INVESTMENT IN EXPLORATION
THE JUNIOR AUSTRALIAN COMPANY VIEW

by

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Investment in exploration companies is very much out of fashion in the current climate. The reasons for the lack of interest appear compelling. However, the author argues that an investment strategy based on a relatively small investment in a basket of suitably qualified juniors can lead to spectacular investment results.

INTRODUCTION

This paper sets down views developed from personal involvement in exploration, investment analysis and funds management and from reading many of the excellent papers which have been published in this area over the years.

It is easy to find arguments not to invest in mineral exploration.

The mining industry is depressed, metal prices are stagnant, and large undeveloped reserves overhang the market in some commodities such as copper. Studies on the cost of exploration indicate that costs are high and the probability of success low. An in-depth study of minerals exploration in Australia between 1955 and 1978 was carried out by Brian McKenzie and Michel Bilodeau in collaboration with the staff of Western Mining Corporation[1]. As Roy Woodall so delightfully put it "the results of the study are not such as to encourage the rational investor".

This paper sets out to examine the current situation and to show that there are reasons for investing in exploration, especially through judicious investment in a portfolio of junior explorers. This discussion looks at exploration from the viewpoint of the investor interested in junior explorers yet to find a major deposit, as opposed to the more commonly discussed view of the major established mining house.

THE EXPLORATION CLIMATE IS NEGATIVE

On the face of it, the climate for investment in exploration is negative. Metals markets are depressed, while studies indicate that the costs of finding an economic deposit are high and the probability of success low.

1. METAL MARKETS ARE DEPRESSED

The mining industry has been experiencing tough times since the early 1970's, with oversupply prevalent during a period of depressed consumption. Metal prices have declined in real terms. On the IMF's index of $US commodity prices deflated by the price of manufacturing (1980 = 100) metals prices have fallen from 131 in 1974 to 85 in 1984. Prices have been even weaker since 1984. Profit performance of the mining sector has been very poor in recent years and is likely in 1985/86 to be negative. Some reasons for the depressed metal price environment are outlined below.

1.1 Reserves are Sufficient

There are sufficient known reserves of virtually all metals to last into the 21st century. Statistics from the US Bureau of Mines show the following reserve life estimates:

Zinc	23 years	Uranium	48 years
Gold	26 years	Titanium	62 years
Lead	29 years	Tungsten	70 years
Copper	42 years	Nickel	72 years
Tin	43 years		

The ratios of Economically Extractable Reserves to Cumulative Primary Demand 1985 — 2000 give a similar picture:

Tantalum	1.1	Cobalt	4.5
Silver	1.2	Titanium	5.2
Zinc	1.2	Iron Ore	5.5
Lead	1.3	Platinum Group	7.0
Gold	1.4	Bauxite	9.7
Copper	1.8	Niobium	10.0
Nickel	2.6	Chronium	200
Manganese	4.4		
Vanadium	4.4		

Source:
The 1985 World Almanac

1.2 Intensity of Usage Declining

Intensity of Usage of many commodities has declined since the early 1970's. John Brunner, Chief Economist for BHP has described this phenomenon well[2]:

- The two oil shocks provided a strong incentive to reduce fuel consumption. Downsizing and other

measures taken to improve fuel consumption have significantly reduced metals' consumption in markets such as automotive and shipbuilding.

- The oil shocks also led economic growth to be lower than it might otherwise have been. Industrial production tends to lead GDP at high rates of growth of GDP and to lag GDP at low rates of GDP growth. GDP has grown faster than industrial production over the last decade.
- Low rates of economic growth are associated with low rates of investment which in turn have held down metals consumption.
- The share of consumer spending on services has increased at the expense of goods in all developed countries since the 1960's.
- The trend to miniaturisation of everything from computers to air conditioners to radios has had a major impact on intensity of usage.
- Emphasis of manufacturers on value engineering to reduce costs and improve profits has had a further impact. Efforts to reduce the weight of materials consumed have been effective in many areas.

Intensity of usage for metals in the newly industrialising countries is rising as the pace of development accelerates but is not sufficient to offset the overall decline.

1.3 Recycling More Important

In a number of industries, a growing proportion of metal requirements are being met by scrap. Brunner makes the following points:

- To the extent that today's supply of scrap is a function of yesterday's sales of consumer durables and the day before yesterday's sales of capital goods, a growing amount of scrap is becoming available from the buoyant level of economic activity prior to 1974.
- The rise in oil prices rendered much plant and transport equipment obsolete, further boosting the supply of scrap.
- Environmental pressures, frequently leading to legislation, have encouraged the use of scrap, particularly in containers.
- The scrap melting or secondary metal industries are increasingly competitive with their advantages of cheap fuel, low capital costs, high labour productivity and location close to major markets.

