

Trends in exploration

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Overview

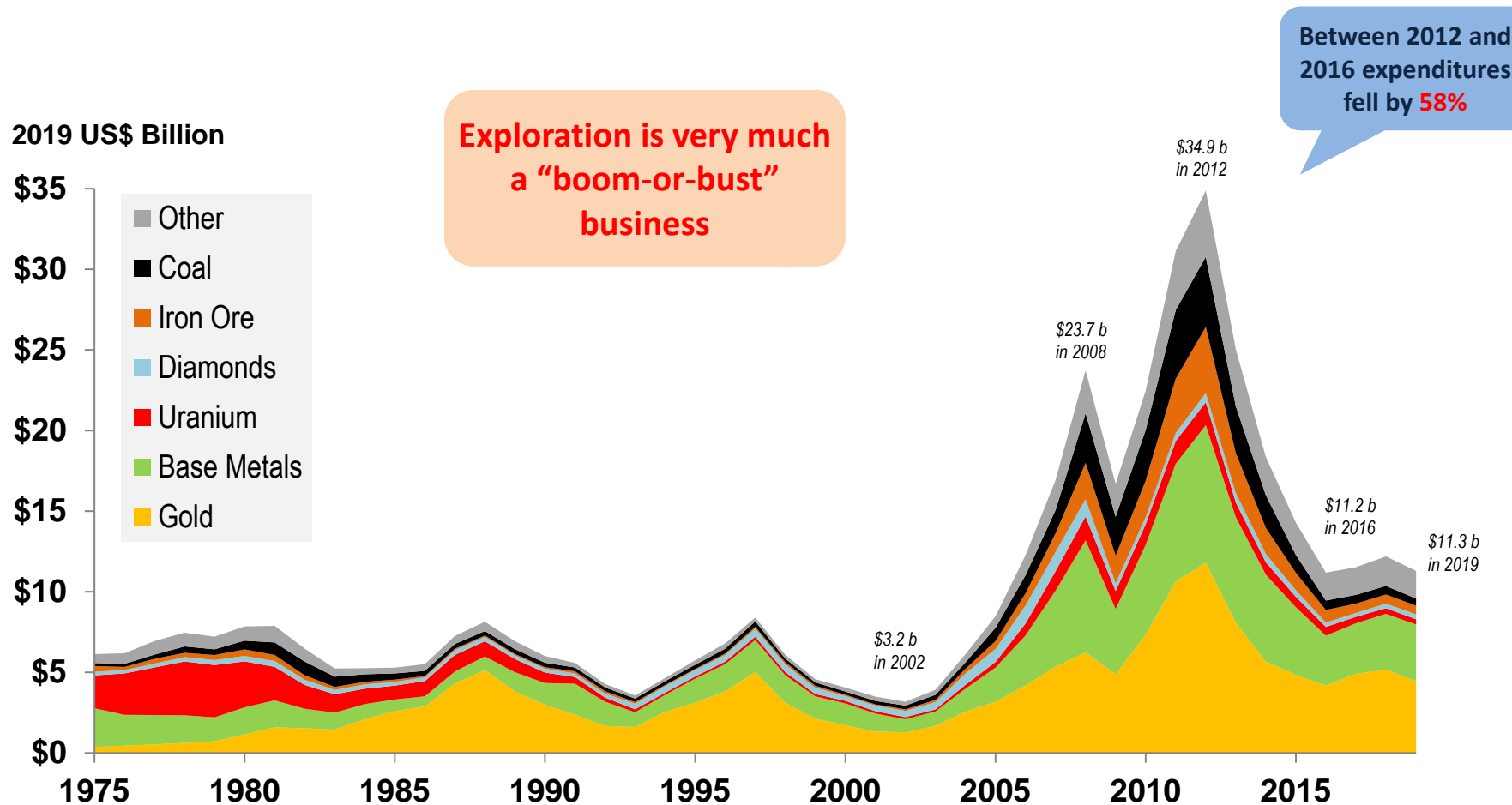
1. How much is spent on exploration ?
2. Location of recent discoveries
3. Trends in the number and type of discoveries
4. Who made the discoveries ?
5. Long term trends in the quality of discoveries
6. The value proposition for exploration
7. Summary / Conclusions

Industry spent \$11.3 billion in 2019, down by 57% from the peak in 2012

1. HOW MUCH IS SPENT ON EXPLORATION

Historical and forecast exploration expenditures by Commodity

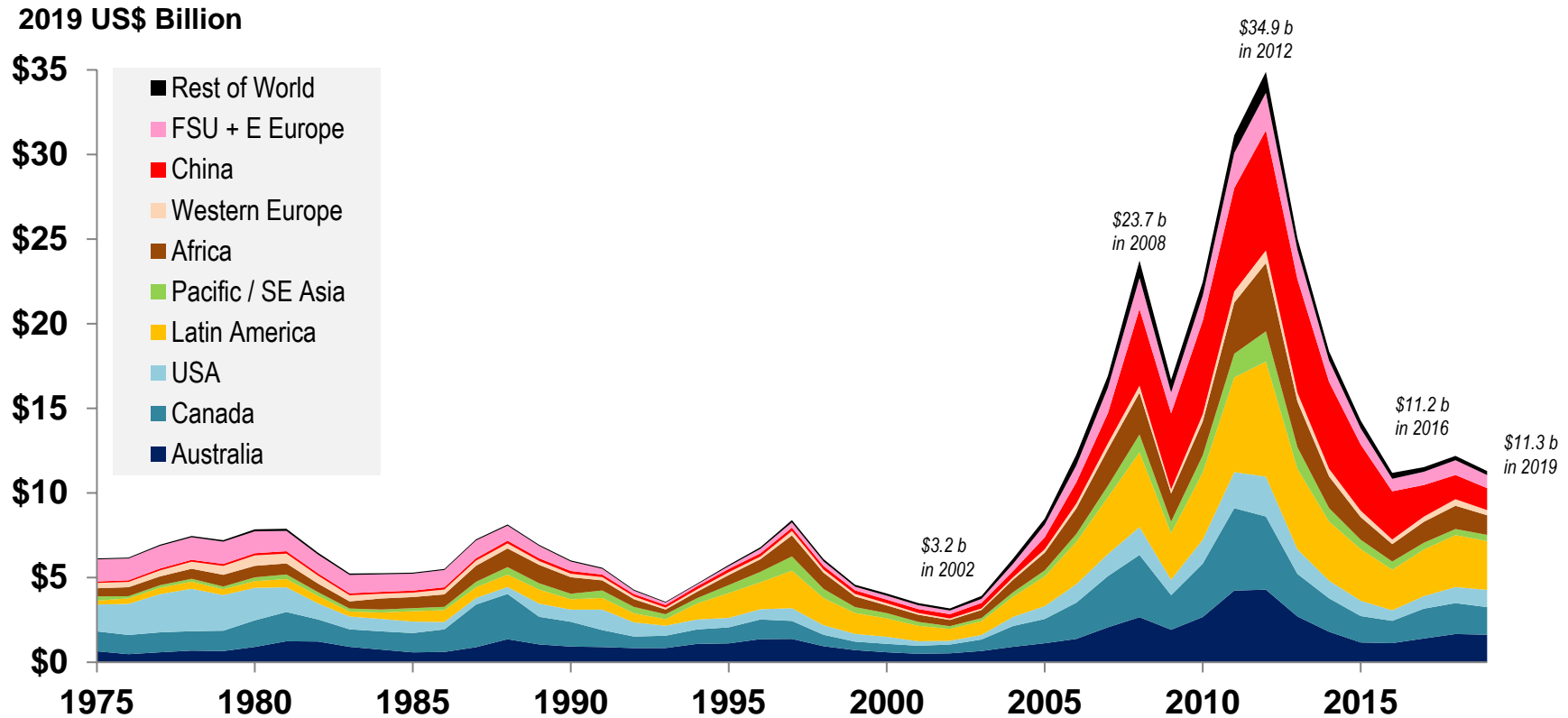
Mineral exploration – World : 1975-2019



Sources: MinEx Consulting estimates, based on data from ABS, NRCan, MNR (China) and S&P

