DECLINE OF DIAMOND PRODUCTION IN BRAZIL, AFTER THE ADOPTION OF THE KIMBERLEY PROCESS CERTIFICATE SYSTEM – KPCS

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RESUMO. Declínio da produção de diamantes no Brasil após a adoção do Sistema Certificado do Processo de Kimberley – SCPK. O estudo investiga as causas do colapso da produção de diamantes em bruto no Brasil. Os Diamantes constituem uma das mais perenes commodities minerais produzidas e comercializadas pelo Brasil. Com reservas de aproximadamente 13,8 milhões de quilates contribuem com apenas 0,04% da produção mundial total. Antes da criação do SCPK, o Brasil produzia uma média de 900.000 quilates/ano; correspondente a 0,57% da produção global atual. Estima-se que, após a implantação do SCPK, a possível perda acumulada na produção brasileira foi de 8,7 milhões quilates, atingindo valores superiores a US$ 2 bilhões. Entre as razões para esta queda está a origem da produção brasileira proveniente de depósitos secundários, geograficamente dispersos, muitos sem o devido registro legal. Os diversos setores que integram a indústria global dos diamantes empregam 10 milhões de pessoas, com valor superior a US$ 74 bilhões/ano. No Brasil, as atividades deste setor foram reduzidas.
Palavras-chave: Diamantes; Economia Mineral; Sistema Certificado do Processo de Kimberley.

ABSTRACT. The study investigates the causes of the collapse of production of rough diamonds in Brazil. Diamonds are one of the most perennial mineral commodities produced and marketed by Brazil. With reserves of around 13.8 million carats contribute with only 0.04% of the total world production. Before the creation of the KPCS, Brazil produced an average of 900,000 carats/year; corresponding to 0.57% of the current global production. It is estimated that, after the implementation of the KPCS, the possible loss accumulated in Brazilian production was 8.7 million carats, reaching values of more than US$ 2.0 billion. Among the reasons for this drop are that the Brazilian production comes from deposits of secondary origin, geographically dispersed, many without proper legal registration. The various sectors that integrate the global diamond Industry employs 10 million people and accounts for more than US$ 74 billion/year. In Brazil all sector activities were virtually paralyzed.
Keywords: Diamonds; Mineral Economy; Kimberley Process Certificate System.

INTRODUCTION

Within the humanitarian aspects of the Security Council of the United Nations, include is the legitimacy to impose a system of control for the trade in rough diamonds. In a General Assembly, resolution Nº 263 of January 2001 create the KIMBERLEY PROCESS CERTIFICATE SYSTEM – KPCS, which require several procedures by which these diamonds can enter the trade system of the world by inhibiting the possible financing of armed conflicts and strengthening the legitimate diamond market. In an article published in the magazine Business & Politics, Kantz (2007) correlates different events leading up to the implementation of the KPCS.

> The international community took its first steps to curb the trade in diamonds from conflict areas by the end of the 90's. In 1998 the United Nations Security Council – UNSC (United Nations Security Council-UNSC) imposed an embargo on all uncertified rough diamonds by the Angolan Government (Resolution 1173). In 2000, the UNSC also imposed an embargo on diamonds from Sierra Leone (Resolution 1306). Even so, the sanctions have proved of little efficiency over the illicit diamond mining activities outside the global trading system. However, this embargo has gotten more attention as the result of campaigns promoted by non-governmental organizations – NGO's, initiated from 1998.

In December 1998, Global Witness edits an article titled the 'Rough Trade' documenting massive violations of UN sanctions imposed against UNITA. The publication directly accused De Beers; Belgium and several other Nations for trade in diamonds produced by UNITA, under UN sanctions. The article highlights the effective participation of non-governmental organizations-Global Witness (GW) and Partnership Africa Canada (PAC) during all phases of the KPCS. It is observed that both withdrew from the Management Committee (PAC, 2009; GW, 2011) due to opposite positioning on the measures adopted by this Committee of the KPCS, which considered the production of the Marange fields in Zimbabwe 'conflict free', despite constant

violations and crimes that occurred (PAC - Other Facets. Aug. 2011).

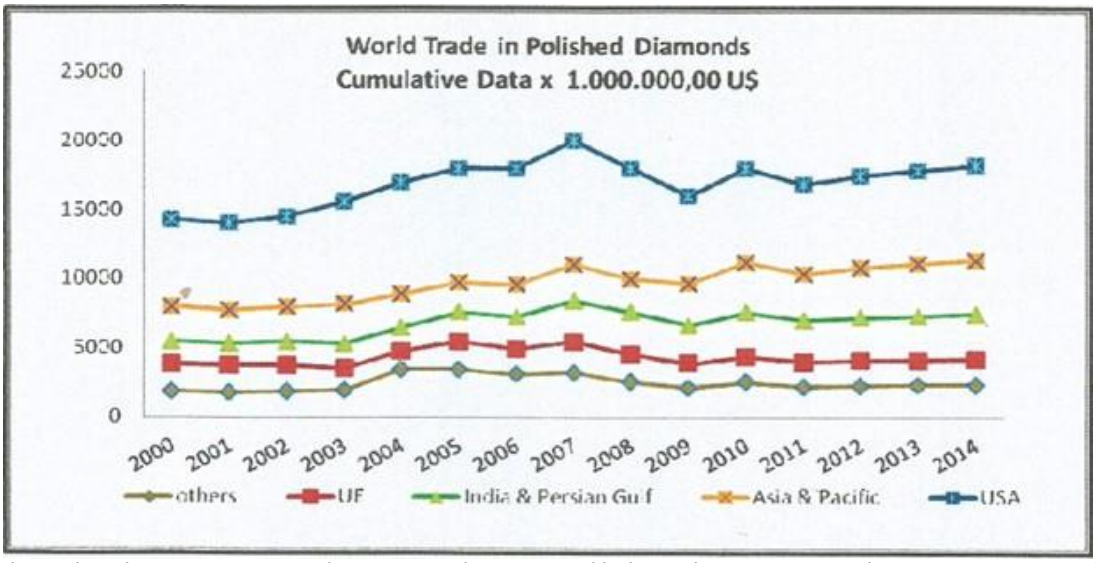
Diamonds represent a limited role in the world economy, unlike other extractive sectors such as ferrous ores, or sectors of energy or food production, not having strategic importance in global trade. However this productive sector moves huge financial volumes and creates many jobs, not only in producing countries, but in many stoning centers in India, United States of America and Israel, or in specialized trade centers as in the cities of Antwerp, London, New York and Tel Aviv.

