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VALUATION OF NON-PRODUCING MINERAL PROPERTIES USING MARKET COMPARABLES

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1. ABSTRACT

Non-producing mineral properties include those at various stages of exploration, properties at the pre-feasibility or feasibility stage, properties with currently uneconomic mineral resources, and past-producers. The market approach is applicable to all these types of non-producing mineral properties. Income approach methods such as discounted cash flow and option pricing are generally not applicable to properties at the exploration stage, but may be applicable to non-producing mineral properties with defined mineral reserves or mineral resources.

The value of a non-producing mineral property depends on its perceived potential for the existence and discovery of an economic mineral deposit. The potential, in turn, depends on a number of factors which must be considered when choosing market comparables. These comparability factors include such items as geology, mineralization, stage of exploration and results, mineral resources, location and geography, and political jurisdiction. The date of the market comparables must be within a reasonable time period of the valuation date of the subject property. Although it is difficult to find good market comparables because of the unique nature of mineral properties and the small number of transactions, these difficulties are compensated for by analyzing a number of transactions on similar properties to develop a range of values for the subject property.

For valuation purposes, market comparables can be expressed in terms of total property value, value per unit area (e.g., $ per hectare), or value per unit of metal contained in mineral resources (e.g., $ per ounce of gold, or $ per pound of copper). The market comparable value can be used to estimate the value of the subject property by using the total property value, unit area value or contained metal value.

Most market transactions on non-producing mineral properties are not straightforward cash or share deals, but rather are typically option, earn-in or joint venture agreements whereby one party obtains the right to earn an interest in the property from another party by fulfilling certain commitments over a period of time. The terms of the option or earn-in agreement must be analyzed to estimate a value for the property being transacted. The option agreement terms analysis method can be used to value the subject property, and must be used to value most properties used as market comparable transactions.

In a typical option agreement, a schedule of firm and optional commitments must be fulfilled to earn an interest in the property. The commitments may include payment of cash, issue of shares to be issued by the earn-in party, expenditures on mineral exploration, and royalties on production. In general the commitments are firm in the first year and optional in subsequent years.

Option agreement terms analysis considers the firm commitments to contribute 100 percent to the value of the property. The optional commitments are assigned a subjective probability of the earn-in party fulfilling each of the annual commitments in the subsequent years of the agreement. The optional commitments multiplied by the probability factor for each year are considered to be the contribution to value. The transaction value is the sum of the firm commitment values and the probability-weighted optional commitment values. If the transaction is for a partial interest in the property, the value is adjusted to a 100 percent interest in the property.

Overall market analysis covering a wide sector of the market can be used to obtain a general guide to the range of transaction values to be expected and to look for trends. Analysis of typical data sets for gold property transactions in recent years serves to illustrate some features of the overall market.

- Large value ranges spanning three orders of magnitude for total property values and for property values expressed as $/ha.
- Large range in $/oz gold values spanning two orders of magnitude.
- Skewed, lognormal-like distribution of total property values, $/ha values and $/oz gold values, characterized by numerous low values and relatively few high values.
- There is no obvious relationship between property value and property size.
- There is a general relationship between $/ha value and property size in that small properties have high $/ha values and large properties have low $/ha values.

In the writer's opinion, overall market analysis cannot be used reliably for valuation of individual mineral properties because of the large ranges in property values, values per

unit area, and value per unit contained metal. Instead, best-fit market analysis must be used for valuation of individual properties.

Best-fit market analysis uses a number of comparable transactions to define a reasonable range of values for the subject property. Considerations in choosing an appropriate range of values for the subject include:

- Consider the market comparables in terms of total property value, value per unit area, or value per unit of metal in mineral resources.
- Examine mean and median values as well as overall range of values.
- Consider eliminating outliers at the high and/or low end of the value range.
- Consider which properties are more similar to the subject.

A method is proposed for valuation by market comparables of properties with mineral resources which contain several metals (polymetallic deposits). For each of a number of market comparable transactions, the gross "value" of metals contained in the mineral resource is calculated using metal prices as of the date of the transaction. A ratio of the property value to the gross metal value is then calculated (metal transaction ratio). The gold transaction ratios are used in market comparables analysis to derive a range of values for the subject property.

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

2. INTRODUCTION

The purpose of this paper is to describe market comparables methodology for the valuation of non-producing mineral properties. Some valuation examples are provided and information is provided on general levels of mineral property values.

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, and royalties.

In this paper, we are dealing with valuation of mineral properties rather than valuation of companies or business entities that hold such properties. In many cases, the value of mineral properties may be the major component of the value of exploration and mining companies. However, there are other components to the value of a company, such as, other assets and liabilities including cash and debt, quality of management, and market recognition and liquidity.

An earlier paper on valuation of non-producing mineral properties described cost approach and market approach methodologies (Roscoe 2003). The present paper elaborates on the market approach methods and repeats some of the information in the Roscoe (2003) paper so that it can be read as a stand-alone paper. The Roscoe (2003) paper should be referred to for other valuation approaches and methods for non-producing mineral properties and for information on standards for valuation of mineral properties.

