EXPLORING THE USE OF MINERAL CORRIDORS AND STRANDED ORE DEPOSITS IN ORDER TO ALLEVIATE RURAL POVERTY AND EFFECT ENVIRONMENTAL AND SOCIAL CHANGE THROUGH A PROPOSED RURAL DEVELOPMENT CORRIDOR IN SOUTH AFRICA.

by

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DECLARATION

This dissertation is submitted in fulfilment of the requirements for the degree of Masters in Geology in the Faculty of Science and Agriculture at the University of Fort Hare. This dissertation is a presentation of my original, independent research work and has not previously been submitted to another university.

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Joan Charlaine Baartjes

24 March 2011

DEDICATION

This thesis is dedicated to Jan Daniel Joubert (my father) and Vincent Mervyn Baartjes (my father-in-law), who really wanted to view the graduate procession. Both of you will have to view it from a higher podium. Thank you for all your sacrifices to get me where I am today.

SOURCES OF PICTURES AND SCHEMATICS

Maps are adapted from “click2map.com”

Photographs were taken by the author, unless otherwise specified.

Schematics were developed by the author, unless otherwise specified.

All mineral occurrences in Chapter 7 are taken from The Mineral Resources of South Africa (1998) eds. M.G.C. Wilson and C.R. Anhaeusser. These are supported by sites known to and visited by the author

ABBREVIATIONS AND ACRONYMS

ABBREVIATION / ACRONYM	DESCRIPTION
°C	Degrees Celsius
ACR	Authorisation Change Request (for the NNR)
AEL	Africa Explosives Limited
AMD	Acid Mine Drainage
AQL	Air Quality Licence
BIF	Banded Iron Formation
CFB	Continental Flood Basalt
CGS	Council for Geo-science
CH_4	Methane
CoR	Certificate of Registration (for the NNR)
CSIR	Council for Scientific and Industrial Research
CSTF	Combined storage tailings facility
DC	Development Corridor
DME	Department of Minerals and Energy
DMR	Department of Mineral Resources
DPRU	Development Policy Research Unit

ABBREVIATION / ACRONYM	DESCRIPTION
EIA	Environmental Impact Assessment
EITI	Extractive Industries Transparency Initiative
EMP	Environmental Management Programme
EMS	Environmental Management System
EMS	Environmental Management System
FeS_2	Pyrite
GDP	Gross Development Product
Ha	Hectares
HIA	Heritage Impact Assessment
ISO	International Standards Organisation
IWWMP	Integrated water and waste management plans
km^2	Square kilometres
kt	Kilotons
KZN	KwaZulu-Natal
LDC	Least Developed Countries
m	Metres
m^3	Cubic metres

ABBREVIATION / ACRONYM	DESCRIPTION
Ma	Million years ago
Mct	Million Carats
MDC	Maputo Development Corridor
MDG	Millennium Development Goals
MML	Main Magnetite Layer
MPRDA	Mineral and Petroleum Resources Development Act
Mt	Million tons
NE	North East
NEMA	National Environmental Management Act
NEMAQA	National Environmental Management Air Quality Act
NEMWA	National Environmental Management Waste Act
NHRA	National Heritage Resources Act
NNR	National Nuclear Regulator
NWA	National Water Act
OCC	O'okiep Copper Company
PAYE	Pay as you earn
PPP	Public Private Partnership

ABBREVIATION / ACRONYM	DESCRIPTION
R	Rands
R/kg	Rands per kilogram
RUDASA	Rural Doctors Association of South Africa
SAMI	South Africa's Mineral Industry
SDI	Spatial Development Initiative(s)
SITE	Standard Income Tax on Employees
SME	Small and medium enterprises
SW	South West
t	Tons
TTG	Tonalitic/Trondhjemetic/Granidioritic
UASA	United Association of South Africa
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
VAT	Value Added Tax
vs.	Versus
WRDM	West Rand District Municipality
WML	Waste Management Licence

GLOSSARY (from Encyclopedia Britannica unless otherwise indicated)

Acidic phase – igneous rocks that has very high silica content.
Aeolian – processes that occur in a desert environment by wind action.
Arenaceous – a sedimentary clastic rock with sand grain size between 0.0625 mm and 2 mm and contain less than 15% matrix.
Argillaceous – a sedimentary rock formed from clay deposits.
Arkosic – an angular, poorly sorted sandstone that contains at least 25% feldspar.
Felsic phase – igneous rocks that have a high concentration of light coloured minerals (quartz, feldspar and muscovite).
Flagstones – is generic flat stone used for pavings, fences and roofs etc.
Greywackes – is a dark, argillaceous sandstone that is poorly sorted, cemented together in a clay matrix.
I-type granites – granites formed from the partial melting of igneous rocks.
Latitude – gives the location of a place on Earth (or other planetary body) north or south of the equator. Constant latitude is represented by lines running from east to west.
Longitude – is the geographic coordinate most commonly used in cartography and global navigation for East-West measurement. Constant longitude is represented by lines running from north to south.
Quartzites – a metamorphic rock, formed by the alteration of sandstone
Redbeds – layers of reddish-coloured sedimentary rocks such as sandstone, siltstone or shale

that were deposited in hot climates under oxidising conditions
Rent Seeking –in economics, rent seeking occurs when an individual, organisation or firm seeks to earn income by capturing economic rent through manipulation or exploitation of the economic environment, rather than by earning profits through economic transactions and the production of added wealth. (Kreuger, 1974)
Resource curse – is that countries that have an abundance of natural resources tend to develop at a slower pace than those with fewer natural resources. (Auty, 1993)
Sandstone - a sedimentary rock composed of sand-sized particles (1/16 to 2mm in diameter).
S-type granites – granites formed from the partial melting of sedimentary rocks.

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ABSTRACT

South Africa has less than 1% of the global land surface, yet it is ranked highly in terms of remaining mineral resources. Mineral wealth has not translated into a better life for all. Poverty, however, abounds; particularly in the rural areas and this study seeks to identify a solution or partial solution to this situation. The study combines two critical areas, Mineral Based Rural Development, and Mineral Based Enterprise Development and draws from it a model for Mineral-driven Rural Economic Development viable for all parts of South Africa.

This study comprised research on a national scale and thus covered a section of each of South Africa's nine provinces. It investigated the conditions in rural and urban centres, and geologically, it traversed examples of Archaean, Proterozoic and Phanerozoic formations. The field visits deliberately set out to look at some of the lowest value commodities; typically the only minerals available to the surrounding rural communities. This was done to see if a case could be made for even the lowest value commodities which are often found furthest from the large markets.

This study indicates that for a rural area to be able to compete nationally or internationally, it is important to be competitive so that the area can participate in the economy. The creation of regional competitive areas allow for the focusing of strategies and funding for targeted rural projects. Enterprises, typically the product of entrepreneurial activity, are required to increase economic intensity and activity.

The goal of poverty reduction, has been identified by government so that enterprises, as products of economic development, can be focused on the situation. Interviews conducted by the researcher indicated that part of the problem to overcome is the bureaucracy created by government which hinders enterprise development. Recommendations are made that government should exempt rural enterprises from some of the compliance hurdles. This will serve to accelerate rural development. An important aspect of urban enterprises is that they have access to labour without too many problems.

Thirteen developed or developing corridors were visited of the five types of development corridors identified. It was found that those in areas of high poverty (for example the corridors of the Eastern Cape) are difficult to develop and make self-sustaining. The corridors linked to any point of Gauteng (Johannesburg or Pretoria) are more robust, although the relatively short length of the corridor is not an indicator of effectiveness.

The key recommendations made include the completion of a national rural mineral-asset audit; the use of the information to demarcate rural-regions that can be developed as nationally and internationally competitive regions; the establishment of a rural Resource and Training Academy(ies) so that skills are developed close to areas where they will be deployed; provision of an easier way to launch mineral-based rural enterprises and incentivise these for accelerated development; and the development of an indigenous body of knowledge to mine small scale deposits.

CHAPTER 1. INTRODUCTION

1.1. Background to the research

South Africa has three key economic-type areas; firstly, the metropolitan areas of Cape Town in the Western Cape, Durban in KwaZulu-Natal and Johannesburg in Gauteng. Secondly, other significant clusters, but not as large economically as the first three, are Bloemfontein, Kimberley, Nelspruit, Pietermaritzburg, Polokwane, Port Elizabeth, Pretoria and Rustenburg. In these towns the size of government contributions to the regional economy are substantial and the levels of economic diversification are lower. Thirdly, the remainder of South Africa's regional economies exist in a state of survivalist participation and do not appear fully integrated into the large economic centres nor are they involved in global trade. This part of South Africa is largely rural and exists almost separately to the rest of the economically developed South Africa.

Formal mining has taken place in South Africa since the 1850s (Smalberger, 1975) and then, like today, most mines are situated in the rural areas. The mineral wealth of South Africa has been prolific and remains substantial. The revenue flows from these mines typically end in economic centres, such as Johannesburg, but also in economic centres abroad. The legacy effect of mines in South Africa is viewed as something that needs to be re-visited, and recent amendments to legislation are focused on dealing with this.

The issues existing today have been described throughout the mining history of South Africa. When the first formal copper mine was opened in Namaqualand in 1850 (the Spektakel Mine), it could have served as a means of support for economic development of the surrounding areas (Bain, 1852). This did not take place, except for the development of some infrastructure required to operate the mine. Throughout the copper mining history of that area, up to the eventual closure of the O'okiep Copper Corporation Mine in 2000, the Namaqualand region has only developed marginally. After visiting the region during this study it was evident that poverty is rife in the area, as well as surrounding communities. There is potentially a real risk of intergenerational poverty.

1.2. **Status quo of South Africa's mineral industry**

South Africa's position in world mining was previously considered unquestionable. However, this is no longer the case due to the depletion of reserves and an increasingly hostile investment climate (such as strong and organised labour movement, high labour cost, low efficiency and skill shortages) when compared with other mining destinations.

Figure 1: Entrance headboard to the Kromdraai Gold Mine, Muldersdrift

The first permitted gold mine was the Kromdraai Gold Mine, established in 1881, 15 km northwest of Johannesburg as can be seen in Figure1.

According to various years of Annual Reports produced by the Department of Minerals Resources (SAMIs), South Africa's gold output was considered amongst the most important for many decades, being in the 400-500 tons per annum range. It rapidly declined to the 200-300 ton range during the 1990s. In 2008, due to declining reserves and the South African electricity crises, it dropped to below 200 tons. Today South Africa is ranked 4th in gold producing countries and its market share is in dramatic decline as can be seen in Figure 2. (DME, 2000 and DMR, 2009)

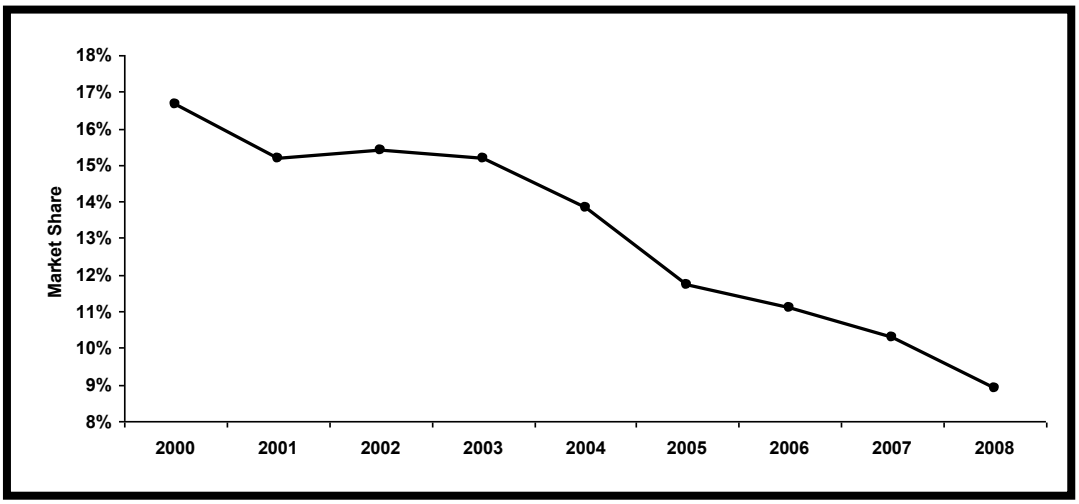

Figure 2: South Africa's gold market share in the period 2000-2008

Source: DMR, various years

The ability to increase output is not easily achieved. South Africa has also become a less favourable destination for exploration companies as South Africa's attractiveness, as measured by the Fraser Institute Rankings (2009/10) has been very low and continues to decline as can be seen in Figure 3.

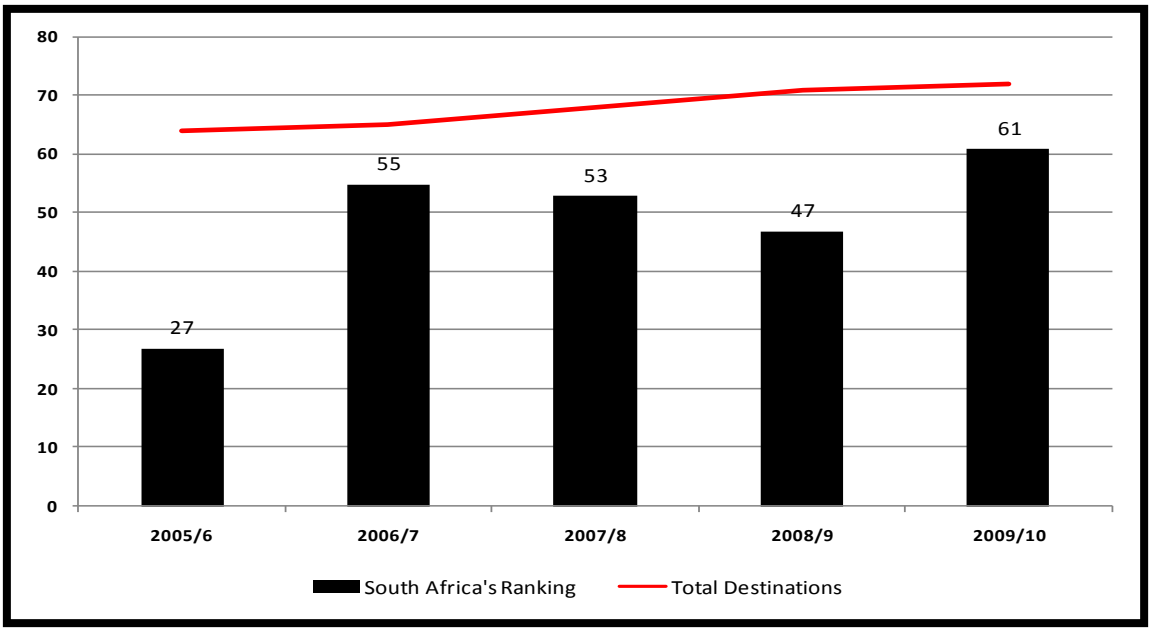

Figure 3: South Africa's Fraser International Ranking

Source: Fraser Institute 2009/2010 Mining Survey.

1.3. Rural areas and South African poverty

It is common cause to assess South Africa as being either urban or rural, according to the specific definition for urbanisation, i.e. being close to services. South Africa's urbanisation levels, released by Statistics South Africa in 2006, are shown in Table 1.

The classification of urbanisation in the Northern Cape and Free State provinces (75-80%) belies the levels of poverty in these provinces and the vast farmlands that occupy most of the region. South Africa's urbanisation levels are increasing as consequence of urban centres expanding to encompass rural areas (RUDASA, 2006).

Table 1: Urbanisation levels of South Africa's Provinces (2001)

Province	Urbanisation Level
Gauteng	96%
Western Cape	90%
Northern Cape	80%
Free State	75%
KwaZulu-Natal	45%
North West	41%
Mpumalanga	39%
Eastern Cape	38%
Limpopo	10%

Source: Statistics South Africa, 2006

Poverty is not only a rural problem, and there are well known examples of urban poverty. Poverty has three dimensions (UNESCAP, 2007):

- Lack of income.
- Lack of access.
- Lack of political and economic power.

These aspects were noticeable in the field visits for this study. The rural poor in the Northern Cape region, and other areas visited during field visits, are characterised by:

- Inadequate income and high requirements for welfare.
- They are removed from basic infrastructure and services.
- They lack political influence, possibly because they are geographically removed from the seats of power.

There are many interventions to alleviate poverty and some of these include providing property rights, granting access to credit facilities under favourable terms, training, provision of grants, and the provision of development aid. In the annual 2010 UASA (United Association of South Africa) South African Employment Report it was reported by a leading economist that in South Africa 12,8-million people were employed and 13,8-million people were receiving welfare payments – and this from a tax base of only five-million people (as cited by Polity, 2010). South Africa appears to have followed a path of utilising welfare to tackle poverty and not the creation of employment to tackle poverty.

1.4. **Hypothesis**

The South African mining landscape is filled with examples of success in the face of adversity. The unique geology of the region has supported the emergence of the largest mineral-industrial complex on the African continent. From the opening up of the copper fields to the development of the diamond

fields, and the exploitation of gold in the east and central regions of the country, these mineral resources funded several types of development, but seldom economically emancipated the area where they were located. The cities of Johannesburg and Kimberley, and towns such as Emalahleni (Witbank), Kathu, Barberton and Lephalale (Ellisras), can draw a direct link to the mineral resources of the area. South Africa's economic diversification can be shown to be underpinned by its mineral basis. Not every known mineral resource has been exploited and rural South Africa still has more, though smaller occurrences of minerals.

The recent mining legislation now makes it compulsory for mining companies to invest in their local communities and foster local development. This has continued to such an extent that the mining companies are becoming *de facto* extensions of national, provincial and local government by providing services in places where government has been ineffective and unable to deliver. Now mining companies provide schools, housing, primary health care facilities and road, water and electricity infrastructure, and there still remain many opportunities for rural South Africa despite their adversity. Examples abound around the world (and now also in South Africa) of development corridors indicate that development can be accelerated.

The author investigated emerging, operating, failing and failed development corridors to see if they can be modified to unlock opportunities for rural areas in South Africa.

Rural poverty is a feature of all countries and South Africa is no exception. Rural poverty needs different mechanisms to address it and cannot be considered as similar to urban poverty. In a similar fashion, rural enterprise development, considered by the author as one of the best development tools, is different to urban enterprise development (where there is a market on the doorstep). It is enterprise development, irrespective of whether located in urban or rural centres, that will ultimately capture new opportunities, provide employment, and trigger economic diversification. This study therefore sets out to answer the following questions:

- What are the challenges of rural entrepreneurs, particularly linked to mining?
- How can rural entrepreneurs and enterprises be supported to increase their success?
- Have the laws of the land supported or enabled rural enterprise development?
- Can South Africa support mining in rural areas on a small scale to start the change process?

With respect to corridor development, the author set out to answer the following questions:

- Where the development corridors in South Africa and what are their characteristics?
- How do development corridors typically evolve and what helps their

critical mass develop?

- Are there examples of rural corridors or rural-linked development corridors that can serve as a basis for modelling a new type of corridor?

Development using mineral resources is considered positive in all respects but the mining legislation is increasingly deterring international investors that indirectly and directly fund local development. Furthermore, the environmental legacy has for many generations been poorly understood, and in many cases certain mining operations externalised some of their costs onto the environment and the adjacent communities (current acid mine drainage problems are a case in point). This is not unique to South Africa. This study looks at mineral development as one forms of rural development. Therefore this study further aims to answer the following questions:

- How can rural South Africa be developed in a way that also takes into consideration the environmental effects of the interventions?
- Can the use of a very challenging corridor (one with high poverty, long distances from urban settings, low or intermediate value resources and scant infrastructure) be used to model the issues to be considered?

Considering rural enterprises, the use of development corridors, and South Africa's increasing emphasis on measuring the negative aspects of mining projects (and treating small projects just as harshly as large projects), the question to ultimately consider is:

Can South Africa's mineral resources (wealth) be used as a catalyst to diversify the economies of rural areas and thereby serve as a basis for social and environmental change while making an economic impact?

In other words, is it possible to develop a model for rural, mineral-based development corridors in South Africa?

1.5. Structure of the research document

The research document is structured as follows:

Chapter 1 and 2 serves as the introduction to the research and research methodology, respectively. Chapter 1 notes the background to the research in more detail, the status quo of South Africa's mineral industry, the extent of rural poverty and details the research hypothesis. Chapter 2 presents the research methodologies and approach such as secondary research (Chapters 3,4 and 5) and primary research (Chapters 6, 7, 8 and 9).

Chapter 3 presents and overview of mineral development and poverty in South Africa. Chapter 4 presents an overview of the key economic geological occurrences in South Africa and Chapter 5 contains a brief overview of the complex legal framework for mining.

Chapter 6 details the mineral-based site investigation by the author, Chapter 7 presents the corridor site visits, and Chapter 8 details the quantitative analysis of the research obtained in the corridor fieldwork and the interviews conducted. Chapter 9 contains the mineral-based rural development case study. Chapter

10 details the major achievements and limitations of the research, and Chapter 11 provides the conclusions and recommendations for further research into mineral-based development.

CHAPTER 2. RESEARCH METHODOLOGY

2.1. Introduction

This study used a combination of techniques to build a body of evidence that can be further analysed. The research methodology comprises both primary and secondary research. The primary research in this study includes interviews and site investigations, and the secondary research involved a review of previous studies.

2.2. Secondary research

2.2.1 Previous studies

The review of previous reports and studies included the revision of published literature in the geology, mineral development and poverty alleviation fields.

In all cases it was preferable to use literature published and reviewed but there were instances where general information was sourced (e.g. from Statistics South Africa, United Nations etc.).

Media articles were used only to illustrate examples and not as sources of fact. A problem with secondary sources is that they do not always deal directly with the topic being researched but provide information that is incidental or peripheral, thus caution was required. The secondary studies might only have been relevant at a particular point in time and not directly transferable to the present situation.

2.3. **Primary research**

2.3.1 Interviews

A pre-determined list of people were interviewed utilising structured interviews. Where additional interviews arose (situation-specific) those were also captured. A minimum of four interview was planned. The structured interviews provided data for assessment and analysis.

2.3.2 Site investigations

To collect first-hand information site investigations were conducted from January 2007 to August 2010. Two types of site investigations were conducted; mineral-based site investigations and development corridor site investigations.

- Mineral-based site investigations – a selection of areas located across South Africa were investigated as they relate to the study of commodities.
- Corridor site investigations – a selection of areas located across South Africa were investigated as they relate to the study of development corridors.

2.3.2.1 Mineral-based site investigations

The following information was gathered:

- The GPS co-ordinates of the site and a general description of how to access the area.

- The mineral commodity mined, processed or manufactured.
- The value chain stage of the mineral development identified.
- General observations if the area is being practically operated and other field observations.

The site selection was based on a typology identified (see Table 2) and also those that exhibited examples of rural poverty – a major focus of this study.

2.3.2.2 Corridor-based site investigations

Corridors linked to poverty nodes were selected for comparison with corridors that linked to some form of integrated economic activity (trade, feeder or manufacturing). The five corridor types were identified and thereafter an example of each was identified and selected for investigation. It was found that the original selection (Table 2) were incorrectly classified, so additional examples had to be found. No feeder corridor could be found and thus eight corridors linked to rural poverty nodes were then identified – see Table 3.

Table 2: Selection of corridors by typology

Type of Corridor	Original Target Corridor
Transport	Thabazimbi – Vanderbijlpark
Trade	Musina – Polokwane - Johannesburg
Manufacturing	Rosslyn – Pretoria
Economic	Durban – Johannesburg
Feeder	None identified.

Table 3: Selection of corridors for Rural and Poverty Centres

Poverty Node(s)	Poverty Node Corridor	Comparison Group of Corridors
1. Maluti a Phofung	Phuthaditjaba - Harrismith	Klerksdorp-Welkom-Bloemfontein
2. Galeshewe	Upington -Kimberley	Lephalale –Emalahleni
3. Chris Hani 4. O.R Tambo	Queenstown – Mthatha	Rustenburg – Pretoria
5. Alfred Nzo 6. Ugu 7. Umzimkhulu	Mthatha – Durban	Springbok – Cape Town
8. Ukhahlamba	Bloemfontein – East London	Welkom-Odendaalsrus-Johannesburg

Eight poverty nodes and 13 corridors were included in the study area. The following were recorded for each corridor visit:

- Towns and Municipal areas along the routes and their Provincial location.
- Type of corridor (dominant type).
- Length of corridor (and map).
- Other observations of the key aspects and intervening towns (key sectors; links to rail, road or air; and what commodities are currently or could be linked to these corridors).
- Known mineral deposits along these corridors.

2.4. **Chapter summary**

This chapter details the research methodology, noting the secondary research source was noted as previous studies. The primary sources of information used were interviews and site investigations.

CHAPTER 3. OVERVIEW OF MINERAL DEVELOPMENT AND POVERTY

3.1. Introduction

This chapter discusses the previous studies about development and poverty. The information gathered was organised into the three sub-themes (enterprise development, rural development and mineral development).

3.2. Enterprise development

Enterprise development is commonly understood to be the establishment of new ventures and business based on a specific opportunity. In the context of this study two aspects of enterprise development are reviewed:

- The role of enterprises in economic growth; and
- The use of corridors to create economic linkages.

According to Henderson *et al*. (2009), there seems to be much agreement on the following:

- Entrepreneurs are diverse with different levels of education, skill and motivation. They can be identified in many different contexts, but the critical defining characteristic is a willingness and ability to innovate.
- Innovation can be found in many different contexts and is not restricted to high-technology sectors.

- As few as 10% of entrepreneurs will succeed in creating enterprises that create significant numbers of jobs and wealth.
- It would be unwise from a policy standpoint to attempt to identify which entrepreneurs will eventually be these job creators, so a prudent approach is to facilitate the creation of a large and diverse pool of aspiring and early-stage entrepreneurs.
- The main challenge is to increase the conversion rate from early-stage entrepreneurs to established business owners through appropriate policies and support.
- The broader economic context for entrepreneurship has changed dramatically through globalisation and related threats and opportunities.
- The following three sections discuss the role of enterprises in economic growth (3.2.1.), the use of corridors to create linkages (3.2.2) and why corridors do not develop.

3.2.1 The role of enterprises in economic growth

Hisrich and Peters (2002) separate the common belief that entrepreneurship and enterprise development are mechanisms to increase productivity, efficiency and income. They view enterprise development within a framework of economic development and identify enterprise development as a means to initiate and continue structural changes to the business sector and social framework. It is the change that occurs that then leads to economic growth and increased output. This growth leads to wealth creation.

Enterprises, they argue, do not emerge at just any stage (Hisrich & Peters, 2002). All responses to business or social enterprises commence with the emerging need. This is followed by a stage where research outputs are developed to resolve the need. This output lacks commercial or social traction and needs to first be implemented. It is in this area that enterprise is required, i.e. in the taking to market or the taking to communities of the research output (Hisrich & Peters, 2002). This is illustrated in Figure 4.

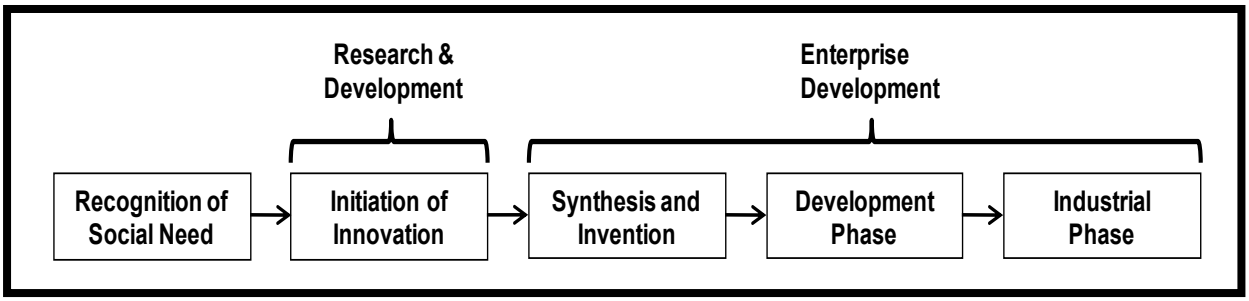

Figure 4: Product evolution and area of enterprise development

Source: Modified from Hisrich & Peters, 2002; Baartjes *et al*., 2010.

The meeting of social need with the research output (where the enterprise development is required) is also identified as the area where technology transfer is required. Three stakeholders can drive this technology transfer:

- Government;
- Existing businesses and enterprises; and
- New enterprises.

Government is a poor implementer of technology transfer and so should play no role as an actual enterprise (Hisrich & Peters, 2002) because it lacks the business skills necessary for commercialisation. The only way government can

provide support is by way of financial resources and research outcomes from its research councils such as CSIR, CGS and MINTEK etc. Existing enterprises can be used to bridge the gap between the research output and the social need, but with the advantage of existing knowledge, business skills, financial resources and access to market systems, the bureaucracy associated with the adoption or incubation of new ventures inhibits progress.

It is therefore left to new enterprises which, though lacking financial resources, existing knowledge and even access to market systems, can overcome the bureaucracy (created by government) to involve itself in development of new solutions where returns on investment are less important. Existing business operate in an environment of hyper-competition whereas new enterprises will not. New enterprises successfully bridge the gap between research outputs and the market place and so these enterprises significantly affect the economy of an area by building the economic base and providing jobs (Hisrich & Peters, 2002).

Dabson (2009) identifies the global trend that the competitive unit is not only the enterprise but the economic region. The competitiveness is founded on the identification and leverage of a unique combination of regional assets, and innovation and entrepreneurship are the keys to translating these regional assets into competitiveness.

Further according to Dobson (2009), “in many regions, the emphasis still focuses on securing only wages, reducing taxes, and recruiting new companies using financial incentives. This emphasis is self-defeating because cheap

labour and natural resources are widely (globally) available, low wages do not yield competitiveness but rather hold down the standard of living, and financial incentives are easily matched by competing regions and only serve to undermine the tax base needed to invest in education and infrastructure. If the aim is to increase regional prosperity, the focus must be on sustained productivity growth, which is at the very heart of competitiveness. Enterprise development is expected to be stronger in locations with large, vibrant economies."

Researchers have found that agglomeration is key to stimulating economic growth (Krugman, 1981). Density and size tend to create substantial advantages in labour and product markets for both workers and enterprises or companies, which is why they are often attracted to urban locations because there is a larger local market to test a wider range of their offerings while also providing a much greater range of resources and financial and labour inputs.

By contrast, smaller and more remote local economies limit the ability of entrepreneurs to build economies of scale (Dabson, 2001). Lack of economies of scale limits the local demand for products and makes resource acquisition more difficult.

3.2.2 The use of corridors to create linkages

Thomas (2009) describes a corridor as "an infrastructural link for logistics with under-utilised economic potential in their environ, the development of which should be explored through spatial planning and development projects (SDIs)".

According to Thomas (2009) trade and investment led economic growth can be promoted by using infrastructure to the full, motivating beneficiation (value added processes) and increasing the competitiveness of the regional economy. This can be achieved by arranging, assessing priority and improving inter-related infrastructure and significant investments in specific geographic areas.

A key feature of South Africa is that its largest economic centre, Gauteng, is located inland. In many countries, including Africa, the economic centres are located along the coast. To ensure that the inland Gauteng centre, the largest regional economy on the African continent, remains resourced, corridors have been developed from Maputo, Richards Bay and Durban. With time it became apparent that large industries could not continue to be developed inland (like those in Vereeniging and Vanderbijlpark in southern Gauteng).

The result was that large developments then took place at the coast, as with the development of Saldanha Bay's steel complex, the Richards Bay coal export terminals, and aluminium industries also around Richards Bay. The Coega complex in the Eastern Cape is a similar example. The utilisation of transport corridors then became essential for the economic development of South Africa. Eventually manufacturing corridors (as in the case with the Maputo Development Corridor between South Africa and Mozambique) evolved to become a trade corridor (Thomas, 2009). This subsequently evolved further to become a transport corridor with manufacturing anchors.

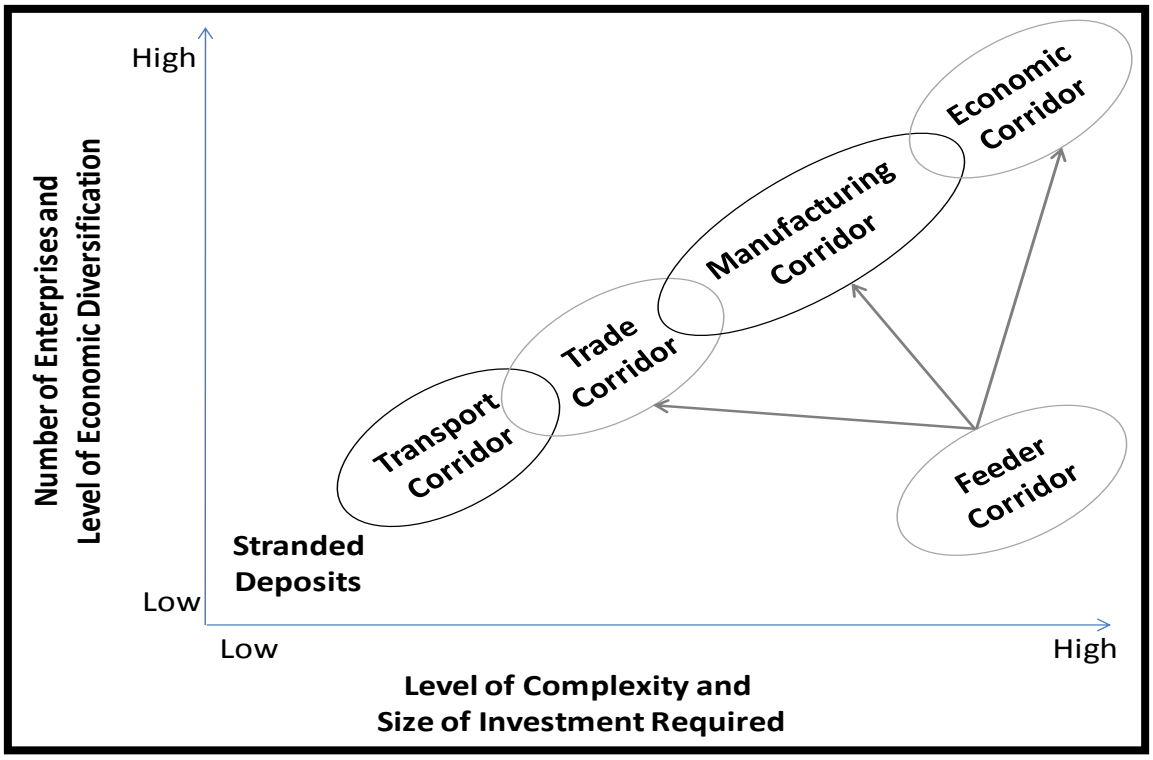

Figure 5: Evolution of corridors from transport dominated to economic dominated

Source: Modelled from Hisrich & Peters (2002) and Nguyen (2008)

Nguyen (2008) notes four types of corridors: transport corridors, logistics corridors, integrated trade facilitation corridors and economic corridors

The development of trade corridors leads to increased infrastructural densification. This means that the corridor grows to incorporate road, rail, pipeline, water and electrical infrastructure. This densification then leads to opportunities for small enterprises (SMEs) to develop around these. The crowding-in effect, it is hoped, supports the introduction of low value commodities (such as agriculture) as well as its downstream linkages (such as agri-processing).

Thomas (2009) and Hisrich and Peters (2002) indicate that the needs of SMEs are not linked to one intervention and that external support is required, including development financing, a sound market, and skills. Development corridors do not provide for all the needs of enterprises but provide a key input.

Enterprises, new or existing, need to create linkages along the value chain so that two important needs are addressed:

- Sustainability through economic diversification; and
- Resilience to market changes.

Thomas (2009) raises several principles, identified below, that underpin the approach:

- "**There must be real economic potential.**

  A corridor must be able to demonstrate true economic potential through either underutilised natural resources or some other such financially viable and quantifiable quality, for example a well positioned deep-water port close to growing or potentially dynamic markets.

- **As far as possible, private sector resources should be mobilised**.

  If a commercial return is possible, then the private sector should be brought in – whether in the form of public-private partnerships (PPPs), or exclusively for private sector investments.

- **Apply scarce public sector resources where they will have the most impact**.

This principle refers to the application of both public financial and human resources (i.e. the time and energy of government officials). Through a spatial development initiative (SDI), limited public resources should be focused in areas where they are likely to have the most advantage, rather than being spread so thinly that they have limited or no effect at all.

- **The benefits of economic growth should be shared with those previously excluded**.

  This principle points to small and medium enterprise (SME) involvement, and is viewed as critical; especially for job creation opportunities. It is also essential to ensure that local communities benefit from the opportunities created."

Thomas (2009) reports further that the key thrusts behind the utilisation of resource-based Development Corridors (DCs) are:

- "Crowding in and coordination of both public and private sector investments in the SDI.
- Ensuring political support, commitment and buy-in from the highest levels of government in order to facilitate fast and focused planning.
- The use of well planned and publicised opportunities (such as road shows and investor conferences) to market opportunities in the development corridor. This, however, requires that project opportunities are well identified, packaged and bankable for presentation to potential

investors."

The example cited as the most successful Southern Africa corridor is the Maputo Development Corridor. This corridor runs from Maputo in Mozambique to Johannesburg in South Africa and has been in place for several decades (Söderbaum, 2001). Across its almost 600 km route, it links the steel mills in Vanderbijlpark and Vereeniging, petrochemical plants in Secunda, quarries, mines and smelters. Low value, high volume agricultural goods, such as sugar cane and forestry plantations, are also situated along the corridor.

These corridors are either specific sectorally or have a combination of sectors along it. The 12 South African SDI corridors considered for development over the years are listed as follows (Söderbaum, 2001):

- "Maputo Development Corridor (MDC).
- Phalaborwa SDI.
- Lubombo Initiative.
- Platinum SDI.
- Coast-2-Coast SDI.
- Richards Bay-Empangeni SD.
- Pietermaritzburg/Msunduzi SDI.
- Blyde River SDI.
- West Coast Investment Initiative.
- Fish River SDI.

- Wild Coast SDI.
- Highveld (Gauteng) SDI."

Notice that corridors that exist at present, like the Sishen-Saldanha Bay iron ore corridor, are not formerly included in the list even though they share many of the attributes of corridors. The manganese rail line from Hotazel to Port Elizabeth, a manganese corridor, is also not included.

The ideal corridor can be described as shown in Figure 6.