1.4 Producer Cartels Have Broken Down

Increasing pressures on individual companies and countries to survive have led to the loss of producer control in commodity after commodity:

- LDC's have tended to produce at full capacity despite internal losses, in an attempt to generate foreign exchange to enable borrowings to be serviced.
- Low cost producers have tended to exploit their competitive position to gain market share at the expense of less efficient producers.
- To the extent that cartels have been successful in maintaining prices at levels higher than they might otherwise have been, marginal producers have been encouraged to enter the market.

Examples of the developing trend away from producer control towards increasing "commodification" include the recent price collapses in oil and tin, aggressive sales practices in zinc and lead by low cost producers in an attempt to force high cost producers out of the business, the entry of low cost producers such as WMC breaking down producer control of nickel. Iron ore, coal, bauxite and copper have been commodity businesses for many years now.

Producer control of some other mineral products such as diamonds are delicately poised with the retention of producer price control depending on the ability of de Beers to hold all producers aligned with the CSO.

2. THE COST OF FINDING AN ECONOMIC RESOURCE IS HIGH

While meaningful statistics are sparse, several recent studies have suggested that, on average, exploration is both very expensive and very risky. This notwithstanding, the fact is that exploration has proven on average to be a profitable investment in both Canada and Australia.

Several studies have investigated the costs of discovering an economic resource.

2.1 Walthier, 1977

Walthier[3] examined the history of mineral properties acquired between 1950 and 1975 by 40 Canadian, U.S., European and African companies. This group of companies discovered a total of 335 new deposits for 904 exploration years, an average 2.7 years each. There was a wide variability in performance. Some companies averaged two discoveries per year while others found only one deposit in 25 years. Average annual expenditure on exploration (for all companies, both small and large) was between $US5 and $US7 million ($US 1975), giving an average cost of discovery of $13.5m to $18.9m at the average of 2.7 exploration years per discovery.

2.2 McKenzie, 1981

McKenzie[4] examined the Canadian exploration experience between 1951 and 1974. His work showed a total of 87 economic discoveries had been found during the period for an average exploration expenditure ($C1980) of $16 million.

2.3 McKenzie & Bilodeau, 1984

Brian McKenzie and Michel Bilodeau[1] analysed the Australian exploration experience between 1955 and 1978. During this period the equivalent of $1.62 billion

($A1980) was spent on metals exploration resulting in 100 discoveries of which 43 can be classed as economic. The study showed that the average cost of finding an economic metal deposit in Australia is $38 million, but this statistic has arguably now been disproven by the successes related to gold exploration in recent years in Australia.

These studies came up with the broadly similar conclusion that the average cost of finding an economic metal deposit for the periods studied lies in the range of $20 to $40 million, a large sum by any standards.

3. THE PROBABILITY OF SUCCESS IS LOW

Statistics in this area are sparse but useful to consider as a guide.

Emerson[5] argues that 1 in 250 prospects tested becomes a discovery in a technical sense.

McKenzie[4] does not address directly the number of prospects that were tested to generate an economic discovery. He does however indicate the cost of making a discovery (defined as "indication of mineralisation of potentially economic grades across mineable widths obtained by drilling") as being of the order of $C450,000. Of 2118 such discoveries in Canada between 1951 and 1974, 40 could be classed as economic discoveries or one in 53 discoveries is economic. McKenzie does not say it, but it might be that each discovery results from the testing of, say, 5 prospects at a cost of $90,000 each. If so, this would suggest that the success rate for economic discoveries might be 1 in 250 prospects tested at an average cost per economic discovery of $23.8 million.

Boldy[6], quoted by Ross Large[7] in 1979, suggested a wide variability. A lucky or top explorer might find one economic discovery per 10 targets tested, an average explorer might find one economic discovery per 100 to 300 targets tested and the unlucky or poor explorer might find one economic discovery per 1000 targets tested. Large was of the view that each target in a volcanogenic terrain might cost $30,000 ($1974) to generate and test, giving costs to find an economic deposit of as low as $300,000 for the lucky or top explorer, $3 million to $15 million for the average explorer, and as much as $30 million for the poor or unlucky explorer.

SO WHY EXPLORE?