Historical and forecast exploration expenditures by Region

Mineral exploration – World : 1975-2025

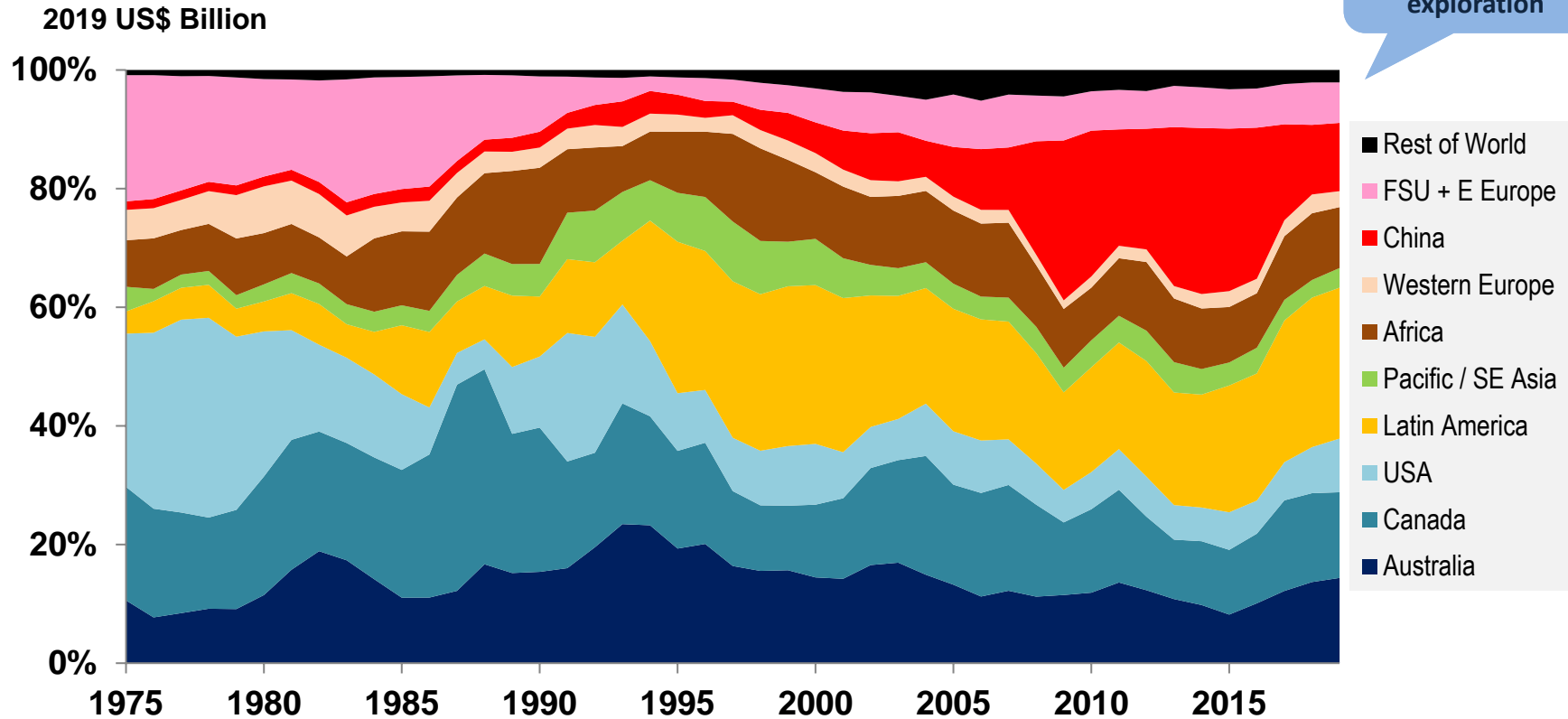


Note: Includes expenditures on non-bulk and bulk mineral (i.e. bauxite, coal, and iron ore) exploration

Sources: MinEx Consulting estimates, based on data from ABS, NRCAN, MNR (China) and S&P

Historical and forecast exploration expenditures by Region

Mineral exploration – World : 1975-2025



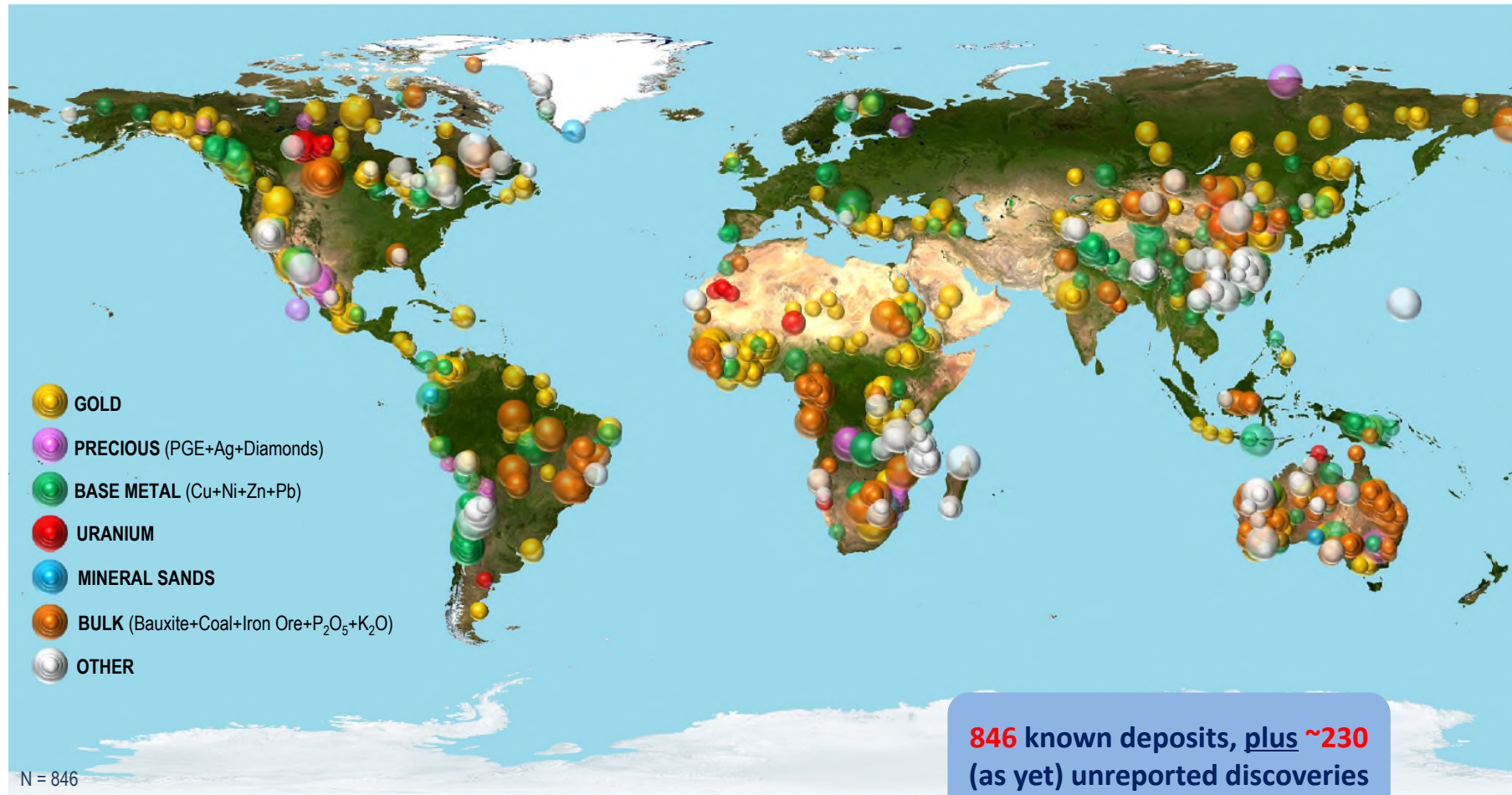
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Sources: MinEx Consulting estimates, based on data from ABS, NRCAN, MNR (China) and S&P

Over the last decade more than 1070 significant discoveries were made in the World

