

Challenges and opportunities for under-cover exploration in Australia

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UNCOVER Summit 2014

31st March 2014 Adelaide

Overview

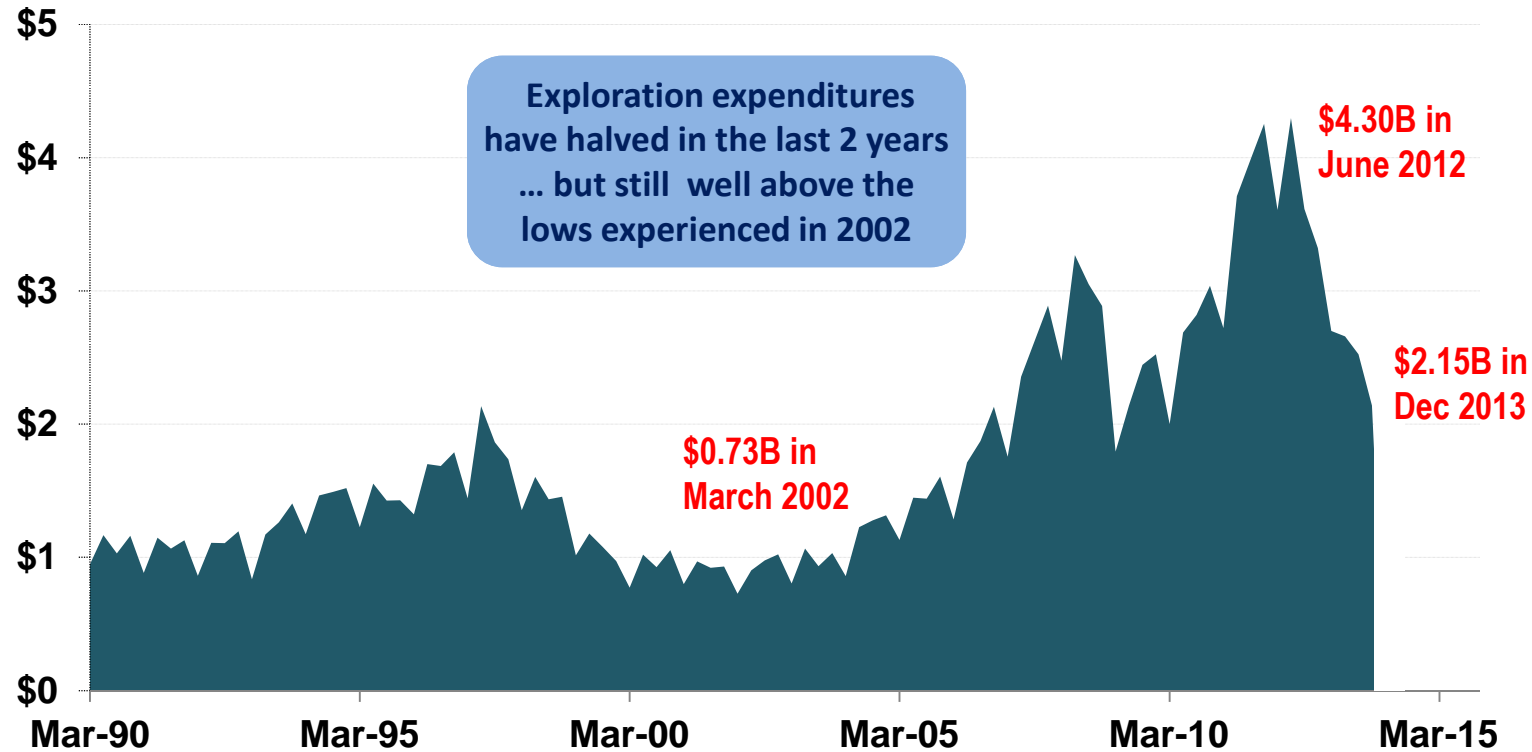
1. Trends in exploration spend in Australia
2. Number of discoveries made
3. Quality and value of the discoveries made (and the business case for why you explore in Australia)
4. Change in the depth of discovery
5. Amount of drilling required to discover
6. Discovery methods used
7. Summary / Conclusions

Exploration expenditures reached an all-time high in 2012

1. TRENDS IN EXPLORATION SPEND

Exploration expenditures in Australia

Total Expenditures (June 2013 Australian \$Billion)



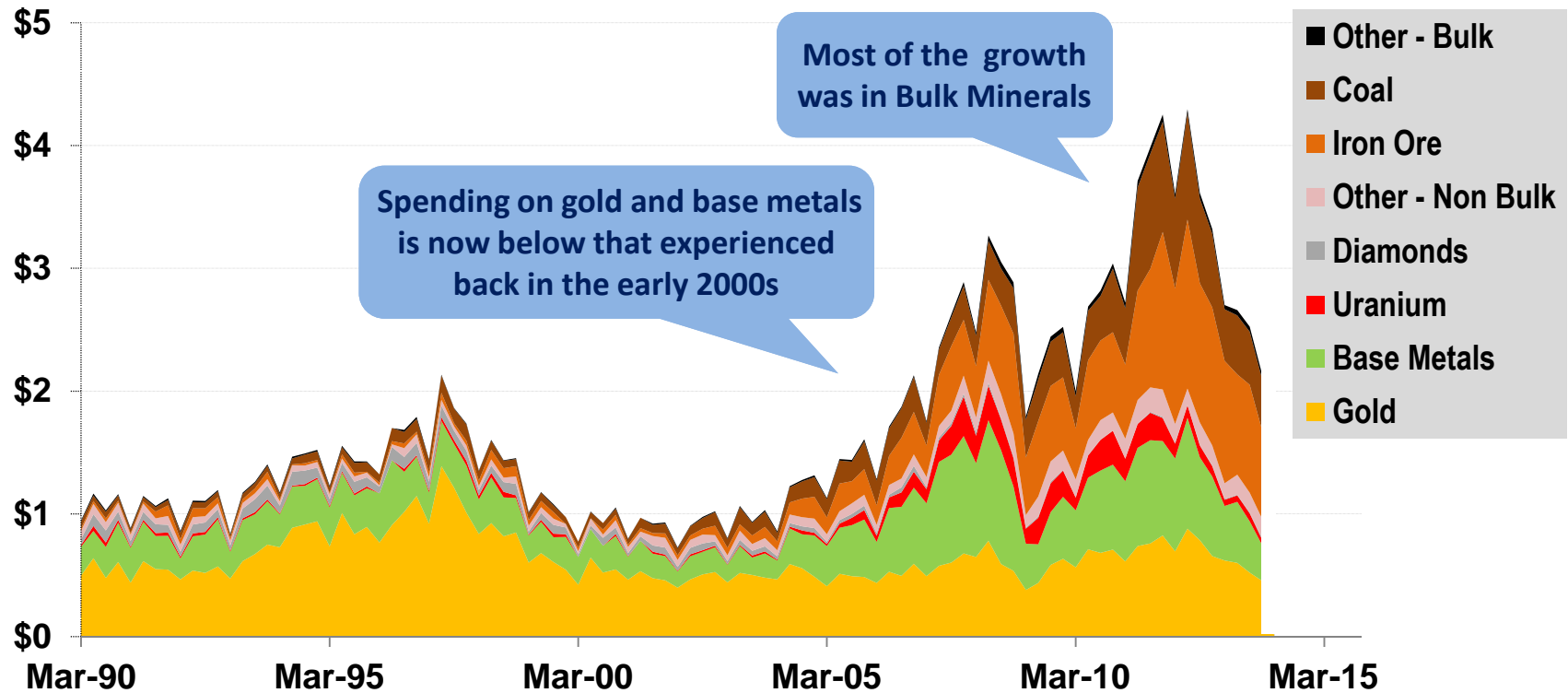
Note: Data reported on an annualised basis

Includes exploration expenditures on Bulk Minerals (such as coal, iron ore and bauxite)

Source: ABS Cat No. 8412.0

Exploration expenditures in Australia by Commodity

Total Expenditures (June 2013 Australian \$Billion)



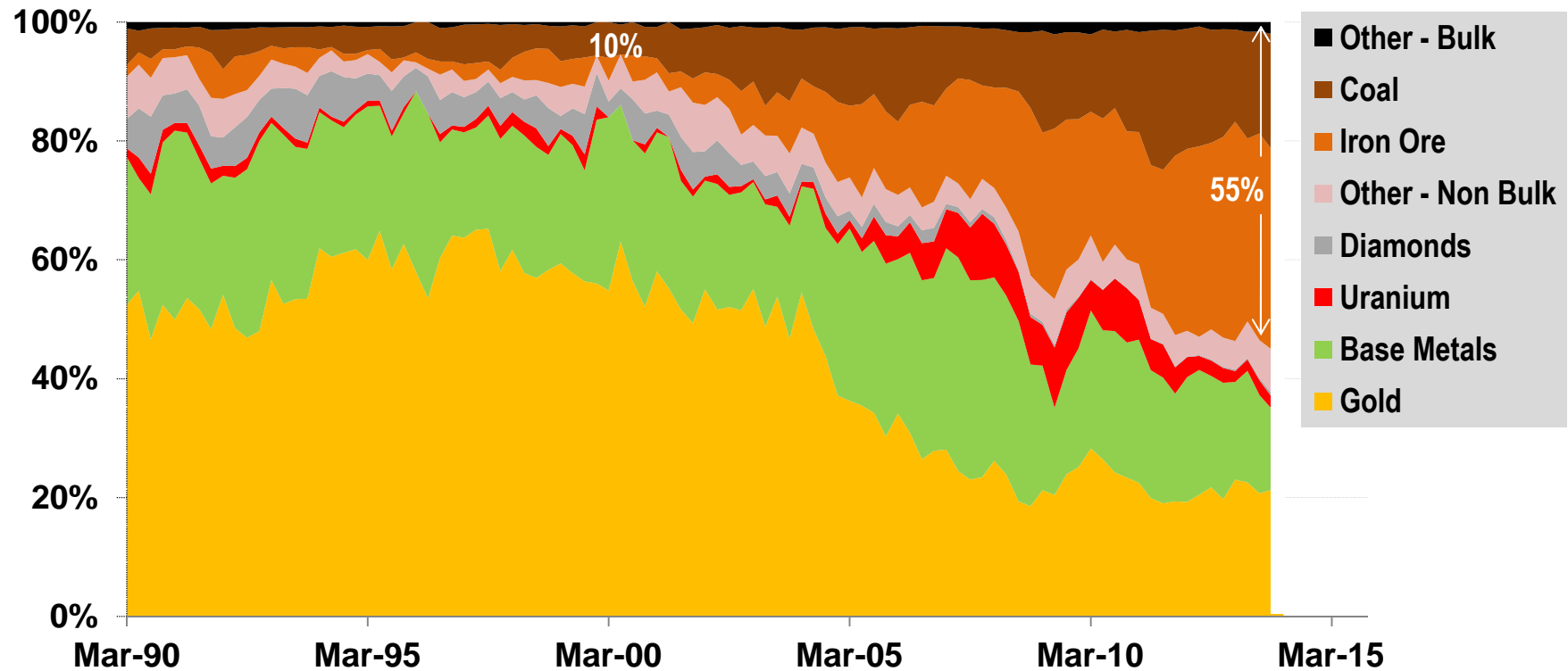
Note: Data reported on an annualised basis

Source: ABS Cat No. 8412.0

Bulk Minerals now accounts for over half of total spend

Level of exploration by Commodity in Australia: March 1990-December 2013

Percentage of Total Expenditures



Note: Data reported on an annualised basis

Source: ABS Cat No. 8412.0

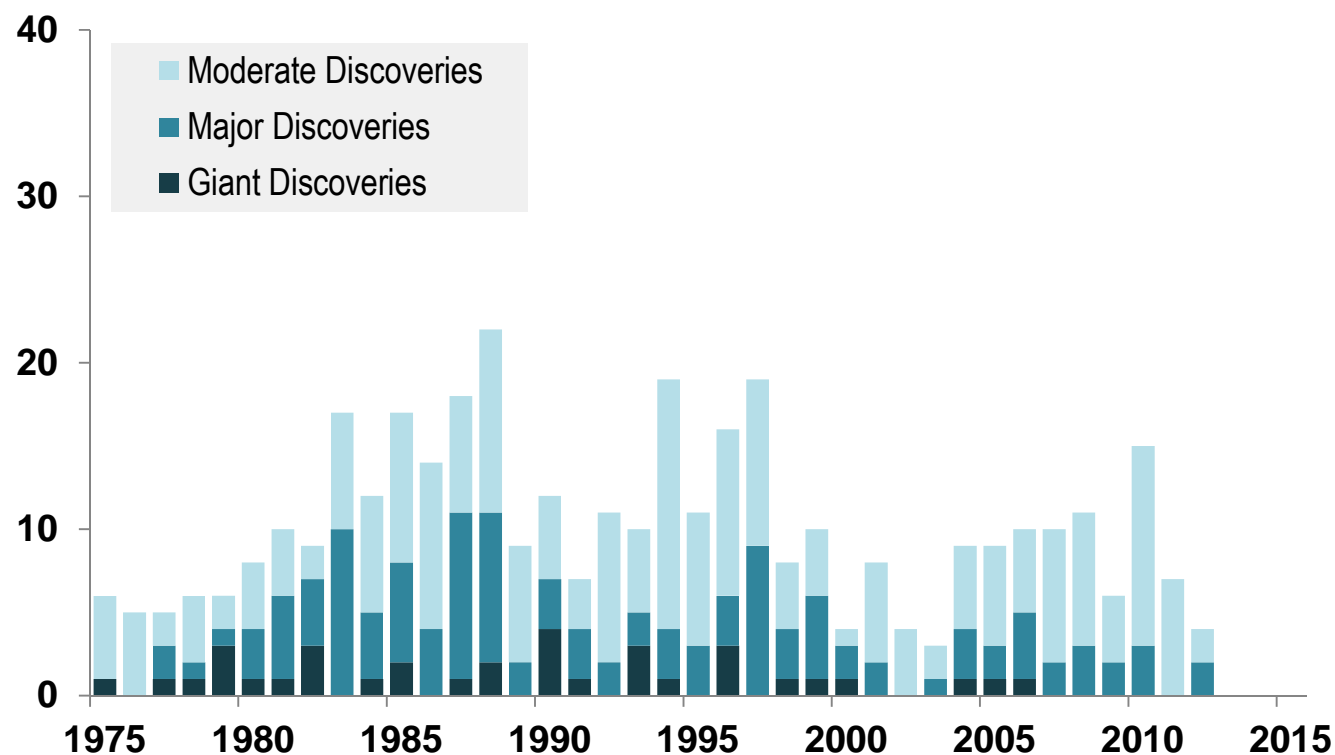
Number of discoveries varies with spend and drilling

2. NUMBER OF DISCOVERIES MADE

Number of significant discoveries made

Non-Bulk discoveries Australia: 1975-2012

Number of Discoveries



Fewer GIANT discoveries in recent years

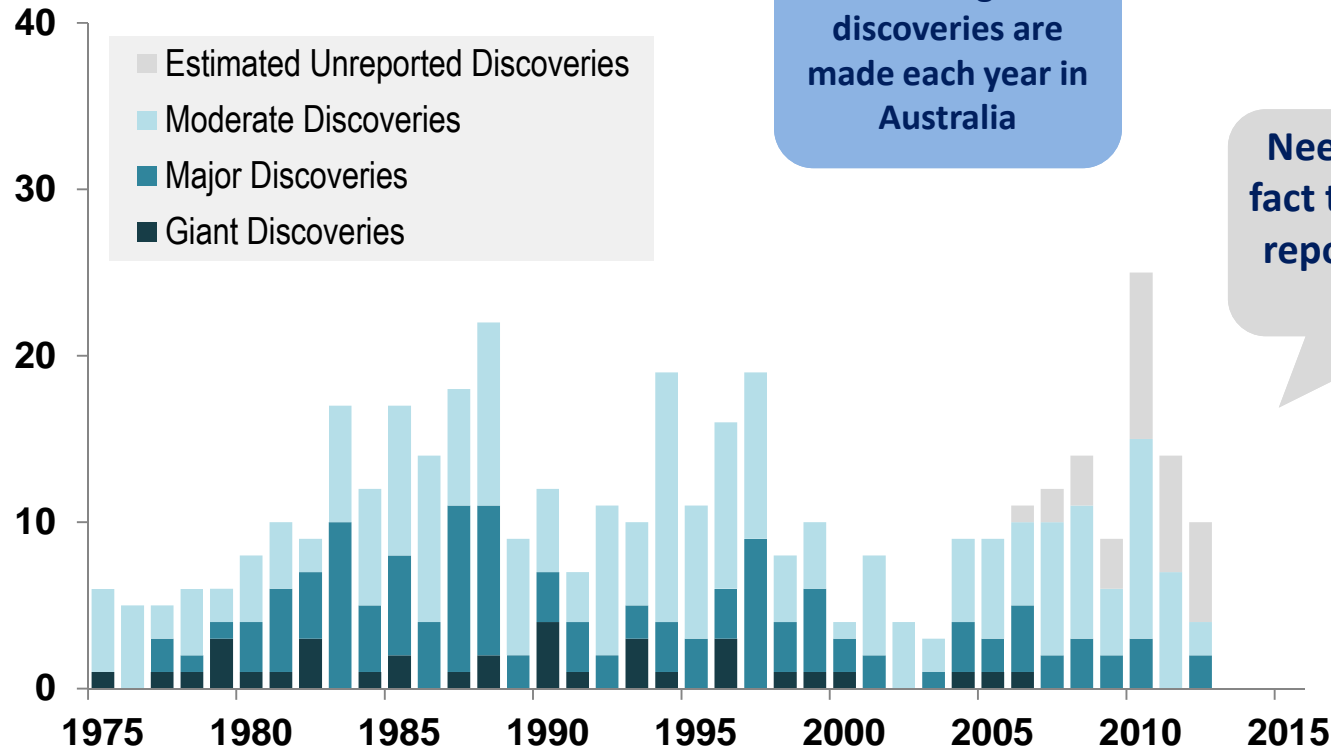
Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries..
Analysis based on Moderate-, Major- and Giant-sized deposits