> Global sales of diamonds currently move values in excess of the $ 74 billion annually. The sector employs, directly or indirectly, approximately 10 million people around the world, not including the final sale in jewelry, through the trade of rough and polished diamonds.

Another significant event, prior to implementation of the KPCS by signatory countries, refers to the approval by the Congress of the United States, in 11/28/2001, of 'The Clean Diamond Trade Act'. After that date, only the United States have become signatories to the Kimberly Protocol, whose participation was considered essential, since the American market has always been the largest and most influential market for diamonds, both in volume and in value, in their varied uses, mainly in the industry of luxury goods.

Figure 1 presents a comparison of the bustling market value of polished diamonds in various economic blocks. The dominance of the United States is evident.

Figure 1. World trade in polished diamonds



Sources: Diamond Trade Center - DTC & Bain & Company/Antwerp World Diamond Center – AWDC (2011, 2013, 2014, 2015).

After the financial crisis of 2008, as a result of austerity in consumption, there was a decline in sales of luxury goods, including here the diamonds, with strong recovery in 2010. The supremacy of the United States begins to be confronted with the growing participation of Asia, or more precisely the 'Greater China' – China, Hong Kong, Macao and Taiwan-representing more than 20%. (BAIN & COMPANY/AWDC, 2013).

Currently the KPCS has 54 participants representing 81 countries; with the European Union and its 28 Member States counting as a single participant; Arab States and other economic blocs encompass all of the major producers, exporters and importers, being the last to enter: Cameroon (08/2012); Cambodia; Kazakhstan and Panama (11/2012). Several other countries are mentioned as future permanent members, among them: Argentina, Chile, Peru, Egypt, Philippines, Kuwait, Cape Verde, Qatar, Bahrain, and Tunisia.

In mayo 2015, the U.S. Department of State published an update of the participating KPCS countries, for the purposes of the Clean Diamond Trade Act, informing the changes, companies and trade bodies in the country, adding the Mali and reiterating the suspension of Venezuela and the Central African Republic on trade in rough diamonds. Today the KPCS members account for approximately 99.8% of the global production of rough diamonds.

Brazil's participation in the KPCS, as a sitting member, occurred after the 2nd Annual Conference of the Committee of the KPCS held in South Africa by means of Law Nº 10.743 of 10/09/2003. According to Porto Filho (2010), the precepts of the Law were copied from the Canadian system of certification and say: "such was the urgency that lawmakers disregarded that the model of Canada's diamond extraction (Kimberlitic) was completely different from Brazil (alluvial)". This aspect will have

great influence over the Brazilian production throughout his participation in the KPCS, as discussed later.

In short, aims to prevent the shipment of rough diamonds plowed into areas of conflict, in protected areas – indigenous or environmental preservation – or in areas not smoothed before the National Department of Mineral Production (Departamento Nacional de Produção Mineral – DNPM), as well as the entry of rough diamonds without Kimberley Process certificates issued by the competent authorities of the country of origin.

Table 1 presents the main diamond producers and total production in million carats, depicting the decade preceding the KPCS, from 1993 to 2003. It is observed that the Brazil occupies the 9th position, with 900,000 carats, corresponding to a reduced portion (± 0,5%) of world production, however significant, close to its historical average for the previous two decades was 832,000 carats. It should be noted that the Zimbabwe even figured in this picture due to its reduced production, event that will change significantly over the next few years, causing a direct change in the credibility of the KPCS.

Table 1. Production of diamonds in the decade preceding the KPCS

Production of rough diamonds-gem and near gem quality by country x 1000 KTs												
Country	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	∑ %*
Angola	130	270	2.600	2.250	1.100	2.400	3.360	3.914	4.653	4.520	4.770	4.48
Austrália	18.844	19.485	18.300	18.897	18.100	18.400	13.403	11.956	11.779	15.142	14.900	26.86
Botswana	10.310	10.550	11.500	12.400	15.100	14.800	17.200	18.500	19.800	21.300	22.800	26.06
Brazil	1.600	900	1.300	800	900	900	900	1.000	700	500	500	1.49
Canada	-	-	-	-	-	278	2.429	2.534	3.716	4.984	11.200	3.75
C A R	370	400	400	350	400	330	311	346	337	311	300	0.57
C. D'ivoire	-	80	52	202	207	207	270	210	207	204	205	0.27
R D Congo	2.006	4.000	4.000	3.600	3.000	3.300	4.120	3.500	3.640	4.400	5.400	6.12
Ghana	106	118	126	125	664	640	546	792	936	770	800	0.84
Guyana	-	-	-	-	-	-	45	82	179	248	250	0.12
Liberia	-	-	60	60	80	150	120	100	100	48	36	0.11
Namibia	1.120	1.312	1.382	1.402	1.345	1.394	1.630	1.450	1.487	1.350	1.650	2.32
Rússia	8.000	8.500	10.500	10.500	10.500	11.500	11.500	11.600	11.600	11.500	12.000	17.60
S. Leona	80	155	113	162	300	200	7	58	167	147	214	0.23
Sth. Africa	4.600	4.340	5.070	4.400	4.500	4.300	4.000	4.320	4.470	4.350	5.070	7.39
Venezuela	146	203	228	99	158	100	59	29	14	46	30	0.16
Zimbabwue	-	104	114	300	321	40	15	8	-	-	-	0.13
Other	288	983	655	425	416	501	785	901	815	880	775	1.15
TOTAL	47.600	51.400	56.400	57.100	56.600	59.500	60.700	61.300	64.600	70.700	82.900	668.700

*Σ% - Participation im world production accumulated in the period.
Sources: USGS – Mineral Year-book: 1993 – 2004.