2. LOCATION OF RECENT DISCOVERIES

Significant discoveries in the world by **Size**: 2008-2017

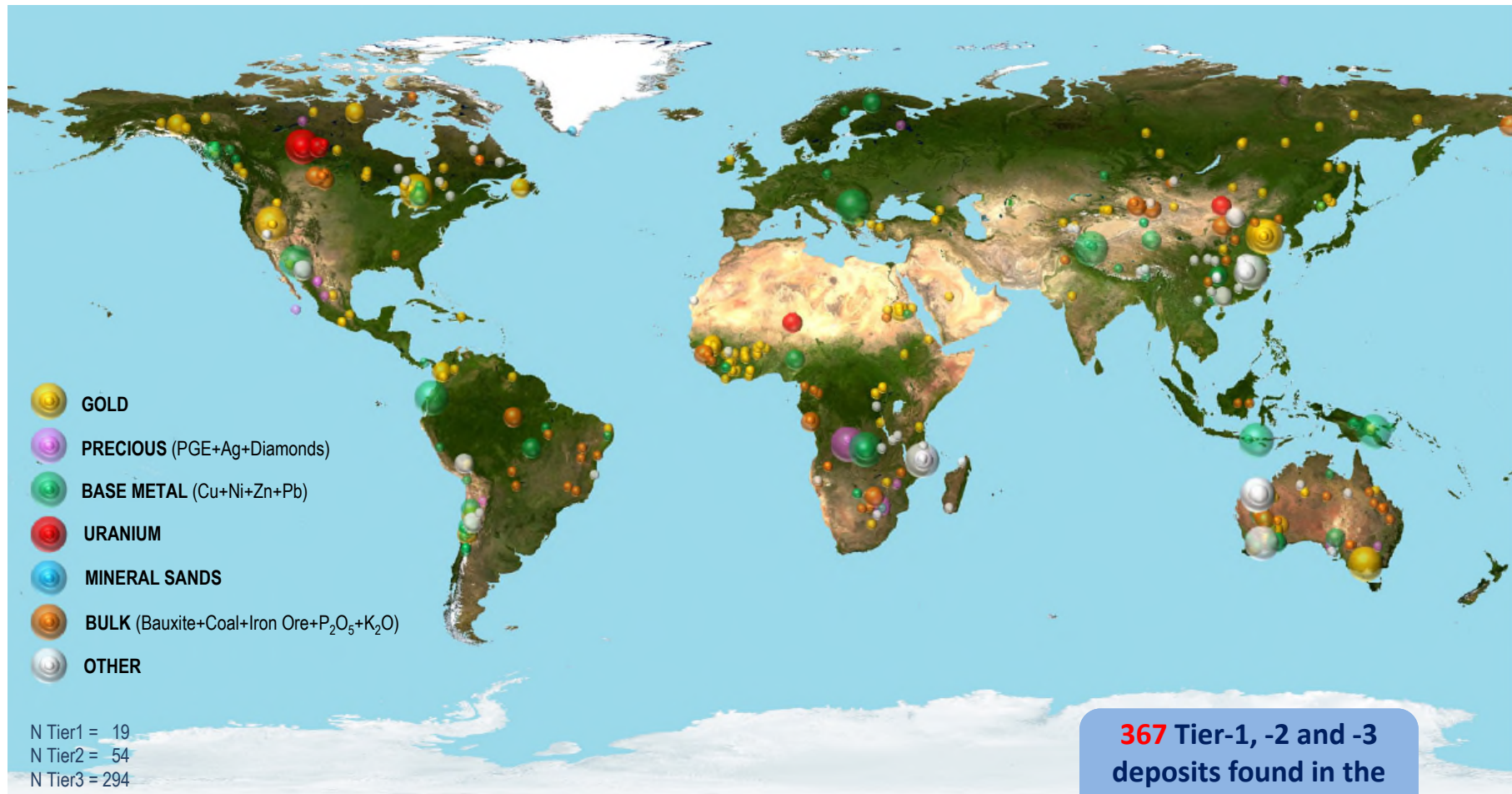


Note: Bubble Size refers to Moderate / Major / Giant deposits

Note: "Moderate" >100koz Au, >10kt Ni, >100kt Cu, 250kt Zn+Pb, >5kt U₃O₈, >20 Mt Fe, >20 Mt Thermal Coal
 "Major" >1Moz Au, >100kt Ni, >1Mt Cu, 2.5Mt Zn+Pb, >25kt U₃O₈, >200 Mt Fe, >200 Mt Thermal Coal
 "Giant" >6Moz Au, >1Mt Ni, >5Mt Cu, 12Mt Zn+Pb, >125kt U₃O₈, >1000 Mt Fe, >1000 Mt Thermal Coal

Source: MinEx Consulting © October 2019

Significant discoveries in the world by **Quality**: 2008-2017



Note: Bubble Size refers to Tier 1 / Tier 2 / Tier 3

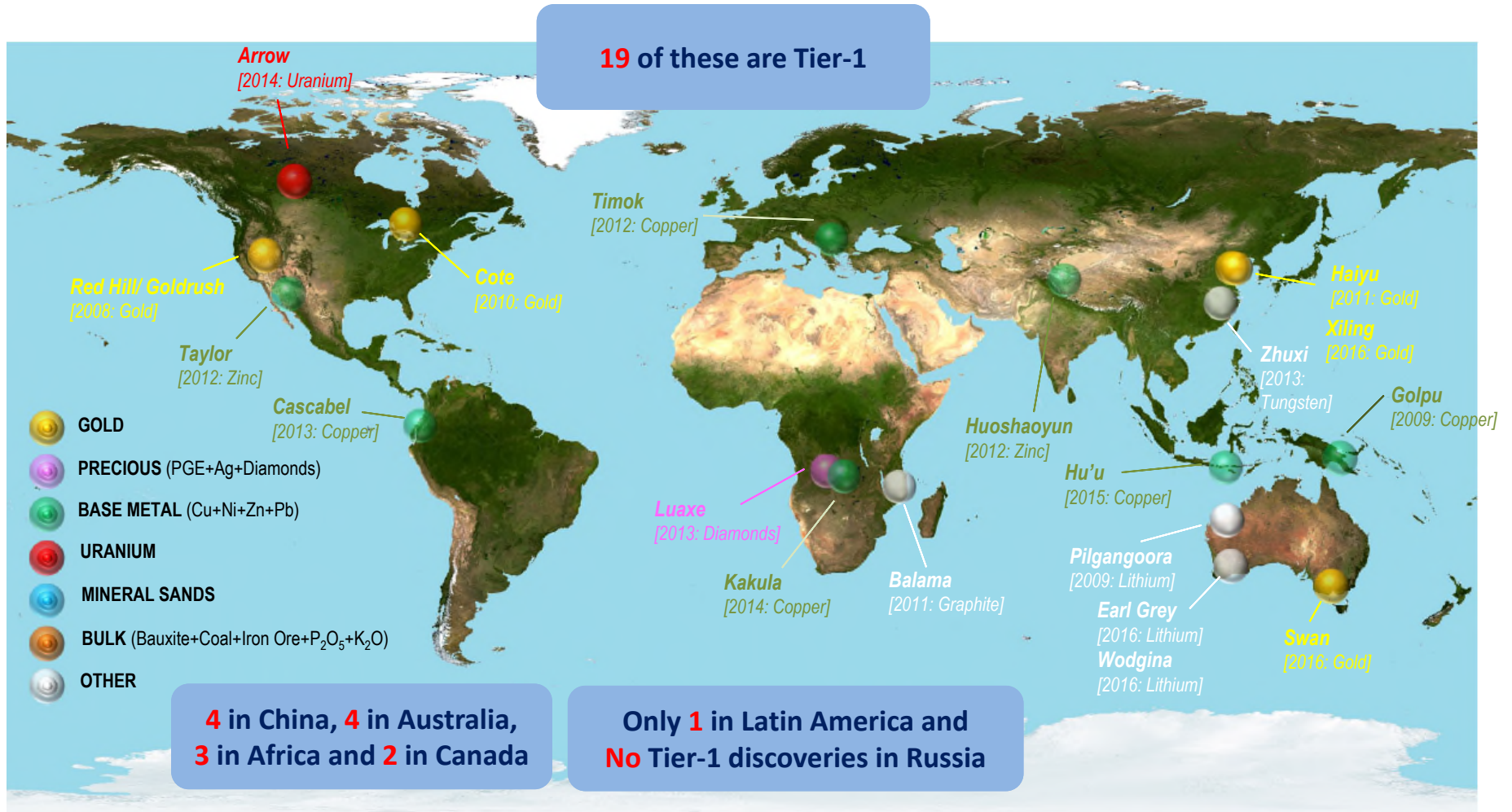
"Tier 1" deposits are company-making mines and are large, long life and low cost with NPV at the Decision-to-Build stage of >\$1000m (in 2013 US Dollars)

"Tier 2" deposits are "significant" and have some of the elements of a Tier 1 but have an NPV of \$200 to \$1000m

"Tier 3" deposits are modest or marginal deposits, with an NPV of \$0 to \$200m

Source: MinEx Consulting © October 2019

Tier 1 discoveries in the World : 2009-2018



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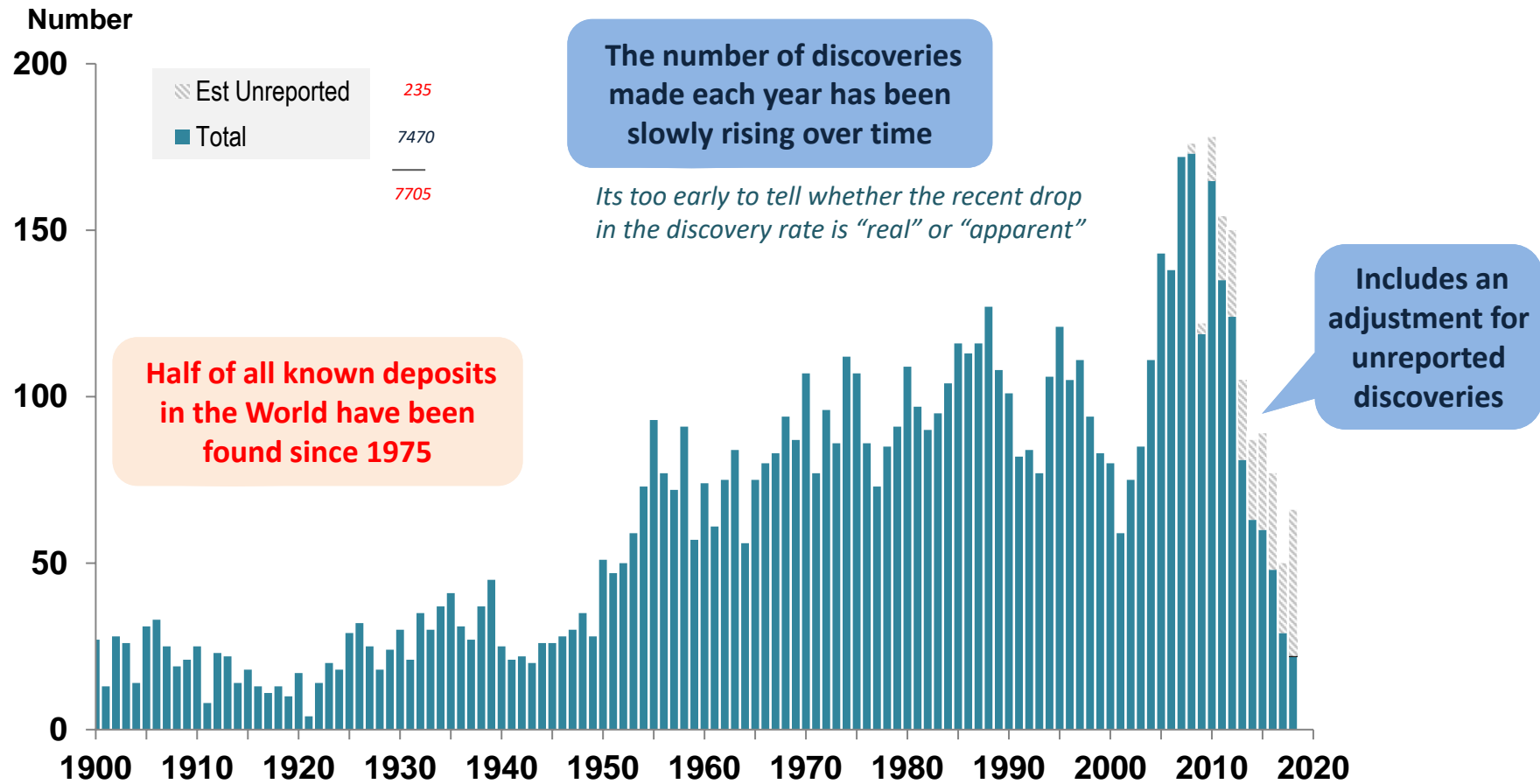
Source: MinEx Consulting © October 2019

