EAGLESTONE SECURITIES

sínese

One century of Angolan diamonds

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Sínese

exploration & research

Created in 1995, the company focused its activity in Economic Geology and Data Analysis. The scope of the projects it has been involved in ranges from technical and feasibility studies, market research, exploration, geological and deposit modeling, design of specialized information systems, field work, mining plans, advising and support to negotiation.

Sínese has been especially active in the exploration, evaluation and mining of diamond deposits in Angola. Other Sínese natural markets include Western Europe, Southern Africa and South America, metallic and industrial minerals, natural stone, gemstones and geofluids.

eaglestone

eaglestone is a new Financial Services Authority "FSA" regulated investment banking business that aims to be a leading independent adviser, trusted partner and reference player for linking investments between Sub-Saharan African economies and other regions in the world, in particular: Europe, Brazil and Middle East. In Eaglestone we provide business from (i) Structured & Corporate Finance Advisory services, (ii) Capital Markets services and (iii) and the establishment and management of several private equity funds, focussed on Sub-Saharan Africa companies and businesses with a particular focus on Angola, Mozambique and respective neighbouring countries.

Our operational platform encompasses established offices across some of the key financial centres for Africa (London, Dubai, Lisbon and Amsterdam) and in the Africa countries we are focused (Angola, South Africa and Mozambique), together with a strong team of professional with investment banking international experience for more than 10 to 15 years. Part of our team is permanently based in Africa.

In Eaglestone we aim to identify opportunities and partnerships arising from the development of African businesses, to exploring the emerging middle-class growth investment opportunities and establishing mutual-benefit business and investment links between Sub-Saharan African economies and other regions in the world, namely Europe, Brazil and Middle East.

Within our Private Equity activity, we are presently setting up 5 new funds – Eaglestone Africa Funds – targeting a total capital of USD 500 M, focused on the following industries /sectors:

- Minerals.
- Real Estate.
- Infrastructure.
- Agribusiness and
- Basic Industry, Services & Consumer Goods.

Apart from the Africa Funds, Eaglestone is launching a renewable energy investment business through Eaglestone Infraventus Holdings, S.A. "EIH", a renewable energy investment company established by the Eaglestone in partnership with Infraventus Groups, a private-owned group with a deep knowledge of the renewable energy sector and a cumulative experience of over 20 years in the business.

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Data sources and methodology

This report has been meticulously prepared, double checking information when possible and using judgement when needed (often), especially because available data sources (*sometimes the same data source*) often present contradictory information. This a particularly serious handicap when the subject of research is an industry in a country with a poor reporting tradition within a global diamond industry with ways of its own.

The problem is compounded by the fact that *garimpo* (artisanal mining) represents an important fraction of Angolan diamond production volume and (even more) value. On top of it, although the Kimberley Process has introduced procedures that greatly minimize it, uncontrolled rough diamond trade is still a fact of life, in Angola and elsewhere. Part of diamonds' value resides in the fact that they are concentrated, portable wealth.

The Kimberley process has been the single most important source used on diamond production and trade (in a country aggregated perspective). The USGS Mineral Yearbook publications, ENDIAMA, DIAMANG for older information on the Angolan diamond deposits, several specialized publications (on paper and online), the annual operating and financial reports of companies such as CATOCA, De Beers, ALROSA and others (often quoting them *ipsis verbis* or with minor editions for clarity and correctness) and the personal records of the author were also important data sources.

Of course, the detail and volume of the information is clearly biased towards those companies and projects that have to publish information due to stock market rules. We have tried to minimize this effect; these efforts were successful to a point. We have also tried to expunge the companies' own bias from the compiled information, retaining only hard facts, preferring neutrality and avoiding subjective or controversial expressions.

This is a first report; others will follow on an annual basis or when major changes or events justify new revisions. All comments, corrections and suggestions are welcome; they will all contribute to a better report and knowledge about the Angolan diamond industry. Please keep in contact and contribute your views and opinions.

Several people at **Sínese** and at **eaglestone** worked hard for this report to be complete. For their contribution I want to leave here a special reference to Luís Caetano, Alexandre Correia, Tatiana Ribeiro and Manuel Reis.

I have worked, as an employee or consultant for several companies and projects involved in diamond mining and exploration in Angola: SPE and SML, ENDIAMA, ESCOM, the BHP/ESCOM JV and SOMIPA. Other than the possibility of allowing me to do the work I like for two decades, these companies' interests and this report's views are independent.

Finally, I have to thank the many friends that allowed me to tap into their personal knowledge and wisdom along two decades of work in the diamond industry. Without them this report would have not been possible. *Numbers are useless unless we are able to interpret them*.

Luís Chambel
Lisboa and Luanda, 20 June 2013

1 One hundred years

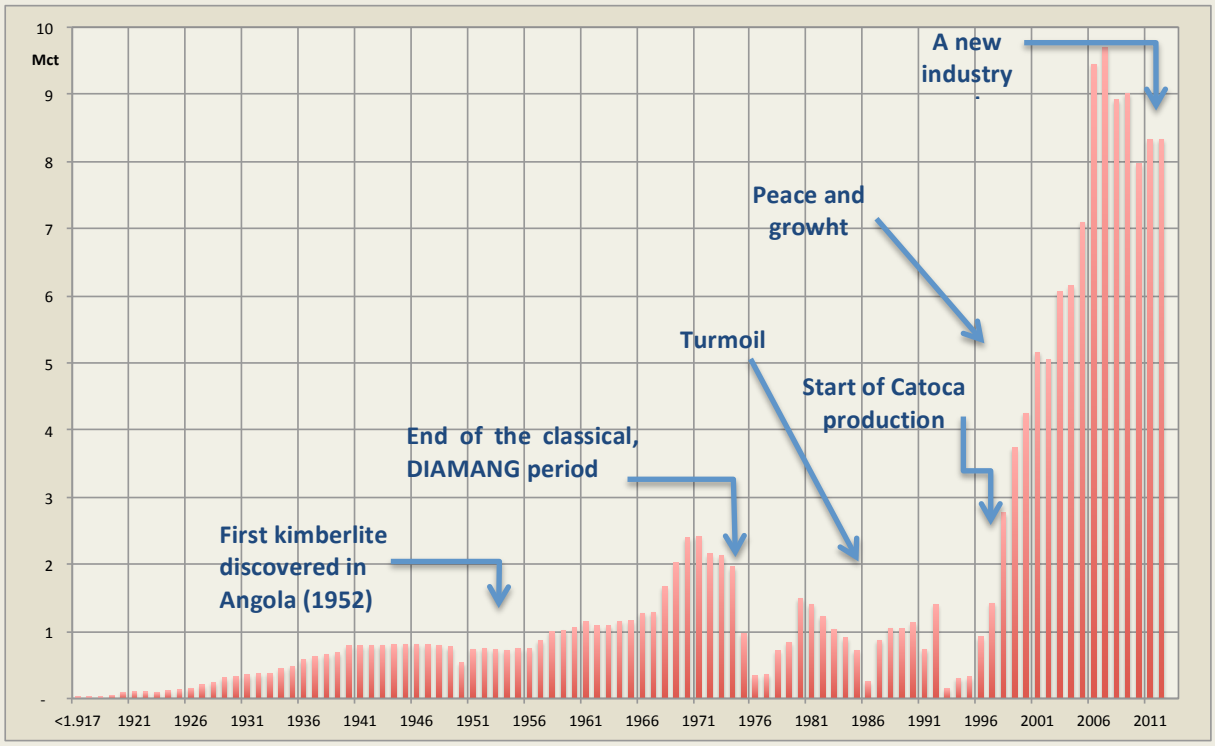

Figure 1 - One century of Angolan diamonds - production (Mct).

2012 is the year in which Angolan diamonds turn one century. Since the discovery of the first diamonds in 1912 in the Mussulala River - Lunda Norte, Angola has rapidly grown into a major producing country. This report celebrates that fact and describes the Angolan diamond industry's current situation, its future perspectives and opportunities.

1.1 Reasons for investing in Angolan diamonds

Angolan diamonds have been known for 100 years. These diamonds are famed for their high quality and high value and have attracted expert buyers from all over the world, from the giant De Beers (the exclusive buyer for many decades) to the smaller scale traders.

The country is endowed in both kimberlites and alluvial diamond deposits; many of those deposits still await development. Probably many more deposits still need to be explored and discovered in a territory with a huge potential for diamond.

There is still a road to walk but the last ten years have seen an increasingly stable and growing economy in Angola, with successive elections being certified as free and fair by international organizations and a growing diversified media sector. The business environment has improved and a new mining code has been approved. Transport infrastructure is also being either rebuilt or erected from scratch.

Angola is a land of many opportunities for diamond investors. It has a special business environment and specific risks and challenges; we will guide you through them in this report. We will also discuss the current situation of the international diamond markets and its future trends and the impacts they may have on the Angolan industry. In the end, we hope this report will help you establish a successful venture in this land of promise.

1.2 Main characters, old and new

Many people and institutions have been involved in the Angolan diamond industry during the last 100 years; places and natural features unknown until then have fallen under the spotlight of the industry. Among those involved, some had a leading role. The reading and analysis of this report benefit from an early introduction to those entities.

DIAMANG discovered and developed the Angolan diamond deposits over a period of sixty years. Four decades after its demise, there has been not a single deposit exploited in Angola that hasn't been found by this company. Until 1971, DIAMANG had a monopoly to explore for and mine diamonds in Angola. It exploited alluvial deposits with unparalleled success

and discovered the kimberlite clusters that are today's backbone of the Angolan industry – Catoca, Camatchia and Camútuè just to name a few.

ENDIAMA is the Angolan State's diamond company. Created after the end of DIAMANG, it's the single most important reference in the industry in the last three decades. Its role has had nuances over this period; ENDIAMA is, however, the main source of power and knowledge in the Angolan industry.

CONDIAMA was a joint venture between DIAMANG and De Beers active in the exploration of the Angolan territory between 1971 and 1975. Despite its short life, this company explored most of the country's territory, kimberlites being its primary target. Its efforts were cut short by the turmoil associated to the transition between the colonial regime and independence. During the 4 years campaign, this joint-venture company discovered many new kimberlites and alluvial occurrences and amassed an impressive volume of early-stage exploration data.

De Beers has had an almost-continuous direct presence in the Angolan diamond mining industry since the early 70's and before that as the exclusive production buyer. The results obtained have been discrete; despite the investment done in exploration the company still didn't develop a single kimberlite (perhaps this will change in the near future). De Beers' importance in the Angolan industry can't however be measured by exploration success only; the company has a special role in Angola, providing technical and marketing expertise.

The Lundas provinces and the cities of Lucapa, Dundo and Saurimo. The Lunda Norte and Lunda Sul provinces (NE Angola), are the heartland of the diamond industry in this country. The most important urban centers of this region are **Lucapa** – in the margins of the Luachimo River – Lunda Norte, **Dundo** – the administrative capital of Lunda Norte, close to the DRC border and **Saurimo**, the administrative capital of Lunda Sul; these are naturally the operational and logistical centers of most of the mining and exploration projects in the region.

Catoca, ALROSA and Odebrecht. A kimberlite, Catoca is currently the most important diamond mine in Angola. The mine is owned by Sociedade Mineira do Catoca, whose main partner is Russia's ALROSA. This company is also involved in several other kimberlite projects in Angola, being one its shining stars. This company's successful activity in the country is also a symbol of the long lasting special relationship between Angola and the Russian Federation. Odebrecht, a Brazilian conglomerate, is also one of the original Catoca partners. This company was also involved in other diamond mining projects in Angola.

SML is a joint venture between ENDIAMA and the Portuguese SPE – Sociedade Portuguesa de Empreendimentos S.A. Established in 1992 with a 35.000 km^2 concession to explore and mine diamond deposits in the Luachimo and Chicapa rivers (from their headwaters to the DRC border), it was prey to underfunding and mismanagement in a very difficult operational environment. The company is still formally alive; legal disputes between its partners place a huge question mark over its survival. The importance of its historical role derives from its capacity to operate in an especially difficult period when other operators didn't dare.

ITM's technical expertise and modern management practices (with their workers' generous bonus scheme, dependent on results) made it the most (perhaps only) profitable diamond mining company during the years of civil strife in Angola. Its activity showed that profitable mining operations could be done even during the most extreme conditions, paving the way to the boom of the Angolan diamond of the early XXI century.

ESCOM Mining has been involved in several exploration and mining projects, both primary (kimberlite) and alluvial, namely the Chimbongo (alluvial) and Camatchia (kimberlite) mines. The huge investment in exploration (arguably the largest diamond exploration company in 2007-2008) resulted in the discovery of many new kimberlites; some of these prospects are mineralized, awaiting further work to determine their feasibility.

The Cuango, Luachimo, Chicapa, Chiumbe, Luana and Luembe rivers. Angola diamonds earned their reputation from their alluvial sources. The rich alluvial deposits of those rivers (running S – N, flowing from the center of Angola into the Kasai River in Congo) contain a very high proportion of gem diamonds. These rivers also cross or border many of the country's kimberlites, e.g. the Camatchia, Camafuca-Camazambo and Sangamina, adding to their importance.

1.3 The Angolan diamond industry

First as a route of Indian diamonds to European markets and then, in the last three centuries, as the heart of diamond production, the South Atlantic has had a central role in this industry for half a millennium. On the South Atlantic margins, Austral Africa (primarily) and South America hold, still today, some of the world's most important diamond deposits.

Angola is one of the main world diamond producers. In addition to its historical importance (a producer since early XX century) and to its present production levels, Angola is also one of the world's main diamond

reserves and has huge potential (undeveloped or undiscovered) resources.

The Angolan diamond deposits have different natures:

Kimberlites (with volcanic origin), of which 1.000 (estimate) have been identified. Among these, many are mineralized and a handful has been exploited since the 70's: Catoca, Camatchia, Camagico, Camútuè, Sangamina. The widely accepted classical emplacement theory of the Angolan kimberlites argues that they erupted during the Cretaceous, contemporary to the early stages of the South Atlantic formation. Other additional (previous and later) stages of kimberlite emplacement have also been suggested. Diamonds produced from these sources vary widely, each deposit with its typical diamond signature, the large volume mine at Catoca fetching diamond prices lower than (the Angolan) average.

Old alluvial deposits, formed immediately after the main kimberlite eruption stage in Cretaceous times. The conglomerates at the base of the Calonda Formation (also known as the Calonda Group or Kwango Group) collected the diamonds released from the then recently erupted kimberlites.

Modern alluvial deposits, along or with close relation with modern river basins. In a simplified model, the diamonds contained in these deposits derived from either kimberlites (continuously being meteorized and eroded), from the Calonda Formation conglomerates (the main, earlier, alluvial diamond collector) or from other modern deposits. Alluvial diamonds were for many decades (until the late 90's) the main Angolan production source. Its average price is well above the world production average.

Although much remains to be done to turn Angola into a first-rate investment target, especially in what concerns infrastructure rehabilitation, local workforce training and legal environment, the quality and volume of its diamond resources and, in recent years, peace and political stability have inevitably placed this country into the mining investors' agenda.

1.3.1 Evolution of diamond mining in Angola

Angola is a carbon-based economy, oil being the country's main drive and diamond deposits the multi-polar centres of economic activity in the country's hinterland. The volume and high gem content of its diamond production turned Angola into a key player in the rough diamond world market for most of the XX and into this century.
For one century, Angolan diamond exploration and mining has had a major role in the country and in the world industry. It has been an eventful history:

Discovery and development (1912-1975). The first years of the XX century witnessed the discovery of the first Angolan diamonds (1912) in the wake of earlier discoveries in the Democratic Republic of Congo (then Belgian Congo). Key points in the first stage of the industry's development include the discovery of the first kimberlite in 1952 – Camafuca-Camazambo, 1958 and 1969, the first years in which 1 Mct and 2 Mct were successively produced. This period ends with a succession of major events:

- The death of DIAMANG's historic chairman, Comandante Ernesto de Vilhena in 1967.
- The end, in 1971, of the *de facto* monopoly of DIAMANG over Angolan diamonds, with the reduction of its exclusive area from the previous 1.000.000 to 50.000 km^2.
- The April 25, 1974 Portuguese revolution and subsequent Angolan independence in November 1975.

Turmoil (1975-2000). The Angolan independence in the sequence of the Portuguese revolution of 1974 was a disruptive event for the Angolan diamond industry. A new Government was established, with radically different protagonists and policies, not without conflict. A violent power struggle (a bloody proxy of the Cold War between the US-led western democracies and the USSR-led communist block) erupted between the three existing nationalist movements (FNLA, one of the contenders, waned into political and military irrelevance and oblivion during this process). This conflict continued for almost three decades, with a brief peace period in 1992.

The former (colonial) diamond mining industry structure (based on a *de facto* DIAMANG monopoly) was one of the first economic casualties of the independence process and the following strife. Important events following Angolan independence included: the nationalization of Portuguese DIAMANG shareholders, DIAMANG's bankruptcy and its replacement by ENDIAMA, the loss of both the financial capacity and technical expertise and the demolition by war of the country's logistical infrastructure.

This led to a marked decrease of diamond production. In a later stage of this period (1992 and onwards), the Government passed legislation that eased restrictions on diamond trade and mining. This led to the emergence of *garimpo* as an open activity. Later efforts (including the compulsory sale of diamonds to a single official channel) were never completely successful in eradicating it up into the present.

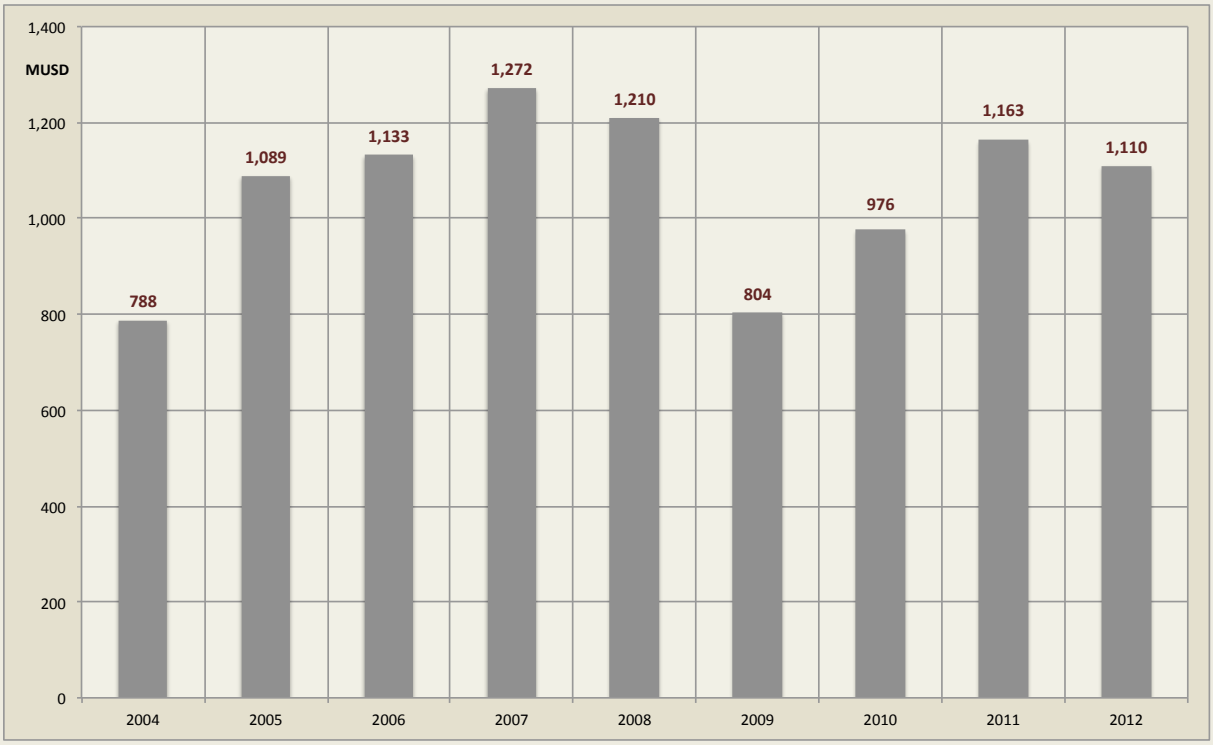

Figure 2 - One century of Angolan diamonds – Angolan production value 2004-2012 (Kimberley Process data).

Recovery, growth and globalization (2000-2011). In this stage, kimberlites are now, increasingly, the backbone of the Angolan diamond industry, with the Catoca mine as a predominant force. This phase has seen the flocking of international companies (both major players, e.g. De Beers and BHP Billiton, and junior companies) to Angolan diamond fields, with variable success. Recent years have also seen the emergence of *bona fide* junior Angolan mining companies. News of a continued expansion of the industry's production capacity – from 5 to 19 Mct in four years – fail however to fully materialize.

Peace and high oil prices ignited the Angolan economy. The country is booming, with a multitude of new projects, both private and public, being announced or started.

One of Angola's traditional economic pillars is diamond mining. This industry is also on the move, both with new prospecting and mining projects online and with increased activity in downstream industries until now either secondary or non-existing (diamond trading, diamond cutting and diamond jewellery).

In this stage, the diamond mining industry is extremely dynamic. Diamond production volume and value increase dramatically. The industry's growth is based in the Catoca kimberlite mine (currently the largest Angolan diamond producer by far).

Although having lost some of its past importance, alluvial diamond deposits still are a major diamond production source in Angola. Despite the fact that this type of deposits will tend to be progressively exhausted in the future, important alluvial diamond reserves still remain to be discovered and exploited.

On the external environment, De Beers changes from a diamond cartel into a luxury products company, as the industry is reshaped. In the final years of this period, the global financial crisis (the antechamber of a new global order, with Europe stalling its way to irrelevancy and China, India and South America getting ever increasing roles) has a major influence in the development of the industry.

Transformation (2011-). Due to both external and internal forces, the Angolan diamond industry has to restructure. On the external side, big changes are happening: the Oppenheimers sold their stake in De Beers to Anglo American, both RTZ and BHP are trying to dispose off their assets in diamond mining (and BHP succeeding in finalizing the transaction in 2013), diamond bourses with online pricing for certified cut diamonds are on the way, diamond commoditization ensuing as a result, the Kimberley Process likely on the path to its demise, the global economic uncertainty initiated in 2008 generating volatility in global prices and moods. Internal forces also play a major role behind the industry's restructuring:

- For several causes, ranging from their reasons to invest in diamond mining in Angola to local conditions, international companies have not been able to show a record of success in the Angolan diamond industry, which led them to paralyze or abandon their operations.

- Infrastructure, both physical and legal, improving but at a slower than needed pace. The new mining code (since December 2011) may solve many of the contract negotiation and investment security issues. Roads, railroads bridges and telecom are better than in the past but clearly still need major upgrades; this is increasingly more visible as you travel away from the coast.
- Local companies, still in small numbers, are emerging as investors in the early stages of the projects, paving the way for, in later stages, larger foreign companies still needed for capital and technology (especially in kimberlite deposits).
- There are still difficulties in hiring expatriates, with scarce local force for specific roles.
- The local markets are much better supplied than in the past, when virtually all items, from food to bolts, had to be imported; today's logistics in this type of goods is much smoother. The import of capital goods is still an issue, with long delays being common (either due to customs and or money transfer restrictions).

The Angolan diamond industry is characterized by:

- Having been based until 1974, in high value, high gem content, alluvial sources.
- After more than two decades of stagnation or, at best, irregular growth (until 1997), in which production was based on the exploitation of alluvial deposits, often outside the law, the current production expansion is based on kimberlitic sources – Catoca, Camatchia, Camútuè and likely other pipes in the future such as Tchiuso, Chiri and Mulepe.
- Big mining companies, such as ALROSA, BHP, De Beers and Rio Tinto, have a marked preference for primary deposits. These deposits' mines are capital and technology intensive; they are thus closed to operators of lesser technological and financial capabilities. On the other side, big mining houses are rigid, operationally and culturally, lacking the flexibility for a successful exploitation of alluvial diamond deposits.
- There are a great number of alluvial concessions in Angola; the vast majority of those concessions' shareholder base is constituted by ENDIAMA (typically, but increasingly less, the majority shareholder), local partners and a foreign investor, responsible for the project's financing and holder of the technical know-how.
- Many foreign companies involved in the alluvial projects in Angola lacked the needed technical and financial backing and are mostly focused on an attempt, unsuccessful most times, to obtain a fast dollar. For that, they try to exploit already known resources or develop ill conceived and underfunded exploration programs generally without environmental or social concerns.
- As a result, most concessions paralyzed, either by lack of an active investor, either by the investor lacking technical or financial capability or, yet, by disagreement between the shareholders, generally due to disappointment for not achieving the expectations of fast profits.
- The Angolan government aims to promote and rapidly increase the involvement of national human capital in the mining projects, restricting work visas for foreign citizens. This policy, associated to the scarcity of fully trained local human resources has led to a short-term low productivity of the projects.
- An Angolan policy for a diversification away from mining and trading of rough diamonds, with an effort being made to include downstream value adding activities, like diamond cutting, jewellery design and manufacturing. The establishment of these activities as profitable, self-sustained industries requires however a continued effort; only the future will tell if these intentions and attempts will ever achieve the desired results.
- Finally, as either an effect of the Angolan government policies or due to the increasing internationalization of its economy, there is a growing concern with environment protection. This trend is accompanied by an increased focus on social responsibility and awareness of the local communities and traditional authorities, their importance compounded by the specific characteristics of their tribal ancestry, geography distribution and political connections.

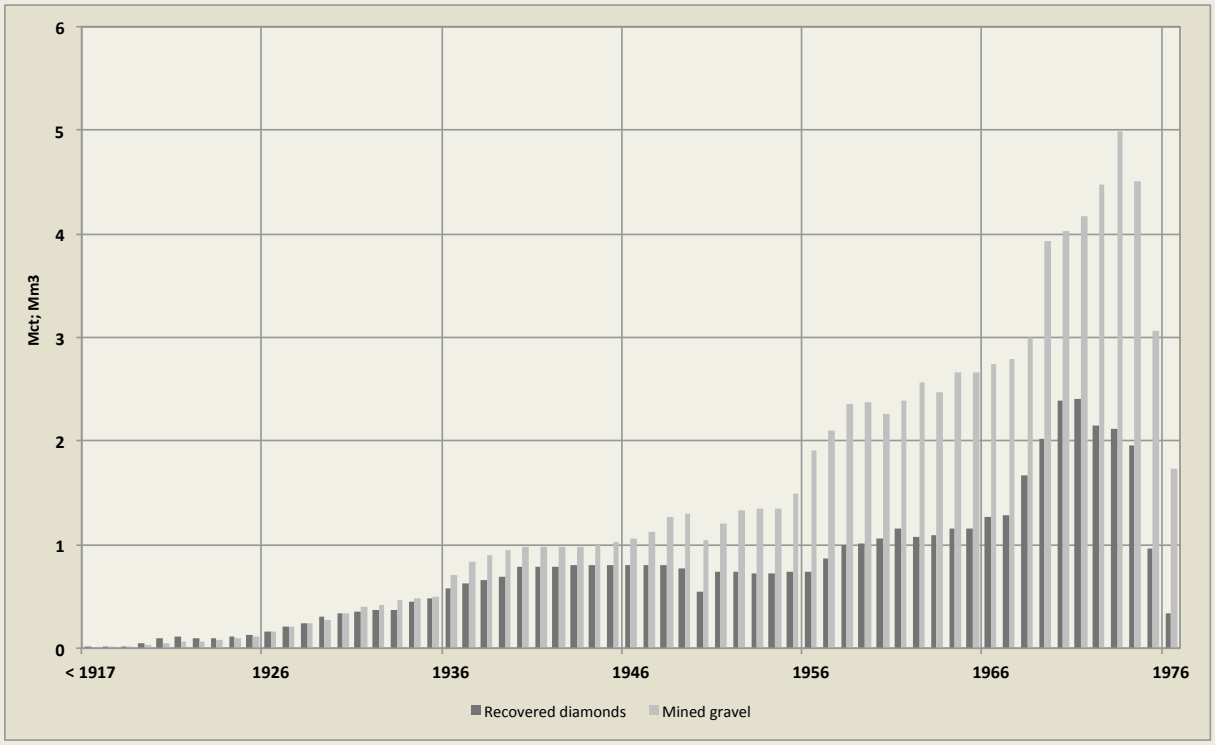

Figure 3 – Diamond (Mct) and mineralized gravel (Mm^3) produced by DIAMANG – discovery and development stage.

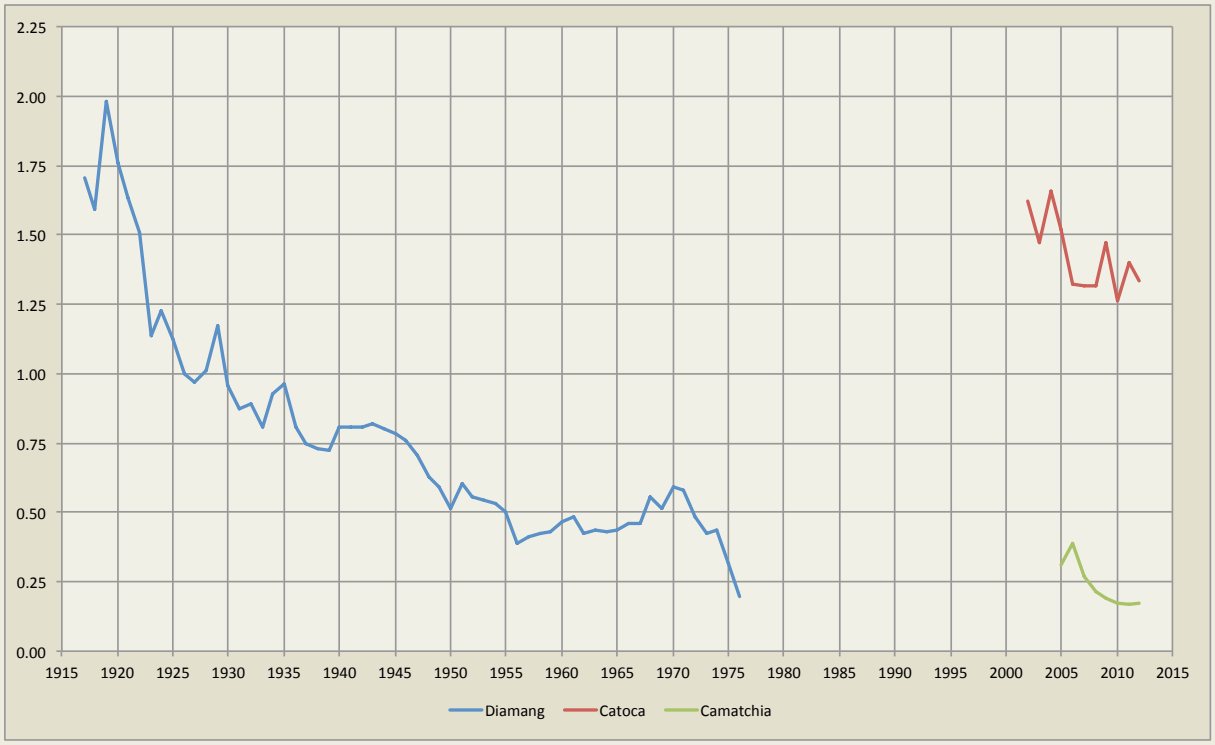

Figure 4 – Recovered grade (ct/m^3) evolution for DIAMANG (1917-1976), Catoca (2003-2012) and Camatchia (2005-2012).

1.3.2 Angolan diamonds: production, resources and reserves – facts, figures & myths

Figure 5 - The Congo craton within the context of the African and South American continents (Approximate location of Mesoproterozoic - older than 1.3 Ga - cratons in South America and Africa. These current two continents have been rotated back to their approximate positions during the Triassic period, to show which cratons were joined before the opening of the southern Atlantic Ocean). – author: (Woudloper, 2010).

The Congo (a.k.a. Congo-Kasai) craton is a major diamond metallogenic province with mining activity since the early XX century. The province includes deposits such as the Mbuji-Mayi cluster of kimberlites (and derived secondary deposits) in D. R. Congo and the Catoca, Camatchia-Camagico, Camuanzanza, Camútuè and several other clusters of kimberlites and a multitude of high gem quality diamond alluvial deposits in Angola.

Both the DR Congo and Angola have witnessed a renewed interest in their diamond deposits in the last decade, generating an unprecedented volume of new geological information since colonial times. Despite this fact, there were no new major deposits online yet as a result of this renewed interest; all producing mines in these countries were the result of the continued exploration efforts during colonial times.

Angolan diamonds occur in both primary and secondary deposits. Up until the late nineties, most diamonds produced in Angola originated in alluvial deposits. With the start-up of the Catoca mine that situation started to change in the late nineties; the Camatchia mine of the Luó project and other projects may add to that trend.

Notwithstanding the growing importance of primary deposits production, alluvial deposits still account for an important share of the total value, especially due to its high unit price. In addition to the currently producing alluvial projects, like Cuango, Chitotolo, Canvúri and Somiluana, many projects now on hold

could be set to start production thus increasing the Angolan diamond production.

1.3.2.1 Production figures

The Angolan diamond industry is in the midst of a major restructuring. This event is the result of both external changes and internal forces. The 2008 financial crisis triggered the closure of several mines and exploration projects. As a result, the number of active operations is more limited than in the past.

The value of the Angolan production has fluctuated around 1.000 M USD per year since 2005 with variations around the average being due to the level of production, its origin mix and the global price level of diamonds.

The volume of production has remained relatively stable at 8 Mct per year since 2006. This behaviour is explained by the stabilizing effect of the Catoca production, with the one originating in other projects varying considerably, both in volume and value - Figure 6 and Figure 7, respectively.

The powerhouse of the Angolan industry is increasingly the Catoca mine that currently mines 5 Mm^3 and processes 10.5 Mton of ore to recover 6.7 Mct worth 579 M USD with an operational margin 36% of sales. The Catoca mine production is equivalent to 84% in volume and just below 60% in value of the Angolan production (2012 values).

The average price of Angolan diamonds had a peak in 2005, with a value of 154 USD/ct. That value decreased since then, reflecting the larger proportion of the lower than average value of Catoca diamonds in the origin mix. Additional fluctuations are due to global market price variations, with a sharp decrease in 2009 and a recovery in 2010 and 2011 (year in which the price reached the pre-crisis level), again falling in 2012 to 133 USD/ct (86 USD/ct for the Catoca diamonds).

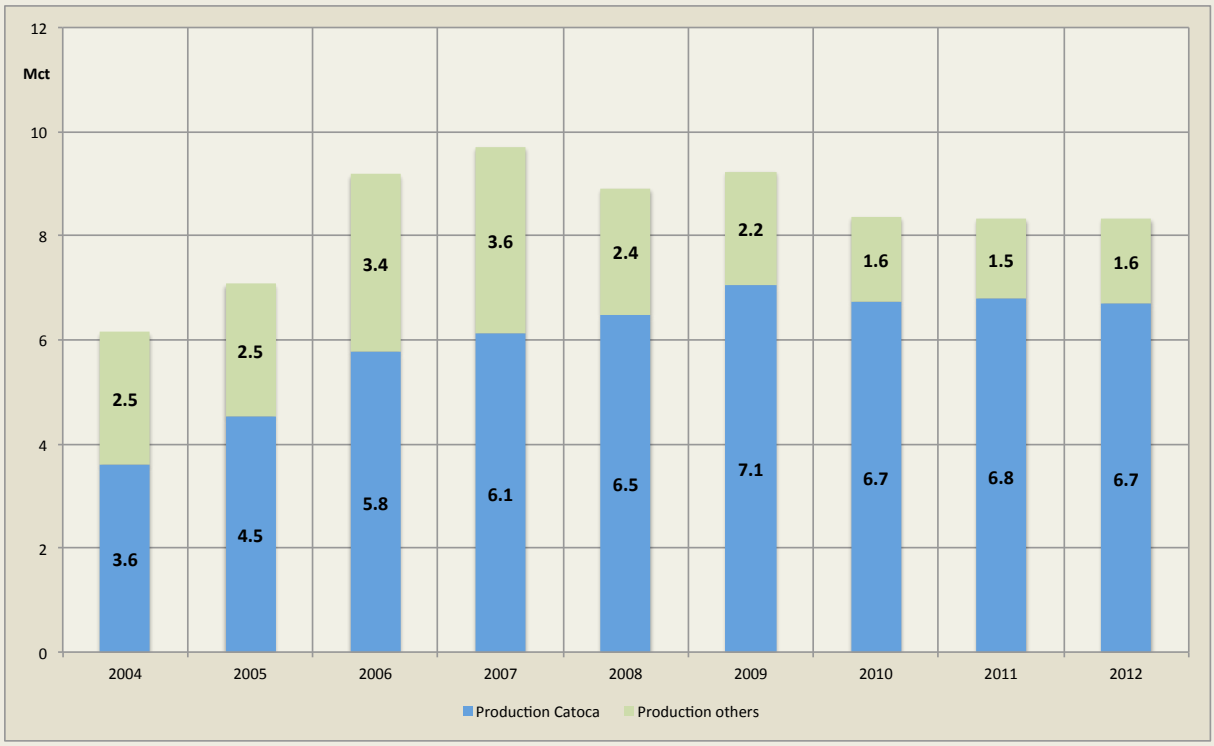

Figure 6 - Angolan diamond production (Mct) - Catoca and the other projects).

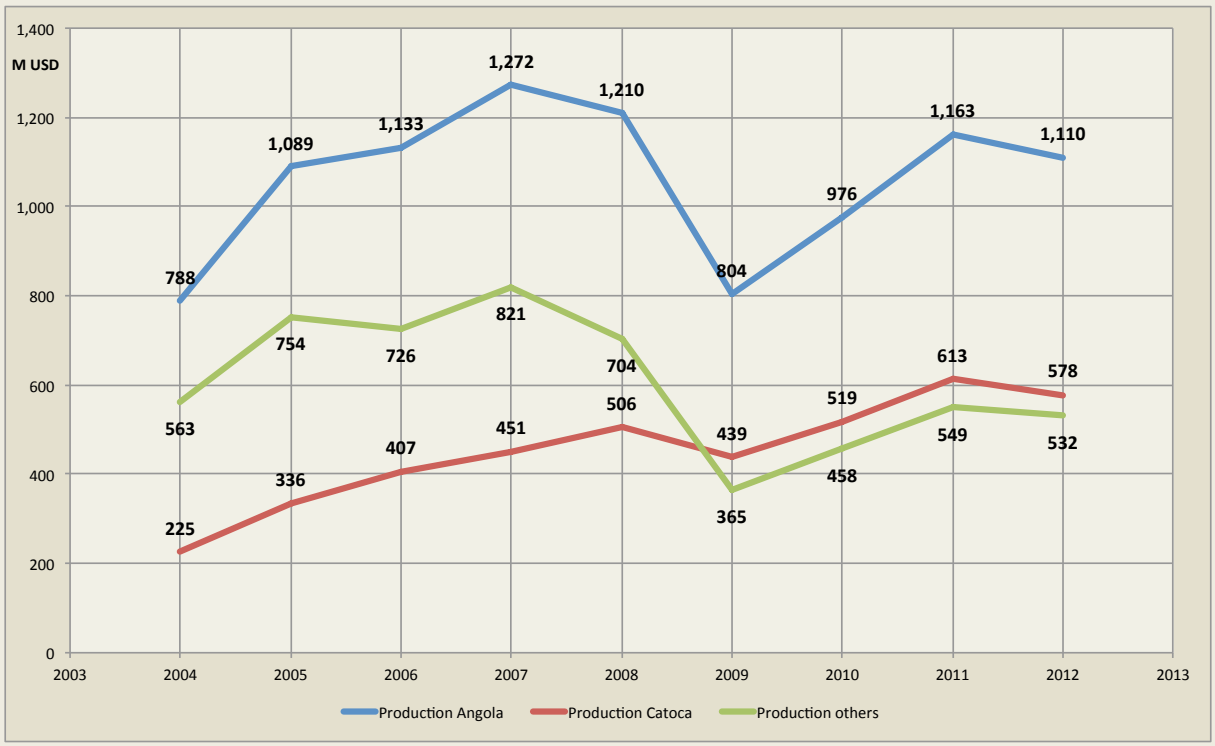

Figure 7 - Angolan diamond production value (MUSD): global, Catoca and others (2012 – estimated value).

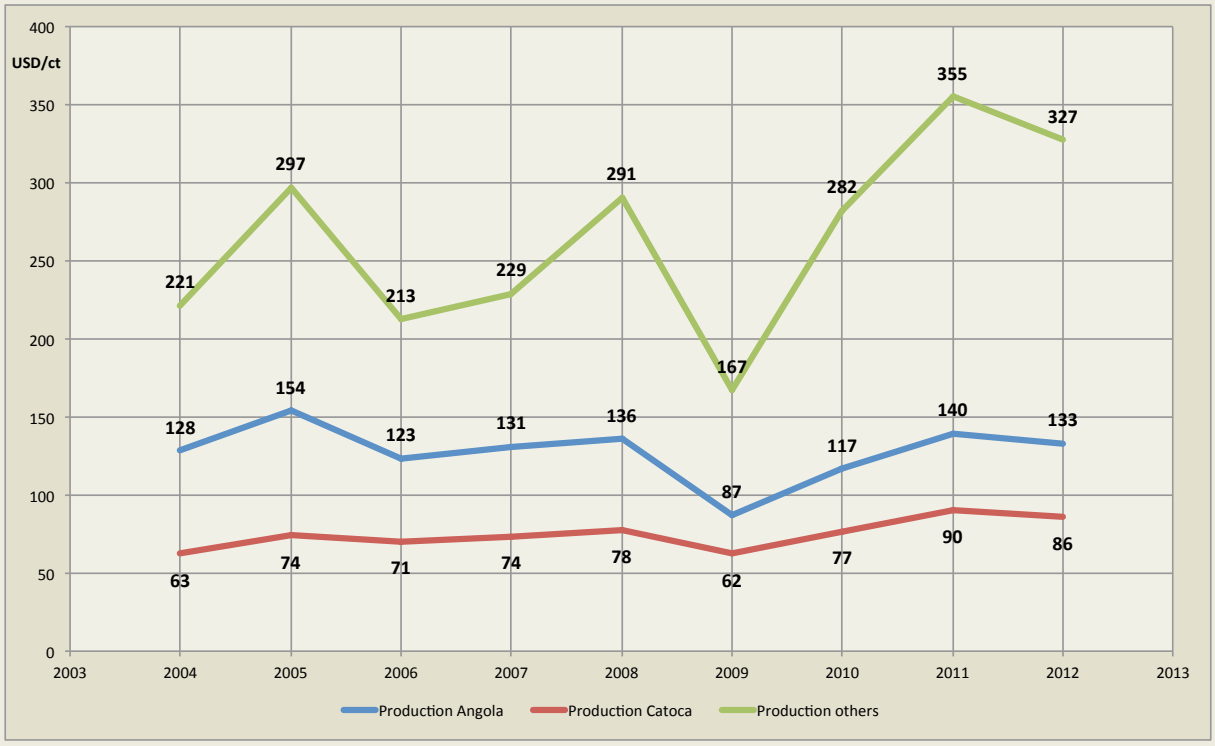

Figure 8 - Angolan average diamond prices: global, Catoca and others (2012).

1.3.2.2 Resources and reserves

Angolan diamond resources and reserves have not been compiled since 1975, leading to senseless discussion around the issue. The confusion derives from several factors:

Conceptual issues. One major problem concerns the informal (ab)use of "resources" and "reserves" in the Angolan context. Those words are precisely defined yet they are often incorrectly used in reports, apples being added to oranges.