CONSIDERATIONS FOR GEOLOGY OF DEPOSITS OF DIAMONDS

Diamonds are found in two types of mineral deposits. A primary, associated with specific volcanic rocks designed to Kimberlitic and Lamprophyre, and another secondary, connected to the processes of erosion, sedimentation and lithification. The methods and operating costs are directly related to this geological typology. While the primary deposits can reach depths exceeding 1000 m, requiring long-term planning, as well as infrastructure and large equipment, having their extensions and locations defined. Secondary deposits are sparse, superficial, shallow with little thickness, and usually associated with inconsistent sediments, allowing their raging with simple, even rudimentary equipment owned by independent small miners or those belonging to prospector unions. In Brazil the production of diamonds comes from these secondary sources of diffuseness, related to gravel rocks, mudslides, *colluviums* and *alluviums* deposits.

According to Heaman et al. (2004, cited by WIT, 2010), except for those related to Brazil, there are known more than 6500 kimberlites and related rocks in the world (South Africa more than 850; North America more than 800; Angola 600; Australia 450; Botswana 250; 1200 Russia and Tanzania 300). However, only 3% have diamonds and only 1% is economically viable. Certainly many areas were not surveyed in detail and with the advancement of

exploitation technologies, many more bodies will be discovered.

We emphasize that the evaluation of a diamond deposit, mainly those of primary origin, constitutes a complex, long and expensive process which will determine its economic viability through the identification of the 'footprint' of the production of the deposit. The 'footprint' characterizes the deposit; it is its 'trademark' and represents: the frequency of the distribution of types of diamonds, sorted by quality gemological parameters; the size and morphology of crystals; and the production capacity and value, which is the determining factor in the planning of the whole production cycle from tilling until placing the product on the market and ultimately influences the decision to proceed or not with a project.

Table 2 presents a comparison between the ' footprint ' of deposits of diamonds from Marange Fields –Zimbabwe (According to African Consolidated Resources, " Marange produces 4,000 carats per 100 tons, and that the top five percent are "very serious gems", while another five percent are "decent quality), with two moments of the Argyle mine production from Australia; at the beginning of its operation in the 90's, and another at present; indicating the average price achieved in the market by each of them.

Table 2. 'Footprint' of Argyle-AU deposits and Marange - ZB

QUALITIES	MARANGE - ZB (2013)	ARGYLE – AU (1993)	ARGYLE – AU (2013)
INDUSTRIAL	90%	53%	25%
'NEARGEM'	5%	41%	70%
GEM	5%	6%	5%
TOTAL	100%	100%	100%
US$/Ct by Country	51.72	15.54*	32.50

* Average price for the year 2004.
Sources: SCPK, USGS and Rio Tinto Co.

The Argyle mine provides a good example of the modern techniques; both to find viable diamond deposits and to recover the gems on a large scale. Increasing the fraction ' near-gem ', verified in the production of the Argyle mine, stems from the establishment of partnerships with the industry and lapidary jeweler from India. Rio Tinto Diamonds, reports:

> Almost all the diamonds produced by Argyle are cut and polished in India and destined for use in the jewelry industry. Rio Tinto Diamonds, in a joint marketing organization with Indian jewelry companies, provide its customer base of diamond traders, manufacturers and exporters with sales and technical support. Argyle has also worked closely with the Indian diamond and the jewelry industry through the Indo Argyle Diamond Council, a joint marketing organization to assist Indian jewelers companies entering the competitive US market.

Furthermore, variations in the characteristics of diamonds, occurring in discrete domains within a single deposit, result in price changes. As in kimberlite from DIAVK – Canada (Diamonds from the Diavik Mine are extracted from three ore deposits in kimberlite pipes), indicated in the Table 3.

Table 3. Variations in the value of diamonds in Diavk-CA

Locations	Average Price:US$/Ct (oct/2012)
A-154 South	135
A-154 North	170
A-418	95
RPR (Reprocessed Plant Rejects)	45

Sources: Harry Winston Diamond Co. and Rio Tinto Co.

SYNTHETIC DIAMONDS

Produced by GE (General Electric) since 1955 the USA has dominated the production of synthetic diamonds, until recently. Similar to natural ones, the natural, industrial quality synthetic diamonds are used in the manufacture of abrasives and cutting tools. These were initially produced exclusively by a method that submits graphite compounds at high pressures and temperatures (HPHT - High Pressure and High Temperature), generating small diamond crystals, in sizes up to 150 microns (± 0.15 mm), but with consistent quality and controlled, featuring competitive prices and in quantities sufficient to attend the demands of the time.

> HPHT remains the major method for producing diamonds suitable for industrial purposes. The downside of HPHT is that most of the diamonds emerge in shades of yellow and brown because of the presence of nitrogen in the manufacturing process. (BAIN & COMPANY - Diamond Industry Report, 2011, pg. 76).

Many gemological quality diamonds, with sizes close to the metric carat (1.00 Ct = 0.2 grams), and even bigger, were produced by this method, but at a cost higher than natural diamonds, precludes its use in jewelry production. Shor (2005), comments:

> Gemological quality diamonds were also produced, both by experimental mode De Beers, as by laboratories of the Soviet Union. However, no producer offered synthetic diamonds on a commercial scale until the year 2003.

