Yukon Energy, Mines and Resources

REVIEW OF THE EMERALD INDUSTRY

March, 2004

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INTRODUCTION

Emeralds were discovered in the Yukon in 1998 and, in light of further exploration, there is potential for the Yukon to become a new producer of gem-quality stones. As a result of the transfer of responsibility for resources from the federal to the Yukon government, the latter now administers the mineral royalty regime which does not lend itself easily to calculating royalty for emeralds and other gemstones. Micon International Limited (Micon) has been retained by the Yukon Department of Energy, Mines and Resources, Mineral Resources Branch, to provide a background paper on the emerald industry as part of its consideration of changes to the existing mineral royalty regime to accommodate gemstones.

The following report has been prepared by Micon with the assistance of Andy Rendle, Vice President Marketing of Rio Verde Holdings Ltd. (Rio Verde), retained by Micon as a subconsultant.

QUALIFICATIONS

Data sources used in the preparation of this report are primarily in the public domain. Emeralds recovered during exploration in the Yukon have not been examined by Micon or Rio Verde, nor has any confidential data on the exploration programs or their results been provided to Micon or Rio Verde for the purposes of this, or any other, report. Micon and Rio Verde are not in a position to comment on the technical or economic merit of emerald or any other gemstone discoveries in the Yukon.

SUMMARY AND CONCLUSIONS

PRODUCTION AND MARKETS

Emerald is a variety of beryl, $Be_3Al_2(Si_6O_{18})$, a beryllium aluminum silicate, in which the characteristic green colour is caused by chromium and vanadium substituting for aluminum in the crystal structure. The finest emeralds are described as having an intense green, the colour of young grass. Annual world production of emeralds is about 15 million carats, compared with around 120 million carats of diamond production.

Emerald is one of the precious "coloured gemstones", with ruby and sapphire. In contrast to the diamond industry, which is dominated by a few major players, coloured gemstones are produced by a very large number of small companies in relatively simple and unsophisticated mining operations. Approximately 60 per cent of emerald production comes from Colombia, and Zambia and Brazil account for a further 25 per cent of output.

The United States is the largest single market for gemstones (including diamonds), followed by Europe and Japan. The principal centres for the trading of coloured gemstones are Thailand, India, Hong Kong and Switzerland. For emeralds, specifically, the principal centres for cutting operations are Colombia, India, Pakistan, Israel and Germany.

QUALITY CRITERIA

Emeralds of gem quality are valued on the basis of the four C's:

- Colour
- Clarity
- Cut
- Carat

Colour is arguably the single most important criterion and the finest colour is judged to be a lively grass-green. Clarity is generally the second valuation criterion. In addition to a grass-green colour, desirable characteristics include intense bluish green or yellow green hues and strong saturation. Unlike diamonds and some other gemstones, gem-quality emeralds almost invariably contain minute inclusions and fissures that affect the clarity of the stone. Gem-quality emeralds that have both good colour and clarity may be more highly valued than a diamond of similar carat weight. The classic "emerald" cut allows reflection of light and brilliance and also minimizes corners that may be broken or chipped. The cut of an emerald is also designed to enhance its colour.

TRADING AND ADDED VALUE

In Colombia, and in other areas, partners in a mining operation estimate the value of rough stones in a parcel and invite bids among themselves. Wholesale buyers who

specialize in rough emeralds may also be present in order to assist in the financing of the purchase, and for which they earn a commission. Mine workers and artisanal miners in emerald operations will also enlist the assistance of dealers in order to trade for cash or for goods (food and equipment). There are, however, very few buyers who are fully qualified to purchase rough emeralds and less than 5 per cent of emerald buyers specialize in rough material.

Since emeralds, typically, contain fractures, cracks and inclusions, they are commonly treated in order to reduce the appearance of such flaws. The materials used generally fill cracks or fissures and reduce their appearance by reducing the change in refractive index across the feature and allowing light to travel more easily through the stone.

Three groups of fillers used for emeralds can be identified:

- Cedarwood, Canada balsam and whale oils (natural, traditional materials).
- Synthetic resins introduced in the late-1980s.
- Dyed epoxy resins and coloured oils, such as Joban.

Use of materials in the latter group is considered deceptive and, therefore, not acceptable.

On average, only about two out of every five rough emeralds will yield a cut gem that can be sold at a significantly increased price. The skill of the buyer in selecting rough emeralds is important factor in the yields achieved in cutting.

In Colombia, but to a much lesser extent in other producing countries, a significant domestic downstream emerald treatment and cutting industry has developed and the majority of good gem-quality material is cut within the country. India and Pakistan cut the majority of lower grade gems using volume methods which achieve results that are adequate for the material. Emeralds produced in Africa, together with some Colombian and Brazilian output, are cut in Israel. The highest degree of emerald cutting skill is found in Germany where precision equipment is combined with careful attention to colour zoning in order to take the best advantage of high quality rough stones. The range of cutting costs is from less than $1.00 per carat for some Israeli product to some $60.00 per carat, or more, in Germany. Costs in Colombia are $5.00-8.00 per carat.

Less than 10 per cent of loose cut emeralds are certified to provide assurance that the stone is natural (not synthetic), to describe any treatment applied and to document the provenance. A conventional laser cannot be used on emerald to physically cut a trademark or logo (as has been developed for diamonds), although the development of branding for marketing purposes can be advantageous.

It is estimated that, on average, an emerald may increase in value from around $200 per carat at the mine mouth, to around $1,500 per carat at a large wholesaler (in a location

such as New York), and to between $4,000 and $10,000 per carat to the final consumer in a piece of jewellery.

In the United States, the largest market and where data are published in trade journals, coloured stone jewellery accounts for about 9 per cent of annual retail jewellery sales. Emeralds are estimated to be the largest single component of coloured stone jewellery.

PRICES

Reported estimates of emerald prices increased steadily between 1982 and the mid-1990's, when the range for a 3-carat, extra-fine, cut stone was between $8,000 and $18,000 per carat. The Asian economic downturn was followed, in 1997/1998, by a crisis in confidence in emeralds, as well as other coloured gemstones, due to the prevalence of colour and heat treatments used to enhance the apparent quality of stones. The price range for a 3-carat, extra-fine cut stone fell to between $4,000 and $10,000 per carat in 1998 and has increased only marginally since then. Emeralds are now, no longer, included in published quotes for gems in trade journals and a publication known as The Guide.

POSITION OF A NEW EMERALD PRODUCER IN THE YUKON

North American sources of coloured gemstones, although few in number, do have strong competitive advantages over supply from less developed countries. These advantages include availability of advanced mining technology, developed infrastructure and political stability. All producers, irrespective of location, will face risks associated with both in-house and third-party theft.

A new producer of emeralds in the Yukon may benefit from the experience gained in the production and sale of sapphires in Montana and emeralds in North Carolina. World emerald production is expected to remain at current levels, or even to decline if there is no new exploration or implementation of advanced mining techniques at existing operations.

Depending on the quality of emeralds that may be produced commercially, a producer in the Yukon would be in a favourable position to meet market demand. If the scale of output is low, the operator is likely to supply the rough stones to buyers on the world market. Additional local economic benefits would be gained if production is sufficient to warrant the establishment of an in-house emerald cutting facility. The focus of such a facility should be on the quality of cutting in order to balance relatively higher labour costs in a jurisdiction such as the Yukon. A producer in the Yukon will have to consider carefully whether to implement further treatment based on the colour, zoning and clarity of the stones. In addition, development of a recognized brand for marketing purposes will provide an important competitive advantage over other sources of emeralds.

The key competitive considerations for a new producer in the Yukon are the following:

- Not burden each stone with an overpriced value in order to quickly recover mining costs. The impression of overpriced stones in the marketplace is very difficult to overcome later.

- Not burden each stone with extremely high cutting costs. Exceptional cut and northern Canadian origin will not be sufficient to overcome the competition posed by fine cut German stones.

- Cutting should focus on immediate market demand for particular shapes since the loss of some yield is outweighed by quicker turnover of inventory.

- The focus of a well-executed marketing campaign should be based on a northern Canadian theme.

GLOSSARY AND INFORMATION SOURCES

GLOSSARY

Cabochon: a gemstone shaped and polished with a smooth, domed surface.

Carat: unit of weight for gemstones; one carat = 200 milligrams.

Clarity: describes the extent of inclusions and fissures that affect the transparency of the gemstone. Coloured gemstones are divided into three groups, Types I, II and III. Emeralds generally fall into Type III. Type III: clarity grades are:

- Eye-clean – appears clean to the unaided eye.
- Slightly included – noticeable inclusions apparent to the unaided eye.
- Moderately included – obvious inclusions very apparent to the unaided eye.
- Heavily included – prominent inclusions that have a negative effect on appearance or durability.
- Severely included – prominent inclusions that have a severe effect on appearance, durability or both.

Coloured stones: general term for gemstones other than diamond.

Comisionista(s): in Spanish (Colombia), local emerald wholesaler(s) or broker(s).

Cutlet: lower cut facet on a gemstone.

Cut: faceting of gemstones carried out on a lapidary wheel.

Dop stick: short piece of thin dowel on which a stone is held with wax while cutting or polishing.

Emerald cut: the "classic" square or rectangular, tabular cut; often confers optimum depth of colour.

Esmeraldo(s): in Spanish (Colombia), buyer(s) of rough emeralds at the mine site.

Ganga: in Spanish (Colombia), the emerald-bearing matrix or mined material.

Garimpeiro(s): in Portuguese (Brazil), artisanal or independent miner(s).

Girdle: the widest part of a cut gemstone.

Grade: a measure of the concentration of emeralds in the host rock, e.g., 1 carat per cubic metre; the term is also used to describe the suitability of rough emerald for further processing, i.e., facet, cabochon, carving grades.

Guaquero(s): in Spanish (Colombia), artisanal or independent miner(s).

Hue: refers to the shade or tint of colour.

Jardin: or 'garden', the appearance of fissures or inclusions in emeralds.

Jeweller's loupe: jeweller's lens, 10 x magnification.

Memo: a parcel of gemstones of similar quality, sent by the supplier to a jeweller in order to allow the jeweller and its customer to select a specific stone.

Native cut: stones cut by hand in relatively low labour-cost locations; often relatively low quality and cut to minimize the reduction in weight.

Pavilion: the portion of a cut gemstone below the girdle.

Precision cut: gemstones cut using equipment that allows precise angling of facets and meeting of faceted surfaces.

Rough: uncut gemstones.

Tone: refers to the relative light or darkness of hue, ranging from colourless to black.

Saturation (intensity): refers to the strength or purity of hue.

Yield: the resulting weight of cut gemstones that can be produced from a single rough stone or parcel of stones.

BACKGROUND INFORMATION SOURCES AND ABBREVIATIONS

American Gem Society (AGS): association of 10,000 guild or high-end jewellers.

American Gem Trade Association (AGTA): association of 350 loose coloured gemstone wholesalers.

Canadian Gemmological Association (CGA).

Canadian Institute of Gemmology (CIG).

Canadian Jeweller Magazine, www.canadianjeweller.com.

Canadian Jewellers Association.

Canadian Jewellers Institute.

Colored Stone, www.coloredstone.com

Diamond High Council.

Diamond Information Center (Canadian branch in Toronto).

Diamond Promotion Service (Canadian branch in Toronto).

Federación Nacional de Esmeraldas: Colombian body which unites the Asociación Productora de Esmeraldas Colombianos, Asociación Colombiana de Exportadores de Esmeraldas and Asociación de Comercializadores de Esmeraldas.

Gemological Institute of America (GIA): non-profit institute for gemological research and education, www.gia.org.

Instituto Brasileiro de Gemas e Metais Preciosos (IBGM), www.ibgm.com.br of Brazil.

InStore Magazine.

International Colored Gemstone Association, www.gemstone.org: association of miners, cutters and wholesalers of coloured gemstones.

Jewellers of America (JA): largest association of retail jewellers in the United States and Canada.

Jewelers Board of Trade (JBT): comprehensive listing of retailers, wholesalers and manufacturers; credit agency.

Jewelers Circular Keystone (JCK) Magazine, www.jckgroup.com

Jewelers Education Foundation (JEF).

Jewelers Vigilance Committee (JVC).

Manufacturing Jewelers and Suppliers of America.

Minercol: amalgamation of EcoCarbon and Mineralco (former Colombian government agency responsible for emeralds).

National Jewelers (NJ) Magazine: highest circulation magazine; free to industry.

Polygon Network Inc. www.polygon.net: internet forum for medium to low-end jewellers and pawnbrokers.

Professional Jeweler Magazine, www.professionaljeweler.com carries archived articles.

United States Geological Survey (USGS): http://minerals.usgs.gov, see Minerals Yearbooks on Gemstones, State and Country surveys.

www.emeraldstone.com: suppliers of loose cut and uncut Colombian emerald gemstones.

www.esmerald.com: sells Colombian emeralds online.

Unless noted otherwise, all dollar values in this report are stated in current, United States dollars.

PRODUCTION AND SOURCES OF SUPPLY FOR EMERALDS

OCCURRENCE

Gemstones are divided into two principal sectors, diamonds and the coloured gemstones, including emerald. World diamond production is of the order of 120 million carats per year, compared with around 15 million carats per year for emerald. Diamond output is dominated by the large, well-known producers such as De Beers and, more recently, Ashton Mining/Rio Tinto and BHP Billiton. Alrosa in Russia is also an important diamond producer. In contrast, production of coloured gemstones, including emerald, is carried out by much smaller companies or entities, at small, relatively low-cost, simple operations.

Emerald is a variety of beryl, $Be_3Al_2(Si_6O_{18})$, a beryllium aluminum silicate, in which the characteristic green colour is caused by chromium and vanadium substituting for aluminum in the crystal structure. The finest emeralds are described as having an intense green, the colour of young grass. Pure beryl is colourless and usually opaque, but other coloured forms are aquamarine (pale green, yellow- or blue-green), morganite (pink) and heliodor (golden yellow). The crystals are hexagonal and have hardness of 7.5 to 8 on the Moh's scale (diamond is 10, ruby and sapphire have hardness of 9). Compared with diamond, emerald is not as tough or resistant to general surface scratches. Other characteristics are refractive index of around 1.56 to 1.59 and specific gravity of 2.65-2.76. Beryl that is green, but does not contain chromium and/or vanadium, is not classified as emerald.

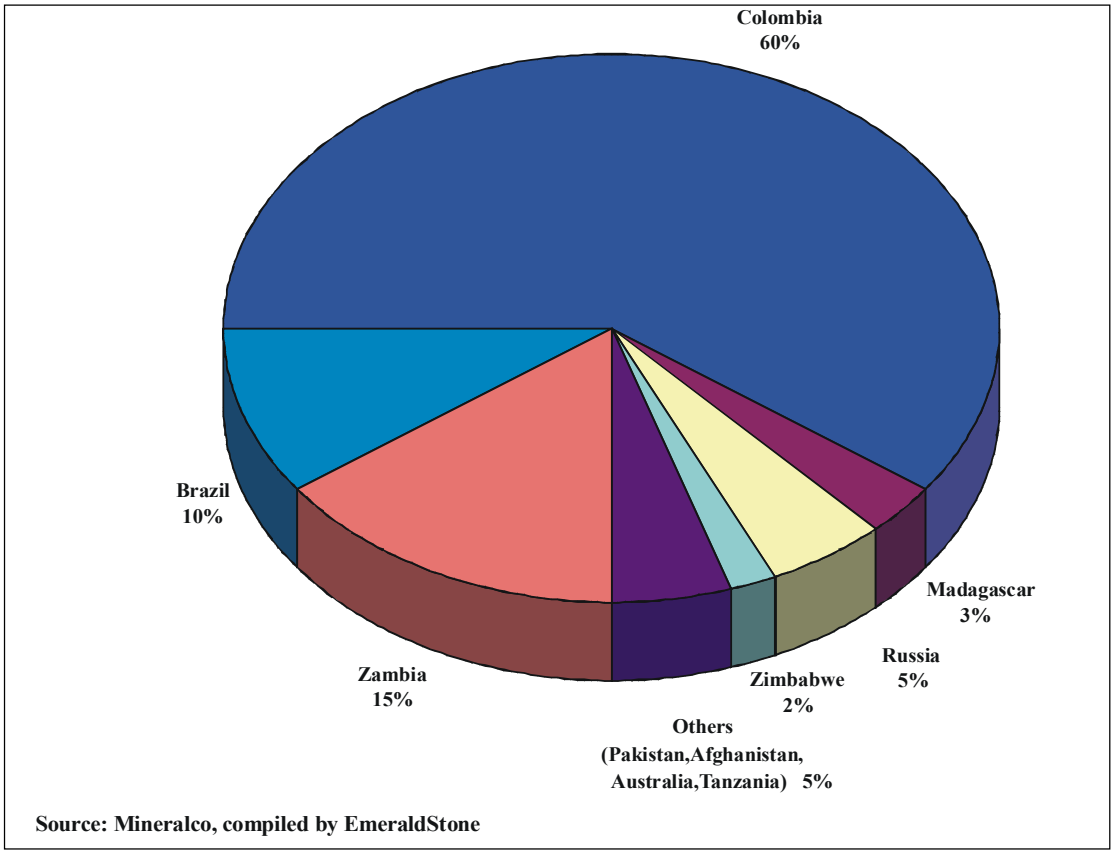
Beryl commonly occurs in vugs in granite and granite pegmatites and, also, in some nepheline syenites, mica schists and marbles. The beryllium ion is too small to substitute in most silicate mineral structures and, thus, tends to be concentrated in the residual magmatic fluids which form late-stage veins and pegmatites. For the formation of emerald, however, the presence of chromium and/or vanadium is essential in order to provide the characteristic green colour, and these elements are not present in residual magmatic fluids. Emerald is formed as a result of beryllium-rich residual fluids acquiring chromium on passing through mafic or ultramafic schists or, less often, through unmetamorphosed mafic rocks and is, therefore, mostly associated with these rock types. In Colombia, for example, it occurs in calcite veins within bituminous limestone. In the Yukon, emerald occurs where quartz veins cut mica schist. Elsewhere in the world, emeralds are found mostly in mica schist.

The metamorphic paragenesis of emerald results in inclusions (often containing liquid, solid and gas phases) and, also, cracks and fissures, to the extent that a flawless stone would almost certainly be fake (glass or synthetic spinel) or synthetic beryl. The term, jardin, or garden is used to describe the pattern of inclusions or fissures that occur in emeralds.

WORLD OUTPUT

Annual world production of emeralds is estimated at 15 million carats, of which about 60 per cent (9 million carats) comes from Colombia. Zambia and Brazil account for a further 25 per cent, at 2.25 million carats and 1.50 million carats, respectively. Russia, Zimbabwe and Madagascar each produce between about 0.75 million carats and 0.3 million carats per year. The balance of output is accounted for by Pakistan, Afghanistan, Tanzania, Australia, Austria and North Carolina in the United States. See Figure 1.

