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Gold exploration ... a balancing act

MinEx Consulting examines the outlook for gold exploration

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The Nobel Laureate, Neils Bohr famously said that “prediction is very difficult, especially if it’s about the future”. This is very much the case for gold.

Last year MinEx Consulting reminded readers that the business cycle was not dead - and that what goes up must inevitably come down. Looking at 2014, the long-term outlook for gold exploration and the efficiency and sustainability of the gold industry, MinEx questions whether we are finding enough metal to replace what we mine.

2013 was definitely a down year - with global exploration expenditures falling by 32% from the all-time high of US\$10.3 billion in 2012. MinEx’s view is that we are still in the down-draft and that spending will fall another 10% this year to US\$6.1 billion before bouncing back in the two years.

The dramatic collapse in exploration spend was driven by the decline in the gold price and a corresponding inability for junior companies to raise fresh equity capital. The high-water mark for the gold price was in September 2011 when it nearly reached \$1900/oz. It then plummeted down to less than \$1200/oz in December 2013. At the time of writing (August 2014) the price has moved back to around the \$1300 mark.

In MinEx’s article in last year’s *Mining Journal* gold supplement it was noted that there is a strong correlation between the commodity prices and exploration expenditures. On the strength of this, MinEx built a multi-factor regression model to predict the future level of spend under range of gold prices. As shown in *figure 1*, the model fits the past history reasonably well (for our statistically-savvy readers the calculated R² was 0.87, which is good). Depending on whether you are a gold-bear or a gold-bug, the model predicts that by 2020 exploration expenditures could range from US\$5.3 billion (at \$800/oz) to \$10.6 billion (at \$1800/oz).

Taking a more middle-of-the-road approach and assuming that the gold price remains (in real terms) at the current rate of \$1300/oz, gold exploration expenditures will be around \$7.7 billion in 2016 and rise to \$7.9 billion by the end of the decade. If so, this suggests that spending could rise by 25% over the next couple of years.

It is significant to note that MinEx’s model didn’t fully capture the short term fluctuations in exploration expenditures – and missed the booms in 1987, 1997 and 2012 and the corresponding busts in 1993, 2002 and 2014.

Obviously, other factors are at play. To paraphrase the economist Adam Smith, these fluctuations reflect the animal spirits of the junior exploration companies – which rapidly flip between over-the-top exuberance and abject pessimism. These emotions are driven by their ability to raise money for exploration.

The junior sector is central to the health of the industry and accounts for 40-50% of total exploration expenditures. However, since 2012 the flood of new junior companies entering the market has dried up – with only a handful of IPO's being listed on the world's stock exchanges in the last couple of years.

Equally importantly, the existing companies have found it extremely difficult to replenish their coffers through issuing fresh equity. To conserve cash, companies have severely cut back on their work programs. The amount raised by the Canadian Junior sector dropped by half in 2013 to \$6.3 billion and 52% of these financings were for less than \$500,000, according to Gamah International.

For many companies this is barely enough to keep the lights turned on, let alone do field work. Even though the situation remains difficult there are early indications of improved availability of funding. Notwithstanding the dire predictions in the press that the sector will disappear, MinEx firmly believes that most junior companies will survive. However their shareholders will carry deep scars.

The majors haven't been immune to the carnage. The lower gold price has impacted on their profitability and cash flows – causing them to savagely cut exploration funding and lay-off staff. It appears that much of the restructuring has now been completed and the majors are looking to being more active in the coming year.

Assuming that the gold price doesn't collapse, MinEx believes that exploration activity will pick up in 2015 and return to balance by 2016.

Discovery rates

With regards to the recent trends in exploration success, in last year's gold supplement, MinEx identified 234 primary gold discoveries (containing more than 0.1Moz each) that have found in the World over the period 2003-2012. The total resource found was 687 Moz. These figures were considered to be very conservative – as it takes several years for a discovery to be reported and even more time for it to be fully drilled out. To highlight this point, the revised figures for 2003-2012 now stands at 328 discoveries, containing a total of 901 Moz.

