THE AK6 KIMBERLITE - DISCOVERY THROUGH TO PRODUCTION
LEARNING THE LESSONS OF HISTORY

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Abstract

The AK6 kimberlite in north-eastern Botswana, better known as Karowe, is today one of the world’s top diamond producers by value. Its potential, however, was not recognised when AK6 was first discovered some fifty years ago. This paper traces the history of Karowe from the discovery of AK6 through to evaluation and production, reflecting on the interplay of economic, technical and corporate elements and highlighting some of the lessons learnt along this journey. Karowe Mine has been operating since 2012 and is fully owned by Lucara Diamond Corporation. In 2015, Karowe yielded the second largest diamond ever found, the 1,109ct Lesedi La Rona (Fig. 1).

INTRODUCTION

The Karowe Mine, located in the Orapa region of Botswana, is today one of the world’s top diamond producers by value. In 2015 the second largest diamond ever found, the 1,109ct Lesedi La Rona, was unearthed at Karowe. However, the potential of the AK6 kimberlite had not been apparent at the time of its discovery and early assessment in the 1970’s-1980’s. This paper traces the history of Karowe, from the discovery of the AK6 kimberlite through to evaluation and production, alongside key technical, corporate and economic developments which have influenced its course.

Some of the lessons learnt along this unique and exciting journey from a sub-marginal project to one of world’s greatest diamond mines are presented through the perspective of one of the key players. Much of the experience that was hard won through the AK6 journey is today retained within the Botswana Diamonds plc team. All information referenced in this paper is available in the public domain. No proprietary or confidential information has been used.

KAROWE MINE TODAY

The Karowe Mine is an open pit kimberlite operation situated in north-eastern Botswana (Figure 2). Fully owned by Lucara Diamond since 2010, it has been operating since 2012.

Figure 1. The 1,109ct Lesedi La Rona (source: Lucara Diamond)

A highly profitable producer (Figure 3), Karowe has yielded 1.8 million carats to date, generating revenue of $1.02 billion at an average price of $566 per carat. Lucara has paid over $188M in dividends to date ($149.7M was paid in 2016 alone; Lucara Diamond Corporation, 2016).

As illustrated in this paper, value estimates of diamonds from the AK6 kimberlite have varied substantially through the course of its history, and this has greatly influenced key decisions made by the main players: De Beers, African Diamonds and Lucara Diamond Corporation.
Karowe is a proven large stone producer, famous for its magnificent Type II diamonds. Most notably, the 1,109ct Lesedi La Rona (Our Light in Setswana) recovered in 2015 is the second largest diamond found in history after the 3,106ct Cullinan found in South Africa in 1905 (Figure 3). Assessments of the presence and abundance of Type II diamonds have also played a decisive role in the history of the AK6 kimberlite, as will become apparent through this paper.

Figure 2. Location of the Karowe Mine (map source: Firestone Diamonds)

Figure 3. Diamond mines and projects ranked by operating margin (modified after Macquarie Research)
Location of AK6/Karowe

Karowe’s location in the Orapa region of north-eastern Botswana places it at the heart of prime real estate for diamond prospecting. The Orapa field is one of the most eminent in the world in terms of diamondiferous kimberlites and diamond mines, in the same league as the Kimberley cluster. Eight of the eighty-five kimberlites discovered in the Orapa field are diamond mines, some no longer in operation. The flagship, Orapa Mine (118ha) is the largest Tier I diamond mine in the world (the world’s largest kimberlite mine being Petra Diamond’s Mwadui in Tanzania).

Early Diamond Exploration

This year is a milestone as Botswana celebrates a half century of successful diamond exploration since the discovery of Orapa in 1967. This is testament to the rich diamond tapestry of Botswana, which has yielded such mines as Orapa, Lethakane and Jwaneng (Figure 4) which have underpinned the sustainable development of the country from one of the Africa’s poorest to its most wealthy per capita. It is also a testament to the strong relationship between the diamond industry players and the Botswana Government, supporting the Government’s vision in producing a stable and predictable fiscal environment in Botswana.

