

Recent trends in copper exploration *- are we finding enough ?*

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Overview

- Trends in Exploration Expenditures
- Current “Hot Spots” for Exploration
 - Half of all recent discoveries were in “High Risk” countries
- Trend in Discovery Rates & Costs
 - Was 1 - 1.5 c/lb, now running at 2.5 c.lb Cu-eq of Resource
- Trends in conversion rates (from Discovery > Development)
 - Not all Resources get converted into Reserves
 - Not all discoveries get mined, and those that do may take many years
- Are we finding enough metal ?
 - Need to find > 2x mine production
- Conclusions

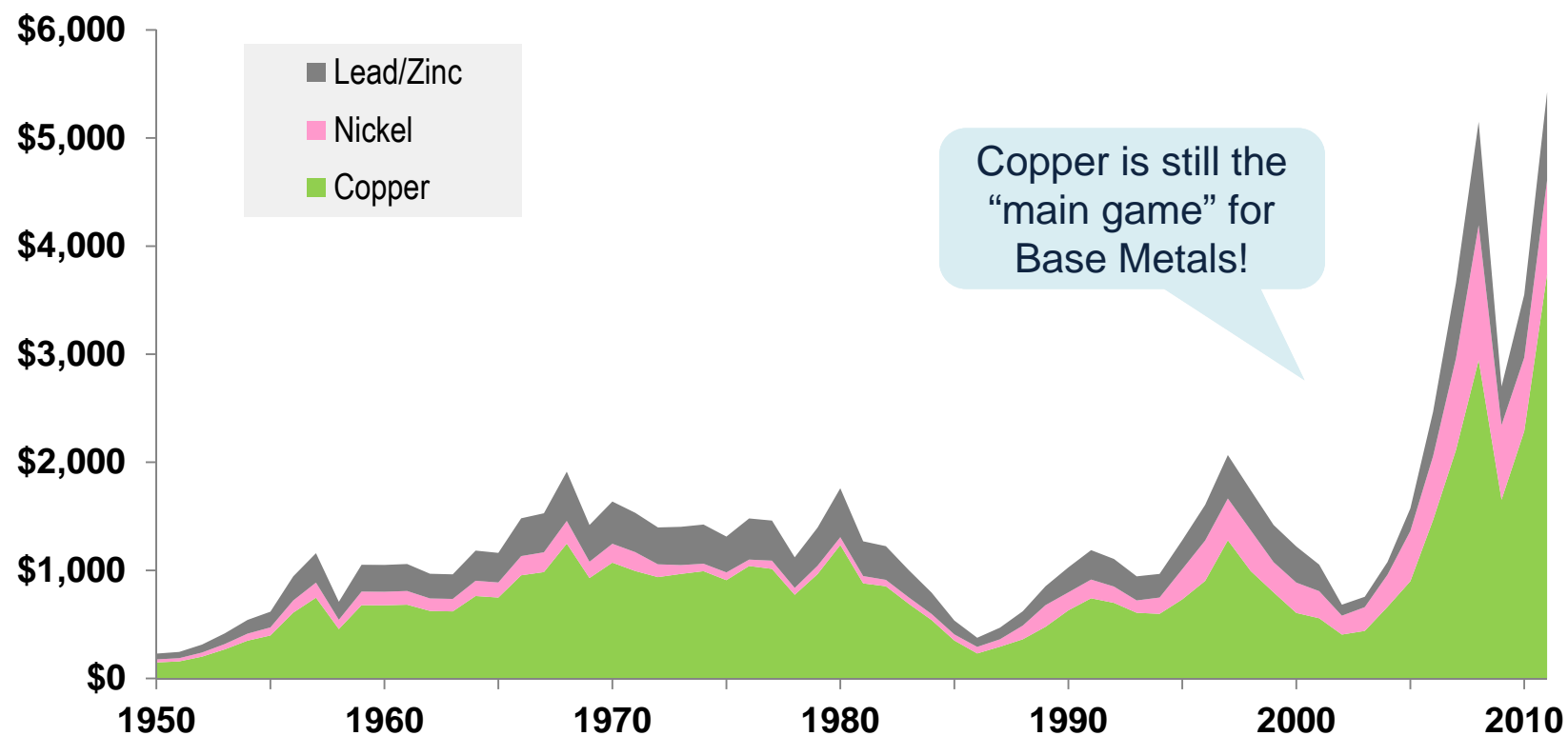
Spending on copper exploration over the last 60 years

