

# Copper Exploration and Discoveries in Australia and the World

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Critical Minerals Course

The University of Melbourne

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# INTRODUCTION



## Richard Schodde

- B Eng (Hons) in Materials Engineering, MBA
- Minerals Economist, with 30 years experience in R&D, project evaluation, business strategy and exploration for WMC Resources and BHP.
- Set up MinEx Consulting in 2008. Have over 100 clients in 19 countries – Mining Companies, Government and Investment Funds.
- Have given over 80 public presentations & papers.
- In 2015, '16 and '17 was recognised by the Mining Journal as one of the 20 most influential people in mining.

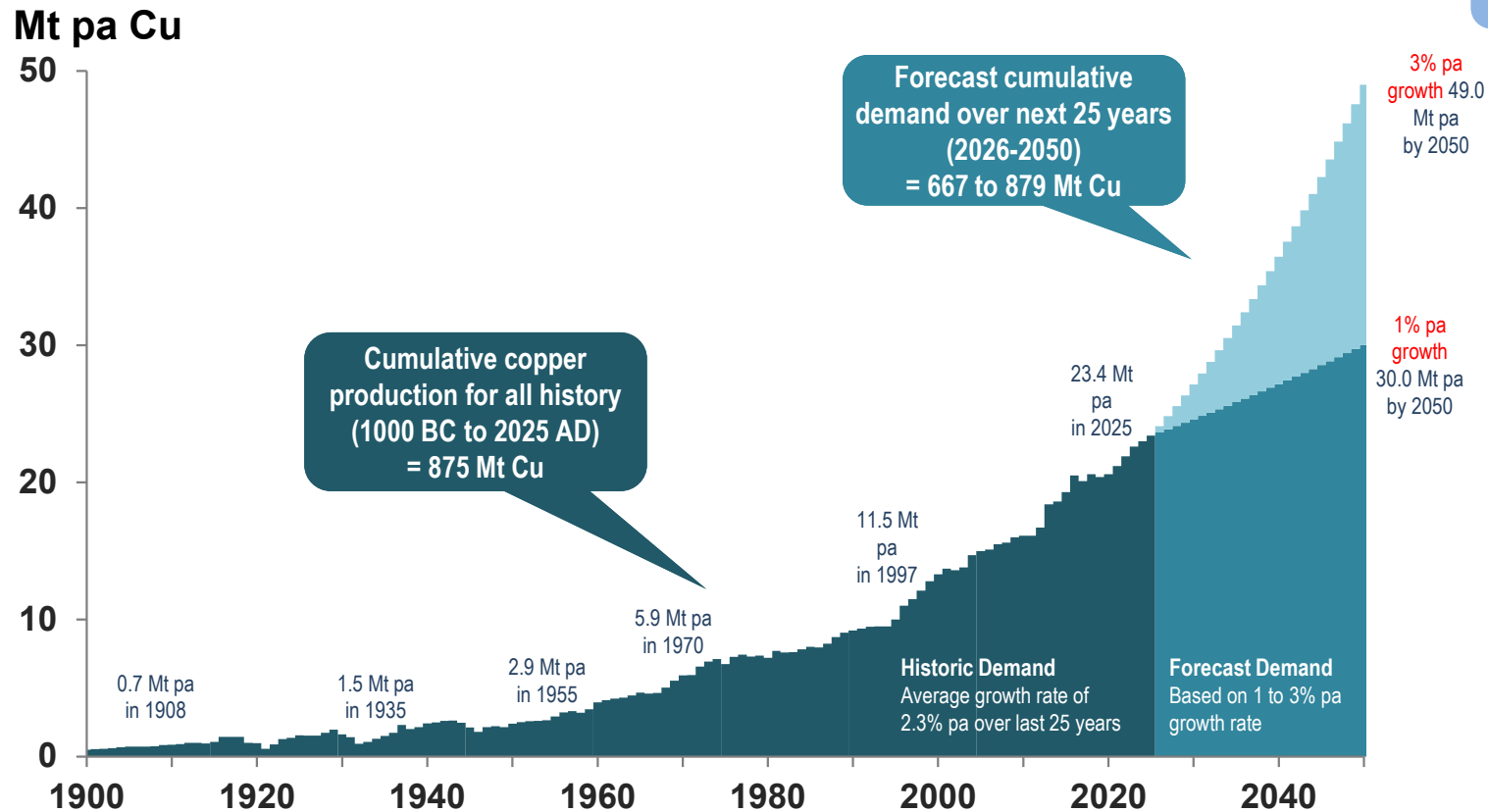
# Overview

1. The need for more copper
2. Number of discoveries and metal found
3. Location of discoveries
4. Trend in size and grade found and depth of cover
5. Deposit styles found
6. Discovery methods
7. Trend in exploration expenditures and unit discovery costs
8. Trend in the quality of discoveries found and the value proposition for copper exploration
9. Summary

World demand for copper is set to double over the next 20-30 years

## **1. THE NEED TO FIND MORE COPPER**

# Copper mine production : World: 1900-2050



**International Copper Association (ICA) forecasts 2.8% CAGR to 2050**

**BHP's latest forecast is 2.6% pa to 2035**

**World's demand for copper has been doubling every 20-30 years**

**Over the next 30 years the World is going to mine more copper than what has been mined in all history !**

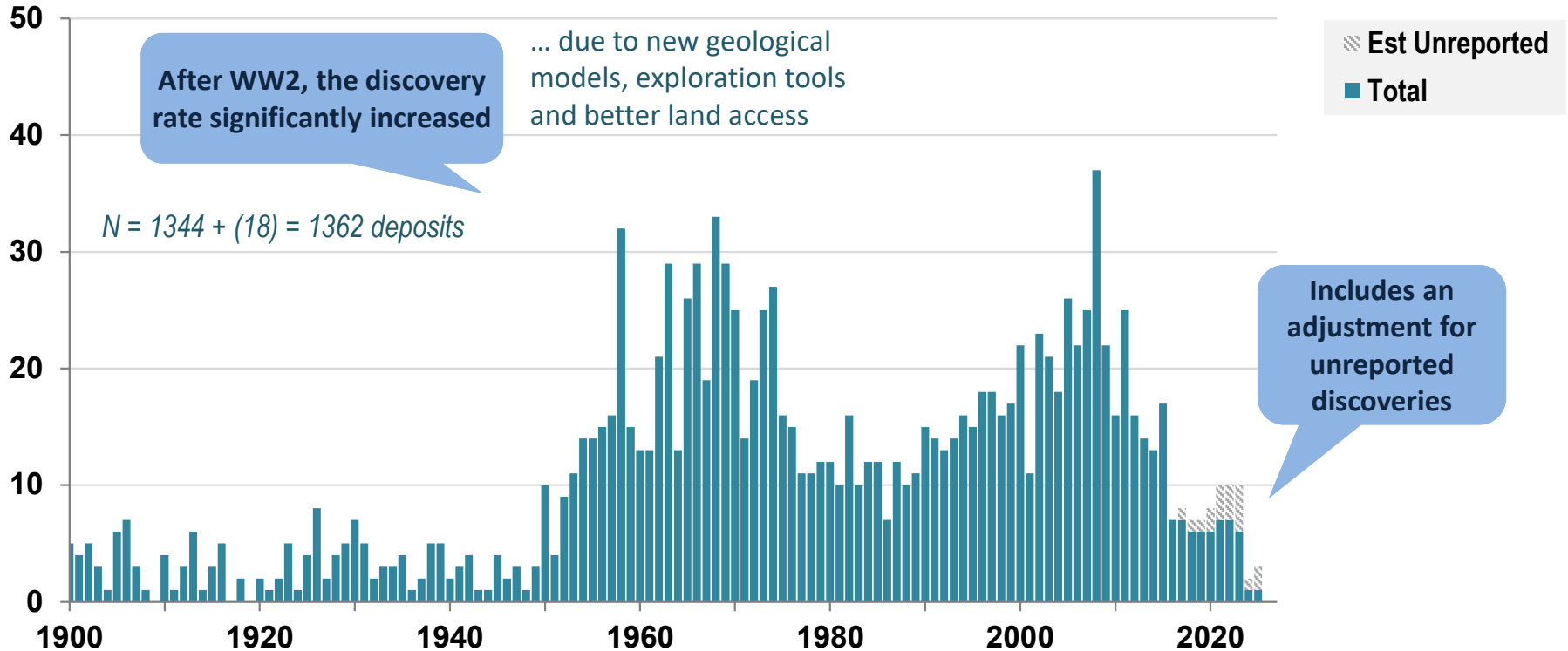
Source: Historical data from USGS Dec 2025  
Forecasts from ICA March 2023 and BHP Sept 2024

## **2. NUMBER OF DISCOVERIES AND METAL FOUND**

# Number of Significant Discoveries

## Primary Copper : World: 1900-2025

Number

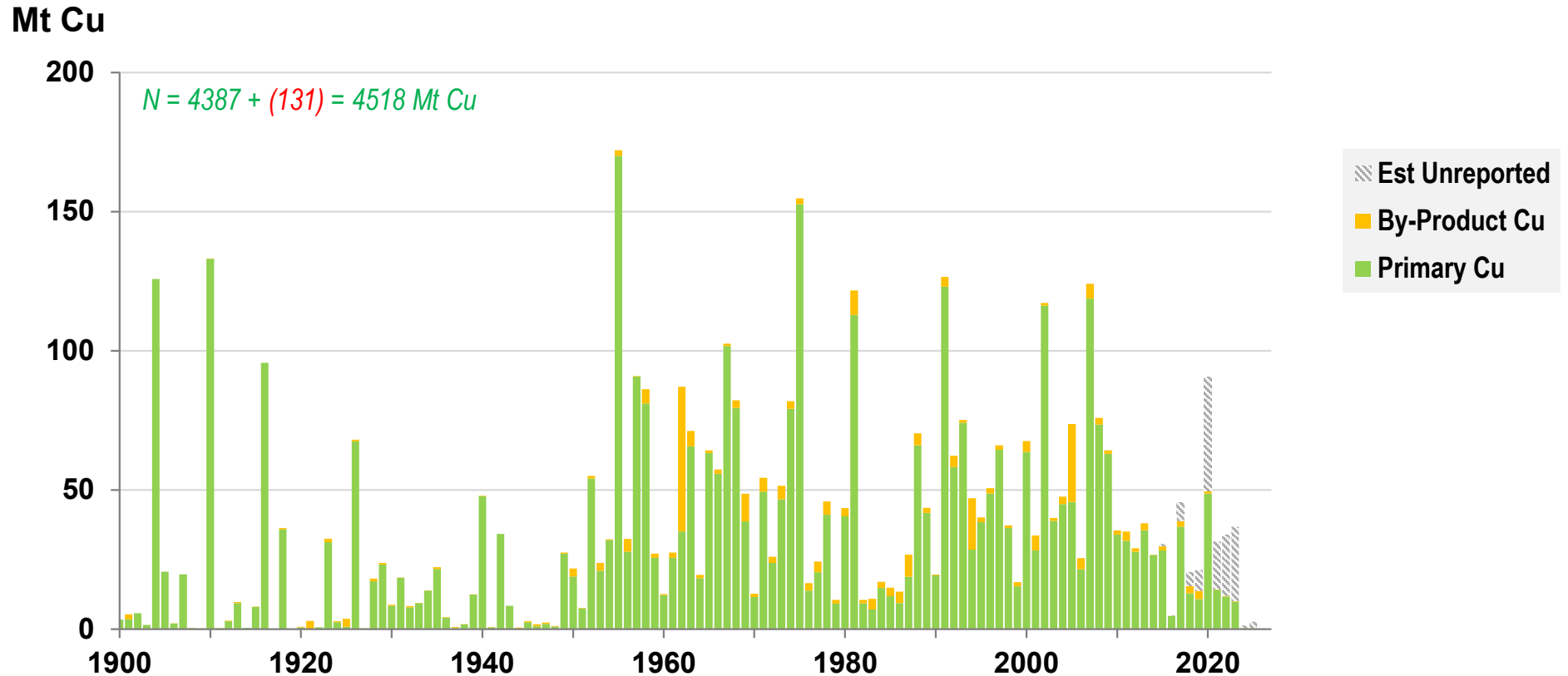


Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

# Tonnes of Copper Found

## Primary & By-Product Copper : World: 1900-2025



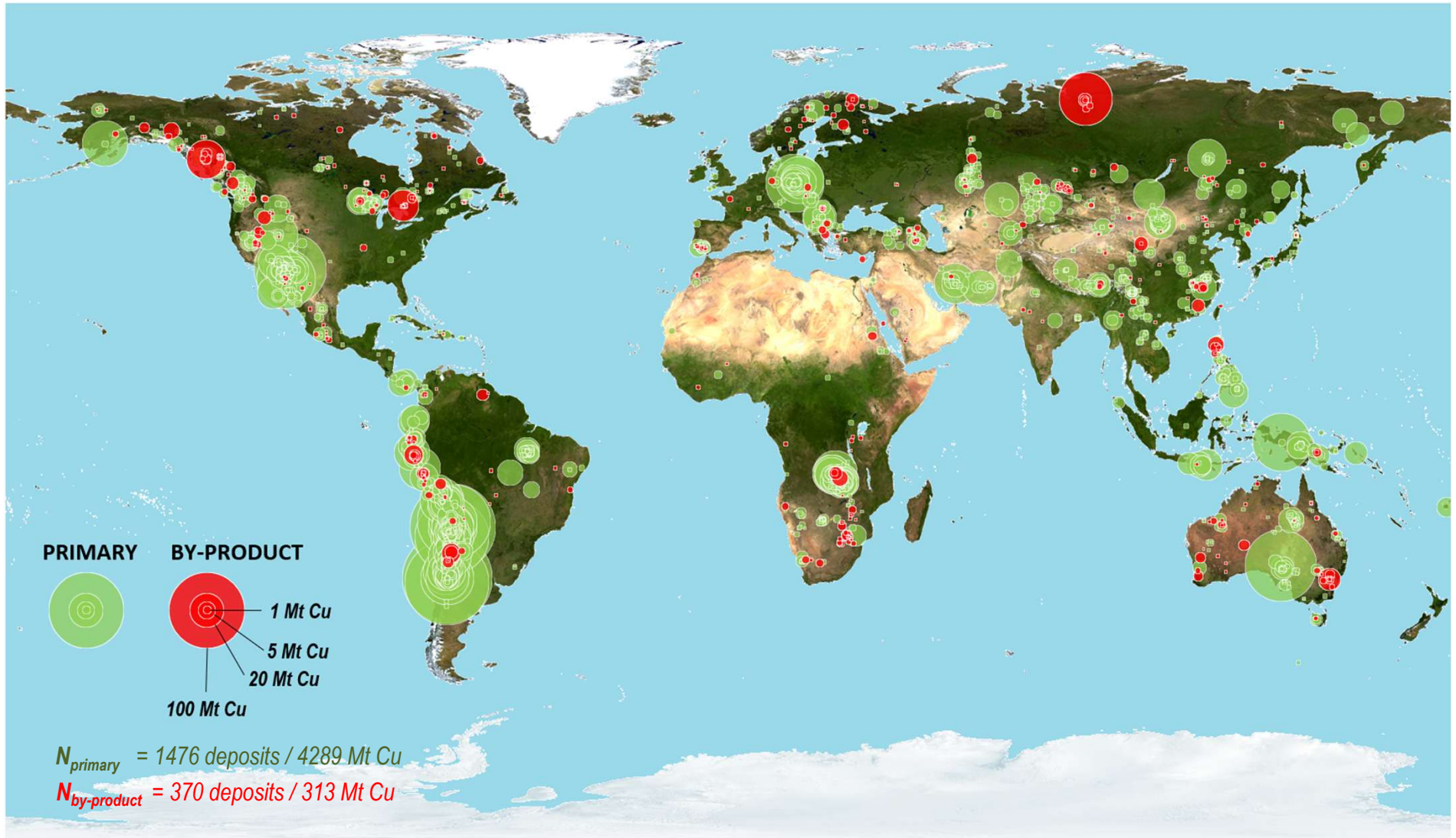
Note: Based on deposits  $\geq$  "Moderate" (i.e.  $>100\text{kt Cu-eq}$ ) in-size