Diamond exploration, however, had begun long before the 1960’s. For example, a quote from W.J. Makin’s 1929 book Across the Kalahari Desert refers to a “mythical diamond field in the Kalahari that would make Kimberley seem an absurd little pothole”. The existence of diamonds in the region was more widely known than may have been suggested in some of the more recent literature (Figure 5).

THE DISCOVERY OF AK6

AK6 was discovered by De Beers Prospecting in 1969. It was initially assessed by De Beers in 1972-1975 by means of 44 percussion holes, 3 pits, 2 core holes and 2 large diameter holes (Figure 6).

Following its delineation and initial assessment, AK6 was estimated to be only 3.2ha in surface size and assessed to have poor mineral chemistry with a low diamond grade (3.5cph). On this basis, it was considered
to be low interest and not taken further at the time. The Kimberlite was briefly reassessed prior to its relinquishment in 1998.

The AK6 Discovery in Context

It is critical to consider the context in which the AK6 discovery occurred. Firstly, De Beers had just recently discovered the world-class Kimberlite at Orapa (Figure 7) thus the company had little appetite for what it considered as small, low-grade, low diamond potential Kimberlites.

From a technical perspective, and with the benefit of hindsight, it has become apparent that the initial assessment of AK6 had a few shortcomings (The MSA Group, 2010a), which included:

- The extent of the basalt breccia was poorly understood due to limited drilling;
- The Kimberlite was under-sampled;
- The use of cable tool (jumper) drilling had caused excessive diamond breakage during evaluation and bulk sampling (Figure 8).

From an economic perspective, the 1970’s-1980’s were a time of economic stagflation, when high inflation combined with slow growth and high unemployment crippled the global economy. The Arab oil embargo with the associated price shock and a major stock market crash compounded what was a dire situation.

In 1973-74, the NYSE’s Dow Jones Industrial Index (DJII) lost 45% of its value (Figure 9); its equivalent on the LSE, the FT30, lost 73%. De Beers was a listed company at the time and its share price followed the trend of the DJII, to which it was closely correlated.
Ironically, at a time of great diamond exploration successes, diamond sales were declining sharply and diamond prices collapsing (Figure 10). All the while, the diamond stockpile at the Central Selling Organisation (CSO) in London kept growing (Boyajian, 1988). This is the particular lens through which one should look through over the time of the discovery of AK6.

**The “Re-Discovery” of AK6**

The context of the early 2000’s was radically different. In the 1990’s De Beers had begun to change its strategy from one of dominating global diamond supply to a market orientated approach with Russia, Australia and Canada moving away from the Central Selling Organisation business model. De Beers’ market share began to decline as a result and by the end of the 1990’s, it had fallen from nearly 90% in the 1980’s to less than 40% (Figure 11) in recent years. The change was at the time of a string of antitrust competition related law suits which filed in the US in 2001. Between 2000 and 2004 De Beers liquidated their diamond stockpile, alongside major company restructuring following privatization of their business (Zimnisky, 2013).

With a long-term outlook of declining diamond supply and increasing demand, the search for new diamond deposits became a major strategic imperative. This prompted the reassessment of many of the uneconomic kimberlites discovered in the 1960’s and 1970’s using second generation exploration technology and analytical techniques.

In 2000 De Beers Botswana Prospecting (Debot) was granted a Prospecting Licence over AK6 (PL 13/2000). The kimberlite was reassessed in 2003 using high-resolution ground geophysical surveys and new drilling technology, and mineral chemistry analysis of a small dataset (295 garnets) pointed to an apparent lack of sub-calcic garnets which downgraded the kimberlite in terms of diamond potential (The MSA Group, 2010a). The surface area was revised upwards to 9.5ha and two
separate lobes (North and South) were identified with percussion drilling. The increased surface area sparked a renewed interest in AK6 and triggered an initial evaluation programme in 2003-2005.