Reporting issues. Companies holding mineral rights (especially those involved in alluvial mining) seldom, if ever, file detailed reports on their concessions to official authorities, many of them lacking the will or capability to do so. Official authorities don't publish disaggregated figures.

Calculation issues. The computation of reported figures may be prone to several problems of which the following are quite common:

- Senseless reconciliation. Reserves reconciliation is frequently done on a simplistic way, by subtracting the raw production values from remaining "reserves" figures. The repetition of this procedure leads to gross accumulated errors.
- Ignorance of the details. Old exploration data (hundreds of thousands of $2m^2$ section wells dug by DIAMANG) is preserved in paper maps and logs. In order to avoid calculation errors, it is necessary to know in detail the logging and reporting procedures used by DIAMANG.

This said, some figures have been advanced for Angolan diamond "reserves". In a document of a decade ago, written on those author's extensive knowledge of the Angolan deposits studied during the DIAMANG period (Pereira, Rodrigues, & Reis, 2003), in 1975:

Proven reserves: 65 Mct, of which:

- Primary sources: ≈ $45x10^6$ carats;
- Sedimentary detrital deposits (recent alluvial-elluvial gravels, and some area with Calonda Formation basal gravels): ≈ $20x10^6$ carats.

Probable reserves:

- Primary sources: ≈ $40x10^6$ carats;
- Sedimentary detrital deposits in recent alluvial-elluvial gravels (undervalued reserves): ≈ $7,5x10^6$ carats;
- Calonda Formation basal gravels: ≈ $26x10^6$ m^3 (a total of $10,4x10^6$ carats is estimated), with an average ore grade of 0,4 ct/ m^3 and 0,8 m for the conglomerate thickness with an overburden thickness of about 30-60 m.

Those authors note that

- The exploitation results are 22% higher than the ones of exploration. On the other hand, an increase in 30-40% of ore proved reserves must be considered, because in almost all the defined mining blocks the exploitation continues beyond the limits of these blocks with ore treatment plant ore grade control.
- The Calonda Formation basal conglomerate was investigated and sampled by drilling. In face of the ubiquitous occurrence of this lithostratigraphic horizon in Lunda, it is easy to point out the huge potential of Calonda Formation as a future diamond reserve.
- The discovery of 383 kimberlites, between 1952 and 1973 (176 in 1973). In addition, 46 new kimberlites were found by CONDIAMA (a De Beers and DIAMANG associated Company), in a total of 429 identified kimberlites until July of 1973, grouped as: 2,8% economically exploitable; 1,2% under evaluation studies; 46,6% without diamonds and 49,4% not studied. At the time of (Pereira, Rodrigues, & Reis, 2003), about 600 kimberlite bodies had been identified.

Current reserves and resources *strictu sensu* figures are very rare. The found exceptions are those of listed companies or of those whose parent companies are listed or intend be so in the near future:

- Catoca kimberlite (values reported in 2002):

Class	Level (m)	Ore (Mton)	Grade (ct/ton)	Reserves (Mct)
B	960-760	135.0	0.69	92.5
C1	760-560	85.5	0.64	55.1
C2	560-360	50.5	0.83	41.7
Total	-	271.0	0.70	189.3

- Somiluana (as of March 31, 2013):

Type	Ore (Mm^3)	Diamond (Mct)	Grade	
Probable reserves	10.568	1.712	0.162	$ct.m^{-3}$
Indicated + Inferred resources	53.659	8.031	0.150	$ct.m^{-3}$

2 Angolan exploration and mining projects

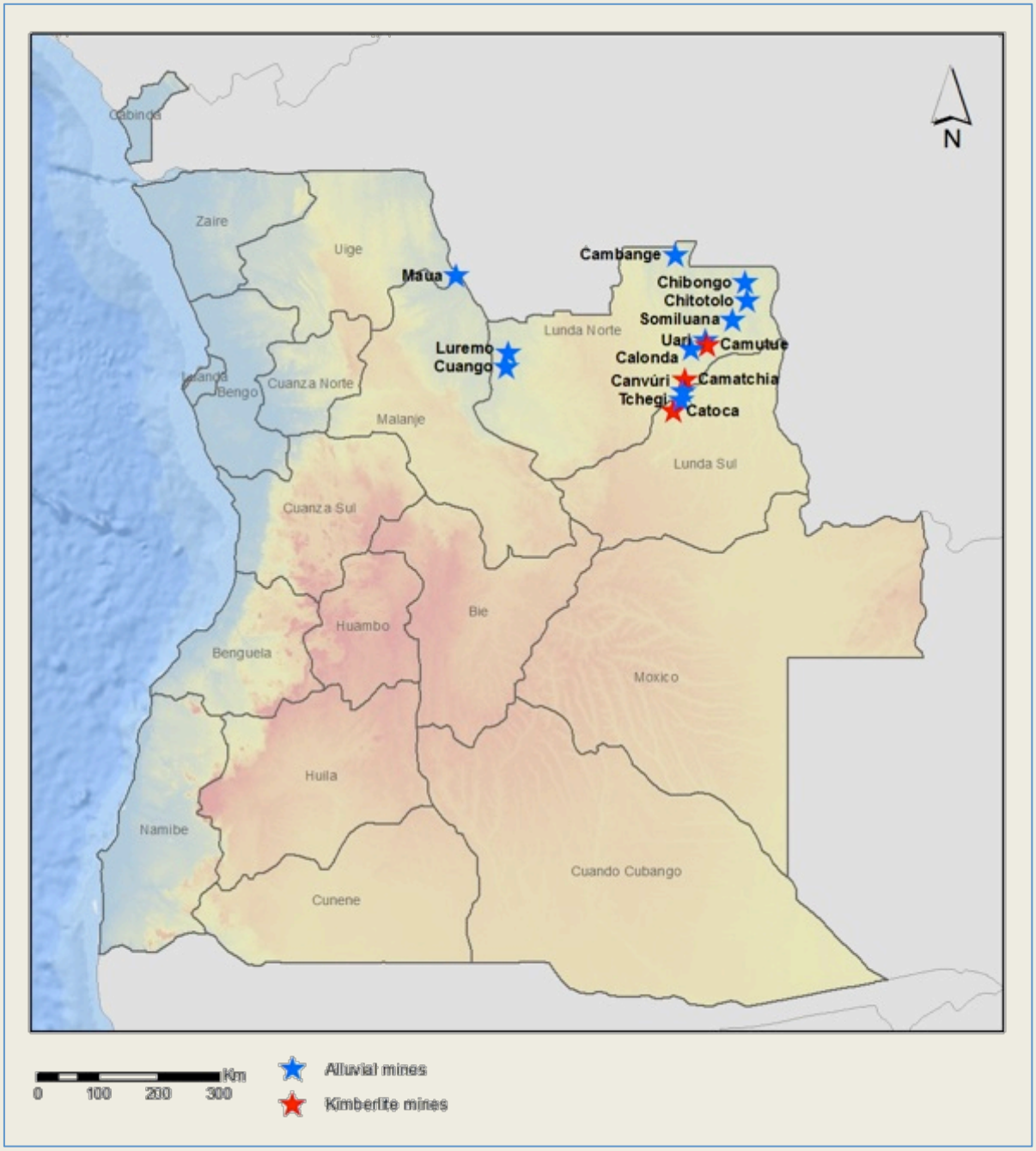

Figure 9 - Active diamond mines in Angola.

Angola has several active diamond mines and exploration projects. The active mines are:

Kimberlite sources:

- Catoca, operated by SMC – Sociedade Mineira do Catoca, the powerhouse of the Angolan diamond industry accounting for 6 Mct per year.
- Camatchia, operated by Luó – Sociedade Mineira do Camatchia Camagico. Production is based on the exploitation of the Camatchia pipe but there are other mineralized kimberlites in this cluster.
- Camútuè. This cluster of kimberlites has been known for 50 years. It is a conveniently located just outside Lucapa and it was known in DIAMANG times for the high quality and value of the produced stones. Nonetheless, the main kimberlite hasn't produced diamonds up to its expectations due to erratic management and investment decisions. The concession is currently on an operational limbo. Nonetheless, there has been production recorded for this kimberlite in the last years (2011 and 2012).

Alluvial sources:

- Luremo, operated by Luminas, Sociedade Mineira do Luremo in the Cuango River had a production close to 125.000 ct and 48 MUSD in 2012.
- Cuango, in the Cuango River, operated by SMC – Sociedade Mineira do Cuango.
- Chitotolo, in the Luembe River, operated by operated by Associação em Participação Chitotolo of which ITM is the investor. It produced 211.000 ct @ 400 USD/ct in 2011 (up from 330 USD/ct in 2010).
- Somiluana, in the Luana River - a tributary of the Chiumbe River, operated by Transhex. This project has a 50.000 ct/y production capacity (41,313 ct produced in 2012 @ 352 USD/ct).
- Tchegi, by ESCOM Mining. Located in the Chicapa River due to start production in 2013.
- Uári (formerly SML), started production in 2013.
- Calonda (formerly SML), started production in 2013.
- Maua, in the Malange province, due to start production in 2013.
- Cambange (formerly Luarica), due to start production in 2013.
- Canvúri, in the Chicapa River, just south of the Luó concession and north of Tchegi.
- Garimpo activity, with activity in the centre and northeast of the country (Lunda Norte, Lunda Sul, Malange, Bié, Moxico provinces). Under a recent law, the Government is issuing artisanal licenses for alluvial diamond mining.

Several other alluvial mines are currently under consideration, in a care and maintenance status or have in the process of having their licences revoked by the Angolan Government. Several concessions, previously active, now fall under this category: Fucaúma, Lacage, Lucapa, Mufuto and Cassanguidi.

There also several exploration (or pre-operation) projects underway:

Kimberlite sources:

- Lunda Nordeste by De Beers. Activities continued on the Lunda Northeast concession with another three pipes discovered, bringing the total number of discoveries to 117 kimberlites. 22 of these have been prioritised for deposit-phase diamond grade testing to confirm their economic viability. The conceptual study for the Mulepe-1 kimberlite was completed in November but indications suggest a stand-alone deposit is uneconomic under current assumptions (De Beers, 2013).
- Lulo by Lucapa Diamond Company (formerly Lohnro Mining). The 3,000 km^2 concession is located east of the Cuango River – Angolan diamond heartland. Since 2008, the exploration work conducted by Lucapa at Lulo has focussed on defining both alluvial and kimberlitic diamond deposits. In 2011, LUCAPA announced plans to drill test the 61 (out of 247 possible kimberlite) targets prioritised. The 30 ha Se12 kimberlite target is be the first of the targets to drill. (Lucapa Diamond Company, 2012)
- Muanga and Cacolo by SOMIPA. Hundreds of kimberlites are located in this region. This is a highly prospective area, next to the sources of the Chicapa and other rivers. SOMIPA has taken over the exploration and evaluation work of the many kimberlite prospects started by other companies in these two contiguous concessions.
- Tchegi and Itengo by ESCOM Mining. These concessions are part of initial eight BHP-ESCOM JV kimberlite exploration concessions (the other concessions being Cabuia, Alto Cuanza, Damba, Sanjungo, Vulege and Xá-Muteba). These two are contiguous and located along the Chicapa River, just south of ESCOM's Luó mine.
- Luó by Luó – Sociedade Mineira do Camatchia Camagico. This is a concession with an operating mine – the Camatchia kimberlite. Several other mineralized kimberlites – notably the Camagico pipe and the Lunhinga I and II blows – are clustered along others (still unexplored). Work done by ATS (wholly owned by ESCOM Mining, Luó) identified several additional targets.
- Chitamba-Lulo. METALEX has a kimberlite license in Angola covering 3,000 km^2 over part of the Chitamba-Lulo kimberlite cluster and the Cucumbi and Cuango Rivers.
- Tchiuso, by Sociedade Mineira do Catoca. This kimberlite is in a pre-production stage. SM Catoca is also involved in other exploration projects: Vulege, Tchiafua, Gambo, Gango, Quitubia and Luangue.
- Chiri. This project was held currently in care and maintenance until 2012, when Gem Diamonds formally ended the Company's participation in the Chiri project (GEM Diamonds, 2013).

Alluvial sources:

- Santechifunga, Genius Mineira.
- Quirima, Sautar, Luando, Sauanga, Caipupa and Zonde by SOMIPA. Five of the six concessions are grouped together; Zonde is isolated, to the south. They have been prospected in the last few years.
- Itengo by ESCOM Mining. Contiguous to the Tchegi concession, it is located along the Chicapa valley, south of the Luó concession.
- Luege, Lunda-Sul, with 3.000 km^2. ENDIAMA has a 51% stake, with the remaining 49% for SGM – Sociedade Geral de Minas.
- Luia, in Lunda Norte, with Trans Uíge, a local company as the main investor.
- Lulo, Lucapa Diamond Company.

2.1 Mines

2.1.1 Kimberlites

2.1.1.1 Catoca

Figure 10 - The Catoca pit - September 2008.

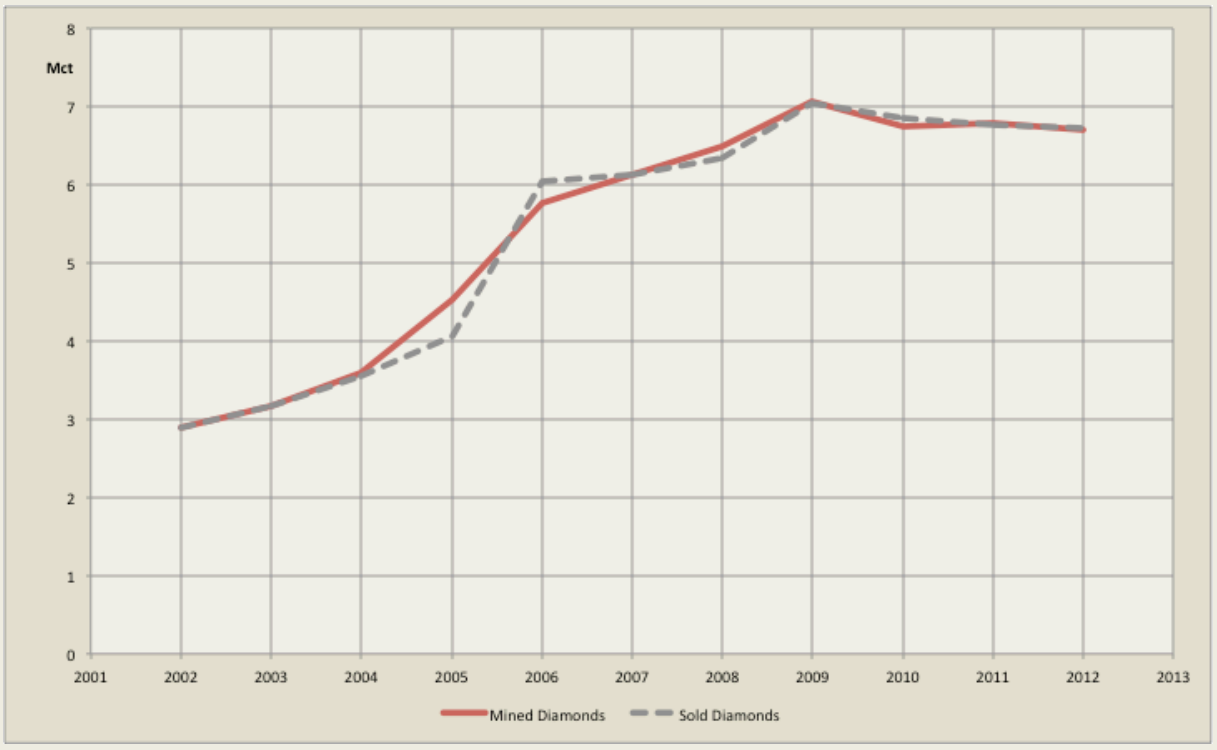

Figure 11 - Catoca mine production (Mct) - compilation of SMC annual reports' data: (Sociedade Mineira do Catoca, 2007), (Sociedade Mineira do Catoca, 2008), (Sociedade Mineira do Catoca, 2009), (Sociedade Mineira do Catoca, 2010), (Sociedade Mineira do Catoca, 2011), (Sociedade Mineira do Catoca, 2012) (Sociedade Mineira do Catoca, 2013).

The Catoca mine is the current powerhouse of the Angolan diamond industry, annually producing close to 7 Mct with a total value of around 600 MUSD. The annual mined ore volume is currently 5 Mm^3 (10 Mton processed ore) with stripped waste rock reaching more than 10 Mm^3 - Figure 15 and Figure 16. The recovered grade is relatively high, exceeding 0.64 ct/m^3, i.e., over 60 cpht, a value offset by the comparatively low diamond price (for the Angolan average), close to 90 USD/ct - Figure 14.

In 2011, Catoca sales represented 87% of Angola's total rough diamond sales by volume and 64% by value (with similar values expected in 2012).

The 2011 production and sales figures were mostly influenced by an increase in diamond prices with produced volumes in line with 2010 figures. Average prices for the Catoca production decreased in 2012, again with volumes and grades unchanged (or with minor fluctuations), with the significant exception of the increased stripped waste rock (with the annual stripping ration jumping from 2.0 to 2.7 - Figure 18). Decreasing prices and increasing operational cost led to a decreased (yet still very profitable) operational margin - Figure 13.

Catoca noted a partial recovery in the U.S. in 2011 while Europe's debt crisis continues to present challenges for the market. Catoca management reported that China increased its consumption of rough diamonds during 2011, while India maintained its consumption in recent years. In addition, the company said it has faced increased competition from the large reserve of diamonds held at the Marange mines in Zimbabwe.

Figure 12 - Competitors - Zimbabwean diamonds.

ALROSA is one of the founders of Catoca, considered to be the fourth largest kimberlite pipe for reserves (estimated at 140 million carats) – Catoca being its only diamond-mining asset outside Russia. Another founder was Endiama - 32.8%. Endiama holds the monopoly for the sale of Catoca diamonds. ALROSA does not have a share of Catoca sales and its participation is restricted to obtaining dividends, which amounted to $37 million in 2011 (Rough and Polished, 2012).

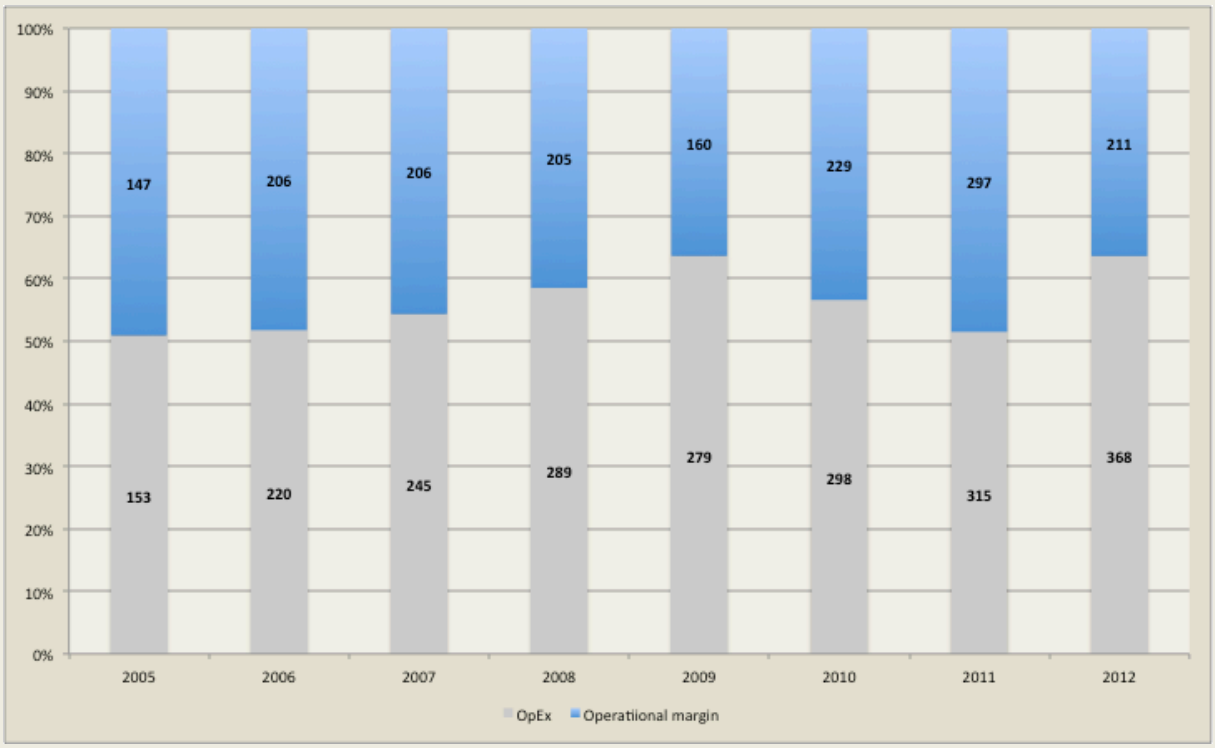

Figure 13 - Operational expenditures - OPEX (depreciation not included) and operational margin at the Catoca mine - compilation of SMC annual reports' data.

Figure 14 - Catoca diamond price evolution - compilation of SMC annual reports' data.

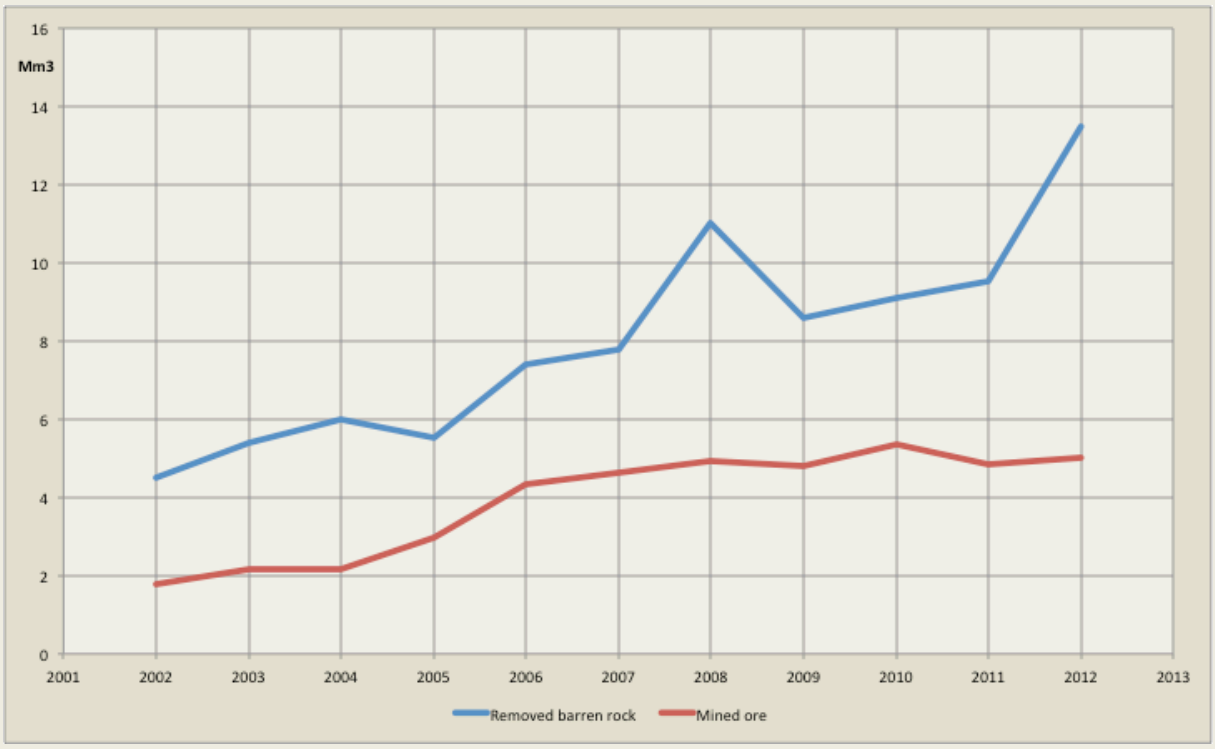

Figure 15 – Volumes of removed waste rock and mined ore at the Catoca mine - compilation of SMC annual reports' data.

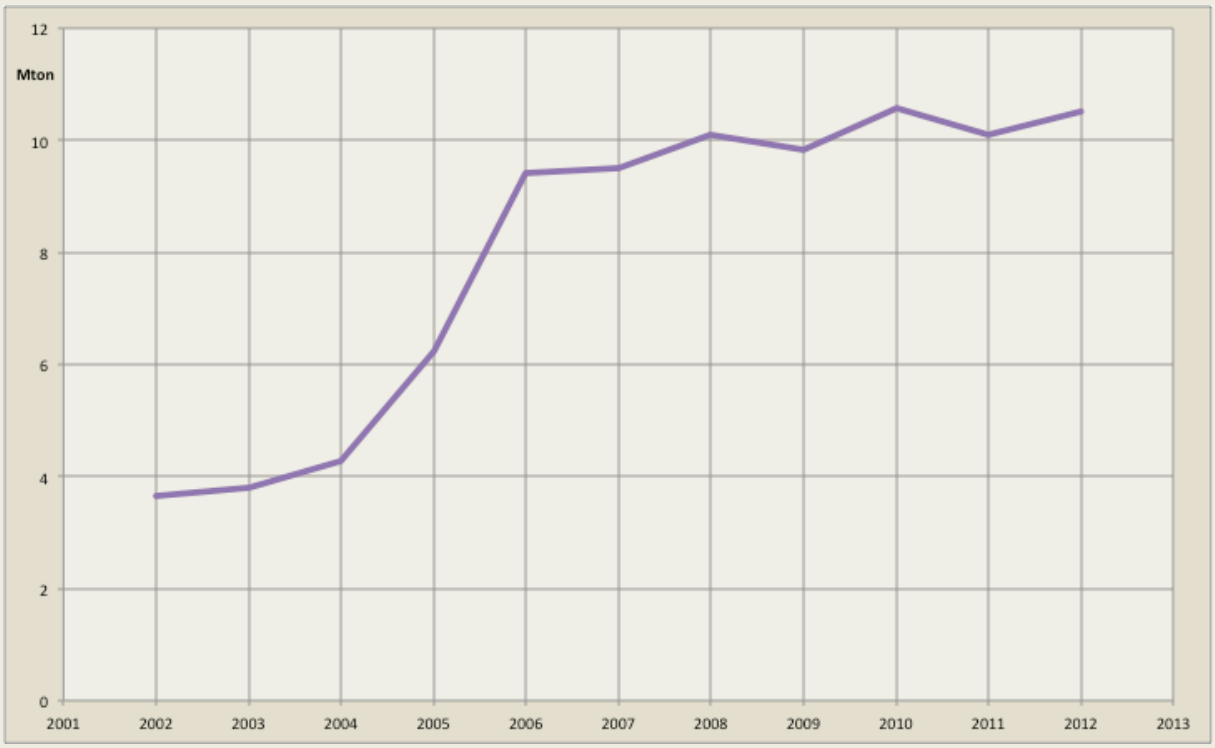

Figure 16 - Processed ore (ton) at the Catoca mine - compilation of SMC annual reports' data.

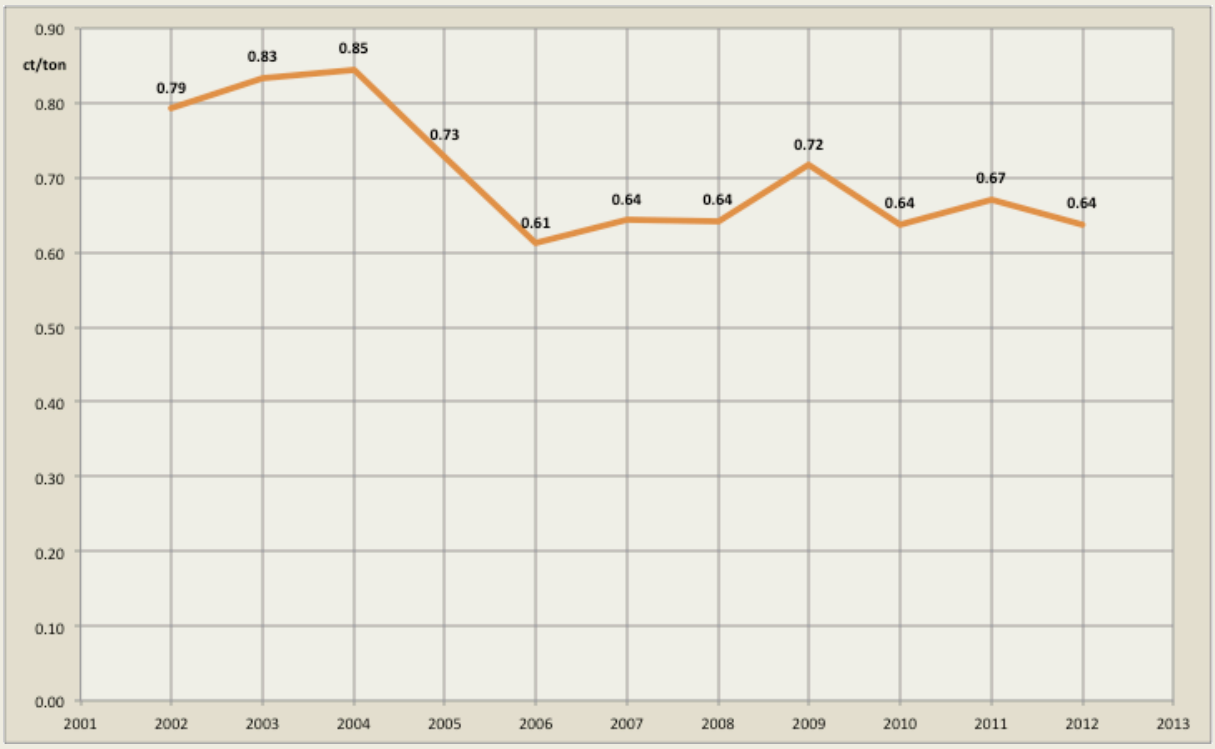

Figure 17 - Diamond grade of produced ore ta the Catoca mine- compilation of SMC annual reports' data.

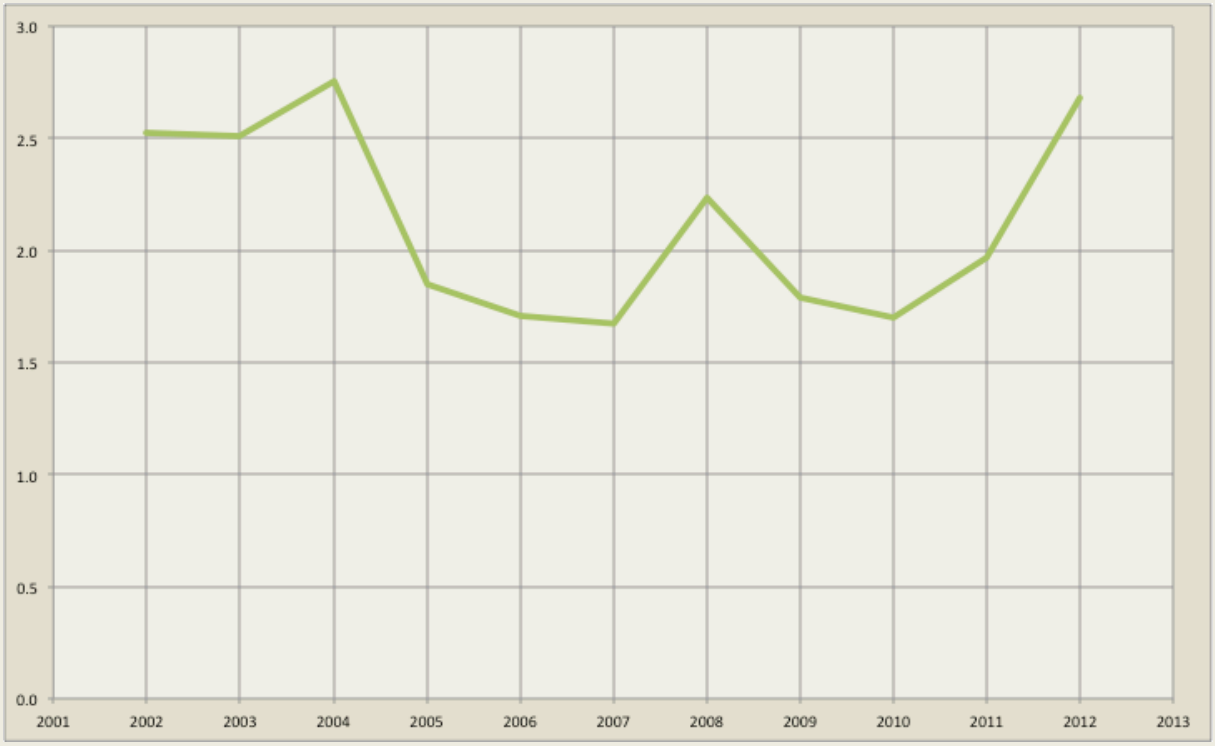

Figure 18 - Stripping ratio at the Catoca mine - compilation of SMC annual reports' data.

2.1.1.2 Camatchia-Camagico

The Camatchia kimberlite is the central pivot of the current mining activity of ESCOM Mining in the Angolan diamond industry.

The Camatchia kimberlite has a surface area close to 30 ha, is oval shaped with a slight elongation in the northeast direction. The top 100m of the pipe is the traditional crater facies, graduating and reducing in size of 17.5ha of hypabyssal kimberlites. The ore body dips at 75 degrees on the southern and northern zones and 85 degrees on the eastern/western limits.

Figure 19 - Installation of the tuff plant in the Camatchia mine.

The Chicapa River flows directly over the kimberlite pipe but this has since been diverted.

The kimberlite cluster of which the Camatchia is the pipe in a more advanced work stage has been the subject of several exploration and incipient mining works since the sixties and seventies.

The mine has extensive infrastructure in place, with residential areas, workshops, social infrastructure, roads and a diesel generated power station.

Figure 20 - The Camatchia kimberlite mine in September 2008: Chicapa River diversion channel and bridge in foreground and the pit in left background.

The Camatchia-Camagico cluster is composed of seven delimited kimberlites and probably several other primary structures (high potential ground geophysical targets):

- Camatchia – 32 ha pipe. The mining activity is currently centred in the Camatchia pipe.
- Camagico – 23 ha pipe.
- Lunhinga I.
- Lunhinga II.
- Cula.
- Carambala.
- Samuchito.

2.1.1.2.1 Production

In the eight years (2005-2012) of its life the SMCC Camatchia mine has produced a total of 1.25 Mct with a value of 252 MUSD. To do so, a total of 22.5 Mton were moved (of which 15.4 Mton ore, with 11.1 Mton treated) - Figure 26.

The mine's best production year was 2006, after which production levels decreased to half that volume in 2009-2010. Diamond production has partially recovered in 2011 and 2012 - Figure 21.

The evolution of Camatchia produced diamonds average price has been globally favorable (with values close or above to 250 USD/ct in the last three years) - Figure 23. Globally increasing diamond prices for the Camatchia production allowed for a more subdued variation in produced value when compared with production's - Figure 22.

In comparison to Catoca mine, Camatchia has lower reserves and grade - Figure 4 and Figure 25 - but a much higher average diamond price. The stripping ratio in the Camatchia project is lower - Figure 24 - but that is probably due to the lower production rate (and selective mining) in this pipe.

2.1.1.2.2 Prospects

Exploration has been particularly active in the Luó concession, with positive results. The 2009 VTEM helicopter-based survey generated 18 targets. Subsequent land gravimetry over those targets optimized the location of 23 pilot and 23 drill holes.

Of the 18 targets, seven new kimberlites were confirmed, four of which where considered potential deposits. A LDD program was designed for macro-diamonds grade testing in a first stage. A second stage of the program will encompass further sampling to recover 3.000 to 5.000 cts (for average price evaluation).

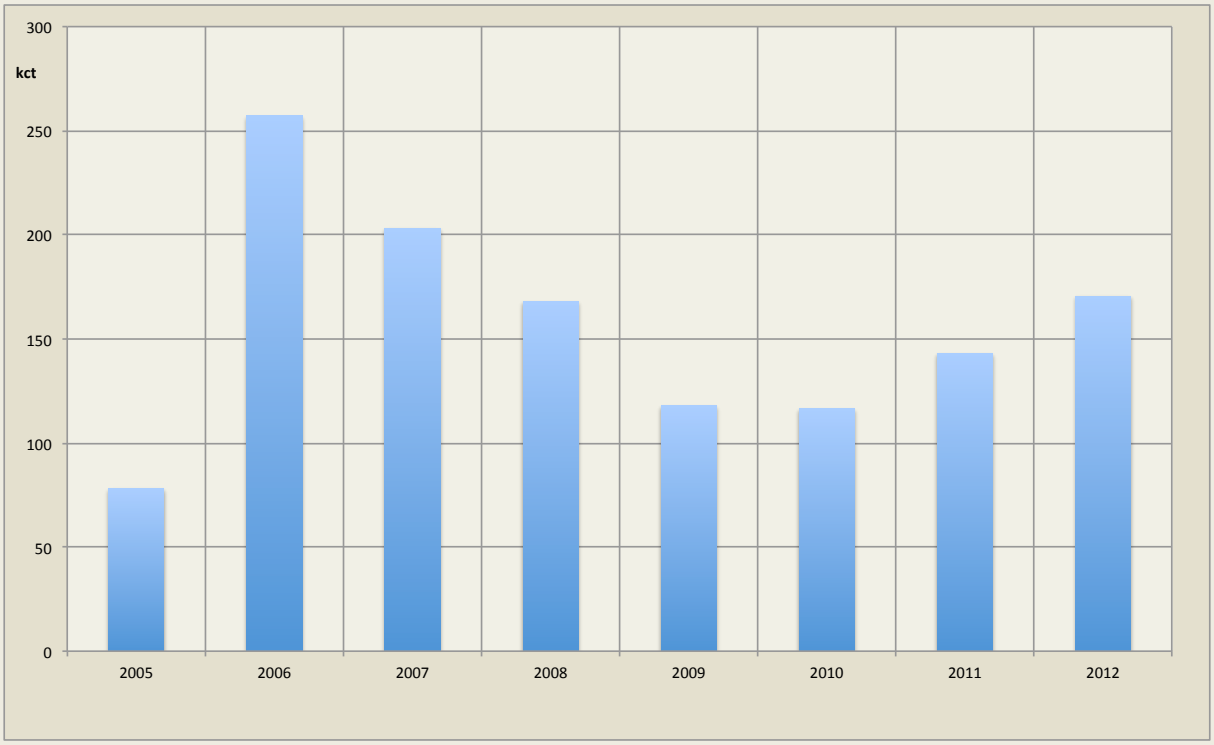

Figure 21 - Camatchia annual production (1000 ct).

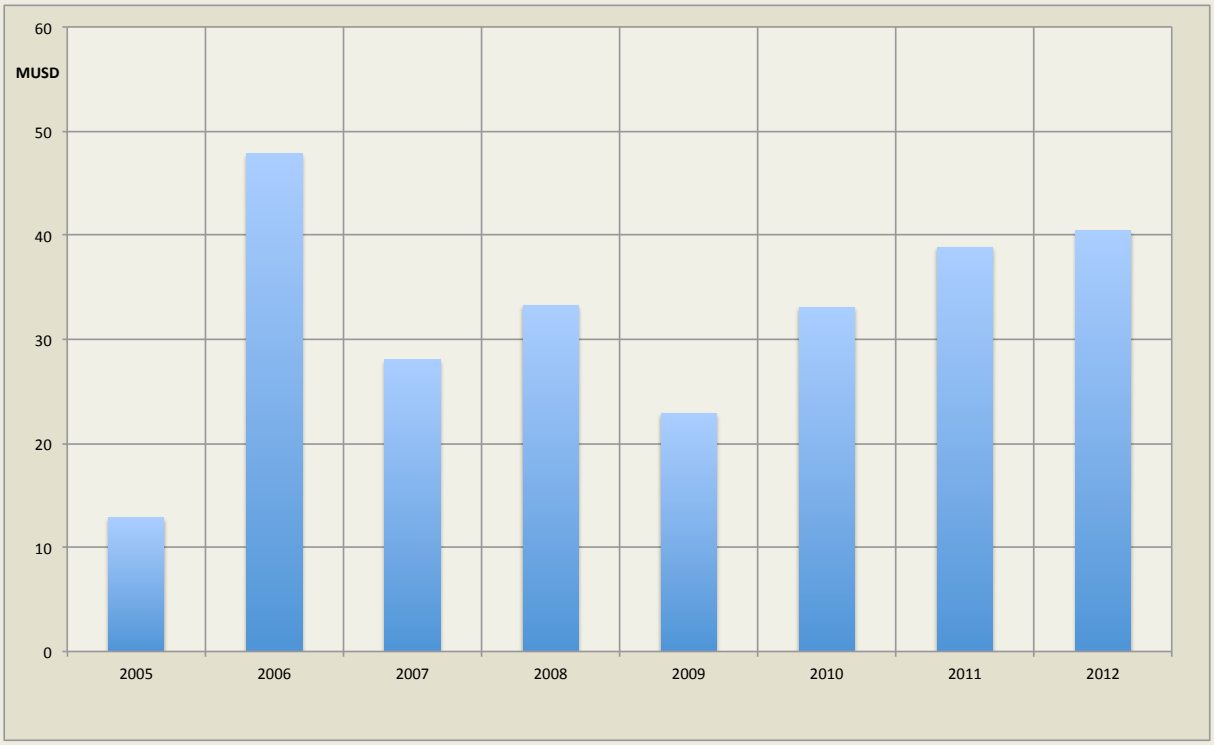

Figure 22 - Camatchia annual production value (MUSD).

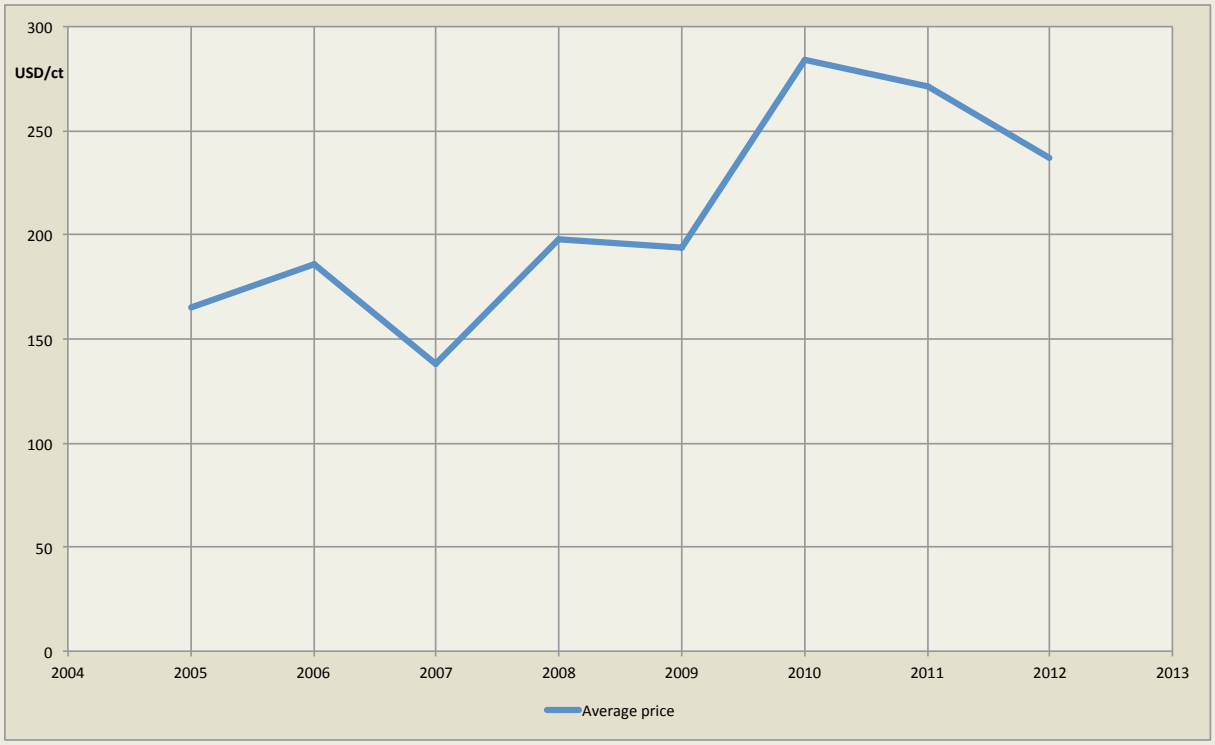

Figure 23 – Camatchia diamond price evolution.

