

THE GEOLOGY OF THE MALMANI DOLOMITE SUBGROUP
IN THE CARLETONVILLE AREA, TRANSVAAL

by

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*A Dissertation Submitted to the Faculty of Science,
University of the Witwatersrand, Johannesburg, in
Fulfilment of the Requirements for the Degree of
Master of Science*

JOHANNESBURG

JANUARY, 1981

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THE CARLETONVILLE AREA, TRANSVAAL

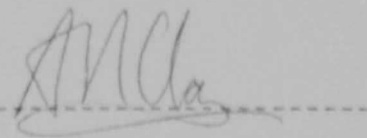
ABSTRACT

This study involves the stratigraphic analysis of the Malmani Dolomite Subgroup, using subsurface data, in the Carletonville area, Transvaal, Republic of South Africa. These dolomite rocks form part of the Transvaal Supergroup and were deposited approximately 2 300 m.y. ago. Using descriptive terminology they have been subdivided into seven distinct zones, and facies analysis has shown that pulsating tectonic activity modified the depositional environment. The dolomites were deposited on a broad-scale, shallow-marine platform, and carbonate processes appear to have been similar to those described from modern environments. Fabrics reminiscent of aragonite were detected, and there remains no positive evidence to suggest a primary origin for the dolomite.

The major- and trace-element geochemistry of the dolomites has been modified by silicification, and element variability can generally be related to this process. Hydrocarbons were proved in several carbonaceous mudstone samples which may represent palaeohydrocarbon material. There are similarities of Transvaal base-metal occurrences with those of the Mississippi Valley-type, and so the economic potential has been investigated. It appears that the Malmani dolomites are prospective for base-metals.

DECLARATION

I, Andrew Neil Clay, hereby declare that
this dissertation is my own work and that
it has not been presented to any other
University for the purpose of obtaining
a Degree.



A. N. CLAY

January, 1981

CONTENTS

THE GEOLOGY OF THE MALMANI DOLOMITE SUBGROUP IN THE
CARLETONVILLE AREA, TRANSVAAL

C O N T E N T S

CHAPTER I

INTRODUCTION

	<u>Page</u>
A. INTRODUCTORY STATEMENT	1
B. SCOPE AND AIMS OF RESEARCH	1
C. LOCATION OF THE STUDY-AREA	2
D. GEOLOGICAL SETTING	3
E. NATURE OF RESEARCH	6
1. Introduction	6
2. Logging methods	6
3. Thin-sections	7
4. Polished-sections	7
5. Geochemical programme	7
6. Presentation and treatment of data	8
F. ACKNOWLEDGEMENTS	9

CHAPTER II

THE GEOLOGY OF THE MALMANI DOLOMITE SUBGROUP

A. INTRODUCTION	11
B. SUMMARY OF THE STRATIGRAPHIC ZONES DEVELOPED WITHIN THE MALMANI DOLOMITE SUBGROUP	11
C. PREVIOUS WORK	12
D. STRUCTURAL SETTING OF THE MALMANI DOLOMITE SUBGROUP	13
E. DESCRIPTIVE STRATIGRAPHY OF THE MALMANI DOLOMITE SUBGROUP	15
F. TRANSITION ZONE	16
1. Introduction	16
2. Sedimentology	17

	<u>Page</u>
G. LOWER DARK DOLOMITE ZONE	19
1. Introduction	19
2. Sedimentology	21
H. COMPLEX DOLOMITE ZONE	22
1. Introduction	22
2. Components of the Complex Dolomite Zone	24
(a) Coarsely, crystalline dolomite	24
(b) Dolosparite and dolomicrite	26
(c) Stromatolites	27
(d) Allochems	28
(e) Mottled dolomite	32
(f) Dark dolomite	32
(g) Evaporites	33
(h) Silica	33
3. Sedimentology	34
I. LOWER-LAMINATED DOLOMITE-AND-CHERT ZONE	35
1. Introduction	35
2. Relict aragonite fabrics	37
3. Sedimentology	38
J. UPPER DARK DOLOMITE ZONE	38
1. Introduction	38
2. Sedimentology	40
K. UPPER LAMINATED DOLOMITE-AND-CHERT ZONE	41
1. Introduction	41
2. Sedimentology	42
L. INTIMATELY-MIXED DOLOMITE-AND-CHERT ZONE	43
1. Introduction	43
2. Sedimentology	47

	<u>Page</u>
M. HISTORY OF DOLOMITIZATION AND SILICIFICATION	47
1. Introduction	47
2. Chemical considerations for the formation of dolomite	48
3. Diagenetic dolomite	51
4. Silicification	53
N. SUMMARY OF THE DEPOSITIONAL HISTORY OF THE MALMANI DOLOMITE SUBGROUP	56
1. Tectonic history	56
2. Summary of the palaeoenvironment	57

CHAPTER III

THE GEOCHEMISTRY OF THE MALMANI DOLOMITE SUBGROUP

A. INTRODUCTION	60
B. PREVIOUS WORK	60
C. SAMPLE SELECTION	61
D. CHEMICAL ANALYSES	61
E. PRESENTATION OF DATA	62
F. RESULTS	63
1. Major elements	63
(a) CaO	63
(b) MgO	64
(c) CaO/MgO	65
(d) Fe ₂ O ₃	65
(e) MnO	66
(f) SiO ₂	66
(g) Other element oxides	67
2. Trace-elements	67
(a) Ag	67
(b) As	68

	<u>Page</u>
(c) Ba	68
(d) Cd	68
(e) Co	68
(f) Cu	68
(g) Ga	69
(h) Ge	69
(i) In	69
(j) Mo	69
(k) Pb	69
(l) S per cent	69
(m) Sr	69
(n) V	70
(o) Zn	70
G. INTERPRETATION AND DISCUSSION OF THE GEOCHEMISTRY	70
H. GEOCHEMICAL CHARACTERISTICS RELATED TO DOLOMITE LITHOLOGY	73
I. ANALYSIS OF BITUMENS IN THE CARBONACEOUS MUDSTONES	76
1. Method	77
2. Results	79
3. Conclusions	79