By way of background, different types of mineral properties are defined since they require different valuation approaches and methods. As 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 or market value. In some circumstances, other definitions of value may apply, such as fair value, net present value, replacement value, salvage value, book value, assessed value, insured value, etc.

As in any valuation, the effective date of the valuation is important. Mineral property values vary over time, depending on events on neighbouring properties, market interest, commodity prices, and other factors. For a valuation related to an expropriation, insurance claim or litigation, the effective date may be a 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 a time of poor market conditions.

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 validity in some circumstances, in the writer's view, the market capitalization is more related to the perceived value of the company than to the value of its major property asset. The property value is just one of many components of the market capitalization of the company.

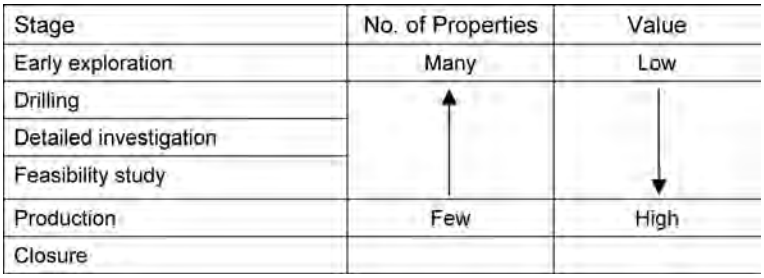
Valuation of non-producing mineral properties is best accomplished by professional geologists or engineers with relevant experience, sound technical judgement and familiarity with mineral property transaction values.

3. TYPES OF MINERAL PROPERTIES

There is a spectrum of mineral property exploration and development stages, ranging from early exploration properties to producing mines (Figure 1). For convenience, min-

eral properties can be divided into three general categories: production and development properties, exploration properties, and marginal development properties. The latter two types are non-producing mineral properties. Each type of mineral property requires different valuation approaches because of its stage of exploration and development and the type and amount of data available on the property.

Figure 1: Generalized Stages of Exploration and Development of Mineral Properties



3.1 Production and Development Properties

Production and development properties include producing mines as well as properties on which development of an economically viable operation is feasible, planned or under construction. Such properties are those on which an economically viable mineral deposit has been demonstrated to exist, either by actual production or by a feasibility or preliminary feasibility study. Production and development properties are at a sufficiently advanced stage that enough reliable information exists to value the property by the income approach with a reasonable degree of confidence.

3.2 Non-Producing Mineral Properties

Non-procuring mineral properties include exploration properties and marginal development properties. Other non-producing mineral property types include advanced projects at the preliminary feasibility or feasibility stage and past-producing mine properties. For such advanced properties, a preliminary feasibility study or feasibility study may be underway and may not have reached a conclusion on the economic viability of the property at the time of the valuation. In this case, it is difficult to value using the income approach because key technical parameters may not yet be well defined. Past-producing mine properties may contain mineral resources and may have potential to resume production. They may also have environmental liabilities resulting from previous operations which may have a negative impact on property value.

3.3 Exploration Properties

Exploration properties are those on which an economically viable mineral deposit has **not** been demonstrated to exist. The 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 at various stages from early grassroots to delineation drilling and can be further subdivided into those with and without quantifiable mineral resources.

3.4 Marginal Development Properties

Marginal development properties contain well-defined mineral resources which could 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 include higher commodity prices, technological improvements, establishment of local infrastructure, and change in ownership. Marginal development properties include mines which are temporarily closed down due to low commodity prices.

4. MINERAL RESOURCES AND MINERAL RESERVES

Mineral resources and mineral reserves as used generally in this paper refer to the definitions set out by the Canadian Institute of Mining, Metallurgy and Petroleum (CIM 2004). These definitions are required by Canadian securities commissions and stock exchanges, as specified in Canadian Securities Administrators National Instrument 43-101. The CIM definitions standards can be summarized.

- A Mineral Resource is a mineral deposit that has reasonable prospects for economic extraction. Quantity and quality of the resource are commonly expressed as tons and grade in measured, indicated and inferred categories which represent decreasing confidence levels.
- A Mineral Reserve is that part of the mineral resource demonstrated, by at least a preliminary feasibility study, to be economically extractable. Allowable reserve categories are proven, which is converted from measured mineral resource, and probable, which is converted from indicated or measured resource. Note that inferred mineral resources cannot be converted to mineral reserves because of the low confidence level of the estimate.

The United States Securities and Exchange Commission (SEC) recognizes only proven and probable reserves which must be demonstrated to be economically viable by either production history or a feasibility study. The SEC allows the reporting of "min-

eralized material" but does not allow the reporting of mineral resources, except where reporting of resources is required by law in a foreign jurisdiction, such as Canada, in which case cautionary notes must be added to warn U.S. investors not to assume that the mineral resources will ever be converted into reserves.

5. 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.

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.

6. 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 Figure 2.

Figure 2: 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
	Real Options	Yes	Yes	No
Cost	Appraised Value	No	Yes	Yes
	Geoscience Factor	No	Maybe	Yes
Market	Market Comparables	Yes	Yes	Yes
	Option Agreement Terms	Yes	Yes	Yes

Descriptions of methods related to the income approach and cost approach can be found in Roscoe (2003) and other papers and presentations. The rest of this paper deals with market approach methodology.