TRENDS IN EXPLORATION EXPENDITURES

Base Metal Exploration Expenditures

Western World: 1950-2011

June 2011 US\$m

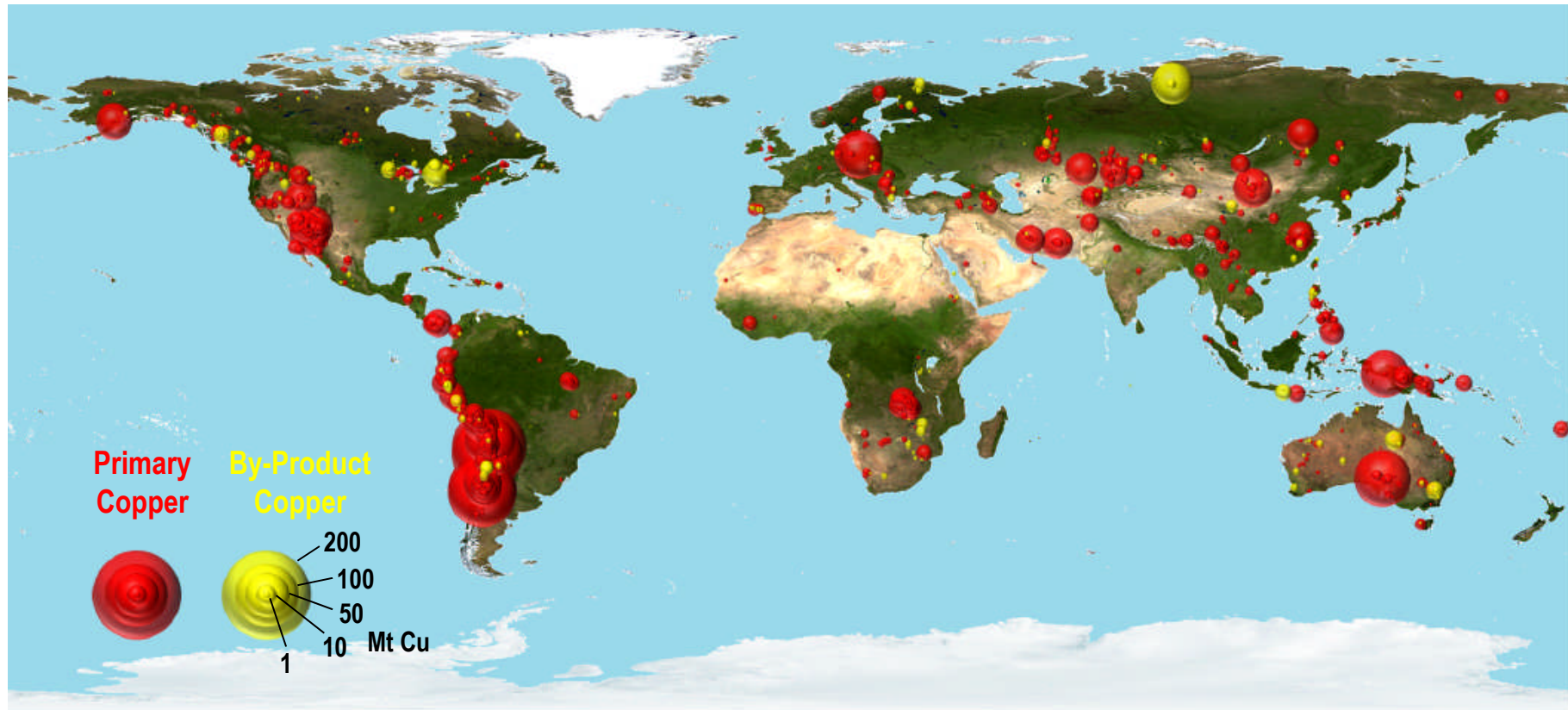


Source: Estimates by MinEx Consulting © August 2012

World map and current “Hot Spots” for copper exploration

RECENT COPPER DISCOVERIES AROUND THE WORLD

Location of major copper deposits



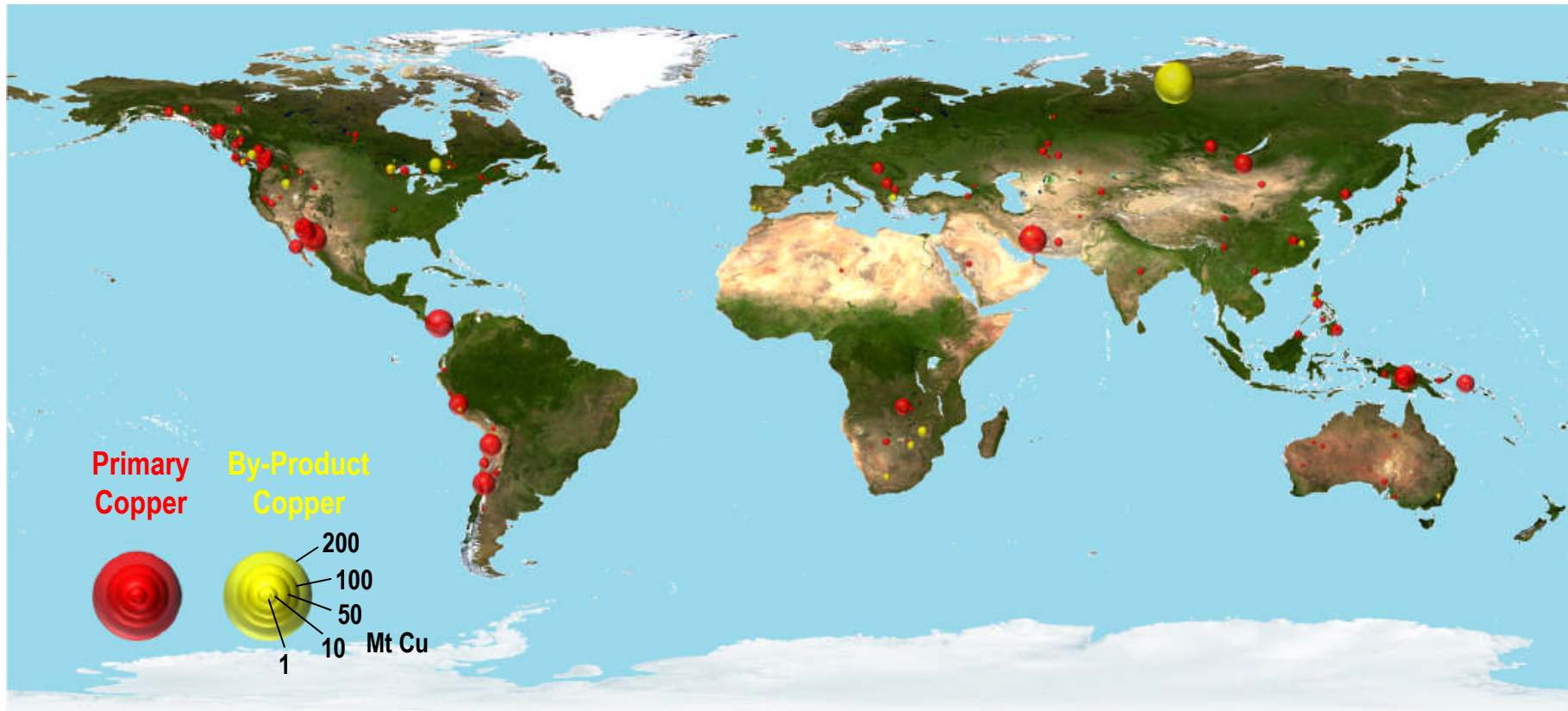
Source: MinEx Consulting © August 2012

Copper discoveries: 1950-59



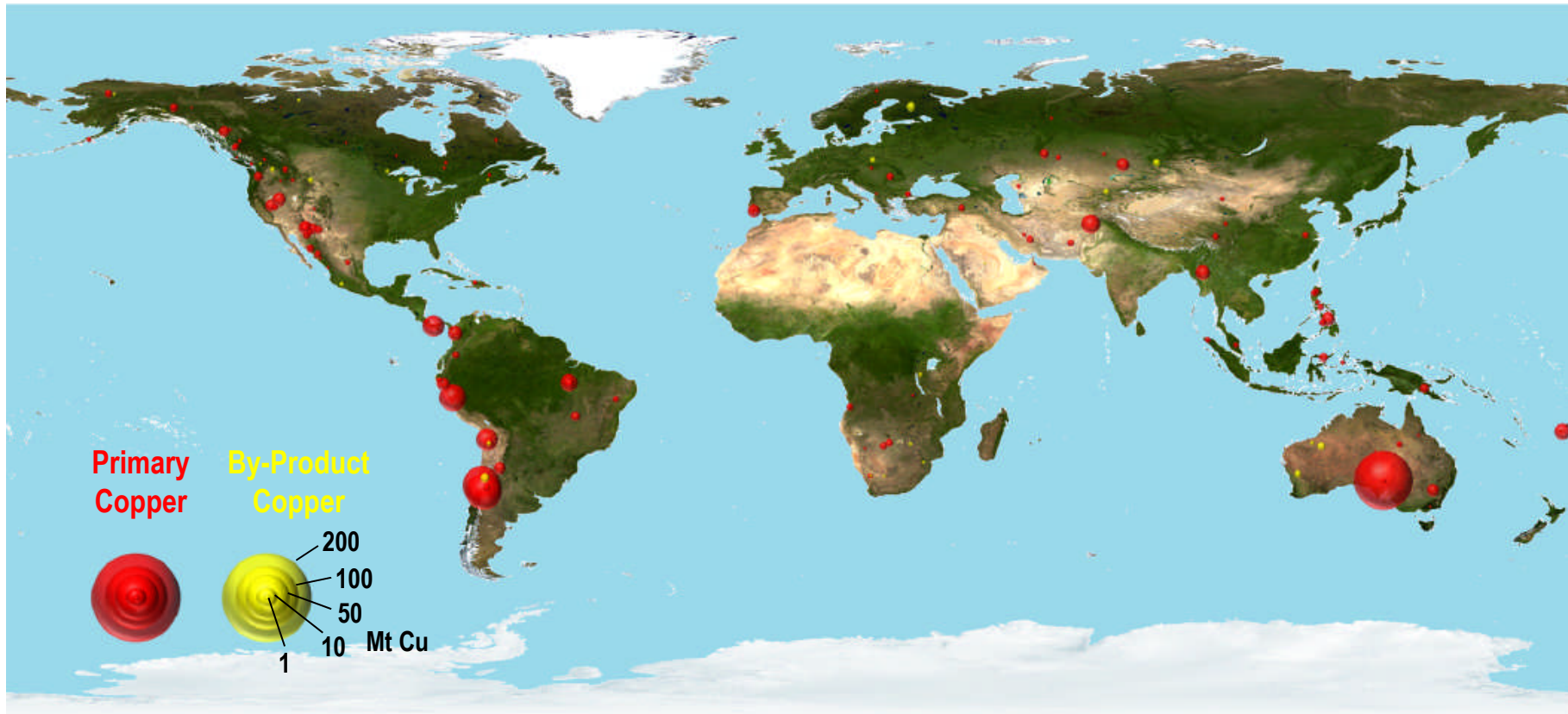
Source: MinEx Consulting © August 2012

