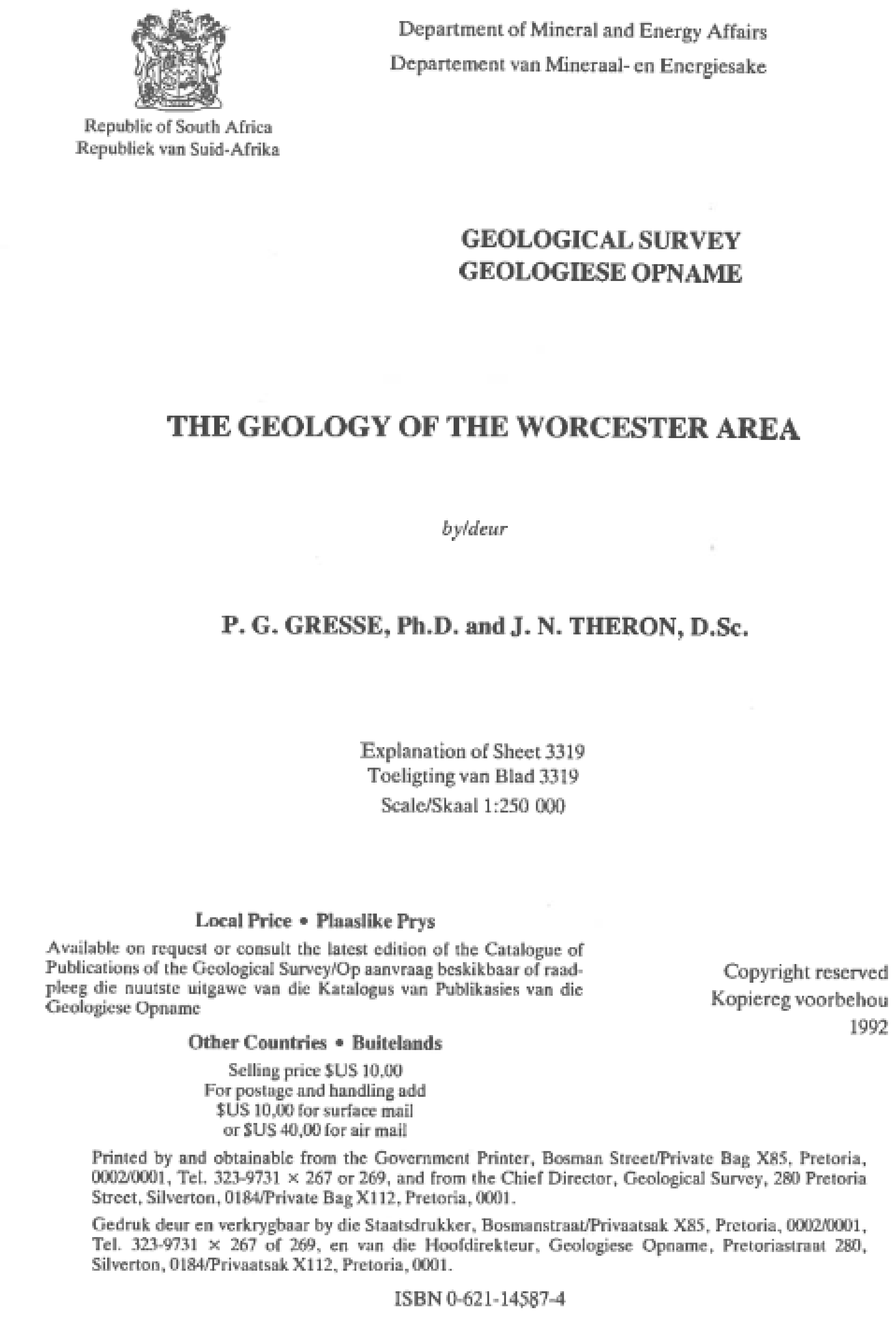
Z. BIBLIOGRAPHY

Z2. Geology



Department of Mineral and Energy Affairs
Departement van Mineraal- en Energiesake

Republic of South Africa
Republiek van Suid-Afrika

GEOLOGICAL SURVEY
GEOLOGIESE OPNAME

THE GEOLOGY OF THE WORCESTER AREA

by/deur

P. G. GRESSE, Ph.D. and J. N. THERON, D.Sc.

Explanation of Sheet 3319
Toeligting van Blad 3319
Scale/Skaal 1:250 000

Local Price • Plaaslike Prys

Available on request or consult the latest edition of the Catalogue of Publications of the Geological Survey/Op aanvraag beskikbaar of raadpleeg die nuutste uitgawe van die Katalogus van Publikasies van die Geologiese Opname

