

A GEOPHYSICAL INVESTIGATION  
AND  
GEOLOGICAL INTERPRETATION  
OF PART OF THE DIAMONDIFEROUS GRAVELS  
ON THE FARM GRASFONTEIN (356 JP),  
WEST OF BAKERVILLE

by

MICHIEL CORNELIS JAN de WIT B.Sc. (Hons.)

Submitted in partial fulfilment of the requirements for  
the degree,

MAGISTER SCIENTIAE

in the faculty of Science of the University of Pretoria.

Pretoria  
May, 1981

GEINGEIN

BIBLIOTHEEK	LIBRARY
GEOLOGIESE OPNAME	GEOLOGICAL SURVEY
— PRETORIA —	
KLAS	553.626 DEW
CLASS.	
AANWINSNOMMER	6589
ACCESSION-NUMBER	



SODIN GRAVIMETER (No. 397)



5. DRILLING AND TRENCHING	50
6. SAMPLING	60
7. PALAEOGEOGRAPHY, GRAVEL DEPOSITION AND ORIGIN OF DIAMONDS	64
7.1 Palaeogeography and gravel deposition	64
7.2 Origin of gravels and diamonds	78
8. SUMMARY AND CONCLUSIONS	82
REFERENCES	84
APPENDIX A 1 Co-ordinates of beacons used in resection	90
APPENDIX A 2 Co-ordinates and theoretical gravity values of the corner points	90
APPENDIX B Gravity base station co-ordinates and values	91

## ILLUSTRATIONS

### Figures

1. Regional geology of the Bakerville area	10
2. Geological map of exposed rocks within the investigated area with an overlay of gravity station positions	12
3. Section through Rooisloot	16
4. Grading in the Rooisloot gravels	16
5. Potato gravel	18
6. Potato gravel lying on a weathered sequence of chert and dolomite	18
7. a) King's Pothole	21
b) King's Pothole	21
8. Geological map of the test area with a topographical overlay	26
9. Drift curve for gravimeter (Sodin No. 397)	28
10. Location map of stations used for the regional gravity	33
11. Geological map of the test area with an overlay of the residual gravity	34
12. Occurrence and nature of major negative residual anomalies	40
13. Determination of the position $X=0$ using the Lamontagne method	44



14. Magnetic profile 1 across the Grasfontein dyke, and its symmetrical and antisymmetrical components	45
15. Magnetic profile 2 across the Grasfontein dyke, and its symmetrical and antisymmetrical components	46
16. Magnetic profile 3 across the Grasfontein dyke, and its symmetrical and antisymmetrical components	47
17. Location map of borehole and trenches	51
18. Drilling profiles A and B	52
19. Legend to boreholes and profiles	53
20. Borehole logs I	54
21. Borehole logs II	55
22. Borehole logs III	56
23. Borehole logs IV	57
24. Borehole logs V	58
25. Sample location map	61
26. Rose diagram - Jointing	65
27. Rose diagram - Dykes	66
28. Rose diagram - Quartz veins	67
29. Rose diagram - Gravel runs	68
30. Rose diagram - Gravity anomalies	69
31. Alluvial sub-facies of a braided river	73
32. Tertiary uplift along the Griqualand-Transvaal axis	75
33. Diagrammatic sequence showing the development of a cave in impure dolomite and subsequent deposition of the gravels	77
34. Gravity base stations on Grasfontein 356 JP	92
35. Gravity models of sections on map 3	*

---

TABLES

	Table	Page
1. Stratigraphical subdivision of the Transvaal Sequence		9
2. Stations used for the calculation of the first order polynomial surface of the regional gravity field		35

- |   |    |
|---|----|
| 3. Calculated values for width and depth to the top of the Grasfontein dyke   | 48 |
| 4. List of minerals found in nine samples which were taken from the test area | 63 |
- 

\*MAPS

1. Geological map of outcropping rocks and geographical location map
  2. Elevation map of part of the Grasfontein area
  3. Bouguer anomaly map of part of the Grasfontein area
  4. Regional and residual gravity map of part of the Grasfontein area
  5. Total magnetic intensity map of part of the Grasfontein area
-

ABSTRACT

The results of a gravity and magnetic study comprising 2911 and 14 650 stations respectively over a small portion of the diamondiferous gravels north of Lichtenburg and immediately west of Bakerville, are described.

The magnetic survey precisely located the Grasfontein dyke which crosses the area.

Two major trends of gravity lows averaging  $-0,6$  mgal are recognised; (i) a main WSW-ENE trend and (ii) a less prominent nearly N-S trend. Geological observations and drilling indicate that the more pronounced WSW-ENE gravity anomaly trend is associated with the major direction of diamond-bearing gravel runs, whilst the N-S trend is more often associated with leached zones in the dolomite, which may be covered with shallow gravels only. These surface geological trends are shown to have developed from a similarly orientated joint pattern in the underlying dolomite of the Chuniespoort Group by differential weathering and erosion. The preferential development of the WSW-ENE joints is reflected in the orientation of the <sup>palaeo-</sup>drainage pattern and was thought to have some influence on it.

The success of the gravity survey in locating subsurface karst topography and gravels can be mainly attributed to the significant density contrast between the dolomite and chert on the one hand and the wad and residual chert in the leached zones and superficial deposits on the other.

Sampling results indicate that the diamonds, following their separation from the primary source may reflect a polycyclic sedimentological history in which the Dwyka tillite is thought to have

been of great importance. The primary source of the diamonds is thought to lie a considerable distance from the Lichtenburg-Ventersdorp region in a north-easterly direction.



## SAMEVATTING

Die resultate van gravitasie en magnetiese opnames van 2911 en 14 650 stasies onderskeidelik oor 'n klein gedeelte van die diamant-houdende gruis noord van Lichtenburg, en wes van Bakerville, word beskryf.

Twee hoof rigtings van gravitasie minima, gemiddeld 0,6 mgal elk, is waargeneem; (i) 'n hoof WSW-ONO rigting, en (ii) 'n minder prominente amper N-S rigting.

Geologiese waarnemings en boorwerk toon dat die prominente WSW-ONO gravitasie-eiging geassosieër word met die hoofrigting van voorkoms van die diamanthoudende gruisafsettings, terwyl die N-S neiging meesal geassosieër word met geloogde sones in die dolomiet. Hierdie sones mag bedek wees met vlak gruisafsettings. Hierdie oppervlakkige geologiese kenmerke het skynbaar ontwikkel vanuit 'n ooreenstemmende patroon van nate in die onderliggende dolomiet van die Groep Chuniespoort waar differensiele verwesing en erosie plaasgevind het.

Die voorkeurontwikkeling van die WSW-ONO tensiebreuke word gereflekteer in die orientasie van die paleo-dreineringspatroon en het vermoedelik 'n invloed daarop gehad.

Die sukses van die gravitasie-onderzoek in die opspoor van ondergrondse karsttopografie en gruis kan grootliks toegeskryf word aan die beduidende digtheidsverskil tussen die dolomiet en chert aan die een kant en die mangaanaarde en verweerde chert in die geloogde sones, en oppervlakkige afsettings aan die ander kant.

Toetse op grondmonsters van die gruis dui aan dat die geskiedenis van diamante, na hulle skeiding van die primêre bron, gekompliseerd is deur die rol wat die Dwyka tilliet gespeel het, 'n polisikliese sedi-

mentologiese geskiedenis reflekteer waarin die Dwyka tiliet 'n belangrike rol gespeel het. Die primêre bron van die diamante is vermoedelik in 'n noordoostelike rigting ver van die Lichtenburg-Ventersdorp gebied.