7. MARKET APPROACH

7.1 Market Transactions on Comparable Properties

The market approach is applicable to all types of mineral properties. The market comparables method uses the transaction value of comparable properties to establish a value for the subject property (Thompson, 1991; Roscoe, 1999; Roscoe, 2003; Lawrence, 2002; Ward and Lawrence, 1998). The market comparables can be used directly to derive a value for the subject property or they can be adjusted by such parameters as property area or contained metal in mineral resources.

As noted in Roscoe (2003), difficulties with the market comparables method, such as lack of true mineral property comparables, relatively few transactions, and complexity of transaction agreements, are compensated for by analyzing a number of transactions on similar properties to develop a range of values for the subject property.

As noted previously, the value of a non-producing mineral property depends on its perceived potential for the existence and discovery of an economic mineral deposit. The potential in turn depends on a number of factors which must be considered when choosing market comparables. These comparability factors include:

- Commodity of group of commodities, e.g., gold, uranium, nickel-copper, diamonds.

- Political jurisdiction.
- Location, access, infrastructure.
- Property size – can normalize by acreage.
- Geological setting and mineralization style.
- Stage of exploration and exploration potential.
- Exploration results and targets.
- Mineral resources – can normalize by contained metal.
- Environmental liabilities from previous operations.
- Activity on neighbouring properties.
- Location, such as in a "hot" area with intense exploration activity and high price transactions versus an inactive area.

As the market for non-producing mineral properties changes over time, market comparable transactions should be within a reasonable time period of the subject property valuation date and in similar market conditions. Typical time periods may be within 6 to 18 months, depending on market conditions and number of transactions available for analysis. In the writer's view, comparable transactions after the subject property valuation date can be used as long as the market conditions remain the same. Although some may consider this practice to be hindsight, it is necessary to do so in many cases because of scarcity of suitable comparable transactions.

Most transactions on non-producing mineral properties are not straightforward cash or share deals, but rather are typically option, earn-in or joint venture agreements whereby one party obtains the right to earn an interest in the property from another party by fulfilling certain commitments over a period of time. The terms of the option or earn-in agreement must be analyzed to estimate a value for the property being transacted. The option agreement terms analysis method can be used to value the subject property, and must be used to value most properties used as market comparable transactions.

The following aspects of market comparables analysis are covered in subsequent sections, along with examples of use.

- Analysis of option agreement terms.
- Analysis of overall market sector transactions.
- Analysis of best-fit comparable market transactions.

8. OPTION AGREEMENT TERMS ANALYSIS

The option agreement terms analysis method can be applied where a property is subject to an existing option agreement. The agreement can also be in the form of an earn-in agreement or a joint venture agreement where one party is earning an interest in the property or the joint venture that holds the property. For simplicity, agreements of this general type are called option agreements in this paper.

In a typical option agreement involving a non-producing mineral property, a schedule of commitments must be fulfilled to earn an interest in the property. The commitments may include payment of cash, issue of shares, expenditures on mineral exploration, and royalties on production. The commitments are usually on an annual basis over a period of several years, typically three to five, and mark decision points for the earn-in party to proceed to the next stage or not. In general, the commitments are firm in the first year and optional in subsequent years. Another characteristic of mineral property option agreements is that the amount of the payments, share issues and work commitments usually increases with time in the later years of the agreement. If any of the subsequent years' commitments are not made, the agreement terminates and the earn-in party retains either no interest or a partial interest in the property, according to the terms of the specific option agreement.

The option agreement terms method involves an analysis of the firm and optional commitments to derive an estimate of the value of the property. The firm commitments in the form of cash payments, stock to be issued by the earn-in party, and exploration work expenditure commitments are considered to contribute 100 percent to the value of the property. The optional commitments are assigned a subjective probability of the earn-in party fulfilling each of the annual commitments in the subsequent years of the agreement. The optional commitments multiplied by the probability factor for each year are considered to be the contribution to value. When share issues are part of the option agreement, the share price on the date of the agreement is used for all years of the agreement. The probability is expected to decrease over time because the amount of the commitments becomes larger, and because of the nature of the exploration business whereby few properties move on to more advanced stages.

The transaction value is the sum of the firm commitment values and the probability-weighted optional commitment values. If the transaction is for a partial interest in the property, the value is adjusted to a 100 percent interest in the property. The transaction value can be adjusted to reflect the existence of a royalty.

An example of an option agreement terms analysis is given in Figure 3, based on the following published description of the deal:

> Great Northern Hope Inc. can earn a 60 percent interest in the Moose Meadows gold property of Golden Fleece Corp. by making payments of $250,000, issuing shares valued at $500,000 and expending a total of $1,000,000 on exploration over a period of 3 years. The first year

requires $50,000 cash and $100,000 in shares on signing and an expenditure commitment of $250,000. Further annual payments of $100,000 in cash and $200,000 in shares, plus work commitments of $500,000 and $750,000 in years 2 and 3, respectively, are optional.