The number of discoveries made has steadily risen over time

3. LONG TERM TRENDS IN THE NUMBER AND TYPE OF DISCOVERIES

Number of discoveries

Significant mineral discoveries in the World: 1900-2018

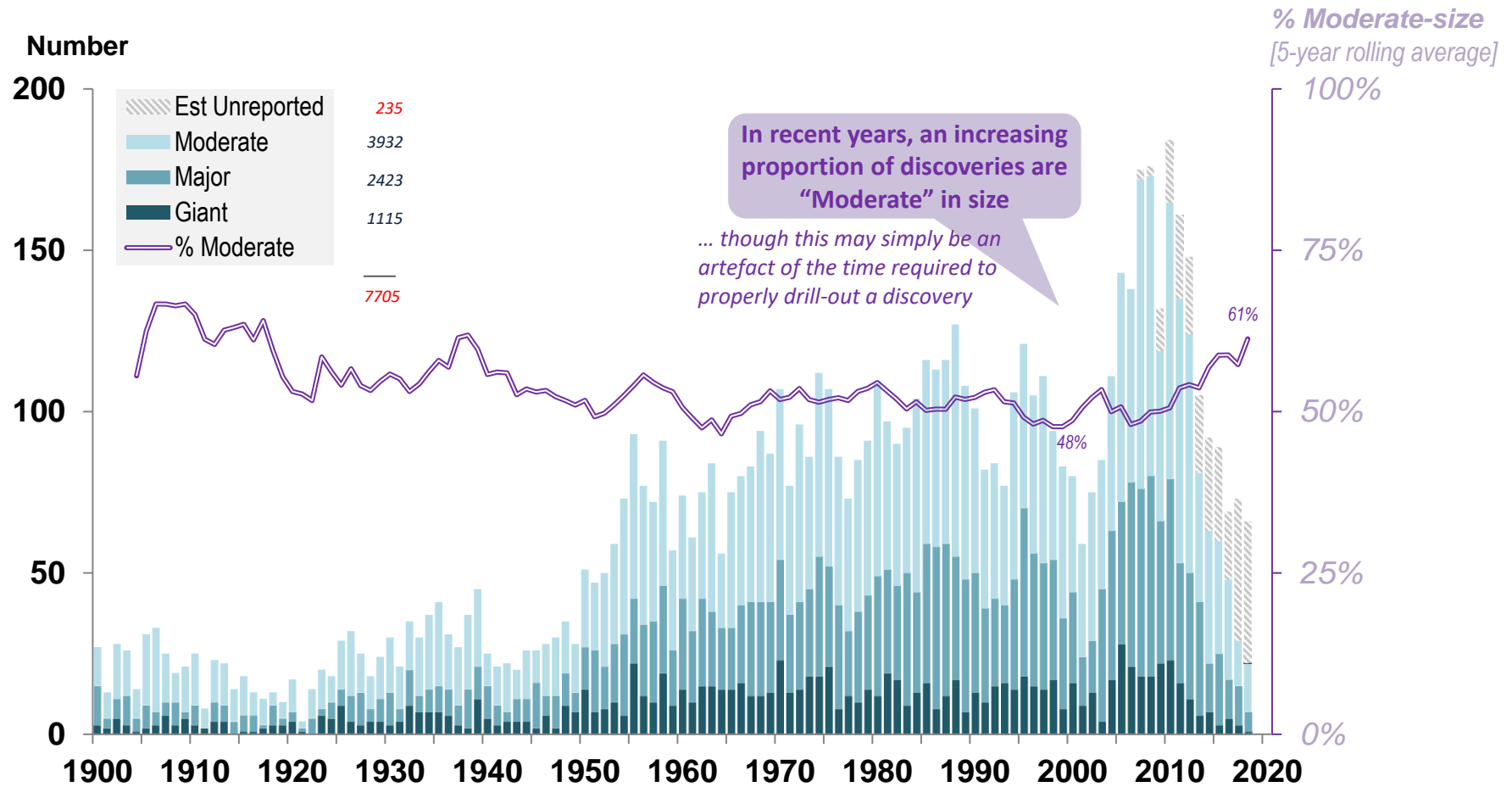


Note: Based on deposits >="Moderate" in-size. i.e. >100koz Au, >10kt Ni, >100kt Cu, 300kt Zn+Pb, >5kt U₃O₈, >5 Mt Heavy Minerals, >20 Mt Fe, >20 Mt Thermal Coal >10 Mt Met Coal, >3 Mt P₂O₅ and >3 Mt K₂O

Source: MinEx Consulting © October 2019

Number of discoveries by size

Significant mineral discoveries in the World: 1900-2017

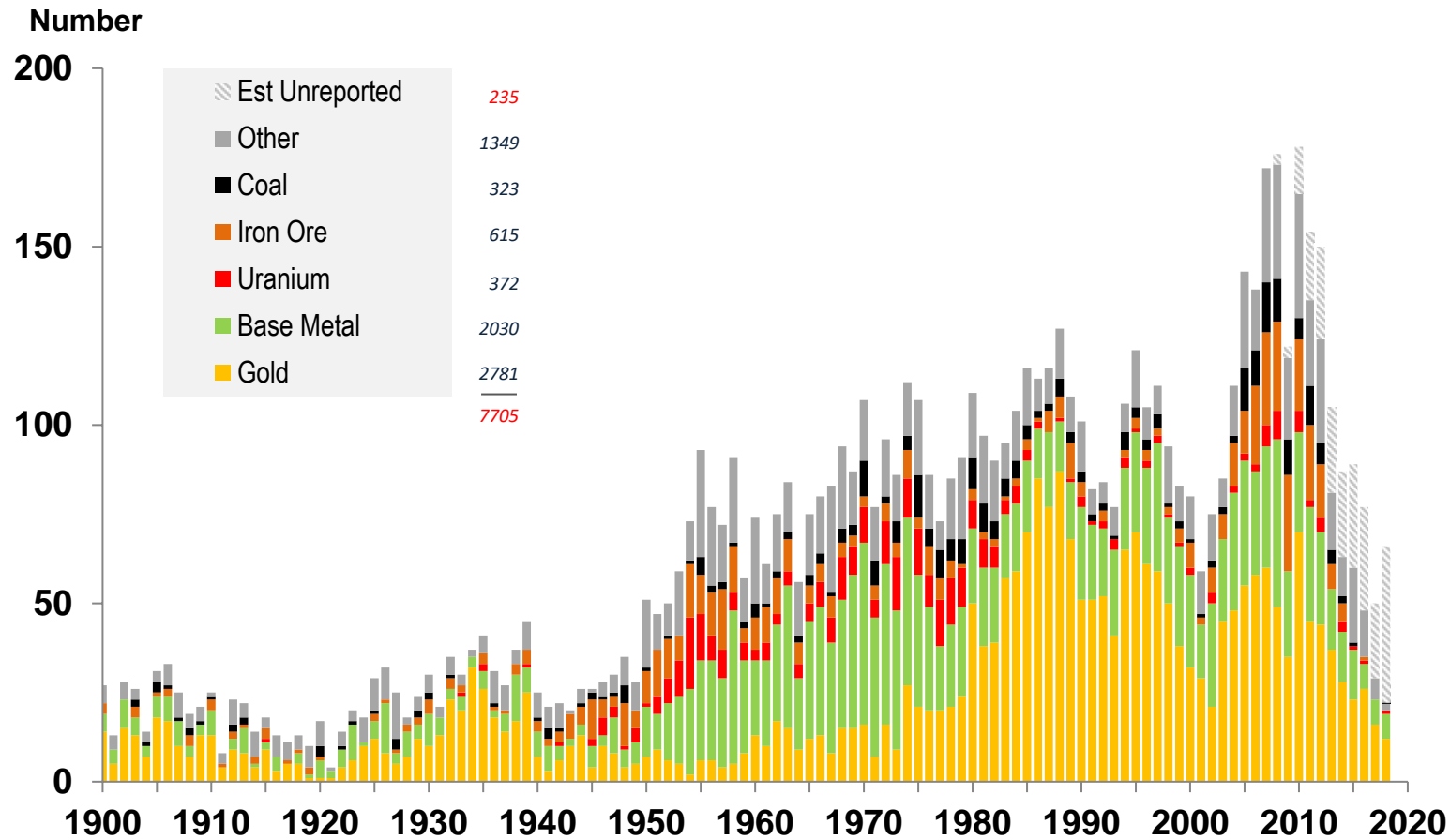


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Source: MinEx Consulting © October 2019