Source: MinEx Consulting © March 2026

# 3. LOCATION OF COPPER DISCOVERIES

# Size & Location of Copper Deposits

Primary & By-Product Copper : World : All Years



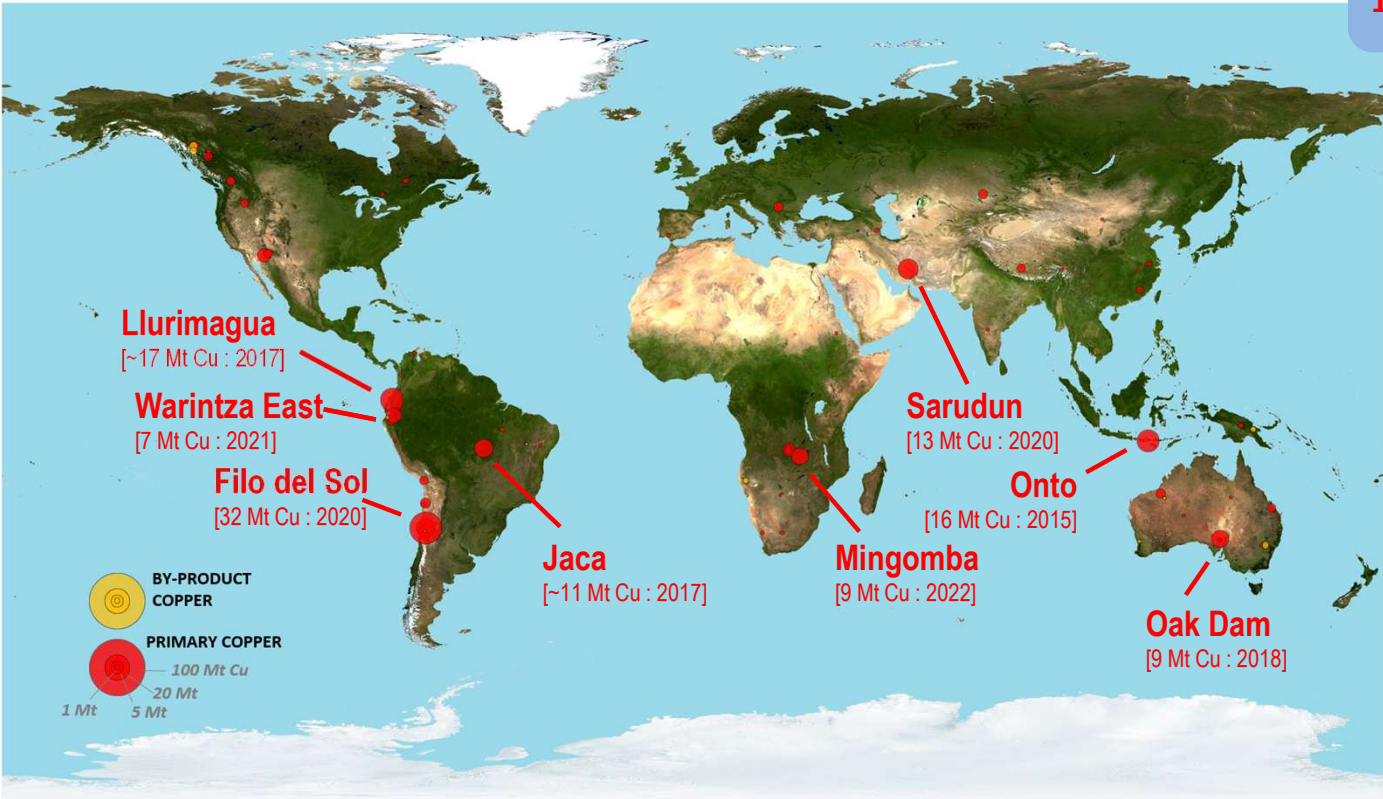
Note: Based on deposits  $\geq$  "Moderate" (i.e.  $>100\text{kt Cu-eq}$ ) in-size.  
No adjustment for unreported discoveries or likely growth in Resource

Source: MinEx Consulting © March 2026

# Copper Discoveries : 2015-2024

**67** deposits containing **176 Mt Cu** were found

Including 8 giant deposits >6 Mt Cu



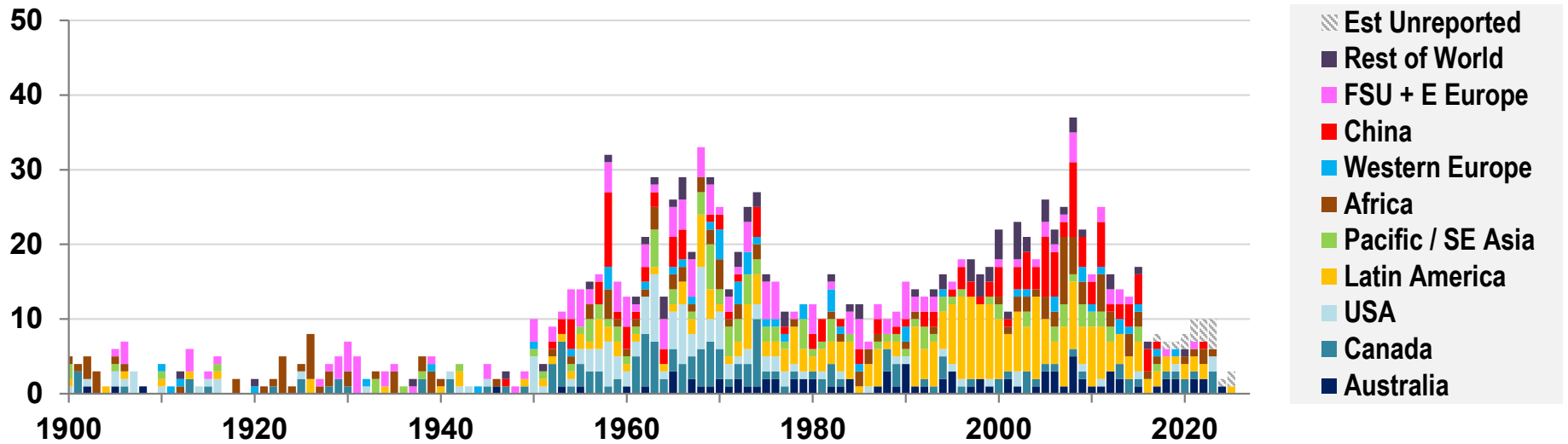
Note: Based on primary copper deposits >100kt Cu-eq

Source: MinEx Consulting © March 2026

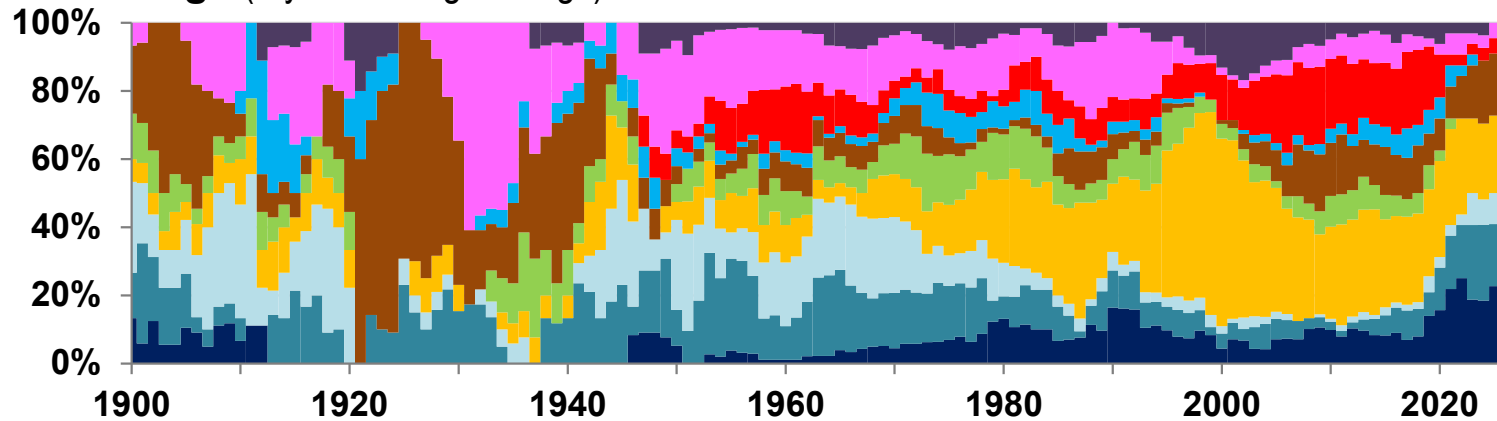
# Number of deposits discovered by Region

## Primary Copper : World: 1900-2025

Number



Percentage (5-year Rolling Average)



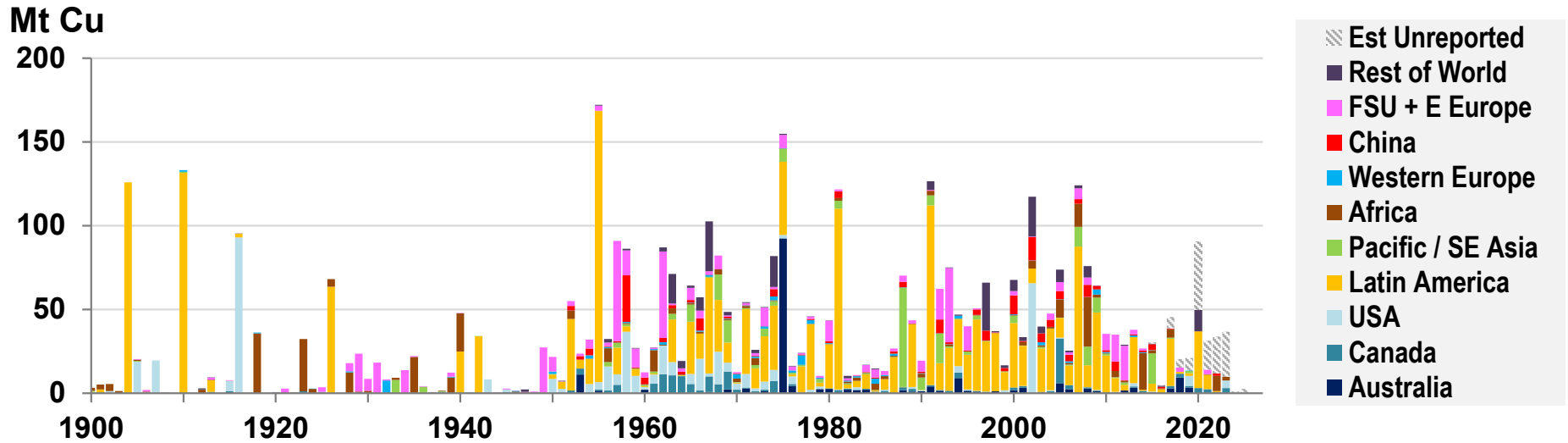
Majority of copper deposits were found in North & South America

Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

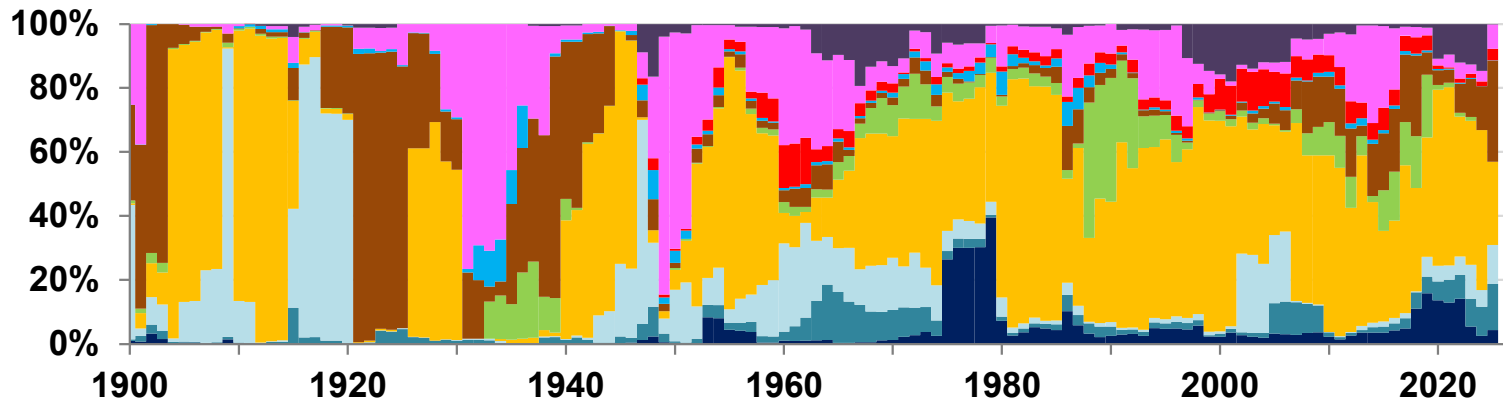
Source: MinEx Consulting © March 2026

# Tonnes of copper found by **Region**

## Primary & By-Product Copper : World: 1900-2025



### Percentage (5-year Rolling Average)



The amount of metal found in a given year is very episodic

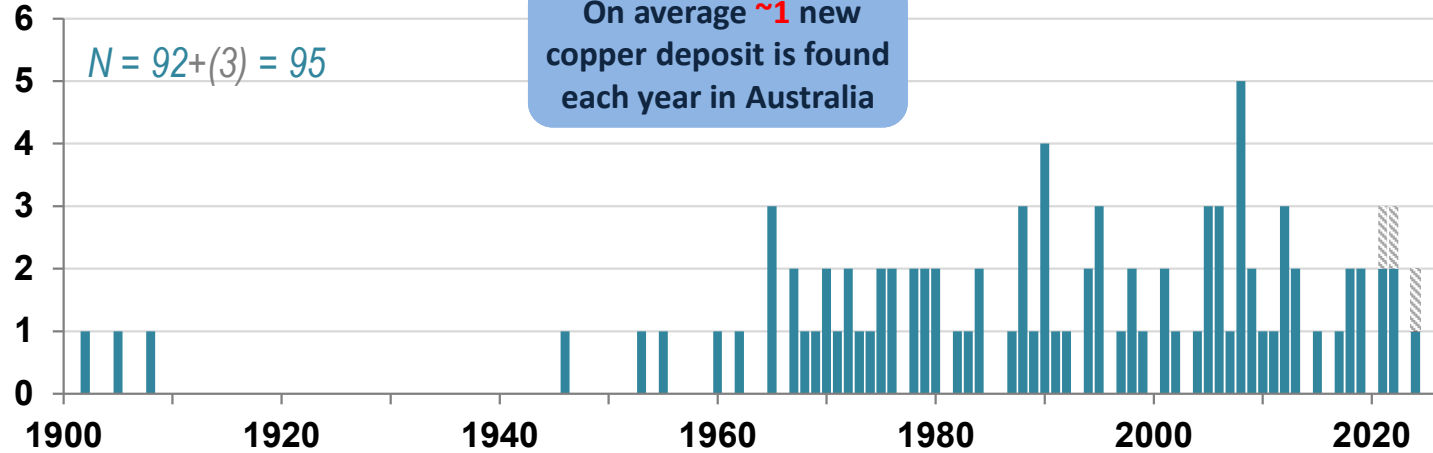
Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

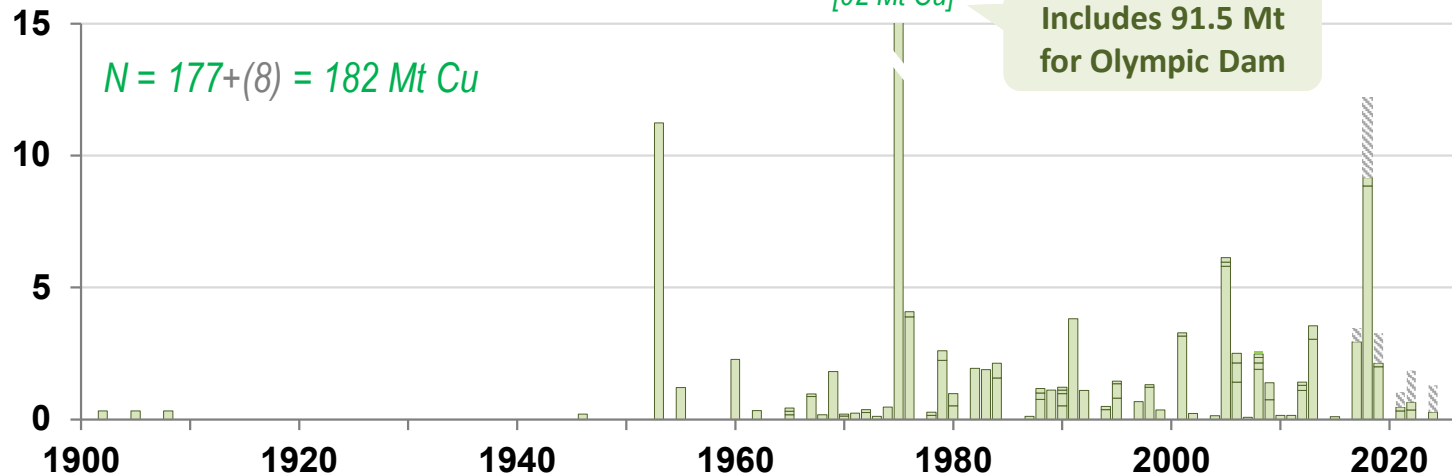
# Copper discoveries : Australia

## Primary Copper : 1900-2025

Number



Mt Cu



Note: Based on 92 deposits  $\geq$  "Moderate" (i.e.  $>100\text{kt Cu-eq}$ ) in-size

