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THE VALUATION OF MINERAL PROPERTIES FOR COMPENSATION

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INTRODUCTION

In recent years the British Columbia government has created a number of new Provincial Parks and has changed the status of some existing Parks so that mineral exploration and mining activity are no longer permitted in these areas. This has resulted in the expropriation or "taking" of mineral properties within the Parks from the property holders, and the payment of compensation to the property holders. Compensation is negotiated between the B.C. government and the property holder and in some cases independent valuation of the mineral property helps to determine the amount of compensation. The new Mining Rights Compensation Regulation under the Mineral Tenure Act of B.C. sets the rules for determining compensation if negotiations are unsuccessful. The process involves independent valuation of the mineral property, initially on behalf of the government, then, as a second step on behalf of the property holder, followed by arbitration. Rarely, cases are heard by the B.C. Expropriation Compensation Board.

The purpose of this paper is to describe approaches and methodology for the valuation of mineral exploration 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 expropriated mineral properties are at the exploration stage, the nature of exploration properties and the exploration process are covered.

At present there are no comprehensive regulations or guidelines in Canada which specify what approaches and methods to use for the valuation of mineral properties. In this paper, the approaches and methods described are what the writer considers to be accepted industry practice, based on over 15 years of valuation experience. The recent TSE/OSC Mining Standards Task Force report recommended that the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) form a committee to review approaches to valuation of mineral properties. The CIM recently formed such a committee, of which the writer is co-chairman.

Mineral properties are done for reasons other than compensation for expropriation. Other purposes for independent valuation include mergers and acquisitions, non arms length transactions, pricing of initial public offering of stock, support for property agreement, litigation and insurance claims.

Value and valuation in this paper refer to market value or fair market value of mineral rights, which are held as various types of mineral tenure, including mineral claims and Crown Granted mineral claims. Although it does not precisely fit mineral properties, market value is defined in the B.C. Expropriations Act as follows:

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The market value of an estate or interest in land is the amount that would have been paid for it if it had been sold at the date of expropriation in the open market by a willing seller to a willing buyer.

One of the important concepts in this definition that is critical to mineral properties is the effective date of valuation, or expropriation. This is because mineral property values vary over time, depending on events on neighbouring properties, market interest, commodity prices, etc. For an expropriation, the effective date may be a contentious issue in that the property owner may perceive that the property may be more valuable in the future when market conditions improve, and that the expropriation forces the valuation in a time of poor market conditions.

TYPES OF MINERAL PROPERTIES

There are three main categories of mineral properties which 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.

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,

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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 the raw material from which mines are made. Exploration properties 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 process which operates by stages. 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 is carried out to get 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 which 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 which 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 the table below.

Valuation Approach	Valuation Method	Development Properties	Marginal Development Properties	Exploration Properties
Income	Discounted Cash Flow	Yes	Maybe	No
	Option Pricing	Yes	Yes	No

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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. 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 analysis to determine the net present value of a stream of estimated future cash flows. The discounted cash flow method can also be used for marginal development properties, but its usefulness is doubtful because low values may be derived which do not necessarily reflect the market value.

The discounted cash flow 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 discounted cash flow analysis.

Discounted cash flow 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.
- Operating cost estimates including mining, processing, administration and management, transportation, infrastructure, environmental compliance, sales, royalties, etc.

Other factors which form important components of a discounted cash flow analysis are:

- Reasonable commodity price projections and currency exchange rate
- Federal, provincial and municipal taxes
- Appropriate discount rate

Valuations by the discounted cash flow analysis 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.

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Sensitivity analyses are commonly done in connection with cash flow analysis to determine the effect of various estimated parameters on the net present value. This is very useful for identifying variables which have a large effect on the viability (and value) of the property, such as metal grade, operating cost, commodity price or capital cost.

The main advantage of the discounted cash flow 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 is that it is commonly applied without due regard for the quality and reliability of the input factors, particularly technical parameters such as mineable reserve tonnage and grade, estimated capital and operating costs, metallurgical recovery, etc. The other 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 discounted cash flow 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 and Goldie (1990), and Palm et al (1986).

In the option pricing approach, 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:

- Option to develop and commence production
- Option to shut down or resume production
- Option to hedge production
- Option to change the rate of production
- 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 discounted cash flow analysis renders low or negative values. One disadvantage may be the

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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 exploration properties and in many cases to 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 (1986, 1988, 1994), 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 which 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.

