

Value creation through exploration

Successful mineral exploration is critical for a sustainable and profitable mining industry. Unfortunately, and despite this seemingly self-evident fact, a combination of dramatically decreased funding and the resulting lack of greenfields exploration is choking the pipeline of new mining projects.

Marcus Willson | 24 Aug 2015 | 16:47 | Feature



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Where are the discoveries that will replace tired old projects and provide better, more profitable, operations, both now and when the commodities cycle returns to boom?

A lack of confidence in the ability of the exploration industry to cost effectively deliver these discoveries can, at least partially, be blamed for this.

Exploration for bulk commodities like iron ore and bauxite can often deliver high probabilities of success from short term exploration programs, albeit with potentially lower grade outcomes.

But high value commodities like gold, copper, lead, zinc, tin, tungsten, vanadium and rare earth elements generally require extensive, concerted and often expensive effort to provide initial indications of possible economic mineralisation to explore to a point where clear economic potential can be established.

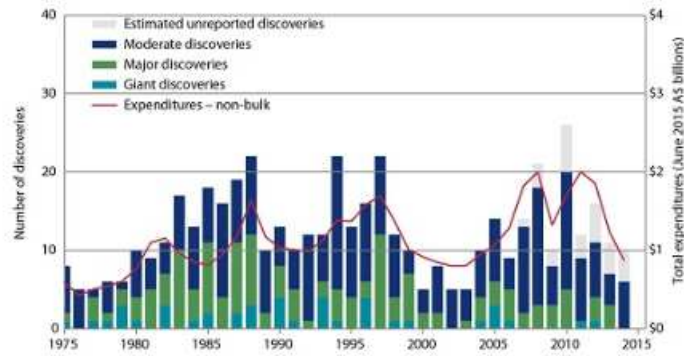
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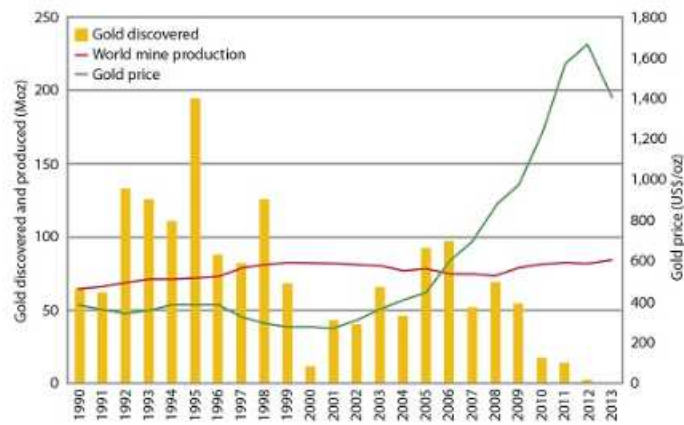
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Historically discovery rates have been linked very closely to expenditure rates, in Australia and elsewhere in the world (see Figure 1 below).

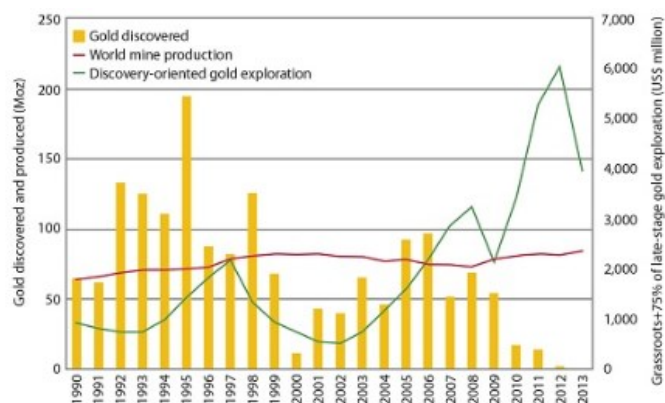


Broadly speaking, exploration success is a function of expenditure and time.

The Australian Bureau of Statistics (March Quarter 2015) shows another 6.1% decline in exploration expenditure in Australia, following a steady trend downward trend since late 2011 (Figure 2 below). While the trend may be showing that this decrease in expenditure is slowing, it ultimately means that decreasing exploration spend inevitably increases the time to the next set of producing mines.



