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19

VALUATION OF NON-PRODUCING MINERAL PROPERTIES

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ABSTRACT

Valuation methods are well established for mineral properties with production or imminent production, and include discounted cash flow and comparable transactions. Valuation methods for non-producing mineral properties, however, are more subjective.

Non-producing mineral properties include those at various stages of exploration, properties at the prefeasibility or feasibility stage, properties with currently uneconomic mineral resources, and past-producers. Different valuation methods may be appropriate for different types of mineral properties.

Income approach methods such as discounted cash flow and option pricing are generally not applicable to properties at the exploration stage. The market approach is generally appropriate to all types of mineral properties, although it is difficult to find good comparables because of the unique nature of mineral properties and the small number of transactions. Cost approach methods, such as appraised value and geoscience factor, are commonly used for exploration stage properties.

Canadian standards and guidelines for valuation of mineral properties are in the process of being finalized by a Special Committee of the Canadian Institute of Mining, Metallurgy and Petroleum (CIMVal Committee). The CIMVal Standards are intended to be consistent with National Instrument 43-101, which sets regulatory standards of disclosure for mineral projects, and with International Valuation Standards. The intent of the CIMVal Standards and Guidelines is that mineral property valuation be carried out by appropriately qualified individuals and that all relevant information be disclosed.

The Standards and Guidelines are based on industry best practice and allow for professional judgment in certain instances.

INTRODUCTION

The purpose of this paper is to describe approaches and methodology for the valuation of non-producing mineral properties, to provide some valuation examples, and to outline general levels of mineral property values. By way of background, different types of mineral properties are defined, since they require different valuation approaches and methods. Since the vast majority of mineral properties are non-producing properties at the exploration stage, the nature of exploration properties and the exploration process are covered.

Valuations of mineral properties are needed for various reasons, including mergers and acquisitions, non-arms' length transactions, pricing of initial public offering of stock, support for property agreements, litigation, compensation for expropriation, and insurance claims. Independence of the valuator is usually implicit for these applications.

Value and valuation in this paper refer to fair market value. In some circumstances, other definitions of value may apply, such as net present value, replacement value, salvage value, book value, assessed value, insured value, etc.

Mineral property refers to any right, title or interest to property held or acquired in connection with the exploration, development, extraction or processing of minerals which may be located in, on or under the surface of the property, together with all related plant, equipment and infrastructure. Mineral property may take the form of real property, unpatented mining claims, prospecting permits, development and mining licenses, mining leases, patented mining claims, etc.

One of the important concepts of fair market value that is critical to mineral properties is the effective date of valuation. This is because mineral property values vary over time, depending on events on neighbouring properties, market interest, commodity prices, etc. In respect of a valuation for an expropriation, insurance claim or litigation, the effective date may be a very contentious issue. This is because the mineral property owner may perceive that the property will be more valuable in the future, when market conditions improve, and that the expropriation or legal issue forces the valuation in poor market conditions.

STANDARDS FOR VALUATION OF MINERAL PROPERTIES

Canadian standards and guidelines for valuation of mineral properties are in the process of being finalized by the CIMVal Committee.

In the wake of the Bre-X gold salting scandal, the Mining Standards Task Force (MSTF) was formed by the Toronto Stock Exchange and the Ontario Securities Commission. The MSTF made a number of recommendations in its 1999 final report with

a view to improving the regulatory climate in the exploration and mining industries. Many of the recommendations dealt with the establishment of professional standards in several areas, including valuation of mineral properties. This led to the formation of the CIMVal Committee, of which the writer is Co-Chair. The CIMVal Draft Standards and Guidelines were released in February 2002 for comments by interested parties. A final draft was released for further comments in September 2002. The CIMVal Standards and Guidelines for Valuation of Mineral Properties are expected to be finalized in late 2002.

National Instrument 43-101, Standards for Disclosure of Mineral Projects (NI 43-101), which came into force February 1, 2001, was formulated by the Canadian Securities Administrators, an umbrella association of provincial securities commissions. NI 43-101 is now the principal regulatory document in Canada for disclosure of information on mining projects. The CIMVal Standards and Guidelines have been drafted to be consistent with and to augment NI 43-101 with respect to valuation of mineral properties. The CIMVal Standards and Guidelines are also intended to be consistent with the general thrust of the International Valuation Standards being developed by the International Valuation Standards Committee.

The Australian VALMIN Code and Guidelines govern the technical assessment and/or valuation of mineral and petroleum assets and securities and set standards for independent expert reports. In South Africa, standards and guidelines for valuation of mineral projects, properties and assets are at the drafting stage (SAMVAL Code). The International Valuation Standards Committee aims to develop standards for the valuation of mineral properties within the framework of its International Valuation Standards.

The CIMVal Standards recognize other documents relevant to valuation in general. These include Ontario Securities Commission Rule 61-501, Canadian Institute of Chartered Business Valuators standards for the valuation of businesses and corporations, and Investment Dealers Association of Canada Bulletin #2827.