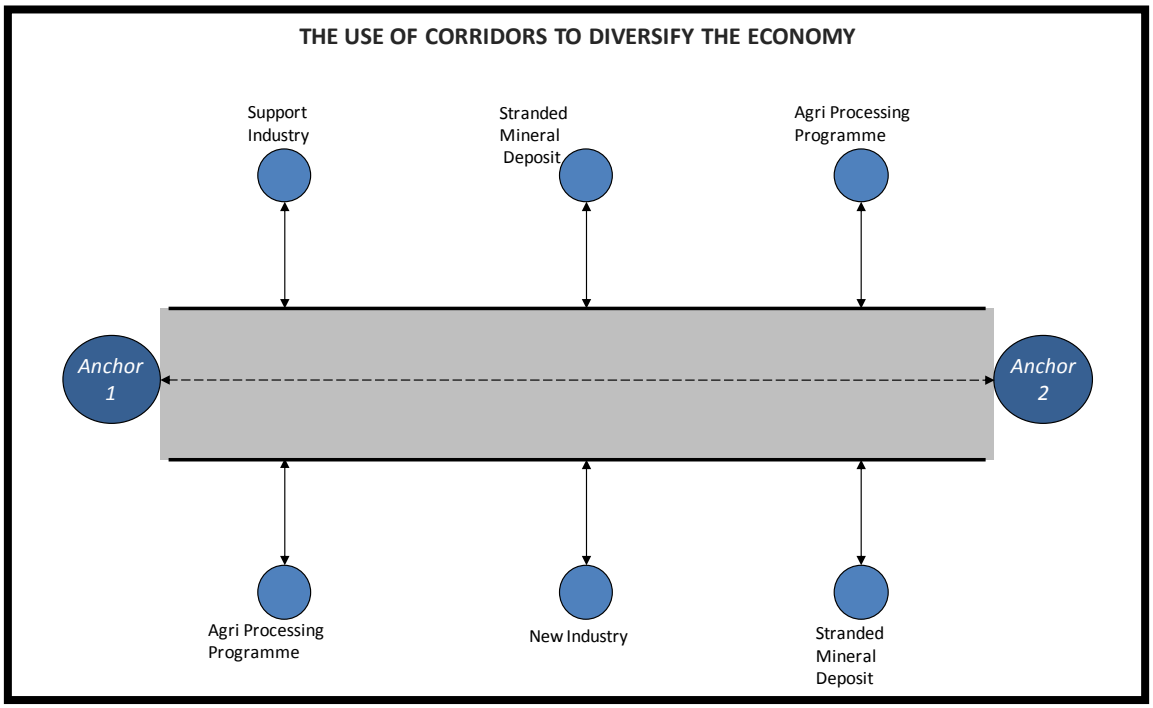

Figure 6: Idealised form of a corridor

Source: Thomas, 2009.

The corridor requires two anchors, typically a commodity located far away around which an anchor project can be developed. This anchor can develop links to smaller projects in the area. The corridor, largely developed by the

private sector, is linked to an export point or a large market opportunity. In many cases this could be a port, and at this port a second anchor develops; typically processing of the items received from anchor 1 (Söderbaum, 2001; Thomas, 2009).

The corridor enables projects that are 'stranded' to link to the corridor and this enhances economic diversification. The costs of transport within the corridor are therefore steeply reduced. It is envisaged that it is government funding that is used to link the satellite projects to the main corridor as these will typically be smaller enterprises than the two major anchors.

3.2.3 Why corridors do not develop

The desire to have a trade corridor does not necessarily mean that one will emerge or can be forced to develop. In their study, Campbell and Meades (2008) recognised that even between two towns as close as Bloemfontein and Welkom (150 km apart) there was no potential to develop a trade corridor for several reasons including the following:

- Poor towns located between them did not bridge the gap.
- There has to be an economic link between the two ends and in that case, Bloemfontein is an administrative centre for Welkom, not an economic centre. A stronger economic link exists between Klerksdorp – Welkom and Johannesburg- Welkom.
- The economies of one of the anchors (in this case Welkom) are dependant on a single economic activity and put all other types of

investment in this corridor at risk.

Campbell and Meades (2008) conclude that the Welkom – Bloemfontein corridor will probably remain as a transport corridor only.

3.2.4 The description of corridors used in this study

The five types of corridors have been sequenced by the author as follows to represent the natural progression of corridors. This is presented in the report as a schematic and each corridor is highlighted on the schematic. An example of the schematic is given in Figure 7; the grey colour indicates the type of corridor being discussed:

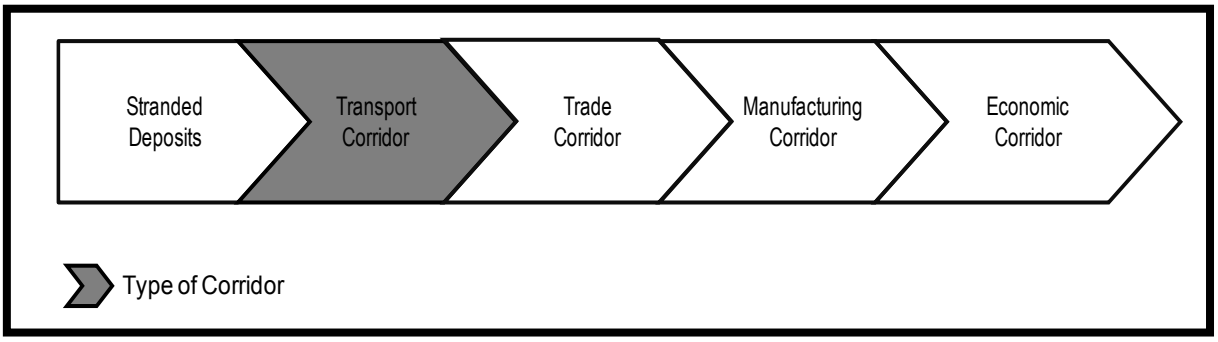

Figure 7: Example of Corridor Schematic

3.3. **Rural development**

A problem in understanding rural development is that there are no clear definitions for 'rural' (RUDASA, 2006). Statistics South Africa (StatsSA) has used a traditional classification system that "classified areas proclaimed as municipalities (mostly the cities and 'white' towns and their associated 'townships') as urban, and everything else as rural". The need to maintain

comparisons with historical data leads to the reluctance to reclassify rural areas. This therefore impacts on agreeing what rural development should take place.

RUDASA (2006) therefore recommended that a rural strategy could be categorised based on the dominance of human settlement patterns and access to amenities in a municipality. They propose the following:

- **Metropolitan area**: Metropolitan municipality.
- **Other urban areas**: Local municipality that consists of a city or major town with mostly tar roads, water supplied through pipes and flushing sanitation, and a broad choice of different services.
- **Close rural area**: Local municipality that has small towns, settlement of more than 50% of the people are closer than 5 km to a tar road, mostly piped water supply, but only a small number of services are available in that local municipality.
- **Deep rural area**: Local municipality that has small towns and/or old 'resettlement areas', settlement of more than 50% of the people is further than 5 km from a tarred road, water from streams, rivers, dams or rainwater tanks are used by more than 25% of people and people have a small number of services available in that municipality.

RUDASA (2006) indicates that South Africa identified rural and urban presidential poverty nodes as part of a national strategy to alleviate poverty.

Table 4: Indicators of Poverty in the ISRDP nodes in 2001

Province	Rural Node	Unemployment (expanded)	No hygienic sanitation	No access to safe water
		% people 15-65 yrs	% households	% households
Eastern Cape	Alfred Nzo	50	98	67
	Chris Hani	40	78	54
	OR Tambo	52	92	87
	Ukahlamba	48	85	62
Free State	Thabo Mofutsanyane	43	58	4
KwaZulu-Natal	Ugu	49	70	64
	Umkhanyakude	53	84	78
	Umzinyathi	62	81	69
	Zululand	54	70	60
Limpopo & Mpumalanga	Bohlabelo	69	92	33
	Sekhukhune	65	90	60
Northern Cape & North West	Kgalagadi	53	63	42
Western Cape	Central Karoo	44	20	3
South Africa	National Average	37	38	

Source: RUDASA, 2006.

Carter and May (1999) reviewed rural poverty in South Africa and identify the following features:

- Income of uneducated labour is so low that other assets (economic and / or social) are necessary to lift a family above the poverty line.
- The poor's ability to use their assets and endowments (e.g. natural resources, land or mineral wealth) are limited by their financial constraints.

Carter & May (1999) argues poverty is not only a matter of little assets, but also the inability to utilise the assets available ineffectively, this includes natural and mineral resources. According to them entrepreneurship is required to unlock these rural assets.

According to Dabson (2009), the typology for rural entrepreneurship comprises five types of entrepreneurs:

- Aspiring entrepreneurs are people that formulated a specific idea of building a business but have not yet started the venture.
- Survival entrepreneurs have resorted to create their own business either to increase their existing, insufficient incomes or are those without many other employment opportunities.
- Lifestyle entrepreneurs are people who create their own business to achieve a specific lifestyle choice or to live in a particular community.
- Growth entrepreneurs pursue opportunities and want to develop and grow their enterprises to create jobs and produce wealth.

- Serial entrepreneurs make a career out of creating businesses, often selling them once they are successful, and sometimes assembling multi-enterprise holding companies.

Of the above types of entrepreneurs, survival and lifestyle enterprises make a significant contribution to their local economies, and only a small fraction will evolve into companies that will become economic drivers based on some form of innovation. It would be a mistake, however, to dismiss these survival and lifestyle enterprises as unimportant in policy terms - not only because of their local economic impact, but also because they do still provide a seedbed for potential economic drivers and they contribute to an overall entrepreneurial climate in their community and region.

Growth and serial entrepreneurs are of most interest to policymakers because they are likely to yield the highest return on investments, and as Dabson (2009) reports, it is these entrepreneurs who are the least likely to want or need assistance from formal sources. Dabson (2009) examined entrepreneurship and enterprise establishment in competitive rural regions and how to pursue entrepreneurship as the core rural economic development strategy. He gave the following reasons:

- Number one, the traditional dependence on relocation or expansion of recruiting companies into rural communities simply does not work for most rural areas, and leaders are considering feasible substitutes.
- Number two, more people are becoming aware of the crucial role of small businesses and entrepreneurs in stimulating both the local and

national economy.

- Number three, innovation and job growth in the rural economy is largely responsible for the activity that can be seen in the representation of these economies, this is the essence made up of small businesses (Dabson *et al*., 2003).

From all this experience, three important policy principles are beginning to emerge that focus on regionalism, systems and assets.

Principle 1. Regionalism

Increased globalisation and the need for countries to compete more intensely has resulted in significant reconstruction in rural areas and communities as these areas have to respond to issues such as price volatility for agricultural commodities, and in certain cases, the collapse of low skills manufacturing sectors. Common examples are the textile sector. Added to this challenge is the concomitant change in the rural landscape as some regions continue to experience a net population loss due to urban migration, while others rural areas are seeing internal immigration.

The rural area, to survive, needs to compete as a region if it wants to compete in a globalised economy. Regional wealth relies on the production of all its assets and industries, including capitalising on the linkages and flows of people, goods, services, ideas, and information within regions.

Principle 2. Systems

The second principle is that any strategy must be systems-based. These programmes are generally donor-driven rather than client-driven, and focus on the business activity or on offering specific products, rather than on the needs and circumstances of rural entrepreneurs. McGranahan and Wojan (2006) show that it is the higher density rural areas that are the most attractive because high levels of social interaction and a degree of diversity are still important. The implication appears to be that only some well-endowed rural regions will benefit from entrepreneurial activity leading to economic growth and competitiveness.

Principle 3. Assets

The third principle is that entrepreneurship strategy must be assets-based. Kretzman and McKnight (1993) propose that communities need to stop thinking in terms of deficits and shortcomings, and start focusing on their assets and potentials. Admittedly, it still remains a challenge for many rural regions to identify and accept that they may have real assets that can yield entrepreneurial opportunities.

It is therefore the people with entrepreneurial characteristics, in this case the entrepreneurs in rural areas, that would be better able to respond to enterprise opportunities in rural areas and make use of particular region's assets. Due to the high premium placed on regional competitiveness by the global markets, this development must be encouraged. For rural areas, the identification of

competitive assets and the recognition of interrelationships with economic or urban centres in a regional context are of paramount importance.

Not all areas can develop similarly, and Henderson *et al*. (2009) report the following:

- Some rural areas are better endowed than others in terms of sources of innovation or climate for entrepreneurship, especially those with universities and research establishments and those with natural assets that can be channelled into entrepreneurship opportunities.
- Entrepreneurship yields equivalent or greater returns for public investment than more conventional economic development approaches such as recruitment and investment in infrastructure.
- Regional frameworks that explore the connections between urban and rural areas provide the necessary policy context for entrepreneurship and economic development.
- With appropriate investments in leadership capacity, tools to identify competitive advantage and regional consensus building, governments, academic institutions, the private sector and nongovernmental organisations can build lasting regional collaborations.
- Given the dearth of financial and knowledge resources in many rural areas, the focus should be on system building to align available resources and efforts to meet the differing needs and characteristics of entrepreneurs.

- Incentives for collaboration and system building to facilitate entrepreneurship development are more effective than categorical programmes.
- The route to rural competitiveness is through the identification of assets and that most, if not all, communities possess assets that entrepreneurs can transform into economic opportunities. Creativity and innovation can be found and encouraged in all rural regions, even those with few obvious endowments.

3.4. **Mineral development**

3.4.1 The natural resource curse

There is a general concern that inferior economic growth of resource-rich economies is resulting in inferior levels of development, to the point that some of these economies are losing ground as a result of their reliance on their natural resources. It is a widely held view that mineral resources represent a curse to many countries (Karl, 1997; Ross, 1999; Palley, 2003). This has taken on such widespread occurrence that it has grown to be called the 'natural resource curse' or the 'resource curse'. It was first identified in the Dutch energy sector where the finding of natural gas and resultant exploitation there-of had a negative impact on the Dutch economy.

It is also referred to as the 'Dutch disease', the phenomenon was noted in 1977 (The Economist, 1977) when the discovery of natural gas by oil explorers (Shell and Exxon Mobil) lead to a Public-Private Partnership with the Dutch

government. The increasing revenue from exploiting the natural gas resulted in the manufacturing sector deteriorating, commonly called de-industrialisation. The term 'resource curse' was widely used by the geographer Richard Auty (1993) who explained in great detail the natural drift towards poor performance of the resource rich countries.

The cycle of the resource curse is as shown in Figure 8:

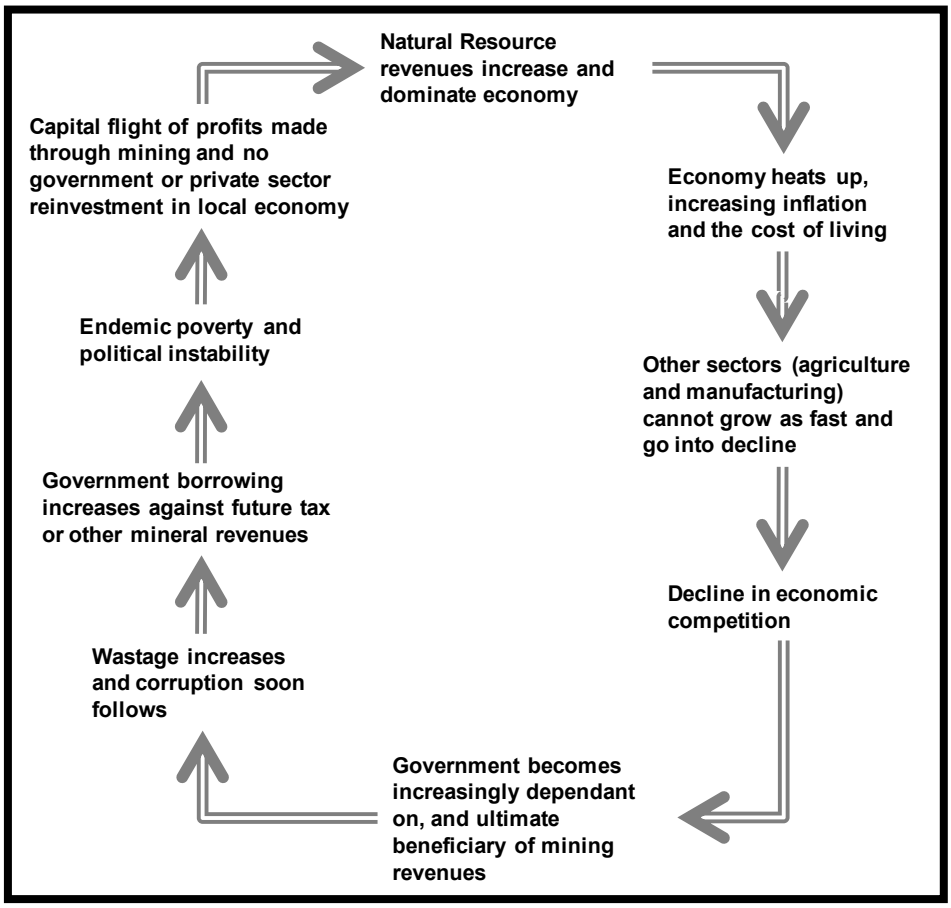

Figure 8: The natural resource curse cycle

Source: Modified from Auty (1993) and Sachs and Warner (1995).

Some key features of the resource curse, as reported by Sachs and Warner (1995) are explained as follows:

- Significant earnings from mineral resources can result in ‘Dutch Disease’, this includes overvaluation and exchange rate fluctuations causing a downturn in competitiveness of other economic sectors (non-mineral).
- Volatility in the minerals market causes problems if the economy of the country rely on mineral-resource income, it can even result in long-term deterioration as the country depends on the wealth of the resource rather than their ability to add value.
- Misguided and anti-competitive policies could result in short term gains, but offers hurdles for long term growth if the occurrence of mineral wealth does not result in responsible development.
- An economy blessed with abundant, but finite, natural resources may over consume.
- Some countries with more mineral wealth could be characterised by political conflict, inequalities and corruption as greed drives the decision makers of the state, rather than effective governance.

UNCTAD (United Nations Conference on Trade and Development, 2002) and Ross (2001, 2003) both claim that reliance on mineral wealth is a contributing factor for increasing poverty levels. It is perceived that mineral wealth divert the attention of government away from suitable macroeconomic strategies, due to rent seeking behavior and armed conflict. This in turn leads to reduced export growth rates. This view of the resource curse being a form of negative consequences of mineral development is not widely held though (Davis, 1995; Stevens, 2005).

Davis (1995) assessed the development level in developing economies and established that human development indicators and revenue levels was better than developing economies without extractive industries. Countries perceived to have escaped the resource curse, has been assessed in attempts to understand what made them different. These countries include Botswana, Chile, Indonesia, Malaysia and Norway.

A shortcoming in the Auty model (1993), as described by Crowson (2009), is that it is based on oil and natural gas rich countries and similar trends did not always appear where solid minerals are mined. Furthermore, the trend was seen more clearly where export-orientated minerals were dominant (oil, gas, gold, diamonds) and the effect was less noticeable where industrial minerals were dominant for local consumption. The argument is made that the cure for the resource curse is the enhancement of the manufacturing sectors. It is hoped that this creates more stable economies and allows countries to compete globally.

The earliest models of the natural resource curse were modelled on mining having some similar characteristics to other natural resources, noting the following:

- Mining is endless or very long-run provided the deposits remain exploitable.
- Manufacturing is a better route to follow as it is globally more desirable.

These characteristics, particularly a country's manufacturing capacity, were considered to be short-run competitive advantages and often reliant on government interventions (like rebates, subsidies or raising tariff barriers) to maintain the advantage.

Davis (2009) summarises debates about the progress of extractive economies in the context of boom–bust cycles, and points out that the cycle will also apply to economic growth. The line of reasoning explaining contradictory analyses of the extractive economies development performance assessment follows. Extractive activity is seen as good for development by Davis (1995), and bad for development by Ross (2003) and Bulte *et al*. (2005) note that it is relatively bad for development. These interpretations are made by looking at essentially the same data over the same time period, and resource intensiveness are interpreted in essentially the same way. The results are, however, not inconsistent, as can be seen on closer inspection.

Ross (2003) and Bulte *et al*. (2005) assessed development performance of an economy over time in comparison with the performance expected of economies at that level of income and conditional on the initial level of income per capita. It is clear that there will be a difference in the assessment of development if the base assumptions differ.

The belief is that mining is unique as it is depleting non-renewable resources and so can attract the highest rent. It is not necessarily meaningful to look at the absolute size of mineral revenues, but rather to understand the importance of mineral revenue within the total economy. It is therefore necessary to review

the effect on Gross Domestic Product (GDP) where minerals are mined (Crowson, 2009). Based on World Bank data for countries from Africa (South Africa is emphasised) Table 5 shows the mineral exports in 1970 and 2000 for a range of countries, together with their GDP. Countries with incomplete data were left out.

Table 5: Minerals contribution to GDP, exports in 1970 and 2000 for select African countries

	GDP (1970)	GDP (2000)	Exports (1970)	Exports (2000)
Algeria	0.5	0.3	2.4	-
Botswana	-	40.1	-	92.5
Cameroon	2.1	1.1	10.7	6.1
Central African Republic	6.7	6	41.1	35.5
Congo	2.1	-	18.3	-
Cote d'Ivoire	0.4	0.4	1.1	1.1
Egypt	0.1	0.4	1.4	8.6
Gabon	5.1	0.9	11.5	1.7
Ghana	2.5	16.3	11.9	61.7
Guinea	-	13.6	-	63.6
Kenya	-	0.7	-	4.9
Liberia	44.9	-	73.2	-

	GDP (1970)	GDP (2000)	Exports (1970)	Exports (2000)
Madagascar	0.7	0.8	5.1	3.9
Morocco	4.1	4.4	33.6	19.8
Mozambique	-	1.6	-	17.1
Namibia	-	20.1	-	52
Niger	0	5.1	0.2	32.4
Nigeria	0.4	0	4	0
Senegal	2.1	2.7	11.7	12.9
South Africa	42.3	11.6	57.4	22.2
Tanzania	-	2	-	26.9
Togo	5.7	5.9	26.3	21.5
Tunisia	3.6	3.4	28.2	11.4
Zambia	54.9	12.2	98.1	59.2
Zimbabwe	-	3.5	-	13.4

Source: Crowson, (2009)

Elsewhere, countries tend to understate the mineral sector's importance (Crowson, 2009). This approach of using nationally available, official data is that unofficial production is not measured and cannot be reported. For example,

the contribution from artisanal mining to China's gold output is believed to be 25% (CGA, 2008) and is poorly captured in national statistics.

As can be seen in Table 5 the GDP share of minerals exported is only an estimate inside the contribution to the GDP. Reliance on minerals can be seen as part of a contribution of GDP (Crowson, 2009). In neighbouring Botswana mineral exports accounted for over 40% of GDP in 2000. Furthermore, the dependence of other African countries is also noted.

This change across the 30 year time frame, where small, can represent changes in commodity prices; however the commodity price impact is less likely to be the only cause where GDP contributions are in excess of 20%.

It is the relationship between mineral dependency and contribution to GDP and growth of GDP that is the macro-scale indicator for the roles of minerals in mineral development. Sachs and Warner (2001) recommended that it was growth of income per capita that will be a more robust measure of the impact of mineral development.

3.4.2 The impact of mineral development

The impacts of mineral development can be both positive and negative.

3.4.2.1 Positive impacts

An advantage of mineral development projects are that they, to varying degrees, tend to integrate into the local economy. In doing so they create additional spin-offs at different stages of the project, particularly at the

construction stage (Crowson, 2009). Local labour is employed, trained and skilled and the local employees furthermore spend salaries on local goods and services which give rise to wider effects through income and employment multipliers.

If larger projects are developed, then additional support infrastructure will be developed, such as electrical infrastructure, transport networks and corridors, ports development and employee facilities such as housing.

The biggest benefit for a country is the tax receipts (including company tax, secondary tax on companies, VAT, PAYE, SITE, SDL and Royalty) that it can acquire.

Highly skilled individuals are required and these individuals gain ongoing experience and eventually continue to grow the economy either by starting their own businesses or transferring skills to younger employees.

3.4.2.2 Negative view

Traditionally mining in South Africa was focussed on the generating of ore for export (Bain, 1852). In recent years some additional processing has occurred. When ore is fully exported then the largest value addition, achieved in processing, refining and manufacturing is largely exported as it occurs elsewhere. The issue therefore is whether South Africa should focus on processing and beneficiation of all ore generated in a country. There is an argument (Crowson, 2009) that indicates that small countries (and small

territories or regions) do not have a large enough market to either process and produce intermediate goods as well as absorb the products manufactured.

Furthermore, due to funding from outside a country, much of the early profits are repatriated to the lending countries to service loans initially made to develop the project. It is therefore only after a time period when amortisation of the loans is completed before the profits accrue to the local area.

If tax revenues are discounted by tax holidays and other forms of investment incentives and rebates are factored in, then this tax revenue will only appear slowly (Crowson, 2009).

Mining also involves the irreversible loss of land, especially if open-cast mines are developed. Waste rock piles and tailings dams are also permanent or semi-permanent features of the landscape. The intense use of water also diverts scarce water resources to mining. Biodiversity can be negatively affected by reducing habitats and ineffective rehabilitation.

Employment is highest during the construction phases and the jobs created at this phase are also only temporary. During the operating phase the skilled and semi-skilled workers tend to be recruited from other existing industries, possibly in the area. This will cause local salaries to jump and create competition for scare skills in the region.

3.4.2.3 Integrated mineral development

McPhail (2009) recommends the enhancement of the socio-economic influence of mineral development enterprises with parallel and integrated interventions by a range of stakeholders. These include:

- Partnerships.
- Deepening governance reforms.
- Intensifying efforts for poverty reduction.

3.4.3 Partnerships

Partnerships between all concerned stakeholders are needed to enhance the positive impacts from mining and to tackle the negative impacts that have been identified. These requirements are clearly stated in the preamble of the Mineral and Petroleum Resources Development Act (MPRDA). With partnerships, the MPRDA is intended to effect the following:

- Achieve the contribution if mining to poverty reduction by leveraging partnerships. Government departments (like treasury and mining) need to work together with each other, companies and the Chamber of Mines to collaborate with their social investment budgets towards achieving the Millennium Development Goals (MDG). In this National government needs to take the lead to ensure national poverty reduction strategies are shared in terms of responsibilities for outcomes by integrating the efforts of the mining sector.

- The special needs of communities affected by mining should be considered and funds from donor agencies and social funds should be better aligned to their requirements.
- Corruption and transparency should be focussed on in order to improve the intended results of royalties and taxes paid by companies. A multi-stakeholder initiative the Extractive Industries Transparency Initiative (EITI) is has a shared goal of promoting transparency and addressing corruption.
- Infrastructure building often gets completed faster than scheduled while government and community capacity building often takes slower than anticipated.
- Funding of activities as mentioned above needs novel ideas as little money (like taxes or royalties) for government (national and local) are available at the beginning of the construction period. (McPhail, 2009).

3.4.4 Deepening governance

McPhail (2009) further suggests that improving the administration of the mining sector is the second opportunity for partnerships to have an impact. According to him impacts on mining projects could be improved by the necessary increasing of local government capacity and increasing decentralisation ongoing decentralisation of decision making to local and regional authorities is needed. .

3.4.5 Intensify efforts at poverty reduction

A third suggestion is to improve efforts for dispute resolution mechanisms and poverty reduction at local levels. The development of mining clusters can be supported by partnerships and in this way contribute to the regional economic diversification. 'Mining clusters' in Chile motivated the more general growth of small businesses. An innovative quality control programme by the Escondida mine helped local suppliers to obtain ISO 9001 and 14001 certification, enabling them to supply to others in the region.

Companies can improve by setting up a grievance procedure process in order to gain the input of all parties, providing a wider decision-making structure including stakeholders and local communities. Local non-governmental organisations can obtain agreement for how benefits can be shared fairly by working with local communities and indigenous peoples'. The marginalised can therefore be better represented.

Slack (2009) viewed the need for mineral development as improved revenue, new work opportunities therefore resulting on meaningful poverty reduction. Due to the international integration of global economies and commodity value chains, he viewed this as the only viable option for developing countries to reduce poverty (Slack, 2009).

3.5. **Summary**

Enterprise development is an important mechanism to alleviate poverty in rural areas because these enterprises, though low yielding in economic terms, do

provide employment opportunities. The enterprises have few assets from which to launch themselves so need to utilise what is closest to them. In rural South Africa, mineral endowments is one of the few available inputs to commence mining.

If these rural mineral occurrences can be adequately released to these rural entrepreneurs, then the clustering effect can be allowed to form hubs and ultimately corridors can develop. The rural entrepreneurs do not enjoy the same advantages as urban entrepreneurs, so will in all instances require assistance. If national government could help the coalescence effect around corridors then these businesses will be more robust and stand a better chance of survival. Stranded mineral deposits abound in rural South Africa where infrastructure density is low, so these remain an untapped source of opportunity.

The following chapter provides an overview of the key economic geological occurrences in South Africa.

CHAPTER 4. OVERVIEW OF KEY ECONOMIC GEOLOGICAL OCCURRENCES IN SOUTH AFRICA

4.1. Economic geology of the Archaean Eon (3644 Ma-2500 Ma)

Figure 9 shows the location of surface rocks in South Africa representative of the Archaean Eon. These are located north of 30^{o} latitude and east of 22^{o} longitude. The Archaean rocks are predominantly exposed in Limpopo, North West and Mpumalanga Provinces, with some also outcropping in Gauteng. KwaZulu-Natal and the Northern Cape Provinces have small surface outcrops.

The Archaean comprises, from its base, the Barberton Supergroup, the intervening Dominion Group, the Witwatersrand Supergroup, and above this the Ventersdorp Supergroup. Coeval with the Witwatersrand Supergroup is the Pongola Supergroup, largely exposed in the KwaZulu-Natal area (see Figure 10).

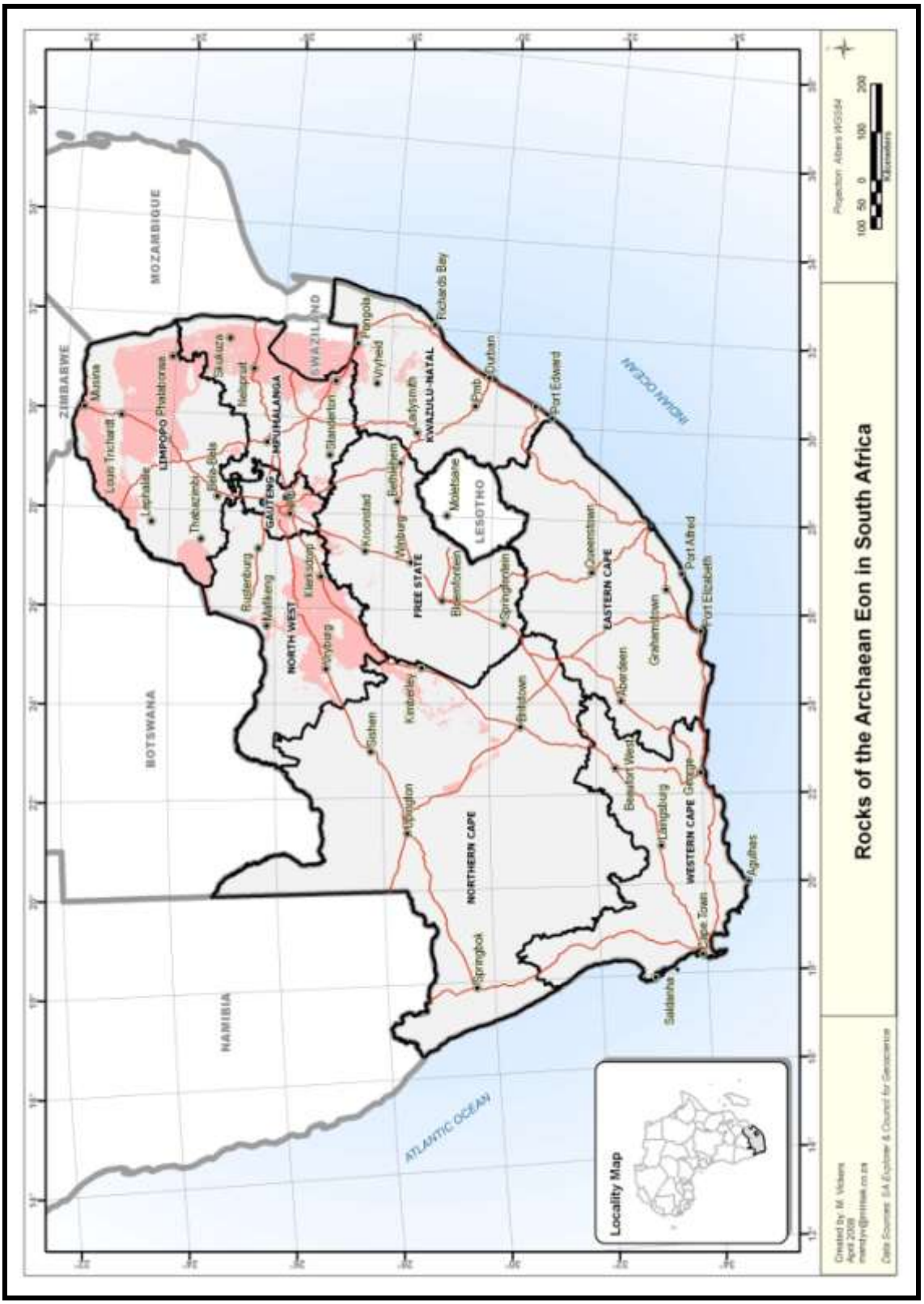

Figure 9: Location of Archaean rocks in South Africa

Source: Supplied by M Vickers (Private consultant)

4.1.1 The Barberton Supergroup/Swaziland Super-Group (3600 Ma-3100 Ma)

The oldest sedimentary sequence in South Africa is found in the Barberton Mountainland area, along the Beit Bridge border and in elongated zones running north-south in the North West Province. In these areas the rocks are well preserved and exposed together with the Archaean granites and gneisses.

This sequence of rock is known as the Barberton Supergroup and it formed approximately 3,547 Ma (Hartzer *et al*., 1998). These volcano-sedimentary rocks are divided into three groups; the oldest of which is the Onverwacht Group. The type locality for this group is found in the Komati valley in eastern Mpumalanga. An important rock type found in this group is the Komatiite (Rubidge & McCarthy, 2005). These provide evidence of an underwater eruption due to the presence of pillow lavas.

Next is the Fig Tree Group, which consists mainly of greywackes and slates as well as banded chert, jasper and iron-rich rocks (Truswell, 1970). These soft contorted rocks are important structurally and economically since they act as reliable marker horizons and as a site for gold and sulphide deposition. The final, and youngest, Moodies Group consists of feldspathic sandstones, siltstones, shales, conglomerates, and banded ironstones, as well as rare volcanics (Truswell, 1970).

The Barton mountainland is the best known South Africa's greenstone gold occurrences.

In the northeast of Barberton the gold occurrences are most prominent. All three groups of the Barberton Supergroup are known to host gold (Brandl *et al*., 2006). The four largest mines of the area, Sheba Gold Mine (c. 90t), New Consort (c. 65t), Fairview (c.42t) and Agnes (c. 25.t) have produced in excess of 70% of the gold from this region. Smaller mines such as Barbrook have until recently been active. Many other mines have long since been closed due to their being mined out or unsafe working conditions.

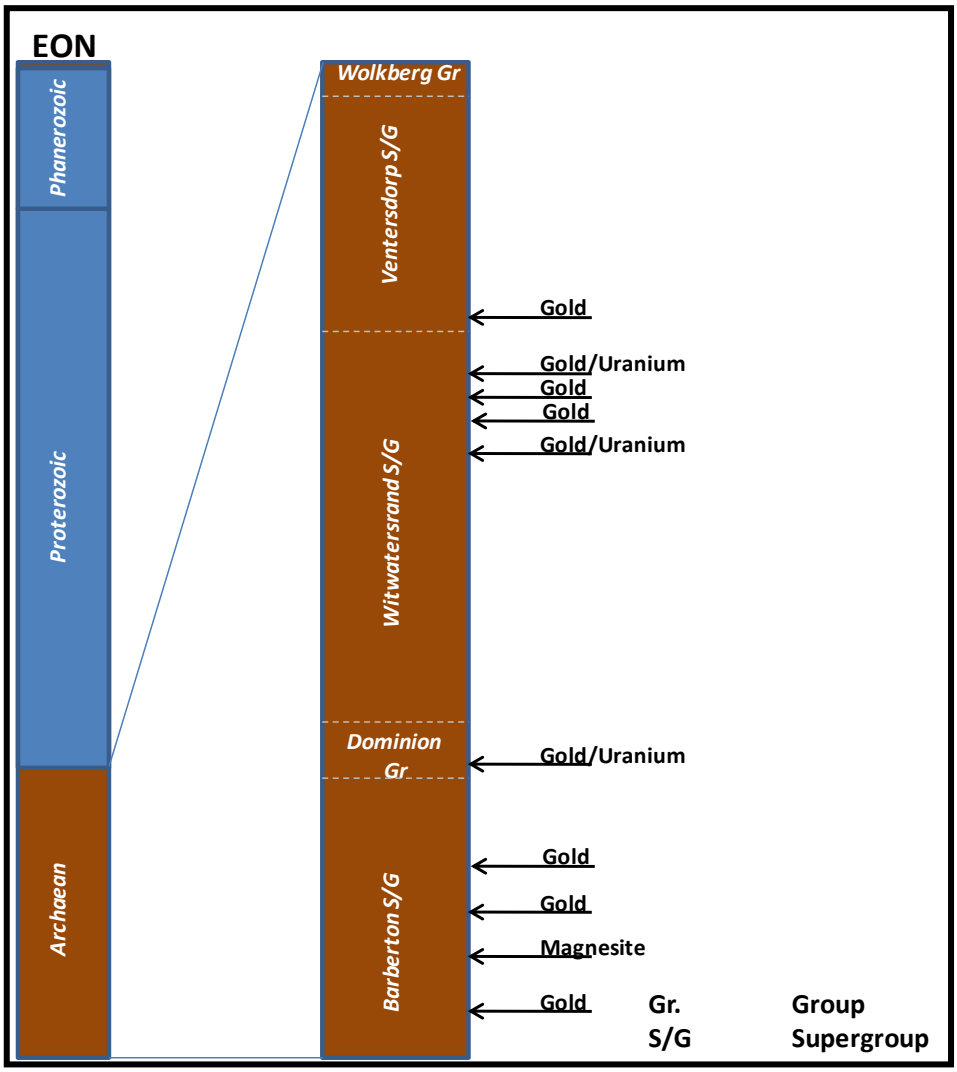

Figure 10: Schematic of Archaean Stratigraphy and associated mineralisation

Source: Adapted from information derived from The Geology of South Africa (2006) eds. M.R. Johnson, C.R. Anhaeusser and R.J. Thomas

The Barberton Supergroup also hosts magnesite and talc mines. The Strathmore Magnesite mine is a small magnesite producer (100 kilotons per annum) with a life of mine in excess of 1 000 years (Chammotte, 2010). The limited use of magnesite, globally available deposits, and distance to key consumer markets means that this mine will continue to produce in small quantities. This mine is close to the Kaapmuiden area (on the border with Mozambique).