Furthermore, despite all time high exploration expenditure in the period between approximately 2010 and 2013, the industry has seen significantly declining discovery rates (shown dramatically for gold in Figure 3 below).



So increased expenditure, for example associated with a turn-around in the commodities markets at the junior and mid-tier end of the spectrum particularly, will not necessarily equate to an increased number of new discoveries. And that lack of increased discovery may undercut any revived investment in exploration.

A generally accepted rule of thumb is that only 1 in 1000 prospects explored for gold will return an economic outcome.

I have personally completed more rigorous work* looking at the Laverton district of Western Australia during a period on when Tier 1 and Tier 2 discoveries were made in that area, and supported by similar analyses elsewhere, showed that between 1 in 100 and 1 in 200 generative stage targets achieved some degree of economic outcome. For the desired Tier 1 and Tier 2 deposits, the discovery risk increases exponentially. However, the probability of progression from one stage of exploration varies depending on the stage.

As the stage of exploration becomes more advanced, with decision points met and increased project knowledge and data, the probability of progression increases. By the time resource and reserve definition phases are reached, a very high percentage of projects make it through to a positive decision to mine (rightly or wrongly).

On a risk versus reward basis, my data shows that the stand out exploration phase is during reconnaissance. This phase covers those prospects being assessed with techniques such as soil geochemistry, geophysics and critically RAB or aircore drilling. Data from many projects show remarkable consistency with only around 1 in 6 prospects at this phase progressing further. What is more, approximately 30% to 40% of the total exploration spend is related to this phase of exploration. Clearly this exploration phase carries the highest risk.

On this basis, it must be concluded that if we are to increase our rate of exploration success, this phase of exploration is the area that requires the most focus.

Figures 1 and 2 show a very strong increase in discovery rates from the early through to mid-1990s. There are number of reasons for this dramatic change in exploration success.

Significant improvements in analytical technologies (starting with the Australian invention of atomic adsorption spectrometry in the 1950s) allowed the lowering of detection limits.

The introduction of technologies such as cost effective aeromagnetic data collection provided a huge increase in understanding of hidden geology and structures.

In Western Australia, and other weathered terranes, advances in knowledge about regolith and weathering processes had a significant impact on discovery, particularly where coupled with widespread adoption of cheap rotary air blast (RAB) and aircore drilling, allowing three dimensional soil sampling to be completed.

This allowed the recognition of supergene dispersion zones above buried mineralisation (gold, copper and nickel in particular). Vast quantities of this type of drilling was completed during this period, contributing to the statistics identified previously.

However, as the decade passed, the success rate of these approaches began to wane. But unfortunately, along with a number of other 'tried and true' methods, many companies continued using these methods.

To improve exploration odds, companies shifted their focus to brownfields exploration. While the odds of brownfields discovery are better, there is an inevitable end to the benefits of this strategy, and the incremental discoveries rarely exceed the size of the initial deposit.

So an increasing reticence to spend time in the field and dollars in the ground (compounded by increasing costs particularly for land access), coupled with the likelihood that the next round of Tier 1 and Tier 2 discoveries will be made under increasing depths of cover, the overall statistics for cost effective discovery are only likely to worsen unless the industry recognises the need to change behaviours.

The cost of exploration on a prospect by prospect basis, in the order of \$70,000-\$100,000, is too low. While this is a material amount of money, particularly for a junior company, it is suggested that the level of effort that goes into making decisions to spend this degree of money is limited.

It is not uncommon that such an expenditure is initiated by a single set of data or one idea, such as a soil or geophysical anomaly. The poor discovery statistics suggest that this approach is much more likely to destroy value than add it. Explorers often support this type of decision making, arguing that there is insufficient additional data upon which to make more considered decisions.

Over the past decade, substantial work has been completed on improving the targeting of exploration. Some companies have embraced this approach, but, more importantly research organisations, such as the Centre for Exploration Targeting at UWA, the Centre of Excellence in Ore Deposits (CODES) at the University of Tasmania, CSIRO and Geoscience Australia underpinning Cooperative Research Centres such Predictive Mineral Discovery and Landscape Environments and Mineral Exploration, and Mineral Deposit Research Unit at UBC in Canada, to name a few.

