

# **CRISIS IN DISCOVERY**

**Improving the Business Paradigm for Mineral Exploration**

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# AGENDA

- Why Explore? – the business case
- Exploration Efficiency – discovery rates, the cost, the value realized
- Will current discovery rates meet future supply/demand needs?
- The lag time from discovery to production
- The Old Paradigm - Mineral Exploration as a Business
- A Possible New Approach to the Business of Exploration

# WHY EXPLORE? THE BUSINESS CASE

- It's simple – for the industrial world to be sustainable, and the quality of daily living to improve for all people, the mining industry needs to find economically viable, new mineral deposits to replace what is mined
- The World's demand for metals doubles every 20-30 years (Schodde, 2017) to meet this desire.

# CASE STUDY: COPPER

- Over the next 20 years the world is going to mine more copper than what was mined in all history
- Cumulative copper production for all history (1000 BC to 2022 AD), about **757 Mt Cu**
- Average global Cu demand growth rate over last 25 years is 3.2% yearly
- Based on a conservative 1.8% annual rate, the forecasted cumulative Cu demand in the coming 20 years (2022-2042) is **761 Mt Cu**
- ***Similar trends are projected for other mineral commodities***

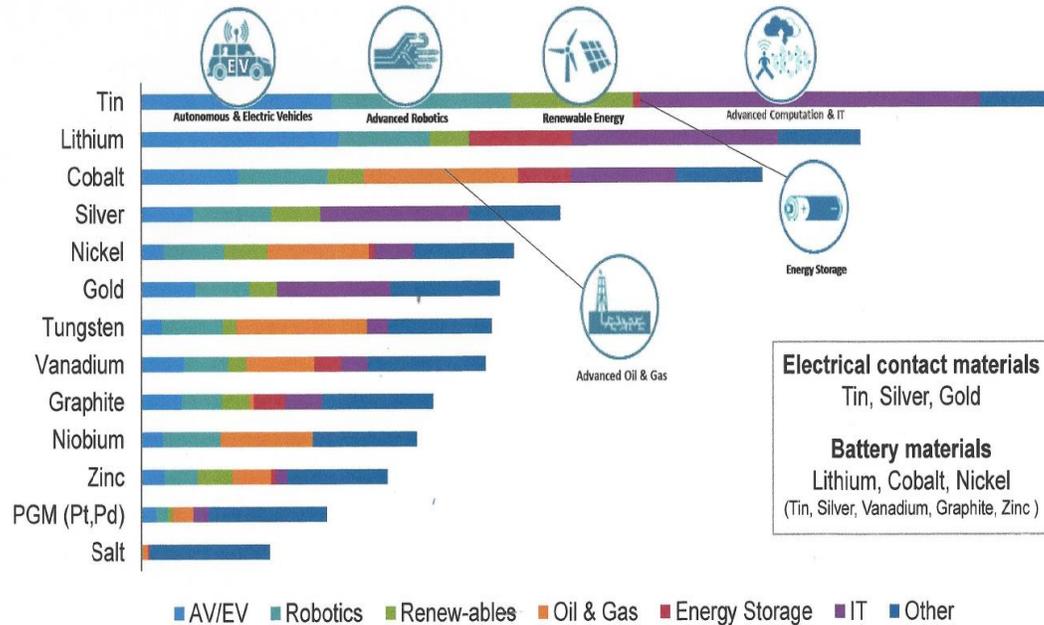
# EXPLORATION EFFICIENCY

To meet this growing future demand, for the dollars spent and the meters drilled, can the Exploration Industry meet these needs:

- In terms of commodities?
- In terms of value created?