Advancing the clock forward by one year (to cover the period 2004-2013) the number of known discoveries is 308 deposits containing 855 Moz. Given the delays in reporting, the true figure may end up being be 30-50% higher than this.

Figure 2 shows the amount of gold found in the World since 1975. Data for the last decade includes MinEx's estimate of the likely amount of gold yet to be reported – which is a major consideration in the most recent years. Including this data changes the discovery rate for the gold industry from one of terminal decline to something approaching steady state. In other words, MinEx's view is that it is not all gloom and doom. This substantially differs from the picture painted by other industry commentators.

In particular, a recent study published in June 2014 by SNL Metals & Mining titled Strategies for Gold Reserves Replacement, identified 217 major gold deposits containing 1660 Moz discovered over the time period 1989-2013. This includes 93 deposits containing 605 Moz found since 2000. These figures were based on primary gold deposits with a reported resource of greater than 2 Moz. On this basis they concluded that the rate of new discoveries in recent years has slowed to a trickle. Using the same minimum size threshold as SNL and ignoring the issue of unreported discoveries,

MinEx identified a total of 300 deposits containing 1960 Moz being discovered over the period 1989-2013, including 146 deposits containing 872 Moz found since 2000. Lowering the size threshold to 0.1 Moz increases the number of ounces found since 2000 to 1050 Moz.

It should be noted that MinEx's figures includes deposits where a resource not been published, but are known to be large. Many of these are in China and the Former Soviet Union or are being mined by artisanal workers in Africa and Latin America.

Discovery costs

Over the last decade there has been a four-fold increase in the amount spent exploring for gold (see *figure 2*). As a result, unit discovery costs have significantly increased. After adjusting for unreported ounces, MinEx Consulting estimates that it cost US\$87 to find an ounce of gold in 2013, up from just \$16 per ounce in 2006 (*figure 3*). The weighted average cost in constant 2013 US Dollars for the last decade (i.e. from 2004-2013) was \$42/oz versus \$28/oz and \$17/oz in the preceding two decades respectively (i.e. from 1994-2003 and from 1984-1993).

The discovery performance per unit of spend varies quite significantly across regions. It also varies depending on which measure is used – whether it be the number, size or quality of deposits found, or the number of ounces discovered.

As outlined in the table below, over the last decade Australia accounted for 9% of the spend, and found 12% of the primary gold deposits (by number) but only 4% of the total reported ounces – suggesting that many of the discoveries in Australia were small in size. After adjusting for unreported ounces, the unit discovery cost is estimated to be US\$56/oz.

The opposite was the case for Canada, which accounted for 20% of the exploration expenditures, 12% of the deposits (by number) and 35% of the total ounces, most of which were associated with giant discoveries such as Snowfield, Cote Lake and Detour Lake. The unit discovery cost is estimated to be US\$27/oz – half that of Australia, and the lowest of all the regions surveyed.

More importantly, Canada accounted for 28% of the highly prized tier one and tier two deposits found in the world during that period. Africa performed well, and accounted for 18% of the ounces found and 26% of the discoveries by number, for 15% of expenditures.

By contrast, Pacific/southeast Asia and Western Europe (which, for purposes of this study includes Turkey) performed poorly, with no tier one or two primary gold discoveries and only 2% of the total ounces found in the world over that period.

Notwithstanding this, it is worth noting that MinEx's analysis excludes base metal discoveries that contain significant amounts of gold as a by-product. An example of this would be Newcrest Mining Ltd and Harmony Gold Mining Company Ltd's joint discovery of the World-Class Golpu porphyry copper deposit in Papua New Guinea. This deposit has a current resource of 9Mt of copper and over 20Moz of gold. Another example would be the Tujuh Bukit copper deposit in Indonesia with nearly 9 Mt of copper and 30 Moz of gold. Both of these are set to grow over time as more drilling is done on them.