This work has focussed on a combination of adapting existing, and developing new, technologies and science that can genuinely be applied at the earliest stages of exploration by all geologists to aid in making better targeting decisions.

Examples of this work include geophysical techniques that aid in understanding geology in three dimensions, both under cover and at greater depth in bedrock. No doubt these are contributing to discoveries, particularly in the brownfields domain, where correlations can be used to constrain outputs.

At the fore-front of these is inversion modelling – adding value to extensive and well understood magnetic and, increasingly, gravity data. With advances in inversion of electrical surveys such as electromagnetics, induced polarisation and resistivity surveys also providing dramatic advances in defining testable targets.

Also emerging as critical exploration tool in mineral exploration is the use of 3D seismic surveys with processing optimised for complex hardrock environments, which, when carried out with the appropriate constraints, can deliver ‘drill here’ type targets at depth, though this approach is typically still used in brownfields settings.

Other less well disseminated and perhaps poorly appreciated methods are multi-element litho-geochemistry (using multivariate statistical analysis) and spectral mineralogy.

Any geologists (or database managers) who have been in the industry for any length of time can tell you that humans are very poor at consistently logging the changes in physical rock features that are the result of the processes associated with the formation of a mineral deposit.

Litho-geochemistry and spectral mineralogy, amongst other methods that loosely fit into the category of ‘alteration mapping’, enable increasingly robust assessment of these features related to mineralising events. Moreover, these features are present not only in near proximity to the deposits (helping to flag near misses) but also offer the potential to recognise deposits from subtle changes far from the deposit itself.

Under the right circumstances, evidence of hydrothermal systems, particularly those associated with Tier 1 -sized deposits, can be measured certainly up to a kilometre from the economic mineralisation, but potentially further. On 500m x 500m drill spacing, the hydrothermal system can also be identified and mapped.

Litho-geochemistry, using a whole rock multi-element analytical digest on any samples ranging from soils through to diamond drill core, is predicated on understanding the elemental changes that occur within rocks as a result of the hydrothermal process.

In certain instances, elemental substitution into primary minerals that would not be visible but measurable with the right data, can be indicative of hydrothermal processes substantially removed from the deposit.

Spectral mineralogy, assessed using instruments ranging from handheld units focussed on rock chips (PIMA or ASD’s TerraSpec), through to aircraft and satellite systems (Hylogger and ASTER respectively), focusses on defining minerals that occur as a result of alteration.

For example, it can be shown that around hydrothermal gold deposits, there is typically a systematic change in the chemistry of white micas and chlorites related to the site of gold deposition.

Measuring these changes – from samples at the bottom of RAB hole, on RC chips or periodically in diamond core, can provide critical data pointing to mineralisation. And all for negligible additional cost. Similarly, collection of this type of data from historical drilling can add significant new information to target exploration for very low costs.

Applying a sound understanding of mineral systems in association with good litho-structural interpretations of available potential field data, in both 2D and 3D, and using tools such as multi-element geochemistry and spectral mineralogy, it really is possible not only to better assess the probability that any early stage target is more likely or not to deliver an economic outcome, but also to suggest the type and style of mineralisation. This in turn can allow more effective decisions in respect to subsequent testing strategies.

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If the mineral exploration industry is to regain management and investor confidence, which ultimately delivers the steady flow of funding required to deliver discovery, we must decide to make decisions based on all of the available information and good science.

I firmly believe that if you are the geologist, manager or director in charge of the exploration purse strings and managing the exploration risk, your team is not considering these types of tools in their exploration processes, you should be asking why not.

Marcus Willson (MSc Geology, BSc Geology, MAIG, RPGeo) is principal consultant at CSA Global, an international mining consulting firm based in Australia. He has 25 years' experience in the mineral exploration industry, ranging from early stage exploration activities, exploration management, strategy development and implementation, through to senior corporate management roles. He has specialist expertise in Archaean lode/orogenic gold, regolith interpretation and geochemistry as well as in geodynamic/litho-tectonic/structural/crustal evolution analysis in the context of hydrothermal mineralisation.