The guiding philosophy and intent of the CIMVal Standards and Guidelines is that mineral property valuation be carried out by appropriately qualified individuals and that all relevant information be disclosed. The Standards and Guidelines are based on industry best practice and allow for professional judgement in certain instances. Key features of the Draft Standards and Guidelines are:

- They cover valuation of mineral properties but not valuation of corporations.
- They cover metallic and non-metallic mineral properties, both subsurface and surface, and energy fuels. Oil and gas properties are not covered.
- Value refers primarily to Fair Market Value.
- The basic tenets are materiality, transparency, independence, competence and reasonableness.
- A Qualified Valuator (QV) is responsible for the overall valuation, and may be

assisted in or rely on a Qualified Person (QP) for various aspects. The QV must be a professional with at least five years of relevant experience, and must belong to a self-regulatory professional organization. The QP is a geoscientist or engineer with at least five years of relevant experience, and must belong to a self-regulatory professional organization.

- All technical input to a valuation, including Mineral Reserves and Mineral Resources, must be verified by a QP.
- The entity commissioning a valuation must reasonably establish that the QV is sufficiently qualified, competent and independent. Similarly, the QV must be satisfied with the credentials of any QPs involved in the valuation.
- The QV has the responsibility to decide which valuation approaches and methods to use. The three standard methods of Income, Market and Cost must be considered.
- The valuation must be reported as a range of values to reflect the uncertainty of the valuation process.
- The valuation must be reported in a Valuation Report that sets out, among other things, the key risks and assumptions used. The Guidelines recommend a table of contents for the Valuation Report.
- Mineral Reserve and Mineral Resource estimates must be disclosed, and must follow definitions as set out in NI 43-101.
- For Income Approach methods, such as discounted cash flow, it is generally acceptable to use all Proven and Probable Mineral Reserves, and to use Mineral Resources that a QP states are likely to be economically viable and for which the higher risk is recognized in the valuation by some appropriate means.
- The valuation date must be specified and all valuations within the previous 24 months must be discussed.
- The Valuation Report must include Certificates of Qualifications for the QV and any QPs involved, and a statement that the valuation complies with the Standards and Guidelines.

TYPES OF MINERAL PROPERTIES

There are three main categories of mineral properties that require different approaches to valuation. These are development properties, exploration properties, and marginal development properties, which are defined below. This subdivision is based on technical information rather on the type of mineral tenure. Exploration properties and marginal development properties are non-producing mineral properties.

In the minerals industry, mineral exploration properties are optioned, joint ventured, bought, sold and traded on the basis of perceived exploration potential. There are a number of different approaches and methods that are used to value mineral exploration properties, all of which are subjective.

There is also a spectrum of mineral properties, ranging from exploration properties to producing mines, each of which requires different valuation approaches. For convenience here, mineral properties are categorized as development properties, exploration properties, and marginal development properties.

Development Properties

Development properties are those on which an economically viable mineral deposit has been demonstrated to exist. Such properties are at a sufficiently advanced stage that enough reliable information exists to value the property by discounted cash flow analysis, with a reasonable degree of confidence. In general, such information includes reasonably assured mineable reserves, workable mining plan and rate, metallurgical test results and process recoveries, capital and operating cost estimates, environmental and reclamation cost estimates, and commodity price projections.

The value of a development property is the net present value of a stream of estimated cash flows, discounted at an appropriate rate to properly reflect the risk of the mining project. Development properties include producing mines as well as properties on which development of an economically viable operation is feasible, planned or under construction.

Exploration Properties

Exploration properties are those on which an economically viable mineral deposit has **not** been demonstrated to exist. The real value of an exploration property lies in its potential for the existence and discovery of an economically viable mineral deposit. Only a very small number of exploration properties will ultimately become mining properties, as discussed in the following section, but until exploration potential is reasonably well tested, they have value. Exploration properties can be further subdivided into those with and without quantifiable mineral resources.

Marginal Development Properties

Dividing mineral properties into exploration or development properties is relatively straightforward for the most part. There are some mineral properties, however, which fall into a grey area between the two groups. These are properties which contain well-defined mineral resources which would become economically mineable reserves under improved circumstances, and have enough reliable data to show that the economics are

marginal under prevailing conditions at the time of valuation. Improved circumstances can include commodity prices, technology improvements, establishment of local infrastructure, etc. Such properties are herein called marginal development properties. These also include mines which are temporarily closed down due to low commodity prices. Marginal development properties may have to be valued by a third type of valuation approach, such as the option pricing method.

EXPLORATION PROPERTIES AND THE EXPLORATION PROCESS

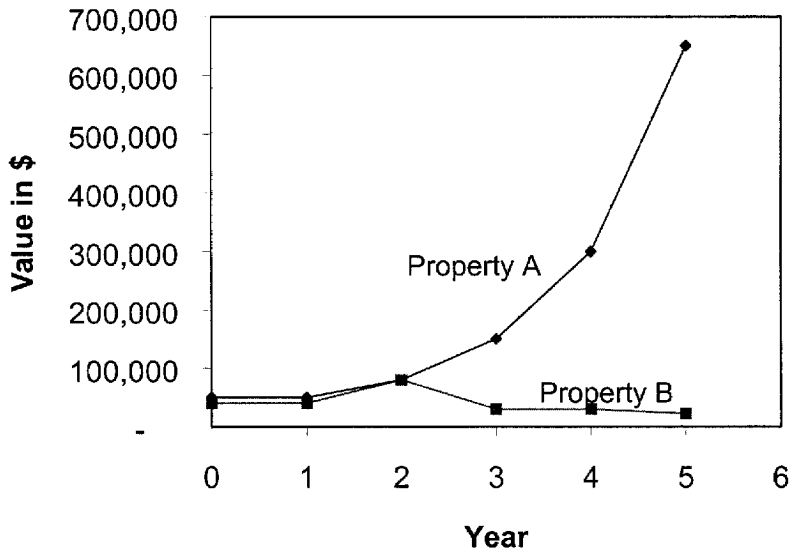
Exploration properties are non-producing mineral properties that are acquired for their perceived potential to host an economic mineral deposit. The challenge of the exploration process is to discover economic mineral deposits on those very few exploration properties where they exist.

