EXPLOITING RSA’S ALLUVIAL DIAMOND DEPOSITS SUSTAINABLY

LYNDON DEMEILLON
www.globaldiamonds.co.za

SADPO WORKSHOP – 22 MAR 2017
Global Diamond Network

Specialists in the geology, origin and exploitation of large stone producing alluvial diamond deposits.
Distribution of Kimberlites

Southern Africa
Kimberlite Erosion

Alluvial Deposit Distribution

- ERODING KIMBERLITES
  - 1200 MY CULLINAN
  - 500 MY VENETIA
  - 240 MY JWAHENG
  - 80 MY KIMBERLEY
- ALLUVIAL TERRACE
- RAISED BEACHES
- DROWNED BEACHES
- ATLANTIC OCEAN

Marine Diamond Placer Deposits

Uplift
Erosion
Deposition
Typical Stratigraphic X-Section

Karoo Sequence Illustrated

- Karoo Volcanics
- Karoo Sediment
- Dolerite Dyke
- Kimberlite Pipe
- Ventersdorp Lava
Post Gondwana

Lower Cretaceous Karoo and Kalahari Palaeo Rivers
Distribution of Alluvial Diamond Deposits

Southern Africa
## Geological History
### Relationship Between Key Events

<table>
<thead>
<tr>
<th>AGE MA</th>
<th>GEOLOGICAL TIME</th>
<th>CLIMATE</th>
<th>GEOMORPHOLOGICAL EVENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>QUAT</td>
<td>POST-</td>
<td>Re-excavation with formation of terraces - 20-40 m Terraces</td>
</tr>
<tr>
<td></td>
<td>PLEO</td>
<td>AFRICAN</td>
<td>Aggradation Top (±3Ma)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>Base (±7Ma)</td>
</tr>
<tr>
<td></td>
<td>TERTARY</td>
<td>POST-</td>
<td>Oldest Orange River Gravels 80-120 m Terraces</td>
</tr>
<tr>
<td></td>
<td>PALAOCENE</td>
<td>AFRICAN</td>
<td>Mahura Muthla gravels (±60-65 Ma?)</td>
</tr>
<tr>
<td></td>
<td>MIOCENE</td>
<td>SURFACE</td>
<td>Post-breakup erosion and peneplanation</td>
</tr>
<tr>
<td></td>
<td>OLIGOCENE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Eocene</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EOCENE</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LATE</td>
<td>POST-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CRETACEOcene</td>
<td>AFRICAN</td>
<td></td>
</tr>
</tbody>
</table>

**DRAKENSBERG VALLEYS**
- Formation of Escarpment with Palaeo-Slope towards the West-Southwest

**KOFFIEHOF LAND AND REGION WITH PALAEO-SLOPE TOWARDS THE WEST-SOUTHWEST**
- Stable floor region
Middle Orange River (MOR)

Northern Cape Province
Digital Terrain Model
Gaap Valley – Vaal, Riet and Orange Rivers Drainages

Pre-Karoo Controls

- Ghaap Escarpment – Proterozoic Dolomites
- Series of Anticlines in Pre-Karoo surface filled by Dwyka sediments (Spioenkop Anticline)
- Softer Dwyka sediments preferentially eroded by Miocene - Pliocene – Recent River Systems
Terraces
Diagram of Terraces from Eocene to Pleistocene Periods
Grade Characteristics
Ultra-low Grade - Large Stone Size

- Higher terraces typically have higher grades

01 ULTRA-LOW GRADE DEPOSITS
- (80-120m above MOR): 0.5 – 1 cpht (i.e. Saxendrift, Remhoogte)
- Most deposits: 0.07 – 0.35 cpht (i.e. Riet River, Marksdrift, De Kalk, Wouterspan)

02 AT 150 000 TPM – 50 TO 100 STONES

03 NUGGET EFFECTS ARE EXTREME

04 EVERY TERRACE / DEPOSIT IS UNIQUE
Alluvial Gravel Deposits

Where do they form?

WHERE DO THEY FORM?

- Knickpoints
- Exit from a gorge with splay
- Dwyka Tillite bedrock
- Tributary junctions with large or high density clast inputs i.e. Banded Iron Formation (BIF)
The Riet River - Dwyka Influence

Dwyka Channelways | Drainage Lines
Riet River Cross Section

Dwyka Clasts and Deposits

Cross Section of Riet River ± 4 Millions Years

Dwyka

Ventersdorp Lava
Riet River X-Section
Dwyka Clasts and Deposits

Cross Section of Riet River
± 1 Million Years

Downstream fining gravel plume of Dwyka clasts

Ventersdorp Lava
Riet River X-Section
Dwyka Clasts and Deposits

Cross Section of Paleo-Riet River Course
Today

Average size decreasing downstream
± 10 kms

Gravel Bars

Dwyka

Ventersdorp Lava
Graphic Elevation Change

Riet River

Gorge through Ventersdorp rhyolite – exhumed Pre-Karoo feature

KNICK-POINT

Dwyka sediments

Modder River Village
Riet River
Video Fly-Through
Ultra Course Gravel
Riet River
Scour Feature