Figure 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 Commitment	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		$575,000
Value of 60% of property = $575,000					
Value of 100% of property = $958,333					
Round to $960,000					

In many cases, published details of option agreements give total amounts for cash payments, shares to be issued and expenditure commitments, but are not specific as to the allocation of the firm and optional commitments in each year of the agreement. In these cases, the valuator must make assumptions based on his or her experience and the structure of typical option agreement.

The option agreement terms method can be used to value the subject property as well as to derive values of market transactions comparable to the subject property.

When used to value the subject property, the valuation date should be close to the date of the option agreement. This is because results of ongoing exploration work on the property may be encouraging or discouraging and the value will increase or decrease accordingly. Obviously, the method cannot be used for properties on which the option has been exercised by fulfillment of all the payment terms and work commitments, at which stage the property value usually exceeds the payments made.

9. OVERALL MARKET TRANSACTIONS

Market transactions over a wide sector of the market can be used to obtain a general guide to the range of values to be expected and to look for trends. Transaction information can be compiled on properties in a large market sector, such as copper properties with

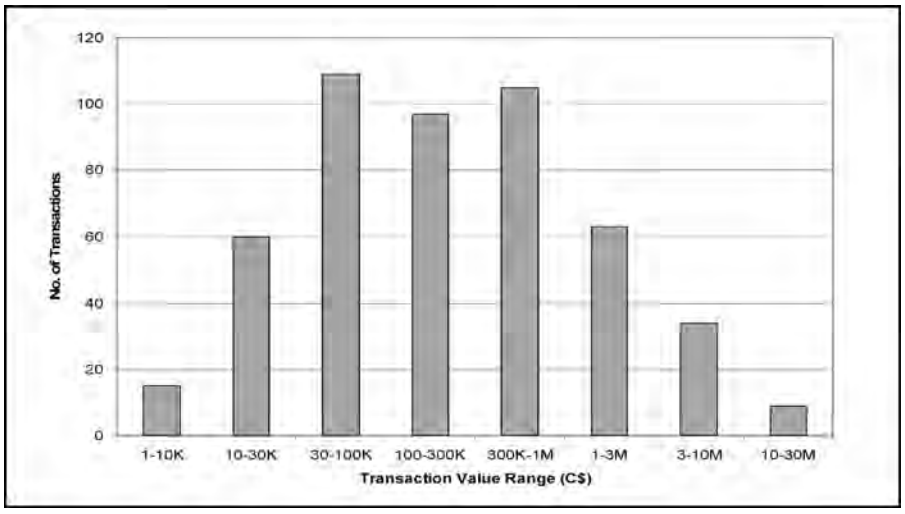
large areas in British Columbia, or gold properties in Ontario and Quebec. The time period of the market transactions can be relatively broad, for example a one to 5-year period. Since most of the market transactions are not strictly cash or share deals, option agreement terms analysis is used to estimate property values.

In practice, analysis of a total market sector can result in very large ranges in property values. Similarly large ranges are found in other measures such as value per unit area and value per unit of contained metal in mineral resources. In the writer's opinion, overall market analysis cannot be used reliably for valuation of individual mineral properties because of these large ranges. Instead best-fit market analysis must be used for valuation of individual properties.

Some examples follow which illustrate the overall market approach.

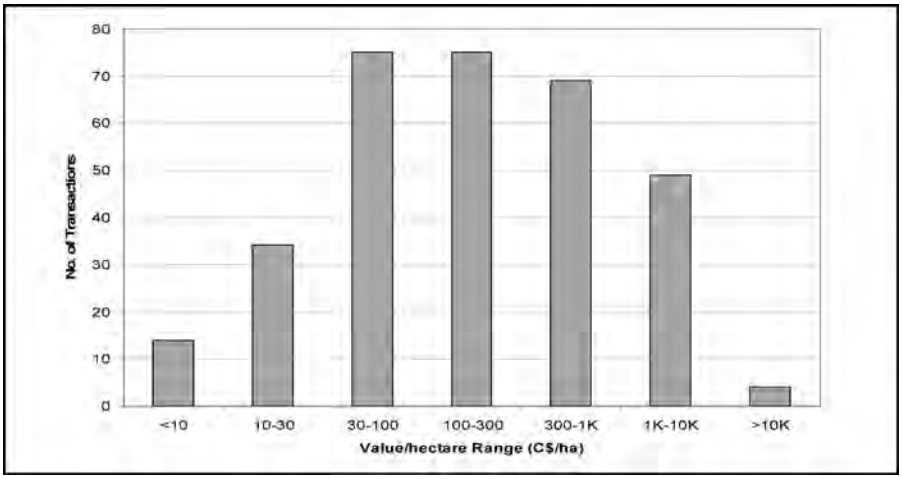
Scott Wilson Roscoe Postle Associates Inc. (formerly Roscoe Postle Associates Inc.) has developed an extensive database of mineral exploration property values, based on published transactions (Agnerian, 1996). Figure 4 shows the overall market for gold property transactions in Canada for the years 2003 to 2005. There is a very wide range in values from $1,500 to $29,000,000. The mean value is $1,029,000 and the median value is $184,000. The large difference between the mean and median highlights the skewed nature of the distribution of values, which are plotted in a geometric progression in Figure 4. The distribution approaches lognormal with numerous low values and relatively few high values.