Number of discoveries by commodity type

Significant mineral discoveries in the World: 1900-2018



Note: Based on deposits >="Moderate" in-size. i.e. >100koz Au, >10kt Ni, >100kt Cu, 300kt Zn+Pb, >5kt U₃O₈, >5 Mt Heavy Minerals, >20 Mt Fe, >20 Mt Thermal Coal >10 Mt Met Coal, >3 Mt P₂O₅ and >3 Mt K₂O

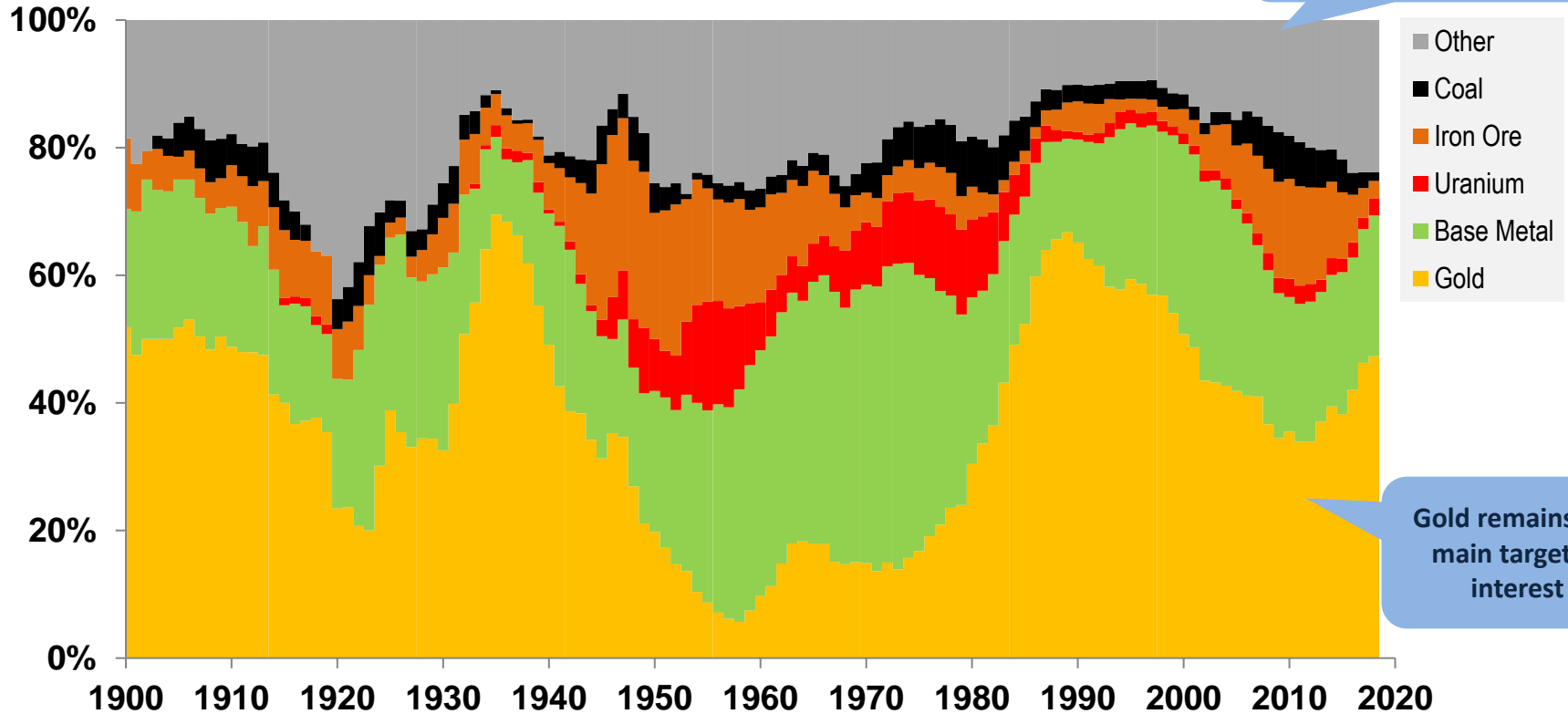
Source: MinEx Consulting © October 2019

Number of discoveries by commodity type

Significant mineral discoveries in the World: 1900-2018

Smoothed Data
(5 year rolling average)

Percentage of Total



“Other” (which includes Li, Co, Graphite, REE etc) have grown in recent years

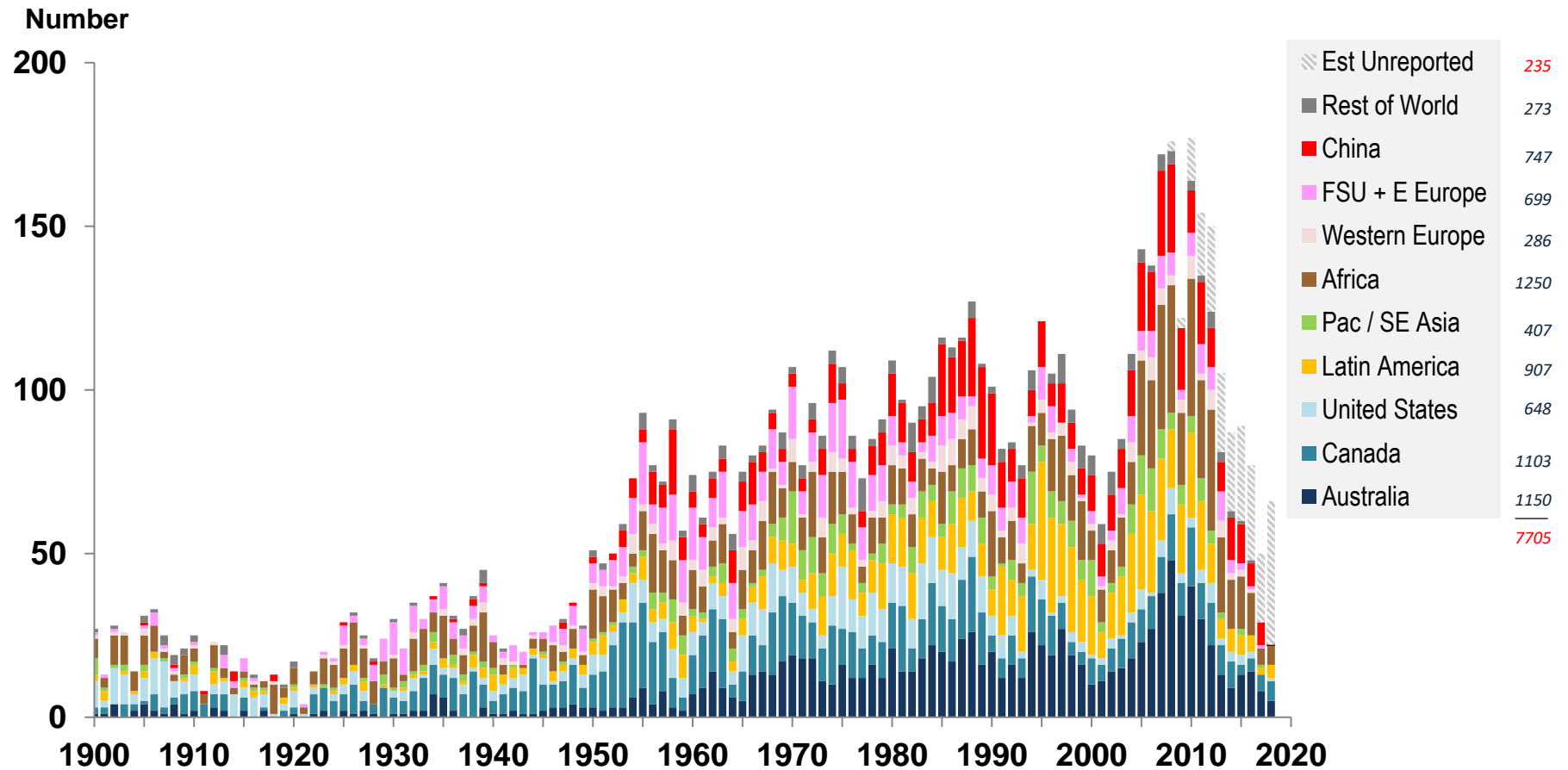
Gold remains the main target of interest

Note: Based on deposits >=“Moderate” in-size. i.e. >100koz Au, >10kt Ni, >100kt Cu, 300kt Zn+Pb, >5kt U₃O₈, >5 Mt Heavy Minerals, >20 Mt Fe, >20 Mt Thermal Coal >10 Mt Met Coal, >3 Mt P₂O₅ and >3 Mt K₂O

Source: MinEx Consulting © October 2019

Number of discoveries by region

Significant mineral discoveries in the World: 1900-2018



Note: Based on deposits >="Moderate" in-size. i.e. >100koz Au, >10kt Ni, >100kt Cu, 300kt Zn+Pb, >5kt U₃O₈, >5 Mt Heavy Minerals, >20 Mt Fe, >20 Mt Thermal Coal >10 Mt Met Coal, >3 Mt P₂O₅ and >3 Mt K₂O