Source: MinEx Consulting © November 2013

Number of significant discoveries made

Non-Bulk discoveries Australia: 1975-2012

Number of Discoveries



On average **10** discoveries are made each year in Australia

Need to adjust for the fact that it takes time to report a discovery and drill it out

Fewer GIANT discoveries in recent years

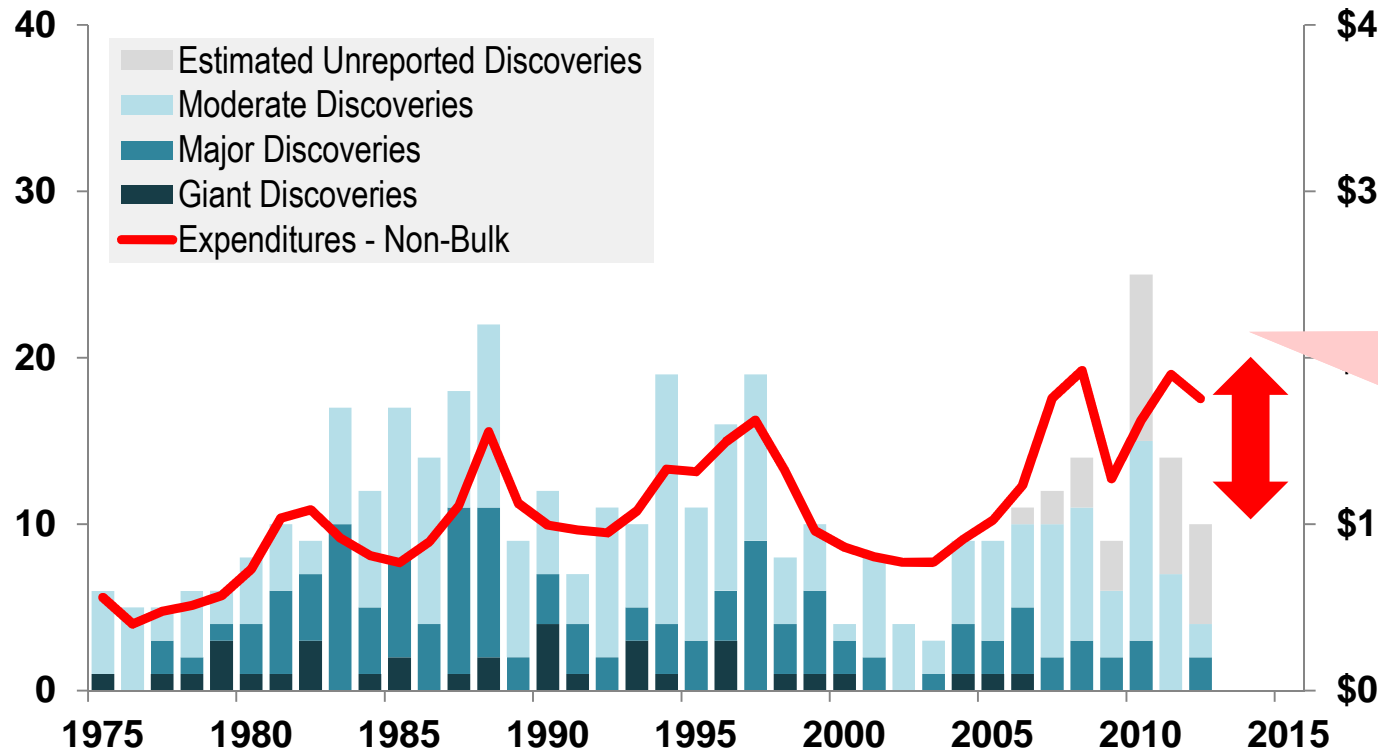
Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.. Analysis based on Moderate-, Major- and Giant-sized deposits

Source: MinEx Consulting © November 2013

Discovery rate moves in-line with expenditures

Non-Bulk exploration spend and discoveries Australia: 1975-2012

Number of Discoveries



Total Expenditures (June 2013 A\$B)

\$4
\$3
\$1
\$0

Even after adjusting for unreported discoveries, in the last 10 years a large gap has opened up between expenditures and number of deposits found

... Gap due to higher input costs (labour, drilling and admin).

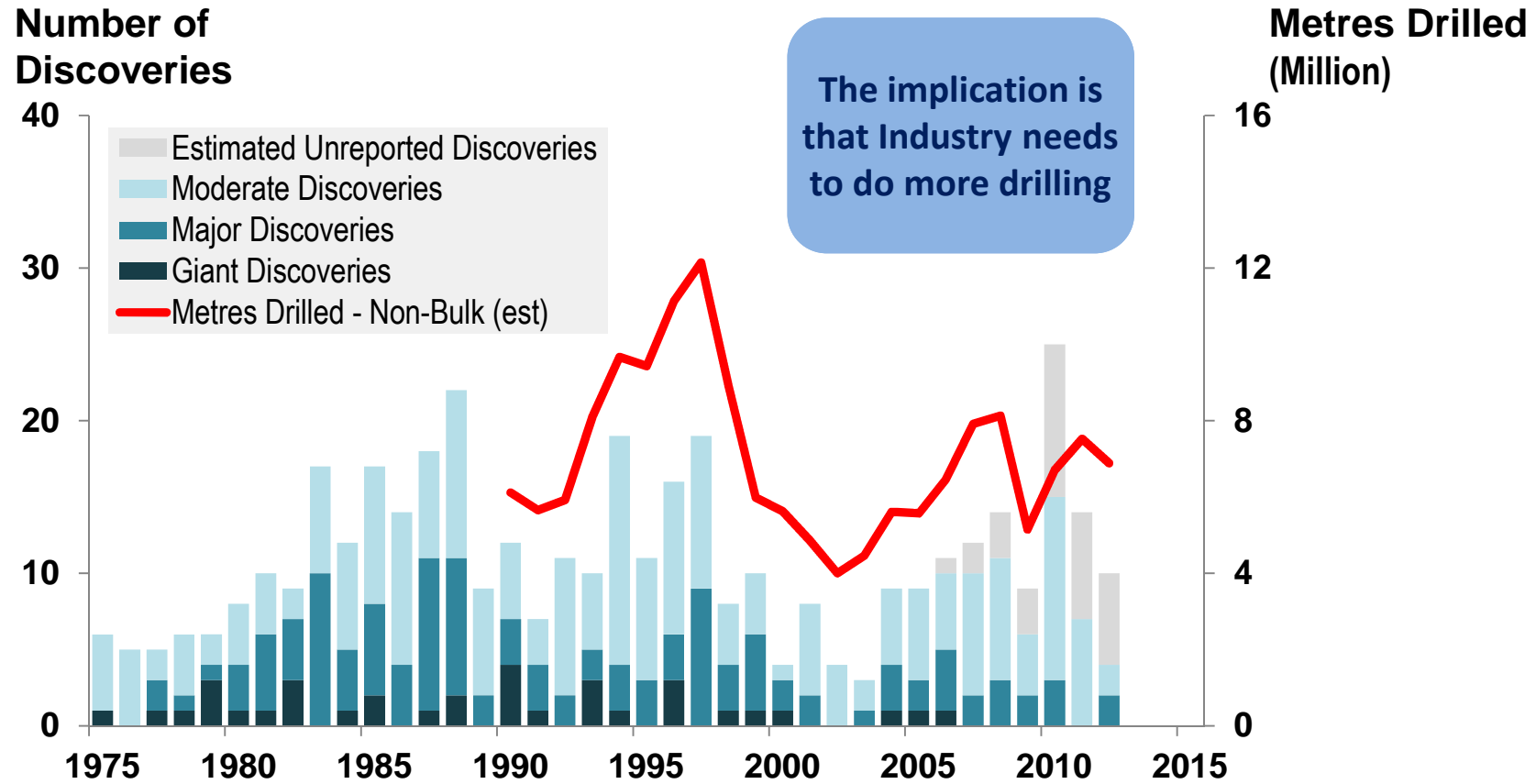
Is partly offset by shift to Brownfield Exploration (but this delivers smaller-sized discoveries)

Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.. Analysis based on Moderate-, Major- and Giant-sized deposits

Source: MinEx Consulting © November 2013

Discovery rate also moves in-line with drilling

Non-Bulk exploration drilling and discoveries Australia: 1975-2012

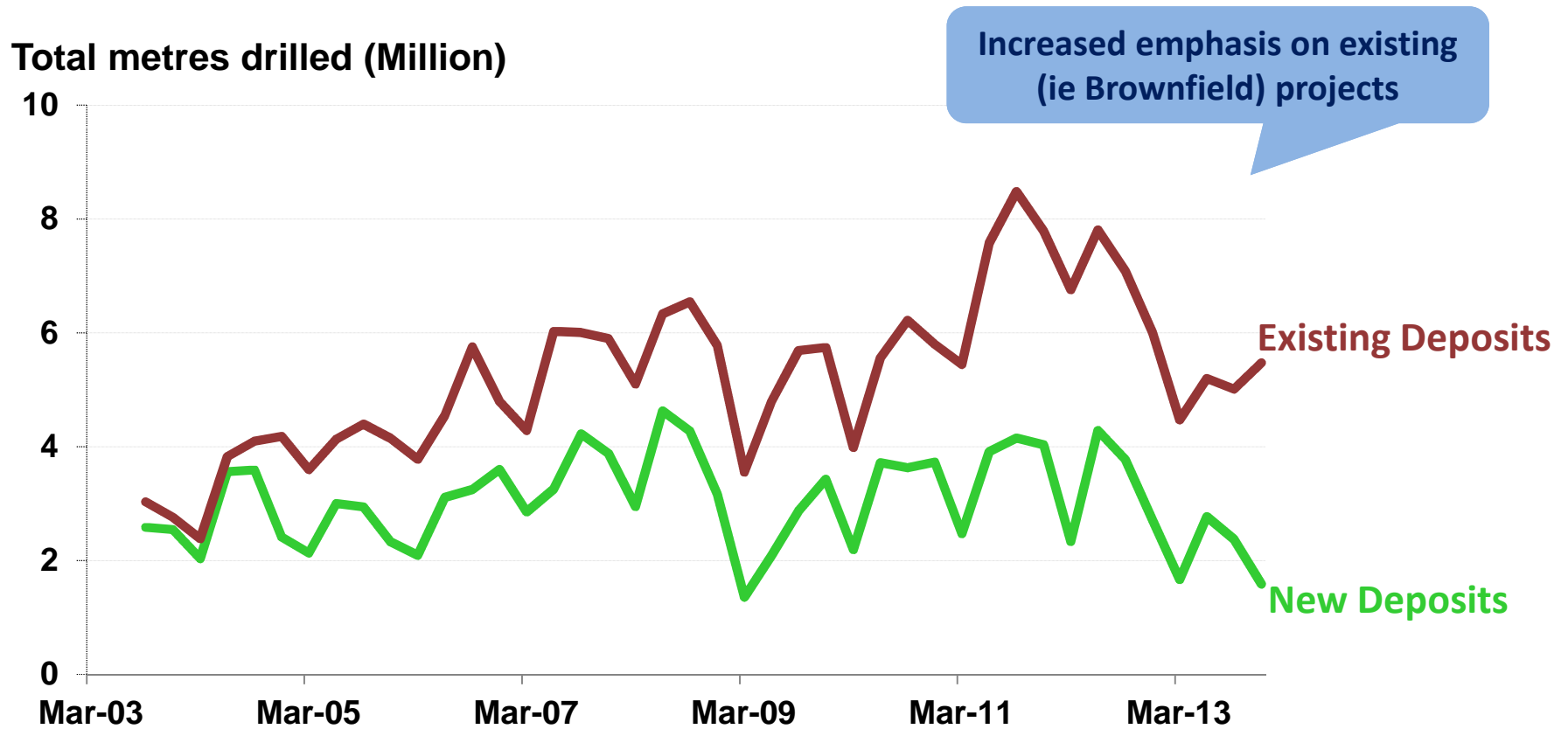


Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries..
Analysis based on Moderate-, Major- and Giant-sized deposits

Source: MinEx Consulting © November 2013

The amount of drilling on new deposits has significantly declined in recent years

Amount of exploration drilling in Australia: Sept 2003-Dec 2013



Note: Includes exploration expenditures on Bulk Minerals (such as coal, iron ore and bauxite)
Data reported on an annualised basis.

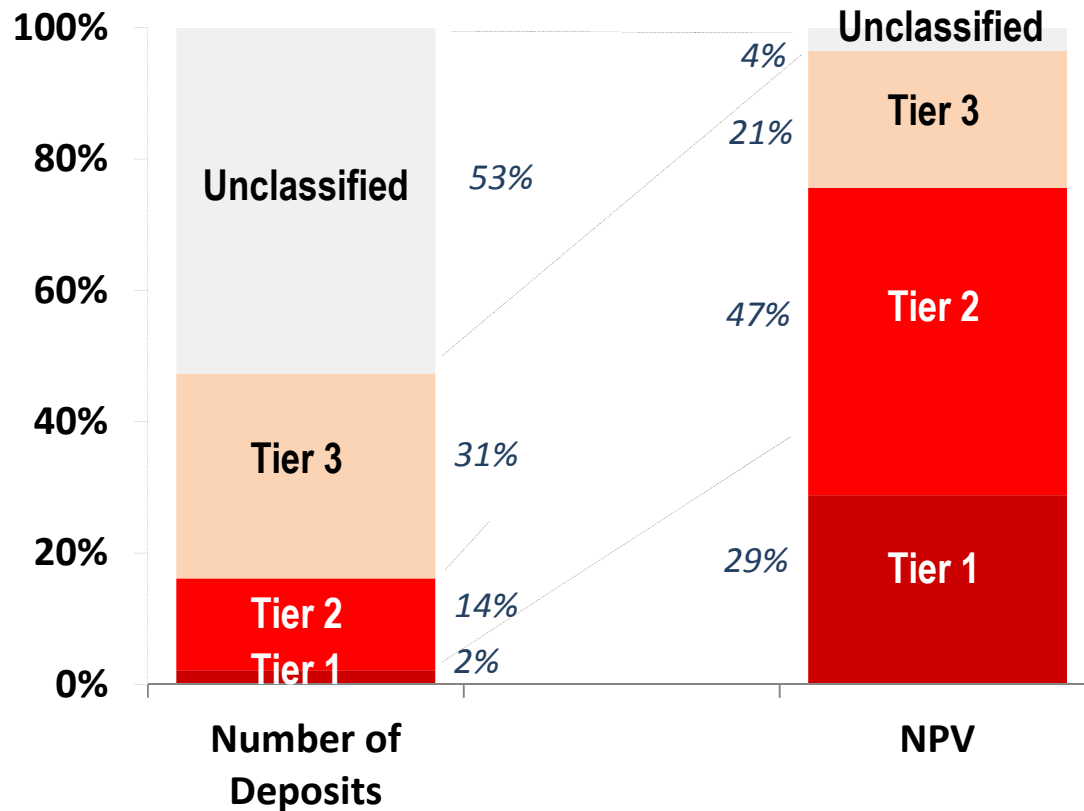
Source: ABS Cat No. 8412.0

Do we make money out of exploration?