Figure 4: Values of 492 Gold Property Transactions in Canada 2003 to 2005



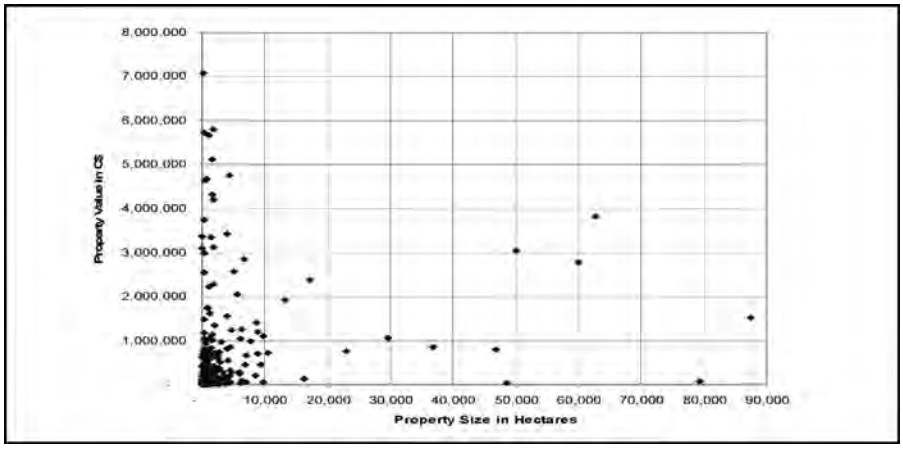
The same set of transactions can be examined further when plotted in terms of value per hectare ($/ha) as shown in Figure 5. This is the same data set as in Figure 4 except that only 320 of the 492 properties had property size reported. Again there is a very large range in $/ha values from $1/ha to $74,000/ha. As can be seen by the geometric progression plot, the distribution is positively skewed with a mean value of $1,217/ha and a median of $187/ha.

Figure 5: Dollar per Hectare Values for 320 Gold Property Transactions in Canada 2003 to 2005



The 2003-05 gold transaction data set is examined further for relationships between property value, value per hectare, and property size. Figure 6 shows that there is no obvious relationship between property value and property size.

Figure 6: Property Value versus Property Size for 320 Gold Property Transactions in Canada 2003 to 2005



When the $/ha values are plotted against property size, however, a general relationship emerges. Figures 7, 8 and 9 show $/ha value against property size for three ranges of property size. In general, it can be seen that small properties have high $/ha values and large properties have low $/ha values.

Figure 7: Dollar per Hectare Values versus Property Sizes up to 2,000 Hectares

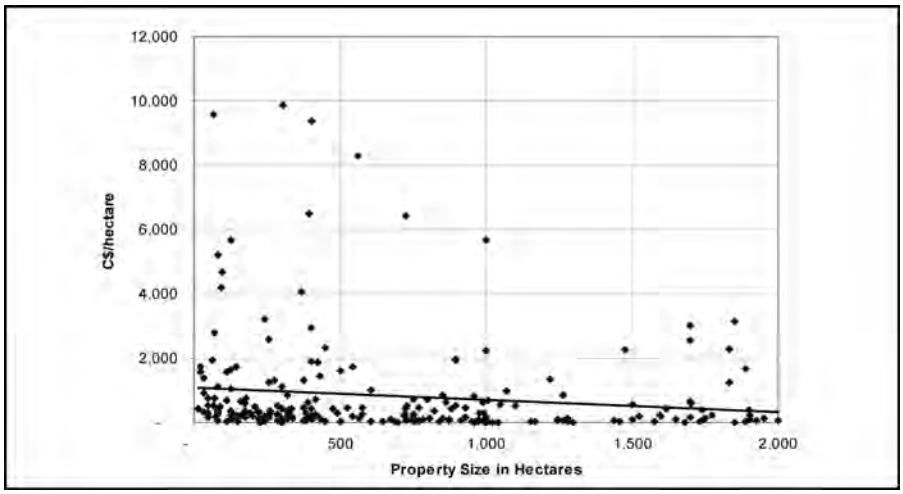


Figure 8: Dollar per Hectare Values versus Property Sizes 2,000 to 10,000 Hectares