Figure 1
Estimated World Production of Emeralds
15 Million Carats



It should be noted that the United States Geological Survey reports gemstone production in kilograms. Apparent inconsistencies between these and Figure 1 may be accounted for by differences between reported weights of rough and cut stones.

Markets

The United States is regarded as the largest market for gemstones (including diamonds), accounting for about 35 per cent of the world total. The USGS reports that while the United States market for unset, gem-quality diamonds was over US$10.5 billion in 2001, the market for natural (non-synthetic) gems excluding diamonds was significantly lower,

at around US$700 million. The second largest market region is Europe at just under US$600 million, followed by Japan at around US$200 million. The total world market for coloured gems is estimated at around US$2 billion, compared to De Beers' estimate of production of diamonds at US$7.2 billion in 2002.

Ruby, emerald and sapphire are the three most important coloured gems. International coloured gem trading centres are Thailand, India, Hong Kong and Switzerland.

Statistics reported by the USGS provide an indication of the relative sizes of diamond and coloured gem markets. See Table I.

Table I
Imports for Consumption of Gemstones into the United States

	Quantity, thousand carats			Value, thousand dollars		
	1999	2000	2001	1999	2000	2001
Diamonds						
Rough or uncut	4,270	2,280	900	734,000	741,000	550,000
Cut but unset	19,130	19,500	16,200	9,160	11,300,000	10,000,000
Emeralds, cut but unset	5,040	22,100	6,370	18,300	176,000	141,000
Rubies and sapphires, cut but unset	11,200	12,900	9,150	239,000	241,000	191,000
Other precious and semiprecious stones						
Rough, uncut	1,330,000	1,070,000	1,020,000	43,500	39,400	22,200
Cut, set and unset	n.a.	n.a.	n.a.	196,000	247,000	213,000

USGS

MINING OPERATIONS AND PRODUCERS

Since the majority of gemstones other than diamonds are mined from small, low cost and relatively unsophisticated operations, often in remote locations, information tends to be sparse and inconsistent. There is no single producer comparable to De Beers, Alrosa or Ashton in the diamond sector.

As noted above, the largest emerald-producing countries are Colombia, followed by Zambia and Brazil. In Colombia, the state company, Minerales de Colombia SA (Mineralco), controls the emerald mining industry. Kagem Minerals Ltd., jointly owned by the Zambian government and Israeli-Indian interests is the largest producer in Zambia. In Brazil, the largest single mining operations are Belmont, owned by Belmont Ltda., and Piteiras, owned by Piteiras Mineração Ltda. Small-scale artisanal mining is a significant contributor to total production in both Zambia and Brazil.

Brief descriptions of the operations are provided below.

Colombia

Emeralds have been produced from the Muzo and Chivor areas since before the Spanish conquest in the sixteenth century. The three principal emerald mining areas are Chivor Muzo and Coscuez, operated by privately-owned companies on properties leased from

the Colombian government. Near Muzo, a new deposit, La Pita, was identified in the late-1990's. A number of individual mines are operated in each area, listed below:

Muzo/Quipama	La Tequendama
	Puerto Arturo
	Las Animas
	Masato
	Cincho
Chivor	Coliflor
	Penas Negras
	El Porvenir
	El Oriente
	El Cuatro Mr. Klien
Coscuez	Cero-cero
	La Marranera
	Itoco
	Las Carretillas
	Los Millonarios
	El Español
	El 22
	Mata de Cana
	Casa Blanca
	La Tabla

Emeralds occur as clusters, single crystals or fragments of crystals in carbonate-pyrite-albite-quartz veins and breccias which cut through black carbonates and shales. The host rocks are generally soft and friable as a result of intense weathering.

In Colombia, in contrast to most other locations, the emeralds are not associated with known granitic intrusions or pegmatites and the host rocks have not been metamorphosed.

According to Simandl et al[1], the official grade reported is one carat per cubic metre.

Bulk mining methods, which were introduced in an attempt to reduce mining costs, have resulted in generation of excess waste rock in river valleys and, as a consequence, underground methods have been reintroduced in some mines.

Zambia

The principal emerald-producing area is within the Ndola Rural Protected Area, about 40 kilometres from the copper mining centre of Kitwe, at Miku-Kafubu.

The emeralds occur in mica chlorite schist in contact with pegmatite. Artisanal miners occupy most of the mining licences. The largest operation, Kagem Minerals Ltd., is owned by the government (55 per cent) and an Indian-Israeli joint venture (45 per cent)

[1] British Columbia Ministry of Energy and Mines, Open File, 1999-10.

and which reportedly mined about 35,000 tonnes per month of ore to yield about 50 kilograms per month of rough emerald. (USGS, 2001).

Zambian emeralds, generally, are deep green and with relatively high clarity, but may be tinged with grey, probably because of the vanadium content, so that, although clean and large, they command slightly lower prices than Colombian emeralds.

Brazil

The Piteiras and Belmont mines in Minas Gerais are the two principal emerald producers in Brazil.

The Piteiras mine which opened early in 2001, is operated by Canadian company, Seahawk Minerals Ltd. which has an interest of 70 per cent in Piteiras Mineração Ltda. The host rock is phlogopite mica schist with mining developed via a ramp which will extend to a depth of 150 metres. An initial selection of emerald-bearing material is based on visual inspection underground. Production is around 2,000 tonnes of ore per month. Run-of-mine material is fed to a vibrating screen. Plus 75-millimetre material is separated, while the minus 3-milllimetre fraction is discharged to a settling pond. The majority proceeds to a trommel screen for separation into 3-12 millimetre, 12-35 millimetre and plus 25-millimetre fractions which are hand-picked on conveyors. Approximately 500 tonnes of material yield 2 kilograms of emerald rough of which 10 per cent is facet-, cabochon- or carving grade. A further 10 per cent of this is considered fine quality.

The Belmont mine, owned by Belmont Ltda., is located east of Itabira in Minas Gerais and has operated since 1978. Emeralds occur in quartz veins which cut through ultramafic biotite schists, or in the schists adjacent to the veins. The majority of output, approximately 1,500 tonnes per month, comes from the stripping of loose material from a hillside. Underground mining, in rock, takes place from a vertical, 75-metre shaft. Processing of mined material is similar to that at Piteiras. Output is approximately 10 kilograms of emerald per month, of which about 20 per cent is 'good' quality. CANELHAS takes 70 to 80 per cent of output. Nova Era in Capoeirana, close to Itabira, produces clearer and relatively large crystals in workings operated by *garimpeiros*.

At Campos Verdes in Goiás state, the deposits are up to 600 metres deep and the emeralds are very small, although well crystallized.

Russia, Zimbabwe, Madagascar

Emerald production in **Russia** is centred in the eastern Urals, about 60 kilometres northeast of Ekaterineburg. The principal mine is the Mariinsky. Emeralds occur in interfoliated micaceous and chlorite schists and gneisses. In 1991, a number of companies were formed to take over the previously government-run operations. Other deposits are Perwomaisky, Aulsky, Krupsky, Chitny and Tsheremshanksy.

Rio Tinto Financing and Exploration Company started production at the underground Sandawana mines in **Zimbabwe** in 1963. The quality of emeralds from Zimbabwe is high, characterized by a deep yellow-green hue, although the stones rarely exceed one carat.

In **Madagascar,** emerald occurs in mica schists. The Ankadilalana mine is a noted location.

Pakistan, Afghanistan, United States

Emeralds occur in ultramafic rocks (referred to as an ophiolite sequence) metamorphosed and metasomatized to talc- and quartz-carbonate lithologies in the Swat Valley of **Pakistan** in the Himalayas. Producing locations are the Mingora, Gujar Kili and Bucha mines. Emeralds from Pakistan are often pale in the interior with darker outer edges.

The Panjsher Valley, **Afghanistan,** lies about 240 kilometres west of the border with Pakistan, northwest of Kabul, at an elevation of between 2,000 and 4,000 metres. Emeralds occur in quartz-albite veins which cut through metamorphosed limestone, calcareous slate, phyllites and micaceous schists and were discovered in 1970. Mining locations are Darkhenj, Mikeni, Butak, Buzmal, Bakhi and Darun. Reportedly, the Mikeni and Darkhenj areas yield the highest quality material. According to an account written in 1985, most of these emeralds are taken in rough form to Pakistan for sale.

North American Gem operates an emerald mine at Hiddenite, North Carolina, in the **United States**. Output is sporadic but the owner has been successful in achieving high values for his stones by appealing to the sentiments of local buyers. Reports indicate that the number of individual stones produced is small but they are relatively large. This North American gemstone producer is discussed in more detail in the section of this report on the potential position of a new emerald producer in the Yukon.

QUALITY CRITERIA

The four principal quality criteria for gem-quality emeralds are the same as those for other gemstones, and known as the four Cs:

- Colour
- Clarity
- Cut
- Carat (size)

COLOUR

For emerald, colour is arguably the most important criterion of quality and the finest colour is judged to be that of young, green grass. Hue, tone and saturation are descriptive terms where hue refers to the shade or tint of colour; tone refers to the lightness or darkness of hue (ranging from colourless to black); and saturation refers to the strength or purity of hue.

In addition to the grass-green colour, hue described as "intense bluish", tone of medium-dark green and saturation described as vivid or strong, are desirable characteristics. (See www.diamonds-gemstones-jewelry.com).

Esmerald publishes the following scale of hue for emerald:

- iBG : intense bluish green.
- sBG: strong bluish green.
- sYG : strong yellow green.
- BG : bluish green.
- lBG : light bluish green.
- lYG : light yellow green.

CLARITY

Clarity refers to the ease with which an object can be seen when viewed through an emerald. The presence of inclusions and/or fissures in emeralds reduces the clarity, or transparency, of the stone.

The GIA scale of clarity is as follows, based on examination under 10 x magnification by an experienced grader:

- FL: flawless – does not exist in emerald.
- IF: internally flawless
- VVS1: very, very slightly included – the best clarity achieved by emerald.

- VS1, VS2: very slightly included.
- SI1: slightly included noticeable under 10 x magnification – considered fine.
- SI2: slightly included, observable to the naked eye.
- I1, I2: included – obvious under 10 x magnification and may affect transparency and brilliance.

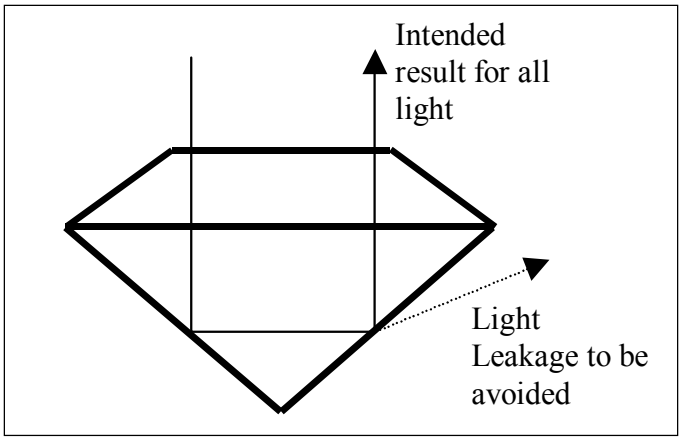
Poor clarity may affect the durability of the stone.

CUT

Emeralds can be cut and faceted or cut *en cabochon* to give a rounded, domed shape. Generally, transparent emeralds are faceted while translucent stones are cut *en cabochon*.

Since emeralds are damaged relatively easily, faceted stones are cut to minimize corners and to allow setting in a strong mount. The cut also affects the appearance of colour in the finished stone. Emeralds with strong saturation may be given a relatively shallow, tabular cut in order to allow the penetration of light, while a deeper cut will benefit a stone of lower saturation. Brilliance is achieved in a faceted emerald when light is reflected from the lower cut surfaces back through the top of the gem, as shown in Figure 2.

Figure 2
Illustration of Light Passage Through a Cut Emerald



EmeraldStone

CARAT

The carat, equivalent to 200 milligrams, is the standard unit of weight for gemstones including emeralds. Weights less than one carat are described in points (100 points per carat) or fractions of a carat. The relationship between length, breadth and depth,

however, is also important since this will affect how the stone is cut and the resultant finished depth of colour, as well as wastage in cutting.

Since emerald has a lower specific gravity than diamond, for example, a one-carat emerald may look larger than a one-carat diamond if the cut is similar. Even among emeralds, Colombian stones have a lower than average specific gravity and are, therefore, larger in comparison to emeralds from other sources, again if the cut is similar. (www.esmerald.com distinguishes between emeralds from within Colombia, noting that those from Chivor and Gachala are light, from Coscuez and La Pita are average, and those from Muzo are relatively heavy).

In general, high quality cut emeralds increase in value per carat with size, and may exceed the value for diamonds in the 1- to 5-carat range. However, above 5 carats, the value per carat of emeralds tends to flatten while the value per carat for diamonds continues to increase.

EMERALD PROCESSING

EXTRACTION FROM HOST ROCK OR *GANGA*

Dealers in the emerald trade generally consider colour to affect 50 to 70 per cent of the value of an emerald. Clarity is generally the second most important criterion and accounts for most of the rest of the value per carat. Although clarity is affected by the geological conditions of each deposit, it is also affected by the process of mining, as described below.

Generally speaking, the closer the emerald is to its natural hexagonal crystal shape, the higher the internal quality and the easier it is to cut. The principal factor which influences whether the naturally-formed crystal remains intact as far as the cutting plate is the host geology which, in turn, affects the extraction method used.

Geology Affecting Clarity

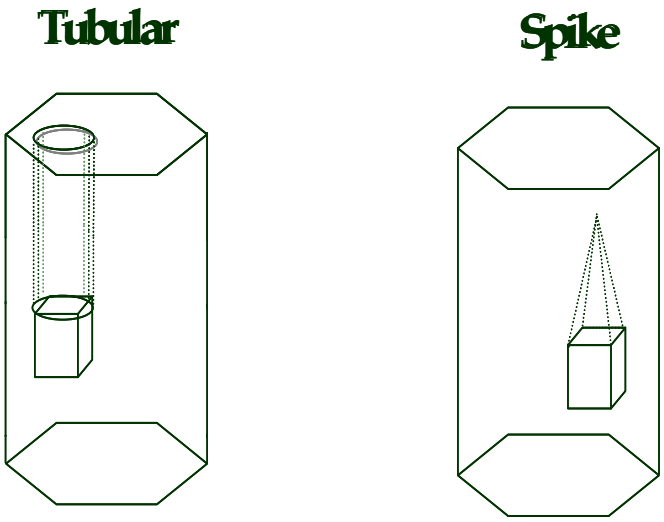
As noted above, most of the world's emeralds come from Colombia where they occur in quartz-calcite veins within organic-rich sedimentary shales. Most of the remaining 30 to 35 per cent of emeralds occur in deposits associated with pegmatite intrusions, as in Brazil, for example. The only other emerald deposits with similar occurrence to those in Colombia, although not with similar gem quality, are located in Russia.

In general, if the host veins and surrounding rocks have been subjected to tectonic deformation subsequent to crystallization of the emeralds, the folding and faulting grinds and stresses the crystals so that very little of the original hexagonal shape remains and the crystals are reduced in size.

The Chivor area of Colombia is particularly unusual in that the emerald, quartz, calcite and pyrite crystals, generally, are not strongly embedded in the host shales. When uncovered, the whole pocket of crystals is described as "pouring out". It is often the case in this area, that if the tectonic movement has been weak, the emerald will be high quality and, since it has already been loosened from the host rock, will fall into the miner's hand when the vein is uncovered. These emeralds are generally known to be the highest clarity emeralds produced in Colombia and, therefore, in the world. Although not the deepest in colour, of all emeralds, these require very little processing cost once they are extracted.

In other vein-deposits, the emerald crystals are usually firmly embedded in the host material. Since most of the crystals in the vein form before the emerald, spaces or 'vugs' are required in order to allow sufficient room for emeralds to grow. If the space is not sufficient, emerald crystallization will occur, but in the process will engulf or capture other crystals and minerals creating 'protogenetic' inclusions. Some rare cases, which produce fascinating inclusions gemologically speaking, occur when the emerald crystal engulfs another crystal 'seed' and both grow syngenetically, or at the same time. Most overly visible inclusions reduce the clarity and sometimes the stability of the crystal

structure thus decreasing the value of an emerald. However, some inclusions considerably increase the value of the natural specimen showing extremely rare internal formations unseen in other gem varieties.



Protogenetic or encountered solid inclusions and the resulting leeward side voids as growth occurs upwards.

EmeraldStone

Extraction Affecting Clarity

Removal of the emerald crystal from its host rock tends to be destructive. It is unfortunate that among the emeralds that have not been broken or abraded as a result of tectonic movement, the majority will suffer abrasion and pressure as a result of mining.

Up to the early-1990's, most deposits in Colombia were mined by open pit methods. Ore or vein access and mucking occurred almost simultaneously. Bulldozers were used to bench and terrace hillsides, often taking far more material than the vein itself in order to stabilize the bench. Small holes were drilled by hand into harder outcrops and loaded for blasting. However, this method of open pit or open-hillside mining mixed up the non-emerald bearing rock with the vein material. As shown in the Discovery Channel television program, "Green Fever", at Muzo, the world's largest emerald producer, foremen walked quickly backwards in front of the bulldozer blade picking through the material as it slowly made its way to the bench edge to be discarded. The mine owner himself, Mr. Victor Carranza, used to say, "you'll see the big ones go by, the rest I don't care about". The emeralds were often rolled for so many metres that the leading edge and sides were eroded to leave a more rounded and fractured crystal. Only if the vein was visible on the slope wall and care was taken to remove it, would any fully-formed hexagonal crystals be preserved.

Estimates, even from the mine owners themselves, suggest that 90 per cent of Muzo's emeralds in those years were mucked off the benches and down the hillsides into the river

valley below. Thousands of workers, or *guaqueros*, in the valley bottom would sort through the discarded material. They essentially used simple dredge-mining methods using water and screening bags to sort and pick for visible emerald crystals. The *guaqueros* would sell their finds to first level dealers in rough stones, or *esmeralderos*, who arrived in jeeps from local provincial towns to purchase what the *guaqueros* found. The payment for the majority of stones was generally food or more simple tools, sufficient to finance the *guaqueros* next few days of work. Only large or high quality crystals would generate hard cash payments for the *guaqueros*. As the crystals by this time had rolled quite a distance down a slope and along a creek bed, not many retained their hexagonal shapes or sizes often losing more than two-thirds of their potential yield in this short distance.

Emeralds mined in Brazil were similarly treated. Most of the production that was not identified at the mine site itself was trucked to the country's emerald headquarters, known as Teofilo Otoni where the *bagaco*, or discarded material, was sorted through by the local townspeople and workers. It was there that the dealers from larger cities came to purchase the informal parcels from the locals.