Modern exploration is a staged process. In general, each stage of exploration work is designed to get to the next decision point, that is, whether or not to continue exploration on a property, based on results of the previous stage. Each successive stage is, in general, more expensive, due to the progressively more detailed nature of the work required. Whenever an exploration program moves to the next stage, the value of a property may be enhanced, reduced, or remain the same, depending on how results of the program affect the perceived exploration potential.

The objective of the exploration process is to identify and concentrate work on the properties that show more promise in terms of exploration potential, and screen out the properties that are downgraded by ongoing work. Obviously the properties on which work demonstrates higher exploration potential are more valuable to mining companies. A corollary is that exploration properties on which work demonstrates little or no potential have little or no value.

Figure 1 illustrates how the values of exploration properties vary over time and emphasizes the importance of the effective date of valuation. Exploration work on Property A gave encouraging results year after year, which shows up as an increase in value over time. Exploration work on Property B gave encouraging results and increased in value over the first two stages of exploration in the first two years, but exploration work in year 3 was discouraging, resulting in a decrease in value. No work was done in years 4 and 5 on Property B, resulting in a leveling off then a decrease in value and market interest declined.

Figure 1: Variation in the Values of Exploration Properties over Time



The intrinsic value of an exploration property lies in its potential for the existence and discovery of an economic mineral deposit. In the mining industry, mineral exploration properties are optioned, joint ventured, bought, sold and traded on the basis of perceived exploration potential. There are a number of different approaches and methods that are used to value mineral exploration properties, all of which are subjective.

VALUATION APPROACHES AND METHODOLOGY

As in other fields, the three main approaches to valuation of mineral properties are income, cost and market approaches. Different approaches apply to different types of mineral properties as do different methods, in the writer's view, as summarized in Table 1.

Table 1: Valuation Approaches and Methods for Different Types of Mineral Properties

Valuation Approach	Valuation Method	Development Properties	Marginal Development Properties	Exploration Properties
Income	Discounted Cash Flow	Yes	Maybe	No
	Option Pricing	Yes	Yes	No
Cost	Appraised Value	No	Yes	Yes
	Geoscience Factor	No	Maybe	Yes
Market	Comparable Transactions	Yes	Yes	Yes
	Option Agreement Terms	Yes	Yes	Yes

INCOME APPROACH

Discounted Cash Flow Method

As noted above, development properties are those on which an economically viable mineral deposit has been demonstrated to exist. Development properties may be in production or may be in preparation for production. Demonstration of economic viability requires that sufficiently reliable technical, financial and other information have been generated to assess the economics of the property with a reasonable degree of confidence. The appropriate approach to valuing development properties is discounted cash flow (DCF) analysis to determine the net present value of a stream of estimated future cash flows. The DCF method can also be used for marginal development properties, but its usefulness is doubtful because low or negative values may be derived which do not necessarily reflect the market value.

The DCF method is a well established and standard method used in the mining industry to value development properties. Such properties are commonly bought and sold on the basis of net present value derived from DCF analysis.

DCF analysis requires that the property is sufficiently advanced that reliable and up to date information is available in the following areas:

- reasonably assured mineable reserves (proven and probable);
- mining plan, rate and schedule;
- metallurgical test or operating results;
- process recovery and design;
- capital cost estimates including mine, process plant, surface facilities and infrastructure, environmental compliance, decommissioning and reclamation, working capital, etc.; and
- operating cost estimates including mining, processing, administration and management, transportation, infrastructure, environmental compliance, sales, royalties, etc.

Other factors which form important components of a DCF analysis are:

- reasonable commodity price projections and currency exchange rate;
- federal, provincial and municipal taxes; and
- appropriate discount rate.

Valuations by the DCF method should always allow for the return of the capital invested in determination of the net present value. The net present value should also take into account all applicable taxes.

Sensitivity analyses are commonly done in connection with DCF analysis to determine the effect of various estimated parameters on the net present value. This is very useful for identifying variables that have a large effect on the viability (and value) of the property, such as metal grade, operating cost, commodity price or capital cost. Monte Carlo analysis can be used to quantify the expected value in response to variability in input parameters.

The main advantage of the DCF method is that it is a well established and widely accepted method of valuing advanced mineral properties and operating mines. There are two main disadvantages to the method. One disadvantage is that it is commonly applied without due regard for the quality and reliability of the input factors, particularly technical parameters such as mineral reserve tonnage and grade, estimated capital and operating costs, metallurgical recovery, etc. The other disadvantage is that the method may undervalue mineral properties in times of low commodity prices.