3. QUALITY & VALUE OF THE DISCOVERIES MADE

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

Estimated value of 93 discoveries found in Australia between 2004-2013



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: Myrtle [Zinc]

'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 ~\$100m

Example: Andy Well [Gold]

'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

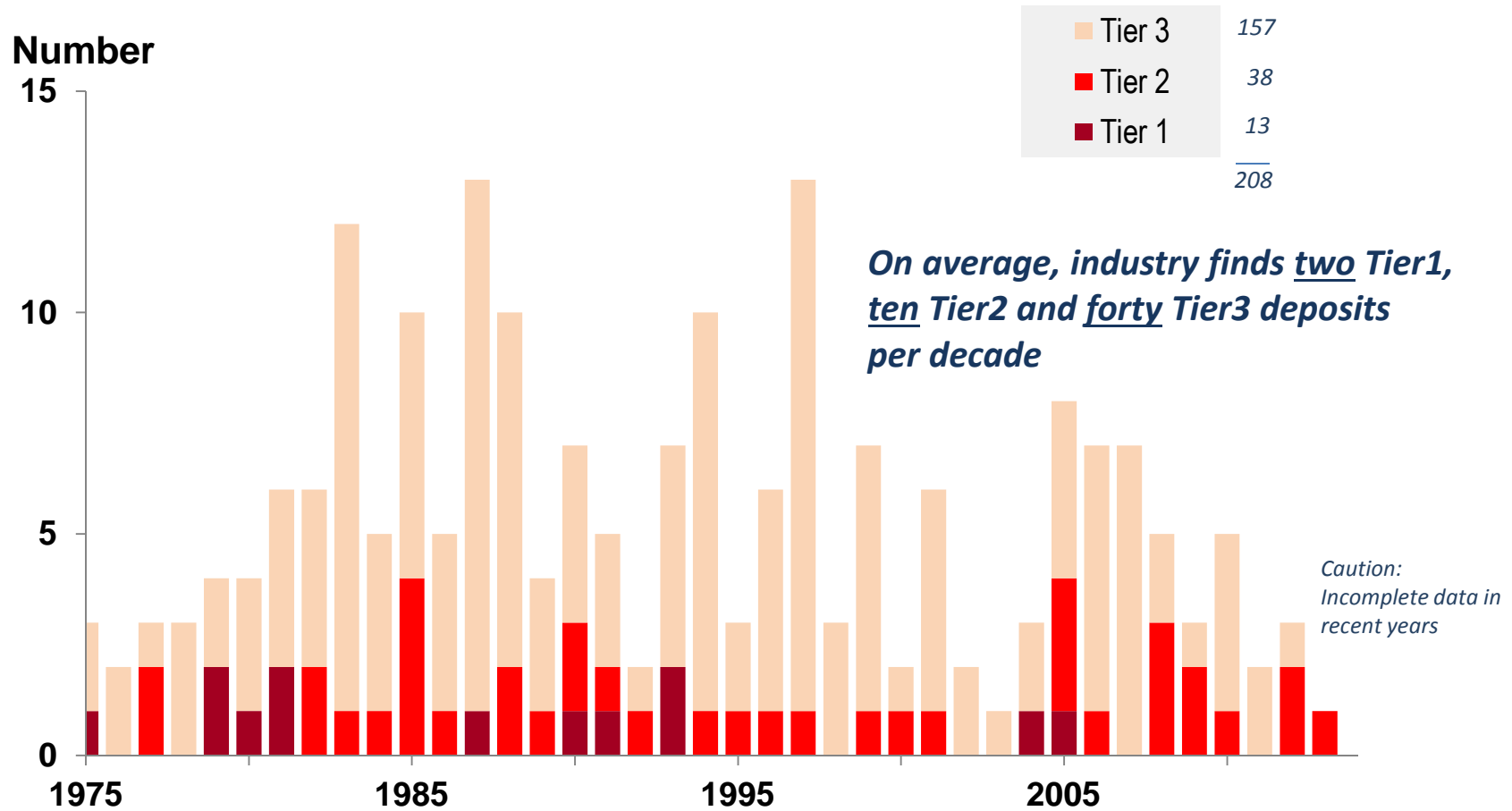
Example: Nova [Nickel]

'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

Examples: Tropicana [Gold], Eucla [Mineral Sands]

Number of discoveries by quality

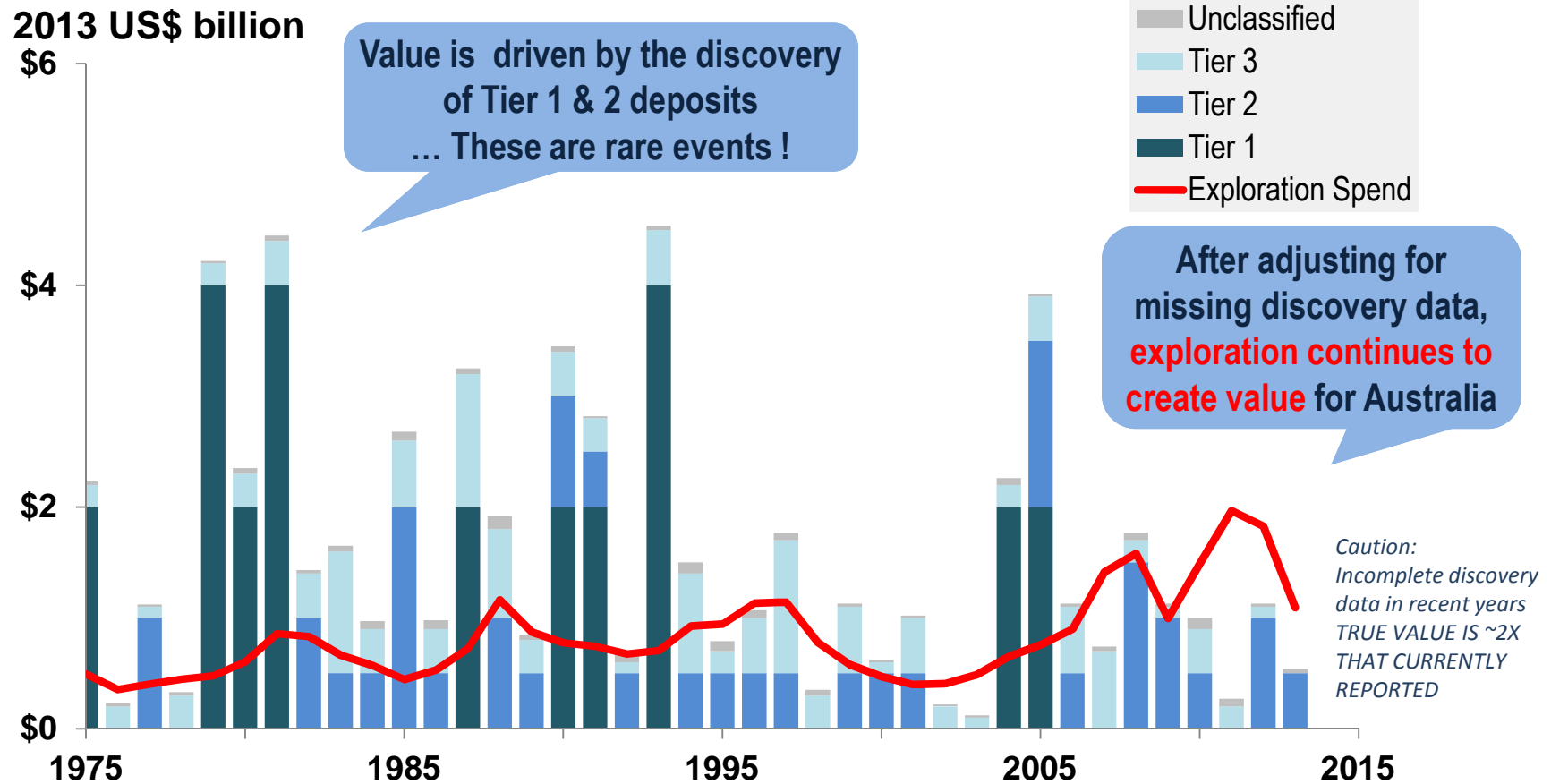
Tier 1,2 & 3 discoveries in Australia: 1975-2013



Note: Excludes satellite discoveries in existing camps. Excludes Bulk Mineral discoveries

Source: MinEx Consulting © March 2014

Exploration expenditures versus expected value of discoveries in Australia



CAUTION: Values are indicative/approximate only.

Analysis based on an average Expected Value (at the time of Discovery) of a Tier 1, 2, 3 deposit of US\$2000m, \$500m and \$100m respectively. Unassigned deposits have been given a notional value of \$10m.

Analysis excludes Bulk Minerals

Source: MinEx Consulting © March 2013

How does Australia compare to the Rest of the World?

Spend & performance by Region: 2003-12

Australia performed 38% better than the World average

i.e. "Bang-per-Buck"

Region	Exploration Spend (2012 \$b)		No of Discoveries #		Tier 1+2 Discoveries		Estimated Value (2012 \$b)		Value / Spend
Australia	\$12	10%	84	15%	14	17%	\$13	14%	1.12
Canada	\$21	18%	74	13%	15	18%	\$15	16%	0.71
USA	\$9	8%	19	3%	6	7%	\$5	6%	0.60
Latin America	\$27	23%	133	24%	15	18%	\$23	24%	0.84
Pacific/SE Asia	\$6	5%	23	4%	2	2%	\$4	4%	0.63
Africa	\$16	14%	124	22%	20	24%	\$22	24%	1.38
W Europe	\$3	3%	24	4%	1	1%	\$1	2%	0.48
Rest of World	\$22	19%	78	14%	11	13%	\$10	11%	0.46
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TOTAL	\$116	100%	559	100%	86	100%	\$94	100%	0.81

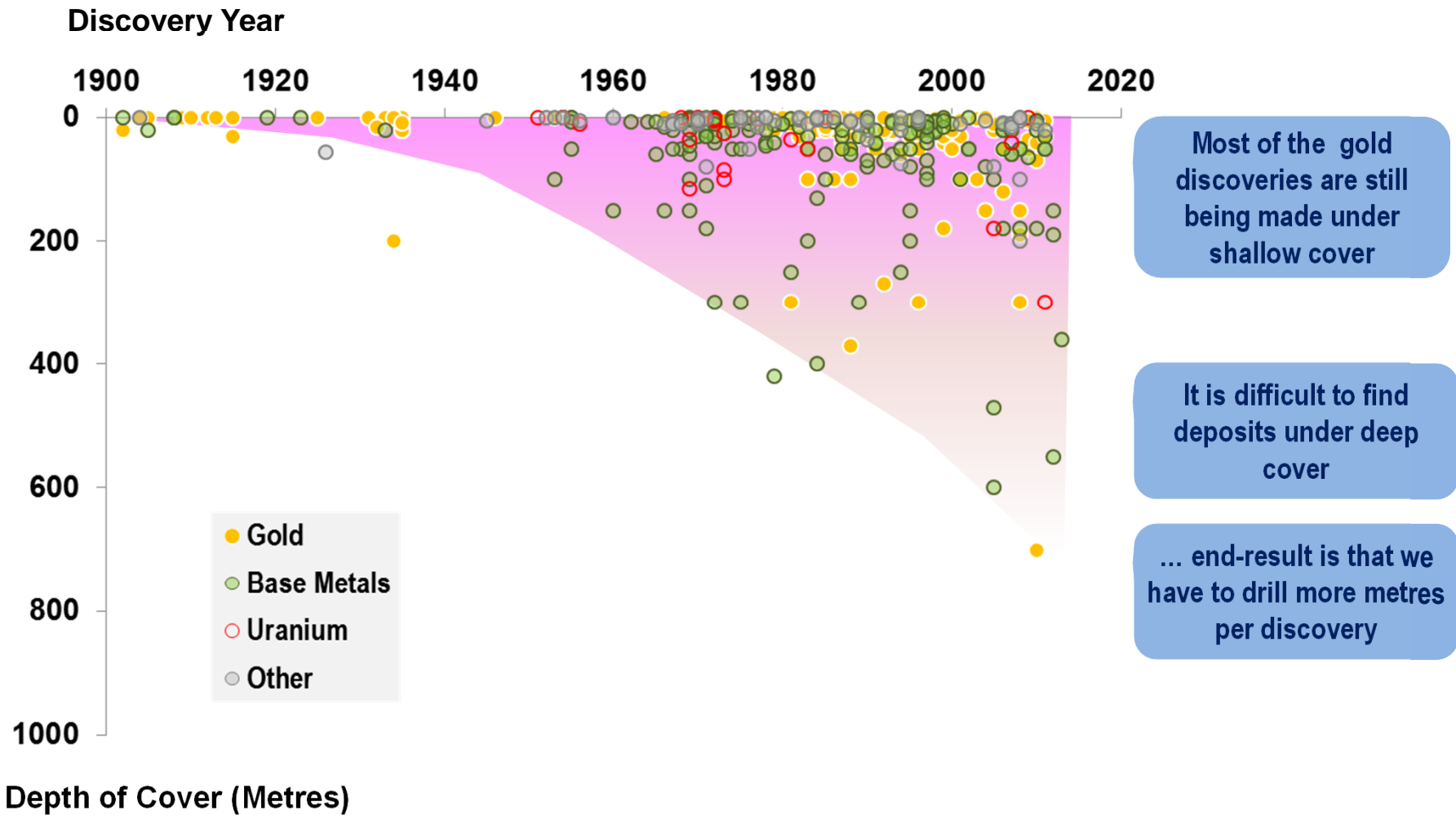
Note: Analysis excludes Bulk Minerals, and excludes satellite deposits found within existing camps
 Discoveries refer to Moderate-, Major- and Giant-sized deposits.
 The Estimated Value is approximate only, and ignores the value of unreported discoveries

Source: MinEx Consulting © November 2013

We are having to progressively explore under deeper cover

4. CHANGE IN THE DEPTH OF DISCOVERY

Depth of cover for discoveries in Australia: 1900-2013

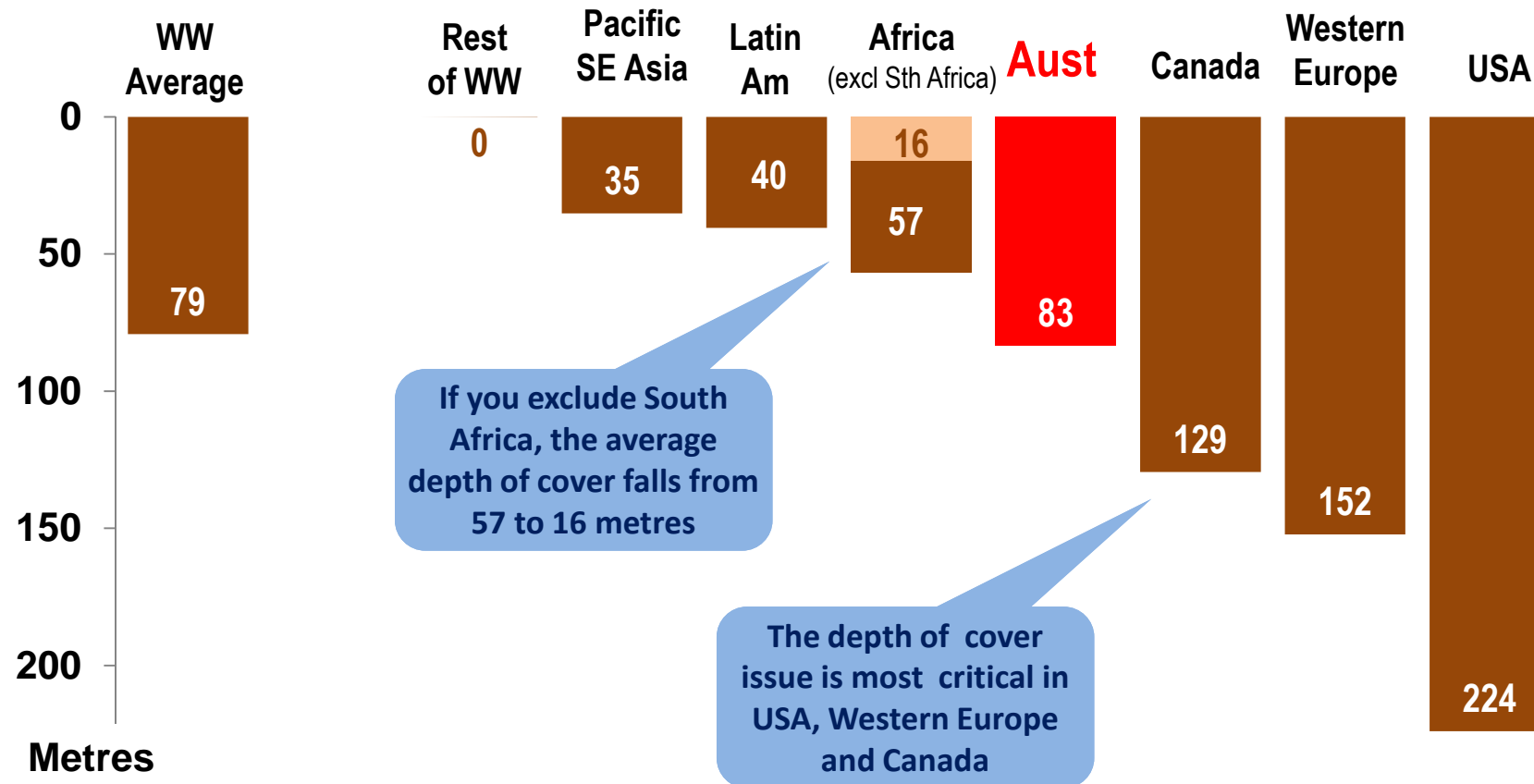


Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.
Analysis based on Moderate-, Major- and Giant-sized deposits

