CONE
MINE EXPLORATION

1 - INTRODUCTION

1.1 – OBJECTIVE

The follow present report has an objective to describe the accomplished works in offices and fields for the geologic and economic description of the area referring to the Ribeirão São José Project of the Cone Mine Exploration. This work has a main goal elaborate an evaluation of the emeralds and alexandrite reserves in the area of the process, quantifying and qualifying them with accuracy.

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1.2 – MINERAL LEGISLATION IN BRAZIL

The laws that conduct the mining activities in Brazil established that the subsoil belongs to the federal government. That way, activities of prospection, exploration and exploitation just are possible with the government authorization through of its department DNPM (National Department of Mineral Production).

Each process of mineral exploration is evaluated by the DNPM based in technique criteria and the authorizations are granted in two stages: Exploration License and The Mine Work Concession.

The authorization holder of DNPM has full and exclusive rights about the work execution, as well about the commercialization of the area.

1.3 – MINING IN BRAZIL

Brazil stands out worldwide as one of the main producers of the minerals goods.

The mining industry in Brazil has a highest technology level and technique, being forward of a several obtained innovations in this area in the last decades.

In all regions of the country exists an extensive web of education for the formation of professional that attempt to the mining's demand. The high workforce qualification, together to good infra-structure and low productive cost becomes the mining in Brazil object of a great interest by the part of the foreign and national investors.

Data of the IBRAM (Brazilian Institute of Mining) presented that in 2008 the Brazilian mineral sector employed 161 thousand people in the mine work activity and the value of the commercialized national production was US$ 29 billion.

Adding the commercialized rude ore production to the production of the sector of mineral transformation, the mining of Brazil generated in 2008 US$ 42 billion, what represents 5.7% of the GIP. The positive scene reflects in the investments of the sector that are foreseen in US$ 47 billion between 2009 and 2013.

1.4 – THE STATE OF MINAS GERAIS

Minas Gerais is located in the Brazilian southeast region, the most developed region of the Country. In this region are concentrated 43% of the Brazil's population, about 60% of the national Gross Domestic Product and the most significant parcel of the Brazilian Consuming Market. On this context, Minas Gerais represents the third economic power of the Country with a Gross Domestic Product (GDP) by an order of US$ 104 billion, in 2005, being 8,5% generated by the agri-stockbreeding, 48,6% by the service sector, which grew significantly in recent years, and 42,8% by the industrial sector.

1.4.1 Geographic Aspects

The state of Minas Gerais is located in the Brazilian southeast region. As the mediterranean area, Minas Gerais make boundary with states of São Paulo,

Rio de Janeiro, Espírito Santo, Bahia, Goiás, Mato Grosso do Sul and Distrito Federal, comprising 588.384 km^2.

The prevailing climate is the tropical of altitude, with rainy and dry stations well defined. The annual average temperatures vary around 18°C and 25°C. The annual average pluviometric precipitations vary between 800 mm in the extreme north and 1,700 mm in southeast of the state.

With 18 million of inhabitants, the population of Minas Gerais is the second bigger of the Country and distributes around 853 counties. The capital of the state is Belo Horizonte, with 2,5 million of inhabitants.

The State is geopolitically shared in region of planning, with features well defined: Zona da Mata, Sul de Minas, Triângulo Mineiro, Noroeste, Centro-Oeste, Jequitinhonha/Mucuri, Rio Doce, Alto Paranaíba e Região Central.

The city of Itabira and the area of the Ribeirão São José Project are located in the Central Region. With a Mountainous relief and privileged climate, this region is one of the richest of the country in the mineral resource, having importants explored reserves of iron, gold, gem, ornamental rocks, manganese and limestone, and others. Inside it is inserted the Metropolitan Region of Belo Horizonte which besides the own capital, includes more 33 counties, with a population of 5,4 million inhabitants.

1.4.2 Infrastructure Aspects

The state of Minas Gerais is united by efficient road-railway system to the main three Brazilian ports: Rio de Janeiro, Vitória and Santos. The transports' infrastructure of the state detached by the extensive road network (264.898 km by road, which 19.266 km paved), and for retain 20% of the national railway system. Therefore, Minas Gerais is the main highway and railway intersection of the Country, as the logistic allows a quickly access to the national and international, since there are 5 customs stations in the interior and in the Tancredo Neves International Airport, besides others regional airports with paved tracks.

The main airlines companies of the country have regular flights to the biggest counties from the state of Minas Gerais. Belo Horizonte has two modern airports, being the Pampulha airport, located inside the limits of the city, have focus on the private flight, the "commuter-airlines" and the "flights-to-flights", while the Tancredo Neves International Airport, located in Confins, in the Metropolitan Region, operates with domestic flights of large range and international flights.

CEMIG-S/A is the main electric power company of the State, which supply electricity for 97% in the state. The power plants under the total or partial control by the CEMIG have installed generation capacity by 5.500 MW and reached around 7.500 MW in 2005. There are four others electric power companies acts in the rest of the state of Minas Gerais.

COPASA is a company responsible for supply treated water to 598 allocations, and serving about 10 million people. In 61 allocations, the company have the concession to manage the collection services and the final destination

of sewerage, service giving to 4,5 million clients. The counties that do not have the COPASA service have autonomous service of water and sewerage, as it is the situation of Itabira.