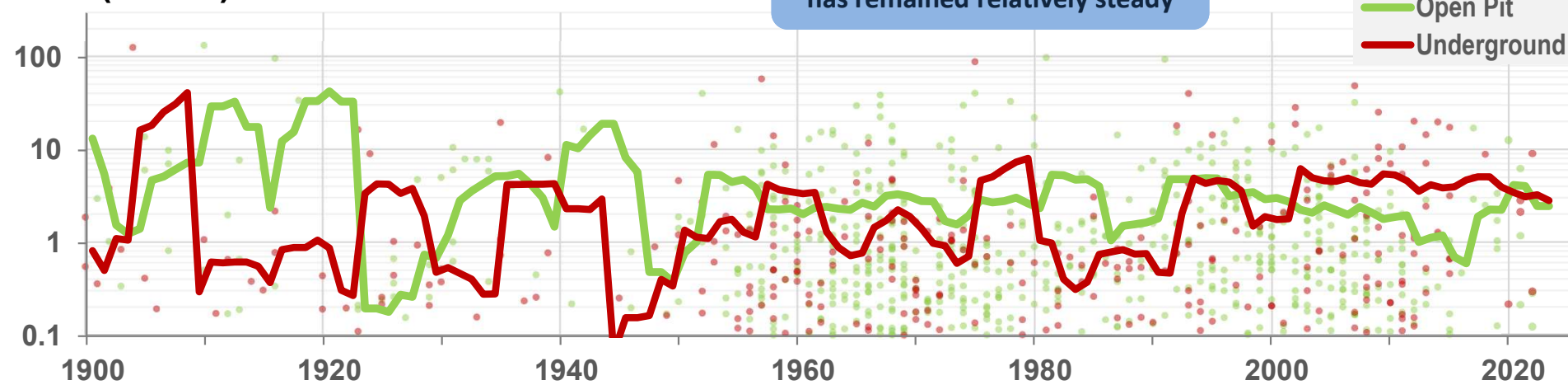
Source: MinEx Consulting © March 2026

## **4. TREND IN SIZE & GRADE AND DEPTH OF COVER**

# Average Size and Grade of Copper Discoveries: World

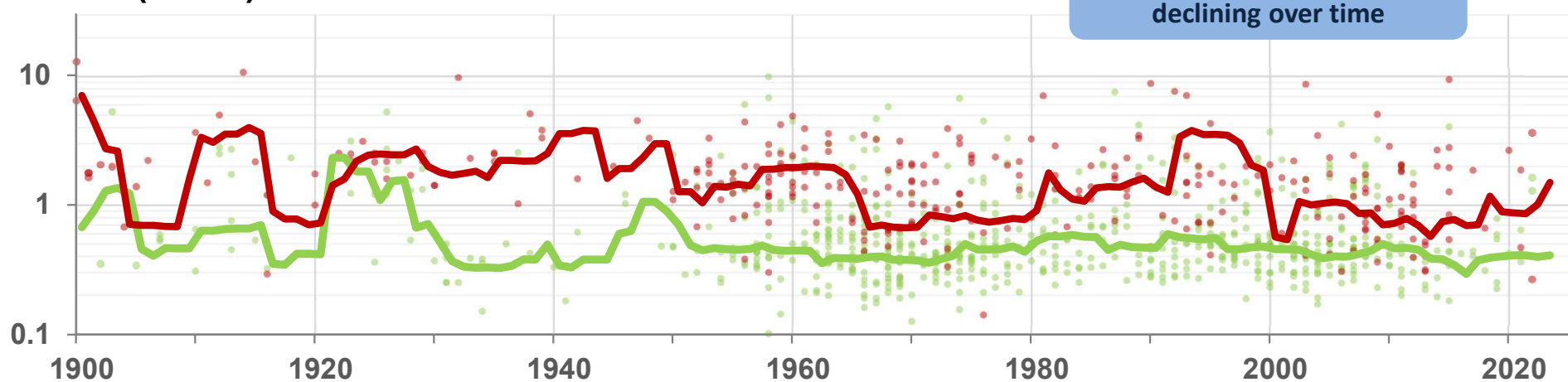
by Mining Method : 1900-2023

## Size (Mt Cu)



## Grade (% Cu)

Note: Trend lines are based on 5-Year Rolling Average

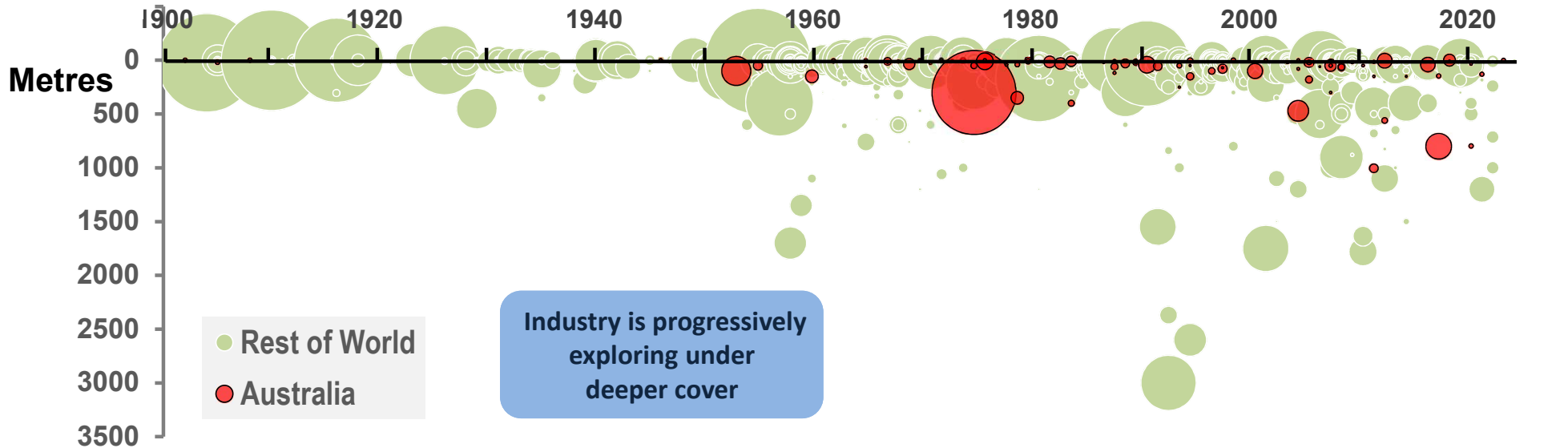


Caution: No adjustment for likely growth in resource in recent years

Source: MinEx Consulting @ April 2025

# Depth of Cover : 1900-2025

## Primary Copper Discoveries : World & Australia



1900-09 1910-19 1920-29 1930-39 1940-49 1950-59 1960-69 1970-79 1980-89 1990-99 2000-09 2010-19

### Average Depth (Metres)

World	5	28	23	26	9	67	54	71	67	131	94	202
Australia	7	NA	NA	NA	0	75	34	57	64	61	88	227

**Increasing by 20-40 metres per decade**

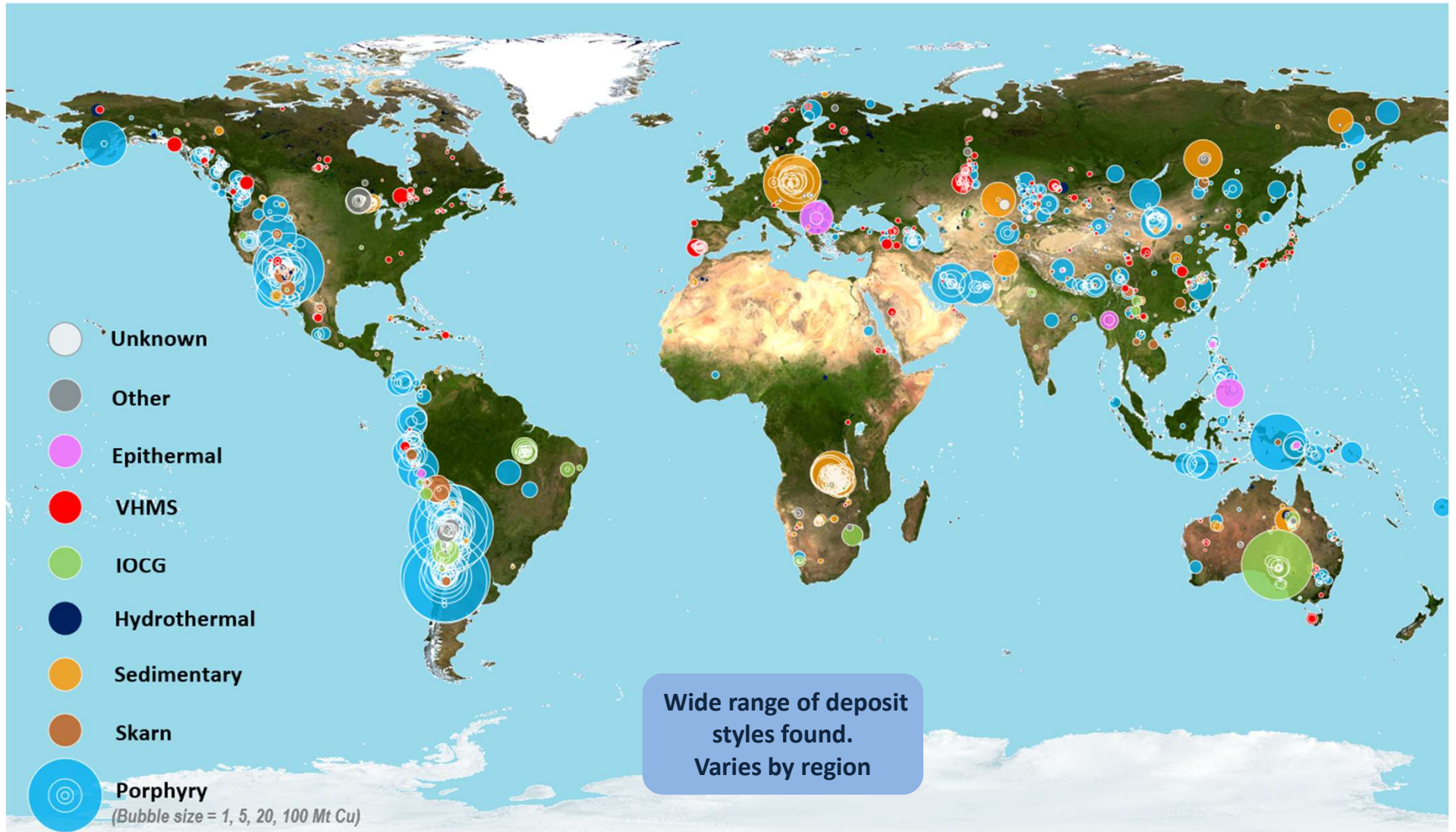
Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

## 5. STYLE OF COPPER DEPOSITS FOUND

# Size & Type of Copper Deposits

Primary Copper : World : All Years

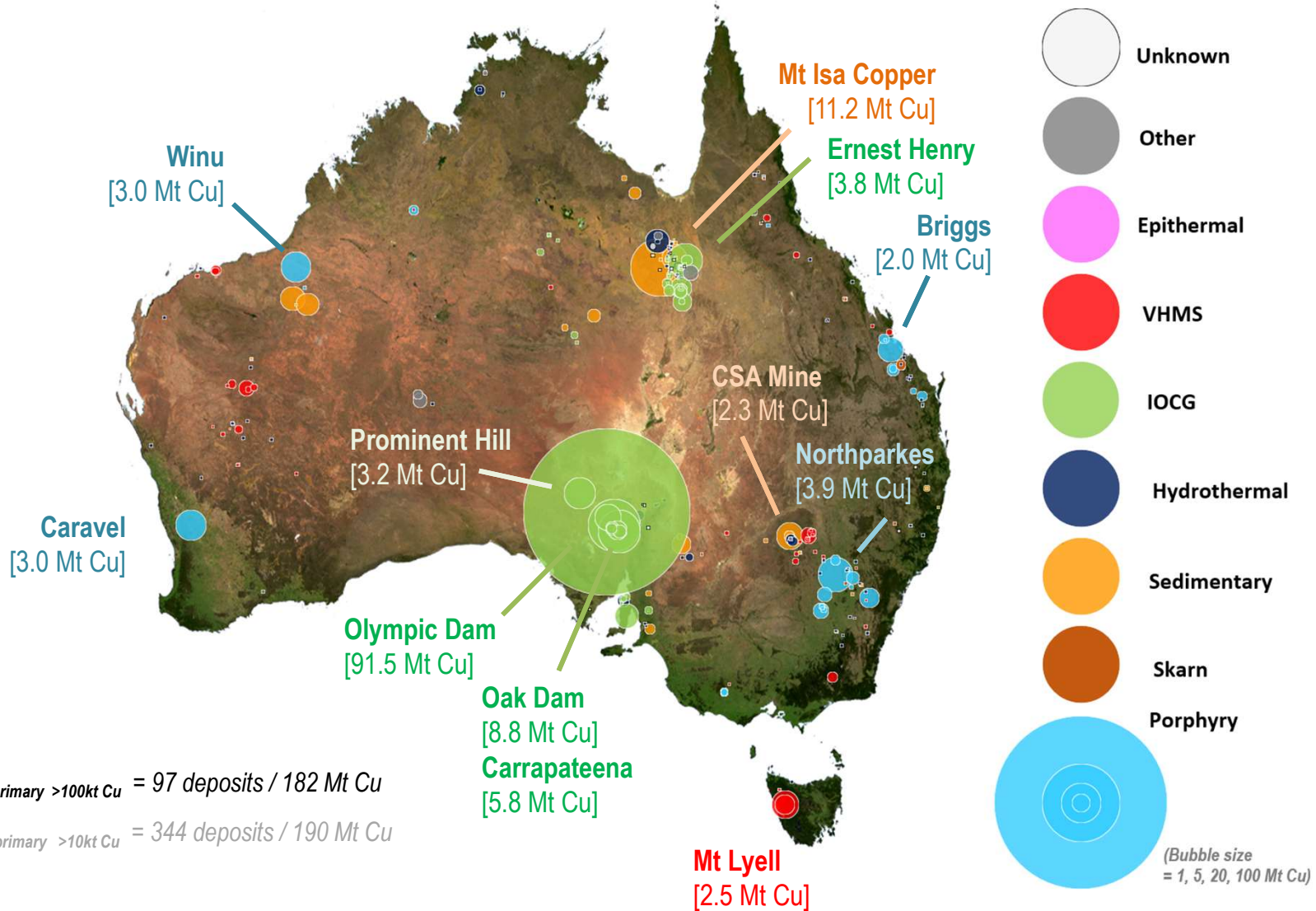


Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size.  
No adjustment for unreported discoveries or likely growth in Resource

Source: MinEx Consulting © March 2026

# Size & Type of Copper Deposits

## Primary Copper : Australia : All Years



$N_{primary >100kt Cu} = 97 \text{ deposits} / 182 \text{ Mt Cu}$

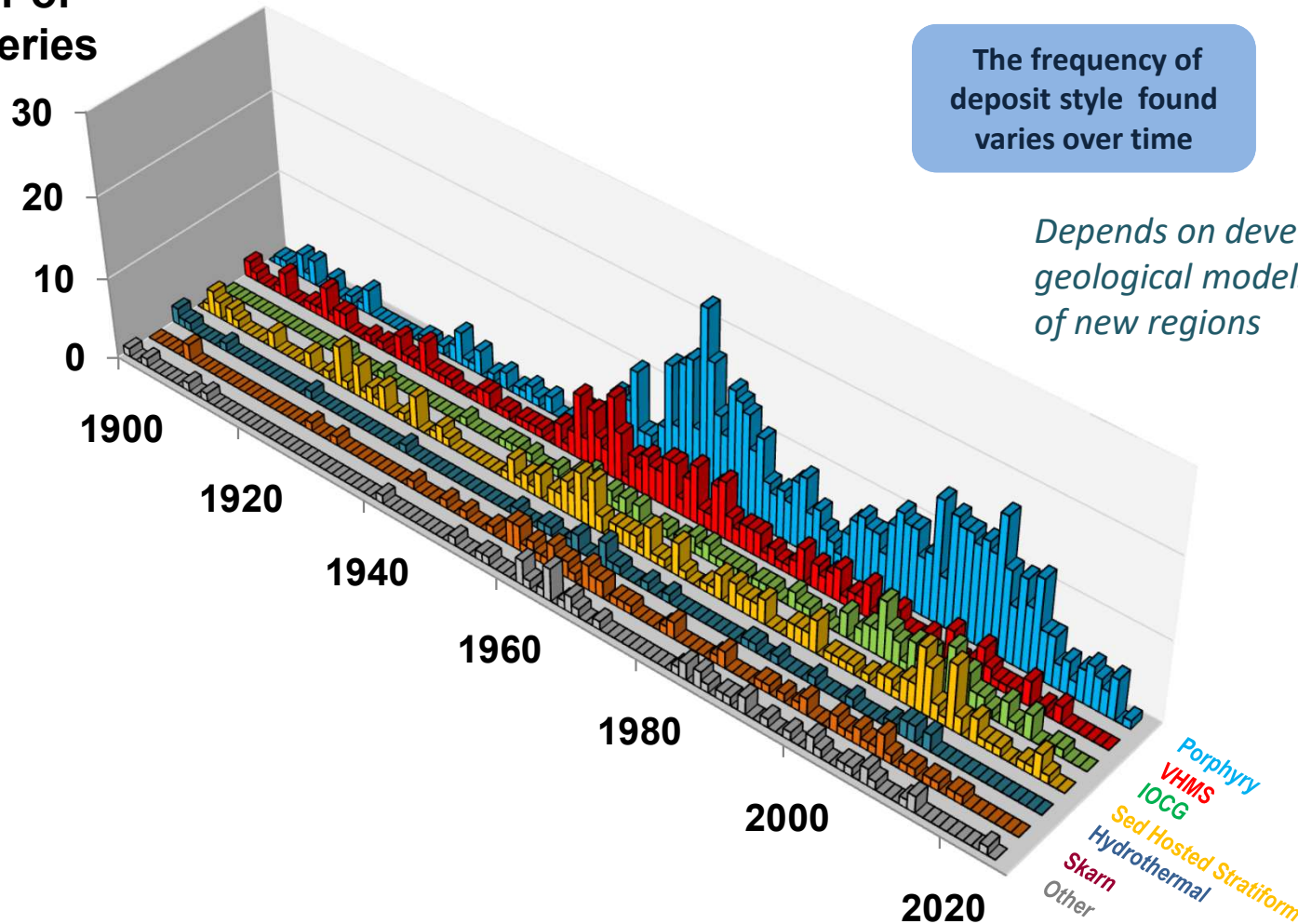
$N_{primary >10kt Cu} = 344 \text{ deposits} / 190 \text{ Mt Cu}$

Note: Based on 344 deposits  $\geq$  "Minor" (i.e.  $>10kt Cu\text{-eq}$ ) in-size, including 102 deposits  $>100kt Cu\text{-eq}$   
 No adjustment for unreported discoveries or likely growth in Resource