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. It requires that the valuator become familiar with the geological setting, the exploration target, the exploration history and results, and appropriate exploration techniques. These requirements are best fulfilled by a seasoned exploration geologist with a variety of experience and sound technical judgement. 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.

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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.

Geoscience Factor Method

The geoscience factor method is a variant on the cost approach. It is based on ranked and weighted geological aspects, including proximity to mines and deposits, the significance of the camp, and the commodities sought (Thompson, 1991). One such method was published by Kilburn (1990) for valuation of mineral properties without exploitable reserves. The general approach is similar to that taken by Woodcock (1985) to assist the British Columbia Securities Commission in assessing suitability of exploration properties for financing. The Woodcock method rates properties by a point system rather than assigning a dollar value.

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 exploration properties and marginal development properties.

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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, 1994; 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 recent years there have been relatively few exploration property transactions across Canada because of the depressed state of the exploration and mining industries. Consequently market values have been 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 area, 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. 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 judgement is needed to identify similar properties.

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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, 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.

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.

One advantage of this 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.

MINERAL PROPERTY VALUATION EXAMPLES

Several examples of mineral exploration property valuations are attached to this paper. 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. One of the attached figures shows the range of values for 445 exploration properties 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 properties lie between \$100,000 and \$1,000,000. Some 27% of the property values are less than \$100,000 and 23% are greater than \$1,000,000.

The other figure is a series of three histograms showing how property values vary with exploration potential, as assessed by the valuator, and how they vary with exploration stage. It can be seen that mineral property values are higher for properties with better exploration potential and at a more advanced exploration stage. The most advanced exploration properties are at the stage of delineation drilling and underground exploration.

CONCLUSION

Valuation of development properties utilizes primarily two methods: discounted cash flow and comparable transactions. These methods are well established and accepted in the industry.

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Valuation of exploration properties and marginal development properties is very subjective and valuations by different parties can vary widely.

There are at present no comprehensive regulations or guidelines in Canada for the valuation of mineral properties, nor are there standards for qualifications and experience of valuers. The CIM has recently formed a committee to examine valuation approaches and methodology, as recommended by the TSE/OSC Mining Standards Task Force.

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VALUATION OF AN EXPROPRIATED B.C. PROPERTY

- Remote location, helicopter access
- Some potential for Ni-Cu-PGE mineralization
- Some anomalous soil and rock samples

Appraised Value (1993)

Retained Value of Past Work	\$26,000
Warranted Future Exploration Work	\$0
Appraised Value	\$26,000
Fair Market Value of Property (50% to 75%)	\$13,000 to \$20,000

Comparable Transactions (1993)

\$22,000	\$25,000
\$18,000	\$31,000
\$24,000	\$36,000

Fair Market Value Range

\$13,000 to \$20,000

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VALUATION OF AN EXPROPRIATED B.C. PROPERTY

- Difficult location, old track access
- Quartz vein with some gold values
- Moderate exploration potential
- Recommend several drill holes

Appraised Value

Retained Value of Past Work	\$50,000
Warranted Future Exploration Work	\$260,000
Appraised Value	\$310,000
Fair Market Value of Property (50%-75%)	\$155,000 to \$235,000

Comparable Transactions

\$102,000	\$144,000
\$114,000	\$204,000

Fair Market Value

\$155,000 to \$200,000

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OPTION AGREEMENT TERMS METHOD

Base metal property with good exploration potential in Year 2 of a four year option agreement whereby another company can earn a 50% interest.

