

CHAPTER 3

DISCUSSION

3.1 DATASETS

The data acquired during the survey on the gold-mines and granite quarries were recorded in Excel spreadsheets (Appendix C) containing the following information:

mine name, farm name, type of mining development, type of reef, mining infrastructure, condition of mine, geology, strike and dip of reef, visibility from road, accessibility, tourism potential and landowners' names and contact details. This information was referenced to GIS maps produced in Appendices B and D.

Photographs were taken at all locations surveyed to aid in the determination of the current state of degradation, and to explain the conditions in the report. These photographs of the mining activities should be regarded as a reference for the state of the mines during the time of the survey. The photographs are available on request via the North-West University.

3.2 GEOCONSERVATION

The term “geodiversity” has been used from the 1990s to describe the variety in abiotic nature and more recently, Prosser (2002) used this concept as a means of promoting geoconservation. The conservation of the Vredefort Dome’s geodiverse sites is important to protect the diverse variety of rock types, and geological events spanning geological time from the Archaean Eon at approximately 3500 Ma to Karoo times of 65 Ma. The mines and quarries allow for a clearer view and understanding of these complex assemblages of igneous, sedimentary and metamorphic rocks. This is evident when comparing the view of a commonly outcropping granite pluton against the sight and information on display at a site following partial mining (Figures 75 a and b).

At the Leeukop Quarry a rich geoheritage is visible following mining of the quarry. This two- and three dimensional presentation of the pseudotachylitic breccia would not have been available had it not been for the quarrying. Conservation allows natural processes to operate and natural changes to occur. This implies that a weathered road cut can be allowed to continue weathering, thus exposing new fresh surfaces while incorporating the weathering factor and making the visitor aware thereof. Human action has often

accelerated or tried to stop natural processes and has thus destroyed much that is valuable in the natural environment. Change through human action is inevitable. The change must be managed. This applies to borrow pits which exist in the study area.



Figure 75. (a) In the distance on the right hand a granite pluton can be distinguished above the flat plain. In (b) so much more can be observed regarding the petrography, the effect of a meteorite impact, as well as the effect of recent weathering on freshly exposed rock surfaces.

Historic pits sometimes distract from the natural landscape and every effort should be made to prevent poorly sighted ones in future. The proposed borrow pits for the road upgrade plans in the listed World Heritage Site should therefore be placed with care and not just considering financial gains to the contractor. This change and human interaction should be managed through the Management Authority with advice from specialist consultants. This is the importance of conservation in geodiversity, according to Gray (2004).

According to Sharples' (2002 in Gray, 2004) definitions it is important to keep the following in mind:

Geodiversity is the quality we are trying to conserve,

Geoconservation is the endeavour of trying to conserve it, and

Geoheritage comprises concrete examples of it which may be specifically identified as having conservation significance.

The question in the geodiverse VDWHS is: how do we select a geologically representative set of these geoheritage sites exposed by mining activity as future reference sites for academic and research purposes, and also to use these sites to stimulate interest in science, history and conservation with regards to the visitor?

The mines, trenches and quarries are categorized according to the schedule of Ellis *et al.* (1996) as exposure sites. These sites provide exposure of a rock which is extensive

or well developed below the ground surface. Integrity sites in contrast provide finite deposits or landforms which are irreplaceable if destroyed. According to Ellis *et al.* (1996), practical conservation planning and implementation will involve the following elements:

- Documenting the special interest of a site;
- Preparing a site conservation plan; and
- Safeguarding the site.

To enable this, all the historic mining areas have been identified and classified (Sections 2.2.2 and 2.3.3). Once the mining excavations were identified and a general geological description done, a representative selection of these activities had to be made. Sites not classified as tourist areas and/or scientifically valuable were earmarked for rehabilitation and selective partial closure.

Geoconservation may include efforts to make a site more appealing to the visitor's eye. In Figure 76 these granite dimension stone blocks and fragments were stained in an attempt to do just that. In the scope of geoconservation, geoheritage and geotourism this effort is questionable as it is unnatural in colour, difficult to apply consistently and probably not environmentally friendly. It also obscures the rock surface for proper viewing by the visitor.



Figure 76. Granite blocks at Leeukop Quarry (GQ3 Kopjeskraal 517 IQ) are stained with an iron oxide in an attempt to blend the freshly exposed granite with the natural environment.

3.3 GEOTOURISM POTENTIAL

3.3.1 IDENTIFIED SUITABLE MINING SITES

Gold-mines

Gold-mining sites with potential, if prepared, equipped and made safe could enhance geoconservation and geotourism in the area. The shallow mines in the Vredefort Dome could be made attractive and safe at less cost than the younger deep-level Witwatersrand gold-mines. The infrastructure accompanying the average Witwatersrand gold-mine is enormous and with shafts and sub shafts ranging in kilometres as compared to tens of meters at most in the VDWHS mines, will involve much larger budget and safety risk to make accessible to tourists.