CHAPTER IV

THE PRETORIA GROUP

A. INTRODUCTION	80
B. FOUNTAINS FORMATION	80
1. Introduction	80
2. Sedimentology	82
C. TIMEBALL HILL FORMATION	82
1. Introduction	82
2. Sedimentology	83
D. SUMMARY OF THE PALAEOENVIRONMENT	84

CHAPTER V

THE ECONOMIC POTENTIAL OF THE MALMANI
DOLOMITE SUBGROUP

A.	INTRODUCTION	85
B.	PREVIOUS WORK	85
C.	CARBONATE-HOSTED LEAD-ZINC MINERALIZATION	85
D.	GENESIS OF CARBONATE-HOSTED LEAD-ZINC DEPOSITS	87
	1. Origin of the mineralization	87
	(a) Syngenetic	88
	(b) Diagenetic	88
	(c) Epigenetic	88
	2. Chemical considerations	90
	3. Origin of the sulphur	92
	4. Lead isotope significance	93
E.	LEAD-ZINC DEPOSITS IN THE MALMANI DOLOMITE SUBGROUP	95
	1. Introduction	95
	2. Genetic considerations	97
	3. Discussion of paragenesis	98
F.	CONCLUSIONS	100
G.	THE DISTRIBUTION AND SIGNIFICANCE OF OTHER ECONOMIC MINERALS	101
	1. Copper	101
	2. Fluorite	101
	3. Gold	102
	4. Limestone	102
	5. Manganese	102
	6. Pyrite	102
	7. Silver	103
	8. Uranium	103
	9. Vanadium	103

CHAPTER VITHE ZINC MINERALIZATION ON THE WESTERN DEEP
LEVELS GOLD MINE PROPERTY, CARLETONVILLE,
TRANSVAAL

A.	INTRODUCTION	104
B.	STRATIGRAPHIC AND GEOLOGICAL SETTING	104
C.	SEDIMENTOLOGY	105
D.	MINERALIZATION	105
	1. Introduction	105
	2. Nature of the ore	106
	3. Geochemistry of the ore and ore-zone	106
	4. Lead isotope data	109
E.	DISCUSSION	111
F.	SYNOPSIS	112
G.	THE GENESIS OF THE WESTERN DEEP LEVELS ZINC DEPOSIT	114
H.	CONCLUSIONS	117
I.	REFERENCES	119

CHAPTER VIICONCLUSIONS

A.	SUBDIVISIONS IN THE MALMANI DOLOMITE SUBGROUP	121
B.	NATURE OF THE PALAEOENVIRONMENT OF THE MALMANI DOLOMITE	121
C.	GEOCHEMISTRY OF THE MALMANI DOLOMITE	122
D.	BITUMINOUS MATERIAL IN THE CARBONACEOUS MUDSTONES	122
E.	THE SIGNIFICANCE OF THE PRETORIA GROUP SEDIMENTS	122
F.	THE POTENTIAL OF THE MALMANI DOLOMITE SUBGROUP FOR LEAD-ZINC DEPOSITS	123

CHAPTER VIII

APPENDICES

124

CHAPTER IX

REFERENCES

163

LIST OF FIGURES

	<u>Page</u>
FIGURE 1 : A map showing the regional distribution of the Transvaal Supergroup in the countries of southern Africa.	2
FIGURE 2 : A map showing the location of the study-area and the main gold mine properties.	3
FIGURE 3 : A diagram illustrating the regional stratigraphic relationships of the subdivisions within the Transvaal Supergroup.	3
FIGURE 4 : A map showing the regional distribution of the carbonates of the Transvaal Supergroup.	4
FIGURE 5 : A diagram showing the generalized stratigraphic column of the major geological units.	4
FIGURE 6 : A map of the surface geology of the study-area.	5
FIGURE 7 : A map illustrating the location of the boreholes used in this study.	6
FIGURE 8 : An isometric, stratigraphic diagram illustrating the broad-scale correlation of the zones of the Malmani Dolomite Subgroup in the study-area.	8
FIGURE 9 : The descriptive stratigraphy of the Transvaal Supergroup in the Carletonville area, showing the zonal subdivisions made within the Malmani dolomite.	12
FIGURE 10 : A map illustrating the main tectonic elements within the Transvaal Supergroup in the area around Potchefstroom (after Eriksson, 1971).	14
FIGURE 11 : An isopach map of the total thickness of the Malmani Dolomite Subgroup in the study-area.	14
FIGURE 12 : A structure contour map of the top of the Ventersdorp lavas which forms the base of the Transvaal sediments in the study-area. Datum is 1 828,74 metres above sea level.	15
FIGURE 13 : A panel-diagram showing the lateral variation of the Transition Zone in the study-area.	16
FIGURE 14 : An isopach map illustrating the aerial variation in thickness of the Transition Zone in the study-area.	16

	<u>Page</u>
FIGURE 15 : A panel-diagram illustrating the lateral variation of the Lower Dark Dolomite Zone.	19
FIGURE 16 : An isopach map showing the aerial variation in thickness of the Lower Dark Dolomite Zone.	19
FIGURE 17 : A percentage map showing the variation in chert content within the Lower Dark Dolomite Zone.	21
FIGURE 18 : A panel-diagram showing the lateral variation of the Complex Dolomite Zone.	23
FIGURE 19 : An isopach map of the Complex Dolomite Zone.	23
FIGURE 20 : An isolith map illustrating the aerial distribution of ooids within the Complex Dolomite Zone.	24
FIGURE 21 : A schematic diagram showing the longitudinal sections of some typical stromatolites from the Malmani dolomite.	27
FIGURE 22 : A diagram showing the schematic relationship between stromatolite morphology and sedimentary structures in a shallow water, near-shore carbonate succession (modified after Eriksson et. al. 1976).	28
FIGURE 23 : A diagram illustrating the distribution of stromatolite varieties within the Malmani dolomite of the study-area.	29
FIGURE 24 : A schematic diagram showing the activity of an algal sheath on a nucleus in the development of an ooid (modified after Fabricius, 1977).	29
FIGURE 25 : A schematic representation of the textures developed in spheroids and ooids.	30
FIGURE 26 : An isolith map illustrating the aerial distribution of flat-pebble breccias in the Complex Dolomite Zone.	31
FIGURE 27 : An isolith map showing the aerial variation in the total, accumulated thickness of intraclastic dolomite within the Complex Dolomite Zone.	32
FIGURE 28 : Schematic illustration of some sedimentary cycles noted within the Malmani dolomite, showing fining-upward sequences.	34