Source: MinEx Consulting © March 2026

# Significant Copper Discoveries by Deposit Style World : 1900-2025

Number of Discoveries



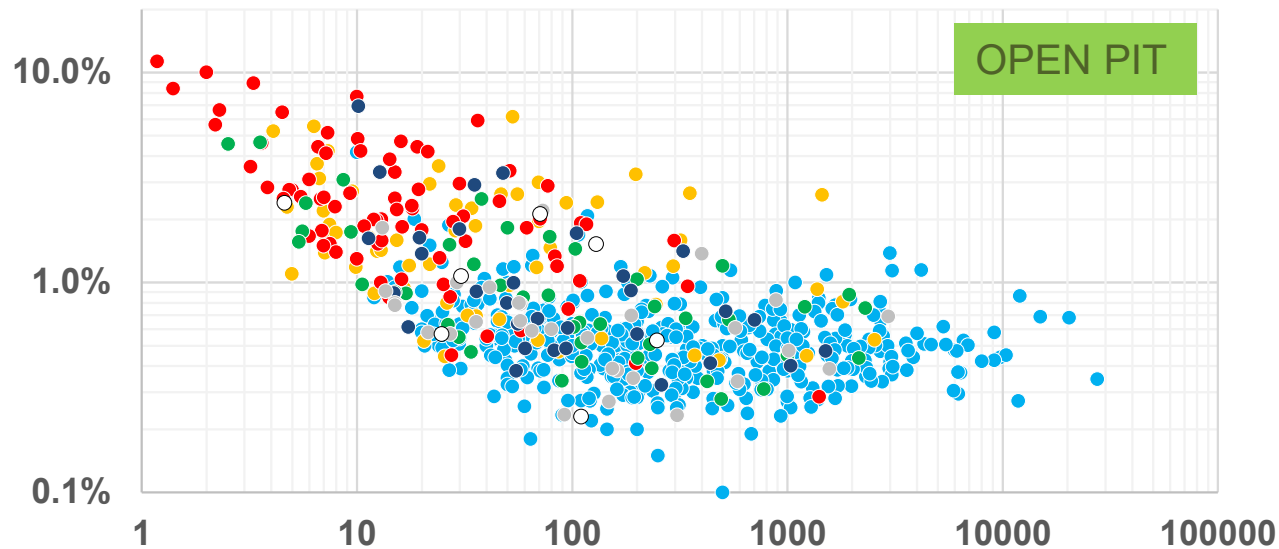
Note: Based on primary copper deposits  $\geq$  "Moderate" (i.e.  $>100\text{kt Cu-eq}$ ) in-size.  
Chart excludes unknown deposits and unreported discoveries

Source: MinEx Consulting © March 2026

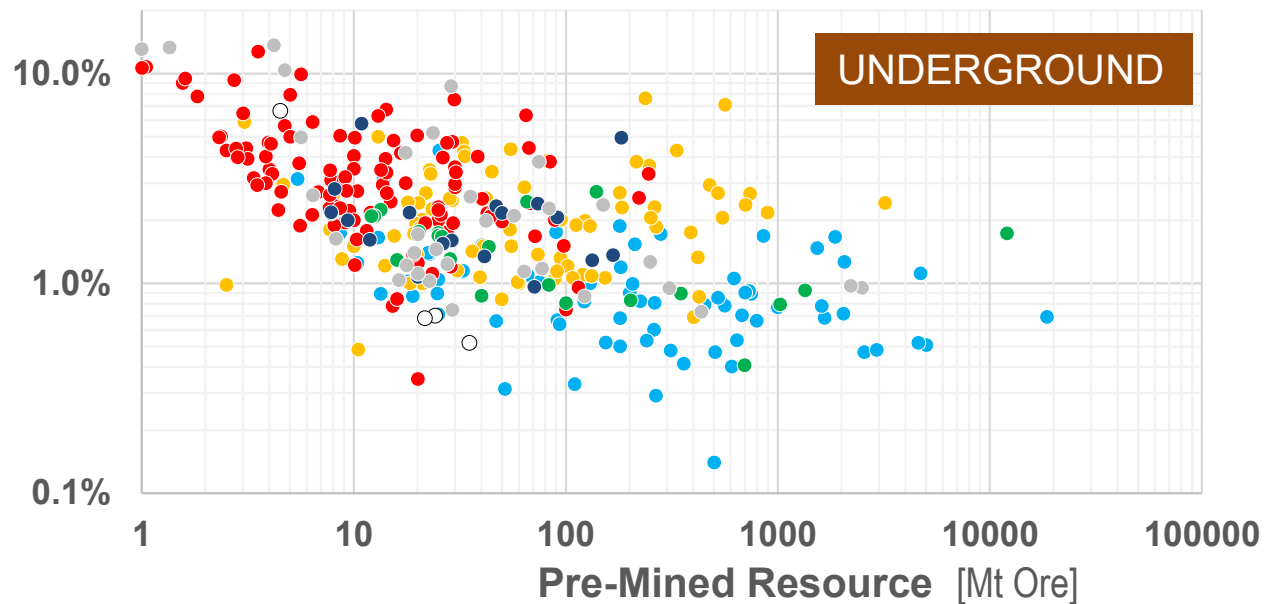
# Tonnes and Grade

## Primary Copper Deposits : World : All Years

Grade [% Cu-eq]



- Porphyry
- Sedimentary
- VHMS
- IOCG
- Skarn
- Other
- Unknown



VMHS are small but high-grade. Porphyries are large & low-grade

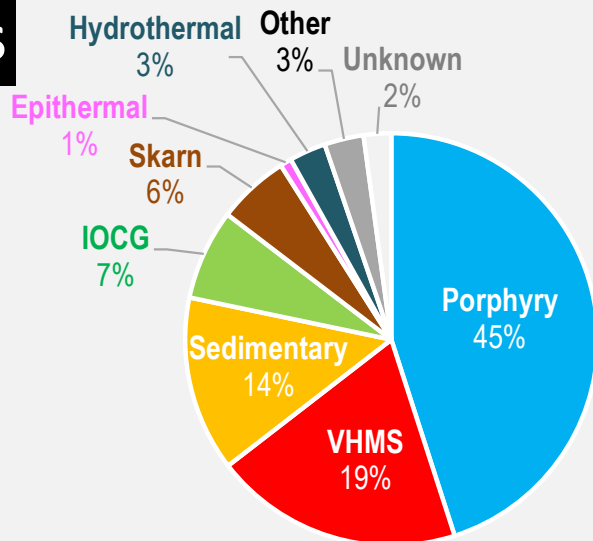
Source: MinEx Consulting © March 2026

# Relative number and amount of contained metal

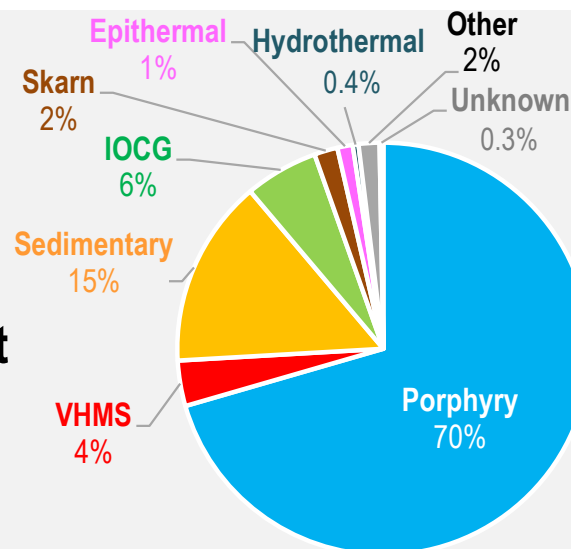
## Primary Copper : World

**ALL YEARS**

**Number  
= 1565**

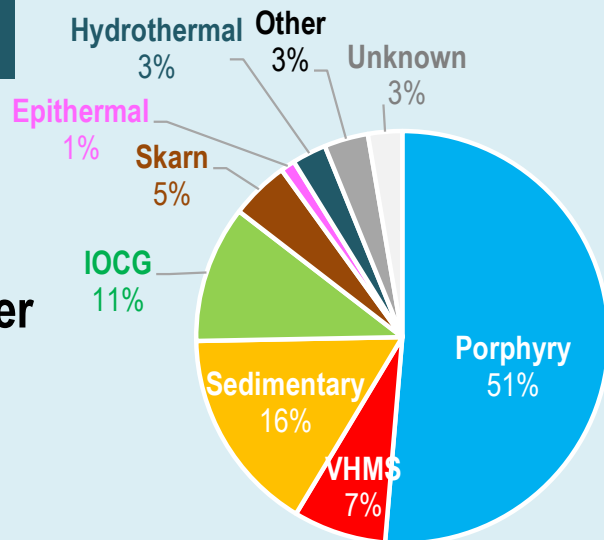


**Cu Metal  
= 4296 Mt**

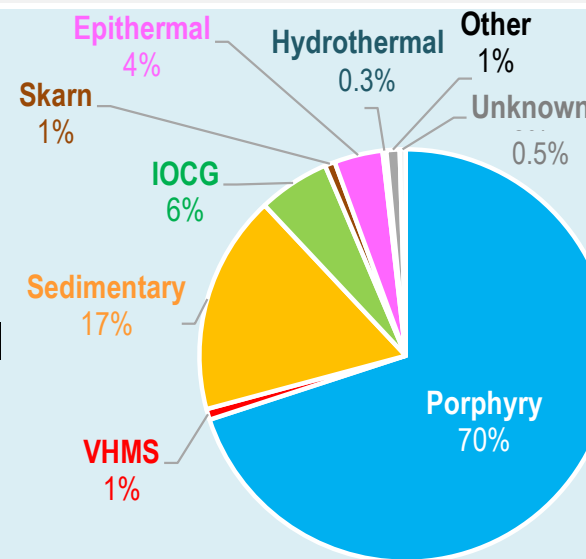


**2006-25**

**Number  
= 261**



**Cu Metal  
= 610 Mt**



Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size. No adjustment for unreported discoveries or likely growth in Resource

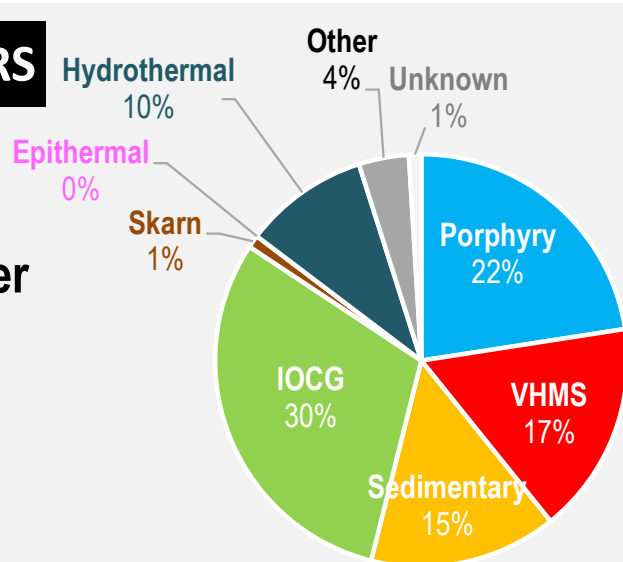
Source: MinEx Consulting © March 2026

# Relative number and amount of contained metal

## Primary Copper : **Australia**

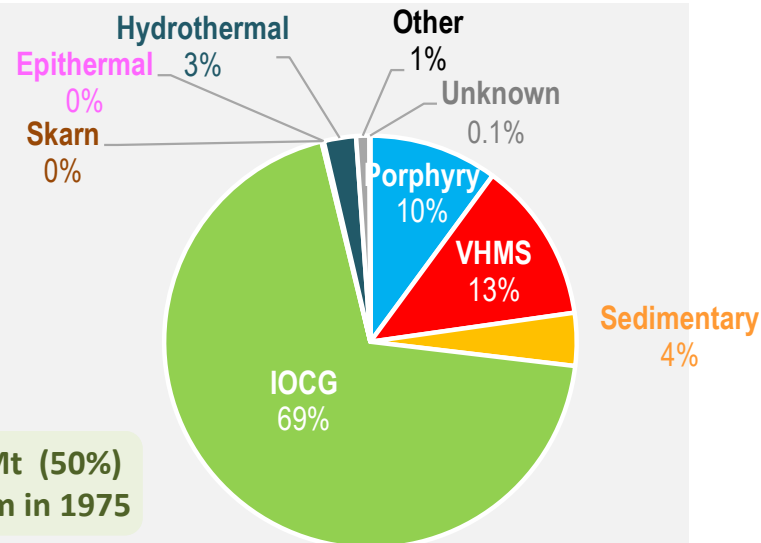
**ALL YEARS**

**Number  
= 102**



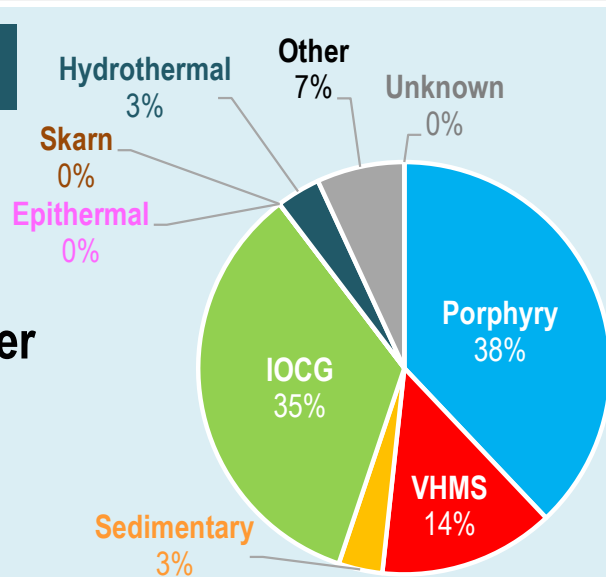
**Cu Metal  
= 182 Mt**

Includes 91.5 Mt (50%)  
for Olympic Dam in 1975

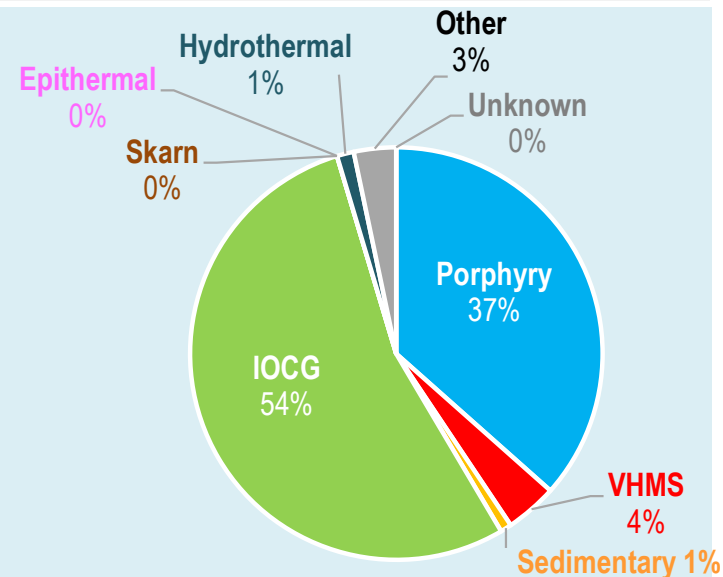


**2006-25**

**Number  
= 29**



**Cu Metal  
= 28 Mt**



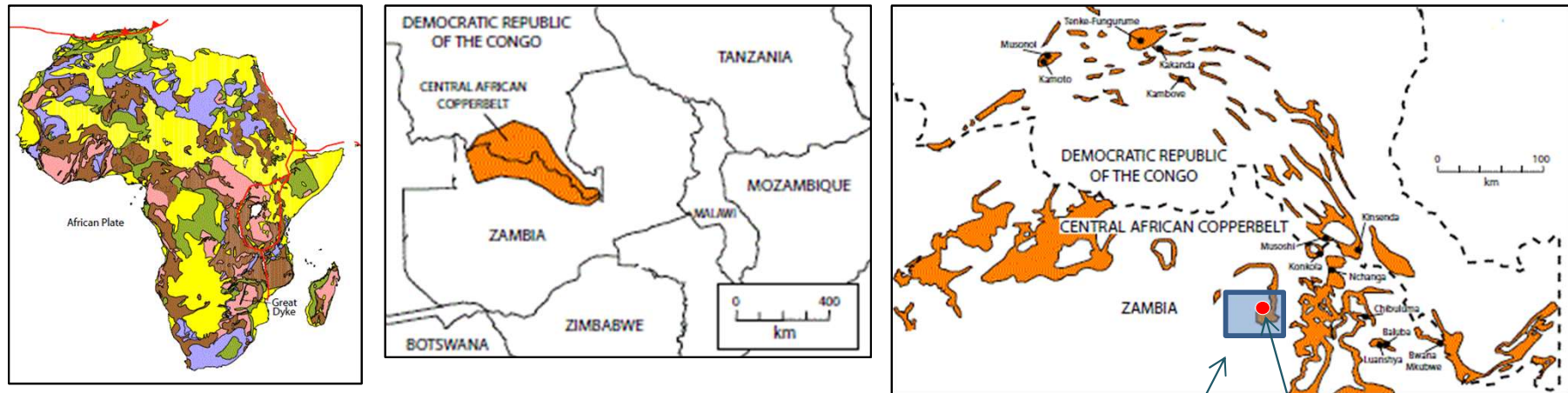
Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size. No adjustment for unreported discoveries or likely growth in Resource

Source: MinEx Consulting © March 2026

## 6. TREND IN DISCOVERY METHOD

# Trends in exploration methods

The preferred search method used varies by commodity type, depth of cover and "scale"