1.5 – ALLOCATION

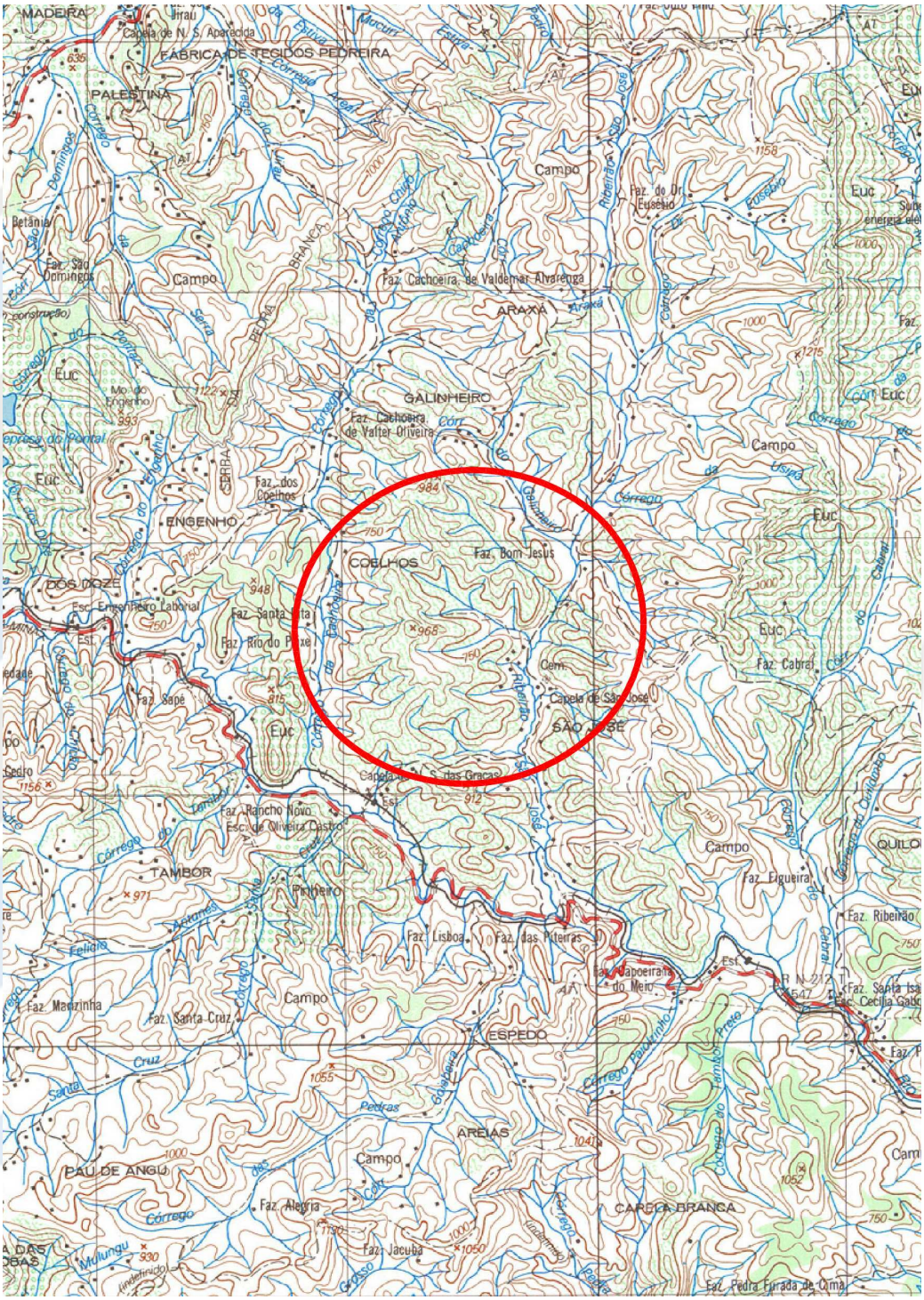

Image 1 - Allocation (Base – IBGE)

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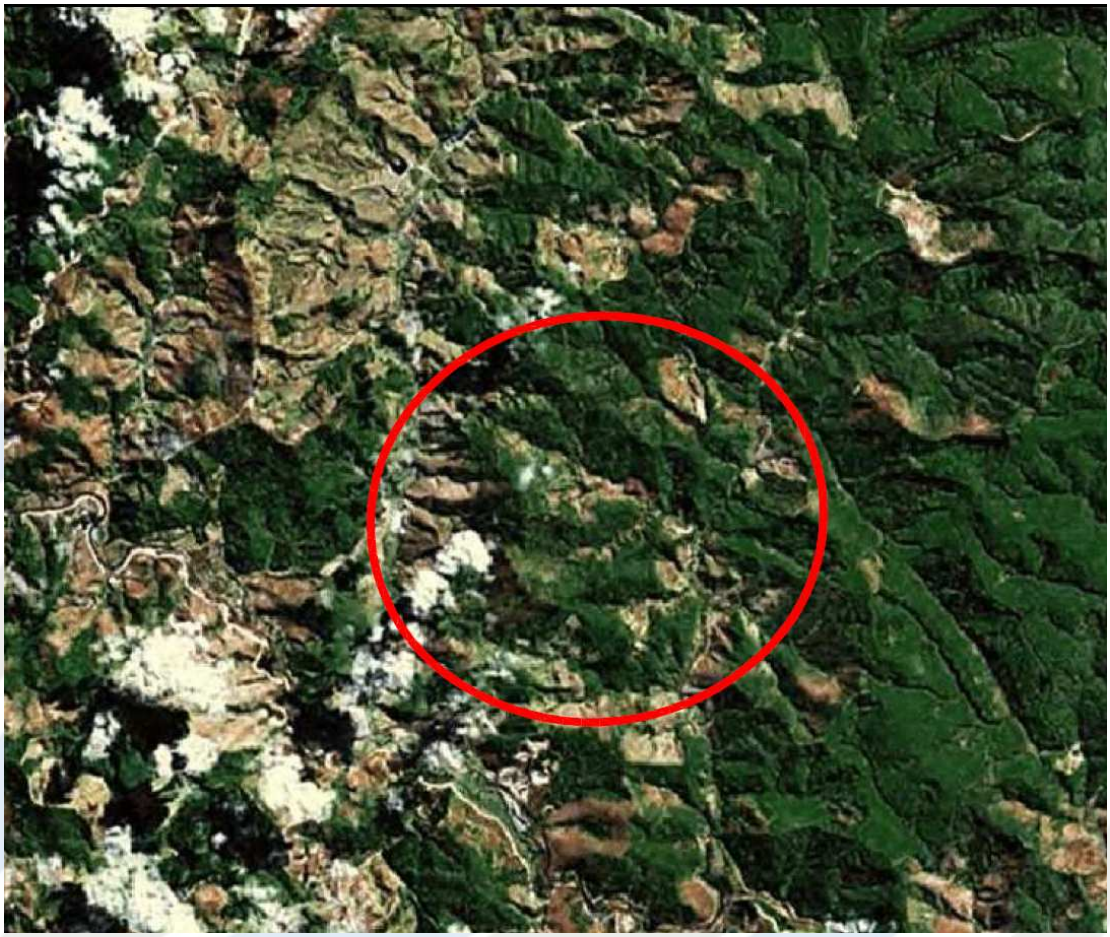

Image 2 - Allocation

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1.6 – THE COUNTY OF ITABIRA

1.6.1 Characterization

Allocation: CENTRAL

Area: 1254,49 Km2

Altitude:

maximum: 1672 m
place: Alto da Mutuca
minimum: 783 m
place: Foz do Corrego do Simao
Central point of the city: 779,91 m

Temperature:

Average annual:	20,1 C
Maximum average annual:	26,5 C
Minimum average annual:	15,9 C

Average Annual Rainfall: 1372 mm

Relief:

Topography	%
Flat:	10
Wavy:	20
Mountainous:	70

Main Rivers:

RIO
RIO SANTA BARBARA

Bay: RIO DOCE BAY

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Sources: Institute of Applied Geosciences - IGA
Brazilian Institute of Geography and Statistics - IBGE

Boundaries Counties:

SANTA MARIA DE ITABIRA
ITAMBE DO MATO DENTRO
NOVA UNIAO
BOM JESUS DO AMPARO
BELA VISTA DE MINAS
JOAO MONLEVADE
SAO GONCALO DO RIO ABAIXO
NOVA ERA
JACUTINGA

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1.6.2 Population

Resident Population

1970, 1980, 1991, 2000, 2005

YEARS	URBAN	RURAL	TOTAL
1970	41.199	15.153	56.352
1980	58.685	12.430	71.115
1991	72.954	12.652	85.606
2000	89.357	8.606	97.963
2005(1)			106.289

Source: Brazilian Institute of Geography and Statistics (IBGE)

1.6.3 Historical Registers

In the year of 1720 became the official constitution date of the Itabira Village. Its existence it was, however, already known since 1705, when it was found the alluvium gold and was built the first chapel. The gold was not too much and than the village does not developed in this initial phase. The iron ore, due the existent prohibition by the Portuguese Crown, had its restricted exploitation to produce cookware.