	<u>Page</u>
FIGURE 29 : A schematic diagram showing the palaeoenvironment existing during the deposition of the Complex Dolomite Zone.	35
FIGURE 30 : An isopach map showing the aerial distribution of the Lower Laminated Dolomite-and-Chert Zone.	36
FIGURE 31 : A panel-diagram illustrating the lateral variation of the Lower Laminated Dolomite-and-Chert Zone.	36
FIGURE 32 : A structure contour map of the base of the Upper Dark Dolomite Zone.	38
FIGURE 33 : A structure contour map of the top of the Ventersdorp Lavas using the base of the Upper Dark Dolomite Zone as a datum.	39
FIGURE 34 : An isopach map of the Upper Dark Dolomite Zone.	41
FIGURE 35 : A panel-diagram illustrating the lateral variation of the Upper Dark Dolomite Zone.	41
FIGURE 36 : An isopach map of the Upper Laminated Dolomite-and-Chert Zone.	42
FIGURE 37 : A panel-diagram illustrating the lateral variation of the Upper Laminated Dolomite-and-Chert Zone.	42
FIGURE 38 : An isopach map of the Intimately-Mixed Dolomite-and-Chert Zone.	
FIGURE 39 : An isopach map of the Fountains Formation.	44
FIGURE 40 : A panel-diagram illustrating the lateral variation of the Intimately-Mixed Dolomite-and-Chert Zone.	47
FIGURE 41 : A diagram illustrating the stability fields for calcite and aragonite under differing temperature and pressure conditions.	49
FIGURE 42 : A diagram showing the hypothetical solubility curves of CaCO_3 and MgCO_3 in sea-water of 4-6 times normal salinity at 25°C , as functions of pH (after Liebermann, 1967).	50
FIGURE 43 : A schematic illustration depicting the seepage-reflux mechanism outlined by Adams and Rhodes (1960).	51

	<u>Page</u>
FIGURE 44 : A schematic illustration depicting the evaporative-reflux model of Hsü and Siegenthaler (1969).	52
FIGURE 45 : A diagram showing the solubility of amorphous silica with respect to temperature (after Krauskopf, 1959).	54
FIGURE 46 : A diagram illustrating the relationship between silica solubility and pH at 25°C (after Krauskopf, 1959).	55
FIGURE 47 : A diagram showing the vertical distribution of SiO ₂ , MgO, CaO, Fe ₂ O ₃ , and MnO within the Malmani dolomite, as developed in Borehole UD30.	63
FIGURE 48 : A graph relating CaO and MgO concentration to silica within the dolomite samples.	64
FIGURE 49 : A graph relating CaO/MgO ratios to silica values within the Malmani dolomite samples.	65
FIGURE 50 : A diagram illustrating the vertical distribution of Zn, Pb, V, Ba, and Al ₂ O ₃ within the Malmani dolomite, as developed in Borehole UD30.	68
FIGURE 51 : Ternary diagram showing the average element compositions for the zones developed within the Malmani Dolomite Subgroup.	75
FIGURE 52 : Graphical plots of some major-element compositions for several dolomite lithologies illustrating poor chemical separation and discrimination.	77
FIGURE 53 : A graph produced on a Gridel Rock-eval machine during the analysis of carbonaceous material. It displays the nature of gaseous emissions derived on the thermal decomposition of the sample.	78
FIGURE 54 : A structure contour map for the base of the Fountains Formation using a datum of 1 828.74 metres above sea level.	81
FIGURE 55 : A schematic diagram showing the principal geological settings of Mississippi Valley-type deposits (after Callahan, 1967).	86
FIGURE 56 : A graph showing the relationship between pH and the solubility of PbCl ⁺ at 25°C.	90

	<u>Page</u>
FIGURE 57 : A graph illustrating the solubility of lead complexes at various oxidation states.	91
FIGURE 58 : A graph showing the density distribution of data for $^{208}\text{Pb}/^{204}\text{Pb}$ vs. $^{206}\text{Pb}/^{204}\text{Pb}$ giving the best-fit growth curve (after Loveless, 1975).	93
FIGURE 59 : A graph showing the density distribution of data for $^{207}\text{Pb}/^{204}\text{Pb}$ vs. $^{206}\text{Pb}/^{204}\text{Pb}$ giving the best-fit growth curve (after Loveless, 1975).	93
FIGURE 60 : A trilinear diagram illustrating the relative abundances (per cent) of ^{208}Pb , ^{207}Pb , and ^{206}Pb in relation to world economic data (after Connan et. al., 1961).	94
FIGURE 61 : A map showing the location of significant lead and zinc mineralization within the carbonates of the Transvaal Supergroup.	96
FIGURE 62 : A schematic diagram showing details of the mineralization detected in Borehole UD30, on the Western Deep Levels Gold Mine property.	104
FIGURE 63 : A graph showing the density distribution of data for $^{208}\text{Pb}/^{204}\text{Pb}$ vs. $^{206}\text{Pb}/^{204}\text{Pb}$ giving the best-fit growth curve (after Loveless, 1975). Data from Borehole UD30 is also displayed together with the Zeerust data.	109
FIGURE 64 : A graph displaying the density distribution of data for $^{207}\text{Pb}/^{204}\text{Pb}$ vs. $^{206}\text{Pb}/^{204}\text{Pb}$ giving the best-fit growth curve (after Loveless, 1975). Data from Borehole UD30 is also shown, together with the Zeerust data.	109
FIGURE 65 : A trilinear diagram illustrating the relative abundances (per cent) of ^{208}Pb , ^{207}Pb , and ^{206}Pb in relation to world-wide economic data, compiled by Cannon et. al. (1961). Contour lines (increasing inwards 4 to 16) represent the density per unit area of deposits containing more than 100 000 tonnes of metal. Borehole UD30 data plotted together with several Zeerust deposits.	111