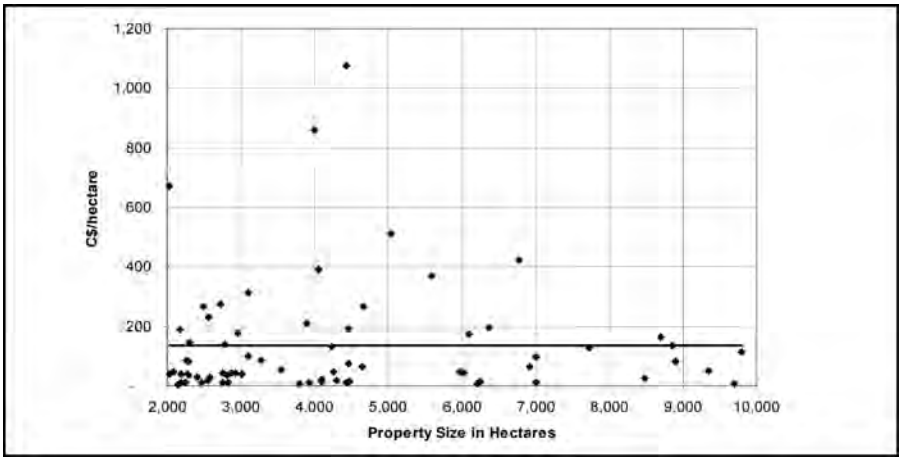
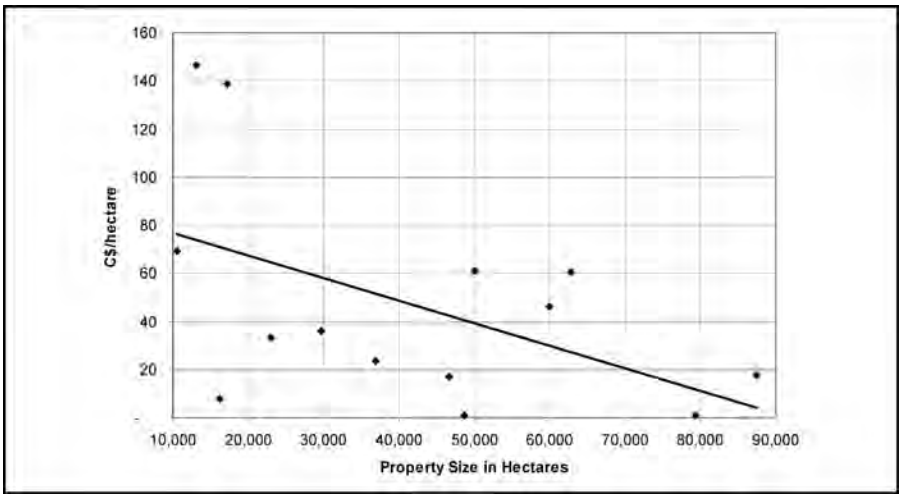


Figure 9: Dollar per Hectare Values versus Property Sizes larger than 10,000 Hectares



Although the general trend goes from high $/ha values for small properties to low $/ha values for large properties, the relationship between $/ha and property size appears to be somewhat different in each of these ranges. The trend lines in Figures 7, 8 and 9 show a possible weak inverse correlation between $/ha values for properties smaller than 2,000 hectares (correlation coefficient – 13 percent), no correlation for properties between 2,000 and 10,000 hectares (correlation coefficient 0 percent), and a moderate correlation for properties larger than 10,000 hectares (correlation coefficient – 50 percent). Basic statistics for $/ha values and the property values in each of the property size ranges are shown in Figure 10.

Figure 10: Statistics of $/ha Values and Property Values by Property Size Range

Property Size Range (ha)	Number of Properties	$ per Hectare Values		Property Values $000	
		Mean	Median	Mean	Median
<2,000	229	837	272	453	101
2,000-10,000	71	133	52	576	207
>10,000	14	47	35	1,427	972

Note the large difference between mean and median $/ha values and property values for properties smaller than 10,000 ha. For properties larger than 10,000 ha the mean and median are closer for both $/ha and property values. The analysis indicates that, although the $/ha values decrease with increasing property size, there is considerable variability especially at property sizes smaller than 10,000 ha.

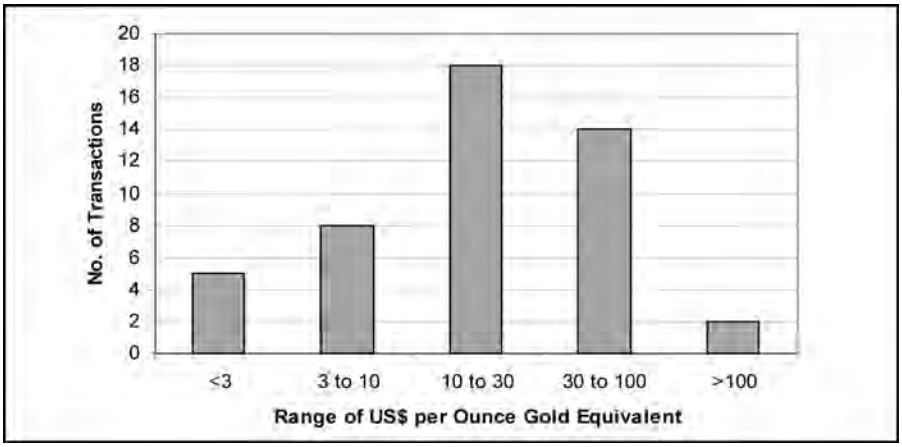
The overall market for non-producing properties can also be looked at in terms of value per unit metal contained in mineral resources, if mineral resources are reported for the property. Dollars per ounce of gold in mineral resources can be calculated for mineral property transactions. The property value from the transaction is divided by the ounces of gold contained in reported mineral resources to obtain the $/oz value, which is a widely used yardstick for comparing gold property transactions. The method is applied to both property transactions and company transactions.

