

Mineral Economics

Valuation of mineral exploration properties using the cost approach

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KEYWORDS: Valuation, Mineral resources, Exploration properties, Appraised value method.

Paper presented at Mining Millennium 2000 and previously published in Mineral Property Valuation Proceedings.

Paper reviewed and approved for publication by the Mineral Economics Society of CIM.

ABSTRACT

Mineral exploration properties are those on which an economically viable mineral deposit has not yet been discovered. Such properties are bought, sold, optioned and joint ventured on the basis of their perceived potential for the existence and discovery of a viable mineral deposit. The intrinsic value of an exploration property is therefore based on the exploration potential. One measure of the exploration potential is the amount that can be justified to spend on exploration for a viable deposit.



Bill Roscoe received a B.Sc. (Eng.) from Queen's University in 1966 and M.Sc. and Ph.D. degrees in geological sciences from McGill University. He has been a consulting geologist and principal with Roscoe Postle Associates Inc. (RPA) since its founding in 1985. Previously, he was a senior associate with David S. Robertson and Associates and prior to that, he worked for a number of years with two major mining companies. Dr. Roscoe is a member of several professional associations and he serves

as Co-Chair of the Canadian Institute of Mining, Metallurgy and Petroleum's Special Committee on Valuation of Mineral Properties (CIMVal). CIMVal is in the process of formulating Canadian standards and guidelines for the valuation of mineral properties. He has extensive experience in mineral exploration, resource and reserve estimation, and valuation of mineral properties and he has published extensively on these topics. As a consulting geologist since 1981, he has been involved in numerous assignments, including management and supervision of exploration projects, monitoring of exploration joint ventures, assessment of exploration and mining projects, resource/reserve estimates and audits, using both conventional and geostatistical methods, valuation of mineral properties, and preparation of qualifying reports for regulatory authorities.

The appraised value method uses a cost approach to value exploration properties. It is based on the premise that an exploration property is worth the meaningful past exploration expenditures plus warranted future costs to test remaining exploration potential. Results of past exploration work are analyzed in order to retain only those past expenditures that are productive in terms of identifying remaining potential. Warranted future costs comprise a reasonable exploration budget to test that potential.

Introduction

The purpose of this paper is to describe a cost approach to the valuation of mineral exploration properties and to provide some valuation examples. The particular cost approach described is the appraised value method, which is best applied to mineral properties at the exploration stage.

At present, there are no comprehensive regulations or guidelines in Canada that specify what approaches and methods to use for the valuation of mineral properties. In this paper, the appraised value method described is one method that the writer considers to be accepted industry practice for mineral properties at the exploration stage.

Mineral properties are valued for a number of reasons, including mergers and acquisitions, non-arm's length transactions, pricing of initial public offering of stock, support for property agreements, litigation, expropriation, 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, development licences, mining licences and leases, and patented lands with mineral rights. Fair market value can be defined as follows:

Fair market value is the amount that would have been paid for a mineral property in the open market by a willing seller to a willing buyer in cash or equivalent at a particular date.

One of the important concepts in this definition that is critical to mineral properties is the effective date of valuation. This is because mineral property values vary over time, depending on events on neighbouring properties, market interest, commodity prices, etc. For an expropriation, insurance claim or litigation, the effective date may be a contentious issue in that the 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.

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 than on the type of mineral tenure.

Development Properties

Development properties are those on which an economically viable mineral deposit has been demonstrated to exist, including producing mines. 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 production 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 develop-

Fig. 1. Variation in the values of exploration properties over time.