LIST OF TABLES

	<u>Page</u>
<u>TABLE 1</u> : Statistical treatment and summary of the borehole data, showing thickness of zones within the Malmani dolomite.	9
<u>TABLE 2</u> : Subdivision of the Malmani dolomite in the Pilgrims Rest area (after Zietsman, 1964, from Button, 1973).	12
<u>TABLE 3</u> : Subdivision of the Malmani Dolomite Formation (after Button, 1973).	13
<u>TABLE 4</u> : Correlation of Zones and Formations developed in the Malmani Dolomite Subgroup in the Central Transvaal.	13
<u>TABLE 5</u> : The structural elements operative during the sedimentation of the Malmani Dolomite Subgroup, in the Carletonville area.	56
<u>TABLE 6</u> : The average trace-element concentrations in sedimentary carbonate rocks, from a wide range of geographical locations (after Wolf, et. al., 1967, and Wedepohl, 1978). Compared with those of the Malmani dolomite, as developed in the Carletonville area (in parts per million).	72
<u>TABLE 7</u> : Average major-element analyses for lithologies present in the Malmani Dolomite Subgroup in weight per cent.	73
<u>TABLE 8</u> : Average trace-element analyses for lithologies in the Malmani Dolomite Subgroup in parts per million.	74
<u>TABLE 9</u> : Gold and uranium assay results for various carbonaceous mudstone samples from the Malmani dolomite.	106
<u>TABLE 10</u> : The average major-element compositions for the Intimately-Mixed Dolomite-and-Chert Zone from the mineralized zone, Borehole UD30.	107

	<u>Page</u>
<u>TABLE 11</u> : The average trace-element compositions from ore samples with >1 per cent zinc, from Borehole UD30, compared with the average Malmani dolomite composition.	108
<u>TABLE 12</u> : Isotopic compositions and model lead ages for galena samples in the Western Deep Levels zinc deposit.	109
<u>TABLE 13</u> : Lead isotope data from localities in the Zeerust lead-zinc ore field.	110

CHAPTER I

Introduction

I. THE GEOLOGY OF THE MALMANI DOLOMITE SUBGROUP
IN THE CARLETONVILLE AREA, TRANSVAAL

A. INTRODUCTORY STATEMENT

Carbonate sediments are extremely susceptible to alteration, and, consequently, with time, many of the textures used to decipher the sedimentology and palaeoenvironment are destroyed. In the past thirty years, great advances have been made in carbonate sedimentology, with the recognition of abundant facies and environmentally-specific biotas. However, a fundamental problem exists in the study of ancient carbonate rocks, because there are few modern analogues with which to make comparisons.

The Malmani dolomite, forms part of one of the very earliest sedimentary carbonate sequences, and was deposited approximately 2300 million years ago. It has been subjected to wholesale dolomitization and silicification, and many of the primary sedimentary textures have been obliterated. However, it does contain environmental indicators which, using modern concepts, can be used to infer the nature of the palaeoenvironment, although deductions made from the simple algal stromatolites are often highly subjective. Detailed sedimentological and stratigraphic analysis has been used to interpret the geology of the Malmani dolomite, and a simple descriptive terminology has been adopted to subdivide them. Sedimentary carbonate processes have been identified which appear to have been similar to those recognised in modern environments, and it is interesting to imagine a vast clear sea, not unlike the present day Bahamas, dominating much of the Transvaal, over two aeons ago.

B. SCOPE AND AIMS OF RESEARCH

The present investigation was initiated in order to interpret the geology of the Malmani Dolomite Subgroup in the Carletonville area, Transvaal. To conduct this study the principal objectives were to unravel the depositional history and sedimentology of the Malmani dolomite, and this has involved the evaluation of sedimentary structures and lithological components within the carbonates. Attempts were made to reconstruct the palaeoenvironment and

develop an understanding of the processes which operated during sedimentation and diagenesis. Stratigraphic analytical methods have been utilized to examine the possible influence of small-scale, syn-depositional structures, and, using this information, descriptive terminology was implemented to subdivide the Malmani dolomite into distinctive stratigraphic zones. The geochemistry was investigated in an attempt to discriminate between the different zones, and to better understand the lithological variation in the dolomites. It was hoped that, by studying the carbonates in detail, on a small-scale, a better appreciation of the palaeoenvironment and depositional facies could be made, particularly with regard to syn-depositional tectonic activity and the development of the diagenetic rock fabrics.

As sedimentary carbonate rocks throughout the world are frequently the host to base-metal mineralization, and lead, zinc, copper, and fluorite deposits are known to occur in the Malmani dolomite, the economic potential of these rocks was also investigated.

C. LOCATION OF THE STUDY-AREA

This study has been concerned with the Malmani Dolomite Subgroup which forms part of the Transvaal Supergroup in South Africa. The regional distribution of the rocks of the Transvaal sequence in southern Africa is shown in Figure 1. The borehole core analysed was obtained from deep exploration