Other Countries • Buitelands

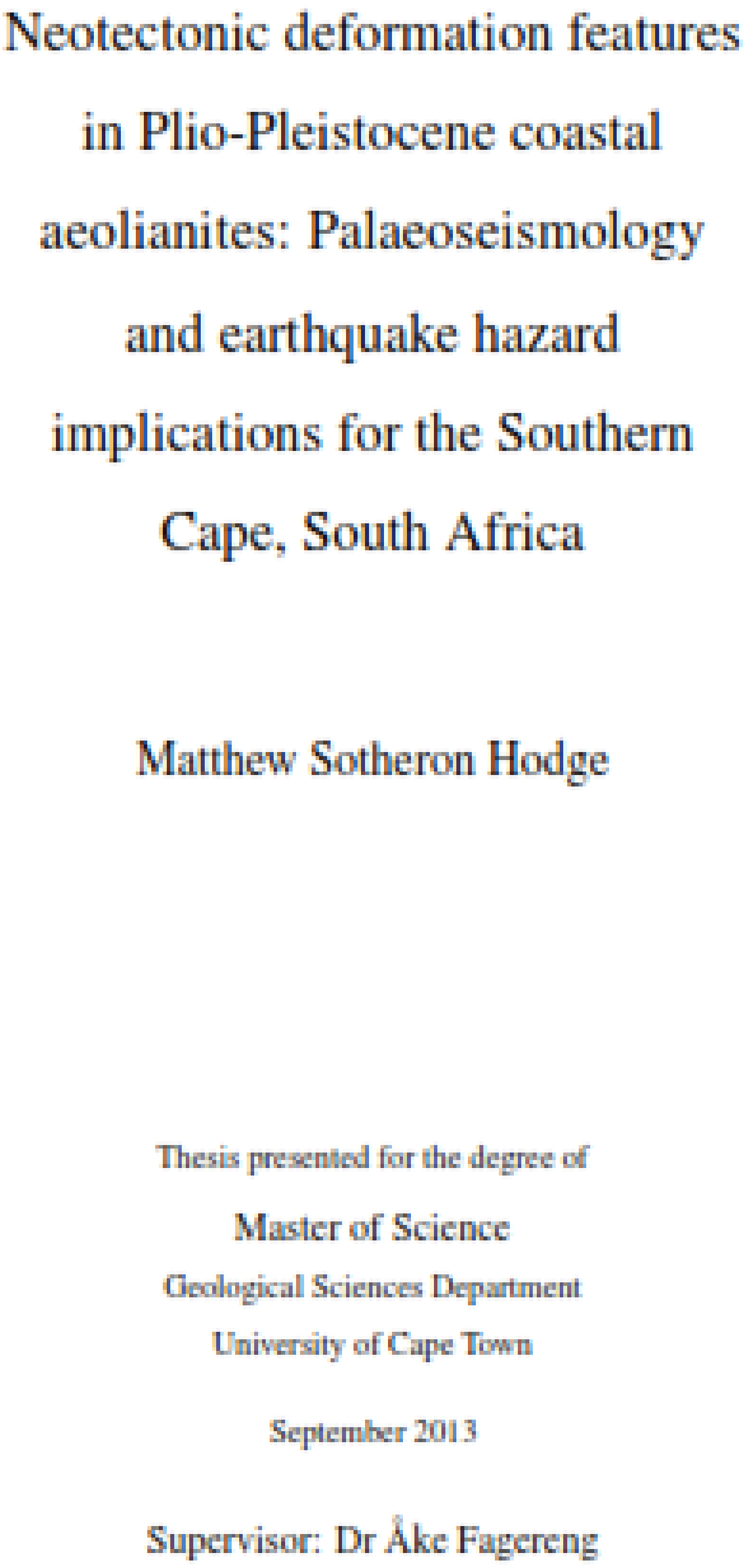
Selling price $US 10,00
For postage and handling add
$US 10,00 for surface mail
or $US 40,00 for air mail

Printed by and obtainable from the Government Printer, Bosman Street/Private Bag X85, Pretoria, 0002/0001, Tel. 323-9731 × 267 or 269, and from the Chief Director, Geological Survey, 280 Pretoria Street, Silverton, 0184/Private Bag X112, Pretoria, 0001.

Gedruk deur en verkrygbaar by die Staatsdrukker, Bosmanstraat/Privaatsak X85, Pretoria, 0002/0001, Tel. 323-9731 × 267 of 269, en van die Hoofdirekteur, Geologiese Opname, Pretoriastraat 280, Silverton, 0184/Privaatsak X112, Pretoria, 0001.

ISBN 0-621-14587-4

1992



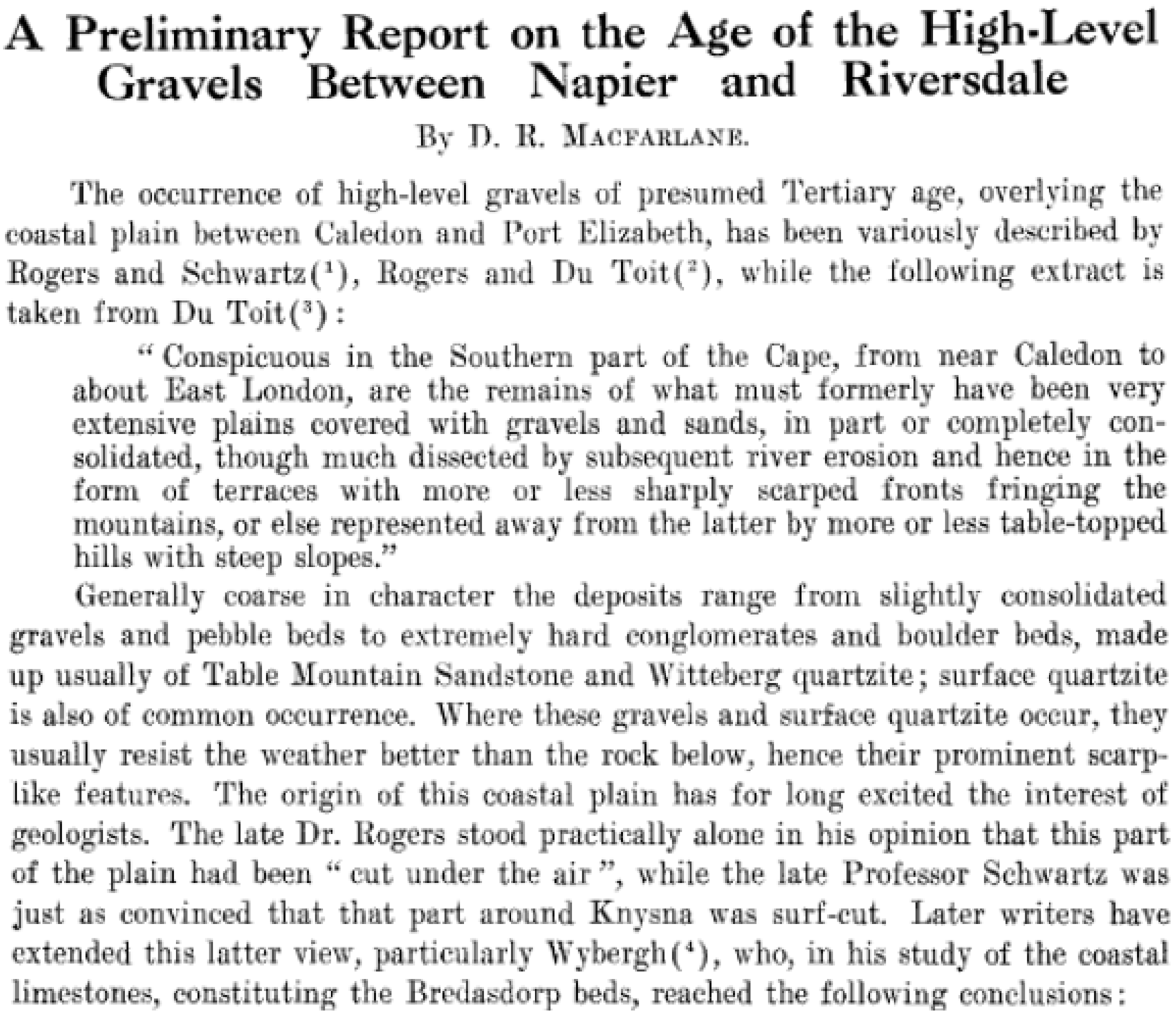
Neotectonic deformation features in Plio-Pleistocene coastal aeolianites: Palaeoseismology and earthquake hazard implications for the Southern Cape, South Africa

