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Accounting for Risk

Metal Transaction Ratio Analysis – A Market Approach for Valuation of Non-Producing Properties with Mineral Resources

W E Roscoe[1]

ABSTRACT

The fair market value of a non-producing mineral property can be derived using the market approach, the income approach or the cost approach, depending on its stage of exploration or development. The market approach, also called the sales comparison approach, can be used for valuation of non-producing mineral properties with mineral resources. In addition to the recognised yardstick methods of using value per unit metal contained in mineral resources and the unit value expressed as a percentage of metal price, this paper emphasises the analysis by metal transaction ratio (MTR) for polymetallic properties with mineral resources containing more than one metal or other commodity. The MTR is the ratio of the transaction value to the gross dollar metal content, expressed as a percentage.

The market approach involves identifying and analysing market transactions on non-producing mineral properties comparable to the property subject to the valuation. Non-producing properties with mineral resources include those at advanced stages of exploration, properties at the prefeasibility or feasibility stage, properties with currently uneconomic mineral resources, and past producers. The comparable transaction values, including MTRs, are analysed to determine a reasonable range of values to apply to the mineral resources of the subject property. Examples are used to illustrate the methodology.

Selection of comparable transactions should consider factors such as commodities, geological setting, mineral deposit type, stage of exploration and results, quantity and quality of 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 analysing a number of transactions on similar properties to develop a range of values for the subject property.

INTRODUCTION

The purpose of this paper is to describe a market approach for valuation of non-producing mineral properties with mineral resources. The paper describes the use of metal transaction ratio (MTR) for valuation of polymetallic properties with mineral resources containing more than one metal or other commodity. Some valuation examples are provided to illustrate the methodology and general levels of mineral property values.

Valuations of mineral properties are needed for various reasons, including mergers and acquisitions, non-arm's length transactions, pricing of initial public offering of securities, support for property agreements, litigation, compensation for expropriation, and insurance claims. Independence of the valuer is usually implicit for these applications (VALMIN, 2005).

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 it pertains to a mineral property, fair market value can be defined as the amount of money or equivalent for which a mineral property asset should change hands on the valuation date in an open and unrestricted market between a willing buyer and a willing seller in an 'arm's length' transaction, with each party acting knowledgeably, prudently and without compulsion. This is adapted from the definition of fair market value in the VALMIN Code (Definition D43).

As in any valuation, the effective date of the valuation is important because mineral property values vary over time, depending on events on neighbouring properties, market interest, commodity prices and other factors.

Different types of mineral properties require different valuation approaches and methods (CIM, 2003; Roscoe, 2003, 2007). This paper focuses on the market approach, also known as sales comparison approach, as applied to non-producing properties with reported mineral resources. Non-

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producing properties with mineral resources include those at advanced stages of exploration, properties at the prefeasibility or feasibility stage, properties with currently uneconomic mineral resources, and past producers.

Dollars used in the examples in this paper are US dollars (US$), but could be considered as Australian or Canadian dollars. The abbreviation M is used for millions of dollars or other units.

This paper deals with valuation of mineral properties as assets 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, including other assets and liabilities (cash and debt), quality of management, market recognition and liquidity.

MARKET APPROACH

General

The market approach, or sales comparison approach, is one of the three generally accepted valuation approaches, the other two being the income approach and the cost approach (International Valuation Standards, 2011; CIM, 2003). Comparable transactions analysis is a market approach that uses a number of market transactions on similar properties to define a reasonable range of values to apply to the subject property.

Two difficulties with comparable transactions analysis are that there are no truly comparable mineral properties and there are few market transactions on mineral properties, compared to the real estate market (Lawrence, 2001; Roscoe, 2007). Another difficulty is the large amount of variability in market transaction values. These difficulties can be largely overcome by identifying and analysing a number of transactions to develop a range of values to apply to the subject property. A further difficulty is that mineral property transaction agreements are often complex and need analysis of the agreement terms to derive a transaction value.