From the early 1990's, however, miners in Colombia began to discover that a more selective approach was needed. Instead of risking the loss of emerald vein material to the bulldozer and, often, being buried by huge landslides from the unstable slopes above, mine operations began to access veins via small drifts, shafts and tunnels. This method decreased the damaging distance the emerald crystal would travel from its host vein to the miners hand, and also decreased the number of emeralds sent out past the mine's lease line. Thus more emeralds stayed 'in-house' and under original miners' control. Now, instead of thousands of people working the river's edge below the Colombian mines, only small groups of people are seen sorting material that has essentially been more efficiently worked.

Emeralds recovered at the mine site are normally divided into two or three distinct paths to the market place. The mine owner's production takes a different route than that of the mine-workers, and than the remaining *guaqueros* in the valley below the mine. This is described further in the following section. In most deposits around the world, similar divisions occur, although not to the scale of what used to occur at Muzo. Most mine owners will quickly and subjectively separate a certain segment of the recognized day's production, usually the lower quality and smaller stones, to give to their own workers. This is often the only form of payment mine workers will get. The ore or vein material that was sorted through by the owners and foreman also gets given to the workers to pick through a second time, often quite successfully.

Underground tunneling now produces a much more concentrated material with a higher carat per ton yield. In the mine drifts, the metres of sterile ground before and after a promising vein are simply mucked out and discarded. Advance is achieved by drilling and blasting. Once the target veins or pockets are visible, only air hammers and picks are used to manually remove this material from its surrounding host rock. As emerald crystals are often not close together, even in an emerald-bearing vein, however, the

miners often resort to imprecise air hammer advance to remove the vein material and surrounding rock. With poor lighting and rough use of air hammers directly on vein material, most emeralds from the vein end up on the floor of the tunnel with the other broken rock. This is sorted through immediately in the mine, or at surface on picking belts or through screening bags.

Both the blasting and use of air hammers causes considerable damage to crystals. Varieties of explosives produced informally were used until the early 1980's. Then, in Colombia, the military industry, or Indumil, began to provide their version of dynamite. The more recent use of ANFO as a mining explosive provides better resistance to humidity and underground water but still causes concussive waves. Explosives like this generally tend to send damaging waves up to two metres past the resultant new mine face. One gemologist considered that 30-50 per cent of all fault type inclusions (cracks) in emeralds today are caused by the explosives used to extract them.[2]

As most emeralds produced by these methods of extraction already are free of their host rock, no further extraction costs are required, albeit the process itself causes a huge loss in potential crystal quality and size yield.

Should the emerald crystal still be affixed to its host rock after being extracted from the mine, careful use of a miner's pick is often employed to remove the crystal. Although extremely imprecise itself, many miners claim that a strike on the affixed section where the crystal meets the rock is simply breaking a section of crystal that is usually heavily included anyway. The Brazilian miners employ pliers to remove emeralds from their host rock once outside the mine. Whether it is caused by geological forces or mining extraction, there is often, but not always, a more flawed area in the crystal closest to the host rock, and often even the use of finger pressure can remove the emerald.

Stones in other Colombian deposits like Chivor, where the host rock is silicified or much harder than the common black sooty shales, can be affixed to the host rock along the length of the stone and are much more difficult to extract. In most of these mines, careful use of a pick is the only method available. However, there are newer methods to separate gemstone from host matrix being studied and which will attempt to preserve more of the crystal integrity.

EMERALD ROUTING FROM MINE SITE

Company Production In Colombia

Depending on the extraction methods, emeralds will suffer considerable reduction in both clarity and size. However, extraction methods also predestine an emerald crystal to differing routes out of the mining areas.

In tunneling operations, mine owners now are able to retain the majority of the emeralds. They divide the production amongst themselves in in-house company auctions. The

[2] Ernie Vaio, ELV Appraisal Lab, Victoria, B.C. Canada.

rough stones are placed on a table in closed-door meetings of the partners. The largest shareholders usually estimate the value of the rough crystal parcels. Partners are asked to offer a bid on the parcels. Whoever ends up purchasing the parcels must pay the full cash value into the pool of partners' funds. These funds then get split in proportion among the same shareholders around the table.

Parcels can range in value between hundreds of thousands of dollars and tens of millions of dollars, depending on production and how many days the miners have waited to accumulate the production. Mine partners themselves are often not solvent enough to offer cash payments, in which case, they will team up with select wholesale buyers of rough material. These may be large investors from within the country or sometimes select invited foreign buyers who specialize in rough material. The mine partner will request that this person sit beside them in the private mine auctions. Then the invited guest will produce the cash to purchase that parcel and the investor/buyer will usually give a significant commission to the miner who invited them.

The parcel is then taken, usually by helicopter, down to the homes or offices of the mine partner or buyer in the capital city and hidden in undisclosed locations to be offered later either as rough or to be cut.

Workers Share Production

If the workers do not divide up the actual stones themselves, their share of the production usually gets sold in similarly-fashioned auctions right in the mess shacks at the mine site, although these are much less formal than the owners' auctions, and with quite a few on-lookers. Workers often will invite one of the "jeep buyers" or *esmeralderos* with whom they are to finance the purchase at the spot price so they do not lose a chance at purchasing the parcel. The *esmeralderos* or the workers will cautiously and hastily take their production in jeep caravans, either to the provincial capital or to the main cities. It is often groups of disgruntled workers from the smaller, sporadic production areas who hijack these jeep caravans on the roads from the mines back to the cities.

***Guaqueros'* Production**

Most of the *guaqueros'* production gets traded or sold and taken down to Bogotá, or other cities depending on the country, by the *esmeralderos* or similar dealers. They essentially bring the food and supplies up to the informal dredge miners at river side and then return to the city with the emeralds from the *guaqueros.*

TREATMENT OF ROUGH VERSUS NATURAL STONES

The filling of flaws or inclusions in an emerald is a process described further below. The treatment of rough emeralds is generally frowned upon by the majority of the emerald industry, and especially by the cutters. Cutters need to see as many of the flaws as they can before they embark on fashioning the final shape. If the internal flaws are masked, the cutter risks the chance of having the stone shatter in the faceting or polishing process.

Most of the smaller emerald mine operations around the world that also cut their own emeralds, generally treat the emeralds at mine site. However, such treatment by the mine operators occurs after the emeralds are cut since they, themselves, need to work with the raw material.

In Colombia, unlike other countries, there is a large industry built around servicing emerald cutting and treatment in Bogotá, away from the mining region. However, there are indications now that one mine is treating its rough material: a number of reports have come out repeatedly of rough material from La Pita coming to Bogotá filled with one of the new polymer type treatments. The cutting community in Bogotá is visibly upset by this and is actively trying to avoid this merchandise. Many have lost large investments after the stones have shattered or broken. The proponents of the polymer-type treatments often claim that some of the polymers stabilize the integrity of the crystal, but a detailed discussion is beyond the scope of this report.

There are very few buyers qualified to buy rough emeralds. Rio Verde estimates that only about 3-5 per cent of emerald buyers specialize in purchasing rough material. This select group is now further burdened with detecting difficult-to-see treatments in the rough. Some have actively avoided stones from La Pita. Others feel that examination through a microscope will permit detection of the use of polymers to fill cracks and inclusions that reach the surface of the stone.

MASKING FLAWS AND ENHANCING CLARITY

Since emeralds, typically, contain fractures, cracks and inclusions, they are commonly treated as described above in order to reduce the appearance of such flaws. The materials used generally fill cracks or fissures and reduce their appearance by reducing the change in refractive index across the feature and allowing light to travel more easily through the stone.

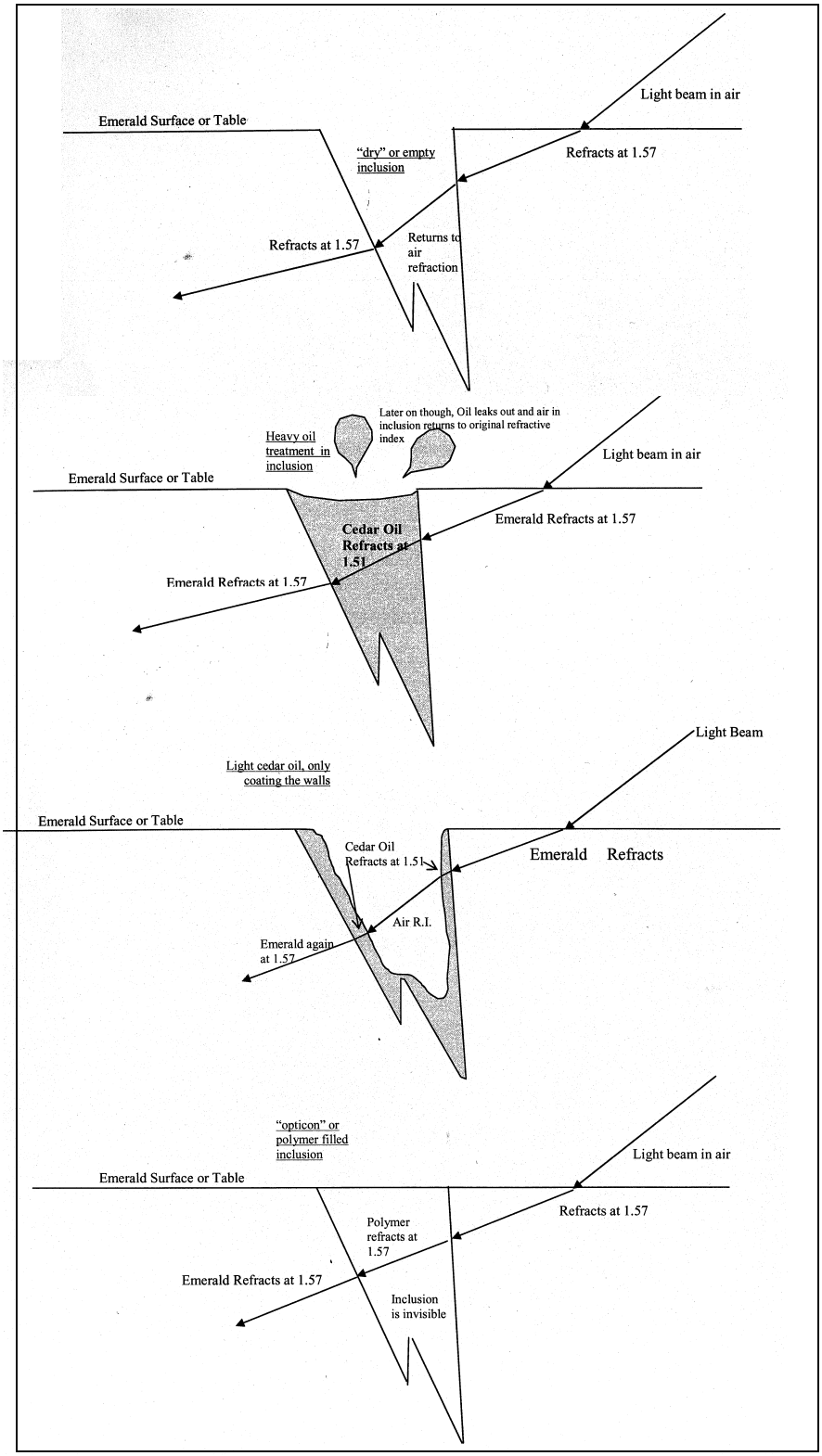
In order to buy and sell knowledgeably, dealers and jewellers must be able to determine both whether an emerald has been treated and, if so, what treatment was used.

Three groups of fillers used for emeralds can be identified:

- Cedarwood, Canada balsam and whale oils (natural, traditional materials).
- Synthetic resins introduced in the late-1980s.
- Dyed epoxy resins and coloured oils, such as Joban (considered deceptive and, therefore, not acceptable).

The following is a short summary of the principal fillers used to enhance the clarity of emeralds. Figure 3 illustrates the effects of these fillers on light passing through a stone.

Figure 3
Diagrammatic Illustration of Light Passage Through Unfilled and Filled Fissures



EmeraldStone

Natural oils are used to render fractures and flaws less visible. Natural cedarwood or Canadian balsa oils applied to the emerald after cutting reduce the change in refractive index across the feature and allow light to travel more easily through the crystal. The oil is visible using a jeweller's lens or loupe.

'Opticon' is a synthetic plastic resin that is used to fill cracks. It is sometimes coloured with a green dye in order to make flaws essentially invisible. Opticon may yellow with age.

'Gematrat' is a synthetic resin developed by the Arthur Groom laboratory. It does not discolour and includes an ultraviolet tracer to allow detection by a jeweller. Gematrat does not add colour to the stone. A similar product, **'Permasafe'**, has been developed in Colombia.

Palma resin was introduced in Colombia to replace natural oils which have a tendency to leak out of the stones. Although it remains in use, palma turns milky-white within a few months.

Joban is an artificially-coloured oil used in India based on copper sulphate and resin. The colour of the oil enhances the colour of the emerald.

Such treatments should be disclosed. The United States Federal Trade Commission law, Section 23.18 states:

> "One of the practices to be considered as inhibited by this rule is as follows: The sale, or offering for sale, of any diamond or other natural precious or semi-precious stone which has been artificially colored or tinted by coating, irradiating, or heating, or by use of nuclear bombardment, or by any other means, without disclosure of the fact that such natural stone is colored, and disclosure that such artificial coloring is not permanent if such is the fact."

It is also recommended by the JVC and Federal Trade Commission that:

> "Permanent treatments that do not require special care should be disclosed if the treatment has a significant effect on the stone value, and if a consumer, acting reasonably under the circumstances could not ascertain that this stone has been treated."

Natural oils, although effective and widely used, suffer the disadvantage of being impermanent or prone to leakage. The procedure may have to be repeated through the life of the gem and the cleaning of emeralds should be undertaken with care. Synthetic resins may be difficult to remove and, as noted above, can discolour with age, although they can also provide some additional stability and resistance to damage.

Substances such as coloured resins and Joban oil are considered deceptive and are unacceptable.

Enhancement

In contrast to both ruby and sapphire, where heating is used to enhance both colour and clarity, enhancement of colour in emerald is not generally practised. The exceptions are the use of Joban oil on relatively poor quality emeralds from India and attempted use of coloured Opticon on stones from Brazil (see above).

Enhancement of clarity, however, is widely practised on emeralds using the methods described above to mask flaws and to ease the passage of light through the stone by reducing differences in refractive index caused by cracks or inclusions. Rio Verde estimates that some 98 per cent of emeralds on the market are enhanced for clarity, principally through the use of polymer fillers and natural oils.

The introduction of emerald fillers, such as Opticon, raised concerns relating to the disclosure of the use of these materials, as well as the ability of jewellers to detect them. The GIA initiated a study on the effects of clarity enhancements in emeralds in 1997.

CUTTING

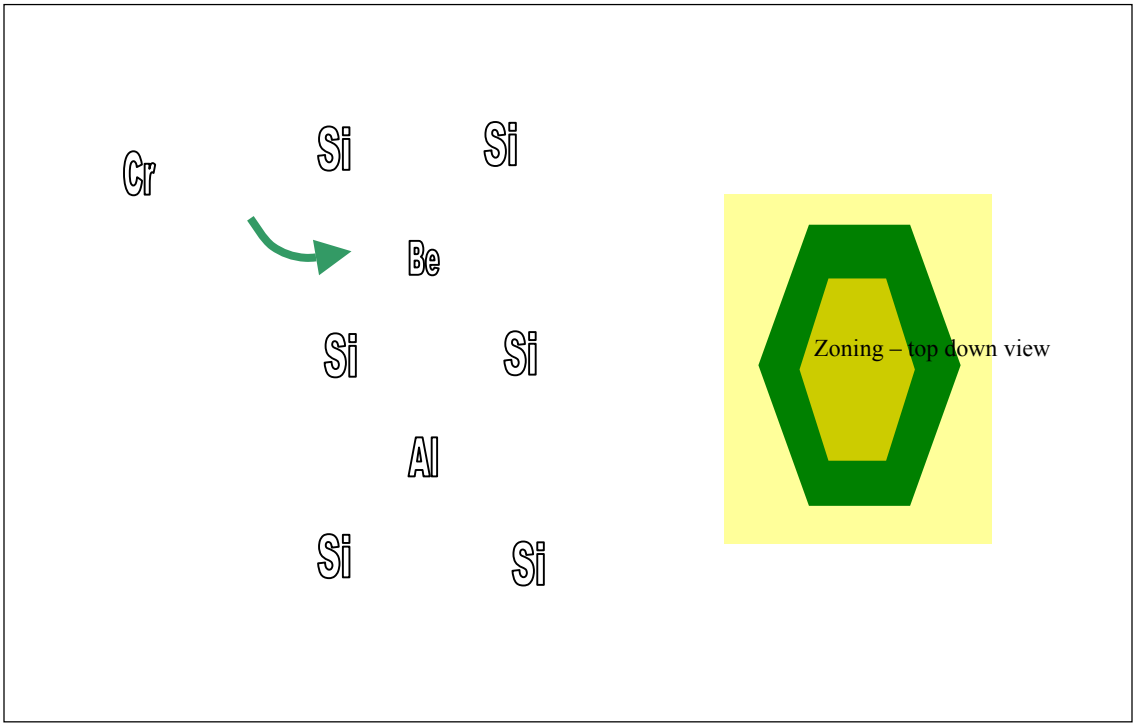
The best ally of the cutter is the buyer of rough emeralds. The buyer will both filter out the treated stones and will examine stones for purchase that contain some internal areas which are not as flawed so as to produce a satisfactory final yield.

Chromium or vanadium are the elements that add the colour to the beryl crystal lattice to produce emerald. The crystallization process often results in the colouring elements lining up in the outer rim of the lattice, leaving a less-coloured crystal interior and a chromium- or vanadium-rich outer rim of the hexagonal crystal. See Figure 4. Cutters must craft the final yield to leave as much colour as possible in the culet or lower "cone" area of the stone and avoid the colourless zoning part of the crystal.

When light enters a faceted gemstone, it is meant to reflect off internal surfaces and always leave via the face. As this light beam travels, it will, if the stone is properly cut, catch some of the colour zoning in the culet and carry this colour with it out the top. As important as it is to perfectly cut the facets of a diamond in order to bounce light back out through the face, it is of further importance, in a coloured gemstone, to make light travel through the coloured zone.

Cutters of emeralds must also avoid inclusions that will either reduce the overall clarity of the stone, or will actually destabilize the stone during setting. The worst mistake, for example, would be to leave a cross section flaw or inclusion at the corner of an emerald cut, or the tip of a pear shape, ready to break off. The jewellery setting process will inevitably place pressure on protruding areas such as tips and corners and these must be free of flaws that will jeopardize the integrity of the crystal.

Figure 4
Substitution of Beryllium in Emerald Crystal
Lattice and Colour Zoning



EmeraldStone

Once the cutter has established which sector of the stone to keep and what to discard, they will then choose the shape of the final gem. The favourite, and most efficient, cut for an emerald is the traditional emerald cut. This takes advantage of the axis of growth of the crystal, and maximizes the colour zone and the length of the hexagonal crystal. Other cuts, such as the pear shape, marquise, round and, especially, cabochon, are usually chosen only because a flaw or colour zoning has limited the ability to produce a traditional emerald cut.

