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

by

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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

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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 diagnetic 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

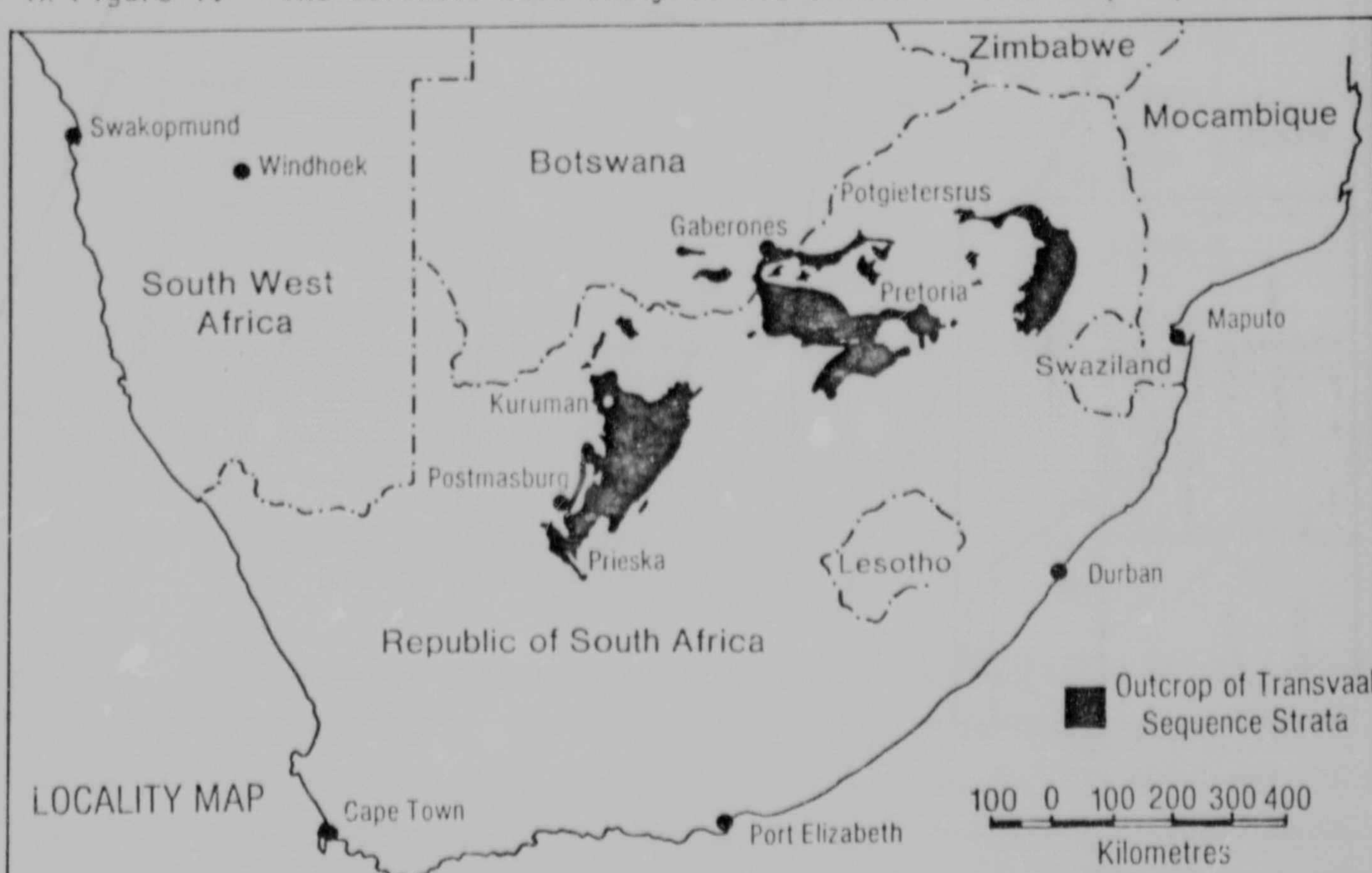


Figure 1 : The regional distribution of the Transvaal Supergroup in the countries of southern Africa.