Altogether, MinEx identified 64 base metal and other discoveries over the period 2004-2013 that contain a total of 166 Moz of by-product gold. This accounted for 16% of all gold found in the World. By comparison, over the last four decades, by-product gold accounted for 21% of all gold found (see *figure 4*). In other words, one in every five ounces of gold found in the world was associated with other metals. Given the huge size of these gold-rich copper porphyry deposits, it is no real surprise that many of the Major Companies are actively exploring for them.

In the 2013 *MJ* gold supplement, MinEx determined that most of the increase in unit discovery costs was less to do with the industry losing its “mojo” (or its technical ability to find deposits) but more to do with large increases in input costs – such as drilling, salaries and administration. All of these costs doubled in real terms over the previous decade - so it is no real surprise that unit cost per ounce of gold discovered also doubled.

On this basis, the silver-lining in the current downturn is that input costs should fall and, in so doing, unit discovery costs should also fall. While we see evidence of 20-30% lower drilling costs, salaries have been more “sticky”.

MinEx’s view is that, due to the current high level of unemployment, wage rates will eventually drop over time. With regard to administration costs, most of the majors have now finished restructuring their exploration teams and project portfolios. Given their smaller scale, this is more difficult for junior companies to reduce their office and compliance costs.

One shouldn’t forget that exploration success requires active work programs. As yet, most junior companies are still in hibernation - and not ventured back out into the field in any big way. Until they do, discovery rates will remain subdued.

Changing direction

Over the last thirty years there has been a progressive movement of exploration spend away from the traditional mining countries of Canada, US and Australia to emerging players in Latin America, Africa and the (now-largely former) Communist Countries.

Looking forward, the likely future level of expenditure will vary from region to region. Based on MinEx’s regression model, Australia and Pacific/southeast Asia are projected to continue to lose market share to Canada, China and the Former Soviet Union.

The changes in market share reflect the relative difference in exploration costs and opportunities between the various regions. It should be emphasised, however, that the actual outcome could be quite different, since it will be influenced not only by changes in the actual gold price, but also by business risk and local exploration success.

Conversion rates slow down

The true measure of success is not discovery but development. To pay for the cost of exploration and return money to shareholders, companies need to quickly convert their discoveries into profitable mines. Unfortunately not all discoveries get developed, and of those that do, the delay between discovery and production can often take a decade or more.

MinEx has carried out a detailed analysis of the development history of 1294 primary deposits found since 1975. Between them, these discoveries contain 3,809 Moz of resources. To date 603 of these deposits (containing 2,269 Moz) were mined and/or are currently under development.

For those deposits found in 1975-1984, 69% by number and 86% of the contained ounces have been developed. As can be seen in figure 5 it took several decades to reach these levels. Notwithstanding this, a quarter of discoveries went into production within 5 years.

The trajectories in figure 5 indicate that the speed and extent of conversion seems to be slowing down over time. For example in the period 1995-2004 it took 9 years for a quarter of the deposits to be developed. Although it is still very early days yet, very few of the discoveries made in the last decade have been developed.

Two other key messages in the data is that, firstly, large discoveries are more likely to be mined than small discoveries. Secondly, at best, only 70 to 80% of all ounces found will ever be mined.

It should be noted that not all of the resources get converted into reserves. Also, mining and processing losses mean that not all of these reserves end up in the final product. As a rule of thumb MinEx estimates that the industry needs to find 1.5- 2 oz of resources to deliver one ounce of saleable gold.

Long-term sustainability

For the industry to be sustainable in the longer term it needs to discover and develop enough new deposits to replace what it mines.

Figure 4 shows the total ounces found since 1975 versus World gold production. Over the last four decades annual discovery rates (from both primary and by-product sources) fluctuated between 60 and 250 Moz, with an average of 144 Moz /y. During this time production doubled - rising from 39 Moz /y in 1975 to around 89 Moz/y in 2013. Applying the 1.5x to 2.0x factor to annual production indicates that the industry has been struggling since the late 1990s to find sufficient resources to meet future needs. Unless there is a sustained increase in discovery rates the situation will get progressively worse over time.