Source: MinEx Consulting © November 2013

Average depth of cover for discoveries - all metals

Western World: 2004-2013



Note: Based on 435 Moderate-, Major- and Giant-sized deposits
Excludes Bulk Mineral discoveries. Excludes undersea deposits

Source: MinEx Consulting © March 2014

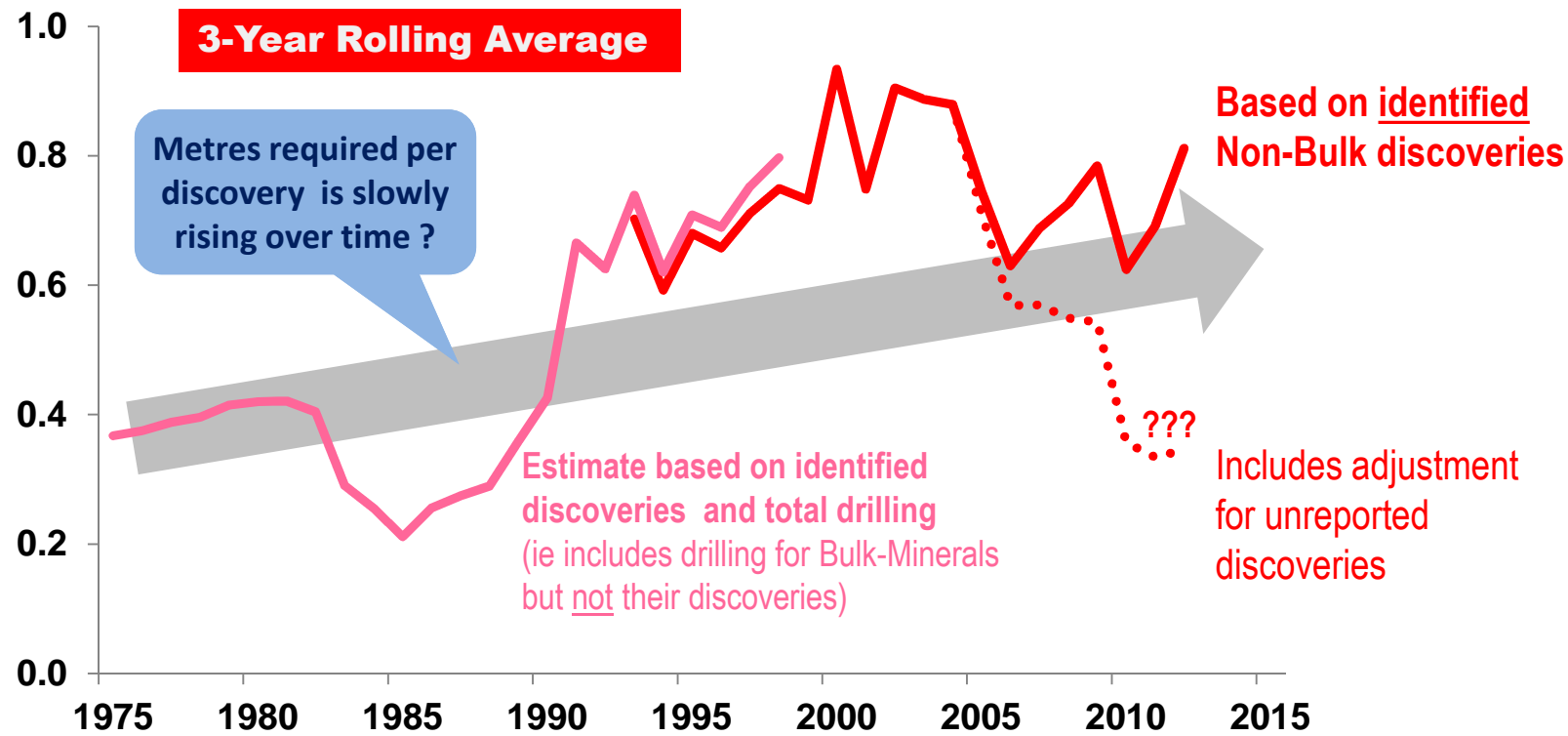
Drilling is an essential for discovery but it is very inefficient

5. AMOUNT OF DRILLING REQUIRED TO DISCOVER

Metres drilled per discovery

Australia: 1975-2012

Million Metres per Discovery



Note: Analysis based on Moderate-, Major- and Giant-sized deposits
Excludes satellite deposits within existing Camps. Data for 1992-2012 excludes Bulk Mineral discoveries and spend.

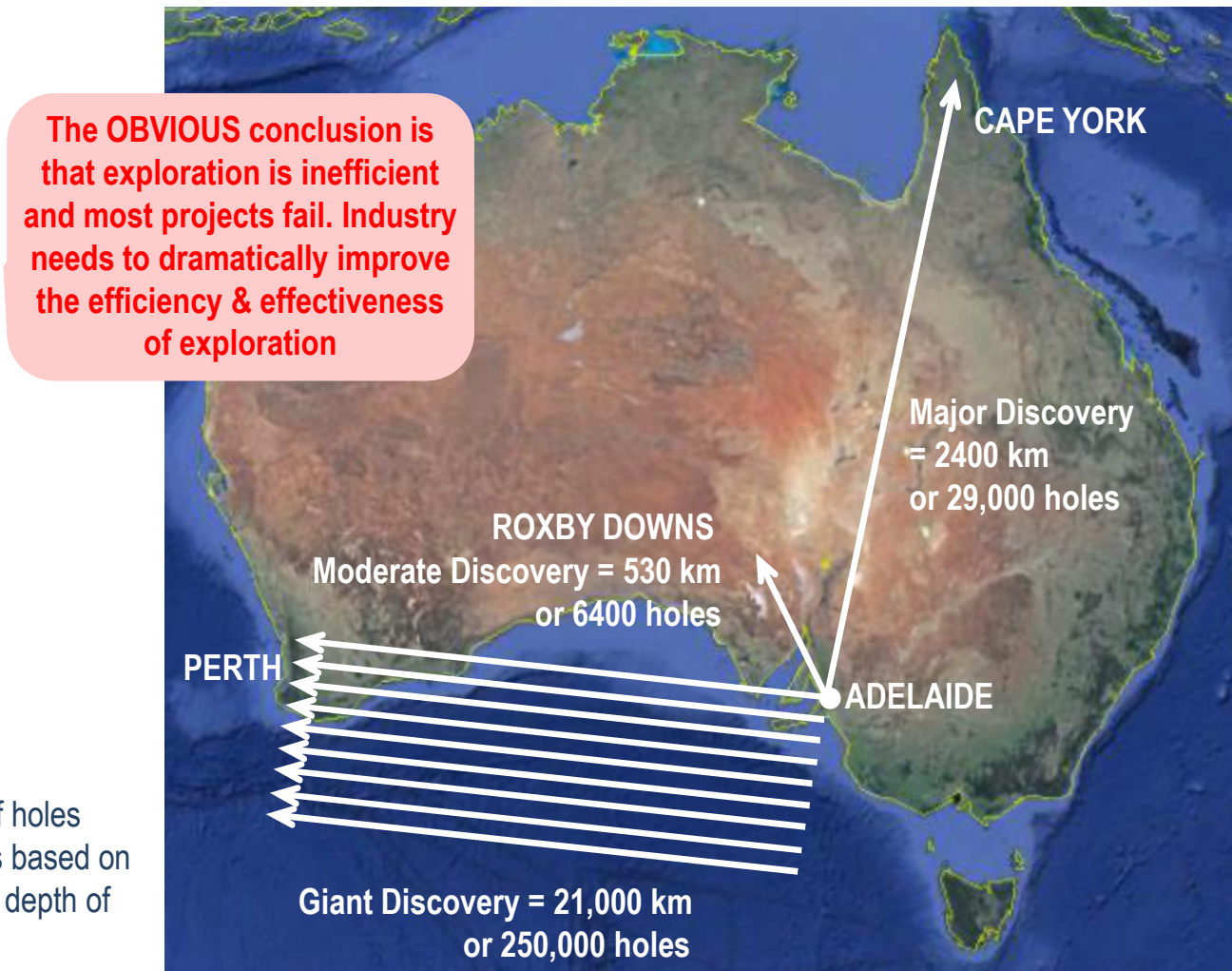
Source: MinEx Consulting © November 2013

Over the last Decade (2004-2013) in Australia

We made ...	3 Giant discoveries 24 Major discoveries 66 Moderate discoveries ~30 ?? Unidentified discoveries <hr/> ~122 discoveries
And spent ...	A\$14.6b (US\$12.7b) on exploration (in 2013 \$)
And drilled ...	~64.9 million metres
Performance >>	A\$120m (US\$104m) per discovery (in 2013 \$) ~0.53 million metres per (>= Moderate) discovery ~2.4 million metres per (>= Major) discovery ~21 million metres per (Giant) discovery

Note: Excludes satellite deposits within existing Camps and Bulk Mineral discoveries and spend.

The amount of drilling required is enormous and the Probability of Success is very low !!



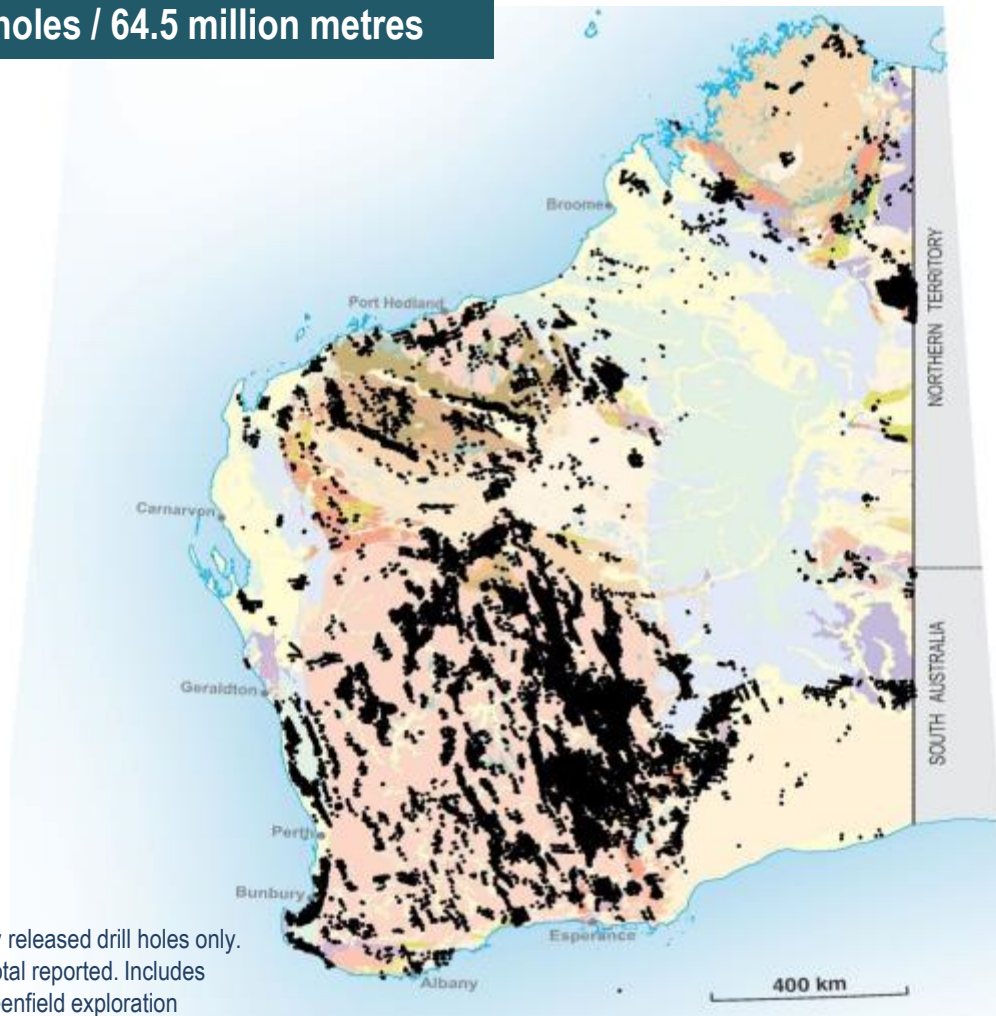
Source: MinEx Consulting © March 2014

Case Study of 36 years of drilling activity in Western Australia

Special
acknowledgement to
Don Flint at WA DMP for
compiling this data

Historical drilling in Western Australia: 1977-2013

All Holes : All depths
1.347 million holes / 64.5 million metres



The analysis covers
~50% of all metres
drilled during this
period

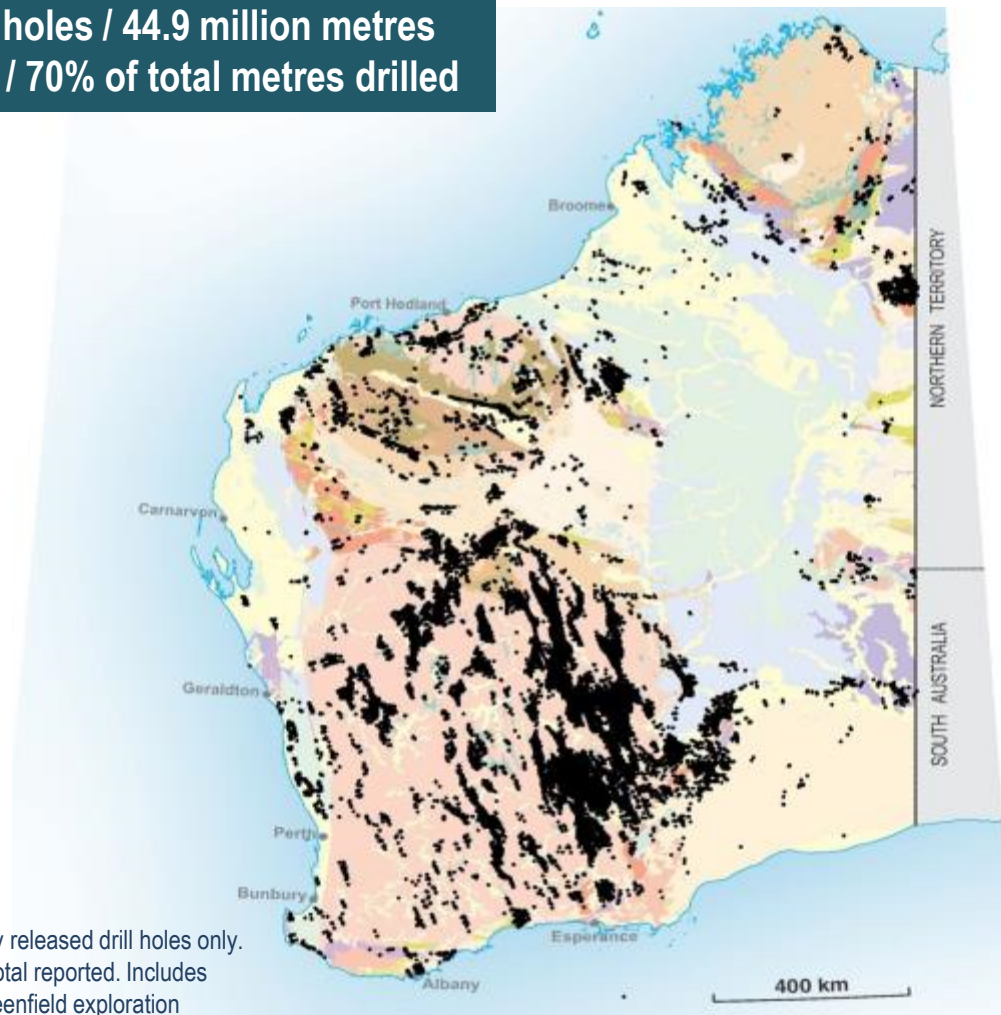
*Incomplete coverage prior to
1992. In more recent years
several holes are locked up
by Confidentiality*

Caution: Chart is based on publicly released drill holes only.
Estimated coverage is ~ 50% of total reported. Includes
resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

Historical drilling in Western Australia: 1977-2013

All Holes : >50 Metres depth
0.463 million holes / 44.9 million metres
34% of holes / 70% of total metres drilled