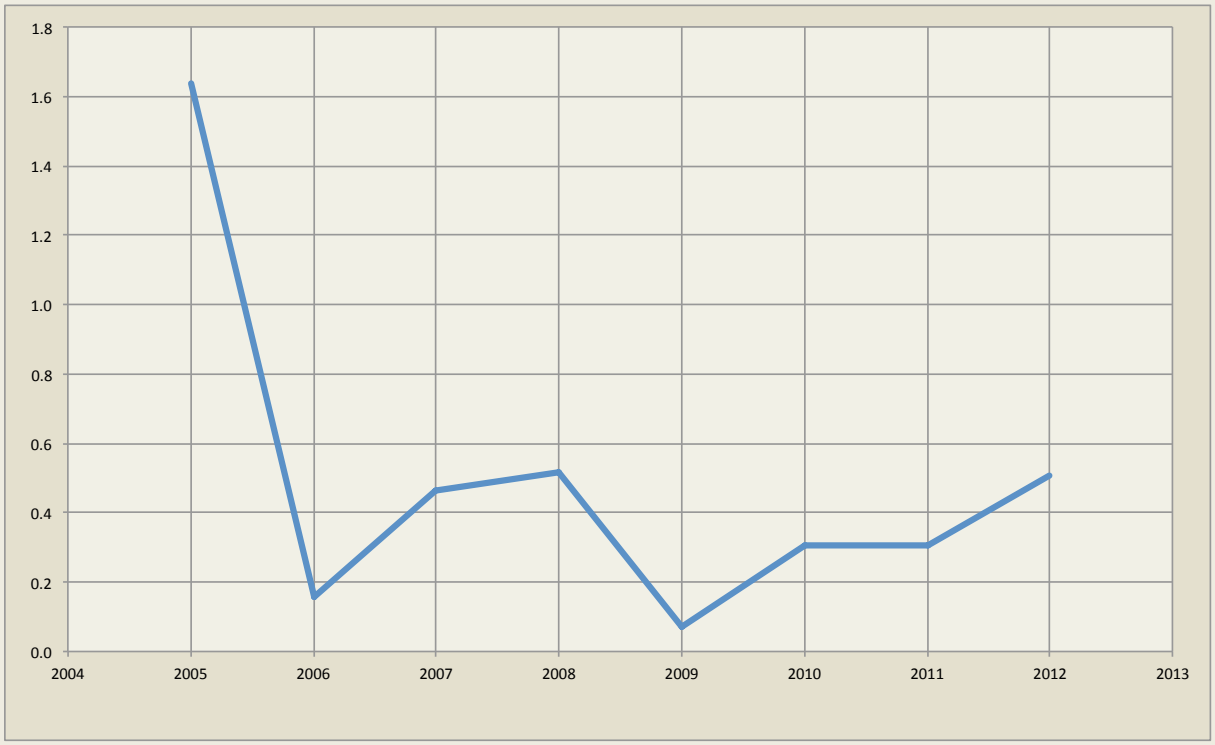

Figure 24 - Stripping ratio evolution at the Camatchia mine.

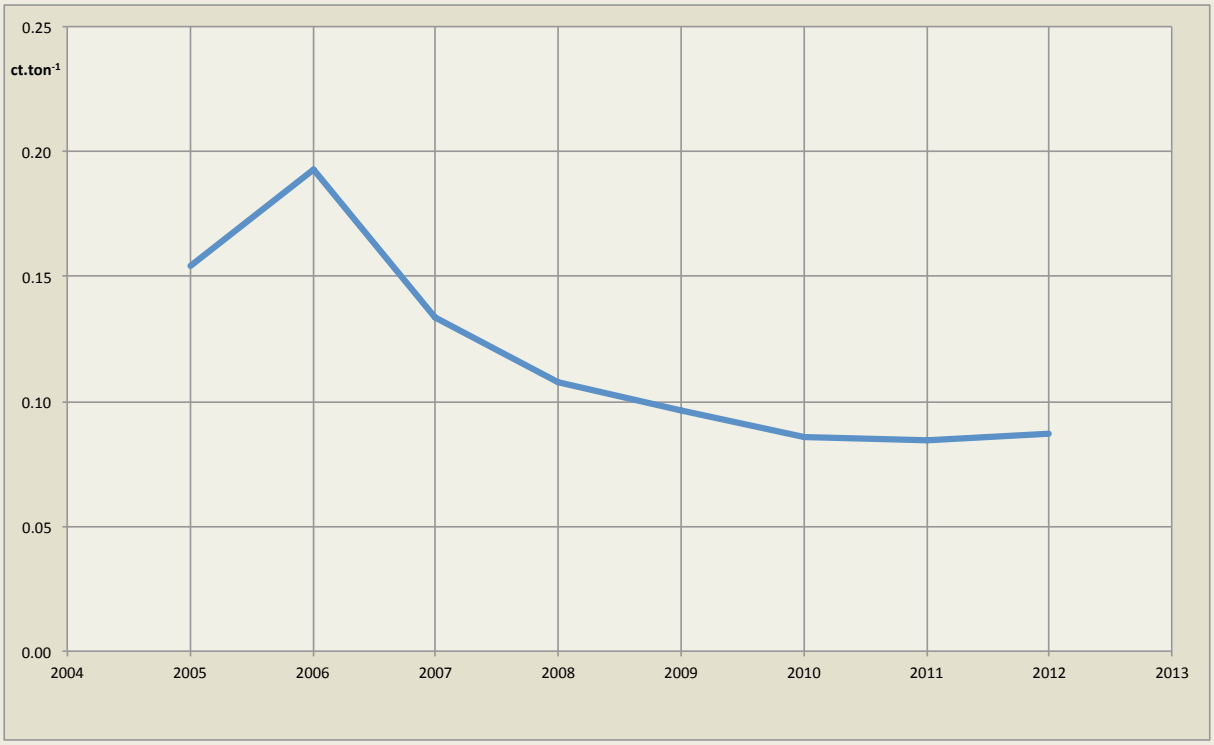

Figure 25 - Recovered grade at the Camatchia kimberlite.

Figure 26 - Removed overburden, extracted and processed ore volumes (Mton).

2.1.1.3 Camútuè

The Camútuè mine is one of the potentially most important deposits in Angola:

- It is a relatively small deposit, yet its diamonds are the most valuable in Angola;
- It is located just next to the city of Lucapa and its infrastructure (notably airport and road network) and
- It is one of several close by kimberlites included in the concession.

Notwithstanding the deposit's economic potential, its exploitation has had several ups (rare) and downs (more frequent). Its production is currently suspended.

In a 2008 report - (RNI, 2008), RNI – Resource and Investment NL, an Australian company, reports that the Camútuè Project, located in north-eastern Angola in Southern Africa, is supervised and operated by Resource and Investment NL (RNI) (ASX: RNI) under an Operating Agreement with Angolan-based Tecmad – Mining Services SARL (Tecmad). Under the Operating Agreement RNI, in consideration for its services, receives a minimum fee of US$100,00 per month or 20% of net cash flow.

The re-commissioning of the operation, including a US$ 5 million upgrade of the existing 50 tph Dense Media Separation (DMS) plant and associated infrastructure, was overseen by RNI but fully funded by Tecmad. The Camútuè Project was successfully re-commissioned in mid-2007, with an initial production plan based on recovery of 80,000 carats over an 18-month period.

Diamond production for the March Quarter from the Camútuè Project was 7,220 carats from 133,175 cubic meters of ore processed. The average stone size was 0.936 carats, with an average gross sale price of US$822/carat and a net sale price of US$704.33/carat.

Table 1 - Camútuè pipe production statistics, first quarter 2008 - (RNI, 2008).

	Jan	Feb	Mar
Cubic metres processed	45.965	45.280	41.930
Carats recovered	2.603,58	2.180,73	2.436,53
Average stone size (ct)	0,997	0,901	0,908
Gross selling price ($/ct)	765	875	826
Net selling price ($/ct)	647	754	712

During the March Quarter, RNI expanded its Operating Agreement with Tecmad to include potential mining of a kimberlite pipe located adjacent to the existing Camútuè alluvial mining operations, subject to the approval of a budget and detailed work plan. Under Deeds of Extension and Amendment to the original Operating Agreement signed on 4 May 2006, RNI and Tecmad have extended the Agreement for a further year and expanded it to potentially cover a number of mining operations at the Caixepa kimberlite pipe. RNI will develop and submit a draft budget and operational plan for the Caixepa Operation for approval by Tecmad and its partners.

Construction of infrastructure, including civil works, access roads and dewatering canals has commenced around the Caixepa pit as part of the preparation for contemplated future development. Tecmad funds all costs.

Caixepa is one of a group of nine known Kimberlite pipes located near the Camútuè Associated Diamond Deposits, 10km east of the town of Lucapa in Lunda Norte (NE Angola). Five of these pipes have been shown to be diamondiferous and two have been mined historically to some extent. For example, the Camútuè-West Kimberlite was discovered in 1958 and was mined between 1961 and 1974, resulting in the recovery of 33,673 carats at an average mine grade of 9 carats per hundred tones (cpht).

As part of a strategy to increase production from the Camútuè Project, RNI has also reached agreement to sell its 500,000tpa diamond production plant to Tecmad for use at the Camútuè Project. The plant includes a Dense Media Separation (DMS) production facility and on-site Flowsort (X-Ray) Final Diamond Recovery Unit.

The additional processing capacity and start of mining operations at the Caixepa Pipe was expected to, over time, enable RNI to significantly increase diamond production from the Camútuè Project. RNI would continue to receive a management fee of either 20% of net cash flow or a minimum US$100,000 per month from the expanded operation.

In a later report - (RNI, 2009), the company states that the commissioning of the operation was successfully completed and diamond production commenced in June 2007. On 20 October 2008 Tecmad gave the Company one month's Notice of Termination of the Agreement dated 4 May 2006. Accordingly, the Company ceased to manage and operate the Camútuè associated diamond deposits in Angola on 20 November 2008 following termination of its monthly management contract. Following the termination of the Tecmad management agreement in Angola, the Company's active involvement in Africa effectively ended.

2.1.2 Alluvials

2.1.2.1 Cuango

The Cuango aluvial mine, operated by Sociedade Mineira do Cuango (38% owned by ITM, 41% by ENDIAMA and 21% by Lumanhe) is the main aluvial mine in operation in Angola. Located in the Cuango river drainage, it accounted for 5.2% (in volume) and 10.6% (in value) of the Angolan prduction in 2012.

2.1.2.2 Maua

This mine started operations in 2013 in the Malange Province.

2.1.2.3 Chimbongo

The Chimbongo alluvial mine has been active for several decades along the Luembe river (north of ITM's Chitotolo alluvial concession). It was until recently operated by ESCOM Mining; the project was closed and is now reopen by different partners with the production recorded in 2012 accounting for 0.1% (in volume and value) of the Angolan production.

2.1.2.4 Luremo

Luremo is an alluvial mine located in the Cuago basin. It is operated by Luminas – Sociedade Mineria de Luremo. It accounts for 1.6% (in volume) and 5.2% (in value) of the Angolan diamond production in 2012.

2.1.2.5 Uári and Calonda

These mines started (or due to start) operations in 2013 in an area previously owned by SML – Sociedade Mineira do Lucapa. Uári is located along the Luachimo River and Calonda along the Chicapa. SOMIPA is the operator of the Calonda concession.

SML - Sociedade Mineira do Lucapa was a joint venture between ENDIAMA (51%) and Sociedade Portuguesa de Empreendimentos (49%). The company's operations were located in Lucapa, Lunda Norte Province, within basins of the Chicapa and the Luachimo rivers.

SML exploited diamonds from secondary deposits that occur in riverbeds, terraces, and valleys. SML had four mining projects: the Calonda project, the Lucapa project, the Mufuto Norte project, and the Yetwene project. Owing to the global economic crisis, Yetwene was put on care-and-maintenance status in 2009 - (Bermúdez-Lugo, 2010).

SML is now prey to a conflict between its partners, ENDIAMA and Portuguese SPE. The judicial conflict may lead to end of SML and the exit of SPE from the Angolan diamond fields, sadly ending a history that may be traced to the origins of the industry in 1912.

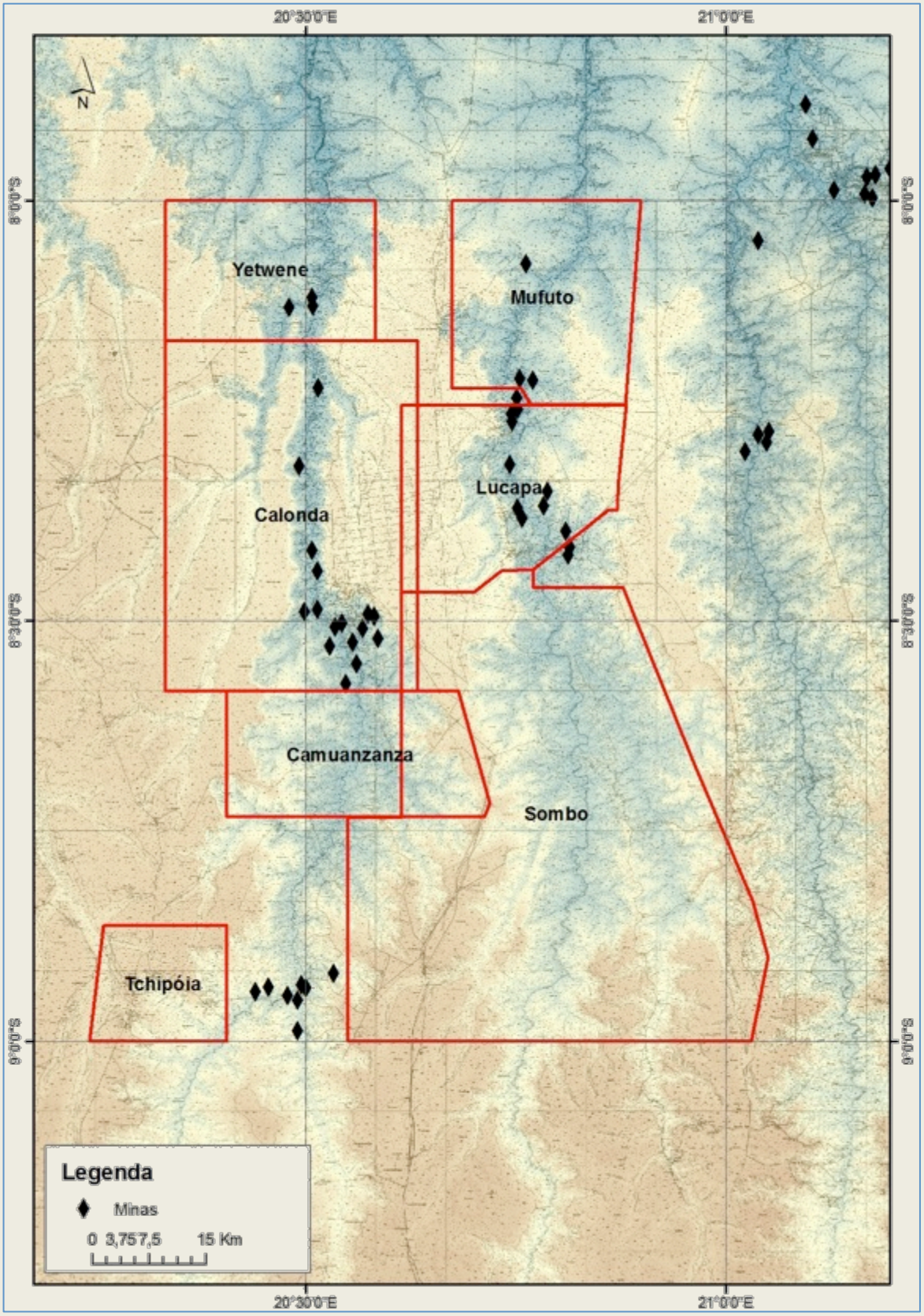

Figure 27 - SML - Sociedade Mineira do Lucapa group of concessions.

2.1.2.6 *Cambange*

Cambange started operations in 2013, resuming activity in the area previously known as Luarica concession.

Trans Hex held positions in three alluvial diamond projects in Angola: Luana (now Somiluana), Luarica and Fucaúma. On 5 October 2011, the Angolan

Ministry of Geology, Mines and Industry issued an order revoking the mining rights regarding the Fucaúma and Luarica joint-venture projects as no mining activities were performed at the sites for a period of three years. As a result, these projects have been classified as discontinued operations (TRANSHEX, 2012), now reopened as Cambange and operated by Kassypal (of the GAM – Grupo António Mosquito, a local investor).

2.1.2.7 Tchegi

This is one of the four alluvial mines that started operations in 2013. It is located in the north-flowing Chicapa River, south of the Canvúri mine. The mine is located in a very fertile kimberlite area, including the Camatchia-Camagico cluster of kimberlites in the north of Tchegi and the Catoca cluster in the south. ESCOM Mining operates this mine.

2.1.2.8 Somiluana

Trans Hex holds a 33% interest in the Somiluana (formerly Luana) project in joint venture with ENDIAMA with a 39% interest and privately owned Angolan firms holding the remaining 28% interest. In May 2010, Trans Hex signed a mining contract and took on the general, operational, and financial management of the project, which is located about 80 kilometers northeast of Lucapa in Lunda Norte Province. Diamond production started in June 2010 (USGS, 2011).

Production at Somiluana was 45.869 carats during 2011 (2010: 27 662 carats). Total sales amounted to US$21,7 million at an average price of US$446 per carat (2010: sales amounted to US$19,3 million, including the sale of pilot production carats). The average grade increased from 0,1836 ct.m^{-3} in 2011 to 0,1916 ct.m^{-3} (TRANSHEX, 2012).

Production at Somiluana in 2012 amounted to 41 313 carats during the reporting period (March 2012 to March 2013), at an average grade of 16,6 carats/100 m^3. Total sales amounted to US$14,9 million at an average price of US$352 per carat (Sharp decrease explained by worse market conditions but also by a smaller average recovered stone size).

Although only operational for just over two years, the Somiluana Mine offers good promise. However, there remains a need to upgrade existing equipment to increase production capacity at the mine and management will continue in its efforts to secure the funding to do this. In the interim, internal cash flow is being reinvested in the mine to achieve production improvements and carat production for the 2014 financial year is expected to surpass the 41 300 carats achieved in 2013 (Trans Hex, 2013).

Table 2 - SOMILUANA diamond resources and reserves - (TRANSHEX, 2012).

DIAMOND RESERVES AND RESOURCES

LAND DIVISION

31 MARCH 2013

DIAMOND RESERVES

	PROBABLE		
Project name	Ore (m^3 x 1 000)	Grade (cts/100 m^3)	Carats (cts)
Baken	13 241	1,29	170 943
Bloeddrift	1 727	1,81	31 246
Reuning	1 087	1,56	16 989
Remhoogte	0	0,00	0
Somiluana*	10 568	16,20	1 711 602
Total	26 623	7,25	1 930 780

DIAMOND RESOURCES

	INDICATED			INFERRED		
Project name	Ore (m^3 x 1 000)	Grade (cts/100 m^3)	Carats (cts)	Ore (m^3 x 1 000)	Grade (cts/100 m^3)	Carats (cts)
Baken	20 839	1,10	229 910	59 074	0,69	404 745
Bloeddrift	29 182	0,49	142 234	21 160	0,47	100 184
Reuning	6 504	0,67	43 390	29 163	0,52	152 260
Remhoogte	0	0,00	0	7 501	1,19	89 377
Somiluana*	11 201	19,09	2 138 703	42 458	13,88	5 891 997
Total	67 726	3,77	2 554 237	159 356	4,17	6 638 563

Notes:

Diamond resources are quoted inclusive of diamond reserves.

All resources are quoted as recoverable grades at a bottom screen cutoff of 2 mm for South African operations and 1,6 mm for Angolan projects.

** Total project resources and reserves are shown for Somiluana. Trans Hex's attributable share is 33% in line with the group's shareholding.*

Diamond reserve grades for Angolan projects are quoted as ROM grades, i.e. bulked and diluted.

All other diamond grades are quoted as in situ grades.

2.1.2.9 Canvúri

Figure 28 - The Chicapa River in the Canvúri area, upstream of the Camatchia mine.

This alluvial mine, situated along the Chicapa river, just south of the Camatchia Camagico kimberlite cluster, has been operating for some years by Sociedade Mineira Canvúri Chicapa.

2.1.2.10 Chitotolo

The Chitotolo alluvial mine covers an area of about 5,400 square kilometres. It averaged about 25,000 carats per month, and 85% to 90% of the stones were of gem quality. The mine is located about 95 km southeast of Dundo and employed about 820 people in 2009; 90% of the employees were Angolan nationals. The average grade at Chitotolo ranged between 0.8 and 1 carat per cubic meter, and in some areas within the concession the grade was as high as 10 carats per cubic meter. The amount of overburden that lies above the mineralized zones in certain areas within the mine could reach as much as 30 meters - (Bermúdez-Lugo, 2010).

The area has been exploited for several decades and the most accessible resources (in the margins, flood plains and terraces of the Luembe River) eventually became close to depletion. The project then exploited the riverbed of the Luembe (diverting its course) and, following old data and a modern exploration programme (with a dedicated large diameter drill) managed to define high-grade and high-value, deep cover (30 m) Calonda Formation basal conglomerate diamond reserves.

The area has also high potential for a primary source, as the Malúdi diamond population has different properties than those of the general diamond population in the area.

2.2 Exploration projects

Figure 29 - A test pit of ATS/ESCOM Mining in a kimberlite - Itengo area (November 2009).

2.2.1 Lunda Nordeste

De Beers helds a 49% interest in the Lunda Nordeste project in joint venture with ENDIAMA (51% interest). The company completed the bulk sampling program of the Mulepe-1 deposits at Lunda Nordeste and 100 carats of diamond were recovered from the deposit for revenue determination purposes. De Beers moved the Mulepe-1 deposit into the investment evaluation phase (USGS, 2011).

In 2011, activities continued on the Lunda Nordeste concession with other three pipes discovered, bringing the total number to 117 kimberlites. 22 of these were prioritised for diamond grade testing to confirm their economic viability.

Drill testing for diamond grade in the Lunda Nordeste concession was completed on 14 of the 22 priority pipes with results expected early in 2013. The concession's seven-year term expired in August 2012. Negotiations are underway for a Mineral Investment Contract under the more favourable terms and conditions set out in the new Angolan Mining Law, which came into force in late 2011. The conceptual study for the Mulepe-1 kimberlite was completed in November but indications suggest a stand-alone deposit is uneconomic under current assumptions (De Beers, 2013).

2.2.2 Chiri

(GEM Diamonds, 2009) A Cooperation Agreement was signed in January 2007 between Gem Diamonds and Avantis Angola Inc to conduct a feasibility study to be on the known Chiri kimberlite in the Lunda Sul Province of Angola in which Avantis has a 25% interest. An Option Agreement whereby Gem Diamonds could acquire an effective 11.25% interest in Chiri from Avantis was signed at the same time. Work started on the project in January 2008. Completion of Phase 1 evaluation activities was scheduled for the first quarter of 2009 (GEM Diamonds, 2009).

According to (Rough and Polished, 2012) GEM's preliminary evaluation indicated that the kimberlite had a large surface expression - 50 to 60 ha, although a significant portion was covered by fine grained kimberlitic sediments of minimal economic potential.

Diamond drilling was carried out to refine the geophysical model and to define the geology of the kimberlite at depth. Bulk sampling at surface returned encouraging results and the large diameter drilling programme provided estimates of grade continuity at depth.

Mined illegally during Angola's civil war, Chiri's diamonds had been assessed and were valued in July

2008 at about $150-$200 per carat (Rough and Polished, 2012).

Due to the current global market conditions and the resulting impact on diamond prices, Gem Diamonds formally withdrew from the Chiri project in Angola at the end of November 2012.

Since its inception, a total of US$14.8 million was spent at Chiri as at 31 December 2012. Following the decision to withdraw from Angola, this amount has been written off. Of the total US$14.8 million spent at Chiri, US$5.6 million was advanced as a loan to the project partner and is subject to a continuing right of repayment should the project go ahead at any time in the future (irrespective of Gem Diamonds' involvement). The write-off of this asset has been disclosed as an exceptional item due to its non-recurring nature (GEM Diamonds, 2013).

2.2.3 Lulo

Lucapa Diamond Company – LUCAPA is exploring for diamonds within the 3,000km^2 Lulo concession (Lunda Norte Province). The Lulo concession has world-class exploration potential (Lucapa Diamond Company, 2012). LUCAPA has recovered gem-quality diamonds of up to 131.5 carats from its on-going alluvial operations and has also identified 247 kimberlite targets within one-third of the concession.

The concession is located within the Cuango River Basin, about 150 km west of the Catoca mine.

There has been extensive artisanal diamond mining on the Cacuílo and Lulo Rivers within the Lulo concession.

This is a favourable stratigraphic setting, as the erosion has progressed to a stage where very large pipes have been exposed beneath the Kalahari sand cover but the denudation has not been sufficiently severe to erode the pipe structures to their root zones (Lucapa Diamond Company, 2012).

Since 2008, the exploration work conducted by LUCAPA (formerly Lohnro Mining) at Lulo has focused on defining both alluvial and kimberlitic diamond deposits (Lucapa Diamond Company, 2012).

2.2.3.1 Alluvial exploration program

The early alluvial exploration programs included an extensive review of old alluvial operations within the concession, covering an area of shallow diggings by artisanal miners (*garimpeiros*) within gravels located in the valley of the Cacuílo River. The *garimpeiro* operations were not mechanised and targeted exposed and easily accessible gravels.

Mapping work carried out by LUCAPA demonstrated that gravel deposits of at least three different ages were present. These included the Cretaceous-aged Calonda Formation *basal conglomerates* (gravels in LUCAPA's website text), identified as the main target for the garimpeiro diggings.

This mapping work was followed by a systematic exploration pitting program to define and delineate gravel distribution within the broader Cacuílo River Valley. Emphasis was placed on identifying areas of Calonda Formation gravels and to locate potential bulk sample sites.

In 2010, LUCAPA established and re-commissioned a 15-tonne per hour Dense Media Separation (DMS) plant near the field camp to test the diamond content of the alluvial bulk samples. Other key items of equipment – including an excavator, front-end loader, bulldozer and six-wheel dump truck – also arrived on site for this program.

The first alluvial diamond recovered from the DMS plant was a gem-quality stone weighing 22.2 carats in November 2010. This was followed by a 53.2-carat stone in November 2011. In August 2012, LUCAPA announced it had recovered a gem-quality 131.5-carat diamond and a 38.3-carat stone from the BLK08 bulk sample.

2.2.3.2 Kimberlite diamond exploration

Following the signing of the joint venture with Endiama, LUCAPA completed a low-level MIDAS aeromagnetic survey of the upper Cacuílo and Lulo rivers in 2008 covering one-third of the 3,000km^2 concession.

Although kimberlites had been recorded within the area, the results of the aeromagnetic survey were a revelation, with 247 potential kimberlite intrusives ultimately identified from the data. Subsequent soil sampling of selected anomalies by Lucapa has confirmed high counts of kimberlitic indicator minerals, supporting the probability of underlying kimberlite pipes.

In 2011, Lucapa announced plans to drill test the 61 kimberlite targets, a new kimberlite exploration program approved by LUCAPA's joint venture partner Endiama in December 2011. The kimberlite exploration program includes:

- On-going surface sampling of the 61 priority targets for kimberlitic indicator minerals
- Construction of access roads and bridges
- Purchase of a new 50tph DMS plant and earthmoving equipment
- Using an excavator to begin sampling shallow buried kimberlite targets
- Narrow diameter diamond drilling of kimberlite targets to confirm the presence of kimberlite
- Large diameter drilling to extract 25 tonne bulk samples for treatment through the DMS plant

LUCAPA's kimberlite exploration phase reached a significant milestone in July 2012 when the specialist BAUER rig arrived on site at Lulo in preparation for the kimberlite drilling program. The BAUER rig can undertake both the narrow-diameter drilling of the kimberlite targets as well as the wide diameter (17.5 inch diameter) holes to extract 25 tonne samples.

The 30-hectare Se12 kimberlite target, which is located about 5km east of LUCAPA's DMS plant, will be the first of the 61 kimberlite targets to be drilled with the BAUER rig (Lucapa Diamond Company, 2012).

After a systematic four-year exploration program, Lucapa is now drill testing 61 high-priority kimberlite targets within the Lulo concession.

In a press release dated October 29, 2012 (Lucapa Diamond Company, 2012), the company announces that it intends to raise approximately $5.73 million to expand its kimberlite exploration program at the Lulo Diamond Concession in Angola.

In September 2012, Lucapa had begun a 12-18 month program to drill test and sample 61 kimberlite targets at the Lulo Diamond Concession. As announced to the ASX on 28 September 2012, Lucapa now expects that kimberlite be expanded as a result of:

- An extensive geological review of all magnetic targets near the BLK08 alluvial bulk sample where the Company recovered a rare 131.4 carat diamond, independently valued at 2012; and
- A low-level aeromagnetic survey to be flown over the two-thirds of the 3,000 km^2 Lulo Diamond Concession not covered in the original survey in 2008. The new survey will include a ~725 km^2 strip very close to the BLK08 bulk sample and is expected to increase the number of priority kimberlite to be drill tested.

The Bauer drilling of the first two kimberlite targets (Se012 and Se222) at Lulo Diamond Concession has recently been completed with coarse resedimented volcaniclastic kimberlite identified in both pipes. The Bauer rig will now move to the Se223 location, a 15ha+ target in close proximity to the BLK08 bulk sample site.

2.2.4 Tchegi and Itengo

ESCOM Mining has made a very high investment in diamond exploration in Angola (arguably the largest diamond exploration company in 2007-2008) that resulted in the discovery of many new kimberlites; some of these prospects are mineralized, awaiting further work to determine their feasibility.

The Tchegi and Itengo kimberlite concessions (contiguous, located along the Chicapa river, immediately south of the producing Luó kimberlite concession - also owned by ESCOM Mining) were considered the most promising in what regards primary diamond mineralization.

Tchegi has already become a alluvial producing mine in early 2013.

Figure 30 - Exploration treatment plant in the left margin of the Chicapa River - Itengo area.

Figure 31 - Ilmenite-rich gravel close to the Dondinha kimberlite.

Figure 32 - Kimberlite core recovered from new discovery in the Tchegi area.

Figure 33 - The Damba kimberlite (right background) - right margin of the Chicapa River, Tchegi area.

Figure 34 - Pit testing in the Tchiuso kimberlite - September 2008.

2.2.5 Tchiuso, Vulege, Tchiafua, Gambo, Luangue, Gango and Quitúbia

In addition to its flagship project in Angola, the Catoca kimberlite mine (through its subsidiary Sociedade Mineira do Catoca), ALROSA is active in several exploration, pre-production and cooperation projects.

The one closest to production is the Tchiuso kimberlite project in the Luemba concession, located 25 km north of the Catoca mine, in the Lunda Sul province. The project is in its final pre-implementation stage after the successful conclusion of negotiations.

The Sociedade Mineira do Catoca – SMC is expected to exploit the new diamond project from 2014 in partnership with Yakutniproalmaz of Russia. Available data point to the existence of diamond resources up to 400 meters deep (Rough and Polished, 2012).

Sociedade Mineira do Catoca with 51% is the new project main shareholder. In addition, given the low value of these kimberlite diamonds (when compared with Catoca's), this project will have its own a dedicated sales channel, exempting it from the general rule in Angola (diamond sales to preferential buyers) - (CATOCA, 2012).

Sociedade Mineira do Catoca has received a green light from the government of the Angolan province of Kwanza Sul to commence diamond exploration work in the Gango and Quitúbia mining concessions. Each of the two projects (Quitúbia and Gango) has a concession area of about 3.000 km^2 and would be the first diamond mining projects in Kwanza Sul (Rough and Polished, 2012).

SM Catoca is also doing exploration work in the Vulege (Lunda Sul), Tchiafua (Lunda Sul and Lunda Norte), Gambo (Lunda Sul) and Luangue (Bié).

2.2.6 Chitamba

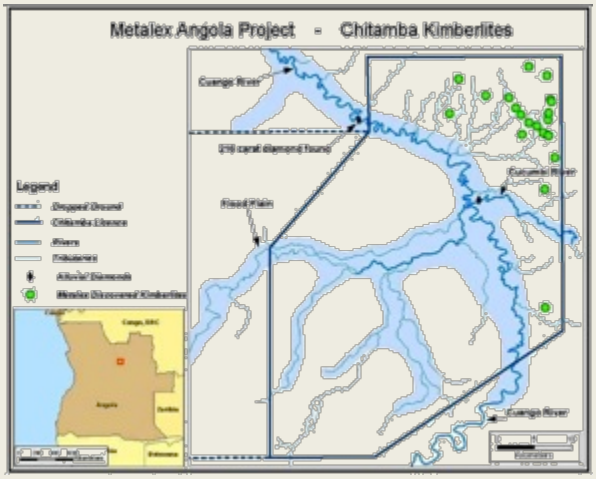

Figure 35 - METALEX Chitamba exploration concession - (METALEX Ventures Ltd.).

METALEX has a kimberlite license in Angola covering 3,000 km^2 over part of the Chitamba-Lulo kimberlite cluster and the Cucumbi and Cuango Rivers. The Chitamba-Lulo kimberlite cluster is thought to be the source area for the abundant alluvial diamonds mined from the Cuango River downstream. Some 11,000 line km of aeromagnetic data was purchased and more than 100 anomalies with the potential to reflect undiscovered kimberlites have been recognized (METALEX Ventures Ltd.).

2.2.7 Quirima, Sautar, Luando, Caipupa, Sauanga and Zonde

SOMIPA – Sociedade Mineira de Angola S.A. is the best example of a new wave of diamond mining companies in Angola. Its shareholders are Angolan and it has been well funded. The company has been active in the center of Angola in the last five years, prospecting for diamonds in six alluvial concessions, five of which in a contiguous block – Quirima, Sautar, Luando, Caipupa, Sauanga - and the sixth – Zonde, a little further south.

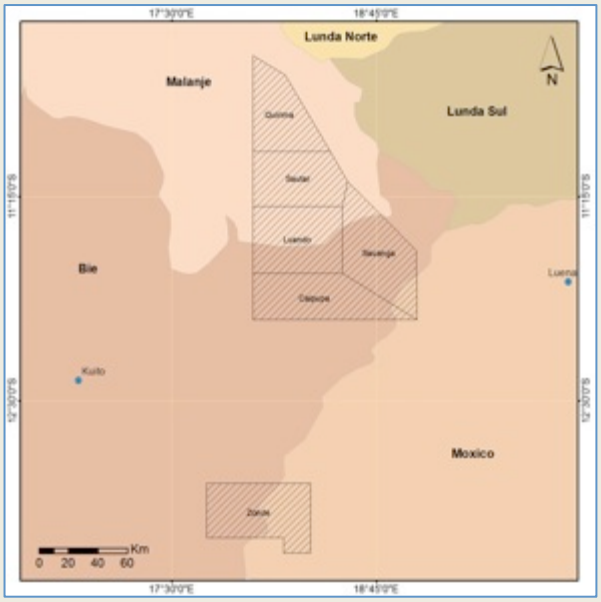

Figure 36 - SOMIPA exploration concessions in the center of Angola.

2.2.8 Muanga and Cacolo

SOMIPA is also prospecting for diamonds in the Muanga and Cacolo contiguous concessions, in a highly prospective territory close to the Cuango River headwaters, where dozens of kimberlites are already known.

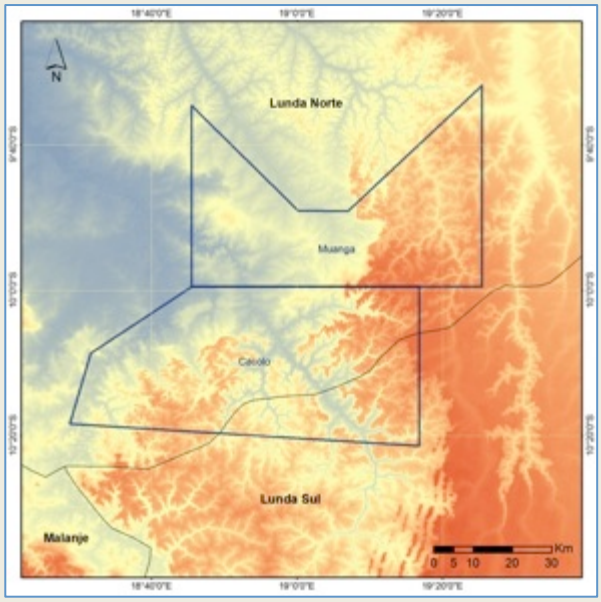

Figure 37 - SOMIPA exploration assets in the Lundas.

2.2.9 Luia

Trans Uíge, with 48% is the main shareholder of the Luia exploration project, located in Lunda Norte. ENDIAMA with 30% and Calonda with 22% are the other partners.

2.2.10 Santechifunga

This is a diamond exploration project being developed by Genius Mineira.

2.2.11 Luege

Luege is a 3.000 km^2 alluvial exploration project in Lunda-Sul. ENDIAMA has a 51% stake, with the remaining 49% for SGM – Sociedade Geral de Minas.

2.3 Garimpo

Figure 38 - Garimpo in the right bank of the Chicapa River - Itengo-Tchegi area.

Figure 39 - Garimpo activity in the left bank of the Chicapa River - Itengo-Tchegi area.

Garimpo is a reality of life in the Angolan diamond industry. Its pervasiveness in the territory has several factors behind it:

- There is a lack of jobs in the interior of Angola. Other than the limited stock of jobs in the industrial diamond projects, in construction works – mostly publicly funded – and Government jobs – civil servants, security and armed forces, the common subsistence options are basic trade, very limited subsistence farming, hunting, fishing and recollection activities typical of pre-agricultural societies.
- The available jobs in the industrial or construction projects often require some kind of specialization and experience – e.g. maintenance technicians, machine operators and electricians. The local workforce lacks the training and experience; as result, people coming from outside the region or even the country occupy many of those positions.
- Alluvial diamond deposits (and the closer to the surface, deeply altered mineralized kimberlite) are easily amenable to exploitation by unskilled or semi-skilled workers. The valuable substance (in this case diamond) has a high unit value, it's loose in the ore (no need for milling and grinding to achieve liberation) and easily concentrated with basic (even if inefficient) methods, with plenty (excessively plentiful in the rainy season, in fact) nearby water sources.

- This is an activity entrained in the local traditions during the last decades, perceived has a right. In addition, there is a network of supporting activities already in place (diamond traders, basic suppliers and financers), following the same immemorial model of other world regions.

It is no surprise that garimpo exerts such a powerful attraction to local populations all over Angola.

Garimpeiros are not criminals. They are common people trying to earn a life in a place where options are very scarce. They live a very difficult life, working and inhabiting in wetlands infested by disease transmitting mosquitoes, snakes and other dangerous wildlife. They have no access to health care or simple medicines, they have poor food supplies and they are subject to the whims of powerful forces. They don't even pursue a dream; they just try to survive.

This has to be taken in consideration when dealing with the common *garimpeiros*. A careful evaluation of all interests at stake is, of course, mandatory.

Figure 40 - Swiss cheese scenario generated by garimpo (vertical wells connecting underground tunnels) over a likely kimberlite – Tchegi area.

Figure 41 – An abandoned *garimpeiro* exploration well (*poço zairense*) – S Malanje province.

3 Diamonds here, diamonds there, diamond everywhere: the markets

Figure 42 - Diamonds from the Luembe River - NE Angola.

Figure 43 - World rough diamond production (2004-2012), MUSD - KP data.

3.1 Pricing and sources

Humans have used diamonds since Antiquity as symbols of power, wealth and status and, more recently, of everlasting love. Other than being the hardest substance in nature, diamonds possess unusual properties upon which rest important technological applications.

Natural diamonds are created deep in the Earth's mantle and transported to its surface in kimberlite and lamproite eruptions in the old continental nuclei (cratons). Natural surface processes, with water as the main agent, decompose and erode the minerals of these rare volcanoes as soon as they erupt. Most of these rocks minerals are readily decomposed and eroded, diamond being the most resistant.

Running water (and glaciers) transport and deposit diamonds released from the volcanic rocks that brought them to the surface of the Earth. Alluvial deposits form in the river basins that intersect mineralized primary (kimberlite and lamproite) structures. Diamond's chemical and physical resistance is the basis for the creation of alluvial deposits sometimes many hundreds of km away from their volcanic sources.

Diamonds may be broadly classified as *gems* or *near-gems* (used in jewellery) or *industrials* (used in technological applications, especially in drilling, sawing and crushing).

Synthetic diamonds dominate the industrial applications, natural diamonds having a very subordinate role in this market segment. The competitive advantage of artificial diamonds resides in the fact that current manufacture technologies – CVD – are able to produce large quantities of industrial stones or coatings with pre-specified morphologies at a low price.

The value of diamonds rests on their rarity, their special properties (both aesthetic and physical) and on the fact that they are highly concentrated portable wealth.

Prices of gem diamonds vary widely: one carat may value one or one million dollars, depending on several factors. The most important factors affecting rough diamonds' unit value (USD/ct) are (Cardoso & Chambel, 2005):

- Weight. Size is value: the larger the diamond, the higher it's unit price.
- Colour. Diamonds are usually almost colourless, with a varying light yellow shade. A totally colourless diamond (D colour in cut diamonds) is much more valuable than a brown diamond (i.e. a diamond with a strong yellow tinge). The value of diamonds with fancy colours (e.g. green, blue, pink, canary yellow) falls outside the normal rules; if until two decades ago these diamonds were considered mere curiosities, today they fetch premium values. Finally, some diamonds may have an apparent colour due to a shallow coating; as this thin layer is polished away during the polishing process, its colour should not be considered as detrimental or incremental of the stone's value (influenced by the body colour).
- Quality. Internal fractures or inclusions, detrimental to a diamond's purity, decrease the stone's value. The impact of imperfections in the diamond's value depends on their position, being irrelevant if located at the rough gem's surface (as they will be easily eliminated during the polishing process).
- Morphology. Rough diamonds occur in many shapes (octahedrons, rombododecahedrons, twinned shapes, chips, cubes, etc.). A specific shape's impact in value is directly related to its impact in the stone's yield in the polishing process; generally speaking, the rounder the stone the higher is its yield and, consequently, value.
- Fluorescence. The ability of certain diamonds to emit light when struck by UV radiation (present in natural sunlight) affects the gems' colour, increasing or decreasing its value.