THE AK6 KIMBERLITE EVALUATION

Initial Evaluation Phase

The aim of the initial evaluation was to achieve a preliminary assessment of size, grade and value as well as an initial geological model, at a mineral deposit level of confidence.

Figure 12. Large Diameter Drilling on AK6 during Initial Evaluation (image courtesy of James Campbell)

A Large Diameter Drilling (LDD) programme was initiated with the objective to recover a kimberlite sample of 100t for macrodiamond potential and preliminary grade assessment (Figure 12). High-resolution ground geophysics was used to estimate the surface area and develop a basic geological model (Figure 13).

Table 1. Summary of Initial Evaluation results from AK6

<table>
<thead>
<tr>
<th>Phase</th>
<th>Techniques</th>
<th>Objectives</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial evaluation</td>
<td>LDD 5x12¼&quot;</td>
<td>Macrodiamond potential, preliminary grade</td>
<td>97t (in situ) 22.46ct 25cpht (+1mm) 124US$/ct (modelled value)</td>
</tr>
<tr>
<td>High-resolution geophysics</td>
<td>Surface area, geological model</td>
<td>9.5ha</td>
<td></td>
</tr>
</tbody>
</table>

In 2004 Debot formed the ‘Boteti’ Joint Venture with African Diamonds plc over a number of Prospecting Licences including PL 13/2000. The two companies had contiguous ground holdings and combining efforts seemed the logical decision at the time (Figure 14). Ownership of the Boteti JV was initially structured at 49% African Diamonds and 51% De Beers, with Debot being the operator and with De Beers Group funding the joint venture was taken to bankable feasibility study (BFS). De Beers’ shareholding would increase to 70% upon completion of the first BFS. The size of any mine resulting from the JV would determine which of the two parties would be the operator.

Ironically, De Beers committed PL 13/2000 to the Boteti JV before without being aware of the encouraging results from the Initial Evaluation Phase. This was due to a 10-month lag between the completion of drilling and the release of the sampling results.

Phase 1 Evaluation

The evaluation of AK6 followed a phased approach, with Phase 1 taking place in 2005-2006. The aim of Phase 1 was to define an Inferred Mineral Resource to 400m (South Lobe) and 180m (Central/North Lobe). Percussion drilling was carried out for delineation and geological modelling, as well as mineral chemistry and macrodiamond analyses. Unlike the earlier assessment, the garnet mineral chemistry analysis was based on a statistically representative sample of 1,742 garnets, which revealed the presence of sub-calcic diamondiferous kimberlite indicators (Figure 15).
Core drilling (inclined and vertical) was aimed at the detailed sampling and logging of the internal kimberlite geology, as well as obtaining samples for microdiamond analyses (Figures 16 and 17). The LDD programme included in Phase 1 was aimed at recovering diamonds for grade and revenue estimation.
At least 500 carats were required for diamond valuation at Inferred Resource level (Figures 18 and 19). The positive sampling results and consistent grades led to the decision to fast-track evaluation. Details of Phase 1 Evaluation are summarised in Table 2.

**Phase 2 Evaluation**

Phase 2 Evaluation was conducted in 2006-2007. Its partial overlap with Phase 1 was designed to compress the overall timeline. The aim of Phase 2 was to define an Indicated Mineral Resource to 400m (South Lobe) and 250m (Central/North Lobe). As required by the Boteti JV arrangement, an Indicated Mineral Resource would provide the input for a Feasibility Study which would be used to raise project finance.