# COMMODITIES

## Metals most impacted by new technology

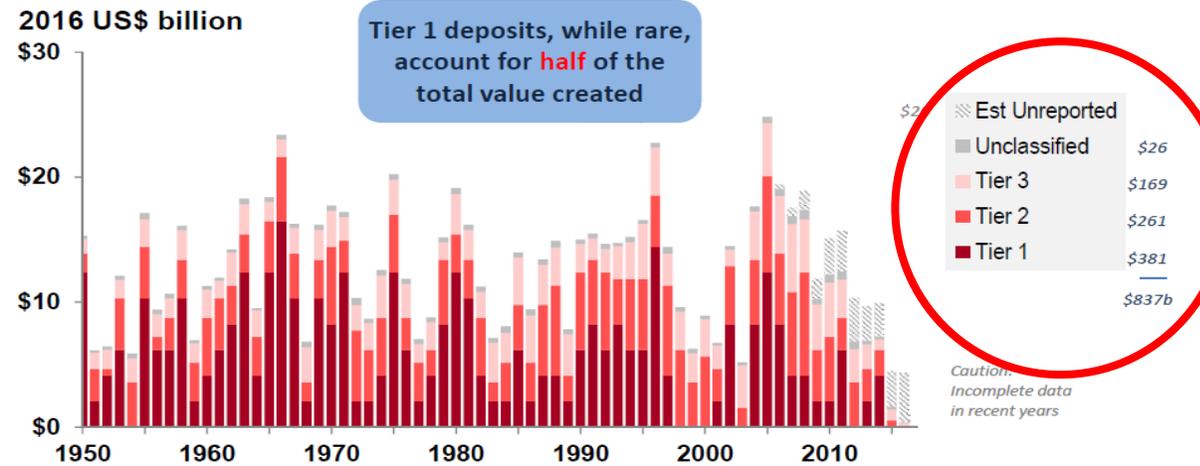


Modified from Rio Tinto

# What are the key commodities of the Green Energy revolution?

## VALUE CREATED

### Number of discoveries by value Mineral discoveries in the World : All Commodities : 1950-2016



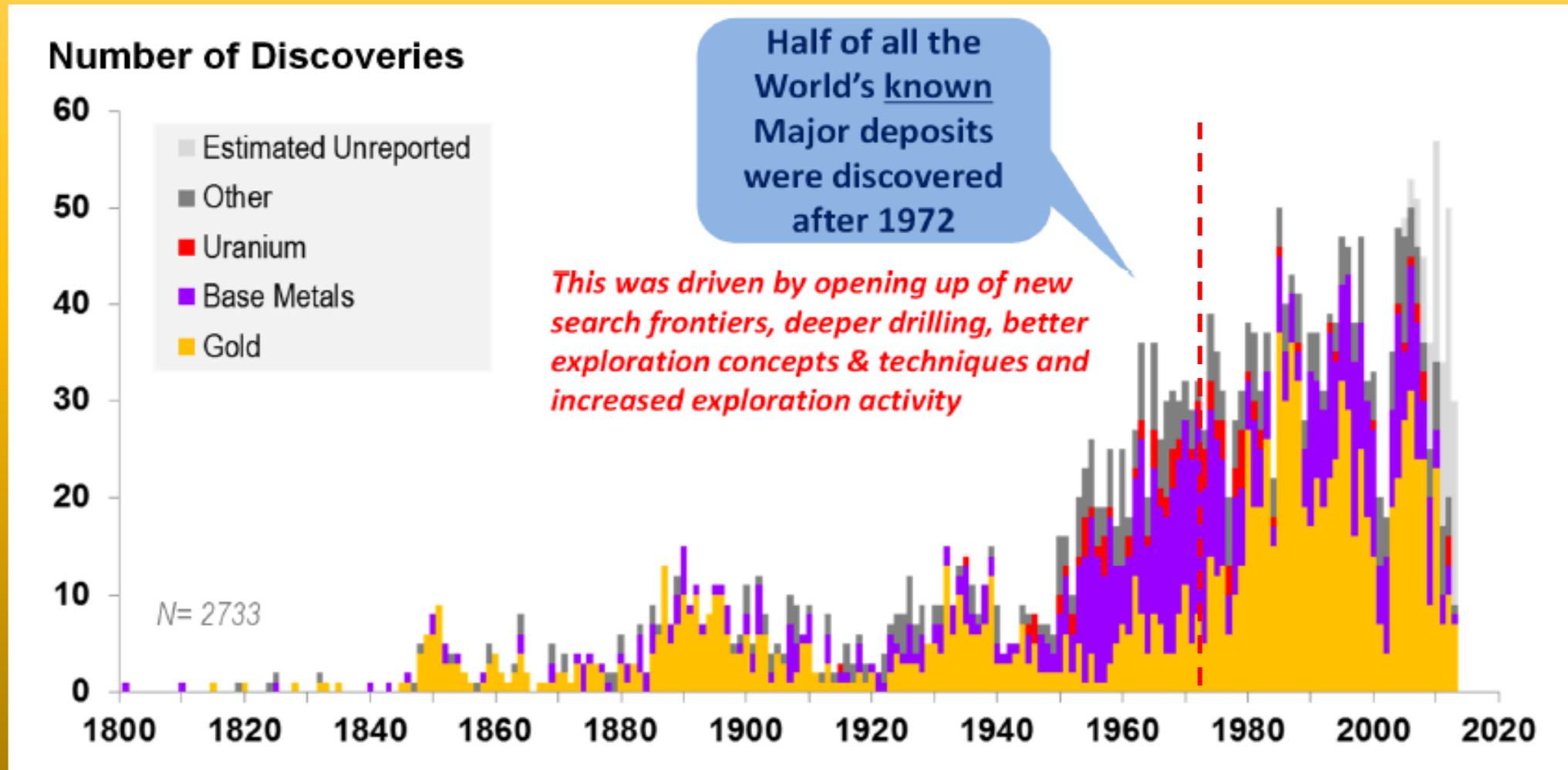
Note: The analysis is based on a notional valuation (in constant 2013 US\$) of \$2000m, \$500m, \$80m and \$10m for Tier 1, 2, 3 and Unclassified deposits respectively.