In summary, gem diamonds (used in jewellery) are classified under several parameters (shape, weight, colour and quality) into hundreds of classes upon which the pricing model is applied – the detailed explanation of this process falls outside the scope of this document. Larger, colourless diamonds, with fewer inclusions or fractures and with shapes yielding lower weigh losses in the cutting process fetch higher prices.

3.2 Market conditions

3.2.1 Volatility

2011 and 2012 have been rollercoaster years for the diamond markets worldwide. The world economy is sick, undecided yet whether it is slowly recovering from the 2008 recession or walking into a double-dip recession.

In the previous years, especially in 2009, rough diamonds had seen their value fall - Figure 44, an effect curtailed by production cuts and/or stocking policies.

With strong consumer demand for diamond jewellery – led by China, India and the US – and a lower than historical level of global diamond production, polished

and rough diamond prices grew rapidly during the first half of 2011 (De Beers, 2012).

For (De Beers, 2012), 2011 was a year of two halves, however, and the extraordinary growth seen in the first half cooled during the latter half of the year. The global economic uncertainty impacted the rate of growth as consumer buying slowed and liquidity in the cutting centres was restricted.

(TRANSHEX, 2012) has a similar perspective, seeing prices for both rough and polished diamonds fell by more than 15% in the last quarter of 2011, under the influence of the financial crisis in the euro zone and a levelling off of demand in China. While rough prices subsequently improved in the first quarter of 2012, trade in polished diamonds remains slow as uncertainty persists.

Correspondingly, by the end of 2011, DTC prices had receded slightly from the highs seen in the middle of the year. Nevertheless, on the whole, 2011 will be remembered as an outstanding year for consumer demand growth – estimated at between 11-13 percent for the full year – and DTC rough diamond price growth (De Beers, 2012).

(TRANSHEX, 2012) expects prices for both rough and polished diamonds to remain volatile for as long as market sentiment is impacted by concerns about financial developments in the euro zone and slower growth in the Chinese economy.

In a similar mood, ALROSA expects (Rough and Polished, 2012) a decline in global demand for rough diamonds (though major consumer markets of diamond jewellery - the U.S., China and India - demonstrate persistently high demand), Vedomosti newspaper reports citing Interfax. Due to this fact that rough supplies will reduce in October (in particular, spot sales and auction sales) and ALROSA will focus on long-terms contract sales of rough diamonds, according to a statement by the company. The diamond miner has retained year sales forecast at $5 billion, a company's representative noted (Rough and Polished, 2012).

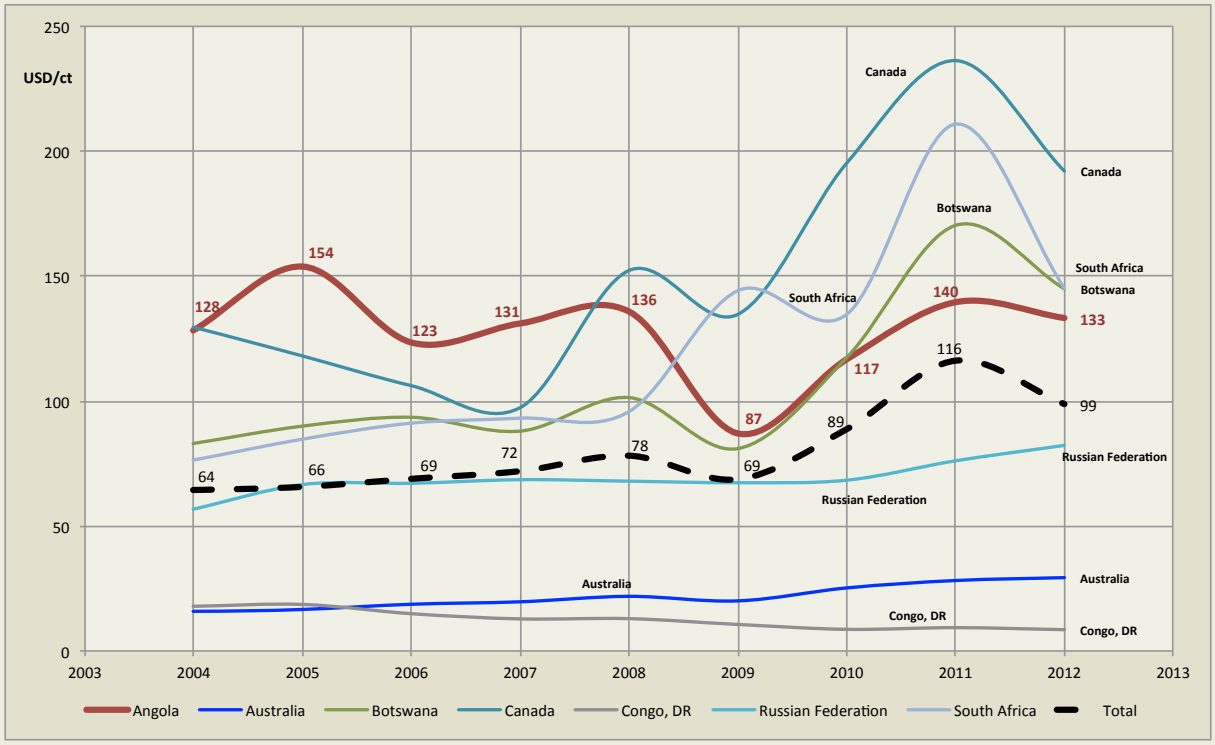

Figure 44 - Evolution of Angola diamond prices (red) vis-à-vis world (black dashed) and other countries' production – based on KP data analysis.

Table 3 – World diamond production (MUSD) – KP data.

Value (MUSD)	2004	2005	2006	2007	2008	2009	2010	2011	2012
Angola	**788**	**1,089**	**1,133**	**1,272**	**1,210**	**804**	**976**	**1,163**	**1,110**
Australia	**314**	**547**	**560**	**365**	**326**	**313**	**252**	**221**	**269**
Botswana	**2,576**	**2,870**	**3,208**	**2,960**	**3,273**	**1,436**	**2,586**	**3,902**	**2,979**
Brazil	26	22	6	26	6	1	1	3	3
Canada	**1,645**	**1,454**	**1,410**	**1,657**	**2,255**	**1,475**	**2,305**	**2,551**	**2,007**
Central African Republic	52	61	59	60	48	47	49	61	62
China, PR	1	1	1	1	1	0	0	0	0
Congo, DR	**536**	**615**	**432**	**365**	**432**	**226**	**174**	**180**	**183**
Congo, R	0	0	0	0	5	2	5	2	4
Ghana	26	34	31	23	18	7	12	15	10
Guinea	40	47	40	46	54	29	28	33	44
Guyana	47	32	44	34	31	15	7	10	8
India	9	10	2	0	0	2	3	2	5
Indonesia	0	5	11	5	8	1	0	0	0
Lesotho	**25**	**64**	**167**	**328**	**223**	**134**	**198**	**359**	**301**
Liberia	0	0	0	3	10	11	16	16	16
Namibia	**673**	**697**	**901**	**715**	**918**	**409**	**744**	**873**	**900**
Russian Federation	**2,205**	**2,531**	**2,574**	**2,625**	**2,509**	**2,341**	**2,382**	**2,675**	**2,874**
Sierra Leone	127	142	125	142	99	78	106	124	163
South Africa	**1,076**	**1,319**	**1,362**	**1,417**	**1,236**	**886**	**1,194**	**1,730**	**1,027**
Tanzania	35	25	26	28	24	25	13	11	34
Togo	11	2	3	2	1	0	0	0	0
Venezuela**	0	3	2	1	1	1	0	0	0
Zimbabwe	**8**	**35**	**34**	**31**	**44**	**20**	**340**	**476**	**644**
Total	**10,222**	**11,606**	**12,129**	**12,107**	**12,732**	**8,262**	**11,393**	**14,407**	**12,645**

Table 4 – World diamond production (Mct) – KP data.

Volume (Mct)	2004	2005	2006	2007	2008	2009	2010	2011	2012
Angola	**6.1**	**7.1**	**9.2**	**9.7**	**8.9**	**9.2**	**8.4**	**8.3**	**8.3**
Australia	**20.2**	**32.9**	**29.9**	**18.5**	**14.9**	**15.6**	**10.0**	**7.8**	**9.2**
Botswana	**31.0**	**31.9**	**34.3**	**33.6**	**32.3**	**17.7**	**22.0**	**22.9**	**20.6**
Brazil	0.3	0.3	0.1	0.3	0.1	0.0	0.0	0.0	0.0
Canada	**12.7**	**12.3**	**13.3**	**17.0**	**14.8**	**10.9**	**11.8**	**10.8**	**10.5**
Central African Republic	0.3	0.4	0.4	0.5	0.4	0.3	0.3	0.3	0.4
China, PR	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Congo, DR	**30.0**	**33.1**	**29.0**	**28.5**	**33.4**	**21.3**	**20.2**	**19.2**	**21.5**
Congo, R	0.0	0.0	0.0	0.0	0.1	0.1	0.4	0.1	0.1
Ghana	0.9	1.0	1.0	0.9	0.6	0.4	0.3	0.3	0.2
Guinea	0.7	0.5	0.5	1.0	3.1	0.7	0.4	0.3	0.3
Guyana	0.5	0.3	0.4	0.3	0.2	0.1	0.0	0.1	0.0
India	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indonesia	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lesotho	**0.0**	**0.1**	**0.2**	**0.5**	**0.3**	**0.1**	**0.1**	**0.2**	**0.5**
Liberia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Namibia	**2.0**	**1.9**	**2.4**	**2.3**	**2.4**	**1.2**	**1.7**	**1.3**	**1.6**
Russian Federation	**38.9**	**38.0**	**38.4**	**38.3**	**36.9**	**34.8**	**34.9**	**35.1**	**34.9**
Sierra Leone	0.7	0.7	0.6	0.6	0.4	0.4	0.4	0.4	0.5
South Africa	**14.1**	**15.6**	**14.9**	**15.2**	**12.9**	**6.1**	**8.9**	**8.2**	**7.1**
Tanzania	0.3	0.2	0.3	0.3	0.2	0.2	0.1	0.0	0.1
Togo	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Venezuela**	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zimbabwe	**0.0**	**0.2**	**1.0**	**0.7**	**0.8**	**1.0**	**8.4**	**8.5**	**12.1**
Total	**159.1**	**176.7**	**176.0**	**168.2**	**162.9**	**120.2**	**128.3**	**124.0**	**128.0**

3.2.2 A new paradigm

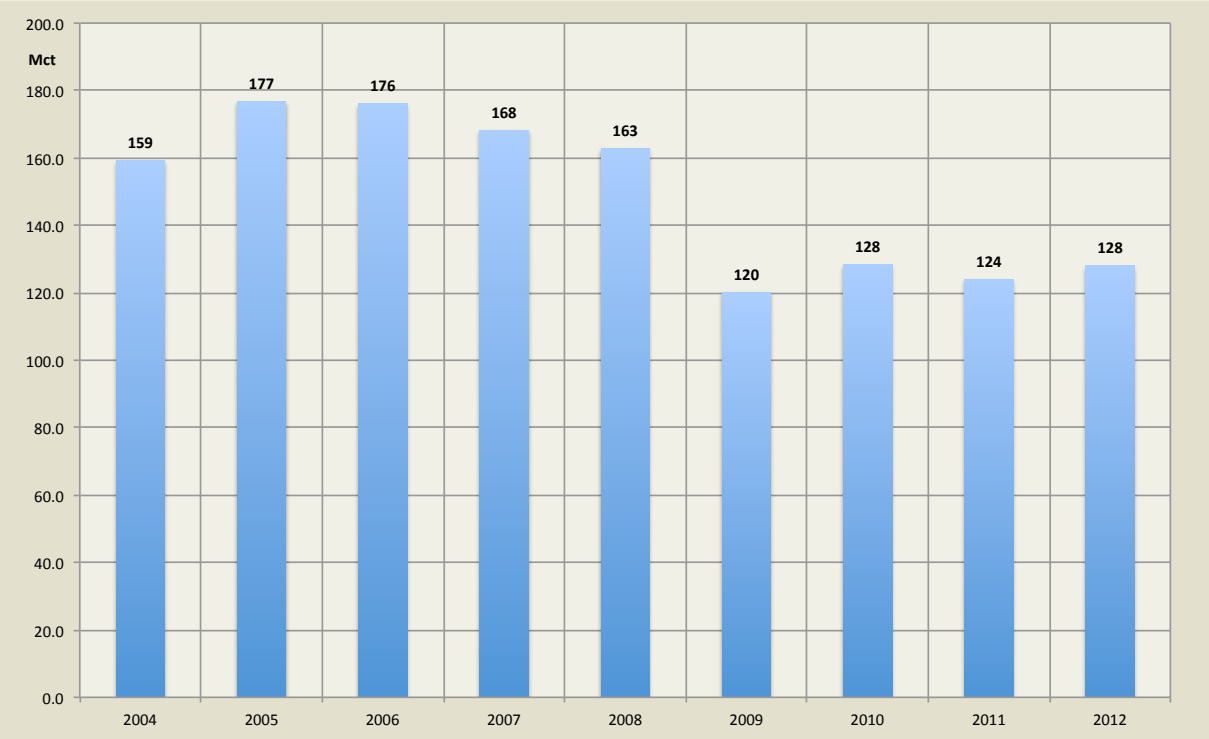

Figure 45 - World KP registered production (Mct) – Kimberley Process data.

The diamond industries are facing an unprecedented structural change. This paradigm shift, brought on by both powerful external forces and internal stress, has been occurring in the last twenty years; the ongoing crisis of the world's advanced economies has fast-forwarded the events.

On the upstream side, in the mining and trading of diamonds:

- The last 15 years have seen a mostly unfruitful search for major kimberlite sources of diamonds by both major and junior companies all over the world. After the discovery of Canadian kimberlites, there has been no major (>5 Mct/year) new source of diamonds found and developed by the endeavours of mining companies.
- Zimbabwe is the novelty of recent years in what concerns major production increases. The country's diamond industry (?) is still involved in rumour and controversy; nevertheless it accounts for 8.5 Mct and 476 MUSD in 2011, a volume similar to and a value half of the Angolan production in the same year. According to KP statistics, the diamonds produced have a relatively low average value (half of the world's average unit value).
- Partly as a result of their inability to grow, but also due to the need to focus on more profitable commodities, major producers BHP and RTZ are now divesting in this industry (BHP finalyzed the sale, with RTZ apparently having quit the exit in 2013). The sale of these assets will create opportunities for other, more agile, competitors – (see example of GEM in Letseng kimberlite – Lesotho, relinquished by De Beers), yet creating additional competition and pressure on prices, a further step towards a new paradigm.
- ALROSA and De Beers are the remaining big players. But even at the core of the diamond mining industry major shifts occurred:
    - The Oppenheimers are no longer shareholders of De Beers, ending a century long relationship, a place of empire building, myth and legend. The iconic diamond company is now the property of Anglo American (85%) and Botswana (15%).
    - De Beers is now focused on the downstream sector of the diamond industry, having reinvented itself into a luxury brand from the previous role as the dominant producer and distributor of rough diamonds. The result, on one side, of anti-cartel legal action in their main market (the US) and, on the other, of the financial burden of trying to control the rough diamonds' market, the refounding of De Beers was conducted gradually but decisively.
    - At the core of industry, De Beers and Alrosa, with 40% and 28% of the world's

rough production value have limited possibilities to control the market as De Beers is barred from purchasing rough diamonds from Alrosa as of the end of 2008.

- The industry has also been influenced by other mineral commodities industries. The emergence of new economic powers (e.g. Brazil, Russia, India and China) has created an increased demand for minerals, with increased prices and price volatility. This new mining boom (now past its first peak) has created many investment opportunities, creating further difficulties for the until then conservative diamond industry.
- Diamond producing countries (Russia, Canada, Angola, Botswana and Australia) have set policies in place to add further value to their rough diamond productions. Despite the fact that these countries' efforts have had varying degrees of success, the fact remains that Governments try to reshape the industry according to their interests and by doing so tend to distort the markets, frequently with unintended consequences.
- Synthetic gem diamonds have been a threat for natural diamond producers for many years. The underlying assumption is that a manufactured, cheaper, similar product will erode diamonds' value; the potential sale of synthetic as natural diamonds may create uncertainty in the clients' minds. Until now, this threat has had limited effects on the prices and in the public's trust on diamonds:
    - The rarity and genuineness of natural diamonds, the myth and legend they have associated and the fact that love, power and status don't go along with *manufactured* gems creates barriers to the direct competition between high-end natural and synthetic diamonds.
    - Gemological labs have been able to devise tests that distinguish the synthetic and natural varieties of diamond; these tests have a cost, though, and the cheaper the diamonds the less likely tests will be performed.
- More and more, there will be two separate markets in rough (and cut) diamonds: the high-end gems (rough 5+ ct, approximately, cut stones 1+ ct, with good colors and qualities) and the standard diamonds. This separation has been widening, with several factors behind it:
- The recycling of diamonds (second hand sale of cut diamonds) may be an additional adverse factor for polished (and rough) diamonds. Economical stress in middle class of the advanced economies may lead to a disposal of diamond jewellery (and its re-entry in the market as loose stones). The symbolic nature of diamond jewellery gifts is an important psychological barrier, making it a last resort measure, though.

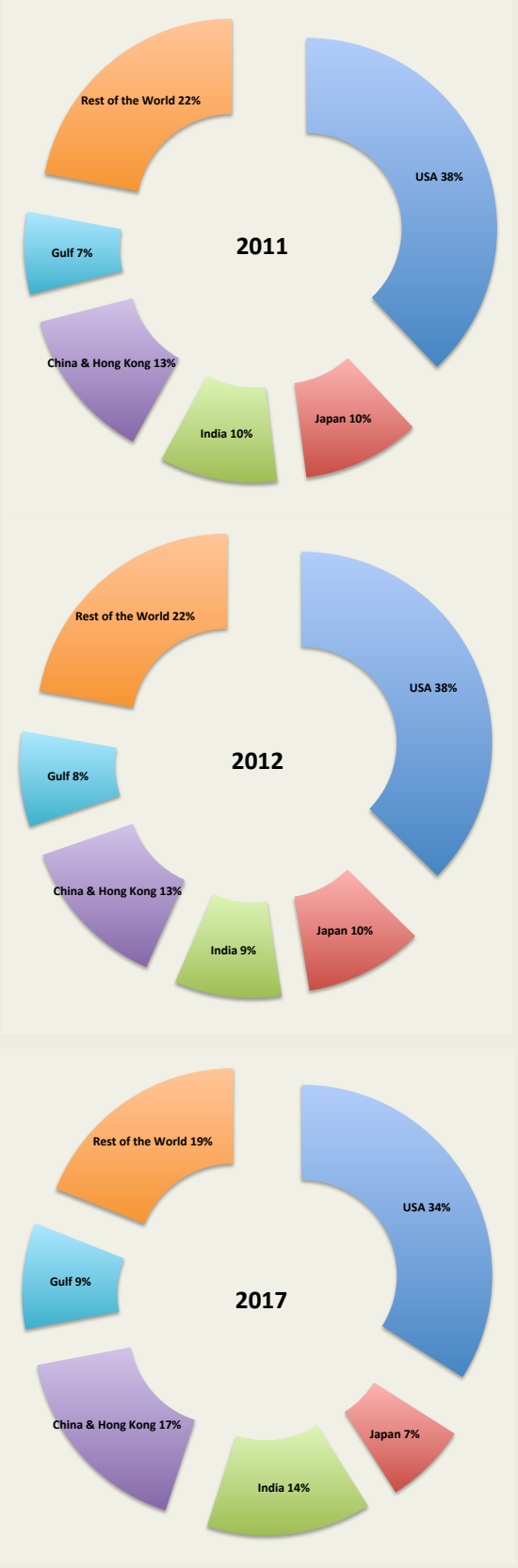

Figure 46 - De Beers consumer demand forecasts, 2011, 2012 and 2017 (US$ PWP) - De Beers Operating and Financial Review 2011 and 2012.

As in mining, the global diamond jewellery market has suffered structural changes:

1. In earlier times, America was the dominant diamond jewellery market, other markets representing minor shares. With the rise of its economy and clever local marketing from De Beers, Japan became par with the USA (both at roughly 30% of the global market) for diamond jewellery (the Asian market focusing in higher quality and value and the Americans in volume). The last decade has seen several events with important (short or long-term) impact in these markets:
    a. Conflict diamonds, Kimberley Process and the Patriot Act. The public outcry of civil wars in diamond producing countries, allegedly rooted or perpetuated by diamond mining, originated the Kimberley Process. Under international coordination and with the cooperation of the industry, the Kimberley Process is a methodology to trace the origin of traded diamonds, thus assuring that they don't originate in countries in conflict. The reinforced administrative control of diamond trade has been further pushed by allegations that diamonds were used as a money laundering mechanism by terrorist and criminal organizations.
    b. September 11, 2001. In addition to the human tragedies that they provoked, the September 11 attacks had deep, long lasting psychological and symbolical consequences.
    c. The financial crisis of 2008, with roots on unchecked, deregulated, greedy market operators and careless, incompetent policy makers, has had a major impact in the USA and Europe. In 2012:
        i. The United States are still trying to cope with an economy that is only marginally better than stagnant, a budget deficit and an ever growing debt.
        ii. European Union countries, particularly those of the Eurozone with sovereign debt problems, are now facing strict austerity measures fuelling a new recession.
    d. The Japanese economy has become stagnant, with inflation at low levels.
2. The last decade has seen the emergence of India and China as major markets. The fast growing middle and affluent classes of the two most populated countries in the world create a wealth opportunities for the diamond jewellery industry:
    a. Asian newcomers' – China and India – demographic weight turns even small relative increases of their middle classes into a large absolute growth of the potential global market. Both these economies keep showing healthy growth rates, in marked contrast with the most powerful western economies.
    b. Despite the fact that jewellery is part of India and China heritage, their propensity to acquire diamond jewellery and their buying behaviour is not the same as the American or Japanese or even when comparing two Asian countries.
3. The new global market won't just be a larger version of the old:
    a. The simultaneous growth of new markets and the economic woes of the USA and Japan will result on a different market structure.
    b. Social and economic trends amongst younger generations and increased competition from other luxury-status products, such as high-end portable electronics (5 million new iPhone 5 sold in the first few days…) will impact on the potential clients' buying habits.
    c. Online jewellery sales are increasing, especially in the US market – a new channel becoming is now firmly established.

The activities in between diamond mining and retail jewellery will keep fighting the competitive pressure and the threat of vertical integration of their suppliers and customers. These companies' profitability is further stressed by the commoditization of diamonds, with online exchanges and open pricing becoming the rule in the near future, replacing face-to-face discussions on the discount on Rappaport.

4 Down to Earth, back to basics: Angolan diamond geology and mining

Figure 47 - Kimberlite rock – Camatchia, February 2007.

4.1 Diamonds in space

The primary sources of the Angolan diamonds are kimberlites located (generally speaking) along a SW-NE tectonic corridor – the Lucapa Trend (not to be confused with the Lucapa Graben). The Lucapa Trend extends from the SW of Angola into DRC territory, including the Mbuji-Mayi kimberlite district.

Being a zone of deep structural weakness, prone to the eruption of magma in the right conditions and timing, this tectonic corridor includes thousands of old volcanoes: barren (most), (relatively frequent) mineralized but uneconomic and (rare) economic kimberlites and many other volcanic rocks, namely the exotic carbonatites (potential sources of phosphates, niobium, tantalum and rare earth elements).

The occurrence of these rocks is structured in several ways:

- Rather than a clean single fault, the Lucapa Trend is made of a mesh of smaller scale fractures (but some deep enough to reach the Earth's upper mantle where diamond-rich magma has thermo-dynamical conditions to exist – 200 km deep).
- Mineralized kimberlites occur in the old core of continents – cratons. As we move away from the center of cratons into their margins and beyond (in this corridor, into the SW of Angola) the likelihood of the occurrence of kimberlites (especially the ones mineralized) decreases. On the contrary, the likelihood of carbonatite volcanism increases. As a result, we observe a mixture of carbonatites and kimberlites along this corridor but with increased dominance of carbonatites in the SW and of kimberlites in the NE of Angola – the Lundas, the heartland of diamonds.
- Known kimberlites occur in this broad, 2.000 km long tectonic corridor in districts (some authors preferring to call them provinces), areas where kimberlites seem to concentrate. Some of the diamond districts may be a little off the SW-NE corridor.

- Kimberlites are also organized on a smaller scale, in clusters of close-by pipes or dikes. When a kimberlite is found others will be present nearby. The metallogenic characteristics of neighbouring structures may be radically different though, with one kimberlite being economic and its neighbour barely mineralized or barren.
- On an even smaller spatial scale, a kimberlite pipe may the result of several eruptions, being built by material successively erupted along time. There are several such examples in Angola, notably the Camafuca-Camazambo (the coalescence at surface of five different pipes) and the Camatchia. This has important economic consequences in the mining of these deposits: these eruptions may have different populations of diamonds – some areas of the deposit may be barren, others may have a combination of high grade – small, lower value stones or low grade – larger, higher value stones. The complexity of the deposit model is compounded by the fact that each area may also contain a variable content of barren country rock as xenoliths.

Kimberlite eruption is a fast, violent process, blowing into the surface a mix of relatively cold kimberlitic magma and CO_2 gas mixed with fragments of the foreign rocks (some of them containing diamond) it shots through in the upper mantle and the crust.

As result of the process, large volumes of debris are spread over the eruption area and a crater develops on top of a carrot-shaped pipe. Minerals in the kimberlite and in other deep-seated rocks are created at pressures and temperatures very unlike those observed at the Earth's surface. They are chemically unstable and are quickly decomposed by atmospheric agents, air and water. Running water (or ice, in cold climates) erodes the clays and oxides that are the final residues of these decomposed minerals. Only the most resistant remain, notably diamond (due to its strong crystalline structure).

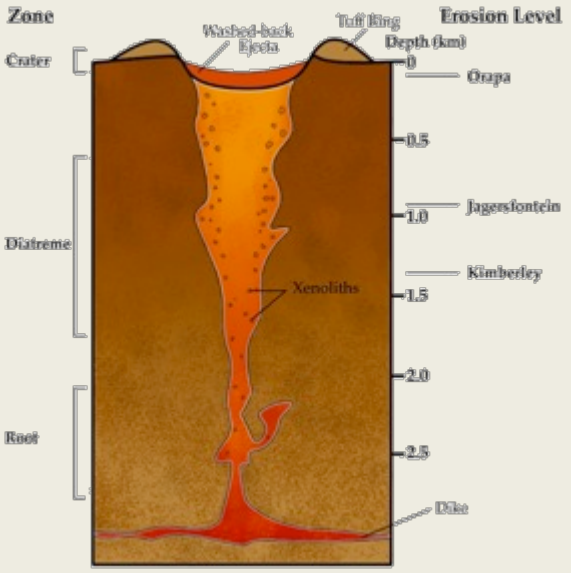

Figure 48 - Diagram of a volcanic pipe - source: wikipedia.

Eventually, a new eruption occurs, through the same channel or close by, modifying the pre-existing volcano or creating a new one close by. If the ascending kimberlite magma captured diamond rich rocks on its way up, a new mineralizing pulse occurs, adding new gems into the eruption area and into the secondary mineralizing cycle.

4.2 Washed diamonds

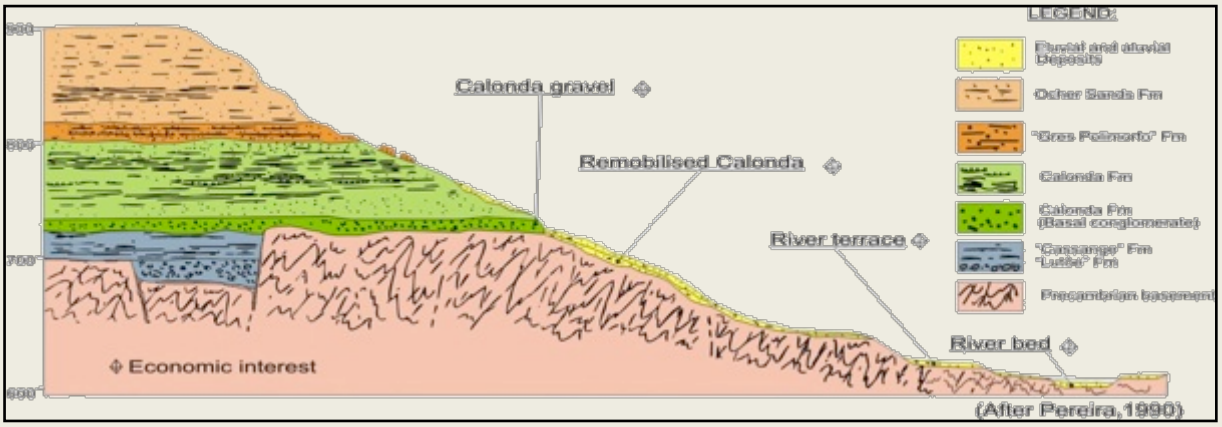

Figure 49 - Conceptual model of Angolan diamond deposits.

Secondary diamond deposits may form as result of river activity in terraces, flood plains and in riverbeds. Flowing water has the leading role in the creation, development and evolution of secondary diamond deposits: flash floods, running streams or even glaciers transport diamonds along the hydrographical basins, away from their primary sources.

Diamonds are carried at the surface by water mixed with gravel, sand and clay. When water loses velocity, it deposits the materials that it carries: the first to be deposited are the heavier and denser particles (gravel

and heavy minerals, such as diamonds, gold and other metallic minerals); then, as it loses energy, sandy materials and finally clays. The initial heterogeneous mix of material is sorted this way by running water, with materials being classified by size, density and shape.

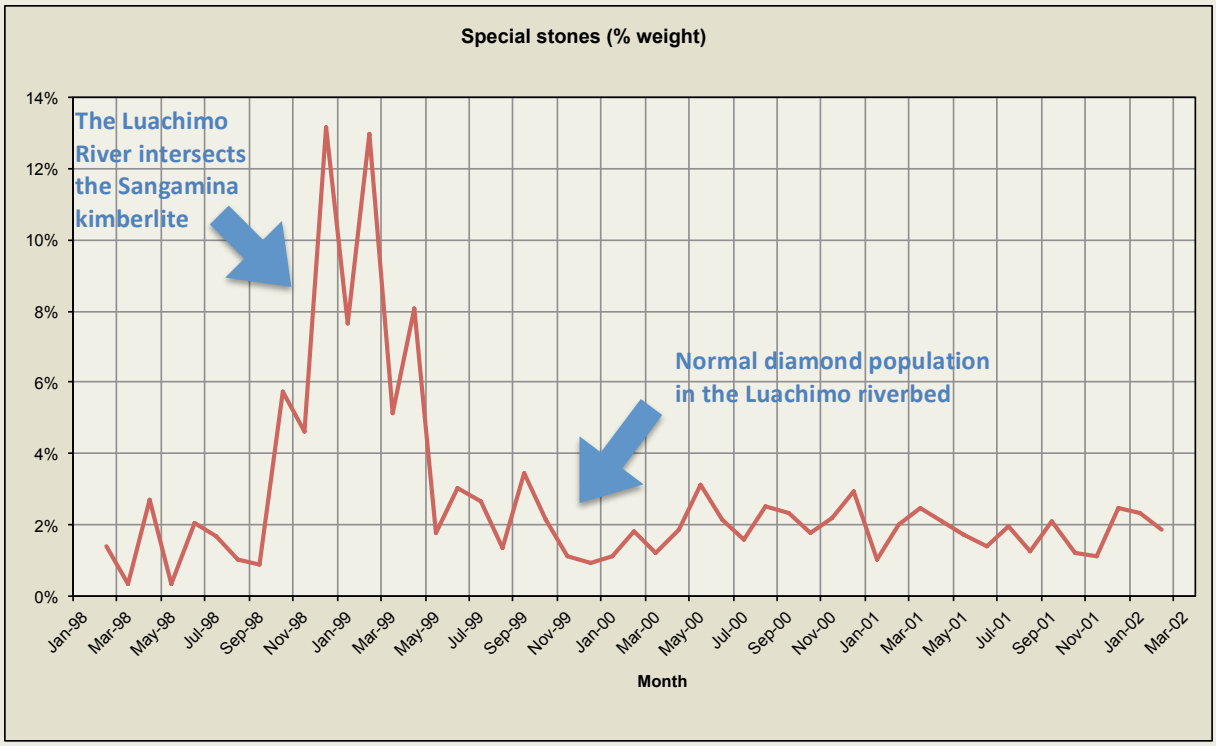

Figure 50 – Weight proportion of special stones (+10.8 ct) along the Luachimo River in the production of a dredging operation.

The other mineralizing factor is the morphology of rivers and riverbeds. Depressions, holes, fissures, channels or barriers, the inner side of curves and the sudden widening of the river act as traps, spots for the preferential deposition of diamonds. The hydraulic behaviour of diamonds is similar to that of quartz gravel (as diamonds, finer, are denser than quartz – 3.520 $kg.m^{-3}$ and 2.700 $kg.m^{-3}$ respectively). Natural pulsation in the water further classify gravel: the smaller, denser diamonds travel through the interstitial spaces into the bottom of the gravel layer, with a more likely deposition close to the interface between gravel and bedrock.

The transport of diamonds by water has important economic consequences. Diamonds are fragile; as they travel in the rivers, shock may break them. The lower quality diamonds (with internal heterogeneities and fractures) will tend to break more likely than the best diamonds. This is the reason why diamonds will tend to be of higher quality as we travel away from their sources, in a natural selection process.

In another effect, the breakage of diamonds as they travel, on one side, and their size selection by the decreasing energy (and carrying power) of water as they are carried downhill, on the other, work towards a decrease in the average diamond weight along the water flow. Diamonds are smaller and of better quality as they travel away from the kimberlites from which they originated.

The type of diamonds found in the deposits along the river basins may show marked deviations from the expected behaviour just described. That may be due to a combination of several factors:

1. The river systems are complex and dynamic, evolving through time. The rivers erode the formations they cross, changing their own course and even capturing other rivers. Climate, tectonics and the position of continents also change, modifying water regimes and river patterns. Diamond deposits are not immune to the changes in rivers, being subject to several transport-deposition-remobilization cycles. The Calonda Formation basal conglomerates are old fluvial gravels being continuously remobilized, thus feeding diamond deposits being formed today.
2. Kimberlites occur in clusters and districts; it is likely that a river drains diamonds from several sources, mixing populations with different signatures (different average weight, color, clarity and morphology). When diamonds eroded from a primary source enter the main transport channel,

a spike occurs if their characteristics are markedly different from the main diamond population – e.g. the Chicapa river crossing the vicinity of the Sangamina kimberlite, with a marked increase in the average proportion of +10,8 ct diamonds, Figure 50.

In certain cases, after traveling hundreds of km, diamonds may reach the mouth of rivers and end their travel in the shores and beaches of continents, where sea currents further classify and redistribute them.

Table 5 – Angolan diamond geology - (Pereira, Rodrigues, & Reis, 2003).

CHRONO-STRATIGRAPHY		LITHOSTRATIGRAPHY	TECTONICS
	PLIOCENE	**KALAHARI GROUP** Ochre Sands and Clays Fm	EROSION
	EOCENE - MIOCENE	Grés Polimorfos Fm	EROSION-HIATUS EROSION-HIATUS
CRETACEOUS	*CENOMA-NIAN*	**KWANGO GROUP** Calonda Fm: Arenites and silcretes; mudstones; conglomerate intercalations; Arenites and arkoses of different colours; reddish muddy arenites; Coarse basal conglomerate.	
	ALBIAN		EROSION KIMBERLITIC EMPLACEMENT CONTINENTAL RIFTING
	APTIAN	**CONTINENTAL INTERCALAR GROUP** Mudstones and arenites with conglomerate intercalations; White and reddish sandstones (arkosic with kaolinization); Brown mudstones intercalations; Mudstones and sandstones; fine-grained conglomerate intercalations.	W-E EXTENSION TECTONICS EROSION-HIATUS
JURASSIC		**KARROO SUPERGROUP** Continental tholeiites	
TRIASSIC		**CASSANGE GROUP** Beds with *Phyllopodia* Fm Beds with Plant Fossils Fm Beds with Fish Fossils Fm	NNE-SSW FRACTURING TECTONICS
PERMIAN		**LUTOE GROUP** Fluvio-Glacial Conglomerate Fm Muddy-Psammitic Fm Yellow Mudstone Fm	NNW-SSE FRACTURING TECTONICS
CARBONIFEROUS		Violet Sandstone Fm Tillite Fm	W-E EXTENSION TECTONICS EROSION-HIATUS WSW-ENE FRACTURING TECTONICS
		Hyper-alkaline granites of Lunda Basic rocks of Lunda	
CAMBRIAN		**WEST CONGO GROUP**	***PAN-AFRICAN OROGENY***
NEOPROTEROZOIC		Luana Fm: Quartzites and red phyllites; Brown quartzites; Conglomerates. Cartuchi-Camaungo Fm: Meta-arkoses and phyllites; Meta-greywackes, quartzites; Conglomerates.	
PALEO-PROTEROZOIC		**METAMÓRPHIC UPPER GROUP ~ (LULUA GROUP)** Superior Unit: silicified meta-limestones; phyllites and quartz-phyllites; phyllites and meta-sandstones with conglomerate intercalations. Inferior Unit: coloured schists and phyllites; fine-grained quartzites; black-shales, quartz-feldspathic schists, amphibolitic schists and gneisses.	***EBURNEAN / UBENDIAN OROGENY***
		Porphyry granites of Lunda	
		METAMORFPHIC LOWER GROUP / LOVUA GROUP~ (LUIZA G.) Mica schists, quartzites and itabirites; Amphibolites, gneisses e gneissic granites.	
ARCHEAN		**BASAL COMPLEX** (undifferentiated) > 2,7Ga	***LIMPOPO-LIBERIAN OROGENY(?)***
		~ (DIBAYA GROUP) Gneisses, migmatites e gneissic granitoids.	
		CHARNOCKÍTIC COMPLEX Charnockites ; Quartzites ; Amphibolitic gneisses, amphibolites and meta-gabros.	

4.3 Angolan diamond deposits

Figure 51 - Angolan diamond districts deposits and occurrences.

4.3.1 Kimberlites and other exotic rocks

4.3.1.1 Overview

Roughly 1/6 of the world's kimberlites are Angolan. In addition to the 700+ kimberlites discovered between 1952 and 1974, recent exploration work has generated a big expansion of that number.

Some of those kimberlites are world-class deposits, namely the Catoca and Camatchia-Camagico. The Camútuè cluster of kimberlites, although with lower reserves, has some of higher-quality Angolan diamonds. Other kimberlites, like Camafuca-Camazambo and Camuanzanza, just to name a few where diamonds occur, have to be further studied to evaluate their real economic value.

Kimberlite eruption in Angola occurs during Middle Cretaceous in association with tectonic movements affecting Continental Intercalary Formation (ENE-WSW and NNW-SSE). It is admitted (Monforte 1993), however, that a second, younger, kimberlitic volcanism period may have occurred. In some areas, kimberlitic eruptions are associated with N-S and E-W tectonic movements. In fact, during the Tertiary, the ENE-WSW and NNW-SSE movements change to E-W and N-S due to the rotation of the African shield.

In addition, silicified blocks with kimberlitic ilmenite are found at the surface of some kimberlite bodies or

mixed with gravels of the present hydrographical network. These silicified blocks are in fact polymorph sandstones (*grés polimorfos*). This means that these kimberlitic eruptions are contemporaneous of the silicification that originated the polymorph sandstones (*grés polimorfos*) and this extended until, at least, Middle Tertiary.

(Monforte 1993) thus believes that two kimberlite generations occurred:

1. Some kimberlites are pre-Calonda, Middle Cretaceous, associated with ENE-WSW and NNW-SSE tectonics, strongly eroded, its diamonds being incorporated into the basal conglomerates of the Calonda Formation.
2. Other kimberlites are post-Calonda, younger (Middle Tertiary) and associated with N-S and E-W tectonics, lightly affected by erosion.

Most of the previously known Angolan kimberlites were only superficially studied in the past and, based on those studies and the technical and economical conditions then prevailing, discarded as not interesting. A thorough study of the kimberlite occurrences in Angola is thus a priority.

One of the most interesting puzzles to solve in what concerns Angolan diamond geology is the discovery of the source(s) of the Cuango River basin diamonds. The Cuango deposits are the richest in Angola (in grade and value, fetching 300+ USD/ct). Although many kimberlites have been found in the vicinity of the Cuango River, all of them were classified as sterile. No primary source was yet found for the Cuango diamonds.

4.3.1.2 Districts, clusters and kimberlites

Angolan kimberlites occur spatially organized in districts and clusters. The issue of the Angolan diamond districts may need a new analysis, given the availability of recent data. However, the major lines are already present in the works of (Monteiro, 1993) and others based on DIAMANG and CONDIAMA information. According to (Monteiro, 1993), there are several kimberlite districts in Angola, further subdivided in clusters:

- **Lunda Northeast** kimberlite district. This district contains a great number of kimberlites, including most of (if not all) the known economic or most important deposits – Catoca, Camafuca-Camazambo, Camútuè and Camatchia:
  - Calonda cluster - 19 accounted kimberlite occurrences.
  - Camatchia cluster – 8 known kimberlites.
  - Camútuè cluster – 12 known kimberlites.
  - Lôva cluster – 14 kimberlites including Catoca.
- **Cuango/Cocumbi/Cacuílo** kimberlite district. This is the most numerous district with roughly 450 known kimberlites – 439 inside the old DIAMANG claims and over a dozen more reposted by CONDIAMA. Most of them were only lightly studied in colonial times but some were diamond bearing and a few had interesting grades. CONDIAMA divides the district in two clusters:
  - From the Cuango NE up to the Cocumbi River.
  - The Luangue tributaries.
- **Cuanza** kimberlite district. There are around fifty kimberlites known from the colonial times in the Cuanza basin, especially in its headwaters area. Most of the known kimberlites weren't studied and most of the kimberlites studied weren't mineralized; a few, however, included diamond. There are however a couple of small economic secondary deposits in the region.
- **Huambo region, Cunene e Queve headwaters** district. Many kimberlites (some dozens) have been discovered in this region by either DIAMANG or CONDIAMA. Most of these kimberlites were tested and classified as barren, although occasional diamonds were found in the gravels of these basins.
- **Longa headwaters**. Some kimberlites were located in this region, leading DIAMANG to stake a claim. The knowledge about diamond metallogeny in this district is, however, very scarce.
- **Chibemba/Colui** district. This district includes 13 kimberlites. It seems, though, that the district corresponds to more than a single unit:
  - N Chibemba cluster. These kimberlites, located North of Chibemba, are presumed diamond bearing, the likely source of the small diamonds found in this region.
  - S Cassinga (Colui River) cluster. Five kimberlites compose this cluster, located South of Cassinga along the Colui River.
  - Cubango valley cluster. Three kimberlites were found up north, in the Cubango valley, close to Mumba. These kimberlites area apparently barren. Even if otherwise, the economic prospects seem very poor, as the diamonds occasionally found in the area are very small.
- **Quando/Cuchigi - Lungué Bungo/Luia** district. Seven kimberlites occur in this district, four of which occur in the Cuchigi River basin, close to Maué. They may be mineralized given the diamond indications in the region. The Kalahari sands have a great thickness here, fact that may limit the economic interest of the district.
  - Cuchigi cluster.