In some cases where both gold and silver are present, the value per ounce of gold equivalent is calculated. In the writer's view, this is acceptable practice as long as the value of the gold ounces exceeds the value of the silver ounces. The method is more complicated and less meaningful when base metals are converted to precious metals equivalent, such as copper to gold equivalent ounces or nickel to platinum equivalent.

The dollars per unit metal method is also applied to other commodities such as dollars per pound of copper or uranium. The resulting values per pound metal can be used to determine a range of values for the overall market.

Figure 11 shows the frequency distribution of 47 gold property transactions in recent years for advanced exploration and feasibility stage properties. Note that the values per ounce are plotted in Figure 11 in a geometrical progression because the distribution is skewed to the right.

Figure 11: Value of Gold Property Transactions in US$ per Ounce



The mean value is US$28 and the median is US$18 per ounce gold equivalent. The values range from less than US$3 per ounce to greater than US$100 per ounce. Because of the large range of $/oz gold values, the overall market values cannot be used reliably for valuation of gold properties, but are commonly used as a rule of thumb for order of magnitude checking of property values. Gold property market transactions with similarities to the subject property (best-fit comparables) should be used to determine a value for the subject on a dollar per ounce of gold basis.

Gold values per ounce are sometimes expressed as a percentage of the gold price at the time of the transaction. For example, if the transactions indicates a value of $25 per ounce and the gold price is $500 per ounce, the value can be expressed as 5 percent of the gold price.

10. BEST-FIT MARKET COMPARABLE TRANSACTIONS

As noted previously, it is not possible to obtain an exactly comparable property to the subject property. For this reason, as well as the relatively small size of the market and considerable variability in transaction values, the writer recommends using a number of market comparables to define a reasonable range of values for the subject property. If the market permits, at least five or six market comparables should be used that have similarities to the subject property in terms of commodity, geographical and geological setting, mineralization style, stage of exploration, political jurisdiction and other characteristics noted previously. Because property value per unit area ($/ha) is somewhat dependent on property size, as shown in the previous section, market comparables should be in the same general property size range as the subject property for a best-fit market analysis.

Information on market transactions can be found in exploration and mining trade publications such as The Northern Miner, Stockwatch, Mining Journal, and, for valuation dates more than 10 years ago, The George Cross News Letter. Options agreement terms analysis is used in most cases to estimate the value of comparable properties, as described above.

Considerations in choosing an appropriate range of values for the subject include:

- The market comparables can be considered in terms of total property value, value per unit area ($/ha), or value per unit of metal in mineral resources ($/oz Au or $/lb Cu).
- Examine mean and median values as well as overall range of values.
- Consider eliminating outliers at the high and/or low end of the value range.
- Consider which properties are more similar to the subject.

The following examples illustrate the best-fit market comparables method.

Figure 12 shows an analysis of market comparable transactions for valuation of a gold exploration property in Ontario. The market transactions are in the period February 2004 to June 2004. The comparable property values range from $0.91 million to $3.04 million and the $/ha values range from $1,050 to $4,510. Property sizes are in the same general range. In this analysis, property E is eliminated because it is an outlier in terms of $/ha value. Without property E, the mean and median values are closer for both property value and $/ha value. The $/ha value is chosen for valuation of the subject because the $/ha values of the comparables are less variable than the property values. In this example, a reasonable range for valuation of the subject property is $1,600 to $1,700 per hectare, based on the mean and median values.

Figure 12: Comparable Transactions for Valuation of an Ontario Gold Property

Property	Transaction Date	Size in hectares	Property Value $M	$/hectare
A	Mar 04	600	1.19	1,980
B	Jun04	864	0.91	1,050
C	May 04	896	0.98	1,090
D	Feb 04	1,068	3.04	2,850
E	Apr 04	665	3.00	4,510
Mean			1.82	2,296
Median			1.19	1,050
Eliminate Property E:				
Mean			1.53	**1,740**
Median			1.09	**1,540**

Figure 13 shows an analysis of market comparable transactions for valuation of a gold exploration property in Brazil. The property values range from $0.18 million to $5.7 million and the $/ha values range from $192 to $1,566. The property sizes also cover a considerable range from 936 ha to 15,000 ha because of the relative scarcity of market transactions in Brazil at the time. When property H is eliminated as an outlier, the $/ha values are less variable and the mean and median values become closer. In this example, a reasonable range for valuation of the subject property is $200 to $250 per hectare, based on the mean and median values.