Talc deposits are also known from the Kaapmuiden area, but as with the magnesite, large deposits have not translated into high production. The Scotia Talc Mine has yielded 70% of the talc produced in the region (Brandl *et al*., 2006). Until the prohibition of asbestos mining in South Africa in 2008, chrysotile asbestos was mined from two deposits, the Havelock and Msauli Mines, the two yielding 80% of total asbestos from the region. The industrial minerals of the area require large deposits to remain economical as few mines have yielded most of the production.

Other auriferous greenstone belts are located in other parts of South Africa but are not as pronounced or prominent. The Giyani Greenstone Belt and Pietersburg Greenstone Belts, located in Limpopo Province, have had small gold operations working these for many years, but erratic gold occurrences lead to their ultimate closure (Brandl *et al*., 2006). The Murchison Greenstone Belt, west of Phalaborwa, is better known for its high yielding antimony deposits with lesser gold.

In the North West Province, the Amalia Greenstone Belt hosts the now defunct Amalia Gold Mine, but further to the north the Kalgold Mine still operates on the Kraaipan Greenstone Belt. The Madibe Gold mine on the Kraaipan Belt is now closed.

4.1.2 The Pongola Supergroup (3107 Ma-2863 Ma)

Due to the same rifting that led to the formation of the Dominion Group rocks, a set of similar rocks were deposited in northern KwaZulu-Natal and Swaziland (Rubidge & McCarthy, 2005) roughly 2,985 Ma. These rocks are the basal rocks of the Pongola Supergroup and are known as the Nsuze Group. The Nsuze rocks consist mainly of volcanic rocks inter-layered with lesser sedimentary rocks. A shallow sea resulted which led to the deposition of the upper Pongola Supergroup rocks known as the Mozaan Group. The Mozaan rocks consist of alternating shales and quartzites with a few conglomerates (Haughton, 1969; Brandl *et al*., 2006).

The conglomerates created some interest with respect to gold exploration but eventually ceased when only poor grades were found (Gold, 2006). Two small gold mines did, however, operate in the Pongola Supergroup. The Denny Dalton Mine is situated on an inlier, whereas the Klipwal Gold Mine was situated along a shear.

4.1.3 The Dominion Group (3074 Ma)

Rifting of the early formed continent resulted in crustal thinning which then permitted renewed sedimentation and volcanic activity (Rubidge & McCarthy,

2005). This activity led to the deposition of the Dominion Group rocks. This group of rocks is preserved scattered in the North West Province. These rocks lie directly over the Archaean Granite-Gneiss basement rocks and are overlain by the younger Witwatersrand Supergroup. They are composed of auriferous conglomerates and quartzites overlain by volcanics.

The source material for the lower quartzites and conglomerates were the basement rocks; evidence of this can be seen at the base of the sequence where weathered granites have been seen *in situ.* The only significant mine developed on the Dominion Group is the former Afrikander Lease Gold Mine which was closed and re-launched as the Dominion Uranium Mine (which also closed down as grades were too low) (UraniumOne, 2010).

4.1.4 The Witwatersrand Supergroup (3074 Ma-2714 Ma)

The next sequence of rocks that were deposited in the shallow sea setting was the lower Witwatersrand Supergroup rocks. These rocks belong to the West Rand Group and were deposited roughly 2,970 Ma (Rubidge & McCarthy, 2005). The basal rocks of this group belong to the ~1490m thick Hospital Hill Subgroup. The overlying ~1930m thick subgroup is the Government Subgroup which is composed of predominantly arenaceous sediments such as sandstones and quartzites, with lesser argillaceous sediments. The upper most subgroup is known as the Jeppestown Subgroup at ~ 1,140m thick (Truswell, 1970).

The upper portion of the Witwatersrand Supergroup is the economically significant Central Rand Group. There is a separation between this group and

the former due to a period of tectonic unrest. The rocks of this group are predominantly quartzites and conglomerates, with only one argillaceous formation present. This formation, known as the Kimberly Shale, serves as the boundary between the two subgroups of the Central Rand Group (Truswell, 1970); the lower subgroup being the Johannesburg Subgroup whilst the upper being the Turffontein Subgroup.

Gold mines of the Witwatersrand extend from as far south as Theunissen in the Free State Province (Free State Gold Field) (Minter *et al.,* 1986). The goldfields extend north to the Klerksdorp region where the basin extends eastwards past Carletonville, Johannesburg and as far as Bethal in the Mpumalanga Province.

The rocks of the Witwatersrand Supergroup can be seen preserved in the Gauteng Province and in the south-east of the North West Province.

4.1.4.1 The Ventersdorp Supergroup (2714 Ma- 2687 Ma)

Rocks of the Ventersdorp Supergroup outcrop within and around the Witwatersrand basin - especially to the west and south of it (Truswell, 1970). The termination of the Witwatersrand sedimentation ended roughly 2,780 Ma (Germs & Schweitzer, 1994) as a result of a vast outpouring of basaltic lavas. This volcanism is believed to be as a result of crustal rupturing that developed when the Zimbabwean craton collided with the Kaapvaal craton.

When the lava erupted along fault zones it eroded the upper Witwatersrand sediments forming a reef, known as the Ventersdorp Contact Reef, consisting of a mixture of conglomerates and lavas. This gold rich reef forms the lowermost

formation of the Ventersdorp Supergroup (Klipriviersberg Group). There are numerous mines that derive most of their gold from this reef formation (van der Westhuizen *et al*., 2006). These mines include the currently active Kloof Gold Mine (Carletonville) and Elandsrand Gold Mine. No other significant economic mineralisation occurs within the Ventersdorp Supergroup.

4.1.5 Early Transvaal Supergroup

The Archaean Eon encompasses the period 3,644 Ma to 2,500 Ma. The age marking the Archaean – Proterozoic boundary, 2,500 Ma, is a cross cutting age and does not coincide with the boundary between the Randian and Vaalian Eras. The result is that the Transvaal Supergroup crosses the boundary and formation of the Transvaal Supergroup commenced in the Archaean Eon and ended within the Proterozoic Eon.

Criteria used to establish the Archaean – Proterozoic boundary are (Negrutsa and Negrutsa, 2007):

- The major structural-metamorphic unconformity between the crystalline basement and deformed, metamorphosed sedimentary cover.
- The global outburst of granitic magmatism in the time interval 2,800-2,500 Ma.
- The age of initial basaltoid volcanism which was extensive in areas of destruction and rifting of the Archaean crust.

These criteria are Northern Hemisphere events and features that have, by historical-geology, replaced the geochronological boundaries. The Wolkberg

Group is the South African emanation of the third criterion above. No economic mineralisation is known to occur in these protobasinal, pre-Transvaal formations.

4.1.6 Limpopo Belt Metamorphism (2800 Ma– 2010 Ma)

The Limpopo Belt formed when the Kaapvaal Craton collided with the Zimbabwe Craton in the north. As a result of the collision, thickening of the crust occurred along the collision boundary as the sedimentary rocks situated there became compressed and folded. This compression caused the rocks to heat up and melt producing granitic magmas (Rubidge & McCarthy, 2005). These magmas caused the metamorphism of the surrounding country rocks. This high grade metamorphism occurred roughly 2,800-2,650 Ma (Hartzer *et al*., 1998). Once again, between 2,540-2,500 Ma and 2,010 Ma high grade metamorphism occurred as the belt continued to collide.

Economic deposits linked to this event include the emplacement of hydrothermal copper deposits in the Musina area, genetically linked to the Messina Fault (Kramers *et al*., 2006). The Gumbu Mine, east of Musina is a graphite deposit formed entirely due to the metamorphism events of the area. Gold mineralisation is sporadic, but associated with the mobile belts interface with the Giyani Greenstone Belt to its south.

4.2. Economic geology of the Proterozoic Eon (2500 Ma-545 Ma)

The Proterozoic rocks of South Africa that are exposed at surface are shown in Figure 11. The Proterozoic rocks at surface are largely in a zone 250-400 km broad trending NE-SW between Limpopo and the Northern Cape provinces. There is a break in the Proterozoic, along the Vryburg Anticline. There are some Proterozoic rocks outcropping in the Western Cape in a N-S form.

4.2.1 The Transvaal Supergroup (2770 Ma-2224 Ma)

Around 2,650 Ma a new period of crustal stretching and thinning of the continent began. Sediments that were carried from the up-rifted areas were deposited into rift basins as well as an occasional basaltic lava eruption forming the Wolkberg Group (Rubidge & McCarthy, 2005). Some believe this group is not part of the Transvaal Supergroup (e.g. Pretorius, 1964), however, the Wolkberg Group is apparently conformable with the Black Reef Formation and thus belongs to the base of the Transvaal Supergroup.

Three structural basins developed at this time; two in South Africa (the Transvaal and Griqualand West Basins) and one in Botswana, i.e. the Kanye Basin (which will not be discussed further) (Eriksson *et al*., 2006).

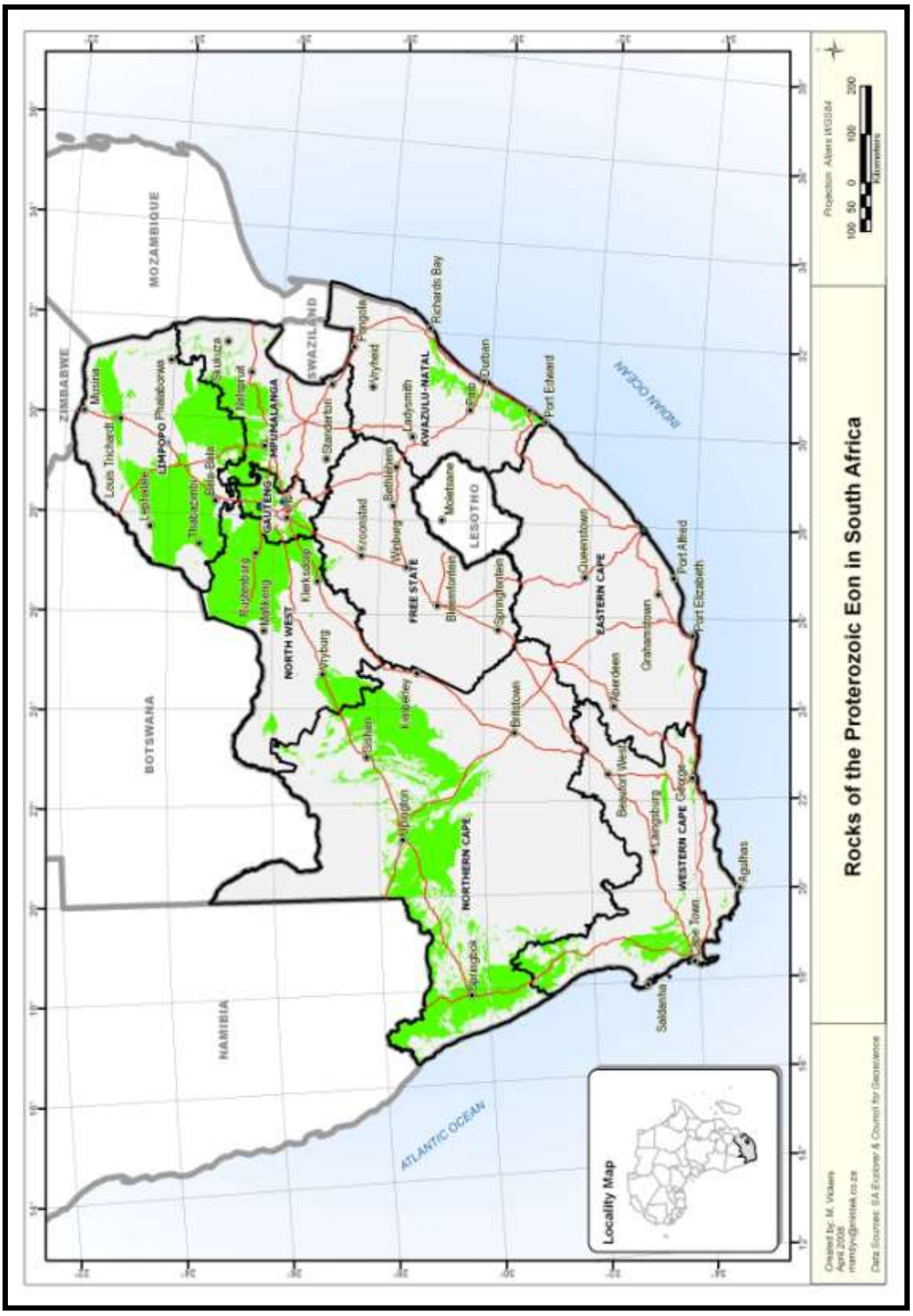

Figure 11: Rocks of the Proterozoic Eon in South Africa

Source: Supplied by M Vickers (Private consultant)

4.2.2 The Transvaal Basin

The Black Reef Formation forms the unconformable base of the Transvaal Basin. It is a fining upwards, arenitic succession with minor conglomerates. The Black Reef Formation attains a maximum thickness in the Dennilton – Amandelbult area. The Chuniespoort Group overlies the Black Reef Formation.

The basal Malmani Subgroup is approximately 2 000m thick and represents the earliest platform carbonate. Stromatolitic dolomites, shales and locally developed quartzites dominate this Subgroup. The Penge Formation overlays the last carbonate sequence (the Frisco Formation). The Penge Formation is the only source of Banded Iron Formation (BIF) in the Basin. The top of the Chuniespoort Group is the Duitschland Formation that unconformably overlay the Penge Formation. The Duitschland Formation comprises carbonaceous mudrock and dolomites.

The Transvaal Basin hosts significant deposits of iron ore which have largely been exploited at the Thabazimbi Mine. Andalusite, like asbestos, is closely associated with the iron formations. Andalusite is extracted at the Havelock and Rhino Andalusite mines. The only significant gold occurrences are from the Sabie area from the Black Reef Formation.

Mines in this area, which is at present sub-economic, are closed. Base metal deposits occur in a region east and northeast of Mafikeng. Lead-zinc-fluorspar deposits have been exploited such as at the Zeerust Fluorspar field (Eriksson *et al*., 2006). Economically significant asbestos deposits are present, but the ban on asbestos mining makes this inconsequential. The ban on asbestos mining

has, however, not influenced the mining of asbestos gemstones, such as tiger's eye.

4.2.3 The Griqualand West Basin

The Griqualand West Basin has been subdivided into the Ghaap Plateau and Prieska sub-basins. Both sub-basins contain a basal Vryburg Formation, which is an equivalent to the Transvaal Basin Black Reef Formation. The base of the Ghaap Group (equivalent of the Chuniespoort Group in the Transvaal Basin) is comprised of the basal Schmidtsdrift Subgroup which is a stromatolitic and carbonate sequence.

The Campbell Rand Subgroup that overlayz the Schmidtsdrift Subgroup comprises numerous successions of dolomite and stromatolitic domes. The Campbell Rand Subgroup is terminated by the Tsineng Formation in the Ghaap Plateau Sub-basin and by the Klein Naute Formation in the Prieska Sub-basin. The latter is a thick shale sequence with intercalated cherts. The Tsineng Formation is a microbial carbonate sequence.

The Asbestos Hill Subgroup of the Griqualand Basin occurs in both sub-basins. It is the three formations of the Asbestos Hill Subgroup, from the basal Kliphuis Formation, the middle Kuruman Formation, and the topmost Daniëlskuil Formation all comprise BIF deposits. The BIF sequences of the Prieska Basin are thicker than the same sequences in the Ghaap Plateau sub-basin. This is considered to be due to faster and longer lasting subsidence of the Prieska sub-basin (Beukes, 1980).

A period of thermal subsidence then ensued which allowed the invasion of the sea onto the Kaapvaal Craton, forming a shallow continental shelf environment. The first sediments deposited were those of the thin basal member, known as the Black Reef Series. These rocks include quartzites, conglomerates, shales and mudstones; particularly towards the top of the succession (Truswell, 1970). These rocks cap the high ridge of the eastern escarpment and spread as far to the west as the Northern Cape and Botswana (Rubidge & McCarthy, 2005). These dolomites, together with the stromatolites, make up the lower portion of the Chuniespoort Group known as the Malmani Subgroup (2,580 Ma).

The second subgroup of the Chuniespoort Group is the Penge Iron Formation. This formation consists of laminated sequence of iron-rich sediments and silica-rich sediments (Truswell, 1970). These rocks, however, also contain fine detrital matter as well as some tuff deposits. The only suitable environment producing these facies is a restricted basin where the chemical conditions are suitable and where detrital and pyroclastic material could be incorporated (Truswell, 1970). This formation is economically important for haematite and lesser gold, zinc and lead, vanadium and fluorite (Haughton, 1969).

The upper most subgroup of the Chuniespoort Group is the Duitschland Subgroup which has a maximum thickness of 460m and contains a similar assemblage to that of the Malmani Subgroup (Truswell, 1970). There are variable dolomites associated bands of chert and shale, and some conglomerate bands and layers (Haughton, 1969).

The overlying Pretoria Group lies disconformably over the Duitschland Subgroup. The dolomites were removed mainly by dissolution, leaving behind chert fragments. After subsidence, the renewed sedimentation formed the Pretoria Group approximately 2,350 to 2,100 Ma (Rubidge & McCarthy, 2005). The rocks of this group include mudstones, quartzites and some basalt. Many of the quartzites in the Time Ball Hill Subgroup contain iron as well as magnetite, whilst others contain oolites ferruginous in composition. The youngest of the quartzites contains a thin bed of oolitic ironstone that in succeeding weathering produces clay.

Economically important minerals of the Griqua Basin include massive iron ore deposits (haematitic) exploited in the Kathu area. The largest source of South African iron ore for internal consumption and international exports is derived here. Fluorite minerals have been recovered from small gemstone occurrences, but no fluorspar or other base metal mines are close by.

Approximately 150 km east of Kathu, lead-zinc deposits are found (Pering & Reivilo). The largest manganese reserves in the world are located in this area (Eriksson *et al*, 2006). No andalusite deposits are located here, but are known in other metamorphic terrains west of the Basin. Limestone deposits are mined at Lime Acres (east of Postmasburg) and the large Ulco cement works is located in the same area.

4.2.4 The Bushveld Complex (2061 Ma-2054 Ma)

The next significant event marked the beginning of the emplacement of the Bushveld Complex. The Bushveld Complex comprises three events that took

place within short periods of each other, grouped together into a complex since they are believed to be genetically related (Truswell, 1970; Cawthorn *et al*., 2006). The Bushveld Complex extends over a large area from the Botswana border to the eastern Mpumalanga escarpment, forming an elliptical structure. The central portion of the Complex is covered by younger sedimentary rocks. If these were to be removed, the Complex would cover a surface area of 66,340 km² (Truswell, 1970).

Between certain zones there are economically important and unique layers. These are the Main Magnetite Layer (MML), the Merensky Reef, and the Main Chromitite Band. The reason for their individuality is because they contain very important minerals and elements. The MML is found between the Upper and Main Zones and is not only an important source of the mineral magnetite but also contains small amounts of vanadium (Rubidge & McCarthy, 2005).

The Merensky Reef is a pyroxenite and lies between the Main and Critical Zones. It is renowned for its platinum content as well as other related elements. Likewise, the Main Chromitite Band, between the Lower and Critical Zone, is important for its chromite as well as platinum (Rubidge & McCarthy, 2005). The Rustenburg Layered Suite is thus one of South Africa's most valuable resources.

The platinum group metals, the chrome and vanadium deposits of the Bushveld Complex are amongst the largest in the world. Mines extend from Northam in the west, Rustenburg in the south, and Lydenburg in the east. This area also hosts some of the most prolific granite quarries, such as those in Brits, Stoffberg

and Belfast. South Africa's only magnetite mine at Roosenekal is a source of both vanadium and iron for the only magnetite-to-steel producer.

4.2.5 The Phalaborwa Complex (2060 Ma)

The Phalaborwa Complex is a feeder dyke to a volcano that erupted approximately 2,049 Ma (Rubidge & McCarthy, 2005). The Complex borders the Kruger National Park in the Lowveld of Mpumalanga. It is a structure that has been intensely studied for economic purposes since it contains large amounts of apatite, vermiculite, copper sulphides, iron-titanium oxides and radioactive minerals (Haughton, 1969). Two mines operate here, the Palabora Mine and the Foskor Apatite Mines.

4.2.6 The Kuruman and Postmasburg Kimberlites (1600 Ma)

The Kuruman and Postmasburg kimberlite pipes formed approximately 1,600 Ma (Rubidge & McCarthy, 2005). These kimberlites are situated close to the western edge of the Kaapvaal Craton and consist of bimineralic eclogites, orthopyroxene-bearing eclogites with and without sanidine, and kyanite eclogites (Jacob *et al*., 2004).

The kimberlites of the Postmasburg and Kuruman areas are the oldest known kimberlites. Economically, they are described as barren kimberlites but diamonds are mined from alluvial deposits immediately east of Kuruman.

4.2.7 The Pilansberg Complex (1430 Ma – 1138 Ma)

The Pilansberg Complex is an alkaline Complex that outcrops in an area 50 km northwest of Rustenburg (Rubidge & McCarthy, 2005). The Complex formed approximately 1,220 Ma (Hartzer *et al.,* 1998) and represents the root of a massive volcano. It is a remarkably circular feature covering an area of roughly 518 km² (Truswell, 1970). It is made up of a series of concentric rings with dykes radiating outwards from the centre. It contains both extrusive and plutonic igneous rocks; the former of which are mainly trachytes and phonalites and the latter of which are foyaites and syenites.

4.2.8 The Premier-National Kimberlites (1200 Ma)

This kimberlite pipe is approximately 1,200 Ma (Rubidge & McCarthy, 2005) and is roughly 883 m long and 426 m wide (Haughton, 1969). It was discovered in 1903 and became the source of one of the largest diamond mines in South Africa. It is the location of the Premier Mine, renowned for its discovery of the Cullinan diamond. The pipe is rimmed by diabase, granophyre and sediments of the Pretoria Group, but one of its most remarkable characteristics is xenolith of post Bushveld Waterberg conglomerate and quartzite (Haughton, 1969).

4.2.9 The Richtersveld Suite (920 Ma)

This granitic suite formed roughly 920 Ma (Hartzer *et al.*, 1998). In the eastern Richtersveld area there are a number of ring complexes and steep-sided plutons that are composed of leucocratic granites, porphyritic microgranites, syenites and quartz-porphyries (Truswell, 1970). These rocks are relatively fine

grained and their formation can thus be assumed to have occurred close to the surface. Associated with the complex are dykes consisting of hornblende diorite and syenitic rocks rich in alkalis but poor in ferromagnesians (quartz bostonite) (Truswell, 1970).

4.2.10 The Kheis Province (1900 Ma-1750 Ma)

In the period 1,900-1,750 Ma (Hartzer *et al.,* 1998) the Kheis metamorphic province formed.

This metamorphic province formed as a result of the collision between the Congo Craton and the Kaapvaal-Zimbabwe Craton and is known as the Ubendian event. As a result the sedimentary rocks on the western edge of the Kaapvaal Craton have been metamorphosed (Rubidge & McCarthy, 2005). The rocks of this province are divided into three groups; the Marydale, Kaaien and Wilgenhout Drift Groups. In the north and west of the province the degree of metamorphism increases with the production of gneisses (Haughton, 1969).

The Marydale Group contains the least metamorphosed rocks, such as basic lavas, tuffs, slates, and occasionally quartzite, arkose, banded ironstone and limestone (Haughton, 1969). As a result of metamorphism these rocks have been altered to granulites, paragneisses (Haughton, 1969), marble and other meta-sediments and meta-volcanics (Truswell, 1970). These iron and limestone deposits represents the economic potential of the Marydale Group.

The Kaaien Group consists of predominantly light coloured, fine-grained quartzites and related quartz-mica schists and granulites. These rocks form

hills as far north as the Kuruman River and as far west as the town of Springbok in Namaqualand (Haughton, 1969). The economic potential of this Group lies in the copper occurrences and small granite mines in the region.

Figure 12: Granitic terrain common of the Kaaien Group, Namaqualand region

4.2.11 The Olifantshoek Supergroup (1928 Ma-1893 Ma)

After the Vredefort impact was believed to have occurred around 2,023 Ma (Rubidge and McCarthy, 2005), a relative regression of the sea level led to the deposition of the Olifantshoek Supergroup rocks on the western edge of the Kaapvaal-Zimbabwe Craton approximately 1,900 Ma (Rubidge & McCarthy, 2005). The rock types making up the Olifantshoek Supergroup are limestones, dolomites, quartzites and mudstones. The Olifantshoek Supergroup, in its entirety, does not host any economic mineralisation.

4.2.12 The Waterberg and Soutpansberg Groups (1900 Ma)

Following the Ubendian event, sediments were deposited on a large alluvial plain that covered most of the Kaapvaal Craton. The resultant rocks form the Waterberg Group. These rocks occur fragmented across the country as a result of subsequent erosion (Rubidge & McCarthy, 2005).

The rocks of the Soutpansberg Group are similar to those of the Waterberg Group, except they are underlain by basaltic lavas inter-layered with volcanic ash beds of rhyolite. These lavas are believed to have erupted approximately 1,900 Ma (Rubidge & McCarthy, 2005). The Soutpansberg and Waterberg Group rocks are known as South Africa's 'Red Beds' and are indicative of an oxygen-rich atmosphere (Rubidge & McCarthy, 2005). Copper occurrences are present in the Soutpansberg, largely in quartz veins. Only small mines ever developed there, and with variable success (Barker *et al*., 2006).

4.2.13 The Namaqua-Natal Metamorphic Belt (1300Ma -1100Ma)

In the period between 1,300-1,100 Ma, the southern margin of the Kaapvaal Craton approached a subduction zone. The ocean basin in eastern Namaqualand began to close, causing island arcs to accrete on the southern margin of the Craton (Rubidge & McCarthy, 2005). This event marked the assembly of the southern African portion of the supercontinent 'Rodinia' and is known as the Kibaran event.

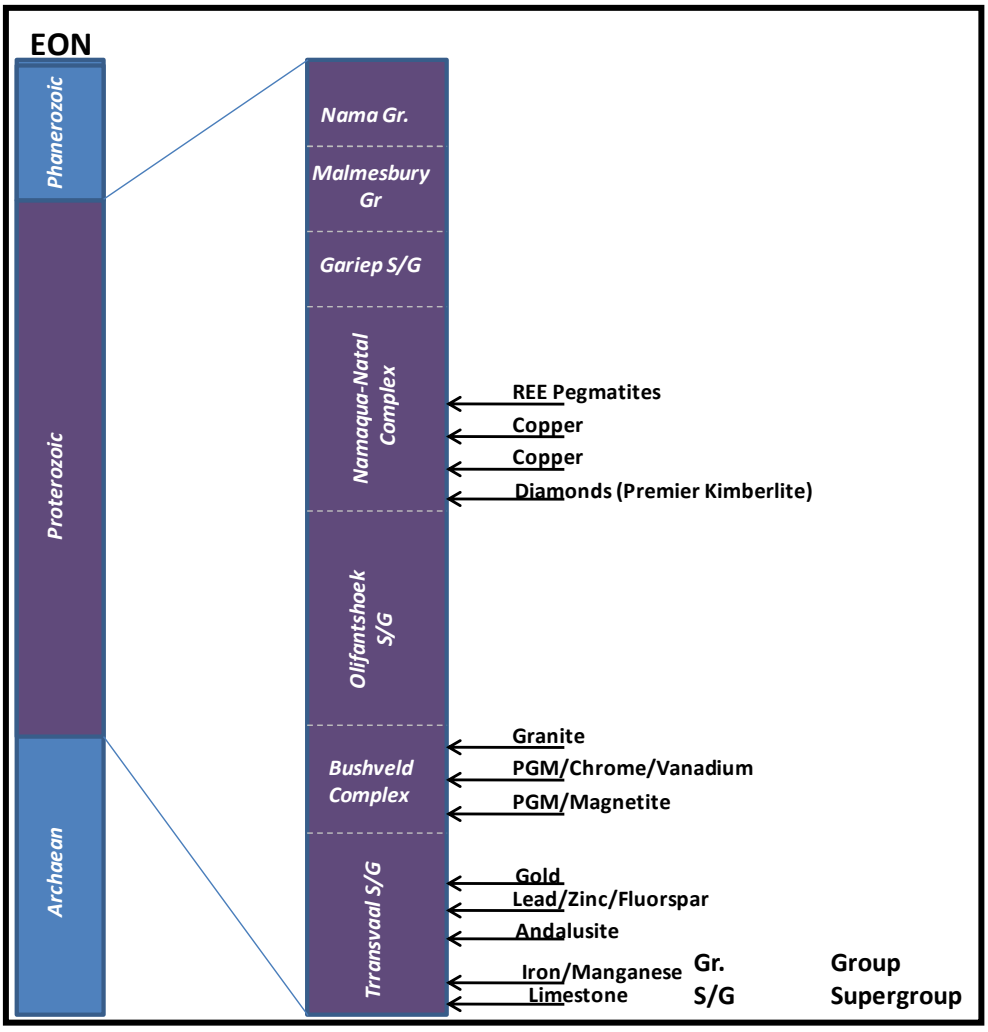

Figure 13: Schematic of Proterozoic stratigraphy and associated mineralisation

Source: Adapted from information derived from The Geology of South Africa (2006) eds. M.R. Johnson, C.R. Anhaeusser and R.J. Thomas

The sedimentary rocks deposited in the rift between the Congo and Kaapvaal Cratons were compressed, intensely folded, metamorphosed and intruded by granites (Rubidge & McCarthy, 2005). Today these rocks can be found in the area between Margate and the Tugela River and much of the Northern Cape. These rocks belong in a belt known as the Namaqua-Natal Belt, or the Namaqua-Natal Metamorphic Province.

The Namaqua-Natal Belt possesses several economic mineral deposits. One of the most important of which is the copper deposits found at Prieska and O'okiep (Rubidge & McCarthy, 2005). Other deposits include zinc-copper and zinc-lead-copper-silver deposits; some of which are associated with barite (Wilson, 2006) as found at Gamsberg near Aggeneys.

The pegmatites of the Namaqualand terrain are feldspar rich, but they are not able to provided profitably to markets in Cape Town and Johannesburg. Small scale miners still try to keep small volumes supplied (Baartjes, 2010). The economic occurrences of the Natal section are considered sparse, with small gold occurrences in the Tugela Terrain, and iron-titanium mineralisation of the Mambula Complex is a sub-economic ilmenite target (Reynolds, 1986).

4.3. Economic geology of the Phanerozoic Eon (545 Ma - Present)

The surface rocks that are exposed and belong to the Phanerozoic Eon are the most prevalent. Even though the Phanerozoic Eon is of the shortest duration (545 Ma vs. 1,100 Ma and 1,800 Ma for the Archaean and Proterozoic Eons respectively) it is preserved in the most localities. Figure 14 shows the location of these rocks. What is very evident is that coastal provinces have the largest amount of Phanerozoic rock exposed.

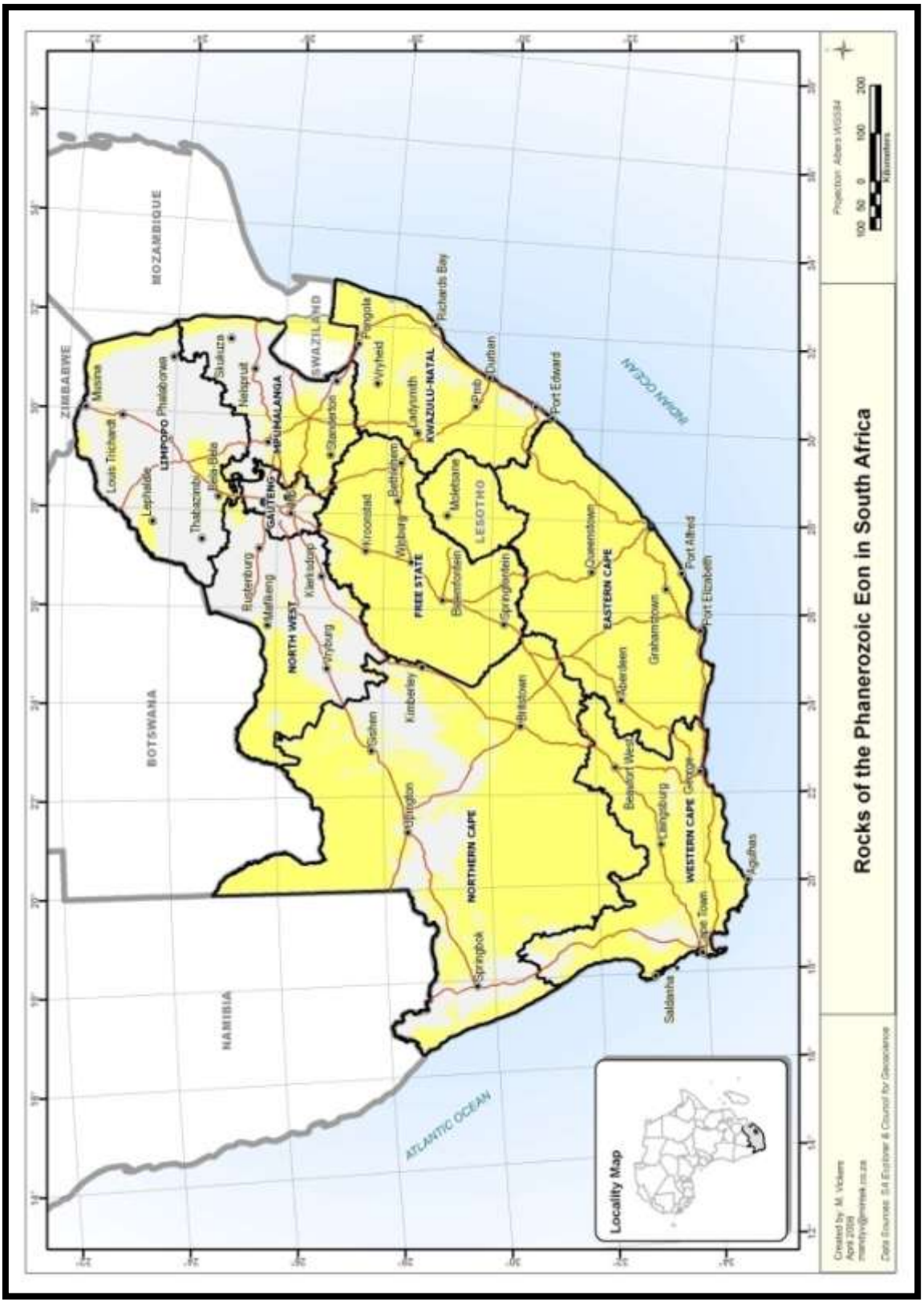

Figure 14: Rocks of the Phanerozoic Eon in South Africa

Source: Supplied by M Vickers (Private consultant)

4.3.1 The Cape Granite Suite

Approximately 600-500 Ma the sedimentary rocks to the south of the Kaapvaal Craton were folded and invaded by granites (Rubidge & McCarthy, 2005). These granites form large rounded outcrops in many parts of Cape Town's beaches and the famous inland outcrop is the Paarl Dome. The eastern group of granites consist of three separate masses and are older in age than the ones in the south-west (Haughton, 1969). No large scale economic mineralisation is known but smaller, isolated occurrences of discreet mineralisation patterns are recognised. These are tin deposits with minor gold, copper and zinc, or tungsten-molybdenum deposits, or lastly, copper-molybdenum-gold deposits.

4.3.2 The Cape Supergroup

Around 500 Ma the super-continent Gondwana had consolidated, forming mountain chains along its sutures (Rubidge & McCarthy, 2005). Around 450 Ma, however, parts of Gondwana began to rift, causing thinning of the crust and ultimately, invasion by the sea. It was this invasion that resulted in the formation of the Cape Supergroup rocks (Rubidge & McCarthy, 2005).

These rocks overlie the older rocks unconformably and extend from the Cape Peninsula northwards to the Bokkeveld mountain north-east of Vanrhynsdorp (Haughton, 1969). It is comprised of three groups, except in the KwaZulu-Natal region where a fourth is included. In the KwaZulu-Natal Province the oldest group in the Supergroup is the Natal Group.

There are no ferrous or non-ferrous deposits of significance. The Cape Supergroup, however, does provide low value 'construction minerals' such as aggregate, limestone and building sand. The shales have limited application.

4.3.3 The Karoo Supergroup (320 Ma-140 Ma)

The Karoo Supergroup rocks formed 320 Ma to ±140 Ma (Hartzer *et al*., 1998). The Karoo basin was one of the largest basins of South Africa and covers half the land surface of South Africa today (Haughton, 1969).

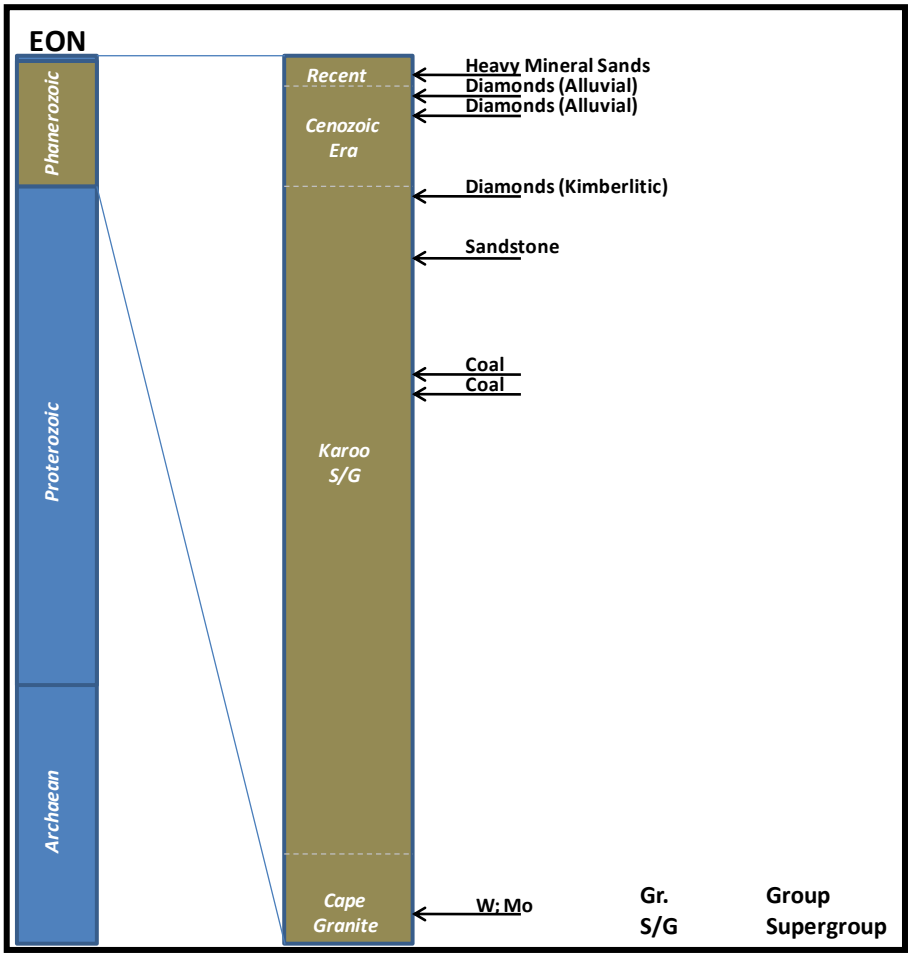

Figure 15: Schematic of Phanerozoic stratigraphy and associated mineralisation

Source: Adapted from information derived from The Geology of South Africa (2006) eds. M.R. Johnson, C.R. Anhaeusser and R.J. Thomas

The Karoo Supergroup consists of, from the base, the Dwyka, Ecca and Beaufort Groups. This is overlain by the Stormberg Group, Elliot and Clarens Formations, and finally overlain by the Drakensburg Group.