Figure 2 : The location of the study-area showing the main gold mine properties.

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 relatioships are shown in Figure 3, and the principal outcrop pattern of the chemical sediments of the

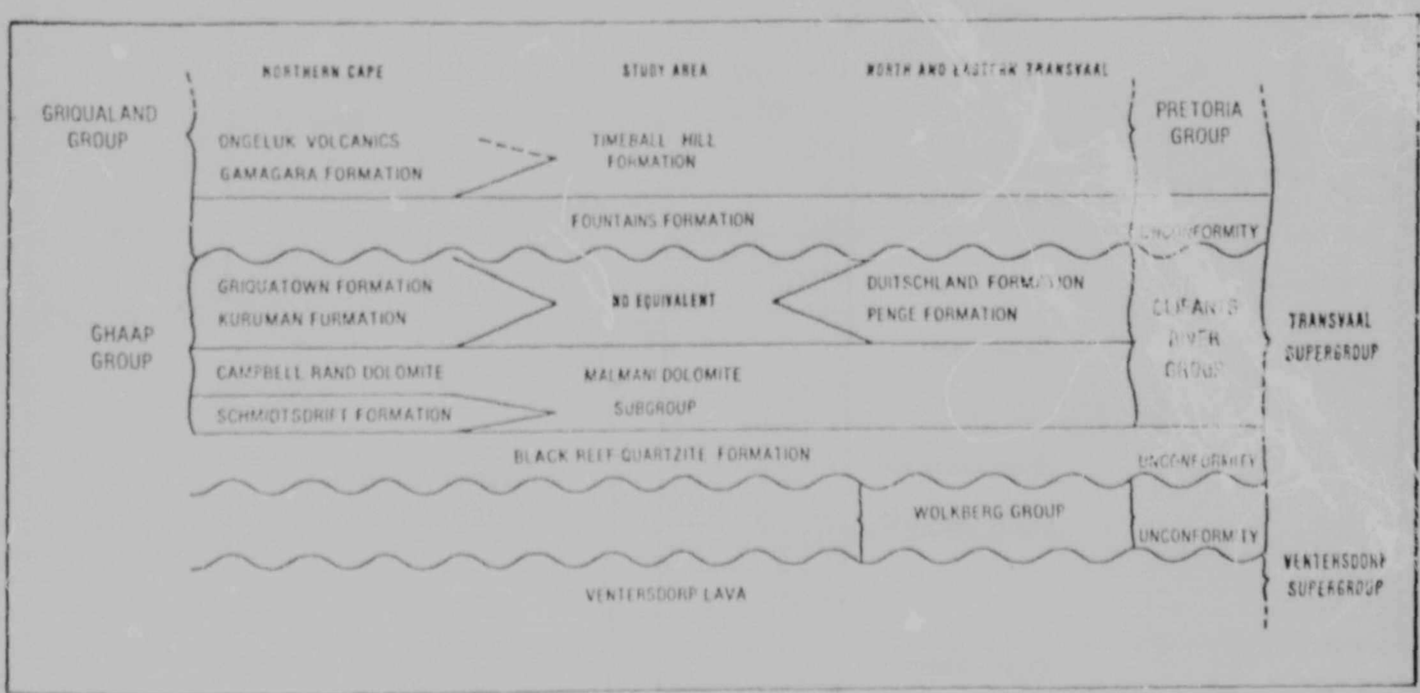


Figure 3 : Composite diagram illustrating the stratigraphic relationships of the Transvaal sequence.