The value of a non-producing mineral property depends on its perceived potential for the existence and discovery of an economic mineral deposit (Roscoe, 2007). For non-producing properties with mineral resources, the value lies in the potential for the mineral resources to be economically viable or to be enhanced to an economically viable level. In order to choose suitable market comparable properties, a number of factors must be considered. For non-producing properties with mineral resources, these comparability factors include:

- commodity or group of commodities, eg gold, uranium, nickel-copper, diamonds
- political jurisdiction
- location, access, infrastructure
- geological setting
- mineralisation type
- stage of exploration or development
- general magnitude and quality of mineral resources
- potential to increase mineral resources
- activity on neighbouring properties
- location in a 'hot' area with new mineral discoveries
- environmental, social or political issues as potential liabilities.

Another consideration in choosing market comparable transactions is the date of the comparable transactions since market conditions, market activity, commodity prices and the like change over time. The comparable transaction dates should be within a reasonable time period of the valuation date of the subject property and in a time of similar market conditions. Typical time periods are in the range of two to three years prior to the valuation date, in order to have similar market conditions and commodity prices, and to ensure that a sufficient number of transactions are available for meaningful analysis. When the value per unit metal is normalised as a percentage of metal price or through the use of MTR, a longer time period can be justified, provided market conditions do not change substantially during the period.

Mineral resources

Mineral resources as used in this paper generally refer to those compatible with the JORC Code (2004), CIM Definition Standards (2010) and equivalent definitions. Measured, indicated and inferred resources are totalled together for the analysis of comparable transactions and the application of value factors to the subject property. There may be some justification to derive different values for different categories of mineral resource, but in the writer's experience it is difficult to derive separate values because of the variability in transaction value data and the relative scarcity of transactions with only one category of mineral resource. In general, mineral reserves have higher unit values than mineral resources, however, only mineral resources are considered in this paper and in the examples used.

Analysis of comparable transactions

Once a suitable set of comparable transactions is selected, the value of each mineral property transacted can be derived. In most cases for non-producing properties with mineral resources, transactions consist of cash, securities or a combination of the two, and may include a royalty in favour of the vendor. The total property value can be readily determined with an appropriate allowance for any royalty. In some cases, transactions may consist of option, farm-in or joint venture agreements which require some analysis to derive the total property value. More detail on analysis of such agreements can be found in Lawrence (2001) under Joint Venture Terms Methods and in Roscoe (2007) under Option Agreement Terms Analysis. The analysis essentially consists of including firm financial commitments, assigning a probability of realisation to future optional commitments, and making an appropriate allowance for any royalty.

The value of the mineral resources of each transacted property can be calculated and expressed in one or more of the following three ways:

1. value per unit metal or other commodity contained in the mineral resource
2. value per unit metal or other commodity as a percent of the metal or commodity price
3. metal transaction ratio for polymetallic mineral resources.

The value per unit metal contained in the resource (Yardstick Method in Lawrence, 2001) is derived from the total value of the property divided by the units of metal or other commodity contained in the mineral resource. A simplistic example is given below for illustrative purposes:

- 50 per cent interest purchased for $10 M: value of 100 per cent property interest is $20 M
- mineral resources total 5 Mt at 3.1 g/t Au: contained gold is 500 000 oz
- unit value is $40 per ounce gold.

Value per unit metal as a percent of the metal price uses the gold price as of the date of the market transaction. This ties the value per unit metal in to the metal price at a particular time and may allow analysis of comparable transactions covering a longer time period since it accounts for the variation of gold price over time. Using the above example and a gold price of $1000 per ounce, a value of four per cent of the gold price is derived.