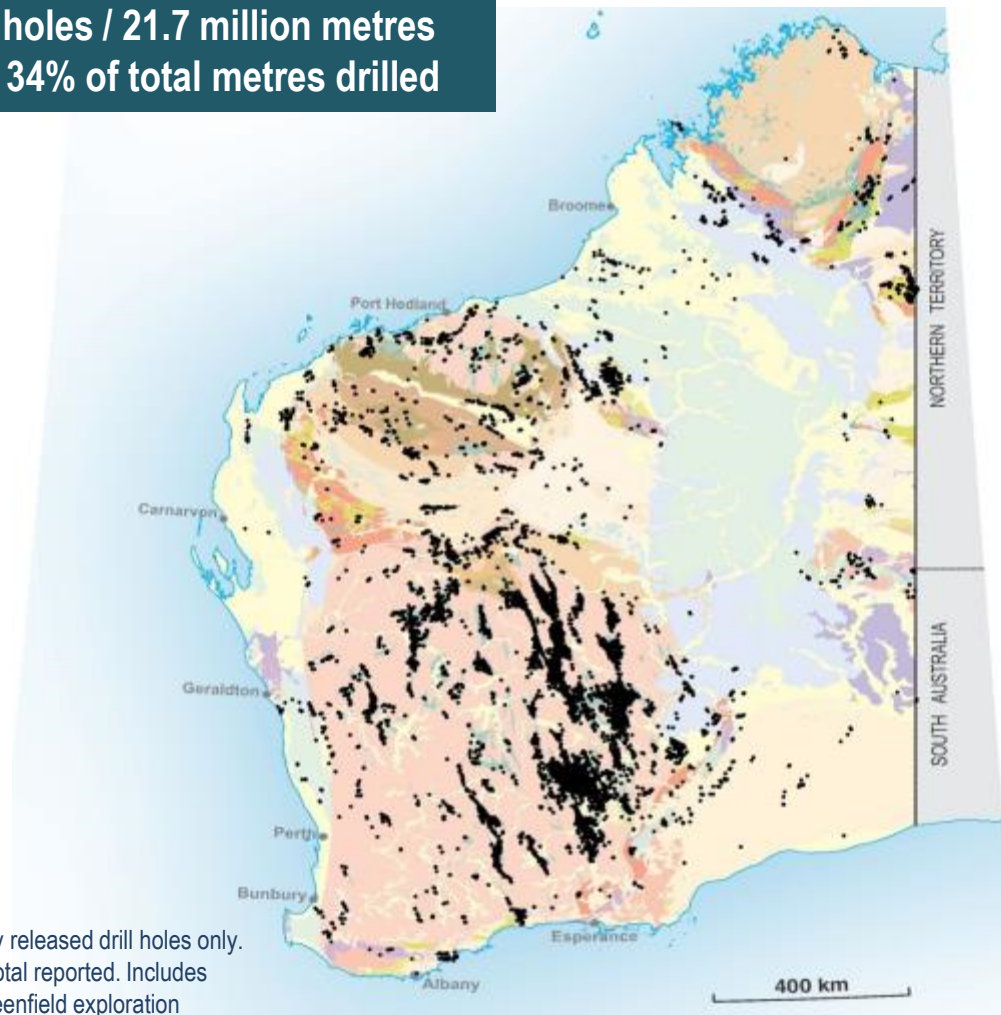


Caution: Chart is based on publicly released drill holes only. Estimated coverage is ~ 50% of total reported. Includes resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

Historical drilling in Western Australia: 1977-2013

All Holes : >100 Metres depth
0.129 million holes / 21.7 million metres
9% of holes / 34% of total metres drilled

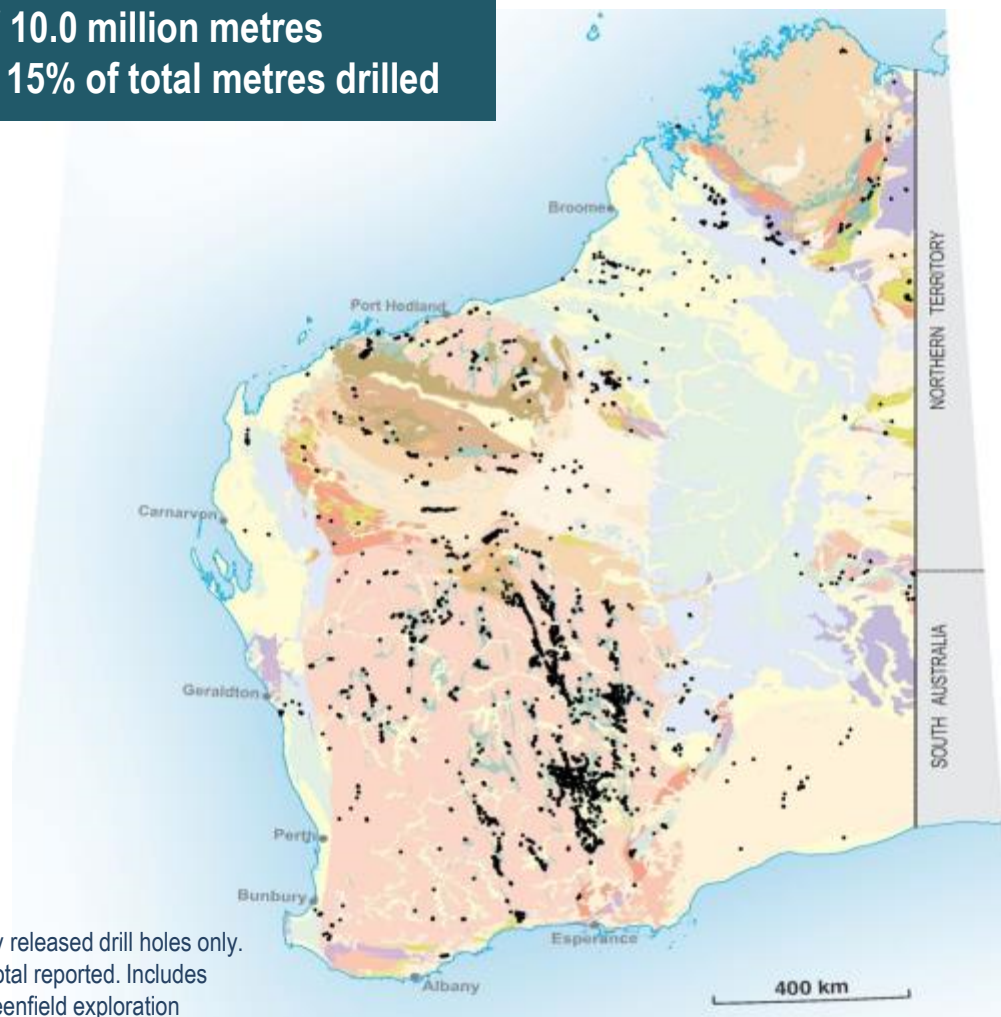


Caution: Chart is based on publicly released drill holes only. Estimated coverage is ~ 50% of total reported. Includes resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

Historical drilling in Western Australia: 1977-2013

All Holes : >200 Metres depth
29,829 holes / 10.0 million metres
2% of holes / 15% of total metres drilled

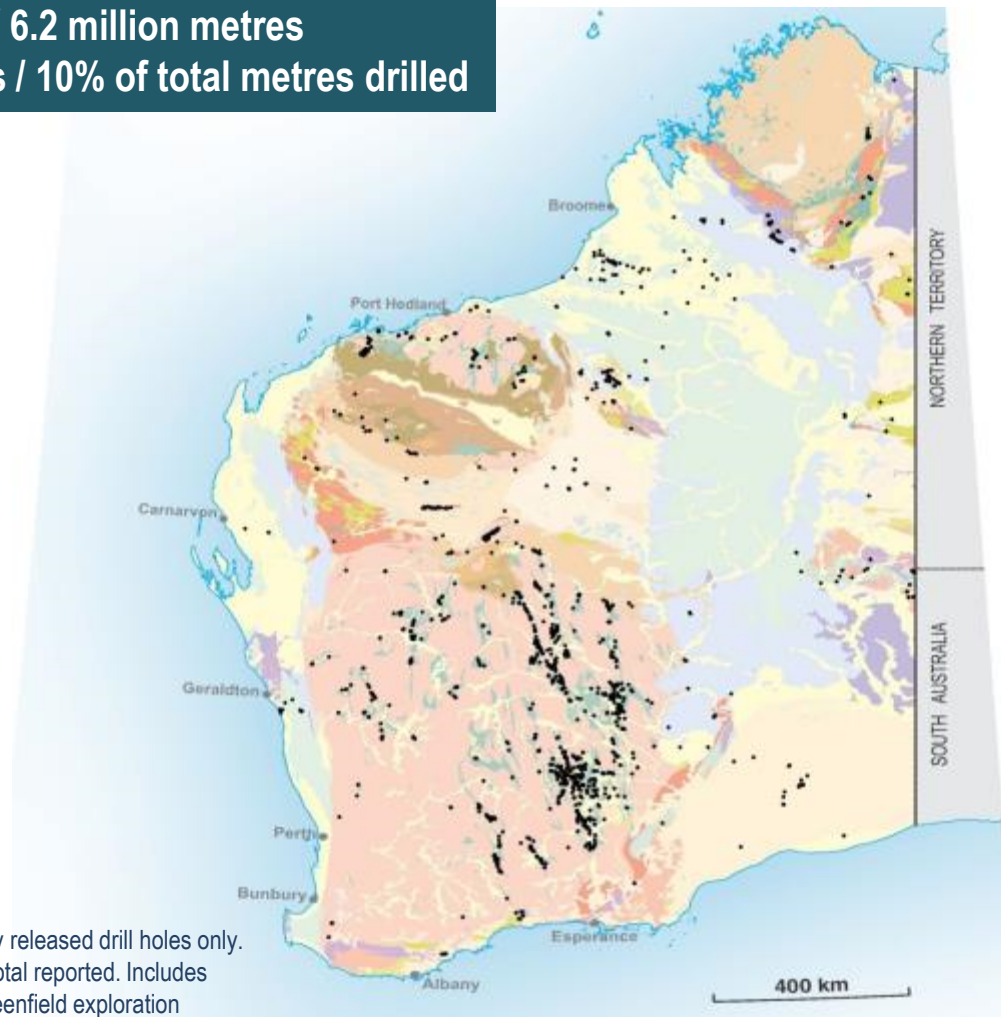


Caution: Chart is based on publicly released drill holes only. Estimated coverage is ~ 50% of total reported. Includes resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

Historical drilling in Western Australia: 1977-2013

All Holes : >300 Metres depth
13,203 holes / 6.2 million metres
0.9% of holes / 10% of total metres drilled

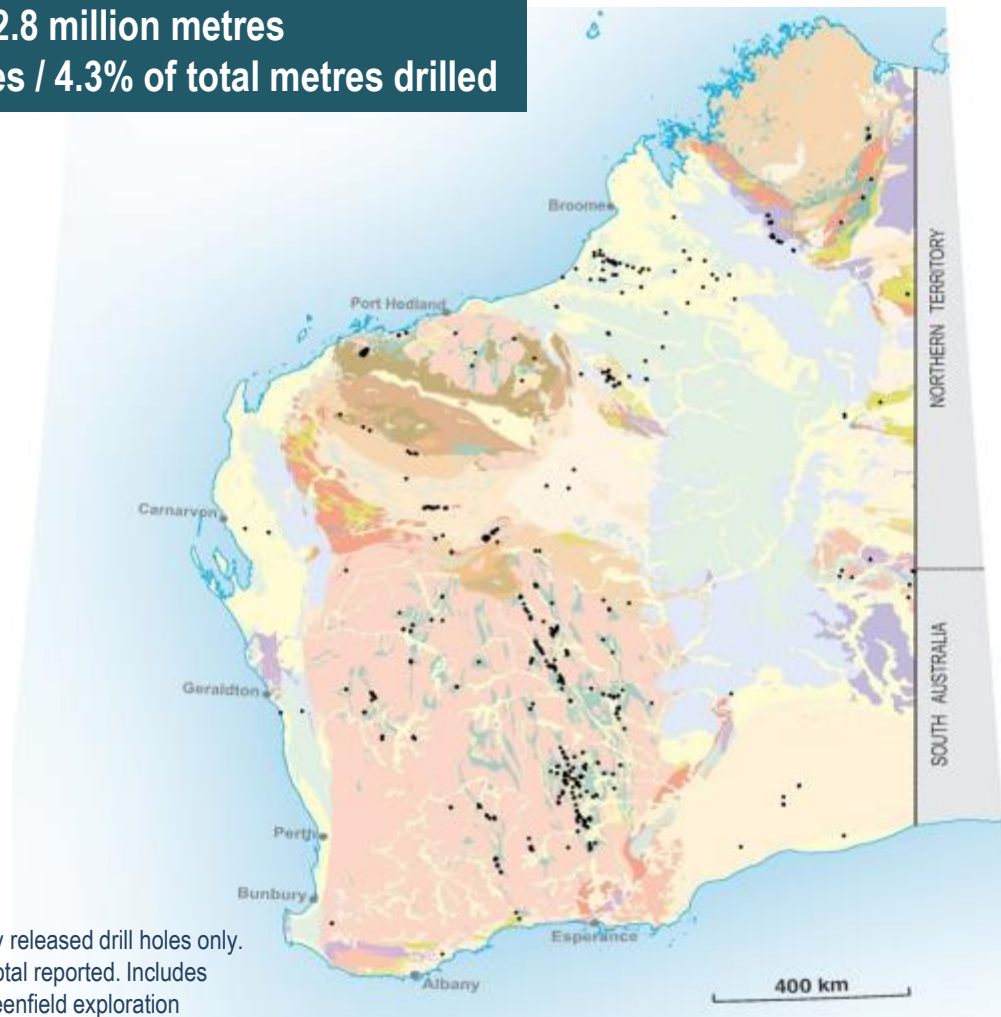


Caution: Chart is based on publicly released drill holes only. Estimated coverage is ~ 50% of total reported. Includes resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

Historical drilling in Western Australia: 1977-2013

All Holes : >500 Metres depth
3,578 holes / 2.8 million metres
0.27% of holes / 4.3% of total metres drilled

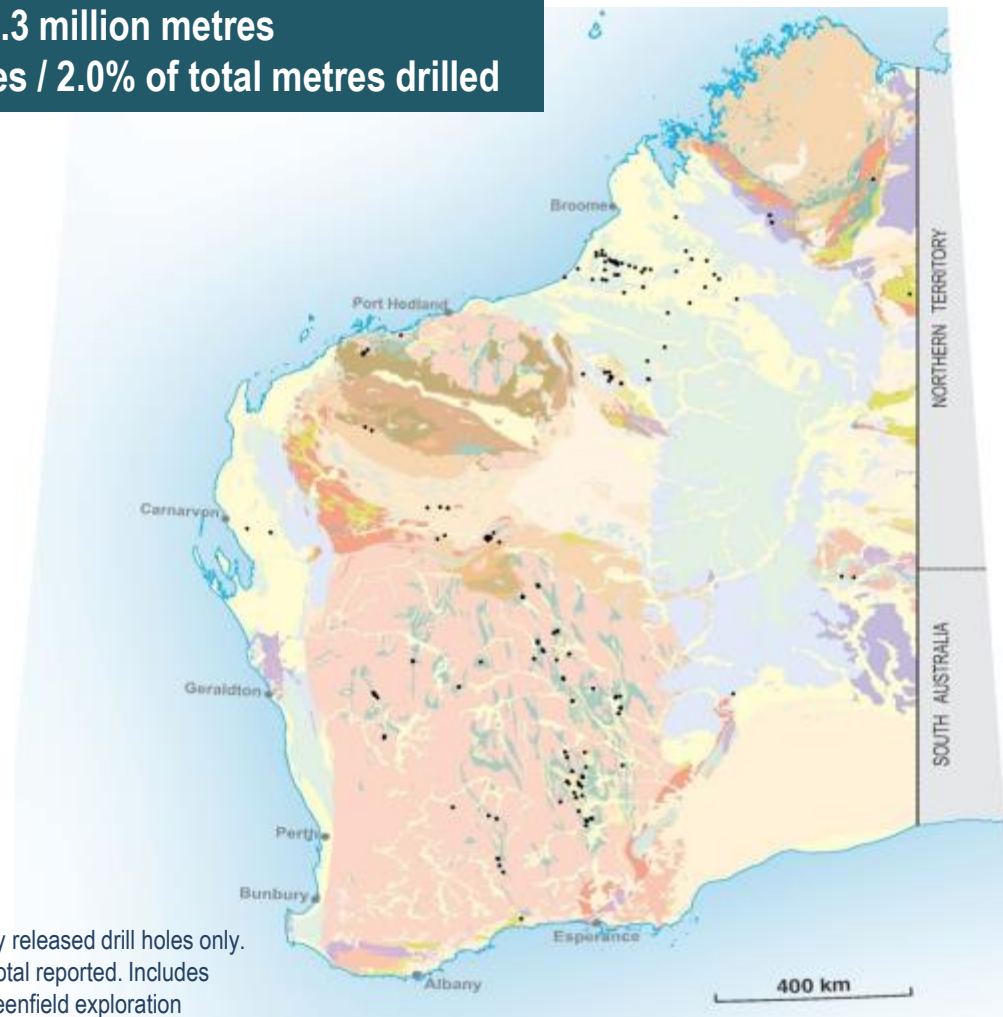


Caution: Chart is based on publicly released drill holes only. Estimated coverage is ~ 50% of total reported. Includes resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

