Uncovering exploration trends and the future: Where’s exploration going?

Richard Schodde
Managing Director, MinEx Consulting
Adjunct Professor, Centre for Exploration Targeting, UWA

Presentation to International Mining and Resources (IMARC) Conference
22nd September 2014  Melbourne

Re-presented at the Rimfire Pacific Mining AGM 14th November 2014  Melbourne
Overview

1. Trends in exploration spend for the World
2. Number of discoveries made
3. Exploration performance – cost per discovery
4. Change in the depth of discovery
5. Location of recent discoveries
6. Current financial situation for junior explorers
7. Outlook for exploration
8. Summary / Conclusions
Exploration expenditures reached an all-time high in 2012, down by 30% in 2013

1. TRENDS IN EXPLORATION SPEND
Exploration expenditures: World
by Commodity: 1975-2013

Spend reached an all-time high in 2012

10x real increase in the last decade

$30B in 2012

$21B in 2013

Sources: MinEx Consulting estimates © September 2014, based on data from ABS, NRCan, MLR (China), OECD and SNL MEG
Exploration expenditures: **World**
by **Commodity** : 1975-2013

- **Gold** continues to be the main target.
- Major increase in spend on Bulk Minerals
- Coal
- Iron Ore
- Other – Non Bulk

**Sources:** MinEx Consulting estimates © September 2014, based on data from ABS, NRCan, MLR (China), OECD and SNL MEG
Exploration expenditures: **World**
by Region: 1975-2013

Note: Includes spend on Bulk Minerals
“Rest of World” refers to, Mongolia, Middle East and South West Asia (including India and Pakistan)

China spends more on exploration than any other country in the World

Can+USA+Aust market share has halved in the last 2 decades

Sources: MinEx Consulting estimates © September 2014, based on data from ABS, NRCan, MLR (China), OECD and SNL MEG
Industry finds on average one significant new deposit every week

2. NUMBER OF DISCOVERIES MADE
Number of significant discoveries made
Non-Bulk discoveries World: 1975-2013

Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.

Giant
>6 Moz Au, >125 kt U₃O₈, >1 Mt Ni, >5 Mt Cu equiv

Major
>1 Moz Au, >25 kt U₃O₈, >100 kt Ni, >1 Mt Cu equiv

Moderate
>0.1 Moz Au, >5 kt U₃O₈, >10 kt Ni, >0.1 Mt Cu-equiv

Source: MinEx Consulting © September 2014
Number of significant discoveries made
Non-Bulk discoveries World: 1975-2013

- Estimated Unreported Discoveries
- Moderate Discoveries
- Major Discoveries
- Giant Discoveries

On average 60-70 discoveries are made each year in the World

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

Rimfire discovered the Au/Ag Sorpresa deposit in 2010 (a)

Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.

(a) A Resource Statement has not yet been released for Sorpresa

Source: MinEx Consulting © September 2014
Number of discoveries made by **Commodity**

Moderate+Major+Giant discoveries in the World: 1975-2013

Number of Discoveries

<table>
<thead>
<tr>
<th>Year</th>
<th>Estimated</th>
<th>Other</th>
<th>Uranium</th>
<th>Base Metals</th>
<th>Gold</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.

Source: MinEx Consulting © September 2014

Over half of the discoveries were **GOLD**
Number of discoveries made by Company Type
Moderate+Major+Giant discoveries in the Western World: 1975-2013

Note: Figures are adjusted for shared discoveries.
Western World only. Excludes discoveries made in FSU, Eastern Europe and China.
Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.

Source: MinEx Consulting © September 2014
Percentage of discoveries made by Company Type

Moderate+Major+Giant discoveries in the Western World: 1975-2013

Note: Figures are adjusted for shared discoveries
Western World only. Excludes discoveries made in the FSU, Eastern Europe and China
Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.