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

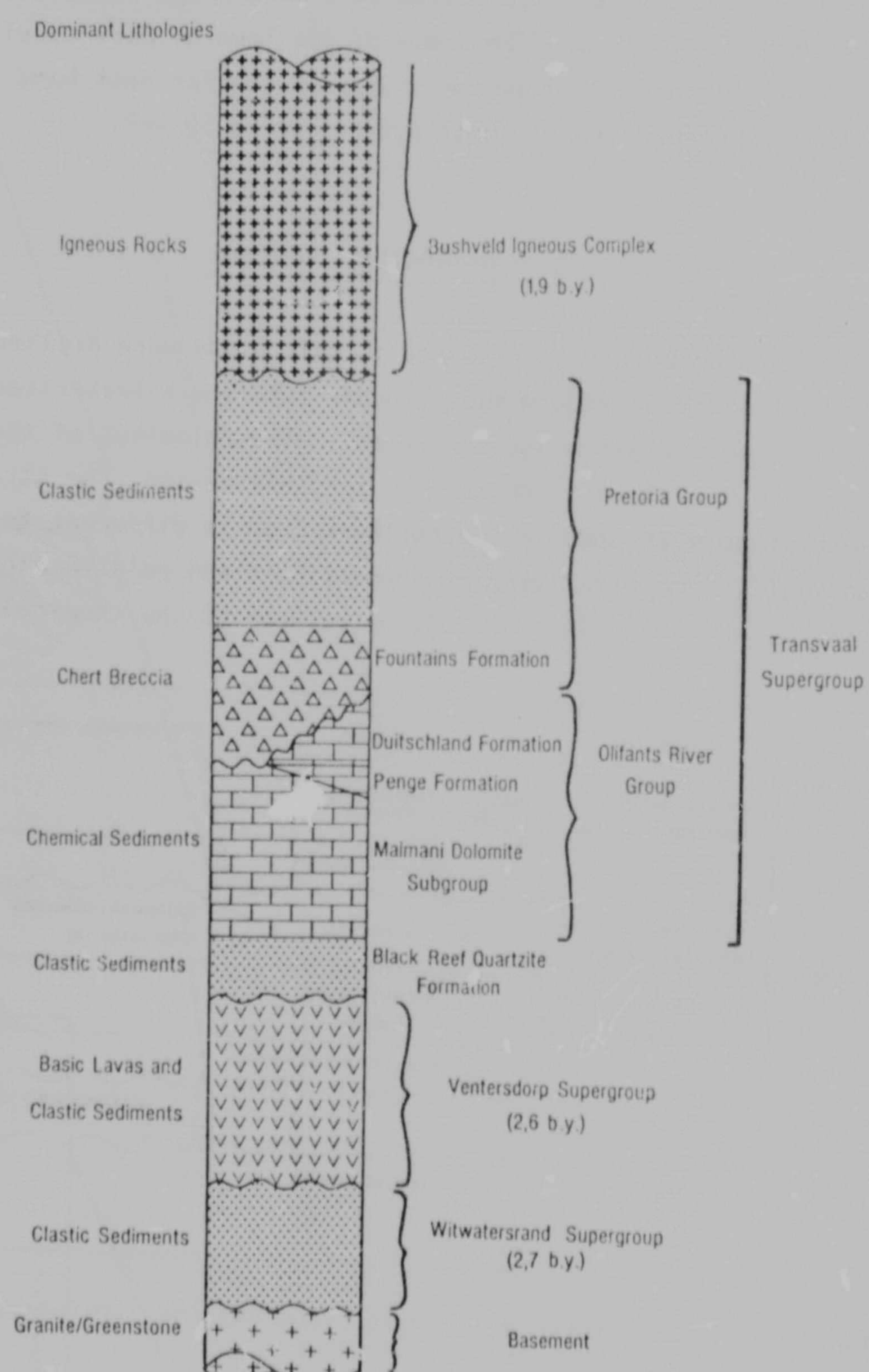


Figure 5 : *Generalized stratigraphic column illustrating the spatial relationships of the major geological units.*