- Luia cluster. Three kimberlites were found but not studied by CONDIAMA. Previous work by DIAMANG had resulted in positive indications regarding diamond mineralization.

- **Cunene** district. Three kimberlites were found near the Ruacaná waterfalls. They are apparently barren.
- **Kuito** district. Two kimberlites were located in the Cuíto basin, over the 20°W meridian. These kimberlites are supposed mineralized, as diamonds have been found in the area.
- **Lomba/Quando** district. This region may contain a diamondiferous kimberlite district under the Kalahari sands, as several diamonds and indicator minerals have been found in the area.

4.3.1.2.1 Camafuca-Camazambo

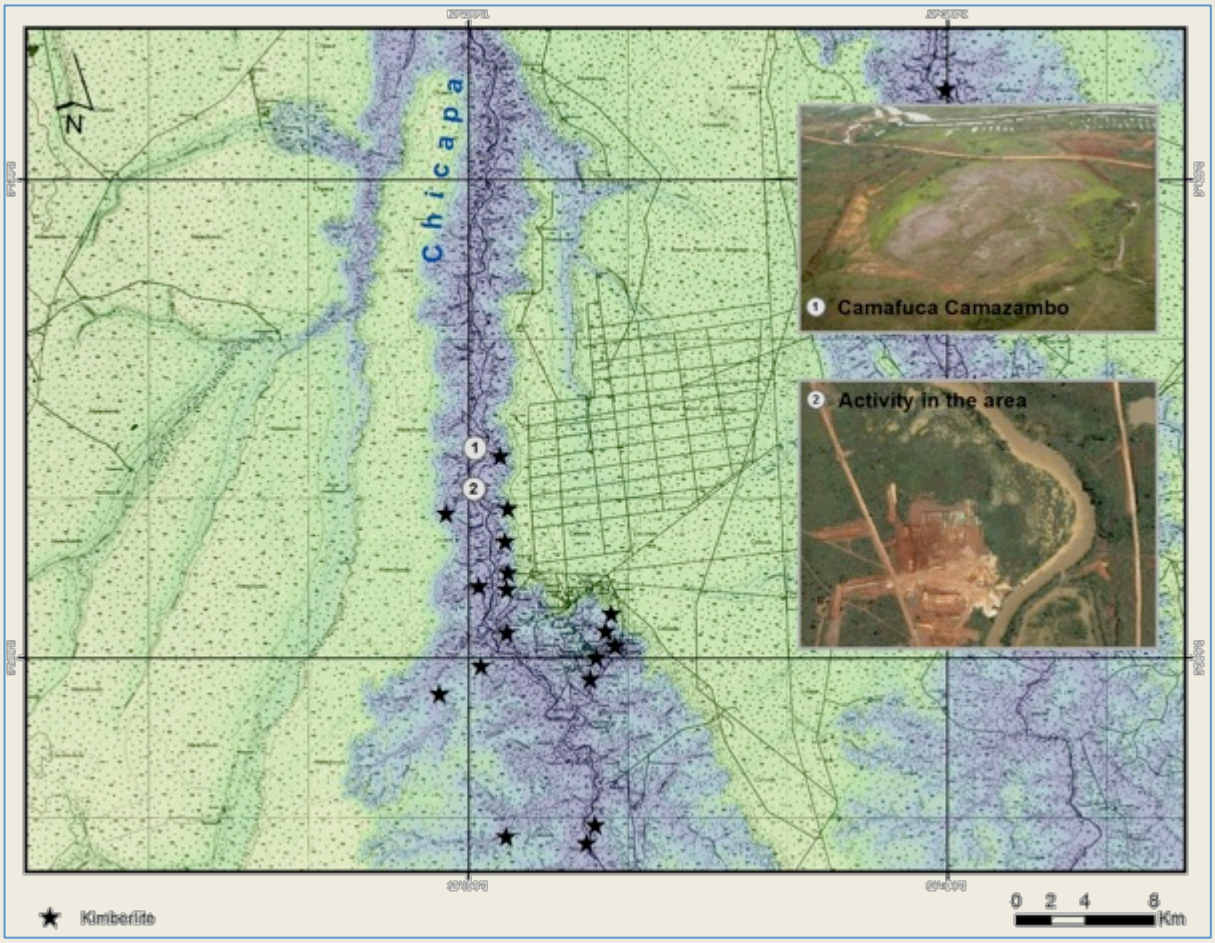

Figure 52 - Location of the Camafuca-Camazambo cluster.

Found by DIAMANG in 1952, the Camafuca-Camazambo kimberlite was the first discovered in Angola. It marked a new era, 40 years after the discovery of the first diamonds in Angola. With a surface of 192 ha, it still is one of kimberlites with largest surface in the world and the largest in Angola.

It is located in the Chicapa River basin; in fact, the kimberlite is crossed by this river, thus posing some engineering and environmental problems to a potential mining project. The kimberlite is mineralized. It has an elongated shape and is crossed by the Chicapa River. Recent exploration and geological modelling has revealed that the Camafuca-Camazambo outcrop is in fact the result of the coalescence of five different separate kimberlite bodies. The technical and economical feasibility of this kimberlite's exploitation has still to be demonstrated.

4.3.1.2.2 Catoca

With 63.9 ha, the Catoca kimberlite pipe is one of the world's largest primary diamond deposits. The kimberlite is only slightly eroded, with the crater still present (with rocks of various facies), with a diameter of almost 1 km (990 m x 915 m). The kimberlite extends in depth to 600 m.

The mineralized body is divided in three parts the central part, up to 200 m deep, is composed of volcano-sedimentary rocks (tuffisitic kimberlite); the ring that around the pipe walls is composed by porphyric kimberlite and other derived rocks; bellow

260m deep, the central part of the ore is composed by autolithic kimberlite breccias.

The structure of the deposit is complex, with the presence of intense intrapipe tectonic processes related to large-amplitude subsidence (Pervov, Somov, Korshunov, Dulapchii, & Félix, 2011).

The geological complexity has a natural impact in mining planning and operations, as different types of ore have to be extracted and processed. The technical challenges in the mine exploitation and management are compounded by uneven grade distribution in the deposit.

The estimated reserve of the Catoca kimberlite in 2002 is reported to be 271 Mt @ 70 carats per hundred tonnes for 189.3 million carats of diamonds.

Table 6 - Catoca kimberlite reserves, 2002.

Class	Level (m)	Ore (Mton)	Grade (ct/ton)	Reserves (Mct)
B	960-760	135.0	0.69	92.5
C1	760-560	85.5	0.64	55.1
C2	560-360	50.5	0.83	41.7
Total	-	271.0	0.70	189.3

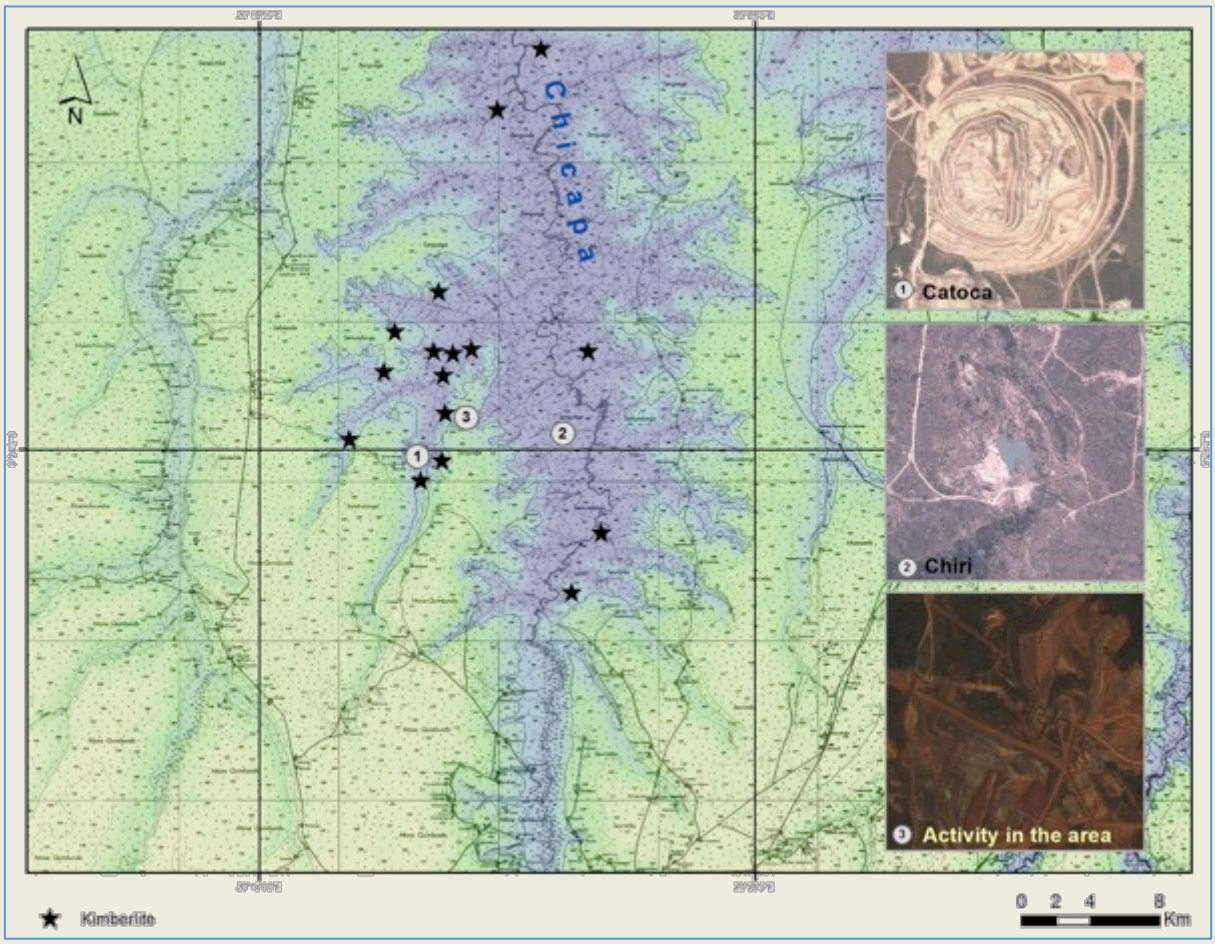

Figure 53 - Location of the Catoca cluster.

4.3.1.2.3 Camútuè cluster

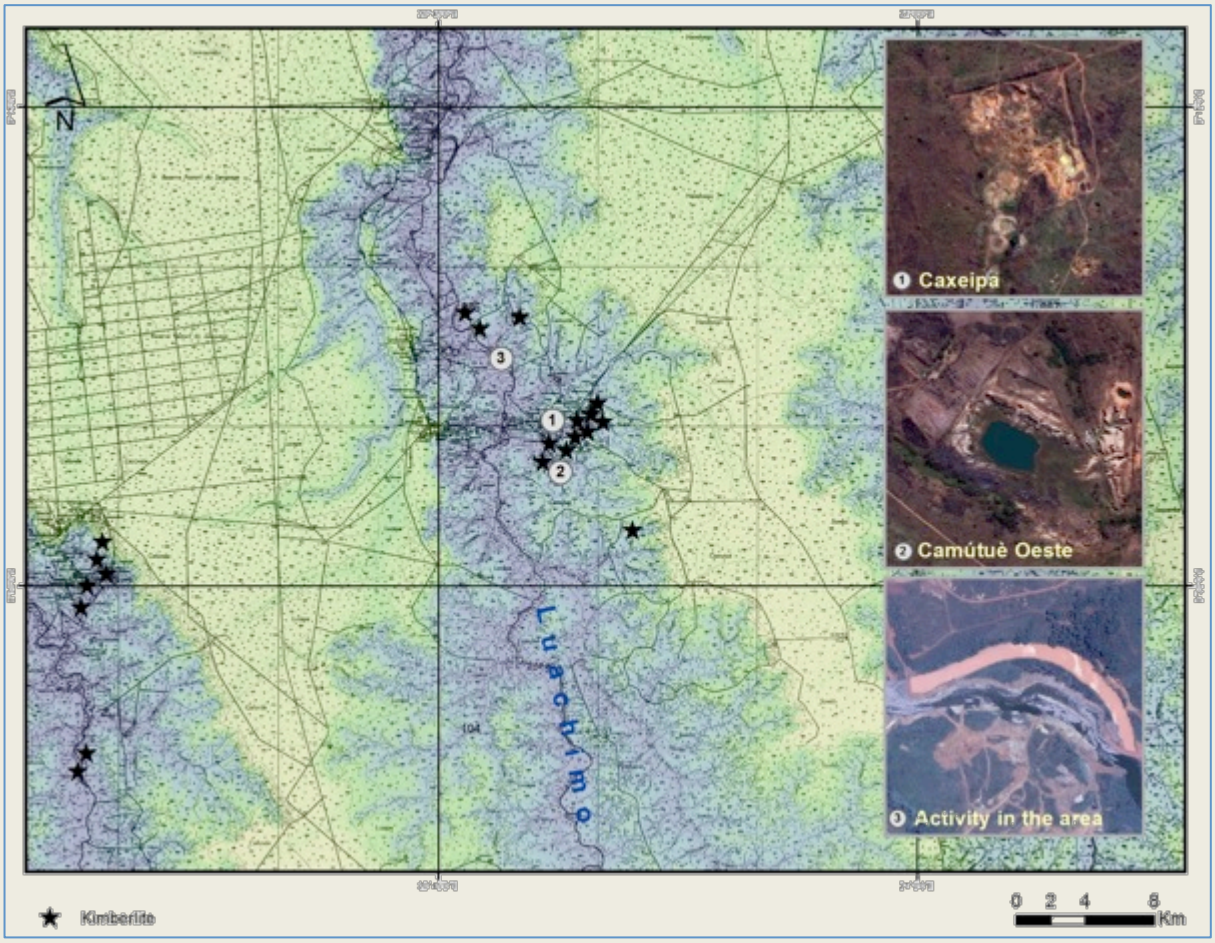

Figure 54 - Location of the Camútuè cluster.

The Camútuè W (sometimes referred as Camútuè I) pipe is one of the most important known kimberlites in Angola, either on the geological or the economical point of view. The Camútuè W kimberlite is located on the left bank of the Goege River, 10 km east of Lucapa. There is another pipe - Camútuè E (also known as Camútuè II) - in the immediate vicinity of Camútuè W (the minimum distance between both is 50 m); it is however an almost barren kimberlite.

A second mineralised kimberlite is located nearby, the Caixepa kimberlite. Its dimensions and reserves are, however, much lower than those of Camútuè W. Other kimberlites occur in area (the Sagombe, Caitondo, Sacuango, Sachipita, Capombo and Muenze kimberlites), forming the Camútuè cluster.

Camútuè W was discovered in 1958 during a routine alluvial prospecting campaign. The presence of chromium-diopside grains in significant numbers in pit sample concentrates led to a more thorough investigation of the Goege River drainage basin. This campaign led to the discovery of the kimberlite in the valley of the Camútuè.

The western pipe is located in a natural depression. Basic rocks outcropping to the west have helped preserving the kimberlite from erosion thus leaving much of the crater facies intact.

A first detailed prospecting campaign on the Camútuè W pipe revealed the presence of a thin cover of mineralised elluvial gravel. The economic importance of Camútuè W was thus established.

The diamond grade distribution within the pipe is not uniform. There seems to be a decreasing grade (and diamond size) trend with depth. Localized mineralized columns, corresponding to different eruptions, also have different grades. It must also be noted that the grade of the effusive-sedimentary facies is much lower (1 to 25) than the one from the eruptive facies.

Camútuè W production diamonds were renowned for their quality and value. The most common morphological type is the octahedron. As expected from a kimberlitic diamond population, its classification is poor.

4.3.1.2.4 Camatchia-Camagico cluster

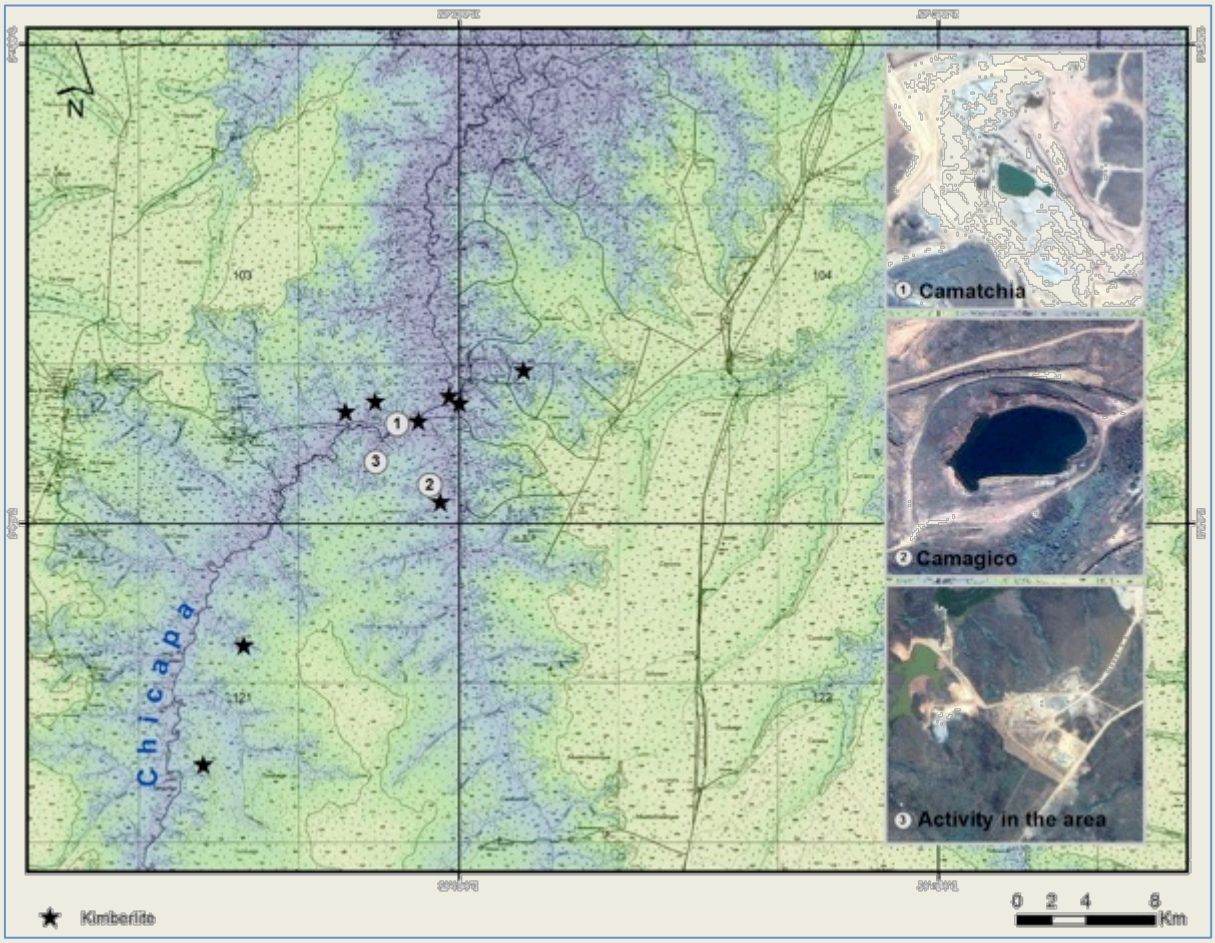

Figure 55 - Location of the Camatchia-Camagico cluster.

The Camatchia kimberlite has a surface area close to 30 ha, is oval shaped with a slight elongation in the northeast direction. The top 100m of the pipe is the traditional crater facies, graduating and reducing in size of 17.5ha of hypabyssal kimberlites. The ore body dips at 75 degrees on the southern and northern zones and 85 degrees on the eastern/western limits.

The Chicapa River flows directly over the kimberlite pipe but this has since been diverted (twice).

Figure 56 - The flooded pit of the Camagico kimberlite.

Figure 57 - Tuff kimberlite – Camatchia.

Figure 58 - Core - Camatchia kimberlite.

Figure 59 - Drill in operation - Camatchia kimberlite.

4.3.1.2.5 Cucumbi – Cacuílo

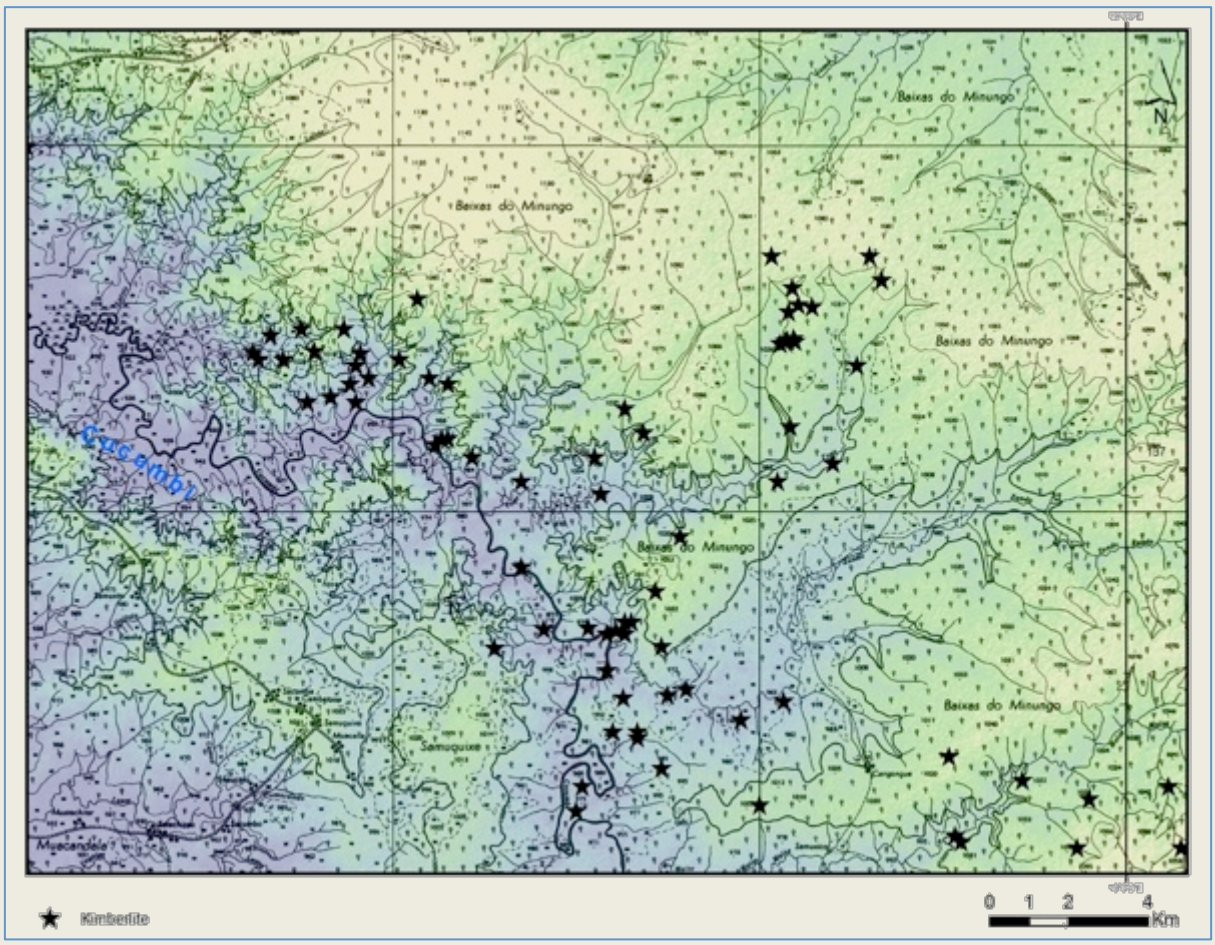

Figure 60 - Location of the Cucumbi - Cacuílo cluster.

Hundreds of kimberlites were discovered in the Cuango/Cucumbi/Cacuílo region both by DIAMANG - 439 kimberlites, and by CONDIAMA - over a dozen kimberlites. CONDIAMA distinguishes two districts:

1. One, NE of Cuango up to Cucumbi River.
2. Another including the tributaries of the Luangue River.

Most of these kimberlites had not been studied in detail until 1975, exploration work been planned or resumed nowadays. Available data classifies most of these kimberlites as sterile. Some of them are, however, mineralized and CONDIAMA expected some of them to be economic.

The Cacuílo kimberlite field - Figure 60 – is located in the Cacuílo basin, in Quaternary to Lower Cretaceous formations. 113 kimberlites outcrop in this field, 108 being pipes and the remaining 5 being dikes and veins. These kimberlites, with a Middle Cretaceous attributed age, erupted through the *Intercalary Continental* System strata and are older than (and perhaps contemporaneous, in part, with) the Calonda Formation sediments.

4.3.1.2.6 Alto Cuílo - Luangue cluster

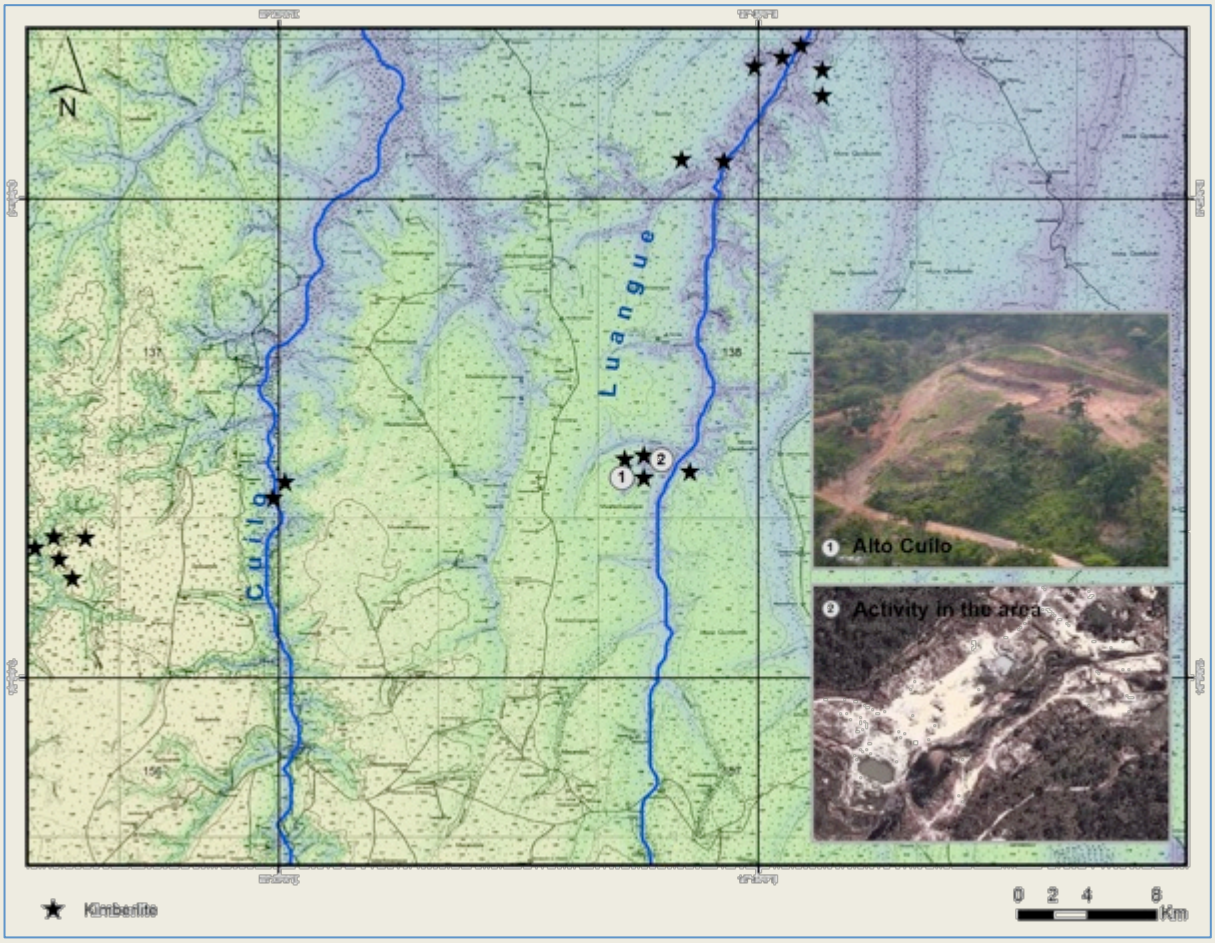

Figure 61 - Location of the Alto Cuílo cluster.

Petra Diamonds extensively explored this cluster of kimberlites for a decade, since 1998. This company's efforts were directed to two contiguous concessions – Alto Cuílo and Luangue – with similar kimberlite cluster geology. A large number of possible or confirmed kimberlites were identified in these areas.

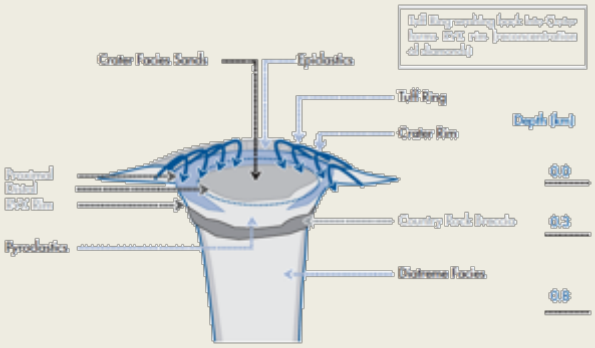

Figure 62 - RVK rims in kimberlite - (PETRA Diamonds, 2008).

The Alto Cuílo exploration project lies within the Lucapa corridor – a structural trend that hosts most of the known kimberlites and alluvial diamond deposits in north-eastern Angola. Granite/gneiss basement is overlain by Karoo sandstones and mudstones whose thickness is fault controlled and highly variable - (PETRA Diamonds, 2005).

Karoo and basement lithologies are overlain by Cretaceous Calonda sands that are the same age as the kimberlite intrusions, and a lack of significant erosion of Calonda and kimberlite lithologies has resulted in almost complete preservation of the kimberlite craters. Calonda and kimberlites have been covered by as much as 60 metres of Kalahari sands that have been incised by the current river systems, resulting in kimberlites outcropping in some river valleys - (PETRA Diamonds, 2005).

The Luangue project lies contiguous to the north of Alto Cuílo in Angola's north-eastern diamond belt, also sitting in the Lucapa corridor. The same host-rock stratigraphy of basement granite/gneiss overlain by Karoo, Calonda, and Kalahari sediments is thought to exist at Luangue based on the limited information from drilling to date, though the new aeromagnetic data suggests that basement may be much closer to surface in the northern and eastern portions of the Luangue concession. - (PETRA Diamonds, 2005).

4.3.2 Alluvial deposits, old and new

Figure 63 - Calonda Formation in exploration - Chimbongo concession (note the Luembe River in background).

Figure 64 - A sample of typical Calonda Formation basal conglomerate.

NE Angola alluvial deposits' diamonds constitute the bulk of the diamonds extracted until now in Angola and represent a large fraction of the still existing reserves. The Chiumbe, Luembe, Luachimo and Chicapa rivers' basins deposits are the most important, only surpassed by Cuango River's.

Secondary deposits were formed in several cycles, starting immediately after kimberlite emplacement (in

Cretaceous times, generally speaking). The first secondary deposits correspond to the basal conglomerates of the Calonda Formation. The erosion of these conglomerates released diamonds that would be concentrated in more recent deposits.

The Kalahari Group has gravel units, where diamonds could hypothetically be present. This happens, although not frequently and generally with low, uneconomic grades. This formation is not usually a paying target.

Recent secondary deposits may be found in:

- River banks (flood plains) - *lezírias*. Alluvial diamond deposits located in the flood plains of the main rivers.
- Terraces - *terraços*. These alluvial deposits are older than the ones in the flood plains. These are the remnants of alluvial deposits formed when the river's base level was located at a higher point.
- River valleys.
- Elluvial (slope) deposits - *colinas*. These are secondary diamond deposits located in hill slopes, i.e., deposits created by the erosion of previous mineralization in which transport is very limited.
- River beds.

(Monforte 1993) classifies the alluvial diamond deposits known in the Lunda provinces as:

- Deposits with a direct and immediate relation with the present river activity:
- River bottom gravels. Deposited in singular points of the water courses, such as depressions, long channels and rocky dams.
- River margins and islands gravels. Deposited by water courses in certain spots in the margins and islands or in the middle of the river bed (close to the water level), in long bars in places where the river is wide and the current week.
- Deposits in relation with old river activity. The Miocene and Plio-Plistocene peneplains are being dissected by the present erosion. The main rivers cut into those peneplains, creating valley and terrace deposits.
- Alluvial plain deposits. Deposited in one or both river margins. They can be subdivided into flats' deposits, spread over the big rivers wide alluvial platforms and creeks' deposits, on the narrow valleys of the secondary tributaries. These deposits generate reserves rapidly.
- Terrace deposits on the valley flanks, with an elevation of 1 up to 40 m above water level.
- Deposits independent of the present hydrographical network:
- Slope elluvium. Deposits created by the sliding of upper level gravel through the depressions' flanks. They derive directly from Calonda Formation conglomerates or from plio-plistocenic gravels.
- Plio-plistocenic gravel beds of the secondary tributaries. These deposits are the elluvial residues of the Calonda Formation. They may be (with its economic value decreasing from 1 to 3):
    1. Directly over the pre-Calonda bedrock.
    2. Directly over the conglomerate or conglomeratic lenses of the Calonda Formation base level.
    3. A variable thickness of sandstone over the Calonda Formation basal conglomerates.
- Calonda Formation. The Calonda Formation basal conglomerates are the most extensive diamondiferous horizon, being the direct warehouse of the diamonds released from kimberlites. There are three basal conglomerate types in Calonda Formation (with economic value decreasing from A to C):
    - Type A – With a fanglomeratic aspect, with big angular and sub-angular blocks and a reduced extension.
    - Type B – Finer than Type A's, with quartzite dominance and continuous over great extensions.
    - Type C – With a small thickness, wind-worn, small size elements in a clay matrix.

(Monforte 1993) only includes the clearly mineralized formations in the designation secondary diamond deposits. He does not include:

- Laterally and vertically very localized Calonda Formation conglomeratic lenses.
- Occasional gravels of Late Cretaceous or Middle Tertiary peneplains.
- Plio-plistocenic gravel blankets of the larger interfluves directly over Calonda Formation sandstones.

Whatever the mechanism involved in the concentration process, e.g. either the current or past river activity, most alluvial deposits (*sensu latu*) derive, directly or indirectly, from the Calonda Formation layers. The study of this formation's basal conglomerates either using descriptive or genetic criteria (aiming to know the paleogeographical conglomerate type distribution and diamonds' transport direction and distance) has a paramount importance.

4.3.2.1 Angolan diamond rivers

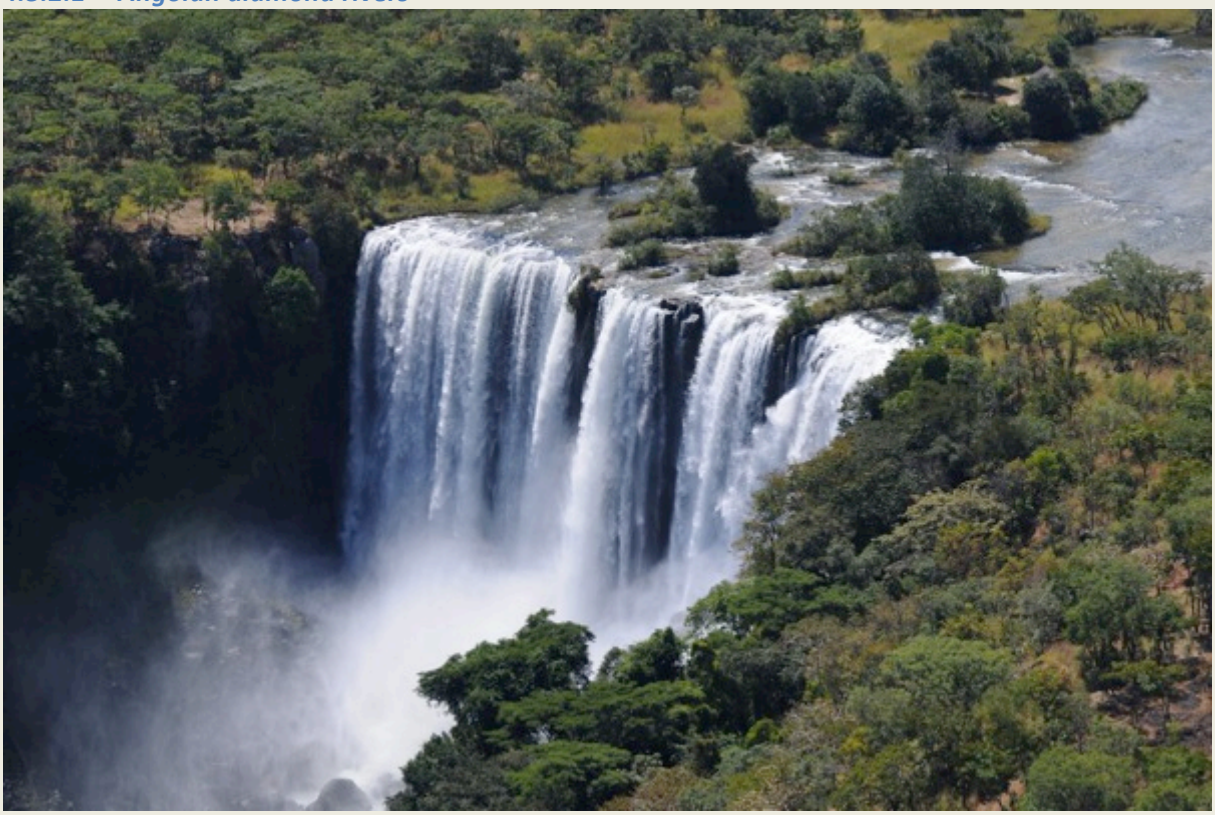

Figure 65 - The Luando falls - north of Bié Province.

Figure 66 - Diamonds from the Luembe River deposits - Chimbongo concession.

Angola diamonds earned their reputation from their alluvial sources. The rich alluvial deposits of those rivers (Cuango, Chicapa, Luachimo, Chiumbe, Luana and Luembe running S – N, flowing from the centre of Angola into the Kasai River in Congo) contain a very high proportion of gem diamonds. Their richness derives from the sorting properties of flowing water and from the fact that these they cross or border many of the country's kimberlites, e.g. the Camatchia, Camafuca-Camazambo and Sangamina.

Cuango is one of the world's mythical diamond rivers. Cuango´s legend was built around the extraordinary characteristics of its diamonds value and grade but is also due to the fact that the primary sources of its fabled secondary deposits are still unknown.

The Cuango River has its sources in the Bié province, centre of Angola. It flows from SE to NW until it reaches (already in the RDC territory) the Kasai River, itself a tributary of the giant Congo River. The Cuango River flows through the Cassange depression for over 100 km, meandering in a soft relief peneplain, with many abandoned river arms. Except in rare cases, diagnostic of old formation outcrops, water flows slowly.

The Cuango River flows in the NW direction south of Cuango massif, deviating to NE-SW during some tens of kilometres, after which it flows again in the NW direction. When the river deviates to NE-SW, it accelerates and the riverbed width decreases, flowing through the Precambrian massif in a succession of rapids and waterfalls.

The river flows in the recent formations next to the Guvo River, meandering again for 100 km in a wide valley between Xá-Muteba and Capenda-Camulemba, with characteristics similar to those presented in the Cassange depression area. These wide valleys are subject to flooding during the rain season; in certain points the river attains a ten-kilometre width.

The river changes again when entering the Tembo Aluma granite massif, where, at midcourse, it falls

into a succession of rapids and waterfalls, before slowing down downstream of Cugo River.

The Cuango tributaries have similar characteristics, its behaviour being dependent of the bedrock they cross. This zone's morphology is intimately connected to bedrock lithology:

In the areas where the Precambrian formations (Base Complex) dominate and generally outcrop, an accentuated relief occurs and tributaries run in rapids in narrow and woody gorges.

In the areas where the sandstone formations of the Bembe System dominate, hilltops are round or plateaus, with a smooth relief, resistant to the river erosion (that descend in rapids).

In the areas where formations are younger (e.g. Kalahari Formation), relief is not always protected by the superior silicified levels. Relief is being eroded by running water, leaving some remnants. In these areas, rivers meander in plains and wide valleys.

Finally, being the hills higher in the right margin, this side of the river has generally a denser hydrographical network, with shorter tributaries; differently, the left margin has a set of longer and slower tributaries, in a sparser network.

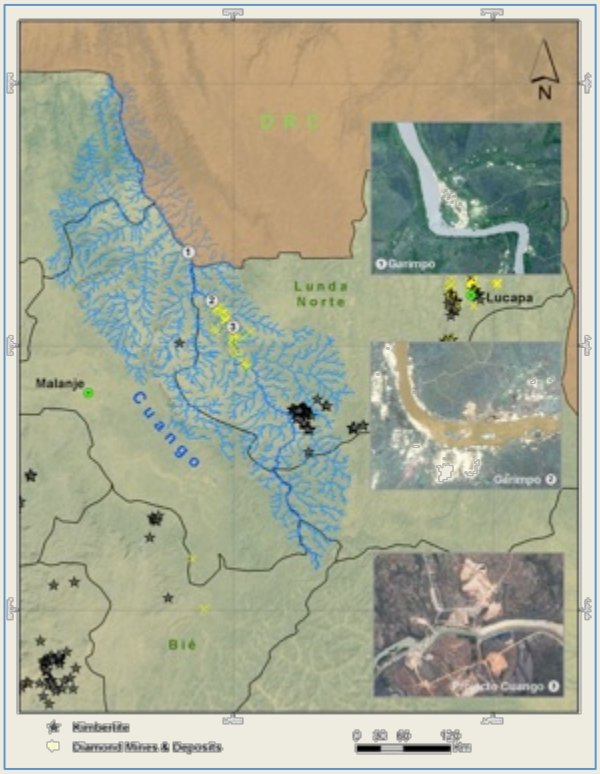

Figure 67 - Cuango River basin in Angola.

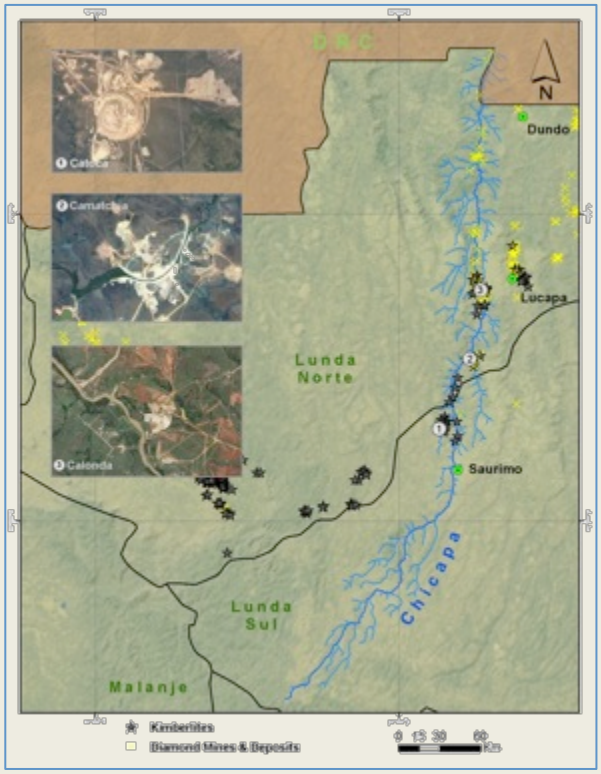

Figure 68 - Chicapa River basin in Angola.