Option Pricing Method

The option pricing method is suited to the valuation of marginal development properties, where the level of information in terms of detail and reliability is similar to that of

development properties, but DCF analysis results in a very low or negative net present value at current commodity prices. Such marginal development properties nevertheless have value, since transactions do occur. Marginal development properties also include mines temporarily closed down due to low commodity prices.

The option pricing method is described in publications by Brennan and Schwartz (1985), McKnight (2002), McKnight and Goldie (1990), and Palm et al. (1986). In general, the method is poorly understood and is not used much in valuation of mineral properties.

In the option pricing method, a mineral property is regarded as a complex option on its mineral reserves. The approach involves developing various models for the options available, which include:

- the option to develop and commence production;
- the option to shut down or resume production;
- the option to hedge production;
- the option to change the rate of production; and
- the option to change the grade of production.

An option pricing model can be developed whereby a value is generated by modelling such factors as the strike price, the costs of exercising the option, and the probability that the option would be exercised. The strike price is the price of the underlying commodity at which management would consider exercising the option.

The advantage of the option pricing method is its ability to value marginal development properties, which in the real world change hands for significant consideration, while standard DCF analysis renders low or negative values. One disadvantage may be the complex mathematics involved. In the option pricing approach, care must be taken that the various options available to management of an operation, such as to shut down and reopen, must be realistic in terms of practicality, cost, and the time needed.

COST APPROACH

Methods using a cost approach, such as the appraised value method and the geoscience factor method, are applicable to non-producing mineral properties, that is, exploration properties and in many cases marginal development properties.

Appraised Value Method

The appraised value method is based on the premise that the real value of an exploration property or a marginal development property lies in its potential for the existence and

discovery of an economic mineral deposit. The appraised value method assumes that the amount of exploration expenditure justified on a property is related to its value. The cost approach is given some validity by the fact that option agreements on mineral properties are often based on expenditures required to earn an interest. There is also often a reference to past exploration expenditures in option agreements, which can be related to value of the residual interest of the optionee.

The appraised value method is described in papers by Roscoe (1988, 1999, 2001, 2002), Agnerian (1996a), Thompson (1991) and Lawrence (1989, 1998).

The basic tenet of the appraised value method is that an exploration property is worth the **meaningful past exploration expenditures plus warranted future costs**. An important element of this method, which is often overlooked in its application, is that only those past expenditures that are considered reasonable and productive are retained as value. Productive means that the results of the work give sufficient encouragement to warrant further work by identifying potential for the existence and discovery of an economic mineral deposit.

Warranted future costs comprise a reasonable exploration budget to test the identified potential, which can be geophysical or geochemical anomalies, or promising mineralization already identified. As noted previously, if exploration work downgrades potential, it is not productive and should not be retained as value. Obviously, if the property is considered to have negligible exploration potential, it has little or no value.

Past expenditures are usually analyzed on an annual basis, using technical expertise to assess which expenditures to retain and which to reject in terms of identifying remaining exploration potential. In times of high inflation, past expenditures are escalated to the effective date of valuation or current unit costs are applied to the work retained. Usually little of the expenditures more than five or so years prior to the effective valuation date are retained.

In the case of dual or multiple property ownership, the Appraised Value of the whole property is determined first. Then the value is apportioned to one or more of the property owners. During an option or earn-in period, the property interests of each party are assumed to be the final earned interests. Some properties carry a royalty, commonly as a net smelter return or net profits interest. Such royalties are deducted as a pro rata percentage from the Appraised Value apportioned to the non-royalty holder. This is done to recognize the existence of the royalty and is not meant to imply a value for the royalty. In some cases it may be necessary to differentiate between a net smelter return and net profits interest royalty by using a higher percentage for the former relative to the latter.

The derivation of an Appraised Value by adding the retained past expenditures to the warranted future costs should be thought of as an abstract exercise to determine the cost of an exploration "play" on a property, which is considered to be the Appraised Value. It should not be thought of in terms of who pays for the future exploration

program, although it is similar to the earn-in aspect of some option agreements. It should also not be thought of as an accounting exercise where exploration expenditures are booked and can be written off over time or against income.

The Appraised Value Method is best applied to properties that are actively being explored. It is more difficult to apply the method to properties that have been idle for some years, especially those that have had substantial expenditures in the past. Many such properties have subeconomic or marginal resources outlined by the past work, and some qualify as marginal development properties. The key to the valuation of inactive properties is a realistic assessment of the remaining exploration potential, which could be in the form of untested targets, potential to increase the grade or tonnage of the existing resource, or potential for development with changes in technology or economic conditions.

For marginal development properties and inactive exploration properties, Roscoe Postle Associates has developed a set of guidelines for what proportion of the past expenditures to retain as value, depicted in Table 2.