Core drilling was used for delineation and internal geology; LDD and trenching for grade and revenue estimations. At least 3,000 carats were required for diamond valuation and Size Frequency Distributions (SFDs) at Indicated Resource level. Phase 2 LDD sampling revealed the presence of different diamond populations in the South and Central/North Lobe, which required that the two areas be treated separately for trench sampling. Targets were set at 1,200ct for the South Lobe and 1,800ct for the Central/North Lobe. However, the extent of the Central/North Lobe had been overestimated due to uncertainty around the geological boundary; as a result, only a reduced dataset from the Central/North Lobe could be used for revenue estimates. Effectively, trenching proved inadequate to recover the required number of carats and only 1,754ct were used for valuation and SFD modelling. This had a crucial influence on the course events that unfolded.
## Evaluation Phase 1

<table>
<thead>
<tr>
<th>Phase</th>
<th>Techniques</th>
<th>Objectives</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation Phase 1</td>
<td>Percussion drilling 44x6.5&quot; (14 in kimberlite)</td>
<td>Delineation, geological model, mineral chemistry, macrodiamonds</td>
<td>4,575m 28t (in situ) 8.41ct 29.6cpht (+1mm)</td>
</tr>
<tr>
<td>Evaluation Phase 1</td>
<td>Core drilling 17xinclined 12xvertical</td>
<td>Internal geology, LDD pilots, microdiamonds</td>
<td>9,883m South Lobe increased</td>
</tr>
<tr>
<td>LDD Phase 1</td>
<td>13x23&quot; @70m</td>
<td>Grade and revenue Inferred Resource 500ct for valuation</td>
<td>2,747t (in situ) 689ct 25.1cpht (+1mm)</td>
</tr>
</tbody>
</table>

Table 2. Summary of Phase 1 Evaluation results from AK6

Interestingly, it was recognised at time that AK6 would be a Type II diamond producer (Campbell et al., 2009); in fact, two layers of Type II diamonds were identified within the kimberlite. This was, however, qualitative information and as such it was not adequately considered – with major implications in terms of future decisions. Details of Phase 2 Evaluation are summarised in Table 3.

## Evaluation Phase 2

<table>
<thead>
<tr>
<th>Phase</th>
<th>Techniques</th>
<th>Objectives</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation Phase 2</td>
<td>Core drilling 11xvertical 29xinclined</td>
<td>Delineation, internal geology, LDD pilots</td>
<td>12,860m Kimberlite at 884m</td>
</tr>
<tr>
<td>Evaluation Phase 2</td>
<td>LDD Phase 2 12x23&quot; @50m</td>
<td>Grade and revenue Indicated Resource 3,000ct for valuation</td>
<td>3,298t (in situ) 485ct 17.8 cpht (+1mm)</td>
</tr>
<tr>
<td>Trenching (S Lobe)</td>
<td>Grade and revenue (1,200ct)</td>
<td></td>
<td>7.393t (in situ) 255.03ct</td>
</tr>
<tr>
<td>Trenching (C/N Lobe)</td>
<td>Grade and revenue (1,800ct)</td>
<td></td>
<td>12.074t (in situ) 327.17ct</td>
</tr>
</tbody>
</table>

Table 3. Summary of Phase 2 Evaluation results from AK6

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**AK6 Mineral Resource Statements**

The first mineral resource statement for AK6 was released by African Diamonds in 2007. An Indicated Mineral Resource was identified to 400m depth, with additional deposit potential below 400m. Average grades estimated at 22cpht were regarded as conservative and some improvement was anticipated with further work. Considerable upside was expected in diamond values, due to the high level of diamond breakage observed and the abundance of Type II diamonds (Campbell et al., 2009). Grades remained fairly consistent through subsequent mineral resource statements in 2009 and 2010. Diamond values were revised upwards in 2009 and, more substantially, in 2010 on the basis of updated SFDs integrating microdiamond data and diamond assortment modelling (Figure 20, Table 4).