Only in the end of century XVIII, the gold associated with the iron ore of the peaks of Conceição, Itabira and Santana, came to be explored by small mining company. At the beginning of century XIX, Itabira was prospering, making possible the socio-cultural advance of their aristocratic class. From the year of 1808, with the Portuguese Real family arrival to Brazil, and with the consequent release of the iron exploration, emerge than several foundries in Itabira that had started to supply instruments for mining, for agriculture, for domestic use and for small arms.

If for one hand the gold production starts to decline in the middle of this same century, and the incipient siderurgy is affected with the slavery's abolition, the city starts the development of an economy focused to the internal consumption and of a regional supplying. In this period of "internal economy" the city takes advantage on their potentialities: extracts the ore and forge the instruments to their agriculture; weaves the cotton and manufacture fabrics; manufacture harness with leather of their animals.

Two importants accomplishments show the reached advances in the city: The creation of the Agronomic Institute (1881), for the improvement of agri-stockbreeding production in the region, and the inauguration of the telegraphic station (1884).

In the first half of century XX, the city will be target of the international and national conjuncture's influence. Detached the International Geologic Congress of Stockholm, which in 1908; make an announcement the ferriferous potential of Minas Gerais and attracted the interested of several foreign investors. In 1910, the English constituted the Itabira Iron Ore Company Limited, with an intention to guarantee the existent reserves of iron ore and the control of the railway that would be built connecting Minas Gerais to Espírito Santo states.

When the First World War finished, the control of the Itabira Iron was transferred to a group of Europeans and North-Americans investors that do not start to explore the ore for a contractual question with the Brazilian Government. Just in 1942, from the designated "Agreement of Washington", was possible the creation of the Companhia Vale do Rio Doce that triggered the exploration of ore consistently.

The city's profile will change drastically with the implantation of the Companhia Vale do Rio Doce - CVRD. Again the city will deflect your economic axis to the international market economy, reorganizing to accept new inhabitants that arrive seeking for a work opportunity. Public and private educational institutions will be created, up to the higher education.

1.6.4 – Recent History

The 80's was marked by the debate about the necessity to search economic alternatives for the county, as the CVRD starts to act in a stable way in others region of the country. So the relation between the city and CVRD was modified, searching solutions through partnerships. In accord hold between the City Hall, CVRD and the Industrial Districts Companies CDI-MG, occurred the first Industrial District of Itabira.

Some adopted methods from the 90's, period of intensification of the globalized economy and the privatization of CVRD, consolidated the search for alternatives, detached the creation of an Agency of Economic Development Itabira – ADI and the Fund of Economic and Social Development Itabira - FUNDESI, with the input of resources of CVRD and City Hall of Itabira.

Along this, the city finds other vocations for their development, besides those purely industrial. So, they created the Community Foundation of Higher Education of Itabira – FUNCESI, which today has courses in the area of Literature, Mathematics, Geography, History, Business Administration, Accounting, Life Science, Information Systems, Tourism and the Rule of Law.

The tourism is already emerging, since the city as the birthplace of an important poet called Carlos Drummond de Andrade, become an important center of studies of his work. Due that was built the Memorial Carlos Drummond de Andrade, project by architect Oscar Niemeyer. Also was built the Museum of Territory "Drummondianos Path" where the poems are recorded in the places which he refers in his work.

In another way seeks to increase the eco-tourism, as in Itabira have natural attractives as waterfalls, forests, rapids in their districts Senhora do Carmo and Ipoema, allowing all kinds of tourism ecological exercise as trekking, canoeing, hiking, camping, etc... .

1.6.5 – Urban Infrastructure

Several accomplishments have contributed to make Itabira one of the cities that offer to its residents and visitors a wide option of social facilities for an example the Cultural Center, with its modern theater to 423 seats and a large park of Agri-stockbreeding Exhibitions with capacity and infrastructure to accommodate more of 50,000 among exhibitors, producers and the general community.

In the health aspects, the city has two hospitals (Nossa Senhora das Dores and Carlos Chagas) and a well equipped E.R. , which is reference to the cities around the region, besides a network of clinics for the population's ambulatory care.

In the total municipal income, of the state of Minas Gerais, Itabira is in 9th place. In relation to the collection tax, is placed in 19th in the statewide.

The electric power that is consumed in the county is supplied by the Power Company of Minas Gerais – CEMIG, which there is a substation with power of 31 kV. The CVRD keeps another substation with Power of 230KV. The water supply is under responsibility of SAAE- Autonomous Service of Water and Sewer, municipal autarchy that operates with 3 systems in a total of 375 l/s of

treated water. In the urban area of the county 95% of the public ways are paved and illuminated.

2 - LOGISTIC AND ACCESSIBILITY

2.1 – HOW TO ARRIVE

Leaving from Belo Horizonte, through BR-381 around 58 km up to the interchange with the road MG-434 and keep going eastbound in the BR-120 going through the south interchange of Itabira in a trajectory around of 26km on this road. From the bridge in front of the Fazenda das Piteiras, follow northbound by the left edge of the Ribeirão São José around 4 km up to the area.

2.2–MAIN HIGHWAYS OF ACCESS

The main access routes to the area of the process are made through the BR – 120, MG – 129 and MG-434 besides the vicinal roads in the rural area of Itabira-MG.

2.3 – AIRPORTS

The main airport next to the area of the process is the Tancredo Neves International Airport, located in the Confins County – MG, metropolitan region of Belo Horizonte, in a trajectory of approximately 150 km up to the area. Another important airport present in Belo Horizonte is the Pampulha Airport, which was considered an international airport before the transference of its activities to the Tancredo Neves International Airport. Nowadays Pampulha

operates just the regional flights. This airport is located about 120 km of distance to the area of the process, being its access by the Tancredo Neves International Airport route, through BR-040.

Image 3 - Partial View of the Tancredo Neves International Airport

3 – GEMOLOGICAL POTENTIAL OF THE ITABIRA REGION

3.1 – THE EMERALDS

The beryl is a very commom mineral, of an origin generally pegmatitic, associated to the granitics rocks. The metal beryllium, of a low ionic radius, it is concentrated in a residual fluid and make several minerals (beryl, phenakite, beryllonite, etc…) that associates spatial and genetically to pegmatites. Because of the color, the beryl is used as gemstone, such as the emralds (green), marine-water (blue), goshenite (colorless), heliodor (yellow), morganite (pink) and bixbite (red). With no doubt, distinct differences can be established between the distinct varieties, above all about the emeralds.