Continental-Scale

Province-Scale

District-Scale

Project-Scale

Prospect-Scale

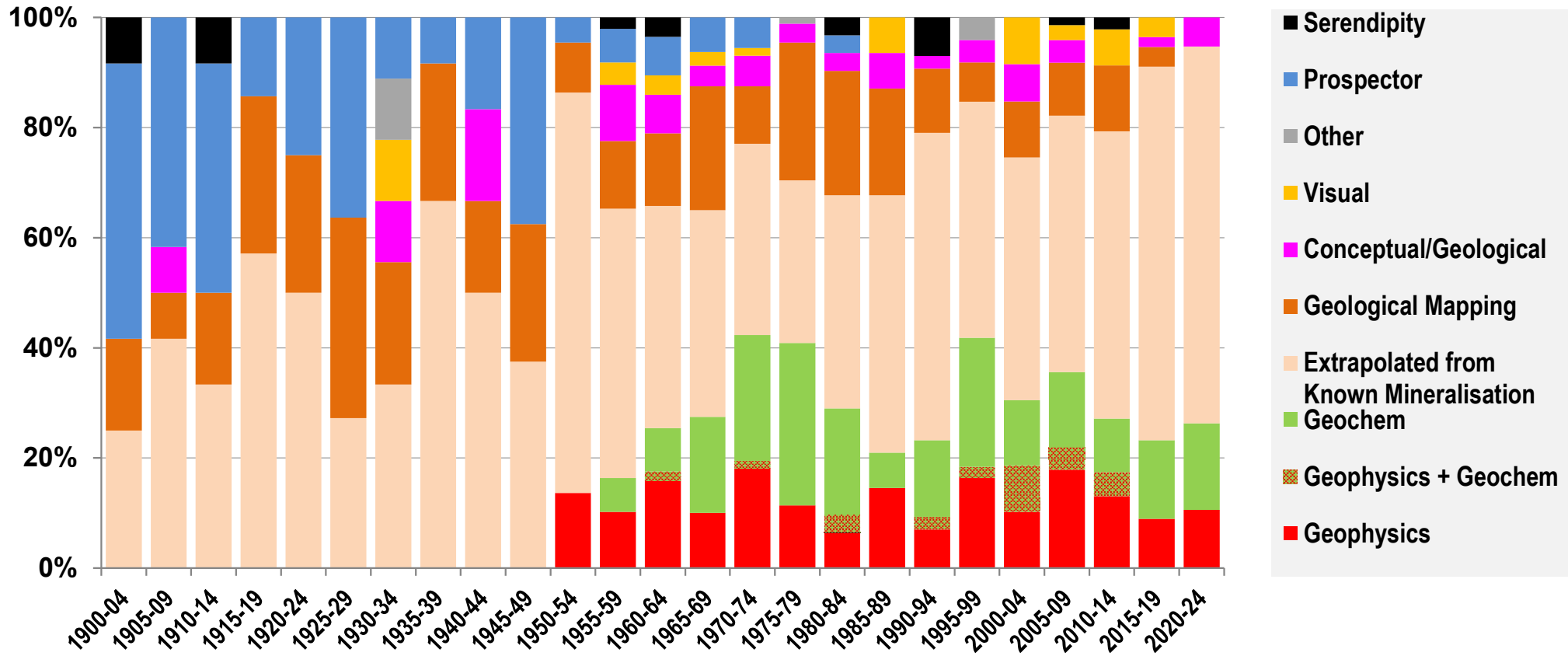
MinEx has carried out a detailed analysis of the discovery history of 800 copper deposits found since 1900

# Primary search method used at the project-scale

Primary copper discoveries in the World: 1900-2024

ie What method was used to decide where to peg the leases

Percentage of total discoveries (by Number)



ie The main targeting method has transitioned from "Prospecting" to "Nearology"

Note: Analysis based on detailed analysis of 800 Cu projects (out of 1344 known discoveries) that contain >100kt Cu-eq

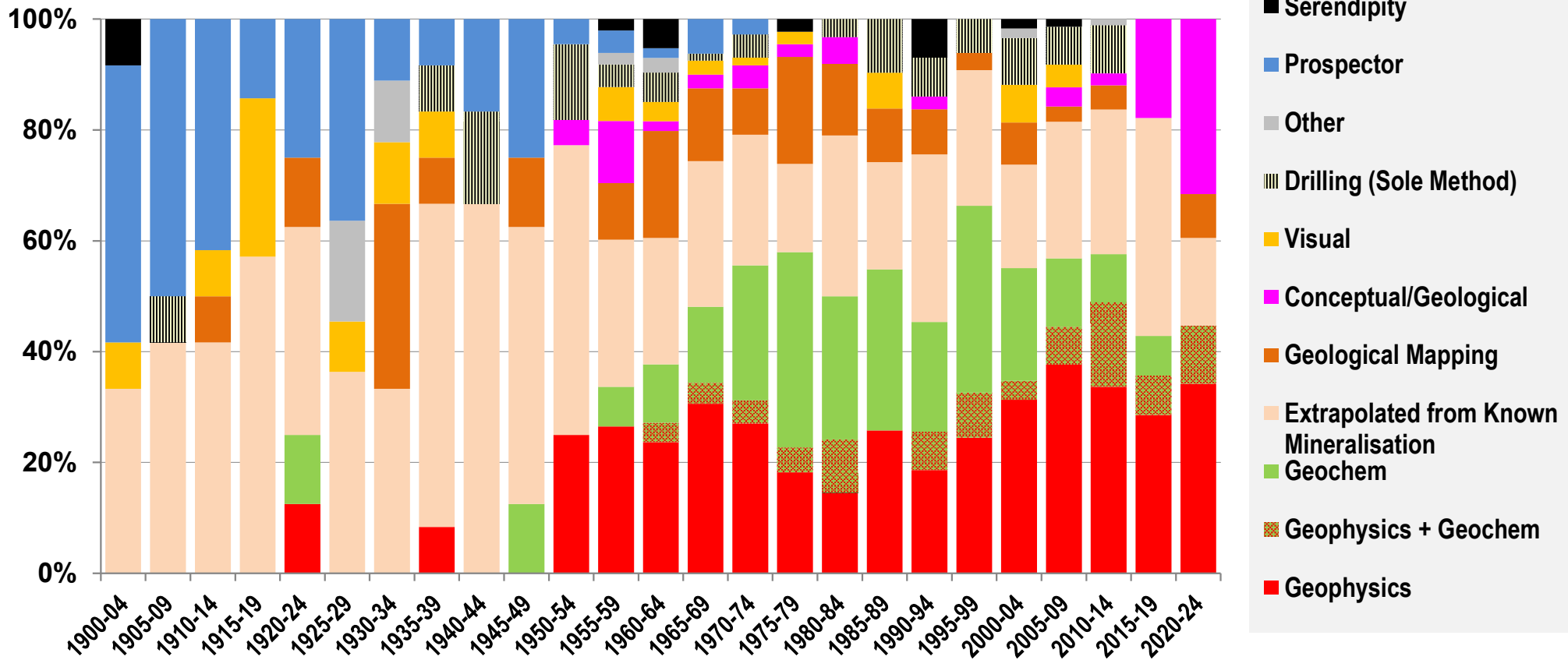
Source: MinEx Consulting © March 2026

# Primary search method used at the prospect-scale

Primary copper discoveries in the World: 1900-2024

ie What method was used to decide where to drill the first hole

Percentage of total discoveries (by Number)



The importance of geophysics increases as we go under deeper cover

Note: Analysis based on detailed analysis of 800 Cu projects (out of 1344 known discoveries) that contain >100kt Cu-eq

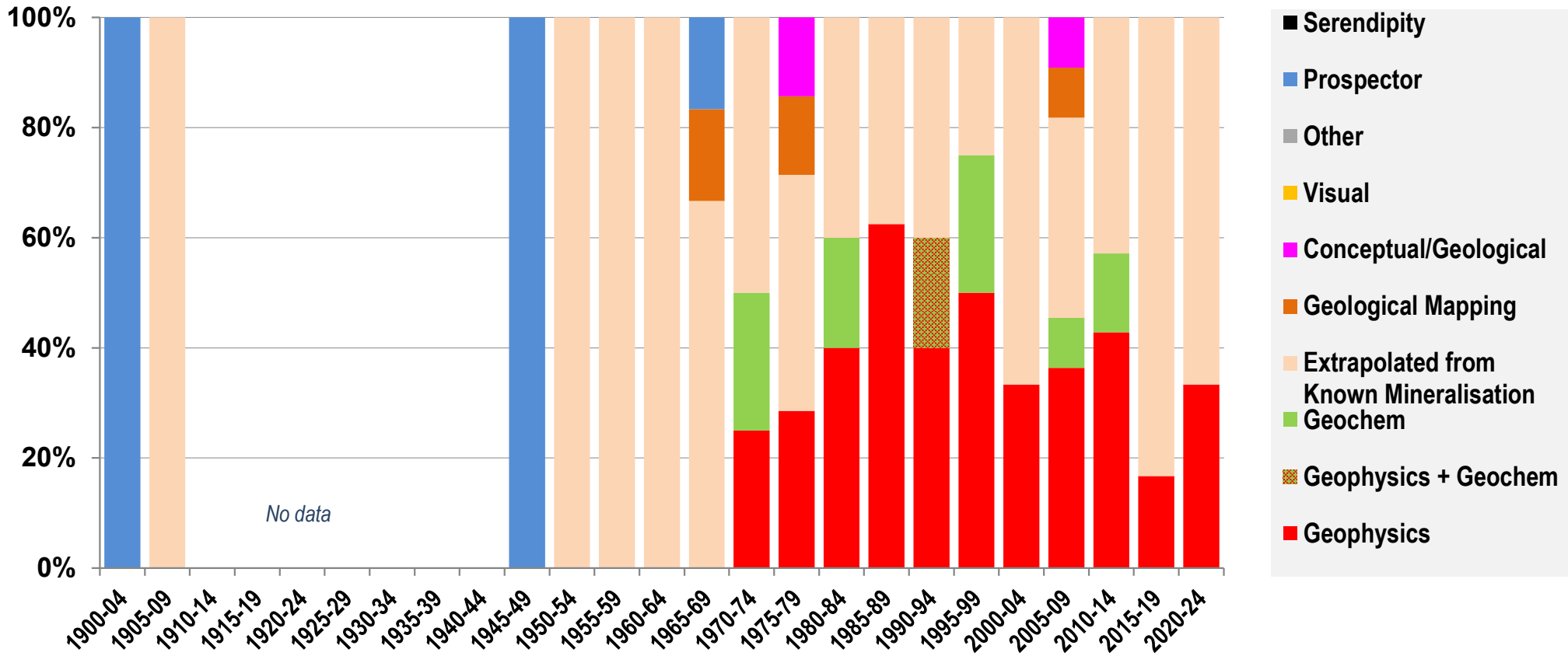
Source: MinEx Consulting © March 2026

# Primary search method used at the project-scale

Primary copper discoveries in Australia: 1900-2024

ie What method was used to decide where to peg the leases

Percentage of total discoveries (by Number)



Note: Analysis based on detailed analysis of 73 Cu projects (out of 92 known discoveries) that contain >100 kt Cu-eq. Includes 5 discoveries pre-1950 and 68 discoveries post-1950.

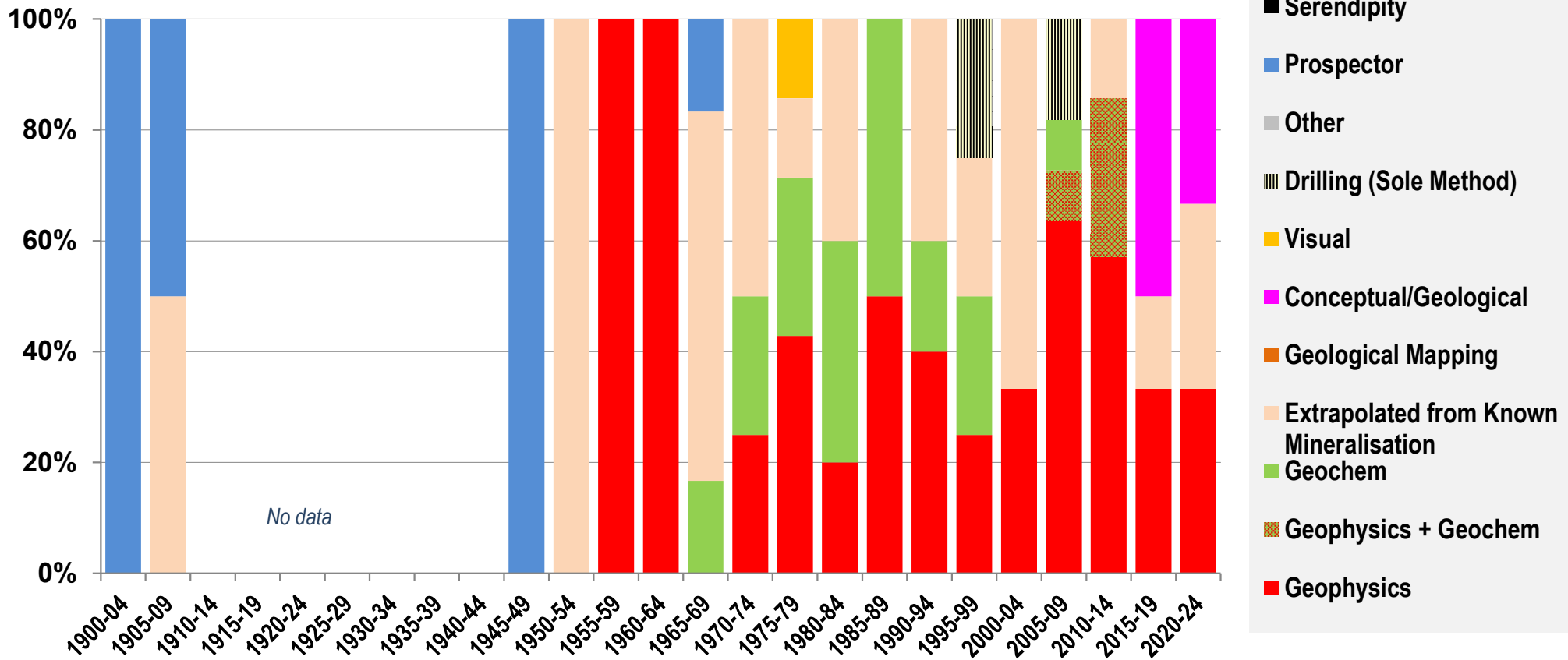
Source: MinEx Consulting © March 2026

# Primary search method used at the prospect-scale

Primary copper discoveries in **Australia**: 1900-2024

ie What method was used to decide where to **drill the first hole**

Percentage of total discoveries (by Number)



Note: Analysis based on detailed analysis of 73 Cu projects (out of 92 known discoveries) that contain >100 kt Cu-eq. Includes 5 discoveries pre-1950 and 68 discoveries post-1950.