Matthew Sotheron Hodge

Thesis presented for the degree of
Master of Science
Geological Sciences Department
University of Cape Town

September 2013

Supervisor: Dr Åke Fagereng



A Preliminary Report on the Age of the High-Level Gravels Between Napier and Riversdale

By D. R. Macfarlane.

The occurrence of high-level gravels of presumed Tertiary age, overlying the coastal plain between Caledon and Port Elizabeth, has been variously described by Rogers and Schwartz(1), Rogers and Du Toit(2), while the following extract is taken from Du Toit(3):

> "Conspicuous in the Southern part of the Cape, from near Caledon to about East London, are the remains of what must formerly have been very extensive plains covered with gravels and sands, in part or completely consolidated, though much dissected by subsequent river erosion and hence in the form of terraces with more or less sharply scarped fronts fringing the mountains, or else represented away from the latter by more or less table-topped hills with steep slopes."

Generally coarse in character the deposits range from slightly consolidated gravels and pebble beds to extremely hard conglomerates and boulder beds, made up usually of Table Mountain Sandstone and Witteberg quartzite; surface quartzite is also of common occurrence. Where these gravels and surface quartzite occur, they usually resist the weather better than the rock below, hence their prominent scarp-like features. The origin of this coastal plain has for long excited the interest of geologists. The late Dr. Rogers stood practically alone in his opinion that this part of the plain had been "cut under the air", while the late Professor Schwartz was just as convinced that that part around Knysna was surf-cut. Later writers have extended this latter view, particularly Wybergh(4), who, in his study of the coastal limestones, constituting the Bredasdorp beds, reached the following conclusions:

Undated

1. Marker M.E. (1984). Marine benches of the eastern Cape, S.A. *Trans. geol. Soc. S.Afr.* **87**, 11 – 18.
2. Russell L. (1982). *Karst surface landforms of the De Hoop Nature Reserve.* MSc thesis, University of Fort Hare, Alice.
3. Dingle R.V. (1976). Tertiary sedimentary history of the continental shelf of southern Cape Province, S.A. *Trans. geol. Soc. S.Afr.* **74**, 173 – 186.
4. Siesser W.G. and Dingle R.V. (1981). Tertiary sea level movements around southern Africa. *J. Geol.* **89**, 83 – 96.
5. Marker M.E. and Sweeting M.M. (1983). Karst development on the Alexandria Limestones, Eastern Cape Province, S.A. *Zeit. Geomorph.* **27**, 21 – 38.
6. Marker M.E. (1976). Aeolianite: Australian and South African deposits compared. *Ann. S. Afr. Mus.* **71**, 115 – 124.
7. Mountain E.D. (1974). Geology of country around East London, Cape Province. Explan. Sheet 3227D/3228C, Geol. Surv. S. Afr., Pretoria.
8. Siesser W.G. (1974). Relict and Recent beach rock from southern Africa. *Bull. geol. Soc. Am.* **85**, 1849 – 1854.

The Bredasdorp Group in the area between Gans Bay and Mossel Bay

Jean A. Malan
Geological Survey, P.O. Box 572, 7530 Bellville, South Africa.

The Bredasdorp Group, in the area between Hermanus and Mossel Bay, consists of a succession of limestone, sandy limestone, sandstone and conglomerate. The limestone beds occur in a narrow belt that extends

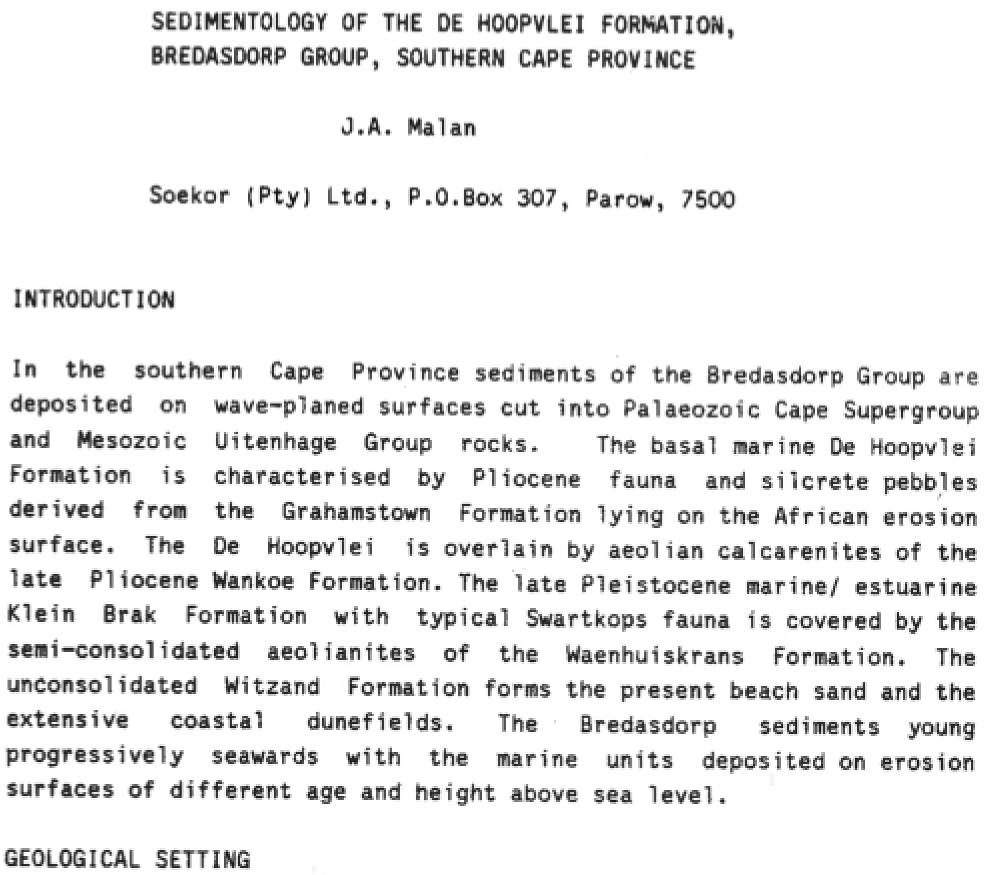
1987

Table 1. Subdivision of the Bredasdorp Group.