As Gondwana continued to drift northwards, South Africa moved out of the southerly poles area and ice melted to produce a large inland water body (Rubidge & McCarthy, 2005). It was in this inland depression where the rocks of the Ecca Group were deposited. During this time period the dominant plant type was Glossopteris, which produced thick coal seams within the Ecca Group (Rubidge & McCarthy, 2005). All South Africa's coal deposits are hosted within the Karoo Supergroup formations, particularly in structural depressions.

It is estimated that 55 000 Mt of coal resources are still hosted in the Karoo rocks. The Karoo Supergroup in the Beaufort West area hosts large deposits of sub-economic uranium and molybdenum. The grade, however, remains low and only attracts interest when uranium prices rise.

4.3.4 The Cape Fold Belt (280 Ma-230 Ma)

In the period 280-230 Ma (Hartzer *et al.*, 1998), while the upper units of the Karoo Supergroup were being deposited, a subduction zone developed along the southern margin of Gondwana. The sedimentary rocks that were deposited on the floor of the Agulhas Sea buckled and folded as the crust became compressed. This buckling and compression caused the crust to thicken and an extensive mountain range formed. These mountain ranges are composed of metamorphosed sedimentary rocks of the Cape Supergroup.

4.3.5 The Kalahari Group and Cenozoic Deposits

Marine deposits from this period are only preserved along the coastal fringes (Haughton, 1969). Inland deposits were concentrated in inland basins. Rivers deposited clay, calcareous marls, sands and occasional gravel bands in the Kalahari basin, forming the Kalahari Group. Their age is uncertain but generally believed to be Tertiary (Truswell, 1970). Economic minerals found in these sands are kyanite, garnets, epidote, sillimanite and andalusite (Truswell, 1970).

Cenozoic deposits, particularly along the drainage channels and west coast shoreline, are diamondiferous with many operations. Furthermore, heavy mineral sands occur in the Cenozoic deposits on the east coast around Richard's Bay and the west coast around Vredendal.

4.4. **Conclusion**

South Africa has a surface area of 1.2-million km^2 which is less than 2% of the global land surface area. However, in this relatively small area the mineral endowment is so substantial that South Africa is a commodity powerhouse. According to the DME, South Africa is ranked in the top two in at least nine commodities (see Table 6).

Table 6: South Africa's rank in world mineral resources

Commodity	Unit	Mass	%	Rank
Chrome	Mt	5 500	72.4	1
Gold	t	31 000	29.7	2
Manganese	Mt	4 000	80.0	1
PGM	t	70 000	87.7	1
Vanadium	kt	12 000	31.0	1
Fluorspar	Mt	80	16.7	2
Titanium	Mt	224	16.3	2
Vermiculite	Mt	80	40.0	2
Zirconium	Mt	14	18.2	2
Diamond	Mct	12.9	7.9	6
Antimony	kt	200	4.7	6
Phosphate	Mt	2 500	5.0	4
Nickel	Mt	12	8.0	5
Uranium	kt	300	10	4
Lead	kt	3 000	2.1	6
Coal	Mt	30 408	3.7	8
Zinc	Mt	15	3.3	8
Iron Ore	Mt	1 500	0.9	9
Copper	Mt	13	1.4	14

Source: DME Mineral Economics Directorate (2008)

CHAPTER 5. LEGAL FRAMEWORK FOR MINING

5.1. Introduction

This chapter serves as an introduction to the complex, myriad pieces of legislation regarding mining in South Africa. The advantages and disadvantages of social development within the mining sector are also noted.

5.2. The advantages and disadvantages of mining for economic and social development

In South Africa the Constitution of the Republic of South Africa (Act 108 of 1996) provides the framework for governance. Section 2 of the act states:

> *'This Constitution is the supreme law of the Republic; law or conduct inconsistent with it is invalid, and the obligations imposed by it must be fulfilled.'*

In terms of rights the Constitution provides a Bill of Rights in Chapter 2 from Section 7 to 39. The Constitution, it is observed, does not mention mineral resources specifically. The ensuing legislation around minerals, i.e. the Mineral and Petroleum Resources Development Act (MPRDA) therefore does not align itself with any part of the Constitution accept to record that the purpose of the MPRDA is to transform the mining sector (not a Constitutional prerogative).

The Bill of Rights of the Constitution (Chapters 7-39) does place emphasis on the environment in Section 24 (provided here below). Here natural resources

are referred to, which could be interpreted to include agricultural and mineral resources.

"24 Environment

Everyone has the right-

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development."

It is the author's view that the mineral legislation used to monitor performance and impact is inadequate due to its narrow focus on the mining development chain (see Figure 16). To understand the impact of mining on an economy the mining legislation (i.e. the Mineral and Petroleum Resources Development Act) as well its supporting regulations (such as the Mining Charter) need a broader footprint. Unfortunately mining legislation has a small impact in relation to the entire mineral development chain. The author has experienced that environmental legislation cuts across all stages of the mineral development chain and is therefore more impactful and should be considered as more

substantial in monitoring the mining sector and all the 'products', whether positive and negative, that emanate from the mining sector.

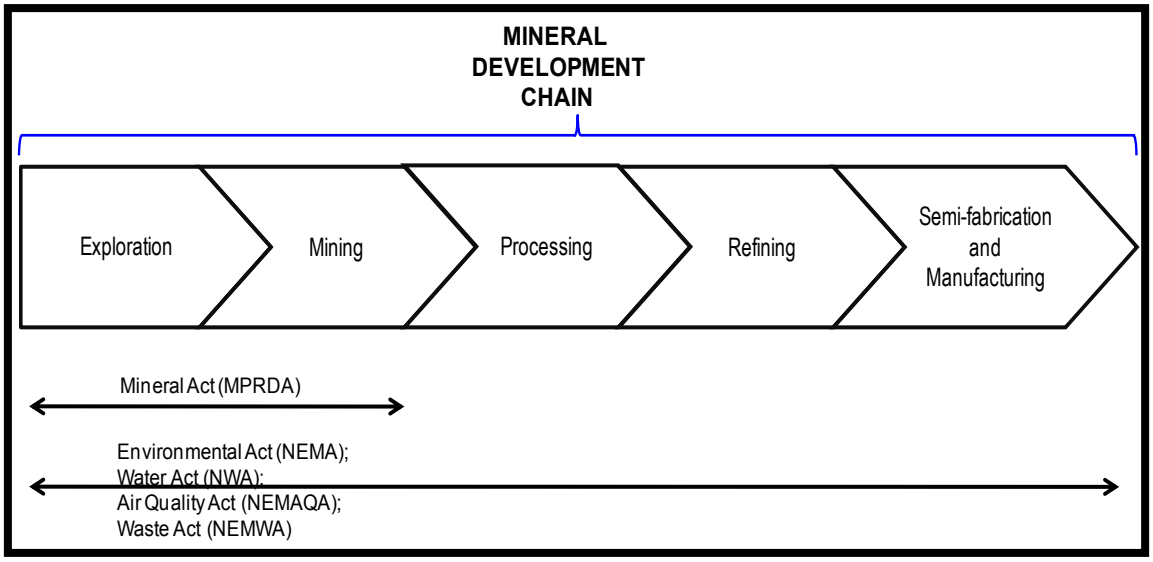

Figure 16: Mining development chain with the scope of relevant legislation illustrated

Source: Baartjes, 2010.

5.3. Relevance to mineral resources used for economic development

Economic development of mineral resources will trigger several legal requirements in South Africa. By its very nature the development of mineral resources is an activity that could result in both economic development and ecological degradation. One Constitutional right is that everyone has the right to an environment that is not detrimental to their health or well-being (Section 24). One of the requirements of this right is that government will ensure protection of the environment through reasonable legislative and other measures.

Environmental legislation in South Africa is spread over a variety of Acts, managed by a variety of Departments, over three tiers of government. The National Environmental Management Act, 1998 (Act 107 of 1998) is used to implement Section 24 of the Constitution. Figure 17 shows the legal framework applicable to mining projects in South Africa at a glance. The implementation of various laws is related to the project stages, and this implementation is often managed from an environmental perspective.

This is by no means a complete list of legislation applicable to mining, but it does provide a starting point for the interpretation of legislation that might be triggered by activities common to all types of mining. The following laws MUST be considered for their applicability to mining projects. It is likely that the development of mineral resources will trigger one, or all, of these laws and their associated regulations:

- Mineral Petroleum and Resource Development Act (MPRDA) (Act 28 of 2002 and Government Notice R 527 of 23 April 2004);
- National Environmental Management Act (NEMA) (Act 107 of 1998);
- National Water Act (NWA) (Act 36 of 1998);
- National Environmental Management Air Quality Act (NEMAQA) (Act 39 of 2004);
- National Environmental Management Waste Act (NEMWA) (Act 59 of 2008);
- National Heritage Resources Act (Act 25 of 1999); and

- National Nuclear Regulator Act (Act 47 of 1999).

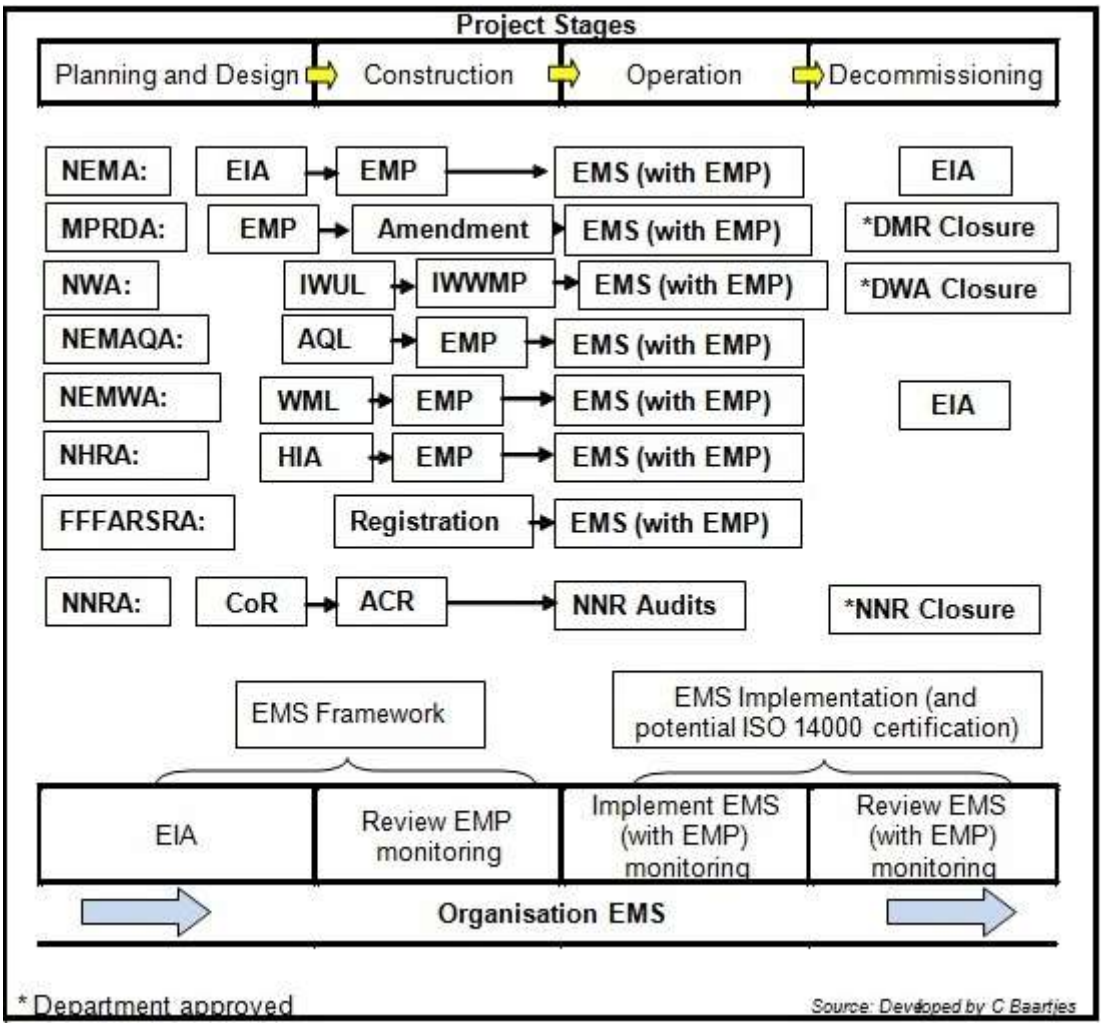

Figure 17: The various environmental authorisations required

5.4. Mineral Petroleum Resources and Development Act

The Mineral Petroleum and Resource Development Act (MPRDA) (Act 28 of 2002 and Government Notice R 527 of 23 April 2004) contains a myriad of environmental requirements. According to the objects of the act the MPRDA was to formally recognise that the state is entitled to sovereignty over the mineral and petroleum resources of South Africa. Once sovereignty was claimed the government could then set itself up as the custodian of the same

mineral and petroleum resources on behalf of the people of South Africa. This change in ownership was a dramatic departure from the 1991 Act which was totally repealed. Government then set about an objective to ensure equitable access to the claimed resources to all the people of South Africa. The link between this last object lead to the 'use it and keep it' policy adopted in reallocating mining rights. The act also states that the use of mineral development is to support sustainable development (promotes economic growth, promote employment, ensure right holders contribute to socio-economic development and compel mineral development to be done in an ecologically sustainable manner).

5.5. **National Environmental Management Act**

The National Environmental Management Act (NEMA) (Act 107 of 1998) did not at its inception seek to address the mining sector. The NEMA Act did set out to reinforce the right of South Africa's inhabitants to an environment that is not harmful to their wellbeing. This was the reversal of many years of mining companies and their downstream industries being able to externalise some of their operational costs onto the environment. The act was designed to reduce or eliminate where possible environmentally harmful practices, a direct challenge to the mining sector.usually applies to mining projects because some of the listed activities, as regulated by Section 24, are triggered. These listed activities can be found in Government Notices R.386 and R.387 of 21 April 2006. Listed activities require a Basic (386)/Thorough (387) Assessment Process, otherwise referred to as an Environmental Impact Assessment (EIA).

5.6. National Water Act

The National Water Act (NWA) (Act 36 of 1998) requires the registration of Water Uses and the application for Integrated Water Use Licences (IWUL). The Water Use License is managed through the Integrated Water and Waste Management Plan.

5.7. National Environmental Management Air Quality Act

The National Environmental Management Air Quality Act (NEMAQA) (Act 39 of 2004) requires the application of an Air Quality License. The integration of various industries is required as air will be managed according to municipal requirements.

Air and water are both considered pollution vectors and in certain mining activities, including processing, it is a very significant requirement. Mining does not only effect water and air but the mining impacts can be transferred through polluted water and air. The effects of acid mine drainage is an example of this transfer between mines and other users of water. The NWA firstly state as an object to prevent pollution and thereafter the cleaning of water. This has not been the case under previous legislation but the Acts, read with their regulations, now makes unlawful all indiscriminate and unauthorised use of water and emissions to the atmosphere.

5.8. National Environmental Management Waste Act

The National Environmental Management Waste Act (NEMWA) (Act 59 of 2008) requires the application of a Waste License. Several Waste Management Activities could trigger waste licenses. The Act compels companies that generate waste to reconsider their processes to minimise waste at every opportunity and stage of mining and processing. The call for cleaner production becomes a competitive hurdle and what is known about mines in South Africa is that their grades are in general decline and their waste ratios are increasing. The requirements of NEMWA raise the costs of processing, particularly of low grade, high-cost ore bodies.

5.9. National Heritage Resources Act

The National Heritage Resources Act (Act 25 of 1999) applies specifically to areas where new ground will be disturbed by mining. Heritage resources need to be assessed and documented before being disturbed by mining activities. In some cases alternative site layouts can be used to mitigate the potential disturbance of resources.

5.10. National Nuclear Regulator Act

The National Nuclear Regulator Act (Act 47 of 1999) applies specifically to areas where the minerals or the ore contain radioactive materials. People wishing to engage in actions that are capable of causing nuclear damage may apply for a Certificate of Registration (CoR) or a Certificate of Exemption (CoE).

Should the original infrastructure, or the way of managing radioactive materials change, then application must be made for an Authorisation Change Request.

The National Nuclear Regulator (NNR) manages their conditions through audits. The act increased control over the extraction and processing of all radioactive minerals. It elevated events around mining and processing of these to high level incidents. The nuclear regulations have an effect on all radioactive minerals and deposits with radioactive minerals. This therefore affects all Witwatersrand Gold mines, all rare earth and carbonatite deposits and in certain circumstances the zircon product stream in heavy mineral deposits. The planning of dump retreatment projects are all subject to this act

5.11. **Summary**

This chapter on legislation has focused on the environmental legislation because the author's experience is that laws and regulations around environmental compliance cut across a much larger part of the mineral development value chain. The mining legislation has a very narrow focus, so it is imperative to track the most all encompassing legislation.

The legal framework for governance in South Africa is the Constitution (Act 108 of 1996). Mineral resources are not mentioned *per se* in the Constitution, and the only reference is to natural resources (mentioned in S24). The legislation in the mining sector has evolved during the history of mining in the post-1994 draft of legislative changes which have dramatically brought to the fore South Africa's

commitment to a new mining regime based on strong social and environmental performance to balance the focus on economic development.

The legislation requires independent specialist input for all mining projects. The result has been that large and small projects have the same compliance requirements. The cost of compliance differs between large and small companies.

Environmental legislation in South Africa is spread over a variety of Acts (currently 86 Acts), managed by a number of Departments over three tiers of government. The National Environmental Management Act, 1998 (Act 107 of 1998) is used to implement Section 24 of the Constitution. Conflicting legislation and regulations provide a wide variety of interpretations, resulting in an industry that is exposed to the understanding of the incumbent official administering the law at that point in time.

The MPRDA regulations have more than 80 environmental requirements for compliance. Further to that there are more than 200 other activities that trigger compliance requirements. A case can be made for streamlining some of these requirements, particularly when rural development projects are considered.

The following chapter details the mineral-based site investigations conducted by the author.

CHAPTER 6. MINERAL BASED SITE INVESTIGATION

6.1. Introduction

This study requires a review of some opportunities and problems experienced by various mines (mineral resource economic developments). Economic development is needed more in areas of greater poverty than elsewhere. It is therefore important to understand the requirements for the establishment of a mine. It is understood that building a large mine will require more capital and thus more exposure to the fluctuation of the specific mineral price - the price needs to be robust through several cycles until the mine is in full operation.

If the objective of this study is to encourage small scale mining in areas of higher poverty, then it is important to understand some of the features of small mines across commodities and across geographical regions.

6.2. Identification of mine sites

To support this study a set of four mine sites of quarries were identified for field investigation. The original basis was driven by their location on the mining life cycle based on operational stages and revenue (see Figure 18).

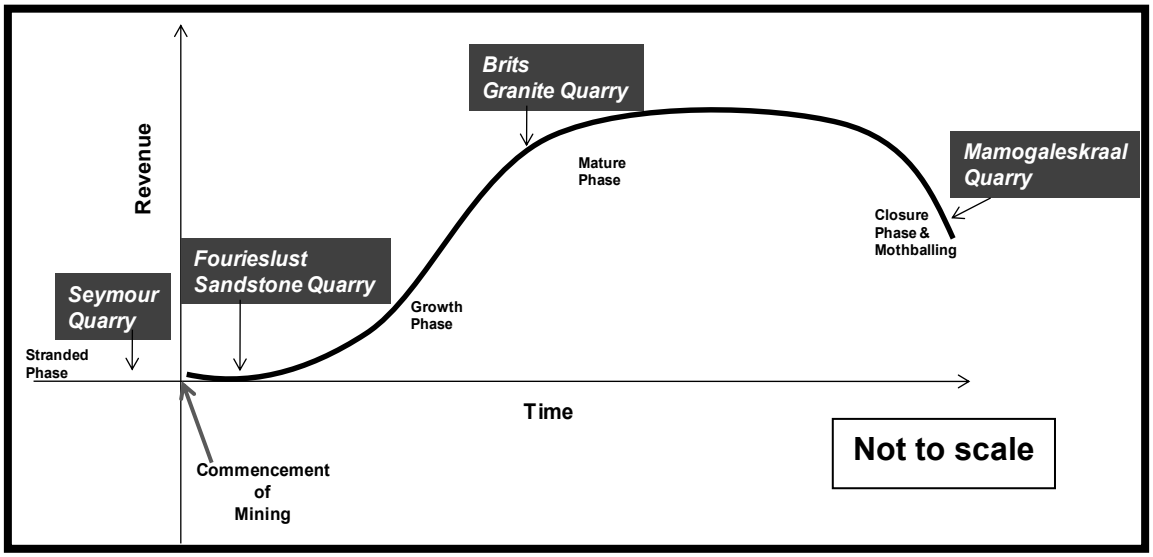

Figure 18: Original mine sites identified for investigation in terms of the mining life cycle

As opportunities emerged during other field visits, the opportunity was taken to visit additional mine sites. Eventually the following eight sites shown in Table 7 were selected for field investigations.

Table 7: List of mines sites visited

Name	Province	Commodity	Visited
Brits Granite	North West	Dimension Stone	June 2006
Fourieslust Sandstone	Free State	Sandstone	February 2007
Kotzeshoop Aragonite	Northern Cape	Aragonite (Gemstone)	July 2007
Mamogaleskraal Granite	North West	Dimension Stone	June 2007, November 2008, June 2009

Name	Province	Commodity	Visited
Nababiep Copper Reprocessing	Northern Cape	Copper	July 2007
Onseepkans Granidiorite	Northern Cape	Dimension Stone	July 2007
Seymour Aggregate	Eastern Cape	Dolerite	May 2008
Witkop Pegmatite	Northern Cape	Feldspar, Mica, Spodumene	July 2007, August 2008

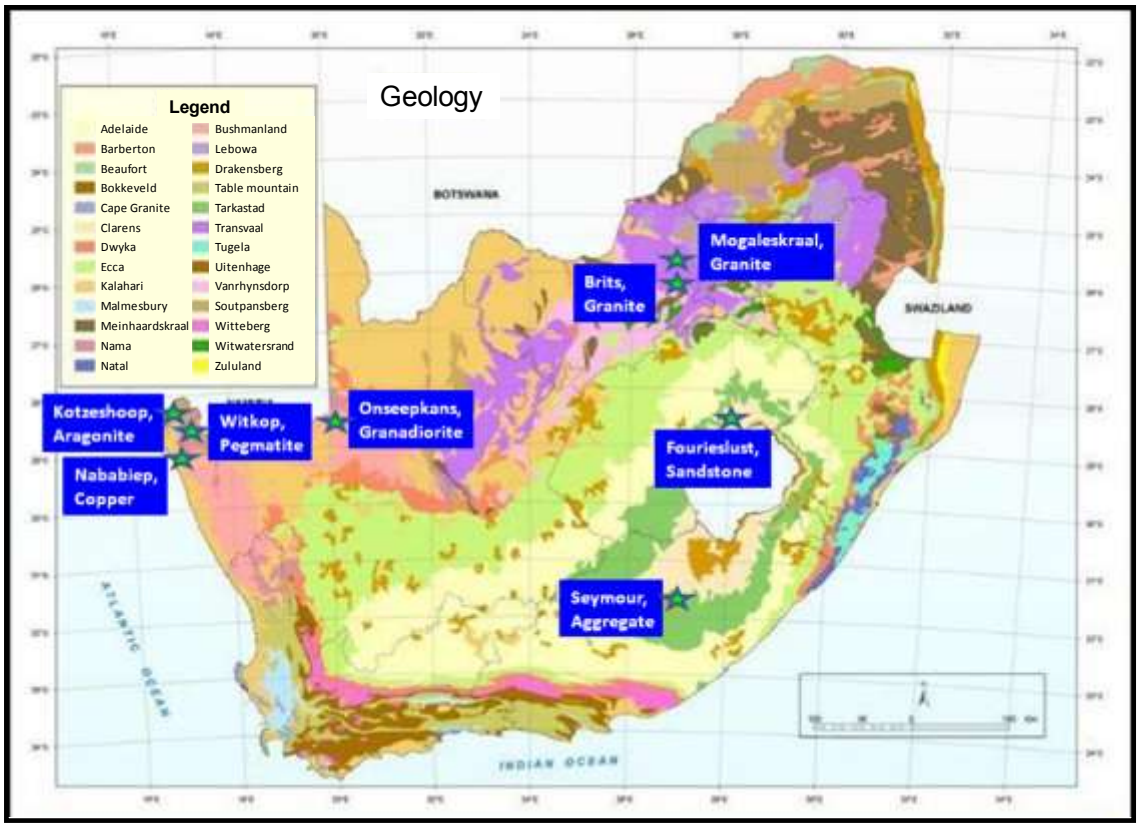

Figure 19: Location of field visits

Source: Private Consultant (M Vickers)

6.3. **Brits Granite, North West Province**

6.3.1 Coordinates and location

The area is located at S 25°38'30.34" E 27°50'43.21". From the Brits N4-R566 intersection, travel towards Ga-Rankuwa. At the Letlabile turnoff there is a dirt road to the south. This is the entrance to the Keeley Granite Quarry (this mine has subsequently been taken over by Eagle Granite).

The cutting works is situated on the R566, approximately 2000m east of the Brits N4-R566 intersection.

6.3.2 Commodity and description

Granites occur in the Lebowa Granite Suite in the Bushveld Complex. Granite is a medium to course grained felsic (potassium-rich) igneous rock, with colours varying from grey to pink.

6.3.3 Value chain stage

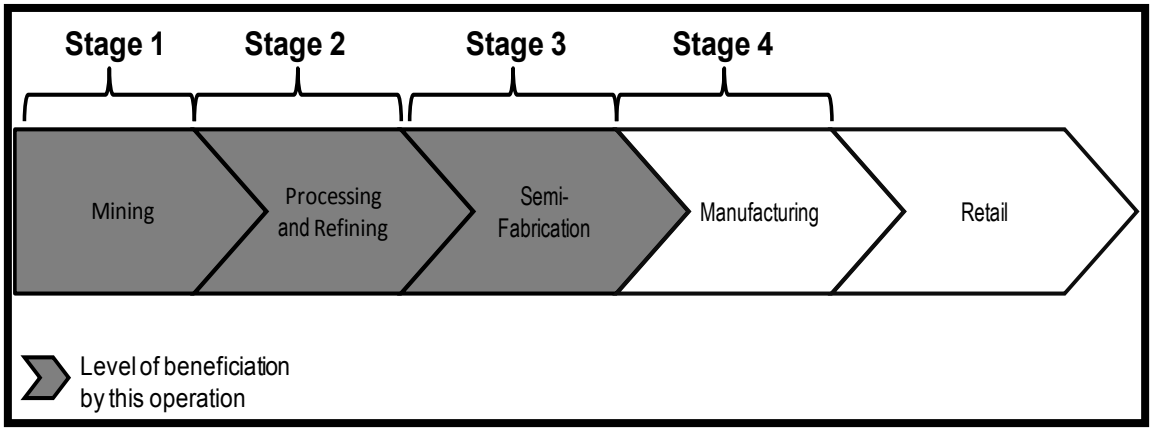

Figure 20: Level of beneficiation of the Brits Granite project

When owned by Keeley Operations the mine was limited to Stage 1 and Stage 2, but Eagle Granite owned nearby granite processing works and this supported the merger. Today the operation involves itself in Stages 1, 2 and 3 levels of beneficiation; up to the exporting of dressed blocks. Some of the blocks are sold within South Africa for the manufacture (Stage 4) of additional goods. Keeley Granite therefore is itself involved up to Stage 3 and supports Stage 4.

6.3.4 General observations

Large blocks are removed from the excavation quarry by large earthmoving equipment, and large blades are used to cut the blocks into smaller pieces as required by the market.

Figure 21: An example of a blade used to cut granite slabs

Figure 22: Gantries used at Keeley Granite, Brits

A granite block will go to the waste rock dump if the block is below market specification. The largest cause of rejection at this operation is due to cracks in the granite blocks. More than 80% of a granite deposit becomes waste. Ninety five percent of the material is exported and sold on the international market. Most of the granite is currently sold in large blocks that weigh between 24 and 32 tons. Smaller blocks are not economically viable for export but may be used in South Africa if it is beneficiated close to the waste rock dump. Cracks make the large blocks uneconomical for the international market.

The logistics associated with the beneficiation present many challenges. The material is very hard and difficult to cut into smaller pieces or even crush. There is furthermore a safety risk in removing the large blocks from the waste rock dump.

Figure 23: Granite cobble stones

Figure 24: Granite garden furniture

Granite is currently a highly sought after commodity. It is very popular for use as kitchen tops, bathroom accessories, and grave stones. Cobble stones and tiles can be cut from very small pieces of granite.

To succeed as a small business Keeley Granite had to make several high impact, but also costly, investments and decisions. They had to:

- Establish an integrated operation that mines from its own quarry and

then processes at its own site;

- Source products from external producers to increase its product range;
- Locate themselves close to a rail head; Brits was accessible for trucking and rail purposes; and
- The business is successful but an integrated (Mine→Process) step is required.

6.3.5 Mining relevance and impact

Small mines need to, at times, become more integrated to be able to achieve better returns. Mining, particularly of granite, is erratic in terms of cost impact and so more stable returns are required. The business needs to be integrated with markets outside of Brits; substantial effort and resources are needed for this.

It is very clear that all the granite mined out of the quarry cannot be used locally. This mine is successful because it is close enough to a rail-port link that makes it economically viable to export. In this manner the highly paid exported product subsidises the cost of transport to South African markets. Reduction of waste will ensure better returns as more of the mining cost is then spread over more material being sold.

6.4. **Fourieslust Sandstone, Free State**

6.4.1 Coordinates and location

The area is located at S 27°57'32.6" E 28°37'36.72". From Johannesburg take the N1 south to Ventersburg. At Ventersburg take the R70 southeast towards Senekal. At Senekal take the N5 east towards Paul Roux. After 5 km along the N5 is the continuation of the R70 to Ficksburg. Along this section of the R70 continue 32 km to Rosendal. From Rosendal continue on the R70 for 12 km. At this point there is a single dirt road to the south east. Take this road for 2 500 m, and the Fourieslust Sandstone Deposit is 70m west of the road.

6.4.2 Commodity and description

Sandstone, a sedimentary rock composed of >90% quartz, is mined in this area. These rocks occur in a variety of colours and are quite resistant to weathering.

6.4.3 Value chain stage

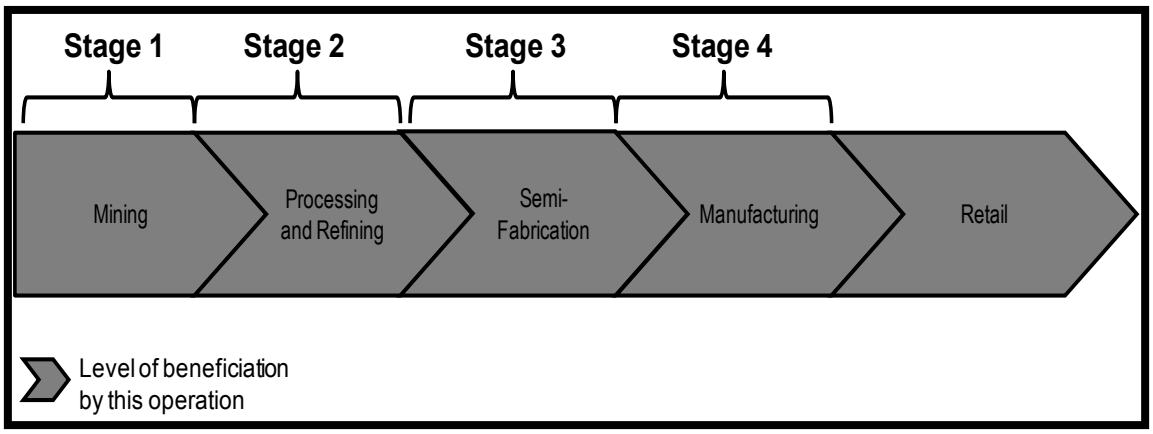

Figure 25: Level of beneficiation of the Fourieslust Sandstone project

This operation is involved at all stages of the value chain because the owner operates a sandstone retail outlet. The operation is still emerging and can expand quickly.

6.4.4 General observations

The location is a gently dipping area away from the farm house but close to the road. The sandstone is largely a pale white, fine grained variety. At a second site several hundred metres away the sandstone appears yellow. The topsoil cover here is thin but the vegetation is very stable with no pioneer species noted. The existing infrastructure includes three dams, a borehole and a windmill on the Fourieslust farm.

An existing road runs from the main tar road to the mining site. A compressor and excavator are used for mining and quarrying (see Figure 26). Approximately 3000 cubic metres of sandstone will be extracted, and the operation will be financed from the personal account of the owner.

Figure 26: Sandstone workings at Fourieslust

6.4.5 Mining relevance and impact

The operation is fairly new, and has the potential to employ eight people from the local area. Unlike operations closer to Lesotho, this site in Fourieslust does get cold but does not experience the same annual closure due to snowfall in winter. The permitting process was slow however, and more than one site can be opened but it is onerous.

6.5. **Kotzeshoop Aragonite, Northern Cape**

6.5.1 Coordinates and location

The area is located at S 28°44'01.70" E 17°35'45.41". From Springbok take the N7 north to Vioolsdrif. At Vioolsdrif take the dirt road to the left (north westerly) which passes the police station. Follow this dirt road along the Orange River for 7 km. A lone house is on the right hand side. From this house continue 300 m until an open expanse of water emerges on the left hand side. Drive up this water course until an earth wall is encountered. Stop here and walk 1 100 m along the mountain track to the deposit. The deposit is on the eastern side of a ravine.

6.5.2 Commodity and description

Aragonite is mined here, a type of elongated calcium carbonate crystals formed either by physical or biological processes. It forms by precipitation or from molluscs shells or exo-skeletons of aquatic invertebrates. Aragonite is a meta-stable mineral and in most cases it converts to calcite.

6.5.3 Value chain stage

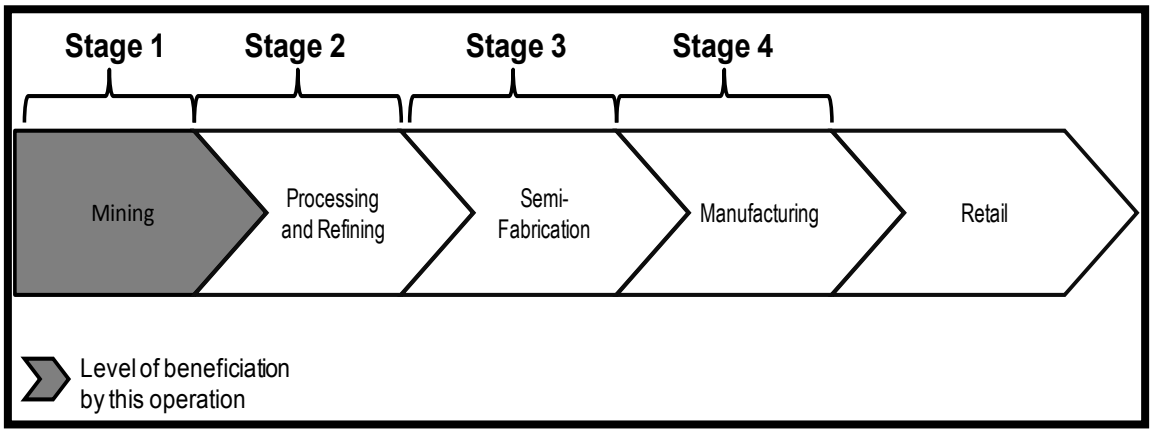

Figure 27: Level of beneficiation of the Kotzeshoop Aragonite project

6.5.4 General observations

The area is extremely inaccessible. The route from the earth wall to the deposit is along a mountain path that is approximately 2 m wide. It is unclear who built this path. The material from the area, according to the guide and owner, is sometimes transported from the site to his home (located close by) with a small tractor. The path does deteriorate and at one point when they were trying to fulfil an order for aragonite, the path disintegrated to the extent that they had to carry the aragonite for 700 m to the break in the path. From here it could be moved by tractor to the house.

A decision was taken to repair the path but it took two weeks and then disintegrated again. The disintegration, from the author's observation, occurs in a weak area in the dolomite which has numerous calcite veins.

The aragonite is taken from veins at the deposit site. The orange and yellow colour is easy to observe against the grey and dark grey background. Material

is sold in 1-3 ton lots. This is what can be transported by open-vehicle or with a trailer. This trailer needs to be hired in Springbok, brought 70 km to the area, and returned to Springbok. Deliveries to date were partway, with the miner only needing to travel to Kakamas, Northern Cape, where he was met by the buyer.

6.5.5 Mining relevance and impact

The site is extremely remote and is mined only when orders are received. Due to the low prices achieved (R4-R15/kg) it is difficult to develop a sustained marketing drive, which would be costly. Marketing via the internet is not possible as there is no internet or telephone access at the site. It is difficult to employ locals for long periods due to the erratic nature of orders. Some attempt was made to clean ore further, but it never developed due to a lack of market; this is a market driven commodity.

6.6. **Mamogaleskraal Granite Quarry, North West Province**

6.6.1 Coordinates and location

The area is located at S 25°34'11.84" E 27°48'33.55". From Brits take the R566 east. After 4 km the tar road to Lethlabile and Barokololo is taken. Eight km along this road, beyond the Vametco mine entrances, are the granite waste piles immediately on the left of the road and 300m to the right, close to a farmhouse.

6.6.2 Commodity and description

This was a site of granite mining, also from the Lebowa Granite Suite. The granite is a medium to course grained felsic (potassium rich) igneous rock, with colours varying from grey to pink. This granite is similar to that of the Keeley Granite quarry.