The emeralds is a variety of beryl that its color is because of the Cr^{3+} , although the vanadium and ferric iron also can influence considerably. The chromium, differently of beryllium, normally is associated to the ultrabasics basic rocks, because of it the coexistence of chromium and beryllium is really unusual, and sufficiently rare the occurrence of the emeralds.

The emeralds is crystallized on the hexagonal system and its chemical formula is $Be_3 (Al,Cr)_2Si_6O_{18.}$ Its color is incomparable ("green emeralds"), being resistant to the light and to the heat, and not is modified up to temperature of 700 – 800 °C. Frequently the emeralds appears in a cloudy color by inclusions (fluid, air bubbles, healed fissure, others crystals), that is not considered as defects, but a proof of the rock authenticity in relation to the synthetic or the fake ones. Theses inclusions, denominated "garden", can indicate the origin of the emeralds, as its may vary between different mineralized zones.

The Stone of a deep green, with inclusions, is worthy that one with a pale color and almost pure to magnifying glass. The color distribution is often irregular, in stain or bands. The emeralds brightness is generally vitreous. Resist to the contact with chemical substances, with exception to the Hydrofluoric acid.

3.2 –OCCURRENCES OF EMERALDS IN THE WORLD

The worldwide mineralized zones of emeralds are Muzo, Chivo, Gachal, Cozcuez and Peñas Blancas, located in Colombia. They have hydrothermal origin and can be found in Black argillite, bituminous, interpolated with limestone.

Other mineralized zones of emeralds localized in the Urals Mountains (Russia), Zimbabwe, Zambia, Madagascar, Tanzania, Mozambique and Brazil (Bahia and Minas Gerais) are associated to metamorphics rocks rich in mica, formed by the occurred reaction between granites and ultrabasics rocks. They can also be formed in metamorphosed ultrabasic rocks, but with a beryllium source that seems to be remote and related with pegmatites and granitic apophyses, as in Austria, Pakistan and Santa Terezinha de Goiás (Brazil).

The main mineralized zones of the world by the quality of the found gemstone are Muzo and Chivor already cited, in the North region of Bogotá – Colombia. For the production detached several mineralized zones of Brazil (Bahia, Santa Terezinha de Goiás, Itabira, etc). In the region of Transvaal (South-African Republic) are mineralized zone with emeralds of poor quality, with plentiful inclusions. Also there are important mineralized zone next to Sverdlowsk and in Urals Mountain (Rússia), in Qazaqstan, Pakistan, India, Tanzania, Mozambique, Zimbabwe, Zambia, Egypt and Austria, although in the last countries just have value as historical testimony and for collectors.

3.3 – THE EMERALDS IN BRASIL

The occurrences of emeralds in Brasil were found, casually, in decades of 1960. The first was in 1963, in Salininha – Bahia, today the area are inundated by the Sobradinho Dam. From there was succeeded a series of great findings, as we can cited the Carnaíba (Bahia), 1964; Itabira (Minas Gerais), 1978; Santa Terezinha de Goias – today is called Campos Verdes (Goias), 1981; Socotó (Bahia), 1983; Nova Era (Minas Gerais), 1988; and, Monte Santo (Tocantins), 1997.

Between 1995 and 1999, new findings occurred in Minas Gerais, among them the Garimpo do Toco and Garimpo da Mina de Canta Galo, in the county of Nova Era / São Domingos do Prata. The last great findings of emeralds, in the State of Minas Gerais (Coal Bed of the Fazenda das Piteiras), occurred in 2000, by the Canadian Company Seahawk Minerals Ltd.

As for the geological aspects, except in the Garimpos de Campos Verdes e Monte Santo, where are not observed pegmatites, all the others coal bed are characterized by the presence of a sequence by volcanicsedimentary rocks in contact with rock of granitic composition. This sequence is formed by metapelitic, schist of metaultramafic, several amphibolites, pegmatoid vein and quartz veins. The emeralds occur mainly associated to schists deriving from the metaultramafic, represented by biotite/phlogopite schist or biotitites. The most big coal bed presents, therefore, the required basic conditions for classic environment of emeralds' formation, where there are pegmatites cutting metaultramafic rocks.

3.4 – THE EMERALDS OF MINAS GERAIS

In the state of Minas Gerais, several mineralizations of emeralds are found in a same region, that compound the Esmeraldífera Province of Minas Gerais. In the scope of this Province, that extends from the North of Rio Casca, going through Itabira and Nova Era, up to the southern of Guanhães, can found the coal bed of São Domingos do Prata (Garimpo do Toco), Nova Era (Garimpo da Capoeirana and Mina das Piteiras), Itabira (Mina Belmont), Breajúba (Santa Maria

de Itabira), Esmeraldas de Ferros e Cubas, all geologically situated in the southeastern edge of the São Francisco Craton.

The Itabira region is recognized as one of the most big emeralds producers in the world. The geologic exploration had started at the beginning of the decade of 1970, when was discovered the occurrence of emeralds in the Belmont Farm, located between the counties of Itabira and Nova Era. From 1990, prospector had found emeralds in Capoeirana Farm, situated a few km southeastern of the area emphasized on this document, confirming the regional potentiality. Since then, several studies are being developed by the Federal University of Minas Gerais – UFMG and by the Federal University of Ouro Preto – UFOP, and by Brazilian and foreign mining companies.

The coal bed of the Belmont, Piteiras and Capoeirana are situated in the same road way (Itabira – Nova Era Road, MG-120), faraway respectively 18 km, 22,5 km and 27,5 km, from the city of Itabira.

The Belmont Mine was found casually in 1978, is exploitated by the company Belmont Gemas Ltda., through an open cast-mine and underground exploitation, with mechanized system since the extraction up to the final processing.

The Garimpo da Capoeirana, also was found casually in 1988, is exploitated by the Cooperative of Prospectors of Central East Miner – COOGEMIG, through rudimentary technique, by means of pit, tunnels and galleries.

The Piteiras Mine was found through systematic methods of mineral exploration, including the geologic mapping, geochemical survey through boring by auger. The Geochemical survey directed rotary boring, which testimony testified the mineralization of emeralds. The mine started to work on January of 2001 and the first rude emeralds' sale occurred in 2002. The procedures of Mine work and the emeralds' separation are similar to the method used in the Belmont Mine.

These three coal beds can be found distributed in a same geologic context, characterized by archaean cratonic foundation compound basically by gnaissic-migmatitic terrain, with characteristic poligenetic and polimetamorphic, including the granitic rocks of a type Borrachudo Suite; Archaean Greenstone Belts belong to the Rio das Velhas Supergroup, paleoproterozoic metasediments of the Minas Supergroup; and metasediments sequences essentially quartizitic, of mesoproterozoic age, associated to the Espinhaço Supergroup.

To the granitic bodies as the Borrachudos Suite and others of crustal derivation, associated to the gathering of an intensive pegmatite activity, that provided the formation called Eastern Pegmatite Province of Brazil, as well the development of the Eastern Gemology Province of Brazil.