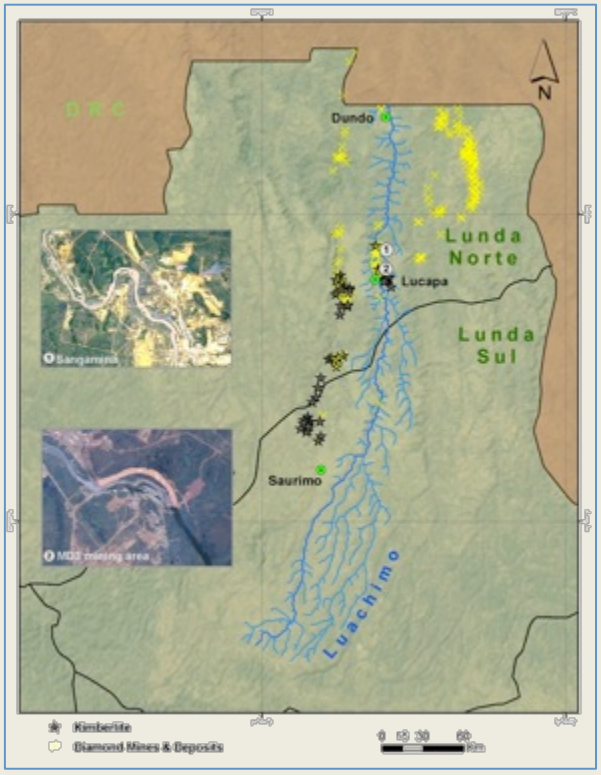

Figure 69 - Luachimo River basin in Angola.

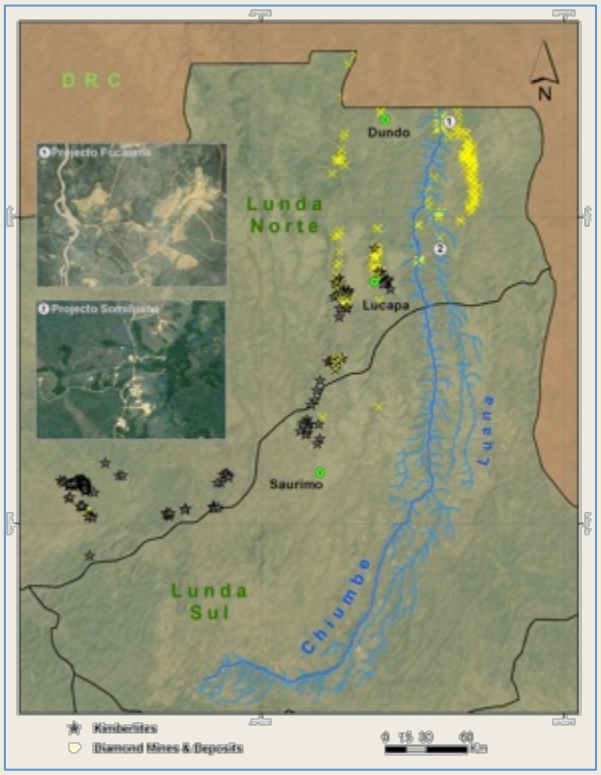

Figure 71 - Luembe River basin in Angola.

Figure 70 - Chiumbe River basin in Angola.

Figure 72 - Cuanza River basin in Angola.

Figure 73 - A bend in the Chicapa River, upstream of the Camatchia kimberlite.

Figure 74 – A garimpo settlement in the Chicapa River – Chingufo area.

Figure 75 - A different landscape in the center of Angola - south Malanje/north Bié area.

4.4 Exploration

Figure 76 - A fundamental tool for greenfield exploration projects in Angola - south of the Malanje Province.

The discovery of a new mineral deposit is every explorer's dream. When you are fortunate to do so, a rush of pride and excitement flows over you. Yet, rather than excitement, the process that may conduct you to that is an exercise of patience, reflection (and yes, some intuition) and hard fieldwork, with money, time and luck being essential ingredients.

To explore for diamond deposits in the interior of Angola is both rewarding and challenging. Nowadays most security issues are a lower threat than in the past (yet they should always be on top of your list), being in a fertile ground you will likely find diamond mineralization (yet to become a deposit beware of economy as costs may be hidden) you have the chance to work in a beautiful, natural, mostly unspoilt environment (yet be aware of the Mother Nature's dangers) and the Angolan common people is friendly (yet know and respect them and their culture and traditions).

4.4.1 Kimberlite exploration

Mineral deposits are rare anomalies in the Earth's crust. They have mineralogical, chemical and physical properties that set them apart from the common rocks surrounding them. The contrast between the properties of common rocks and diamond deposits is the basis for the exploration methodologies that we use.

Time and money are also restrictive criteria, generally working in opposite directions. These criteria are increasingly important as the area to explore becomes larger. Low unit cost (dollars/km^2) methods will be used firstly; more expensive methods will be used in later stages, when you want to confirm the nature of selected targets or sample them.

Exploration work starts with a desk exercise, collecting and analysing available bibliography and cartography about the region's geology and known mineral deposits. Buy satellite imagery (or aerial photos, if available) and proceed with a preliminary metallogenical modelling (where will most likely kimberlites be located?). Use (even if crude) economical criteria from the onset in your modelling exercise (no use looking for deposits if a large barren cover – say 100+ m – is present, like the Kalahari Group in large regions of Angola).

Obtain the legal licenses to explore the regions prioritized in your desk study (be patient and cautious in the negotiation and budgeting processes). Assess risk and design appropriate minimization measures; the security situation is much better than in the past but you have to take war remnants (land mines and UXO's) and other risks into account.

Set up a small office in the capital (Luanda is a very expensive city) as base to support the fieldwork (where the important tasks will be done). Concentrate effort in setting up the exploration camps using local materials and human resources as much as possible (this lower your costs, the administrative work of importing goods and will go a long way to gain goodwill and establish a local support network).

The first field phase is an aerial geophysical survey. For kimberlite exploration, the magnetic and radiometric are the standard methods. These are general methods, used to guide subsequent work: some Angolan kimberlites are very elusive, showing no magnetic signatures even in detailed surveys. VTEM surveys have proved very effective, yet they are much costlier, amenable to be used in smaller areas. Finally, make sure that the interpreters know the local

geology (or at least similar geological settings elsewhere).

Geological groundwork starts along the rivers, sampling sediments with the purpose of finding minerals characteristic of kimberlites: diamond itself and special varieties of ilmenite, diopside, pyrope and phlogopite. These minerals form concentric aureoles around the kimberlites they originate from; the wider the more resistant the minerals. Following the mineral trails may lead to their source. Groundwork may also include geochemical soil analysis, looking for anomalous element concentrations diagnostic of kimberlite presence – e.g. chromium.

Ground geophysics, with the use of gravity, magnetic or electromagnetic methods, may precede the drilling stage to confirm the presence of kimberlite. The ground geophysics stage may be skipped altogether if the aerial survey had detail (resolution) enough.

Targets generated by the analysis of remote sensing, geophysical, geochemical and mineralogical data are prioritized for confirmation by drilling. Think out of the box and pay attention to unusual features: in addition to the ones generated by technical work based on new data or the reinterpretation of old data, targets may also be generated from human activity in the area. In favourable ground in Angola, you will likely find kimberlite structures. It is a first good step; only 1-2% of kimberlites will be economic. Expensive microdiamond analysis and fine geochemical work on the kimberlite's minerals may hint about its economic potential; however, more work has to be done to definitely upgrade the kimberlite into a mineable deposit.

The final exploration stage is the work conducive to a final feasibility study. It will include:

- Drilling to obtain:
  - Detailed geometrical and geotechnical characterization of the ore body and surrounding country rock. This task may be completed using medium to small diameter (faster, less expensive) drilling.
  - Sampling of the diamond population to assess its distribution, grade and diamond characteristics and value. Diamonds are rare, even in economic deposits. To obtain a good, reliable estimate of grade and large enough diamond parcels for valuation, the samples collected by drilling (and consequently its diameter) have to large.
  - Characterize the metallurgical properties of the ore types present. These samples can also be used for preliminary metallurgic tests.
- Bulk sampling. The final metallurgical tests and diamond valuation will require bulk sampling of the several ore types present. To decide whether to develop a several hundred million dollar mine based on incomplete data or unconfirmed assumptions are a fool's exercise. Always check; never assume, even based on the neighbouring kimberlite characteristics.

4.4.2 Alluvial exploration

With minor adaptations, the preliminary stages of an alluvial exploration program are similar to the ones comprised in kimberlite work:

- Bibliography, cartography and remote sensing acquisition.
- Preliminary metallogenic modelling.
- Concession negotiation and budgeting.
- Risk assessment and planning.
- Office and exploration camps setup.

Even in the richest deposits, diamonds occur in low absolute concentrations, not generating a signature (as for instance VMS sulphide deposits), the basis for aerial geophysical surveys. Unlike kimberlites, which may be picked up in that type of campaigns, aerial geophysical surveys don't add information about alluvium to what can be obtained by satellite imagery or aerial photos.

In the case of alluvial diamond deposits, rivers are the center of the work. It's the rivers that transport and deposit the diamond rich gravels in their beds and in the margins they flood. Rivers also the best transport ways for an alluvial project; don't spare on boats!

Alluvial diamond mineralization is controlled by morphology: diamonds concentrate on depressions and morphological traps. The analysis of high-resolution imagery allows the delimitation of the alluvial formations but also the identification of interesting morphological features. This method has the highest results/cost ratio.

Unfortunately, inexpensive high-resolution imagery does not give information about the morphology of riverbeds, under (frequently far from transparent) water. Geophysical and hydrographical surveys for riverbed deposits are the solution. In the past, this objective was obtained by 4 to 6 inches Banka (percussion) drills; nowadays, a combination of bathymetry, sonar, magnetometry, single-channel reflection seismics with limited percussion drilling and mini-bulk sampling is the best methodology for the evaluation of riverbed deposits.

Sampling of emmerse gravel layers along the river courses is also fundamental; they confirm the presence of mineralization, define the deposits extent (in area and within the sediment packet) and quantify the grade and average size and value of diamond populations present:

- In earlier stages, erratic sampling through manual concentration of gravel contained in morphological traps along the river basins.
- Percussion or auger drilling to obtain small size samples (a fast collection method yet with an inherently larger statistical sampling error) and information about the geometry of the deposits. Part of this work can be replaced by event faster and inexpensive geophysical prospecting (resistivity or seismics - refraction or reflection).
- Large diameter drilling (the modern equivalent of the successful manual $2m^2$ section well digging used by DIAMANG) to collect larger gravel samples, as the Chitotolo project did with so much success when evaluating the basal conglomerates of the Calonda Formation in Malúdi.

Plan your work according to the river moods; it rains in Angola to put it mildly, especially in the October to March period. Don't count on working productively in areas immediately close to the rivers during that period.

When prospecting for alluvial diamonds, pay attention to the eventual presence of other minerals – notably gold - that may contribute to the project's economy. Bear in mind also that other minerals may also be indicative of nearby kimberlites.

A final word of advice concerning exploration work, valid for either kimberlite or alluvial prospecting: invest in industrial security, intelligence and, especially, good relations with locals: a diamond lost in exploration may mean a missed deposit.

4.5 Mining

Figure 77 - A D8 CAT bulldozer in operation in the Chimbongo concession.

Kimberlite and alluvial diamond deposits' only common characteristic is the useful mineral they contain. They sharply contrast in what concerns spatial dispersion (one up to several mineralized kimberlite pipes in close vicinity and, in the case of alluvial deposits, widespread gravel deposits along river basins dozens or hundreds of km long), geometry (multiple meter thick gravel lenses or layers close to the surface in the case of alluvials and carrot shaped pipes extending up to 600 m deep and up to a few dozens of ha at the surface in the case of kimberlites) and the type and characteristics of the ore (a loose mix of quartz gravel, sand, clay and diamonds in the alluvial deposits and diamonds within an ultramafic silicate rock with a variable degree of decomposition).

Mining (extraction and ore processing) methods, capital and operating costs involved in the exploitation of the two types of deposits are completely different.

4.5.1 Kimberlite deposits

Economic kimberlites either outcrop or are covered by a relatively thin layer of sediments. The first stage of mining is a conventional open-pit operation that may extend several hundreds deep. This stage is followed by an underground stage, provided the project economy justifies it.

To ensure a profitable and safe operation, the open pit slope has to be as high as possible (thus minimizing the barren rock to move, increasing reserves and decreasing OPEX and CAPEX) without creating slope instability problems and risks for personnel, equipment and operations. This optimum balance can only be achieved by a careful design based on detailed geotechnical and hydrological studies.

Another major issue in extraction concerns the induction of diamond fracturation. Ore has to be mined out with explosives: this process has to be fine-tuned, as diamond breakage should be avoided to minimize the loss of value.

The processing of kimberlite ore has the purpose of liberating and concentrating diamonds from the mined rock – ROM, the run-of-mine. The liberation of diamonds is achieved by breakage and milling, the first phase of the ore processing. Again, comminution is a very sensitive process, with the separation of minerals being achieved with minimum diamond breakage.

Once separated from its matrix, diamonds are concentrated into a final product using a mix of processes based on its special properties:

1. Above average specific weight: 3,520 $kg.m^{-3}$. This is the property upon which most of the concentration process is based. Diamonds and other heavy minerals are concentrated into an intermediate product, lighter minerals discarded by this process – HMS, Heavy Media Separation.
2. Low magnetic susceptibility. Magnetic minerals are removed from the ore being processed, increasing the relative content of diamond.
3. X-ray fluorescence. The final concentration stage is commonly based on SORTEX machines. These equipments emit X-rays focused on a stream of mineral grains. Most diamonds emit light when excited by X-rays; the light is captured by photo-electronic sensors that remove the diamonds through the use of compressed air.
4. Hydrophobia. Diamonds adhere to grease. This property is also used in final stage concentration, frequently in conjunction with SORTEX machines to improve diamond recovery.

Diamonds are sorted from the final concentrate by visual inspection in secure installations. Classified and evaluated by highly trained experts, diamonds enter the distribution channels to be sold, polished and set.

4.5.2 Alluvial deposits

Figure 78 - Luembe River diversion: closing the dyke - Chimbongo project, October 2008 (Fernando Vieira photo).

Investment in the development of mining operations in typical alluvial and kimberlite operations varies by one order of magnitude. Setting up an industrial alluvial operation in Angola can cost a few dozens of MUSD; a kimberlite mine multiplies that value by ten.

Instead of centralized big open pit and treatment plant for several Mton per year, alluvial operations consist of widespread alluvial blocks with mobile treatment plants. Kimberlite operations focus on capacity, alluvial operations on flexibility and mobility.

The need for flexibility is also derived from the type (morphology and position) of blocks mined: some will be located in wide flood plains, conditioned by the river cycles, others will be on the bottom of the river or in hill slopes, terraces or narrow valleys, outcropping or under a few tens of meters of barren sediments. Each case presents a different challenge, different options to consider.

Ore processing is generally done in two, physically separate, stages:

1. Pre-treatment, closer to the blocks in operation. In this stage the (naturally loose) ore is sieved, with two size fractions being discarded:
   1.1. Diamonds are rarely larger than 30 mm (this may vary from deposit to deposit); beyond a certain grain size, it is not worthwhile to pay the extra cost incurred in processing the larger elements contained in gravel as the likelihood of recovering one diamond is low. This is a fine balance to achieve, as the cost incurred has to be set against the low likelihood but very high value diamonds eventually recovered.
   1.2. Diamonds smaller than 2 mm are common but their value is too low to justify the cost

of recovering them. Again, this depends on the deposit and on the diamonds' quality. A fine balance has to be achieved between expected additional value recovered and extra processing cost incurred.

1.3. As result, ROM is reduced to a first concentrate – *grão*, with a global volume 25-30% of the initial feed. This concentrate is sent to the DMS (a.k.a. HMS) installation for further processing.

The concentrate from the PT plants operating in the mine is generally sent to DMS plant in a central location (this plant should also be movable as the mining operation progresses, but less often than the PT plants). In this plant, gravitic separation with DMS cyclones is the heart of the process: diamonds and other heavy minerals are separated from the mostly quartz gravel elements based on their specific weight. This is achieved by circulating a pulp made of ferrosilicon and water mixed with the PT concentrate at high speed inside the DMS cyclones. The concentrate resulting from this process is only 1-2% of the initial ROM (run-of-mine). The final concentration stage consists of X-ray and/or grease tables' concentration, followed by hand sorting in secure installations.

5 Institutions, companies, people and issues

5.1 The diamond industries' structure

Natural diamonds are **explored** for, **mined** (with ore being excavated, transported and processed), sold and **traded** to and between lapidaries, **polished**, again to be sold and traded to manufacturers, where they are **set in jewellery**, sold again to retailers, and sold one more time before being **worn** and **showed-of** by the final clients.

The diamond industries employ ten million people worldwide (WORLD DIAMOND COUNCIL) in the most varied functions and activities. Rather than the simple pipeline described above, diamond industries constitute a very complex mesh of activities, specialized know-how, relations and (material and value) flows - **Error! Reference source not found.**.

Producing countries have been attempting to increase the value created in their economies diversifying the activities they perform in the diamond cluster of industries. Diamond producing countries commonly establish:

- Partnership agreements in the mining operations rather than the conventional concession and royalties model.
- Centralized valuation and selling of rough diamonds.
- Cutting and polishing operations.
- Jewellery design and manufacturing.

Angola is no exception. Still focused on the mining and rough trading activities, the country has a policy to diversify its activities associated to diamond. The next few pages describe the institutions, companies, but also the people involved and the main issues pending in the Angolan diamond industries.

5.2 The Angolan industry

5.2.1 Past

Diamonds were first found in Angola in 1912, exactly one century ago. Belgian prospectors, looking upstream of their finds in the territories that are now the DR Congo, found the first Angolan diamonds in the Mussulala stream, putting the wheels of human will and ingenuity in motion and creating a dynamic industry in the heart of Africa.

Up until 1971, the Angolan diamond industry was DIAMANG. The company had a monopoly of the diamond exploration, mining and selling activities in the country. It held a concession of 1.000.000 km^2 (the Angolan territory, with the exception of a stretch of land in the SW coastal region). The company grew into becoming an industrial giant under the guidance of Ernesto de Vilhena.

In 1971 the DIAMANG concession was reduced to a total of 50.000 km^2, creating the opportunity for new companies to enter the Angolan diamond fields. The most important to do so was CONDIAMA, a joint-venture between DIAMANG and De Beers.

This would be a short-lived venture, as it had to close its operations in 1975 due to the poor security situation consequence of the independence transition process then in course. Despite its short existence, CONDIAMA did a remarkable job of diamond exploration in most of the Angolan territory. As a result many new kimberlites and some alluvial deposits have been discovered or hinted. Time is of essence in developing mineral deposits, though, and most of the new potential primary sources were only superficially studied or completely untested.

Turmoil in the industry closely followed the establishment of a new political and economical order in Angola. The Cold War was fought by proxy in Angola (with the direct or indirect involvement of Soviet Union, Cuba, South Africa and the United States), with a huge human toll and the destruction of infrastructure. The evolution of the international situation and the efforts of the Angolan people made peace, recovery, progress towards democracy and economic growth the rule for more than a decade now.

5.2.2 Today's key players

5.2.2.1 Government and supervising agencies

5.2.2.1.1 Ministério da Geologia e Minas

The *Ministério da Geologia e Minas* (MGM) is the Government entity responsible for the negotiation of mineral rights contracts, for enforcing mining laws, and for executing the Government's policy regarding geologic and mining activities. The MGM is also the entity responsible for coordinating efforts regarding Kimberley Process Certification Scheme (KPCS) compliance. The KPCS is an international certification scheme established to prevent trade in conflict diamond – (USGS, 2011).

5.2.2.1.2 ENDIAMA – Empresa Nacional de Diamantes de Angola U.E.E.

ENDIAMA is responsible for creating partnerships with international companies prospecting for diamond and is a partner in all diamond ventures.

ENDIAMA can also enter into joint ventures with foreign diamond companies operating in the country – (USGS, 2011).

ENDIAMA's subsidiaries include Sociedade de Comercialização de Diamantes de Angola (SODIAM), which is in charge of the marketing, sale, and trade of all diamond produced in Angola and the entity responsible for KPCS compliance; and ENDIAMA Prospeção e Produção S.A.R.L., which oversees all ENDIAMA's mining and prospecting interests – (USGS, 2011).

5.2.2.1.3 CSD – Corpo de Segurança do Diamante

The *Corpo Especial de Fiscalização e Segurança de Diamantes* (CSD) is the Government entity responsible for ensuring the security of Angola's diamonds as they travel to the capital city of Luanda for export from mining operations and buying houses located throughout the country. The CSD reports directly to the President through the Chefe do Serviço de Informações [Chief of Information Services]. CSD has administrative, financial, and operational autonomy but works closely with the National Police and Customs – (USGS, 2011).

(Partnership Africa Canada, 2008) The Corpo Especial de Fiscalização e Segurança de Diamantes (CSD), a specialized force of some 500 officers, is responsible for ensuring the security of Angola's diamonds as they travel to Luanda from mining projects or buying houses in the interior. The CSD also controls security at Sodiam's diamond sorting facilities in Luanda. CSD agents are present at every step as the diamond parcels are opened, sorted, valued and then re-packaged for export.

In the informal sector, the CSD is in charge of licensing the diamond traders who buy from garimpeiros in the interior. The CSD also has a mandate to investigate and curb illicit mining and smuggling, but in practise seems to have taken little action in this field - (Partnership Africa Canada, 2008).

5.2.2.1.4 ADPA - African Diamonds Producers Association

The Association was constituted in November 4, 2006. Its founders include Angola, South Africa, Botswana, Guinea, Ghana, Namibia, Central African Republic, Democratic Republic of Congo, Sierra Leone, Tanzania, Togo and Zimbabwe. Several other countries signed the Luanda declaration as observers: Algeria, Republic of Congo, Côte d'Ivoire, Gabon, Liberia, Mali and Liberia.

The Association has the following objectives (ADPA):

- Cooperation and inter-assistance between Members States in policies and strategies concerning prospecting, mining, production, cutting and polishing, as well as to develop the human resources, acquisition and fitting at technologies and legal issues in the diamondiferous sector.
- The adoption of harmonised legal solutions and the exchange of information between member countries in areas correlated to the mining and commercialisation in which individual States have acquired valuable experience.
- To promote mutual technical assistance in the coordination of policies and strategies of development of the diamondiferous sector.
- To transform conflict diamonds, where available, into diamonds of peace and sustainable development.

The Members of the Association may be Effective or Honorary.

5.2.2.1.5 The Kimberley Process

5.2.2.1.5.1 KP Basics

The Kimberley Process started when Southern African diamond-producing states met in Kimberley, South Africa, in May 2000, to discuss ways to stop the trade in 'conflict diamonds' and ensure that diamond purchases were not financing violence by rebel movements and their allies seeking to undermine legitimate governments.

In December 2000, the United Nations General Assembly adopted a landmark resolution supporting the creation of an international certification scheme for rough diamonds. By November 2002, negotiations between governments, the international diamond industry and civil society organisations resulted in the creation of the Kimberley Process Certification Scheme (KPCS). The KPCS document sets out the requirements for controlling rough diamond production and trade. The KPCS entered into force in 2003, when participating countries started to implement its rules (Kimberley Process, 2013).

5.2.2.1.5.2 Countries and institutions

The Kimberley Process (KP) is open to all countries that are willing and able to implement its requirements. As of November 2012, the KP has 54 participants, representing 80 countries, with the European Union and its Member States counting as a single participant. KP members account for approximately 99.8% of the global production of rough diamonds. In addition, the World Diamond Council, representing the international diamond industry, and civil society organisations, such as Partnership-Africa Canada, participate in the KP and have played a major role since its outset (Kimberley Process, 2013).

5.2.2.1.5.3 Kimberley Process Certification

The Kimberley Process Certification Scheme (KPCS) imposes extensive requirements on its members to enable them to certify shipments of rough diamonds as 'conflict-free' and prevent conflict diamonds from entering the legitimate trade. Under the terms of the KPCS, participating states must meet 'minimum requirements' and must put in place national legislation and institutions; export, import and internal controls; and also commit to transparency and the exchange of statistical data. Participants can only legally trade with other participants who have also met the minimum requirements of the scheme, and international shipments of rough diamonds must be accompanied by a KP certificate guaranteeing that they are conflict-free.

The Kimberley Process is chaired, on a rotating basis, by participating countries. So far, South Africa, Canada, Russia, Botswana, the European Union, India, Namibia, Israel, the Democratic Republic of the Congo and the United States of America have chaired the KP, and South Africa is the Chair in 2013. KP participating countries and industry and civil society observers gather twice a year at intersessional and plenary meetings, as well as in working groups and committees that meet on a regular basis. Implementation is monitored through 'review visits' and annual reports as well as by regular exchange and analysis of statistical data (Kimberley Process, 2013).

5.2.2.1.5.4 Angola participation in the KP

The authority responsible for implementation of the KPCS in Angola is the Ministry of Geology and Mining and industry, which in turn created the Kimberley Process National Commission, in charge of all KP issues and procedures in Angola. The institutions involved in the Kimberley Process National Commission in Angola are:

- MGMI (Authority for the implementation of the PKCS in Angola and as well as KPC issuing authorities).
- ENDIAMA (National Company of Angola Diamonds).
- SODIAM (Angola Company for Trading and Exporting Diamonds).
- Corpo de Segurança de Diamantes (Diamond Security Body).
- Ministry of Interior (National Police and National Direction of Criminal Investigation).
- Ministry of Finance (Customs).
- Ministry of Commerce (KPC validating authority).

The authorities involved in the process of exporting of rough diamonds are:

1. Screening done by Customs and Sodiam, followed by
2. Certification of the diamonds according to KPCS requirements by the Ministry of Geology and Mines and Industries (CNPK – Angola National Commission for the KP) and
3. Finally, the Ministry of Commerce, that validates the KP certificate (Angola National Commission of Kimberley Process, 2012).

The export process is initiated after the sale is closed between the producers and Sodiam or their partners. Usually the process starts with the reconfirmation of the diamonds weights by Customs in Sodiam, with the buyer and CSD (Diamond Security Corps) as witnesses in the event. The parcel is then boxed and sealed.

A document is then produced, with the report signed by the involved parties (Angola National Commission of Kimberley Process, 2012). Based on that, Sodiam requests certification to the Ministry of Geology and Mines and Industry (CNPK). That issues a certificate signed and stamped by the coordinator of KP Angola. Subsequently, the National Director of Mines will issues the export documents; finally the Ministry of Commerce endorses the certificate. The parcel is then (and only then) fit for export, with a copy sent for the records of:

1. Ministry of Geology and Mining and Industry.
2. Ministry of Commerce.
3. Sodiam SARL.
4. Diamond Security Corps.
5. Customs.
6. Customs Broker.

The control of artisanal mining is pursued by three lines of action:

- The Angolan borders are actively being controlled through the use of LRD (Long Range Defence) technology by the Angolan Government.
- Endiama EP the Angola National Company of Diamonds and holder of all mining rights, has started to issue licenses of artisanal miners, following new specific Angolan legislation and the recommendation of Moscow declaration for artisanal activities.
- The new Mining Code, reinforcing internal control mechanisms, thus meeting KPCS minimal requirements, has been approved (Angola National Commission of Kimberley Process, 2012).

Recognizing that reliable and comparable data on production, trade, certificates count are an essential tool for the implementation of the certification system and in particular to identify any irregularities or anomalies, Angola submits complete data on the Kimberley Process Statistic on a regular basis. As a

double check, the Angola Working Group on Statistics, reconciles trade data with its trading partners (Angola National Commission of Kimberley Process, 2012).

The Angolan National Police, along with CSD - Diamond Security Corps and other institutions are actively engaged in border control and in the mining areas trying to prevent the illegally exploitation. The citizens detained (foreign and domestic) are submitted to legal process under National Direction of Criminal Investigation (Angola National Commission of Kimberley Process, 2012).

5.2.2.1.6 ANIP – National Private Investment Agency

Set up by the Angolan Government, ANIP' aim is to promote the private investment by Angolan or foreign citizens in economic activity sectors well identified and in development areas. The agency works within a legal framework that provides financial incentives for investment and seeks to assist investors during streamlined application procedures.

5.2.2.2 In mining

5.2.2.2.1 ENDIAMA, E.P.

ENDIAMA is the Angolan State's diamond company. Created after the end of DIAMANG, it's the single most important reference in the industry in the last three decades. Its role has had nuances over this period; ENDIAMA is, however, the main source of power and knowledge in the Angolan diamond industry. Founded in 1981, Endiama (Empresa Nacional de Diamantes) is the exclusive concessionary of diamond mining rights, responsible for the exploration, research, mining, polishing, cutting and trading of Angolan diamonds. The company was established on 15 January 1981, as the exclusive government appointed controlling body for the mineral rights of diamond fields in Angola - (ENDIAMA, 2010).

ENDIAMA E.P has the freedom to associate itself with other entities, establishing joint-ventures or associations with other companies (local or foreign) to achieve its objectives.

In its own words (ENDIAMA, 2010), Endiama vises to contribute to the rapid, consistent and orderly development of the diamond sub-sector in order to increase the national value added in the context of a "cluster" of mineral resources and the diversification of the national economy and contribute to the sustainable development of Angola. As specific strategic goals for the development of the diamondiferous sub-sector, ENDIAMA E.P aims to:

- Insert the national diamondiferous activity in the various phases of the world diamond sector, from prospecting, mining, trading to jewellery;
- Create strategic partnership with distinguished international companies in the sectors of prospecting, mining and polishing, foreseeing the effective execution of action programmes and the transference of "know-how" for the technical-professional upgrading of national cadres;
- Contributing for the upsurge and development of a national jewellery industry based in the vast resources of the country, both in precious or in semi-precious stones, as in other jewellery metals;
- Valuing and development the sub-sector's human resources;
- Eradicating illegal diamond mining and trade,
- Assuring the sustainable mining of diamonds, protecting the environment;
- Contributing to the restoring and development of the diamond business sector, obtaining national private investment and strategic partners;

Whereas in the institutional sector, ENDIAMA E.P follows, in the capacity of national concessionary of mining rights in the diamond field with highlight to:

- Following, supervising and controlling the geologic-mineral activities;
- Promoting mineral prospecting nationwide;
- Implementing programmes for the expansion of production and of valuing the country's diamond;
- Partnership negotiations with national and foreign entities;
- Reinforcement of political-institutional relations between ENDIAMA, E.P and administrative authorities and chieftains, in the ambit of community development of the populations in diamondiferous areas.

5.2.2.2.2 ALROSA

Catoca is currently the most important diamond mine in Angola. The mine is owned by Sociedade Mineira do Catoca, whose main foreign partner is Russia's ALROSA. This company is also involved in several other kimberlite projects in Angola. ALROSA's successful activity in the country is also a symbol of the long lasting special relationship between Angola and the Russian Federation.

ALROSA, established in 1992, is one of the two largest in the world (along with De Beers) and is engaged in the exploration, mining, manufacture and sale of diamonds. The geographic reach of its operations stretches from the Russian Arctic to southern Africa - (ALROSA, 2012).

In Russia, the company carries out diamond mining operations at nine primary and ten alluvial deposits (ALROSA, 2012).

5.2.2.2.3 Sociedade Mineira do Catoca

Sociedade Mineira de Catoca - SMC is a joint-venture established in 1992 by Yakutalmaz (Russia), Angola's Endiama and Odebrecht Mining Service Inc. (Brazil) for the mining and sales of diamonds from the Catoca kimberlite pipe. The current SMC shareholders are:

- ENDIAMA E.P. – 32.8%;
- Open Joint Stock Company ALROSA (Russia) – 32.8%;
- China-SONAGOL International Holding Ltd. – 18.0%;
- Odebrecht Mining Services Inc. (Brazil) – 16.4%.

With 65.7 ha, the Catoca pipe is one of the largest kimberlite pipes in the world,. After a series of geological studies performed up to the depth of 600 meters, the total ore reserves of the Catoca pipe are estimated at 271 million tons, out of which up to 189 million carats of diamonds may be recovered (ALROSA, 2012).

The first production facilities were put into operation in 1997. Today Catoca - SMC has two processing plants, the overall performance of which exceeds 10.0 million tons of ore per year. Every year Catoca mines and sells 6.8 million carats or rough diamonds. The development program of the Catoca kimberlite pipe supposes its open-pit mining down to 600 m in 2012–2034.

Catoca's sales volume is more than 80% of the total rough diamonds sold by all Angolan diamond mining companies (in carats) and more than 60% of the total revenue of the Angolan diamond market (in value).

Catoca's sales return in 2011 was USD 611.3 million, a record-breaking value (ALROSA, 2012).

5.2.2.2.4 De Beers

De Beers has had an almost-continuous direct presence in the Angolan diamond mining industry since the early 70's and before that as the exclusive production buyer. The results obtained have been discrete; despite the investment done in exploration the company still didn't develop a single kimberlite. De Beers' importance in the Angolan industry can't however be measured by exploration success only; the company has a special role in Angola, providing technical and marketing expertise.

De Beers holds a 49% interest in the Lunda Nordeste project in joint venture with ENDIAMA - 51% interest. The joint venture explored for diamond at the Lunda Nordeste and the Dando-Kwanza concessions, the later relinquished because none of the 44 kimberlites discovered proved economical. The company completed the bulk sampling program of the Mulepe-1 deposits at Lunda Nordeste and 100 carats of diamond were recovered from the deposit for revenue determination purposes. De Beers moved the Mulepe-1 deposit into the investment evaluation phase, expected to be completed by the second quarter of 2011. Thereafter, if the project meets the criteria of the De Beers investment committee, the company planned to conduct additional drilling and engineering studies to complete feasibility study by 2012 – (USGS, 2011).

In 2011, activities continued on the Lunda Nordeste concession where another three pipes were discovered, bringing the total number of discoveries to 117 kimberlites. 22 of these have been prioritised for deposit-phase diamond grade testing to confirm their economic viability (De Beers, 2012).

Exploration will continue to focus on projects with the best potential to deliver carat production within three to five years, and to build a strong pipeline of discoveries at the early stage to add value over the longer term. In Botswana, South Africa, Canada and India the focus will be on conducting early-stage technical reviews of the databases, licence applications and reconnaissance programmes to establish discovery portfolios. **Angola represents one of the most exciting prospects and offers De Beers real potential to organically grow its business and secure profitable long-term diamond production, given the good prospects of the underlying craton**. (De Beers, 2012).

5.2.2.2.5 ESCOM Mining

ESCOM Mining is a company of the Espírito Santo Group (until 2012, when it's acquisition by SONANGOL, the Angolan State's company for the oil industry is finalized). The company has been involved in several exploration and mining projects, both primary (kimberlite) and alluvial, namely the Chimbongo (alluvial, abandoned by ESCOM Mining; the project has been reactivated by other investors), Camatchia (kimberlite) and Tchegi (alluvial) mines. The huge investment in exploration (arguably the largest diamond exploration company in 2007-2008) resulted in the discovery of many new kimberlites; some of these prospects are mineralized, awaiting further work to determine their feasibility.

The Escom group was founded in 1993 by the Espírito Santo Group and by Helder Bataglia. It began business in the trading area, later diversifying its investments in order to provide continuity to the Espírito Santo Group's projects in Africa (ESCOM, 2010).

5.2.2.2.6 SOMIPA – Sociedade Mineira de Angola

SOMIPA –Sociedade Mineira de Angola S.A. is the best example of a new wave of diamond mining companies in Angola. Its shareholders are Angolan and it has been well funded. The company has been active in the centre of Angola in the last five years, prospecting for diamonds in six alluvial concessions, five of which in a contiguous block – Quirima, Sautar, Luando, Caipupa and Sauanga – and sixth –Zonde, a little further south.

The company is also prospecting for diamonds in the Muanga and Cacolo contiguous concessions, in a highly prospective territory close to the Cuango River headwaters, where dozens of kimberlites are already known.

The company is also investing in the operation of alluvial diamond mines, in a step further on a clear strategy to become a full-fledged mineral company.

5.2.2.2.7 SDM – Sociedade de Desenvolvimento Mineiro

SDM is a diamond mining company active for many years in the Cuango basin. It holds the mining rights in a 2.950 km^2 concession located in the hydrological basin of Cuango River - Lunda Norte - (ENDIAMA, 2010).

Its shareholders include: ENDIAMA and OMSI - Odebrecht Mining Service Inc. (Brazilian private company).Its main goal is of prospecting, developing, mining and trading diamonds from primary and secondary deposits identified in the region of Cuango River, in the NE of Angola - (ENDIAMA, 2010).

The SDM mine produced diamond from both primary and secondary deposits located within the basin of the Cuango River in NE Angola. For many years this was the most important alluvial mine in Angola. The mine generated annual revenues of about $100 million in 2009 - (Bermúdez-Lugo, 2010).

5.2.2.2.8 Lucapa Diamond Company (previously Lohnro Mining)

Lucapa Diamond Company Limited is a diamond exploration company based in Perth (Western Australia) and is listed on the Australian Securities Exchange (ASX: LOM). Lucapa is exploring for diamonds within the 3,000 km^2 Lulo concession in the Lunda Norte Province.

The Lulo Project is operated as a joint venture between Lucapa and Endiama. Under the joint venture arrangement, Lucapa holds a 40 per cent interest in the concession relating to alluvials (39 per cent for kimberlites), with Endiama and private Angolan interests holding the balance. Lucapa is the manager and operator on the concession and funds all exploration activities.

In the event that a diamond mining operation is established, Lucapa is entitled to first recover all of its exploration and development costs, after which the proceeds from diamond sales will be shared proportionally between the stakeholders.

5.2.2.2.9 SML - Sociedade Mineira do Lucapa

SML is a joint venture between ENDIAMA and the Portuguese SPE – Sociedade Portuguesa de Empreendimentos S.A. Established in 1992 with a 35,000 km^2 concession to explore and mine diamond deposits in the Luachimo and Chicapa rivers (from their headwaters to the DRC border), it was prey to underfunding and mismanagement in a very difficult operational environment. The company is still formally alive; legal disputes between its partners place a huge question mark over its survival. The importance of its role derives from its capacity to operate in an especially difficult period when other operators didn't dare.

According to (ENDIAMA, 2010), SML was established on 30 November 1992 as a society between ENDIAMA, E.P., with 51%, and SPE – Sociedade Portuguesa de Empreendimentos S.A., with 49%, as included in the State Gazette number 26 - III Series of 02 July 1999. The current concession area is of 8.212,88 km2, occupying a part of the basins on the Chicapa and Luachimo Rivers. Concession reserves are of 2.441.120 Carats.

SML participates in five projects being the Lucapa Project in which SML is the operating company and the Mufuto Norte Project in which the operating firm is ITM Mining that are totally owned by SML.

The Associations in Participation with Lumanhe Company, Lda, in which the operating firm is ITM Mining in the Calonda project and with the Yetwene and Rich View companies in which the operator is SML and Yetwene, with SML owning a 50% share.

SML is now prey to a conflict between its partners, ENDIAMA and Portuguese SPE. The judicial conflict may lead to end of SML and the exit of SPE from the

Angolan diamond fields, sadly ending a history that may be traced to the origins of the industry in 1912.

5.2.2.2.10 Sociedade Mineira do Canvúri Chicapa

Sociedade Mineira do Canvúri Chicapa exploits an aluvial mine along the Chicapa river, just south of the Luó SMCC concession (home to the Camatcha mine and cluster of kimberlites).

5.2.2.2.11 Luminas – Sociedade Mineira do Luremo

Luminas is the holder of a 3,000 km^2 aluvial concession in the Cuango River. Luminas partners are ENDIAMA (47%), NOFAR (40%) and the Twice Consortium (13%). The company produced 115,000 ct in 2011 (43 MUSD) and increased its production to 125,000 ct and 48 MUSD in 2012 (estimated values).

5.2.2.2.12 Sociedade Mineira do Cuango

Sociedade Mineira do Cuango is the holder of the Cuango project, the most important alluvial diamond mine in Angola (and the second in the global ranking, Catoca leading with 6 times as much production value). SMC is held by ITM, Lumanhe and ENDIAMA (see below).

5.2.2.2.13 Genius Mineira

Genius Mineira is an Angolan mining exploration company with work in several areas and commodities. Unlike most exploration companies active in Angola until now, its focused in metallic minerals. This company is involved however in at least one diamond exploration project, the Santechifunga project.

5.2.2.2.14 Kassypal

Kassypal is the diamond mining specialized company of the Grupo António Mosquito – GAM holding. The Uári alluvial concession (formerly exploited by SML – Sociedade Mineira do Lucapa) is Kassypal's main project and asset (49% stake, ENDIAMA with the remaining 51%).

5.2.2.2.15 Transhex

Trans Hex held positions in three alluvial diamond projects in Angola: Luana (now Somiluana), Luarica and Fucaúma. On 5 October 2011, the Angolan Ministry of Geology, Mines and Industry issued an order revoking the mining rights regarding the Fucaúma and Luarica joint-venture projects as no mining activities were performed at the sites for a period of three years. As a result, these projects have been classified as discontinued operations (TRANSHEX, 2012).

Trans Hex currently holds a 33% interest in the Somiluana (formerly Luana) project in joint venture with ENDIAMA with a 39% interest and privately owned Angolan firms holding the remaining 28% interest. In May 2010, Trans Hex signed a mining contract and took on the general, operational, and financial management of the project, located about 80 kilometers northeast of Lucapa in Lunda Norte Province. Diamond production started in June 2010 (USGS, 2011).

5.2.2.2.16 METALEX

Metalex Ventures Limited is a Canadian public company listed on the TSX Venture Exchange ("MTX"). The Company's principle business activity is the acquisition, exploration and development of mineral properties. The Company's long-term growth strategy is to generate substantial capital growth by developing kimberlite hosted diamond deposits. The Company's principal projects in Canada are its Kyle Lake (U2), "Ring of Fire", Attawapiskat, and Wawa projects in Ontario and James Bay Lowlands project in western Quebec. Its overseas projects are located in Angola, Morocco and Mali.

METALEX has a kimberlite license in Angola covering 3,000 km2 in aerial extent over part of the Chitamba-Lulo kimberlite cluster and the Cucumbi and Cuango Rivers. (METALEX Ventures Ltd.).

5.2.2.2.17 ITM

ITM's technical expertise and modern management practices (with their workers' generous pay dependent on results) made it the most (perhaps only) profitable diamond mining company during the years of civil strife in Angola. Its activity showed that profitable mining operations could be done even during the most extreme conditions, paving the way to the boom of the Angolan diamond of the early XXI century.

(ITM Mining, 2008) ITM is a specialized company involved in mining, mineral processing, geology, prospecting and all associated activities .

ITM plays a central role in the alluvial mining sector in Angola since 1993. It is a shareholder in the following partnerships - Sociedade Mineira do Chitotolo - Chitotolo Project, and Sociedade Mineira do Cuango - Cuango Project, as well as currently developing alluvial mining activities for Sociedade Mineira do Calonda, in the Calonda Project, and between 1998 and 2005 for SML - Sociedade Mineira do Lucapa, in the Mufuto North Project.