6.6.3 Value chain stage

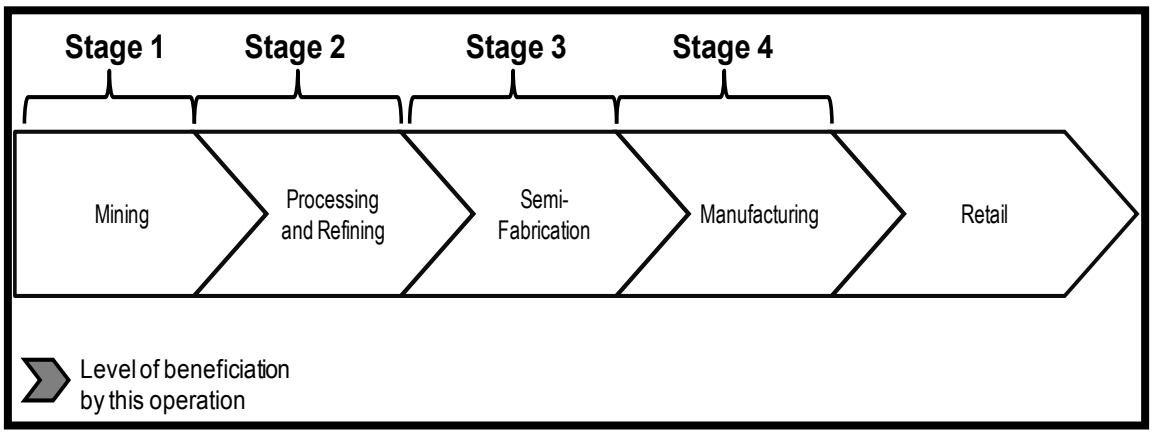

Figure 28: Level of beneficiation of the Mamogaleskraal Granite site

6.6.4 General observations

It is currently abandoned, or mothballed, and mining was stopped without rehabilitation. It is evident that there is still a portion of the resource available for mining.

The “Mamogaleskraal site’ is one of three areas lying on either side of the Lethlabile – Brits tarred road. The area has been mined and stacking of granite waste has kept this out of easy sight and some pioneer species have returned. The grey granite is particularly popular. No interest can be seen in the local community. Mamogaleskraal is 3 000 m to the north but the inability to

transport the granite waste, and lack of onsite facilities, means that this site, and the waste will remain unused.

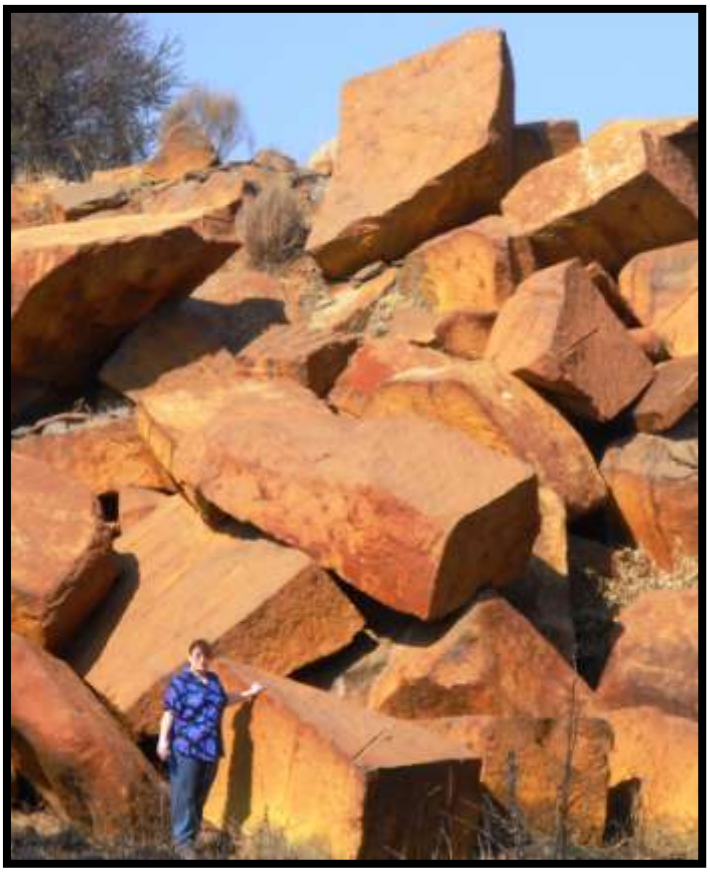

Figure 29: Granite waste at Mamogaleskraal (Source: NL Baartjes)

6.6.5 Mining relevance and impact

The proximity to a small mine site, whether abandoned or operating, does not represent an immediate opportunity. The Mamogaleskraal community do not attempt to access the material here due the inability to process the granite waste. It needs a capital-intensive programme (crushers, saws etc.) to be able to process the material, and an accessible market. In addition, training and effective logistical planning is required.

It will also be difficult for the local community to market the product for export. All of the material will need to be considered for local consumption; typically grave stones.

6.7. **Nababiep Copper Reprocessing, Northern Cape**

6.7.1 Coordinates and location

The area is located at S 29°35'05.86" E 17°47'15.49". From Springbok one travels north on the N7 towards the Vioolsdrif border. After 10 km the exit to Nababiep and O'okiep is taken. Turn left and follow the winding road into Nababiep, a further 6 km. On entering the town one passes the first line of shops but this soon gives way to the Okiep Copper Mining Company smelter operations. The operation is located here.

6.7.2 Commodity and description

Copper ore is reprocessed and copper waste is reclaimed. Copper mineralisation is visible as a light green coating such as malachite on rocks. As a metal, copper is a reddish metal that is ductile and has high thermal and electrical conductivity.

6.7.3 Value chain stage

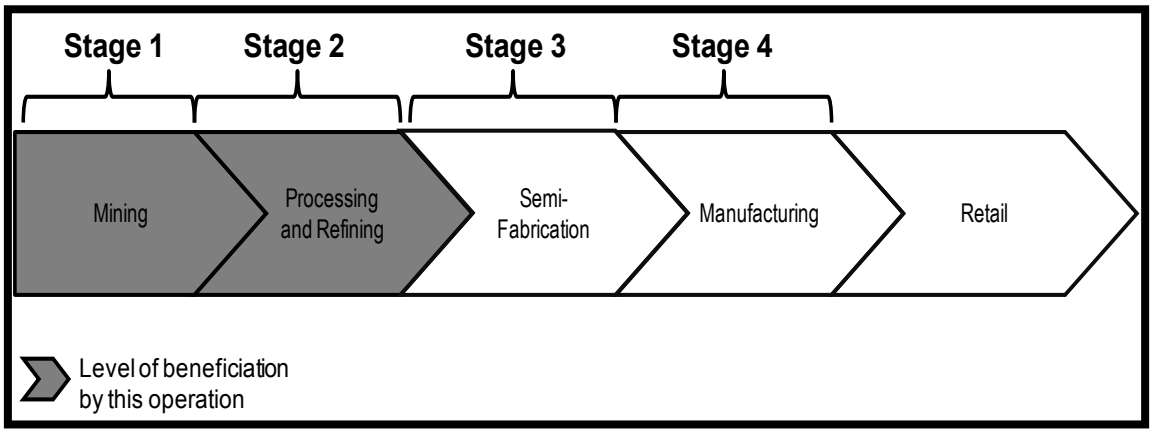

Figure 30: Level of beneficiation of the Nababiep Copper processing project

6.7.4 General observations

The mine has reached a state of closure and is for sale. The current offices are being used by small companies such as Africa Explosives Limited (AEL) and Copper Reprocessors that the author met at site. The ore is brought into this area if it is hand-sorted elsewhere. Some ore was reported as being handpicked and brought from the Schaap Rivier Copper Mine approximately 30 km away. The processing equipment at the Nababiep site has been stripped and removed as per the operator.

The operation now sends copper ore to Rosh Pinah in Namibia (in excess of 300 km away) where base metal processing can take place. Rosh Pinah is a zinc mine and the Aggeneys-based Black Mountain operation of Exxaro is not considered as a point to send ore, even though it is 100 km away along a tarred national road (the N14). The skills required to make effective use of this ore have been acquired through years of experience.

6.7.5 Mining relevance and impact

Small-scale miners require the reprocessing of high grade ore. Large components of the mine infrastructure were removed and the small-scale miners were reduced to alternative means. They have developed a mechanism to “roast’ the ore in order to provide a higher grade so as to increase the profit margin. This makes the operation skills intensive.

The inability to provide ore to the closest base metal mine means that there is actually only one possible buyer, and this leaves negotiating power in the hands of the mine in Namibia and not with the small-scale miner in Nababiep.

6.8. **Onseepkans Granidiorite, Northern Cape**

6.8.1 Coordinates and location

The mine is several close by sites in the area, but two points of activity are at S 28°52'20.69" E 19°37'6.87", and the second located 700 m to the southwest is S 28°51'44.65" E 19°37'49.59".

The site is accessed from Pofadder, travelling towards Kakamas. At the 36 km mark there is a sign indicating the road to Onseepkans. This road is a tarred. For 11 km along this road the terrain is flat but begins to become hilly. At the first point of real mountainous terrain is the granite quarry.

[Note: The first site that the author went to was in the area, 10 km to the southeast but the author could not find the entrance to the property and was informed that further along the road to Onseepkans she would find another

granite quarry. The author did not access the property as no permission was received and it was decided to not force entry to the site].

6.8.2 Commodity and description

The commodity mined here is granodiorite, commonly sold as granite. Granodiorite is an intrusive rock similar to granite, but is richer in plagioclase such as potassic feldspar. It also contains abundant mica and hornblende, giving it a darker appearance than granite.

6.8.3 Value chain stage

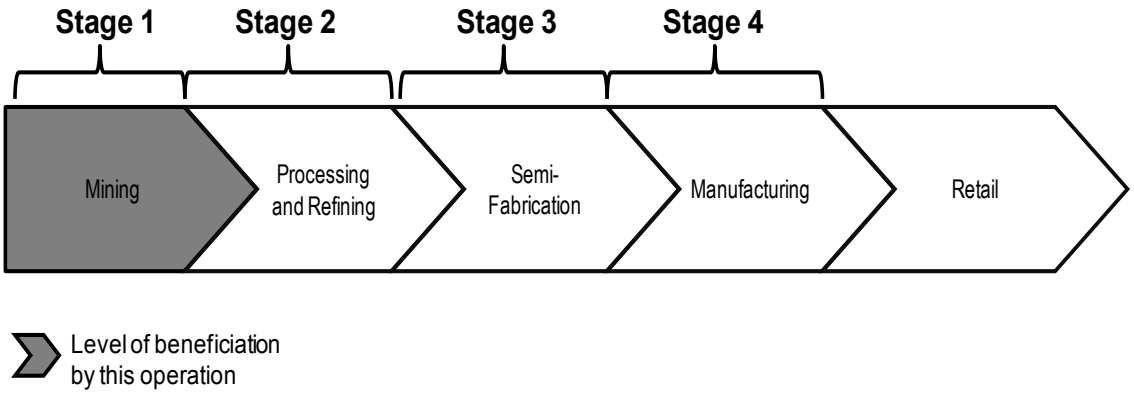

Figure 31: Level of beneficiation at the Onseepkans Granodiorite project

6.8.4 General observations

The site appears to be abandoned or dormant. No security was at the site. There were only broken blocks in the area and approximately nine whole blocks. The hill is dark grey to black where quarry faces have been exposed. The granite waste suggests that the granite has varying colours, looking green on some blocks and yellow to dark grey on others. The blocks are packed close to the road for easy handling and truck collection.

The site south east of the road is smaller and only one face is exposed. The waste from this site looks similar (dark-grey predominantly) to that at the main site.

6.8.5 Mining relevance and impact

Some commodities, and in this case granite, have to be carefully transported and transporting across bad roads can lead to disintegration or spoiling of the blocks. The sites therefore are limited to where good tar roads can be accessed. It is understood from the interview conducted in the area that the trucks are typically returning trucks, and on occasion specially commissioned trucks travel between Johannesburg and the site (about 800 km away).

6.9. **Seymour Aggregate, Eastern Cape**

6.9.1 Coordinates and location

The area is located at S 32°34'18.97" E 26°44'57.41"

The area is accessed by travelling from Queenstown south, on the R67 towards Fort Beaufort. After approximately 70 km is the town on Seymour. Continue through Seymour and approximately 2 km after leaving Seymour travelling in a westerly direction is an area to stop. From here it is a 180m walk east north east to the site. This site was visited in July 2008.

6.9.2 Commodity and description

The small-scale miner has identified a dolerite dyke in the area. It was previously a normal road borrow pit but has since become available for additional supply as aggregate. The dolerite dyke is a vertical intrusion of a mafic, medium-grained igneous rock that cross cuts across the country rock.

6.9.3 Value chain stage

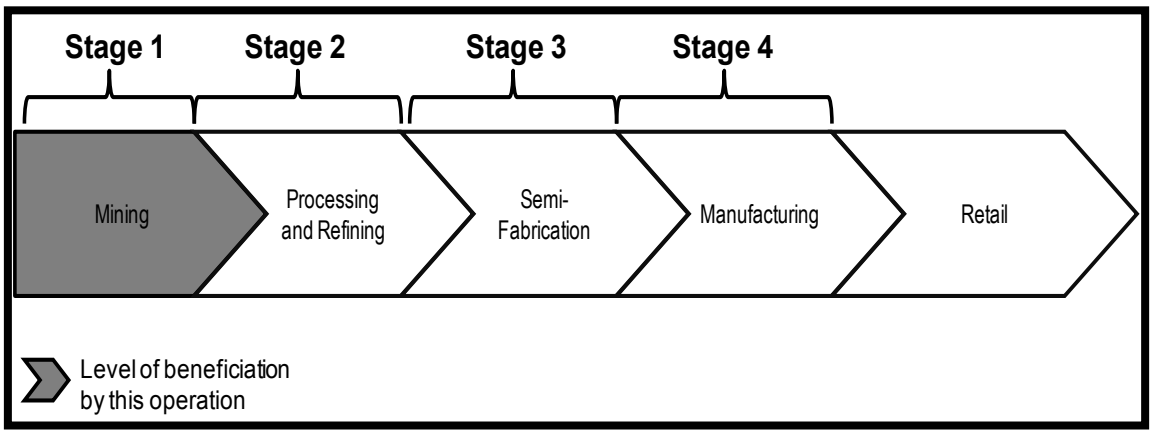

Figure 32: Level of beneficiation of the Seymour Aggregate project

6.9.4 General observations

The site has been mined as a borrow pit for road making materials in this region (see Figure 33). The small-scale miner has identified a shortage of road aggregate at projects as far way as Adelaide. At Adelaide, they source aggregate from a point believed to be 70-80 km away.

That makes this Seymour aggregate source even closer. There is a small dam; the Kat Dam located 750m to the east. The dyke is wide, and 50m has been exposed in the borrow pit face. In examining the area a second dyke was seen striking southwest. This second dyke has not been exploited.

Figure 33: Aggregate quarry outside Seymour

6.9.5 Mining relevance and impact

The small-scale miner interested in accessing the site wants to commence small excavations so that the aggregate here can be tested by the road project in Adelaide. The access, however, is not possible because there is no permit and the road makers require $3m^3$ to test if the material is adequate before placing an order.

A permit has been applied for, but seven months had elapsed at the time of the visit. The issue at stake is the inability to provide a rehabilitation guarantee.

The small-scale miner has been trained and has already received loan funding from the IDC (R7 million) on provision of the permit.

6.10. **Witkop Pegmatite, Northern Cape**

6.10.1 Coordinates and location

There are two sites that were investigated during this field visit. The area is located at S 29°01'33.77" E 18°00'24.74" and S 29°00'57.956" E 18°00'47.85". The two sites are 1 100m apart.

Travelling north along the N7 from Steinkopf to Vioolsdrif, Northern Cape, at the 13 km mark a poor quality dirt road branches to the northeast, towards Henkries and Goodhouse. Along this road, after 26 km, is a short farm track to the west. There is a sign board that says “Witkop’. Travel west onto this farm and after 1900 m the Witkop “pit’ is first exposed.

6.10.2 Commodity and description

Feldspar with minor mica is an aluminium-silicate rock formation found in primary and secondary rocks.

6.10.3 Value chain stage

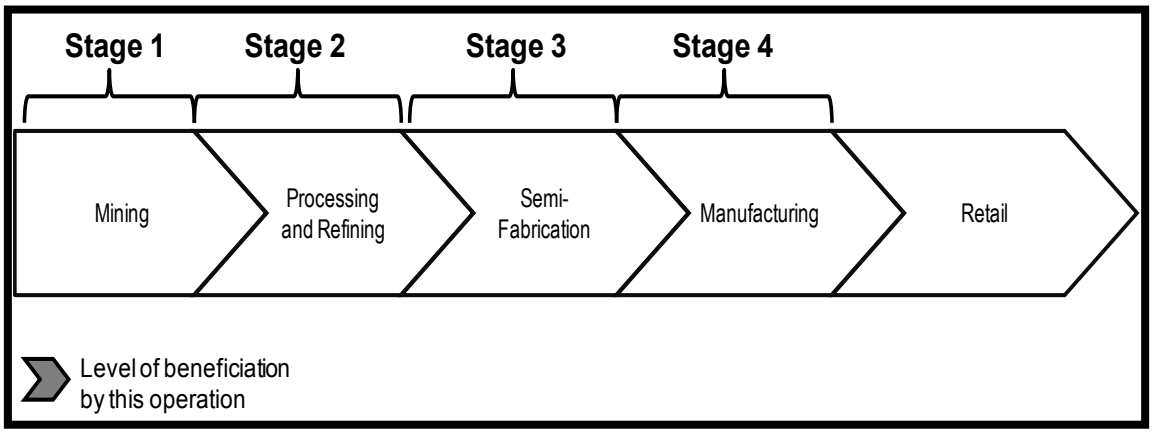

Figure 34: Level of beneficiation of the Witkop Feldspar site

6.10.4 General observations

Over the years, Witkop has been a source of feldspar for the glass making industry based in Cape Town. However it closed and reopened as a mica source, but this was short lived as better sources of mica were located closer to the N7 tarred road. The area is largely un-rehabilitated and sparsely populated.

Figure 35: The Witkop outcrop, Namaqualand

The ownership of the mine is unclear but Commercia Pty. Ltd, a Springbok based Community Company applied for the rights.

They could not get the mining permit for the area because the site is larger than the permit cut-off (1.5 ha). To complicate matters the 'Witkop mine' traditionally includes the worked out pit to the south east of the conical hill. This means that a mining right for this area, including this part of the traditional Witkop mine, will require provision of guarantees and rehabilitation of this damaged area.

Figure 36: Abandoned gantry at the Witkop south excavation

6.10.5 Mining relevance and impact

Small-scale miners try and secure mineral rights through using the mine permit system. The system has the advantage over a mining right in that it:

- Is quicker to obtain (months as opposed to years).
- Is awarded locally (at a Provincial or Regional level) and not awarded nationally.

Small-scale miners, in trying to re-mine abandoned or derelict mines, would tend to focus on the dumps, high grade areas, or easily accessible areas. With the restriction placed that derelict and abandoned mines have to be taken over entirely, and not in smaller pieces, means that the rehabilitation liability becomes too big for a small mining projects to develop.

Furthermore, the need to apply for a full mining right (larger than 1.5 ha) means that the application process is longer, and more specialist studies are needed. This means the application process is onerous and costly, with no guarantees of being awarded the rights.

6.11. **Chapter summary**

The study was supported by eight field visits to mines and quarries that produce low value commodities. Many of these mines or quarries were closed during the visits due to economic pressures.

The Northern Cape operations were difficult to keep afloat due to the additional impact of transport costs. Sites closer to the main urban centres (Brits granite and Fourieslust sandstone) were only able to continue operating due to their proximity to markets and the fact that the operations were more integrated (i.e. not only restricted to mining but comprised also preparation and retailing).

This is evidence that the retail aspects are important to low value markets and that rural entrepreneurs will need to be supported here.

The following chapter details the development corridor site visits.

CHAPTER 7. DEVELOPMENT CORRIDOR SITE VISITS

7.1. Introduction

The author believes that development corridors can serve the purpose of linking poorly developed mineral deposits and mothballed or abandoned mines to markets where they will either be processed further or even consumed.

South Africa currently has numerous types of development corridors in place. With the objective of understanding the issue of development corridors (both successful and unsuccessful), 13 corridors (including some sites of potential corridors) were visited with the aim of proposing a resource-based development corridor. Individual corridors were chosen to link "poverty areas" with potential anchors in an attempt to alleviate poverty. There was also an attempt to include the entire spectrum of corridors available.

Table 8: Development corridors and potential corridors field visits in South Africa

Anchor Towns	Anchor Province(s)	Visited
Bloemfontein – East London	Free State – Eastern Cape	May 2008
Durban -Johannesburg	KwaZulu-Natal - Gauteng	June 2007
Harrismith - Phuthaditjaba	Free State – Free State	May 2008
Klerksdorp – Welkom - Bloemfontein	North West – Free State	August 2007
Lephalale-Pretoria-Emalahleni	Limpopo – Mpumalanga	July 2009

Anchor Towns	Anchor Province(s)	Visited
Mthatha – Durban	Eastern Cape – KwaZulu-Natal	May 2008
Musina – Polokwane- Johannesburg	Limpopo – Gauteng	July 2009
Queenstown - Mthatha	Eastern Cape – Eastern Cape	May 2008
Rosslyn - Pretoria	Gauteng - Gauteng	July 2010
Rustenburg - Pretoria	North West - Gauteng	March 2010
Springbok – Cape Town	Northern Cape - Western Cape	Dec. 2007
Upington - Kimberley	Northern Cape – Northern Cape	June 2008
Welkom –Odendaalsrus-Johannesburg	Free State - Gauteng	Sept. 2009

7.2. **Bloemfontein – East London**

7.2.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor.

Bloemfontein Free State

Smithfield Free State

Aliwal North Eastern Cape

Queenstown Eastern Cape

East London Eastern Cape

These towns are linked across approximately 580 km (see Figure 37).

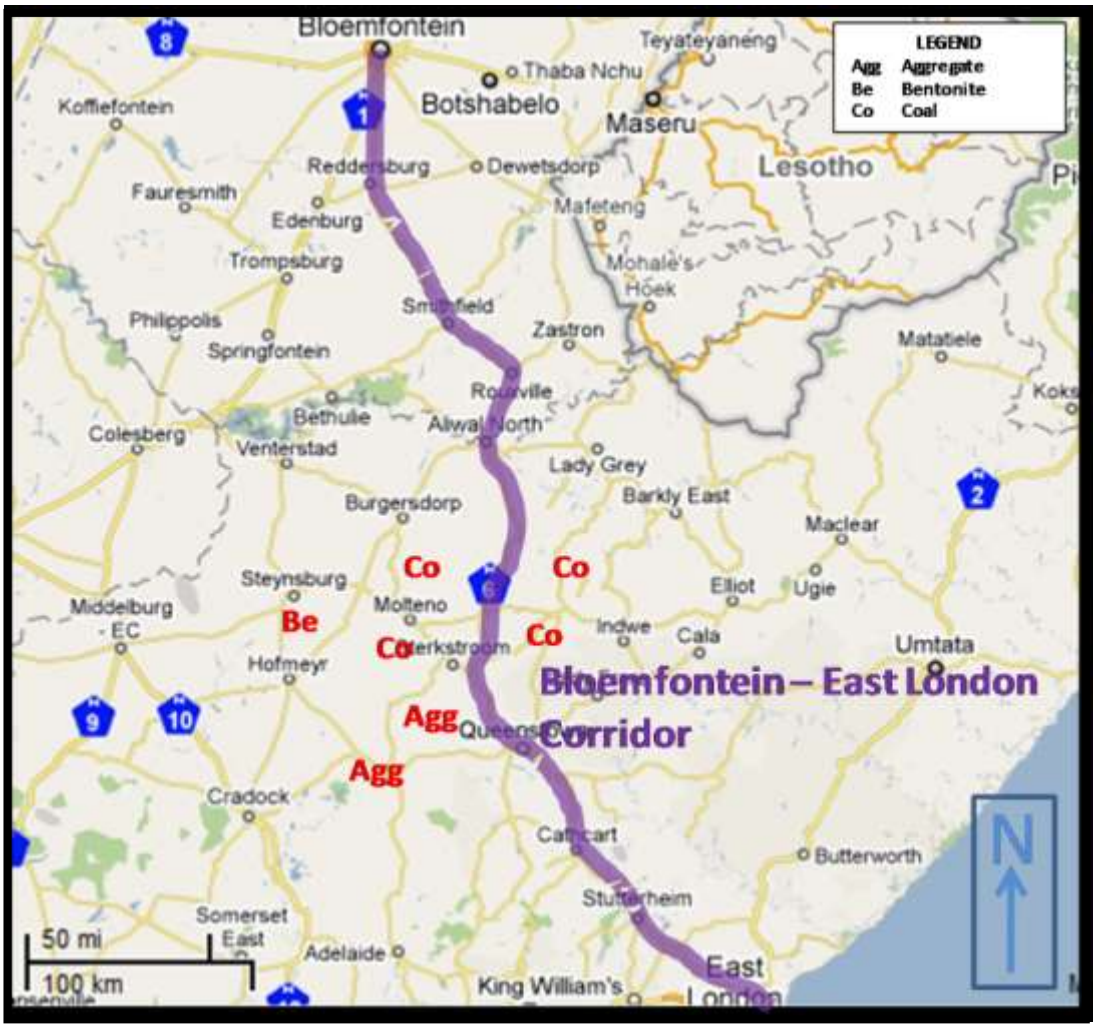

Figure 37: Bloemfontein –East London Corridor

7.2.2 Type of corridor

This is a transport corridor between two regional economic centres.

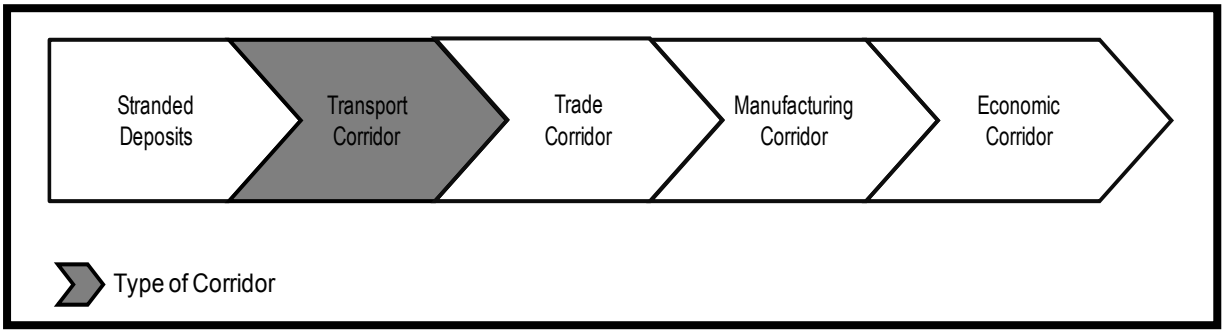

Figure 38: Typology of the Bloemfontein – East London Corridor

7.2.3 General observations

Figure 39: Landscape typical of the area around Aliwal North

Bloemfontein is an agricultural node for the surrounding areas. Smithfield is an agricultural centre with limited agri-processing infrastructure. There is a rail link from Bloemfontein to East London. Queenstown does not have extensive manufacturing centres and acts as a large hub for the surrounding towns which it services.

East London has largely been overshadowed by developments at Coega and Port Elizabeth. An Industrial Development Zone (IDZ) was established in East London.

The Molteno Coalfield lies to the west of this corridor and is still in the drilling phase by Elitheni Coal (Pty) Ltd. In the 19th century this was the coal mining centre to supply material to the diamond mines in Kimberley, but due to its high ash content and difficult mining conditions, this coalfield remains poorly developed.

Figure 40: Trucks outside the Queenstown Quarry, located in the background

7.2.4 Mineral occurrences in the corridor

Along the Bloemfontein –East London Corridor the following key commodities and deposits are known to occur:

Coal: In the vicinity of Molteno, low grade coal, with a high ash content and low calorific values is known to occur. The coal deposits fall in the Molteno-Ingwe coal field. It was discovered in Cyfergat near Molteno, and the coal was used to supply the Kimberley Diamond Mines, until the discovery of higher quality coal in KwaZulu-Natal, Free State and Gauteng.

Bentonite: This occurs along the R56, on the Pronksberg Farm, 76km west of Dordrecht, in the Elliot Formation, at about 120 m below the Clarens contact. The mineralogy of this deposit consists mainly of montmorillonite and low 5% quartz which make preparation easy. This deposit is estimated at about 1 Mt but the amount of overburden renders it sub-economic at present.

7.3. **Durban – Johannesburg**

7.3.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor.

Durban	KwaZulu-Natal
Pietermaritzburg	KwaZulu-Natal
Howick	KwaZulu-Natal
Harrismith	Free State
Heidelberg	Gauteng
Johannesburg	Gauteng

These towns are linked across approximately 600 km (see Figure 42).

7.3.2 Type of corridor

This has the characteristics of an economic corridor.

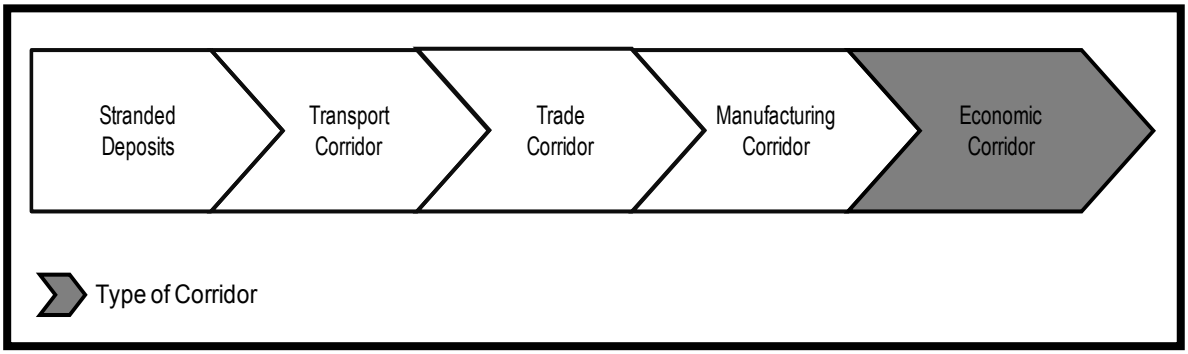

Figure 41: Typology of the Durban-Johannesburg Corridor

Figure 42: Durban – Johannesburg Corridor

7.3.3 General observations

This corridor has developed largely as the key link providing bulk import goods to the Gauteng Province. There are not many large towns within the corridor (the next largest being Pietermaritzburg, close to Durban).

In a reverse direction, goods from Johannesburg were exported through Durban. As manufacturing declines inland and consumption increases inland, exports from Gauteng can dwindle. The alternative ports for Gauteng Province are now Maputo in Mozambique (550 km), and Richards Bay (595 km).

Figure 43: View of Johannesburg from the southwest.

This Durban – Johannesburg corridor has road, rail and pipeline linkages.

7.3.4 Mineral occurrences in the corridor

Along the Durban – Johannesburg Corridor the following key commodities and deposits are known to occur:

Kaolin: Kaolin occurs about 30 km NNW of Durban (around Verulam). These deposits formed from the weathering and leaching of 1,200 Ma granites, the downward percolation of water, leached out the granites, and kaolinisation occurred along faults at the base of the granites.

Kaolin deposits also occur in a few locations close to the Johannesburg side of the corridor, where deposits occur within the tillite and shale layers of the Karoo Supergroup. There are three deposits in the East Rand area (Modderfontein, Daggafontein and Rietfontien), with a resource of 11.3 Mt good refractory clay and 22.4 Mt low refractory kaolin clay. In the West Rand deposits occur from Bankstation, through Westonaira to Lwaley, with a resource of 140 Mt good refractory clay and 54 Mt low refractory clay.

Coal: Within the corridor coal occurs in the Klip River Coal Field (in KwaZulu-Natal) and the South Rand Coal Fields (in Gauteng). The Klip River Coal Field is the most important coal field in KwaZulu-Natal; the first exploitation of the coal field began in 1865 near Dundee. The coal field has two coal seams, with nine types of intersecting dolerite dykes. The coal has a 25% ash content but through beneficiation it yields high grade products.

The South Rand Coal Field has three seams, granite domes which form palaeohighs, faults, and a 100m dolerite sill that disrupts the seams. The coal here is of poor quality and is prone to spontaneous combustion.

Dimension stone: A deposit of coarse grained, porphyritic, greenish grey, garnetiferous charnockitoid granite that is exploited in the Mgeni pluton in Cato Ridge. Slate occurs in small deposits in the western Pietermaritzburg area.

Iron: The titaniferous magnetites in the Mambula Complex contain about 38-55% Fe, with an estimated reserve of 22 Mt.

Copper: Small uneconomical deposits in the Empangeni and Mfume areas in KwaZulu-Natal.

Titanium: Tabular deposits occur in the Muden region, exposed on a sandstone cliff. However, the high rainfall in the area has weathered the deposits to an extent where the minerals disintegrate during recovery. Another deposit is the Mambula Complex in the Zululand area. The titanium occurs in the titanium-magnetite layers of the gabbroic rock, and the deposit is of low grade (9-16% TiO_2).

7.4. **Harrismith - Phuthaditjaba**

7.4.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor.

Harrismith	Free State
Phuthaditjaba	Free State

These towns are linked across approximately 60 km (see Figure 44).

Figure 44: Harrismith - Phuthaditjaba Corridor

7.4.2 Type of corridor

This has the characteristics of a transport corridor.

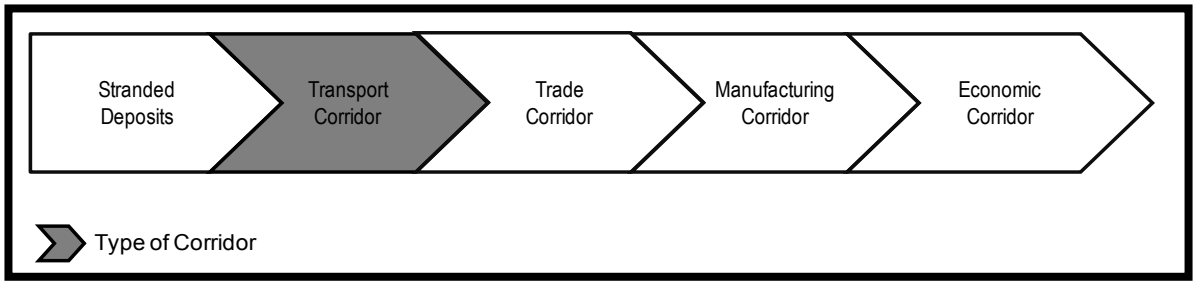

Figure 45: Typology of the Harrismith - Phuthaditjaba Corridor

7.4.3 General Observations

Phuthaditjaba is a large district municipality in the Maluti, a Phofung poverty node. It is not able to develop industries, but while it was a homeland (Qwa Qwa), it developed an industrial centre which has since gone into decline and manufacturing has dwindled. The link for goods from Phuthaditjaba to large centres like Durban and Johannesburg would be via Harrismith. The corridor therefore is not a true corridor, but a link onto a larger corridor.

Figure 46: Quarry between Phuthaditjaba and Harrismith

Figure 47: Sandstone mining in Phuthaditjaba

7.4.4 Mineral Occurrences in the Corridor

Along the Harrismith – Phuthaditjaba Corridor the following key commodities and deposits are known to occur:

Sandstone: The sandstones of the Karoo Supergroup are widely distributed in this area.

7.5. **Klerksdorp - Welkom - Bloemfontein**

7.5.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor:

Klerksdorp	North West
Orkney	North West
Welkom	Free State

Theunissen	Free State
Bloemfontein	Free State

These towns are linked across approximately 270 km (see Figure 48).

Figure 48: Klerksdorp – Bloemfontein Corridor

7.5.2 Type of corridor

This is predominantly a transport corridor.

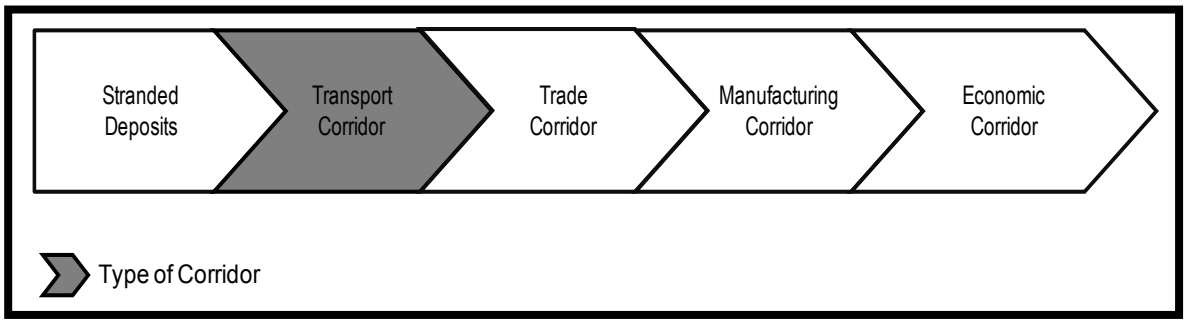

Figure 49: Typology of the Klerksdorp - Welkom - Bloemfontein Corridor

7.5.3 General observations

There are few linkages between Welkom and Bloemfontein, but with Bloemfontein as provincial capital there is some provision of administrative services. Bloemfontein and Welkom have stronger economic links to Johannesburg and can co-exist without developing a strong link between them.

The economic links does exist between the gold mining sectors of Welkom, Orkney and Klerksdorp. Klerksdorp is thriving as a town, but Welkom is in some degree declining as mining industries around Virginia and Odendaalsrus close.

7.5.4 Mineral occurrences in the corridor

Along the Klerksdorp - Welkom - Bloemfontein Corridor the following key commodities and deposits are known to occur:

Gold: The gold rich conglomerates of the Witwatersrand Basin occur in this region from Theunissen in the south, through Welkom, Orkney and to Klerksdorp. All the gold mines are deep level and only those types of operations can be established here.

Diamonds: In the area between Welkom and Theunissen, there are two diamondiferous kimberlite clusters. The one cluster is Type-II kimberlites near Theunissen, and the other cluster is a Type-I kimberlite and is located near Virginia.

Titanium: Titanium occurs in a heavy mineral deposit in the Bothaville-Wolmaranstad area, the deposits occur in an area of 16 km in strike length and 12 km width.

Aggregate: In the Bloemfontein and surrounding areas, unweathered Karoo dolerites are used as coarse aggregate; this provides the primary source of coarse aggregate for the Free State.