<table>
<thead>
<tr>
<th>2007</th>
<th>AK6 Mineral Resource</th>
<th>tonnes</th>
<th>grade (cpht)</th>
<th>M Carats (+1 mm)</th>
<th>Value (US$/ct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicated Resource (to -400m)</td>
<td>51.8</td>
<td>22</td>
<td>11.1</td>
<td>131</td>
<td></td>
</tr>
</tbody>
</table>

| 2009 | Indicated Resource (to -372m) | 40 | 22 | 8.9 | 153 |
|      | Inferred Resource (372-758m) | 31 | 19 | 6 | 139 |
| 2010 | Indicated Resource (to -400m) | 51.2 | 22 | 11 | 194 |
|      | Inferred Resource (400-750m) | 21 | 19 | 4 | 183 |

Table 3. AK6 Mineral Resource Statements, 2007-2010 (Campbell et al., 2009; The MSA Group, 2010a and 2010b)

The use of microdiamond data in size modelling has the potential to compensate for the effect of diamond breakage in a macrodiamond population obtained by LDD sampling. Techno-economic studies were initiated in parallel to Phase 2, thereby further accelerating project development. A synopsis of the outcomes of the various studies based on information in the public domain illustrates the vast differences in the valuation of the project by different players, with NPV values ranging from -$70M to $209M (Table 5).
MINING AK6: KAROWE MINE

Karowe Mine went into production in the second quarter of 2012. Considering the range of capital estimates from the techno-economic studies above, it is worth noting that Karowe Mine went into production on the basis of a $130M Phase 1 construction and commissioning project. The 2013 Mineral Resource/Reserve Statement based on production information (Table 6) reflected a drop in grades and increase in values, the latter almost threefold (Figure 21).

<table>
<thead>
<tr>
<th>Study (Year)</th>
<th>Company</th>
<th>Hurdle Rate</th>
<th>IRR</th>
<th>NPV (US$)</th>
<th>Economics</th>
<th>Capital</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conceptual</td>
<td>De Beers</td>
<td>17%</td>
<td>19%</td>
<td>10M</td>
<td>Marginal</td>
<td>$380M</td>
<td></td>
</tr>
<tr>
<td>(2007)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-Feasibility</td>
<td>AFD</td>
<td>0%</td>
<td>53%</td>
<td>209M</td>
<td>Robust</td>
<td>Not disclosed</td>
<td>Boteti Mining Licence Application</td>
</tr>
<tr>
<td>(2007)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feasibility</td>
<td>Boteti</td>
<td>10%</td>
<td>4.3%</td>
<td>-70M</td>
<td>Marginal</td>
<td>$380M (phase 1 &amp; 2)</td>
<td>Boteti Retention Licence Application Boteti issued Mining Licence</td>
</tr>
<tr>
<td>(2008)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conceptual</td>
<td>AFD</td>
<td>12%</td>
<td>30%</td>
<td>25.5M</td>
<td>Robust</td>
<td>$88M (Phase 1)</td>
<td>Lucara buys DeBot’s share in Boteti</td>
</tr>
<tr>
<td>VES (2009)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feasibility</td>
<td>Boteti</td>
<td>10%</td>
<td>34.8</td>
<td>189M</td>
<td>Robust</td>
<td>$165M (Phase 1 &amp; 2)</td>
<td>Lucara buy-out of AFD</td>
</tr>
<tr>
<td>(2010)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Synopsis of techno-economic studies for AK6 (modified after The MSA Group, 2010b)

This substantial increase was chiefly due to the incorporation of production and sales data into the diamond value estimates, whereas the higher bottom cut-off size (1.25mm) accounts for the grade decrease. The 2013 value estimation was qualified as conservative, as proven by Karowe’s realised average price of $566 per carat.

A reliable performer, Karowe has consistently exceeded 350,000 carats in annual production (Figure 22). Estimated production for 2017 is 290,000-310,000 carats, for an estimated revenue of $200-220 million. Karowe’s anticipated life of mine is 15 years. During the first 5 years of its life, the mine has delivered consistent volumes and grades (Table 7) and, most importantly, magnificent Type II diamonds. Average diamond values from production have been considerably higher than any previous estimate.