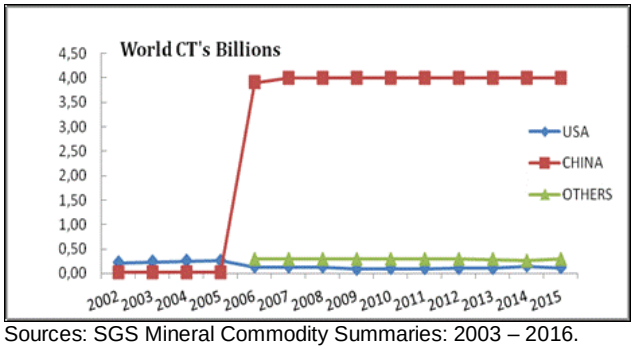
At the end of the Decade of 80 a new method called CVD (Chemical Vapor Deposition) that transforms the carbon in plasma being, after, precipitated on a diamond substrate; went on to be employed on a large scale and quickly developed,

allowing a more intense and varied use in several industrial segments. Davis (2003) publishes the magazine Wired an article for the first time, signaling the possibility of profound changes in the secular structure of the production and marketing of diamonds, with reflexes in all its industrial segments, being:

> Two American companies (*Genesis Co.* and A*pollo Diamond)* produce and market synthetic diamonds, both for the segment of jewelry (GEMS), as for cutting-edge industries, breaking the old paradigm of use, almost exclusively, of manufactured diamonds as abrasives or cutting tools.

After the year 2004 China went on to produce synthetic diamonds in an order of magnitude higher than the other countries. Figure 2 compares the Chinese production with other producing countries (Belarus, Ireland, Japan, Russia, South Africa, Sweden, and the United States). Note that the USA dominated this market with an average annual volume of around 260 million cts. Today China produces approximately 4.00 Billion cts/year, serving virtually the entire world demand and making irrelevant the consumption of industrial diamonds of natural origin. Virtually all industrial diamonds are synthetic and manufactured in China.

Figure 2. Synthetic Diamonds. World Production X Chinese Production



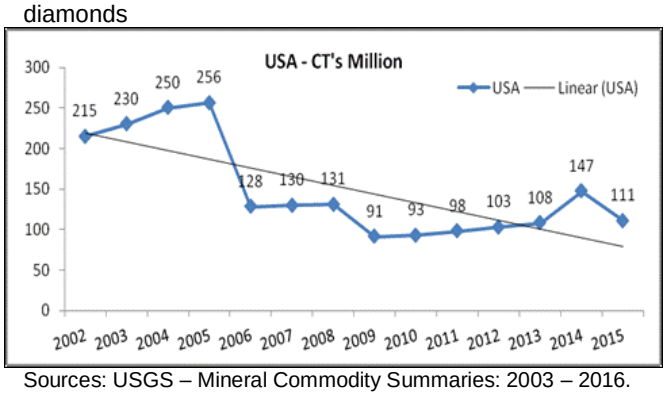
Sources: SGS Mineral Commodity Summaries: 2003 – 2016.

The American production declined as a result of this new scenario, as shown in Figure 3.

For use in jewelry, the synthetic diamonds produced by CVD method, similarly to those of industrial use, are also economically viable, which has pressured the market of polished diamonds. You can check in specialized sites on faceted synthetic diamonds trade, (Brilliant Earth and Pure Grown Diamonds Inc., among others) the price difference between natural diamonds and synthetic, same quality, meaningful and sometimes exceeding 30%. Statements issued by the Antwerp World Diamond Centre (AWDC), an organization representing the interests of several suppliers and traders of natural diamonds, when he says:

> At the demand side, the complexity of the process and manufacturing capacity are limiting restrictions. Need of significant capital expenditure initially, and until now the only company that offers quality gemológica for the synthetic diamonds and has the capacity to produce them in mass is Apollo. (The Element Six has also all patents and necessary resources, but chooses not to participate in this market.) In addition, there are currently no companies that can produce mass required reactors commercially to manufacture synthetic diamonds. If consumers start to accept the synthetic diamonds, low-price, in jewelry and the manufacturers decide to enter the market, the initial investment required to build a sufficient number of reactors with capacity to produce up to 10% the market demand, would be on the order of half a billion dollars. (BAIN & COMPANY, 2011, p.80).

Figure 3. Decline in American production of synthetic diamonds



Sources: USGS – Mineral Commodity Summaries: 2003 – 2016.

Despite claims in favour of the contemporary model, such statements contribute to generate some uncertainty. And more, the irregular placement of synthetic diamonds, without proper gemological certification, probably from China; as pointed out by Krawitz (2012) in article *on line* of RAPNET. Which was also reviewed by the AWDC, but with an approach that refers only to the commercial control: "the event underscored the importance of the diamond certificates to ensure the authenticity of the stones bought", has contributed to increase the uncertainties around the productive segment.

RESERVES AND BRAZILIAN PRODUCTION

In 2015, the world diamond reserves were estimated at 700 million ct's, according to the data contained in the Mineral Commodity Sumaries (Diamond Industrial) from USGS 2016. The Australia is the country that holds the largest reserve (250 million ct's), followed by the Democratic Republic of Congo (150 million ct's) and Botswana (130 million ct's). Brazilian stocks are currently 13.8 million metric carats- Kt (DNPM-Mineral Contents/2013), considering the possible reserve of production declared by holders of mining concessions, which represents approximately 2.6% of world reserves.

According to Svisero (1995), in Brazil, Kimberlite type rocks were discovered only in the late 1960s, first in the Coromandel area in Minas Gerais and later in Goiás, Mato Grosso, Rondônia and Piauí States. After more than 1,200 kimberlites have been found in other States, resulting from the work developed by multinational companies operating, among them stand out De Beers and Rio Tinto; to a lesser extent Canadian 'Juniors ' companies (Vaaldiam, Brazilian Diamonds, Diagem, Octa Majestic, Sole Resources, and other); In addition to the Search Company and Brazil's Mineral Resources (Companhia de Projetos e Recursos Minerais –CPRM). Cassedanne (1989), comments: *"...*Unfortunately none of them proved to contain economic quantities of diamonds". However, it is believed that most people don't adequately was analyzed in the light of current knowledge.

Technical Report Nº 50-Diamond Profile (Gem and Industrial diamond); developed for the Duo-decennial Mining Plan 2010/ 2030 (MME/SGM-2009); indicates those kimberlites that have undergone evaluation procedures and economic viability (volume sampling for content definition, operational costs studies, determination of the footprint and corresponding average price of diamonds, geometric definition of bodies, etc..), being: Canastra 1 in Minas Gerais; the Braúna Province in Bahia; Juína in Mato Grosso; Catalão 1 in Goiás and Carolina and Cosmos/Peppers in Rondônia.