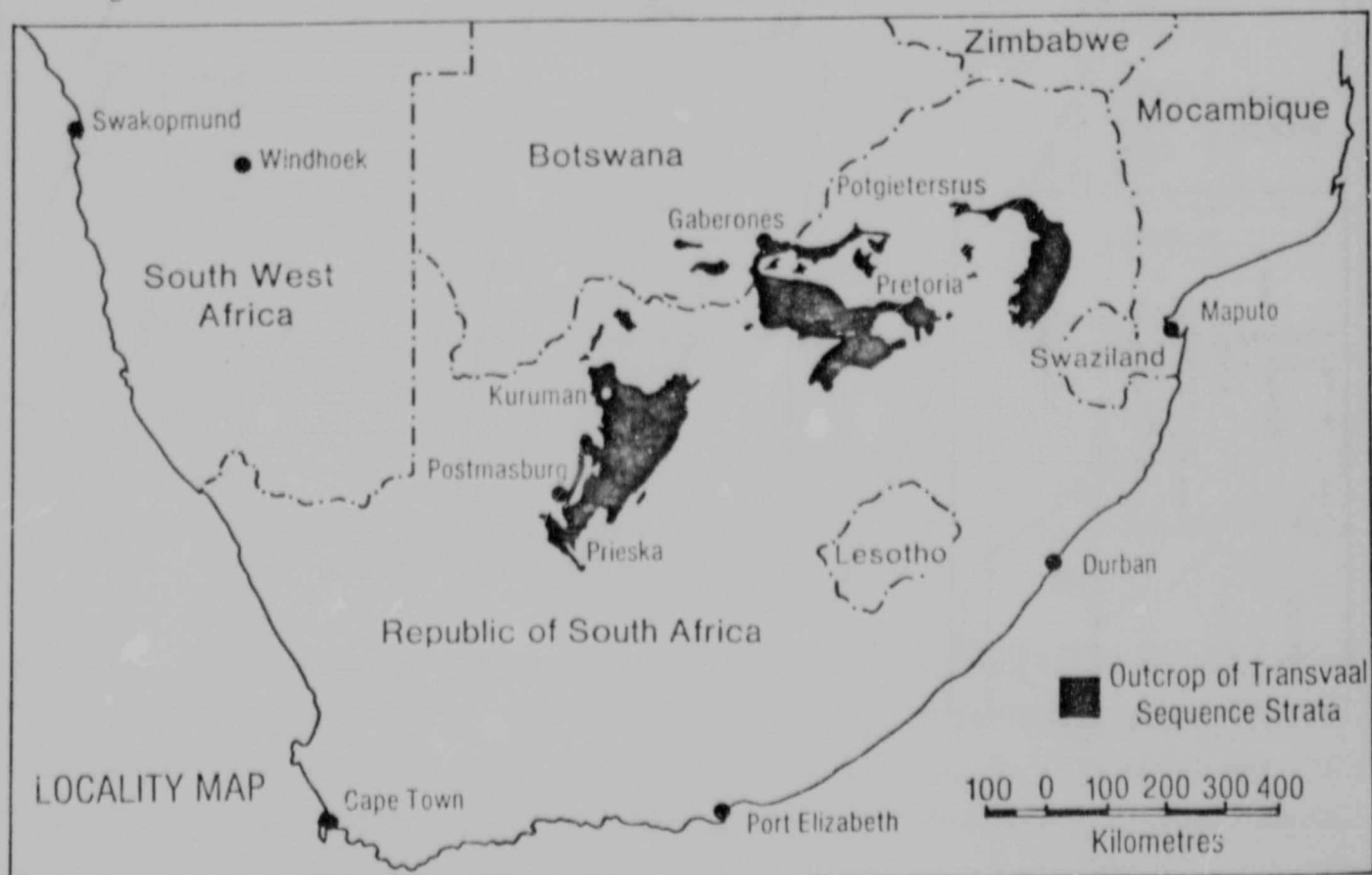


Figure 1 : The regional distribution of the Transvaal Supergroup in the countries of southern Africa.

holes drilled by the Anglo American Prospecting Services (Pty) Limited, on the Western Deep Levels and Elandsrand Gold Mine properties. These mines are situated approximately 10 km south of the town of Carletonville, which is 80 km west-south-west of Johannesburg, on the Far West Rand (Figure 2). The total surface area of these properties is 50 km².

D. GEOLOGICAL SETTING

The boreholes examined in this study were drilled through the Transvaal and Ventersdorp supergroups, into the Witwatersrand Supergroup, as part of a gold exploration programme. The dolomites of the Transvaal Supergroup are widely distributed and, for this reason, the stratigraphic nomenclature developed in the northern Cape is different to that of the Transvaal. The stratigraphic nomenclature and relationships are shown in Figure 3, and the principal outcrop pattern of the chemical sediments of the

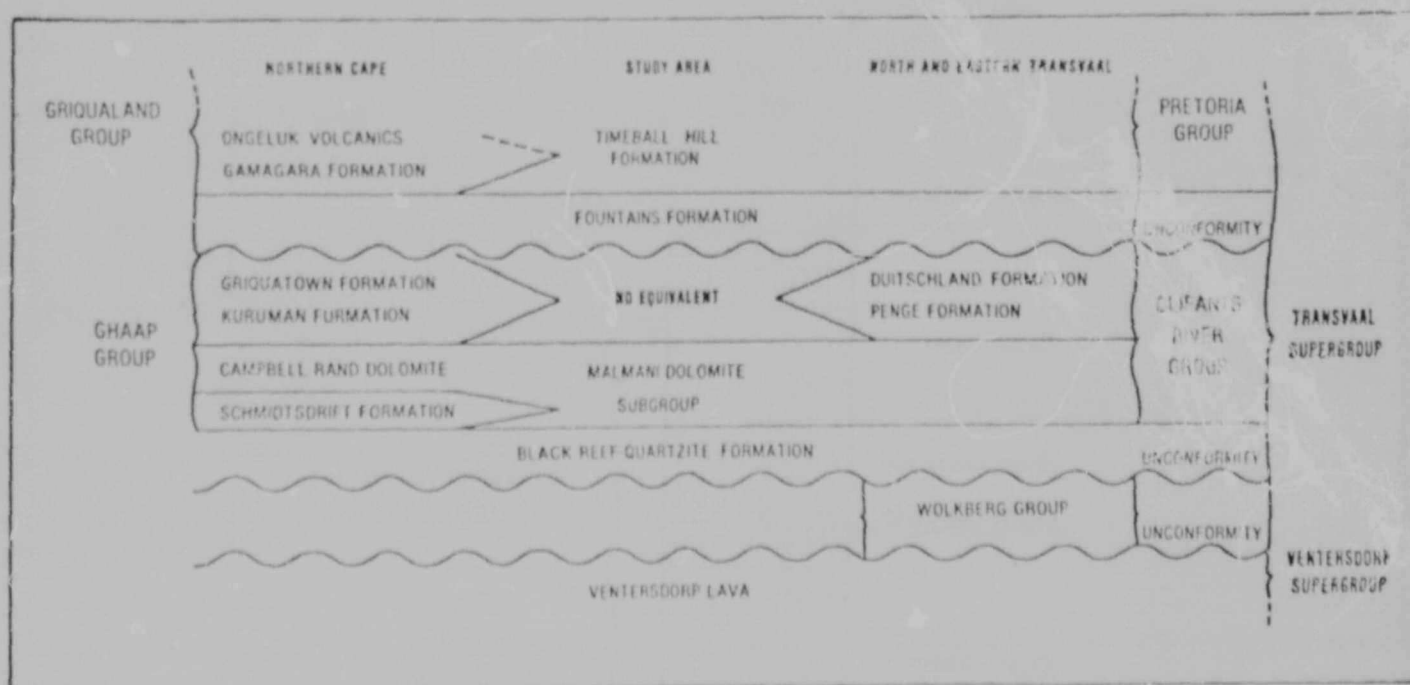


Figure 3 : Composite diagram illustrating the stratigraphic relationships of the Transvaal sequence.