Although it seems difficult to believe, cutters in less developed countries rarely pay attention to market demands or requests. Cutters and their bosses, the gemstone miners and owners, always want to maximize yield in order to preserve as much weight as possible. This was most apparent in the late 1990's when round solitaires were a sudden global trend[3] and generated the highest demand. The cutters, however, seemed unaware of this and continued to produce emerald cuts and square shapes simply because "that is what the crystal lends itself to". So while round shape emeralds were selling within days, cutters preferred not to lose the weight of the four corners and produced emerald cuts which took months to sell. To local cutters it just "doesn't make sense to lose all that weight" and they insisted on ignoring the demand trend.

[3] Sitcom actress, Ellen DeGeneres, appeared on People Magazine front cover for her "I'm gay" announcement. She wore a diamond round solitaire which set the world trend for round gems; even De Beers was surprised at the effect of the publicity it gave them.

In spite of the best efforts by both rough buyer and cutter alike, only about two out of five stones produce a cut stone that can be sold at a greatly increased price. The other three stones, on average, either just maintain value, or even lose value. The greatest difficulty is that the abrasions and outer cracks on the crystal surface produce a "fish-scale" effect with overlapping inclusions. These make it very difficult to establish the internal colour zones and flaws, and then to project the proper geometry for the final cut stone. One often hears of large rough buyers losing their entire investment because the final product "washed out" or became a colourless faceted gem.

There are methods to improve the visibility of the interior of a rough crystal, but none have proven themselves sufficiently so as to avoid any mistaken crystal loss. Brazilians and Colombians have often used immersion in baby oils or other liquids which fills the "scaly" outside inclusions allowing a slightly better view of the inside. However, this method also slightly hides the large flaws that would need to be cut away or avoided in the first place.

More modern approaches could involve X-ray or laser mapping. Although ultrasound would be the most effective mapping technique, the effect of sound waves would be damaging to inclusions that are already present. A company called GemPrint uses laser beams shot through a diamond to map out its distinct scatter-pattern of dots on a back-board. So far, it has been effective only on clear gems like diamonds and the company is now heavily marketing this system for tracing stolen gems and comparing them, like fingerprints, for insurance companies and police. Gemex is another company that has attempted to map out the colour zoning in coloured stones but, so far, the method only works on cut stones where fissures and cracks do not impede full scanning of the inside of the gem.

In an ideal situation, if the original hexagonal emerald crystal was intact, and not abraded or cracked, yields of up to 80 per cent could be projected. For example, two opposing gems could be cut from the same crystal in order to maximize yield. However, tectonic, explosive, and other extractive damages to the rough crystal leaves true faceted yields at about 20 to 35 per cent of original size. As noted above, the general rule of thumb is to assess a profit potential on an average of only two out of five stones for cutting. This ratio improves with the skill of the rough buyer. Labour costs associated with cutting are negligible relative to the cost per carat, but the value increase is based on the risk.

Table II shows a simplified example of how a parcel of five rough stones, each 3 carats in weight, might result in five cut stones, each 1 carat in weight, but having different values depending on the colour and clarity of the final piece.

Table II
Simplified Breakdown of Values Obtained During Cutting

Carats in rough parcel: 15					
Value of rough parcel: $3,000					
Average value per carat: $200					
Weight of rough stone, carats	**$/carat**	**$/stone**	**Cutting Yield, carats**	**$/carat**	**$/stone**
3	200	600	1	3,000	3,000
3	200	600	1	1,000	1,000
3	200	600	1	600	600
3	200	600	1	400	400
3	200	600	1	0	0
Total					**5,000**
Carats in cut parcel: 5					
Value of cut parcel: $5,000					
Average value per carat: $1,000					

EmeraldStone

Steps in Cutting

1. "First Cut" or "desbaste". This is the cut that uncovers what will be the face of the gem. It is the most important step as it involves projecting the remainder of the final shape of the gem and positioning within the original crystal. Usually the rough buyer and cutter discuss this decision together. This step is the most highly qualified and most risky process in the entire path of an emerald to final consumer.

2. Pre-forming. A cutter uses a more gritty or abrasive lapidary plate to fashion the general shape of the backside or pavilion of the stone. The cutter can now see more clearly into the stone in order to maintain original plan, or to alter the final shape, depending on flaws that may have been invisible before first cut. Although the first cut has lined up the stone to set its pavilion in the colour zone, the cutter must still be aware of this zone and not cut it away.

3. Faceting. Possibly carried out by the same cutter as the pre-forming, this step is often combined with the previous one. A slightly finer grit lapidary plate is used to produce the actual final angles between facets. It is important both to geometrically produce opposing angles for proper refraction of light inside, but also to maintain colour zones within the crystal and not to cut any colour away.

4. Polishing. This uses the finest grit of lapidation. Polishing is often carried out by different individuals than faceting. As well as leaving the facets shiny and as close to flat as possible, polishers also gently 'grind' down imperfections or pock marks flush with the surface of the facet. Polishers are not concerned with internal fractures or inclusions unless these reach the surface of the stone. If a

surface fracture is encountered and is visible, a polisher must decide if further removal of the surface will "open" or reveal a wider crack, or if it will "close" the crack to a narrower gap.

Styles and Cutting Centres by Quality and Volume

Colombia: "Native". Colombia still cuts the majority of gem-quality emeralds above the $200 per carat price range. First cuts either involve simply "grinding down", or more modern facilities use a fine cutting saw. Faceting and polishing is set up on makeshift tables with a round hole for each type of wheel. A motor beneath the table runs both the wheels on a pulley system and both spin at the same speed. The lapidary plates are usually manually coated in diamond dust via a water drip system or hand application with a tooth brush. As the cutter holds the gem onto the plate with one hand, the other hand holds the brush on the plate and repeatedly dips it into a diamond dust dish. The dop stick holding the emerald in place is manually pegged into a succession of holes in a block above the lap plate, each of which results in a different angle relative to the plate. The stone is rotated around six sides of the dop stick, shaped to form a hexagon. The final result is what is called a "native" cut where there is some indexing of sides and angles but it is also greatly affected by the eye of the cutter. The lack of perfect precision reduces the internal reflectancy potential of the stone. Some light "leaks" out of the sides instead of all being cast or reflected out of the face as is ideally intended. However, the native cut also is the best system for adapting to surface flaws and colour zoning. Cost per carat to cut: $5.00-8.00.

India/Pakistan: "Semi-Calibrated". These are the centers for cutting the great majority of the lower quality Brazilian, Colombian, Pakistani and African emeralds below the $200 per carat range, usually around $2 to $20 per carat. Although India has a large diamond cutting facility now, its mass production of coloured cut stones is still its biggest contribution to the world of gems and jewellery. In order to effectively mass produce cut gems, Indian cutters have to multiply the finished product ten-fold compared to their Colombian counterparts. Indian cutters use far fewer indexing pegs or posts and are often able to hold multiple gems onto a single lapidary wheel by using each finger to hold a dop stick. What they sacrifice in precision is made up for in volume. Since the clarity of these gems is relatively low, any further precision in the cut would probably not increase either clarity or brilliance by any economically significant factor. Both Indian and, to a lesser extent, Colombian cutters, produce what can be termed "semi-calibrated" cuts. Neither Indian nor Colombian cutters can match their finished product to a closed millimetre size so that the usual result is a parcel of emeralds in a range of sizes. Although the difference in sizes is less than 0.3 millimetres, the parcel is categorized as semi-calibrated. A "3-millimetre parcel" actually contains emeralds ranging in size from 2.70 to 3.30 millimetres. Mass jewellery makers in Asia expend more labour to "fit" the setting to a variety of sizes and thus prefer as precise a calibration as possible. However, true precision is expensive and is not cost effective for mass produced jewellery. Cost per carat to cut: <$2.00.

Israel: "Calibrated". Calibrated stones are ones produced to similar dimensions either to match each other in a finished jewellery suite or simply to fit exactly into open claws of mass produced Asian jewellery.

The bulk of African stones and, to some extent, Brazilian and Colombian stones also, are cut in Israel. The quality, generally, is midway between Indian and Colombian cut material. The Israeli cutting community has a strong background in diamond cutting and has extended this knowledge and expertise to coloured stones. However, the machines used for faceting coloured stones are not the same as those for diamonds. Machines for coloured gems can cut a number of stones at the same time by multiplying the number of dop sticks per lapidary wheel. All held by the same indexing arm, the stones are rotated to very precise dimensions and angles. The benefit is that each of the stones can be calibrated to exactly the same dimensions as the others in the run and that truly calibrated parcels can be produced, i.e., all 3.00 millimetre stones, or all 3.50 millimetres, et cetera.

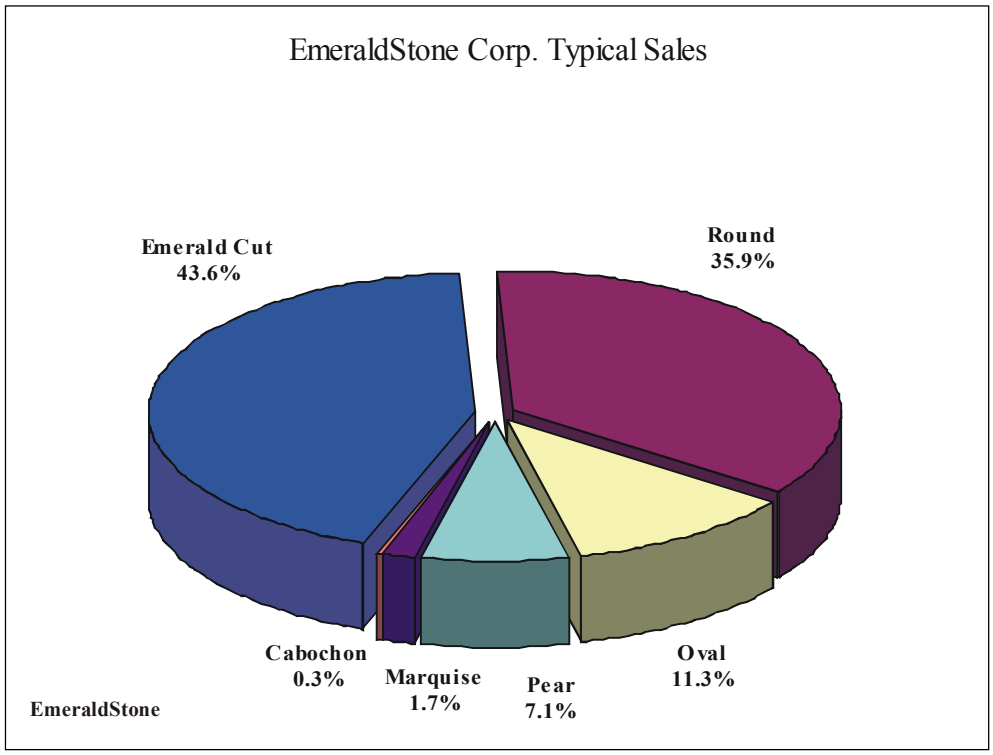
The disadvantage of fully calibrated cutting is that it ignores the need for supervision of colour zoning and often colour spots or areas are cut off which greatly decreases the colour quality of the finished product. Cost per carat to cut: $<1.00-10.00.

Germany: "Precision". Although they are few in number, coloured stone cutters in Germany have taken the positive aspects of native cutting from Colombia to artfully craft each stone to include minute colour zones. Perfect precision is then applied to the final faceting. This may be regarded as the ultimate and ideal cut for an emerald since it produces perfection in light refraction while maintaining the highest colour yield possible. Cost per carat to cut: $60.00+.

Other Mix styles: Most of the remaining cutting is carried out in jewellery centers in New York or Los Angeles, either by independent cutting facilities or in-house cutting factories in large gem or jewellery corporations. Most of these apply precision cutting using machines made in the United States and are able to supervise and guide colour zoning and inclusions, although generally not with the expertise of the German or Colombian cutters.

The principal cuts used for emeralds are the traditional, rectangular (emerald cut) and round shapes, followed by oval and pear shapes, as shown in Figure 5.

Figure 5
Typical Distribution of Type of Cut Sold in Emeralds



CERTIFYING STONES

Overall, Rio Verde estimates that less than 10 per cent of cut loose emeralds are certified by independent, bona fide laboratories, and these are usually only for the finer quality larger stones.[4] Before the treatment crisis of 1997/1998, the main reason to certify an emerald was to prove that it was natural and, secondarily, to mention its origin. Since 1998, most certificates have been used to validate a stone with respect to enhancement.

While it is relatively simple to establish the presence of colour enhancement, the detection of transparent clarity enhancement requires a far more sophisticated approach. Only select laboratories around the world can attempt to distinguish whether the more modern fillers to enhance clarity are present or not. These laboratories compare the optical properties of light refracted through an emerald crystal as opposed to its refraction through a filler. The laboratory technician must first try to select, using a microscope, an area in the emerald most likely to be flawed and, thus, filled. Then, using either FTInfraRed or a Raman spectrophotometer, the beam must be focused onto the previously selected spot and the spectra of that area must be compared with those of a natural emerald. Up until very recently only the AGTA laboratory in New York and the

[4] Loose stones are not certified to the same extent in the pre-jewellery phase. Once they are mounted into jewellery, the laboratories state that almost 80 per cent of stones over 1 carat are certified by the retailer for the final consumer for insurance purposes.

SSEF laboratory in Europe could compare the reading obtained to known spectra of polymers that are often used. The GIA does not yet certify to the type of treatment, only if there is one present or not. (See Appendix 1 for list of certifying laboratories).

These certificates and processes cost upwards of $200 per stone and can become cost prohibitive on smaller, less expensive gems. The issue also arises with time between date of certification and that of the gem being offered to a customer. Should the dealer be showing this stone for many months, customers may wonder if the stone has been retreated with some masking agent after the certificate was issued. If the customer feels strongly about this, the stone may be sent for recertification which incurs additional expense.

Fewer than 3 per cent of emeralds are fully natural or unenhanced, and almost all of these are certified. The expense is justified since unenhanced emeralds can secure a premium of 15 to 20 per cent over an enhanced emerald of otherwise similar quality. Recently, however, there have been reports of some Burmese sapphires commanding a premium of 100 per cent for being unenhanced[5]. This trend in sapphires may be reflected in similar premiums for unenhanced emeralds. Larger, high-end independent and chain stores, such as Tiffany's, for example, require all their better gems to be third-party certified.

Emerald values on certificates are usually provided by smaller appraisal firms and are only done on cut gems, never on rough material. Values are based primarily on the four C's (colour, clarity, cut, carat), since these firms do not have the technology to detect the more modern clarity enhancements. Appraisers mostly use The Guide, by Richard Drucker, to judge values based on the index for that year. Although many high level dealers disregard The Guide's pricing, claiming it to be far removed from reality, (and sometimes even Drucker has not been able to publish emerald estimates in certain years) it remains the only chart that attempts to follow emerald pricing and, thus, is the only guide available to appraisers.

Although more applied to diamonds, branding deserves a brief mention. Branding, or more exactly, 'marking', usually entails physically imprinting an identifying mark on the gem itself which will link that stone to a paper or digital certificate. It was discovered that laser drilling a small impression of the identification number on the girdle of a gem was the only procedure that would not be visible and would not reduce the clarity value of the gem. Emeralds can only be lasered using cool laser technology since heat from a normal laser would further expand or 'run' any flaws present in an emerald, essentially shattering the stone. There is little demand for branded emeralds purely in order to certify for enhancement or origin. This does not preclude a brand's usefulness in marketing, as discussed in the section on the potential position of a new producer in the Yukon, below.

[5] JCK Magazine, Spring 2003, quoting Richard Drucker's, "The Guide".

INDUSTRY STRUCTURE

For the purposes of starting a value-added line, Rio Verde considers a buried and undiscovered gem to have zero value per carat. Allowing for the fact that most emeralds at the post-extraction phase are rough and abraded, Rio Verde estimates an average value per carat of around $200 for the mines that produce more than 50 per cent of the world's gem quality emeralds, i.e., the areas of Muzo, Coscuez and La Pita/Cunas in Colombia. Large, regular producers, such as the Santa Terezhina areas of Brazil, might average around $100 per carat, while Chivor emeralds, at mouth of mine, might reach $300-500 per carat.

Reported prices can vary greatly. Some companies or producers may communicate one price to lenders or investors, another price to the departments of their local Ministry of Mines[6] and declare another price entirely to customs agents at international borders. In a recent effort to describe a diamond's value-added chain from mine to customer, a senior industry analyst for the GIA added that, "Colored gemstones are much more difficult to track because of the huge variations in prices and trading networks"[7]. Table III provides an illustration of how value is added along the supply chain for emeralds. It should be noted that few estimates exist for these increments and the value of a final stone can exceed $20,000 per carat.

Table III
Emerald Estimated Average Price Increment along Supply Line

		Increment, $/carat	$/carat
A	Emerald crystal, in situ	-	0
B	Rough emerald at mine mouth, ex-works	200	200
C	Transport to cutting or capital city	75	275
D	Cutting risk investment	725	1,000
E	Local wholesaler to exporter (*comisionista*)	200	1,200
F	Exporter to large wholesaler (e.g., New York)	300	1,500
G	Wholesaler to retailer	500-1,500	2,000-3,000
H	Retailer to final consumer[8]	1,000-8,500	4,000-10,500

EmeraldStone

Once the stones are cut, the tug of war between supply and demand occurs in Bogotá and other producing centres, and market centres such as Los Angeles or New York. It is based on cut stones since more buyers and sellers understand cut quality and valuation. Initially, miners and merchandise owners perceive the value of their merchandise as far higher than the market can bear. It is fair to say that the miners are not just setting a high

[6] The first reported price from General Manager Mittal of the Kagem emeralds from Zambia established them at $30 per rough carat, but dealers recently feel that the Zambian colour is more saturated than the Colombian giving it depth of colour, if not brilliance quality, which would put the value higher.
[7] Russell Shor, The Loupe, GIA, Winter 2003.
[8] Most jewelers will sell the stone at an estimated markup of 2.2-3.5 per cent and then cost out the mounting for its labour and precious metal content. Designers will add premium for their name or logo stamped on the finished piece.

price as a negotiating tactic, but that they truly believe that the effort it took to retrieve that particular parcel makes the stone both rare and highly valuable.

In Colombia, miners can become quite offended when getting offers that are far below what they had considered. For this reason, usually the only people to deal directly with them are the *comisionistas,* or informal street sales brokers. Outside of this group, only a few select international buyers will take the chance to negotiate directly with the miner at the risk of either an emotional outburst, or a silence which communicates that no further business will be had with that person.