Copper discoveries: 1960-69



Source: MinEx Consulting © August 2012

Copper discoveries: 1970-79



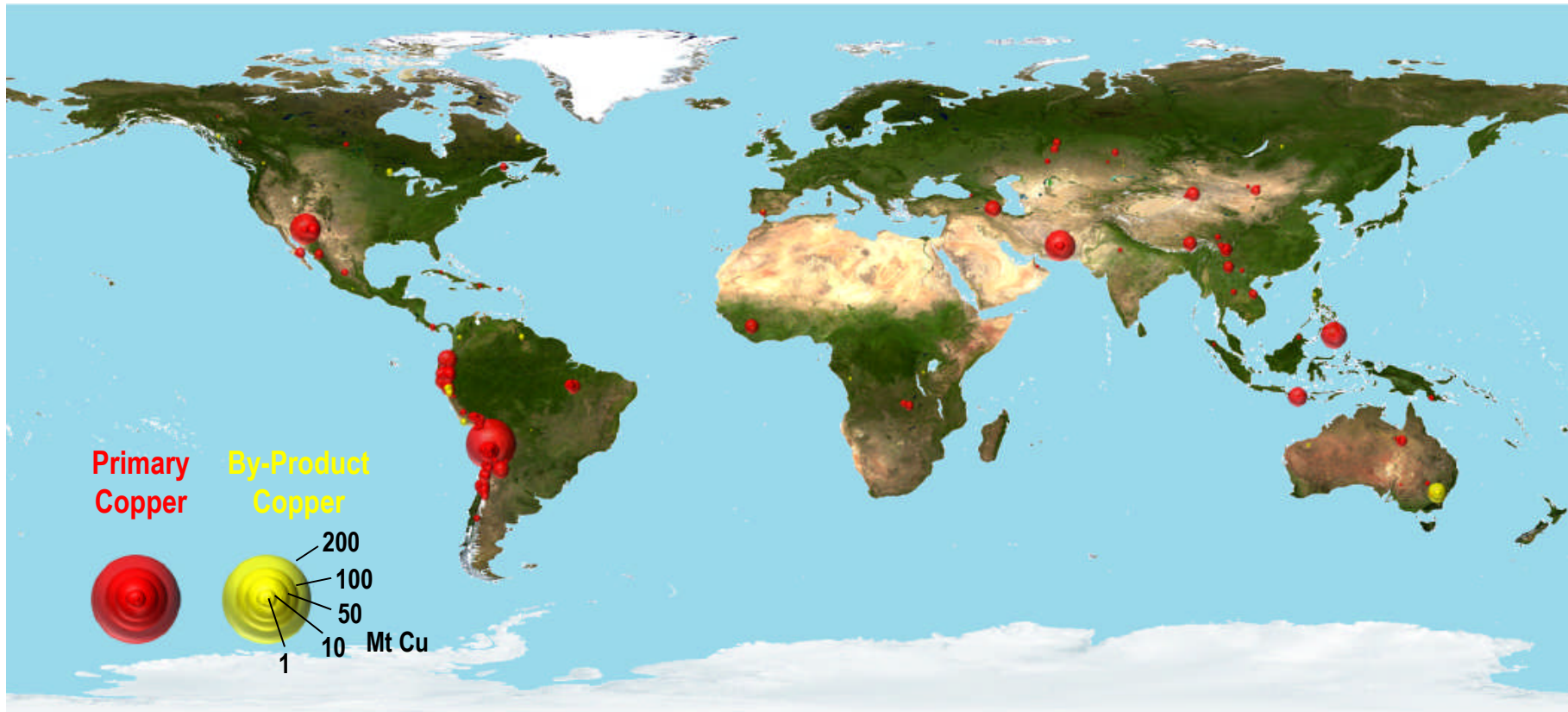
Source: MinEx Consulting © August 2012

Copper discoveries: 1980-89



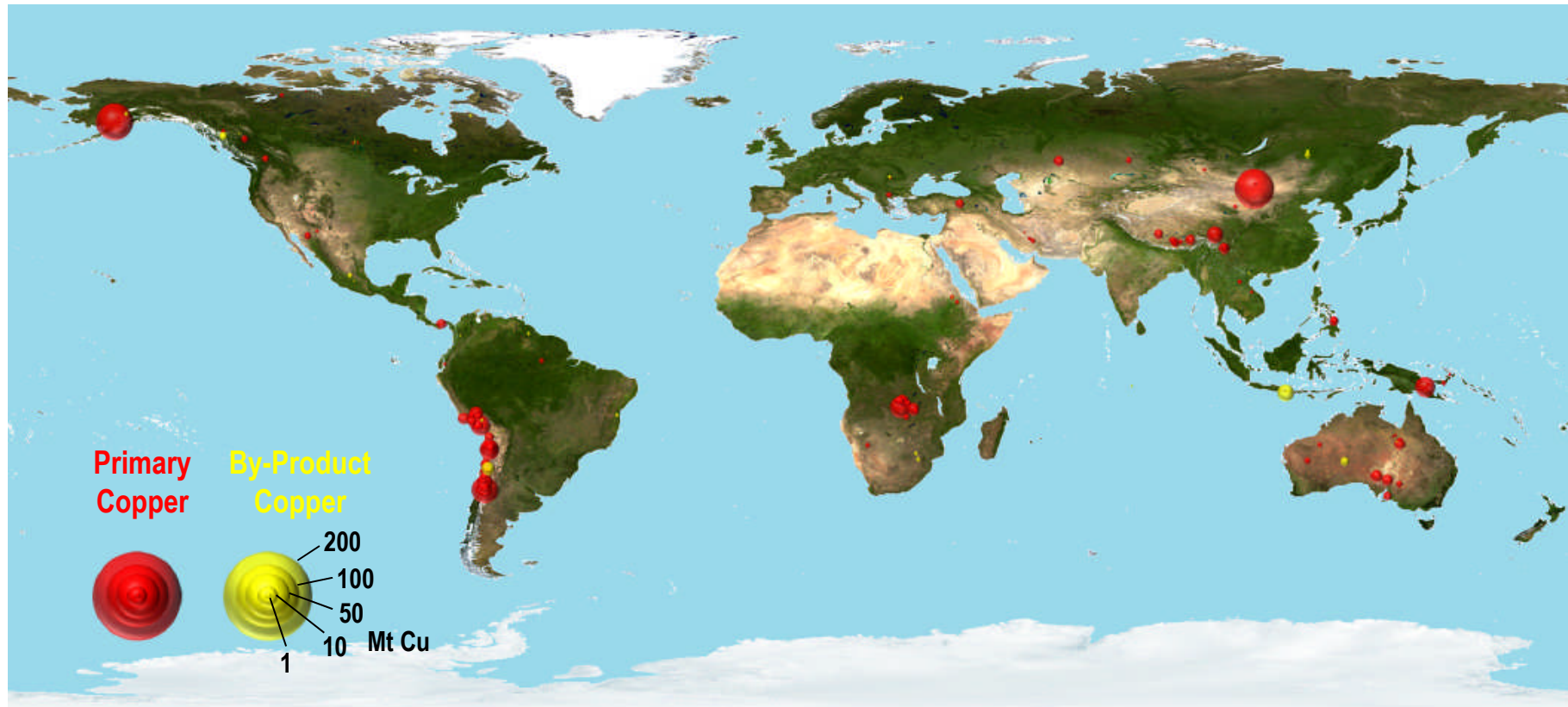
Source: MinEx Consulting © August 2012

Copper discoveries: 1990-99



Source: MinEx Consulting © August 2012

Copper discoveries: Since 2000

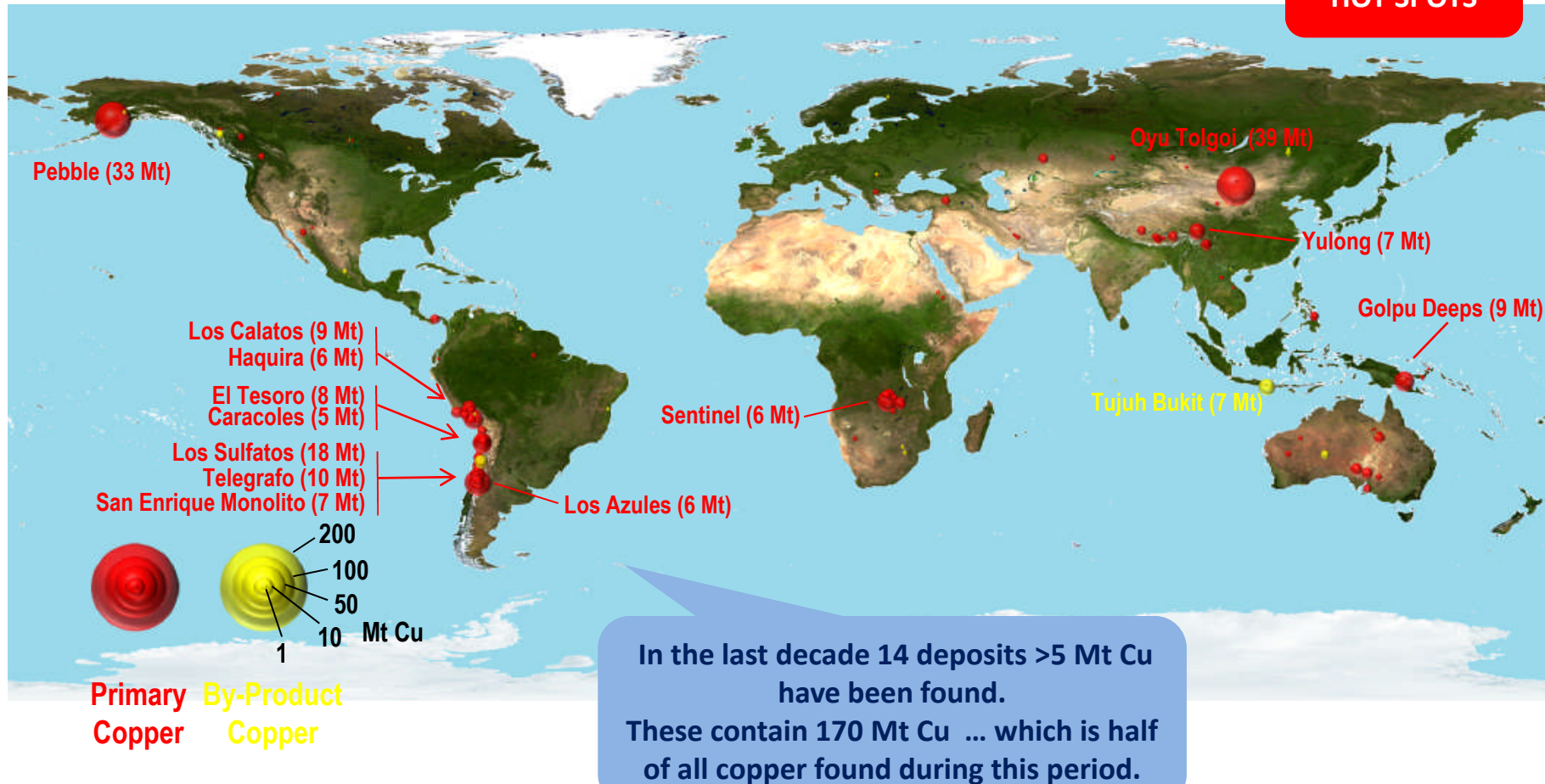


Source: MinEx Consulting © August 2012

Copper discoveries: Since 2000

Deposits > 5 Mt Cu

Current
"HOT SPOTS"