Formation	Description	Age
Strandveld	Unconsolidated wind-blown dunes	Holocene
Waenhuiskrans	Semi-consolidated aeolianite	Pleistocene
Rooikrans	Shelly quartzose sand and conglomerate	Pleistocene
Wankoe	Consolidated aeolianite	Mio/Pliocene
De Hoopvlei	Shelly quartzose sand and oyster-bearing conglomerate	Mio/Pliocene

Wankoe Formation. This aeolian facies forms the bulk of the Bredasdorp Group, and in areal extent occupies nearly the entire outcrop area as vegetated, consolidated dunes. These calcarenites consist of cream- to white-coloured, well-rounded quartz grains, scattered pebbles and lenses of coarse material and broken shelly material. Dark specks of glauconite are also present. Typical aeolian cross-bedding characterizes this unit. The maximum calculated thickness of the aeolian facies is 290 metres.

Rooikrans Formation. The Rooikrans Formation is only partly con-



SEDIMENTOLOGY OF THE DE HOOPVLEI FORMATION, BREDASDORP GROUP, SOUTHERN CAPE PROVINCE

J.A. Malan

Soekor (Pty) Ltd., P.O.Box 307, Parow, 7500

INTRODUCTION

In the southern Cape Province sediments of the Bredasdorp Group are deposited on wave-planed surfaces cut into Palaeozoic Cape Supergroup and Mesozoic Uitenhage Group rocks. The basal marine De Hoopvlei Formation is characterised by Pliocene fauna and silcrete pebbles derived from the Grahamstown Formation lying on the African erosion surface. The De Hoopvlei is overlain by aeolian calcarenites of the late Pliocene Wankoe Formation. The late Pleistocene marine/ estuarine Klein Brak Formation with typical Swartkops fauna is covered by the semi-consolidated aeolianites of the Waenhuiskrans Formation. The unconsolidated Witzand Formation forms the present beach sand and the extensive coastal dunefields. The Bredasdorp sediments young progressively seawards with the marine units deposited on erosion surfaces of different age and height above sea level.

GEOLOGICAL SETTING

1988

THE STRATIGRAPHY AND SEDIMENTOLOGY
OF THE
BREDASDORP GROUP,
SOUTHERN CAPE PROVINCE

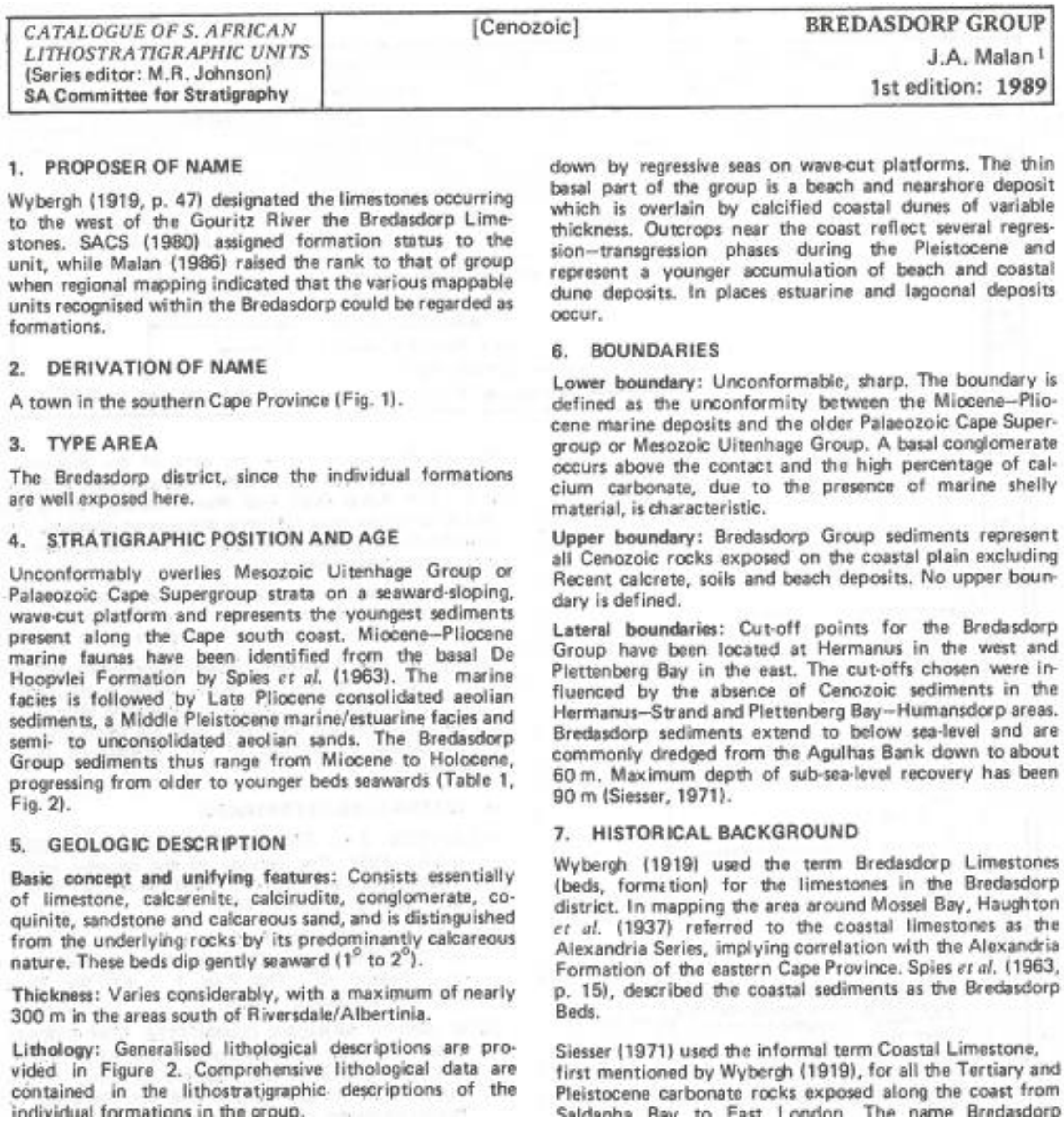
BY

JEAN ARNAUD MALAN

Master of Science in Geology

University of Cape Town

September 1990



CATALOGUE OF S. AFRICAN LITHOSTRATIGRAPHIC UNITS
(Series editor: M.R. Johnson)
SA Committee for Stratigraphy