![Figure 21. AK6 Mineral Resource Statements and Diamond Value, 2007-2013 (Campbell et al. 2009; The MSA Group, 2010b; Lucara Diamond Corporation, 2014)](image1.png)
CORPORATE CONTEXT

The significance of the corporate context in the history of the AK6 kimberlite development is best illustrated by retracing the chronology of key events and technical triggers that prompted certain corporate action.

- April 2004: Debot (‘DB’) signed the Boteti Joint Venture agreement with African Diamonds plc (‘AFD’) on the basis of a 51/49% split. Each party contributed their contiguous properties in the Orapa region. DB was the operator and could earn up to 70% on delivery of a Bankable Feasibility Study (‘BFS’).

- January-December 2006: positive evaluation results are released, indicating the presence of Type II diamonds. DB’s conceptual study however suggested marginal economics. James Campbell (JAHC) moved from DB to AFD as MD, joining Dr Alex van Zyl (former Consulting Geologist for DB) who was Technical Director at AFD.

- February-September 2007: AFD’s prefeasibility study indicated robust economics and lower capital. Boteti applied for a Mining Licence over AK6 and agreed to fund AFD’s share upon DB delivering a BFS. AFD disputed that bulk sampling was inadequate and diamond value did not meet Indicated Resource category and thus...
fell short of the minimum criteria for a BFS. DB overcame this by becoming the bank. Project capital USD380M.

- July-October 2008: DB’s feasibility study suggested marginal economics (negative NPV; $380M capital). DB applied for a Retention Licence over AK6 citing power shortages and its stance against auctioning diamonds on the open market as reasons. A very traumatic time ensued for the Boteti JV. AFD launched an urgent high court action against DB/Boteti on the basis that the Retention Licence application was invalid as a Mining Licence has already been applied for and the project was economic (c.30% higher independent diamond valuation; lower capital). Boteti’s application for a Retention Licence was rejected as a Mining Licence had already been applied for. Boteti proceeded to conclude the terms for the award of a Mining Licence. DB rejected AFD’s offer to buy their interest in AK6.

- June-November 2009: AFD’s alternative Value Engineering Study (rejected by DB) suggested robust economics and lower capital. DB was unable to finance the project due to marginal economics (in their view) and the poor financial climate post-GFC and offered to sell their stake to AFD. AFD scoured a depressed market trying to raise funds or find an alternative investor. Eventually, AFD’s innovative approach to mining and confidence in the resource paved the way for the new investor: Lucara Diamond (LUC) bought DB’s stake in Boteti for $49M (acquisition fully funded by a LUC insider) following an introduction by JAHC and rapid negotiations.

- May-November 2010: LUC’s feasibility study confirmed robust economics. LUC acquired AFD’s stake in Boteti for a c.30% premium. AFD listed at 7p in July 2004 and sold for equivalent 52p. AFD’s exploration assets were spun off into Botswana Diamonds plc.

LESSONS LEARNT

Economic Context: 2009, Annus Horribilis

In the aftermath of the Global Financial Crisis, the mining boom of the past decade ground to a sudden halt and investment activity in the mining sector dropped dramatically. Juniors were the hardest hit, being seen as the high-risk “project generators” and funding to this sector dried up overnight. In such context, there was little hope for a junior wanting to attract funding for a diamond project which a major had deemed to be marginal – especially when that major was regarded as the ultimate authority in diamonds.

It should be borne in mind that De Beers was far from immune to this colossal crisis, as demonstrated by a few key indicators:

- Net profits for H1 2009 dropped 99% to just $3m, compared to $316m in H1 2008;
- Sales of rough diamonds declined by 57% to $1.4bn;
- Production was slashed by 73% to 6.6m carats
- Global workforce was cut by 23%;
- Production at mines in Africa and Canada was temporarily halted

In fact, De Beers was a very short time away from running out of money owing to timing of renewal of a large proportion of its bank syndicated debt at that time.