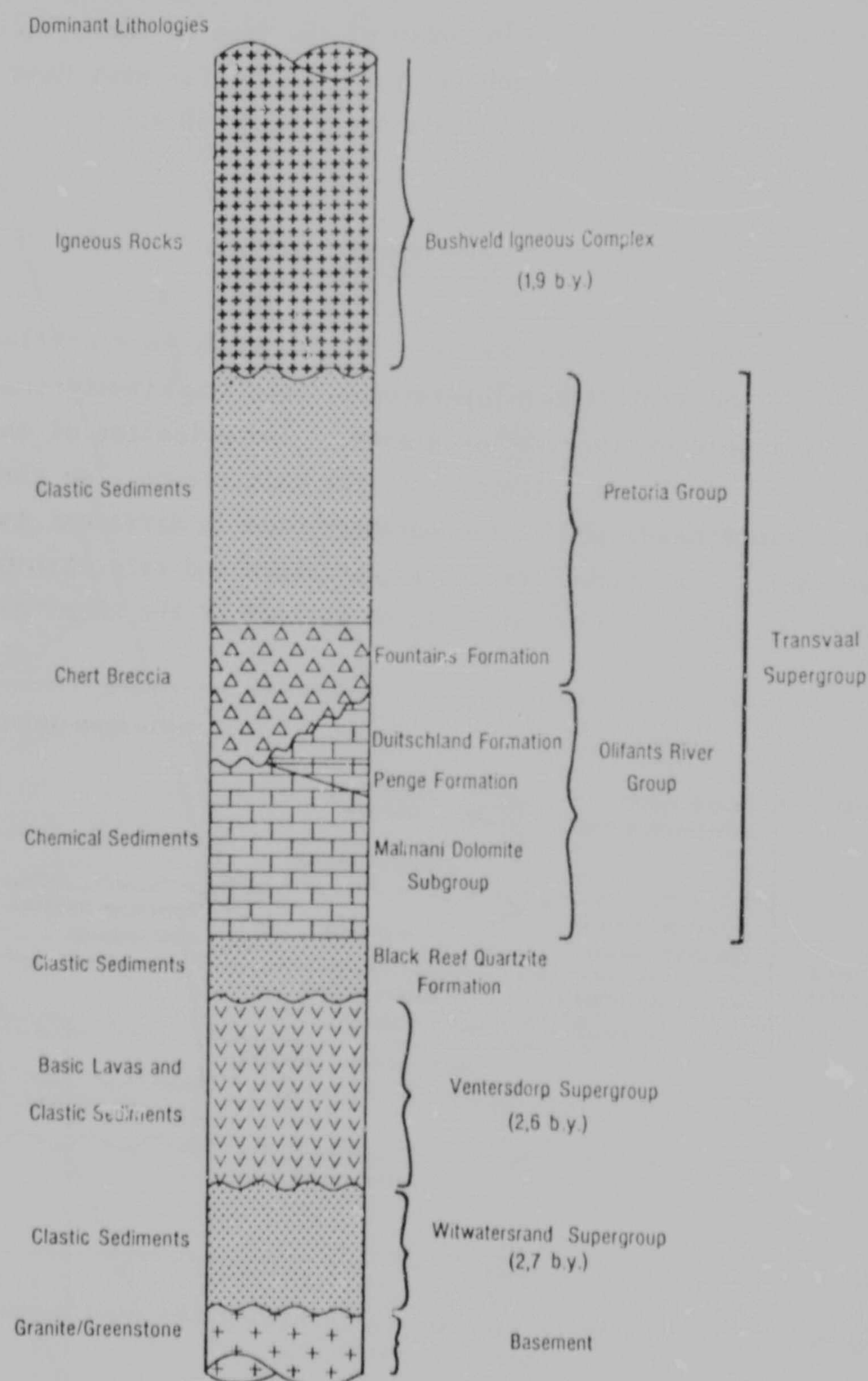


Figure 5 : Generalized stratigraphic column illustrating the spatial relationships of the major geological units.