Table 2: Guidelines for Retained Expenditures for Marginal and Inactive Properties

Retained Portion of Past Expenditures	Guidelines
75%	Property with resources but no work done for some years. Some future work is warranted. Usually a property with marginal resources and potential for more but not quite exciting enough to attract exploration expenditures easily. May be at the underground exploration stage.
50%	Property with subeconomic resources, but may have some potential in future, conditional on commodity prices, infrastructure, improved technology, economic conditions, etc. No work recommended at time of valuation. Could be a property with potential for a commodity with a low price or low demand at the time of valuation.
25%	Inactive property with subeconomic resources with very little hope for development, but cannot write them off completely. The resources represent *in situ* mineral inventory with only a long shot at eventual development. No work recommended.
0 to 10%	Inactive property with no resources and negligible or very little exploration potential. Could be a property with all of the geophysical targets tested that will be dropped when assessment credits run out.
Nominal value of $5,000 to $10,000	Inactive property with indeterminate but low or negligible exploration potential. Could be a property with little or no data available but in a geologically uninteresting area.

The Appraised Value may have to be adjusted to Fair Market Value if the local market for properties is markedly depressed or markedly high as of the effective date of the valuation. For example, during the peak of flow-through financing in Canada from 1986 to 1988, exploration property transactions values were at high levels. Unit costs for exploration expenditures were also commonly higher than before and after the flow-through period. In other periods, such as in the early 1990s and the late 1990s, exploration activity was at a relatively low level, which was reflected in low market activity for exploration properties. These conditions can be recognized by applying a subjective market factor, usually in increments of 25%, as either a discount or a premium to the Appraised Value. A premium may be applied to the Appraised Value to recognize an advantageous location such as proximity and geological similarity to an operating mine or new discovery.

Application of the appraised value method requires a thorough understanding of the exploration process, industry standards, and unit costs for drilling and other exploration techniques. The valuer, therefore, must become familiar with the geological setting, exploration targets, exploration history and results, appropriate exploration techniques, mining parameter, costs, processing methods, etc. Hence, a seasoned exploration geologist or engineer, who has varied experience and sound technical judgment, would be required. Above all, the valuer needs familiarity with "real-world" mineral property transaction values.

One advantage of the appraised value method is that exploration cost information and technical data are readily available for most exploration properties and marginal development properties. It is a good way of comparing the relative values of exploration properties. The main disadvantage is that experienced judgement is required to separate the past expenditures considered to be productive from those considered not to contribute to the value of the property. This leaves the method open to misuse and possible abuse.

It is prudent for the valuator to compare the Appraised Value of a mineral property with values derived from other methods, particularly those that use a market approach, as summarized in a later section.

Geoscience Factor Method

The geoscience factor method is a variant on the cost approach, used for non-producing mineral properties. The method is based on ranked and weighted geological aspects, including proximity to mines and deposits, the significance of the mining camp, and the commodities sought (Thompson, 1991 and 2002). One such method was published by Kilburn (1990) for valuation of mineral properties without exploitable mineral reserves. The general approach is similar to a point system once used to assist the British Columbia Securities Commission in assessing suitability of exploration properties for financing.

The Kilburn (1990) geoscience factor method is based on four main characteristics: location with respect to other mineral occurrences, grade and amount of mineralization, geophysical and geochemical targets, and geological patterns considered favourable for mineralization. These main categories are divided into subcategories which are then ranked by relative importance and assigned factors. Each mineral claim equivalent in the property is given a base value and the various geoscience factors are estimated by the valuer. The value of each claim is determined by multiplying the base value by all of the geoscience factors. The claim values are summed to arrive at the total property value.

Kilburn (1990) points out that the value determined by his method is based on the expertise of geologists and engineers, commodity market factors, financial market factors, stock market factors, mineral property market factors, metal prices and political and economic conditions, which vary with time.

One advantage of this method is that it forces a disciplined technical approach on the geologist or engineer doing the valuation, so that different parts of a property and different properties should be ranked according to their technical merit. A major disadvantage of the method is the degree of dependence of the property value on the assumed basic value of each claim (or area unit). A change in the basic claim value has a proportional effect on both the claim and the property value. In addition, large properties would tend to have very high values and very small properties would tend to have very low values, which may not reflect the real exploration potential. These disadvantages make it difficult to recommend the geoscience factor method for valuation of non-producing exploration properties and marginal development properties.

MARKET APPROACH

Methods using a market approach are applicable to all types of mineral properties. The two methods described here are comparable transactions and option agreement terms. The option agreement terms method is often used to place a value on mineral property transactions used for comparative purposes, since most mineral property transactions are not cash sales. For these and other methods, the effective date of the valuation is important, therefore comparable transactions should be within a reasonable time from that date.

Comparable Transaction Method

The comparable transaction method uses the transaction price of comparable properties to establish a value for the subject property (Thompson, 1991; Roscoe, 1999; Lawrence, 2002; Ward and Lawrence, 1998). The difficulty of this approach in the mining industry is that there are no true comparables (unlike real estate or oil and gas), since each property is unique with respect to key factors such as geology, mineralization, costs, stage of exploration, and infrastructure. In addition, there are relatively few transactions for

mineral properties compared to the frequency of real estate transactions in general. When transactions do occur they rarely involve strictly cash, leaving the valuator the task of converting blocks of shares, royalties or option terms into present day money equivalent.

In spite of the above qualifications, transaction prices of comparable properties can indicate a range of values for a particular property. Exploration property transactions also give an indication of how active the market may be at any given time. For example, in the late 1990s there were relatively few exploration property transactions across Canada because of the depressed state of the exploration and mining industries. Consequently market values were relatively low.