Historical drilling in Western Australia: 1977-2013

All Holes : >800 Metres depth
1123 holes / 1.3 million metres
0.08% of holes / 2.0% of total metres drilled

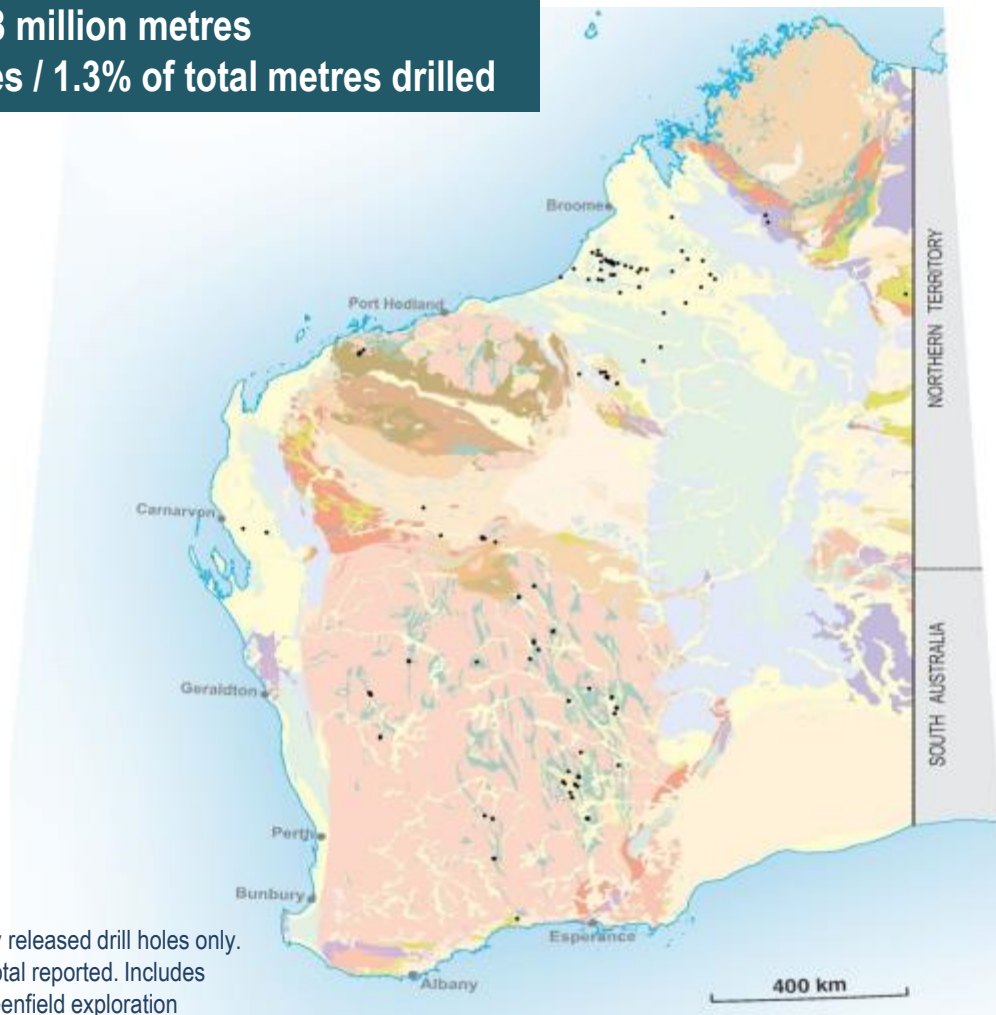


Caution: Chart is based on publicly released drill holes only. Estimated coverage is ~ 50% of total reported. Includes resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

Historical drilling in Western Australia: 1977-2013

All Holes : >1000 Metres depth
611 holes / 0.8 million metres
0.05% of holes / 1.3% of total metres drilled



KEY MESSAGE: The Yilgarn is not a mature Province for exploration ... there are huge areas of untested ground below 300 metres depth

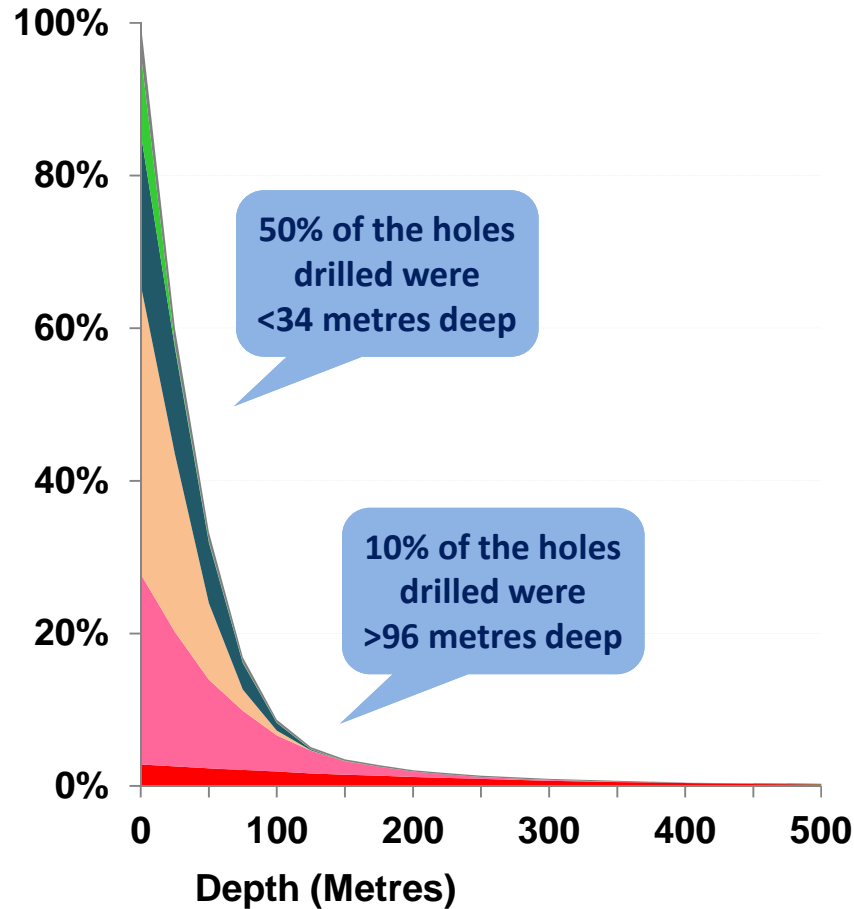
Caution: Chart is based on publicly released drill holes only. Estimated coverage is ~ 50% of total reported. Includes resource delineation as well as greenfield exploration

Source: WA Department of Mines & Petroleum
GeoView database March 2014

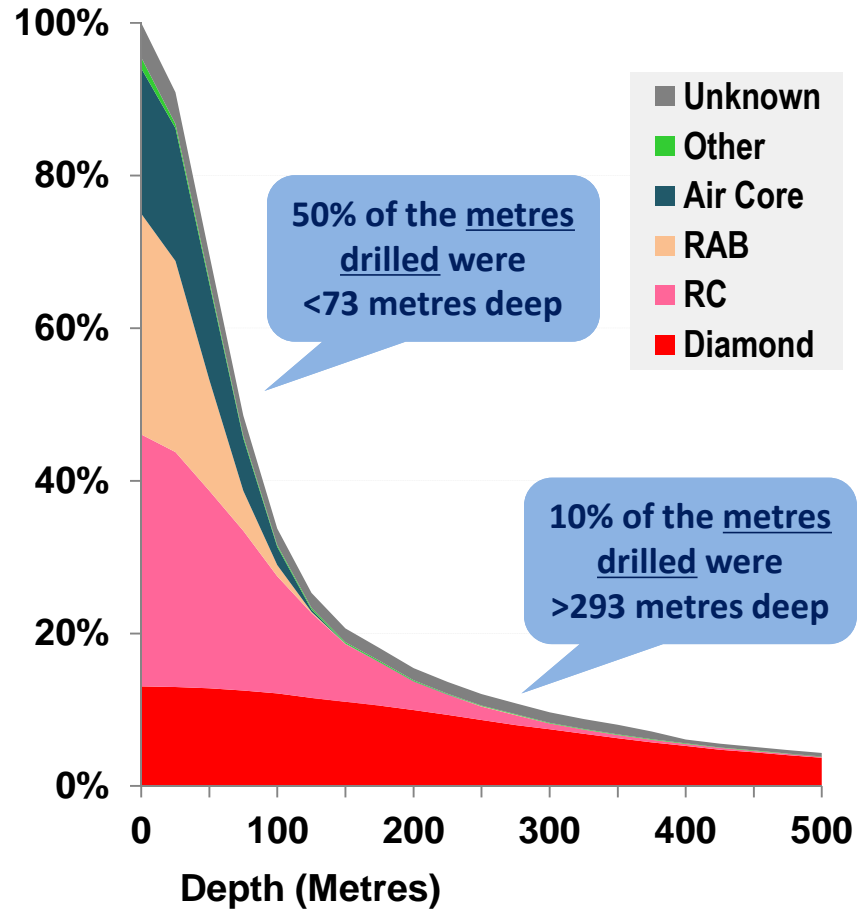
Most of the holes drilled were very shallow

Holes drilled in Western Australia: 1977-2013

Cumulative Number of Holes



Cumulative Metres drilled



Caution: Chart is based on publicly released drill holes only. Reported coverage is ~ 50% of total. Includes resource delineation as well as greenfield exploration

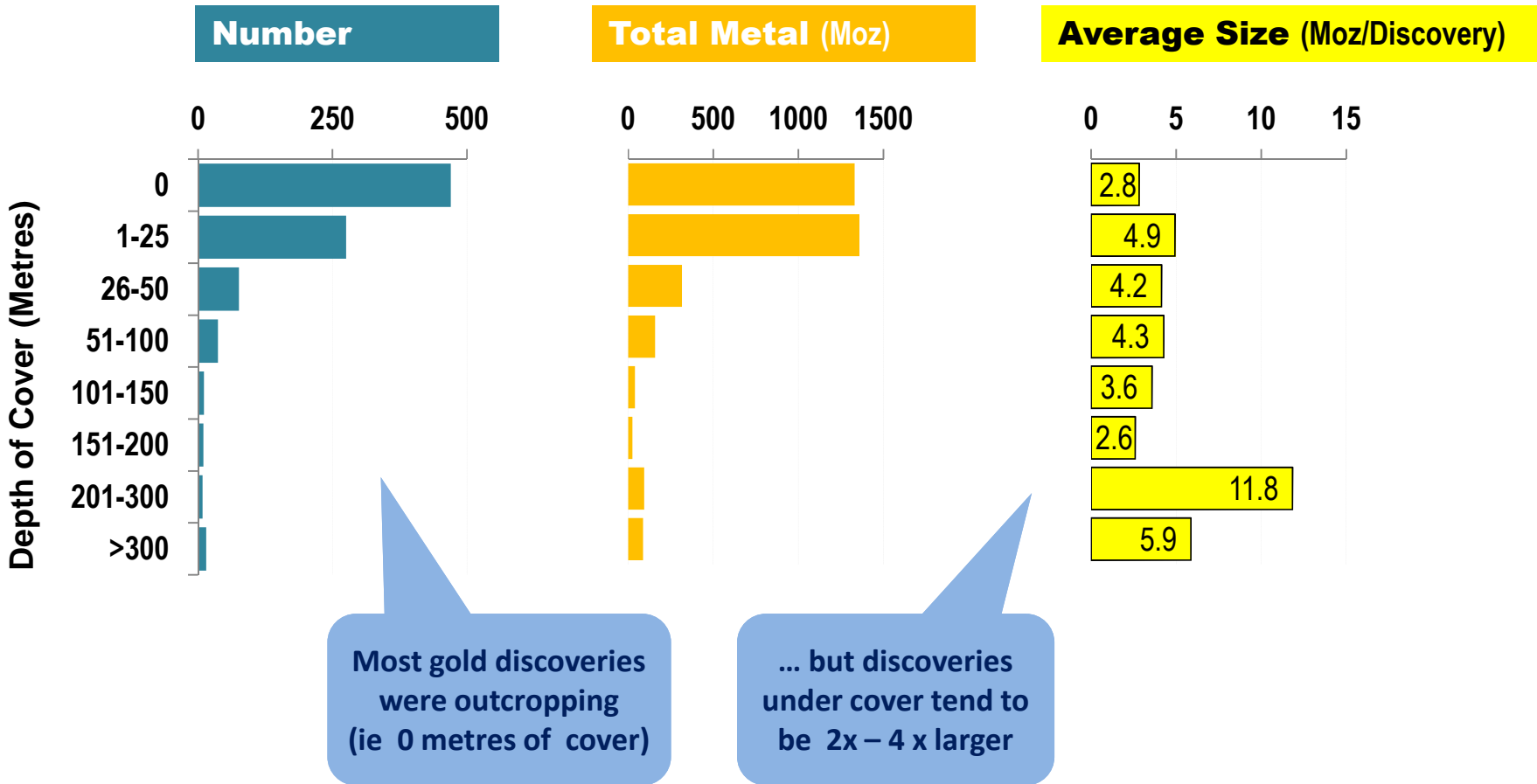
Source: WA Department of Mines & Petroleum
GeoView database March 2014

Good deposits are waiting to be found under deep cover

The following analysis is based on data for the Western World for the period 1950-2013

Number and size of discoveries by depth

Primary gold discoveries in Western World: 1950-2013

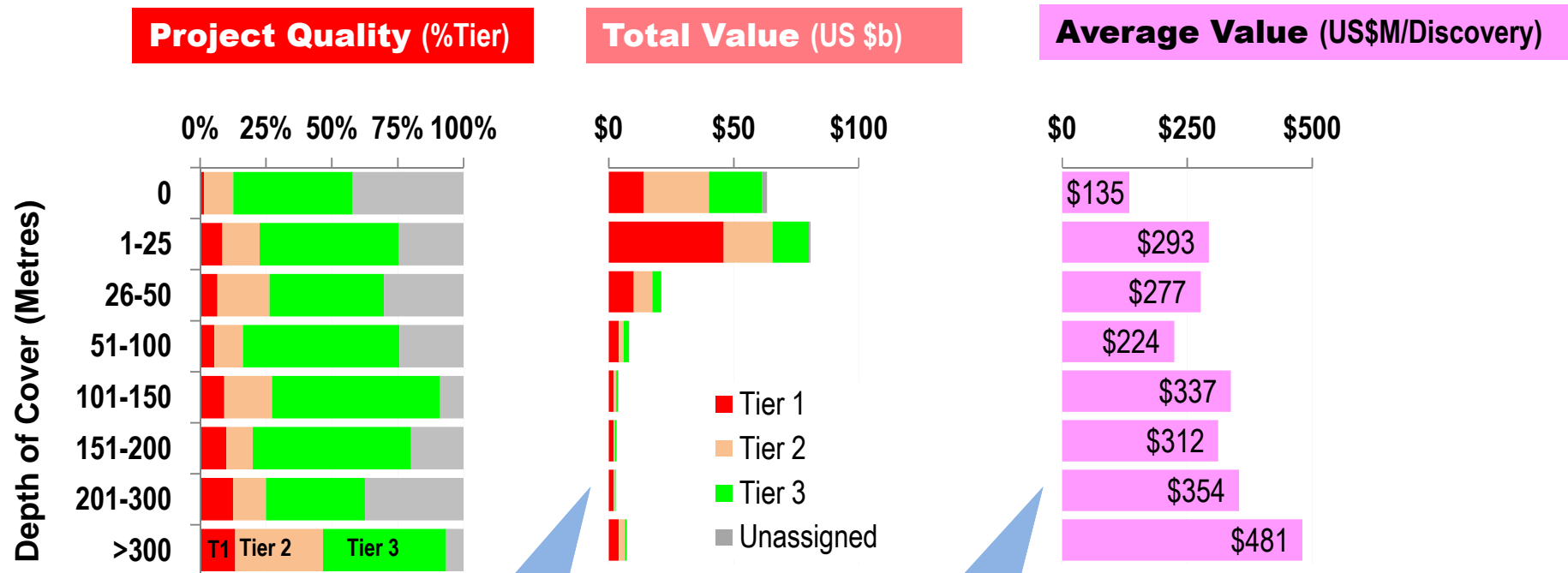


Note: Analysis based on detailed analysis of 902 primary gold discoveries > 0.1 Moz
Excludes satellite discoveries in existing camps. Excludes South Africa