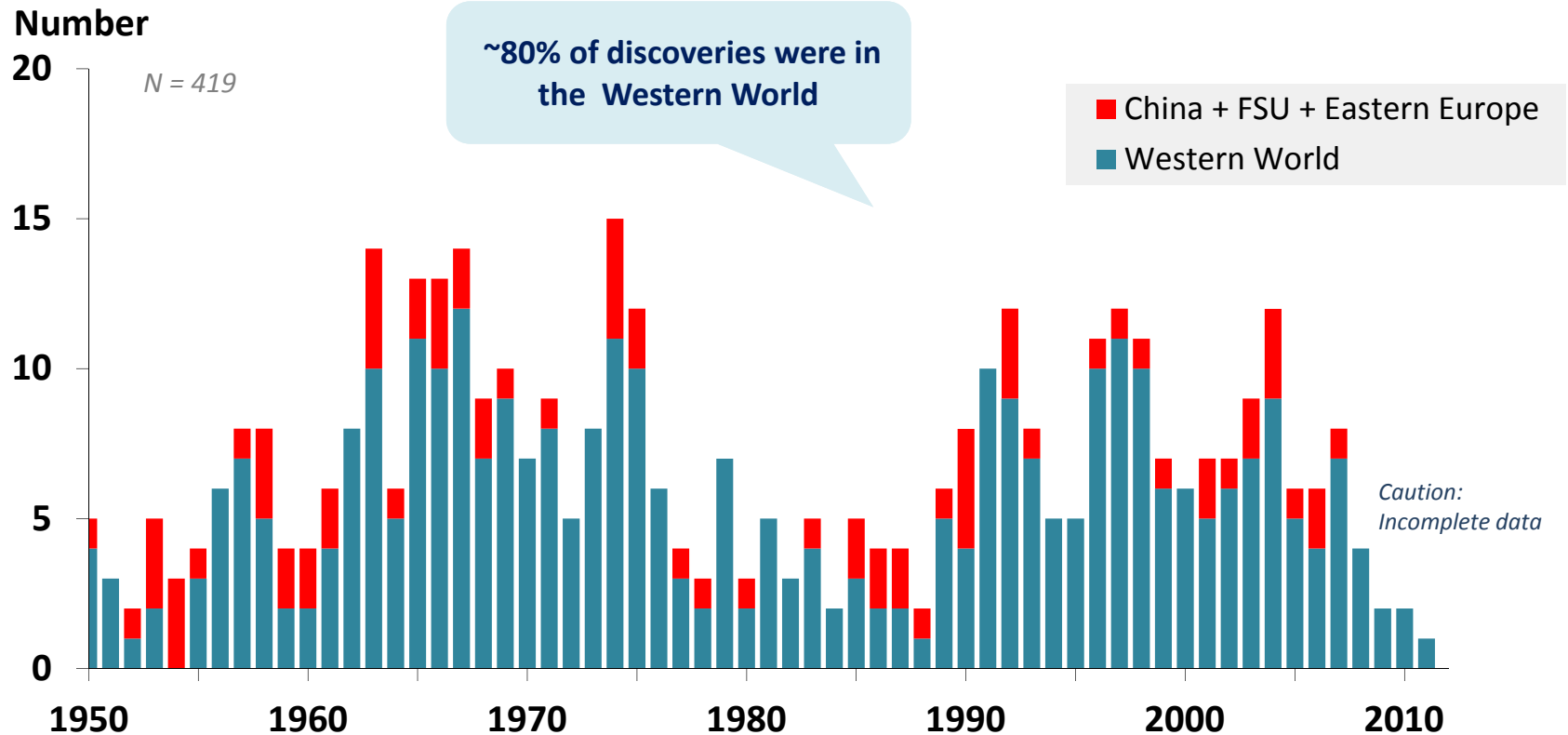
Source: MinEx Consulting © August 2012

Much of the value is tied up in a handful of giant discoveries

TRENDS IN LOCATION AND SIZE OF COPPER DISCOVERIES

Number of copper deposits found in the World

Primary Copper deposits >0.5 Mt Cu found : 1950-2011

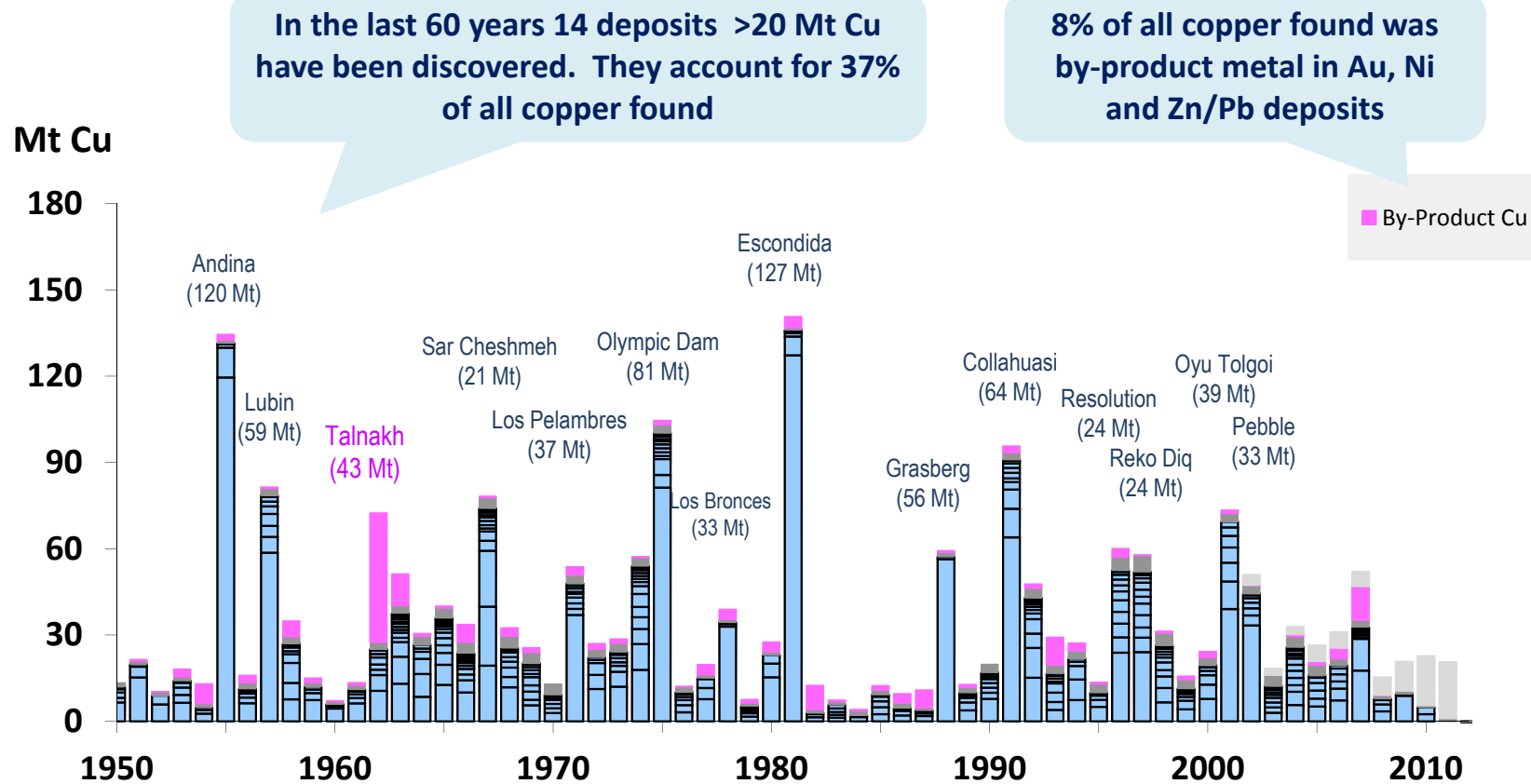


Caution: Chart excludes deposits with unknown discovery date, or deposits not captured in the database

Source: MinEx Consulting © August 2012

Discovery: Most of the metal found is tied up in a handful of deposits

Copper Resources for deposits >0.1 Mt Cu found in the World: 1950-2011

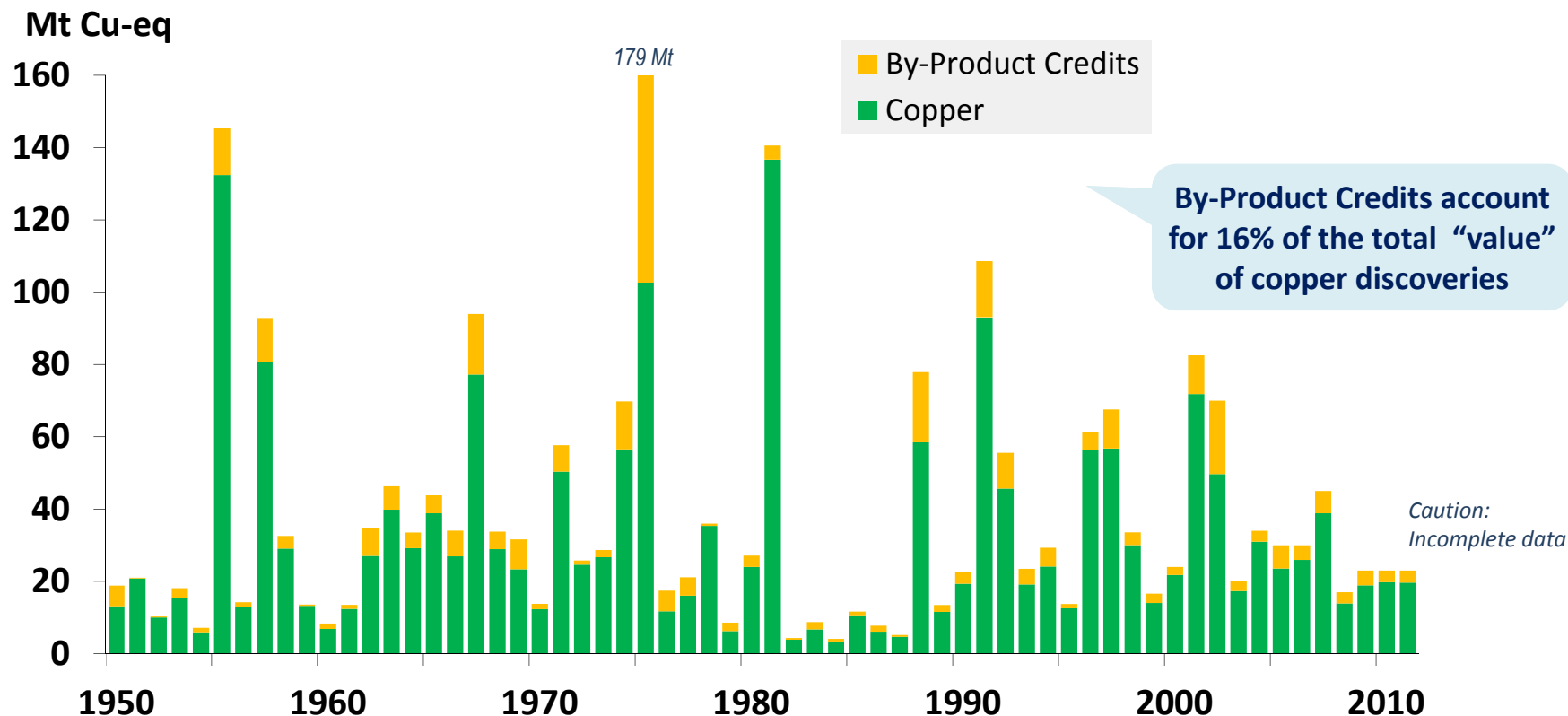


Note: Chart include minor adjustment for deposits missing from the database

Source: MinEx Consulting © August 2012

Amount of copper & by-products found in the World

Primary copper deposits >0.1 Mt Cu found : 1950-2011



Note: Estimate includes adjustments for deposits with no discovery year and deposits missing from the database

By-Product credits calculated on basis of 1% Cu = 3.26% Zn = 4.76% Pb = 0.30% Ni = 0.25% Mo = 0.43% Co