In this technical report are related to the prices of diamonds in some deposits in Brazil, as follows:

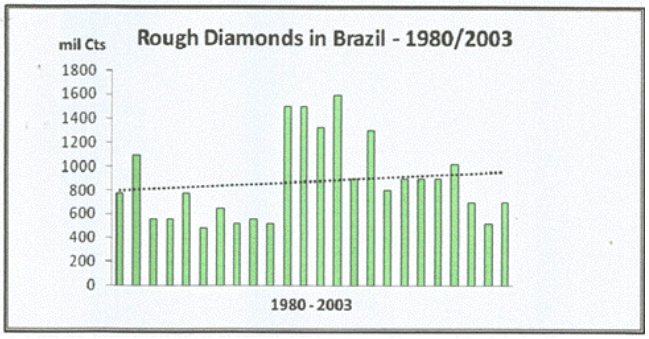
> The quality of the diamonds in mudslides in Brazil is high and therefore achieve market prices, between US$ 100.00 and US$ 400.00 the carat. The exceptions are for the mudslides of Juína, Mato Grosso, where the average value of diamonds "run of mine" reaches a maximum of US$ 25.00 the carat, however sporadically recover large diamonds of highest quality, extremely high values. In alluvial rivers mainly Santo Antônio do Bonito and Santo Inácio, in the Coromandel region in Minas Gerais, is frequent recovery of very large stones, of high quality, very high market value. For the diamonds come from kimberlites, prices range from US$ 20.00 per carat in Juína, up to US$ 170.00 in Canasta 1.

Other information provided by mining companies as Canadian Vaaldiam Resources ("... the average diamond carat of two bars – Minas Gerais is US$ 165.00, while the Chapada dos Guimarães – Mato Grosso is US$ 497.00") or national (Joint Ventury Hong Kong, Belgium, Canada, Brazil) Lipari mining, current copyright holder about the mineral kimberlite Brauna-BA. ("Second preliminary analyses already made in material extracted in the area, the value of the rough diamonds reaches US$ 338.00/Kt's, cipher that is equivalent to the diamond in the rough of Namibia, one of the countries with the highest Carat average price in the world."), reaffirm the variation in prices that occurs between the different deposits.

Figure 4 presents the Brazilian production of diamonds between 1980 and 2003, previous period to the KPCS. Is observed a trend stabilized around 900,000 Kt's/year, corresponding to a reduced portion (± 0.57%) of the global market in 2003, the year Brazil became a signatory of the KPCS was 158.1 million Kt's. though small, with some relevance.

With the effective adoption of measures that have arisen with Brazil's participation in the KPCS, this production went into steep decline. Significant losses (Figure 5), when compared with the historical average, started to occur year after year, making meaningless the Brazilian participation in the international market.

Figure 4. Production of rough diamonds in Brazil before the KPCS

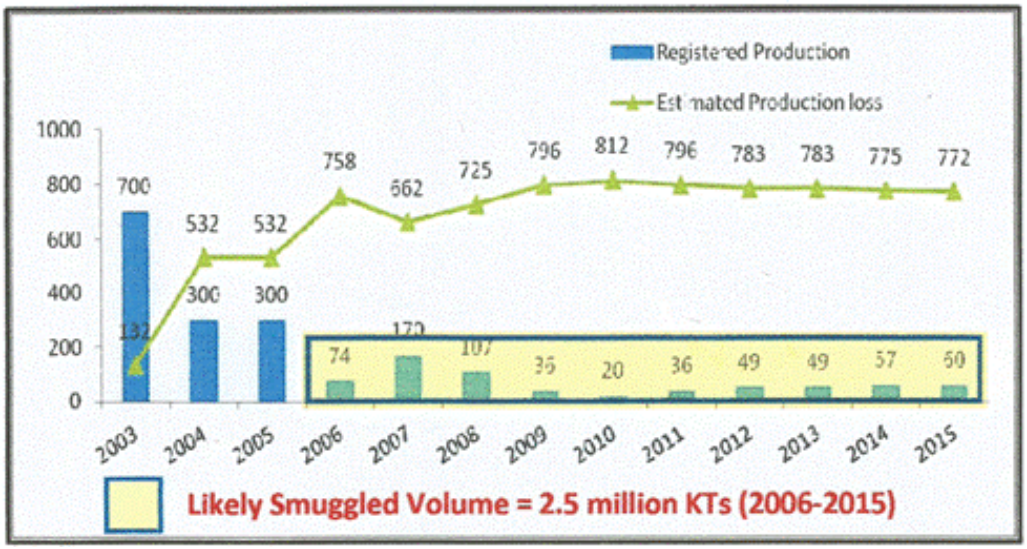


Sources: DNPM: Anuário Mineral Brasileiro – 1981 - 2004.

The DNPM had already alerted to possible impacts on the production of diamonds in Brazil (Brazilian Mineral Summary 2003, pg. 61), in view of the adoption of the procedures and reported:

> the origin of the diamond production in Brazil, in almost all comes from artisanal mining (prospecting), whose producers do not hold mining rights for mineral extraction, except for a very small percentage of producers almost everyone working in areas that are encumbered, irregularly before mineral legislation. With the advent of the Kimberley Protocol, which requires the officialization of origin for export, traders (dealer, buyer, trader, and other intermediaries) who buy diamonds from prospectors, are prevented from exporting because of its illegal extraction, which prevents the officialization of the origin.

Figure 5. Estimated Deficit in the production of rough diamonds in Brazil



Sources: DNPM/USGS/SCPK.

Certainly a strong reason for this decline, however, we believe not only the single.

In the years 2005 and 2006 the NGO PAC published two reports (The Failure of Good Intensions: Fraud, Thief and Murder in the Brazilian Diamond Industry and Fugitives and Phantoms: The Diamond Exports of Brazil), with very suggestive titles, about irregularities in the trading of diamonds Brazilians that culminated with the arrest of agents of the DNPM and traders involved in several crimes as foreign exchange evasion, money laundering, conspiracy, corruption, among others. The fragility of this productive sector became apparent. The police operation was known as '*Operação Carbono'* (REVISTA VEJA, 2001).