We have established so far that the exploration climate is unattractive, that the costs of discovery are high and that the probability of success low. Why then, should we be interested in exploration?

There are, in fact, many reasons, particularly from the viewpoint of the junior explorer. The statistics concerning the sufficiency of reserves and intensity of usage are misleading; the costs of funding an economic resource need not be high, and the probability of success need not be low. Exploration can be rewarding, especially for a junior while history has shown that depressed metal prices do not last forever. Finally, exploration provides one of the few means by which an aspiring junior can secure a competitive resource base and so develop into a profitable mining house.

1. THE STATISTICS ARE MISLEADING

While the statistics quoted earlier suggest that there are sufficient known reserves to satisfy demand well into the 21st Century, these statistics do not address the *quality* of the reserves. A lot of the resource counted in such statistics is not likely to support economic development in the near to medium term for a whole host of reasons. Other resources included in the statistics form the long term reserve base for existing mines and are not likely to contribute to an expansion of capacity.

In fact, events during the 1980's tend to suggest that the structure of the resource base is likely to change. For example, many mines are adopting high grading techniques in an effort to survive. In so doing large low grade reserves are being sterilised, or to put it another way, the required price to support development of such resource is increasing.

A proper analysis of such statistics should address the costs, including capital service charges, of bringing such reserves into production.

In some commodities, such as copper, there are a large number of undeveloped deposits overhanging the market. However, there is nothing to say that these deposits must be developed in the order in which they have been found. The development potential, and hence value, of a mineral deposit is a function of its cost to deliver product to the relevant market. This in turn is a function of factors such as

(a) grade and tonnage of ore
(b) nature and disposition of deposit
(c) location with respect to infrastructure, and
(d) mineralogy and metallurgy.

A deposit which can be developed at cyclical lows and meet both its operating and capital service costs with a sufficient margin can, and should, be developed. Deposits which cannot meet these admittedly harsh criteria should not and will not be developed.

It is also true that where two deposits of similar quality and cost structure exist, one in an LDC perhaps in Africa or Asia, and the other in a politically stable country such as Australia, the Australian project is more likely to be developed first since it is more likely to find funding support. The experience of funding entities such as the banks has not been happy in recent years in the LDC's.

One of the key factors leading to the depressed metal price environment of recent years has been the declining intensity of usage. It would appear that the rate of decline in intensity of usage is now likely to

lessen or perhaps stop altogether. The incentives to reduce intensity of usage are now much less pressing and the scope to further reduce intensity more limited. In fact the situation is such that if the intensity of usage of the developed western nations stabilises then the average world intensity of usage could pick up as the developing countries grow.

2. THE COSTS OF FINDING AN ECONOMIC RESOURCE NEED NOT BE HIGH

It is most important to recognise that the statistics indicating high cost for a economic discovery are based on *average* industry experience over a long time. There is abundant evidence to suggest that much of the money spent has not in fact been spent on low cost and effective exploration. Several factors arise:

- Many analyses show that there is a big difference between the efficiency and effectiveness of different exploration organisations. Some explorers have not had a single significant success despite many years of trying, while others have had repeated successes.
- The statistics used in such analayses do not distinguish between expenditures actually spent *exploring* i.e. in generating and testing of targets to the stage where a discovery is evident, and moneys spent on *proving* up discoveries. The latter sums are often very large and could dramatically distort the statistics.
- In some cases reported exploration expenditures will include sums not spent in the exploration area at all. Such items could include corporate, administrative, legal and other costs which are not strictly exploration in the terms of this discussion. Other such items could include research and development expenditure.

Periodically, a technical or economic breakthrough leads to an avalanche of new discoveries at low cost. The uranium discoveries of the Northern Territory and Canada and recent gold discoveries in many countries illustrate this phenomenon, for example Australian gold discoveries previously mentioned above in Section 2.3.

3. THE PROBABILITY OF SUCCESS NEED NOT BE LOW

Analysis of the track record of the exploration industry reveals that there are some companies which are improbably successful — far more successful than a statistical distribution based on dollars spent would predict. By contrast, a fair number of companies are improbably unsuccessful.