Junior Companies now account for 50-60% of all discoveries in the Western World

Source: MinEx Consulting © September 2014
3. EXPLORATION PERFORMANCE

Unit discovery costs are rising
Until recently discovery rate moved in-line with exploration expenditures
Non-Bulk exploration spend and discoveries World: 1975-2013

Huge increase in spend, but no corresponding increase in the number of discoveries

Discovery performance has been affected by higher input costs (labour, drilling and admin).
Is partly offset by shift to Brownfield Exploration (but this delivers smaller-sized discoveries)

Note: Based on Moderate, Major and Giant discoveries. Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries and expenditures.

Source: MinEx Consulting © September 2014
Discovery costs are rising
Unit cost per for a moderate-sized Gold or Base Metal discovery in the World

Average Cost per discovery (2013 US$m)

**GOLD**
- Weighted Average for 1980-89 = $44m
- Weighted Average for 2000-2009 = $77m

**BASE METALS**
- Weighted Average for 1980-89 = $23m
- Weighted Average for 2000-2009 = $64m

- Estimated

Unit discovery costs have doubled in the last decade
Between 1999-2010 Rimfire spent a total of US$10m on exploration and discovered Sorpresa

If your exploration budget is $5m then the odds of making a (modest) discovery in a given year are less than 1 in 30

**Exploration is a high-risk/high-reward activity**

Note: Discoveries are for deposits >0.1 Moz Au or >0.1 Mt Cu-eq
Data from 2005 onwards have been adjusted for unreported deposits

Source: MinEx Consulting © September 2014
4. CHANGE IN THE DEPTH OF DISCOVERY

We are having to progressively explore under deeper cover.
Depth of cover for discoveries in Australia: 1950-2013

Most of the gold discoveries are still being made under shallow cover.

It is difficult to find deposits under deep cover.

... end-result is that we have to drill more metres per discovery.

Note: Excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.

Analysis based on Moderate-, Major- and Giant-sized deposits.

Source: MinEx Consulting © September 2014

Admiral Bay (1981 Zn) 1350m
Average depth of cover for discoveries - **GOLD**

**World: 2004-2013**

<table>
<thead>
<tr>
<th>Region</th>
<th>Depth of Cover (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World Average</td>
<td>56</td>
</tr>
<tr>
<td>Rest of World</td>
<td>3</td>
</tr>
<tr>
<td>Pacific SE Asia</td>
<td>19</td>
</tr>
<tr>
<td>EE + China</td>
<td>40</td>
</tr>
<tr>
<td>Western Europe</td>
<td>29</td>
</tr>
<tr>
<td>Latin Am</td>
<td>53</td>
</tr>
<tr>
<td>Africa</td>
<td>71</td>
</tr>
<tr>
<td>Aust</td>
<td>109</td>
</tr>
<tr>
<td>USA</td>
<td>112</td>
</tr>
<tr>
<td>Canada</td>
<td>112</td>
</tr>
</tbody>
</table>

If you exclude South Africa, the average depth of cover falls from 53 to 5 metres.

The depth of cover issue is most critical in Canada, USA, and Australia.

**Note:** Based on 267 Moderate-, Major- and Giant-sized deposits.

Source: MinEx Consulting © September 2014
Junior companies are doing it “tough”

6. CURRENT FINANCIAL SITUATION FOR JUNIOR EXPLORERS

The Junior sector makes up ~40% of total spend and finds over half of all discoveries ... so the future of the industry depends on them.
Cash Reserves and Expenditures have dropped dramatically

**MEDIAN** Australian Junior Exploration Company : 1998-June 2014

During a downturn, “in-field” exploration & development expenditures are cut the most

Cash Reserves are at an all-time low

Admin costs tend to be “fixed”

Note: Survey based on a sample of 125 junior exploration companies listed on the ASX between 1998-2014
“Net Other” includes production and other costs less interest income, mine revenue, Government Assistance and R&D tax credits
Quarterly spend data has been multiplied by 4x to produce an annualised spend rate