Transvaal Supergroup is illustrated in Figure 4. Sedimentation of the Transvaal rocks was initiated by the development of two proto-basins, one located in the north-western Transvaal, into which the Buffalo Springs Group was deposited (Tyler, 1978), and the other in the north-eastern Transvaal, where

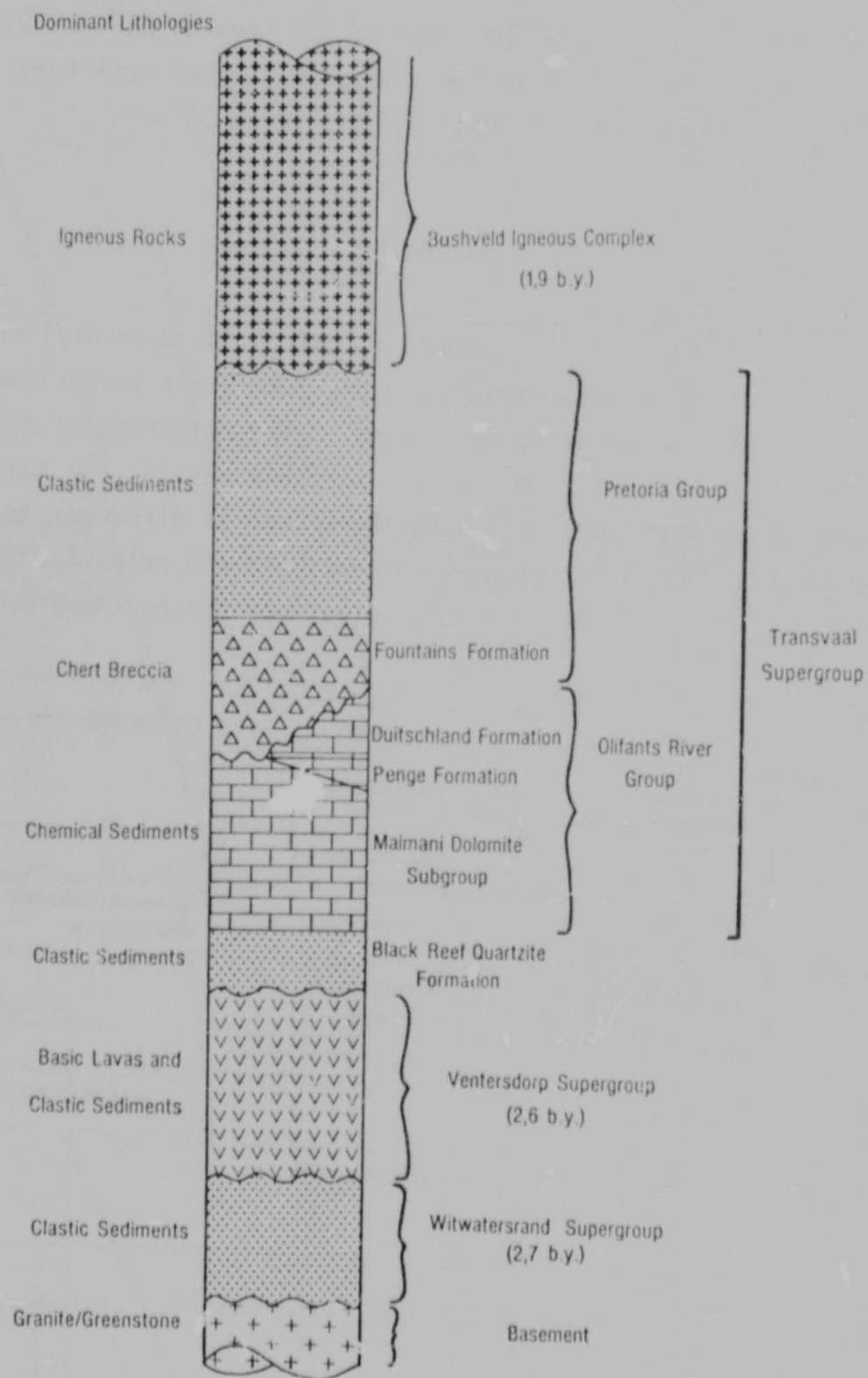


Figure 5 : Generalized stratigraphic column illustrating the spatial relationships of the major geological units.

the Wollberg Group clay
followed by regional
by the sheet-sands of
sedimentary processes
River Group and Ehaap
shallow platform. The
lower part of this sequence
formation of the Penge
tion (see Figures 3 and