Riet River Splay

River flow direction
Digital Elevation Model

Middle Orange River - Hopetown to Douglas

Hopetown to Douglas – Gorge and Splay

- More than one splay - several deposits
- Much older system than the Riet River (70 m – 10 m Terraces)
- Different source of diamonds

Gradients:
Hopetown – Ettrick: 1 :680
Ettrick - Confluence: 1 : 1266
Confluence – Prieska: 1: 2018
EXPLORATION: Target Selection

Tools

01 Satellite image

02 DEM

03 Drill data
  • Fine-tune logging of Basal Gravels
  • Calibrate

04 Pitting data

05 Outcrop logging

06 Geophysics?

07 Modelling
  • NB: Accurate data = accurate model
Understand Your Exploration Data

Know what you are mining!

- Only relative course gravel with good matrix carries grade depending on where you are in the system
- Deposits
- Identify Good trapsites
  - Push out of a scour
  - Tillite floor with large boulders
  - Shale/tillite – Ventersdorp Lava contact
  - Ventersdorp Lava Outcrops
  - Drainages
  - Neck and splay
Typical Targets

Bedrock Model

Satellite Image

Push out of a Scour

Impact of Drainages
Tillite Floor with Large Boulder

Riet River
Payable Gravel

Riet River
Mining

Most difficult commodity to mine – no continuity of grade

➢ Gravel Bars – the Net that catches diamonds moving downstream in the alluvial system.

➢ Their sedimentology/bedrock features indicates ability to trap and hold diamonds.

Understanding your deposit

• Use the correct TMM Combinations
• Selective mining - target higher grade areas
  • Based on sedimentological parameters
  • Strictly control stripping of payable layers from gravel packages
• De-Sanding (4 - 6mm)
• Optimise Prosessing Facility
Mining Costs
Guidelines on Operational Mining Expenses

ROM Cost
R44/tonne (US$3.50 per tonne)

Diesel Cost
32% of total cost

2.9 Tonnes
Mine and strip per liter diesel
Golden Rules

01. Know your Setting
02. Know your Diamond Characteristics
03. Know your Deposit
04. Know your Equipment
05. Keep Record of EVERYTHING
De Kalk History
Historic Alluvial Diamond Deposit and Mining History

Site of first RSA diamond discovery - 1867
Rooikoppie Mining – 1930 to 1998
Drilled 10.4 mt Resource (Venmyn Report)
DiamondCore tested Basal Gravel in 2008 - 2009 – considered uneconomic
Acquired by Steyn Diamante in 2013
De Kalk Deposit
Features Controlling Diamond Concentration

Channel features
Bedrock features
Push out of a scour
De Kalk Deposit

Features Controlling Diamond Distribution

Target selection

Mining blocks

Recovered grade
# Modeling of Sedimentology

**Orange River**

<table>
<thead>
<tr>
<th>Bedrock Type</th>
<th>Gravel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;all other values&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

- **SRC LSP (GD) 2015-0**
- **SRC LSP (GD) 2015-0**
- **Drill Points**
- **SRC Bdr Elev 2015-05**
- **SRC OB thick 2015-0**

**RGB**
- Red: Band_1
- Green: Band_2
- Blue: Band_3

**Global Diamond Network**
## Diamond Provenance

### Quality Relative to Source Rock Contributions

<table>
<thead>
<tr>
<th>Location</th>
<th>Average Stone Size (Carats / Stone)</th>
<th>Types &amp; Colours:</th>
<th>Kimberlite Sources:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOR Hopetown - Douglas</td>
<td>2.7 - 5</td>
<td><strong>Type</strong>-II (dominant) yellow, rare-coloured (pink)</td>
<td>Lesotho</td>
</tr>
<tr>
<td>MOR Douglas - Prieska</td>
<td>2.2-3.5</td>
<td><strong>Mixed population</strong>, <strong>Type</strong>-II, commercial-whites, yellow, brown, rare-coloured (pink)</td>
<td>Gaap Plateau, Vaal River, Kimberley, RSA Interior</td>
</tr>
<tr>
<td>Riet River</td>
<td>2.5</td>
<td><strong>Localised population</strong>, Commercial-whites, <strong>Type</strong>-II, yellow</td>
<td>Koffiefontein, Jagersfontein, Kimberley</td>
</tr>
<tr>
<td>Vaal River (Gaap Valley)</td>
<td>1.5</td>
<td><strong>Mixed population</strong>, Commercial-whites, yellow, rare coloured</td>
<td>Gaap Plateau, Kimberley, RSA Interior</td>
</tr>
</tbody>
</table>
Diamond Value: Orange River vs Riet River