= 0.94 lb U₃O₈ = 0.44 tonnes Magnetite = 3.0 g/t Au = 156 g/t Ag

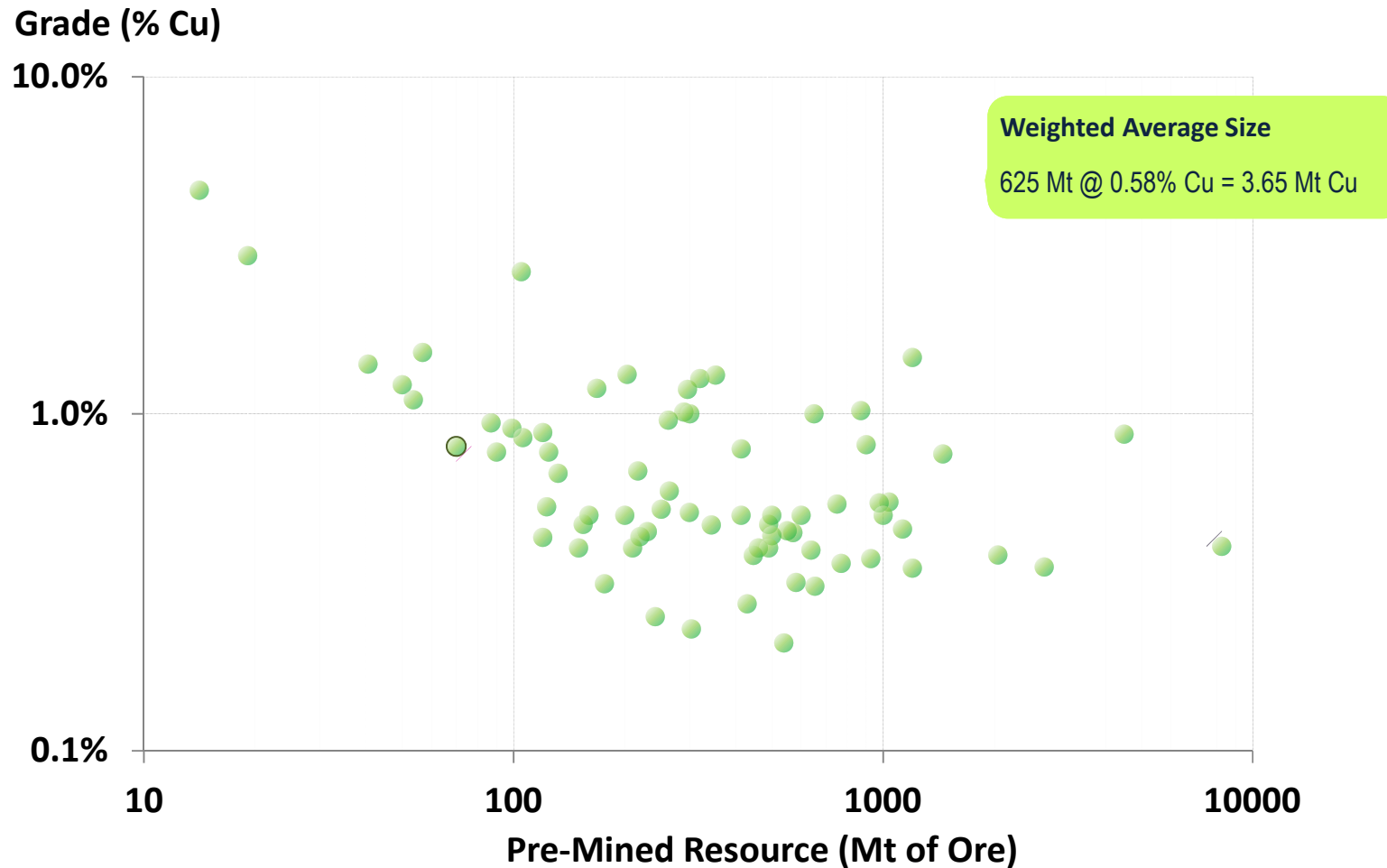
Source: MinEx Consulting © August 2012

Quality of recent discoveries

COPPER TONNES & GRADE

Tonnes & Grade for recent discoveries

Copper Deposits >0.5 Mt Cu found 1999-2011



Source: MinEx Consulting © August 2012

Over half of recent discoveries were made in risky countries

BUSINESS RISK

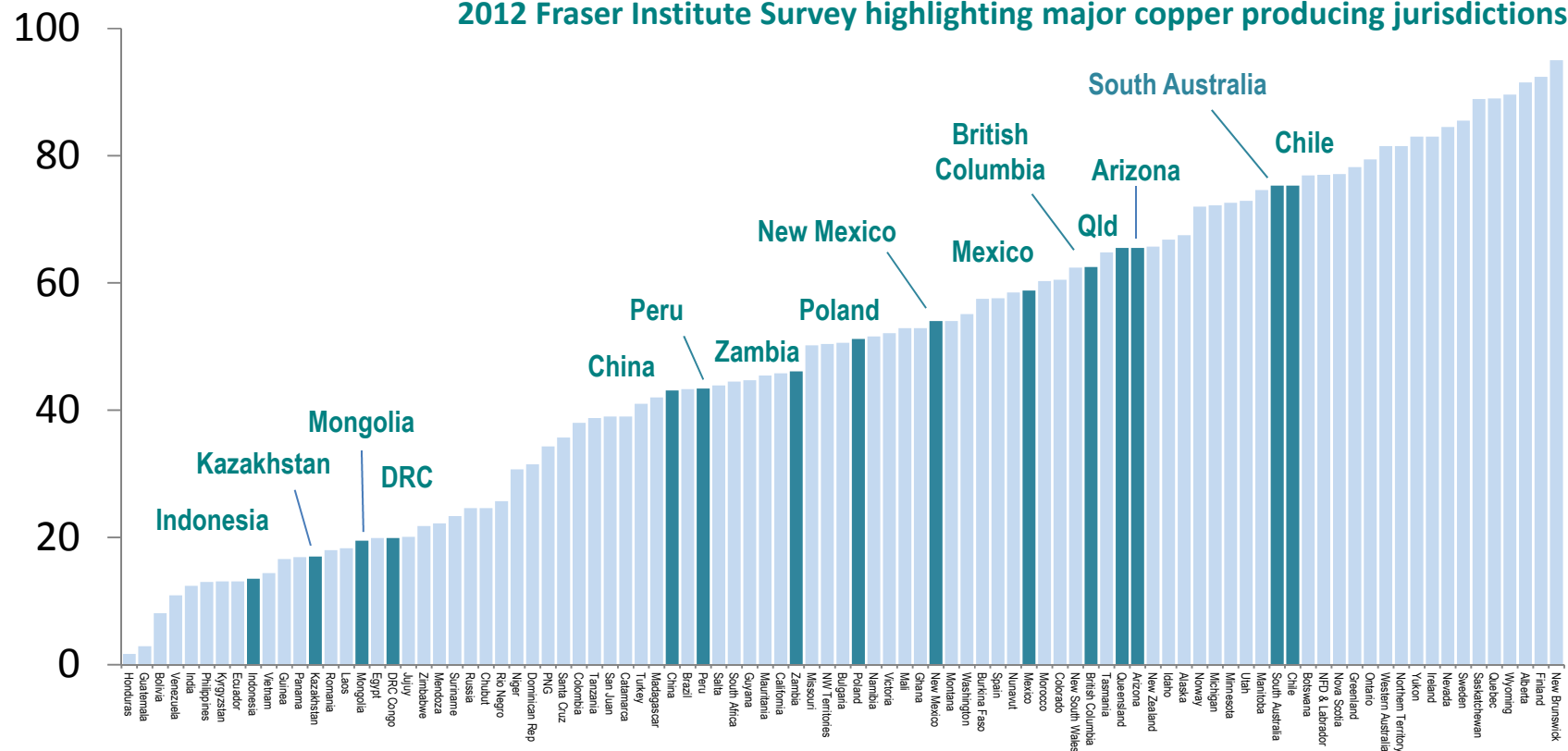
Business risk ratings for major Cu-production countries

Policy Potential Index (Measures the “ability to do business” there)

PPI Score

Note: Higher the Score, the better

2012 Fraser Institute Survey highlighting major copper producing jurisdictions



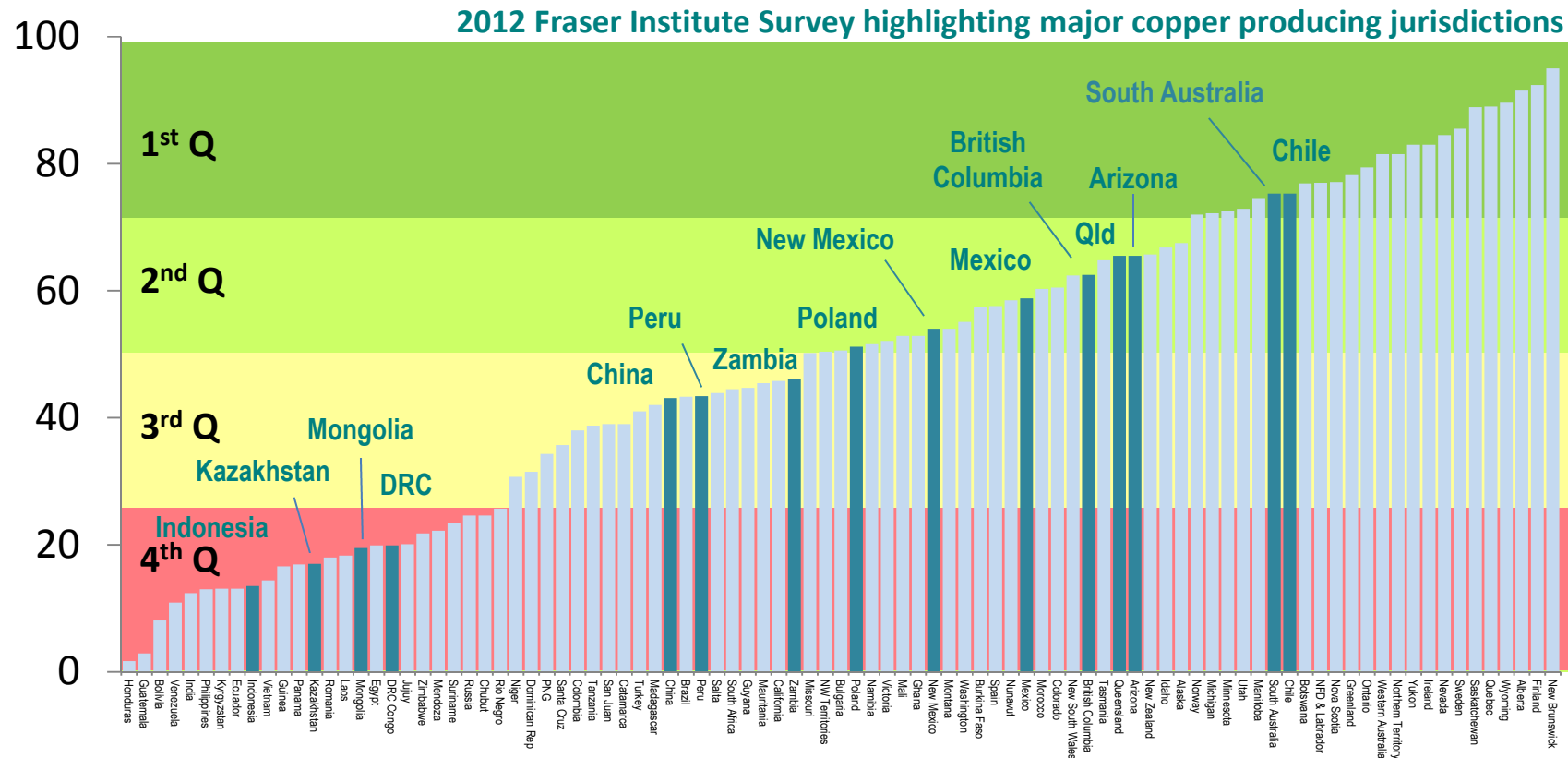
Source: Fraser Institute March 2012

Business risk ratings for major Cu-production countries

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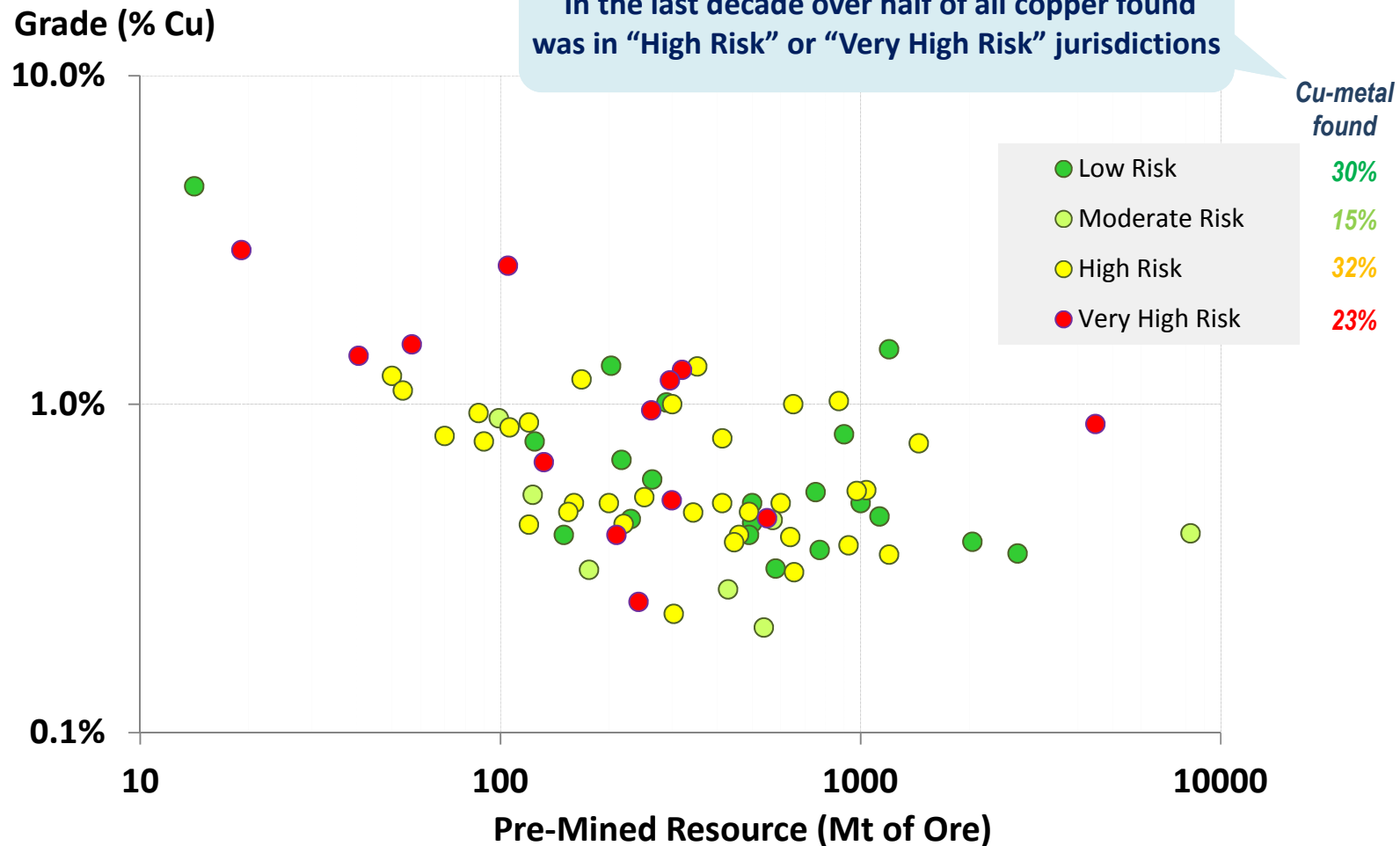
Note: Higher the Score, the better