In the short term the gap can be met by acquiring and developing projects found in prior decades. However, the general view held by many of business development managers is that most of the remaining undeveloped projects are of mediocre quality. To a degree this is not a new problem - there are never enough good projects around to satisfy demand. Exploration has a key role to play in replenishing and upgrading the pool of quality new projects.

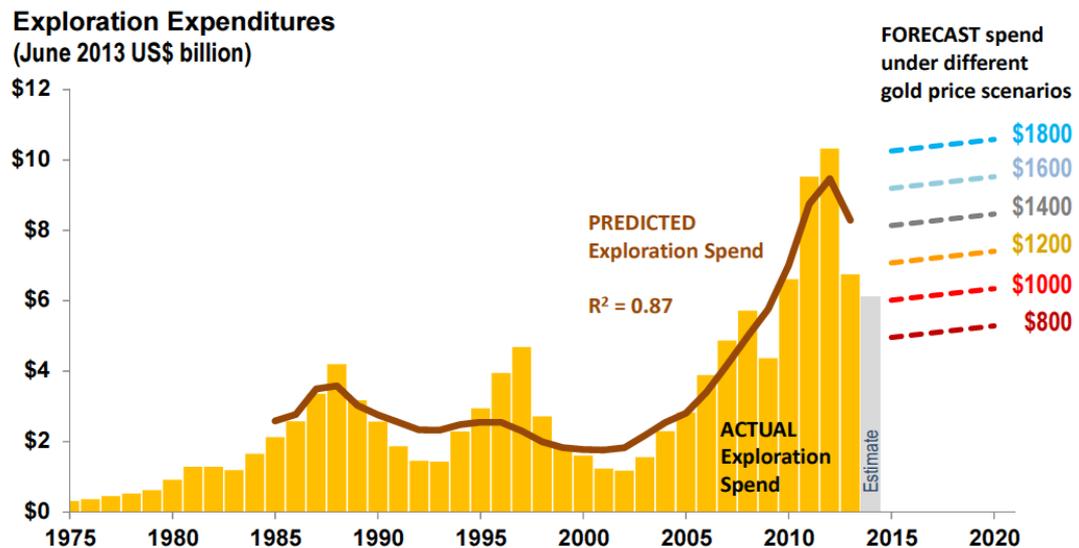
As discussed, the level of exploration activity is driven by commodity prices. Assuming a long run gold price of \$1300/oz in 2013, MinEx Consulting forecasts that the industry will spend around \$7.8 billion/y. on exploration over the rest of this decade. Using an average discovery cost achieved in the last decade (of US\$42/oz), industry could expect to find around 170 Moz/y-200 Moz/y of gold. Applying the 1.5x to 2.0x rule of thumb, this is sufficient to sustain only 90 Moz/y-120 Moz/y of production.

To be sustainable, the gold industry will need to balance the competing demands of growing its output by improving recovery factors and project conversion rates and/or being better at exploration. The ultimate balancing item is the gold price itself.

Higher prices will allow producers to operate at lower cut-off grades (and so grow their resource) and encourage the development of marginal projects. More importantly, higher prices will enable the exploration industry to raise additional funds and make more discoveries. The dynamics of this means that gold exploration will continue to be a challenging and exciting industry to be in. But success will come to those to those that plan for it.