DISCUSSION

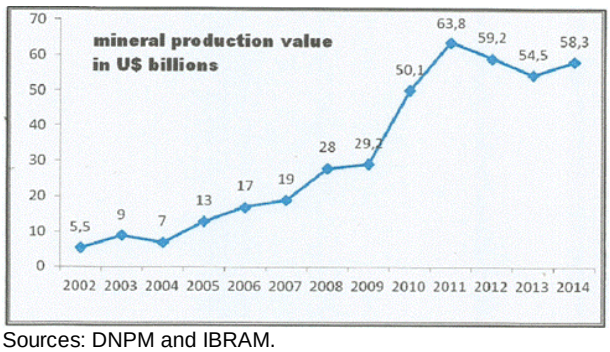
A study conducted by the Brazilian Mining Institute (Instituto Brasileiro de Mineração – IBRAM, 2012), on the basis of information provided by the DNPM, reports that the Brazil produces 70 derived minerals (45 metals, 21 industrial minerals and 04 fuels), being the main world producer of niobium (58,000/t, with export amounting to US$ 1,840 billion) and the second largest iron ore, with a 19% stake in this production (398 million/t, with exports valued at US$ 42 billion in 2011), and China, Japan, Germany, France and Korea as major buyers. It is also the seventh largest producer of Tin (10,700/t, with exports worth US$ 23 million) and the thirteenth largest producer of gold in the world (66/t, worth US$ 2,239 billion). Other assets also include minerals like potassium, manganese, bauxite and copper nickel, apart from oil and gas production.

> The growth of the last decade put Brazil in prime position on the world market-the contributions foreseen for the country until 2016 correspond to 20% of the overall investment in the sector laid down in the period, having been driven by technological improvement and better knowledge of the reserves already discovered. (IBRAM. 2012).

In this same line, but with the official data of the mineral sector in Brazil, the DNPM informs that in 2014 the value of Brazilian mineral production, driven by increased oil production and iron, amounted to $ 80.2 billion, representing 4.0% of the Brazilian GDP. A breakthrough ' exponential ' 800% compared to the year 2002 which was US$ 11.2 billion.

Today, the slowdown in the Chinese economy, though in high growth rates, caused a restructuring within the mineral sector investment in Brazil, reaching mostly the investment related to the production of iron. Figure 6 represents the change in the value of Brazilian mineral production between 2002 and 2015, already showing a decline after the year 2010, perhaps as a result of this new scenario.

Figure 6. Total value of Brazilian mineral production in the last decade



Sources: DNPM and IBRAM.

Figure 6 represents the growing change in the value of Brazilian mineral production in the last decade.

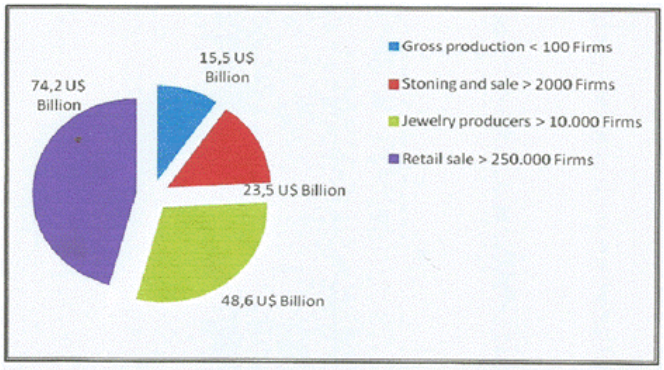
Although heavily focused on iron ore, followed by gold, the expressive growth of the mineral sector, in matching period the KPCS, contributed to the increase of capital which increased the productive cycle. But the same was not the case in the mining of diamonds; on the contrary, there was a strong retraction that stretched for every productive sector.

According information from the IBRAM, relating to 2014, Brazil ranks among the ten largest mineral producers in the world. But, among the leaders in the ranking, is the least invested in research in the sector. The country accounted for only 3% of the total private investment in mineral exploration (projects of non-ferrous metals), which reached US$ 11.4 billion that year. The amount invested by Brazil, US$ 342 million, was equal to that of Argentina, whose territorial area corresponds to less than a third of the Brazilian. The Chile, with the equivalent of only 9% of the Brazilian territory, invested US$ 798 million in research, the same value that was applied by Mexico.

It is considered that the productive chain of diamonds is structured in three distinct segments: the industrial diamonds, the diamonds for jewelry and diamonds as an investment, which consist of "gems often features special quality – (exceeding 3.00 kt, exceptional color, etc.), giving them the necessary value to be used as an investment or as collateral for bank loans. (Yu, W. 'DeBeers – Rulers of the Diamond Industry')". Each segment aggregates different recipes, which in total is one of the main natural resources.

Figure 7 presents an illustration with the values moved by every sector of the diamond industry and the approximate number of companies acting in each of these sectors, as follows:

Figure 7. Cumulative growth of the value of production to retail



Sources: IDEX – International Diamond Exchange and Diamond Value Chain (In SANTOS, 2015).

In Brazil the sector of stoning, with their potential to add value to the rough stones, is also in sharp decline. The President of the Brazilian Institute of Gems and Precious Metals (IBGM), comments:

> the stoning was disappearing with the low-cost competition, mainly from India, which shapes currently about 80% of the world's diamonds. In addition to the growth of these markets, the low domestic production does not justify a lapidary industry. Until the beginning of the years 90, the lapidary industry still flourished in the country, the city of sea of Spain – MG had 10,000 lapidaries. Now I must get to 20.