Figure 13: Comparable Transactions for Valuation of a Brazilian Gold Property

Property	Transaction Date	Size in hectares	Property Value $M	$/hectare
F	Jun 03	12,000	5.70	475
G	Jul 03	15,000	3.04	203
H	Apr 03	2,235	3.50	1,566
I	Jan 03	936	0.18	192
J	May 03	5,265	1.09	207
Mean			2.70	434
Median			3.04	207
Eliminate Property H:				
Mean			2.50	**269**
Median			2.07	**205**

Figure 14 shows an analysis of market comparable transactions for valuation of a non-producing gold property in the Americas. The market comparable properties are all at the advanced exploration stage to feasibility stage. They have mineral resources that range form 2.61 to 5.39 million ounces of contained gold and the property values range from $49 million to $418 million. The calculated $/oz gold figure vary from $9 to $119 per ounce. When the obvious outlier of $9/oz is eliminated, the range tightens to $77 to $119 per ounce and the mean and median values are very close. In this example, a reasonable range for valuation of the subject property is $90 to $100 per ounce of gold contained in the resource estimate, based on the mean and median values.

Figure 14: Comparable Transactions for Valuation of a Gold Resource Property in the Americas

Property	Transaction Date	M oz Au in Resources	Property Value $M	$/oz Au
K	Dec 05	3.58	360	101
L	Dec 05	5.39	49	9
M	Nov 05	2.61	200	77
N	Jan 06	4.33	386	89
P	Oct 05	3.50	418	119
Mean			283	79
Median			360	89
Eliminate Property L:				
Mean			341	**96**
Median			373	**95**

A method is proposed for valuation by market comparables of properties with mineral resources which contain several metals (polymetallic deposits). The proposed method uses the estimated mineral resources as illustrated by the example in Figure 15. Market comparable transactions are chosen for properties with a similar mix of base metals and mineral resources in the same order of magnitude. The gross "value" of metals contained in the mineral resource is calculated for each property using metal prices as of the date of the transactions. A ratio of the property value to the gross metal value is then calculated (metal transaction ratio). The gold transaction ratio is used for market comparables analysis. The metal transaction ratio is analogous to the ratio of $/oz value to gold price for a gold property transaction.

Figure 15: Comparable Transactions for Valuation of a Polymetallic Base Metal Resource Property in the USA

Property	Transaction Date	Gross Value of Metals in Resource	Property Value $000	Metal Transaction Ratio[1]
Q	Dec 04	$926 M	216	0.02%
R	Oct 04	$1,010 M	573	0.06%
S	Nov 04	$679 M	1,790	0.26%
T	Jun 04	$538 M	3,906	0.73%
U	Oct 04	$339 M	3,092	0.91%
Mean			1,915	0.40%
Median			1,790	0.26%
Eliminate highest and lowest ratios:				
Mean			2,090	**0.35%**
Median			1,790	**0.26%**

[1] Metal Transaction Ratio is the property value divided by the gross value of metals in the mineral resource expressed as a percent.

In the example in Figure 15, gross metals "values" in mineral resources range from $339 million to $1,010 million and property values range from $216,000 to 3,906,000. There is a large range in metal transaction ratios from 0.02 percent to 0.91 percent which is reduced somewhat when the highest and lowest ratios are eliminated. In this example, a reasonable range of metal transaction ratios for valuation of the subject property is 0.25 percent to 0.35 percent, based on the mean and median values. This range of metal transaction ratios is applied to the gross "value" of metals in mineral resources of the subject property to derive a value range.

11. CONCLUSIONS

Non-producing mineral properties include those at various stages of exploration, properties at the pre-feasibility or feasibility stage, properties with currently uneconomic mineral resources, and past-producers. The market approach is applicable to all types of non-producing mineral properties.

The value of a non-producing mineral property depends on its perceived potential for the existence and discovery of an economic mineral deposit which, in turn, depends on a number of factors which must be considered when choosing market comparables.

These include geology, mineralization, stage of exploration and results, mineral resources, location and geography, and political jurisdiction.

The date of the market comparables must be within a reasonable time period of the valuation date of the subject property, such as 6 to 18 months.

Although it is difficult to find good market comparables because of the unique nature of mineral properties and the small number of transactions, these difficulties are compensated for by analyzing at least five or six transactions on similar properties to develop a range of values for the subject property.

Market comparables can be expressed in terms of total property value, value per unit area (e.g., $ per hectare), or value per unit of metal contained in mineral resources (e.g., $ per ounce of gold, or $ per pound of copper). The market comparable value can be used to estimate the value of the subject property by using the property value, unit area value or contained metal value.

Since most market transactions on non-producing mineral properties are option type agreements, the terms must be analyzed to estimate a value for the property being transacted. Firm commitments are considered to contribute 100 percent to value and optional commitments are probability-weighted to estimate their contribution to value. The option agreement terms analysis method can be used to value the subject property, and must be used to value most properties used as market comparable transactions.

Overall market analysis of typical data sets for gold property transactions in recent years shows very large ranges and lognormal-like distributions for total property values, for $/ha values and for $/oz gold values. In the writer's opinion, overall market analysis cannot be used reliably for valuation of individual mineral properties because of these large ranges, and best-fit market analysis must be used. Best-fit market analysis uses a number of comparable transactions to define a reasonable range of values for the subject property, with consideration of mean and median values, range of values, and elimination of outliers.

A method is proposed for valuation of properties with mineral resources in poly-metallic deposits which calculates a "metal transaction ratio" of market comparable properties for use in deriving a range of values for the subject property.

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

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