Caution: Values are indicative / approximate-only

Source: MinEx Consulting © March 2017

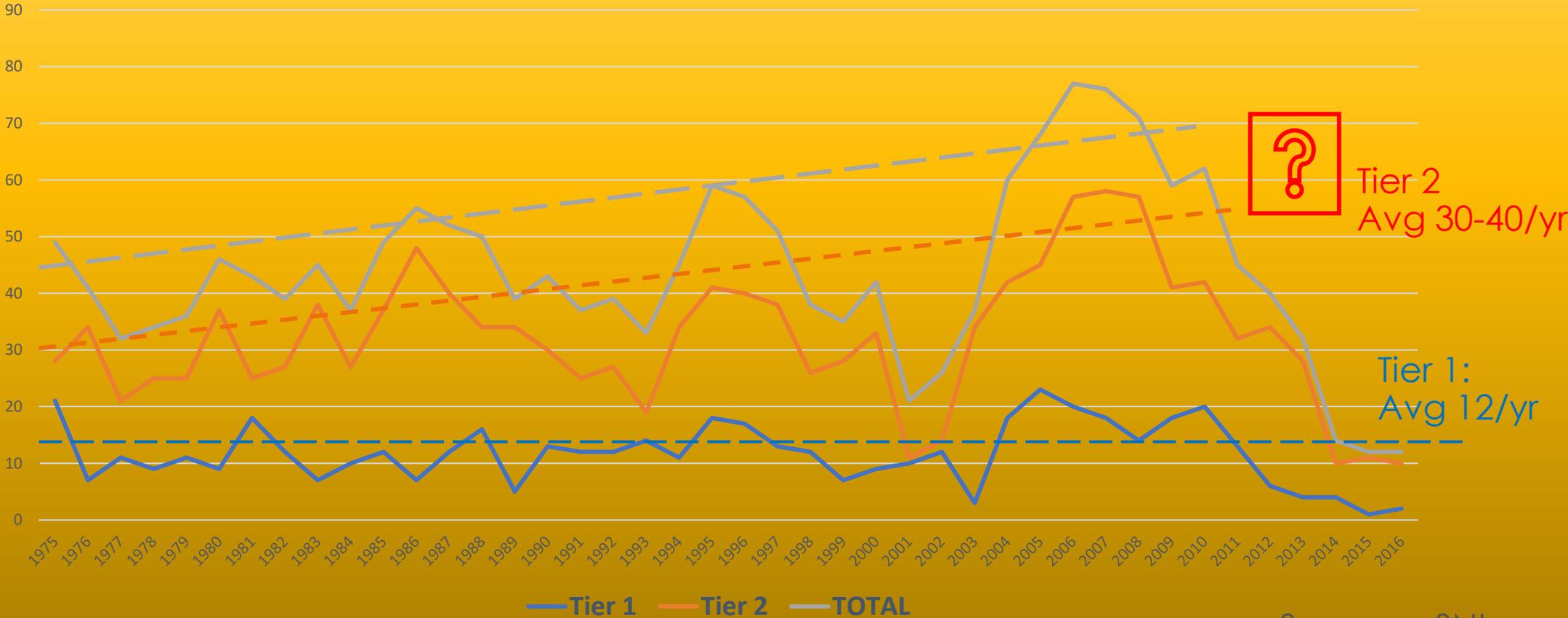
# MINERAL DISCOVERIES OVER TIME

Source: Modified from Schodde, 2017



# Precious and Base Metals Discoveries 1975-2016

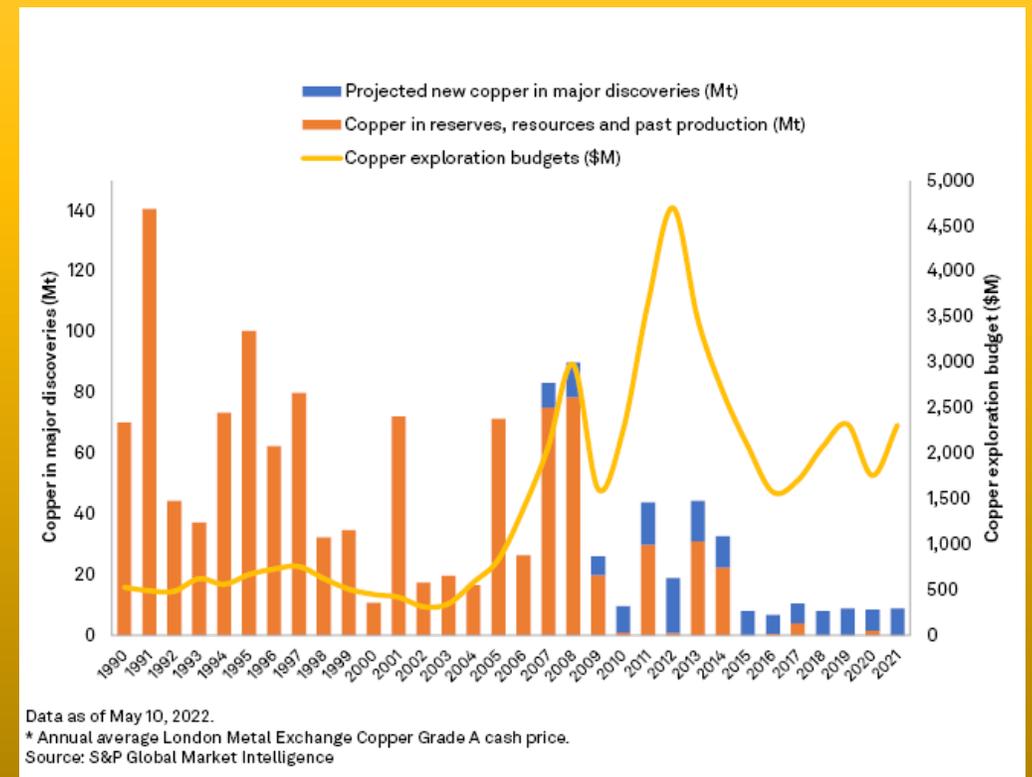
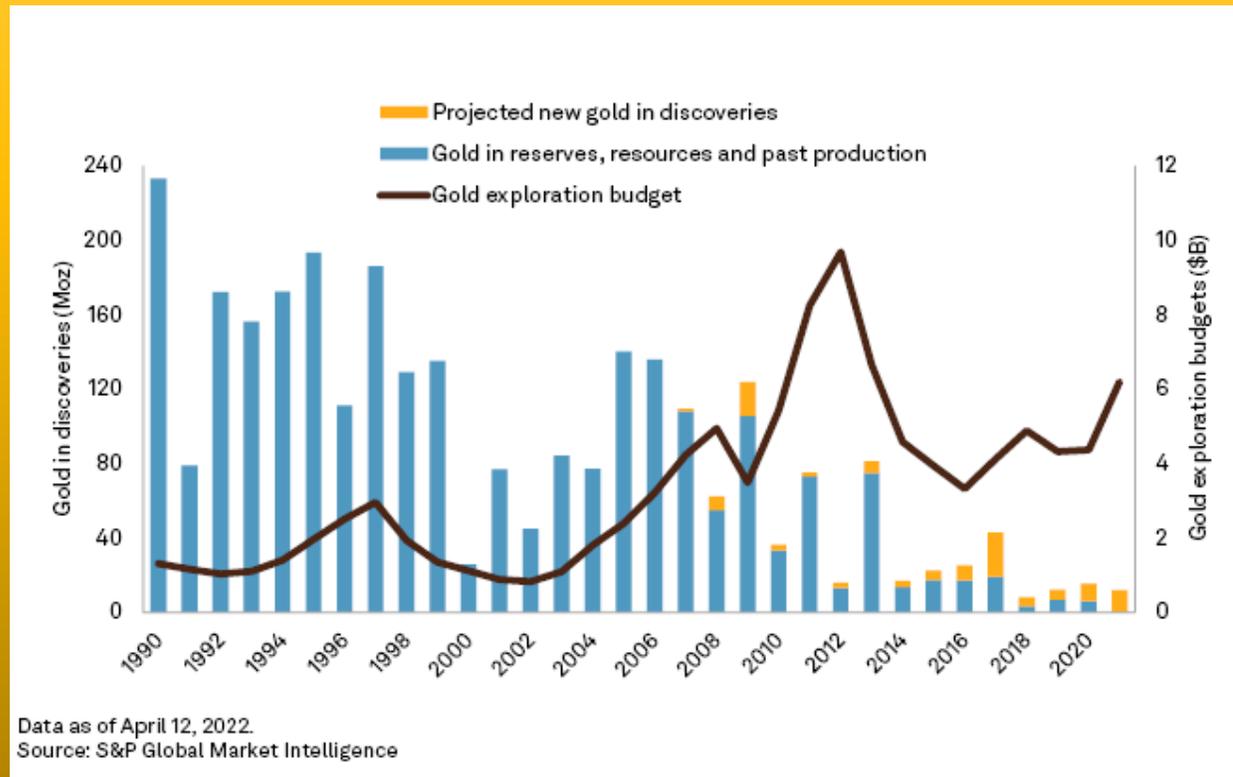
About 40-50 Meaningful Discoveries per Year