[Cenozoic]

BREDASDORP GROUP
J.A. Malan[1]
1st edition: **1989**

1. PROPOSER OF NAME

Wybergh (1919, p. 47) designated the limestones occurring to the west of the Gouritz River the Bredasdorp Limestones. SACS (1980) assigned formation status to the unit, while Malan (1986) raised the rank to that of group when regional mapping indicated that the various mappable units recognised within the Bredasdorp could be regarded as formations.

2. DERIVATION OF NAME

A town in the southern Cape Province (Fig. 1).

3. TYPE AREA

The Bredasdorp district, since the individual formations are well exposed here.

4. STRATIGRAPHIC POSITION AND AGE

Unconformably overlies Mesozoic Uitenhage Group or Palaeozoic Cape Supergroup strata on a seaward-sloping, wave-cut platform and represents the youngest sediments present along the Cape south coast. Miocene–Pliocene marine faunas have been identified from the basal De Hoopvlei Formation by Spies *et al.* (1963). The marine facies is followed by Late Pliocene consolidated aeolian sediments, a Middle Pleistocene marine/estuarine facies and semi- to unconsolidated aeolian sands. The Bredasdorp Group sediments thus range from Miocene to Holocene, progressing from older to younger beds seawards (Table 1, Fig. 2).

5. GEOLOGIC DESCRIPTION

Basic concept and unifying features: Consists essentially of limestone, calcarenite, calcirudite, conglomerate, coquinite, sandstone and calcareous sand, and is distinguished from the underlying rocks by its predominantly calcareous nature. These beds dip gently seaward (1° to 2°).

Thickness: Varies considerably, with a maximum of nearly 300 m in the areas south of Riversdale/Albertinia.

Lithology: Generalised lithological descriptions are provided in Figure 2. Comprehensive lithological data are contained in the lithostratigraphic descriptions of the individual formations in the group.

down by regressive seas on wave-cut platforms. The thin basal part of the group is a beach and nearshore deposit which is overlain by calcified coastal dunes of variable thickness. Outcrops near the coast reflect several regression–transgression phases during the Pleistocene and represent a younger accumulation of beach and coastal dune deposits. In places estuarine and lagoonal deposits occur.

6. BOUNDARIES

Lower boundary: Unconformable, sharp. The boundary is defined as the unconformity between the Miocene–Pliocene marine deposits and the older Palaeozoic Cape Supergroup or Mesozoic Uitenhage Group. A basal conglomerate occurs above the contact and the high percentage of calcium carbonate, due to the presence of marine shelly material, is characteristic.

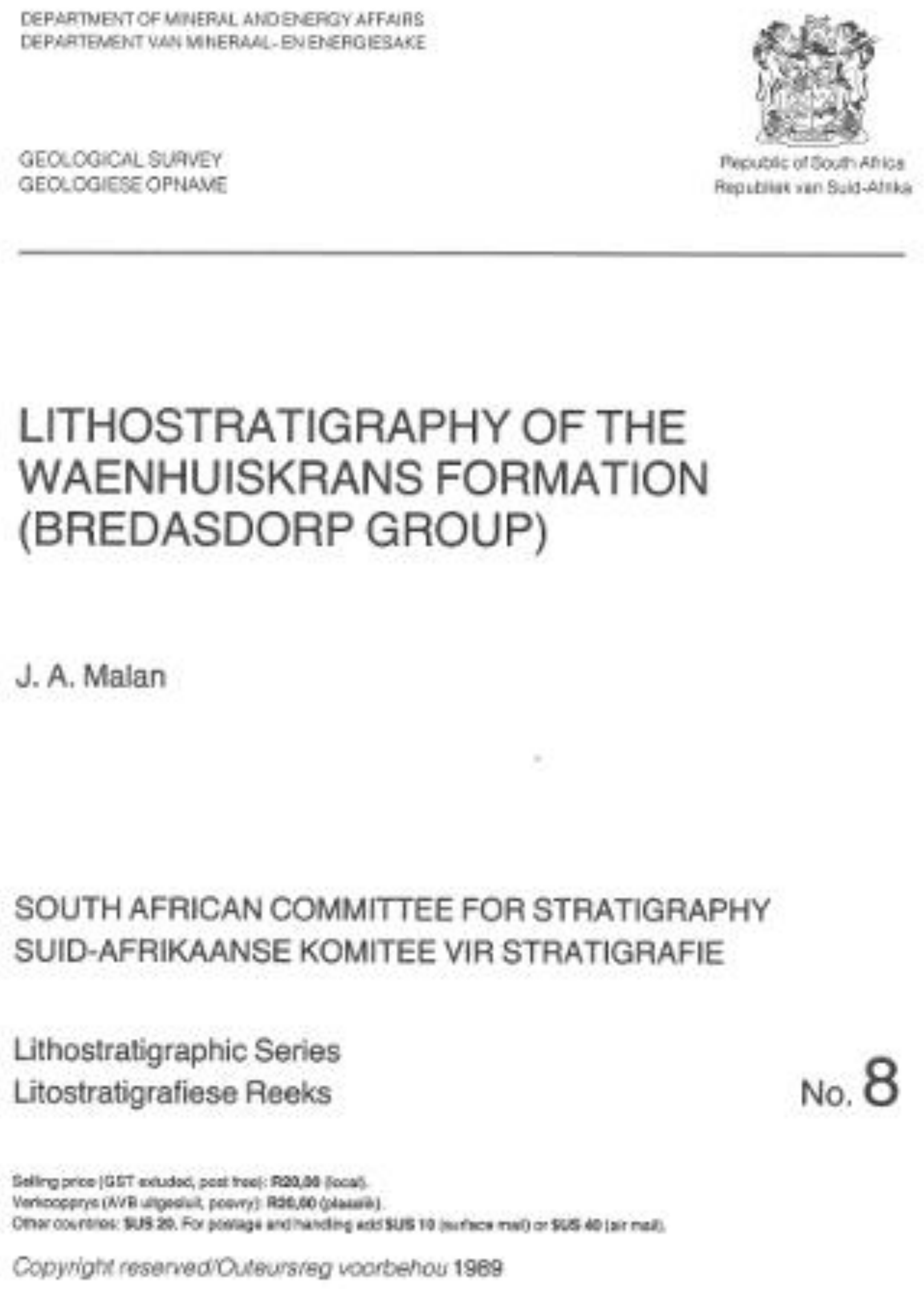
Upper boundary: Bredasdorp Group sediments represent all Cenozoic rocks exposed on the coastal plain excluding Recent calcrete, soils and beach deposits. No upper boundary is defined.