The Technological Mineral Center (Centro de Tecnologia Mineral – CETEM: < http://www.cetem.gov.br/>) reported that, in 2009, the total number of employees, directly in the production chain of diamonds, i.e. 624 workers. Below the number 3919 workers employed at the end of the 80's decade. Already the investment sector, the source of some controversy, is absent in Brazil. However, investment funds with financial ballast in diamonds are marketed in several countries

A relevant aspect about the recent global production scenario, discusses the performance of the largest diamond miners; ALROSA, BHP Billiton, Rio Tinto and DeBeers; along with smaller Gem Diamond and Petra Diamond; and other companies, which in 2013 produced 130.48 million carats of rough diamonds; increase of 2.0% compared to 2014. In 2007, the year before the global financial crisis, these mining companies contributed more than 73% of global output. Already at the end of 2012 that participation fell to 66%, as a result of the decline in the production of DeBeers (-56%) and Rio Tinto (-70%). This fact justifies the production stabilized around 125 million kt/year after 2008, keeping the heated demand and prices with bullish trend. Table 4 presents the variation in the production of the main mining companies between 2007 and 2012, 2013, and may also be seen in the production of each of them, as well as the total and average values involved. In 2013 the contribution of large mining companies returns to the level of 73% of the total, indicating a resumption of control over the volume of world production and, possibly, of the prices charged.

According to Krawitz (2014), the end of the first half of 2013, the prices of polished diamonds up to 1.00 Kt showed a fall of 2%, while that of 3.00 ct, the fall was similar to 5%. That fall, linked to high stocks of mining companies, puts into question the ability of the market to absorb the crude supply increase, which should intensify in the second half of the year, from information from DeBeers and Rio Tinto that report significant increases in their respective productions. However, in January 2014, again according to Krawitz, the market of polished diamonds has remained stable, with a fall of 2.3% only in diamond segment above 3.00 ct, showing the dynamism of this global market.

Table 4. Participation of the major mining companies in the diamond world production: 2007, 2012 and 2013

MINER CO.	2007 (Million/kt's)	2012 (Million/kt's)	2013 (Million/kt's)
Debeers	51.00	21.87	22.80
Rio Tinto	35.00	10.20	11.30
Alrosa	31.00	27.50	31.00
BHP Billiton*	2.50	3.10	4.20
Petra Diamonds	3.00	2.65	3.30
GEM Diamond	0.90	1.00	0.53
Mundial Production	167.98	127.95	130.48
Amount US$	11,605,931,894.85	12,644,531,207.40	14,085,172,32.57
Average Value US$/Cts	65.68	98.81	107.95
% (in Total)	73.46%	66.32%	73.13%

Source: SCPK. Annual Global Summary: 2007 and 2012, Rapaport.Diamonds.Net, De Beers Group, Rio Tinto Co., ALROSA, BHP Billiton, Petra Diamond and Gen Diamond.

CONCLUSIONS

Santos (2015), being considered the KPCS Committee information itself, notes that today the flow of conflict diamonds on the world market is significantly reduced to less than 1%, this index registers only 0.2% of diamonds in the global market with a possible origin in areas from. However, it remains extremely difficult to quantify accurately the current levels of illicit diamonds in the global trade, both for historical reasons and the very definition of conflict diamonds. Traditionally the KP defines conflict diamonds as; only those which finance conflicts fought by rebel groups against Governments. The KP has therefore not counted as conflict diamonds produced in areas of relative stability, or even in those where changes to the policy framework, that have occurred over time, give a character of legitimacy to these conflicts, as in the striking example of production of the Marange fields in Zimbabwe. And, says:

> From the implementation of the KPCS until the year 2013, whose data are available, few changes have occurred in the primary sector of diamond production, with emphasis on the entry of Zimbabwe. However, even with the addition of production from Marange fields, in the southeast of the country, of 10,411,817 .65 carats, world production has not changed significantly during the period of validity of the KPCS, being approximately 150 million in 2003, passing through a maximum of 175,917,823 .48 carats in 2006 – period pre-global financial crisis – and stabilizing around 125 million carats, in present day, reflecting a possible control of prices by controlling supply.

In Brazil the diamond is produced and marketed continuously since the early 18th century. Of largest producer during the colonial period (1729-1822) and part of the Empire (1822-1889), "*favored by the abundance of mines and by extensive use of slave labor*" (Cassedanne, 1989). Passed in recent decades to a regular producer with an annual average around 900,000 metric carats. The beginning of the KPCS until the end of 2015, whose data are available, it is estimated a cumulative deficit in the production of more than 8.7 million carats (Figure 5). As the entirety of this production comes from secondary deposits and adopting the mean of the values reported in the Technical Report Nº. 50 (MME/SGM. 2009) around $ 250.00/cts, projected a loss of approximately US$ 2.2 billion for that period.

The causes of this decline are more extensive than reported by the DNPM (Brazilian Mineral Summary. 2003), passing through short-term and structural problems, as its model of world production, concentrated in the hands of large mining companies, apart from Brazil, as will be discussed below.

Notably the production of natural diamonds is an activity of global character, dominated by large corporations and a few specialized mining companies, which control, through the own productive activity and stocks regulators, supply and market prices. The knowledge of their reservations allows judicious choice on effective allocation of your investments, decreasing the risks inherent to the research of new productive fields and the development of new mining projects. In Brazil no one is present in the research and production of diamonds. Maybe, after the discovery and the development of a world-class brand, by junior mining companies, they may re-evaluate the interest in returning its activities in the country.

For Brazil the observance of requirements of the KPCS has impacted not only the primary production as the entire industry. It was evident the total disorganization of activity that, failing to meet the KPCS regulations, collapsed. In summary, the KPCS imposed control and, in response, have

emerged various crimes such as; contraband; illegal production; invasion of indigenous lands and environmental reserves; disrespect to environmental legislation; robberies; deaths and other crimes. Note that prior to the KPCS the Brazil attended with approximately 0.57% of the world production, with an average around 900,000 kt's/year. Currently its participation in the production of diamonds gems is irrelevant, in the order of 0.04%. It can be affirmed that the country was the only one to have real damage with the KPCS.

