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VIEWS

A Looming Crisis for the Mineral Exploration Industry: A Geological Perspective

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INTRODUCTION

Data on discovery and resource inventories for metals indicate that the discovery rates in the mineral industry are declining and discovery costs are rising steeply (Richard Schodde, www.minexconsulting.com/publications.html). These factors, plus a bear market for exploration stocks with consequential lack of access to finance, create a looming crisis for mineral exploration.

There are several interrelated exploration issues that have led to this. Two key, geologically oriented factors are discussed here: an inefficient industry structure and the education of its exploration geologists. Several other factors have been discussed in previous Views articles.[1] Although we have a largely Australian perspective, we believe that our generalizations identify key issues worldwide, and that there are improvements that can be made in the next upswing of the mineral exploration "boom and bust" cycle.

[1] Available at www.segweb.org/views

INEFFICIENT NATURE OF THE MINERAL EXPLORATION INDUSTRY

The principal issue that we recognize is the current uneven scale distribution of mining companies. Over the last decade, driven by booming commodity prices, there has been an explosion in the number of junior explorers. At the same time, the major companies have grown through acquisition, principally through buying up midsized companies with quality assets, such that these represent a lower proportion of the total industry. Certainly, this has been the case for Australia. Connolly and Orsmond (RDP 2011-08 of Reserve Bank of Australia) present evidence that, of the top 20 mining companies listed on the ASX in 2000, only seven were still listed at the end of 2005, and this followed the pre-2000 acquisition of numerous midsized gold-mining companies with significant resources by the major gold companies of the time, most of which were subsequently acquired by the current gold-mining major companies. Midsized companies are often the most vibrant explorers and were commonly the acquirers of the discoveries made by the junior sector. Mineral deposits follow a log-normal size distribution, and for every tier 1 (world-class) discovery, an additional three tier 2, 12 tier 3, and 20 smaller deposits are discovered (Richard Schodde, pers. commun., 2014). The major companies are essentially interested in acquisition of potential tier 1 assets. As a result, smaller deposits are left to small- and mid-scale producers.

The junior explorers also have their own problems, the most pressing being the current inability to replenish cash reserves. As a result, many juniors have sharply cut back on exploration and have, based on our reading of their releases, shifted focus to brownfield exploration. Although high-quality discoveries are still being made, only greenfield exploration can result in the new world-class districts required to underpin the future viability of the mineral industry.

With regard to the majors, as they grow in size, their ability to find deposits of sufficient scale and quality to make an impact on their business declines. This drives them to focus on commodities with the largest sales revenues, such as iron ore, coal, aluminum, and copper. As a result, they are moving away from exploring for the smaller deposits and specialized commodities such as nickel, lead/zinc, diamonds, and precious and critical metals. Another challenge facing many major companies is an increasingly large structure, which is an anathema to successful exploration. Exploration success classically also needs staunch support from the top (Wood, 2010, January *SEG Newsletter*), yet larger

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companies now typically have scant technical expertise on their boards and executive committees. The lack of technical guidance ultimately defaults to growth by acquisition. Exploration concepts from highly competent technical teams can become lost as they pass up complex managerial structures toward the decision-making level, a problem compounded by a lack of technical knowledge. There seems to be a dearth of Roy Woodall-like leaders that can make companies grow through exploration success, as Woodall did with Western Mining Corporation through his pursuit of technical excellence.

At the other end of the scale, junior companies that are serious explorers do have technical expertise on their boards and in management; they are driven by exploration success, as it affects their market value and ability to raise capital. A sizeable discovery and subsequent acquisition by a midsized or major company provide financial reward for all the company team and investors. A significant problem, however, is that capital raisings for exploration-focused initial public offerings (IPOs) still sit at decade-old levels of US$5 to 10 million, when the costs of listing compliance, an office, salaries, and drilling have typically doubled in real terms in the last decade. This lack of funding severely lowers the chance of exploration success. To improve the odds of discovery, many junior explorers focus on brownfield targets, but, with a few important exceptions, these lie in mature districts of relatively low prospectivity. If this is a serious problem in bull markets, then bear markets provide an almost insuperable problem for juniors because of their inability to raise funds and take on long-term projects of high risk (and high reward).

Geologic teams for junior companies are typically less well qualified than those of the majors, with significant exceptions; they are often reliant on consultants for technical input and interpretation, particularly in geophysics. These consultants, along with other service providers, such as geochemists, field mappers, or structural geologists, typically are lost to juniors as exploration budgets decline in bear markets. The midsized companies, with producing mines as a buffer, escape many of the structural problems of the larger groups and funding issues of the smaller groups, and hence have greater long-term security.

In terms of industry structure, the present system will struggle unless juniors can raise their IPOs to US$20 to 25 million levels when the marketplace improves. This may be possible if the number of juniors decreases as the less successful fall away in an extended bear market. More discoveries could lead to more successful mid-tier companies that would assist stability in the industry, unless, like many of their predecessors, they are taken over by majors.

Possible solutions

Although both major and junior companies have inherent weaknesses, they also have many positive features that could be complementary. In addition to the differences noted above, the majors are generally risk averse and wary of exploration in terranes with political issues, whereas juniors exist that will explore wherever there is perceived high prospectivity. Perhaps a return to the cooperative mechanism would be productive, where a major company provides essential exploration funding for a defined period for juniors, selected by an internal technical and commercial panel on the basis of their tenements, management, technical staff, and previous exploration record. This would provide seed funding for technically competent juniors with a string attached for future quality discoveries. Of course, maintaining sufficient value upside for both parties in such arrangements requires careful attention. A recent agreement between copper-focused Antofagasta and ASX-listed junior Encounter Resources is one example in Australia, with the larger partner funding technical programs that are managed by the smaller partner with local expertise.