Lateral boundaries: Cut-off points for the Bredasdorp Group have been located at Hermanus in the west and Plettenberg Bay in the east. The cut-offs chosen were influenced by the absence of Cenozoic sediments in the Hermanus–Strand and Plettenberg Bay–Humansdorp areas. Bredasdorp sediments extend to below sea-level and are commonly dredged from the Agulhas Bank down to about 60 m. Maximum depth of sub-sea-level recovery has been 90 m (Siesser, 1971).

7. HISTORICAL BACKGROUND

Wybergh (1919) used the term Bredasdorp Limestones (beds, formation) for the limestones in the Bredasdorp district. In mapping the area around Mossel Bay, Haughton *et al.* (1937) referred to the coastal limestones as the Alexandria Series, implying correlation with the Alexandria Formation of the eastern Cape Province. Spies *et al.* (1963, p. 15), described the coastal sediments as the Bredasdorp Beds.

Siesser (1971) used the informal term Coastal Limestone, first mentioned by Wybergh (1919), for all the Tertiary and Pleistocene carbonate rocks exposed along the coast from Saldanha Bay to East London. The name Bredasdorp



DEPARTMENT OF MINERAL AND ENERGY AFFAIRS
DEPARTEMENT VAN MINERAAL- EN ENERGIESAKE

GEOLOGICAL SURVEY
GEOLOGIESE OPNAME

Republic of South Africa
Republiek van Suid-Afrika

LITHOSTRATIGRAPHY OF THE WAENHUISKRANS FORMATION (BREDASDORP GROUP)

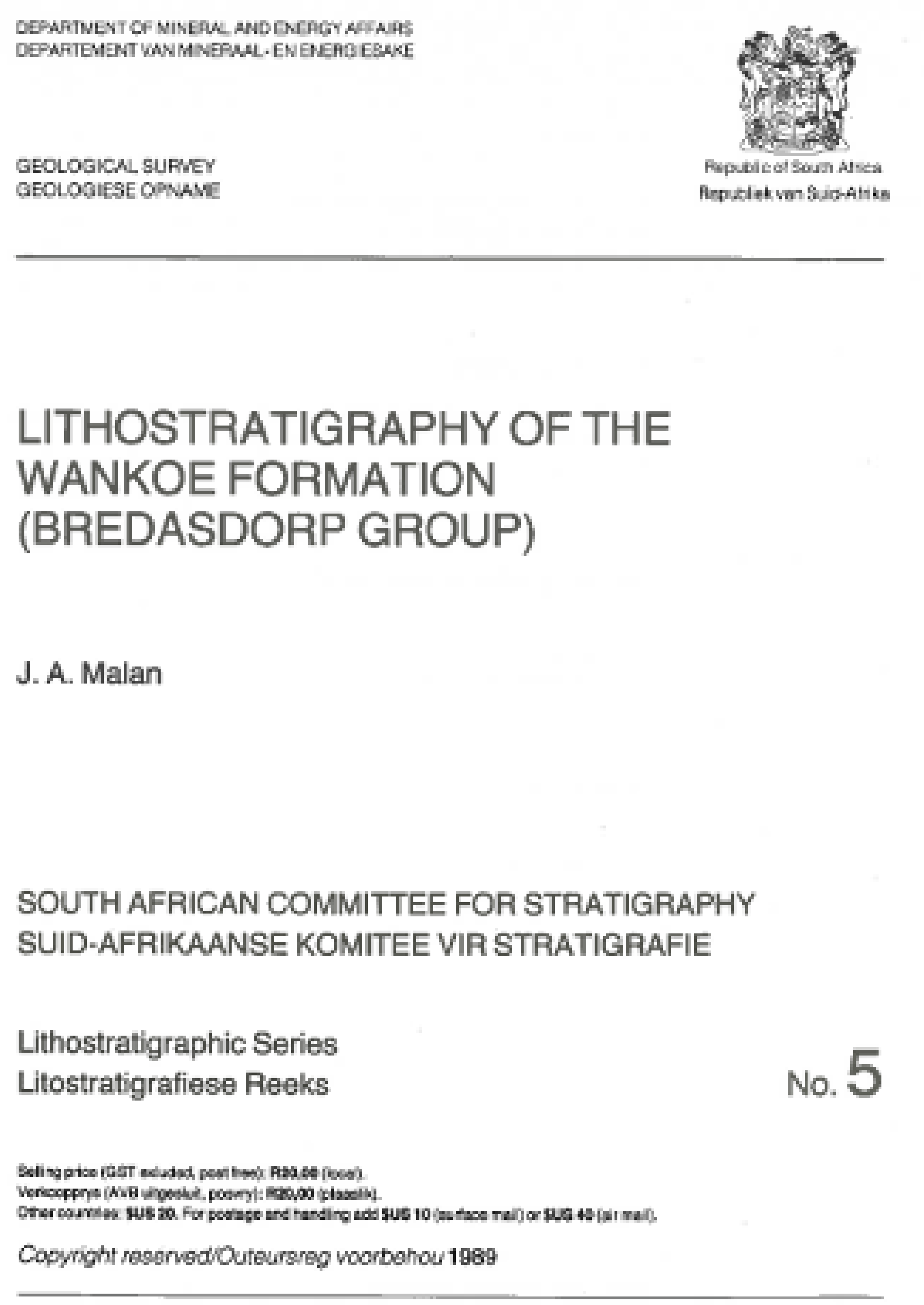
J. A. Malan

SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY
SUID-AFRIKAANSE KOMITEE VIR STRATIGRAFIE

Lithostratigraphic Series
Litostratigrafiese Reeks

No. 8

Selling price (GST excluded, post free): **R20,00** (local).
Verkoopprys (AVB uitgesluit, posvry): **R20,00** (plaaslik).
Other countries: **$US 20**. For postage and handling add **$US 10** (surface mail) or **$US 40** (air mail).