Joint Venture dynamics

As mentioned previously, the Boteti JV agreement was signed ahead of the release of the first bulk sampling results. This was due to a 10-month lag between sampling and issuing of results by De Beers, which is an unacceptable timeframe to a junior. Moreover, and as demonstrated by the variances in the techno-economic studies, the two JV partners had fundamentally different perspectives and funding structures. Substantial variance became evident in aspects such as:

- Risk appetite
- Plant design philosophy
- Capital estimates
- Project economics
- Approach to financing
- Hurdle rates
- Decision making processes

A further differentiator was the fact that AFD was dual-listed on the London AIM and the Botswana Stock Exchange. This provided AFD with strong local shareholding (20% of shareholders were Botswana citizens), enabling it to raise funds in the country where it was doing business.

The dynamics that played out within the Boteti JV were not unique to De Beers and African Diamonds. Research conducted on the differentiators of juniors and majors’ approach to exploration has highlighted some interesting traits, as illustrated in Table 8.
Technical considerations

Impact of technology
The impact of new technology and innovative analytical techniques on the “re-discovery” and assessment of the AK6 kimberlite cannot be overemphasised. One of the fundamental lessons which can be learnt from the history of AK6 is that developments in technology warrant revisiting past decisions with an open mind.

Exploration Stage
From an exploration point of view, it is evident that the statistical representativity of indicator mineral samples is crucial to making informed decisions at an early stage. Had the presence of sub-calcic garnets been detected in the early days, AK6 might have been developed a few decades earlier. Geophysics played a dual role: if it is thanks to high resolution geophysics that the size of AK6 was increased from the initial unpromising estimate, geophysics could be “blamed” for overestimating the proportion of kimberlite to basalt breccia until detailed drilling results became available.

Evaluation Stage
The key lesson that AK6 has taught us from an Evaluation perspective is that the abundance of large diamonds was significantly underestimated; the impact on the project’s value proposition is unquantifiable. The underestimation of large diamonds can be ascribed to the undersampling of certain diamond populations combined with a poor understanding of diamond breakage. Advances in LDD technology have resulted in a reduction of diamond breakage during evaluation sampling. The impact of breakage on diamond value estimations and modelled SFDs is better understood than it was in the early days of AK6, and somewhat mitigated through the use of microdiamond data for diamond size modelling. However, there remains room for further improvement.

Mining Stage
From a Mining perspective, the integration of Karowe Mine production data (Figure 23) has dramatically improved the understanding of diamond SFDs for the AK6 kimberlite.

Geological model
The geological model of the AK6 kimberlite has not changed substantially since its evaluation (Figure 24), except for the increased granularity of the internal geology (kimberlite and breccia domains). According to the NI 43-101 Technical Report on the Karowe Mine (February 2014), “[…] the updates to the 3D geology model are considered to be minor and represent refinement of the previous model based on the availability of new mapping data […]” (Figure 25).

<table>
<thead>
<tr>
<th>Some common traits of <strong>juniors</strong></th>
<th>Some common traits of <strong>majors</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Discoverers and developers of new economic deposits</td>
<td>• Owners of mining operations</td>
</tr>
<tr>
<td>• Typically small-cap companies</td>
<td>• Typically more than one mine</td>
</tr>
<tr>
<td>• Exploration spend is their lifeblood</td>
<td>• Publicly traded, well capitalised companies</td>
</tr>
<tr>
<td>• No/little production cashflow to fund exploration activities</td>
<td>• Exploration activities internally funded by production cashflow</td>
</tr>
<tr>
<td>• Funding derived from share issues &amp; management</td>
<td>• Exploration spend viewed as discretionary</td>
</tr>
<tr>
<td>• No dividends paid - shareholders rewarded by share price increase</td>
<td>• Steady, predictable cashflow</td>
</tr>
<tr>
<td>• Results attract high degree of public scrutiny and assurance</td>
<td>• Large corporate structures</td>
</tr>
<tr>
<td>• Subject to full extent of regulatory and reporting obligations</td>
<td>• Complex decision processes</td>
</tr>
<tr>
<td>• Technical management teams with deep practical experience</td>
<td>• Internal assurance processes</td>
</tr>
<tr>
<td>• Innovative, agile and fast</td>
<td>• Able to adjust production to changing market conditions</td>
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<td>• Large technical and non-technical management departments.</td>
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<td>• Often bureaucratic and slow moving</td>
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Table 7. Juniors and majors’ approach to exploration (source: investopedia.com; mineralsnorth.ca; undervaluedequity.com)
Unlike the geological model, value estimates of diamonds from the AK6 kimberlite have varied substantially through the course of its history, with major implications in terms of strategic decisions. The fact that Karowe Mine is consistently delivering large and exceptional stones is not surprising, once all historical information - both quantitative and qualitative - is taken into account.