The pegmatites of the Eastern Pegmatite Province can be of the magmatic or anatetic type and occur in the extension of the Araçuaí Area and the Atlantic Belt, that compound tectonic belts carrying of infra and supracrustal rocks from Archaean to Neoproterozoic ages. The pegmatites of the magmatic type are crystallized from the granitic residues and have more complex mineralogy. The anatetic pegmatites, in a general way, presents a mineralogy more simple and

small dimensions in relations to the magmatic, corresponding to the felsic mobilized generated by partial fusion of the regional rocks. In the most ages of these bodies are included in the range between 580 and 460 million of years.

All the coal bed or emeralds' occurrence of Minas Gerais are associated to the schists of ultramafic, derivation, in local of intense percolation of drothermal fluids related to the pegmatites. These schists, presented essentially by biotite/phlogopite schist, chlorite schist and tremolite/actinolite schist, compound intercalation from decimeters to meters thickness associated to mica schist pelitic and amphibolites, generated intemperized in the superficial level of the terrain. The mineralized area always occurs next to the contact between the metaultramafic schists and granitic rock of the Borrachudo type which are sterile in the endocontact zone.

3.5 – THE ALEXANDRITE

The alexandrite is a rare mineral, occurring associated to the granitic rocks, in the pegmatites and mica schists, and ploughed with more frequency in secondary deposits (alluvium and gravel). Of a very high hardness (8½ at the Mohs scale), the alexandrite is a beryllium and aluminium oxide (Al_2BeO_4), of the Chrysoberyl Group. Of an emerald green color, the alexandrite acquire tonality red (alexandrite effect) when exposed to the artificial light.

The variety of cat's eye or cymophane, when polished, exhibit an opalescent shine and in the polished surface an illuminating, narrow and long band that change its position to each movement that is given to the gemstone. This effect, known as chatoyancy (acatassolamento) is obtained mainly with

stone cutting in cabochon, oval or circular. The chrysoberyl is the real cat's eye, not to be confused with minerals that have similar properties.

According to some researchers, the chrysoberyl occurs mainly in desilicificated pegmatites or rich in Al_2O_3. The aluminium replacement by the Cr^{3+} in the chrysoberyl structure, in small percentage, originates the alexandrite effect. By conditioning to granitic and pegmatitic bodies associated to ultramafics rocks, seems to identify a genetic relation between the alexandrite and the emeralds.

It was discovered in 1833 by a Swedish explorer Nils Nordenskiöld, in the Ural Mountain, their denomination was in honor of the Tsar Alexandre II, becoming the national symbol of Russia. Considered as a mystic stones, the alexandrite is an emerald in the day and a ruby at night. How thickness is the stones, easily is to observe the color change.

Nowadays an alexandrite stone well cutting and of an excellent quality have its carat evaluated in US$15,000.00.

3.6 – ALEXANDRITE OCCURRENCE WORLDWIDE

The known alexandrite coal bed located in Sri Lanka, Zimbabwe, besides Birmania, Brazil, Madagascar, Tasmania and U.S.A. The Ural Mountain's coal bed in Russia after more than hundred years of exploitation is almost wasted.

In Brazil and in Sri Lanka can found the most notable alluvial deposits of alexandrite. The Sri Lanka, between the decades of 1960 and 1980, emerged as an important commercial source of this gemstone, however including the cat's

eye variety and specimen with stronger red color under incandescent light, becoming more valued than the Russians.

3.7 – THE ALEXANDRITE IN BRASIL

The Brazilian alexandrite emerged in the market from the decade of 1970, originating from small prospecting situated in the states of the Bahia and Espirito Santo, being the production small and the stone of low quality.

In 1975 was discovery the first occurrence in the Minas Gerais State, in Córrego do Fogo, county of Malacacheta, that becoming the main world producer of alexandrite up to 1987. But, the discovery of alexandrite on Hematite, county of Antônio Dias, in the year of 1986, practically concentrated the whole Brazilian production. The coal bed of Antônio Dias, also in Minas Gerais and next to Itabira, is considered in the gemological world the largest discovery of alexandrite in history, placing Brazil as the bigger world-wide producer of this gem.

Nowadays, the Hematite deposit is exploited by two companies: the Alexandrita Mineração Comércio e Exportação Ltda, detainer of the bigger world-wide coal bed of alexandrite, with reserve measured approximately of 60 kg, and the Mineração Itaitinga, with inconstant production.

3.8 – THE ALEXANDRITE IN MINAS GERAIS

The deposit of Malacacheta was discovery accidentally. In 1979 were found the first pocket of alexandrite in an affluent of the Córrego do Fogo. Between 1979 and 1987, the Córrego do Fogo became the main world-wide deposits of alexandrite, having produced 2 kgs of gems by excellent quality and between 6

and 7 kg of gem by lower quality. One of the specimen found weighed 18 g that after the stonecutting resulted in two stones of 13 and 15,6 carats. In Ribeirão Soturno, a stone weighing 14,6 g, after the stonecutting, resulted in cabochon Stone of 18,5 carats, considered in one of the most rare and elegant alexandrite cat's eyes of the world.

In the deposits of Malacacheta, the alexandrite is found in paleo-alluvion, alluvion and talus deriving of the geomorfological processes that affect the region. The host rock of the primary mineralization of alexandrite have not been identified yet.

From the geologic point of view, the deposits of Malacacheta is associated to the granitic intrusion, of braziliana ages (537± 8 Ma), in peraluminous of the Salinas and Capelinha formations, also intruded by a body of ultramafics rocks. The alexandrite's formation age is correlated to the granitic body, since this one is source of beryllium.

In 1987, with the discovery of the Hematite's deposit, the mining of Córrego do Fogo was pratically abandoned. As occurred with the deposit of Malacacheta, the Hematite also was discovery accidentally. On the three first months of exploitation by the processing of mining, were found exceptional stones, consisting among them an allotment of five facet stones weighing 11 carats and sold by US$ 40 thousand. The prospecting was closed on June of 1988, and reopened in 1989 as Mining, nowadays being explored, as already related, by two companies.

The alexandrite of Hematite is ploughed from the recent alluvion deposits, situated in the Liberdade and Derrubada Streams. The gravel from the layer of these streams is removed, whashed and bolted for posterior selection. Beyond the alexandrite are recovered chrysoberyl, emeralds, marine-water, garnet, quartz and amethyst.

In Hematite were executed recently exploration works that had detected the presence of alexandrite in the mantle of alterations of the Proterozoic rocks. The alexandrite, in recovered crystals by hydroxide of iron and manganese, can found it associated to metaultramafics levels (phlogopite-biotite schist) tacking small pegmatitics veins. In the concession of the Alexandrita Mineração, the big part of the exploitation is already from this mantle of alteration.