Source: SNL

# A GENUINE DROUGHT IN DISCOVERY 2010-2020

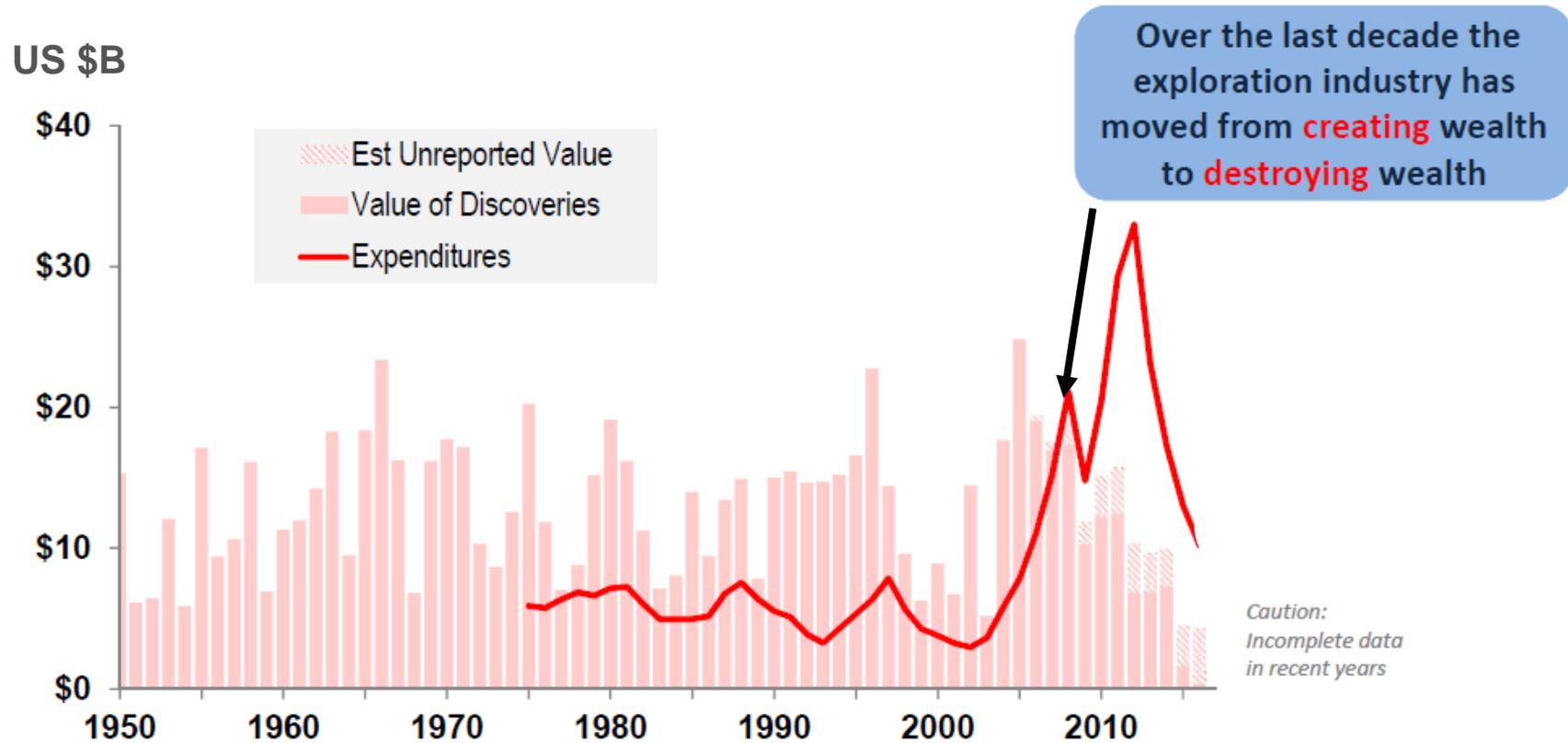
- Gold, 11 Tier 1 & 2 deposits/yr found since 1990; only 3.6/yr since 2010
- Copper, 7.6 Tier 1 & 2 deposits/yr found since 1990; only 2/yr since 2010



# THE REASON FOR CONCERN

## Estimated value of discoveries versus expenditures

Mineral discoveries in the **World** : All Commodities : 1950-2016



Caution: Values are indicative / approximate-only  
No World exploration expenditure data prior to 1975

Source: Schodde, 2017

# HOMING IN ON 2007-2020 A VALUE DESTRUCTION SITUATION

## What was Discovered?

Commodity	Expenditure	No. of Major Discoveries*	Estimated Value	Value per \$ Spent
Gold	\$65 B	21	\$30 B	0.46
Copper	\$35 B	18	\$17 B	0.47
Nickel	\$ 7 B	4	\$ 3 B	0.47
Zinc + Lead	\$11 B	5	\$ 5 B	0.50
Diamond	\$ 6 B	1	\$ 1 B	0.19
Other	\$65 B	32	\$36 B	0.55
<b>TOTAL</b>	<b>\$197 B</b>	<b>81</b>	<b>\$92 B</b>	<b>0.47</b>