Western Mining provides a spectacular example of exploration success in Australia. The McKenzie/Bilodeau study of Australian exploration prepared in collaboration with WMC addresses this point. Roy Woodall[8]: "WMC spent 7 per cent of the exploration funds during the 24 year study period and discovered 19 per cent of the economic discoveries (by mineral fields) including by far the largest deposit i.e. the giant Olympic Dam copper-uranium-gold deposit. Assessed on the same basis as the total industry, but with its discoveries grouped into mineral fields to reflect most accurately the situation in the Kambalda region, WMC's exploration investment between 1955 and 1978 shows an expected value of $35 million (industry average = $4 million) and a rate of return of 17 per cent before tax (industry average 11 per cent) (see Table). This assessment of WMC's performance excludes the financial benefits of the giant Olympic Dam deposit although this deposit was considered in calculating the financial returns for the total industry. When WMC's performance is removed from the industry average, the results are very discouraging for the expected value of an exploration investment is negative (minus $12 million) for other companies when taken as a group and the rate of return is only 7 per cent."

Other companies in Canada, Australia and elsewhere, some of which were juniors at the time of their major discoveries, have shown that the apparent odds against success can be beaten.

4. EXPLORATION CAN BE REWARDING

Exploration *can* provide a means by which a junior company can overcome the barriers to entry in gaining control of a resource base and there are many examples of this. Most, if not all, of today's major mining companies both Australian and overseas have resulted from participation in one way or another in major discoveries.

An interesting point is that a discovery can permit a company to raise funds and acquire cash flow opportunities *without* the original discovery having been developed. A prime example of this is Pancontinental, whose Jabiluka uranium discovery gave it the ability to raise funds and grow by acquisition and exploration.

Discovery of even modest orebodies can be very rewarding for the explorer even if the deposit does not appear likely to support a project. The nature of the mining industry is that metal prices tend to be highly cyclical. Further, the nature of markets is such that buyers of assets tend to proliferate at cyclical highs giving opportunities to sell deposits on very favourable terms. Few companies manage, however, to achieve this. Most sales take place at cyclical lows when the owners become depressed and financially stressed. At the cyclical highs owners tend to become caught up in the enthusiasm of rising markets and fail to capitalise on the opportunity to sell a competitively unattractive resource.

There are many examples which show that the rewards of discovery can be considerable. Examples of companies, most of which were juniors at the time of their major discovery, with significant discoveries in recent years, include the following incomplete list:

Pancontinental Mining	Jabiluka
Western Mining Corp.	Kambalda
Queensland Mines Ltd.	Nabarlek
Greenbushes	Greenbushes
Peko Wallsend	Juno
Poseidon	Mt Windarra
Niugini	Lihir Island
Mungana Mines	Red Dome, Starra

Other bonanza discoveries made by majors might have been made by juniors. An example of this is the Pajingo deposit near Charters Towers.

Table *Financial Assessment of Australian Exploration 1955—1978*

Total Expenditure	$1618 million
No. of Economic Discoveries	43
Average Expenditure per Discovery	$38 million
NPV of Average Exploration Expenditure*	$19 million
NPV of Average Return from Development*	$23 million
∴ Expected value at start of exploration*	$ 4 million
D.C.F. Rate of Return	11%

NPV = Net Present Value at start of exploration assuming 10% discount rate

Table *Comparative Financial Assessment of Exploration 1955—1978*

	ANALYSIS BY INDIVIDUAL DEPOSITS		ANALYSIS BY MINERAL FIELDS
	WMC	Other Companies	WMC
Total exploration expenditure ($ Million)	112	1506	112
No. of Economic Discoveries	15	28	5
Expenditure per discovery ($ Million)	.8	54	22
Years per discovery (Per $2.5 million annual budget)	3	22	9
NPV of exploration expenditure ($ Million)	7	22	14
NPV of return from development ($ Million)	33*	10	51*
∴ Expected value at start of exploration ($ Million)	26*	-12	35*
D.C.F. Rate or Return	23%*	7%	17%*

* Olympic Dam excluded.

Source: R. Woodall (8)

5. DEPRESSED METAL PRICES DO NOT LAST FOR EVER

While the mining industry is currently depressed, history shows that the industry is highly cyclical. Depressed prices tend to cause high cost mines to close and cause investment in new mines to be deferred as well as stimulating demand. Thus, cyclical lows contain within themselves the seeds for a subsequent cyclical recovery.

The explorer who can raise sufficient funds to maintain activities through cyclical lows is well placed to benefit from the eventual recovery. First, cyclical lows offer opportunites to acquire properties and prospects at low prices. Second, the explorer is well placed to benefit from the upturn since the merit of the portfolio will tend to be recognised by investors and joint venturers giving opportunites to raise funds by equity raisings or by farm out.