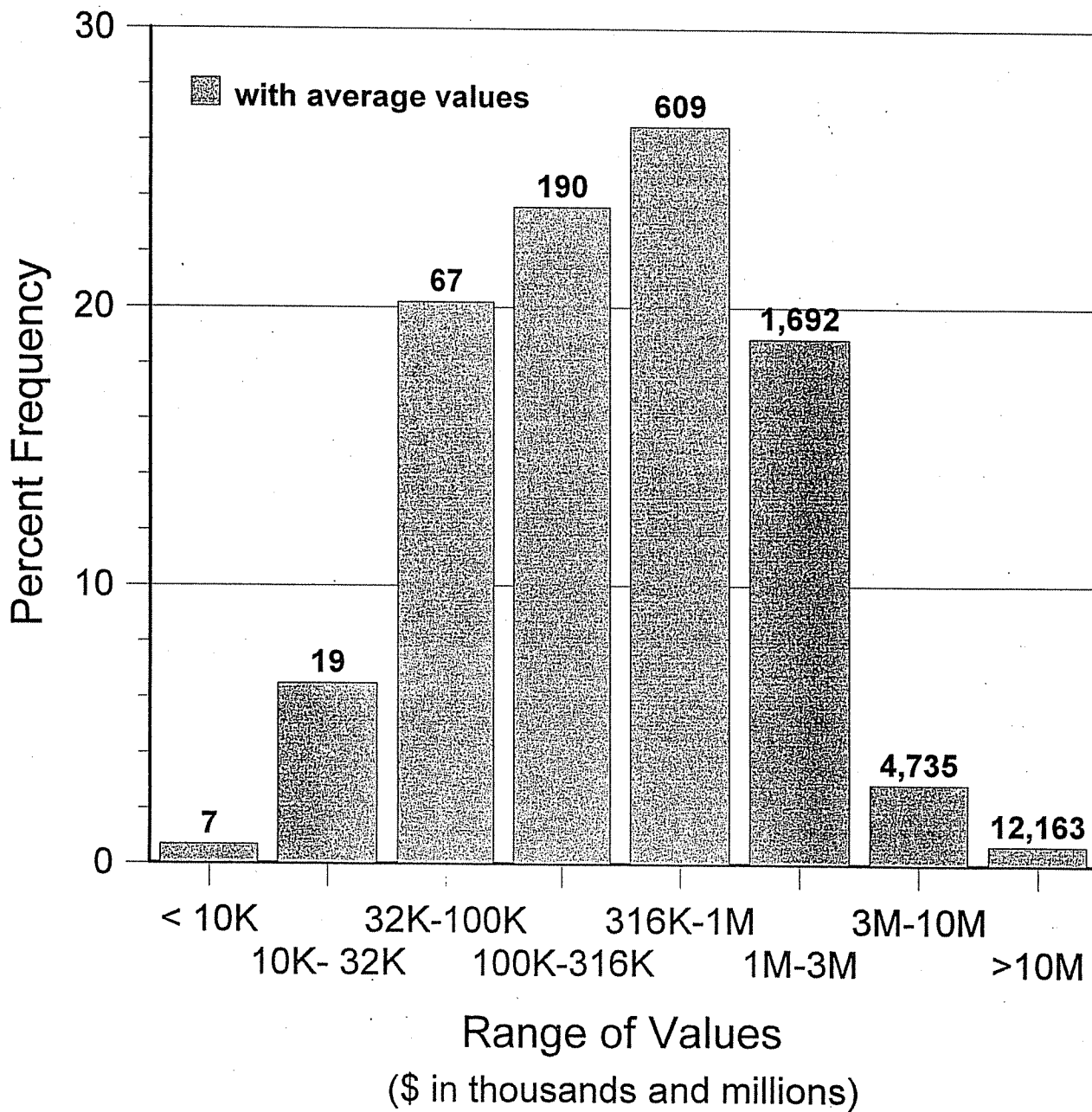
Year	Payments	Work Commitmnt	Status	Probability	Value Implied
1	10,000	50,000	Fulfilled	100%	60,000
2	30,000	150,000	Committed	100%	180,000
3	60,000	300,000	Optional	50%	180,000
4	100,000	500,000	Optional	25%	120,000
Totals	200,000	1,000,000			540,000

Value is \$540,000 for a 50% interest.

Property value is therefore \$1,080,000.