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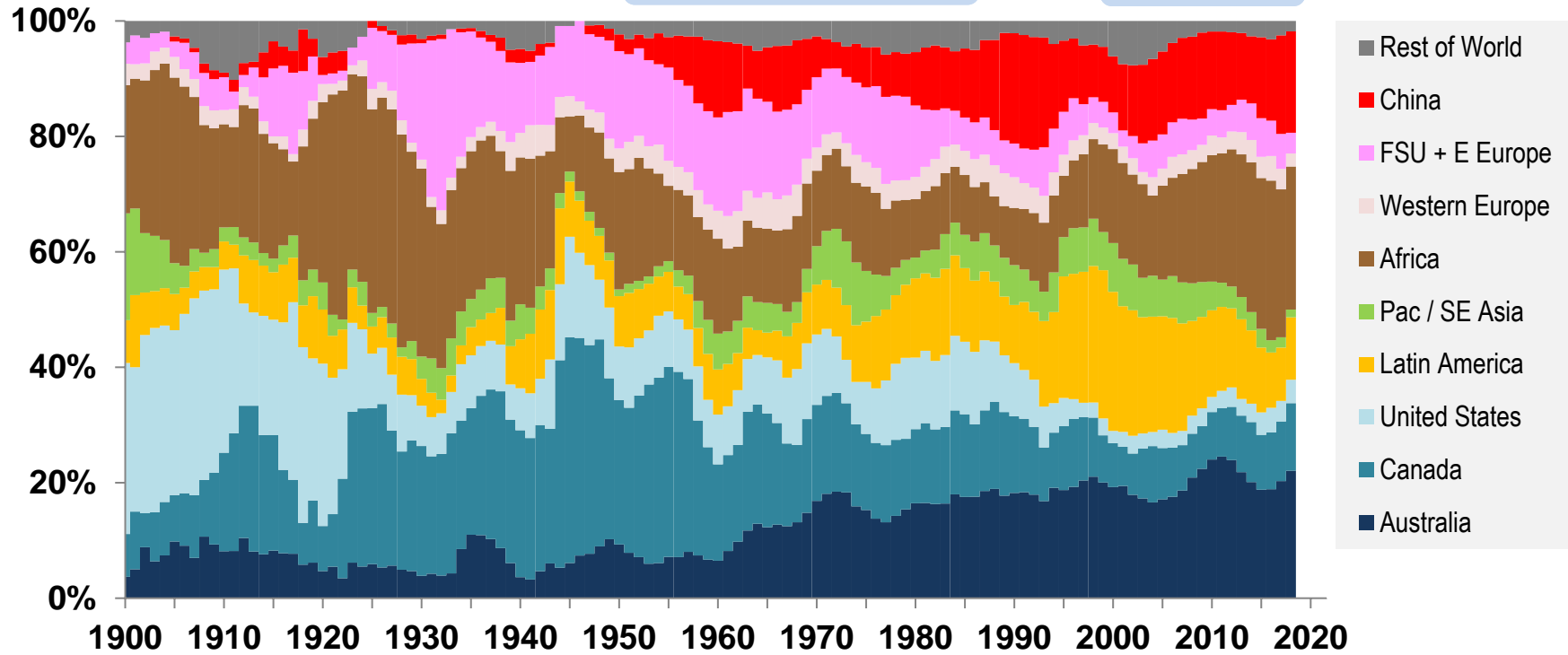
Significant mineral discoveries in the World: 1900-2017

Smoothed Data
(5 year rolling average)

The relative importance of each Region changes over time

... is driven by geological maturity, technology, infrastructure and Country Risk

Percentage of Total



Russia dropped out following the collapse of the Soviet Union in 1991

Rise of China and the return of Africa

In the early 1900's USA was dominant ...

... followed by Canada

Australia has grown ... but many of these discoveries are small in size

Source: MinEx Consulting © October 2019

Junior explorers are now finding most of the deposits

4. LONG TERM TRENDS IN WHO MADE THE DISCOVERIES

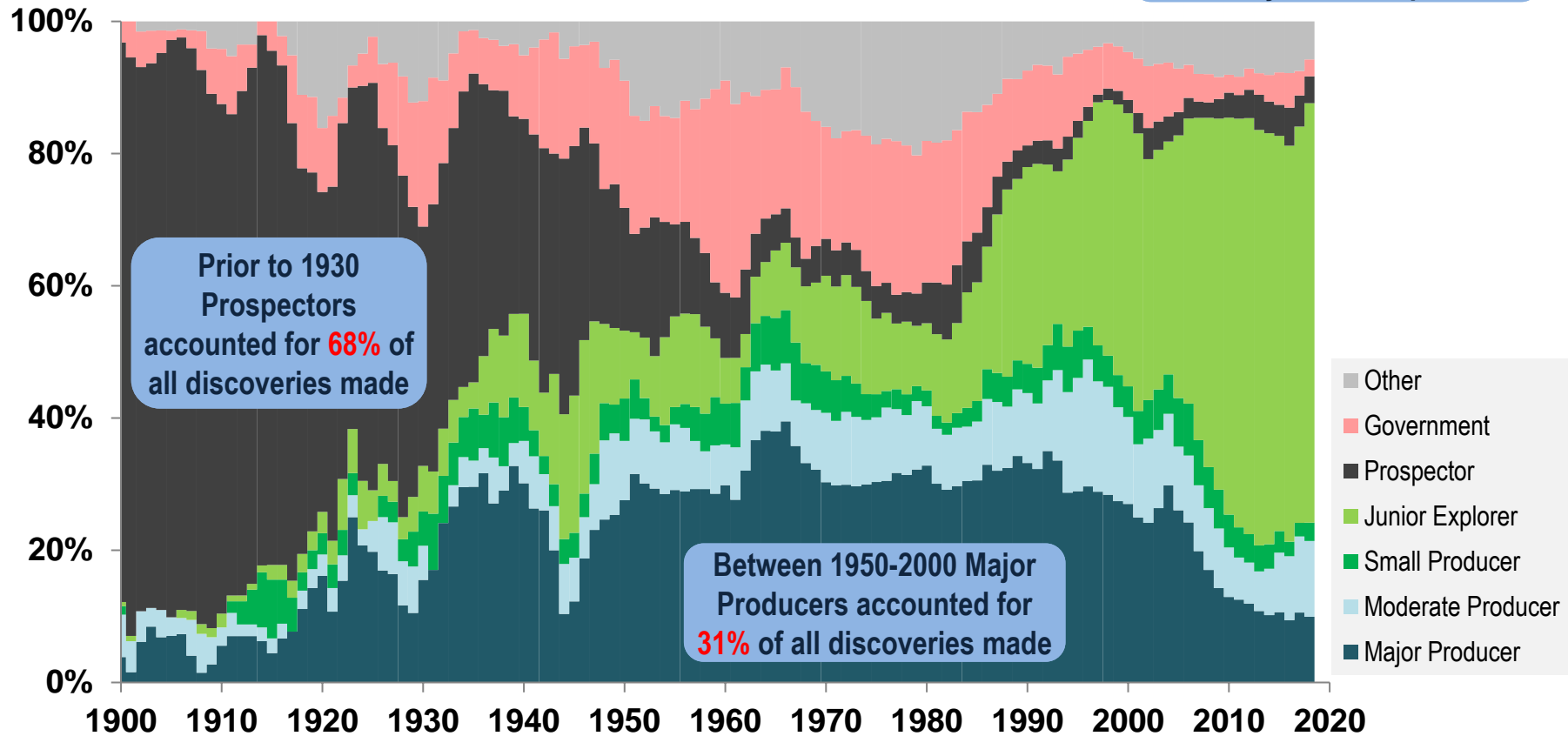
Number of discoveries by company type

Significant mineral discoveries in the **Western World**: 1900-2018

Smoothed Data
(5 year rolling average)

In the last decade **63%** of all discoveries in the WW were made by Junior Explorers

Percentage of Total



Note: "Junior Explorer" has no income
 "Small Producer" has a single small mine and <\$50m pa sales revenue (in 2013 US Dollars)
 "Moderate Producer" has 1-3 mines and \$50-500m pa sales revenue
 "Major Producer" has several large mines and >\$500m pa revenue
 "Other" includes industrial companies, major oil companies and private/unlisted companies