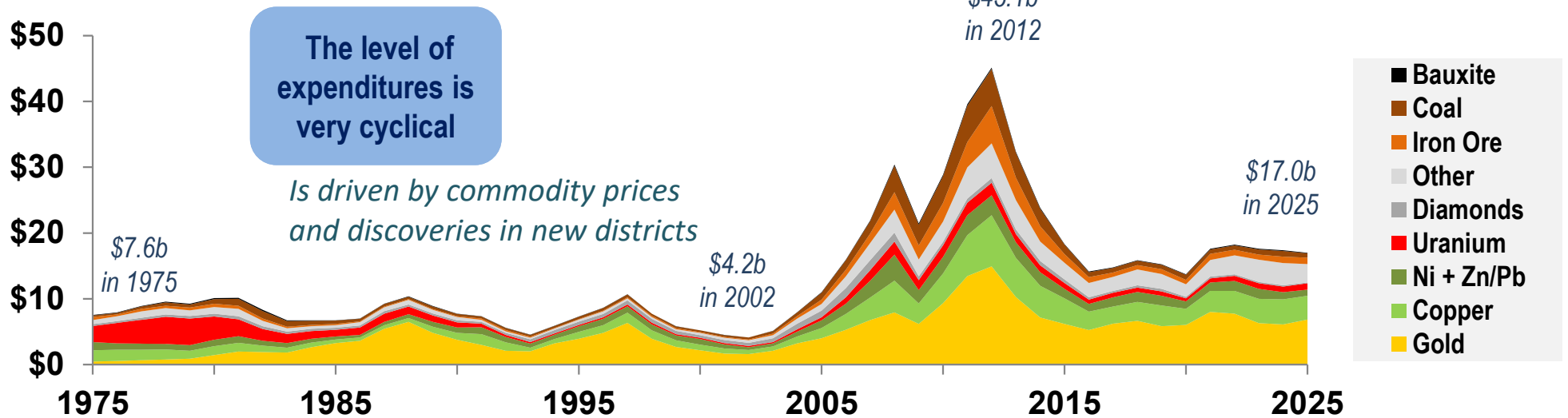
Source: MinEx Consulting © March 2026

# 7. TREND IN EXPLORATION EXPENDITURES

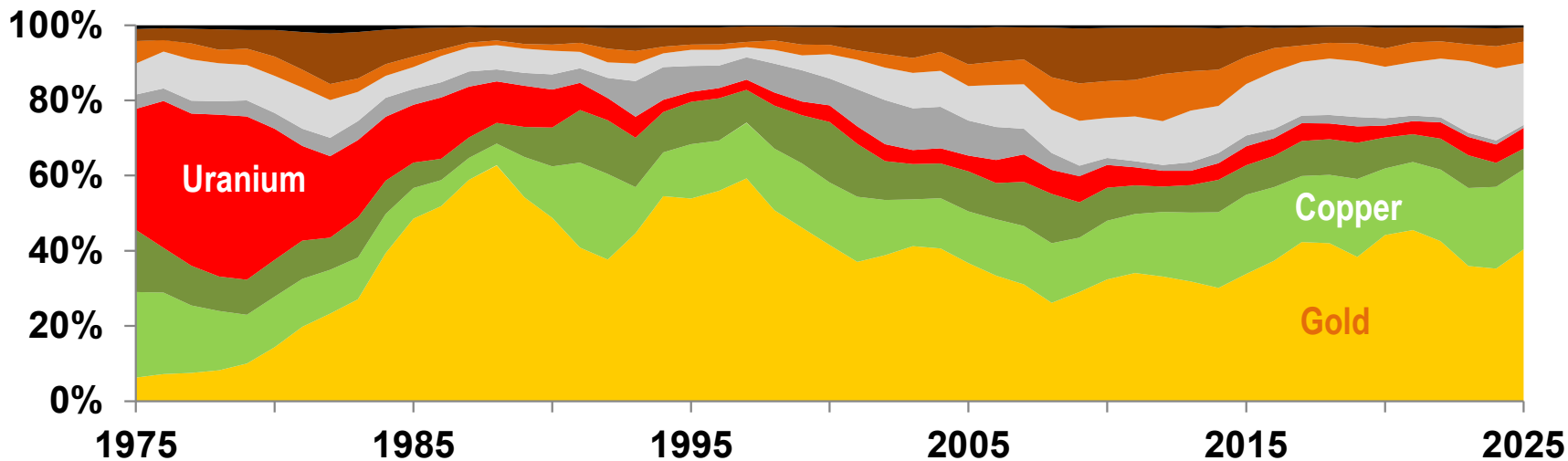
# Exploration expenditures: World

by Commodity : 1975-2025

Dec 2025 US\$ billion



Percentage

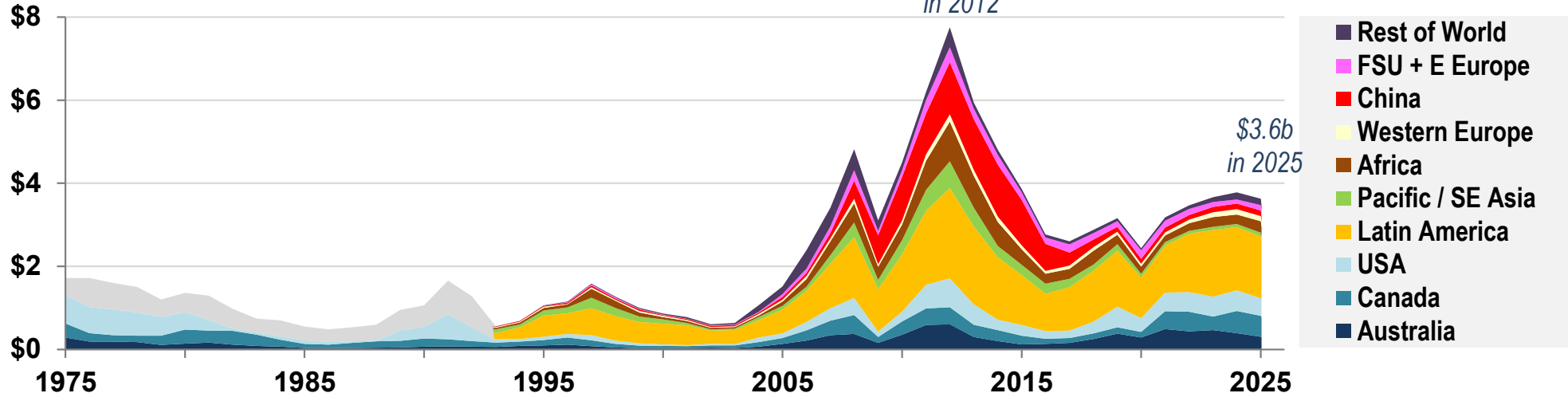


Sources: MinEx Consulting estimates © March 2026, based on data from ABS, NRCAN, MLR (China), IAEA and S&P

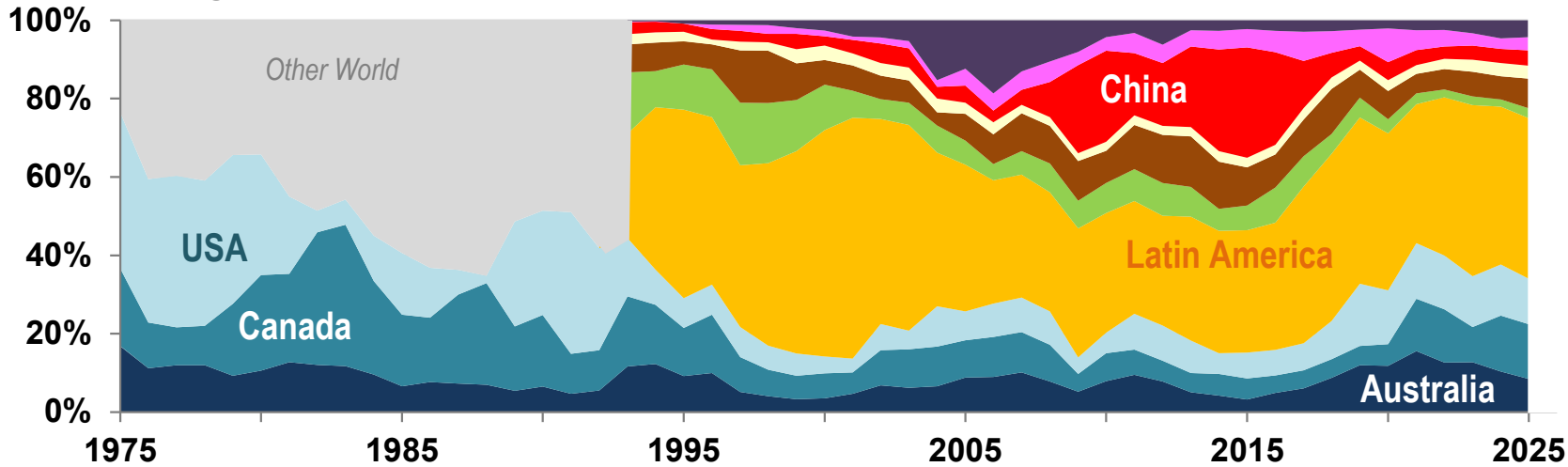
# Copper exploration expenditures

by Region : 1975-2025

Dec 2025 US\$ billion



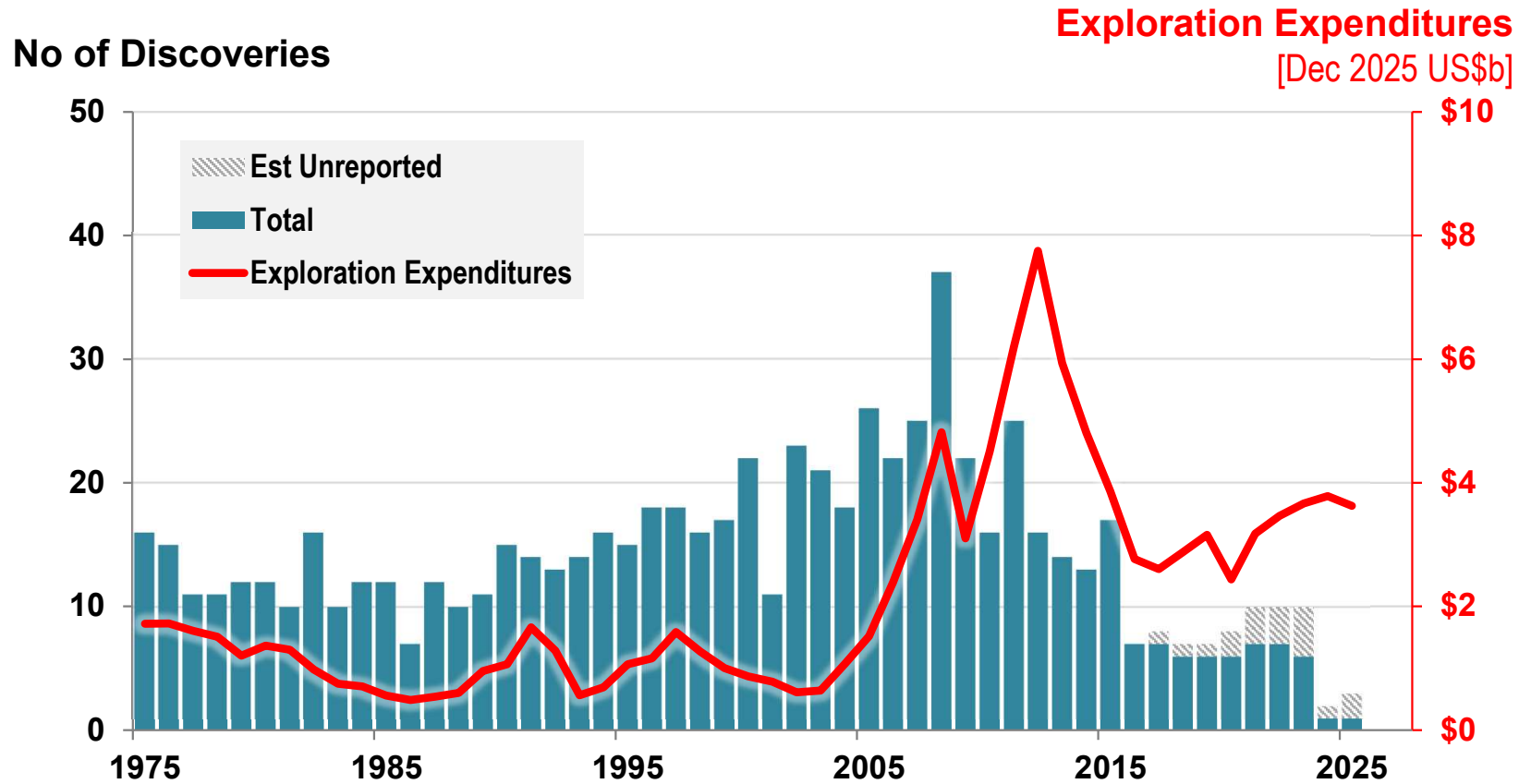
Percentage Share



Sources: MinEx Consulting estimates © March 2026, based on data from ABS, NRCan, MLR (China) and S&P

# Number of Copper Discoveries versus Exploration Spend

## World: 1975-2025



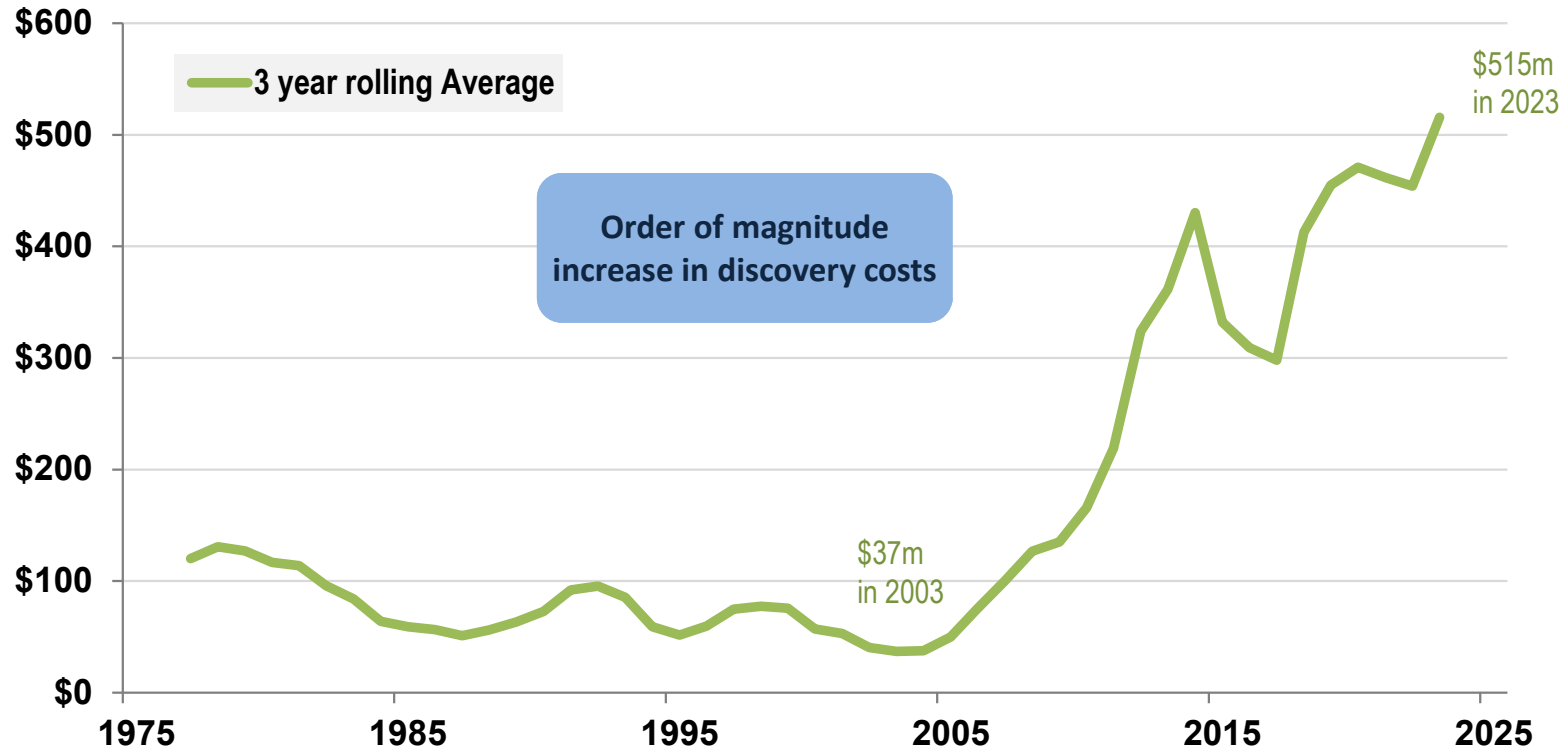
Since the late 1990s expenditures are **up by 4x** but number of discoveries is **down 2x**

Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

# Unit Discovery Cost : World : 1975-2023

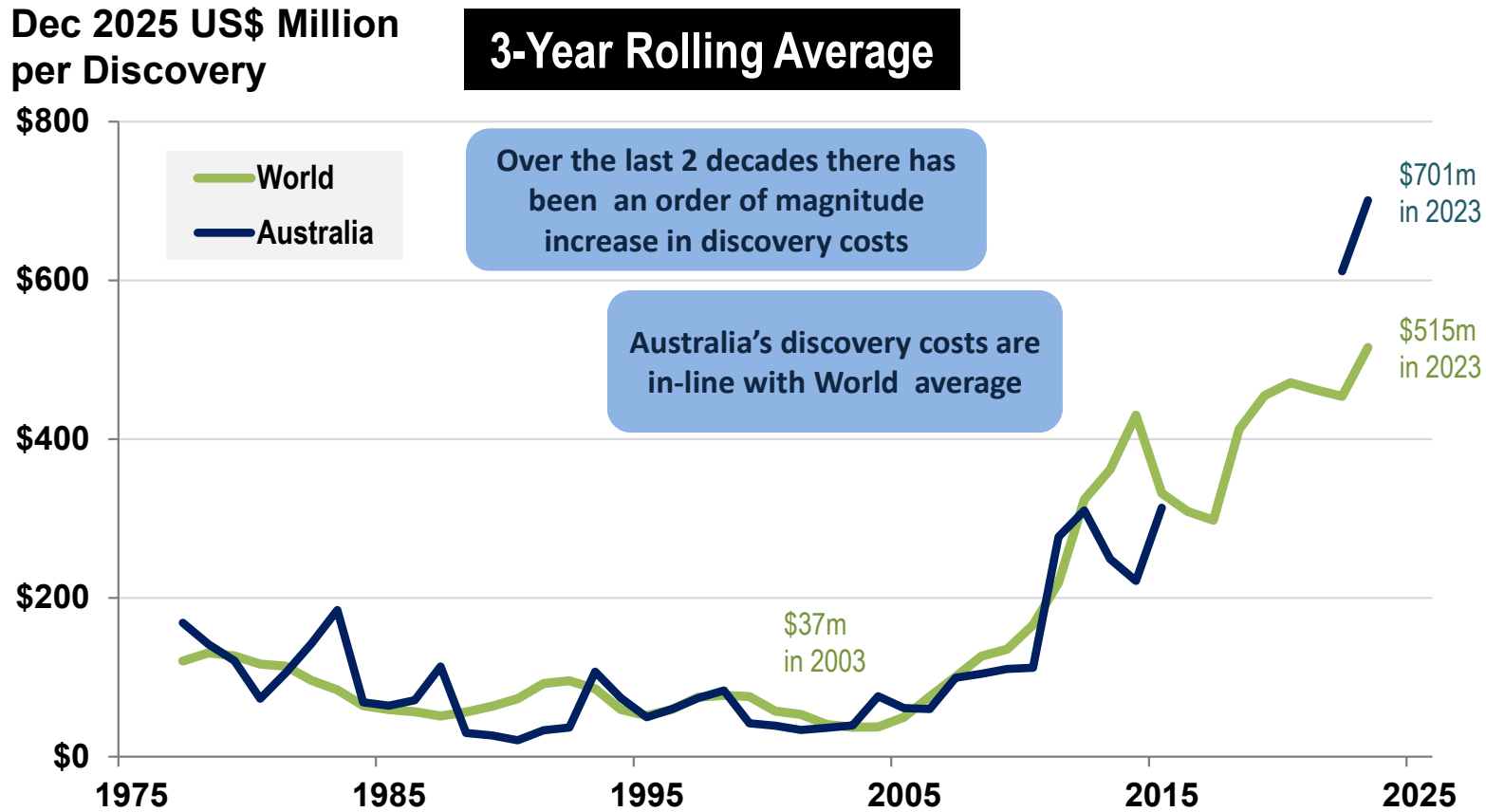
Dec 2025 US\$ Million  
per Discovery



Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

# Unit Discovery Cost : World : 1975-2023

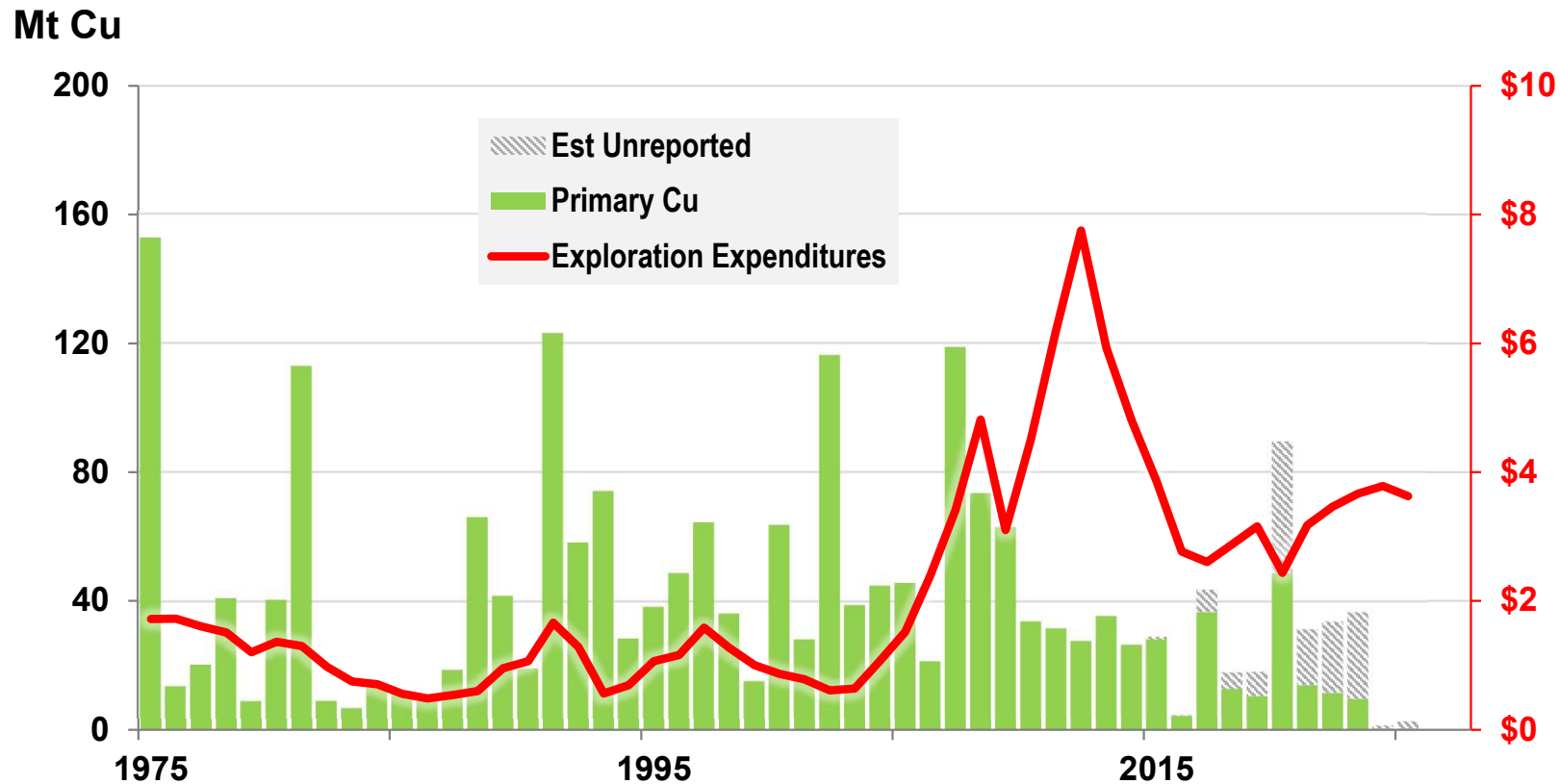


Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

# Tonnes of Copper Found versus Exploration Spend

## Primary Copper : World: 1975-2025



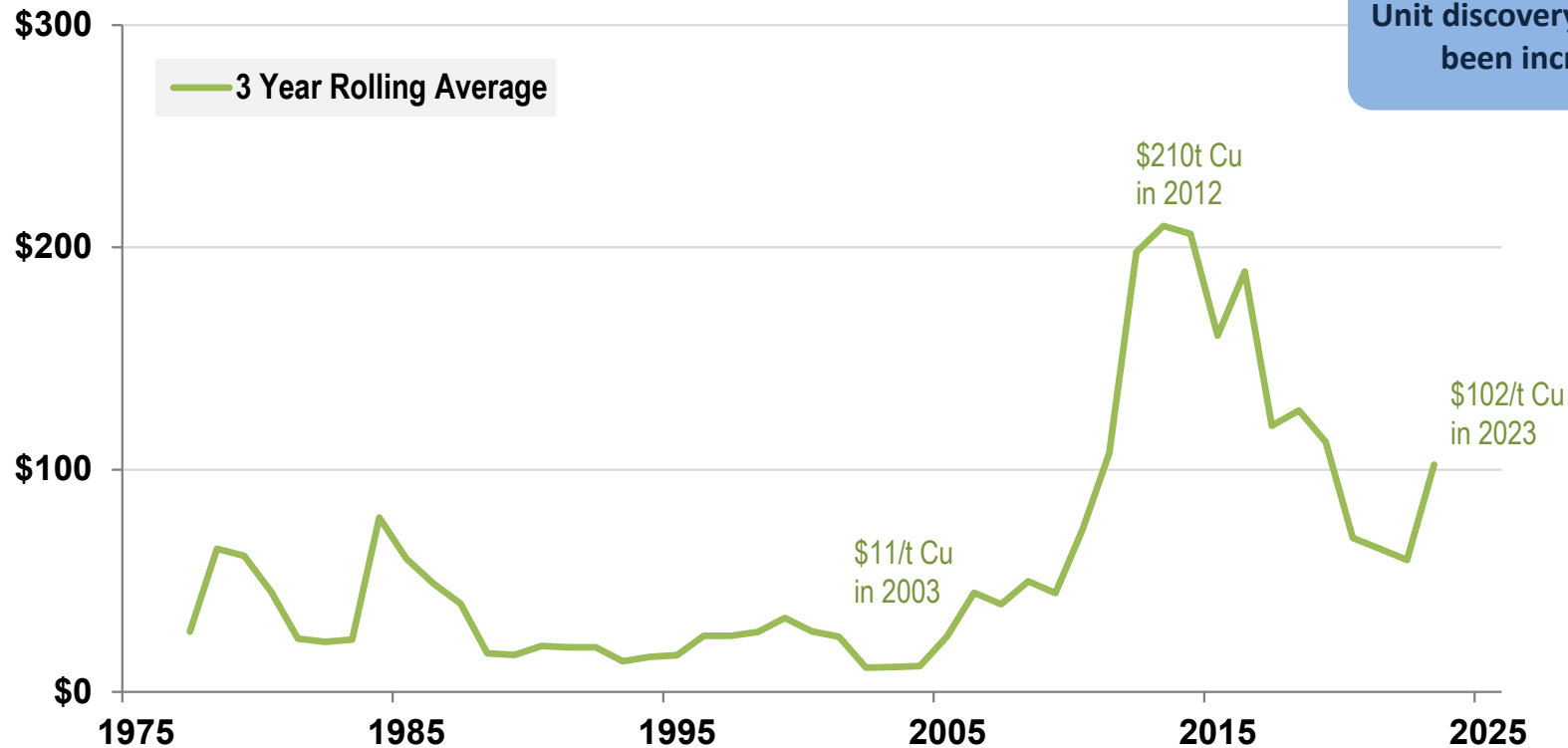
Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

# Unit Discovery Cost : World : 1978-2023

Primary World: 1975-2025

Dec 2025 US\$/t Cu  
metal found



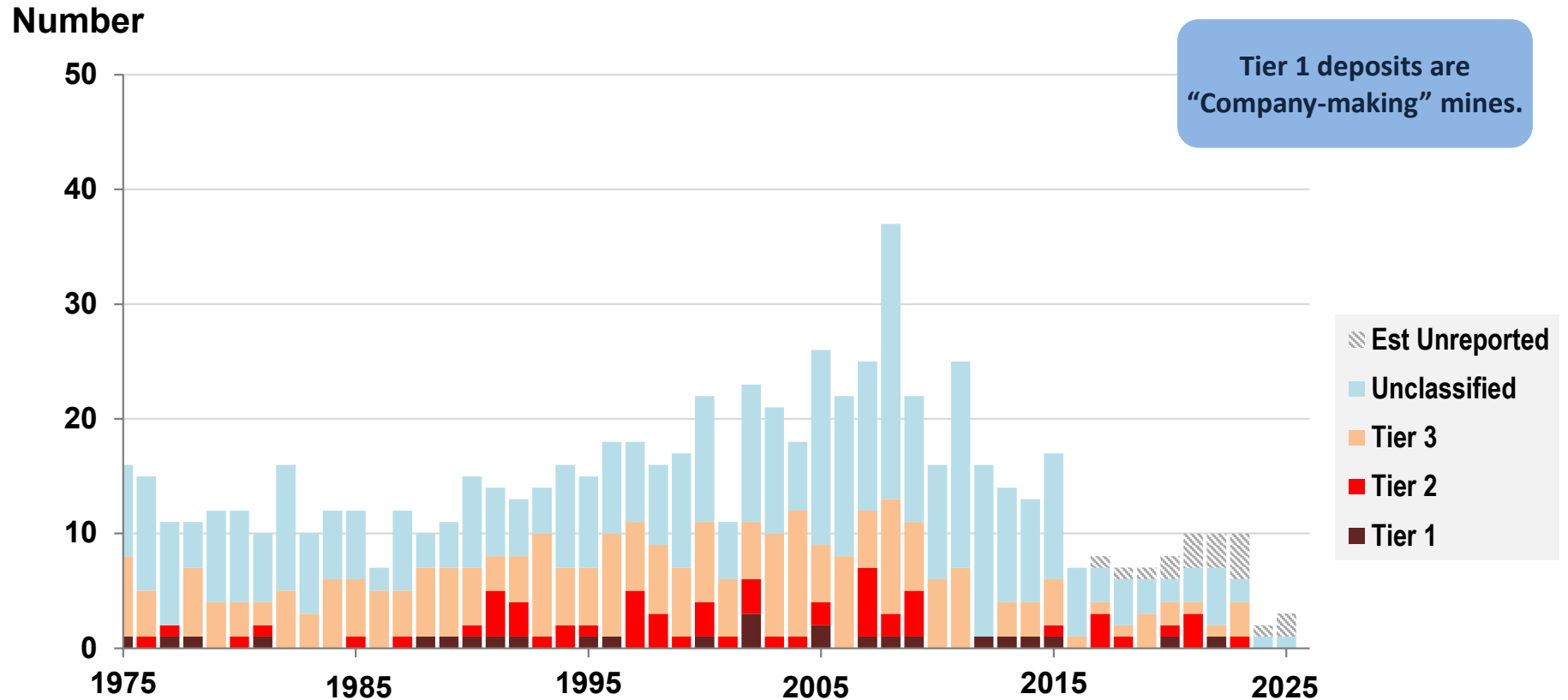
Note: Based on deposits >="Moderate" (i.e. >100kt Cu-eq) in-size

Source: MinEx Consulting © March 2026

## **8. TREND IN QUALITY OF DISCOVERIES MADE AND THE VALUE PROPOSITION FOR COPPER EXPLORATION**

# Number of copper discoveries by quality

Tier 1,2 & 3 discoveries in World: 1975-2025



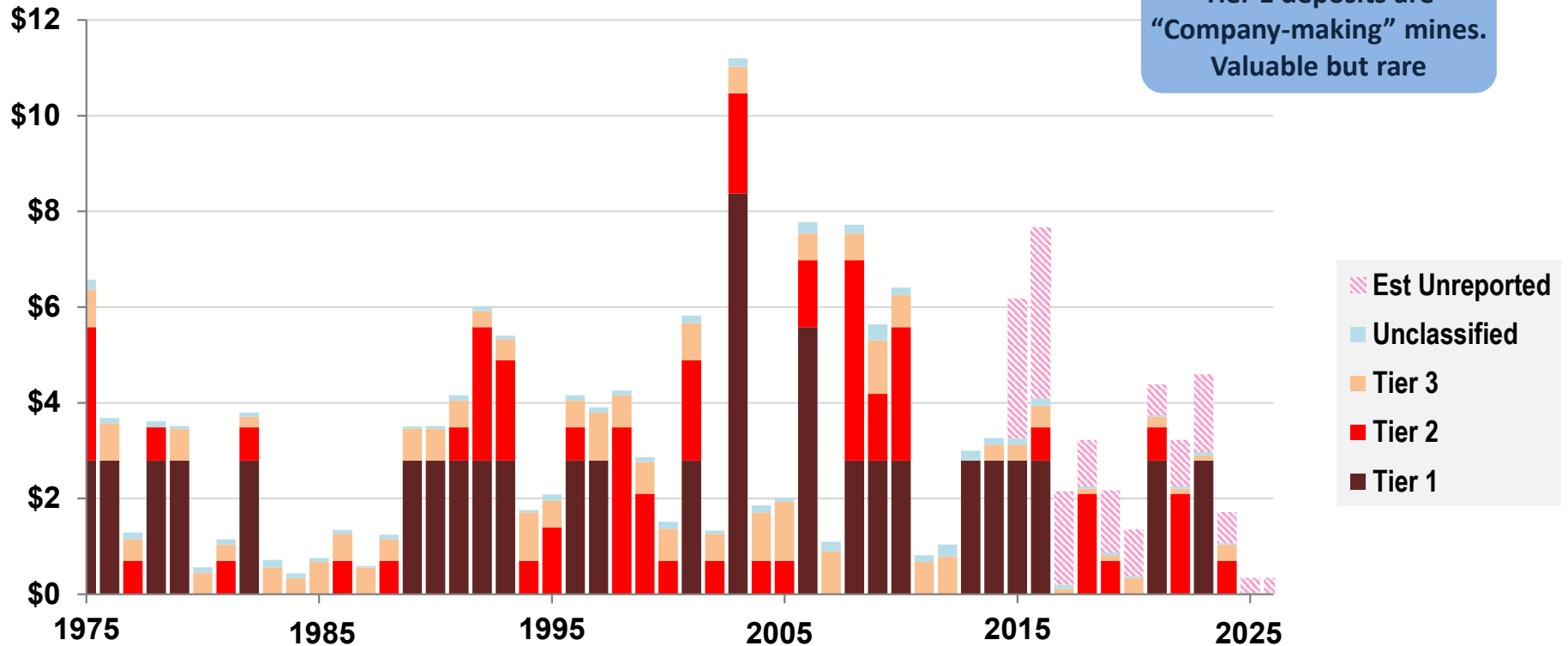
Note: **Tier 1** deposits are large (i.e. >200ktoa Cu), long life (>20 years) and low cost (Q1)  
**Tier 2** , has 2 of the 3 characteristics of a Tier 1 deposit  
**Tier 3** have only 1 of the 3 characteristics of a Tier 1 deposit  
**Unclassified** deposits are too small (i.e. Resource <1 Mt Cu) to be given a Tier Classification

Source: MinEx Consulting © March 2026

# Estimated value of copper discoveries by **quality**

Tier 1,2 & 3 discoveries in World: 1975-2025

Dec 2025 US\$ Billion

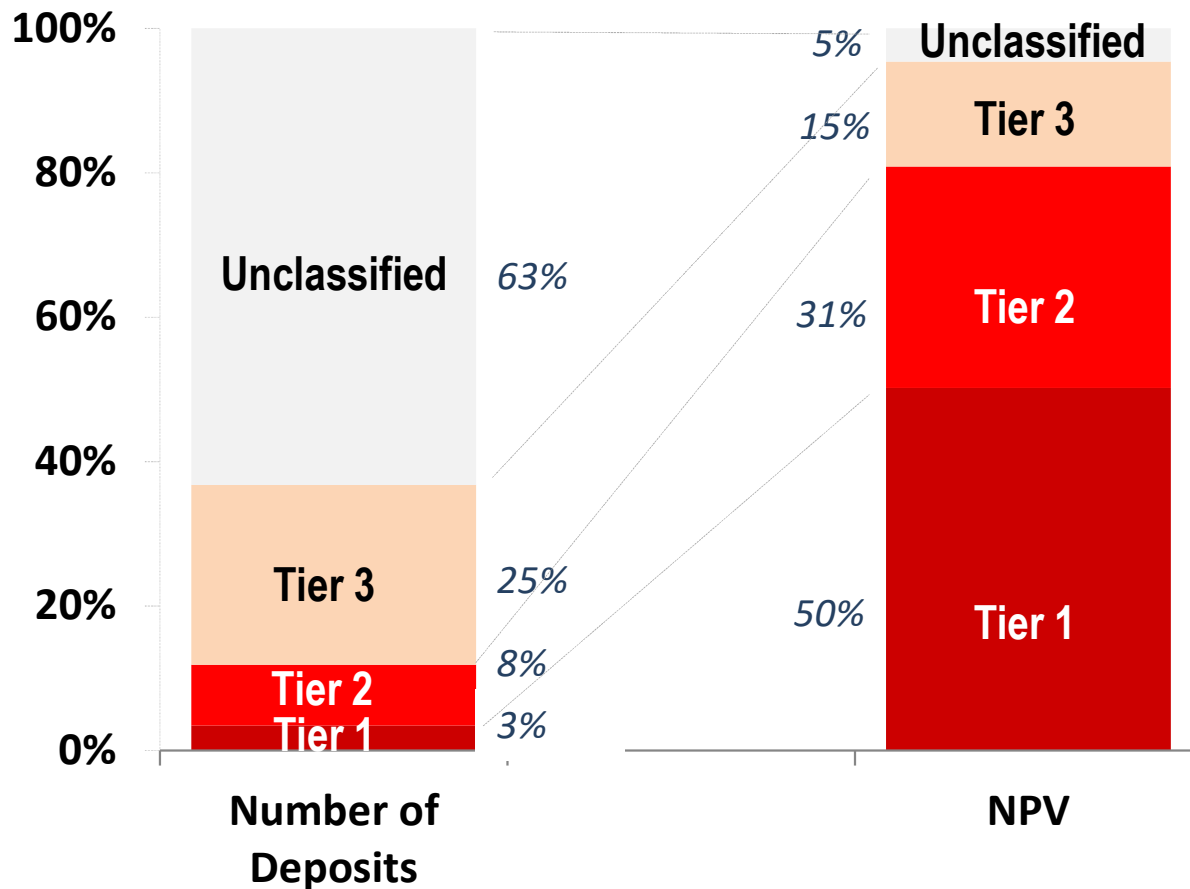


Note: Tier 1 deposits are large (i.e. >200ktoa Cu), long life (>20 years) and low cost (Q1) .... US\$2000m in Jan 2013 US Dollars  
 Tier 2 , has 2 of the 3 characteristics of a Tier 1 deposit .... US\$500m in Jan 2013 US Dollars  
 Tier 3 have only 1 of the 3 characteristics of a Tier 1 deposit .... US\$80m in Jan 2013 US Dollars  
 Unclassified deposits are too small (i.e. Resource <1 Mt Cu) to be given a Tier Classification .... US\$10m