Such schemes must deliver to majors a disproportionally large "bang for their buck" versus "going it alone." For the junior, it means financial security and a period where the company need not seek cash from the market. Whatever the specific outcomes, it is essential that the industry seriously addresses these problems before they escalate, with negative consequences if quality projects do not continue to appear in the exploration pipeline. In addition to these problems, another significant factor is the training and experience of economic geologists tasked with exploration for new resources.

EDUCATION OF EXPLORATION GEOLOGISTS

The issue of the professional standards of exploration geologists is a complex one, starting with changes at all educational levels; some of the problems are country specific.

For future geologists, the trend in high schools is to a lesser maths and science curriculum, less emphasis on hierarchical and logical thinking, and little instruction in logical, as opposed to creative, writing.

At the university level, the traditional professional degrees in geology had students progressing through three or four years of structured science training, with at least one-half of such training in some form of geologic science. Due to recent university policies, graduates in our discipline now possess something more akin to a liberal arts degree of a well-rounded graduate, rather than being prepared to be professional industry geologists on the cutting edge of technology. Taking away a degree with a field-based component and replacing it with coursework, as appears to be increasingly happening globally, is not optimal in terms of a future career in industry.

Lack of field experience limits the usefulness of a young geologist to exploration companies, particularly as the opportunities to work for government surveys or attend company-based field courses have declined. Over the past decade, there has probably been an overreliance on high-technology geophysical and geochemical data at the expense of careful geological interpretation. These days, aspiring young geologists are challenged to get the field time, interpretive skills, and thinking time to compete effectively in the industry. Although digital technology may provide an improved platform for overlay of exploration-relevant datasets, many computer-generated maps capture fewer and lower-quality field data and lack the geological insights to fully interpret all the data layers.

There is also an increasing problem with mentorship of young geoscientists, a critical mechanism by which young professionals can benefit from the experience of older geologists. This is something that has been discussed in previous Views and has engaged the attention of SEG, which has put in place

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mechanisms to redress this for motivated students. At university, effective mentorship is best achieved at the research stage, but this is threatened as university staff are increasingly asked to do more within their available time. Based on discussions with recent graduates, mentorship within exploration companies—once a common feature in larger companies—has also declined. Graduates are often sent directly out to log drill chips or carry out ore grade control without training, stunting their development and with limited effectiveness for the company.

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There is a clear need for the exploration industry to recognize these changes and heed the problems generated in order to thrive in the next upturn. Although industry can fund specific university positions and research programs, it cannot readily influence the changing philosophies of either school or university systems to produce more professional graduates. This is largely because universities, through government shifts and economic necessity, have become businesses driven primarily by numbers of undergraduate students they can enroll. At the research level, the industry has influenced postgraduate projects to be of greater exploration significance by funding research beyond immediate mine environments, through AMIRA and similar groups. However, most direct funding from companies continues at the mine scale.

The industry should also seek to find mechanisms to promote mentorship, either directly in its own workplaces as in the past—the preferred option—or indirectly through schemes to help economic geology centers in universities and organizations like SEG to do so. It is essential that this is implemented and succeeds. In all discussions that we have had, lack of mentorship stands out as the most common issue. It is interesting in this regard that an article in the *West Australian* newspaper this year reported that the U.S. Human Resources Institute in 2010/2011 found that there was an average 88% rise in productivity when mentoring was involved in training, compared to a 24% rise with training alone. They also report that 60% of graduates listed the availability of mentoring as a key factor when choosing an employer.

From the above discussion, it is evident that one of the most useful ways the industry can redress the problem of professional training is to support universities and other organizations specifically for field training or applied mineral exploration courses, at least at the postgraduate level. The other is to recognize the importance of mentorship and to provide it either internally or via consulting groups with the support of institutions such as SEG, which can continue to help coordinate mentoring.

CONCLUSIONS

There is little doubt that the mineral exploration industry is in a time of change and is facing numerous challenges. The challenges are multifaceted, and the inefficient structure of the mineral industry and problems in education of future generations of exploration geologists loom as major issues. In terms of the industry, we believe that a change in structure via development of a generic strategy of formal alliances between majors and high-quality juniors is one way forward. In terms of education, there needs to be increased dialogue between industry and academia of how funding can best facilitate field-based training, which has exceeded the financial and personnel capabilities of many universities. Emphasis must also be placed on mechanisms for the effective mentoring of young graduates, either within the company or via external groups, if not both.

We believe that SEG has a potential role to play in these areas, including publishing more Views by economic geologists that help better define the problems and suggest solutions and, possibly, chairing a forum with a select committee to determine what pragmatic actions can be taken to address these issues.

We have benefited from discussions with attendees at the CET Discovery Day in Fremantle, where these issues were discussed. We are particularly indebted to Richard Schodde and Rich Goldfarb for initial editing and to Jeff Hedenquist, John Thompson, Shaun Barker, and Andrew Wurst, who reviewed the submitted draft. We emphasize that, although taking their diverse comments into account, the views are our sole responsibility.