7.6. Lephalale – Pretoria - Emalahleni (formerly Ellisras – Pretoria - Witbank)

7.6.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor.

Lephalale	Limpopo
Modimolle	Limpopo
Pretoria	Gauteng
Bronkhorstspruit	Gauteng
Emalahleni	Mpumalanga

These towns are linked across approximately 430 km and three provinces (see Figure 50).

Figure 50: Lephalale - Emalahleni corridor

7.6.2 Type of corridor

This is predominantly a trade corridor. There is only a road link and no rail link.

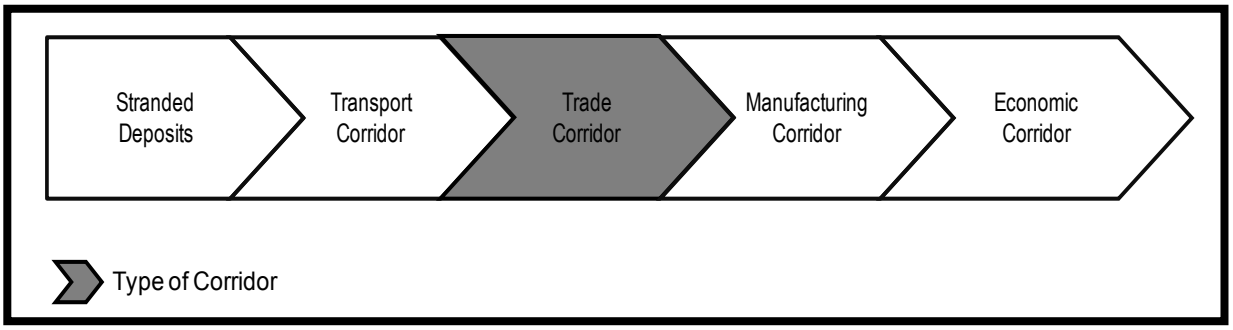

Figure 51: Typology of the Lephalale - Pretoria - Emalahleni Corridor

7.6.3 General observations

The fact that the Ellisras coalfield has the largest coal reserves, and that Mpumalanga coalfields are declining in their ability to supply Mpumalanga-based power stations, means that it is expected that coal will be transferred from Lephalale to Emalahleni. Currently there is no rail link and the Transnet Capital Expansion programme does not plan a link from Lephalale to Polokwane. Currently the coal in Lephalale can be considered stranded and has to be consumed in that area. Ideally the Lephalale area can be linked to Emalahleni through the Polokwane - Steelpoort region. There are two coal fired power stations in the area; the existing Matimba Power Station and the developing Medupi Power Station.

Currently the key activities involved in this corridor are the farming and tourism linkages, as well as the transport corridor along the N4 from Pretoria to Emalahleni.

7.6.4 Mineral Occurrences in the Corridor

Along the Lephalale - Pretoria - Emalahleni Corridor the following key commodities and deposits are known to occur:

Coal: The Springbok Flats Coalfield north of Pretoria is confined to a 30 km x 160 km basin. The coal in the area is of low grade is not developed due to its high uranium content. The coal reserves are generally at depth but there has been coal mined from surface outcrops as well. This coal field also has some coal-bed methane potential.

The Witbank Coalfield at Emalahleni is the most important coalfield in South Africa. It has five coal seams that are contained in a 70m thick succession. The grade of the coal varies across the basin.

Chrome: In the Western Limb of the BIC, the Rustenburg Layered Suite is poorly exposed. However, all six chromite seams (LG1-LG6) are present.

Vanadium: Vanadium occurs in the titaniferous magnetites of the Upper Zone of the Bushveld Complex. These layers contain titanium and iron as well, but the primary commodity mined is vanadium.

Copper: Copper is produced as a by-product of platinum mining on the Bushveld Complex. The copper is not in large enough concentrations to be economically mined on its own.

Titanium: Titaniferous magnetite occurs in the Upper Zone of the Rustenburg Layered Suite. The titanium content increases from the bottom to the top of the layer; however there has not yet been any technique developed to extract this titanium.

Fluorspar: The Vergenoeg deposit is a volcanogenic deposit near Rust de Winter. The deposit is funnel shaped, and 900m across at the surface, at a depth of 400m the width of the pipe is 400m.

7.7. **Mthatha - Durban**

7.7.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor:

Mthatha	Eastern Cape
Mount Frere	Eastern Cape
Mount Ayliff	Eastern Cape
Kokstad	KwaZulu-Natal
Port Shepstone	KwaZulu-Natal
Durban	KwaZulu-Natal

The visit also included Ixopo in the KwaZulu-Natal hinterland above Umzinto. These towns are linked across approximately 440 km (see Figure 53).

7.7.2 Type of corridor

This is currently a trade corridor with goods being supplied from Durban.

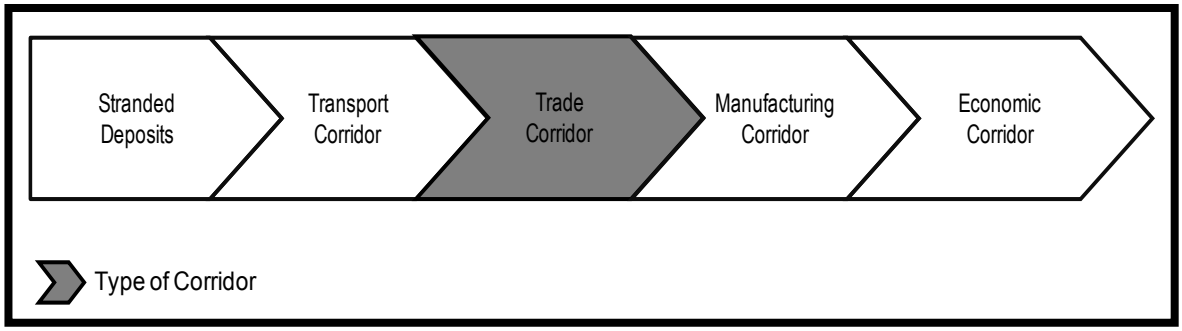

Figure 52: Typology of the Mthatha –Durban corridor

Figure 53: Mthata – Durban Corridor

7.7.3 General observations

The agricultural activities in KwaZulu-Natal remain key, and are believed to also support the north-eastern parts of the Eastern Cape. The area has numerous poverty nodes along it, and this is also where some poverty nodes in KwaZulu-Natal occur. There is a road link, and the rail link is established from Harding (north of Port Shepstone) to Durban. There is no rail link all the way to Mthata. Durban is a major economic hub and Mthatha, in the context of the Eastern Cape, is also a major economic centre. The rail link to Mthatha is through Pietermaritzburg. There are several timber forests on route inland.

Figure 54: Forestry plantation close to Mount Frere

Figure 55: Timber processing near Mount Ayliff

7.7.4 Mineral occurrences in the corridor

Along the Mthatha - Durban corridor the following key commodities and deposits are known to occur:

Gold: Gold occurs in the Umzinto area; the occurrence is a small shear-hosted, quartz-veined deposit in the Mzimlilo Granites, KwaZulu-Natal.

Titanium: Titanium occurs as heavy mineral sands along the coast from Durban to Mthatha. Deposits have been identified at Umgababa, Isipingo, Umkomaas, Hibberdene and Xamani on the South Coast of Durban, and at Xolobeni and Mngazana in the Eastern Cape.

Dimension Stone: Charnokites are present at Bombela near Port Shepstone. The rock is dark green in colour, but it has a high sulphide content.

Limestone: There are marble outcrops, 10 km north of Port Shepstone, in the rocks of the Mapululo Group. The outcrop is about 6 km in length and is oval in shape. The rocks are generally coarse grained, and towards the centre of the deposit are dominantly dolomitic.

Copper: Copper has been found in the Insizwa Complex which are four mafic to ultramafic lobes near Mount Ayliff. The copper is low grade (0.25% Cu, Wilson, 1998) so this deposit cannot be mined for copper only. The area remains a polymineralic target.

Nickel: The Insizwa Complex contains some nickel (0.3% Ni, Wilson, 1998) but has not been considered a pure nickel target. It is an intrusive complex centred around Mount Ayliff but extends towards the border with KwaZulu-Natal. The area believed to be economic is a small area around the waterfall Gorge area where some PGM is also present.

7.8. **Musina - Polokwane - Johannesburg**

7.8.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor:

Musina	Limpopo
Louis Trichardt	Limpopo
Polokwane	Limpopo
Mokopane	Limpopo

Pretoria	Gauteng
Johannesburg	Gauteng

These towns are linked across approximately 550 km (see Figure 56).

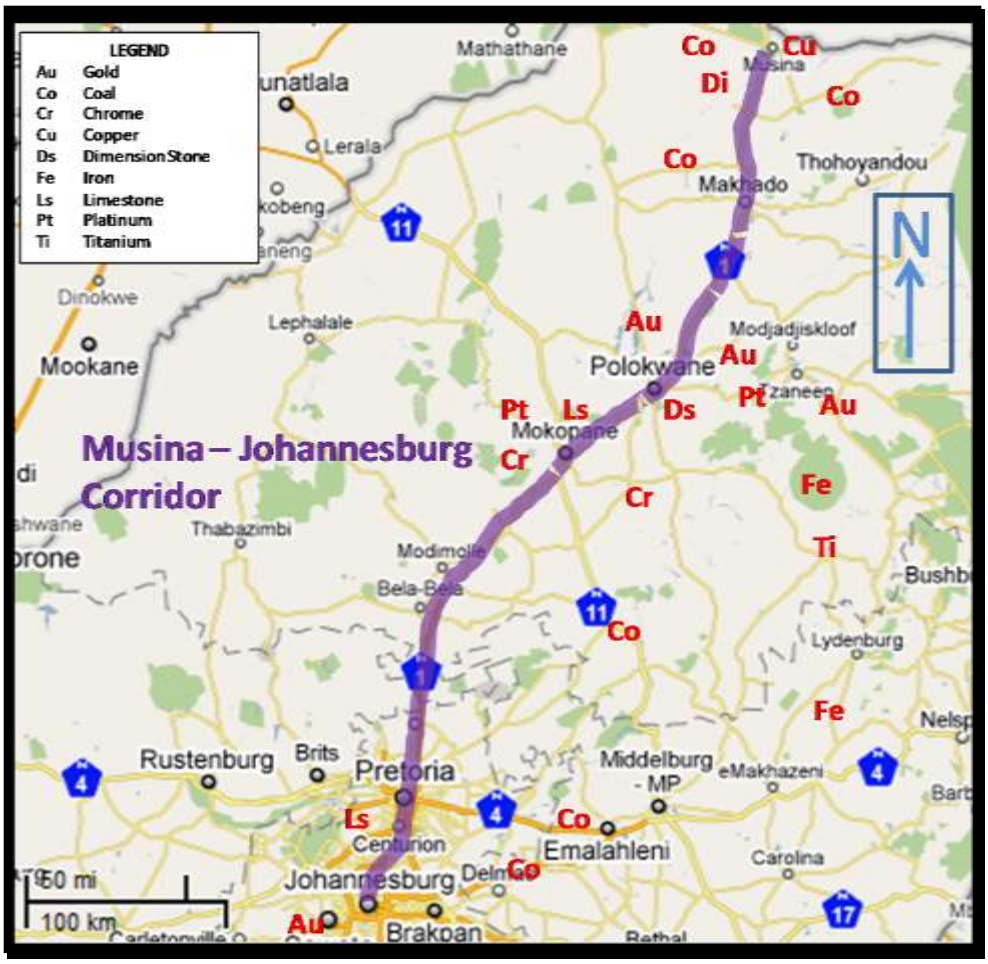

Figure 56: Musina – Polokwane – Johannesburg Corridor

7.8.2 Type of corridor

This is largely an economic corridor.

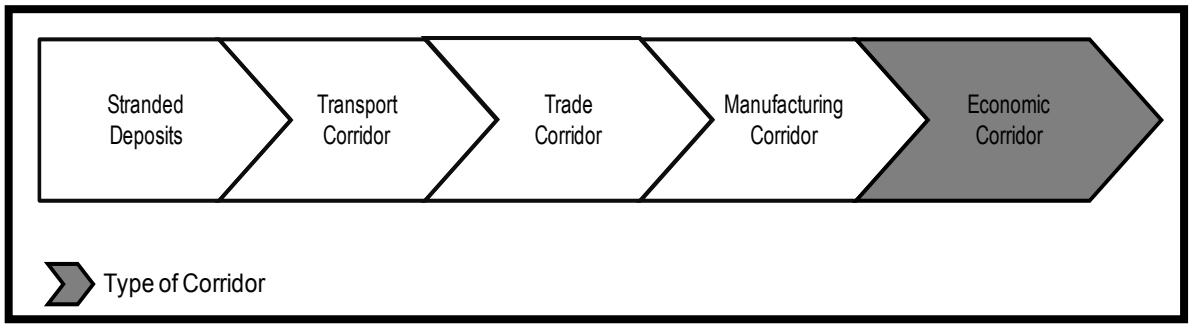

Figure 57: Typology of the Musina - Polokwane - Johannesburg corridor

7.8.3 General observations

This is the main corridor for trade between South Africa and Zimbabwe. The largest towns along the corridor are Polokwane and Mokopane. This corridor is a trade corridor, and an economic corridor in some places. The emergence of economically robust mines in the Mokopane area (granite, tin, platinum and chrome) has seen this strong link developing. Polokwane, largely an administrative centre, serves as the economic hub for the towns around it. There is no rail link from Polokwane to the west (Lephalale) and so no links can be strengthened to those coal fields.

Around Musina, coal mining (Tshikondeni Mine), copper mining (in decline) and diamonds are dominant. The largest diamond mine (De Beers' Venetia mine) is approximately 80 km south west of Musina.

7.8.4 Mineral occurrences in the corridor

Along the Musina – Polokwane - Johannesburg Corridor the following key commodities and deposits are known to occur:

Gold: Gold occurs in the volcano-sedimentary sequence of the Pietersburg Greenstone Belt. The gold occurrences are subdivided into four main groups; the Roodepoort, Mount Máre, Eerstelling and Amatave goldfields.

PGMs: The Northern limb of the Bushveld Complex does not contain a UG2 layer although it has a layer equivalent to the Merensky Reef.

Coal: Coal seams in the Tshipise Coal Field alternate with mudstones. Coal in this basin has an ash content of 25% and vitrinite content decreases with depth. This corridor also cuts across the Springbok Coal Field.

Chrome: The Northern Limb of the BIC, hosts a Lower Zone of 1600m, with the lower and upper chromitite seams about 57m apart. Only the other four layers are thin; two of them just stringer layers.

Iron: Iron ore occurs in the titaniferous magnetites of the Bushveld Complex, which as a whole has 26 000 Mt at a grade of 50-67% Fe.

Sandstone: A yellowish fine grained sandstone of the Clarens Formation is produced near Naboomspruit. The deposit is horizontal and is about 8-9m thick.

Limestone: Limestone occurs near Mokopane in several continuous layers. The emplacement of the BIC caused the dolomites to de-dolomitise into limestone that is relatively free of magnesium.

Dimension Stone: In the Polokwane area a grey and pink gneissic migmatite occurs; this product is sold commercially as Capricorn, Tropicale and Edelweiss.

7.9. **Queenstown - Mthatha**

7.9.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor:

Queenstown	Eastern Cape
Cofimvaba	Eastern Cape
Engcobo	Eastern Cape
Mthatha	Eastern Cape

These towns are linked across approximately 220km- Figure 59.

7.9.2 Type of corridor

This is a poorly developed transport corridor and other trade corridors to these places are more robust, i.e. East London - Queenstown and East London - Mthatha (along the N2).

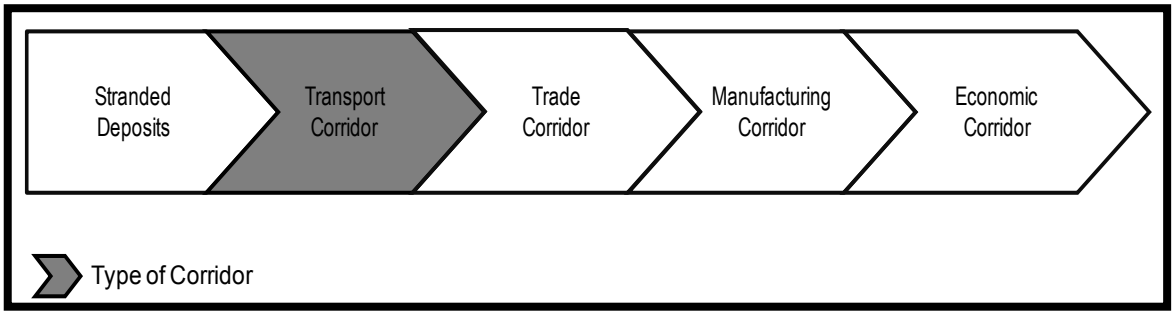

Figure 58: Typology of the Queenstown – Mthata Corridor

Figure 59: Queenstown - Mthatha Corridor

7.9.3 General observations

The towns of Queenstown and Mthatha serve as regional nuclei for the towns around them, and they do not tend to support each other. However, the opportunity to link poverty nodes in this node was investigated. The problem with these nodes is that there is insufficient economic activity to build strong links. Forestry operations were noted during the field visit, as well as subsistence agricultural activities. Agri-processing facilities do utilise this R61 corridor.

Figure 60: Agricultural landscape between Cofimvaba and Engcobo

Figure 61: Borrow pit and quarry between Engcobo and Mthatha

7.9.4 Mineral occurrences in the corridor

Along the Queenstown - Mthatha Corridor the following key commodities and deposits are known to occur:

Sandstone: North of Mthatha in the vicinity of Madadeni there are sandstone occurrences. These are part of the Clarens Formation.

Aggregate: Some aggregates are derived from metamorphosed sandstones, but these enjoy the largest prominence where large towns like Queenstown and Mthatha are located.

Coal: The Indwe coalfield to the north of the corridor extends up to Dordrecht. Locals recover coal from outcrops but these are not ideal for indoor use, being very smoky. Coal is used in brick making.

Dimension Stone: The dolerite in the area, particularly around Mthatha, has been sold as a cheaper substitute of the popular Belfast Black granite.

7.10. **Rosslyn - Pretoria**

7.10.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor:

Rosslyn	Gauteng
Pretoria	Gauteng

These towns are linked across approximately 40 km and exist within the same province (see Figure 62).

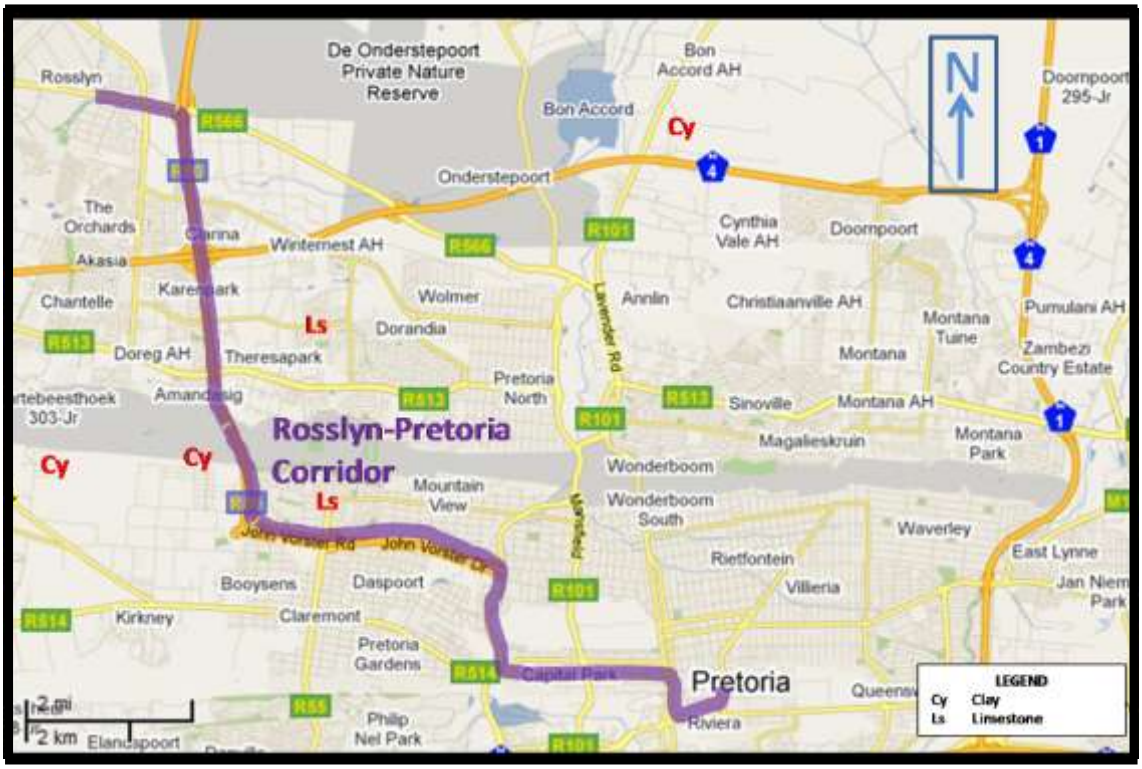

Figure 62: Rosslyn - Pretoria corridor

7.10.2 Type of corridor

This has the characteristics of being a manufacturing corridor. There is road and rail links between the two points.

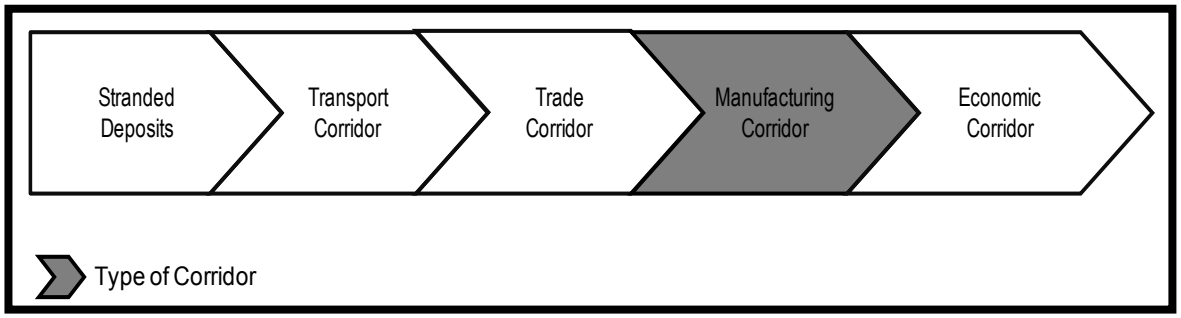

Figure 63: Typology of the Rosslyn – Pretoria corridor

7.10.3 General observations

Rosslyn is a large automotive manufacturing centre and derives some of its raw material inputs from the Gauteng area. It is located close to Shoshanguve which it linked via the Shoshanguve Manufacturing Technology Demonstration Centre. Toyota has based its national manufacturing centres here.

Figure 64: Automotive Supply Park, Rosslyn

A similar automotive corridor exists in the Eastern Cape between Uitenhage and Port Elizabeth. Due to the large size of the products (vehicles in both cases), the corridors tend to be short (<100 km).

7.10.4 Mineral occurrences in the corridor

Along the Rosslyn - Pretoria corridor the following key commodities and deposits are known to occur:

Limestone: The Malmani Subgroup of the Transvaal Supergroup is a source of dolomites, used mainly for metallurgical purposes. These dolomites are considered high grade, and do not contain more than 1-2% combined alumina and silica.

7.11. **Rustenburg - Pretoria**

7.11.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor.

Rustenburg	North West
Mooi Nooi	North West
Brits	North West
Pretoria	Gauteng

These towns are linked across approximately 120 km across two provinces (see Figure 65).

Figure 65: Rustenburg – Brits - Pretoria corridor

7.11.2 Type of corridor

This is a trade corridor.

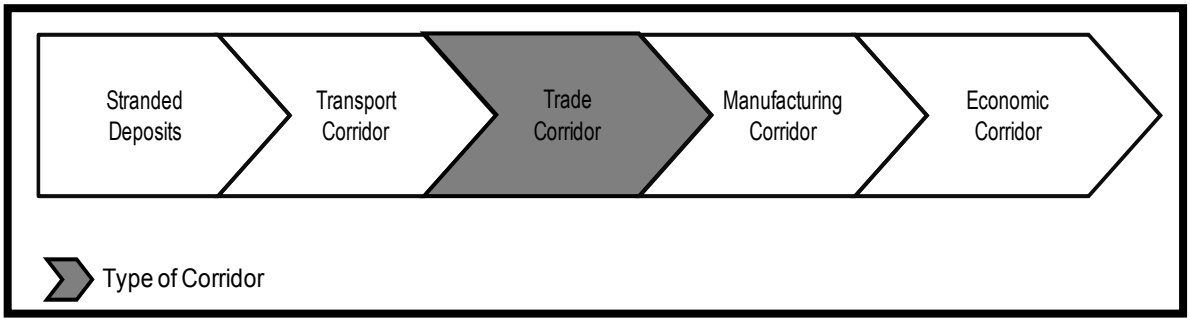

Figure 66: Typology of the Rustenburg – Pretoria corridor

7.11.3 General observations

The corridor has become more significant as economic activities were previously highest in Pretoria, but as Rustenburg developed fast in response to the platinum boom, that town also started developing its own economic strength.

This platinum boom is expected to continue and serves as an indicator of how other platinum-linked corridors could develop. This corridor is also supported

by the chrome mining activities in Mooi Nooi and granite mining in Brits. The production of ferrochrome in Brits also serves to strengthen the economic importance of this corridor.

Figure 67: Hernic Ferrochrome Smelter, Brits

There are still agricultural activities taking place along this corridor and this is able to leverage off the infrastructure. There are road and rail links between Rustenburg and Pretoria. The short distance and intensity of development has helped this corridor remain diversified. The main route from Gauteng to Botswana and the rest of Africa travel along this corridor. Some imports from the rest of the world go to Botswana via this corridor.

Figure 68: Rail link between Rustenburg and Pretoria

7.11.4 Mineral occurrences in the corridor

Along the Rustenburg - Pretoria corridor the following key commodities and deposits are known to occur:

PGMs: Economic concentrations of platinum occur in the UG2 and the Merensky Reef of the Bushveld Complex. The Merensky Reef is a pegmatoidal pyroxenite and the UG2 a chromitite layer; together these layers host the world's largest platinum deposits.

Chrome: In the Western Limb of the BIC, the Rustenburg Layered Suite is poorly exposed. The Lower Zone containing the chromitites is patchy, but in the Rustenburg area it is well developed. The Lower Group (LG), i.e. the bottom most chromitite layer, is the most economical to extract and is therefore sought after.

Dimension Stone: In the Rustenburg to Pretoria corridor there are two types of gabbroic dimension stone, known as the Rustenburg Grey, in the upper part of the Upper Zone of the Belfast Black in the Main Zone of the BIC.

Vanadium: Vanadium occurs in the titaniferous magnetites of the Upper Zone of the Bushveld Complex. These layers contain titanium and iron as well, but the primary commodity mined is vanadium.

Titanium: Titaniferous magnetite occurs in the Upper Zone of the Rustenburg Layered Suite. The titanium content increases from the bottom to the top of the layer; however there has not yet been any technique developed to extract this titanium.

7.12. **Springbok - Cape Town**

7.12.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor:

Springbok	Northern Cape
Garies	Northern Cape
Vanrhynsdorp	Western Cape
Clanwilliam	Western Cape
Malmesbury	Western Cape
Cape Town	Western Cape

These towns are linked across approximately 550 km and across two provinces (see Figure 70).

7.12.2 Type of corridor

This has the characteristics of being a transport corridor; however, in the context of the Cape Town - Windhoek link, it is a trade corridor.

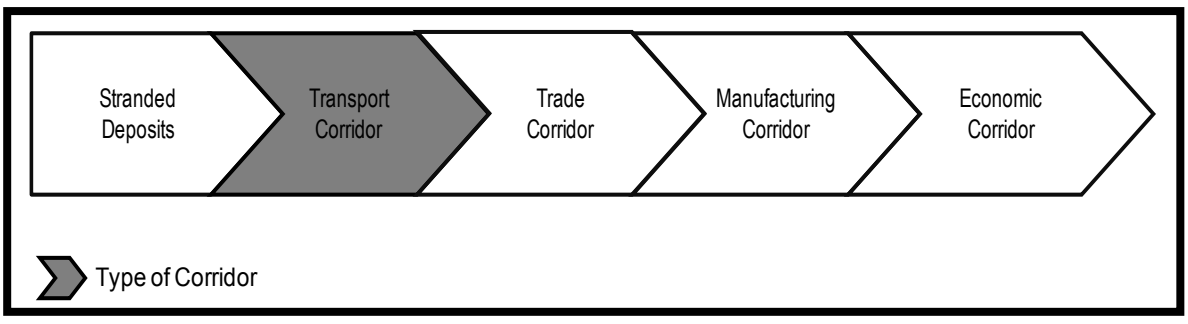

Figure 69: Typology of the Springbok - Cape Town corridor

Figure 70: Springbok – Cape Town corridor

7.12.3 General observations

The rail line runs to Bitterfontein (70 km south of Garies) and thereafter the road link is the only one that remains. There are no pipelines and Springbok has previously been linked to Cape Town by an air service. This is no longer the case. Garies has attempted to develop a granite processing centre but hosts largely agricultural activities (sheep farming in this area). No substantial meat processing facilities have developed.

Malmesbury is a large agricultural node linked to Cape Town by road and rail. There are extensive agri-processing facilities in this area which are linked to the corridor. Mostly wine and grape products are exported through Cape Town by air.

Other important mining activities along the corridor include the cement manufacturing in Piketberg (30 km north of Malmesbury) along the N7 route, and the BPB Gypsum mine at Maskam, 15 km north of Vanrhynsdorp.

7.12.4 Mineral occurrences in the corridor

Along the Springbok - Cape Town Corridor the following key commodities and deposits are known to occur:

Copper: The Okiep Copper District extends to this area from Springbok to Bitterfontein, but mines only developed close to Springbok. Copper mineralisation occurs in the rocks of the intrusive Koperberg Suite. The copper concentrated in the north trending pipe-like bodies during three deformation events.

Gypsum: In the Vanrhynsdorp Fields, gypsum occurs in clay deposits and some powdery gypsum occurs along dry water courses. The Maskam Gypsum Mine is located here.

Aggregate: More than 90% of the concrete used in the Western Cape comes from the Malmesbury Group. These are dark blue to black shales or argillaceous quartzites.

Dimension Stone: The high grade terrains of the Northern Cape produce the Swartmodder Granite, which is commercially sold as Desert Rose. The colour of the granite varies from terra-cota red to pinkish to dark grey. In the Western Cape the Paarl Granite is found; a medium grained granite, light grey in colour.

Iron: In the Vanrhynsdorp area, iron gossans occur. This mineralisation does not continue below the surface and only a reserve of less than 150 000t, with a grade of 56.8% Fe is known.

Titanium: The Namaqua heavy mineral sands contain titanium that was probably derived from the Namaqua Metamorphic Province. The deposit has a reserve of about 530 Mt, with a grade of 9% heavy minerals.

Limestone: Carbonates of the Nama Group occur in the Vanrynsdorp-Bitterfontein area of the Western Cape. These have been folded and metamorphosed into lenses of white marble that extend for several kilometres.

7.13. **Upington - Kimberley**

7.13.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor.

Upington	Northern Cape
Groblershoop	Northern Cape
Griekwastad	Northern Cape

Kimberley Northern Cape

These towns are linked across approximately 400 km (see Figure 71).

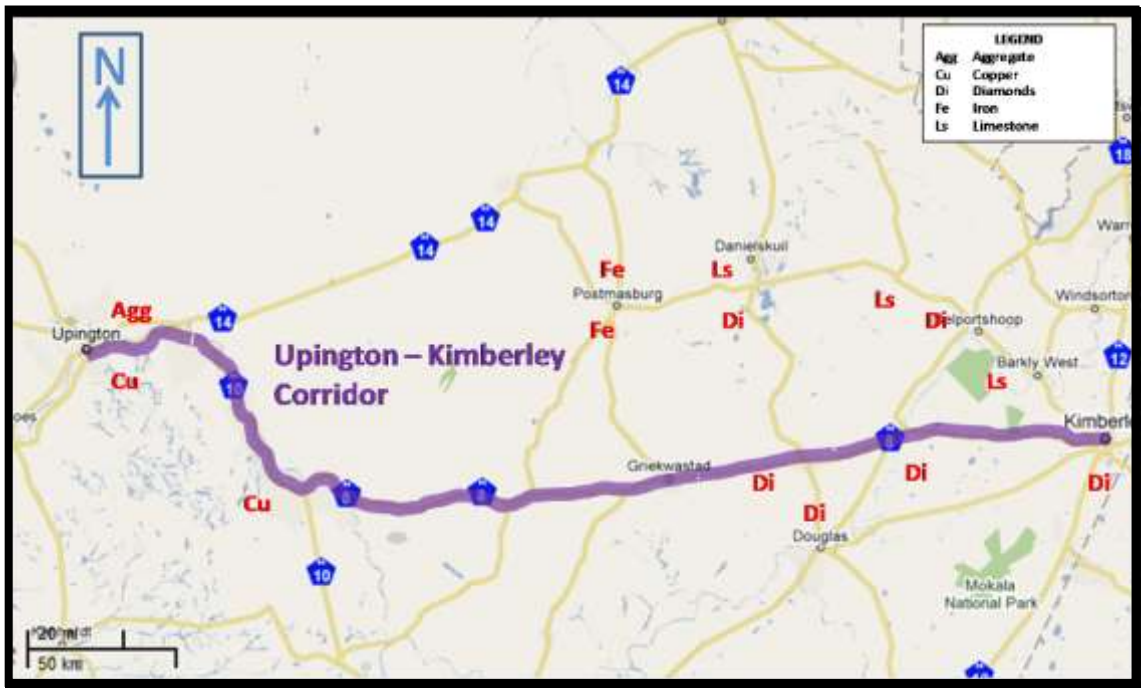

Figure 71: Upington - Kimberley corridor

7.13.2 Type of corridor

Currently this is a transport and trade corridor. There is no rail link between these two points.

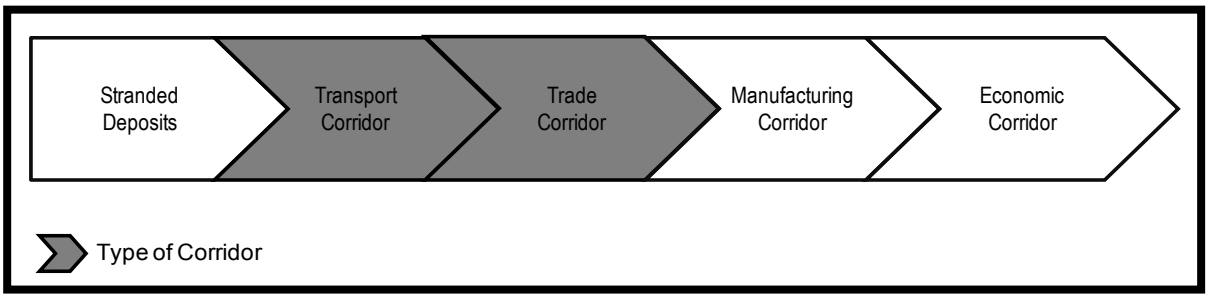

Figure 72: Typology of the Upington - Kimberley corridor

7.13.3 General observations

Kimberley is the largest town in the Northern Cape. It is also the administrative centre of that province. It is linked to Upington by road, and even though both towns have airports, there is no direct air link between these two. Upington is the agricultural centre from which some exports take place. The only international linked airport of the Northern Cape is the one at Upington.

The export of grapes, flowers and wine from this international hub is critical for that region. It is the provincial strategy to develop Upington into an international cargo hub as it has an international airport licence (which Kimberley Airport does not have). There is some supply of consumer goods between the two towns and the result is that a tentative link does exist. Groblershoop and Griekwastad are small agricultural centres along the route. They do not contribute substantially to the corridor but could themselves benefit if transport links are strengthened in this area.

7.13.4 Mineral occurrences in the corridor

Along the Upington - Kimberley corridor the following key commodities and deposits are known to occur:

Diamonds: Alluvial diamonds are present in most of the drainage channels in the Kimberley area, but at Kimberley itself kimberlitic diamonds are recovered from dump re-treatment and there is some mining of the remaining mines.

Copper: The Okiep Copper District extends to this area, a little past Upington. Copper mineralisation occurs in the rocks of the intrusive Koperberg Suite. The

copper concentrated into north trending, pipe-like bodies from three deformation events.

7.14. **Welkom - Odendaalsrus - Johannesburg**

7.14.1 Provinces and towns linked

The following towns and provinces are within the range of the corridor.

Welkom	Free State
Odendaalsrus	Free State
Kroonstad	Free State
Johannesburg	Gauteng

These towns are linked across approximately 300 km across two provinces (see Figure 74).

7.14.2 Type of corridor

This is an economic corridor with rail and road links.