Different Diamond Populations

01 **Orange River**
- Pre-confluence: US$3500 - 7000 per carat
- Post-confluence: US$3000 per carat

02 **Riet River**
- US$2100 per carat

03 **Vaal River**
- US$1200 per carat
Diamond Stone Sizes
Middle Orange River – Hopetown to Douglas

Gorge To Confluence

AVERAGE SIZE – CARATS PER STONE – SAME ELEVATION TERRACE

<table>
<thead>
<tr>
<th>Location</th>
<th>Average Size</th>
<th>Price per Carat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kameeldrift</td>
<td>5.76</td>
<td>US$7000/ct</td>
</tr>
<tr>
<td>Probeerfontein</td>
<td>4.37</td>
<td>US$5000/ct</td>
</tr>
<tr>
<td>Marksdrift</td>
<td>2.75</td>
<td>US$3000/ct</td>
</tr>
</tbody>
</table>
Orange River Alluvials
Kameel LT, Probeerfontein and Koodoosberg

Gorge Deposits

- Shows over-recovery of coarse stones
- Poorly sorted
Selling

Percentage Difference between First and Second Bid

01 Average % Difference between First and Second Bid is 21%
02 Value Difference = 10%
03 Average Value Difference between the 10 most expensive parcels = 7%
04 Difference between First Bid and Average of all Bids will be much larger?
05 Valuation before tender is on average 15% lower than tender price – much larger on special stones.

% Difference between First and Second Bid
Developing a New Alluvial Mining Operation

Mining Essentials Required

01 Expertise and experience
02 Mentoring – new entrants
03 Access to decent mineral resources
04 Understanding the legislation
05 Capital and equipment
06 Operational experience - mentoring
07 Professional diamond sales outlets
08 Cash flow
09 Reliable and skilled employees
10 Good support services (DMR, Municipalities, roads, medical, education)
11 Enabling small business environment
Mentoring
Challenges with Alluvial Diamond Mining

01 Alluvial diamonds are highly **challenging** minerals to mine.

02 Very **limited** modern and **reliable** published information on Alluvial Diamond Deposits – very low grade, great price variability.

03 Most small to medium scale Alluvial Diamond mines are **private** family businesses.

04 Very few new entrants into the industry – no one to **mentor**.
Global Diamond Network

Capital & Equipment
Requirements

To Mine And Process 100 000 tonnes per month:

**Capex R62 million**

- Screening Plant and Scrubber
- 4 x 16 Pans and BV X-Ray Machine
- 80% Refurbished Equipment
- R3.5 million Cash Flow to start up
Income per Tonne

Income and Deductions

<table>
<thead>
<tr>
<th>Grade:</th>
<th>US$0.25 cpht</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value:</td>
<td>US$2 000/ct</td>
</tr>
<tr>
<td>Revenue per tonne:</td>
<td>US$5.00</td>
</tr>
</tbody>
</table>

Mining cost: US$3.50/t
Marketing cost (2%): US$0.10
Mineral rights / land fees (10%): US$0.50
State royalty (3%): US$0.15
SLP (2%): US$0.10
Capital repayment (5%) US$0.25

Net Income per Tonne:
US$0.24 (ZAR3.36 @14)

Revenue per 100 000tpm:
US$24 000
ZAR336 000 p/m or R4.032m p/annum

Effective payback on R60m capital outlay = 25 years

Income per tonne: US$0.40
- Tax (40%) US$0.16
Income vs Cost
Paleostone Mining 2016-2017

Breakeven

US$
Legislation Challenges
South Africa Alluvial Diamond Mining

- **01** Lack of Policy consistency
- **02** RSA is a ‘no-go’ for mining investors (see latest Fraser Institute report)
- **03** Mining right applications – slow processing / awards, fronting, middle-men, ‘use or lose’ should apply
- **04** B-BBEE requirements – expensive, many supposed partners want ‘cash-out’, but provide no ‘value add’
- **05** Social and labour requirements / responsibilities
- **06** Health and Safety requirements
- **07** Environmental requirements
- **08** Water use licenses

Consume time and money – impacts cash flow negatively
South Africa Alluvial Diamond Mining is facing a crisis

**01** Current legislation unsuitable – developed for large, highly profitable mines.

**02** Margins are too small to attract new entrants.

**03** Enough resource for 100 years – depending on ability to mine decreasing grades.

**04** SADPO – We need you to tell our story
THANK YOU
QUESTIONS?

LYNDON DE MEILLON
Mobile: +27 82 600 6627
Email: Ldem@africa.com