ITM has a strong presence in the diamond sector of Angola. ITM in partnership with ENDIAMA E.P., Sociedade Mineira do Lucapa Lda. (SML) and

LUMANHE Lda., has contributed to the majority of Angola's official alluvial diamond production.

The mining projects in which ITM has been involved have produced a total of approximately 8,8 million carats, between 1993 and 2007.

ITM Mining Ltd was established in April 1993, by ITM International SA and KNR Mining Limited. KNR had previously been formed by some of the senior management team in Angola of Roan Selection Trust International Limited (RST) - (ITM Mining, 2008).

RST was the mining company of ITM International SA, responsible for most of Angola's diamond production between 1986 and 1992. The annual levels of production during this period, made Angola the world's 3rd largest producer of diamonds by value. The RST mining operations were centred on the Cuango River.

The management team of RST, now under KNR Mining Limited, brought to ITM Mining Ltd the specific mining expertise and professional experience capable of obtaining optimum production results, through intensive and cost efficient mining operations coupled with the skill in determining and specifying the most appropriate mine methods as well as mining and processing equipment.

ITM started its mining operations in June 1993, as a joint company between ITM International (51%) and KNR (49%). In February 1995, KNR acquired the shares of ITM International and became the sole corporate owner of ITM Mining Ltd.

5.2.2.2.18 CHITOTOLO - Sociedade Mineira do Chitotolo

The Sociedade Mineira do Chitotolo, Ld.ª concession area was one of the first exploited by DIAMANG due to the quality of their deposits. The early activity in the area originated a settlement where many important operational infrastructures where located. The new locality, first called Vila Paiva de Andrada (Andrada for short), is now the city of N'Zagi - (Sociedade Mineira do CHITOTOLO, 2006).

After the end of DIAMANG, ENDIAMA operated the Penz Project in the area. On a later stage, ENDIAMA hired KNR (currently ITM Mining Ltd.) as project operator.

The positive result of ITM's work for the Penz Project took ENDIAMA to upgrade their relation, creating a joint venture (*Associação em Participação*) between ENDIAMA, ITM and LUMANHE Mineira Ld.ª, approved by Decree nº 36/96 of August 30, 1996.

The joint venture was established for a 10-year period, or longer if reserves were available. Despite difficult security and logistical conditions, the joint venture success was beyond the initial expectations. As a result, 8 years after the initial association, the joint venture associates decided to create a company – Sociedade Mineira do Chitotolo, Ld.ª - with an indefinite end - (Sociedade Mineira do CHITOTOLO, 2006). The new company's shares are divided by:

- ENDIAMA – 45%.
- ITM – 40%.
- LUMANHE – 15%.

5.2.2.2.19 GEM Diamonds

(Gem Diamonds, 2012) Gem Diamonds is a leading global producer of high value diamonds. The Company owns two mines, the Letšeng mine in Lesotho and the Ellendale mine in Australia, as well as the Ghaghoo mine, currently in development in Botswana. The Letšeng mine is famous for the production of large, top colour, exceptional white diamonds, making it the highest average dollar per carat kimberlite diamond mine in the world. Since Gem Diamonds' acquisition of Letšeng in 2006, the mine has produced four of the twenty largest white gem quality diamonds ever recorded.

Gem Diamonds has growth strategy based on the expansion of the Letšeng mine to double its production capacity by 2014 and the development of the Ghaghoo mine, expected to be in production during 2013. The Company also seeks to maximise revenue and margin from its rough diamond production by pursuing diamond cutting, polishing and sales and marketing initiatives further along the diamond value chain. (Gem Diamonds, 2012).

(GEM Diamonds, 2009) A Cooperation Agreement was signed in January 2007 between Gem Diamonds and Avantis Angola Inc ("Avantis") with respect to a feasibility study to be conducted on the known Chiri kimberlite in the Lunda Sul Province of Angola in which Avantis have a 25% interest. An Option Agreement whereby Gem Diamonds could acquire an effective 11.25% interest in Chiri from Avantis was signed at the same time. Work started on the project in January 2008. Gem Diamonds continued the evaluation programme at Chiri with a view to assessing the viability of the project. Completion of Phase 1 evaluation activities was scheduled for the first quarter of 2009 (GEM Diamonds, 2009).

According to (Rough and Polished, 2012) GEM's preliminary evaluation indicated that the kimberlite had a large surface expression of some 50 to 60 ha, although a significant portion of this was covered by fine-grained kimberlitic sediments of minimal economic potential.

Diamond drilling had been carried out to refine the geophysical model and to define the geology of the kimberlite at depth. Bulk sampling at surface had returned encouraging results and the large diameter drilling programme had provided estimates of grade continuity at depth.

Mined illegally during Angola's civil war, Chiri's diamonds had been assessed and were valued in July 2008 at about $150-$200 per carat (Rough and Polished, 2012).

Due to the current global market conditions and the resulting impact on diamond prices, Gem Diamonds formally withdrew from the Chiri project in Angola at the end of November 2012.

Since its inception, a total of US$14.8 million has been spent at Chiri as at 31 December 2012. Following the decision to withdraw from Angola, this amount has been written off. Of the total US$14.8 million spent at Chiri, US$5.6 million was advanced as a loan to the project partner and is subject to a continuing right of repayment should the project go ahead at any time in the future (irrespective of Gem Diamonds' involvement). The write-off of this asset has been disclosed as an exceptional item due to its non-recurring nature (GEM Diamonds, 2013).

5.2.2.2.20 LUMANHE – Extracção Mineira, Importação e Exportação, Ld.ª

Lumanhe – Extracção Mineira, Importação e Exportação, Limitada, a private company under Angolan law, was constituted in 1995 and its statutes published in the Official Gazette (*Diário da República de Angola*) III SÉRIE - N.49 of December 8, 1995. Its purpose is the trade, exploration, mining transformation and sale, import and export, as well as any other economic activity.

LUMANHE is a shareholder of:

- CHITOTOLO.
- Sociedade Mineira do Cuango.
- Sociedade Mineira do Calonda, with SML – Sociedade Mineira do Lucapa.

5.2.2.3 In trading and cutting

The Angolan diamond-trading sector has suffered several transformations along the last 15 years:

- 1996 to 2000. Half-a-dozen companies were licensed to deal in Angolan rough diamonds. Angolan production originated in medium sized projects or the informal sector, part of which controlled by UNITA rebels.
- 2000 to 2003. All licenses were revoked and SODIAM was created as the single channel for Angolan rough diamonds. SODIAM (51%) and with Welox and TAIS - Trans Africa Investment Services (49%) created ASCORP – Angola Selling Corporation; ASCORP held the monopoly of buying diamonds produced in the Angolan informal sector.
- 2004 to today. Angola enacts the Kimberley Process, replacing its own diamond tracking system by KP's internationally audited origin certification. ASCORP's monopoly over the informal sector is broken with the onset of a network of SODIAM, LKI – Lazare Kaplan International operated, buying houses in the interior of Angola. The operational model of both networks is similar:
    - Small widespread satellite buying operations run by independent owner-operators licensed by the CSD in Luanda.
    - The small buying offices are controlled by larger buying houses, run and staffed by either ASCORP or SODIAM/LKI, in the most important localities.
    - The commercial relations between the smaller and controlling houses is quite variable and related to the financial assistance they receive. Buying offices working with their own capital may be quite autonomous, selling to the best bidder; those financed by ASCORP or SODIAM/LKI are *de facto* branches of those companies.

These modifications have been induced both by external or internal factors:

- The Angolan Government wants to regulate the market and to capture a larger share of the value created by diamond mining. As a result of this policy the Government created instruments, through ENDIAMA, to control the marketing of the Angolan diamond production. The Government's policy includes inroads into other value adding activities, such as cutting and jewellery.
- The Kimberley Process. The issue of blood diamonds was news in the transition to the new millennium. As a means to control the production and trade of diamonds from conflict areas, allegedly generating and maintaining the conflicts, several countries and the industry created a mechanism to control the origin of rough diamonds. Angola was one of countries in the focus of this process, more than a decade ago.

5.2.2.3.1 SODIAM

The subsidiary of ENDIAMA for the marketing of Angolan diamonds, created in 1999, SODIAM is Angola's single channel marketing arm, responsible for exporting all of Angola's diamonds. SODIAM is also

the instrument through which ENDIAMA expanded its interests into diamond polishing with the creation of a factory - APD.

Also through SODIAM, ENDIAMA increasingly internationalized its activity with the establishment of offices or centers for the sale of Angolan diamonds in the main diamond centers such as Israel, Belgium, USA, United Arab Emirates' Dubai, India and China - (ENDIAMA, 2012).

SODIAM buys Angolan production directly from industrial operations or indirectly from the informal sector through AESCOPR or the SODIAM/LKI operation.

In addition to sorting and grading the stones, Sodiam carries out all of the practical tasks involved in certifying the stones under the Kimberley Process. (The actual certificate gets pro-forma final approval by the Ministry of Geology and Mines) (Partnership Africa Canada, 2008).

As far as Angola's formal diamond production in concerned, Sodiam's performance has been exemplary. The diamonds from each mine are brought to Sodiam's Luanda facility in run-of-mine parcels, where Sodiam personnel sort the stones. An Angolanization policy combined with an aggressive training program has enabled Sodiam to dispense with expatriates and employ exclusively Angolan sorters. The stones are then valued three times, once by Sodiam, once by the producer and once by an independent valuator. Once the price has been agreed, the package is sealed and the Kimberley Certificate attached. The designated signatories are the Deputy Minister of Trade and the Deputy Minister of Geology and Mines (Partnership Africa Canada, 2008).

5.2.2.3.2 Angola Polishing Diamonds

As part of a push to develop a polishing capacity in Angola, Sodiam, teamed up with Lev Leviev in 2005 to create Angola Polishing Diamonds, a joint venture 48% owned by Sodiam and 47% by the Leviev company LLD, with the remaining 5% held by an Angolan consortium known as PROJEM - (Partnership Africa Canada, 2008).

Angola Polishing Diamonds was established in 2005 with an initial investment of about $10 million (Rough and Polished, 2011). Mindful of the advantage India has on smaller sizes, Angola Polishing focused on stones between 0.7 and 1.5 ct - (Partnership Africa Canada, 2008).

APD cutting operation is located in the new southern suburbs of Luanda. The company has invested in the latest cutting and polishing equipment, much of it automated or semi-automated. The polishing staff of 470 are 90% Angolan, supported by a small cadre of experienced foreign cutters, drawn from both Israel and Russia - (Partnership Africa Canada, 2008).

APD has the capacity to process diamonds worth $20 million per month, currently processing diamonds worth $4 million per month. The cut diamonds were mainly exported to Israel while some were sold locally (Rough and Polished, 2011).

This emblematic project was closed in 2011.

5.2.2.4 Other activities

Diamond projects are critically dependent on many other activities, on the availability of certain resources (human, financial and material) and on events that occur outside its sphere of influence:

- Logistics.
- Communication.
- Human resources.
- Financing.
- Climate.
- Legal environment.

5.2.2.4.1 Logistics, transports and communication

Logistics is a key activity in diamond exploration or mining projects in Angola:

- The transportation networks are improving but still limited and unreliable, especially in the rainy season.
- Angola is dependent of external supplies of machines and spare parts. Fuel and lubricants are manufactures in country but located in the coastal area. With the improvement of land communications, food supplies may be obtained locally, at least partially.
- The projects are located in the centre or east of the country, with many hundreds or over a thousand km of logistical train from the main harbour or stores.

Sociedade Nacional de Combustíveis de Angola (Sonangol) is the Government-owned company responsible for petroleum exploration and production – (USGS, 2011).

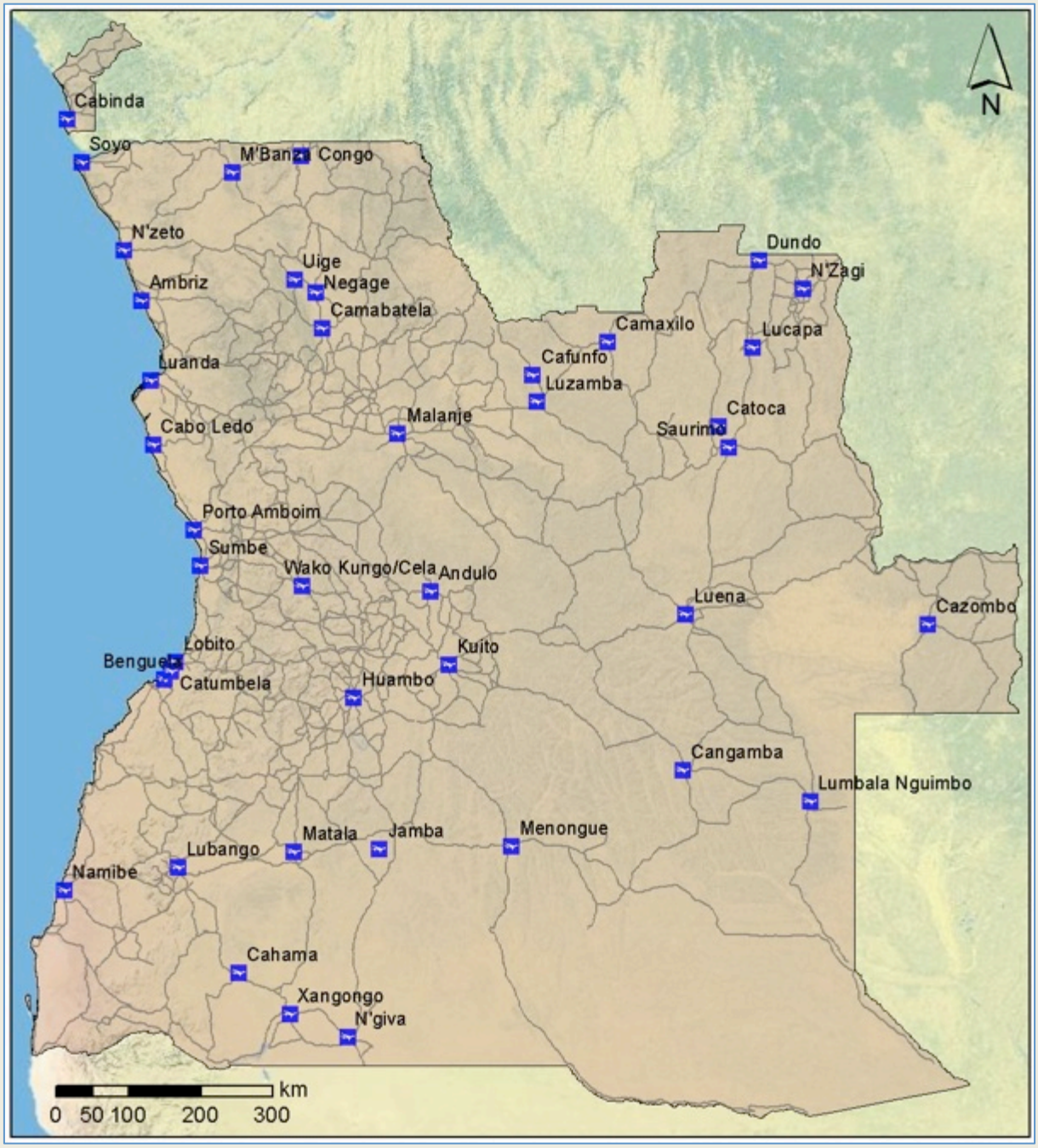

Figure 79 - Angolan road and airport network.

5.3 Issues

5.3.1 Two seasons

Figure 80 - The Luxilo base camp under heavy rain – Chimbongo concession.

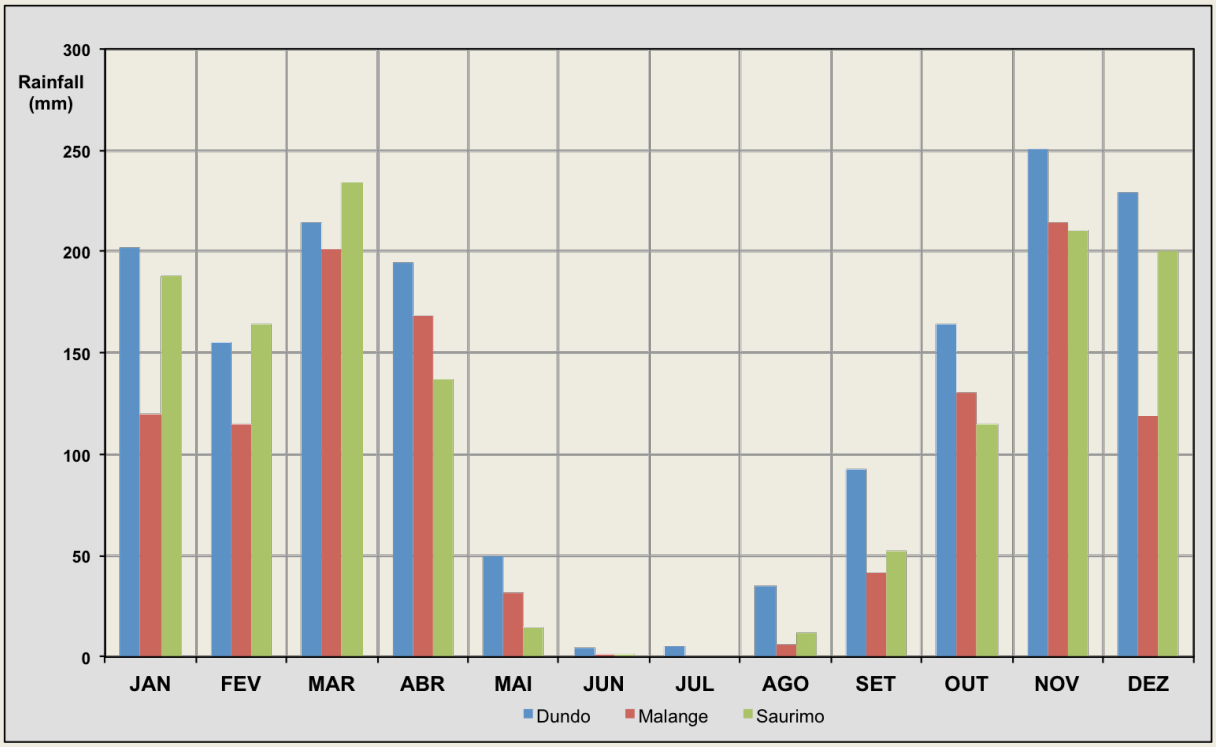

Figure 81 - Rainfall distribution in the Angolan diamond fields.

The Angolan climate is one of the factors affecting the operations and logistics of diamond mining and exploration projects. Two marked seasons characterize the climatic conditions in Angola; operations may be disrupted or show a marked productivity decrease during the rainy season – October to March, generally speaking, with variations due to latitude, proximity to the ocean and altitude. Projects should plan their activity accordingly.

5.3.2 Human resources

The Angolan diamond industry has a severe shortage of qualified human resources, from machine operators to geologists and engineers, from clerks to executives, in technical and management functions.

The problem has several components:

- Big city lights. Luanda is the magnet that attracts many Angolans in their quest for a better living, with easier access to education, public health services and work. Luanda is especially attractive for qualified personnel, draining the provinces of the human resources critically needed in the diamond mining projects.
- Public policy. The Angolan government has an Angolanization policy in place. This policy aims to increase the number and qualification of the jobs occupied by nationals at all levels. In the long term, it is a legitimate and good measure and it will work. If applied with rigidity in the short and medium terms, it creates problems that may turn good projects unfeasible, curtailing the policy's purpose by diminishing the creation of new jobs.

5.3.3 Garimpo

Garimpo (or artisanal or small scale mining in the English expressions) is a major, unsolved issue in Angola, a problem common to countries with alluvial deposits of high unit value minerals (diamonds and other gemstones, gold and other precious metals).

Garimpo has its roots in:

- Employment opportunities (or lack of them) in the formal sector of economies.
- The low-end technology needed to recover (at least a part) of the useful minerals contained in loose, low cover widespread alluvial formations.

Garimpo and small-scale trade have a symbiotic relationship in diamond fields:

- Local traders finance the *garimpeiros'* activity and day-to-day needs (food and basic supplies) in exchange for a share or first option on the produced diamonds. Local traders hold the best hand, with chronically in debt *garimpeiros* having to sell their production at low prices.
- The vast majority of *garimpeiros* mine the diamonds in sub-human dangerous conditions in malaria-prone areas, infested with dangerous animals. Recovered diamonds, sold by a fraction of their value, allow for a subsistence livelihood characterized by a never-ending cycle of debt and low bargaining power vis-à-vis their creditors, the local traders. Their only hope is to grab the once-in-a-lifetime diamond. When that rare event occurs, they usually dissipate in it alcohol and (much deserved) fun, just to quickly return to their old life and a renewed hope of a second chance.

5.3.4 Illegal immigration

Illegal immigration has also been in the past an issue in headlines with relation with the diamond industry. This problem and the way the Angolan authorities dealt with it also led to an exchange of words with RDC.

For several years, tens of thousands of immigrants from RDC crossed the permeable north and east borders of Angola. These immigrants were fleeing their country to either conduct in garimpo and diamond trading or plainly to earn a living, predominantly in trade in the Lundas regions and elsewhere in Angola.

In 2003, to control the flow of illegal artisanal miners in these two Provinces, the Government began deporting illegal miners from its territory. According to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA), there have been at least six major waves of Congolese expulsions from Angolan territory since 2003. The total number of foreign citizens expelled from these areas was estimated to range somewhere between 100,000 and 300,000. The vast majority of those expelled were Congolese miners who had dominated the sector since the 1990s when many entered the country to mine for the União Nacional para a Independência Total de Angola (UNITA) rebel group.

In October 2009, as a retaliatory response to such deportations, the Government of Congo (Kinshasa) began extraditing Angolan citizens from its national territory. As of early November, both Governments had agreed to stop the deportations. The expulsions of Congolese miners were only partially effective in reducing cross-border activity because many of those extradited returned to the country shortly after their expulsion (Lourenço Mahamba Baptista, Deputy Minister of Geology and Mines, Ministry of Geology and Mines, oral commun., August 24, 2009; and Paulo Mvika, National Director of Mines, Ministry of Geology and Mines of Angola, written commun., August 24, 2009). (USGS2009)

5.3.5 UXO and abandoned war artefacts

The conflicted that affected Angola is now well in the past; UXO and other abandoned war artefacts of that period still pose a risk, especially in the areas where the conflict was more intense. There has been an effort to identify, recover or inactivate still active or potentially dangerous explosive devices; notwithstanding that effort, exploration and mining projects should always carefully assess and manage this risk, putting in place the adequate measures.

6 Angola, the country: legal, economical and financial framework

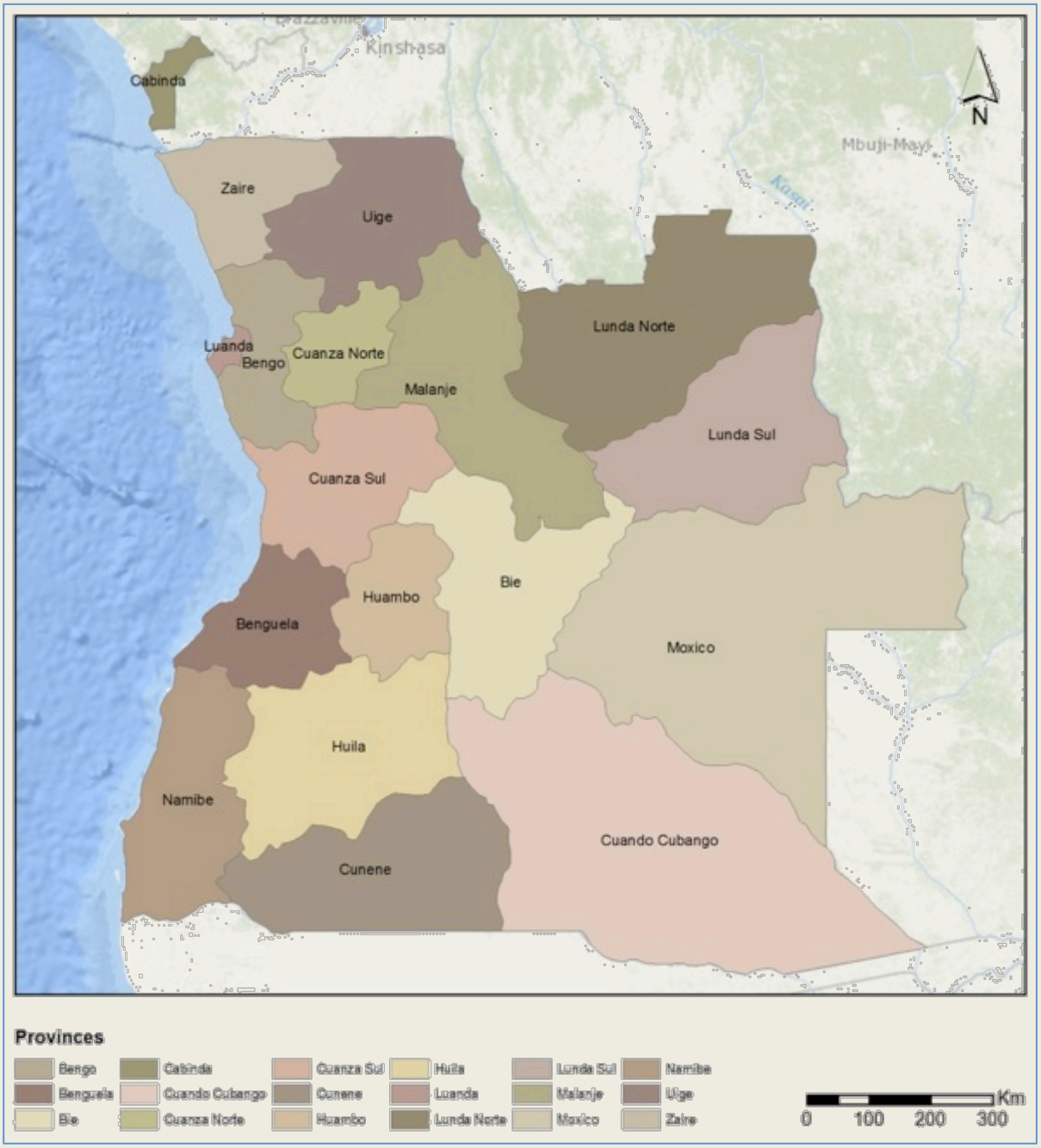

Figure 82 - The Angolan provinces.

Angola is a key country of southern Africa, given:

- Its position on the Atlantic coast, facing Brazil in South America, a crossroad of seaways between Europe, Africa, Asia and the Americas.
- Its economy, currently based on carbon (oil and diamonds), is one of the most dynamic in region.
- Its friendly and vibrating population.
- Its large territory (over 1,000,000 km^2) is endowed with abundant natural resources, namely minerals, abundant freshwater and fertile soils and sea.

The capital is Luanda, the largest urban centre, located in the country's northern half of its west-facing coast. The country is divided into 18 administrative Provinces – *Províncias* - with their own Governors appointed by the President.

6.1 A carbon economy and much more

Angola is a carbon economy. The two pillars that sustain the country are oil and diamonds. Of course, oil production – from onshore and (increasingly deeper and technically challenging) offshore sources, generated much higher cash volumes:

- 50-60 bn USD is the range of expected annual oil production value, compared to
- 1 bn USD for the diamond production value, the annual diamond production being roughly equivalent to a week's oil production.

6.1.1 Macroeconomic stability

For a decade Angola has been one of the fastest growing economies in the world, with its real GDP expanding at an average annual rate of 11% in this period. The country has become Africa's second largest oil exporter after Nigeria and its third largest.

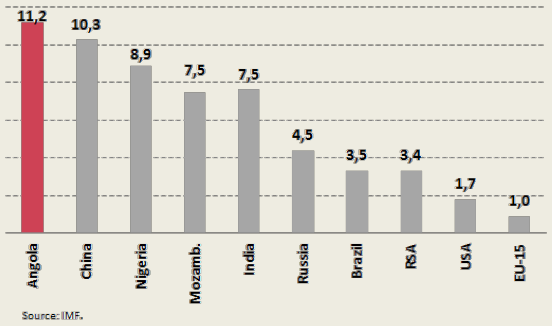

Figure 83 - Average GDP 2002-11 growth (%).

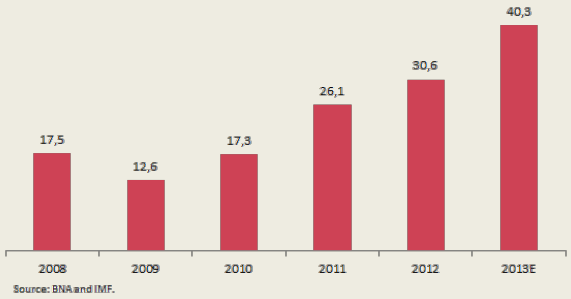

Figure 84 - Net International Reserves (US$ bn)

Angola was vulnerable when the global financial crisis hit in 2009, as fiscal and monetary policies in the country were highly expansionary to support its reconstruction efforts at the time. The kwanza was also overvalued, trading at about 75 kwanzas to the US$ (vs. 90-95 in 2010-12). With the collapse of oil prices in 2008-09, the country saw a sharp contraction in oil revenues, its main source of foreign exchange, and faced increasing macro instability. Real GDP growth fell sharply to 2.4% from 13.8% in 2008 while inflation levels increased after a sustained decline in previous years. With international reserves falling by one-third during the first half of 2009, Angola sought support from the IMF.

Figure 85 - Average Exchange Rate (US$/AOA).

With stability, Angola has taken advantage of the oil boom in the mid-2000s to rebuild its infrastructure and enhance its democratic institutions. A strong performance in both the oil and non-oil sectors (mostly real estate and retail) has also allowed per capita income to reach levels above US$ 5,000. Angola remains highly dollarized, but thanks to its Central Bank the appetite for loans/deposits in kwanzas, for instance, has gradually increased in recent years.

The stabilization program supported by the IMF's Stand-By Arrangement (2009-12) achieved its key objectives. Three years following the abrupt decline in world oil prices, Angola has achieved (1) an improved fiscal position, (2) a more comfortable level of international reserves (covering almost 8 months of imports), (3) a stable exchange rate and (4) lower inflation.

The Angolan economy has improved since 2011, witnessing a recovery in oil production and a continued robust performance in the non-oil sector. Real GDP growth reached an expected 8.4% in 2012 (vs. 3.9% in the previous year). Meanwhile, a steady rise in oil output and historically high global oil prices should continue to drive real GDP growth in 2013-15. Crude output is expected to increase from an average of 1.75m barrels/day in 2012 to over 2m barrels/day during this period. However, given the history of technical delays and a slight possibility that the OPEC may try to enforce a stricter quota on Angola, there is some risk that production may increase at a slower pace.

The non-oil sector (namely transport, light industry, commerce and services) is expected to expand rapidly, but the lack of reform and a somewhat overvalued exchange rate could hinder a more business friendly environment in the country. On top of this, the development of a more dynamic private sector will be further penalized by weak human

capital as well as the need to improve the judicial and regulatory environments in the country.

All in all, the IMF's latest forecasts suggest that Angola should record real GDP growth of 6.2% this year, 7.3% in 2014 and 7% in 2015. These figures compare with the government's targets of 7.1% this year, 8% in 2014 and 8.8% in 2015.

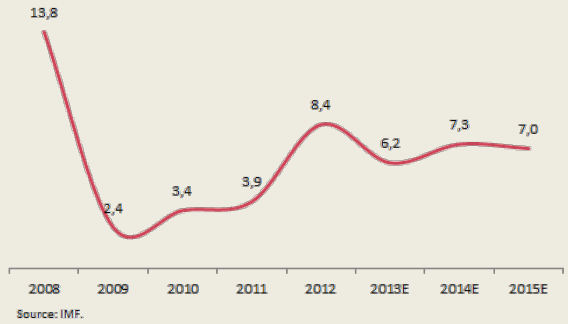

Figure 86 - Real GDP Growth (%).

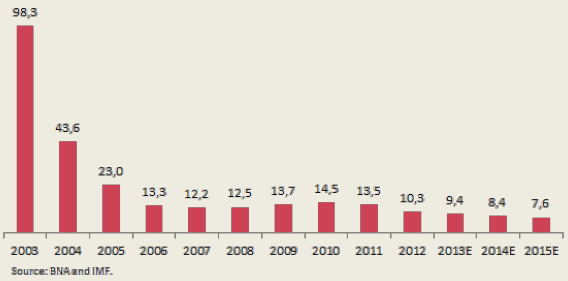

Figure 87 - Annual Inflation (%).

Meanwhile, inflation dipped to 9% by end-2012, which is below the authorities' target, reaching single digits for the first time in over a decade. This evolution has been partly due to the Central Bank's (BNA) ability to support the exchange rate and its key role as a monetary anchor, which improved markedly with the recovery in the level of international reserves. In addition, the government appears to have ruled out any further near-term reduction in the fuel price subsidy.

That said, a new foreign exchange law for oil and gas operations is expected to increase liquidity in the second half of 2013 and could exert some upward pressure on prices. In a nutshell, this new law states that oil companies operating in Angola and their domestic and foreign partners will be obliged to process all of their payments through accounts domiciled at Angolan banks. As a result, the funds related to the transactions involving these companies that did not pass through the domestic banking system will now be internalized.

According to the latest current account data for Angola, this could represent an additional US$ 20-30bn per year in liquidity for the domestic financial system. As a reference, we note that deposits held in domestic banks stood at about US$ 42bn in December 2012.

Despite the potential impact of this law, the BNA's Monetary Policy Committee is expected to adopt a relatively cautious monetary policy stance in order to avoid inflationary risks. As a result, consumer price growth is likely to remain in single-digits in 2013-15.

6.1.2 Not just an oil growth economy

The Angolan GDP structure has slowly changed in the last decade, although the oil and gas sector remains the largest contributor to GDP, accounting for 47% of the total in 2011 (vs. 56% in 2002).

Revenues from the oil and gas sector spilled over to the non-oil economy, specifically in the infrastructure and construction sectors, which doubled their joint market share (from 7% to 14% in 2011), fuelled by the Public Investment Program (PIP) in the country.

Although the government will open up more than 50 new blocks for oil and gas exploration in the next couple of years and, as a result, attract significant interest from international oil players, it remains committed to diversification. Specifically, the government is hoping that a new mining code will encourage investment in the exploitation of largely untapped reserves of minerals like iron, copper, gold and uranium, helping to diversify the economy away from oil and gas. However, improvements in infrastructure and labour skills will be crucial if Angola is to achieve its objective of becoming an important player in the mining industry.

6.1.3 International Trade and Investment

Angola's exports are mainly oil-related (97.1% in 2011), but also include (1) minerals, (2) coffee, (3) commodities, (4) fish, (5) sisal, (6) timber and (7) cotton. Imports include (1) machinery and electric equipment, (2) vehicles and spare parts, (3) medicines, (4) food, (5) textiles and (6) military goods. Its main trading partners are depicted in the charts below.

Meanwhile, the global economic crisis has had an impact on FDI levels in Angola during the last three years. However, FDI inflows are expected to rebound in the period 2013-15 partly due to Angola's strong ties to the fast growing emerging markets such as Brazil and China.

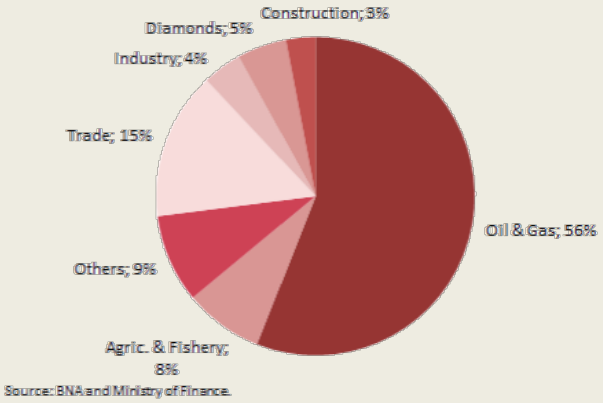

Figure 88 - GDP structure 2002.

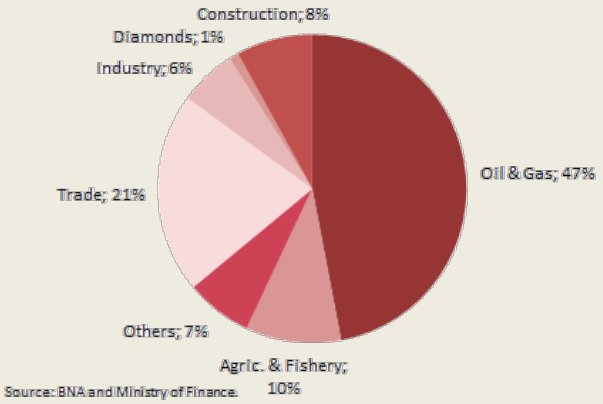

Figure 89 - GDP structure 2011.

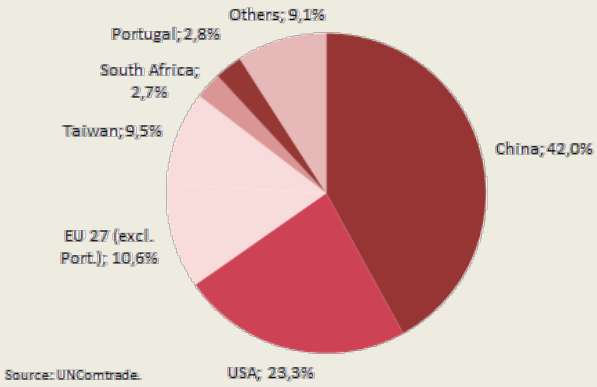

Figure 90 - Exports 2011 (US$ 67.2bn).

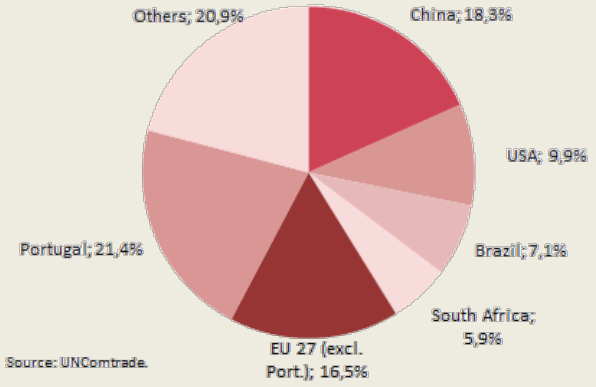

Figure 91 - Imports 2011 (US$ 20.2bn).

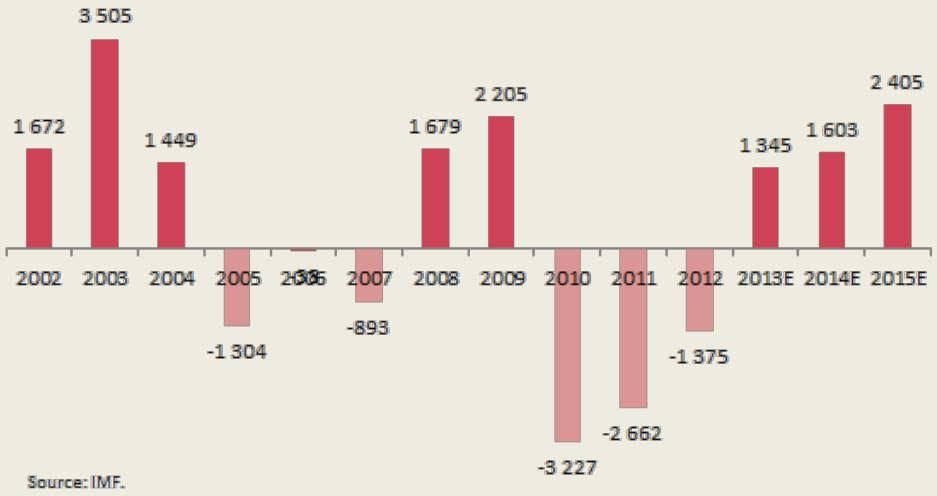

Figure 92 - FDI Inflows (US$ bn).

In the future, Angola should continue to consolidate relations with its key strategic partners, namely China, Portugal and Brazil. On one hand, Angolan and Chinese relations should remain centred on large trade and investment deals in oil, construction and agriculture. This despite local press reports suggesting increasing civil opposition to Chinese involvement in the country as discontent rises over the influx of Chinese immigrants and the quality of Chinese construction. On the other, strong ties with Portugal are expected to continue, particularly as Portugal remains highly keen on attracting Angolan investment.

Angola is also expected to give priority to a different set of large infrastructures, namely in areas such as roads, railways and housing. Additionally, it should

also focus on projects targeted at the recovery of national production, less supported in external intermediate consumption. The government is also diversifying in (1) agriculture, (2) livestock, (3) fishing, (4) energy and water, (5) construction and (6) logistics. Angola is expected to be self-sufficient in terms of cement and ceramics production and produce at least 50% of timber and steel consumed in the country.

Doing business in Angola remains rather challenging though. The country is ranked 172nd (out of 183) in the World Bank's Doing Business Report. Angola is currently looking to have a proper framework for private sector development.

6.1.4 Political stability

Angola has faced political stability in these decades of peace, as President José Eduardo dos Santos and his ruling party, Movimento Popular de Libertação de Angola (MPLA), have been in power since 1979. The last legislative elections in August 2012 saw the MPLA securing an absolute majority with 72% of the votes (10% less than in 2008) and 175 of the 220 seats in parliament.

The adoption of a new constitution in January 2010 has established a presidential-parliamentary system under which the president is no longer elected by popular vote but instead is the head of the party with the most seats in parliament. Although a limit of two five-year presidential terms was set under this new constitution, this does not apply retroactively, which means that the President could remain in office until 2022. The succession of President José Eduardo dos Santos is the biggest challenge on the political future of Angola, with Vice-President Manuel Vicente as a most likely candidate to succeed.

Meanwhile, besides these last decades of peace and stability, the government is strongly focused in tackling the more complex challenges of inclusive economic growth, widespread poverty and corruption. Under the theme of "Grow More to Distribute Better", the 2013 budget (approved in February) is part of the government's five-year plan (2013-17) to focus on social infrastructure and the provision of better public services. Specifically, the 2013 budget allocates around 32.3% of total expenditure to investment in social infrastructure and welfare, with 8.1% for education, 5.3% for healthcare, 10.8% for social protection, 7.0% to housing and 1.1% for environmental protection.

According to government estimates, the 2013 budget should result in a deficit of 3.4% of GDP. The government is expected to fund this highly expansionary budget (expenditures to increase by 27% from 2012) through the issue of bonds in the domestic market and international credit lines. The government could also go ahead with the issue of Eurobonds this year, particularly after the successful issue of EUR 750mn by Zambia last year.

Table 7 - Angolan Government budget.

GOVERNMENT BUDGET					US$ BN
	2011 Budget	2011 Exec.	2012 Budget	2012 Exec.	2013 Budget
Total Revenues	**38 032,3**	**50 808,1**	**39 043,3**	**49 447,2**	**47 471,7**
Current Revenues	38 007,4	50 803,2	39 011,4	49 447,1	47 461,7
Total Expenditures	**33 106,4**	**40 156,4**	**36 312,8**	**40 643,2**	**51 668,7**
Current Expenditures	24 354,3	31 153,2	26 746,5	29 894,2	34 644,9
Total Balance	**4 925,9**	**10 651,7**	**2 730,5**	**8 804,0**	**-4 197,0**
Current Balance	13 653,1	19 650,0	12 264,9	19 552,9	12 816,8
Total Balance (% of GDP)	4,7%	10,2%	2,4%	7,7%	-3,4%

Source: Ministry of Finance.