Source: Fraser Institute March 2012

Tonnes & Grade for recent Discoveries by Country Risk

Copper Deposits >0.5 Mt Cu found 1999-2011



Note: The Country risk rankings are based on the Policy Potential Index data from the latest Fraser Institute survey

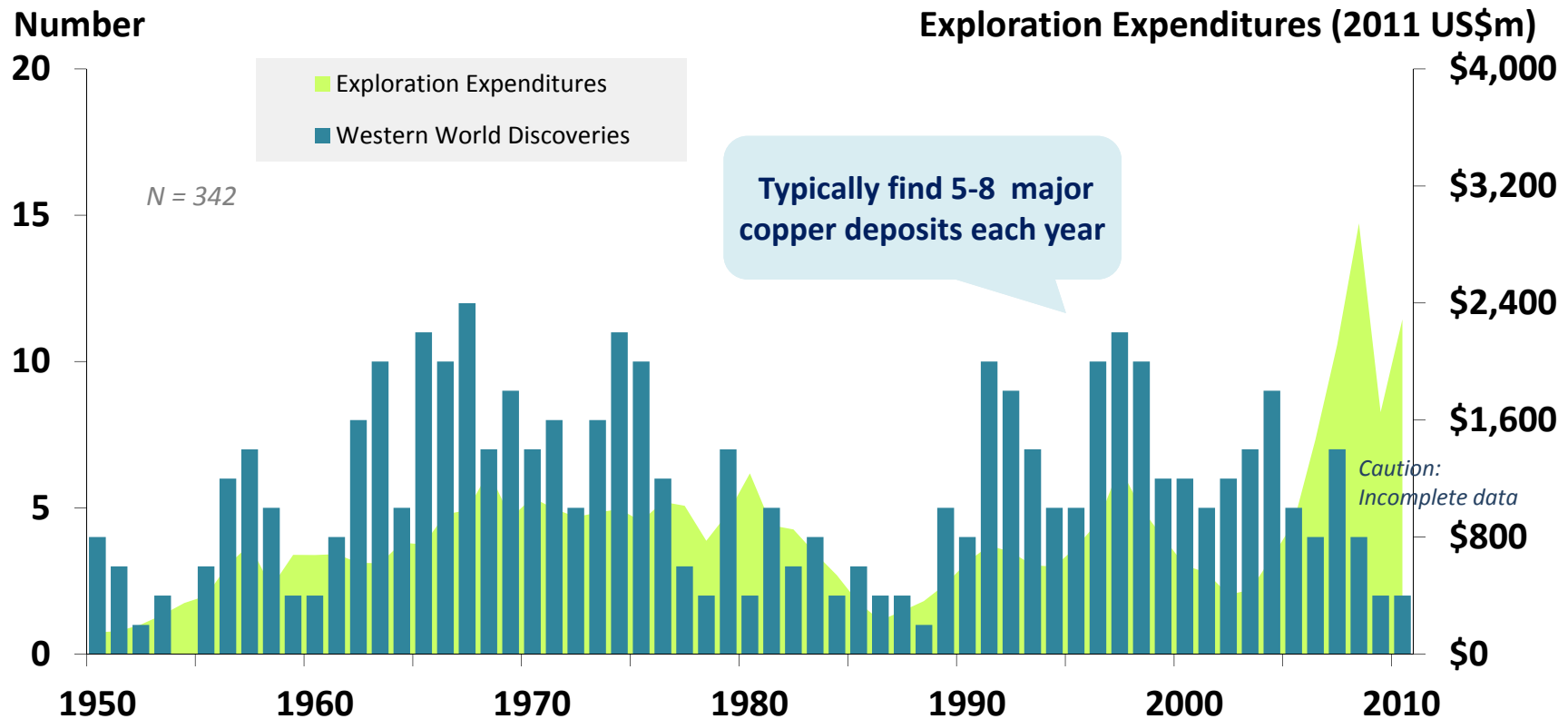
Sources: MinEx Consulting © August 2012
based on Fraser Institute March 2012

Cost per lb of Cu found in in the Western World 1950-2011

TRENDS IN DISCOVERY COSTS

Exploration expenditures and number of deposits found

Primary copper deposits >0.5 Mt Cu-eq found in Western World: 1950-2011

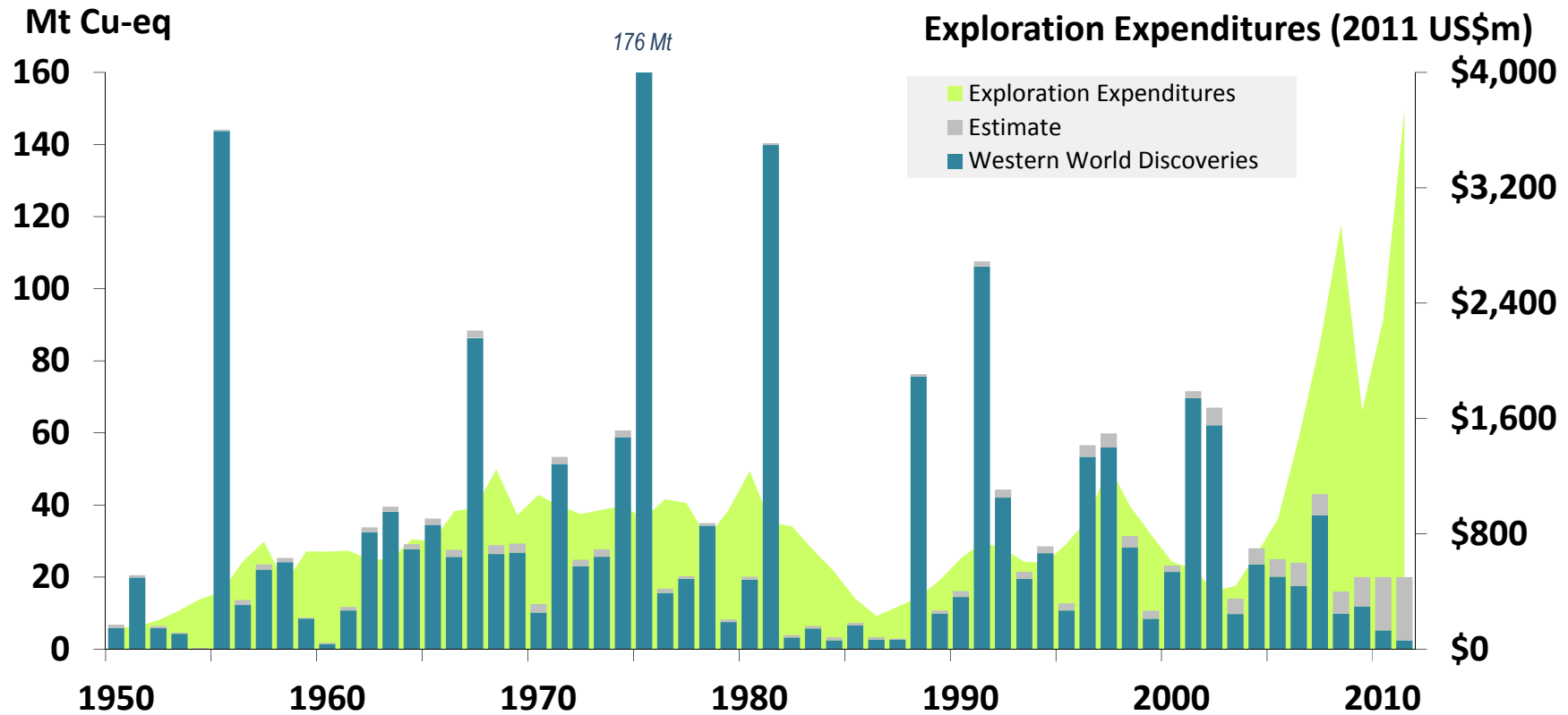


Caution: Chart excludes deposits with unknown discovery date, or deposits not captured in the database

Source: MinEx Consulting © August 2012

Exploration expenditures and amount of metal found

Primary copper deposits >0.5 Mt Cu-eq found in Western World: 1950-2011



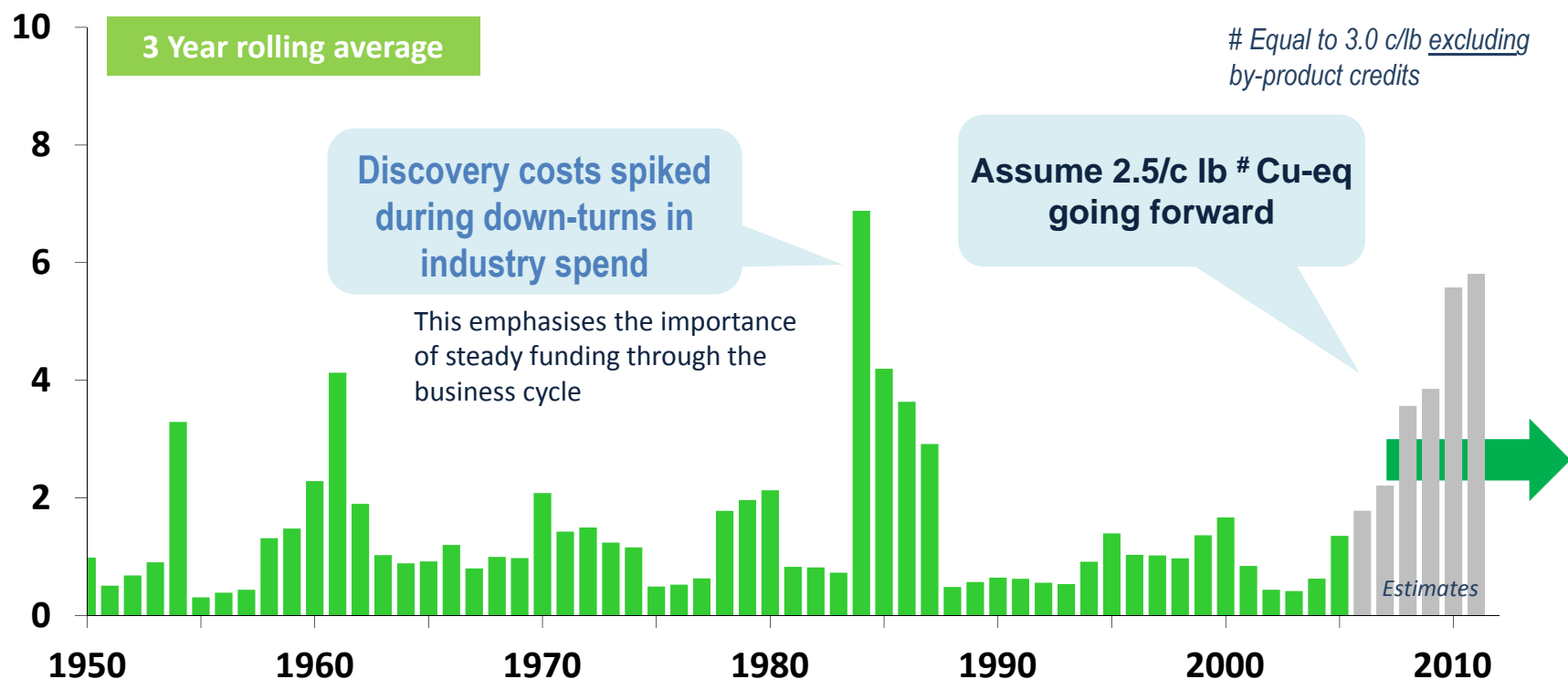
Note: Estimate includes adjustments for deposits with no discovery year and deposits missing from the database