Source: MinEx Consulting © March 2014

Value of discoveries by depth

Primary gold discoveries in Western World: 1950-2013



Tier 1 & 2 discoveries are rare but valuable

Significant value yet to be found below 25 metres

Deeper discoveries tend to be more valuable

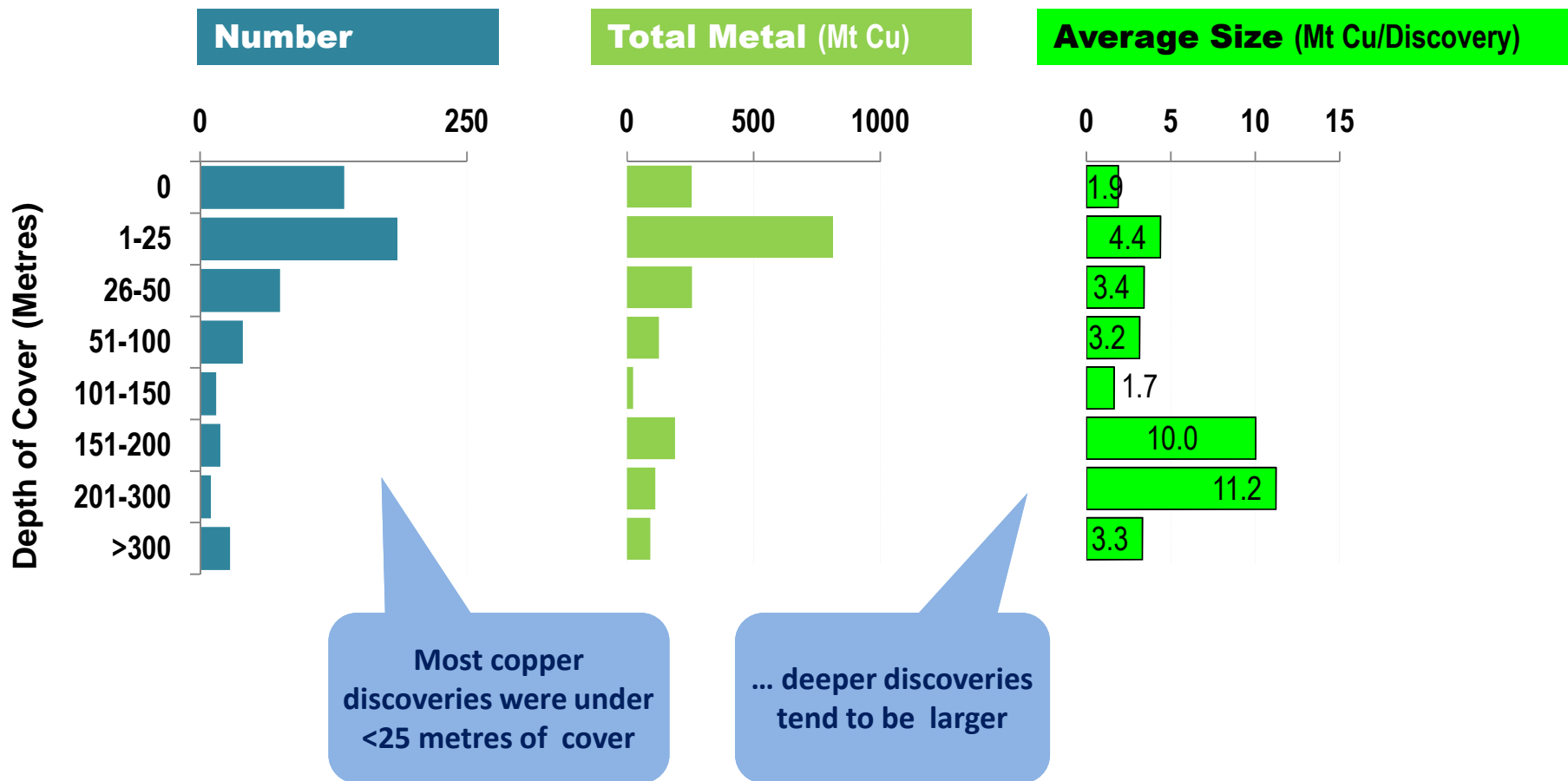
... That shouldn't be a surprise, as the deeper search-spaces haven't been depleted yet

CAUTION: Values are indicative/approximate only. Analysis based on an average Expected Value (at the time of Discovery) of a Tier 1, 2, 3 deposit of US\$2000m, \$500m and \$100m respectively. Unassigned deposits have been given a notional value of \$10m.

Source: MinEx Consulting © March 2014

Number and size of discoveries by depth

Primary copper discoveries in Western World: 1950-2013

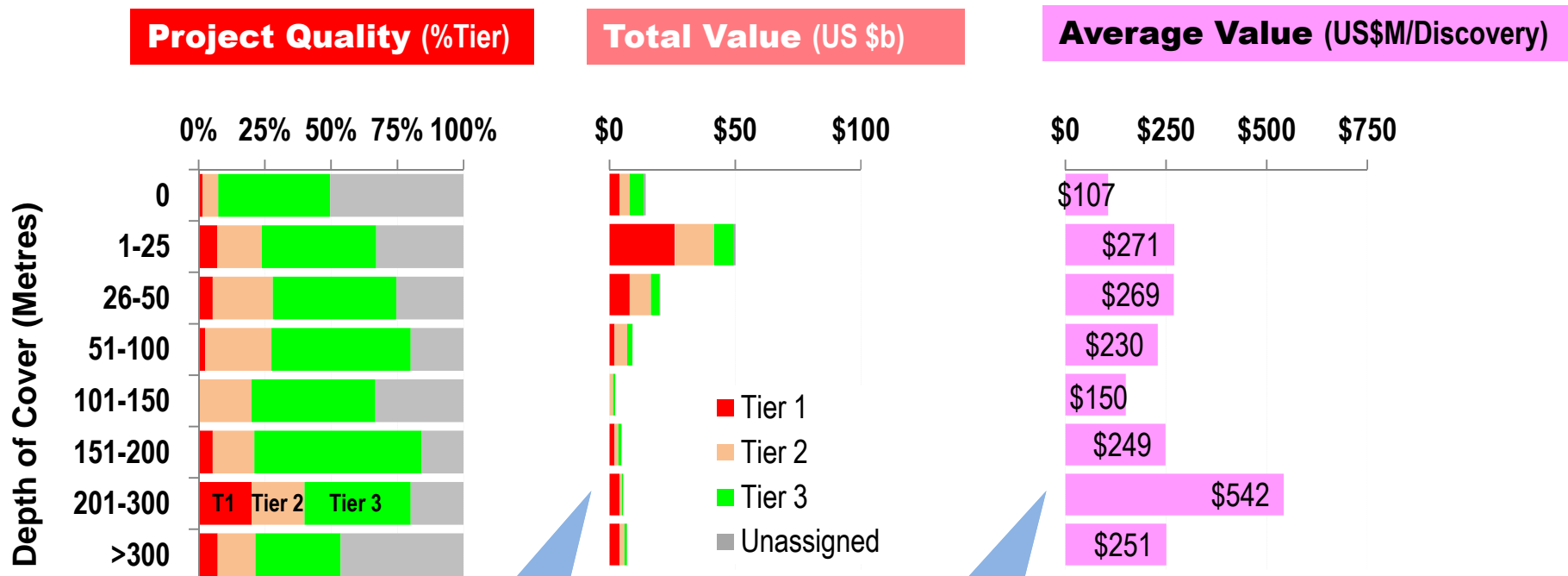


Note: Analysis based on detailed analysis of 507 primary copper discoveries > 0.1 Mt Cu
Excludes satellite discoveries in existing camps. Excludes undersea deposits

Source: MinEx Consulting © March 2014

Value of discoveries by depth

Primary copper discoveries in Western World: 1950-2013



Tier 1 & 2 discoveries are rare but valuable

Significant value yet to be found below 50 metres

Apart from the outcropping deposits value doesn't vary with depth

... That shouldn't be a surprise, as the outcropping deposit space has been depleted

CAUTION: Values are indicative/approximate only.
 Analysis based on an average Expected Value (at the time of Discovery) of a Tier 1, 2, 3 deposit of US\$2000m, \$500m and \$100m respectively. Unassigned deposits have been given a notional value of \$10m.

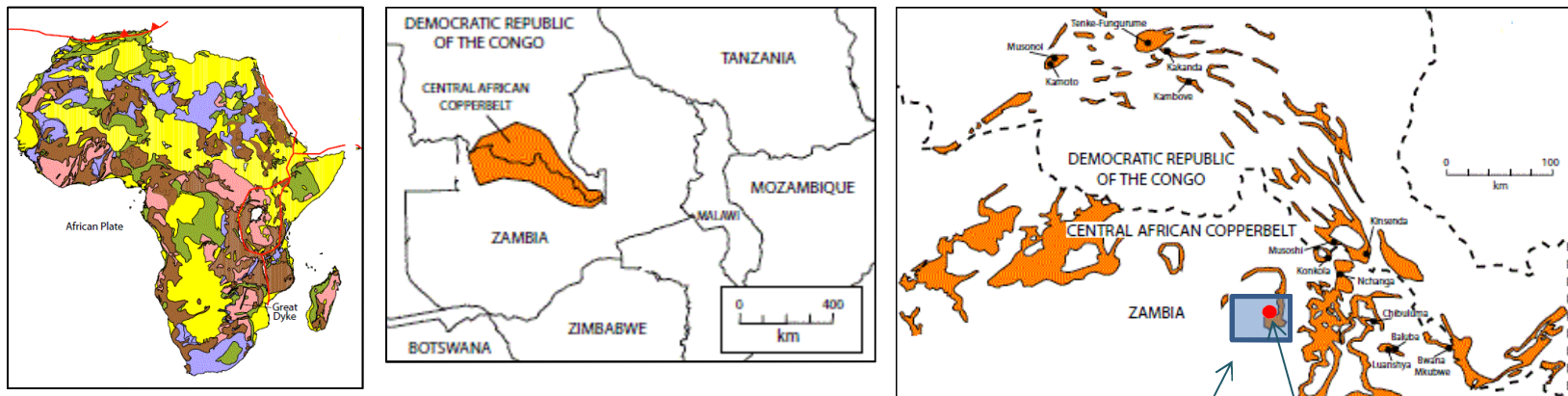
Source: MinEx Consulting © March 2014

There have been several innovations in the exploration tools used to make discoveries in Australia

6. DISCOVERY METHODS USED

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

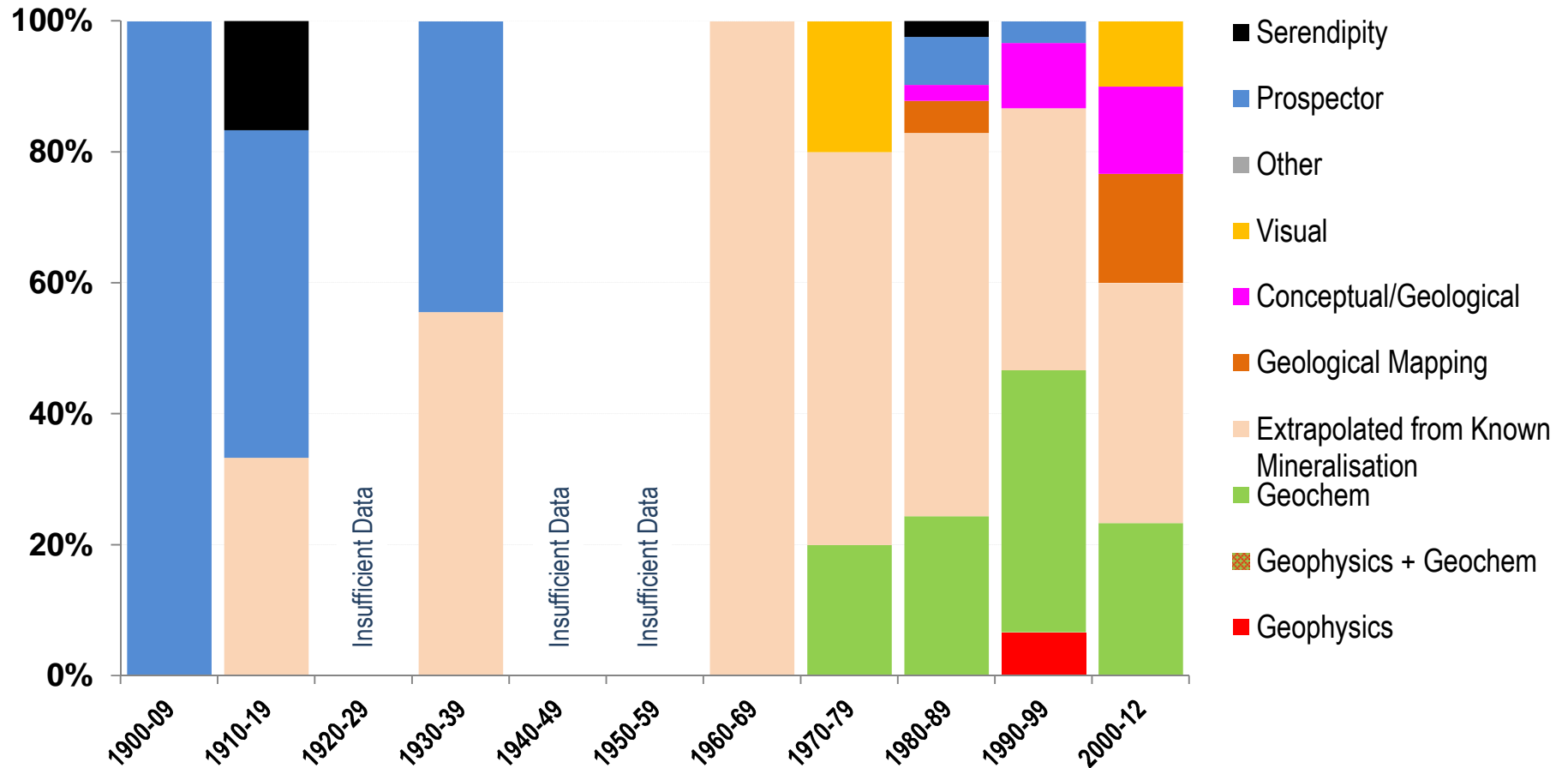
MinEx has carried out a detailed analysis of the discovery history of **261** deposits in Australia at these two scales

Primary search method used at the project-scale

GOLD discoveries (>0.1 Moz) in Australia: 1900-2012

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

Percentage of total discoveries



Note: Analysis based on detailed analysis of 134 gold projects (out of 244 known discoveries)