6. EXPLORATION PROVIDES A MEANS OF ENTRY

The aspiring mining company has a strong incentive to explore. Such a company has to secure control of a potentially economic resource if it is to establish a strong position in the mining industry and make profits. There are limited means by which control of an economic resource can be achieved:

1. Buy an operating mine.
2. Buy an undeveloped resource.
3. Explore.

All three avenues need to be looked at by the ambitious junior. Each approach involves different degrees of risk and funding requirements. Development of a profitable operation by any of the three methods is facilitated by the application of sound management approaches, effective industrial relations, innovative marketing and the introduction of relevant new techologies. Acquisition of operating mines or undeveloped reserves is not really possible for the junior except perhaps at cyclical metal price lows. But even at such times the junior will find difficulty in raising the necessary funds. And it is also clear the deposits which find their way to the market place are often not terribly attractive. McKenzie: "There is little incentive for the discoverer of a bonanza to sell that discovery at anything less than a premium price. There are, infrequently, distress sales where acquisitions come onto the market at bargain terms. In these instances, flexible, aggressive and well informed management, with the capability to evaluate a broad spectrum of deposit types and mining methods are in a position to make bold moves which can affect corporate profits and growth. Noranda, for a number of years, has prospered using this technique. In contrast, companies such as Western Mining and Selection Trust have succeeded by concentrating their resources on primary generative exploration."

7. SUMMARY OF REASONS TO EXPLORE

1. Exploration is a necessary and potentially effective method for a junior to overcome the barriers to entry.
2. The rewards for successful exploration can be spectacular and at the very least offer opportunities to stay in the game until the bonanza is discovered.
3. Continuation of exploration activities during metal price lows offers opportunities when prices recover.

4. Political and economic factors suggest that there is always room for a well located, high quality deposit to be developed, especially if it is located in a politically stable country such as Australia.
5. A well managed junior following a carefully developed strategy can achieve exploration success at relatively low cost.

WHAT FACTORS DISTINGUISH THE EXPLORER MOST LIKELY TO SUCCEED ?

Quite a few writers have investigated the characteristics that distinguish successful explorers from unsuccessful explorers. An extraordinary unanimity of view emerges when one reviews this literature.

Successful exploration clearly results from effectively harnessing the talents of very few talented, experienced and highly motivated individuals. The need for an imaginative entrepreneurial approach is evident. Exploration is about effective entrepreneurship in the conventional commercial sense, but also in a technical sense.

Exploration is best carried out by small teams with a lot of freedom to develop and pursue their ideas or perhaps even by talented individuals backed up by an appropriate support organisation. Persistence, aggressiveness, flexibility, and technical depth are all necessary.

Successful explorers are likely to follow clearly articulated strategies designed to embrace important concepts such as 'first pass' exploration. Some consideration will have been given to the odds against discovery and there will be little reliance on 'luck'.

1. FIRST PASS EXPLORATION

An effective exploration strategy needs to address the concept of first pass exploration. McKenzie: "Exploration is a dynamic process in the long term, tending to detect first those deposits which are largest, highest grade, closest to surface, or closest to market. Consequently the best, easiest-to-find deposits will, on average, be discovered, developed, and exhausted first. Lower quality, smaller, or harder-to-find deposits will remain for the future."

It is important to be the first to look at a new territory using conventional methods *or* the first to look at well explored territories in new ways. New ways might encompass the use of innovative exploration technologies, new ore genesis concepts, new models of tectonic controls, etc.

Most major discoveries fall to those who position themselves to undertake first pass exploration. Mt. Isa and Broken Hill were discovered by the first prospectors who recognised the significance of the surface outcrop. The Kidd Creek deposit was located by the first company to try the area with airborne geophysics, the Ranger and Nabarlek deposits were located by the first companies to use airborne radiometrics in the East Alligator River area.

2. TECHNICAL EXCELLENCE

An explorer must ensure that a sufficiently high level of technical expertise is committed to a program. Many targets are drilled unnecessarily when a competent explorationist could have discerned that the probability of success, in that particular case, was very low.

Exploration is an area with a lot in common with Research and Development. In many companies, no-one really expects the explorationists to find an orebody, and if they do it may not be clear whether the success is due to luck or a technically excellent piece of work. Few managements properly assess the quality of the technical work being done.

Two results develop from this:

1. Money is wasted testing targets which should never have been drilled.
2. Valid targets, which should have been identified and tested, remain unrecognised in the data.