Metal transaction ratio can be calculated for mineral resources that contain more than one metal (Roscoe, 2007). The gross dollar content of metals contained in the mineral resource is calculated using metal prices as of the date of the market transaction. The MTR is the property value divided by the gross dollar metal content. The MTR is analogous to the ratio of unit metal value to metal price. An example is given below:

- property value is $55 M
- mineral resource is 50 Mt at five per cent Zn, four per cent Pb and 20 g/t Ag
- contained metal is 5512 M lbs Zn, 4409 M lbs Pb and 32 M oz Ag
- metal prices $1/lb Zn, $0.95 Pb and $20/oz Ag
- gross dollar content of metals $5512 M Zn, $4189 M Pb and $1286 M Ag – total $10 986 M
- MTR = $55 M/$10 986 M = 0.50 per cent.

Note that the gross dollar metal content cannot be considered to be a value and is used here only for the purpose of deriving the MTR. Reporting of such numbers as 'gross *in situ* value' and the like is not allowed under JORC or CIM Definition Standards.

The market comparable transactions are analysed to derive an appropriate value or range of values to apply to the mineral resources of the subject property in terms of value per unit metal, unit value as a percent of metal price and/or MTR. Considerations in choosing an appropriate range of market values include:

- examine mean and median values as well as overall variability and range of values
- consider eliminating outliers at the high and low end of the value range
- examine possible relation of values to transaction date, size or grade of mineral resource, size of transaction, political jurisdiction or other factors
- consider which properties are more similar to the subject property.

EXAMPLES OF MARKET APPROACH TO VALUATION OF NON-PRODUCING PROPERTIES WITH MINERAL RESOURCES

Three examples follow of comparable transactions analysis using yardstick methods and MTR. One is for a single metal resource property and the other two are for properties with polymetallic resources. For each of the examples, the value of each property was derived from published details of the transaction. If the transaction was for less than 100 per cent of the property, the transaction value has been adjusted to a 100 per cent interest in the property. Contained metals have been calculated from the published mineral resources with all categories added together, with no allowance for process recoveries.

First, market transactions are analysed to derive an appropriate range of values and, second, the range of values is applied to the mineral resources of the subject property. The transactions were sourced from proprietary databases compiled by Intierra Resource Intelligence (2011) and Metals Economics Group (2011) Acquisitions Service.

Example 1 – gold property in West Africa

For valuation of a non-producing gold property in West Africa with mineral resources, 13 comparable gold properties were identified for which market transactions had taken place. None of the 13 comparable transactions were in production and none contained mineral reserves; all contained mineral resources. The valuation date of the subject property is late 2009 and the comparable transactions were within the previous three years. Table 1 lists information on the market comparable transactions.

Value of each transaction is expressed in $/oz gold, which is the property value divided by the contained ounces, and as $/oz as a percentage of the gold price as of the date of the transaction. MTR, if calculated, would be the same as $/oz as a percentage of the gold price.

The lower part of Table 1 shows statistics of the transaction values for all 13 transactions, and for subsets of the transaction value data. The transaction values range over two orders of magnitude from $1.36/oz - $125.55/oz and from 0.17 - 16.76 per cent of the gold price. The highest and lowest values are considered to be outliers, and when they are removed, the range is reduced by an order of magnitude to $6.17/oz - $49.53/oz and 0.69 - 4.20 per cent of the gold price. The standard deviation of the values is also reduced substantially. Without the outliers, the average transaction values are $22.84/oz and 2.37 per cent of the gold price, and the median values are $19.64/oz and 2.17 per cent of the gold price.

Table 1 also shows statistics for two different time periods: 2007 and 2008 - 2009. It can be seen that the 2008 - 2009 mean and median values are significantly higher than those of 2007, presumably due to the impact of the global financial crisis in late 2008. The $/oz and per cent of gold price values for 2008 - 2009 are therefore relied on more than the 2007 values for derivation of an appropriate range of values to apply to the subject property with a late 2009 valuation date.