Source: MinEx Consulting © August 2012

Discovery costs in the Western World

Until recently, discovery costs have been fairly steady at around 1-1.5 c/lb Cu-eq

US Cents per lb Cu-eq in 2011\$



Note: The reported costs include credits for by-product metal

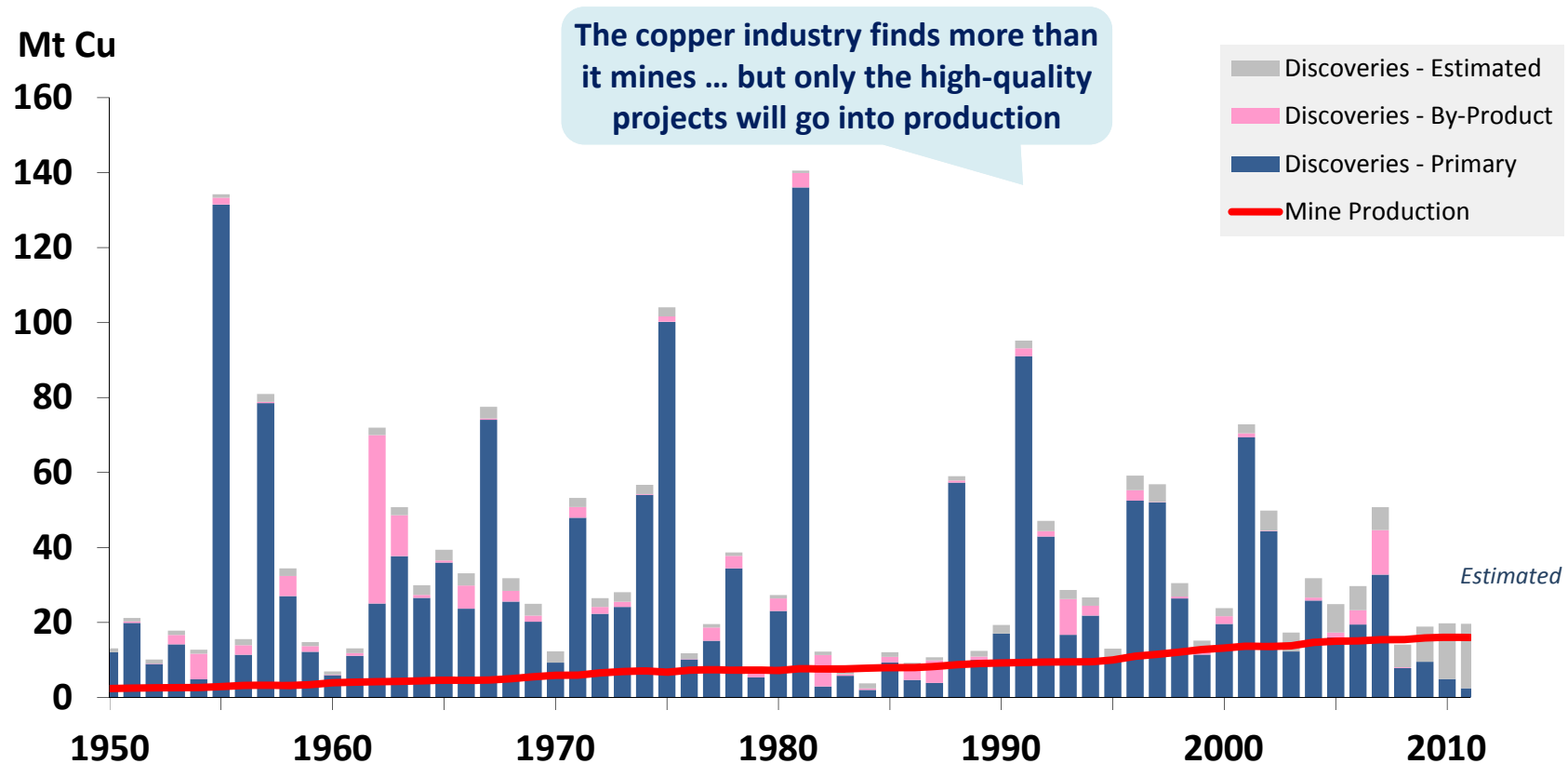
Source: MinEx Consulting © August 2012

Trends in the finding and mining rates for copper

ARE WE FINDING ENOUGH METAL ?

Amount of copper found and mined in the World

Primary copper deposits >0.1 Mt Cu found : 1950-2011

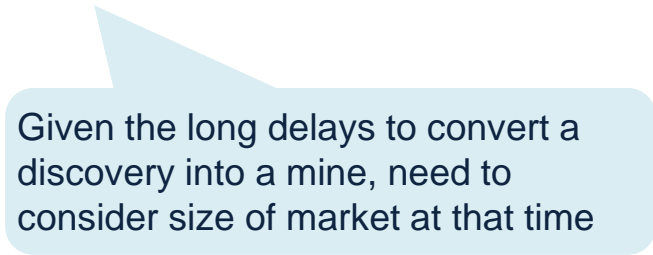


Source: MinEx Consulting March 2012

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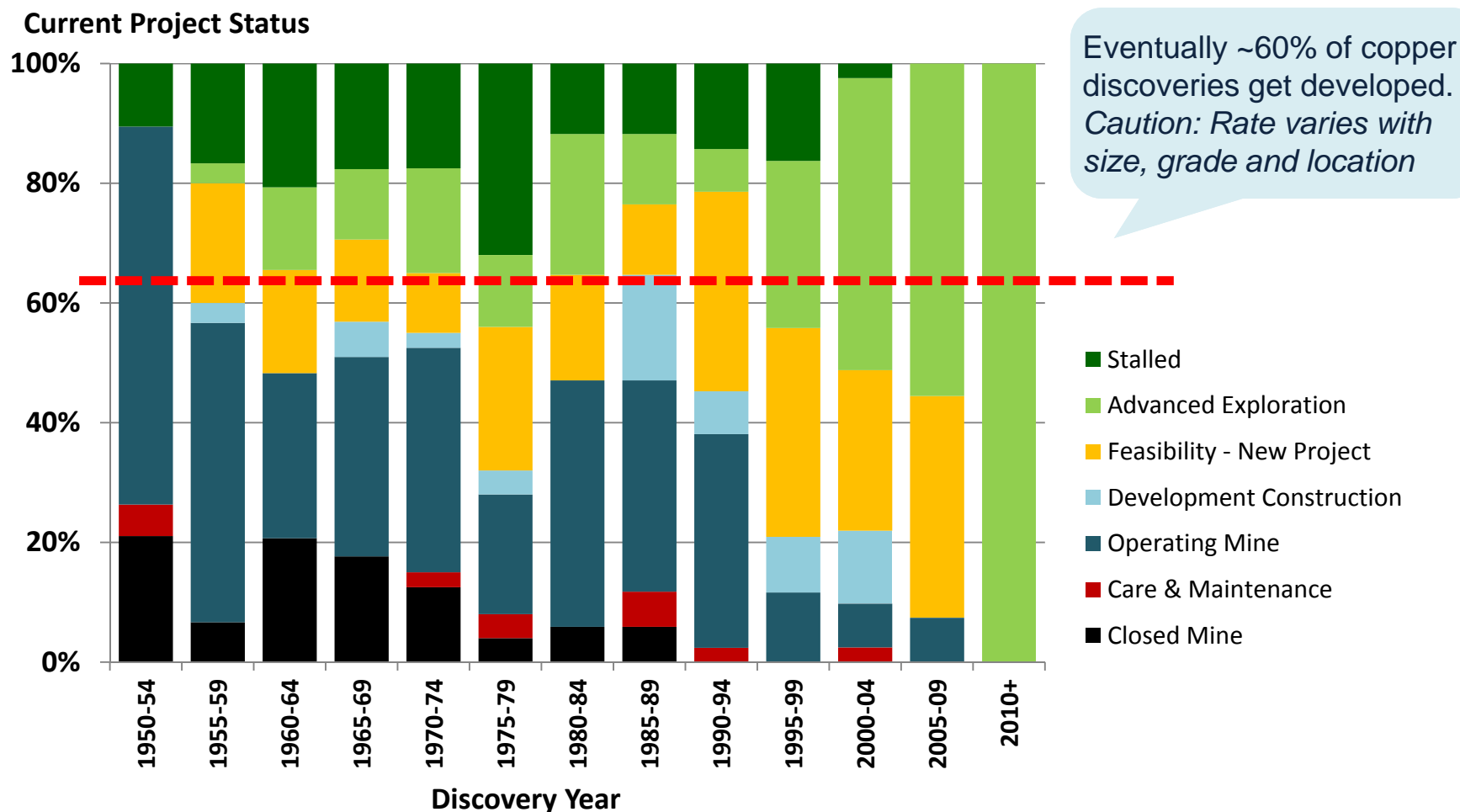
Are we finding enough metal ?

- Key drivers
 - Current discovery rates
 - Importance of By-Product credits
 - Conversion rate for Resources > Reserves
 - Conversion rates (from discovery to operating mine)
 - Lag between discovery and development
 - Losses on mining
 - Current and (more importantly) future demand for metal



Given the long delays to convert a discovery into a mine, need to consider size of market at that time