Source: MinEx Consulting © September 2014 based on Quarterly Reports to the ASX
Cash Reserves and Expenditures
Rimfire Pacific Mining: December 1998-June 2014

2013 A$ Million pa

RIM’s cash raisings are episodic
RIM’s expenditures have doubled in recent years
Most of the spend is “into the ground” rather than Admin

Note: “Net Other” includes production and other costs less interest income, mine revenue, Government Assistance and R&D tax credits
Quarterly spend data has been multiplied by 4x to produce an annualised spend rate

Source: MinEx Consulting © November 2014 based on Quarterly Reports to the ASX
Most Junior Explorers in Australia & Overseas currently have less than $1m in Cash Reserves

Note: Based on an analysis of the cash reserves (as at March-June 2014) for 1980 publicly listed Junior Explorers - 1258 on the TSE/TSX, 589 on the ASX and 133 on other exchanges (such as the CSE, NYSE, AIM, NEC, NZE, OTC and NEC and Pink Sheets). Excludes companies with annual revenues >A$1m. Based on ExRate of A$1.00 = C$1.00 = US$0.90

Source: MinEx Consulting © September 2014
The lack of cash is of main concern to those junior companies with low market caps.

Companies can always raise cash by issuing new shares … but that’s difficult if the market cap is low.

There are some companies where Mkt Cap < Cash!!

Note: Cash reserves (as at March-June 2014) for 1980 publicly listed Junior Explorers. Excludes companies with annual revenues > A$1m. Based on ExRate of A$1.00 = C$1.00 = US$0.90.

Source: MinEx Consulting © September 2014
Junior Explorers with very small market-caps are at most risk of failing

### Market Cap (A$ Million) as at 14 Sept 2014

<table>
<thead>
<tr>
<th>Mkt Cap</th>
<th>ASX</th>
<th>TSX</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;A$0.5m</td>
<td>1%</td>
<td>12%</td>
<td>20%</td>
</tr>
<tr>
<td>&lt;A$1m</td>
<td>5%</td>
<td>26%</td>
<td>30%</td>
</tr>
<tr>
<td>&lt;$A2m</td>
<td>17%</td>
<td>42%</td>
<td>48%</td>
</tr>
</tbody>
</table>

Note: Based on an analysis for 1980 publicly listed Junior Explorers - 1258 on the TSE/TSX, 589 on the ASX and 133 on other exchanges (such as the CSE, NYSE, AIM, NEC, NZE, OTC and NEC and Pink Sheets). Based on ExRate of A$1.00 = C$1.00 = US$0.90

Source: MinEx Consulting © September 2014
... But junior explorers are incredibly resilient and most will survive

“Junior companies are like cockroaches ... they can both survive a nuclear winter!”

Source: Canadian Mining Industry spokesperson (who wishes to remain anonymous) March 2014
History of Junior exploration companies over the last decade
(100 ASX-listed Junior Explorers in June 2004 versus June 2014)

Note: The analysis is based on a random sample of 100 junior mineral exploration companies (out of ~300) listed on the ASX on 30th June 2004.

Source: MinEx Consulting © July 2014
Value of a portfolio of 100 ASX junior exploration companies
Each company purchased for $1000 on 4th July 2004 versus its value on 4th July 2014

- The top 10 companies accounted for 77% of the total value created
- Over the decade, the share portfolio increased in value by 60%
- Only 22 companies increased in value
- 41 companies have shares worth less than 10% of their original value
- ... and shares in 18 companies are now worth less than 1% of their original value

Note: The analysis is based on a random sample of 100 junior mineral exploration companies (out of ~300) listed on the ASX on 30th June 2004. Final value is based on share price prevailing on 4th July 2014, or on the date it was delisted from the ASX (through takeover or liquidation)

Source: MinEx Consulting © July 2014
Spending is set to rise in the next 2-3 years

7. OUTLOOK FOR EXPLORATION
Forecast exploration expenditures **World: 1990-2020**

Exploration spend is driven by commodity prices and World GDP growth. MinEx’s view is that the exploration activity will start recovering from 2016 onwards.