\* Notional valuation > \$ 500M threshold

Source: SNL and Schodde, 2017

# HOMING IN ON 2007-PRESENT A VALUE DESTRUCTION SITUATION

## Where were the Discoveries?

Location	Expenditure	No. of Major Discoveries*	Estimated Value	Value per \$ Spent
Australia	\$23 B	12	\$12 B	0.54
Canada	\$27 B	14	\$16 B	0.62
USA	\$12 B	4	\$ 5 B	0.42
Latin America	\$38 B	12	\$13 B	0.33
SW Pacific	\$10 B	4	\$ 7 B	0.69
Africa	\$25 B	17	\$20 B	0.80
Rest of World	\$64 B	18	\$21 B	0.33
<b>TOTAL</b>	<b>\$197 B</b>	<b>81</b>	<b>\$92 B</b>	<b>0.47</b>

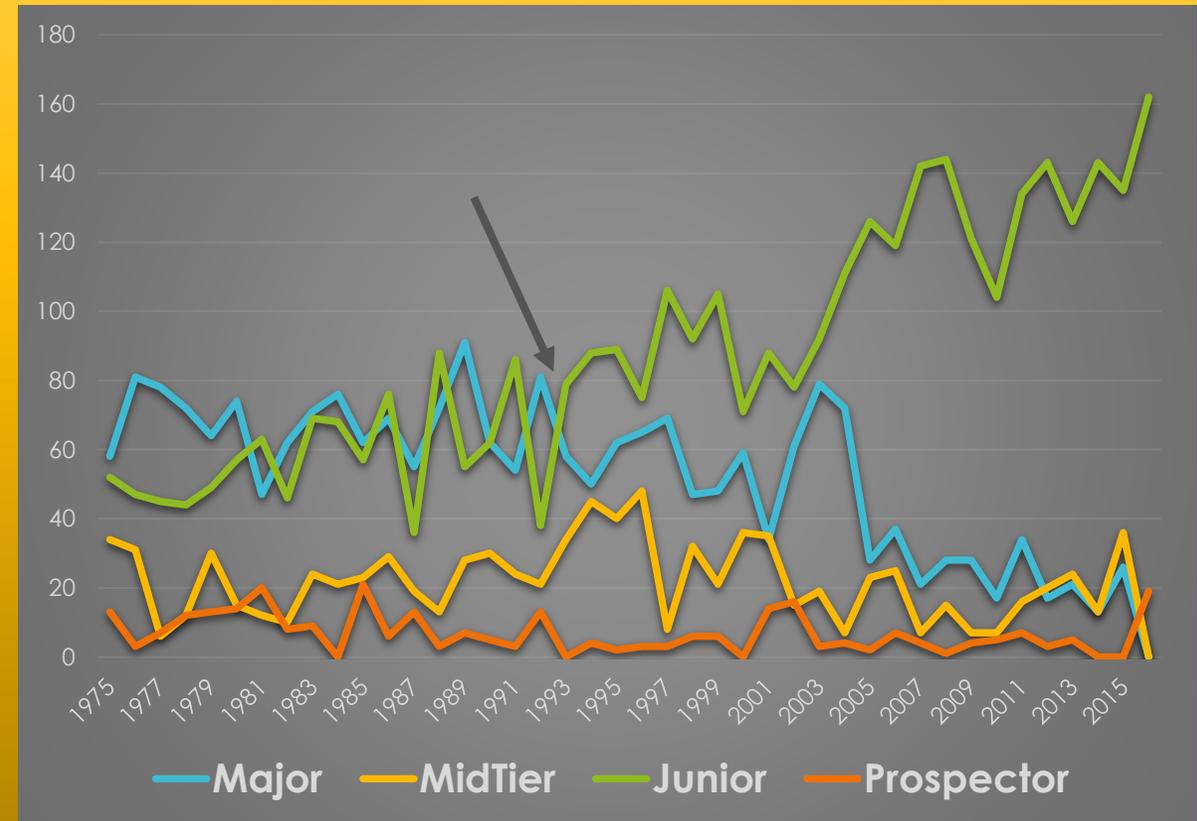
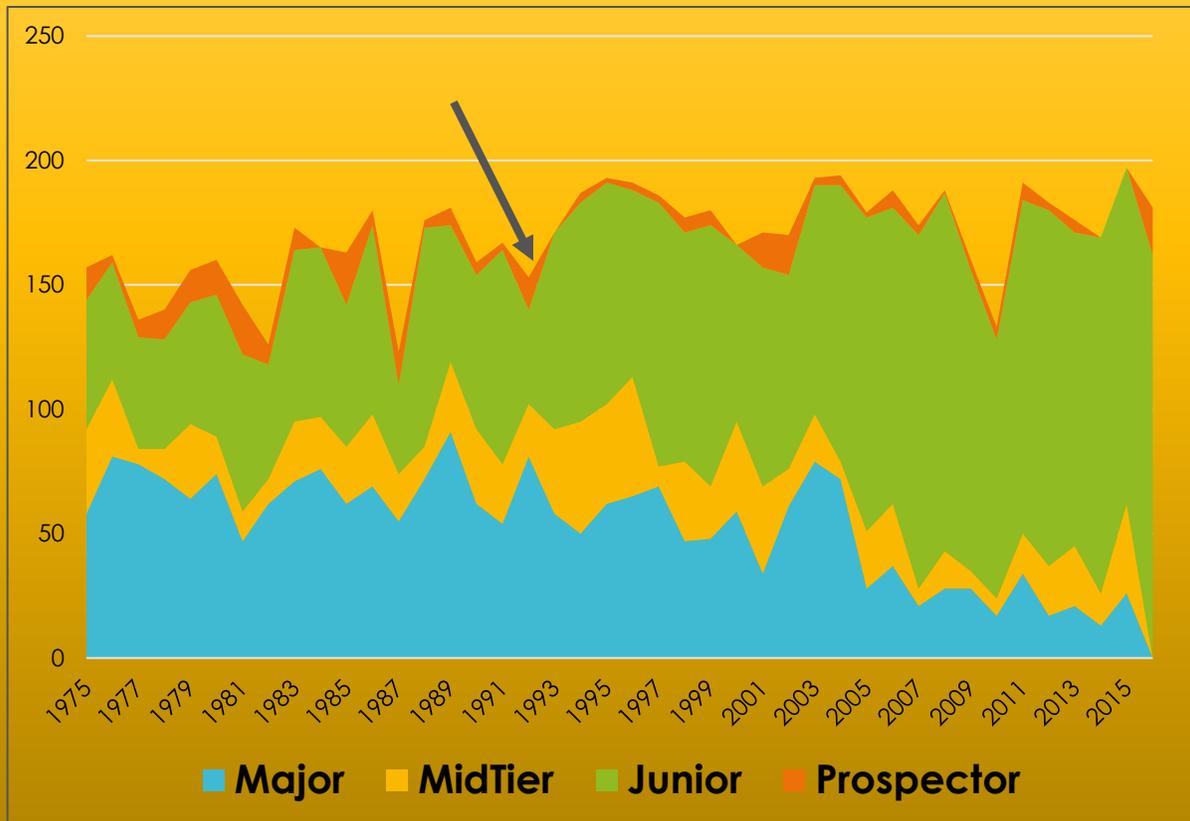
\* Notional valuation > \$ 500M threshold