Diamond value

Unlike the geological model, value estimates of diamonds from the AK6 kimberlite have varied substantially through the course of its history, with major
The abundance of Type II and larger diamonds in AK6 was recognized early on during evaluation, yet inadequately considered in the initial valuations. Compounding this, the impact of diamond breakage was poorly understood (and still is). As a result, diamond value was significantly underestimated in the financial modelling which underpinned key decisions on the development of the project.

From a methodology perspective, diamond valuation can use one of two end-member systems: fixed price book or open tender. The former is typically preferred by larger established producers, while the latter is better suited to smaller producers.

Some advantages of open tenders include:
• Market related price
• Competitive bidding
• Pricing transparency
• Clients get the goods they want
• Premium paid for valued goods

Disadvantages of open tenders include:
• Less predictable cash flows
• Higher risk of price volatility
• Speculative buying

There can be up to 30% variance between valuations using either of the two systems.

**Economic value**

From an economic perspective, the AK6 story demonstrates that the right set of technical and corporate skills, coupled with the right opportunity and timing can generate attractive returns for shareholders through increased share price (Figure 26).

Lucara acquired De Beers 70% share in the AK6 project for US$49M in 2009. The company is now valued at CAD1.2 billion. LUC had a market capitalisation of c. CAD30 million immediately prior to the acquisition of De Beers’ stake in AK6, i.e. it had a 40 times increase in market cap (Figure 27). Lucara bought 70% of a $1 billion business for $49 million.

**CONCLUSIONS**

**Corporate Perspective**

From a corporate point of view, it is clear that contrasting strategic, corporate and financial agendas between the initial Joint Venture partners played a crucial role in the history of the AK6 development. Differences in such factors as risk appetite, ways of raising finance, approach to mine development and diamond pricing methodologies were pivotal to the strategic decisions that shaped the AK6 project. Contrasting approaches of this kind are bound to pose a fundamental challenge for any major who decides to partner with a junior.

The old “cash is king” adage holds true, and particularly at the bottom of the economic cycle. The Lucara insider was able to come up with $49 million at the bottom of the market, at a time when no one had funds to invest, especially so in a project deemed to be uncertain.

**Technical perspective**

From a technical angle, it is evident that the inadequate size of the evaluation bulk sample led to deficiencies in SFDs and diamond value modelling. A poor understanding of diamond breakage also negatively affected value estimations and modelled SFDs. Although much more is known today about diamond breakage, it still remains an issue.
Too rigid an approach to data modelling had major consequences on the assessment of the presence and abundance of Type II diamonds in AK6. Qualitative information which had been gathered during the evaluation process included reconstituting broken Type II diamonds. This illustrated that there were larger than 12mm diamonds (this being the bottom cut-off of the bulk sampling) that had not been recovered nor modelled. This was valuable qualitative information which was not fully utilised in the evaluation process - with major consequences.

The development of AK6 has been an exciting, enriching and humbling journey. Much of the experience that was hard won at AK6 is today retained within the Botswana Diamonds team.

REFERENCES