6.2 Legal framework

The legal environment of a project is a key factor conditioning its success. The Mining Law of the country is the single most important piece of the legal framework. It sets the rights and duties of the mining companies in their relations with the State, the Government and the society and establishes the legal and administrative procedures associated to the exploration and mining of mineral deposits.

Other important pieces of legislation include the laws concerning environmental protection, the foreign investment and the fiscal laws and regulations.

6.2.1 The new mining code

Angola has a new mining code (*Código Mineiro*), in effect since September 2011 - Law 31/11 of the 23rd September 2011. The new law revoked previous disperse legislation – namely the Law 1/92, of 17th January 1992, the previous legal framework for Mining and Geologic Activities (the "Mining Law"), and the Law 16/94, of 7th October 1994, the Diamond Law.

The Mining Code is the result of the Angolan law makers' efforts to consolidate the majority of the rules and regulations applicable to the mining industry and governing mineral operations into a single piece of legislation, and to update the legal regime that was in force for almost two decades, whilst simultaneously addressing a number of the common concerns of the international mining industry players. For instance, the former double-contract model was replaced by a single-contract model, according to which exploration, mining and marketing rights are granted from the outset under the same instrument, thus ensuring a seamless transition between the exploration and the mining phases (Fialho, 2012).

The new Mining Code purpose is to integrate and modernize all legislation applicable to mining activities, thus making it easier to harmonize, understand and apply – an effort directed towards investors and official institutions, while simultaneously addressing the issues of mining impact in the environment and local communities.

Conceptually, the Mining Code endeavours to establish a compromise between the acquisition of rights for the exploration of mining resources by both national and foreign investors vis-à-vis the public interest, and the State-domain principle of natural resources (MAYER BROWN, 2012).

Under the new law, according to the Chairman of ENDIAMA, it is now possible for investors to take a majority stake in mining companies, to reduce their tax burden from 35 percent to 25 percent and allow a single contract to be signed covering exploration and mining[1] - (macauhub, 2012).

Local communities and environmental protection are dealt with in in the new Mining Code:

- **Local communities.** (MAYER BROWN, 2012) points out the right that local communities have under the code to be actively engaged in the discussions pertaining to the development of mining activities in their territory. It is mandatory to establish communication/consultancy channels with local communities every time the mining activities have a potential detrimental effect to the communities' material, cultural or historical assets. The holders of mining rights have the obligation to resettle local communities in case mining activities cause any habitation damage. In such resettlement cases the communities' habits, traditions and other cultural aspects need to be taken into account by the holder of the mining rights.
- **Environmental protection.** Operators involved in mining activities have the obligation to comply with the generic and mining-specific environmental protection laws and regulations and to develop those activities preserving nature and environment. Specific obligations include (MAYER BROWN, 2012):
    - The realization and filing with the authorities of an environmental impact study; local communities potentially affected by the mining activity have to be given access to the environmental impact study.
    - The protection of water (namely regarding the populations' water supply) and other natural resources (soil, wild fauna and flora).
    - The quality of the working and living environment, especially concerning noise, vibration dust, radiation and polluting waste.
    - The obligation to inform authorities on events that cause (even if only potentially) damage to the environment.
    - The strict adherence to the rules on the occupation and use of land, urban and territorial planning and management, landscape impact and mine or project closure.

Other important aspects of the new Mining Code refer to:

[1] "prospecting and exploration" in the original text; a common confusion arising from the similarity between exploration and *exploração*, the Portuguese word for exploitation.

1. **State participation in the mineral projects**. In consideration of the granting of the mining and marketing rights, the State is entitled to participate:
    a. Through a State-owned company with a minimum of 10% in the share capital of the company to be set up for the mining stage, and/or
    b. Through a production sharing agreement in a proportion to be defined.

    Other than this requirement for State participation, there are no industry-specific rules or restrictions on corporate structures, nor are there mandatory participations or ownership interests reserved for national associates, although preference is to be given to national partners or companies (Fialho, 2012).

2. **Preference to local content**. Concession holders will give preference to national local workers in the hiring process. These workers will also receive training from the company. In addition, local products and services are also to be preferred provided that local alternatives are at least of the same quality, delivery time and their prices not significantly (>10%) higher than competing alternatives (MAYER BROWN, 2012).
3. **Geological information**. Geological information is the property of the Angolan State. Entities hired to collect geological information are not allowed to use for other ends than those contractually defined with the State. Entities collecting geological information that don't hold mineral rights are obliged to communicate those activities and their results to the State. All geological information collect is classified as strictly confidential (MAYER BROWN, 2012).
4. **Property of mineral resources**. Mineral resources are the property of the Angolan State; the holders of the mineral rights own the mineral production.
5. **Mining rights, contracts and land ownership**:

    a. **Types of mining titles:**

    Prospection title: exploration and evaluation of mineral resources. The title is granted for a total period of 7 years. By the end of the initial 5-year period, concessionaire must release 50% of the area and upon each extension it shall release the area to be determined by the Mines and Geology Ministry. Should the rights' holder wish to keep all areas it must pay a surface tax of USD 105/km^2 (MAYER BROWN, 2012).

    Production title: for the production of mineral products. Production titles subsequent to a process of exploration and evaluation are always granted except if there is any breach of law or contract or when there are public interest sound reasons. Attribution of these rights is dependent on the previous filing of a business/technical plan, environmental impact study and of the production plan. Rules applicable to the mining activities under this title will be the ones provided by the Mining Contract. These rights are granted for a 35-year period, including the prospection and appraisal period, and are subject to 10-year extensions subject to Ministerial approval (MAYER BROWN, 2012).

    Mining license – for the production of mineral products used in construction works.

    Mining pass (*senha mineira*) – for artisanal (*garimpo*) mining activities.

    b. **Acquisition of mining rights – public tender** The acquisition of mining rights is made upon request or after public tender. Strategic mining locations are always granted through public tender. A noteworthy new feature of the Mining Code is the requirement that mineral rights over areas of great geological potential or relating to strategic minerals be granted by means of a public tender procedure. Minerals are legally qualified as strategic in view of their economic importance, use for strategic purposes, specific technical mining aspects, rarity, level of demand in the international market, relevant impact on economic growth, significant job creation, or importance to the military industry. Diamonds, gold and radioactive minerals are expressly defined as strategic under the Mining Code, and the Government has powers to extend such classification to other minerals (Fialho, 2012).

    c. **Mining Contract** Private investment in the mining sector is subject to authorization by the Mines and Geology Ministry or the Counsel of Ministries, depending on the whether or not strategic minerals are at stake. The investment framework applicable of the 3 stages of the mining activity (i) reconnaissance and prospection, (ii) study and appraisal, and (iii) production will be set by a mining contract. Mining

rights for the trading of the minerals is also subject to this contract, which is negotiated by a special Negotiation Committee (MAYER BROWN, 2012).

d. **Land ownership** When mining rights are granted on land owned by individuals, authorization from the latter will have to be obtained. These individuals will be entitled to a rent and a security (bail) to cover potential damages (MAYER BROWN, 2012).

e. **Concession Area** – Maximum up to 10.000 km^2 except if a larger area is required in which case the Mines and Geology Ministry may have to provide a special authorization (MAYER BROWN, 2012).

f. **Assignment and pledge of mining rights** – Mining rights are transferable to third parties, with the restrictions set by the Mining Code. Mining rights can be provided as a credit security and be subject to judicial enforcement. Mining rights may only be pledge to secure concessionaire loans obtained to finance the mining activities. Mining rights cannot be seized (MAYER BROWN, 2012).

g. **Guarantee** – The private holders of mining rights are obliged to provide a guarantee to cover their investment contractual obligations. During the reconnaissance, exploration and appraisal stages, the guarantee shall cover 2% of the investment obligations. During the production stage 4% of the investment obligations. Mining companies shall have a legal reserve corresponding to 5% of the invested capital to be used on the abandonment or environmental restoration (MAYER BROWN, 2012).

6. **Taxes and royalties**. Investments in mineral activities by Angolan or foreign private entities are subject to a specific authorization, in the form of the approval of the relevant mineral investment contract, to be approved by the Minister of Geology, Mines and Industry or the President of the Republic, as the case may be. Investors in the Angolan mining sector may be given tax and other incentives, are subject to a more favourable industry-specific customs regime and are guaranteed the reimbursement of their investments from the proceeds of the sale of the minerals produced (Fialho, 2012):

   a. Corporate Income Tax – 25%
   b. Royalty on production – 5%
   c. Surface Tax - USD 7,00/km2 on Year 1 up to USD 35,00/km2 on year 5.
   d. Investment Income Tax – 10% on dividends distributed, 15% on interest payments.
   e. Customs duties – Exemption on the definitive or temporary importation of listed equipment for the exclusive use of mining operations (MAYER BROWN, 2012).

6.2.2 Small scale mining (garimpo) legislation

Small-scale, artisanal mining (i.e. *garimpo*) has recently been regulated by Decreto 53–09 of September 22, 2009. The law allows the exploitation of alluvial diamond deposits by holders of a license. The licensees must be Angolan nationals living in the area for at least 10 years.

6.2.3 Other legislation

ANIP's website has a compilation of legislation relevant for foreign investors. The English version of the website - http://www.anip-angola-us.org/ - includes the text of:

- The regulations concerning the legal status of expatriates in the Republic of Angola.
- The Private Investment Law.
- The PPP Public Private Partnerships Law.
- The Public Enterprises Law.
- The Law To Combat Money Laundering & Financing Of Terrorism.
- The Basic National Planning System Law.

The Portuguese version of ANIP's website - http://www.anip.co.ao/ - is more complete, including also:

- The Mining Code.
- The Law of the Micro, Small and Medium Companies.

6.2.4 How to apply for a diamond concession

Mineral rights are owned by the Angolan State. All concession contracts, either for exploration or mining, have to be approved by the Government and published in the Official Gazette – *Diário da República*. Exploration contracts have a first 5-years duration; after that period 50% of the initial area has to be relinquished. The mining right, also negotiated with the Ministério de Geologia e Minas – MGM (Ministry of Geology and Mines) can subsequently be awarded for the mineral deposit's life.

Only ENDIAMA or joint-ventures with ENDIAMA are allowed diamond mining rights, awarded by the Council of Ministers. The agreements between

ENDIAMA and the foreign partners are subject to approval by MGM – Ministry of Geology and Mines and by the Council of Ministers.

Diamond concessions have been limited to a maximum of 3.000 km^2 since 2000. Previous concessions could (and generally had) larger areas; security and the effective control of illegal mining over large areas were advanced as the reasons behind the current limit. Companies may be allowed several concessions.

The process to apply for a diamond concession has the following steps:

1. Letter of intent sent to the President of ENDIAMA EP with the following documents:
    a. Company profile.
    b. Balance sheet and profit and loss statements of the last 2 fiscal years.
    c. Statement demonstrating the company's technical capability and financial soundness.
2. ENDIAMA's *Direcção de Planeamento e Investimento* – DPI (Planning and Investment Direction) evaluates and issues a report about the financial soundness of the potential investor.
3. ENDIAMA's *Direcção de Geologia e Desenvolvimento Mineiro* – DGDM (Geology and Mining Development Direction) evaluates and issues a report about the technical capability of the potential investor.
4. Review and analysis of the geological and metallogenical information available in the DGDM and visit to the concession.
5. After the potential investor's review process and approval, the concession request follows two different paths, depending on the nature of the diamond deposit:
6. **Alluvial concessions**:
    a. Minimum investment – 5 MUSD.
    b. Preparation of a file to DGDM, then sent to the *Departamento de Análise Jurídica* – DAJ (Department of Legal Analysis).
    c. Negotiation and celebration of a joint-venture agreement with ENDIAMA.
    d. Deposit of 500.000 USD by the investor as a guarantee.
    e. Signing of an exploration contract and constitution of the joint-venture.
    f. Aprovall by the *Ministério de Geologia e Minas* – MGM (Ministry of Geology and Mines).
    g. Incorporation and publication in *Diário da República* – the Official Gazette.
6. **Kimberlite concessions**:
    a. Minimum investment – 10 MUSD.
    b. Signing of a letter of intent.
    c. Deposit of 1.2M USD by the investor as a guarantee.
    d. The process is sent by MGM (Ministry of Geology and Mines) to the Council of Ministers for approval.
    e. Approval by the Council of Ministers and the respective certificate issuing.
    f. Certificate sent to ENDIAMA by the MGM (Ministry of Geology and Mines).
    g. Signing of an exploration contract and constitution of the joint-venture.
    h. Incorporation and publication in *Diário da República* – the Official Gazette.

7 Current opportunities, future trends

7.1 Typical funding structure for mining projects

The primary objective of mining finance is to find the right allocation of Debt and Equity Capital over the mining project cycle by prudently managing several types of risks.

In general, funding structures for mining projects combine equity investments (e.g. IPO's and secondary offerings), highly leveraged Structured/Project Finance to individual mining projects and both debt and equity for general corporate leverage and/or Mergers & Acquisitions transactions (M&A):

- Equity Investment in Mining Companies: due to the high risk profile of mining activities and given that equity is subordinated to debt, the equity return required by investors will typically be high.
- Corporate Lending to Mining Companies: at this level, debt is usually unsecured and reflects the mining company policy for balance sheet leverage, namely taking into consideration tax efficiency and/or enhanced returns that debt may provide.
- Structured Finance: consists in the particular funding of a mining project and thus addresses the decisions on allocation of debt and equity capital. The key issues form debt providers (Banks, etc.) are how to mitigate the risk in the provision of debt to any mining project. At this level, debt is less risky than equity but riskier than corporate debt as it relies mainly on the resource/assets developed and the minerals produced.

According to PwC/E&Y data, over USD 341 bn of capital was raised in 2011 for mining companies worldwide. Approximately 20% of that amount corresponds to equity raising whereas the remainder 80% consist of debt. From the total equity raised of USD 68 bn, 49% was used for M&A purposes, 40% for exploration/expansion/project finance and 11% for general corporate use. The total debt raised amounted to USD 273 bn with 44% channelled for M&A transactions, 33% for loan refinancing, 16% for general corporate use and only 7% for expansion/project finance.

The selection of funding structure for a particular mining project may vary according to the mining cycle phase where it stands. There are 4 main stages of development with different funding needs and risk profiles:

- Exploration (private placement versus company funded);
- Development (Equity IPO's, Secondary Issues, Project Finance, Structured Lending);
- Production (Corporate Debt, Balance Sheet Lending, Trade Finance);
- Growth (M&A, Organic Growth, Mine Expansion, Exploration).

7.1.1 Exploration

The exploration stage includes 2 different phases: early stage exploration and a pre-development.

Early stage exploration of a mining project inherently has a high level of uncertainty. These projects are frequently undertaken by junior mining companies which face challenging issues in terms of financing:

- No revenues and several operational expenses, with no tangible assets being generated until the discovery of a mineral resource;
- The junior explorer company usually lacks any securable assets;
- Uncertainty about discoveries and their commercial potential.

These risk factors significantly reduce the credit worthiness of early stage exploration projects and thus their debt capacity is limited, with equity funding being the preferred source of funding. Early stage exploration is undertaken by all levels of mining companies with different ways of funding the on-going annual expense:

- Private equity placements;
- Internal funding allocations;
- Investment in Junior Explorers; and
- Joint-Ventures.

Pre-development phase follows early stage exploration from the moment a successful discovery is made. The primary concern is to define resource and mine design with a view to establishing a statement of reserves:

- Resource: inferred, indicated and measured;
- Reserves: 3Ps – possible, probable and proven.

From a funding requirements perspective, the project still generates operational expenses and has limited or inexistent securable assets. Feasibility studies and mine design are undertaken to assess reserves/resources and subsequently establish the project's debt capacity and bankability. Nonetheless, the risk levels and nature of balance sheet still limit the leverage potential, which leads to similar funding sources as in early stage exploration with a difference that public funding (e.g. IPO) may be envisaged if reserve status are attractive:

- Private equity placements;
- Internal funding allocations;

- Investment in Junior Explorers;
- Joint-Ventures; and
- Public equity (assuming reserve potential is marketable).

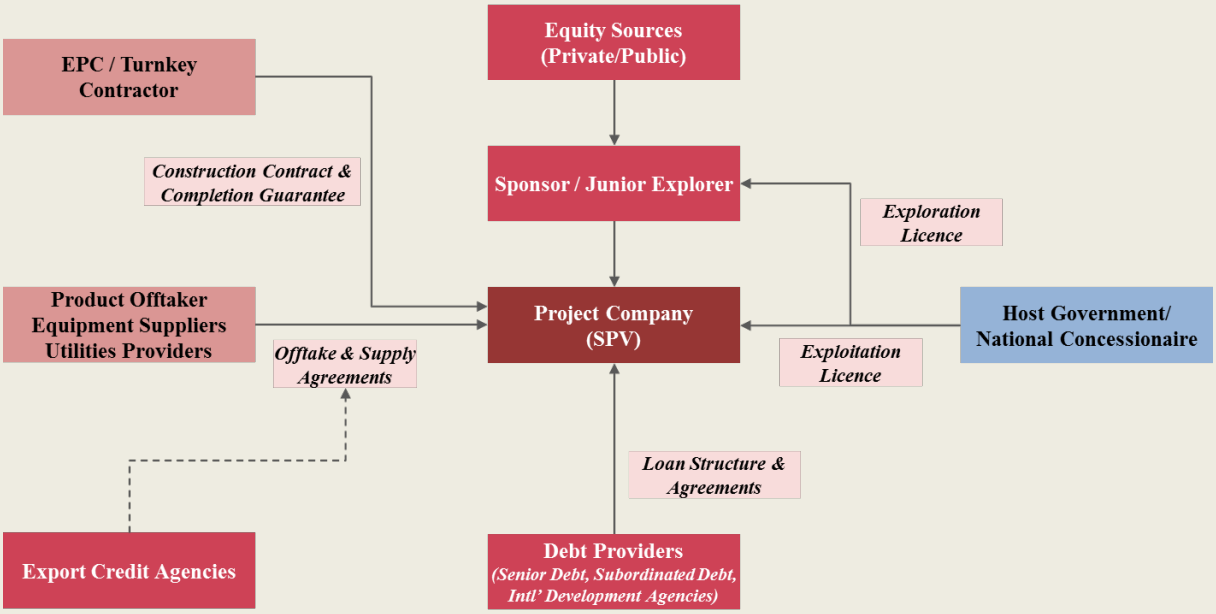

Figure 93 - Mining finance - project and contractual structure

7.1.2 Development

Following exploration, the development phase is initiated if the feasibility study is considered bankable. Development of a mining project typically includes capital expenditure in extraction/processing facilities, ancillary access/transport infrastructures and support facilities (personnel accommodation, office, etc.). Thus significant funding is required from multi-sourced financing and additional equity from secondary offerings can also be raised.

For a project to be bankable, the feasibility study has confirm that the proposed financing structures shows sufficient debt capacity to pay interests and repay loans to the extent and within the tenor required by Lenders.

A development project consists fundamentally of a capital expenditure that is determined by the size/quality of the reserve. Junior companies/sponsors still have limited securable assets at this stage and therefore a SPV (special purpose vehicle) structure is typically created to undertake project development.

SPV funding is usually based on a mix between public equity and debt. The SPV leverage capacity is assessed against the project's expected cash flows and the ability to meet the lenders' covenants (e.g. debt service ratios, etc.). Debt capacity of a development project will be higher than in exploration stage due to the risk level reduction achieved because:

- Debt is secured by cash flows rather than assets of SPV;
- Lenders typically require project completion guarantees to ensure cash flows (these guarantees will be backed by sponsor's or contractor's balance sheet);
- Both sponsors and lenders will seek long-term product off-takers to mitigate commercial risk and safeguard future cash flows – that will depend on the mineral to be exploited.

7.1.3 Production

Following an optimised development stage, a mine should remain in production for at least 15 years – it lifecycle will depend on the economically viable reserves that exists in the mining concession.

In the production phase the growth and stabilization of cash flows is evident, enabling the payment of debt and decreasing the role of mining finance. Even though, the cash flows are still subject to price volatility and cost inflation, which imply a strict monitoring of working capital and possibly hedging (usually borrowed on a revolving 6-12 month basis).

The typical balance sheet of this stage is a Mid-Tier based on a single commodity with assets in the form of Plant & Equipment, Commodity Debtors and Cash Balances. The projects usually require additional capital in the production stage, with public equity and revolving debt for working capital financing. In this stage the companies typically get listed in a major stock exchange, making easier the measurement of debt capacity and equity value against the company's balance sheet and projected cash flows.

During this period the completion and debt repayment lead to a clear risk level reduction, creating higher debt capacity for growth. The nature of the company's balance sheet also allows liabilities to be secured on assets and projected cash flows. Additionally, one may also witness an increase of investor appetite for the project's equity as the company typically reaches an optimised leverage level. Following a successful project development, the company usually becomes a mid-tier producer.

7.1.4 Growth

The growth stage is characterised by an enhanced debt capacity and less onerous completion requirements due to proven technology. This phase occurs through 3 corporate development activities:

- Continued exploration for organic growth;
- Greenfield & brownfield expansions;
- M&A for inorganic growth.

Even though the market uncertainty and volatile commodity prices led to a lower volume of M&A transactions in 2012, these operations still represent one of the main growth drivers of the industry.

In 2012, M&A transactions in the mining sector totalled USD 110 billion, an amount that accounts with the Glencore-Xstrata USD 54 billion merger. Moreover, the industry presented 1,103 transactions, reflecting a year of considerable M&A activity.

In order to overcome financial constraints, mining companies were forced to be creative when it comes to raising money to fund acquisitions or advance projects while considering the bond market, joint-ventures and streaming agreements to finance their projects.

Table 8 -Top 20 M&A mining deals of 2012.

#	Target	Acquiror	Resource	Country	Value
1	Xstrata plc	Glencore International plc	Diversified Metals	Switzerland	54,000
2	Inmet Mining Corporation	First Quantum Minerals Ltd.	Copper	Canada	6,700
3	Anglo American Sur SA	Mitsui & Co. Ltd.	Copper	United Kingdom (Chile)	2,900
4	Richards Bay Mining (Pty) Ltd. Richards Bay Titanium (Pty) Ltd.	Rio Tinto plc	Diversified Metals	South Africa	1,910
5	Roy Hill Holdings Pty Ltd.	POSCO	Iron Ore	Australia	1,560
6	Minefinders Corp. Ltd.	Pan American Silver Corp.	Gold	Canada	1,430
7	KazzInc JSC	Glencore International plc	Copper	Kazakhstan	1,400
8	Neo Material Technologies Inc.	Molycorp Inc.	Rare Earth Metals	Canada	1,300
9	Kolwezi Investments Limited Frontier Sprl La Compagnie minière de Sakania Sprl Roan Prospecting & Mining SPRL	Eurasian Natural Resources Corp plc	Copper	South Africa Democratic Republic of the Congo	1,250
10	CGA Mining Limited	B2Gold Corp.	Gold	Australia	1,196
11	ArcelorMittal Mines Canada Inc.	POSCO, CSC Steel Australia Holdings Pty Ltd.	Iron Ore	Luxembourg (Canada)	1,100
12	Eramet SA	Fonds Stratégique d'Investissement SA	Diversified Metals	France	1,035
13	Kumba Iron Ore Ltd.	Anglo South Africa Capital (Proprietary) Limited	Iron Ore	South Africa	909
14	Talison Lithium Limited	Windfield Holdings Pty Ltd.	Diversified Metals	Australia	769
15	AuRico Gold de México, S.A. de C.V.	Minera Frisco, S.A.B. de C.V.	Gold	Mexico	750
16	Allied Gold Mining PLC	St Barbara Ltd.	Gold	Australia	650
17	Trelawney Mining and Exploration Inc.	IAMGOLD Corp.	Gold	Canada	613
18	Mimosa Investments Limited	National Indigenisation and Economic Empowerment Fund	Precious Metals	Zimbabwe	550
19	Camrose Resources Daletona Properties Limited	ENRC Congo B.V.	Copper	Democratic Republic of the Congo	549
20	Billion Win Capital Limited	Prosperity International Holdings (H.K.) Limited	Iron Ore	British Virgin Islands	537

Source: Bloomberg and Zephyr.

7.2 Financing diamond projects in Angola

Raising fund to develop diamond projects in Angola is challenging, due to (i) the current stage of development of the Angolan diamond industry, and to (ii) the lack of a domestic capital markets industry.

The sector is currently recovering from an international downturn on the overall raw diamond industry. Angolan diamond sector was hit hard, as a result of the international financial crisis that led to a decrease in the diamonds market, and several active concessions ceased their operations.

Currently, the industry is dominated by Catoca – the main diamond producing mine in Angola, accounting for 80% of Angolan production of diamonds with other contributors both kimberlite and alluvial projects. A significant part of diamond projects are still in the exploration phase.

Angola is home to logistic challenges, especially in the Lunda Norte and Lunda Sul Provinces - where most of the diamond concessions are located, impacting significantly on the exploration program and budget: access to energy, road infrastructure, distance from Luanda – the country's commercial and financial center, dependence on imports, implying a substantial investment in stocks, and the climatic conditions are risk factors that can jeopardize exploration project cost projections.

Besides Alrosa and DeBeers, the players of the Angolan diamond industry are typically junior or midsized international companies, in partnership with Endiama and domestic private investors. The New Mining Code, approved in 2011, may increase the appetite of the Majors in Angola – one of the most relevant elements of the new framework is the possibility of celebrating a single contract for exploration and production phases, mitigating a renegotiation risk for the production phase.

Typically, midsized and junior mining companies target Toronto, Johannesburg and London as the preferred stock exchanges to list their companies.

In Angola, capital markets are still incipient, limiting the internal capacity to raise equity for mining projects. On the debt side, there are no financial intuitions with a special focus on the mining sector. Furthermore, despite the strong growth of credit granted by local banks, new credit regulation and the improvement on credit risk management will limit local financial institutions availability and appetite to provide loans to the mining projects (especially in the early stages of the concession)

7.3 Financing mining project in Angola – current status and trends

7.3.1 Overview

Major players like DeBeers of Alrosa have access to a diversity of funding sources, typically supported by their balance sheet. On the opposite side, junior and midsize companies dotting the landscape of the Angolan diamond sector, face higher restrictions to fund their exploration projects in the country.

The funding structures of mining projects are strongly dependent on the status and stage of development of the concession. On an early stage, the main source of funding is through equity, which is (i) provided by the sponsors, or (ii) raised through private placements or, (iii) on a more advanced stage, through listings in the stock exchange. Developing a mining project in Angola carries risk factors that need to be addressed and mitigated:

- Risk of cost overrun in exploration due to technical and logistics factors.
- Legal framework, improved with the New Mining Code.
- Governance of the mining projects and strategic alignment between all the shareholders/partners.

The players who have a limited access or experience in raising international funds for diamond projects tend to focus on secured loans granted by domestic banks, and, in many times, not covering all the funding needs of the exploration budget. Funds shortage added to mismanagement in the implementation of exploration project may lead to serious delays and ultimately lead to failure.

7.3.2 Market trends

Domestic banking sector will remain, in the medium term, adverse to mining risk. Smaller players and early operations should improve international fund raising capabilities. Addressing international players and investors to secure funding for early stage diamond operations in Angola requires a rigorous assessment on key critical issues:

- The overall framework of the diamond sector;
- A credible and proper project governance;
- A technically sustained exploration plan;
- An experienced team, with a track record that can mitigate risks on the implantation phase

The future of the Angolan diamond industry will require sponsors that comply with international practices to raise funds globally, providing standard technical information and technical reports, and presenting a comprehensive Info Memorandum, addressing political, institutional, economic, legal, regulatory, technical, financial, market and corporate governance matters, and advised, on a case by case basis, by experienced technical and financial consultants with strong technical and industry background and a fund raising track record. The fierce competition in the mining sector to attract international funding requires a new positioning from the Angolan sponsors in order to be successful amongst other diamond producing countries.

7.4 Opportunities in exploration and mining

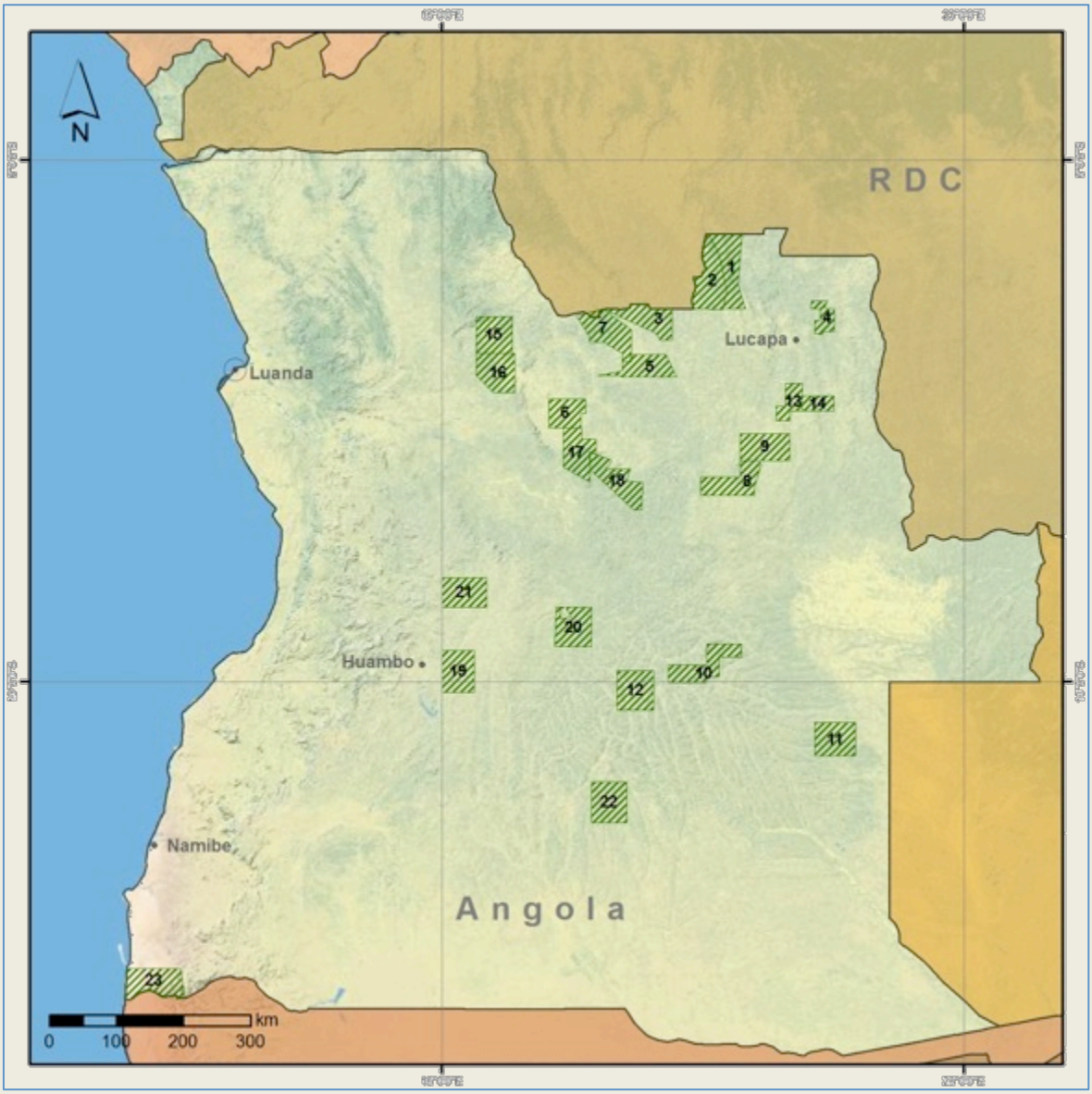

Figure 94 - New opportunities - concessions promoted by ENDIAMA as of June 2012.

With a major role in the international diamond industry, Angola is now entering its second century as a diamond producer. This moment is also one of tectonic reshaping, both of the international diamond industry – from mining through to the diamond jewellery markets – and in the structure and organization of the Angolan sector.

These mutation moments present difficult challenges; on the other hand, opportunities abound. As it stabilizes (socially and politically) and rapidly grows (economically), Angola has been improving both its infrastructure, modernizing its mining code and regulations and investing in geological knowledge acquisition (a countrywide aerogeophysical survey). ENDIAMA has also slowly been rethinking its role in the Angolan diamond industry: they are now in the first steps of a (especially challenging) branding process and acting as promoters of exploration or mining projects.

Angola is a traditional diamond producer, yet the country still holds many opportunities to discover and develop major new deposits. ENDIAMA is currently promoting a series of diamond concessions in Angola - Figure 94 and Table 9. Some of these concessions have a high mineralization potential or (albeit limited) already defined diamond resources. Some of them are good opportunities for the right investors, both in alluvial and kimberlite deposits.

Table 9 - New opportunities - concessions promoted by ENDIAMA as of July 2012.

ID	Project	Sector	Province	County	Distance to	Locality	Area (km²)
1	**Carumbo**	Lunda Norte	Lunda Norte	Cuílo e Chitato	160 km NE	Caungula	3,000
2	**Congolo**	Lunda Norte	Lunda Norte	Cuílo	140 km NE	Caungula	3,000
3	**Cuengo**	Lunda Norte	Lunda Norte	Caungula	35 km N	Caungula	3,000
4	**Lucapa Leste**	Lunda Norte	Lunda Norte	Lucapa	50 km NE	Lucapa	1,143
5	**Sachenda**	Lunda Norte	Lunda Norte	Caungula e Lubalo	80 km NE	Cuango	3,000
6	**Xá-Muteba**	Lunda Norte	Lunda Norte	Xá-Muteba	50 km W	Cuango	3,000
7	**Zovo**	Lunda Norte	Lunda Norte	Caungula e Cuango	95 km N	Cuango	3,000
8	**Chamunua**	Lunda Sul/Moxico	Lunda Sul	Dala			3,000
9	**Dala**	Lunda Sul/Moxico	Lunda Sul	Saurimo			3,000
10	**Lacage**	Lunda Sul/Moxico	Moxico	Moxico	110 km S	Luena	2,958
11	**Luanguinga**	Lunda Sul/Moxico	Moxico	Lumbala Nguimbo	SE	Lumbala Nguimbo	3,000
12	**Sacarimbua**	Lunda Sul/Moxico	Moxico	Luchaze	140 km SE	Camacupa	3,000
13	**Sanjungo**	Lunda Sul/Moxico	Lunda Sul	Saurimo	62 km	Saurimo	1,400
14	**Sombo Sul**	Lunda Sul/Moxico	Lunda Sul	Lucapa	100 km SE	Lucapa	1,011
15	**Bange Angola**	Cuanza Sul/Malanje	Malange		130 km N	Malange	3,000
16	**Cambo Sungingi**	Cuanza Sul/Malanje	Malange	Caombo			3,000
17	**Mazunzo**	Cuanza Sul/Malanje	Malange	Cambundi-Catembo	N	Cambundi-Catembo	3,000
18	**Quitapa**	Cuanza Sul/Malanje	Lunda Norte	Xá-Muteba			3,000
19	**Huabi**	Centro/Sul	Huambo	Tchicala-Tcholohanga			3,000
20	**Luei**	Centro/Sul	Bié	Camacupa			3,000
21	**Mungo**	Centro/Sul	Huambo	Mungo			3,000
22	**Sapuila**	Centro/Sul	Cuando Cubango	Cuito Cuanavale	W	Longa	3,000
23	**Welwitchia**	Centro/Sul	Namibe	Tombua			3,246

7.4.1 Alluvial deposits

Major mining companies shy away from alluvial diamond deposits. They lack the flexibility, enterprise culture and know-how to explore for and develop this type of deposits. Medium sized companies capable of integrating (as DIAMANG did) technical, scientific and managerial know-how – that small companies and garimpeiros lack - with flexibility and social skills – of which the mining giants are short - may be able to capture the huge value hidden in Angolan gravels.

Angolan alluvial fields still contain huge economic resources, particularly:

- In the Calonda Formation basal conglomerates. These are understudied deposits, with huge potential being the first sedimentary unit to collect the diamonds of the then just erupted kimberlites. ITM – Chitotolo is an example of a project that thrived by exploring and mining Calonda Formation conglomerates (in the Malúdi area). Adding to their economic potential, these deposits are covered by a variable thickness of sediments, shielding them from *garimpo*.
- In riverbeds. With some exceptions (relatively limited river diversions and dredging) in some stretches of the rivers that drain the Lunda provinces, riverbed gravels are relatively untouched. These deposits frequently contain high grade and high average value diamonds. These formations are more difficult to evaluate and to exploit than the corresponding alluvials in dry land. The risk involved and high capital cost of river diversions has limited the use of these

potential resources until now. There is now technology easily available (with the combined use of bathymetry, sonar, magnetometry and seismic reflection complemented by mini-bulk sampling and percussion drilling) to minimize the risk involved in finding, defining, evaluating and exploiting these deposits.

- In modern alluvial emmerse deposits in the classical Cuango, Chicapa, Luachimo, Luembe and Chiumbe but also in the Cuanza and other fluvial basins. These deposits were the backbone of the Angolan diamond industry for almost nine decades. Despite its continued productivity for such a period, many potential resources can still be found in the classical locations and, if properly explored, in new areas in the north and center of Angola.

Figure 95 - Looking for diamonds in Angolan rivers - north of Bié.

7.4.2 Kimberlite deposits

Kimberlites are a different issue. Again, the potential for discoveries in Angola is huge. The challenges are different from those posed by alluvials, though, and a different type of company is needed to tackle them.

In exploration projects, foreign companies need to be aware that exploration methods and metallogenical models proven in other geological environments and settings (e.g. Canada or South Africa) may be inadequate in Angola. Many Angolan kimberlites have no magnetic signature; being the standard geophysical method of choice for kimberlite discovery, there is a high likelihood that good targets will be missed. VTEM, an electromagnetic method has proved its reliability in the Lundas finding pipes otherwise missed; it is however a much more expensive exploration method. Gravity ground surveys have also been effective in locating kimberlites in the Angolan setting.

In mine development projects, success depends ona good knowledge of local logistics and product availability, cost and delivery time in the local markets but also of the local unwritten rules and procedures.

The ideal company will have easy access to risk capital (for exploration projects) and technical, scientific and managerial knowledge. It will also need to adapt its internal operational rules and procedures to the environmental idiosyncrasies – both strict rigidity and complacency are sure recipes for failure.

The potential for new discoveries may be guided by:

- The detailed analysis of diamond populations from past productions.
- Analysis of untested known kimberlites, especially in the central areas of the craton (the likelihood of economic discoveries in marginal areas decreases).
- Exploration in classical areas. Many kimberlites await their discovery in the NE of Angola.
- The countrywide aerogeophysical survey. It is not likely that new kimberlite discoveries will be directly derived from this investment; it will surely lead to a refined interpretation of the Angolan geology and new metallogenical and exploration models that will, in turn, generate new discoveries.

7.5 Future trends

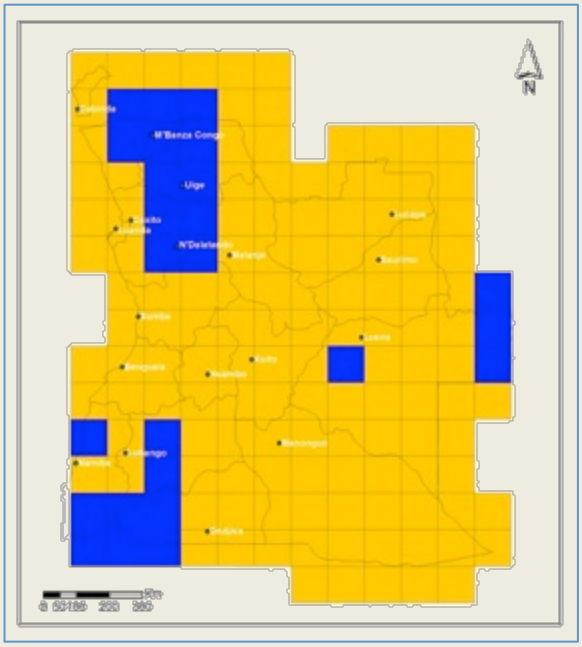

Figure 96 - 250K published geological maps.

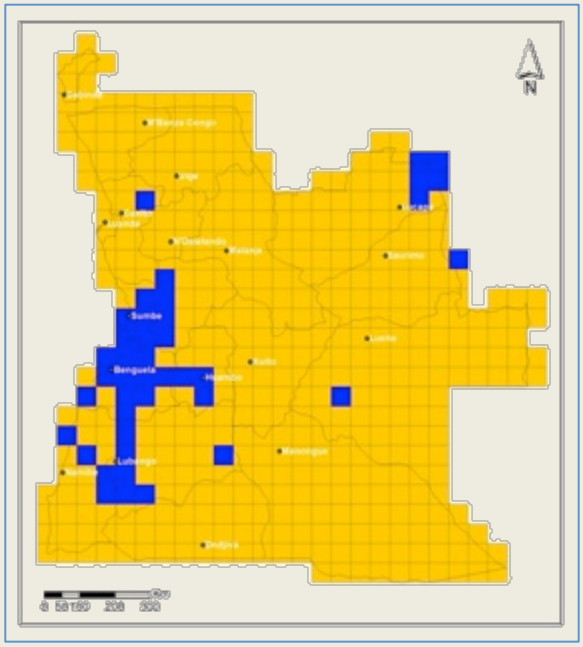

Figure 97 - 100K published geological maps.

It is learning from past mistakes that a better future may be built.

Angola is doing that, to a degree, with the new mining code - a step in right direction. Angola is rebuilding and building new infrastructure. The country has also been in a path of peace and institutional stabilization with successive free elections for more than a decade and multiple voices in the press. As a result the economy has grown and slowly diversified from oil and diamonds.

In the Angolan diamond industry, production has successively beaten records with the development and growth of the Catoca kimberlite mine and the contribution of several other projects already (or potentially soon to be) online.

Yet a lot remains to be achieved, challenges to be tackled.

The country needs to further strengthen its institutions and keep pursuing the current policy of creating and maintaining a public reliable transport infrastructure, reaching the totality of the territory. The spirit of the new mining legislation has to pervade the minds of those that apply it at all levels, in a natural transition from the earlier framework.

The country's diamond industry (and the whole mineral sector) will foster its growth and development if basic geological and metallogenical information is publicly available (in digital format). Brazil and Canada are examples in which policies of wide public geological data availability pays results.

The same principle applies to the availability of public information on the mining projects. Who produces what (e.g. volume, grade, income) at which cost in a period may be used as a benchmark for other projects, enabling better management and investment decisions from both public institutions and private companies.

The country also lacks support services specialized in the mineral industry, e.g., geophysical and drilling contractors, topography services and mineral laboratories. These services lack or are present in insufficient quantity, thus increasing the difficulty and cost of operating in Angola.

Of course, there is no point in having all the needed services located in Angola. Very specialized services (e.g. micro-diamond analysis) have a low local demand and are performed in only a few labs around the world. In this case (and in other very specialized yet needed analysis), the Government has to set in place a controlled yet straightforward, easy, cheap process to export the samples to analyse.

Should Angolan infrastructure rehabilitation and development proceed and workforce productivity and negotiation procedures improve, the once booming Angolan diamond industry may keep its present promises well into another century.

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