Comisionistas provide one of the most important consolidation services to the whole industry. As production parcels are so varied with each output, *comisionistas* will consolidate those sizes, shapes and qualities that are being requested by the exporter. Still, their most important role is price stabilization. Like a hyena around a lion, *comisionistas* learn how to tread gently and diplomatically around the miners or owners. They always try to avoid being the first ones to take a consignment from the miner or owner, since first consignments are always unreasonably priced. When a *comisionista* returns with no sale, he/she faces a very upset and impatient miner who quickly fires him/her because of perceived 'incompetence'. The miner then goes through a few more *comisionistas* until deciding to slightly accommodate prices. This process can take days to many months. Finally, the offers to purchase start meeting the asking prices and, having suffered a reality check, the miner decides to sell. As there are hundreds of *comisionistas* in the Bogotá market, for example, there is room for each to go through the cycle a few times a year. *Comisionistas* will return to the miner who fired them a few months previously in order to try again for another consignment.

Highly trusted *comisionistas* are priviledged with taking consignments on the order of half to even ten million dollars worth of emeralds to select buyers in Europe, Asia or North America. However, these individuals often suffer the same fate as their local counterparts in Bogotá, returning numerous times with no sale. A certain number of them are also hijacked on the road, or at some hotel, or fall to the temptation of disappearing with the whole parcel for themselves. Regardless of the outcome, prices are driven by global demand, although the reverse does not hold true. Thus, as shown in Table II, above, offer prices in Bogotá hover around the levels shown in lines G or H, until coming back down to D or E.

REGULATORY VALUE INCREMENTS: EXPORT AND IMPORT TAXES

Using emeralds from Colombia as an example, since most of the world's production originates there, the taxes incurred on the path to a typical buying country can be built up as follows. Prior to export, an emerald leaving Colombia must obtain the receipt for royalties paid. As the royalty is rarely paid at mine source, for logistical reasons, the Ministry of Mines of Colombia charges the royalty upon export based on a complex set of formulae that approximate 1.5 per cent for mounted goods and up to 3 per cent for loose cut emeralds. These ranges are based on incentives to increase value-added processes within the country, prior to export. Emeralds being taken to the United States

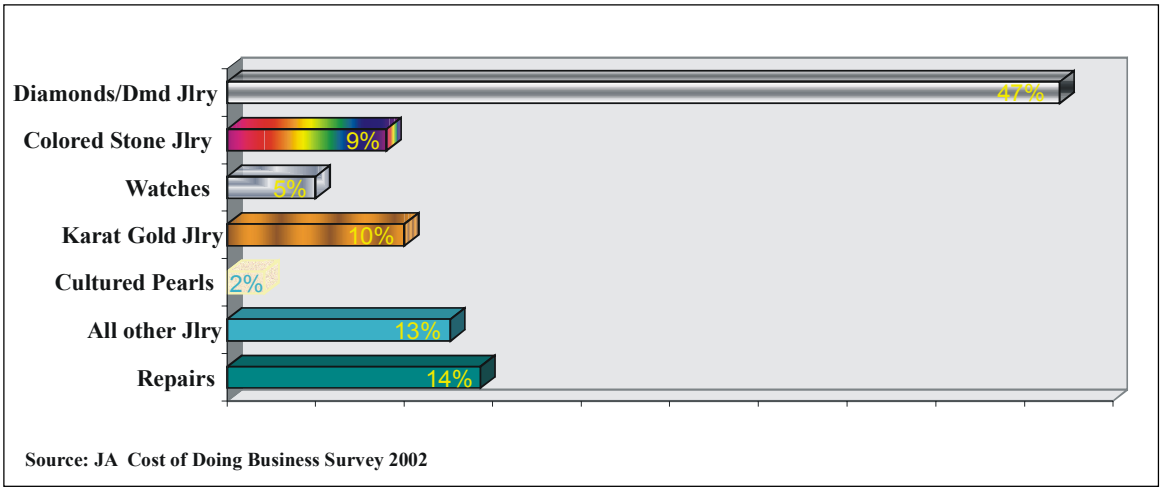
are not subject to a direct duty since Colombian products are covered under a "most favored nation" status. However, the associated bond and merchandise processing fees can be between $150 up to 0.21 per cent. For goods entering Canada, however, there are accumulated value added taxes of 17.7 per cent, and Switzerland imposes far higher taxes. For countries with higher taxes of course, the amounts on the chain of value in the table above increase by these amounts in level F, as shown in Table II.

MARKETS

Position of Emeralds in the General Jewellery Market

World annual retail jewellery sales are estimated at $83 billion.[9] The estimate of annual sales in the United States of jewellery, from both jewellery and department stores, is $52.1 billion[10]. This places the United States at around 60 per cent of world jewellery sales, making it the single most important market. Canada's jewellery sales amounted to $1.7 billion on 2002.[11]

Figure 6
Present Jewellers Distribution of Sales
Overall Jewellery Firm Average



Source: JA Cost of Doing Business Survey 2002

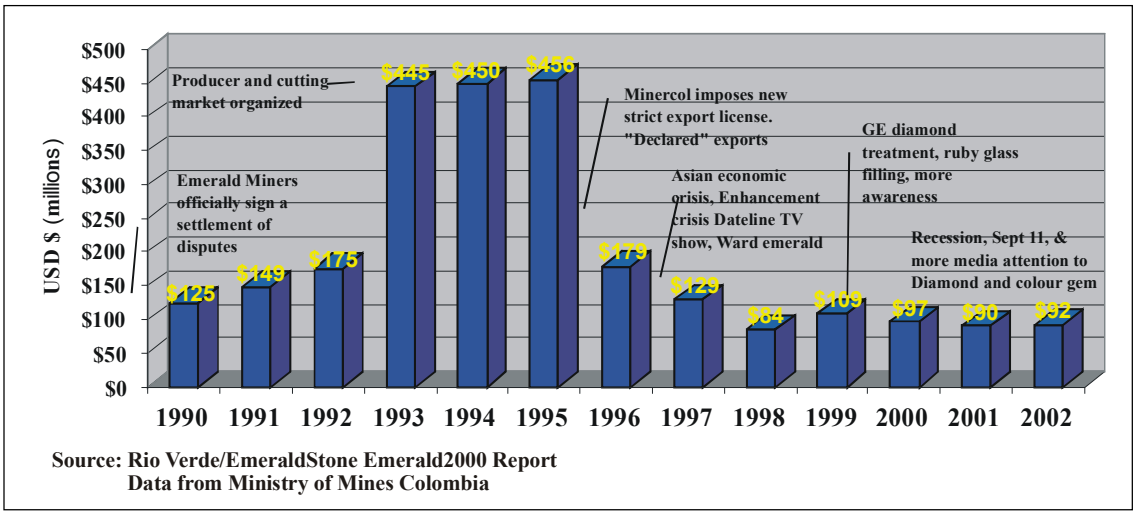
In the United States, diamond jewellery holds by far the most important share of retail sales at 47 per cent, with coloured gemstone jewellery sales holding 9 per cent, as demonstrated in Figure 6. In Canada, diamond jewellery is more significant, at 65 per cent or $1.1 billion, of the total market.[12] Rio Verde estimates that 44 per cent of coloured stone jewellery sales is accounted for by emeralds and is the largest single component.

[9] Based on 1998 figures of $50 billion: Forester Research, Modern Jeweler Magazine, October 1999.
[10] JCK Magazine Research data from Claritas Inc. 2002.
[11] Canadian Jeweller Magazine, August 2003.
[12] Canadian Jeweller Magazine, August 2003.

The average annual sale of emerald jewellery per store is estimated at $30,251. The approximate price of those emeralds alone is about two-thirds of the price of the finished product, or about $20,000. The cost of the emeralds to the jewellery store is estimated at $9,781 per year.[13]

In the United States, emeralds have a 2 per cent share of the imported cut gemstone market, diamonds account for between 87 per cent and 90 per cent, and all other stones make up the remaining 8-11 per cent. Emeralds and sapphires are the leading imported coloured stones, each holding 21 per cent of precious coloured gems. Prior to the treatment crisis of 1997/1998, emeralds held a 44-50 per cent share of coloured stones and a 3-4 per cent share overall.[14] Semi-precious stone imports have risen dramatically, from 1.6 per cent in 1996 before the treatment crisis, to 3.6 per cent afterwards. This is attributed to all three coloured precious stones (emerald, ruby, sapphire) facing enhancement issues from 1997 to 2003. Japan, being the second largest importer of emeralds, brought in a value of $66 million in 1997, but this dropped to $33 million in 1998. Emeralds also account for about 3.8 per cent of the imported loose gem market in Japan.[15]

Figure 7
Colombian Emerald Exports 1990-2002



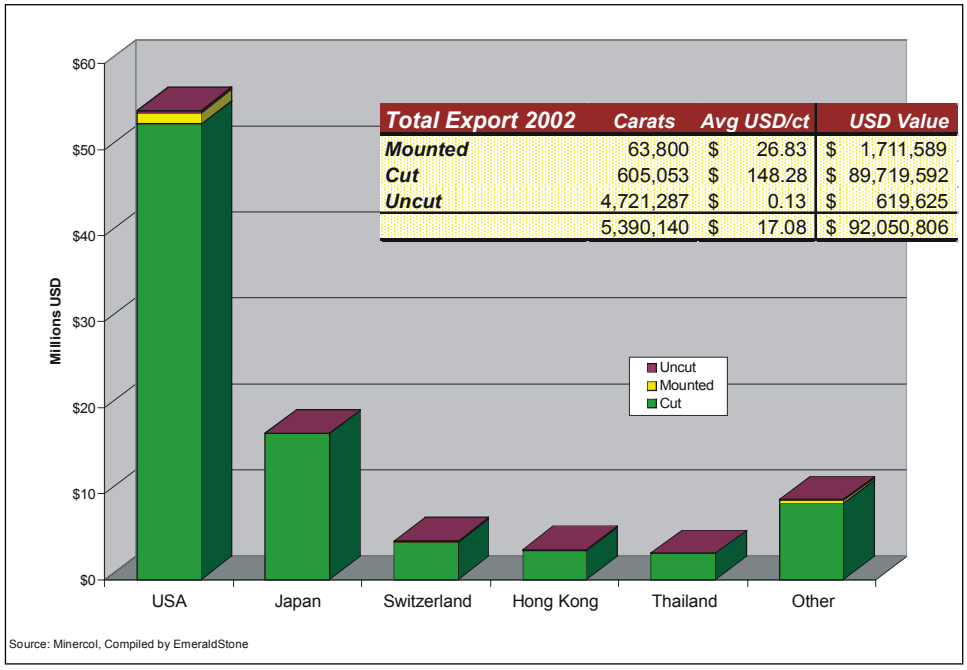
Colombian emerald exports since 1990 are shown in Figure 7. The lower figures, and the levelling out after 1996/97, reflect the effect on supply of the treatment crisis, augmented by an extended economic slowdown. However, more recent export figures may also reflect lower declared values in order to avoid taxes in European Union jurisdictions, as re-exports from the United States. It is also likely that the lower numbers reflect the

[13] Gross Margins on coloured stones reported by Jewelers of America, Cost of Doing Business Survey as 51.5 per cent.
[14] US Department of Commerce.
[15] Basel Magazine, May 1999.

same volume of stones, but higher exports of lower-priced rough material to processor countries that attempt to avoid treated stones by purchasing uncut material.

Client countries for emeralds are divided between those that take in rough and/or cut loose stones for further processing, and the final consuming countries. The United States, Japan and Switzerland usually can be considered final consumer countries. These and others are developed nations with high gross national product per capita. Hong Kong, Thailand and Israel are considered primarily as processor countries which add value either by cutting or by setting the stones in jewellery, and then reexporting to other markets, the majority of which are the main consumer countries. See Figure 8.

Figure 8
Declared Emerald Export Value from Colombia and Import Country Dollar Value for 2002



Although Colombia produces around 60 per cent of the world's emeralds, between 20 and 40 per cent of emeralds imported to the United States come directly, while the remaining 20 to 40 per cent comes via the processor countries.[16] More recently, the United States has received closer to 43 per cent of its emeralds directly from Colombia, probably due to the effects of the Asian economic crisis of the late-1990's. Wholesalers and purchasers also are probably using the United States as a consolidation point before sending to processor countries, particularly in light of Patriot Act rules (October, 2001) for reporting gemstone origin because of security issues and potential links with terrorist groups.

[16] Figures from US Census Bureau Trade Desk for 2003, Export figures from Brazil and Colombia Ministry of Mines "Minercol" and Mineral Export Promotion offices "IBGM". Figures for other producers come from Emerald2000 report prepared by Rio Verde.

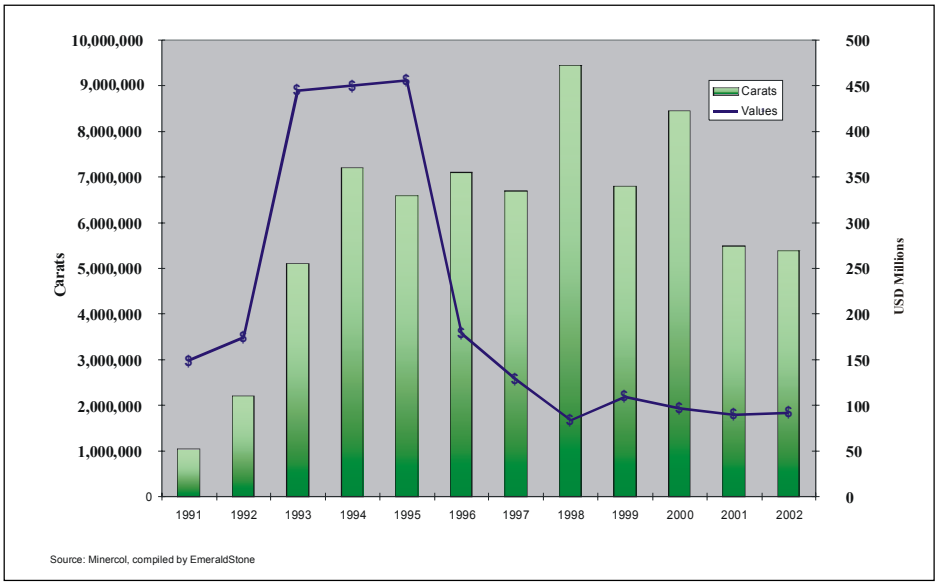
It is worth noting that producer countries, such as Colombia, Brazil and Zambia, have studied and attempted to implement different methods to induce producers and local exporters to increase value added processes within the producer country.[17] However, the discount on export tax of 1.5 per cent for stones mounted in Colombia does not make up for the import duty of 5.5 per cent levied on entry into the United States.

The United States Customs and Border Protection registered a value of $53,681,410 for cut emeralds coming in from Colombia in the year 2003.[18] A value of approximately $16 million in cut emeralds came in from Brazil in 2002.[19]

Historic Price Ranges and Influences on Price

In the years during the emerald treatment crisis, Colombia actually exported more carats. The export of uncut merchandise, which is three times the carat weight of its cut stone yield, rose substantially. A few manufacturers and wholesalers, wishing to be certain of emerald treatments, decided to undertake the cutting themselves, out of country, in order to ensure control over all steps in the processing of the stone. In 1995, 75 per cent of the exported carats, or 8 per cent of the total value, were uncut stones. By 1999, exports of uncut stones increased to 90 per cent of the exported carats, or 23 per cent of the value. Figure 9 shows the inverse relationship between normally priced exports of mostly cut stones in the early 1990's and very low priced, large volume exports in the second half of the decade and early 2000's.

Figure 9
Colombia Emerald Exports in Carat and Dollar Values

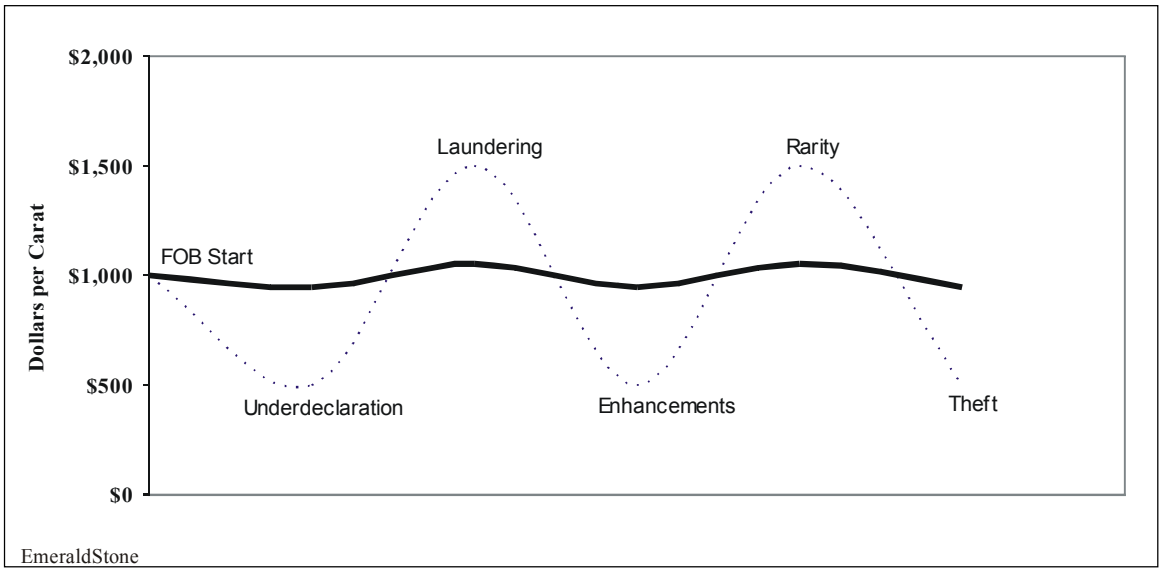


[17] Mining Planning Unit of Ministry of Mines in Colombia or UPME.
[18] U.S. Census Bureau Trade Desk, Feb 24/04.
[19] Brazilian Mineral Export Promotion IBGM using govt. info from MDIC/SECEX/DECEX depts.

For the producing country, Colombia, it is more difficult to confirm price per carat for uncut or rough merchandise. Government officials find it hard to validate declared FOB (free on board) values. It is difficult to estimate how many value declarations are misleading versus those that are legitimate. For example, countries like the United States and India, or exporters to them, and who take the lion's share of rough carats, declare values of approximately 0.20 cents per carat. Exporters to Germany and Spain have declared values of 0.07 and 0.02 cents per carat, respectively. Since Colombia produces the world's highest quality emeralds, averaging between $500 and $8,000 per carat, it is quite possible that 90 per cent of the country's exports are being declared at such values in order to reduce the import tax liability at the border of the destination country. This would be one of the first pressures to artificially affect price.

Figure 10 illustrates the effect of potential pressures on price. The scale does not represent the relative proportions of such pressures. Some may exert a far greater influence than others, but cannot be quantified within the scope of this report.

Figure 10
Pressures on Price



The laundering of funds using emerald exports requires exporters to legally register much higher values than the actual cost of the gem. Smuggling of the outbound gemstones serves no purpose in laundering. The higher the registered value, the more is laundered and the greater the efficiency of the operation. However, because most non-laundering exporters attempt to reduce their tax liability, they declare extremely low values. If, for example, the true value of the emerald is $1,000, under-declaration might put it at $20. Consider that the majority of emerald exports are at very low values. An effective laundering operation would require declared values much higher than cost, thus $3,000 to $5,000 would be minimally sufficient. Registering such values within a consistent list of $20 values would most likely alert the monitoring authorities to suspect activities. The Drug Enforcement Agency of the United States is usually most aware of these issues.