Source: SNL and Schodde, 2017

# WHO IS MAKING THE DISCOVERIES?

Prior to about 1990 Major Companies were the more successful Discoverers. Since that time, the Junior Sector has shown to be more prolific

Data Source: SNL

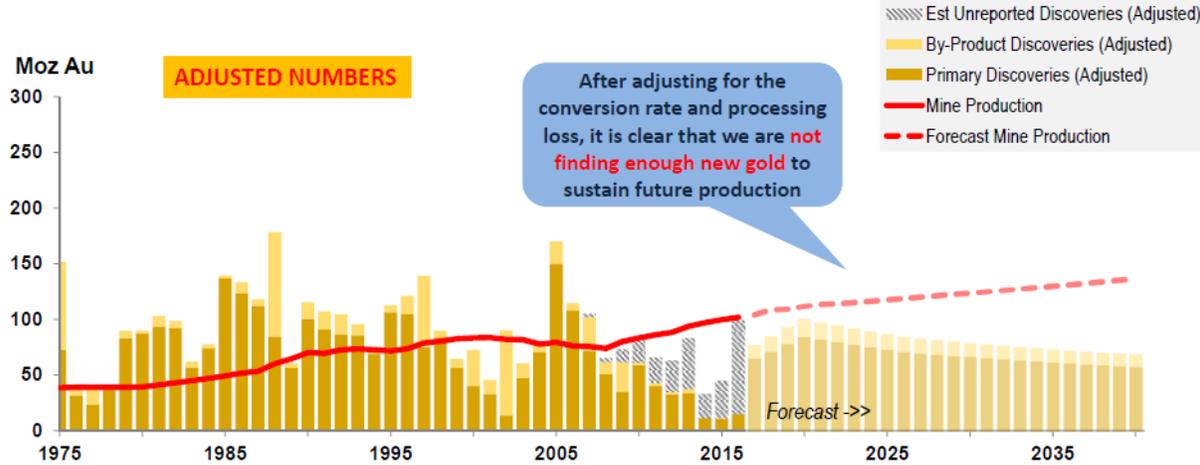


# DISCOVERY VERSUS DEMAND

SOURCE: SCHODDE, 2017

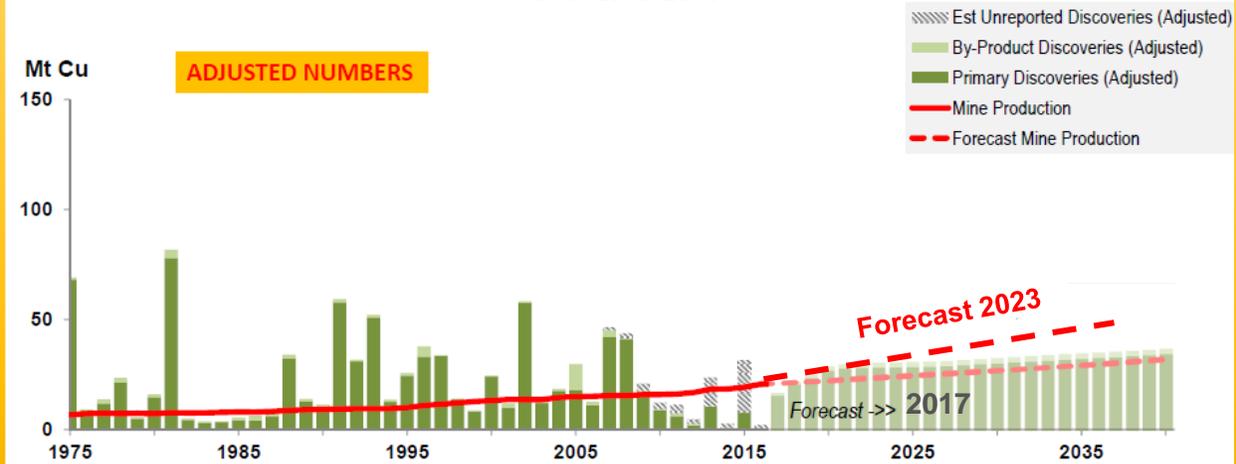
## Estimated Replacement Rate versus Mine Production : Gold

