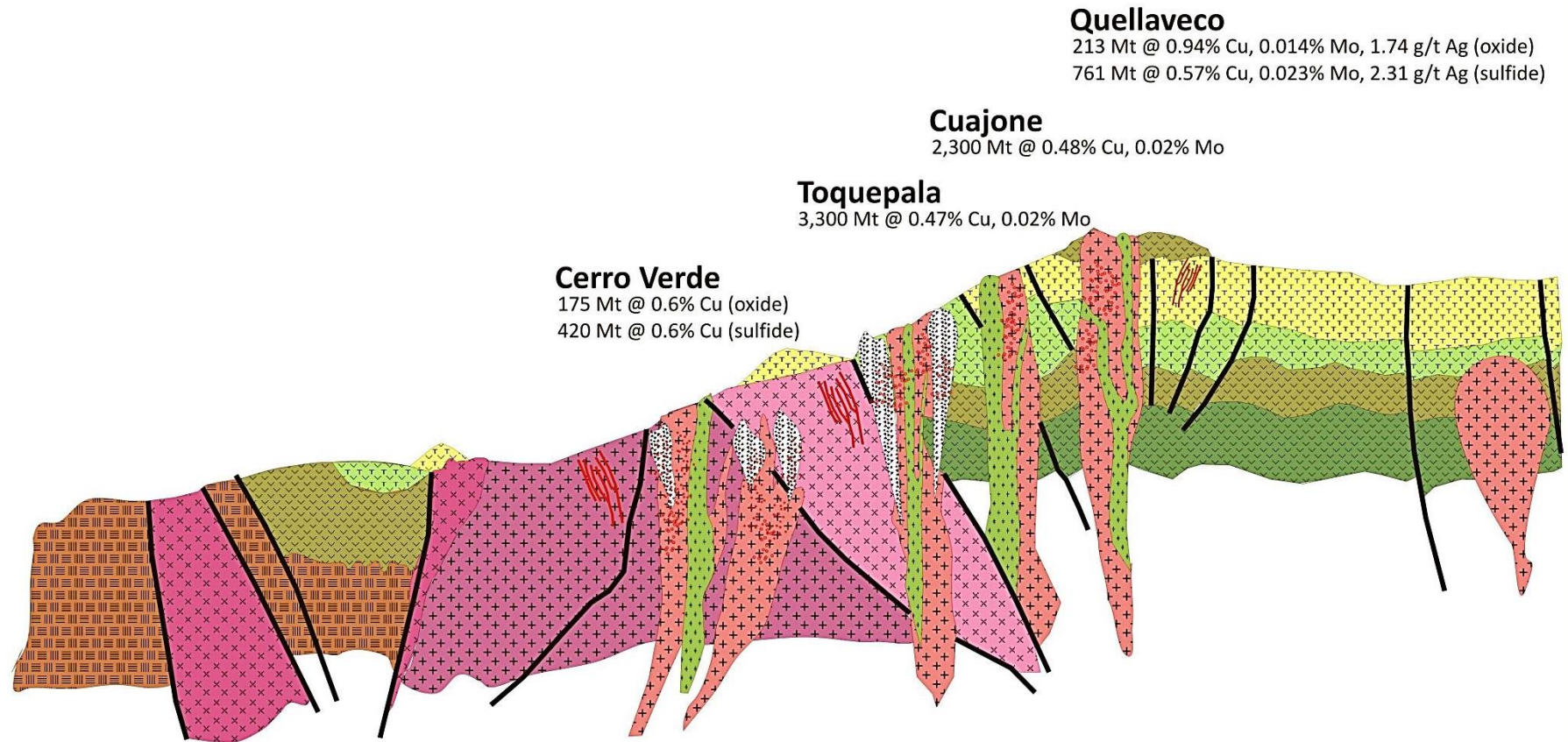


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Geological Models of the Main Porphyry Belts in peru