Certain companies develop a reputation as being good to follow in that they do good basic data collection but seldom recognise the significance of the data. Clearly, these companies have both wasted an exploration effort, and worse, may have missed an orebody through improper testing. Such poor quality work is evident in a lot of data lodged on the open files of the various Mines Departments.

A common feature of larger organisations is that the most experienced explorationists are often promoted to management roles out of touch with the all important field activities which are left to relatively inexperienced people. Talented entrepreneurial explorationists often become frustrated in the big company environment and resign, leaving the more security conscious, more conservative individuals to dominate the organisation.

3. CLEARLY ARTICULATED STRATEGY

A successful exploration effort needs to develop a strategy to find the target deposit. There are many strategies which could be successful in finding orebodies — the important thing is to choose one which capitalises upon the particular strengths of the company.

WMC clearly develops successful strategies based on the persistent and patient pursuit of a particular target type and ensures that superior expertise is devoted to developing the strategy.

Most successful exploration strategies would consider the following issues:

1. Articulate the nature of the target being sought, its likely tonnage, grade and type.
2. Establish the likelihood that such a target might exist by comparing the target with the known population of such orebodies either world-wide

or locally. For example, it is clearly fruitless to look for a porphyry copper deposit grading 3.0 per cent if no such deposit is known to exist.

3. Consider the likely competitive economics of the target deposit in the environment in which it is being sought. It is more important to establish the likely cost of delivering product than it is to look at likely profitability.
4. Investigate the geological rationale for the target deposit to exist in the environment being considered. The best evidence for the target existing in an environment is the existence of a real orebody in similar rocks nearby. Age, type of rocks, tectonic environment all offer clues as to the likelihood that the target deposit might be present.
5. Anticipate the clues that the target deposit might give as to its presence. Will it have a geochemical signature, geophysical signature, or other indications. This concept can be termed "Findability". There is no point in looking for a deposit if the target is unlikely to leave tracks which can lead to its discovery. The only tactic which might find such an orebody would be pattern drilling.
6. Consider the likely cost of an exploration program — can the target be located and tested cheaply or will a long and comprehensive program be needed to locate the deposit, if it exists.

A simple ranking system addressing each of these factors as high, medium or low gives a ready means of establishing priorities and allocating funds.

Finally, the explorer must consider how the program will be funded. Different considerations may apply if funds are to be provided by third parties, such as joint venturers, as opposed to internally generated funds. This consideration is particularly important in the case of junior explorers.

One strategy may involve the establishment of a mine or a small resource in a mineralised area. If the project is profitable, although small, many benefits arise.

a. The presence of a mill in a mineralised district opens up opportunities to exploit other small deposits which themselves could not support a mill.
b. In mining the deposit the geologists gain a detailed understanding of the ore occurrence and its controls.
c. A moderately paced but persistent program can be pursued in the area funded out of mine cash flows.

The entire exercise takes advantage of the notion that ore tends to occur in areas where ore is known to occur.

The important thing is to develop a strategy and pursue it with persistence and dedication.

4. CAPABILITY MORE IMPORTANT THAN LUCK

Exploration can be seen as having characteristics in common with poker, i.e. a game where skill and strategies are in the long run far more important than "luck". Exploration is far from being a game of chance although, as in poker, an understanding of the odds plays an important role. Exploration clearly embodies, like poker, rewards for skilful players.

McKenzie and Bilodeau[10] refer to the role of 'luck' in exploration when they discuss what they term the 'intuitive' approach.

McKenzie: "Traditionally, exploration decisions have been based in large part on intuitive, subconscious considerations which may be referred to as hunches, gut feelings, or subjective judgements. This seemingly ill-defined, oldfashioned method continues to be an important 'tool' in exploration management. Indeed, there is no doubt that the intuitive approach can be of real assistance in generating ideas and choosing alternative courses of action under conditions of limited information and high risk.

"A clear distinction should be drawn between intuitive exploration decisions and decisions based on random guesses. No intuition, or skills of any sort, are required to make random guesses, only a table of random numbers. Exploration approaches such as grid drilling, saturation prospecting, and mechanistic follow-the-rules exploration (e.g., always spend 30 percent of the program budget on drilling), arise from an implicit belief that exploration is a random process. Such procedures negate the purpose of the sequential exploration process which is to make decisions in the light of evolving information. Mineral exploration does have some of the characteristics of gambling, but the idea that exploration is a random or chance device, where success is based on 'luck', leads to fallacious high-cost exploration management."