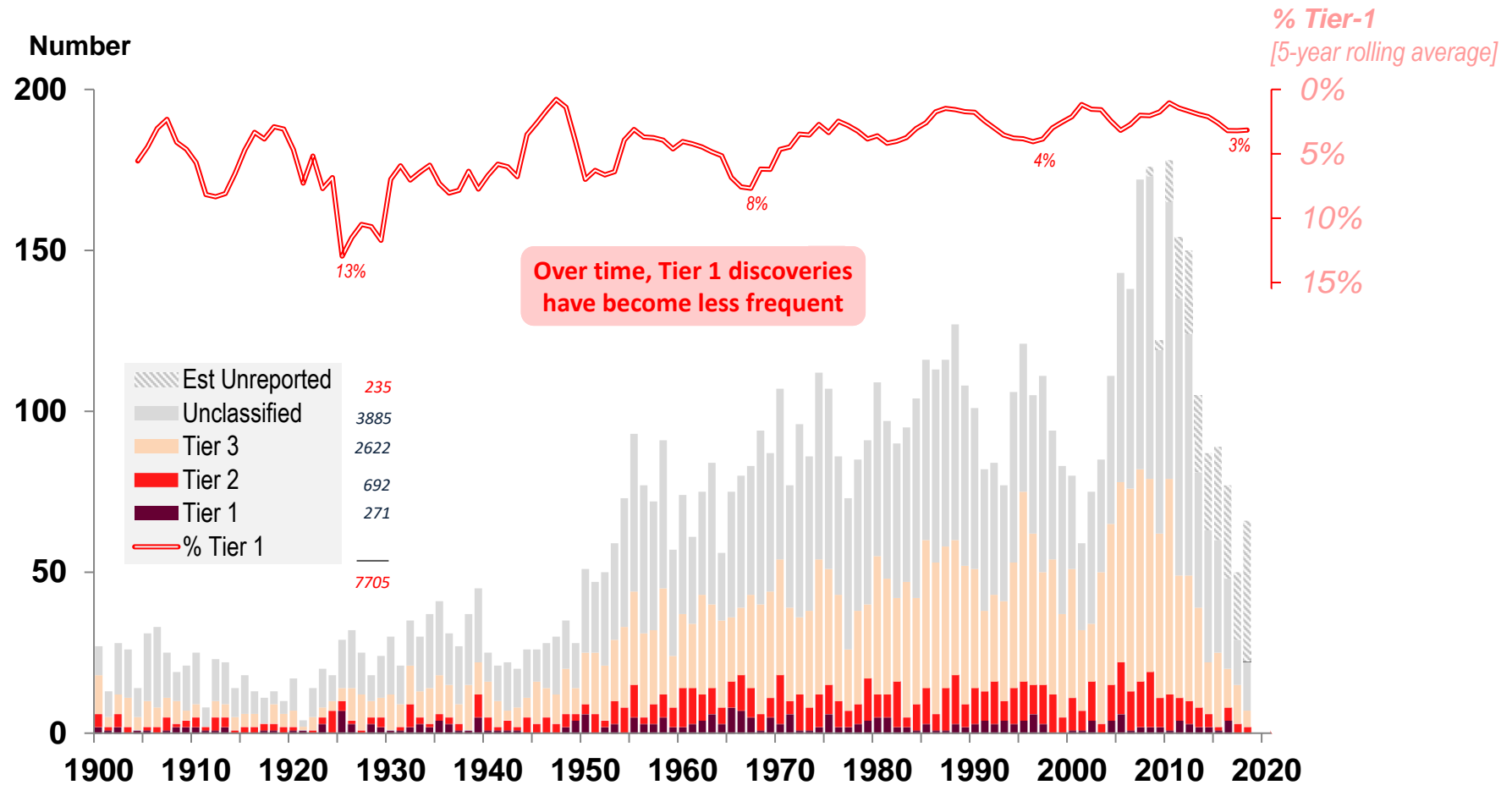
Source: MinEx Consulting © October 2019

In recent years the discoveries have been of lower quality

5. LONG TERM TRENDS IN THE QUALITY OF THE DISCOVERIES

Number of discoveries by quality

Tier 1, 2 & 3 mineral discoveries in the World: 1900-2017



Note: "Tier 1" deposits are company-making mines and are large, long life and low cost with NPV at Decision-to-Build of >\$1000m (in 2013 US Dollars)

"Tier 2" deposits are "significant" and have some of the elements of a Tier 1 but have an NPV of \$200 to \$1000m

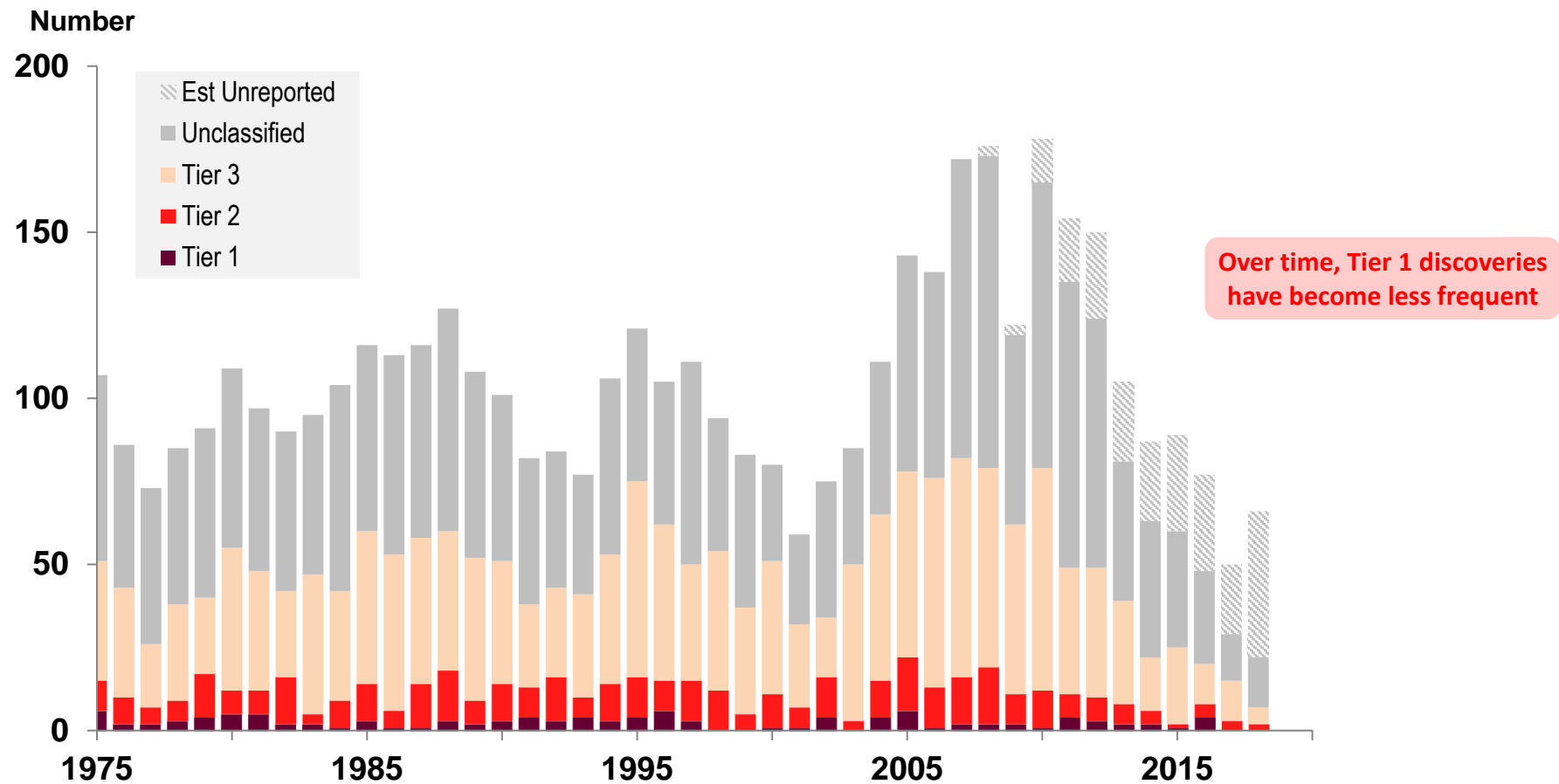
"Tier 3" deposits are modest or marginal deposits, with an NPV of \$0 to \$200m

"Unclassified" deposits are small deposits with an Expected Value of ~\$10m

Source: MinEx Consulting © October 2019

Number of discoveries by quality

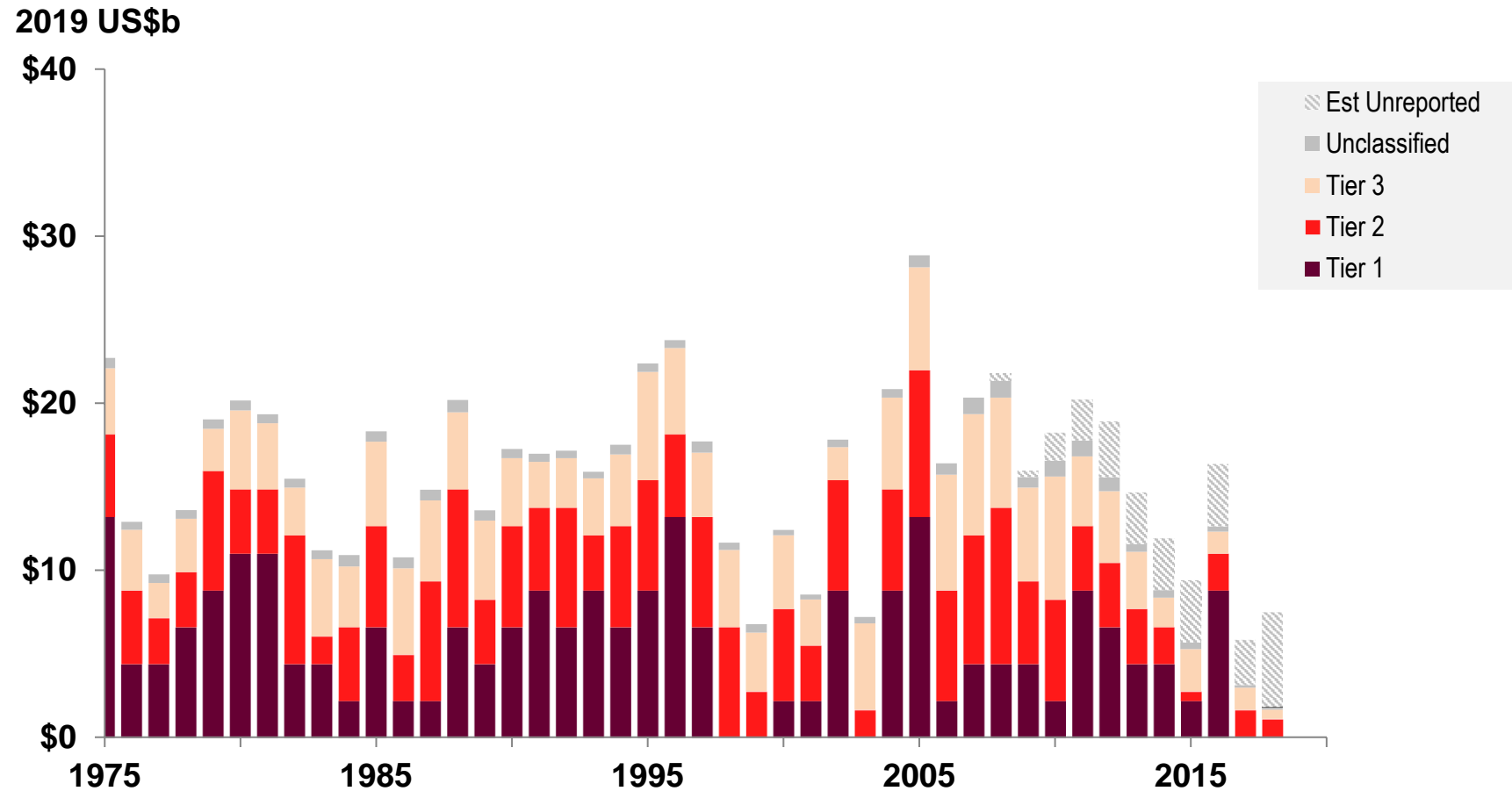
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Source: MinEx Consulting © October 2019