As discussed previously, the value of an exploration property depends on its potential for the existence and discovery of an economic mineral deposit. The potential of a mineral exploration property depends to some extent on its acreage, but depends to a greater extent on its geological attributes, mineralization, exploration results and targets, neighbouring properties, and other factors. There is an analogy with real estate properties in that location is important. Non-producing exploration properties in established mining areas often have a premium value because of the higher perceived potential for discovery of a mineral deposit, and because of developed infrastructure.

The main advantage of this method is that it "ground truths" the value of mineral properties derived by other methods, and provides a general measure of relative property values. The main disadvantage is that there are no true comparables; each mineral property is unique as noted above. Subjective judgment is needed to identify similar properties.

Option Agreement Terms Method

The option agreement terms method can be applied where a property is subject to an existing option agreement. In a typical option agreement involving a non-producing mineral property, a schedule of committed and optional cash payments and work commitments applies over a period of several years. An approximation of the value of the property is reflected in the payments made and work commitments fulfilled, plus the subjective probability of the optionee making the rest of the payments and fulfilling the balance of the exploration programs. In some cases payments are made in stock of the company earning in. Table 3 provides an example of how a transaction value is estimated from the option agreement terms.

This method is best applied to properties being actively explored during the option period. The method is generally not applicable to properties on which the option has been exercised by fulfilment of the payment terms and work commitments, at which stage the property value usually exceeds the payments made.

Table 3: Analysis of Option Agreement Terms to Estimate Transaction Value

Option agreement terms to earn a 60% interest in the mineral property					
Year of Agreement	**Nature of Commit-ment**	**Payment Schedule**	**Exploration Expenditure Schedule**	**Probability of Realization**	**Value Component**
1	Firm	$25,000	$100,000	100%	$125,000
2	Optional	$50,000	$200,000	75%	$187,500
3	Optional	$100,000	$300,000	25%	$100,000
4	Optional	$225,000	$400,000	10%	$62,500
Totals		$400,000	$1,000,000		$475,000
• Value of 60% of property = $475,000					
• Value of 100% of property = $791,667					
• Round to $790,000					

One advantage of the option agreement terms method is that it has some real world validity in the early years of the option period. A disadvantage is that the valuation is meaningful only during the early years of the option period. As time goes on and more exploration results are collected, the property value is likely to diverge either up or down from the option agreement terms. Either the results will not justify continued expenditures and the option is dropped, or results will be good enough that further expenditure and payment terms will seem to be a bargain compared to the property value.

The option agreement terms method can be used to determine the value of comparable transactions, since most exploration property transactions are option or joint venture earn-in agreements.

OTHER VALUATION METHODS FOR NON-PRODUCING PROPERTIES

The valuation methods described above are those considered by the writer to be the most commonly used and the most widely accepted. Several other methods used by mineral valuation practitioners for non-producing properties are described briefly below, along with the writer's view on their acceptability.

A probabilistic DCF method uses assumed mineral reserves to produce a net present value, which is then factored by the subjective probability of realizing the assumed mineral reserves. This method is not widely used and is generally not well accepted because of its highly subjective nature.

The gross value of metal in the ground, based on a mineral resource estimate, is used occasionally to characterize the value of a mineral property. This method is unacceptable since it fails to take into account the cost of extracting and processing the mineral deposit to a saleable product.

A related method uses an estimate of the net value of metal in the ground, based on a mineral resource estimate. In many cases the "net value" is an arbitrary number, for example US$50 per ounce of gold. This widely used rule of thumb should not be used as a primary valuation method, but can be used as a check on valuations by other methods or to compare property values on an order of magnitude basis.

Value per unit area ($ per acre or hectare) factors are sometimes used to estimate the value of large exploration properties. This should be used as an order of magnitude check on valuations by other methods or to adjust transaction values on large properties by area for comparison purposes (see Valuation Example 4 in Appendix).

Many publicly traded junior mining companies hold a dominant exploration property as their major asset. This leads to the practice of putting a value on that exploration property based on the market capitalization of the junior company. Although this method may have some validity in some circumstances, the market capitalization is more related to the perceived value of the company than to the value of its major property asset, in the writer's view. The property value is just one of many components of the market capitalization of the company.