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4 – DETERMINATION OF RESERVES

4.1 – ACCOMPLISHED EXPLORATION WORKS

The exploration works of emeralds and alexandrite in the Ribeirão São José Project had duration of one year, following basically the same methodology adopted by the Seahawk in the definition of the Piteira Farm deposits. These works consisted of:

Topographic Survey at scale 1:2.500, with equidistant level curves in 5m, executed with the utilization of geodesic GPS, device of Total Station and Altimeter control from the data of the Brazilian Institute of Geography and Statistics – IBGE.

Execution of 270 borings by manual Auger (manhole), that reached on average 1,5 m by depth, with a total bored of 400 m. The soundings were disposed in lines guided in direction N-S, intervals of 100m, with collection of samples to each 25 m.

Manual digging of 24 circular pits (0,70 m of diameter and 14,0 m of average depth), up to the static level of the ground level, located with the basis on the analyses' results of the Auger' samples. So were showed points of occurrence ultramafic schist.

Opening of a trench (6,00 m of length per 1,00 of width) by the side of the Pits 01, to improve the exposition of the ultramafic schists.

Cleanness, removal obstructions, propping and draining of 8 old galleries digged by prospector, totalizing 800m of extension, opened throughout a pegmatitic body with general direction N-S and 100 m width .

Execution of 2 rotary boring, with 84,0 m and 101,5 m of length, placed in function of the geologic controls of the carrying ultramafic schists from the emeralds' mineralization.

Collect of 20 m^3 by samples to execution of industrial assays, from the exploration works.

Execution of 254 chemical analyses for collected samples through of borings by manual auger (manhole). It was analyzed 31 elements through of the Multiacid Digestion Method /ICP (Ag, Al, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sc, Sn, Sr, Ti, V, W, Y, Zn and Zr); for the element F, was used the Electrode Method of Specific Ion in 275 samples.

Geologic Mapping at scale 1:2.500, with execution of profiles preferentially perpendicular to the general structure of the geological unities, besides the profile of the executed control parallel to these structural, with localization through of GPS GARMIN 12. It was accomplished sampling of the litologic types found in outcrops, objectifying its petrographic, mineralogical and chemical characterization.

Geophysic evaluation with used of the survey air-geophysic maps accomplished by CPRM, in 1990, for the Layers Itabira-Ferrous, including: gamma spectrometry – total counting, for delimitation of lithologic differences in surfaces); magnetometry – total derivative, for definition of bodies and shallow structures; and, analytic sign, for the detection of anomalous bodies in depth, projected in surface.

4.2 – SIGNIFICATIVE GEOLOGICAL ASPECTS

In the Itabira region occur granitic and pegmatitic intrusions in volcanic-sedimentary sequence compound by metapelitic schists, quartzite, and metaultramafics rocks. Locally were identified and mapped the unities of the Borrachudos Suite and associated pegmatites, besides the volcanic-sedimentary.

The Borrachudos granitoid is a rock compound by 45-55% of feldspar (K-feldspar of plagioclase), 40-45% of quartz and 10-15% of biotite, showing invariably deformed and, in some points, gneissified. The biotite indicate very well the rock's foliation, contouring the quartz and feldspar grains, also deformed and prolongated according to foliation's plain.

Pegmatoid Levels occur relatively in a homogeneous ways inside the granitoid body, not exceeding 30 cm of thickness, disposing at the same time to the foliation of the igneous. These levels are compound by feldspar and quartz (in crystal that reaches up to 10 cm), biotite and amphiboles, besides the magnetite.

The pegmatite body mineralization followed by the galleries, in the northwest bound of the area, includes quartz, white feldspar (plagioclase), green marine water, and white beryl. The body is inserted in layers if several thickness of ultramafic schists, with predominance of biotite and coloration of reddish purple. Samples of schists had evidenced the presence of emeralds' specimen by soft to moderate color, highly crystallized.

The waste fluid of crystallization or remobilized solution deriving from granitic and pegmatitics intrusion, rich in Be, Si and K are responsible by the process of metamorphic-metasomatic observed in the metaultramafics rocks, rich in Cr and V. When percolated by such fluid, these rocks are transformed into biotite or phlogopite, host of the emeralds' mineralization.

The geochemical mapping confirms the raised hypotheses by the geologic mapping, this means, the delimitation of the granitic bodies and the volcanic-sedimentary sequences. The shown standard by Ba, similar to the results of the geophysics' raise, indicate a granitic body in the NE bound of the area, also defining the perfect structuration N-S of the lithologic bodies. The Cr shows anomalous values in the west portion of the studied area. The big anomalous observed in the south portion of the area indicates a probable ultramafic sequence not identified by the geologic mapping and by the geophysics.

From the field work was verified a significative occurrence of kaolin, resultant of the decomposition of feldspar presents in the pegmatites bodies, beyond of quartz associated to the hydrothermal activity.

These occurrence were not considered for effect of economic analyses of the enterprise, but taking into consideration the almost 1.000m of galleries existents

along these pegmatitics bodies, it can estimate a reserve of 1,2 million tons of kaolin, with low grades of silica and elevated whiteness, that reach a price of US$25,00/tons FOB Mine.

Finally is detached that the area of the Ribeirão São José Project is defined in denominated Pegmatitic District of Santa Maria de Itabira, associated specifically to Pegmatitic Field Itabira-Ferrous. In this domain can found the referred previously pegmatite igneous of complex mineralogy, emerald' generators, marine-water, according to the several studies which are published.

4.3 – RESERVES AND GRADES

The exploration works accomplished in the area of Ribeirão São José Project detected new levels of mineralized schists to emeralds and others gemological minerals as alexandrite, chrysoberyl, marine-water, besides of granada, Kyanite, spinel, corundum.

For effect of the calculation of reserves, it was considered the volcanic-sedimentary rocks (which the schists levels are carried of the mineralized) detected by the rotary soundings up to 150m by depth. It is not abstained the possibility of the reserve increase in bigger depth.

The configured block of reserve is prismatic and have 500m of base, 300m of height and 250 m of width, resulting a volume of 37,5 million m³ of rocks by the volcanic-sedimentary sequences. With a good safety margin, from its dimensions and distribution's density in the terrain, it is esteem that the levels of mineralized schists represents about 5% of the considered block and therefore, a volume of ore at least 1,875 million m³ .

The grade of the explored area are compatible historically observed to others deposits explorated in the region, situating in 3,4 gram of emeralds per cubic meter of mineralized rocks. For effect of the calculation of reserves, this grade includes the expected content of alexandrite, chrysoberyl, spinel and corundum.

The gem's reserve is esteem in at least 6.375.000 gram, having mineralogical indicatives tests of the proportionality following: 50% of emeralds, 15% of alexandrite, 15% of chrysoberyl, 10% of corundum, 10% of spinel. To the commercialized minimum price for the Indians, of US$50,00 per gram, this esteem gem's reserve will offer an invoicing of US$318,75 million. It is accentuated that exemplary of emeralds and alexandrite, of extra quality, can reach US$ 2.000 the carat.