DEPARTMENT OF MINERAL AND ENERGY AFFAIRS
DEPARTEMENT VAN MINERAAL- EN ENERGIESAKE

GEOLOGICAL SURVEY
GEOLOGIESE OPNAME

Republic of South Africa
Republiek van Suid-Afrika

LITHOSTRATIGRAPHY OF THE WANKOE FORMATION (BREDASDORP GROUP)

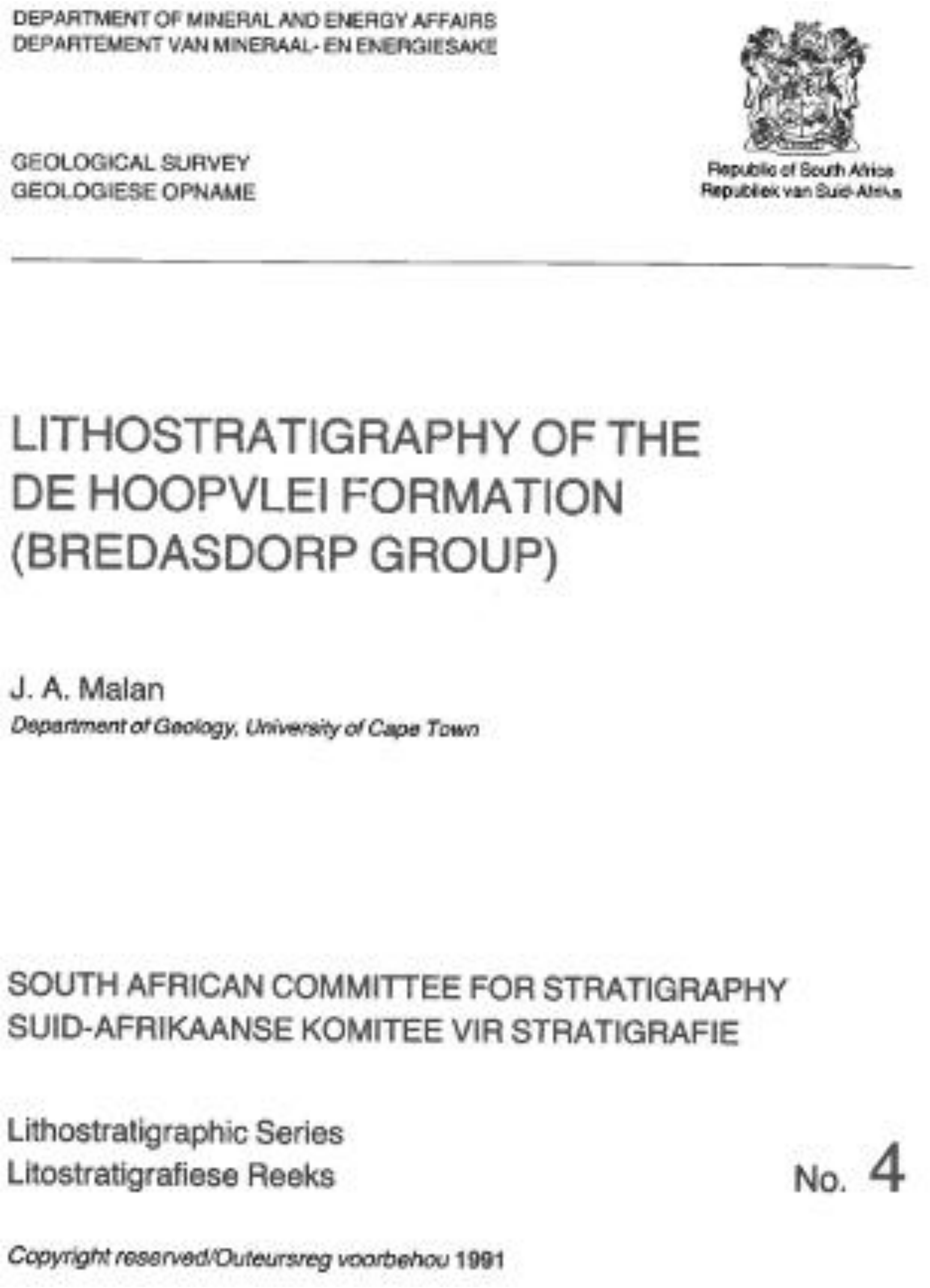
J. A. Malan

SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY
SUID-AFRIKAANSE KOMITEE VIR STRATIGRAFIE

Lithostratigraphic Series
Litostratigrafiese Reeks

No. 5

Selling price (GST excluded, post free): R30,00 (local).
Verkoopprys (AVB uitgesluit, posvry): R30,00 (plaaslik).
Other countries: $US 20. For postage and handling add $US 10 (surface mail) or $US 40 (air mail).