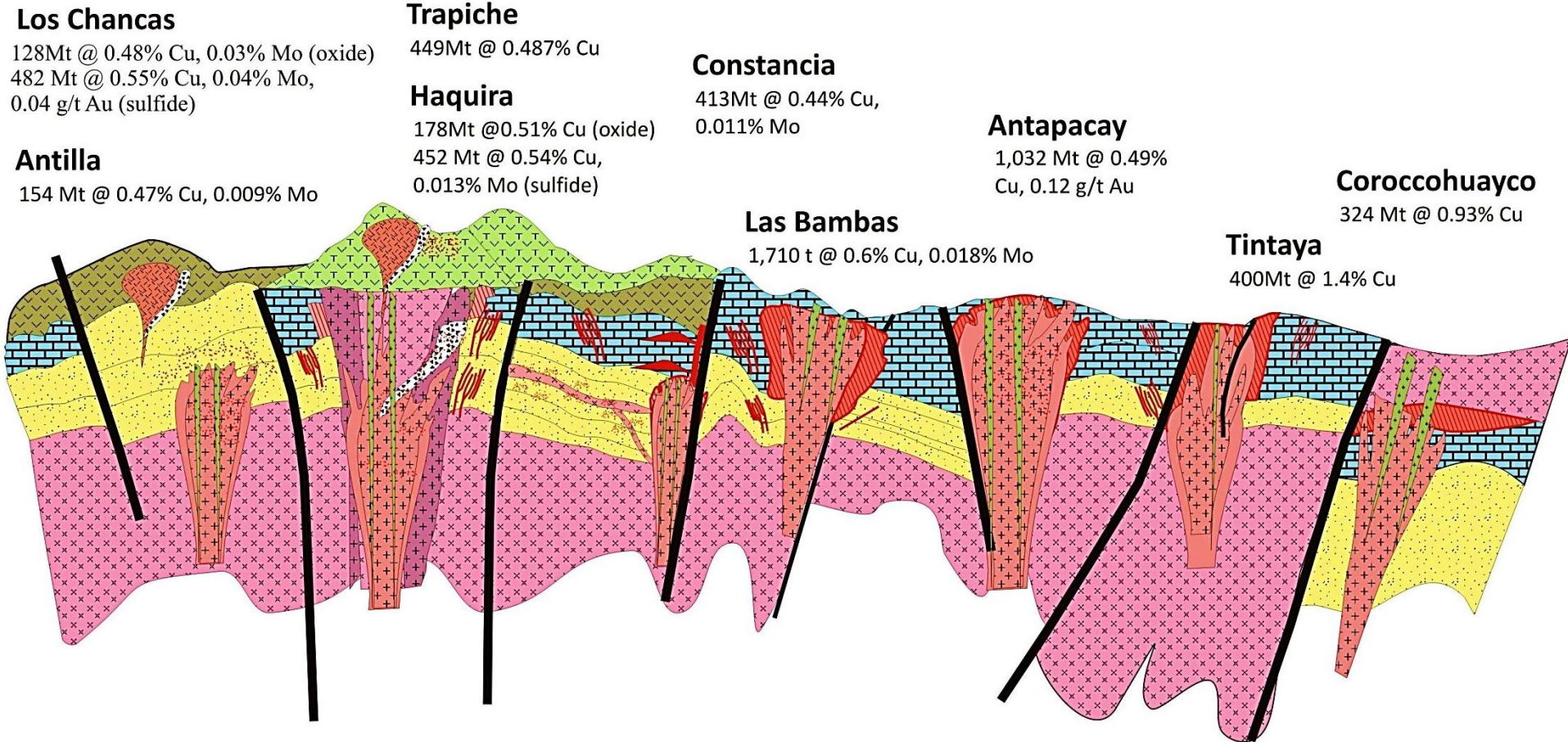
Geological Models - Paleocene Magmatic Belt



LEGEND

	Tuff		Late porphyry		Disseminated		Breccia
	Andesitic Tuff		Monzonite (Porphyry)		Mesothermal vein		
	Andesite		Granodiorite		Porphyry Cu ± Mo ± Au		
	Andesic pillow lavas		Diorite				
	Metamorphic		Gabro				