The detected marine-water occurs disseminated in big pegmatites bodies that, maintaining lenticular ways are disposed parallel to the foliation of gneiss and amphibolite. The calculation of the pegmatite rock volume indicated the existence of an approximate reserve of 20.000 Kg of beryl from the marine-water variety, esteem in 5% the contained gems. So compute a final volume of 1.000 Kg of marine-water that with average value of US$30,00 per gram, projects a return of US$ 30 million.

Therefore, the total invoicing value of the gemological minerals reserves of the area from the Ribeirão São Jose Project is esteem in US$348,75 millions.

5 – TECHNICIAN AND ECONOMIC ASPECTS OF THE PROJECT

5.1 – INITIAL CONSIDERATIONS

The Ribeirão São José Project was conceived from the results of the developed exploration in the phases, initial and of detailing that culminated in the mineral reserves presented in the previous item.

About of the mineral occurrences defined in its majority in situ, and other part in alluvium environments, the Project will have to forcibly pass, for the adoption of the methods at the open-cast and underground exploitation, initiating by the first, meanwhile the development of the second is executed.

At the open-cast Exploitation as it is an alluvium, with variable thickness of 1m to 3m, and a middle capping of 1,5 m, the extraction will be executed by the exploitation system in layers, traditionally used in the clay mines. The loading will be made by the proper digging equipment (backhoe) and the transport will be accomplished by dump trucks with capacity of 10 tons, in an average distance of 150 m, up to the processing installations.

At the underground Exploitation is foreseen an opening of a master gallery by an extension of 500m, with a belt conveyor that will lead the ore up to the processing installations. The sterile material will be carried up to the pile to be projected in the northwest portion of the area, and the ore will be deposit in a silo that will feed an inclined grill. The *over size* will be guided to the jaw's crusher, with the purpose of disintegrate the biggest blocks. The *under size* will feed a vibratory to moist sieve of 4 decks, where the products of a bigger granulometry will pass for a visual evaluation and qualitative separation. The

product that going to pass through the finest sieve of the under size will feed 4 selected table, from where the concentrate will be carried through the belts up to the optic separator for the final verification.

Subsequently, the waste of alluvial material, practically exempt of gems, will be moved to reserve areas for the formation of sub-product's pile, in the case of quartz, it can be sold or be used in the recovery of access' ways and for fulfilling of emptiness in the Mining Work. As the waste proceeding from of the underground exploitation also can have part advantage in the recovery of roads and the remaining will be deposit in the basins formed by the exploitation's layers of the alluvial material, downstream from the processing plant.

5.2 – BOARD OF INVESTMENTS

5.2.1 - Preliminary Investments

The preliminary investments include the necessary costs to the implantation's phase of the Project, including specific technical studies and environmental demands, as shown in the Table 1.

Table 1 - Preliminary Investments

DISCRIMINATION	Value (US$)
▫ **Environmental Studies (EIA/RIMA, RCA/PCA),Management, etc.**	20,000.00
▫ **Plan of Economic Advantage**	8,000.00
SUBTOTAL 1	**28,000.00**

5.2.2 – Exploitation Equipment and Auxiliary

In case of a mine with lifetime approximately about 20 years, the specific investments in equipment of Exploitation and auxiliary will be those sufficient for the prompt operation of the project, in a horizon of a minimum lifetime about 10 years of these equipment, as presented in the table below.

Table 2 - Investments in Exploitation Equipment and Auxiliary

DISCRIMINATION	Quantity	Value (US$)
▫ **Excavator FX-215**	02	187,000
▫ **Pneumatic Drill**	06	20,000
▫ **Loader FW 140**	01	80,000
▫ **Jumbo Drilling**	01	300,000
▫ **Stationary Compressors**	02	50,000
▫ **Tractor CAT D6N**	01	150,000
▫ **Trucks Mercedes Benz 1620**	01	270,000
▫ **Belt Conveyor**	500 m	200,000
▫ **Rotary Sounding**	01	40,000
▫ **Mechanical Auger**	04	8,000
▫ **Electric Pump**	02	4,000
▫ **Ventilation System / Exhaustion of the mine**	01	100,000
▫ **Pick-up Toyota**	02	30,000

▫ **Vehicle Gol VW 1.6**	04	30,000
▫ **Vehicle Van Sprinter**	01	20,000
▫ **Tooling**	01	20,000
▫ **Personal Protection Equipment - EPI'S**	01	10,000
▫ **Equipments and Electric Installations**	01	90,000
▫ **Electric Command Board**	01	30,000
▫ **Air Conditioner Device**	10	8,000
▫ **Computers**	08	8,000
▫ **General Features**	01	12,000
SUBTOTAL 2		**1,667,000.00**

5.2.3 – Civil Work and Infrastructure

The civil work and infrastructure necessary to the Project involve the housing construction, refectory/kitchen, dressing room/ rest room and toilet, administrative Office, First-aid station, mechanic garage and storehouse, besides others items discriminated in the table below.

Table 3 - Investments in Civil Work and Infrastructure

DISCRIMINATION	Quantity	Value (US$)
▫ **Housing for 18 people**	01	35,000
▫ **Refectory/Kitchen for 50 people**	01	35,000
▫ **Set of Dressing Room with Rest room and Toilet**	01	12,000

▫ **Office**	01	20,000
▫ **First-Aid Station**	01	8,000
▫ **Mechanic Garage**	01	40,000
▫ **Storehouse**	01	20,000
▫ **Laboratory of Physical-Chemical analysis**	01	35,000
▫ **Fuel Reservoir (15.000 liters)**	01	10,000
▫ **Lodge**	01	4,000
▫ **TV Internal Circuit**	01	30,000
▫ **Stockpiles of Explosives (Electronic Monitoring)**	01	4,000
▫ **Basins System of Decantation/Captation**	01	20,000
SUBTOTAL 3		**273,000.00**

5.2.4 – Processing Plant

It will be implanted a processing plant, that the main equipments and costs are presented in the following table.

Table 4 - Investments in Processing Plant

DISCRIMINATION	Quantity	Value (US$)
▫ **Grill**	01	8,000
▫ **Vibratory Feeder**	01	8,000
▫ **Jaw Crusher 62”x40” Swedalla**	01	35,000

▫ **Vibratory Sieve with 4 Decks**	01	20,000
▫ **Concentrated Tables**	04	2,000
▫ **Optic Separator**	01	35,000
▫ **Collectors of Final Products**	04	1,500
▫ **Hydraulic Monitors**	02	2,000
▫ **Belt Conveyor**	100 m	35,000
SUBTOTAL 4		**146,500**

5.2.5 – Working Capital

The working capital considered was calculated with base on the 6 (six) months of operation executing the fees which will give the following cost:

Table 5 - Investmnts in Working Capital

DISCRIMINATION	Value (US$)
▫ **Working Capital correspondent to 6 months of operation**	670,000.00
SUBTOTAL 5	**670,000.00**

5.2.6 – General Summary of the Investments

The board presented below summarizes the investments foreseen in the Project.