However, other agencies tend to attribute a far greater importance to use of emeralds in this illicit manner.

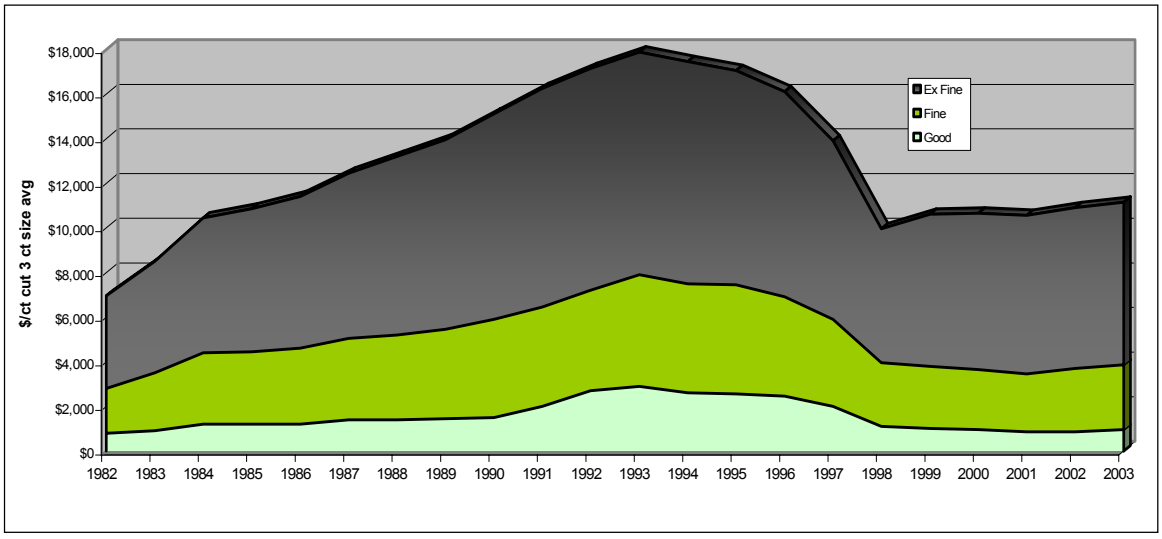
Enhancements have a far greater effect on reducing demand for emeralds. However, the enhancement of other gemstones is also causing considerable reduction in demand and this has helped to mitigate the downward pressure on emeralds relative to other gems.

Rarity of the gemstone has a strongly positive influence on price in the international marketplace. The only time it has been overwhelmed was during the enhancement crisis.

Theft of emeralds may affect price in two opposing directions. The removal of one or more parcels from supply can increase the 'rarity' factor. However, such stones are inevitably fenced or dumped with unscrupulous jewellers (often in New York or Los Angeles), at discounts as low as ten cents on the dollar. Subsequently, the availability of quality gems on the market at hugely discounted prices has a significant impact on overall perceptions of price.

It is for all these reasons that Richard Drucker, the creator of The Guide to gem prices, and the trade magazines such as JCK, started, in 2002, to leave out emeralds in their general gem pricing reports because they are difficult to follow and statistics are unreliable.[20] Figure 11 represents the estimates from The Guide[21].

Figure 11
Emerald Price Trend



Source: The Guide: Gemworld International

[20] Appraisers and subscribers to The Guide, Ernest Vaio of ELV Appraisal Labs and Greg Thompson of GemScan in Dallas, TX.
[21] Richard Drucker, GemWorld International, Northbrook IL.

With respect to the higher qualities, The Guide notes that, "Extra-fine quality can top off at around $7,300 per carat, with a premium reserved only for Colombian gems."[22]

The first significant variance on the price chart can be attributed to political factors. From the late 1980's, mining became increasingly focused on final gem quality after extraction. In 1989, Colombian emerald miners survived the "green wars" and managed to keep the Medellin cocaine cartel at bay and out of the control of their emerald mines. By 1990, the emerald miners organized themselves into formal mining companies and began valuing the finer Muzo and Chivor merchandise at premium prices.

The initial drop in emerald prices after 1997 was first due to the Asian economic crisis as Colombia depended heavily on Japanese buyers before that year. Just previous to this, however, an artificial drop in registered export values occurred when the Ministry of Mines in Colombia, under pressure from the United States Drug Enforcement Agency, revoked all existing export licenses and required all exporters to renew their licenses under a more rigorous new standard of export permits and licensing procedures. Although the same total value of emeralds was, in fact, leaving the country, a good portion was being smuggled out. Subsequently, the treatment crisis pummelled emerald prices taking them down to the low of 1998.

After 1999, different levels of buyers, from large wholesalers to retailers and to even the consuming public, started to become aware that the majority of other gemstones such as rubies, sapphires and diamonds were also being treated and enhanced in various ways. This understanding has been the main motivation in the upward trending emerald prices since that date.

Competitive Pressures

Overall, the jewellery industry competes with other sectors for consumers' discretionary spending on medium- to high-price ticket items. Consumers generally spend more on vacations and investments than they do on jewellery. Jewellery is, however, the highest-ranking choice amongst consumers in the highest price categories including antiques, luxury cars, art or collectibles, for example.

During the Valentine season, the competition is more direct, between flowers, chocolates and jewellery.

Within the jewellery industry, gemstone jewellery competes with karat gold jewellery products and repairs. Although repairs account for 9 per cent of jewellery store sales in the United States, they are considered a complementary service to all jewellery and are rarely regarded as true competition. Watch sales have been a significant competing category, but decreasing margins for jewellers have reduced the pressure from this area.

Finally, within the gemstone sector of the jewellery industry, emeralds face pressure from diamonds, sapphires, rubies and pearls, and semi-precious coloured stones.

[22] JCK Magazine quoting The Guide, Spring 2003.

Diamonds are by far the biggest competitor against all other gemstones. The success of this "colourless coal", as other gemstone camps jokingly call it, is two-fold. Diamonds are harder than emeralds and other gemstones, and they have the support of approximately $200 million per year in promotional dollars sponsored by the Central Selling Organization and, from 2000, by the Diamond Trading Company which replaced it.

The most recent campaign, known as "Past, Present, Future", and promoting three-stone diamond rings was hugely successful. Sales of three-stone rings were taken from approximately $500 million to over $2 billion as a result. However, the campaign has probably had an even greater effect in taking market share from other non-jewellery, luxury items, and may have helped to promote gemstone sales, generally, as jewellers offer coloured gems as a variation of the three-stone ring.

The biggest detriment to the diamond market is what the industry calls "commoditization". The ability to sell diamonds by simple text or verbal descriptions initially assisted in highly fluid transactions that were both quick and global in scale. However, the categorization of diamonds (by their particular ranges of qualities), places them in a similar position to other commodities sold on large mercantile exchanges. Jewellers were then forced to compete with wholesalers of diamonds, who mostly sell to the public over the internet, and the result was diminished margins on diamond sales. Since the educated consumer now understands that there is no difference between suppliers if the diamonds offered are certified to certain standards, the principal way for either vendor group to compete is by reducing margins.

There are two approaches to branding diamonds that have been taken in order to provide differentiation in the market place, as well as to emphasise the provenance of a stone. There are a number of diamond cuts that have been trademarked (for example, the Tiffany Lucida™) as well as the microscopic engraving by laser (for example, the Polar Bear Diamond™, or the AURIUS™ and CanadaMark™ logos for diamonds from the Ekati mine). All are accompanied by documentation to support the authenticity of the stone.

Natural **green diamonds** are far removed from emerald pricing categories and do not compete in the same markets. Green and red diamonds are among the rarest of all diamonds and can be valued as high as $1 million per carat.[23] The colour results from natural exposure to radiation, probably though proximity to uranium-rich minerals, over long periods of time and, although this association may not scare the consumer, price alone may very well do so for most consumers of green gemstones.

Sapphires, rubies and pearls. Between 20 and 40 per cent of the coloured stone market is taken up by sapphires. Sapphires, generally, have been sold at about half the price of

[23] Canadian Jeweller Magazine, March 2003 and coloured diamond supplier Arthur Langerman from Antwerp.

their emerald and ruby counterparts although the highest quality Kashmiri sapphires can sell for six times the price of traditional sapphires.[24]

In Canada, both sapphires and emeralds are dwarfed by imports of rubies which account for 51 per cent of the market. Prices for both sapphire and ruby increased from the early 1980's, but plateaued in the early 1990's when it was discovered that they were being heat-treated in order to improve the colour. The recent discovery of sapphires being treated with beryllium (bulk diffusion of beryllium into the crystal lattice causes higher value yellow, orange and gold colouration) has been a great cause of concern for jewelers, due to both the potential health hazards to operators of the diffusion equipment associated with this method, and the resultant perceptions of price.

Due to a huge promotional campaign in the late-1990's, annual sales of pearls surpassed the billion dollar mark. Production is estimated at about $640 million in value.[25] Advertisements targeted towards consumers helped to boost pearl sales by over 500 per cent in the past decade. New Chinese freshwater cultivated pearls have resulted in some over-production that may hurt some of the traditional Japanese suppliers.[26]

The biggest competitors to emeralds in the **semi-precious coloured stone** category are green tourmaline and tsavorite garnet. Although they have less depth of colour than emeralds, these stones are extremely high in clarity and prices are far below those of the precious coloured gemstones. Green garnets and tourmalines are generally considered an alternative to emeralds for consumers at lower price points in the jewellery market. Semi-precious stones also tend to take up the slack in sales of precious gemstones during economic slowdowns, or when reports of treatments or enhancements appear for a particular precious stone.

Synthetic emeralds have about the same impact as semi-precious green stones on emerald sales. If consumers cannot afford real emeralds, they tend towards the synthetic alternative which can be one-tenth of the price of a natural stone. Companies like Chatham, Gilson and Byron often promote their products during recessionary cycles because, as Chatham says, "consumers have cut back, but they haven't cut out."[27]

PROSPECTIVE CLIENTELE

Rio Verde divides the buyers and sellers of emeralds, or clientele, into three tiers. On the first tier are those firms that transport larger, consolidated quantities of emeralds, usually from the source of mined stones to the regional areas of final consumption. Second tier clients are those that receive the emeralds, process them and market them to the final consumer. Final tier clients are the final consumer.

[24] Gemkey.net's Palmeiri's Market Monitor December 1999.
[25] Canadian Jeweller Magazine, November 2002.
[26] Gemkey Online News, January 6, 2000.
[27] Chathams full page advertisement, AGTA brochure 2004.

Tier One Clients: Transporters/Exporters and Wholesalers

The first set of transactions downstream from the mine is carried out by companies, or their representative agents, who are often specialized in coloured stones and usually specialize only in emeralds. In the transaction line in Colombia, for example, *comisionistas* and local wholesalers sell to the exporters. These are either registered in the country as local, domestic corporations or are foreign companies that buy from one of the local wholesalers, but which personally go to Bogotá to select their stones.

The International Colored Gemstone Association should be the representative organization for this level of client. It is not all-inclusive, however, and also includes some companies that do not really fit the category.

There are seven registered ICA exporters in Colombia and 23 in Brazil.[28] The true number of exporters in each country, that consolidate enough emeralds to have a significant effect on the market, is easily double those figures, however. Although there were approximately 150-300 holders of the specialized emerald export license in Colombia, the actual numbers may be significantly different. For example, statistics for Brazil show only two permitted exporters solely of emeralds. [29]

It is difficult to estimate the number of large clients that arrive in Colombia or Brazil to purchase significant parcels, either with the assistance of a local exporter or on their own. Rio Verde estimates that, during low seasons, there are between one and five international buyers in each of Colombia and Brazil, every 15 days (which is the average time to buy parcels). Before the high seasons, around Christmas, the Tucson gem show in February, and in May (Mother's Day and the emerald birthstone month), there may be double the number present.

Manufacturers Buying Direct

Japanese buyers of emeralds can be identified as a separate group due to their significant impact on the emerald business. Before 1997, large Japanese wholesalers or jewellery manufacturers sent agents to live in Bogotá to purchase and supply their head offices with shipments of emeralds. At the time, Japan was the largest single client for emeralds and the Japanese government was reported to have supplemented some of its international monetary reserve with emerald gemstones.

Japanese buyers have been adamant about not buying from syndicates or directly from mining companies since they know that prices will be high. Instead, Japanese agents posted in Bogotá would buy only from *comisionistas* or local wholesalers. This helped develop the community of *comisionistas* to the size it is today. Japanese buyers have never wanted to become involved in any levels farther upstream since they considered cutting too risky and they did not feel versed enough in mining knowledge.

[28] ICA Directory 2000.
[29] Minercol data from 1996-2000 for Colombia, IBGM data from 2003 for Brazil.

With the fall of the Japanese economy in 1997 and the consequent Asian economic crisis, most agents returned to Japan. As the economy picked up again, the uncertainty over emerald enhancement was full blown and this dissuaded large Japanese companies from reestablishing permanent purchasing offices/buyers. Other reasons contributed to the change in approach including information relating to misrepresentation of purchases by their own agencies in Bogotá, diversion of funds to entertainment and large sums on recreational cocaine.[30] At the same time, the adoption of tunneling in the mining operations was concentrating more production in the hands of the mining groups themselves so that fewer emeralds were being missed and sent down the riverbeds. Since Japanese buyers often also refused to accept the price structuring held by miners, their incentive to reinvest in buying agencies in Bogotá was greatly diminished. Local exporters and other international wholesalers are now attempting to replace this interrupted demand by delivering the product directly to Japan.

Large/International Wholesalers

These purchasers buy from exporters at level F and sell to other smaller wholesalers or directly to retailers at level G, as shown in Table II, above. The majority are located in the world's gem centres of New York, Los Angeles, Basle, Antwerp, Tel-Aviv, Rome, Tokyo, Hong Kong or Seoul. At this level, the majority of companies wholesale in all coloured gemstones, with emeralds comprising between 10 and 40 per cent of their business. Upstream from this level, companies which deal in emeralds usually do so exclusively.

The American Gem Trade Association encompasses a large number of coloured stone wholesalers at this level but, like ICA, it is not inclusive and contains many that probably do not fit the group. The AGTA 2004 directory lists 187 of its 400 members as potential suppliers of emeralds, as well as other lines of gemstones. Before the 1997/1998 treatment crisis, a high percentage of these would have specialized in only emeralds. After the treatment crisis, however, many needed to diversify into other gemstones and now only about 10-15 of those listed in the AGTA directory are specialized in emeralds. Probably half of the AGTA emerald suppliers have at one time or another traveled directly to Brazil, and a few to Colombia, to select and buy their stones directly from one of the big exporters.

Global Trade Shows

The major international gem and jewellery trade shows provide one venue for large wholesalers to sell emeralds to smaller regional wholesalers and to retailers.

Two factors have reduced the importance of trade shows for loose gem sales, however. Firstly, the treatment crisis caused retailers to restrict their emerald purchases to their one or two trusted suppliers. Secondly, retailers have become more conservative with their travel and trade show budgets and are limiting themselves to one trip a year to purchase finished jewellery, rather than loose merchandise which they then have to design and set.

[30] Interviews with un-named permanent agents in Bogotá in the 1990's.

Reduced travel after September, 2001 also had a large impact on trade show attendance, particularly in 2002. A number of suppliers have suggested that loose gem trade shows provide sales only sufficient to cover the expenses of exhibiting, but the reconnection with clients from around the world is still important to generate yearlong purchase orders.

The trade shows are listed below by what is estimated to be their level of importance to emerald sales by dollar value, not in carat volume.

AGTA, Tucson, Arizona. Every year, at the beginning of February, the conference centre is taken up by the higher quality suppliers of the AGTA show. Hotels and motels are filled by secondary, lower quality merchandise suppliers although the sales of mineral specimens and semi-precious stones in this group are beginning to dominate the show. As a result, a number of the higher end retailers are losing interest. A recent comment from a retailer was "this year it was just a bead show".[31] Notwithstanding, the AGTA show is probably the largest concentration of value in sapphires, rubies and emeralds every year.

JCK of Las Vegas in June (2,750 exhibitors, 20,400 attendees) and **Basel** of Switzerland in April (2,100 exhibitors, 64,300 attendees) are the world's largest finished jewellery shows in terms of value. They are also becoming more important in terms of retailer attendance and may soon become the most important venues for loose gemstone sales. Both shows now have incorporated tangential shows in adjoining conference halls that focus on loose gemstones. Many large wholesalers are attempting to focus their largest exhibit budgets on these shows.

Hong Kong (2,000 exhibitors 36,000 attendees,) and **Bangkok** (23,000 attendees) jewellery shows in September are important for medium and low-grade emeralds. Another show in Bangkok, during March, has approximately 20,000 attendees.

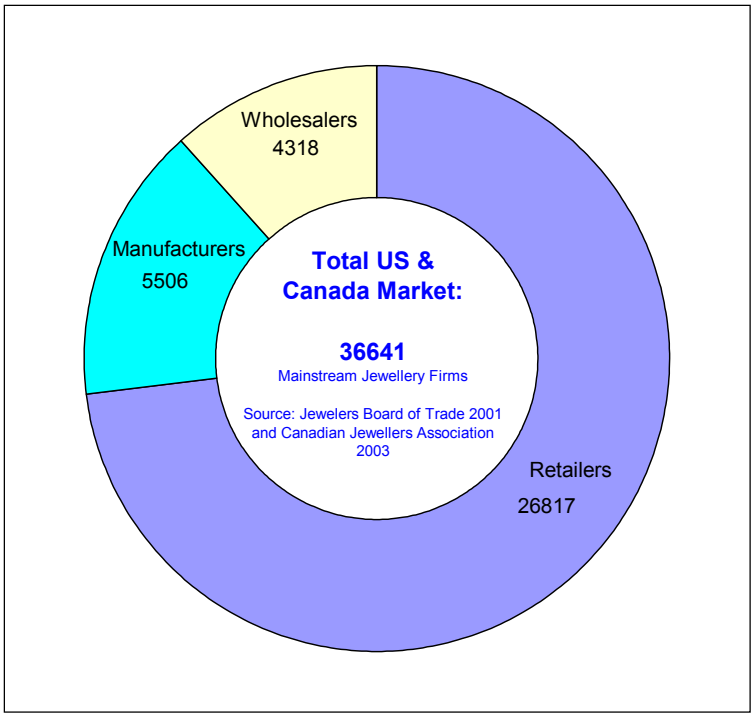
Inhorgenta of Munich in February is one of the most important German shows with approximately 30,000 attendees.

Tier Two Clients: Pre-Consumer Processors and Marketers

According to the Jewelers Board of Trade and the Canadian Jewellers Association, approximately 36,600 firms own around 44,400 stores in the United States and Canada. The Canadian Jewellers Association reports an approximate number of 4,500 jewellery stores in Canada. Retailers account for nearly three-quarters of the North American total, shown in Figure 12.