Note: “Rest of World” refers to, Mongolia, Middle East and South West Asia (including India and Pakistan).

8. SUMMARY / CONCLUSIONS
Summary / Conclusions [1/4]

1. Trends in exploration spend
   - Over the last decade global exploration spend rose 10-fold, reaching an all-time high of US$31 billion in June 2012. Its half that now.
   - Gold still the most important target, but bulk minerals now account for ¼ of all expenditures.
   - Traditional countries (of Canada, USA and Australia) have lost market share to Latin America and Africa. Big news story is that the country with the largest domestic exploration spend is China (17% in 2013 versus 2% in 1997).

2. Number of discoveries
   - On average 50-60 significant discoveries are made each year in the World
   - Gold accounts for 55% of all discoveries
   - Junior sector has risen in importance and accounts for 50-60% discoveries in the Western World
3. Exploration performance
   - Over the last decade, expenditures have risen but discovery rates haven’t.
   - Unit discovery costs have doubled in the last decade. Average cost of finding a significant gold deposit is US$150m. Discovery cost for a base metal deposit is now US$180 million.

4. Depth of cover
   - Industry is having explore under progressively deeper cover.
   - Average depth is now 56 metres for gold and 114 metres for base metals.
   - The imperative to have effective exploration tools is critical in mature countries like Canada, USA, Western Europe and Australia.

5. Location of major discoveries
   - Ten “Hot spots” identified around the World – covering all continents
6. Current financial situation for junior explorers

- Expenditures are driven by the junior’s ability to raise capital.
- In a downturn, the first cost to be cut is spending on fieldwork.
- 19% of Australian and 60% of Canadian juniors have <A$200k in cash reserves.
- Market cap is much more important than cash. 5% of Australian and 26% of Canadian juniors have a market cap <$1m. Which makes it very difficult to raise fresh cash. Notwithstanding this....
- Junior explorers are incredibly resilient - and most will survive. 56% of Australian junior explorers in 2004 were still operating a decade later.
- Over the last decade Australian shareholders on made a 60% return on a broad portfolio of junior explorers. However most of this came from just 10% of the investments. 8 out of 10 juniors lost money for their shareholders.
7. Outlook for exploration

- To be sustainable, the mining industry needs to continue to fund exploration.
- The level of exploration spend is primarily driven by commodity prices, world economic growth and the availability of funds for juniors.
- Based on the latest commodity price forecasts, MinEx Consulting projects that global exploration spend will bottom out at $15 billion in 2015 and recover back to 2013 spending levels (of $21 billion) by the end of the decade.

In summary, the long-term outlook is good and most companies will survive the current nuclear winter.
Contact details

Richard Schodde
Managing Director
MinEx Consulting
Melbourne, Australia

Email: Richard@MinExConsulting.com
Website: MinExConsulting.com

Copies of this and other similar presentations can be downloaded from my website
Due to time constraints the following slides were left out of the main presentation

**SPARE SLIDES**
A1. HISTORY OF EXPLORATION

Most mineral deposits have been found in our life-time
Half of all of the World’s major deposits have been found in the last 40 years

Number of Major discoveries in the World: 1800-2013

Number of Discoveries

- Estimated Unreported
- Other
- Uranium
- Base Metals
- Gold

Half of all the World’s known Major deposits were discovered after 1972

This was driven by opening up of new search frontiers, deeper drilling, better exploration concepts & techniques and increased exploration activity

Note: “Major” is defined as > 1 Moz, >100kt Ni >25 kt U3O8 and >1 Mt Cu or metal equivalent

Excludes Bulk Mineral discoveries.
Excludes 91 deposits found prior to 1800, and 194 deposits with unknown discovery dates