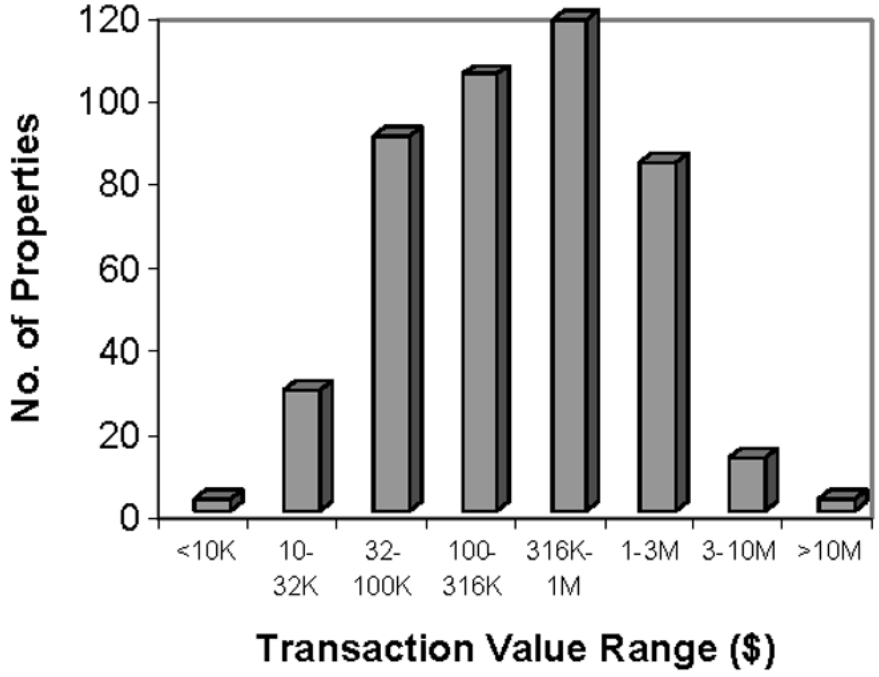
MINERAL PROPERTY VALUATION EXAMPLES

Seven examples of mineral exploration property valuations are given in the Appendix. These give a brief description of the subject property, then show how the value is derived, by one or more methods.

RANGE OF EXPLORATION PROPERTY VALUES

Roscoe Postle Associates has developed an extensive database of mineral exploration property values, based on published transactions (Agnerian, 1996b). Figure 2 shows the range of values for 445 exploration property transactions located across Canada during 1995 and 1996. The histogram shows the percentage frequency in each range of values, on a logarithmic scale. Some 50% of the property values lie between $100,000 and $1,000,000. Some 27% of the property values are less than $100,000 and 23% are greater that $1,000,000.

Figure 2: Frequency Distribution of 445 Transactions in Canada in 1995-96



CONCLUSIONS

Non-producing mineral properties include those at various stages of exploration, properties at the prefeasibility or feasibility stage, properties with currently uneconomic mineral resources, and past-producers. Different valuation methods may be appropriate for different types of mineral properties.

Income approach methods such as discounted cash flow and option pricing are generally not applicable to properties at the exploration stage. The market approach is generally appropriate to all types of mineral properties, although it is difficult to find good comparables because of the unique nature of mineral properties and the small number of transactions. Cost approach methods, such as appraised value and geoscience factor, are commonly used for exploration stage properties.

Canadian standards and guidelines for valuation of mineral properties are in the process of being finalized by the CIMVal Committee.

Valuation of non-producing mineral properties is best accomplished by professional geologists or engineers with relevant experience, sound technical judgment and familiarity with mineral property transaction values.

REFERENCES

Agnerian, Hrayr (1996a): Valuation of Exploration Properties; CIM Bulletin, v. 89, no. 1004

Agnerian, Hrayr (1996b): Survey of Mineral Property Transactions July 1994 to June 1996; Canadian Mining Journal, July 1996

Brennan, Michael J. and Eduardo S. Schwartz (1985): Evaluating Natural Resource Investments; Journal of Business, v. 58, No. 2, pp. 135-157

Kilburn, Lionel C. (1990): Valuation of Mineral Properties which do not Contain Exploitable Reserves; CIM Bulletin, v. 83, pp. 90-93, August 1990

Lawrence, Ross D. (1989): Valuation of Mineral Assets: Accountancy or Alchemy?; Paper presented at the CIM Annual General Meeting, Quebec, May 2, 1989

Lawrence, Ross D. (1998): Valuation of Mineral Assets: An Overview; Paper presented as part of a course offered by the Geological Association of Canada and the Prospectors and Developers Association of Canada, May 17, 1998

Lawrence, Ross D. (2002): Valuation of Mineral Properties without Mineral Resources; a Review of Market-Based Approaches; CIM Bulletin, v. 95, no. 1060

McKnight, Robert T. (2002): Valuing Mineral Opportunities as Options; CIM Bulletin, v. 95, in press

McKnight, Robert T. and Raymond J. Goldie (1990): The Use of Option Theory to Value Mining Projects and Mining Equities; Paper presented at the Pacific Rim '90 Congress, Queensland, May 1990

Palm, Scott K., Neil D. Pearson and James A. Read, Jr. (1986): Option Pricing: a New Approach to Mine Valuation; CIM Bulletin, v. 79, No. 889, pp. 61-66, May 1986

Roscoe, William E. (1988): Valuation of Mining Exploration Properties; The Land Economist, v. 18, No. 4, p. 3, January 1988

Roscoe, William E. (1999): The Valuation of Mineral Properties for Compensation; paper presented at the Fall Seminar of the British Columbia Expropriation Association, Vancouver, B.C., October 1999

Roscoe, William E. (2001): Outline of the Cost Approach to Valuation of Mineral Exploration Properties; *in* Mineral Asset Valuation Issues for the Next Millenium 2001, The Australian Institute of Mining and Metallurgy, Publication Series 5/01, pp. 138-146, October 2001

Roscoe, William E. (2002): Valuation of Mineral Properties Using the Cost Approach; CIM Bulletin, v. 95, no. 1059

Spence, Keith N. (2002): An Overview of Valuation Practices and the Development of a Canadian Code for the Valuation of Mineral Properties; CIM Bulletin, v. 95, no. 1057