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 Duitschland Formation (see Figures 3 and 5). The latter units are not present in the study-

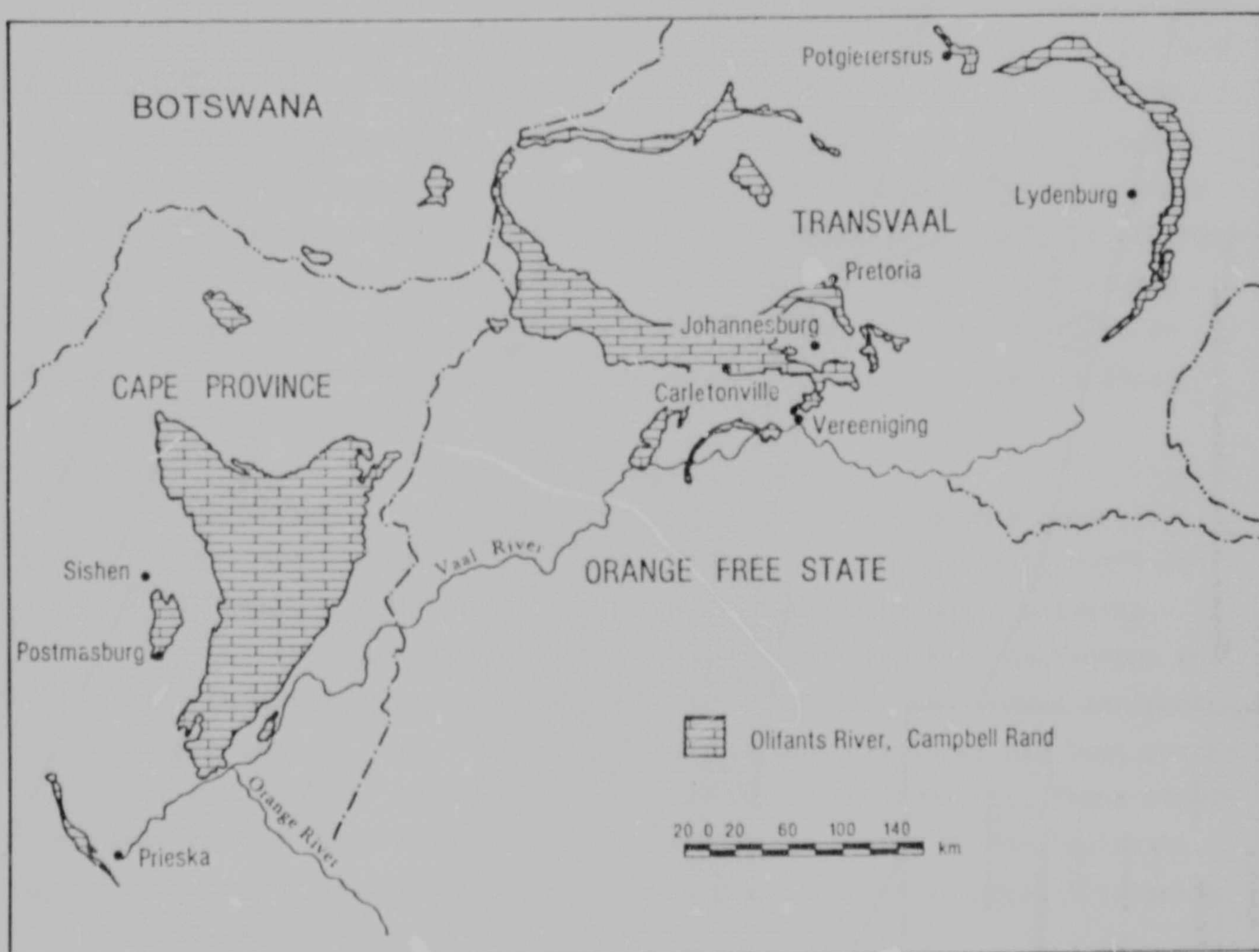
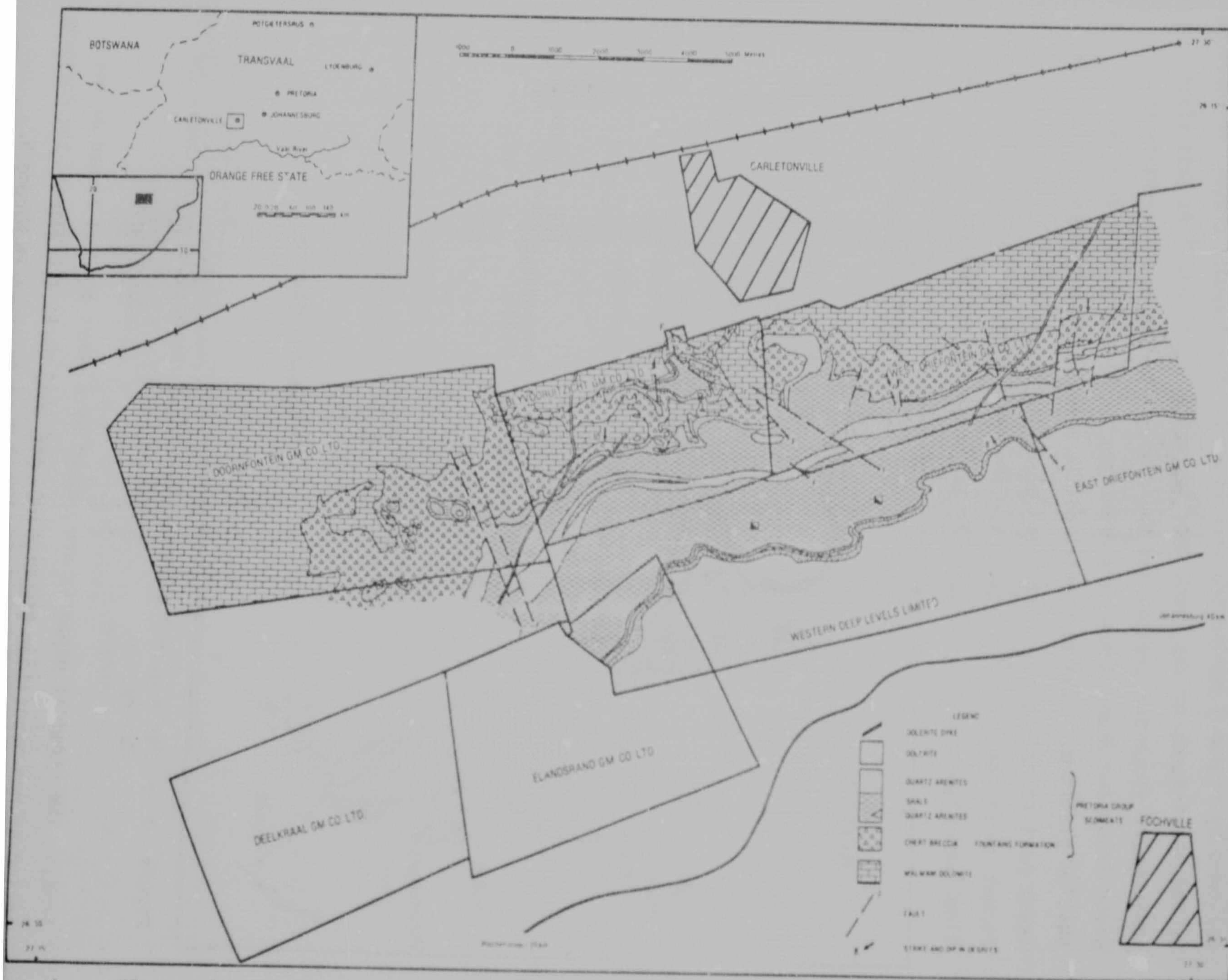


Figure 4 : The regional distribution of the carbonates of the Transvaal Supergroup.

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.



e 6 : *The surface geology of the study-area.*