Source: MinEx Consulting © September 2014
Quality of the discoveries made
Discoveries in the World by Tier: 1975-2013

Number of Discoveries

<table>
<thead>
<tr>
<th>Year</th>
<th>Tier 1</th>
<th>Tier 2</th>
<th>Tier 3</th>
<th>Unassigned</th>
<th>Estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>986</td>
</tr>
<tr>
<td>1980</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1151</td>
</tr>
<tr>
<td>1985</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>268</td>
</tr>
<tr>
<td>1990</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2485</td>
</tr>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: “Tier 1” defined as World Class deposits that are large, long life and low cost and are worth >$1000m at the Decision-to-build stage
“Tier 2” defined as having some (but not all) of the characteristics of a Tier 1 and are worth $200-$100m
“Tier 3” are large (generally > Moderate in size) but marginally economic deposits and worth $0-$200m
“Unassigned” refer to Moderate-sized deposits of modest value (~$10m)
Analysis excludes satellite deposits within existing Camps. Also excludes Bulk Mineral discoveries.

Source: MinEx Consulting © September 2014

Tier 1 discoveries are very rare ... on average only 2 found per year in the World
5A. LOCATION OF MAJOR DISCOVERIES
Significant Mineral Deposits in the World by Size: All Years

All of the continents host significant mineral deposits

Note: Excludes Bulk Mineral discoveries.

Note: “Moderate” >100k oz Au, >10 kt Ni, >100 Kt Cu equiv, 250 kt Zn+Pb, >5 kt U₃O₈
“Major” >1 Moz Au, >100 kt Ni, >1 Mt Cu equiv, 2.5 Mt Zn+Pb, >25 kt U₃O₈
“Giant” >6 Moz Au, >1 Mt Ni, >5 Mt Cu equiv, 12 Mt Zn+Pb, >125 kt U₃O₈

Source: MinEx Consulting © September 2014
Significant discoveries in the world by **Quality**: 2004-2013

<table>
<thead>
<tr>
<th>Tier</th>
<th>Metal</th>
<th>U₃O₈</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tier 1</td>
<td>Gold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tier 2</td>
<td>Gold</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tier 3</td>
<td>Gold</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:** Excludes Bulk Mineral discoveries.

Note: “Tier 1” is a Company making mine which is both large, long life and low cost. Has an NPV at Decision to Build >US $1000m

“Tier 2” is a significant mine, has some of the characteristics of a Tier 1. Has an NPV at Decision to Build of US $200-1000m

“Tier 3” is a marginal mine, and only has one of the characteristics of a Tier 1 or 2. Has an NPV at Decision to Build of US $0-200m

**Source:** MinEx Consulting © September 2014

**17 Tier 1 ands 72 Tier deposits found in the last decade**

**No Tier 1 deposits found in FSU, China or Europe**
6A. CURRENT FINANCIAL SITUATION FOR JUNIOR EXPLORERS
Change in cash position: 1998-June 2014
Sample of Australian Junior Exploration Companies

Note: Survey based on a sample of 125 (past & present) junior exploration companies out of a total of 800+ companies listed on the ASX between 1998-2014

Source: MinEx Consulting © September 2014 based on Quarterly Reports to the ASX
Change in expenditures: 1998-June 2014
Sample of Australian Junior Exploration Companies

A$ Million per Company
(in Constant Dec 2013$)

Note: Survey based on a sample of 125 junior exploration companies listed on the ASX between 1998-2014 Expenditure figures are reported on an annualised basis. Expenditures are defined as the net operating cash flow (and include exploration, development, administration and other expenses, less any incidental revenues).
The Median Burn Rate generally stays around 0.8 - 1.2 years

Note: Survey based on a sample of 125 (past & present) junior exploration companies out of a total of 800+ companies listed on the ASX between 1998-2014

Source: MinEx Consulting © September 2014 based on Quarterly Reports to the ASX