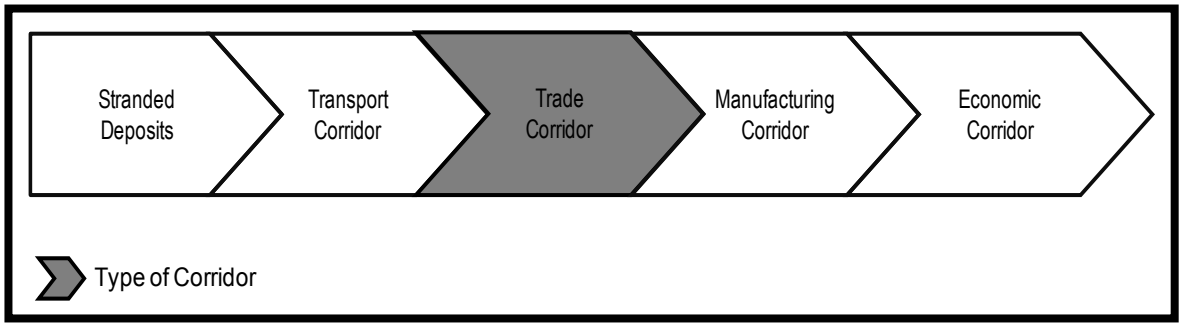

Figure 73: Typology of the Welkom-Odendaalsrus-Johannesburg corridor

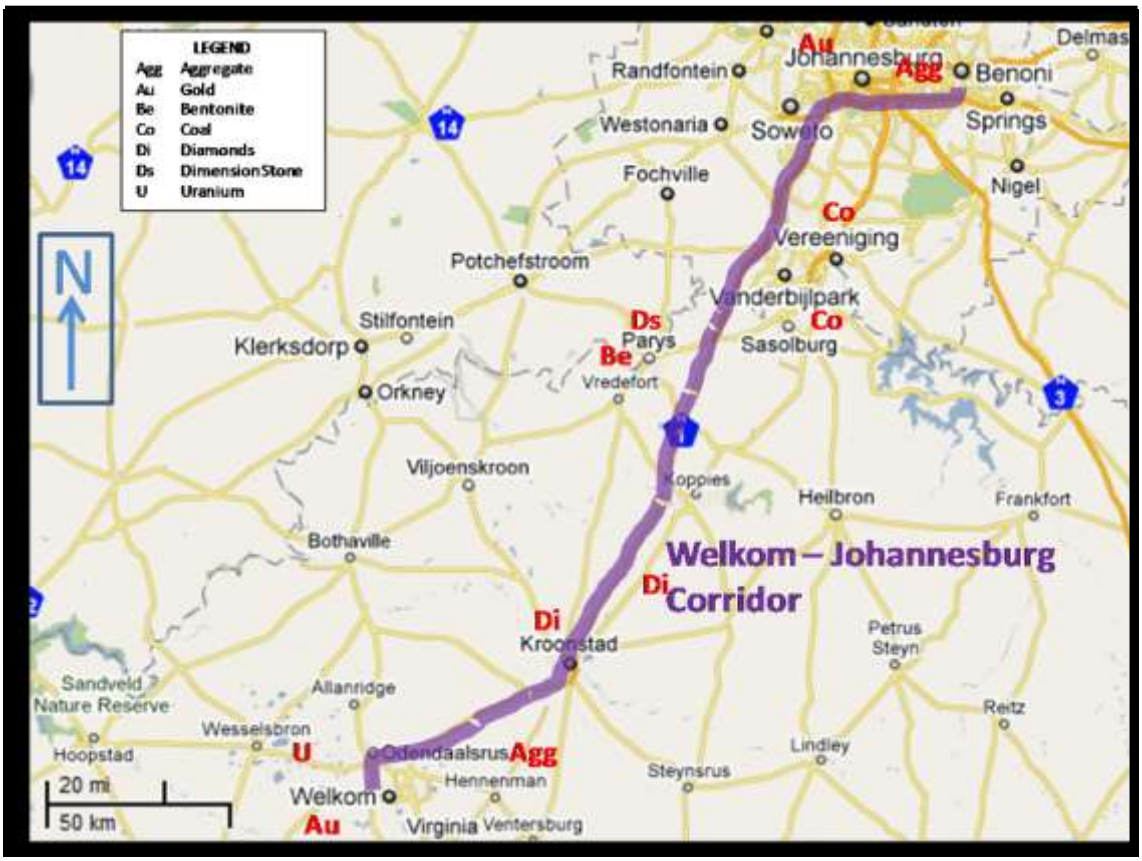

Figure 74: Welkom - Johannesburg corridor

7.14.3 General observations

Welkom derives trade and transport support from Johannesburg. It is a strong economic link as Welkom receives inputs of consumer and manufactured goods. The support infrastructure (banking, commercial and retail) is also closely linked to Johannesburg. As Welkom declines (linked to the closure of gold mines in that area) the corridor can develop into a transport corridor over time. Odendaalsrus is situated close to numerous gold mines but it still has a strong agricultural importance, with maize silos located close to this town. Some agri-processing can develop and be linked to this corridor.

7.14.4 Mineral occurrences in the corridor

Along the Welkom - Odendaalsrus - Johannesburg corridor the following key commodities and deposits are known to occur:

Dimension Stone: The Parys granite occurs in this area; it is part of the Archaean basement which underwent metamorphism during an impact event. The granites are pinkish to reddish in colour, with a network of pseudotachylite veins.

Coal: This corridor cuts across the Free State Coal Field; the coal zones are between 25 to 50m thick and occur at depths of 50-360m, depending on its location in the basin. The coals are rich in mineral matter and are used by Eskom for electricity generation

Aggregate: In the Welkom, Virginia and Odendaalsrus area, waste quartzite from the Free State goldfields are used as aggregate.

7.15. **Summary**

Thirteen corridors of five key types were assessed, the five key types are transport, trade, manufacturing and economic corridors. Feeder corridors can link to any of these corridors. The only economic corridor investigated was the Johannesburg-Durban corridor. Most of the corridors are trade corridors or transport corridors.

For poverty alleviation, corridors will need to be developed to link stranded ore deposits to markets. Observations are that corridors can easily be declared but

if there are no attempts to increase critical mass of activities then they are likely to flounder or fail. Most of the corridors are road-linked with very view corridors able to leverage off rail links.

South Africa will need to initiate projects on low and intermediate value ore deposits. High value commodities find alternative means of transport (typically pipeline or by air) so cannot be factored into corridor development. The following chapter details the quantitative analysis of the corridors and the fieldwork.

CHAPTER 8. QUANTITATIVE ANALYSIS OF CORRIDORS AND FIELDWORK

8.1. Introduction

This chapter presents the quantitative analysis of the author's site visits to the various corridors, noting the type of corridor and mineral occurrences, and the analysis of the interviews with various miners.

8.2. Analysis of corridor developments

The analysis of the corridor developments attempted to establish a discriminate function that would help to separate the typology of corridors in a quantitative tool. This was achieved in the following manner.

Five criteria of corridors were determined by the author:

- Is the corridor linked to a major economic centre such as Johannesburg, Cape Town or Durban?
- Are poverty nodes situated along the corridor and factored as 'contributors'?
- Is the corridor attached to an export port?
- Are there industrial feeders current or in development along the corridor?
- Is there a semi-direct or direct rail link to move mass manufactured goods along the corridor?

These were scored where a ‘no’ answer was 1, and a ‘yes’ answer was 10. The scale was chosen to emphasise the relative scoring difference. A weighted score was then calculated (see Table 9).

Table 9: Quantitative assessment of the 13 corridors

	Name	Length	Type	Directly Linked to CT, Jhb and Dbn	Semi-Direct Rail Link	Attached to a Port	Industrial Feeders	Poverty Nodes excluded	Weighted Score
1	Durban - Johannesburg	600	Economic	10	10	10	10	10	100.0%
2	Rosslyn - Pretoria	40	Feeder	10	10	1	10	10	82.0%
3	Rustenburg - Pretoria	120	Economic	10	10	1	10	10	82.0%
4	Musina - Polokwane - Johannesburg	550	Trade	1	10	1	10	10	64.0%
5	Springbok - Cape Town	550	Transport	10	1	10	1	10	64.0%
6	Welkom - Odendaalsrus - Johannesburg	300	Trade	10	1	1	10	10	64.0%
7	Klerksdorp-Welkom-Bloemfontein	270	Transport	1	10	1	1	10	46.0%
8	Bloemfontein - East London	580	Transport	1	10	10	1	1	46.0%
9	Lephalale-Emahlaleni	430	Trade	1	1	1	10	10	46.0%
10	Mthatha - Durban	440	Transport	10	1	10	1	1	46.0%
11	Harrismith - Phuthaditjaba	60	Transport	1	1	1	1	1	10.0%
12	Queenstown - Mthatha	220	Transport	1	1	1	1	1	10.0%
13	Upington - Kimberley	400	Transport	1	1	1	1	1	10.0%

The result of the quantification of the corridor can be viewed as the robustness of that corridor to be self-sustaining, and also identifies areas where interventions can be established.

The following information can be gleaned from this quantification exercise (the results are graphically displayed in Figure 75).

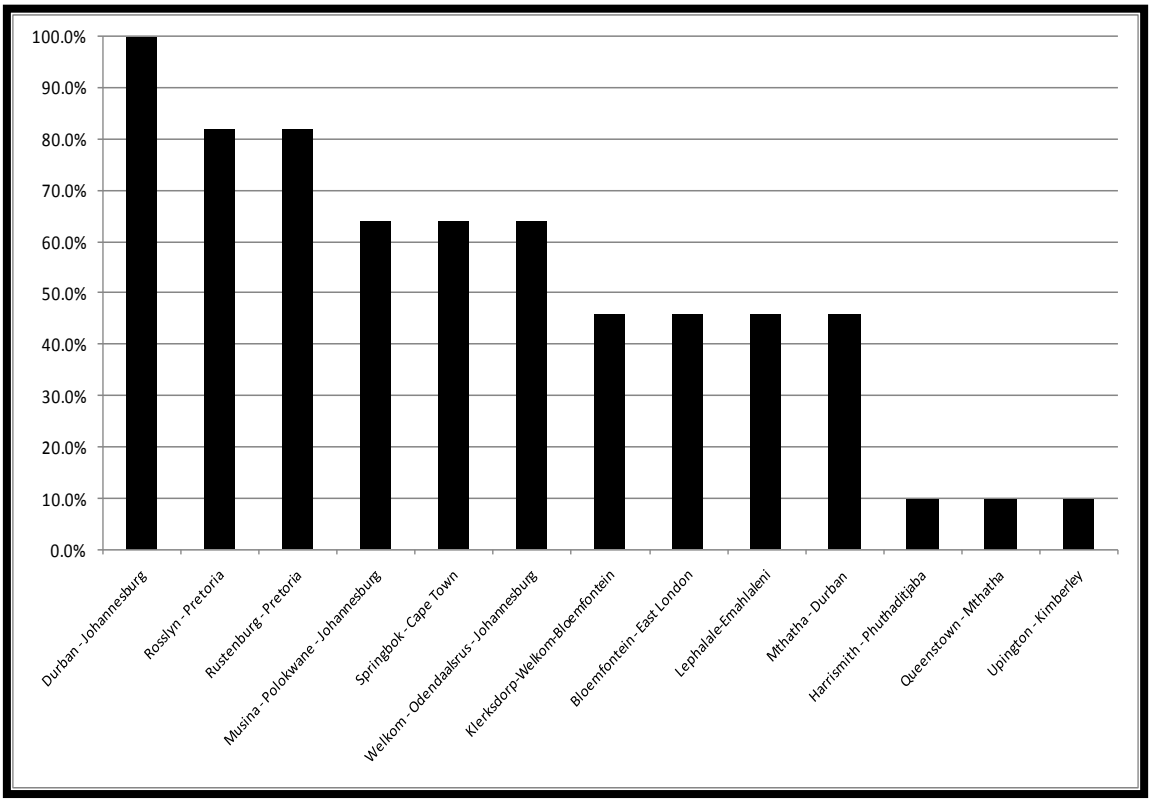

Figure 75: Quantification of corridor effectiveness

The information can be interpreted as follows as follows:

- Economic corridors have a score of 80-100%.
- Feeder corridors have a score between 70-90%, overlapping with economic corridors.
- Transport corridors that are well established score between 50-70%.
- Corridors with a large proportion of poverty nodes along it score less than 20%.

The overlap in the scores means that the criteria need to be expanded further if this is to be used for similar studies in the future.

8.3. **Analysis of interviews**

This study aimed to complete four interviews but ultimately seven were completed. These were structured interviews, but in two areas they were limited to a specific focus area:

- The biggest challenges experienced by rural based miners; and
- Changes that they would recommend.

All parties were restricted to three challenges and three changes that they would recommend. This provided a pool of 21 responses per question that were then analysed. The interviews are presented in the Appendix A. The results of the interview are presented in Table 10.

Table 10: Summary of key challenges and changes required, derived from the interviews

		Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6	Interview 7
Challenges	Top Issue	Markets	Permits	Transport	Permit	Market	Transport	Transport
	2nd Issue	Permits	Skills	Market	Market	Equipment	Reserves	Skills
	3rd Issue	Prices	Reserves	Equipment	Infrastructure	Permits	Equipment	Market
Changes	Top Changes	Permits	Permits	Skills	Permit	Transport	Equipment	Transport
	2nd Issue	Markets	Consultant	Market	Market	Equipment	Equipment	Skills
	3rd Issue	Transport	Reserves	Equipment	Equipment	Market	Price	Consultant

8.3.1 Biggest challenges

Nine issues were identified, but only eight issues are considered key challenges. These are listed in Table 11, and their relative importance (as a percentage) is indicated:

Table 11: Key challenges identified by a group of rural miners

	CHALLENGES
Market	24%
Permits	19%
Equipment	14%
Transport	14%
Reserves	10%
Skills	10%
Infrastructure	5%
Prices	5%
Consultant	0%

The key issue related to the market is that all miners believe that they are responding to a need in the market place. Some have done so for a single request or multiple requests.

The importance is that there needs to be a link to more markets and not just small opportunities. Many of the miners perceive markets as only small and local and they need to access international markets. Export corridors typically do not exist. The low value of the commodities makes it difficult to compete.

The permit process many perceive as problematic, and the researcher did not query whether the miners actually have valid permits. It is important to note that

if permits are an issue, government must understand that its regulatory burden could be the cause of continued illegal mining. Miners with equipment, or those in need of equipment, are 'getting by', but they identify that the lack of correct or sufficient equipment is a challenge to their business.

Transport is a problem for rural miners, but is ranked only 4th as a challenge. This is possibly due to the small volumes. If the volumes increase or orders increase, then issues around transport could become more prominent. The issue of reserves and skills (jointly 5th at 10%) is linked to the capacity to expand. To expand the reserves allows for more flexibility. The sandstone and granite commodities demonstrate this where various styles or colours are recovered. Furthermore, skills also enable more productive and efficient use of the deposit. Infrastructure and prices received were only identified by one miner each.

The profile of challenges (compared to desired changes) is shown in Figure 76.

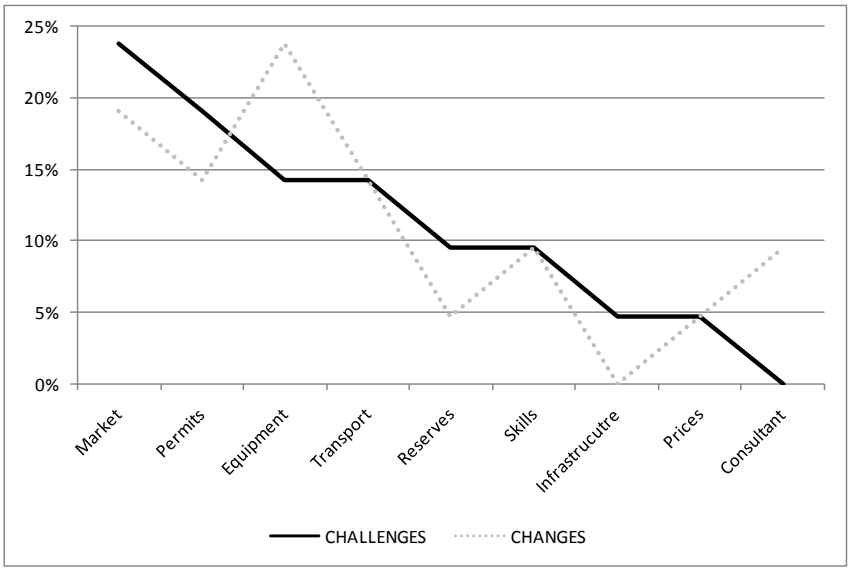

Figure 76: Comparison of challenges and changes identified from interviews

8.3.2 Desired changes

Table 12: Key changes identified by a group of rural based miners

	CHANGES
Equipment	24%
Market	19%
Permits	14%
Transport	14%
Skills	10%
Consultant	10%
Reserves	5%
Prices	5%
Infrastructure	0%

Of the nine issues raised by all interviews, only eight have been noted as areas where changes are required (see Table 12). All miners believe that it is government that can help them with their challenges. The miners identify the need for equipment (24%), and the provision of equipment by one or other level of government remains an identified need.

Thereafter, the need for a market (19%) and help with marketing activities is required. The need for permitting (14%) and transport (14%) are also issues that miners believe government can help them with.

The challenge of skills of labourers as well as complex skills (i.e. consultants) is something they do recognise, and two miners believe that government needs to support the small mines sector with consultant skills and provide subsidised services, whether through universities or consultants. Reserves (5%) and prices (5%) were identified by two separate miners as challenges and they do not see government playing a role here, but similarly an improved permitting system could help with the concerns around reserves.

One of the concerns raised was that the people were selected because they have previously or are currently operators of mine operations in rural areas. Their age groupings were requested. The profile of their ages is presented in Figure 77.

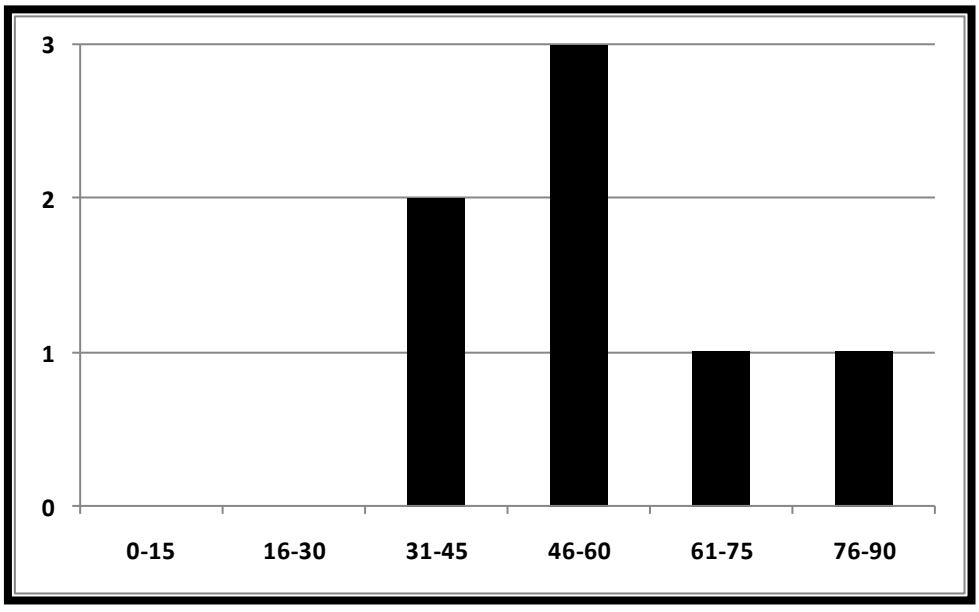

Figure 77: Age profile of interviewees

Most of the miners are above 46 years of age. The concern is that there are very few rural entrepreneurs in the 16-30 category.

If rural development is to become a normal situation, entrepreneurial activity needs to be encouraged in the lower age groups. The long lead time to transfer knowledge and experience means that this is an important feature of rural development.

8.4. **Summary**

This study investigated 13 corridors to assess good, intermediate and poorly performing corridors. It identified various examples of corridors according to a typology that was developed.

What is evident is that there is still a place for mineral-based corridors to develop, but successful corridors need to be more intense (more industries over shorter distances). Clearly the corridor first needs to be developed as a nucleus around which clustering can occur.

What would help sustain corridors is a link to a large local or international market. The corridors linked to Johannesburg are robust, but east-west running corridors, such as those in the Eastern Cape and Free State, struggle. The access to ports in East London, Port Elizabeth or Durban strengthens commodity corridors. Inland corridors, not linked to markets or ports, will need to find other mechanisms to create economic diversification.

The information from the interviews indicated that there are two areas of concern. Rural entrepreneurs are self-taught, and so it takes many years to gain enough experience to operate as a mineral-based rural entrepreneur.

There is also an acute shortage of opportunities so younger entrepreneurs are not entering the landscape quickly enough.

The entrepreneurs identified areas where they need government support that they feel has either raised the barrier to entry, or can modify regulations to allow some relief. The greatest challenge is securing markets, permits, and equipment. High transport costs were also problematic. Similarly, the changes needed that they identified were the provision of equipment and securing a market.

CHAPTER 9. MINERAL-BASED RURAL DEVELOPMENT CASE STUDIES

9.1. Introduction

This chapter describes a case study conducted by the author. The case was selected because the author believed it would deepen understanding in the areas covered by this thesis.

9.2. The case studies

The case was chosen because the author elected to investigate a rural development corridor that met the following criteria:

- Situated at the furthest point from Johannesburg, the largest South African market.
- Has some mineral potential (high, medium and low value).

The author chose the N14 route. The N14 route runs for 1200 km westward from Johannesburg to Springbok in the Northern Cape. It was the author's view that if this very difficult corridor could be modelled then it would showcase most of the problems that many other South African corridors face.

9.3. Case Study- The development corridors of the N14

9.3.1 The location of the Northern Cape 'development corridors'

The theoretical corridor extends from Springbok in the Northern Cape and ends in Upington. Then a second corridor extends from Upington to Kuruman (see Figure 78). Most of the underlying geology is of the Proterozoic Eon formations.

Figure 78: Two theoretical corridors along the N14 National Road

9.3.1.1 Mining along the corridor

The following mines (west to east) have developed along the corridor (a limit of 100 km is used to denote mines to include feeder operations to the corridor) and are listed as the following:

- Diamond mines of the Namaqualand Coastal Plain (many have ceased operating);
- O'okiep copper mines and copper district (all have largely ceased working);

- Aggeneys lead-zinc mine;
- Gamsberg Barytes deposit;
- Diamond Mine at Bosluispan, Bushmanland District (small mine);
- Onseepkaans Granite Mining;
- Diamond mines of the Orange River at Kakamas;
- Kieselguhr mine at Olifantsfontein;
- Clay-brick operation at Olifantsfontein;
- Copper mines of the Prieska Area (the last mine at Copperton is closed);
- Iron ore mines at Kathu; and
- Manganese mines at Wessels and Hotazel.

In addition to the above mines there are numerous gemstone and industrial mineral deposits including those for:

- Aragonite (at Kotzeshoop);
- Iolite (at Dabonaris);
- Rose quartz (at Kakamas and Riemvasmaak);
- Smokey quartz (Concordia);
- Sugilite (at Wessels);
- Tigers Eye (at Kuruman);
- Rare earths (at Henkries); and

- Uranium (at Henkries).

The large mines are in general decline, particularly the western end of the corridor. The base metal mine at Aggeneys has gone through an extensive exploration phase and is still in decline with about 10 years life left at current production levels. The eastern end of the corridor has also experienced closure of some mines, like that at (Copperton), but the ongoing mining operations coupled with rail expansion to accommodate manganese and iron ore expansion projects indicate this area to be particularly robust.

9.3.1.2 Observations

The poverty node at Kuruman (the Kgalagadi poverty node) remains an area in need of development. The rail link runs from Sishen to Saldanha Bay is largely an iron ore corridor.

The corridor can be described as two 'short' corridors or one 'long' corridor. The N14-East Corridor, approximately 110 km long runs from Kuruman in the east up to Olifantsfontein. The N14-West Corridor runs for 370 km from Upington in the west to Springbok in the east. Together they comprise the 630 km long N14 corridor (see Figure 79).

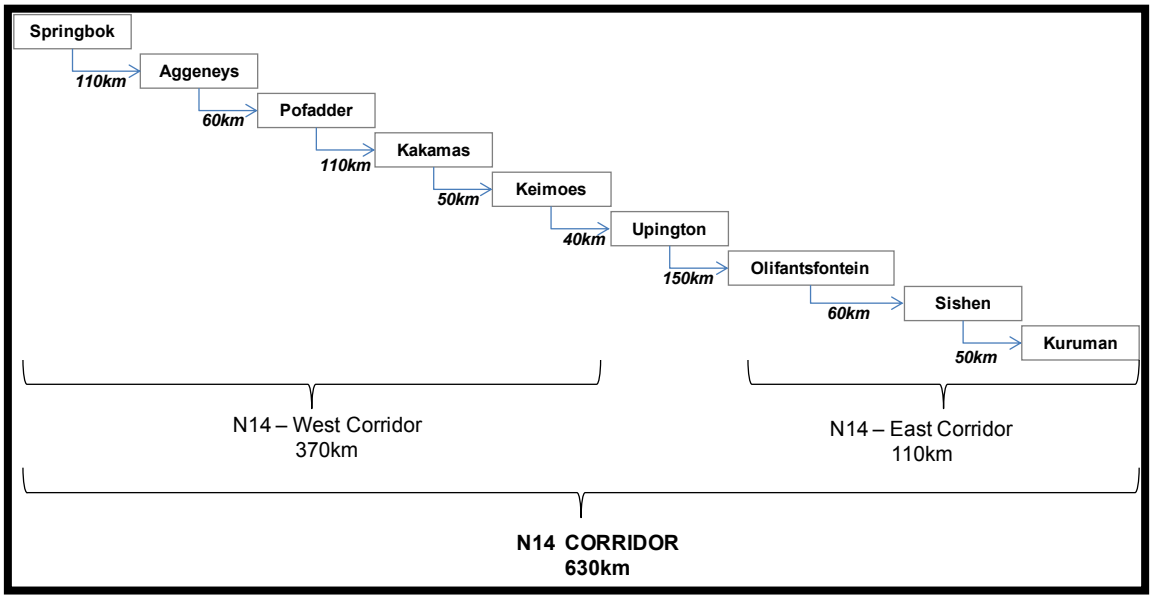

Figure 79: N14 Corridor and sub-corridors

There are no longer any substantial activities along the eastern corridor and the entire N14 corridor can be said to traverse rural areas. The strengthening and economic densification of these development corridors can be a catalyst for the development of this region.

9.3.2 N14 West corridor (Springbok -, Upington)

The N14-West corridor transects the Namakwa and Siyanda District Municipalities. When the corridor is compared with the dataset of corridors investigated for this study, it has a poor ranking (28.0%) (see Figure 80).

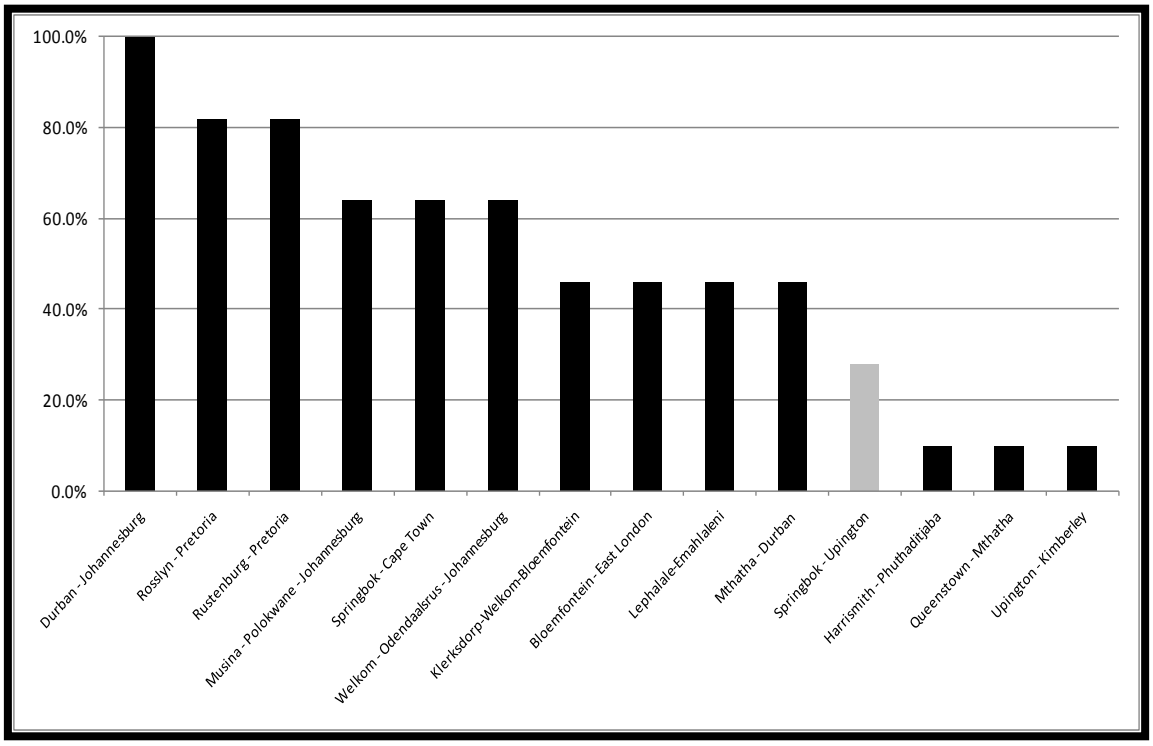

Figure 80: Ranking of the N14 west corridor in the dataset

The feature of this corridor is that it is not encumbered by the needs of a poverty node and thus gives it a developmental edge on some of the other corridors in the dataset. To continue to provide support for the Northern Cape it is important that poverty levels in this area do not increase to the extent that this area can be categorized as a *de facto* or undeclared poverty node.

For future development, to enhance this corridor, it would be imperative to commence some form of manufacturing and industrialisation. The rail link that runs up to Kakamas (280 km from Springbok) will not be developed in the near or medium term so this link is not an option. Extension of the Bitterfontein rail line from Cape Town could support development here, particularly for the movement of bulk commodities.

9.3.3 Development opportunities for the N14 west corridor

The following projects have been identified to support the densification of the N14 west corridor:

- Development of gem-cutting and faceting centres in key towns such as Springbok and Upington.
- Development of a tourism route around gemstone sites along the corridor.
- Establishment of granite cutting and polishing points at Garies or Bitterfontein (along the N7 to Springbok) or expansion of the granite cutting and polishing works at Pofadder.
- Establishment of granite dressing (cutting and polishing) facility at Kakamas, where the current rail line ends. This is approximately 70-80 km from the granite mining sites around Onseepkaans, and transporting can be better managed for granite quarries in this entire region between Pofadder and Upington.
- Development of a global geopark of the Namaqua structural metamorphic belt (see Appendix C for more information of GeoParks).

9.3.4 N14 east corridor (Olifantsfontein - Kuruman)

The N14 east corridor transects the Siyanda and Kgalagadi District Municipalities.

This corridor cuts across the iron and manganese fields in South Africa. When compared with the dataset of corridors investigated for this study, it ranks well (64.0%) (see Figure 81).

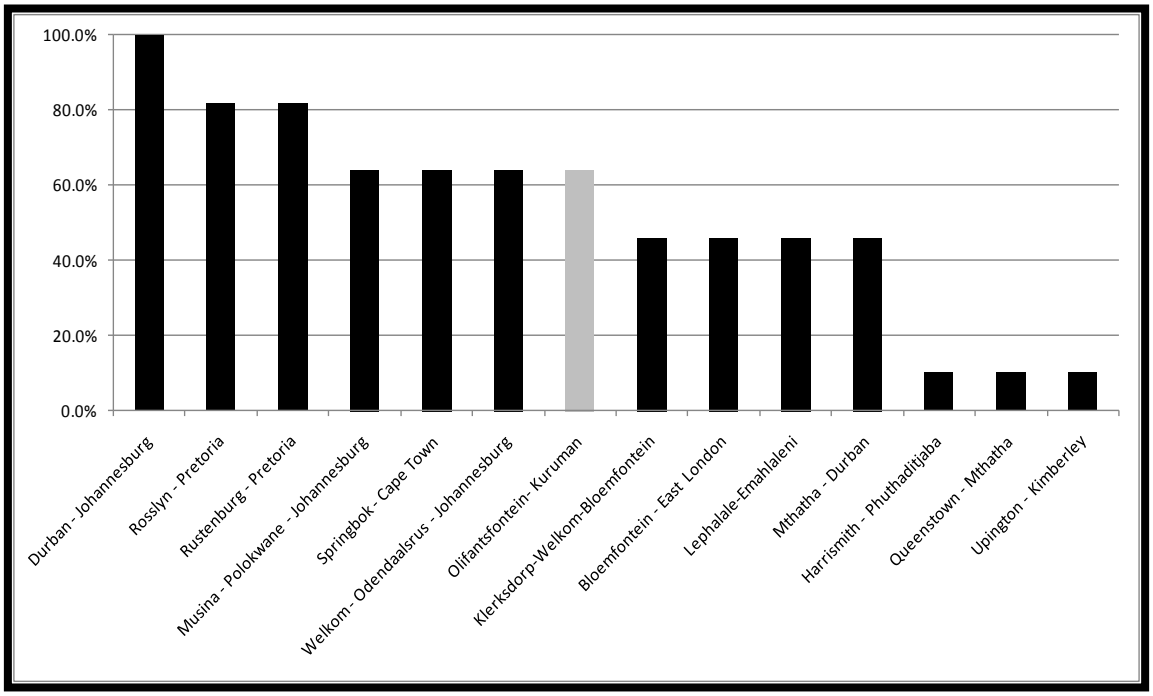

Figure 81: Ranking of the N14 east corridor within the dataset

A key feature that this corridor it that it is well developed due to other attributes, even though it has the encumbrance of the Kgalagadi poverty node. It has a substantial rail link to the deep water port in Saldanha Bay, and due to the changing procurement strategy of the mines in the area, they are developing manufacturing centres to supply some of their own mining requirements. With time these can be expanded.

A point of concern is that the rail link from Sishen to Saldanha Bay is notionally 'full' due to the dominance of Assmang and Kumba on this rail line dominating most of the bulk freight used on the line. A change in bulk profile may enable, with time, other goods to also be railed from here.

9.3.5 Development opportunities for the N14 east corridor

The following mineral-linked opportunities are considered for this corridor, and pending the outcomes of feasibility investigations, should be considered conceptual only.

- Establishment of a tool and die fabrication centre, possibly in Sishen or near Postmasburg to supply iron ore and manganese mines in the area.
- Establishment of a gemstone enterprise linked to sugilite, tigers eye and other gemstones from the area.
- Creation of a tiger's eye gem-route from Kuruman to Prieska, along the Asbestos Mountains in the area.
- Establishment of a Transnet wagon repair centre at Sishen or Postmasburg, to ensure reliable supply to the mines.
- Development of a centre to manufacture protective clothing and equipment to supply the mines. This can be based in Kuruman or within the Kgalagadi poverty node.
- The mines generate substantial fines which cannot be transported, so the construction of a sinter facility in Postmasburg, Sishen and Hotazel can be considered.
- All the input for steel manufacturing can be brought to the area except water. The rail link from Sishen to de Aar can be enhanced and a feeder relationship established between Sishen and Postmasburg to De Aar (250 km south of Postmasburg), where rail and water infrastructure is in

place, can be assessed.

- Steel mini-mills can be established in the area to make intermediate products, such as direct reduced iron. These can be exported or sent to Saldanha Bay (or inland to Vanderbijlpark). The sintered fines can be used as feedstock. Coal, a missing input, can be brought to the area on empty rail trucks returning.
- Expansion of mining tourism into the region.
- Establishment of a geological museum for iron and manganese mines and minerals.

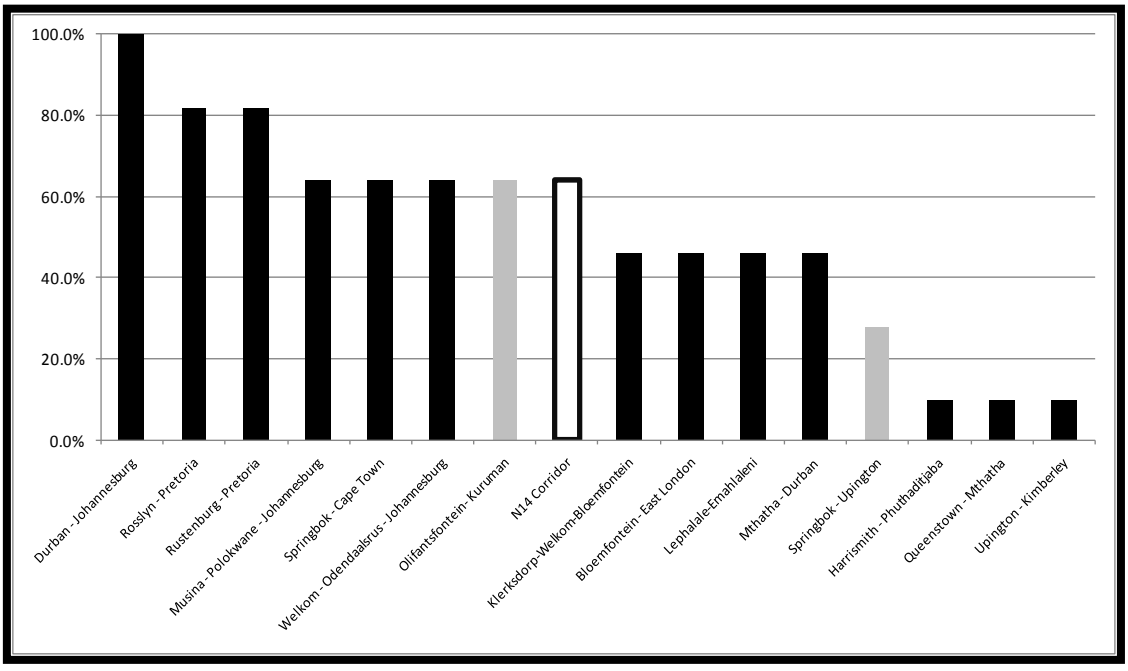

Figure 82: Ranking of the N14 corridor within the dataset

9.4. Summary

The case deals with the establishment of a theoretical development corridor along the N14 road through the Northern Cape. The area is geologically

extremely prospective, located on the largely Proterozoic terrain. The corridor, it has been established, can commence with rural development around mineral deposits in the region. Where there are mines in place there is an opportunity to increase economic diversity by establishing component manufacturers, particularly close to the iron ore mines.

CHAPTER 10. LIMITATIONS OF THIS RESEARCH

10.1. Introduction

The limitations of the research are illustrated.

10.2. Limitations to the research

The thesis has set out a way to strengthen the link between South Africa's complex, and rich mineral endowment. It explores the use of mineral corridors as a means to strengthen stranded deposits in rural areas. However, there are some limitations to the research that need to be presented to help strengthen future research in this area, such as

- Primary information;
- Secondary information;
- Lack of South African-specific information;
- Costs of this study; and
- Access to experts.

10.2.1 Secondary information

Secondary data has the advantage of being the easiest to obtain and can be sourced at relatively low costs. However, some shortcomings with secondary data sources were related to:

- Sometimes it was general and vague;
- The information and data may not be accurate or was dated; and
- The sample used to generate the base data may have been too small.

10.2.2 Primary information

10.2.2.1 Structured interviews

Interviews are useful ways of gathering site specific data. A decision was made to use structured interviews and if any additional information was provided these would be captured for a single site.

The interviews commenced with an explanation to the interviewee of the authors interest in their project. In doing this some interviewees tried to be too helpful and answer questions in a way that they thought would help this study. Further, when they thought the research was a 'document for government' they would overemphasise the role government could play to help them. When this happened the interview was stopped and re-commenced from a different perspective. This added to the time required to complete an interview. It is believed, from experience, that open-ended interviews (unstructured interviews) would also be too time consuming.

To identify problems and model these, it was found that some were identifying one problem with several examples, and so when required to identify their three biggest challenges they would provide several examples of a single type of problem. They would then brush over other problems, particularly when the author investigated its impact.

It is the author's understanding that a structured interview would seem to create a sense of taking control away from the interviewee and so they do struggle.

It was found that many interviews highlighted permitting processes (four of seven interviews) but because permitting is at an early stage, very few understood its impacts but identified daily problems (transport, access to markets) as their major problem. This imbalance, the author believes, is due to recency effects (assigning highest priority to things that happened most recently).