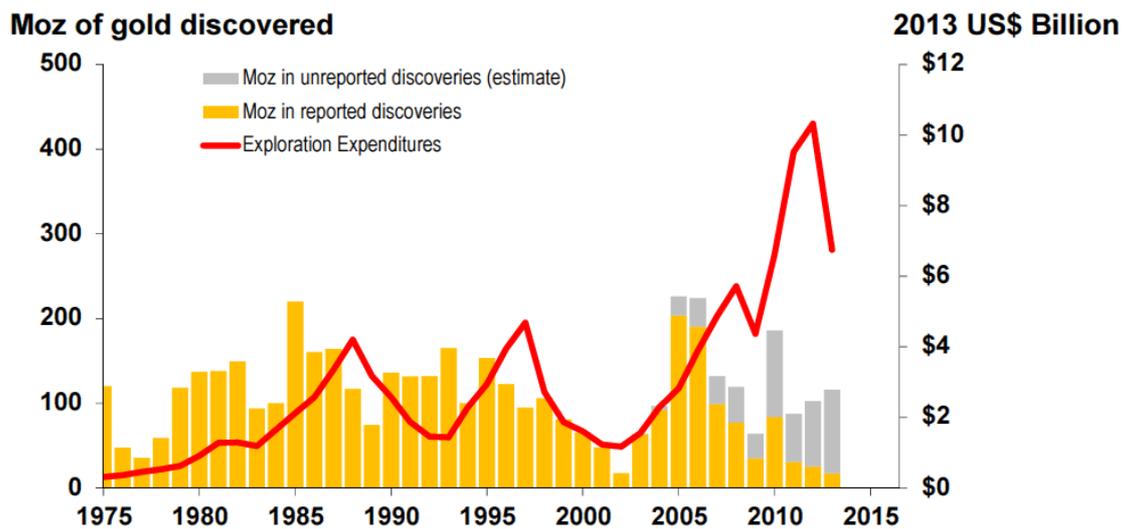
Richard Schodde is managing director of MinEx Consulting, a consultancy group which specialises in providing strategic and economic advice to resource companies, with a particular emphasis on the economics of mineral exploration. Additional articles and presentations on related exploration topics can be downloaded at: <http://www.minexconsulting.com/publications.html>

Figure 1: World gold exploration expenditures – actual, predicted and forecast



Sources: MinEx Consulting estimates August 2014, based on historical data from ABS, NRCan, MLR (China) and MEG-SNL

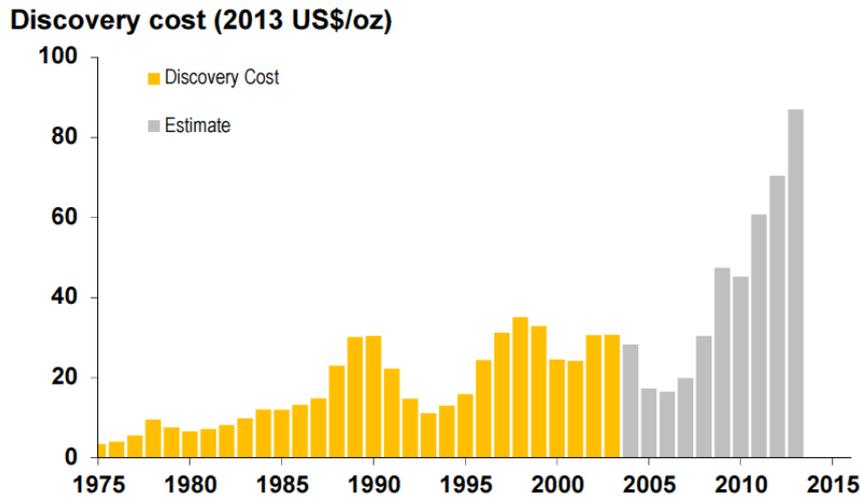
Figure 2: Gold exploration expenditures and discovery rate: 1975-2013