An attempt was made to identify gold-mining sites representing different reefs, mining methods and beneficiation activities whilst keeping accessibility in mind. The possibility of making selective sites safe was also a prerequisite, as was provincial locality. These sites, with specific mining excavations identified at each, should be the only mining excavations available to the public through guided tours.

Mining activities with potential for geotourism, keeping the proposed selection criteria (Section 2.4) in mind, are listed below.

- **Western portion of Buffelskloof 511IQ**

Mines B6 and B2 (Appendix C) require safety measures

- **Eastern portion on Buffelskloof 511IQ.**

Care should be taken to make adit, B9, safe.

- **Buffelskloof 483IQ**

Reef drives, BK2 and BK4 (Appendix C), require safety measures.

- **Rooderand 510 IQ**

Adits R1, R19, and R24 (Appendix C) are recommended for geotourism. These sites must, however, first be inspected and a monitoring plan implemented to ensure regular inspections. It is recommended that the remaining accesses into the mine on this farm be closed off after careful consideration of animal and bird occupants. The animals and birds using these adits, reef drives and vent-holes seem to be very sensitive to human

interaction and it has been observed that with increased human activity over the last 26 years animal and bird presence has remarkably decreased. The reef and waste rock dumps also pose a safety threat as evidence of subsidence has been observed.

- **Nooitgedacht 508IQ**

Adit K3 (Appendix C) is recommended for tourism activity following a proper safety and risk management plan. The mines are visible and within close proximity to the road. Entrance into the mines through the adits would only be advised following proper inspection and safe making. The remainder of the entrances should be closed off.

- **The Great Western Mine at Elandslaagte 28.**

Some of the surface infrastructure like the slimes dams and cyanide leaching pads could be good tourist attractions.

- **Rooderand 510IQ.**

The decline RO1 and adit RO2 (Appendix C) should be considered for tourism access as there is limited access to the Yellow Reef / Rous Series or Red Reef / Main Reef.

- **Elandslaagte 28.**

E1 and E2 occur on the old Great Western Mine. E2 is an adit which could be considered for access, while E1 served as the main shaft and is water-filled. E1 could, however, be considered for access.

- **Rebokkop 290**

BE1 Is close to the road and has an adit going into the hill but end in a very dangerous dead end which is unventilated and passes over a water filled vertical shaft. The adit entrance, however, could be made safe.

- **Mizpha 516**

M1 is a vertical shaft quite far from the road but still the only mine in the vicinity which could be made safe to visit.

- **Nooitgedacht 89**

N1 contains an adit, shaft and stope which are open to surface. This area lends itself to tourism as beneficiation activities are also present here.

- **Rooderand 510**

Decline RO1 and adit RO2 are the only workings to be considered for tourism on the Red Reef. The decline is water-filled but it could be pumped out to expose reef intersections.

A risk assessment was conducted to assess the safety risk associated with the identified sites (Appendix E). The results of risk rating of the recommended sites (RR) and the ranking of the sites, with the highest risk (1) to the lowest risk (16), are summarized in Table 5. It is evident from the table that with the exception of one site the rest are all high risk. It must be stressed that these sites are merely recommended sites that could possibly be made safe for future activities keeping geodiversity in mind.

Since the mines are all still considered to be open and no closure certificates have been issued, any activities in or around the mines must adhere to the safety standards as set out in the Mine Health and Safety Act (South Africa, 1996). This will include strict adherence to approved hazard identified risk assessment activities and measures.

Granite quarries

In the case of the granite quarries no specific criteria were used to identify sites with potential. This is due to the relatively uncomplicated nature of the quarries as compared to the gold-mines. The quarries are therefore all potential sites for tourism but attention must be given to the general unsafe conditions discussed in Section 2.4.

3.3.2 SELECTIVE CLOSURE AND REHABILITATION RECOMMENDATIONS

Selective closure recommendations are made in an attempt to safeguard the visitor against safety risks posed by open mining excavations whilst at the same time allowing continuous use of the sites by wild animals and birds.

All identified shafts, adits, vent-holes, winzes and prospecting trenches deeper than two metres should be fenced off in the VDWHS. Mines with tourism potential could be fenced off with relevant access gates to enable potential future access to visitors.

Table 5. Risk assessment results of sixteen gold-mining activities with tourism potential. Sites are ranked from 1 as highest risk to 16 as lowest risk according to the risk ranking assessment.