The recommended ranges to apply to the subject property are $24/oz to $30/oz and 2.2 - 3.0 per cent of the gold price. If the subject property has a mineral resource containing 1.5 million ounces and the gold price at the late 2009 valuation date is $1100/oz, the subject property can be valued as follows:

- $36 M - $45 M using $24/oz - $30/oz
- comparables range using 2.2 - 3.0 per cent of the $1100 gold price is $24.20/oz - $33/oz
- this results in $36.3 M - $49.5 M as per cent of gold price
- value range for the subject property is $36 M - $47 M in late 2009 weighting the two equally.

Example 2 – polymetallic property in eastern Canada

For valuation of a non-producing Ni-Cu-Co-Pt-Pd-Au property in eastern Canada with mineral resources, ten comparable polymetallic properties with a similar mix of metals were identified for which market transactions had taken place and for which mineral resources were reported. The valuation date of the subject property is early 2011 and the comparable transactions were within the previous 26 months. Table 2 lists information on the market comparable transactions.

TABLE 1

Comparable transactions analysis for a non-producing gold property in West Africa.

Transaction date	Property value $ M	Contained gold M oz	$/oz gold	Price on transaction date $/oz Au	$/oz as % of Au price
2007	333.3	2.66	125.55	749	16.76
2009	200.0	4.04	49.53	1180	4.20
2008	54.5	1.26	43.19	960	4.50
2008	31.3	0.92	33.98	864	3.93
2009	240.0	8.41	28.54	1062	2.69
2009	565.0	22.57	25.03	1040	2.41
2009	4.8	0.25	19.64	917	2.14
2007	346.0	19.09	18.13	834	2.17
2008	31.5	2.74	11.48	915	1.26
2007	4.7	0.55	8.57	749	1.14
2007	6.4	0.92	7.00	719	0.97
2009	2.0	0.32	6.17	889	0.69
2008	1.5	1.08	1.36	804	0.17
All transactions					
	Mean		29.09		3.31
	Median		19.64		2.17
	Standard deviation		32.51		4.27
Without highest and lowest values/oz					
	Mean		22.84		2.37
	Median		19.64		2.17
	Standard deviation		14.77		1.34
2008 and 2009 transactions without lowest value/oz					
	Mean		27.19		2.73
	Median		26.79		2.55
	Standard deviation		14.89		1.39
2007 transactions without highest value/oz					
	Mean		11.23		1.43
	Median		8.57		1.14
	Standard deviation		6.02		0.65
Recommended comparables ranges for late 2009 valuation date					
			$24 - $30/oz	**2.2 - 3.0 per cent of price**	

The gross dollar metal content of the resources for each property has been derived from the published mineral resources with all categories added together. The contained quantities of copper, nickel and cobalt have been calculated in pounds and multiplied by the published metal prices on the transaction date. Similarly, the contained quantities of precious metals (platinum, palladium, gold, silver, and in one case rhodium) have been calculated in troy ounces and multiplied by the published prices on the transaction date. No allowance has been made for potential recovery of the various metals. The contained dollar metal contents are summed to obtain the gross dollar metal content of resources listed in Table 2.

The MTR is the value of the transacted property divided by the gross dollar metal content of the resources and is expressed as a percentage. Metal prices are those as of the transaction date.

The lower part of Table 2 shows statistics of the MTR values for all ten transactions. The transaction values range from 0.15 - 0.99 per cent and the average and median MTR values are 0.46 per cent and 0.35 per cent respectively. Without the highest and lowest values, which are not considered to be outliers, the average and median MTR values are essentially the same and the standard deviation decreases slightly.

The range of MTR values recommended to apply to the subject property is 0.35 - 0.45 per cent. If the subject property has mineral resources containing 40 M lbs of nickel, 100 M lbs of copper, 50 000 oz of platinum and 100 000 oz of palladium, the gross dollar metal content of the mineral resources and the property value are derived as follows, using metal prices as of the early 2011 valuation date and the MTR range derived above:

- gross dollar content of nickel – 40 M lbs at $12/lb = $480 M

TABLE 2

Comparable transactions analysis for a polymetallic property in eastern Canada.