World: 1975-2040



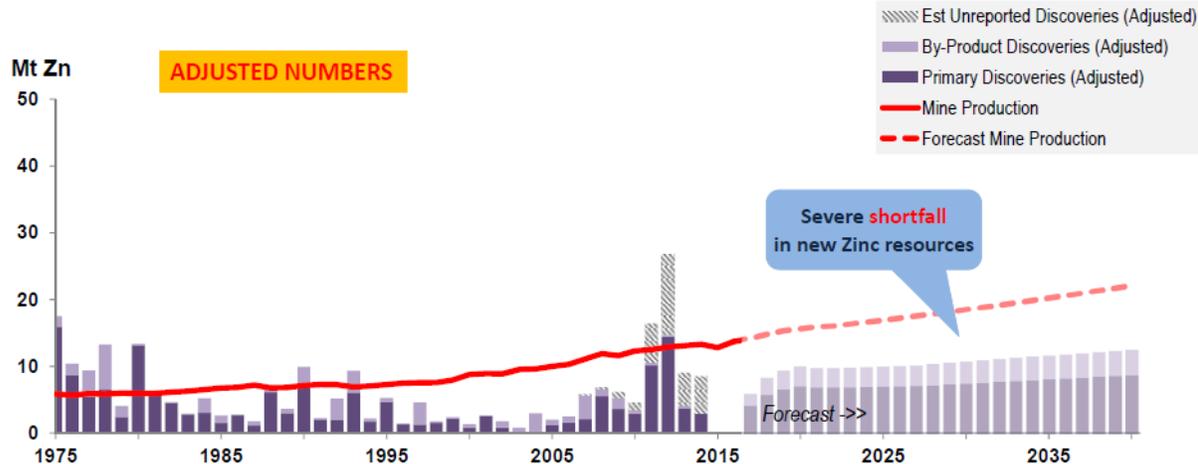
## Estimated Replacement Rate versus Mine Production : Copper

World: 1975-2040



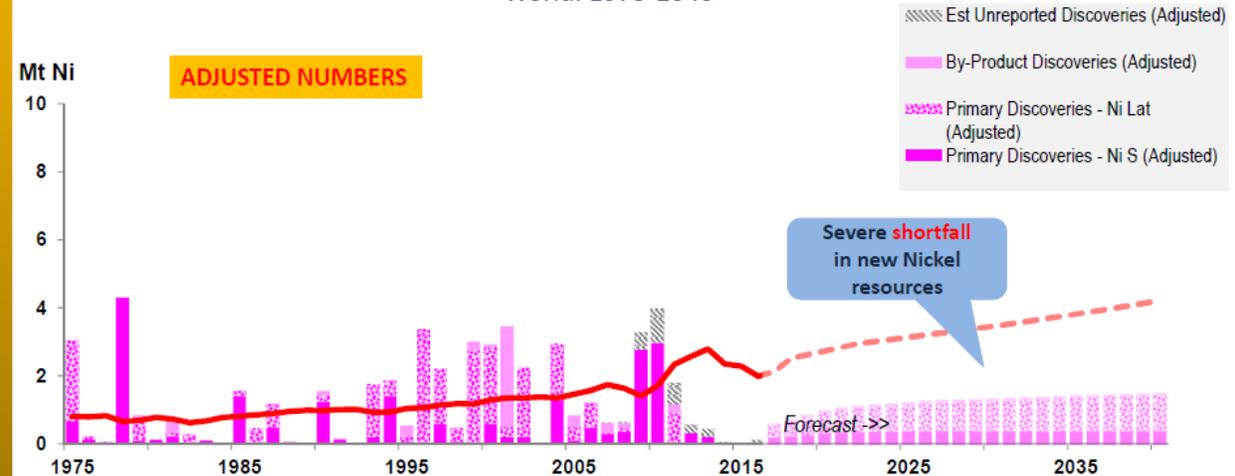
## Estimated Replacement Rate versus Mine Production : Zinc

World: 1975-2040



## Estimated Replacement Rate versus Mine Production : Nickel

World: 1975-2040



# TIME LAG - DISCOVERY TO PRODUCTION 1950-2017

- On average only half of all discoveries turn into mines. Of those deposits that are mined, there is a 12-year delay between discovery and development, on average.
- The lag time from a “Discovery Hole” to a “Deposit” (initial resource calculation) is about 3 years.
- Conversion of a “Discovery” to a “Mine” is dependent upon commodity, size, grade and location.

Commodity	No. Discoveries	No. Mines	% Developed	Lag Time
Gold	1992	1018	51%	10.2 yrs
Copper	950	353	37%	16.8 yrs
Zinc+Lead	313	169	54%	14.1 yrs
Nickel Sulfide	288	82	39%	12.8 yrs
Other	1063	450	42%	12.6 yrs
	4606	2072	45%	12.4 yrs