Figure 4 : The region
Supergroup

area. The chemical
period of non-deposition
Group. The generaliz

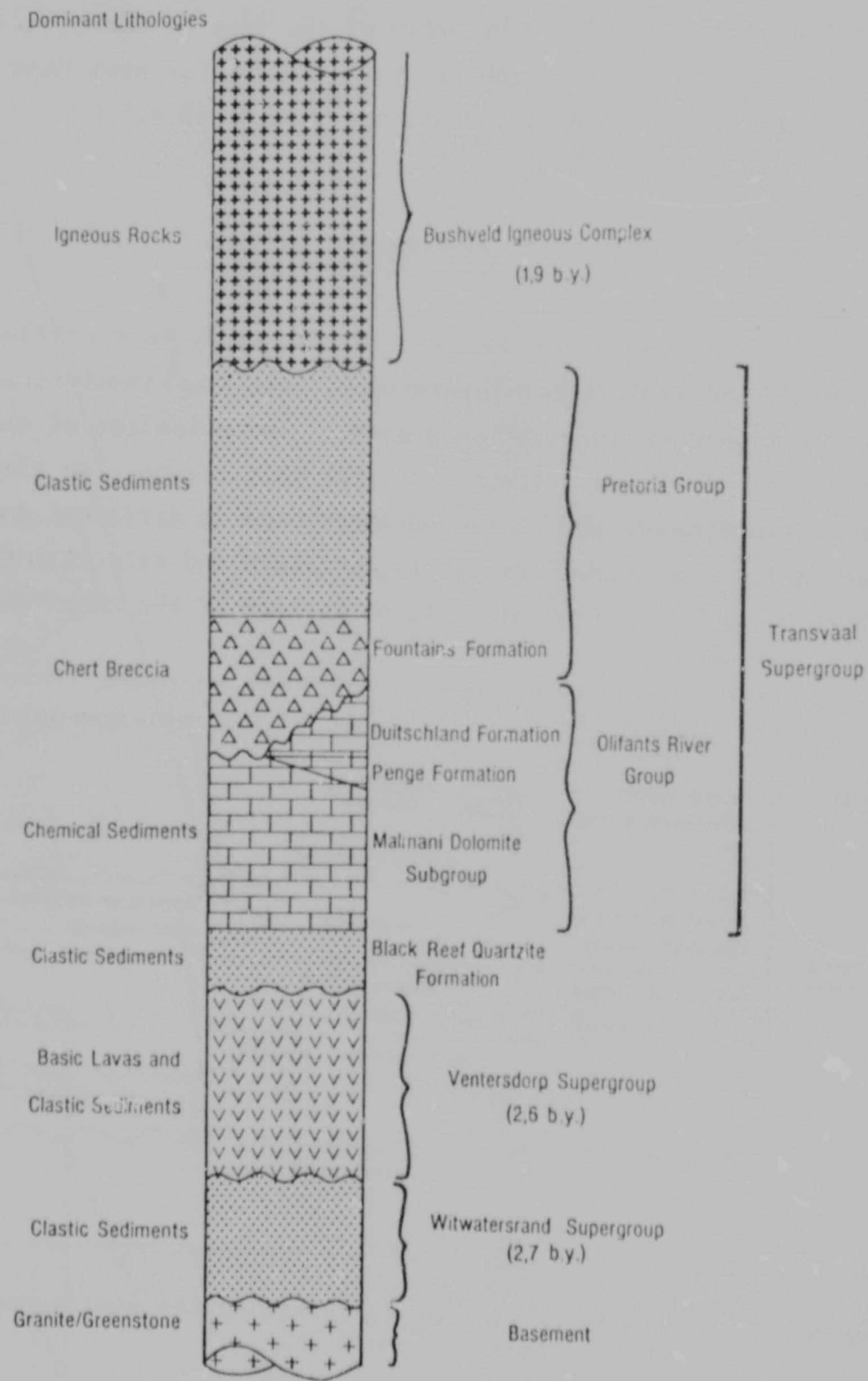


Figure 5 : Generalized stratigraphic column illustrating the spatial relationships of the major geological units.

the Witwatersrand Group clastic
followed by regional
by the sheet-sands of
sedimentary processes
River Group and Ghaap
shallow platform. The
lower part of the sequence
formation of the Penge
tion (see Figures 3 and



Figure 6 : The regional geological context.

area. The chemical de
period of non-depositio
Group. The generaliz

the Wolkberg Group clastic sediments accumulated (Button, 1973). This was followed by regional marine transgression over the Kaapvaal craton, represented by the sheet-sands of the Black Reef Quartzite Formation. At this stage, sedimentary processes changed and the chemical sediments of the Olifants River Group and Ghaap Group were deposited in an epeiric sea, on a vast shallow platform. The carbonates of the Malmani Dolomite Subgroup form the lower part of this sequence of chemical sediments, followed by the iron-formation of the Penge Formation, and the carbonates of the Deutschland Formation (see Figures 3 and 5). The latter units are not present in the study-