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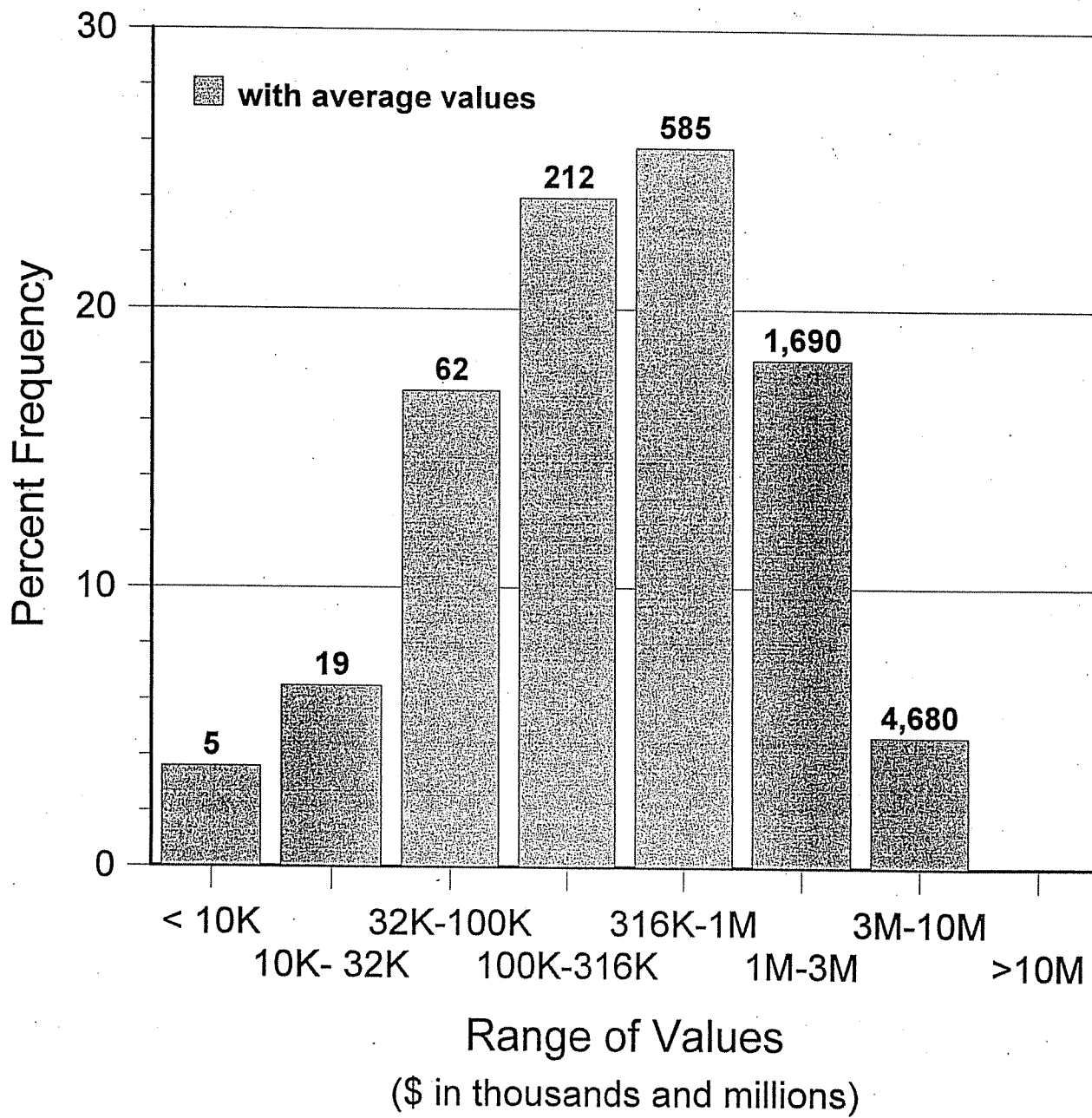
VALUATION OF EXPLORATION PROPERTIES
1995 to 1996
445 Gold Properties