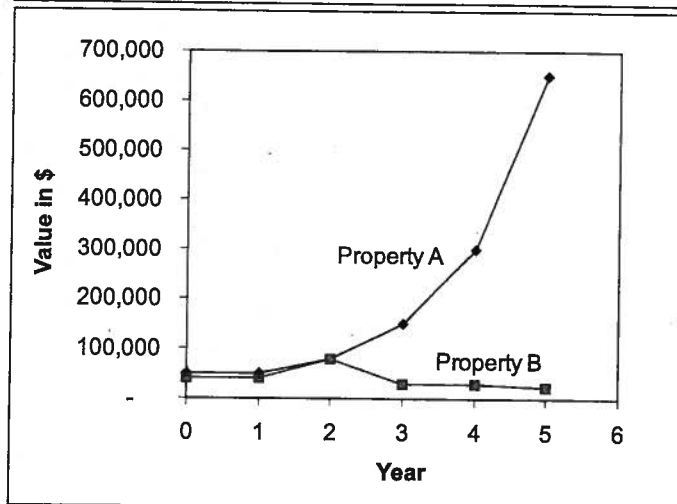


Fig. 2. Frequency distribution of 445 transactions in Canada in 1995-1996.

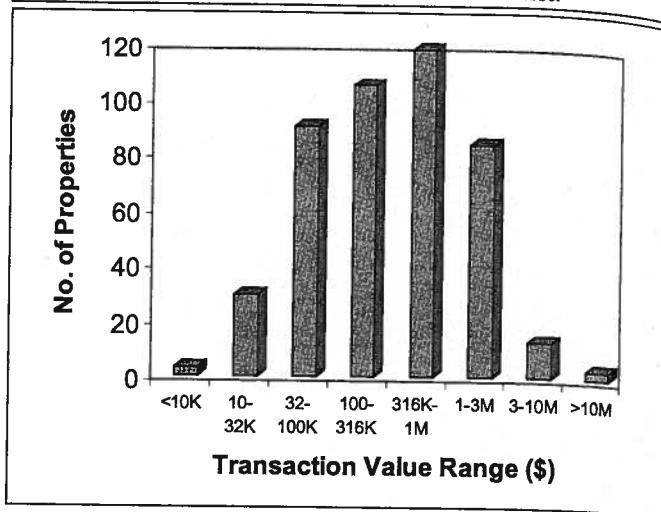


Table 1. Valuation approaches for different types of mineral properties

Valuation Approach	Valuation Method	Development Properties	Marginal Development Properties	Exploration properties
Income	Discounted cash flow	Yes	Maybe	No
	Option pricing	Yes	Yes	No
Cost	Appraised value	No	Yes	Yes
	Geoscience factor	No	Maybe	Yes
Market	Comparable transactions	Yes	Yes	Yes
	Option agreement terms	Yes	Yes	Yes

ment of an economically viable operation is feasible, planned or under construction.

Exploration Properties

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

Marginal Development Properties

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

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.

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

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, as illustrated in Table 1.

The appraised value method, which is the subject of this paper, can be applied to exploration properties and, in many cases, to marginal development properties. Other valuation

approaches and methods are described in other papers presented at Mining Millennium 2000 (MM2000). The geoscience factor method is a variant of the cost approach, and is also described in another paper presented at MM2000. Income approaches are not considered to be appropriate for properties at the exploration stage. Market approach methods are described briefly in this paper, since they are commonly used as a check on the appraised value method.

Cost Approach

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 a reference to past exploration expenditures in option agreements, which can often be related to value of the residual interest of the optionee.

The appraised value method is described in papers by Roscoe (1986, 1988, 1994, 1999), Agnerian (1996), 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 showings or mineralized zones already identified. As noted previously, if exploration work downgrades potential, it is not productive and its cost should not be retained as value or should be reduced. Obviously, if the property is considered to have negligible exploration potential, it has little or no value.

Past expenditures are usually analyzed on an annual basis, using technical expertise to assess which expenditures to retain and which to reject in terms of identifying remaining

Table 2. Guidelines for retained expenditures for marginal and inactive properties

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

exploration potential. In times of high inflation, past expenditures are escalated to the effective date of valuation or current unit costs are applied to the work retained. Usually little of the expenditures more than five or so years prior to the effective valuation date are retained.