Thompson, Ian S. (1991): Valuing Mineral Properties without Quantifiable Reserves; Paper presented at CIM Mineral Economics Symposium, Toronto, January 17, 1991

Thompson, Ian S. (2002): A Critique of Valuation Methods for Exploration Properties and Undeveloped Resources; CIM Bulletin, v. 95, no. 1061

Ward, Mary-Claire and Lawrence, Ross D. (1998): Comparable Transaction Analysis: the Market Place is always Right; Paper presented at a Short Course, Prospectors and Developers Association of Canada, March 11, 1998

APPENDIX

Valuation Example 1

- British Columbia exploration property, 1993 valuation date
- Remote location, helicopter access
- Some potential for Ni-Cu-PGE mineralization
- Some anomalous soil and rock samples
- No future work warranted in 1993
- Total past expenditures estimated at $65,000

Appraised Value (1993)	
Retained value of past work	$26,000
Warranted future exploration	nil
Appraised Value	$26,000
Fair market value adjustment (50% to 75%)	$13,000 to $20,000

Comparable Transactions (1993)	
$11,000	$25,000
$18,000	$31,000
$24,000	$36,000

Fair Market Value Range $13,000 to $20,000

Valuation Example 2

- British Columbia exploration property, 1993 valuation date
- Difficult location, old track access

- Quartz vein with some gold values
- Moderate exploration potential for small gold veins
- Several drill holes recommended
- Total past expenditures 1983 to 1992 estimated at $200,000

Appraised Value (1993)	
Retained value of past work	$50,000
Warranted future exploration	$260,000
Appraised Value	$310,000
Fair market value adjustment (50% to 75%)	$155,000 to $235,000

Comparable Transactions (1993)	
$102,000	$144,000
$114,000	$204,000

Fair Market Value Range $155,000 to $200,000

Valuation Example 3

- Large grassroots exploration property, 1998 valuation date
- Northwestern Quebec location, fixed wing or helicopter access
- Company has option to earn 50% interest
- Gold and base metal showings in banded iron formation
- Some soil, till and EM anomalies
- Good potential for economic gold mineralization
- Total past expenditures $100,000

Appraised Value (1998)	
Retained value of past work	$100,000
Warranted future exploration	$365,000
Appraised Value	$465,000
Value of Company share (50%)	$233,000

Fair Market Value of Company Share $233,000

Valuation Example 4

- Huge diamond exploration property, 1997 valuation date
- Northwest Territories location, fixed wing or helicopter access
- Company has 50% joint venture interest
- Much of past work downgraded diamond potential
- Property is adjacent to promising diamond prospect

- Future work involves reprocessing geophysics and till samples, plus follow-up geophysics and drilling
- Total past expenditures estimated at $5.3 million

Appraised Value (1997)	
Retained value of past work	$2,466,000
Warranted future exploration	$1,812,000
Appraised Value	$4,278,000
Value of Company share (50%)	$2,139,000

Comparable Transaction (1997)
$4.8 million (prorated from $8.0 million on a per hectare basis)

Fair Market Value of Company Share $2,139,000

Valuation Example 5

- Small gold exploration property, 1998 valuation date
- Northwest Ontario location, adjacent to producing gold mine
- Valuation required for acquisition by owner of adjacent gold mine
- Negative results from near-surface drilling in the past
- Ore-bearing structure projects onto the property at depth
- Good deep exploration potential will be tested in the future
- Total past expenditures over 50 years estimated at $1.0 million in 1998 dollars

Appraised Value (1998)	
Retained value of past workp	$250,000
Warranted future exploration	$772,000
Appraised Value	$1,022,000
Appraised Value with 50% premium for proximity to producing mine	$1.5 million

Comparable Transactions (1994-97)
Four transactions in the same area range from $0.5 to $3 million, but none are considered to be directly applicable

Fair Market Value Range $1.0 to $1.5 million

Valuation Example 6

- Medium size property, 1988 valuation date
- Northern Manitoba location, fixed wing or helicopter access
- Exploration work followed up reported airborne EM conductors

- No significant results from 1984 exploration program
- Property dormant since 1984 and no work recommended

Appraised Value (1988)	
Retained value of past work	nil
Warranted future exploration	nil
Nominal Value	$5,000

Fair Market Value $5,000

Valuation Example 7

- Advanced small exploration property, 1997 valuation date
- Ontario location, good road access
- Company can purchase a 100% interest subject to a 2% net smelter return
- Property contains a significant low grade gold resource with heap leach potential
- Preliminary cash flow analysis gives encouraging results but is very sensitive to gold price, recovery and cost assumptions
- Future work includes drilling, metallurgical testwork, environmental work and prefeasibility work
- Total past expenditures 1986-90 estimated at $1,080,000

Appraised Value (1997)	
Retained value of past work	$810,000
Warranted future property payment and work	$900,000
Appraised Value	$1,710,000
Company Share net of 2% net smelter return	$1,676,000

Comparable Transactions (1996, Western U.S.)	
$1.1 million	$3.4 million
$2.1 million	$3.9 million
$2.4 million	$4.4 million

The subject property is considered to be most comparable to the low end of the range.

Fair Market Value Range $1.1 to $1.7 million