Transaction date	Property value $M	Metals in mineral resources	Gross dollar metal content of resources $M	Metal transaction ratio %
2009	1.0	Cu, Co, Au	101	0.99
2011	90.0	Ni, Cu, Pt, Pd	10 075	0.89
2011	7.5	Ni, Cu, Co, Pt, Pd	1107	0.68
2010	14.4	Cu, Pt, Pd, Au, Ag, Rh	2173	0.66
2010	12.6	Ni, Cu, Pt, Pd	3269	0.39
2010	5.3	Ni, Cu, Pt, Pd, Au, Ag	1683	0.31
2011	5.3	Ni, Cu, Pd, Au, Ag	2423	0.22
2009	0.6	Ni, Cu, Co, Pd	337	0.17
2009	6.2	Ni, Cu	3952	0.16
2011	3.1	Ni, Cu, Pt, Pd, Au	2037	0.15
All transactions				
		Mean		0.46
		Median		0.35
		Standard deviation		0.32
All transactions without highest and lowest metal transaction ratio				
		Mean		0.44
		Median		0.35
		Standard deviation		0.28
Recommended metal transaction ratio range for early 2011 valuation date				**0.3 - 0.5**

- gross dollar content of copper – 100 M lbs at $4.30/lb = $430 M
- gross dollar content of platinum – 50 000 oz at $1800/oz = $90 M
- gross dollar content of palladium – 100 000 oz at $770/oz = $77 M
- total gross dollar metal content of mineral resources in early 2011 = $1077 M
- value range is $3.8 M - $4.8 M in early 2011 based on an MTR range of 0.35 - 0.45 per cent.

Example 3 – porphyry copper property in South America

For valuation of a non-producing porphyry copper property in South America with mineral resources, nine comparable gold properties were identified for which market transactions had taken place. The valuation date of the subject property is early 2011 and the comparable transactions were within the previous four years. Table 3 lists information on the market comparable transactions.

Value of each transaction is expressed in three ways: as cents/lb copper, which is the property value divided by the contained pounds of copper and converted to cents; as $/lb copper as a percentage of the copper price on the transaction date; and as MTR.

The lower part of Table 3 shows statistics of the cents/lb Cu, the per cent of Cu price and the MTR values for all nine transactions. The highest value/lb and possibly the lowest value/lb are considered to be outliers and, when they are excluded, the average values decrease and the standard deviation is reduced substantially. Without the highest and lowest values/lb, the value ranges are from 1.24 - 4.87 cents/lb Cu, from 0.52 - 1.37 per cent of the copper price and from 0.31 - 1.30 per cent MTR. Note that the MTR values are all lower than the per cent of Cu price values because the latter do not account for the other metals in the mineral resources.

The 2009 - 2011 transactions show generally lower average and median values than the 2007 transactions, presumably due to the impact of the global financial crisis in late 2008. For the 2009 - 2011 transactions without the highest and lowest values, average and median values are as follows:

- average 2.11 cents/lb copper and median 2.16 cents/lb copper
- average and median both 0.71 per cent of copper price
- average MTR 0.56 per cent and median MTR 0.63 per cent.

The recommended ranges to apply to the subject property are 1.8 - 2.4 cents/lb Cu, 0.6 - 0.8 per cent of the copper price, and 0.5 - 0.7 per cent MTR. These ranges rely on the 2009 - 2011 transactions without the highest and lowest values and are based on the average and median values as well as the variability of the data. If the subject property has mineral resources containing 8000 M lbs of copper, 400 M lbs of molybdenum and 4 M oz of gold, the gross dollar metal content of the mineral resources is derived as follows, using metal prices as of the early 2011 valuation date:

- gross dollar content of copper – 8000 M lbs at $4.30/lb = $34 400 M
- gross dollar content of molybdenum – 400 M lbs at $16/lb = $6400 M
- gross dollar content of gold – 4 M oz at $1500/oz = $6000 M
- total gross dollar metal content of mineral resources in early 2011 = $46 800 M.