[31] Austin, TX jeweller, client of EmeraldStone Inc.

Figure 12
Total US and Canada Jewellery Market



Medium to small wholesalers are next in the chain of emerald supply and they usually buy at level G and sell at H (see Table II). They often buy their product at the shows from the bigger wholesalers or via phone request. These firms are typically located in medium-sized cities, such as Edmonton, Alberta or Austin, Texas. Retail jewellers will often call initially on their local wholesaler as these are often the "one-stop-shop" for all semi-precious and medium to lesser-value precious stones. Local wholesalers also are known to be much more responsive to clients in their area, and even deliver personally, while the larger New York firms have a reputation for poor service to smaller retailers, particularly by telephone. There some estimated 3,968 smaller wholesale firms in this category in North America.[32]

There are an estimated 5,506 **jewellery manufacturers** in North America. Although approximately 80 per cent of retail jewellery stores make a lot of their own jewellery for sale, about 30 per cent of total jewellery sales is accounted for by the products of manufacturers.[33] Large chain stores do, sometimes, purchase loose gemstones but the bulk of their intake is finished product from manufacturers. The majority is mass produced, lower price point merchandise from Asia. Asian manufacturers usually

[32] JBT 4,318 wholesalers; AGTA 350 large wholesalers.
[33] JBT and US Census Bureau quoted in Professional Jeweler Magazine, 2003. $5.3 billion in manufactured jewellery sales to retailers, markup average 2.2-3.5 per cent. Around $11-13 billion retail value, percentage of total retail sales between $40-$49 billion.

process emeralds at a cost between $0.50 and $200 per stone wholesale, with most between $1 and $5. China has become the largest supplier of jewellery of this quality for the North American market.

However, every chain or department store requires the availability of repair and 'restyle' support within close proximity to each of their locations and for this they rely on local manufacturers.

The largest players in the **retail** jewellery business are the **chainstore** "super sellers" made up of 31 firms which each sell more than $100 million in jewellery per year. Combined, these firms sell $17.5 billion a year in jewellery and watch sales, or approximately 40 per cent of the total retail jewellery sold in the United States.[34]

The storefront super sellers are peculiarly more concerned with prime real estate than with inventory issues. Their efforts are spent not on acquiring quality merchandise but on swiftly securing quality mall locations around the continent before their competitors do, even buying out smaller independents just for their location. Any detailed analysis of the jewellery and gemstone markets must take account of this category of client since their movements have a great impact on the rest of the jewellery community.[35]

The remaining chain stores are categorized as firms with sales between $12.5 million and $99 million per year. These companies have an average of 10 to 31 stores each.

Independent retailers make up 60 per cent of total retail jewellery sales and also account for approximately 60 per cent of storefronts. Surveys indicate that they are the most trusted and chosen places to shop for fine jewellery for the target demographic of 25- to 55-year old middle to upper income consumers.[36]

Among independent retailers, 33 are considered "Eight Figure Independents".[37] These achieve more than $10 million in annual sales per storefront. This group is made up of such names as Borsheims of Nebraska, Shreve of San Francisco and Hamilton of Palm Beach. Places like Molina's of Phoenix average $25,000 per sale (although individual transactions can be in the millions of dollars), and Hyde Park of Denver purchased $2 million worth of viewing equipment for customers to better see their jewellery during their visit to the store. Such companies cater to elite clients in either large retail outlets of 10,000 square feet, or more, or specialized boutiques with multiple private rooms.

The vast majority of the remaining independent retailers have annual sales of under $1.5 million and average around $300,000 to $700,000 per year.[38] About two-thirds rent their establishments. These retailers occupy a variety of locations - stand-alone stores, strip

[34] National Jewelers Super Sellers Report, June 2003.
[35] National Jeweler Super Seller Annual report, 2003.
[36] JCK Annual Consumer Surveys.
[37] National Jeweler Eight Figure Independents Annual report, 2002.
[38] JA Cost of Doing Business Survey, 2003, reported in Professional Jeweler Magazine October 2003.

malls, larger malls. As for all mall locations, both chain stores and independents usually provide a percentage of sales along with their rent.

Outside the United States, the city of Idar-Oberstein in Germany is considered to be one of the most important locations for the highest-end independent jewellers. The city is regarded as the birthplace of the finest quality jewellery makers in the world and many of the high-end independent firms located around the world have some sort of direct or family tie to the city, having been trained in or lived there.

Jewellery designers set the trends for the global jewellery industry and yet, ironically, average the lowest sales overall[39]. Their average annual sales are around $500,000 per firm. Being primarily artists, rather than business people, designers tend to not have sufficient financing to purchase the higher value stones and produce the majority of new pieces with semi-precious coloured stones. When a designer wins one of the world jewellery awards, the piece is profiled on the front cover of the leading jewellery magazines for the whole month. Most independent retailers display these magazines in their store lobby to give ideas to customers.

The upper echelons of designers do not sell to the public, rather they wholesale their lines to retailers who carry display sets, complete with product and designer profiles, pictures, and so on. Independent retailers often promote their stores based on the designer lines they carry. Once designers begin to move larger product volumes, they often team up with manufacturers to produce each unit in series.

The leading designers considered trendsetters in the trade are Cathy Carmendy of Santa Monica, Jochen Pohl of Idar-Oberstein and Steven Webster of London.

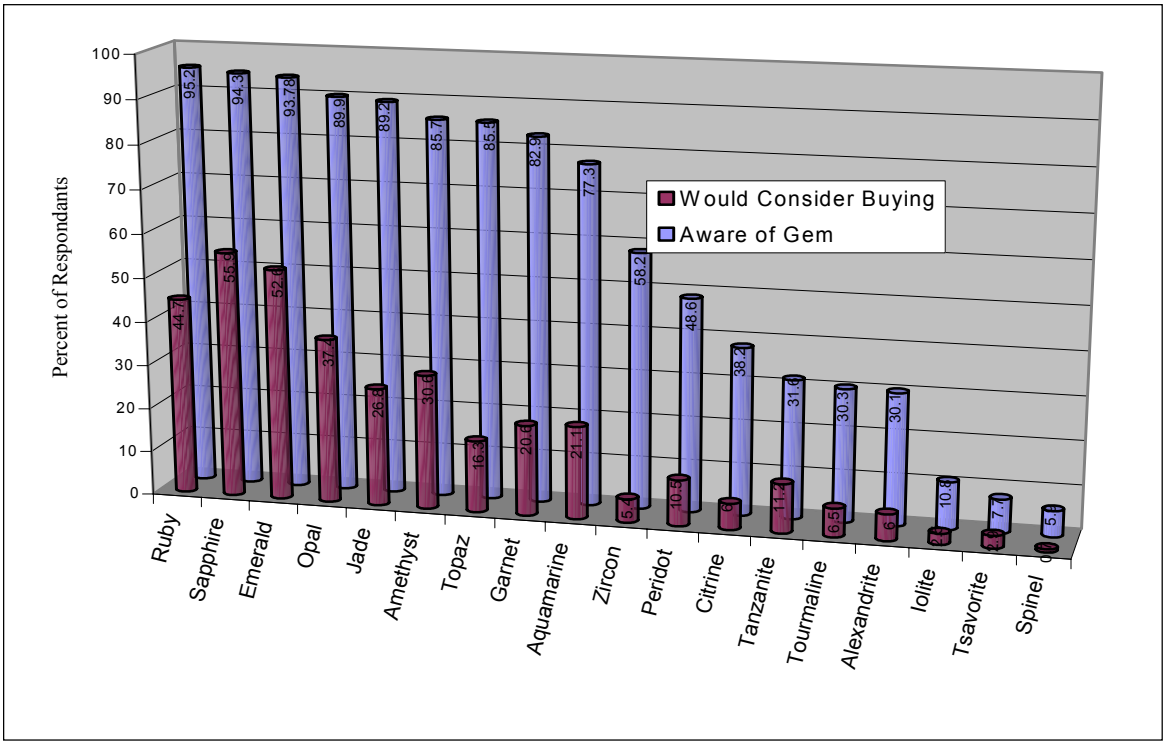
Smaller designers run boutique-type shops that cater to single customers from the public. Although similar to some retailers who also design, true designers tend to spend more time on a piece from concept to execution, are far more qualified, and their trademark imprint on the final piece carries a premium beyond the sum of the assembled products.

Final Consumers

The final consumer in the United States is placed among the 11 to 18 per cent of the adult population that buys jewellery.[40] According to the Canadian Jeweller Magazine, the average jewellery purchase a consumer makes in the United States is $300, with the average diamond purchase being $600.

[39] According to the JA report, focus on coloured stones has placed designers among the highest margin earners per sale.
[40] US Bureau of Labor Statistics 1997 and JCK Survey , 1999, respectively.

Figure 13
Consumer Gemstone Knowledge



Source: Jewelers of America J Report, Survey of 460 women in Puget Sound, '99

Women buy 69 per cent of coloured stone jewellery and they buy much more jewellery for themselves than they do as gifts. Men are considered "assistant" buyers who usually buy jewellery of any type as gifts. Being generally less knowledgeable of jewellery than women, when choosing gifts men tend to follow marketing trends set by diamond promotions.

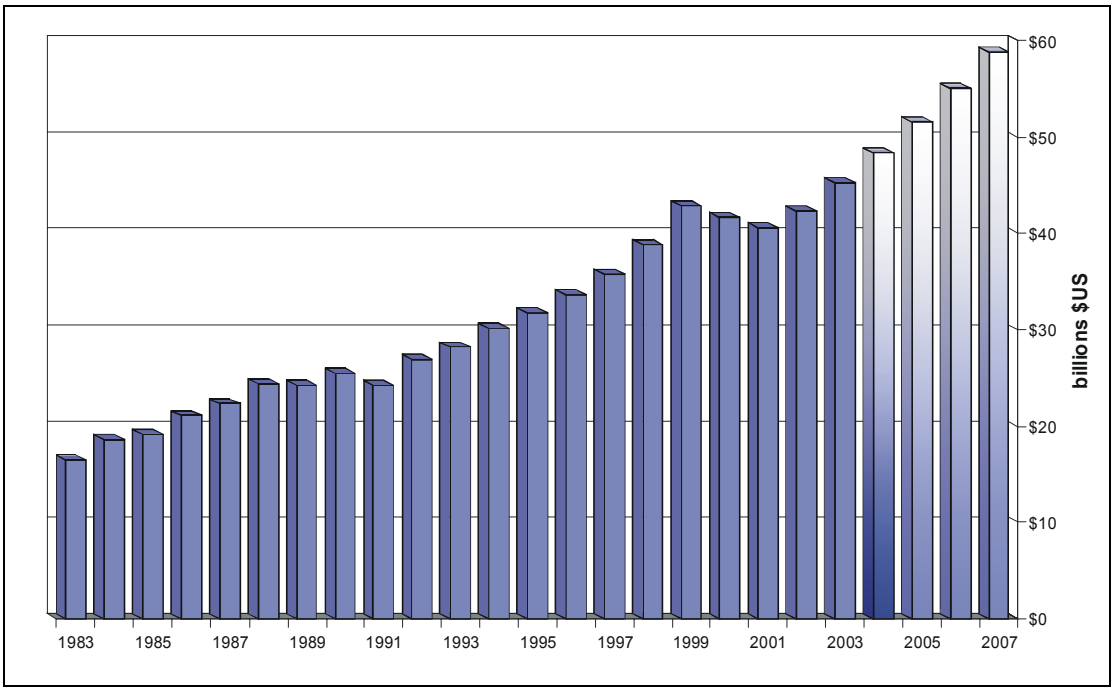
Although carried out in the middle of the treatment crisis, which by the time of the report began involving many other gemstones, the results of the survey summarized in Figure 13 has been invaluable for gemstone marketing and positioning analysis. Emerald placed third in the "is aware of" and second in the "would consider buying" category. JCK magazine, which reprinted the survey, suggested that jewellers might wish to consider sticking to ruby, sapphire and emerald to capitalize on sales potential amongst the coloured stones.

Within North America, emeralds of darker colour and with less clarity are preferred in the Midwest of both Canada and the United States. On the West Coast, emeralds of high clarity are preferred with slightly less importance being placed on depth of colour, especially amongst the affluent Asian population. The traditional emerald, with a balance of colour and clarity, is still the preferred choice of consumers on the eastern seaboard of North America.

MARKET OUTLOOK

GENERAL JEWELLERY MARKET

Figure 14
Jewellers Annual Retail US Sales
Historical and Predicted



Source: National Jeweler, State of the Jewelry Industry, September, 2002

Annual sales in the general jewellery market show a lagging effect from the 1989 and 1997 stock market crashes, as shown in Figure 14. The most recent recession is apparent from growth figures falling from 10.5 per cent per year in 1999, down to 3.3 per cent per year in 2000, and holding with no growth for the last two years. Although many feel that the events of September, 2001 caused the downturn, analysts show that the market was already softening at the beginning of 2000. The National Jeweler Magazine reported in January, 2004 that analysts are still split on the present state of the market. Some feel that the luxury industry is recovering from its two years of recession, while others still consider it flat.

Jewellery Styles

By individual jewellery product sectors, there are some emerging trends and jewellery lines will be influenced by the following designer trends. "Snow White" promotes lighter colour metals and pearls. "Ice Storm" refers to the huge success in the three-stone ring campaign launched by De Beers and which most of the industry feels will continue. "Bridal Showers" describes jewellery styling itself with more chandelier and antique styles. This trend will involve more coloured stones as the central gem, with diamonds as accents on the side. "Rainbow" will contain citrus colours like lemon yellows, lime

greens and fiery oranges. "Gold" refers to the more rose gold colours that will be prevalent, especially coming into summer of 2004.[41]

The future of the **diamond** business seems to consistently swing between the struggle for diminishing returns and yet huge advertising campaign successes. Already at around 90 per cent of the gemstone market, very large advertising expenditures will only increase the share of diamonds in jewellery by, possibly, only fractions of a percentage point. However, it is the very successful diamond promotions that have made jewellery itself gain ground within the luxury market overall, and accounting for a larger piece of the luxury products sector.

Certain issues within the diamond industry are somewhat mitigating the success of promotional campaigns. The decision to set up the supplier of choice program has upset traditional diamond sightholders. The De Beers decision to start retailing diamonds directly to the public also is making traditional retailers feel somewhat betrayed by their largest supplier.

Synthetic and enhanced diamonds are having a different effect, by shaking consumer confidence in the middle to lower end purchases that are not normally certified by laboratories. With General Electric's HPHT (high pressure high temperature) enhanced and improved diamonds, and the 12 or 13 Russian, Korean and Asian manufacturers producing near-indistinguishable synthetics, top gem laboratories around the world are making the development of detection procedures a priority. De Beers, however, has the size and advertising power to encourage certain media to limit, or simply to avoid, coverage of this.

The issue of conflict diamonds is one of such magnitude, however, that none of the players involved could have silenced media comment. Amongst knowledgeable consumers, the campaign to brand non-conflict stones was successful in separating the good from the bad. However, the perception of the general public was so adversely affected that most retailers around the world have had to display signs inside their stores explaining how their diamonds are guaranteed to be "non-conflict". The campaign in itself caused many socially conscious consumers to make the simplistic choice of no African diamonds, or no diamonds at all, because it was too hard to make an informed choice. The Kimberley branding and tracing program was fully endorsed by the largest diamond players and has taken great strides in educating the public. As in other diamond campaigns, this will most likely be successful and will instill confidence in a seemingly strict diamond monitoring process.

With respect to **precious metals**, the campaign by platinum producers and marketers was successful in creating increased demand for the metal in jewellery products. However, analysts feel the prices placed the metal beyond the value range to an inaccessible and unnecessary level. Jewellers were quick to price their gold at a simple $400 per ounce level and recent price swings have not affected sales.

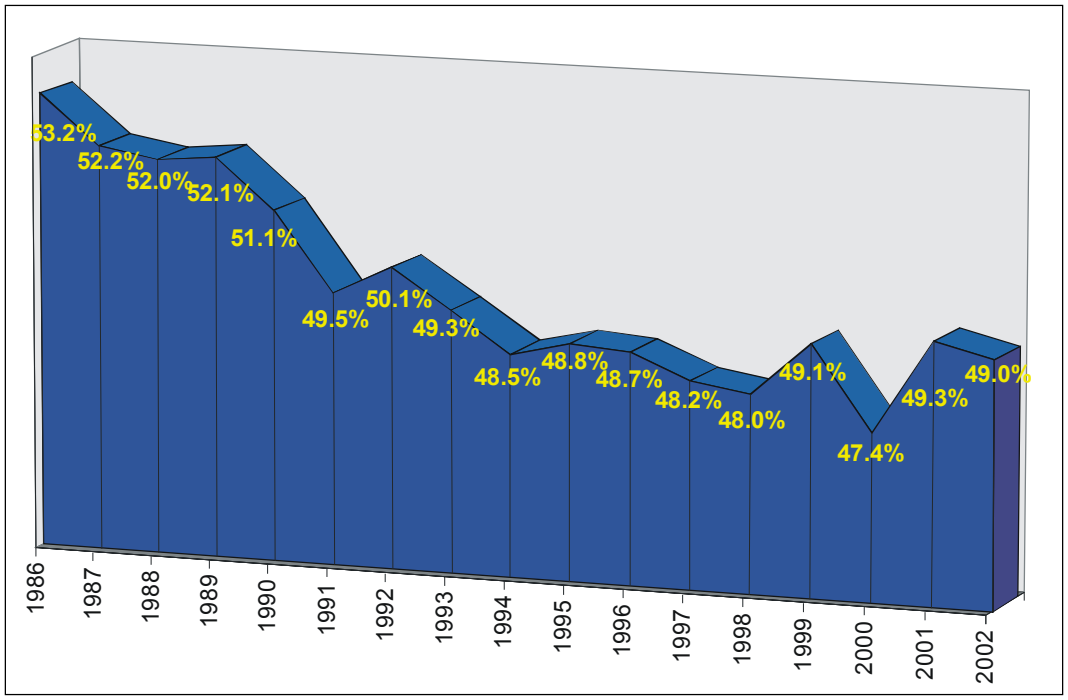
[41] Basel Magazine Jewellery Report 2004.

As shown in Figure 6, above, watches account for about 5 per cent of jewellery sales in the United States and compete for consumer spending with other jewellery items. The **watch** distribution system has gone through some major changes in the last five years and, because of competition with other retail watch sources, many general jewellery retailers have dropped most or all of their watch lines. Rio Verde estimates that within the next five years the Jewelers Board of Trade listings will distinguish watch companies from jewellers. For the final consumer, watches will be less readily available within jewellery stores as a choice against precious gemstone and other jewellery.