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

The derivation of an appraised value by adding the retained past expenditures to the warranted future costs should be thought of as an abstract exercise to determine the cost of an exploration "play" on a property, which is considered to be the appraised value. It should not be thought of in terms of who pays for the future exploration program, although it is similar to the earn-in aspect of some option agreements. It should also not be thought of as an accounting exercise where exploration expenditures are booked and can be written off over time or against income.

The appraised value method is best applied to properties which are actively being explored. It is more difficult to apply the method to properties that have been idle for some years, especially those which have had substantial expenditures in the past. Many such properties have sub-economic or marginal resources outlined by the past work, and some qualify as marginal development properties. The key to the valuation of inactive properties

is a realistic assessment of the remaining exploration potential, which could be in the form of untested targets, potential to increase the grade or tonnage of the existing resource, or potential for development with changes in technology or economic conditions.

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

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

Application of the appraised value method requires a thorough understanding of the exploration process, industry standards, and unit costs for drilling and other exploration techniques. It requires that the valuator become familiar with the geological setting, the exploration targets, 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 judgment, as well as familiarity with real world property transaction values.

One advantage of the appraised value method is that exploration cost information

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

It is prudent for the valuator to compare the appraised value of a mineral property with values derived from other methods, particularly those which use a market approach, as summarized in the next section.

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, 1999; 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.

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 early years of the option period. The method is generally not applicable to properties on which the option has been exercised by fulfillment of the payment terms and work commitments. At that time, the property value usually exceeds the payments made.

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.

The option agreement terms method can be used to determine the value of comparable

transactions, since most exploration property transactions are option or joint venture earn-in agreements.

Mineral Property Valuation Examples

Seven examples of mineral exploration property valuations are given in Tables 3 to 9. These give a brief description of the subject property, then show how the value is derived by the appraised value method, in most cases using another method for confirmation of the value range.

Range of Exploration Property Values

Roscoe Postle Associates has developed an extensive database of mineral exploration

Table 3. Valuation Example 1

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

Appraised value (1993) (60% of property dropped)	
Retained value of past work	\$26,000
Warranted future exploration	nil
Appraised value	\$26,000
Fair market value adjustment (50% to 75%)	\$13,000 to \$20,000
Comparable transactions (1993)	
\$11,000	\$25,000
\$18,000	\$31,000
\$24,000	\$36,000
Fair market value range	\$13,000 to \$20,000

Table 4. Valuation Example 2

- British Columbia exploration property, 1993 valuation date
- Difficult location, old track access
- Quartz vein with some gold values
- Moderate exploration potential for small gold veins
- Several drill holes recommended
- Total past expenditures 1983 to 1992 estimated at \$200,000

Appraised value (1993)	
Retained value of past work	\$50,000
Warranted future exploration	\$260,000
Appraised value	\$310,000
Fair market value adjustment (50% to 75%)	\$155,000 to \$235,000
Comparable transactions (1993)	
\$102,000	\$144,000
\$114,000	\$204,000
Fair market value range	\$155,000 to \$200,000

Table 5. Valuation Example 3

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

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

Table 6. Valuation Example 4

<ul style="list-style-type: none"> • Huge diamond exploration property, 1997 valuation date • Northwest Territories location, fixed wing or helicopter access • Company has 50% joint venture interest • Much of past work downgraded diamond potential • Property is adjacent to promising diamond project • Future work involves reprocessing geophysics and till samples, plus follow-up geophysics and drilling • Total past expenditures estimated at \$5.3 million 	
Appraised value (1997)	
Retained value of past work	\$2,466,000
Warranted future exploration	\$1,812,000
Appraised value	\$4,278,000
Value of company share (50%)	\$2,139,000
Comparable transactions (1997)	
\$4.8 million (\$8.0 million prorated on a per hectare basis)	
Fair market value of company share	\$2,139,000