For the three valuation parameters derived from the comparable transactions, the subject property which has mineral resources containing 8000 M lbs of copper plus other metals is valued as follows:

TABLE 3

Comparable transactions analysis for a non-producing porphyry copper property in South America.

Transaction date	Property value $M	Metals in mineral resources	Contained copper M lb	Cents/lb copper	Price on transaction date $/lb Cu	Cents/lb as per cent of Cu price	Gross dollar metal vontent of resources $M	Metal transaction ratio %
2010	733	Cu, Au	7116	10.30	2.83	3.64%	29 638	2.47
2007	403	Cu, Au, Ag	8275	4.87	3.55	1.37%	31 073	1.30
2007	791	Cu, Mo, Ag	22 088	3.58	3.35	1.07%	123 026	0.64
2011	80	Cu, Au, Ag	2927	2.73	4.54	0.60%	14 594	0.55
2010	72	Cu, Au	2627	2.73	3.33	0.82%	9952	0.72
2010	350	Cu, Mo, Au	21 996	1.59	3.25	0.49%	155 868	0.22
2009	31	Cu, Au	2188	1.40	1.48	0.94%	4175	0.73
2007	194	Cu, Mo	15 657	1.24	2.40	0.52%	61 832	0.31
2009	26	Cu, Mo	2422	1.07	3.14	0.34%	11 596	0.22
All transactions								
		Average	3.28		1.09%		0.80%	
		Median	2.73		0.82%		0.64%	
		Standard deviation	2.91		1.01%		0.71%	
All transactions without highest and lowest values/lb								
		Average	2.59		0.83%		0.64%	
		Median	2.73		0.82%		0.64%	
		Standard deviation	1.32		0.32%		0.35%	
2009 - 2011 transactions without highest and lowest values/lb								
		Average	2.11		0.71%		0.56%	
		Median	2.16		0.71%		0.63%	
		Standard deviation	0.72		0.21%		0.24%	
2007 transactions								
		Average	3.23		0.99%		0.75%	
		Median	3.58		1.07%		0.64%	
		Standard deviation	1.84		0.43%		0.50%	
Recommended comparables ranges for early 2011 valuation date								
			1.8 - 2.4 cents/lb		**0.6 - 0.8 per cent of price**		**0.5 - 0.7 per cent metal transaction ratio**	

- $144 M - $192 M based on 1.8 - 2.4 cents/lb copper
- $206 M - $275 M based on 0.6 - 0.8 per cent of copper price of $4.30 lb
- $234 M - $328 M based on MTR of 0.5 - 0.7 per cent
- value range for the subject property is $205 M - $281 M in early 2011 weighting the MTR value range 50 per cent and the other two 25 per cent each, because the MTR recognises the contribution of other metals in addition to copper.

CONCLUSIONS

A non-producing mineral property with mineral resources can be valued by analysing transaction and mineral resource data from comparable mineral properties on which market transactions have taken place.

A number of comparable transactions should be used in the analysis to compensate for a small market and variability in the values. Comparable transaction dates should be within a two to three year period prior to the valuation date of the subject property, although a longer period can be justified by normalising values as a percentage of metal price or through the use of MTR.

Comparable transactions should have similarity to the property being valued in terms of commodities in the mineral resource, political jurisdiction, infrastructure, geological setting, mineralisation type and the like.

MTR analysis is a useful tool for market approach valuation of properties with polymetallic mineral resources, in addition to the recognised yardstick methods involving value per unit metal and unit value as a percentage of metal price.

The value of the subject property is estimated by applying the range of values per unit metal or other commodity, per cent of price and/or MTR to the mineral resources of the subject property. A single value can be selected from the range of values if required.

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