As shown in Figure 5, the diamond production presents steep decline after the year 2005, passing the historic average of 900,000 ct's/year, to 300,000 ct's/year until this year. We assume that the imposition of standards of the KPCS impacted part of the production, due to impossibility of companies in answering them, preventing it from participating in the formal market and probably leaving the activity. However, other party, with the sharp condescension of the institutions of control and supervision, continued to be produzidaoperar, resulting in the ' Carbon ' Operation and the subsequent temporary suspension of Brazil in 2006. The Brazilian authorities believed they might be signatories to the Protocol and does not comply with the requirements laid down. We believe that in this first moment were abandoned the stones of lesser value, due to the higher risk of sells them.

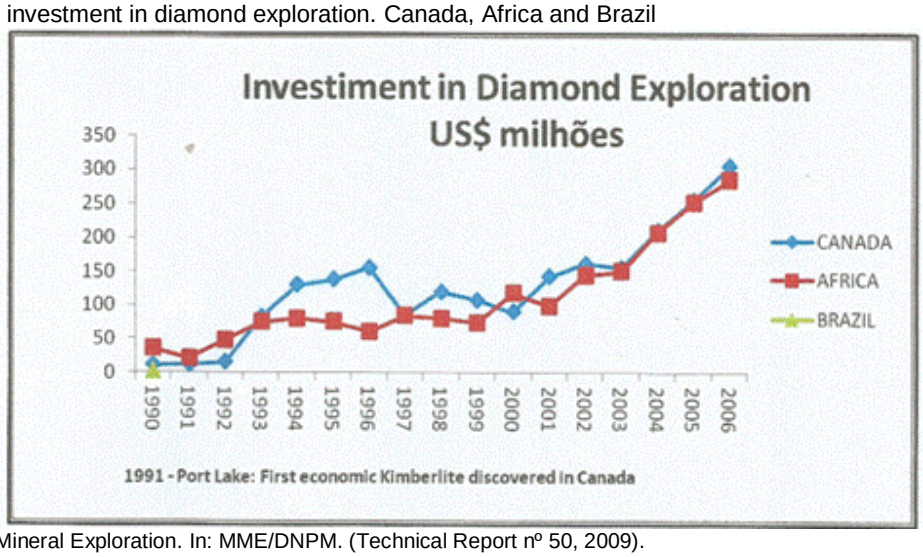
After this year of 2006, it appears the collapse of formal production of diamonds in Brazil. Now the annual average is less than 50,000 Ct's, with a tendency for stability in this level. Probably you can assign, without further consideration, that the complement to the average of the initial years of the KPCS; around 250,000 ct/year; continue being produced and marketed illegally, accumulating a possible volume, in this period of more than 2 million carats.

Despite the more than 1200 Kimberlites known in Brazil, a statistical advantage points to, at least, the existence of 12 viable deposits, investment remains far below the need to translate that potential into production. Figure 8 presents a comparison of diamond Exploration investments between Canada, Africa and South America between 1990 and 2006. As noted by Pisani, after the discovery of kimberlite from Port Lake, in 1991, in Canada (The Ekati diamond mine went into operation in October 1998. Until April 1999 had already produced 1.00 million kt's), "Bi 2.00 $ invested in diamond exploration since 1991 has resulted in the discovery of new diamond mines 4 = more than 2.00 Bi $ diamonds per year". Of course, the discovery leveraged resources to other similar ventures, resulting in the full development of the known mineral potential, reaching the current production levels.

In Brazil investments in search of diamonds are restricted to junior companies and a the 'Diamond Project Brazil' by the Mineral Resource and Research Company (CPRM, 2010), with a budget of $ 2,7 million, started in 2008 and scheduled for completion in 2010, however extended to 2014. No doubt the results expected will be proportional to the amount invested, even with the completion of good jobs, with few chances to change the current frame.

The Heritage Foundation, which evaluates the global conditions for the creation of business in 183 countries, classifies Brazil in the category of "non-freedom in most cases", with a 56,9 index relating to the average of several monitored parameters – degree of freedom, fiscal, monetary, financial, business, etc., while the average in the countries of Latin America is 59,4, and free trade, as countries in Europe, USA and Singapore, the index's average of 84,5.

Figure 8. Private investment in diamond exploration. Canada, Africa and Brazil



Source: Canadian Mineral Exploration. In: MME/DNPM. (Technical Report nº 50, 2009).

And more, according to the rankings released by the World Economic Forum, despite being the seventh economy in the world, from about 148 countries, it lies in 71st in terms of infrastructure. These characteristics help to understand the small fee of private investment in national mining.

According to industrial experts, in addition to the general factors that prevent a greater amount of capital in the Brazilian economy, privet investors are discourage because of other mineral sector specifics, such as; complicated and excessive regulations; delay in approval of the New Mining Code, or the absence of legislation, such as that regulating the mining on indigenous lands (Project of Law N°. 1610/1996); and, furthermore, the precarious infrastructure suitable for the sector; the limited set of qualified professionals, the lack of precision of geological data for most areas; among other things.

As the increasing production of synthetic diamonds, which dominate the market for industrial use, together whit seeing a significantly increased participation in the jewelry segment, has imposed a new reality for the industry and acts as an additional uncertainty factor in global decisions, especially those concerning the allocation of resources for the exploration and development of new sources.

For the country to resume the ancient production indexes, around 900,000 Ct/year, traditionally from secondary deposits, the adoption of measures to encourage the return of small producers and prospector associations must be considered, whereby the activity is duly adjusted and subject the KPCS regulations. Furthermore, administrative, fiscal and tax incentives, in addition to the demarcation of new reserves of Mining Prospecting, would be sufficient and at the same time, would enable the restructuring of the activities of stoning, an expertise still present in old *laborial* lapidary centers of Brazil, which haves been losing marketing possibilities for lack of rough diamonds.

However, for full utilization of the Brazilian diamond potential, it will be necessary to alter the productive model, giving emphasis to mining of primary deposits as a primary source of diamonds, and seeking to meet the varied demands that appear. For if the previously commented cyclical issues, along with the specific sector and structural issues, are considered, they affect not only the mining, but also other national productive sectors

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