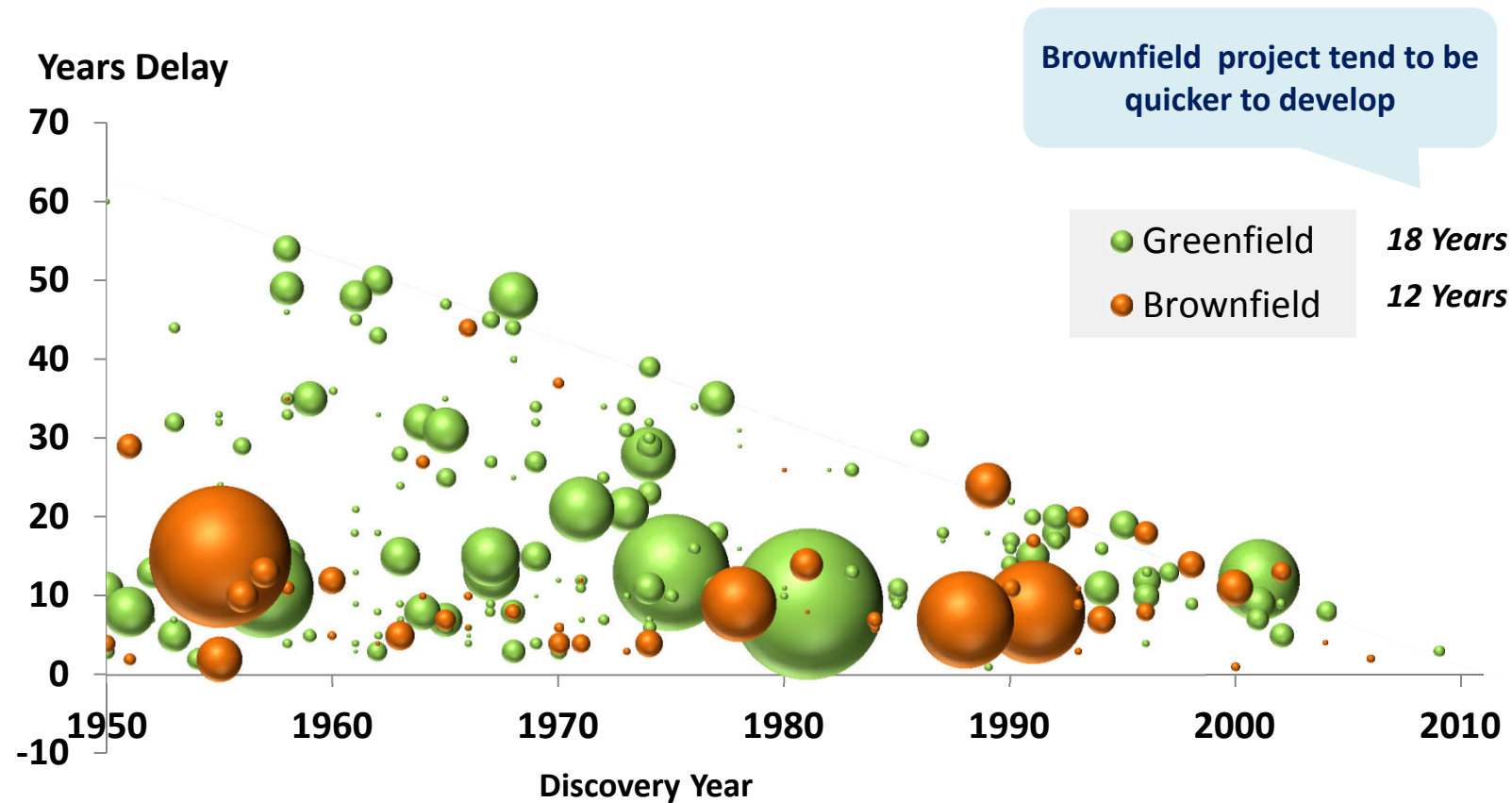
Not all copper projects get developed as mines



Analysis based on 384 copper deposits >0.5 Mt Cu found in the World 1950-2011

Source: MinEx Consulting © August 2012

For those deposits that are developed into mines, it takes on average 16 years from discovery to production

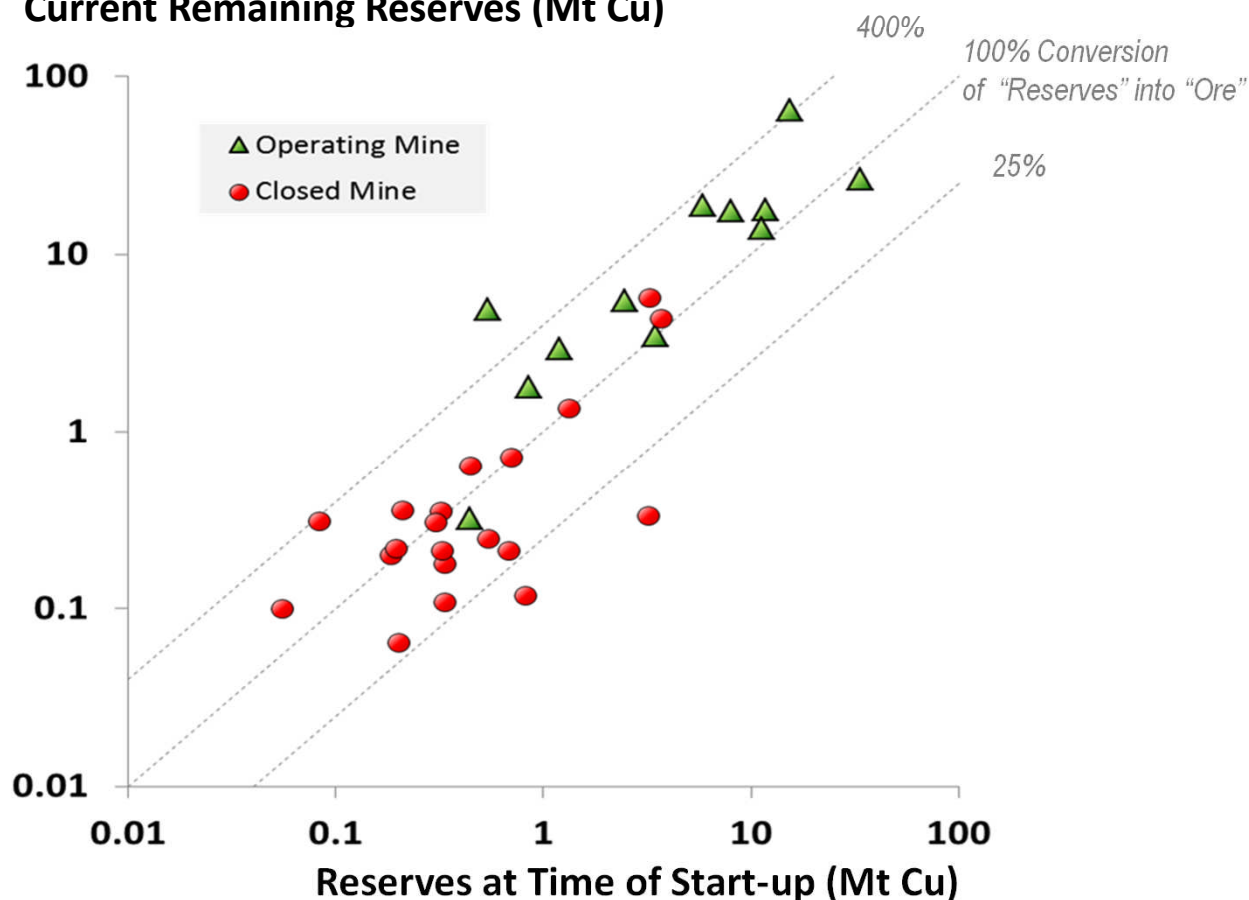


Note: Bubble size refers to the pre-mined Resource
Analysis based on 233 primary copper deposits >0.1 Mt Cu found in the World

Question – do all Reserves (and Resources) get Mined ?

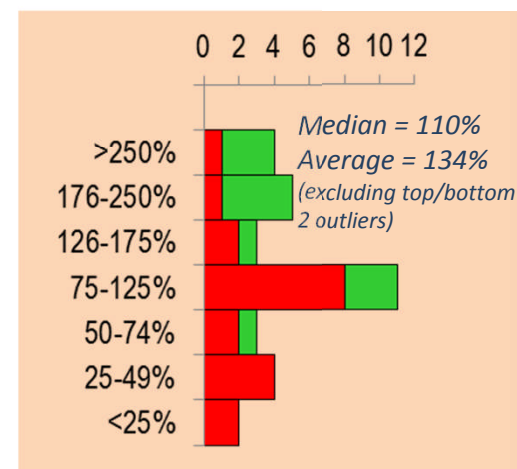
On “average” YES, especially for bigger deposits.
However the apparent high conversion rate may be due to under-estimating the true size of the Reserves at start-up.
In practice , deposits “grow” over time as mining progresses

Total Ore Mined +
Current Remaining Reserves (Mt Cu)



Analysis of 32 copper mines developed in the Western World between 1970-90

Note: Analysis covers ~40% of all mines built in that period



Source: MinEx Consulting © August 2012

Are we finding enough metal ?

- Key drivers

- Current discovery rates ... *is slowing down*
- Importance of By-Product credits ... *only a minor effect*
- Conversion rate for Resources > Reserves ... *Not all gets converted*
- Conversion rates (from discovery to operating mine) ... *only 60-80%*
- Lag between discovery and development ... *typically 12-18 years*
- Losses on mining ... *typically 10-15%*
- Current and future demand for metal ... *Demand doubling every 25 years*

- Modifying factors

- Current inventory of undeveloped projects (and their quality)
- Ability to increase resources through lowering the cut-off grade
- Long term costs
- Impact of environmental and social factors)
- Long term prices

Given the feedback loops, is this an input or an output ??

How much metal do we need to find ?

To ensure no supply interruptions in the longer term the industry needs to be finding 2-3x as much metal as it currently mines

Estimated Discovery/Production ratios

	Copper		Comments
Unit discovery costs	~ 3 US c/lb Cu		<i>Excludes credits for By-Products</i>
World exploration spend rate (2011 US\$m pa)	[A] = \$1670m [P] = \$4000m		<i>Includes FSU + China</i>
Expected amount of metal to be found	[A] = 27 Mt [P] = 65 Mt		<i>Includes 8% adjustment for Cu associated with Au, Ni and Pb/Zn exploration</i>
Mine Production	2011 = 16.1 Mt 2026 = 25.0 Mt		<i>Assumes 3% pa growth over next 15 years</i>
Discovery/Production Ratios	[A]	[P]	
At 2011 Production Rate	1.7x	4.1x	
At 2026 Production Rate	1.1x	2.6x	Target is > 2x

Industry will be sustainable in the longer term ... but only if spending stays at high levels

[A] = Average exploration spending rate over last decade (1999-2010)

[P] = Peak exploration spending rate (in 2011)

Source: MinEx Consulting © August 2012

The future for copper exploration

SUMMARY/CONCLUSIONS

Summary / Conclusions (1/2)

- Exploration Expenditures are cyclical
 - Industry is currently spending ~\$4 billion on Cu up from \$1b pa 20 years ago
- The current hot spots for exploration success are Latin America, PNG, Central Africa, South Australia and China
- The industry is getting riskier
 - Over half of the copper found in last decade was in “High Risk” countries
- Discovery rates are rising for copper
 - Over last two decades has increased from 1 - 1.5 c/lb to 2.5 c/lb Cu-eq. This is equal to ~3.0 c/lb for Cu-only
- Not all discoveries turn into mines
 - Conversion rates are only 60%, depending on the size, quality and location
- For the successful projects, there is a lag of 16 years between discovery and development
- To be sustainable the industry needs to find ~2x what it finds
 - The ratio is projected to be ~1.1-2.6x of the 2026 copper mining rate

Summary / Conclusions (2/2)

- In the longer term the market will “balance itself” through the complex interplay between:
 - Level of exploration spending
 - Efficiency and effectiveness of exploration activities
 - Speed of converting discoveries into mines
 - The current inventory of undeveloped projects (quality & number)
 - Proportion of new projects that are economically viable
 - Innovations in technology (that make marginal projects viable)
 - Changes in mining costs and business risk
 - Change in cut-off grades (which can increase/decrease available resources)
 - Growth in primary metal demand
 - **Commodity Prices**
- Given the long delays between discovery and development , there is a real risk that the industry sector could face supply constraints in the short term *As always, there is a shortage of quality projects !*

Contact details

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