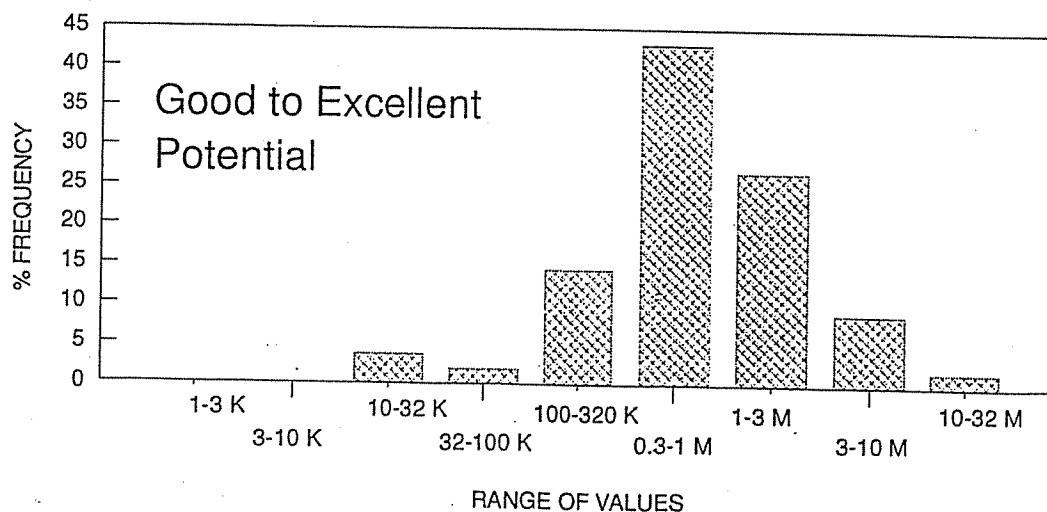
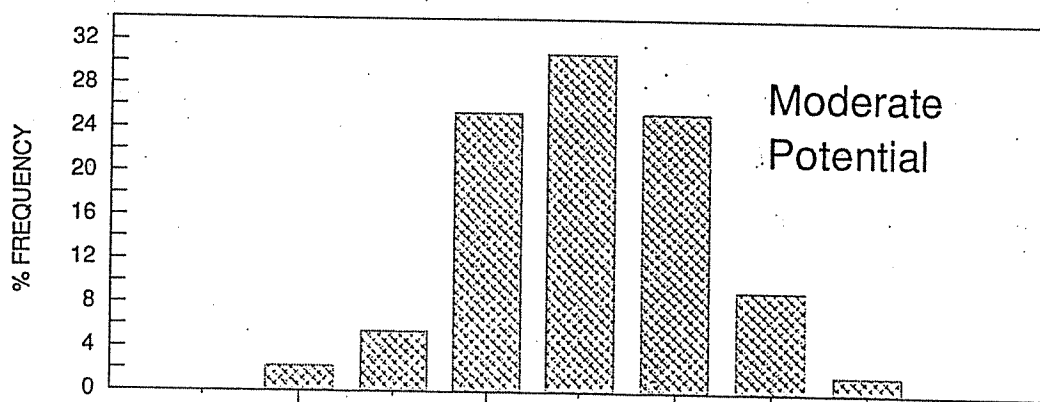
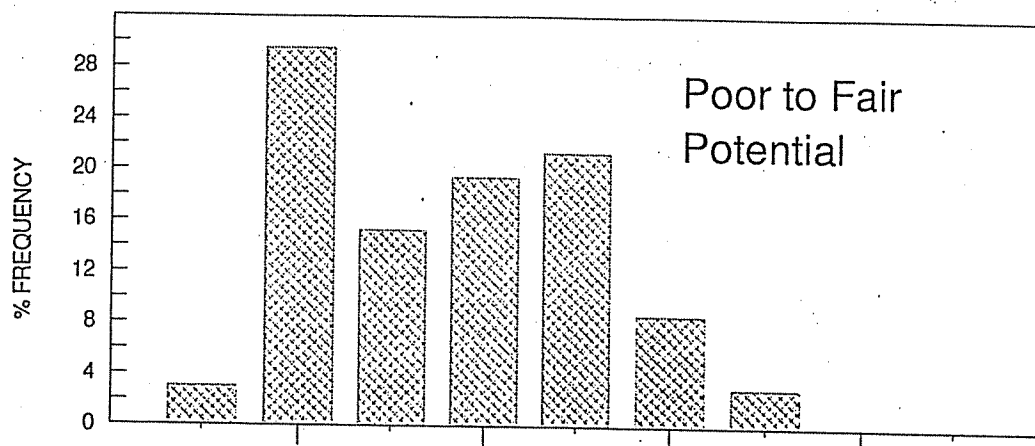
VALUATION OF EXPLORATION PROPERTIES