Source: MinEx Consulting © March 2026

# Most of the wealth created are in Tier 1 and 2 discoveries

Estimated value of 261 discoveries found in World between 2006-2025



Note: NPV values refer to the Net Present Value at the Decision-to-Build stage  
 EV = Expected Value, which is the weighted average value of the NPV range  
 Values are based on long run commodity prices as prevailing at Jan 2013

Caution: Values are indicative / approximate-only

## Definitions

**'Unclassified deposits'** are small deposits that are less than "Major" in size and/or of minimal value. EV of (say) ~\$10m

*Example: Stavely*

**'Tier 3 deposits'** are small / marginal deposits. While they can be profitable they often only get developed at the top of the business cycle. At they don't meet more than one of the Tier 1 or 2 criteria. NPV of \$0 to \$200m, EV of ~\$80m

*Example: Eloise*

**'Tier 2 deposits'** are "Significant" deposits - but are not quite as large or long life or as profitable as Tier 1 deposits. They have an NPV of \$200-1000m and EV of ~\$500m

*Example: Prominent Hill*

**'Tier 1 deposits'** are "Company making" mines. They are large, long life and low cost. ... ie >20 Years, >200 ktpa Cu or >250koz pa Au, and Bottom Quartile costs. Have an NPV of >\$1000m, and EV of ~\$2000m

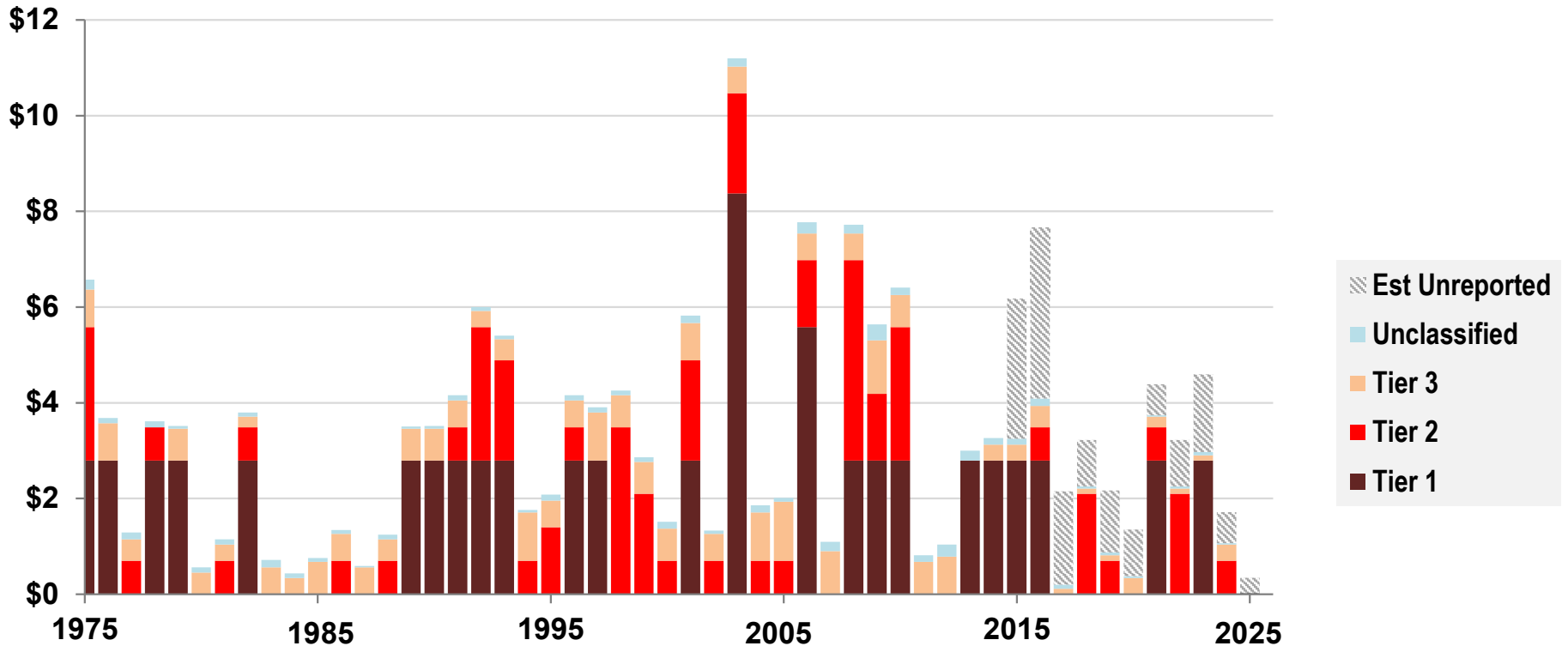
*Example: Olympic Dam*

Source: MinEx Consulting © March 2026

# Estimated value of copper discoveries versus Exploration Spend

Tier 1,2 & 3 discoveries in World: 1975-2025

Number

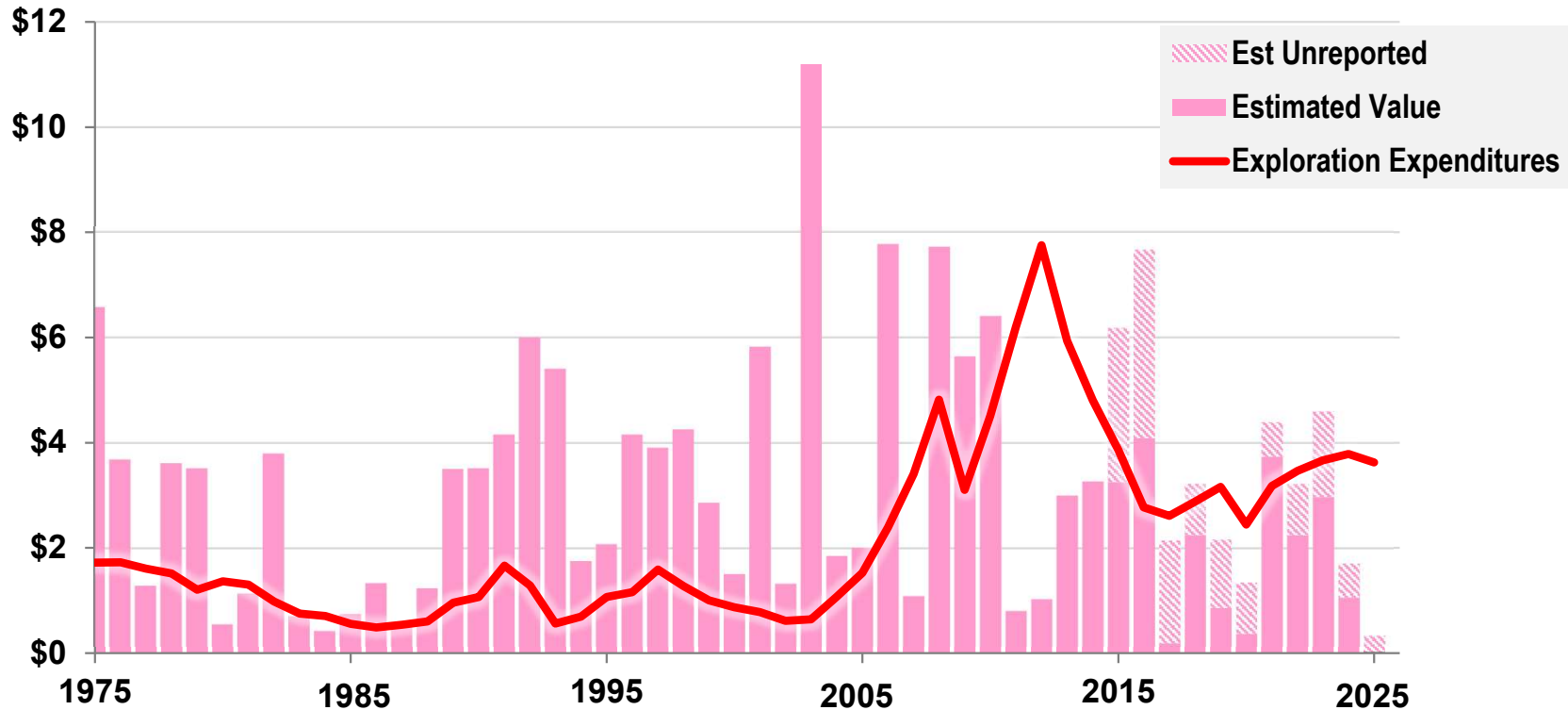


Note: Tier 1 deposits are large (i.e. >200ktoa Cu), long life (>20 years) and low cost (Q1) .... US\$2000m in Jan 2013 US Dollars  
 Tier 2 , has 2 of the 3 characteristics of a Tier 1 deposit .... US\$500m in Jan 2013 US Dollars  
 Tier 3 have only 1 of the 3 characteristics of a Tier 1 deposit .... US\$80m in Jan 2013 US Dollars  
 Unclassified deposits are too small (i.e. Resource <1 Mt Cu) to be given a Tier Classification .... US\$10m

Source: MinEx Consulting © March 2026

# Estimated value of copper discoveries versus exploration expenditures : World 1975-2025

Dec 2025 US\$ Billion



Over the last 4 decades copper exploration has shifted from **“value-adding”** to **“break-even”**

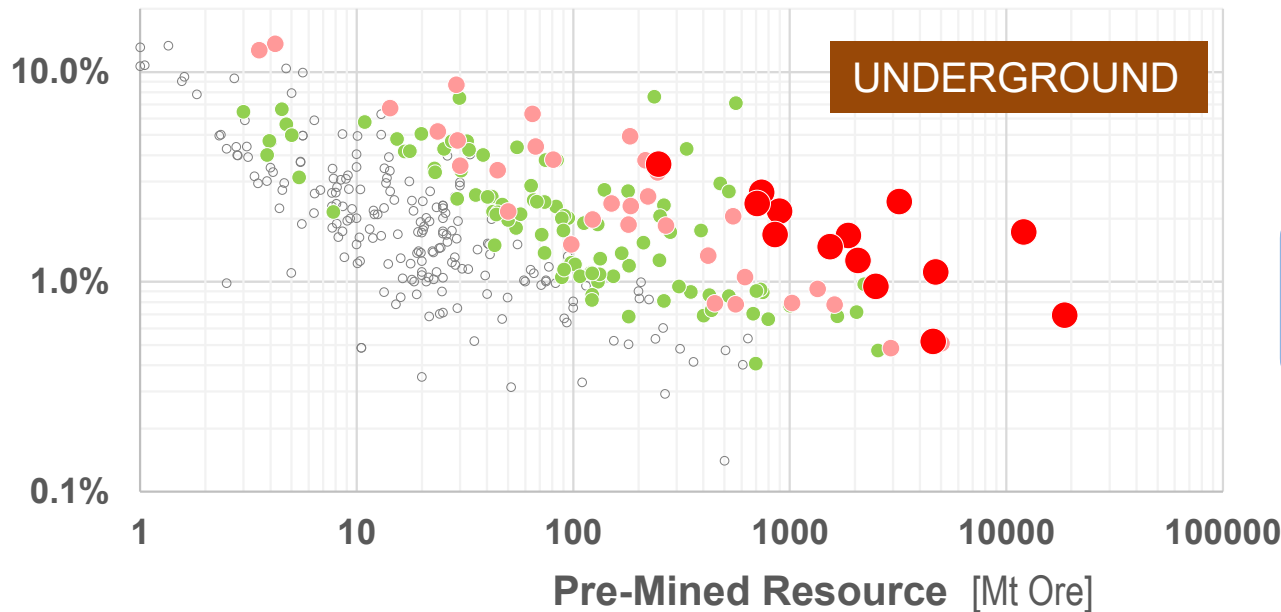
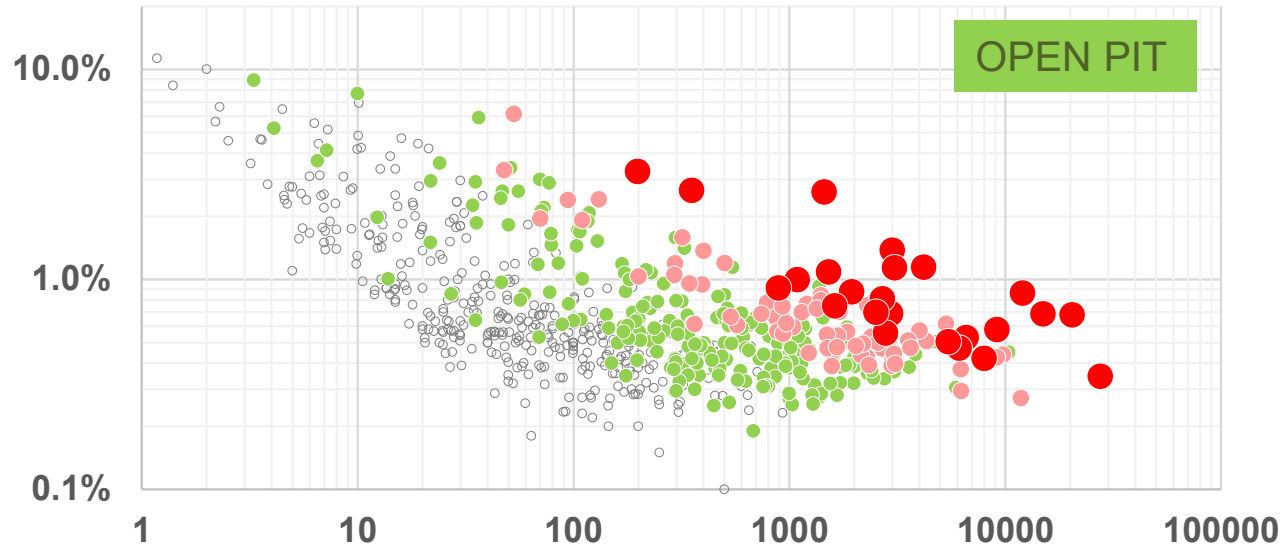
Caution: Values are indicative / approximate-only

Source: MinEx Consulting © March 2026

# Tonnes and Grade by Tier

Primary Copper Deposits : World : All Years

Grade [% Cu-eq]



Charts show the target tonnes-grade required for Tier-1 discoveries

Source: MinEx Consulting © March 2026

# 9. SUMMARY

# Overview

1. The need for more copper ... Demand is doubling every 20-30 years.
2. Number of discoveries and metal found ... ~1360 significant primary copper deposits have been found since 1900, containing ~4200 Mt of Cu
3. Location of discoveries ... mainly in North & South America
4. Trend in size and grade found and depth of cover ... average grade is slowly declining over time. Over the last 50 years the average depth of cover rose from 54 to 202 metres
5. Deposit styles found ... Porphyry is associated with 45% by number and 70% of copper metal found
6. Discovery methods ... at the Project & Prospect-scale, the main discovery method has evolved from simple “Prospecting” to “Nearology” and geophysics (at depth)

# Summary 2/2

7. Trend in exploration expenditures and unit discovery costs  
... Between 1985-2005 global spend on copper averaged \$0.9b (in constant 2025 US Dollars), before peaking at US\$7.8b in 2012. Currently running at US\$3.6b. Even though spend is up 4x, the average number of discoveries went down by 2x. It currently costs ~US\$500m (and \$100/t Cu) to make a significant copper discovery
  
8. Trend in the quality of discoveries found and the value proposition for copper exploration ... Tier1 discoveries are rare (less than 3% by number) but capture 50% of the value. Over the last 50 years, copper exploration has shifted from a value-adding to a break-even investment.

The threshold tonnes & grade for an open-pit Tier1 discovery is 1 Bt @ 1% Cu dropping to 0.5% Cu at 10 Bt. The Tier 1 threshold for an underground discovery is 1 Bt @ 1.5% Cu dropping to 1.0% Cu at 10 Bt

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