Risk Ranking of the gold-mining activities with tourism potential			
Farm	Risk Ranking	Category	Ranking (1=Highest risk)
B2-Buffelskloof 511 IQ	822	High	1
B6-Buffelskloof 511 IQ	770	High	2
RO1 Rooderand 510	753	High	3
R1-Rooderand 510 IQ	685	High	4
R19-Rooderand 510 IQ	685	High	5
R24-Rooderand 510 IQ	685	High	6
E2-Elandslaagte 28	619	High	7
B9-Buffelskloof 511 IQ	618	High	8
K3-Nooitgedacht 508 IQ	583	High	9
RO1 Rooderand 510	514	High	10
BK4-Buffelskloof 483 IQ	490	High	11
N1-Nooitgedacht	488	High	12
BK2-Buffelskloof 483 IQ	478	High	13
BE1-Rebok Kop 290	475	High	14
M1-Mizpha 516	286	High	15
E1-Elandslaagte 28	159	Medium	16

At all the mines the shaft holing at surface is very dangerous and should be fenced in. This can be done through either rolls of security fencing or diamond-mesh fencing where animal access is not expected. Information and warning signs should be erected at the entrances to all mining areas. These signs should inform visitors that they need permission to be on private land and that the management authority can direct them to mines opened up for visits. The dangers of illegal entrance into mines like histoplasmosis (also known as "cave disease" is a disease caused by the fungus *Histoplasma capsulatum*. Symptoms of this infection vary greatly, but the disease primarily affects the lungs. Histoplasmosis is sometimes contracted from contact with microscopic bacteria borne by decomposing biological excretions from bats), dangerous vertical shafts, water-filled holes, and other relevant aspects, should be clearly indicated.

Fencing should be installed once biodiversity studies for each area have been done to ensure the smallest impact on the fauna frequenting the mining excavations.

Since these mines are still seen as if in operation the recommended safety personal protective equipment as prescribed by the Mine Health and Safety Act (South Africa, 1996) should be issued by the tour guide or tourist company during mine visits. Access to approved sites by professional scientists should also be led by a guide, namely a representative from the Management Authority or the DMR, to ensure that safety standards are met. Where sites not recommended for public access are visited, the management authority should be informed along with the relevant landowner, and a representative from the DMR should accompany such visits.

The locality of rock dumps and mining infrastructure releasing acid mine drainage close to the Vaal River should also be investigated further.

It is important that selected parts of the mining value chain not be removed as this is vital to the future communication and training potential of the mining sites. Further erosion of slimes or tailings dams for example should rather be constraint as opposed to removing the dam.

The erosion of tailings slimes into the Vaal River at Great Western mine is, however, a cause for concern (Figure 73). It is recommended that a run-off water deflection channel be constructed to prevent surface water from washing tailings slime into the river. A retention wall can also be constructed to enable collection of potential future spillages.

Rehabilitation at the granite quarries should be considered with care. The remains of stained excavated blocks bear testimony to earlier attempts to restore the site. However, with a more focused visit to the site the attempt seems obviously distracting to visitors. Some of the rubble material provides excellent viewing decks to the environment even though it is riddled with erosion trenches. The rubble also provides a resource for sample collecting. Drainage systems are recommended to deter run-off water which causes erosion. In some instances such as at Salvamento quarry, vegetation that obscures a special quarry face with excellent exposures of pseudotachylite should be removed.

3.3.3 LEGAL ACCOUNTABILITY AND RESPONSIBILITY

From discussions with the DMR (Anthony Katina, 5 August 2010), it is important to realize that the mines are still perceived as active since no closure certificates have been issued. No regular inspections are being done on the mines currently by the DMR. The North West Province has, however, undertaken an inspection of a small portion of the sites (seemingly Rooderand only) as a general reconnaissance and a report was submitted from the Mine Health and Safety, North West Region on 25 May 2007. In this report it was recommended that the accesses to mines be fenced in, that accesses inside the mountain leading to excavations on a lower level be fenced off, only guided tours by the holder of a first-aid certificate be allowed, persons entering mine workings be issued with hard hats and torches, no other activities like abseiling be allowed and that the officer from that office will visit the sites on a monthly basis to verify the safety of the tunnels.

The responsibility for safety of tourists visiting these mining sites lies with the tour operator and the property owner in this case (Rooderand Mines) where the original mining company is not traceable. Closure, rehabilitation and safe making costs are according to the DMR for the landowners account, but alternative options are proposed under Section 4.2.

3.3.4 SITES OF INTEREST IN THE VICINITY OF MINES

The sites mentioned in Sections 2.2.2 and 2.5 are seen as complementary sites that add to the geodiversity of the VDWHS. The sites are in some or other way linked to either the geology or the mines in the VDWHS and can be classified as Culturally or Aesthetically Significant Heritage Sites.