1998 to 1999

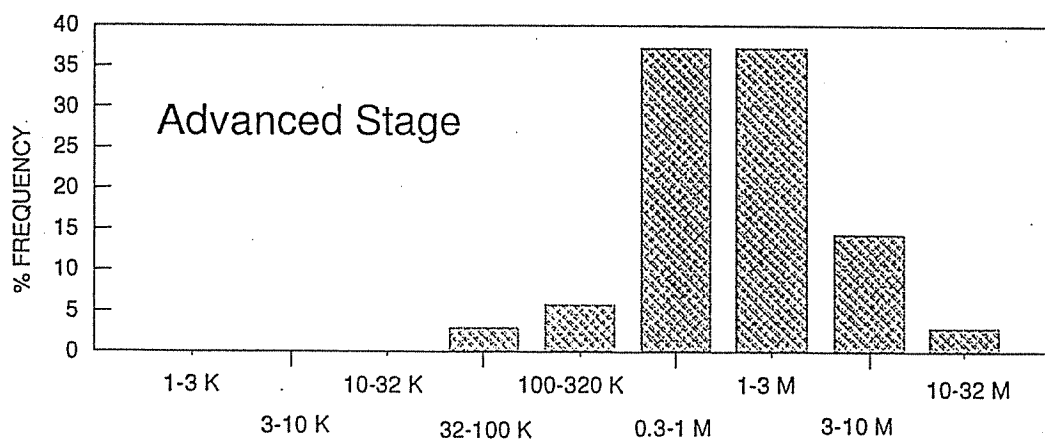
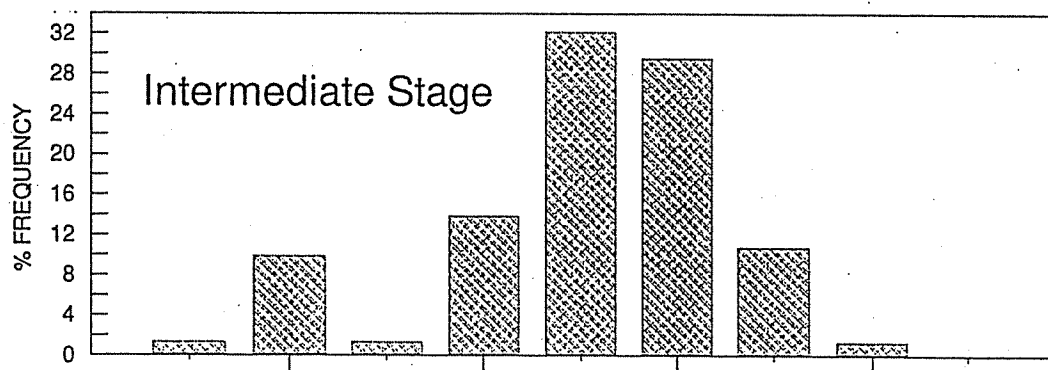
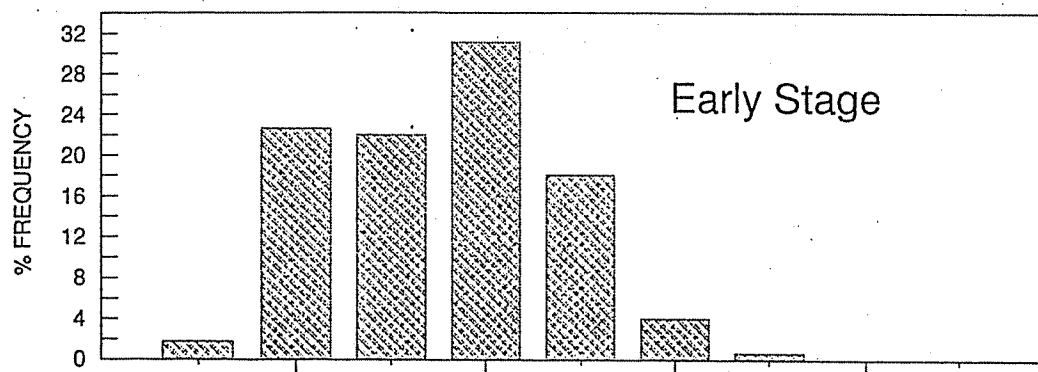
275 Gold Properties



VALUATION OF EXPLORATION PROPERTIES VALUES BY POTENTIAL RATING



VALUATION OF EXPLORATION PROPERTIES VALUES BY EXPLORATION STAGE



RANGE OF VALUES