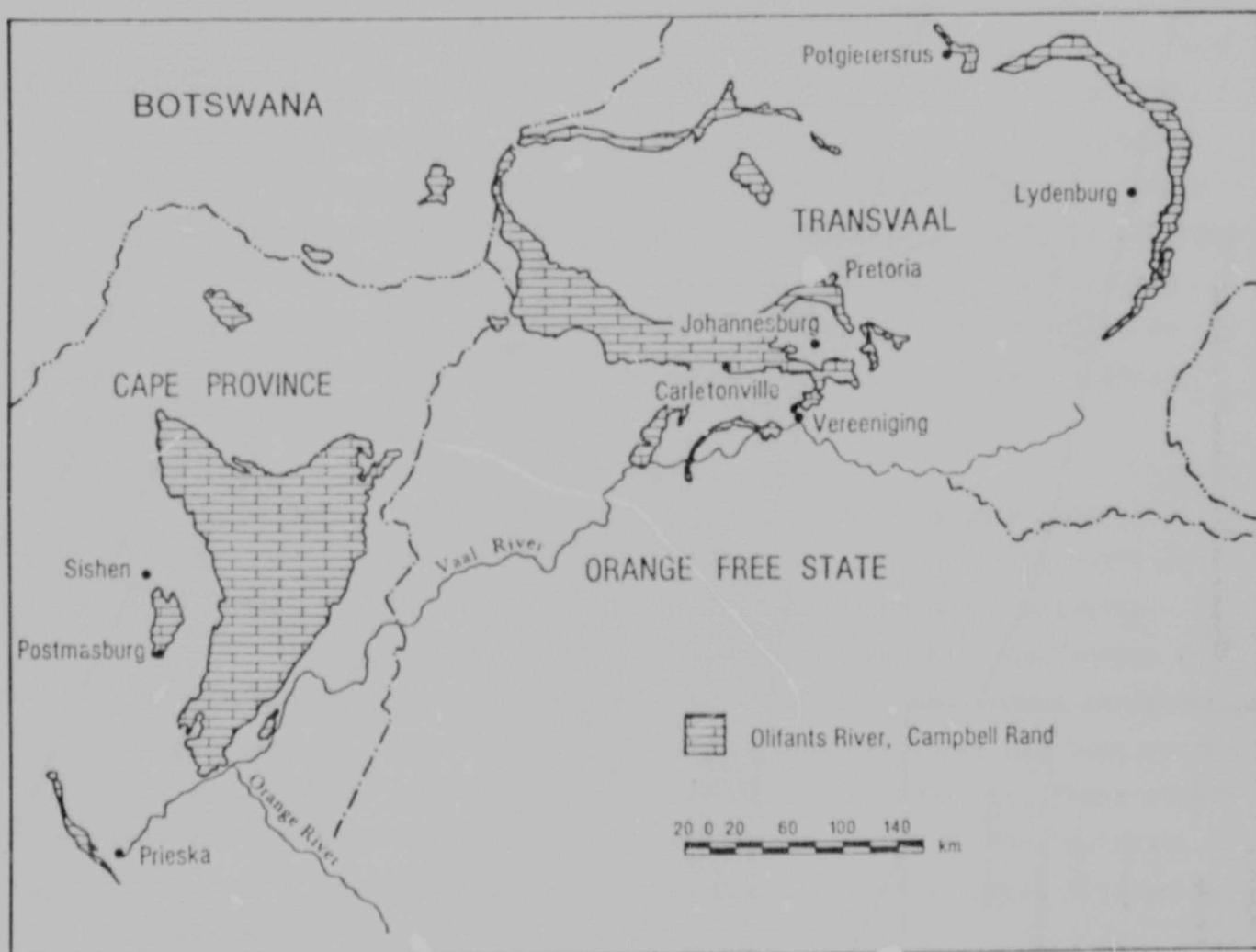


Figure 4 : The regional distribution of the carbonates of the Transvaal Supergroup.

area. The chemical deposits are capped by a chert breccia formed during a period of non-deposition and erosion, and this marks the base of the Pretoria Group. The generalized stratigraphic column is shown in Figure 5.

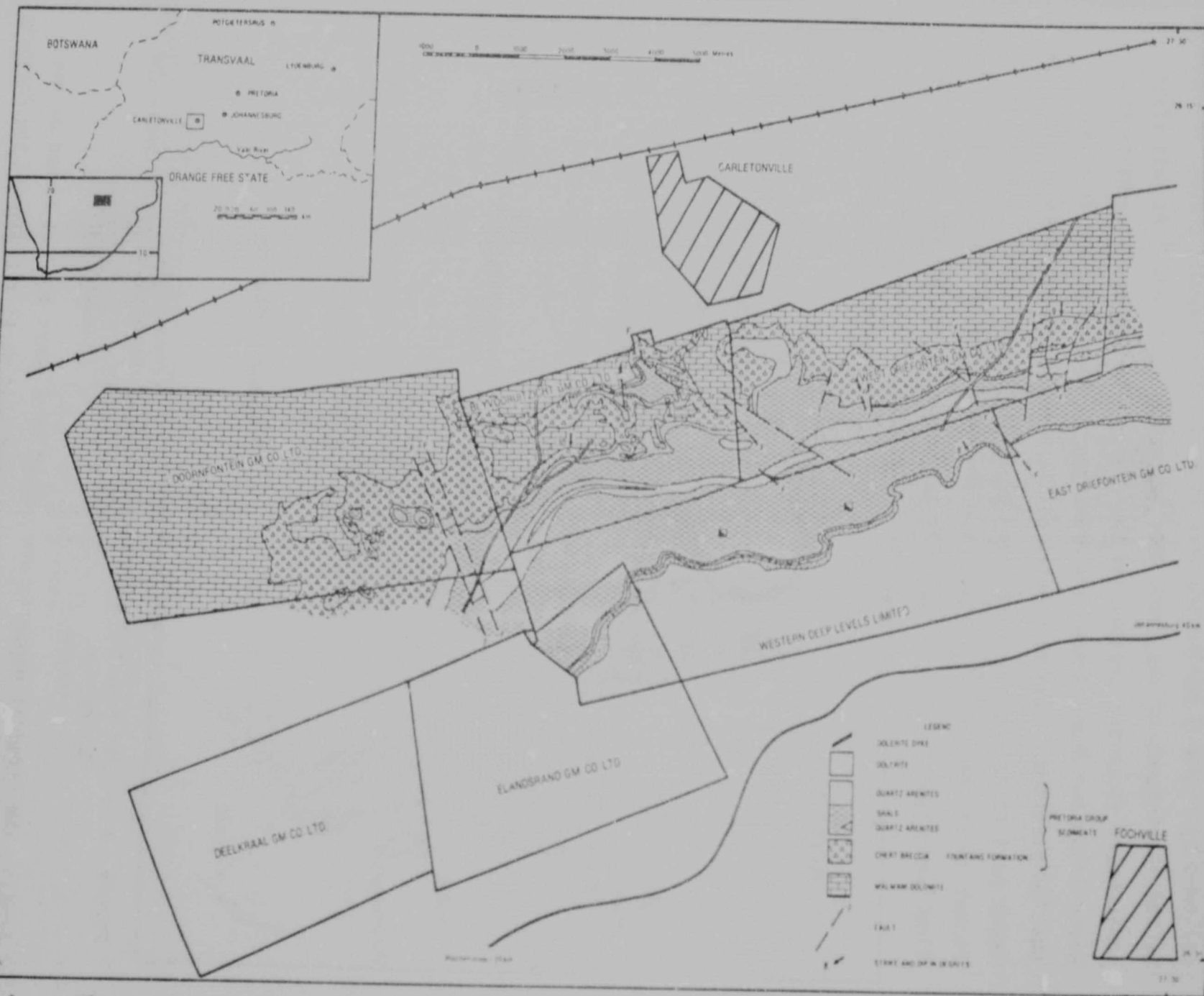


Figure 6 : The surface geology of the study-area.

Author Clay A N

Name of thesis The geology of the Malmani Dolomite Subgroup in the Carletonville area, Transvaal 1981

PUBLISHER:

University of the Witwatersrand, Johannesburg

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