It could be argued that what McKenzie and Bilodeau refer to as the "intuitive" approach could be another term for the distilled experience of many years of participation in many and varied exploration problems. Certainly, the point tends to support the need to involve experienced, talented individuals in exploration programs.

5. CONSIDERATION OF THE ODDS

An issue which needs to be considered in developing an exploration strategy is to consider what might constitute a meaningful number of prospects to be tested. In general the more prospects tested, the more likely will success be, but that is not all there is to it. It is better to test a few high quality targets than to test many less attractive targets. However, in many cases it is difficult to distinguish the relative merits of different targets, so in general the more targets tested the better.

A conceptual example might illustrate the point. Earlier discussion suggested that the success rate for

exploration in Canada and Australia might be one economic discovery for every 250 targets tested. Cost to generate and test each target might average $90,000 giving an expenditure of $22.5 million to find an economic discovery (ignoring the concept of Gamblers' Ruin for the purposes of this discussion). Now if the explorer carefully screens the 250 targets using criteria suggested earlier,it is probable that he might be able to eliminate 200 of the 250 targets as less likely to be prospective, giving 50 more-prospective targets, which hopefully will still contain the bonanza target sought. If a strategy can be developed which allows the cost of generating and testing of the target to be reduced from $90,000 to, say, $45,000 then the cost to find the economic discovery drops to $2.25 million from $22.5 million. It may be that the first such program is unsuccessful in which case a similar program could be pursued giving *better* chances of success for only 20 per cent of the initial outlay.

Let us illustrate the situation with an example in the area of oil exploration.

Statistics on Australia's oil exploration used to indicate that, on average, one hole in 30 was successful. The figure today may well be different — it certainly is in the Cooper Basin where the rate might be more like one successful well in five or three! The main point to note is that if an explorer is playing a 1 in 30 game, then if he wants to be sure of being successful, he must participate in at least 30 wells.

If an explorer is exploring in a known field with a higher success rate, then the number of wells needed will be far less, but the entry cost of securing access to the program will be correspondingly higher.

Conversely, if an explorer is looking in a basin which has proven to be unsuccessful or has odds of say one successful well in 100, his program needs to take this into account.

Of course, it is always possible that an explorer will convince himself that an oil field is present from seismic or other means. In that event, if he is right he will only have to drill one hole to achieve his success, even if the target lies in a basin where there have been no successful holes.

The point does not need to be laboured, but it does need to be taken into account when considering exploration strategies.

A lovely example of what can happen when these principles are ignored was given a few years back. A newly listed oil explorer raised several million to participate in two (count them) offshore oil wells. The participation in each case was significant. The two holes were subsequently drilled and both proved to be dusters. The company's funds were exhausted and you can guess the response from the market when additional funds were sought.

The company clearly would have been better advised to take lesser participation in a larger number of less costly holes. There is room for the bold plays but they are best left to the majors who are adopting a portfolio approach from a much stronger funding base.

Similar principles apply in the area of mineral exploration. Statistics are meagre and in any case not very helpful, but it is clear that in minerals, the odds in general are longer than in oil, i.e. more prospects must be tested, but the cost of each test is generally much less.

This type of analysis should not be taken too seriously but it does indicate issues which need to be considered when strategies are formulated.

THE ROLE OF THE JUNIOR

It becomes clear that junior companies may be more able to establish an effective exploration outfit than the big companies, and at a much lower cost. In many cases the corporate organisation itself may be a major stumbling block for many companies involved in exploration and mining. This is because an entrepreneurial activity (exploration) is combined with an essentially conservative activity (mining). This combination can create conflict. The successful company has to be able to harness diverse activities and mixed disciplines into a corporate structure that remains flexible and willing to undertake risk. This is not always easy in a large organisation which presents opportunities for a top heavy bureaucracy, frequently leading to delays in important decision making.

Juniors have a major advantage in attracting and utilising talented explorationists:

1. Juniors can offer direct participating interests in discoveries — seldom attainable in large organisations.
2. The work environment of a junior is more likely to be stimulating, challenging and entrepreneurial.
3. Communications in a junior company can be excellent, with a short chain of command.
4. Juniors can eliminate bureaucracy, maximise management time and minimise administrative activities.
5. Juniors can make quick decisions.

Many majors today recognise the advantage that juniors have in generating grass roots exploration projects and in securing title to prospective ground. Many majors prefer to let the juniors carry out the grass roots project generation work, secure title and demonstrate the prospectivity of an area. The majors take advantage of their relatively stronger financial position and select projects in which to participate by way of a farm-in.