NB: Discoveries are for primary gold deposits >0.1 Moz Au

Source: MinEx Consulting August 2014

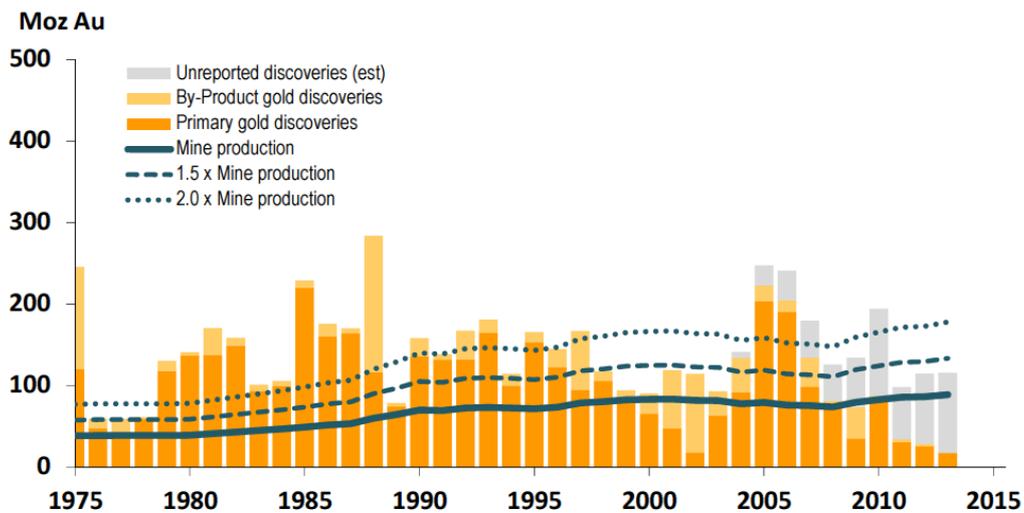
Figure 3: Unit gold discovery costs in the World



NB: Discoveries are for primary gold deposits >0.1 Moz Au

Source: MinEx Consulting August 2014

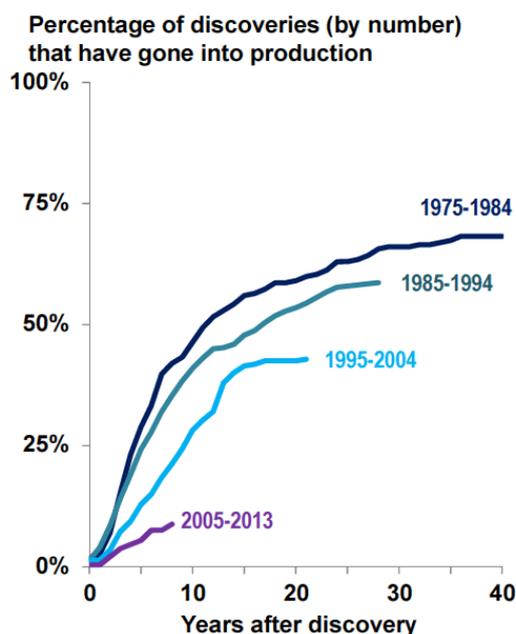
Figure 4: Mining and discovery rates (including primary and by-product) for the World



NB: Based on all primary and byproduct gold discoveries containing >0.1 Moz in the World

Sources: MinEx Consulting August 2014
Mine production data from USGS

Figure 5: Speed of conversion from discovery to mine start-up – as measured in terms of the number of deposits found



Analysis based on 1294 primary gold deposits >0.1 Moz found in the World between 1975-2013, of which 603 deposits have gone into production.

Source: MinEx Consulting August 2014

Table: Gold expenditures and discovery performance for 2004-2013

Source: MinEx Consulting © August 2014

NB: # Discoveries are from primary gold deposits >0.1 Moz. Excludes satellite deposits within existing camps. No adjustment made for likely future growth in the number and size of reported discoveries.

NB: ## Includes an adjustment for unreported discoveries and likely growth in known deposits

Region	Exploration Spend (2013 US\$b)		Moz Discovered #		Unit Cost \$/oz ##	No of Discoveries #		Tier 1+2 Discoveries	
	\$	%	Moz	%		Total	%	Total	%
Australia	\$5.2	9%	38	4%	\$56	37	12%	4	10%
Canada	\$11.5	20%	303	35%	\$27	38	12%	11	28%
USA	\$5.3	9%	46	5%	\$64	15	5%	4	10%
Latin America	\$13.4	23%	196	23%	\$43	66	21%	9	23%
Pacific/SE Asia	\$3.7	6%	8	1%	>\$200	12	4%	0	0%
Africa	\$8.8	15%	155	18%	\$33	79	26%	7	18%
W Europe	\$1.3	2%	10	1%	\$85	11	4%	0	0%
China+FSU+EE+RoW	\$8.1	14%	99	12%	\$52	50	16%	4	10%
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TOTAL	\$57.2	100%	855	100%	\$42	308	100%	39	100%