Early in the interviews the author became aware that one mine owner could not write. This occurred a second time with another interviewee who said they could not see the interview sheets. The author was later informed that he could also not read. It was then decided that the interview would be scribed by the author asking all questions. All interviews were scribed, then typed by the interviewer.

10.2.2.2 Site visits

One of the major limitations with site visits is that for detailed observational notes to be made, a considerable amount of training, experience, and skill was required before the trip to record useful observations. The observations were therefore limited to pre-site visit preparation and some ideas had to be formulated before the field visits.

Site visits could be made to areas where the author knew where people were operating and where the author could secure invitations. Some visits had to be

done with people away from all their mine sites and they had to be interviewed where convenient. Therefore interviews of miners are not correlated with the site visits. Some visits the author had to do twice and could only get to one site the second time.

Some sites were being mined illegally or were legal but with unsafe acts taking place. This meant that the author was rushed through some parts of either the interviews or the visits, and therefore the observations could not be detailed or may not have been correct.

The author is limited to fluency in English and Afrikaans, and so sites selected were selected where owners and operators were English or Afrikaans speaking. South Africa is a largely multilingual society and so mines where owners or operators could not speak English or Afrikaans could not be readily interviewed without additional expense.

10.2.2.3 Corridor investigations

The development corridors were difficult to understand because as more work was done to investigate these, more learning was taking place. This meant that corridor visits early in the project were done well, but could have been done better. This resulted in more corridor visits being undertaken to strengthen that part of the dissertation.

The corridor visits entailed travelling 5,700 km and some corridors required travelling over routes not assessed for the benefit of the dissertation, to get to the corridors that the author wanted to investigate.

10.2.2.4 Data

There was a problem finding reliable secondary data because agencies that have long time lead data (i.e. World Bank) did not classify minerals data in the same manner as traditionally included in the South African regime. They would include processed products and inputs, which were not necessarily correct. For example, South Africa imports bauxite but exports aluminium.

This would be treated as two separate products in South Africa, but as one product by the World Bank.

10.2.3 Lack of South African-specific information

It is difficult to source South African databases that can be modelled. The data used by the DMR classifies it as confidential, and so only provides aggregated data. It is difficult to therefore link national production levels to output on provincial levels. This would furthermore enable one to assign provincial output to levels of productivity and levels of employment.

10.2.4 Costs of this study

10.2.4.1 Fieldwork

Originally it was decided to conduct four field visits, four interviews and four corridor visits. These eventually grew to eight field visits, eight interviews and 13 corridor visits. This study wanted to introduce a new mechanism for rural development, the Rural Development Corridor, and transfer it from the major, well tested areas and attempt these in the rural parts of South Africa. The eight

field visits, 13 corridor visits, and eight interviews covered 12 820 km of road and 54 nights away from home over more than two years. These impacted on the costs available to do more work.

10.2.5 Access to experts

Due to the newness of the approach within the South African context it was difficult to find national experts that were able to be interviewed.

10.3. **Effect of the limitations on the conclusion**

Secondary information was verified against other information prior to utilising it to form part of the conclusion. The author read widely to ensure general or vague data can be contextualised in the broader context. Secondary information was used in a supporting role.

Conclusions were largely based on primary information. Structured interviews limited the interviewee to questions asked, but it provided a more focussed reply for the benefit of the study. Site visits limited to only English and Afrikaans speaking individuals makes more than 90% of sites accessible. Pre-site visit preparation enabled observations to be useful.

The learning that took place related to development corridors, formulated the results presented in the dissertation. Data were verified against other data in order to contribute effectively. The conclusion, that development corridors can effect environmental and social change alleviating rural poverty by using the suggested recommendation, rely largely on primary information.

CHAPTER 11. CONCLUSION AND RECOMMENDATIONS FOR A NEW ROLE FOR MINERAL-BASED DEVELOPMENT

11.1. Introduction

This chapter details the conclusions to the research, and also provides some recommendations for further research into the role of mineral-based development.

11.2. Mining in South Africa

South Africa's mining reputation is in general decline. It is no longer a dominant gold or diamond producer after more than 100 years of continuous mining. Its ranking is in decline and it is unlikely to recover in the medium term. The gold sector, which was one of the largest single employers (more than 1-million employed), is in decline and this is likely to continue. South Africa's inability to attract mining interest that could lead to new projects is still one of its largest drawbacks. Since 2005 it has become dramatically unfavourable for new ventures as the country's legal framework and land use demands is too restrictive.

11.3. **Legal framework for mining in South Africa**

The author has established that to understand and model mineral development better, the current mining legislation is too narrowly focused and therefore inadequate. The use of other legal codes, particularly around air, water and soil impacts, is a better mechanism to track sustainable rural development.

11.4. **Rural development**

South Africa has a mining sector that, due to its unique geology, has seen most mines located in the rural areas. The similar situation exists whereby mines that have long since closed are also largely located in rural areas. These deposits remain off limits for numerous reasons, including a lack of permitting, a shortage of information to decide whether to re-open them, and a clear shortage of rural entrepreneurs. Those that do exist, this study has found, are largely old or semi-retired and there is a distinct shortage of young rural entrepreneurs to take up opportunities. This study has indicated that the focus on the problems of rural areas, and not the assets of rural areas, is partly responsible for why rural entrepreneurs do not approach opportunities around these deposits.

For a rural area to be able to compete internationally and ultimately nationally, it is important to establish rural regions which can act as competitive areas that can participate in the economy. This advances the debate of regionalism.

The designation of regional competitive areas also allow for the focusing of strategies and the funding for targeted rural projects.

11.5. **Enterprise development**

This study identified two mechanisms to drive enterprise development. Enterprises, typically the product of entrepreneurial activity, are required to increase economic intensity and activity.

A need has been identified, i.e. poverty reduction, and so enterprises, a product of economic development, should be applied to the situation. There is a role for the private sector, and government has a limited role to play.

It has been identified that government is a poor implementer and has no capacity to commercialise activities. Government therefore needs to make available financial resources. Part of the problem to overcome is the bureaucracy created by government which hinders enterprise development. Government should exempt rural enterprises from some compliance hurdles. This will serve to accelerate rural development. An important aspect of urban enterprises is that they can access labour without too many problems.

However, the ability to reach economies of scale is needed, so rural enterprises need to have a larger region to establish themselves.

11.6. **Mineral development**

One of the concerns with mineral resource-dominated regions is that they develop rapidly at the expense of other sectors. Typically one sector (in this example mining) continues to grow, and eventually the salaries earned attract skills and labour away from other regions. Even though national performance

was considered as affected by the natural resource curse, it was also applicable at the sub-national level. The cases considered for this study therefore identified areas where there was surplus labour (though not necessarily skills) and so mining projects would not draw labour away from other sectors of the local economy.

Furthermore, the growth of mining (primary sector activity) would, it is feared lead to 'deindustrialisation'. In this research it is demonstrated that if carefully planned and executed, a structured development programme that involves partnerships, a deepening of governance reforms, and intensive efforts at poverty reduction, linked to minerals could help industrialise a region.

11.7. **Development corridors**

Different types of corridors were identified, including transport, trade, manufacturing, feeder and economic corridors. These were assessed and it was noted that South Africa has many transport corridors. Stranded deposits, it is recommended, can be developed by linking these to transport corridors.

South Africa has identified 12 trade and feeder corridors that will receive prioritised support to create economic corridors. This does not preclude the formation of new corridors or the strengthening of other transport corridors. The inland location of South Africa's largest economic hub in Gauteng means that there is a requirement for substantial movement of all goods. Gauteng is linked to numerous trade, feeder and economic corridors. The use of corridors,

however, as they evolve, occurs with increased economic and infrastructure densification.

This densification then leads to opportunities for small enterprises (SMEs) to develop around these. The crowding in effect, it is hoped, supports the introduction of low value commodities (such as agriculture) as well as its downstream linkages (agri-processing). A total of 13 corridors were investigated and reported.

11.8. **Summation of the case study**

The case study looks at the potential to develop a hypothetical corridor along the N14 between Springbok and Kuruman in the Northern Cape. The region is characterised by low population density but high mineral potential and diversity. Across the length of the identified corridor, a list of 12 mineral projects have been identified, currently or historically. The projects identified for the corridor speak to all levels of the minerals development:

- Exploration;
- Mining;
- Manufacture and repair of mining capital goods;
- Manufacture of consumables; and
- Expanding possible reprocessing of intermediate grade products.

11.9. **Summation of corridor visits**

Thirteen corridors were visited. These ranged across all types identified, except that a manufacturing corridor could not be adequately identified. A manufacturing cluster in Johannesburg's East Rand has increased in size and is now fused to the metropolitan with no clear distinction. Also, the manufacturing node at Rosslyn near Shoshanguve was classified part of a feeder corridor.

The corridors were scored, and it was found that those passing through areas of high poverty (for example the corridors of the Eastern Cape) are difficult to develop because industrial feeders are difficult to make self-sustaining. The corridors linked to any point of Gauteng (Johannesburg or Pretoria) are more robust. The length of the corridor is not an indicator of effectiveness. The movement of goods is very important and it is the Transnet and SANRAL agencies of government that play the most important role in developing first transport corridors, and if the multi-year development strategies do not include unlocking stranded deposits, then new corridors are unlikely to be added.

11.10. **Summation of interviews**

Interviews were conducted with rural entrepreneurs or with operators of rural enterprises. The interviews were structured in some areas so that some form of comparative analysis could be conducted. Without limiting the interviewees (and due to the distances already covered) they were provided an opportunity to express their opinions without restriction.

The three most substantial challenges experienced by rural entrepreneurs are the following:

- They need improved or wider access to local markets so that they can increase sales volumes;
- They need easier mechanisms to obtain permits because the current system is unreliable and costly; and
- Equipment is required to help increase their productivity, and in some cases, to help access the areas.

When provided with an opportunity to identify changes that they would like to see, the same three issues were mentioned, but in a different order. The changes, and many sought government support with this because they could not identify other support structures in their rural areas, were the following:

- Provision of equipment to increase output levels. They acknowledge that industrial minerals are reliant on volumes and economies of scale (though not called that) and that that would make them more competitive;
- Support to access international markets was important because the experience was that sales to local consumers were only possible at discounted prices. These, though necessary, could not be relied on. The rural enterprises felt that to have additional market opportunities would strengthen their ability to operate year round and also strengthen their negotiation position; and
- Permits for more areas or larger areas would enable them to increase

product ranges and diversity, which is required in some industries.

There is an acknowledgement that some of these would make operating more competitive and these entrepreneurs would be able to increase their ability to expand and employ more people for longer periods. The views are that these issues can be where government should help them.

A further feature of the interview outcomes is that the rural entrepreneurs interviewed are old, have used their own resources to date, and would continue irrespective of support or not. The problem is that there were no young entrepreneurs identified. The loss of intellectual property when these people leave the industry means that there will a need to re-learn for the next generation of mining entrepreneurs.

11.11. **Summary of recommendations**

The recommendations made commence with a structured approach to mineral-based rural development. This commences with the following:

- Complete a national rural mineral-asset audit;
- Use the information to demarcate rural-regions that can be developed as national and international competitive regions;
- Establish a rural Resource and Training Academy(ies) so that skills are developed close to areas where they will be deployed; and
- Provide an easier way to launch rural enterprises and incentivise these for accelerated development.

The recommendations for mineral-based development in rural areas are premised on the support roles that can be played by two other activities: mineral-based rural development and mineral-based enterprise development.

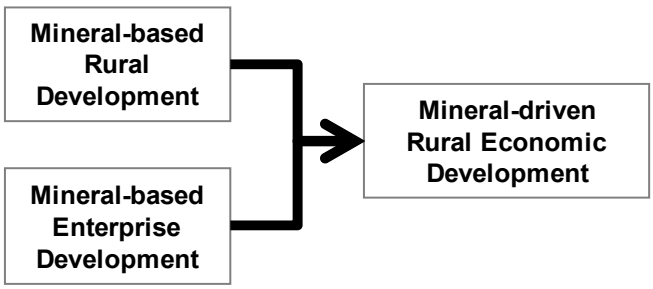

Figure 83: Schematic showing mineral-driven rural economic development achievement

11.12. **Recommendations for mineral-based rural development**

It is the recommendation emanating from this study that rural development is achieved in the following manner:

- Commence with an 'asset audit' for rural mining areas so that the mineral asset base can be correctly understood and contextualised;
- Identify a rural-region that can be built up as an economic entity that can compete as an economic entity on a national level first and ultimately on the global level. Perhaps District Municipalities are already or can be adapted to be these regions;
- The high mean-age of the rural entrepreneurs indicates that there is a substantial gap in knowledge and skills transfer to a younger generation of rural entrepreneurs. When these people leave the sector (switching, retirement or death) then re-learning of emerging entrepreneurs needs to

take place. Some of the learning has taken place over several decades and so re-learning is very slow. A mechanism is required to store knowledge and transfer this more quickly (e.g. the establishment of Resource and Training Academies in rural areas); and

- Incentivise rural development with greater rebates, a quicker permitting process, and grant funding for infrastructural aspects.

11.13. **Recommendations for mineral-based enterprise development**

It is the recommendation emanating from this study that rural development is achieved by the following structures:

11.13.1 Rural enterprises

- Identifying mineral resources (occurrences, deposits, unmined areas and derelict and abandoned sites) and conducting feasibility assessments to determine their economic viability for rural enterprises to operate;
- Identify the infrastructural shortcomings (what needs installation and what requires upgrade or repair);
- Complete a skills assessment to see what skills are available or require development in the region; and
- Reduce the barriers to entry for entrepreneurial activities and enterprises if they are based in rural areas.

11.13.2 Development corridors

Corridors do not develop first, and this section is based on the assumption that the enterprises required are allowed to develop. Thereafter, to strengthen these enterprises, before they struggle with logistical issues, development corridors need to develop. This would entail the following:

- Look to establishing rural feeder corridors where these are close to urban centres (e.g. within 100 km of Cape Town, Durban or Johannesburg);
- Attempt to link stranded deposits to transport corridors (see Figure 5 for more information). This stage will have to be linked to development strategies of Transnet (rails and ports) and the South African National Road Agency Ltd. (SANRAL);
- Economic potential of potential corridors must be investigated in detail and only those with a reasonable expectation of success should progress. Those that do not have an immediate chance at progressing successfully and sustainably must be allowed to develop as regionally competitive areas first; and
- Utilise Public-Private Partnerships (PPPs) more extensively for rural development along approved or envisaged corridors.

11.14. **Recommendations for further research**

It is the recommendation emanating from this study that areas for further research include:

- Quantification of regional and local issues;
- Conduct national impact studies; and
- Development of monitoring indicators.

11.14.1 Quantification of regional and local issues

In South Africa the major statistical and information gathering is conducted by Statistics South Africa. They tend to use aggregated data, and due to the coarse resolution of these it is difficult to focus on specific performance criteria. It would be important to numerically model South Africa's rural issues and opportunities.

11.14.2 National impact studies

National impact studies must be conducted by multi-disciplinary, independent teams to investigate the economic impact of corridor projects before, during and after commencement. Many new corridors develop for political reasons and require disproportionate incentives and concessions to ensure survival.

The studies must also look at long established corridors to serve as an unbiased baseline. The author has, for example, the case where political credits are being accepted for the success of the Maputo Development Corridor with amounts of $5 billion invested along the corridor. It has been indicated in this study that this was a natural trade corridor for several generations before the corridor was formally proposed, and what was claimed as a developmental corridor success was merely an expansion phase of a corridor that developed in

the 19th century. It is better to have realistic assessments of government capacity and impact than propaganda-driven information.

11.14.3 Development of monitoring indicators

The development of rural enterprises and corridors will be reliant on the provision of scarce financial resources from the national government. It is therefore important that a set of independent indicators are developed so that provinces can apply for resources and the most deserving or most likely to succeed projects are supported. The indicators should also serve to indicate the impact of mining-specific projects on poverty levels. Levels of poverty, education and health can be incorporated into these indicators, along with indications of governance and environmental impact.

11.15. **Answering the hypothesis**

The legislative requirements of South Africa have made mining projects very difficult for rural entrepreneurs to emerge, so support is required to help them establish as small businesses, and then be further supported and allowed to expand. If they can be helped to link to trade corridors, then provincial as well as national government can play a role.

South Africa has many forms of corridors and they have also grown at a pace determined by their key anchors and support enterprises. From a simple transport corridor to a deeply integrated economic corridor, the evolution with time is well understood. Rural enterprises would typically first benefit from

transport corridors, where the cost of transferring their goods is lowered by developing critical mass at the hub or depot to the receiving market. The rural corridors examined in this study (particularly those of the Eastern Cape) failed to develop.

The Northern Cape corridors proposed along the N14 have a suite of projects that can be developed and linked to these corridors. This will play a role in the development of the entire rural region along this N14 corridor.

The final message is that it is possible to use South Africa's mineral resources (wealth) as a catalyst to diversify the economies of rural areas and thereby serve as a basis for social and environmental change while making an economic impact.

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APPENDICES

Appendix A Interviews

Interview with Michael Kota

Contact Details: +27 (0) 82 363 2193

Age category

0-15	16-30	31-45	46-60	61-75	76-90
		✓			

Commodity/(ies) of Interest:

Aggregate (crushed dolerite)

Involvement in the Mining Sector:

The Interviewee was involved in the mining sector even before this project. He has attempted some other small mining projects (sandstone and coal) but these were closed when the market changed. Also the sites were far from where he lives. This project is, in his view, his third attempt.

Location: The site is located approximately 5 km south of Seymour, Eastern Cape.

Reasons for involving themselves in the mining

There are not much work job opportunities in the immediate vicinity of Seymour. Even the towns close by are struggling and so there are no jobs not just in Seymour but in towns around Seymour as well. Therefore the only way out is to be involved in farming and mining at a small scale.

Biggest challenges experienced (try and provide three)

The interviewee identified the following areas where their business either experienced problems or challenges:

- More local building projects are needed (projects closer to Seymour) which can get material closer.
- The application for permits is not easy, each time the applicant had to travel to Port Elizabeth and if there is problems it is difficult to solve these only over a phone.
- The price received for material supplied is not always high enough because to mine you need to hire unemployed locals at a fixed rate and when you think it will cost you so much it costs more because you either got paid too little for the aggregate or the workers wanted too much.
- The interviewee experienced fierce competition with the more established “Queenstown Quarry’ approximately ’10 km up the road’ [the author found this was 80 km away].

Changes they feel may be required to help them operate better

In line with the issues identified above the changes required by the interviewee are:

- An easier way to apply for mining permits and rights when projects are for the benefit of the community and by small players in the community.
- Government projects must buy its materials or at least some of its materials from community projects. This can be put into law.
- Transport costs are too high. This is also adding to the costs.

Additional Comments

The training provided by the MQA sponsored small scale mining school was very useful, but it does not address the real challenges they face, like transport costs, permit authorisations and competition.

Interview with Chris MacPherson

Contact Details

+27 (0) 11 464 1409 / +27 (0) 82 651 4261 / + 27 (0) 82 659 5244

Age category

0-15	16-30	31-45	46-60	61-75	76-90
			✓		

Commodity/(ies) of Interest

Sandstone

Location:

The site is south of Rosendal and north of Senekal in the Free State province

Reasons for involving themselves in the mining sector

The interviewee was involved in other construction sector projects and decided, after receiving numerous queries, to source sandstone from sites available to him. This was to try and supply sandstone into his own construction projects.

Biggest challenges experienced (try and provide three)

The interviewee identified the following three areas where their project or business experienced problems:

The permitting process was so long and took more than 19 months. Eventually he was informed there was a problem with the application and he had to travel

the 130km to Welkom to solve the problem. He is, after the correction, again waiting 7 months to present.

It is difficult to employ locals because most of the people in the area are working on the nearby farms and mining needs different skills.

He needs more than one site for different colours of sandstone and cannot get more permits. He needs different reserves in different places.

Changes they feel may be required to help them operate better

Permitting needs to be simplified. It cost him R16,000 to complete the application form and then heard it had a problem. He had to spend more money to go to Welkom and try to solve the problem, and then he had to wait again, eventually more than 2 years from first application.

Part of his form needs Consultants to help him and he needs to fetch them in Bloemfontein or Johannesburg. If government could give him a 'development voucher' to part pay to Consultants or universities that can help him.

The permit is for 1.5 ha and he needs to apply for multiple sites. He would like a permit to be for a larger area, like 3-4ha. It allows him to mine more or for longer. He tried once but he needed to get a mine engineer to site which cost too much and there was no guarantee the report would be accepted by DMR.

Additional Comment

Nothing further to add.

Interview with George Swanson

Two interviews were held with George Swanson, in April 2007 and September 2007.

Contact Details

+27 (0) 82 496 2484

Age category

0-15	16-30	31-45	46-60	61-75	76-90
					✓

Commodity/(ies) of Interest

Gemstones and industrial minerals of Namaqualand, Richtersveld and southern Namibia.

Involvement in the Mining Sector

The interviewee has been in South Africa since childhood (more than 60 years). Originally family were brought to South Africa from the United States to work at the O'okiep Copper Mine. The interviewee has a record of having mining projects during the 1950's already for tungsten and then expanded these across the region.

Location:

Namaqualand and Richtersveld, Northern Cape.

Reasons for involving themselves in the mining

From an early family interest in prospecting, the interviewee said he had followed in his mother's footsteps as a prospector. He has, over the decades, been able to benefit from swings in commodity prices because he has had opportunities to link to markets, particularly in the USA.

Figure 84: Gem collection belonging to George Swanson

Biggest challenges experienced (try and provide three)

The interviewee identified the following three areas where their business experienced problems:

- Transport of goods to Cape Town is difficult and over the years has improved but it remains difficult.
- He is required to do his own marketing and even when he asked for help he was always left alone to do his own marketing. The result is that he

only deals with commodities where he can get more than R20/kg.

- The equipment he has at the various sites he works is difficult to maintain. The areas are rugged and equipment can get damaged going into the area or coming out. Sometimes these machines, like compressors, do break and remain broken for months until parts can be sourced.

Changes they feel may be required to help them operate better

- Government must help him to train people. He would like to train more of the locals in the areas but he found it difficult to keep paying for training and then they leave as soon as there is a swing in the market but never return when things improve. Sometimes he finds they left for better prospects not using the training he provided.
- He needs help with marketing his products overseas, particularly in Asian countries. He knows they are interested but he struggles to get exposure.
- It is possible to sell more and extract more but more equipment is required.

Interview with Danie Van Zyl

Contact Details

+27 (0) 84 689 4072 / +27 (0) 27 761 8196

Age category

0-15	16-30	31-45	46-60	61-75	76-90
			✓		

Commodity/(ies) of Interest

Aragonite and feldspar.

Involvement in the Mining Sector

The interviewee has lived in Springbok for many years and relocated to Kotzeshoop. He now lives between the two towns. From the days living in Springbok he got involved in pegmatite mining first and secured an area near Eksteenfontein. On moving to Kotzeshoop he maintained his operations around the pegmatites but only in the last 3 years seriously tried to develop the aragonite occurrence near his home.

Location

Kotzeshoop, Northern Cape

Biggest challenges experienced (try and provide three)

The interviewee identified the following three areas where their business experienced problems:

Permitting was difficult because the application required a detailed map of the area with surveyed corner points. This he could not afford because the nearest land surveyor to the Kotzeshoop operation was in Springbok. If he could get the maps as required by the DME he could have completed his application process.

The price in South Africa is low and he knows outside South Africa the prices offered is higher. The interviewee believes he was able to get better prices and to better markets if he could have more sellers to deal with.

The area is difficult to access so local government support to help with access roads is important. The rental of local municipality equipment must possibly be considered.

Changes they feel may be required to help them operate better

The interviewee identified three problems and linked his needs to the three challenges.

- Permitting must be made cheaper and less reliance of external consultants must be required because they are expensive, or government must subsidise the expert help.
- Help with marketing is always required. These commodities need to be marketed not individually but as a group.
- Equipment centres can be considered so that small operators can access these at low costs because to source heavy equipment from Springbok, a struggling town, to service Kotzeshoop, a small settlement,

becomes disproportionate.

Additional Comment

He has responded to an order for aragonite and when he arrived at the agreed meeting point with the correct quantities the buyer baulked and offered only 1/3rd of the agreed price. This was difficult to accept but due to the expenses incurred already he had no other market and agreed to the sale.

Interview with Keeley Granite

Contact Details

Age category

0-15	16-30	31-45	46-60	61-75	76-90
		✓			

Commodity/(ies) of Interest

Granite

Involvement in the Mining Sector

Keeley Granite has staff that has worked for other companies in the Brits granite industry. They have an operation in Brits but drives sales and marketing from its Johannesburg office.

Location:

Brits, North West.

Reasons for involving themselves in the mining

There is a historical link to the granite mining industry.

Biggest challenges experienced (try and provide three)

The interviewee identified the following three areas where their business either experienced problems:

- Sometimes they need to mine at a loss and make profits when goods are

processed. They need help and relief when part of the business is running at a loss.

- Equipment and up to date technology is all imported and difficult to source cheaply. The exchange rate also works against them when needing to buy. There are local producers of equipment but the erratic quality has an impact on the quality of the completed products.
- They cannot supply everything from one quarry and need to source from outside the region. Those operations, however, are under threat of closure because permitting is slow.

Changes they feel may be required to help them operate better

- Access to international markets is important and it is difficult to export large blocks so expensive road transport is used because rail transport is difficult to secure.
- Local technology and engineering must be supported and developed so that they can supply the local industry, particularly for cheaper.
- Support in establishing cutting facilities is required. These products need to compete with cheaply imported goods so needs help if local beneficiation is going to be driven by laws.

Additional Comment

There are some big players in the granite industry in South Africa but in the international scheme these companies are very small. There are also many small operators mining in South Africa but their failure is to expand into different

colours and types of granites. The industry does generate substantial amounts of waste so some cutting needs to take place close to the mine. The Keeley Granite Brits Quarry supports this.

Interview with Koos Gilbert

Contact Details

+27 (0) 83 271 3260

Age category

0-15	16-30	31-45	46-60	61-75	76-90
				✓	

Commodity/(ies) of Interest

Copper

Involvement in the Mining Sector

The interviewee had been involved in small mining projects in the Namaqualand region for more than 30 years. He has owned and operated a pegmatite deposit but it became too difficult to supply small amounts at irregular intervals. Thereafter it evolved to other commodities as opportunities arose, including granite and wolfram (tungsten). With the closure of the O'okiep Copper Company (OCC) he was originally permitted to supply its plant high grade ore. He supplied this from defunct copper mines in the area as far as 20km away. The relationship changed as Metorex took over the mine and when the OCC was mothballed, the interviewee was able to supply his ore, as well as copper-rich salvaged material. He eventually sold this to the Rosh Pinah mine in Namibia where it was toll treated.

Location

Nababiep, Northern Cape

Reasons for involving themselves in the mining

The interviewee had originally been employed on small mines in the area and as these closed he would be unemployed. He eventually joined consortium to take up a mining supply contract but later commenced on his own mining projects, largely for feldspar and spodumene.

Biggest challenges experienced (try and provide three)

The interviewee identified the following three areas where their business either experienced problems:

He could not make 'big money' because he was paid for producing ore and delivering the ore and the salvage material. The toll treatment costs were too high and the transport costs were his to cover (as high as R30 000 per trip).

There were only two mines where he could source ore and the OCC property for salvage material. The problem was that he could quickly deplete these and have nowhere else to go.

There are other commodities that he can pursue and start mining 'tomorrow' but the inability to get equipment required makes it difficult to switch to these. He tried applying for a big mining right but he had to do water studies and could not find someone to do the work so eventually abandoned this. He then decided

that hand picking copper ore is relatively free of needing to use capital technology but the other opportunities will need some equipment.

Changes they feel may be required to help them operate better

- A government sponsored treatment facility situated in the region will open more abandoned copper mines and dumps and enable these to be retreated.
- The cost of capital equipment is a problem
- He wants to know what prices are regularly because he does not always know if he is getting a fair price.

Additional Comment

He wants to supply lithium and spodumene from old mine sites. He thinks this is the next trend mineral.

Interview with Redge Howell

Contact Details

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Age category

0-15	16-30	31-45	46-60	61-75	76-90
			✓		

Commodity/(ies) of Interest

Granite

Involvement in the Mining Sector

He has worked in granite quarries across South Africa and most recently returned from Zimbabwe. Kelgran offered to sell him its quarries in Pofadder and buy his product. He relocated from Brits to Pofadder to mine granite in this area. He still goes to Brits once per month where he cuts some of the granite.

Location:

Pofadder, Northern Cape

Reasons for involving themselves in the mining

He has worked as a granite miner for many years and started cutting as well. In Pofadder there is a cutting work which he has taken over but may sell if he can successfully cut his granite in Brits.

Biggest challenges experienced (try and provide three)

The interviewee identified the following three areas where their business either experienced problems:

The transport of material from Pofadder to Brits is difficult and they are reliant on returning trucks between Namibia and Brits, North West Province. Sometimes they cannot wait and have to commission their own truck which costs more.

There is a problem with labour in the area because the site is situated 40km outside Pofadder and staff needs to be transported daily. If he goes to Brits he cannot take people to the quarry.

The relationship is very reliant on the strength of Kelgran which has reached difficult trading conditions in recent years. Kelgran leads him to his market.

Changes they feel may be required to help them operate better

- If a more regular transport link can be established then more blocks can be sent to Johannesburg.
- He needs to find a way to keep the mine site operating even when he is away on business. This is something he is trying to work on.
- He cannot source consultant skills this far away and some things in his applications need consultants. He wants government experts or government sponsored consultants to help him.

Additional Comment

He is aware that mining granite has low margins and that the sale of cut blocks is more lucrative. For this reason he needs to keep travelling to Brits to do this for a part of the month.

Appendix B Corridors illustrating District and Local Municipalities

	Name	Length (km)	Type	Directly Linked to CT, JHb and DBn	Semi-Direct Rail Link	Attached to a Port	Industrial Feeders	Poverty Nodes excluded	Weighted Score	Provinces	DM	LM
1	Durban - Johannesburg	600	Economic	10	10	10	10	10	100.0%	KwaZulu-Natal Free State Mpumalanga Gauteng	City of Ethekwini Umgungundlovu Uthukela Thabo Mofutsanyane Fezile Dabi Gert Sibanda Sedibeng Ekhurhuleni	City of Ethekwini Mkhambathini The Msunduzi uMgeni Mpofana Umtshezi Emnambithi/Ladysmith Maluti a Phofung Phumelela Mafube Dipaleseng Lesedi Ekhurhuleni
2	Rosslyn - Pretoria	40	Feeder	10	10	1	10	10	82.0%	Gauteng	City of Tshwane	City of Tshwane
3	Rustenburg - Pretoria	120	Economic	10	10	1	10	10	82.0%	North West Gauteng	Bojanala City of Tshwane	Rustenburg LM of Madibeng City of Tshwane
4	Musina - Polokwane - Johannesburg	550	Trade	1	10	1	10	10	64.0%	Limpopo Gauteng	Vhembe Capricorn Waterberg Metsweding City of Tshwane Ekhurhuleni	Musina Makhado Molemole Polokwane Mogalakwena Modimolle Mookgophong Bela-Bela Nokeng tsa TaemaneCity of Tshwane Ekhurhuleni
5	Springbok - Cape Town	550	Transport	10	1	10	1	10	64.0%	Northern Cape Western Cape	Namakwa Western Coast City of Cape Town	Nama Khoi Kamiesberg West Coast Matzikama Cederberg Bergrivier Swartland City of Cape Town
6	Welkom - Odendaalsrus - Johannesburg	300	Trade	10	1	1	10	10	64.0%	Free State Gauteng	Lejweleputswa Fezile Dabi Sedibeng Ekhurhuleni	Matjhabeng Moqhaka Ngwathe Emfuleni Midvaal Ekhurhuleni
8	Olifantshoek - Kuruman	110	Trade	1	10	10	10	1	64.0%	Northern Cape	Siyanda Kgalagadi	Gamagara Ga-Segonyana
C	N14 Corridor	630	Trade	1	10	10	10	1	64.0%	Northern Cape	Namakwa Siyanda Kgalagadi	Nama Khoi Namakwa Khai-Ma Siyanda Kai !Garib //Khara Hais Gamagara Ga-Segonyana
7	Klerksdorp-Welkom-Bloemfontein	270	Transport	1	10	1	1	10	46.0%	North West Free State	Southern Lejweleputswa Motheo	Matlosana Moqhaka Nala Matjhabeng Masilonyana Mangaung
9	Bloemfontein - East London	580	Transport	1	10	10	1	1	46.0%	Free State Eastern Cape	Motheo Xhariep Ukhahlamba Chris Hani Amathole	Mangaung Kopanong Mohokare Maletswai Inkwanca Lukanji Amahlathi Buffalo City
11	Lephalale-Emahlaleni	430	Trade	1	1	1	10	10	46.0%	Limpopo Gauteng Mpumalanga	Waterberg Metsweding City of Tshwane Nkangala	Lephalale Modimolle Bela-Bela Nokeng tsa TaemaneCity of Tshwane Kungwini Emahlaleni
10	Mthatha - Durban	440	Transport	10	1	10	1	1	46.0%	Eastern Cape KwaZulu Natal	O.R. Tambo Alfred Nzo Sisonke Ugu Ethekwini	King Sabata Dalindyebo Mhlontlo Umzimvubu Greater Kokstad Umzimkhulu Ezinqoleni Hibiscus Umdoni City of Ethekwini
A	Springbok - Upington	370	Transport	1	1	1	1	10	28.0%	Northern Cape	Namakwa Siyanda	Nama Khoi Namakwa Khai-Ma Siyanda Kai !Garib //Khara Hais
12	Harrismith - Phuthaditjhaba	60	Transport	1	1	1	1	1	10.0%	Free State	Thabo Mofutsanyana	Maluti a Phofung
13	Queenstown - Mthatha	220	Transport	1	1	1	1	1	10.0%	Eastern Cape	Chris Hani O.R. Tambo	Lukanji Inxuba Yethu Engcobo King Sabatha Dalindyebo
15	Upington - Kimberley	400	Transport	1	1	1	1	1	10.0%	Northern Cape	Siyanda Pixley Ka Seme Frances Baard	//Khara Hais !Kheis Pixley Ka Seme Siyancuma Sol Plaatjie

Appendix C GeoParks

The generally accepted definition of a Geopark is that it is; a territory encompassing one or more sites of scientific importance, not only for geological reasons but also by virtue of its archaeological, ecological or cultural value.

The importance of Geoparks is that they serve as nodes of aggregation and attraction. Ideally geotourism and agritourism can dominate these regions. The advantages of Geoparks are (Municipality of Lukovit, 2007):

- They are a territory, in which geological heritage is protected and managed in a sustainable manner;
- In order to be successful a Geopark has to rely on strong commitment on behalf of local communities;
- The Geopark is an initiative that can achieve international recognition for geological sites of local and regional importance;
- Enhancing the value of such sites while at the same time creating employment; and
- Promoting regional economic development.

The Geoparks system is intended to be continental Geoparks (a European network of Geoparks and a Chinese network of Geoparks are already in place). Of the current network of 57 Global Geoparks, only two occur in the Southern Hemisphere, Araripe Geopark in Brazil and Kanawinka Geopark in Australia. Furthermore, Europe hosts 33 (58%) and China hosts 20 (35%) of all the Geoparks.

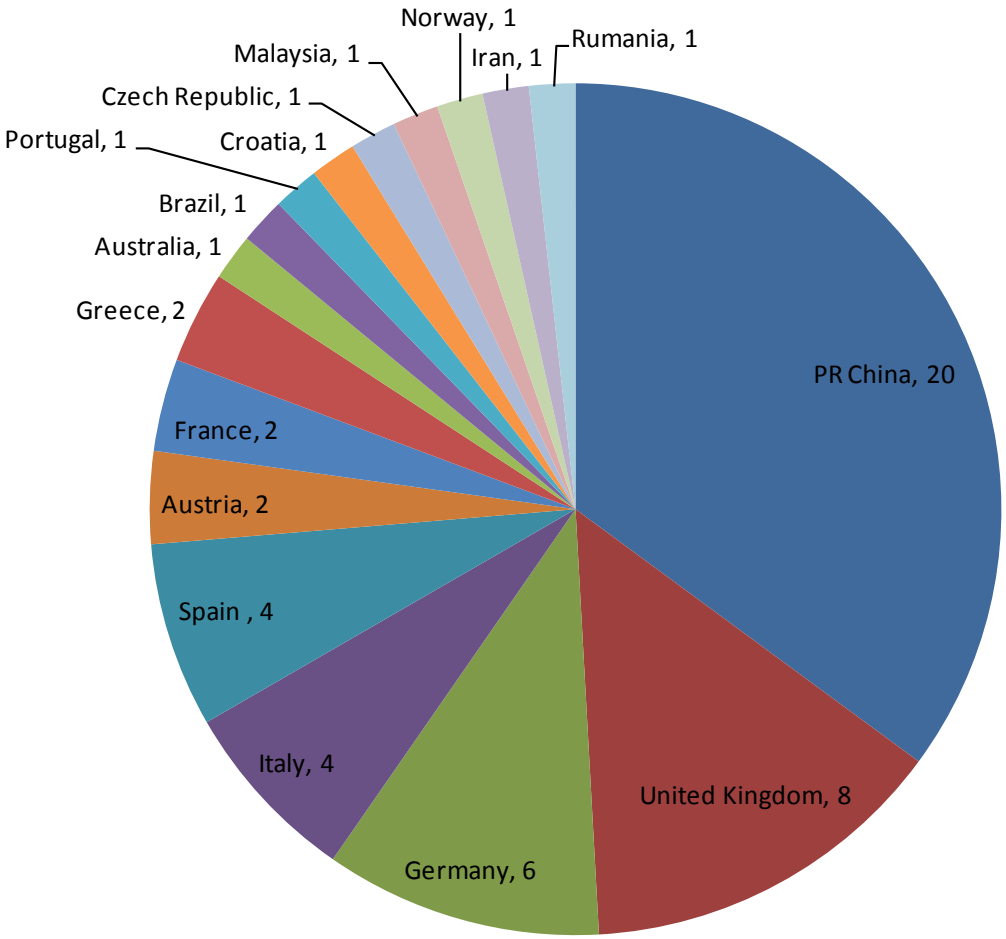

Figure 85: Distribution of global Geoparks per country

It is a proposal emanating from this study that the area bound by the Orange River in the north, the Atlantic Ocean in the west, Upington in the east and possibly the N14 to the south can be delineated as a South African Geopark. Due to the immense size and areas that may pose problems in the application process, it may be better to recommend 2 or 3 smaller Geoparks for this area.

References

Municipality of Lukovit (2007). Untitled. Online: http://geopark-bg.com/e_6.html. Accessed 3 September 2010.