Value of exploration : 1975-2018



Caution: Values are indicative / approximate-only

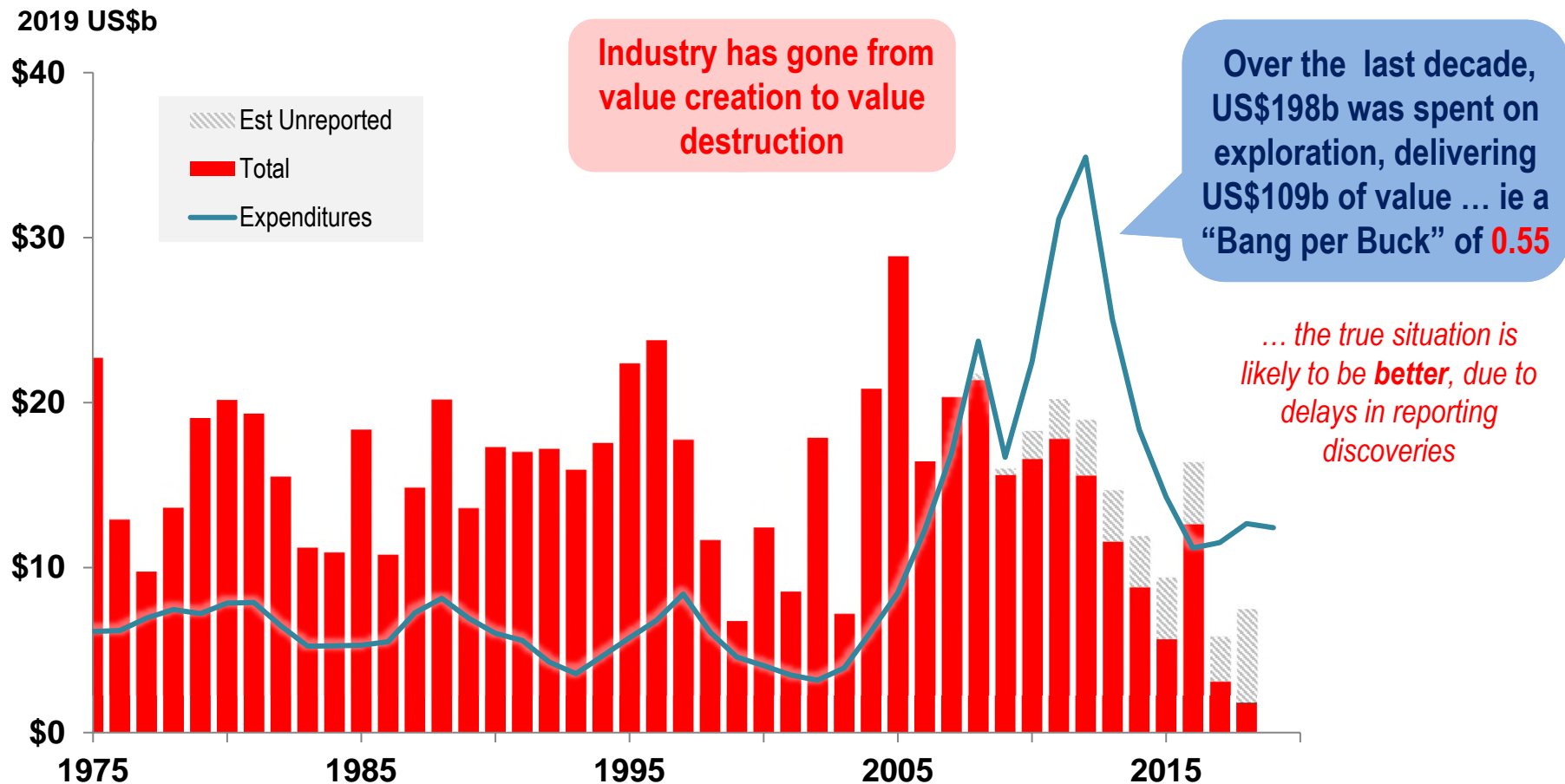
Assumes that the average value of a Tier1/Tier2/Tier3/Unclassified discovery is \$2000m / \$500m / \$80m / \$10m in 2013 Dollars

Source: MinEx Consulting © October 2019

Does exploration create or destroy value?
What are the best commodities and places to explore?

6. VALUE-PROPOSITION FOR EXPLORATION

Cost and value of exploration : 1975-2018



Caution: Values are indicative / approximate-only

Assumes that the average value of a Tier1/Tier2/Tier3/Unclassified discovery is \$2000m / \$500m / \$80m / \$10m in 2013 Dollars

Source: MinEx Consulting © October 2019

Discovery performance by Region : 2009-2018

Australia and Africa performed well

i.e. "Bang-per-Buck"

Region	Exploration Spend (2019 \$b)		No of Discoveries #		Tier 1+2 Discoveries		Estimated Value (2019 \$b)		Value / Spend
Australia	\$23	12%	185	22%	14	19%	\$21	20%	0.90
Canada	\$25	13%	87	10%	11	15%	\$14	13%	0.55
USA	\$13	6%	27	3%	2	3%	\$6	5%	0.44
Latin America	\$39	20%	110	13%	11	15%	\$13	12%	0.34
Pacific/SE Asia	\$9	4%	27	3%	2	3%	\$6	4%	0.63
Africa	\$20	10%	209	25%	15	21%	\$23	22%	1.11
W Europe	\$4	2%	29	3%	1	1%	\$2	2%	0.40
FSU+EE+China	\$58	30%	154	18%	16	22%	\$25	23%	0.42
Rest of World	\$6	3%	17	2%	1	1%	\$1	1%	0.21
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TOTAL	\$198	100%	846	100%	73	100%	\$109	100%	0.55

Note: Analysis includes Bulk Minerals, but excludes satellite deposits found within existing camps.

No of Discoveries refer to Moderate-, Major- and Giant-sized deposits.

Source: MinEx Consulting © October 2019

Caution: The Estimated Value is approximate only, and ignores the value of unreported discoveries

Comparison between commodities : World : 2009-2018

Best performer was “Other” Minerals (ie Lithium, graphite, cobalt etc)
Worst performers were Bulk Minerals (ie Coal & Iron Ore)

	Exploration Spend (2019 \$b)		No of Discoveries #		Tier 1+2 Discoveries		Estimated Value (2014 \$b)		Value / Spend
Gold	\$68	34%	336	40%	18	25%	\$34	31%	0.50
Base Metals	\$51	26%	176	21%	22	30%	\$30	28%	0.59
Uranium	\$9	4%	18	2%	5	7%	\$5	4%	0.52
Diamonds	\$4	2%	9	1%	1	1%	\$3	2%	0.63
Iron Ore	\$19	9%	96	11%	0	0%	\$4	4%	0.24
Coal	\$22	11%	40	5%	5	7%	\$5	4%	0.22
Other	\$25	13%	171	20%	22	30%	\$29	26%	1.12
	-----	-----	-----	-----	-----	-----	-----	-----	-----
TOTAL inc Bulks	\$198	100%	846	100%	73	100%	\$109	100%	0.55
TOTAL excl Bulks	\$157		710		68		\$100		0.63

Note: Analysis excludes satellite deposits found within existing camps.

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Caution: The Estimated Value is approximate only, and ignores the value of unreported discoveries

7. SUMMARY / CONCLUSIONS

Summary / Conclusions

1. **Location of recent discoveries** ~ 1070 discoveries have been made in the last decade ... but only 19 of these were Tier 1 (or World Class). 4 each were found in China and Australia, 3 in Africa and 2 each in Canada, USA and Pacific / SE Asia.
2. **Trends in the number, size and quality of discoveries** – Gold still remains the main focus. Appears to be a drop in the size and quality of recent discoveries. Its getting harder to find a Tier 1 deposit. The number of discoveries made each year has been slowly rising over time.
3. **Who made the discoveries ?** – Used to be driven by the Majors. Junior explorers now account for 63% of all discoveries (by number).
4. **Value proposition for exploration** – 66% of the value is tied-up in the Tier 1 and 2 discoveries – but these account for less than 8% by number. The bang-per-buck is currently only 0.55 ... which means that the industry is destroying value, not creating it

The outlook is subdued / uncertain... to meet our future needs we need to improve our performance

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