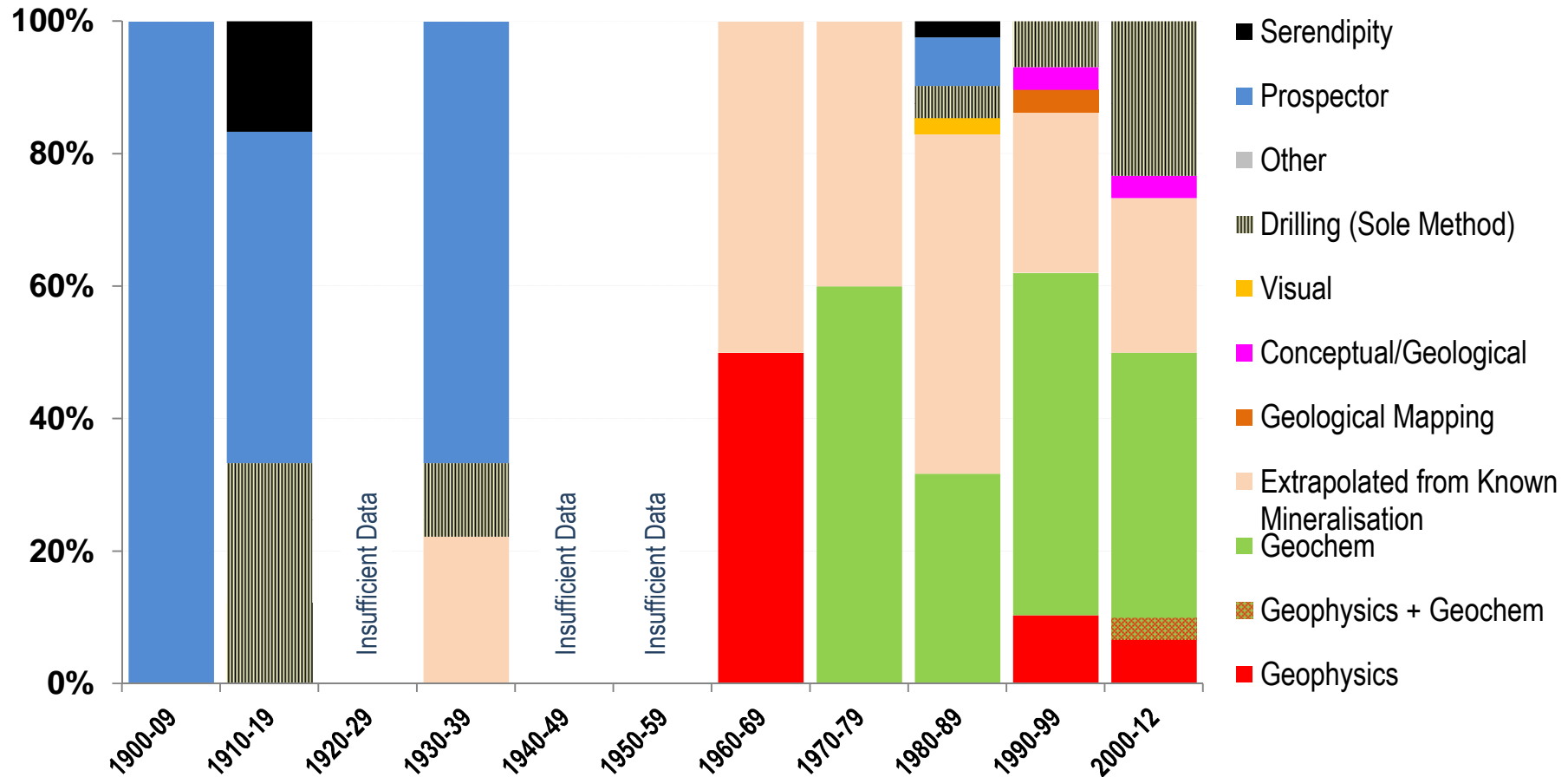
Source: MinEx Consulting © November 2013

Primary search method used at the prospect-scale

GOLD discoveries (>0.1 Moz) in Australia: 1900-2012

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

Percentage of total discoveries



Note: Analysis based on detailed analysis of 134 gold projects (out of 244 known discoveries)

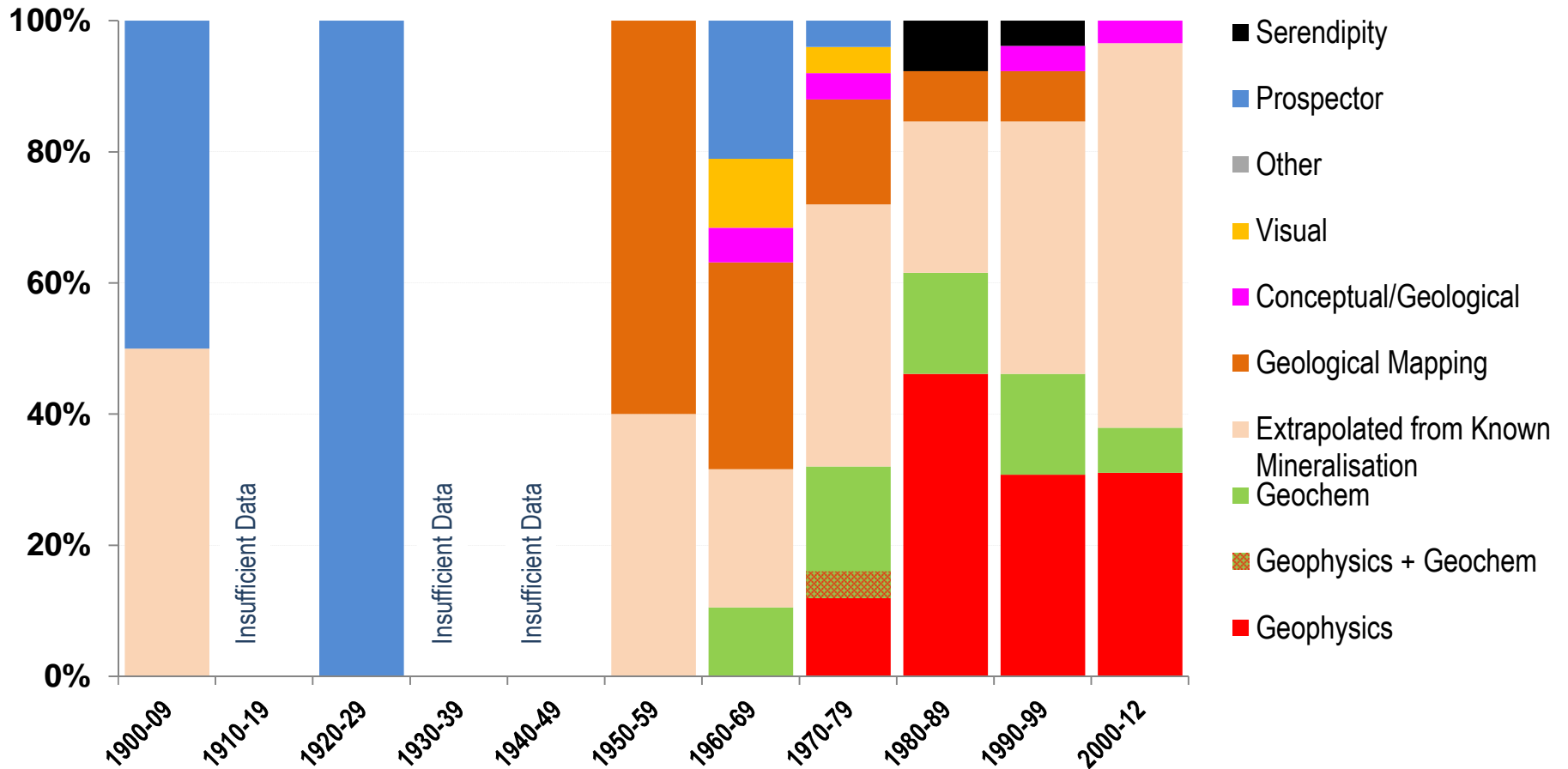
Source: MinEx Consulting © November 2013

Primary search method used at the project-scale

BASE METAL discoveries (>0.1 Mt Cu-eq) in Australia: 1900-2012

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

Percentage of total discoveries



Note: Analysis based on detailed analysis of 127 Cu+Ni+Zn+Pb projects (out of 185 known discoveries)

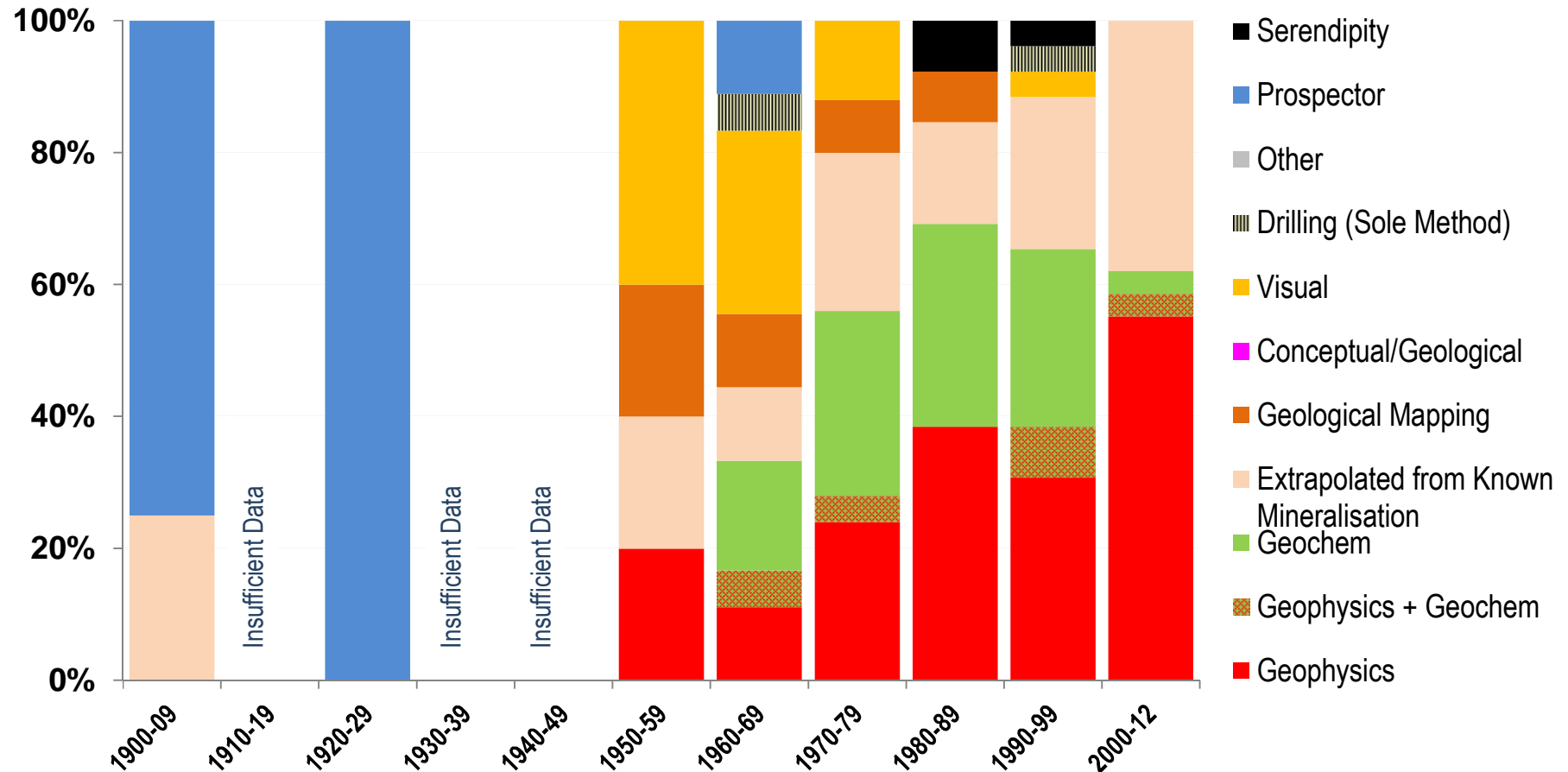
Source: MinEx Consulting © November 2013

Primary search method used at the **prospect-scale**

BASE METAL discoveries (>0.1 Mt Cu-eq) in Australia: 1900-2012

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

Percentage of total discoveries



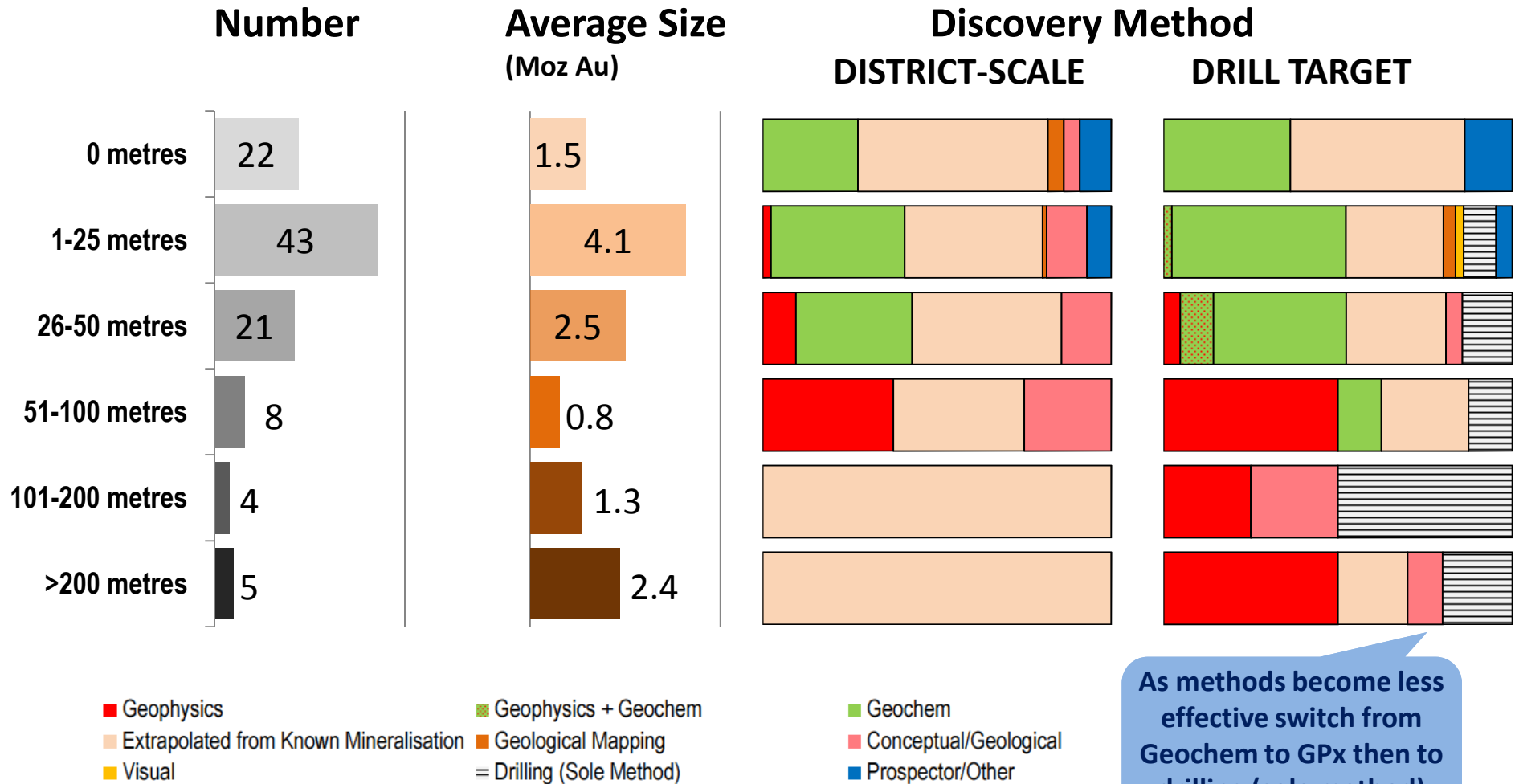
Note: Analysis based on detailed analysis of 127 Cu+Ni+Zn+Pb projects (out of 185 known discoveries)

Source: MinEx Consulting © November 2013

The problem is that the effectiveness of the exploration techniques deteriorates with depth

Discovery method changes with depth

Primary **gold** discoveries >0.1 Moz in Australia: 1980-2013



Source: MinEx Consulting © March 2014

Summary / Conclusions [1/3]

1. Trends in exploration spend

- Over the last decade exploration spend in Australia rose 4-fold (in A\$ terms), reaching an all-time high of A\$4.3 billion in June 2012
- Bulk minerals make up over half of current spending in Australia
- Increasing focus on Brownfield exploration (impact on the No. of Giants found)

2. Number of discoveries

- On average 10 significant discoveries are made each year in Australia
- Discovery rates follow spending ... but performance has declined in recent years (due to higher input costs and over-focus on Brownfield targets)

3. Quality & value of the discoveries made

- $\frac{3}{4}$ of the wealth created in Australia come from Tier 1 and 2 discoveries
- After adjusting for unreported discoveries, the value of discoveries found exceeds the cost of finding them ... ie exploration does add value !
- Australia is one of the top performing locations (40% better than average)

Summary / Conclusions [2/3]

4. Change in the depth of discovery

- Have to progressively explore under deeper cover
- Average depth of cover is 83 metres in Australia. Canada, Western Europe and USA are even deeper

5. Amount of drilling required to make a discovery

- Currently takes 500-600,000 metres to find a \geq Moderate-sized deposit in Australia (up from 400,000 metres back in 1980). Takes 5x as much drilling to find a Major-sized deposit and 40x as much for a Giant-sized deposit
- This translates into ~21 million metres (or 250,000 holes) to find a Giant. Drilling, while essential for discovery, is clearly a very inefficient activity !
- The average depth of drilling in Western Australia is 34 metres. 90% of the holes were under <96 metres. Good / high quality deposits are waiting to be found under deeper cover. For example, large parts of the Yilgarn has not been drilled below 300 metres. Think of deep cover as a new search-space

Summary / Conclusions [3/3]

6. Discovery methods used

- The preferred search method used varies by commodity type, depth of cover and “scale”
- As we go deeper, for base metals the use of GPx becomes more important
- At the prospect-scale, ~20% of the gold discoveries are associated with “Drilling as a sole method”
- The challenge is that, as we go deeper the discovery tools become more costly / less effective

RESOLVING THIS IS THE TASK OF THIS WEEK'S CONFERENCE

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