OUTLOOK FOR EMERALDS AND OTHER GEMSTONES

Short-term trends for the upcoming spring and summer season, 2004, are predicting colours within the red and green groups. Trendsetting designer, Pohl, has said that "the cut should never be more important than the colour, only enhance it", which could reduce the value of cut in relation to the other C's in coloured gem pricing.[42]

Figure 15
Gross Margin – Retail Jewellers in the United States



Source: JA Cost of Doing Business Survey 2002

Gross margins are declining overall within the jewellery industry, as shown in Figure 15. It is apparent, however, that as diamonds and watches decline, coloured stones are becoming more important. Jewellers have often claimed that their traditional diamond

[42] Basel Magazine, February 2004.

sales now earn them a margin of 20 per cent, while coloured stones at similar price points earn them 2.2 to 3.5 times markup.[43]

By client type, jewellery chain firms, independents around the $500,000 to $1 million per year range, and designers, often exhibit high gross margin return on inventory in their coloured stone sales compared with their diamond sales. In 1999, JA reported huge differences, of 154 per cent and 70 per cent, for coloured stones and diamonds, respectively, in chain store sales. On average, across all types of stores, coloured stone sales show one of the highest gross margins, second only to karat gold jewellery sales. Gross margins of this magnitude are allowing jewelers to reconsider coloured stone jewellery for inventory, despite the uncertainty over enhancements, which now is shared by diamonds.

In the short term, the new treatments on pearls, beryllium-diffused sapphires and the difficult to detect diamond synthetics will cause market disarray. The reduced supply of emeralds from Brazil and Colombia in the latter part of the 1990's, during the emerald crisis, has not been offset by new large-scale production from the La Pita deposit because of the rumour of polymer treatment of emerald rough at mine site. One of the representatives of a synthetic laboratory said, "I see the market getting bigger and bigger for the laboratory grown stones. I don't see how it can't, the mines are producing junk."[44]

Other emerald production is contributing significantly to the need for regular supplies. The drop in output from Colombia, from exports of $500 million per year to less than $100 million per year has certainly affected the market. Once the Zambian government liberalized emerald mining, the new Kagem mine in Zambia, an Israeli-Indian joint venture, has developed more formalized production.[45] Zambia is now reportedly becoming the second largest producer of fine emeralds, but reports of any increased production overall are still pending. Production coming from Afghanistan was severely curtailed in the latter part of 2001. Gary Bowersox, an expert on gems in Afghanistan, said that production of both emeralds and rubies is declining further because of lack of technology. The interim government is attempting to curtail informal local scale mining.[46]

Demand for entirely natural, unenhanced emeralds is starting to become apparent and full-page advertisements are appearing in the trade magazines to promote their supply. Prices in The Guide indicate premiums on unenhanced gems up from 20 per cent to 100 per cent. Rio Verde believes that these promotions will increase interest in the gemstone overall, for both moderately or lightly enhanced emeralds, as well as for completely unenhanced stones.

[43] Unnamed jeweler on the elite Union street in San Francisco California.
[44] Carter, Synthetic Laboratory firm quoted in National Jeweller, 1998.
[45] Weldon, Robert. Professional Jeweller Magazine, October 2003.
[46] Colored Stone Magazine, Afghani Trade More Dangerous, Prost, August 2003.

Although diamond promotions may reduce consumer appetite for coloured stones in the short term, in the long run they will increase overall jewellery sales. With the Diamond Trading Corporation expecting growth of diamond sales by 50 per cent in the next 10 years, the same may be expected for all accompanying jewellery sectors, including emeralds.[47]

[47] National Jeweler Magazine, May 2003.

POTENTIAL POSITION OF A NEW EMERALD PRODUCER IN YUKON

North American deposits of coloured gems possess strong competitive advantages over deposits in less developed countries. The availability of advanced technology for mining and superior infrastructure eases communications and access to sites. North American deposits also benefit significantly from political stability, the lack of which often jeopardizes third world mine site safety for employees and equipment.

NORTH AMERICAN COLOURED STONE GEM DEPOSITS CASE STUDIES

Montana Sapphires

Sapphires were discovered near Helena, Montana in 1865. The American Gem Corp. began to develop a modern mine on site in 1992. The company raised $20 million in its first sale of shares, followed by another $10.5 million in 1995, and a further $1.3 million in 1997. However, the company has shown losses of $1 million for each of its first four years with spending on the property alone rising to $12 million in the start up phase. Losses increased from $3 million in 1995 to $5 million in 1996 and to $8 million in 1997. Initial sales before 1996 were at $5,681. The company then mined about 4 million carats in 1996 and sold $131,000 in the first year and then $1.4 million in the next.[48]

Recent figures showed Extra Fine qualities at $140 per carat, Fine at $100 per carat, Good at $75 per carat and Commercial at $60 per carat.[49] Gem deposits usually produce the majority of output in Commercial to Good qualities. It is safe to assume that the majority of stones result in small, 3-millimetre to 4-millimetre rounds, based on The Guide's reporting of Montana sapphire prices. If the first production of 4 million carats could maintain these prices, at the lowest of $60 per carat the company should have more than $240 million in inventory. The gem market is not as dynamic as the stock exchanges, and it seems that the executives of AGC underestimated this factor. Limited marketing that was designed by personnel with mining expertise was probably a contributor to the results.

Retail jewellers initially expressed great optimism regarding Montana sapphires and looked forward to the marketing potential of "home grown" product. Once the gems appeared on the market, however, retail jewellers immediately complained of highly overpriced stones compared to sapphires from other countries. The company had hoped to benefit from its branding as North American gems but retailers felt the high prices were an attempt to recover initial capital investments.

Among all the North American coloured gemstone deposits, Montana sapphires were the first to exceed sales of $1 million. In Rio Verde's estimation, however, the project suffered from the prevalent tendency to overvalue a gem deposit and to subsequently justify large mining and processing expenditures. Miscalculating marketing requirements

[48] JCK Magazine, January 1998.
[49] JCK Magazine, August 2002.

is an added overall concern. Regarding a stock exchange listing application, an SEC spokesperson said, "At present, there is no assurance that any of the company's properties contain a commercially viable sapphire bearing deposit."[50]

Most Montana sapphires require heat treatment, as do their foreign counterparts. However, one small deposit, called Yogo Gulch, reportedly produces some sapphires which require no heat treatment at all. The Roncor company, working this deposit, does benefit from the higher quality gems but this gain is slightly offset by the inability to work in the winter conditions.

North Carolina Emeralds

The Hiddenite, North Carolina emerald deposit is regarded by most in the emerald community as a 'boutique' type of mine. Very small, sporadic discoveries of pockets of emeralds may appear not to be commercially viable, but the possibility of high returns per carat based on the inherent marketing potential makes it a useful example.

James Hill has successfully exploited one of the most important needs in gemstone marketing, the story behind the find. A gem hunter, Hill ended up discovering North Carolina's best emerald deposit in 1995 on his family's farm.

Although few emeralds have been produced, Hill has taken advantage of the marketing potential of domestic pride by branding his two most important stones with a local flare. The discovery of the large 858 carat rough emerald, initially named the Jolly Green Giant, was branded the "Empress Caroline". A total of 70 carats of facetable material was cut into a pear-shaped 18.8 carat "Carolina Queen", and an oval-shaped 7.8 carat "Carolina Prince".[51] Depending on which level of uncut original carat weight is used to start with, the yield could be calculated at either 38 per cent from the 70-carat stone, or 3 per cent based on the original Empress Caroline stone.

Due to the efforts in marketing the finds, at an auction in 1999, a local investor paid $500,000 for the 7.8 carat stone. This results in a final sale value of $64,100 per carat. Although material of this quality would probably not have fetched such a high price in the general jewellery market, Hill will probably continue to benefit from low overhead and a branding campaign which is likely to secure higher sales revenue from local collectors.

Over 3,000 carats have been found and a further 30 potential areas were discovered by ground penetrating radar. A company performing exploration adjacent to the Hill property has found many similar pockets but none has yielded any emeralds. Hill has been delayed in further mining activities by the North Carolina state government while he meets the local requirements for environmental and security issues.

[50] JCK , January 1998.
[51] National Jeweler Magazine, January 16, 2000.

In an attempt to increase brand awareness of his stones over competing emeralds, Hill stated: "Just imagine. Here we have all-American gems that are free of conflict, free of association with drugs or terrorists, and gems I'll make sure are free of treatment."[52] Just two months later, however, Hill began to rethink his stance on treatments. Hiddenite emeralds have substantial colour that rivals Brazilian and some Colombian emeralds, but the clarity or inclusions are similar enough to have drawn the new emerald miner to the matter of enhancements and treatments. Hill noted, "Clear oiling might improve the appearance of a few of the stones. These are bright, beautiful gems of great colour to begin with so not much would be needed."[53]

On a competitive level with other gem deposits in both North America and the world, the Hiddenite deposits cannot match the supply levels that would be required. The advantage that Hill has, of local patriotic collectors, however, may turn any future finds into high revenue emeralds, such that the owner may not need more than sporadic output in order to earn more than other emerald miners around the world.

CRIME AND SECURITY

Although North American gem deposits do not suffer from political and other security issues at the mine site, both North American and developing country gem deposits are likely to suffer almost equally from in-house and third party theft and crime.

In-House Theft

All gem processing facilities place very high value material in the hands of employees who, potentially, may mistrust management, may see themselves as underpaid and who may think, "they're not going to miss this little one." Fundamentally, there is no competitive advantage to location in North America with regard to employee theft.

Although employees in large diamond mines may not even see the gems they extract, emerald mining is smaller scale and is based on narrow veins so there is potential for theft by employees at the point of discovery of an emerald-bearing pocket. Theft which occurs after emeralds are extracted and logged is usually hidden within ledger statistics as cutting losses in yield or broken stones.

The common methods of protection or intervention are the use of cameras, monitoring by supervisors and even the watchful eyes of other employees. Threats of severe and/or illegal punishments, while possibly effective, create other obvious problems for the operator.

Third Party Theft

While gem producers or buyers benefit from low shipping and warehousing fees due to weight of transported product, they incur relatively high associated security costs. The

[52] Professional Jeweler Magazine, April 2002.
[53] Professional Jeweler Magazine, June 2002.

Jewelers Security Alliance (JSA) reported that in 2000, losses of $122.7 million were incurred in crimes against the jewellery industry. This was an increase of 21 per cent over the previous year. There were 13 homicides in 2001 within this category.

Crimes of this nature have greater effect on jewellery retailers than on wholesalers or jewellery and gem suppliers, and tends to involve individuals or small local gangs who hold up jewellery stores for their show case and open safe inventory. Organized crime, however, targets vulnerable points along the wholesale distribution chain. In general, emerald parcels would be less vulnerable to third party theft at a mine site in the Yukon, or at a cutting facility, but exposure will be higher during sales visits to jewellers in high-crime incidence locations such as Carmel in California, Miami or Los Angeles.

South American theft groups are highly-skilled criminals trained in distraction techniques. They primarily prey on jewellery sales people or manufacturer representatives who deliver or show large values of jewellery at one time during sales visits around the country. The Los Angeles police department and the FBI have recently set up task forces to identify and target members of the South American theft groups.

Postal Loss and Retailer Theft

As suppliers and wholesalers often need to deliver a single stone or a small selection to a prospective client for inspection or approval, this is usually done by mail or specialized shipping on a temporary 14-day consignment contract called a Memo.

If the client does not need the stone overnight, shipping can be accomplished by registered and insured mail for around $12-20. There are no markings on the parcel to indicate gems or jewellery inside. Customs declarations are required for international so this is far more vulnerable to theft in transit. Other methods of insured shipping, including commercial courier reduce this problem.

Once at the retailer, there is the potential for the owner or, more likely an employee, to switch the gemstone on memo for a similar one of lower quality, or even for a synthetic copy. This is not as common as postal theft, although the losses can be considerable. A precaution is to measure the full weight and dimensions of the outgoing stones so that on return, they can be examined for any anomaly.

Although an emerald producer in the Yukon will not face the specific issues of political and economic instability associated with countries less developed than Canada, once the emeralds leave the mine and processing site, the producer will have no particular advantage in dealing with third party organized crime.

SALE OF CUT VERSUS UNCUT STONES

World emerald production is expected to remain at current levels, or even to decline if there is no new exploration or implementation of advanced mining techniques. A new producer in the Yukon would, therefore, be in a favourable position.

For a new producer, if output is low, the operator is likely to supply the rough stones to buyers on the world market. If the supply of emeralds is sufficient to warrant the establishment of an in-house cutting facility, this would benefit both the local economy and the company's margins. However, it will be important to ensure that the cost of a gemstone increases based on the quality of cutting and not on labour costs, since the market is dominated by low labour cost yet high quality emeralds.

FOREIGN CURRENCY ISSUES

The weakness of the United States dollar has affected prices for emeralds. Many precious gemstone dealers have had to increase their prices for United States clients, being unable to wait longer for the dollar to recover to previous levels. This was notable at the February, 2004, Tucson show where local United States retailers suffered "sticker shock" seeing higher prices on most gemstones due to only to an adjustment for currency.[54]

Over the longer term, however, producers in less developed countries, are likely to benefit from a strengthening dollar. This may be less marked for a new producer of rough stones in Canada. With respect to cut stones, as noted above, the competitive position of a potential new producer in Canada will depend to a large extent on the quality of cutting to offset higher labour costs compared with cutting carried out in less developed countries.

QUALITY AND TREATMENT

Since personal examination of emeralds from deposits in the Yukon was not part of the scope for this report, Rio Verde is not in a position to comment on the quality of the stones and the potential level of acceptance and position in the global emerald market. As described above, such an assessment would be based on fine balances between colour, tone, zoning and clarity.

Based on geological reports, emeralds from deposits in the Yukon[55] show inclusions that may be due to freeze-thaw effects. Even if it is possible for a potential producer to reduce further inclusion or fracture damage by using precise mining and extraction techniques, emeralds from the Yukon appear likely to face the same issues relating to treatment and enhancement as suppliers in the rest of the world.

A producer in the Yukon will have to consider carefully whether to enhance production, to what level, and with what product.

[54] InStore Magazine, post-Tucson report, 2004.
[55] Joe Montgomery, Montgomery Consultants.

BRANDING AND MARKETING

De Beers has demonstrated that marketing effort results in significant returns that may outweigh all other aspects of gem production. On a modest scale, this has been shown, also, by James Hill in North Carolina. A potential Canadian emerald producer will have the opportunity to assess approaches that have already been tested.

It appears that the branding of northern Canadian-themed diamonds has reached a plateau and, possibly, is becoming overdone. "Under present market conditions, an additional De Beers Canadian brand would negatively impact the current branding initiatives. There is a feeling that what's happening in Canadian branding is not healthy," said the President of De Beers in Canada.[56] Perceptions of overpricing based on branding may inhibit the scope of branding in the future. For example, although Tiffany & Co. may now be considered among suppliers of mined diamonds, a spokesperson has noted that some retailers are refusing to buy Canadian diamonds as they claim that the suppliers are increasing prices by as much as 20 per cent due to the Canadian origin.[57]

The perception of higher prices for Canadian diamonds is also based on local tax issues, although this only affects Canadian consumers who comprise a much smaller market than the United States. The Canadian Jewellers Association and a report from the Toronto Globe and Mail recently stated that up to 75 per cent of the retail diamond business is going underground or through parallel wholesale networks in order avoid additional costs incurred for Canadian excise tax. "We don't think it is remotely appropriate that a Canadian consumer can buy a Canadian diamond more cheaply in Seattle than they can buy it in Vancouver," said Catherine Sproule, the executive director of the CJA.[58]

The main benefits of branding are to associate the branded gems with a positive theme, such as a Canadian origin, and which has been positive in a range of sectors (from Disney to the RCMP, for example), and to disassociate them from conflict gems of any sort.

In this regard, the issue of conflict diamonds in itself has great relevancy to emeralds from the Yukon. "Diamonds, A Girl's Best Friend?" was a typical caption on the media photograph of a little African girl with missing limbs due to land mines financed by diamonds.[59] The anti-diamond campaign by Oxfam and Amnesty International tainted all non-North American gemstones, not only diamonds, with the possibility of being conflict gemstones also.

Another case concerns tanzanite from Tanzania. Although the main thrust of the State and Treasury Departments and FBI in the United States was to investigate a direct connection between parcels of tanzanite and al-Qaeda, rumours began to surround other gemstones from developing countries. For a short time, there were mentions in the trade

[56] Richard Molyneux, De Beers Canada, Canadian Jeweller May 2003.
[57] JCK Magazine April 18, 2003.
[58] "Canadians Buy Diamonds Cheaper in the US" National Jeweler, February, 19 2004. (75% figure estimated by Antwerp Facets News Service, a Montreal consulting firm).
[59] See also powerful internet campaign at http://www.amnestyusa.org/diamonds/d4.html

media that Colombian emeralds, for example, were helping finance "violent drug trafficking paramilitary groups".[60] Although most of these rumours arose immediately after September, 2001, there has been a tendency to simplify the issues and to assume that all non-North American gemstones are possibly tainted in some way.

A new Canadian gem producer should utilize the advantage of a North American location, but should be aware of the potential for environmental or First Nations issues to become targets of negative media attention. Negative publicity for any sector of the jewellery industry, however, could cause consumers to direct their purchases to other luxury goods.

Unless the quality of emeralds from the Yukon is notably superior, branding will provide an important advantage over its competitors, worldwide.

SUMMARY AND CONSIDERATIONS FOR YUKON EMERALD PRODUCER

The public perception of the Yukon and Canadian origin of the emerald could afford the stones a premium of 5 to15 per cent over stones of similar quality from other countries. While a well-produced marketing and branding campaign will not allow the market to bear a further premium, it will generate higher sales volume and faster turnover in the jewellery marketplace.

Key competitive considerations for the mining and cutting operations of a potential emerald producer in the Yukon are the following:

- Not burden each stone with an overpriced value in order to quickly recover mining costs. The impression of overpriced stones in the marketplace is very difficult to overcome later.

- Not burden each stone with extremely high cutting costs. Exceptional cut and northern Canadian origin will not be sufficient to overcome the competition posed by fine cut German stones.

- Cutting should focus on immediate market demand for particular shapes since the loss of some yield is outweighed by quicker turnover of inventory.

- The focus of a well-executed marketing campaign should be based on a northern Canadian theme.

[60] "Tread Carefully; The gem industry grapples with crisis, controversy and confidence", Victoria Gomelsky, National Jeweler Magazine, April 1, 2002.

APPENDIX 1
RECOGNIZED GEM LABORATORIES

- Gubelin Gem Lab in Lucerne Switzerland
- SSEF: Swiss Gemmological Laboratory, Basel.
- Gemmological Association and Gem Testing Laboratory of Great Britain in London England.
- European Gemological Laboratory (Europe, USA and Canada are different companies now)
- Gemological Institute of America in Carlsbad California
- American Gem Trade Association Gemological Testing Center in New York

All laboratories will provide detailed gemological information on a particular stone. Some will further establish enhancements levels and fewer will attempt to establish types of enhancements present. Laboratories do not establish values on rough stones, and most do not establish any value on a loose stone.