Geological Models - Eocene-Oligocene Magmatic Belt

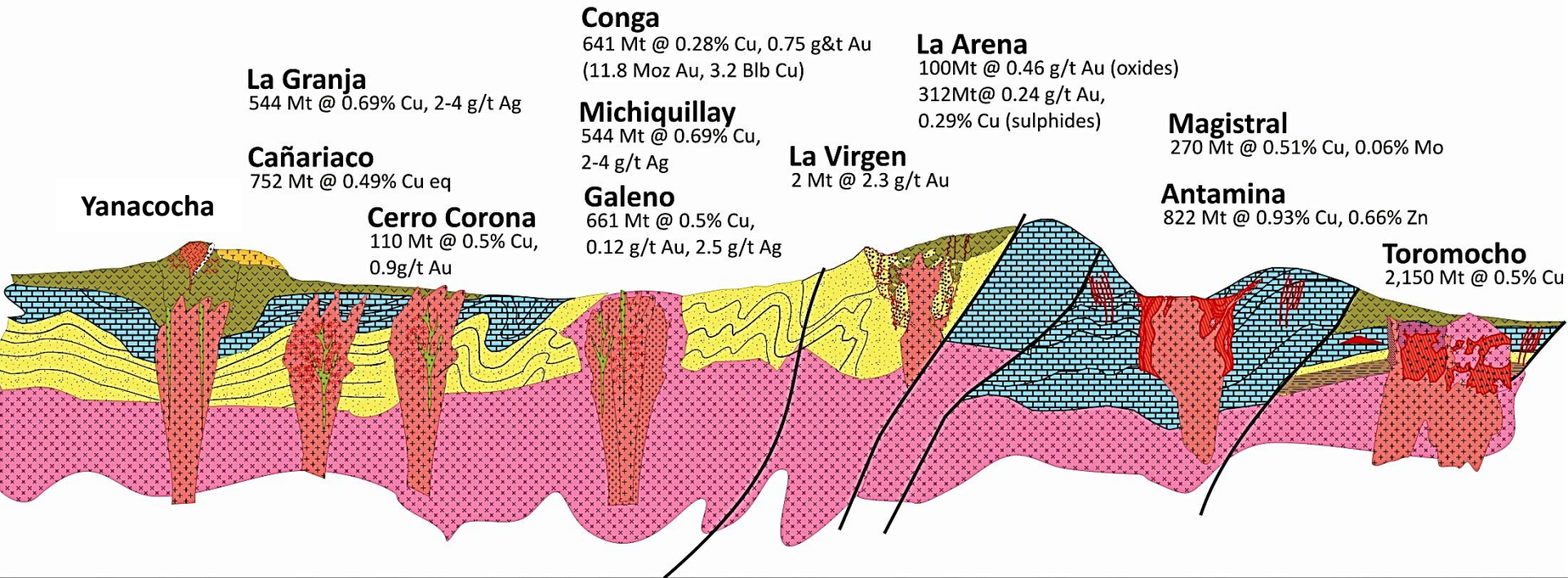


LEGEND

	Tuff		Breccia		Disseminated		Replacement
	Andesite		Late porphyry		Vein/ disseminated		Epithermal/mesothermal vein
	Dome		Monzonite (Porphyry)		Skarn		Porphyry Cu $\pm$ Mo $\pm$ Au
	Carbonate		Monzodiorite				
	Sandstone		Diorite				

Sources: Articles from SEG, Peruvian Geological Congress, ProExplos, Annual Reports from Mining

Geological Models - Miocene Magmatic Belt



LEGEND

	Tuff		Late porphyry		Disseminated		Replacement
	Andesite		Monzonite (Porphyry)		Vein		Epithermal/mesothermal vein
	Dome		Monzodiorite		Skarn		Porphyry Cu ± Mo ± Au
	Carbonate		Diorite				
	Sandstone		Breccia				
	Shale						

Facts and Challenges

Distinctive Features of Main Deposit Belts and Types

Belt Features		Paleocene	Eocene-Oligocene	Miocene
Size		Mostly large to very large, +300 MMT to 4,000 MMT	Mid- to large, +400 MMT to 1,800 MMT	Mid- to very large, +400 MMT to 4,000 MMT
Average grade	Copper	0.39 - 0.47 % Cu	0.44 - 0.93 % Cu	0.28 - 0.69 % Cu
	Gold	0.03 g/t Au	0.04 - 0.25 g/t Au	0.05 - 0.90 g/t Au
	Silver	2.20 - 3.10 g/t Ag	1.45 - 4.75 g/t Ag	1.24 - 6.90 g/t Ag
	Moly	0.02 % Mo	0.013 - 0.030 % Mo	up to 0.010 % Mo
Weathering		Commonly, intense development of oxide and secondary sulphide vertical zones	Limited	Limited
Geometry		Clusters of mid- to large-sized porphyry. Mineralization occurs in the intrusives as well as in their country rocks.	Complex, mineralized skarn bodies are small- to mid-size and irregular, mostly above porphyries but also underneath intrusive bodies. Gold mineralization occurs	Structurally aligned porphyries. Mineralization occurs in the intrusives as well as in their country rocks. Gold mineralization in sandstones and bulk-tonnage, polymetallic mineralization in skarns frequently associated

Exploration Challenges

- Among the challenges we have in the short term is to guarantee the implementation of future copper producers in Peru and ensure that the initial exploration projects become mining operations. In the long term it is necessary to increase investment in mineral exploration to expand reserves and resources and discovery of new deposits, so it will need to improve, innovate and implement new geophysical methods.
- Worldwide investment in mineral exploration is expected to drop in 2013 by no less than 40%.
- Last decrease was 42% in 2009, while it dropped only 18% in Peru as major mining houses maintained their drilling programs whereas junior exploration companies cut their programs.
- In 2013, investment in mineral exploration in Peru will likely follow the international tendency, as exploration cuts and significant delays in environmental permitting are affecting all companies.

Exploration Challenges

- Promoting mineral exploration is essential to increase both metal production and long-term resources.
- Both financial and technical incentives are required and social barriers have to be removed.
- INGEMMET offers 1:100,000 and 1:50,000 scale regional maps covering the whole of the country and most of the territory is also covered by drainage geochemical sampling.
- Regional geophysical surveys (magnetic and radiometric) are insufficient.
- Radiometric age data is extensive, but still needs to be expanded.
- Isotopic studies useful to distinguish most productive mineralized systems and to identify mineralization sources are still very limited.
- Studies of magmatic arcs related to mineralized systems are insufficient.

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