This process is to the great advantage of both parties.

Some companies take this process a step further by entering into an exclusive general joint venture with a junior. A fine example of this approach is the Kennecott Joint Venture with Niugini Mining which

has resulted in the discovery of the world class Lihir Island gold deposit. Kennecott funded the program developed by Niugini Mining and allowed Niugini Mining a free carried interest in the program.

CONSTRAINTS ON JUNIORS

Juniors are usually constrained in their activities by the limited availability of funds. They can make up for this by their resourceful and efficient approaches.

A significant problem for juniors is that the availability of funds tends to be dictated by the current "flavour of the month". Stock market interest and equity funding capacity is usually limited to the commodities currently in favour and this also tends to be true of joint venture funds available from majors.

It is therefore difficult for a junior to take advantage of cyclical lows to build up a portfolio of commodities currently out of favour but which next year might be "flavour of the month".

A significant problem for junior explorers is their inability to utilise the tax losses generated by their exploration activities. It is important to find a source of income to keep the company going and utilise the tax losses.

Incidentally, it is worth noting the circumstances surrounding the formation of WMC. WMC was incorporated on March 2, 1933 with an initial issued capital of two million pounds. That is a not inconsiderable sum, if escalated to 1986 dollars!

SUGGESTED INVESTMENT STRATEGY

Investment in junior exploration companies can be very rewarding. It can be argued that a small proportion of investable funds should be allocated to what might be termed high risk/high reward investments, especially when the potential returns from such investments will come by way of capital gains and so be attractive to non-tax paying funds.

It is suggested that portfolio managers invest in a portfolio of say 5 junior explorers and treat this exposure as one investment. Providing that stock selection is done according to some simple criteria, and providing that the investor is prepared to let the stocks mature in their own time, the probabilities are that at least one, if not more, of the companies invested in will generate spectacular capital gains thereby easily offsetting the possible writeoff of the other holdings. Even better gains will be achieved by investors who adopt a contrarian approach and buy during periods of depressed metal prices when explorers are out of favour.

By this means, the investor is in a privileged position to participate in a sufficiently wide spread of exploration projects so that the probability of failure is reduced to very low levels.

For example, if an investor bought into five companies each of which had plans to participate in a meaningful way in 100 projects over a five year period, the investor would have exposure to some 500 projects over that time. That is a sufficiently large number to offer a high probability of success.

Juniors provide a highly leveraged way of participating in exploration. A discovery worth $100 million will have a major impact on a junior with 20 million shares and market capitalisation of $10 million before the discovery, whereas the same discovery made by a major would have only a modest impact on the share price.

CRITERIA FOR SELECTION

The objective is to identify companies with the best chances of exploration success, and the best prospects of significant capital gain if such a success is realised.

1. Does the company engage experienced highly qualified explorationists with a track record of ore discovery?
2. Does the company use an integrated exploration approach effectively utilising all relevant disciplines?
3. Do the key explorationists have a stake in the company or in the deposits they may find?
4. Does the company have a clear exploration strategy to effectively utilise the skills at its disposal?
5. Does the company have a spread of exploration exposures across different commodities and exploration regions?
6. Is the company well regarded by the major explorers? This can usually be established by direct enquiry.
7. Has the company been successful in attracting majors as joint venturers on favourable terms given the market environment?
8. Has the company been active for two years or more?
9. Is the issued capital base reasonably tight and market capitalisation modest considering its other asset?
10. Are the people associated with the board and management of the company regarded as professional, competent, and of integrity?
11. Has the company used funds raised to date in building an attractive portfolio of assets?
12. Has the company been effective in raising joint venture funds to supplement internal funds? What is the ratio of internal expenditure to expenditure on the company's funds by joint venture partners.

A company which passes all of these criteria is likely to prove an attractive investment in the long run and should be able to attract the funds necessary for its survival.

CONCLUSION

Despite an apparently unattractive climate for investment in mineral exploration, it is likely that investment in a basket of judiciously selected juniors can be very profitable.

The current depressed metal price environment will not last forever and well positioned junior explorers are likely to benefit from the eventual upturn in metal prices and the return of investment interest to the sector.

Some juniors can be identified as more likely to be successful in finding a bonanza orebody and leverage to a discovery can be very high.

A small proportion of available funds can be invested in a basket of junior explorers selected using the criteria given with a high degree of confidence.

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