Table 7. Valuation Example 5

<ul style="list-style-type: none"> • Small gold exploration property, 1998 valuation date • Northwest Ontario location, adjacent to producing gold mine • Valuation required for acquisition by owner of adjacent gold mine • Negative results from near-surface drilling in the past • Ore-bearing structure projects onto the property at depth • Good deep exploration potential will be tested in the future • Total past expenditures over 50 years estimated at \$1.0 million in 1998 dollars 	
Appraised value (1998)	
Retained value of past work	\$250,000
Warranted future exploration	\$772,000
Appraised value	\$1,022,000
Appraised value with 50% premium for proximity to producing mine	\$1.5 million
Comparable transactions (1994-1997)	
Four transactions in the same area range from \$0.5 to \$3 million, but none are considered to be directly applicable	
Fair market value range	\$1.0 to \$1.5 million

Table 8. Valuation Example 6

<ul style="list-style-type: none"> • Medium-size property, 1988 valuation date • Northern Manitoba location, fixed wing or helicopter access • Exploration work followed up reported airborne EM conductors • No significant results from 1984 exploration program • Property dormant since 1984 and no work recommended 	
Appraised value (1988)	
Retained value of past work	nil
Warranted future exploration	nil
Nominal value	\$5,000
Fair market value	\$5,000

Table 9. Valuation Example 7

<ul style="list-style-type: none"> • Advanced small exploration property, 1997 valuation date • Ontario location, good road access • Company can purchase a 100% interest subject to a 2% net smelter return • Property contains a significant low grade gold resource with heap leach potential • Preliminary cash flow analysis gives encouraging results but is very sensitive to gold price, recovery and cost assumptions • Future work includes drilling, metallurgical testwork, environmental work and prefeasibility work • Total past expenditures 1986 to 1990 estimated at \$1,080,000 	
Appraised value (1997)	
Retained value of past work	\$810,000
Warranted future property payment and work	\$900,000
Appraised value	\$1,710,000
Value share net of 2% net smelter return	\$1,676,000
Comparable transactions (1996, Western U.S.)	
\$1.1 million	\$3.4 million
\$2.1 million	\$3.9 million
\$2.4 million	\$4.4 million
The subject property is considered to be most comparable to the low end of the range.	
Fair market value range	\$1.1 to \$1.7 million

property values, based on published transactions. Figure 2 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. About 50% of the property values lie between \$100,000 and \$1,000,000. About 27% of the property values are less than \$100,000 and 23% are greater than \$1,000,000.

Conclusion

The appraised value method uses a cost approach to value mineral properties at the exploration stage, and in many cases, marginal development properties. Wherever possible, it should be used in conjunction with other valuation methods for confirmation.

Proper application of the appraised value method requires experienced judgment on the part of the valuator, who should be experienced and knowledgeable in the mineral exploration business and also have familiarity with real world property transaction values.

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NEWS IN BRIEF

EIGHTH INTERNATIONAL CONGRESS OF THE METALLURGICAL INDUSTRIES

The Organizing Committee of the 8th International Congress of the Metallurgical Industries "METALURGIA 2002," is pleased to invite all professionals and specialists belonging to the sector to present works related to the thematic ones of the Congress with the purpose of meeting again in Havana City, Cuba, to show what is new after the start of the new millennium.

METALURGIA 2002 will be held on July 15-17, 2002 at the Convention Palace of Havana, Havana City, Cuba. Workshops will be held on the following topics: raw materials for the siderurgical industry, refractory, ferro alloys, and other goods; manufacturing of carbon, special and stainless steel, its systems and infrastructure, quality control products and applications; steel products, wire and its by-products, and metal services - products and applications; and engineering and services.

The official languages of the conference are Spanish and English with

simultaneous interpretation of the general activities.

Registration fees are as follows:

Delegates	US\$250
Speakers	US\$180
Students	US\$120

Payment can be carried out in cash, through travelers' checks, by credit card (MasterCard, VISA International, JCB, Access, Banamex, Bancomer, Carnet, Cabal and Diners Club International, with no emmission from U.S.A. banks). Included in the registration fee, are: participation in all the events of the convention and the special activities; assistance to the traveler; materials from all the events of the convention; credentials for the convention with access to the commercial fair without payment of extra fee; participation in the Welcome Cocktail and the cultural activities; and the Farewell Dinner (needs previous registration).

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