Table 6 - General Summary of the Investments

DISCRIMINATION	Value (US$)
▫ **Subtotal 1 – Specific Studies and environmental demands**	28,000
Subtotal 2 - Exploitation Equipment and Auxiliary	1,667,000
▫ **Subtotal 3 – Civil Work and Infrastructure**	273,000
▫ **Subtotal 4 – Processing Equipments**	146,500
▫ **Subtotal 5 – Working Capital**	670,000
▫ **Contretemps, Exchanges Variation, etc (15%)**	417,675
TOTAL OF THE INVESTMENTS	**3,202,175**

5.3 – OPERATIONAL COSTS

5.3.1 – Workforce and Social Tax

The direct cost with personal will totalize US$ 21,460/month. Considering 117% of social tax, this count will be **US$ 25,109/month.**

Table 7 - Operational Costs with Workforce and Social Tax

QUALIFICATION	Quantity	Salary/ US$/un.	Value US$/month	Tax US$/month	Subtotal US$
DIRECT WORKFORCE					
▫ **General Management**	1	3,000	3,000	3,510	6,510
▫ **Assistant Manager**	1	2,000	2,000	2,340	4,340
▫ **Mining Engineer**	1	2,000	2,000	2,340	4,340
▫ **Geologist**	1	1,500	1,500	1,755	3,255
▫ **Business Administration**	1	800	800	936	1,736
▫ **Person in charge of Processing**	1	700	700	819	1,519
▫ **Person in charge of Subsoil**	1	650	650	760	1,410
▫ **Chief of Mechanic Maintenance**	1	650	650	760	1,410
▫ **Mining Technician**	1	550	550	644	1,194
▫ **Work Safety Technician**	1	500	500	585	1,085
▫ **Physical-Chemical Technician**	1	500	500	585	1,085
▫ **Blaster**	1	300	300	351	651
▫ **Nurse Assistant**	1	300	300	351	651
▫ **Office Assistant**	2	225	450	527	977
▫ **Mobile Equipment Operator**	5	350	1,750	2,047	3,797

▫ **Control Panel Operator**	2	400	800	936	1,736
▫ **Driver**	3	250	750	878	1,628
▫ **Mechanic**	3	200	600	702	1,302
▫ **Subsoil Assistant**	8	160	1,280	1,498	2,778
▫ **Surface Assistant /Verification**	12	140	1,680	1,966	3,646
▫ **Cooker**	2	200	400	468	868
▫ **Cooker Assistant/General Services**	3	100	300	351	651
INDIRECT WORKFORCE					
▫ **Patrimonial Security Company**	12	1,000*			12,000*
MONTHLY TOTAL	**65**	**X-X**	**21,460**	**25,109**	**58,569**
ANNUAL TOTAL	**65**	**X-X**	**434,980**	**326,417**	**761,397**

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5.3.2 - Input/Maintenance

The main inputs to be used involve explosives, diesel fuel, electric power, replacement material for equipments in general, lubricant, material of galleries' propping and foodstuffs.

The monthly expenses esteem with inputs and maintenance, for the productive activity, will be about **US$ 41,600.00**, resulting in an annual expenditure of **US$ 499.200,00** (four hundred and ninety nine thousand and two hundred dollars).

5.3.3 – Environmental Recovery

The costs with the environmental recovery are esteem in about 5% (Five per cent) of the operational costs of the whole Project, representing therefore approximately **US$ 6,000/month**.

5.3.4 – Administrative Expenditure

It is esteem a monthly cost of **US$ 15,000.00** with administrative expenditure which will totalize **US$ 180,000.00/year**.

5.3.5 – General Summary of the Operational Costs

Table 8 - General Summary of the Operational Costs

DISCRIMINATION	Monthly Value (US$)	Annual Value (US$)
▫ **Workforce and Tax**	58,569	761,397
▫ **Input/Maintenance**	41,600	499,200
▫ **Environmental Recovery**	6,000	72,000
▫ **Administrative Expenditure**	15,000	180,000
TOTAL	**121,169**	**1,512,597**
Unit Operational Costs	**US$ 14,3/ton**	**US$ 14,3/ton**

5.4 – ECONOMIC ANALYSIS

5.4.1 – General Criterion

Below are presented the criteria and basic data established for the economic analysis of the Project..

Table 9 - Duty and Tax

DUTY & TAX	
▫ **PIS**	***0,65% of the Gross Income***
▫ **FINSOCIAL**	2,00% of the Gross Income
▫ **CFRM**	0,20% of the Net Income
▫ **ICMS**	12,0% of the Gross Income
▫ **Social Contribution**	10,0% of the Operational Profit

Table 10 - Data of the Project

RESERVES AND GRADES	
Lifetime	18 years
Average Grade	3,4 g/m3
Measurement Ore Reserve	1,875 million m3
Gem Reserve	6.375.000 g
ANNUAL GROSS INCOME	
Annual Production	105,600 m3/ year
Sales' Average Price	US$ 50/g
Annual Income	US$ 17,952,000
INVESTMENTS	
Investments	US$ 3,202,175
ANNUAL OPERATIONAL COST	
Annual Operational Cost	US$ 1,512,597

5.4.2 –Result's Demonstrative (Cashflow)

The demonstrative of Results (Cashflow), considered standard of the project and shown as follow below, obey to the technique and economic criteria described on the previous item. Distinguish it that was considered, on this economic analysis, only the measured reserve, with lifetime of 18 years. The cashflow as established shows the technician-economic viability of the project.

Year	Foreseen investments US$	Operational Cost US$	Income US$	Tax 20% US$	Net Cashflow US$
0	3,202,175				(3,202,175)
1		1,512,597	17,952,000	3,590,400	12,861,003
2		1,512,597	17,952,000	3,590,400	12,861,003
3		1,512,597	17,952,000	3,590,400	12,861,003
4		1,512,597	17,952,000	3,590,400	12,861,003
5		1,512,597	17,952,000	3,590,400	12,861,003
6		1,512,597	17,952,000	3,590,400	12,861,003
7		1,512,597	17,952,000	3,590,400	12,861,003
8		1,512,597	17,952,000	3,590,400	12,861,003
9		1,512,597	17,952,000	3,590,400	12,861,003
10		1,512,597	17,952,000	3,590,400	12,861,003

11		1,512,597	17,952,000	3,590,400	12,861,003
12		1,512,597	17,952,000	3,590,400	12,861,003
13		1,512,597	17,952,000	3,590,400	12,861,003
14		1,512,597	17,952,000	3,590,400	12,861,003
15		1,512,597	17,952,000	3,590,400	12,861,003
16		1,512,597	17,952,000	3,590,400	12,861,003
17		1,512,597	17,952,000	3,590,400	12,861,003
18		1,512,597	17,952,000	3,590,400	12,861,003
TOTAL	**3,202,175**	**27,226,746**	**323,136,000**	**64,627,200**	**228,295,879**

5.5 – TIMETABLE OF IMPLANTATION

ACTIVITY X MONTH	1	2	3	4	5	6
Opening of Access						
Preparation of the Exploitation face						
Preparation of the Deposits						
Earthwork						
Civil Work						
Assembly						
Exploitation and Processing						

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