Table modified from Schodde, 2016

# SOME CONCLUSIONS

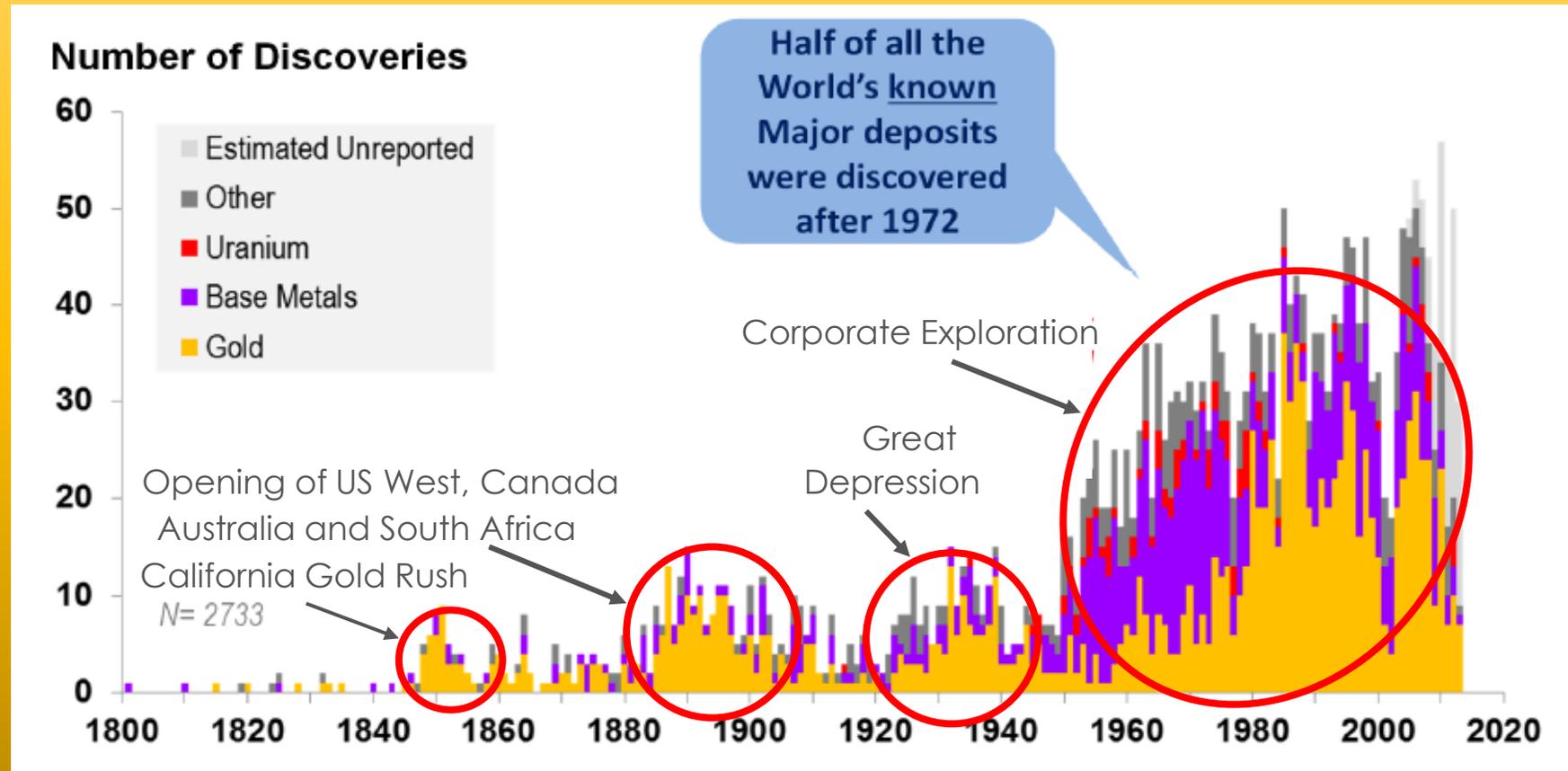
- Historically, ~50-60 Medium to Giant deposits were found each year in the World.
- Most of the discoveries were of small size and low value: World Class deposits are rare. Typically, only 10-12 found each year. Over the last decade the discovery record has halved to about 5-6/year.
- Over the last 20 years the role and importance of junior exploration company has risen. Junior Explorers accounted for ~70% of the total number of discoveries, but discovery record has dropped, probably due to economic cycles, forcing inconsistent funds and efforts.
- Since 2007, due to significant increases in exploration spending and only modest increase in the number of discoveries, the average cost per discovery has increased on average by 3x !
- Due to the declining discovery rate and lack of Tier-1 discoveries, the Exploration Industry switched from “Wealth Creation” to “Wealth Destruction” ... with the Value/Expenditure Ratio falling below 1.0, to 0.47

# SOME CONCLUSIONS (2)

- The conversion rate from discovery to mine varies by commodity. In recent years, it appears that the lag time from discovery to production has increased.
- After considering the declining Discovery Rates, the likelihood for a Discovery converting (or not) to a mine is diminishing.
- The exploration business is not adding sufficient metal inventory to meet increasing global demand for society to be sustainable.
- Over the next several decades, gold and lead supplies are moderately unsustainable, copper is lagging, and zinc and nickel face severe shortfalls.
- **A new approach to the Exploration Business may be needed to address these issues, one that provide consistent funding and sustained effort.**

# MINERAL EXPLORATION AS A BUSINESS

Business Drivers of Discovery over Time



# A NEW EXPLORATION BUSINESS PARADIGM

- What are the economic drivers of the future world? These drivers will focus future discovery targets and spending allocations.
- How do we meet projected shortfalls in the supply of many mineral commodities?

## Alternative Business Models

- Organic Corporate Growth Business Model
- Discovery–Predator Business Model
- Prospect Generator Business Model; Accelerator Model
- A Sustainable Discovery Business Model – A “Collaboration Model”

# HOW IS A SUSTAINABLE, COLLABORATIVE EXPLORATION BUSINESS MODEL STRUCTURED AND FUNDED?

- Mining companies want to produce, not explore
- Exploration teams want to discover and have sustainable funding for future exploration
- Will need government/ regulatory buyin – permitting schedules need to accelerate
- Create well-structured joint ventures or alliances to accommodate needs of both (takes Prospect Generator Model to a new level by leveraging skills, funding and rewards)
- JV Basics: A timeframe and funding commitment between Discoverer & Producer at IPO
  - Mutually agreed geography, commodities, annual program, JV percentages
  - Funded annually by ~50% Discoverer : ~50% Major to milestone (PEA or PFS)
  - Funded thereafter >>50% Major : <<50% Discoverer to construction
  - Construction financed jointly at final JV percentage, or
  - Major buys out Discoverer at fair/premium price, Discoverer retains a royalty

# WHAT DOES A “SUSTAINABLE DISCOVERY” BUSINESS MODEL LOOK LIKE?

- Efficiently leverages and allocates funds and skills/personnel to mineral commodities of the future and geographies
- Efficiently delineates and engineers new discoveries utilizing best available technologies, environmental protection and community outreach practices
- Minimizes artificial delays (regulatory and legal-social challenges)
- Requires cooperation or collaboration among industry, government and society to fairly measure the financial/quality of life benefits and trade-offs against the disruption costs perceived by society and the environment
- Possibly consider government compensation payments (“takings”) for shelving viable mining projects during times when social values outweigh business value (inventory for future?)

# FINAL COMMENTS

## ADVANTAGES:

1. Early financial and exploration risk should be levered by all stakeholders
2. Producers can have multiple, non-overlapping exploration activities at lower cost than in-house programs, leveraging the funding and partnering with several “A teams”
3. Discoverers and Producers have consistent, long-term project funding and collaborative relationships..... Board seat(s) for the Producer
4. Discoverer receives the development and operational support that it lacks
5. Participants do what they do best – Discoverer explores; Producer mines
6. With success, the Discoverer, the Investor and the Producer benefit financially
7. Society has the mineral supply chains needed to maintain its preferred standard of living

# QUESTIONS AND DISCUSSION