DEPARTMENT OF MINERAL AND ENERGY AFFAIRS
DEPARTEMENT VAN MINERAAL- EN ENERGIESAKE

GEOLOGICAL SURVEY
GEOLOGIESE OPNAME

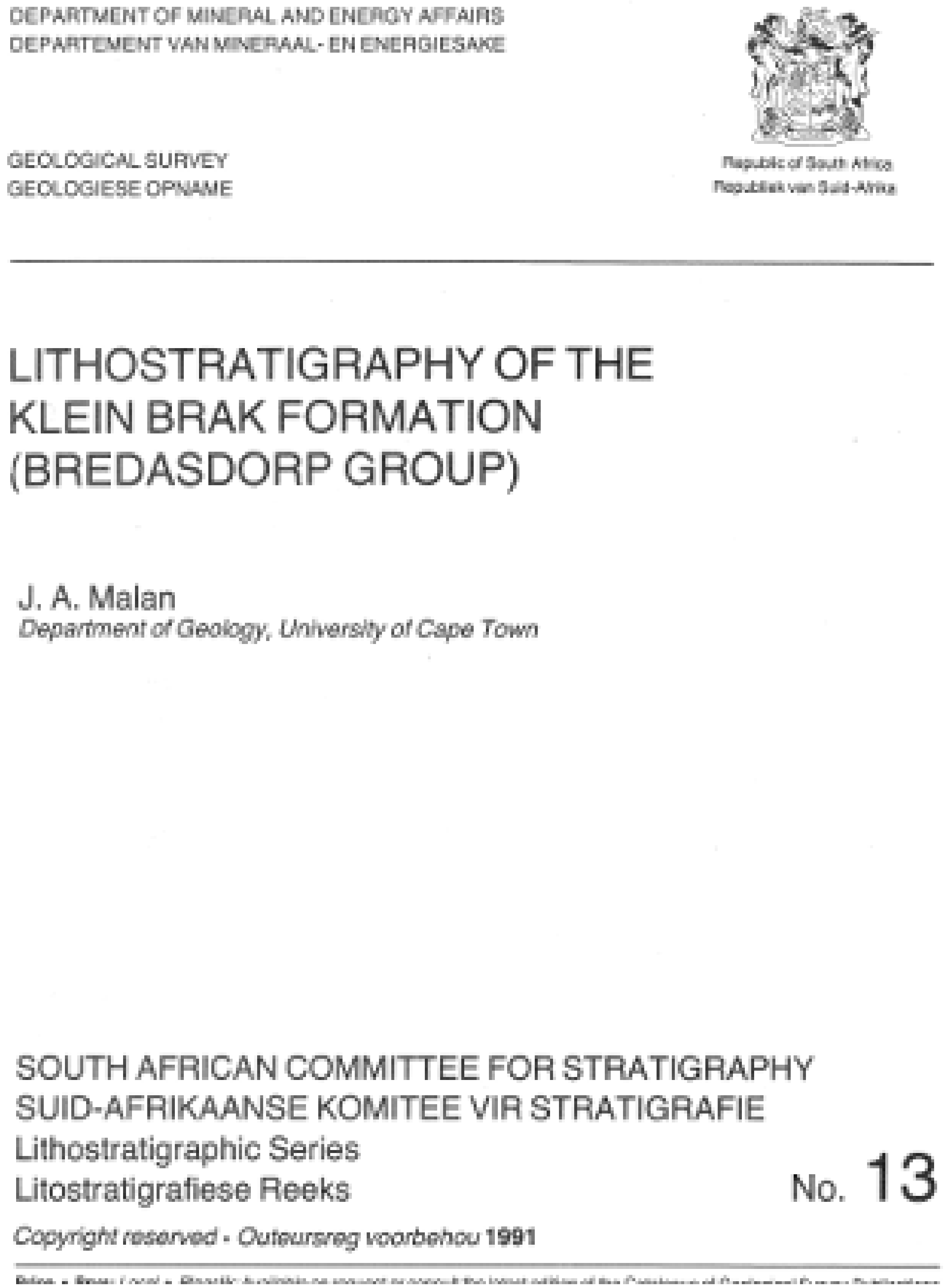
Republic of South Africa
Republiek van Suid-Afrika

LITHOSTRATIGRAPHY OF THE DE HOOPVLEI FORMATION (BREDASDORP GROUP)

J. A. Malan
Department of Geology, University of Cape Town

SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY
SUID-AFRIKAANSE KOMITEE VIR STRATIGRAFIE

Lithostratigraphic Series
Litostratigrafiese Reeks
No. 4



DEPARTMENT OF MINERAL AND ENERGY AFFAIRS
DEPARTEMENT VAN MINERAAL- EN ENERGIESAKE

GEOLOGICAL SURVEY
GEOLOGIESE OPNAME

Republic of South Africa
Republiek van Suid-Afrika

LITHOSTRATIGRAPHY OF THE KLEIN BRAK FORMATION (BREDASDORP GROUP)

J. A. Malan
Department of Geology, University of Cape Town

SOUTH AFRICAN COMMITTEE FOR STRATIGRAPHY
SUID-AFRIKAANSE KOMITEE VIR STRATIGRAFIE
Lithostratigraphic Series
Litostratigrafiese Reeks
No. 13

Ann. geol. Surv. S. Afr., 21 (1987), p. 83–87

NOTES ON AN ENON BASIN NORTHEAST OF BREDASDORP, SOUTHERN CAPE PROVINCE

by

J. A. Malan, B.Sc. (Hons.) and J. N. Theron, D.Sc.

Abstract

Geological mapping has revealed a previously unknown occurrence of Uitenhage Group sediments northeast of Bredasdorp. Reddish-brown monomictic clast-supported conglomerates represent the basal Enon Formation and crop out over an area of about 60 km². These outcrops probably represent erosional remnants of the landward extension of the offshore Bredasdorp Basin present on the Agulhas Bank.

1. INTRODUCTION

Fifteen kilometres northeast of Bredasdorp reddish-brown rudaceous sediments crop out intermittently over an area of about 60 km² (Fig. 1.1). The stratigraphical relationship of these grits and conglomerates, exposed in the lower reaches of the Salt River and in the catchment area of the Waterskilpads River (Fig 1.2), has as yet not been satisfactorily clarified. Wybergh (1919) interpreted coarse grits and conglomerates exposed along the lower reaches of the Salt River as part of the basal unit of the Bredasdorp Formation. During a geohydrological research project, clay and claygrounds in excess of 80 m were identified beneath the arenaceous Bredasdorp limestones in the same area (Whittingham 1969). An internal report to the Department of Transport also described extensive pebble and boulder gravels of Pleistocene to Recent age in this area (Kantey et al. 1973). However, geological mapping during 1984 in the districts of Bredasdorp and Riversdale and research on the Bredasdorp Formation have now clarified the stratigraphical relationship of these rudaceous beds.

The reddish-brown conglomerates are unconformably overlain by Late Tertiary Bredasdorp calcarenites on the farm Wind Hoek 78 and rests in turn discordantly on Palaeozoic Bokkeveld pelites along the Waterskilpads River on Zout Pans Vlakte 82 and Roode Valley 87. The basal conglomerate of the Bredasdorp Group* is predominantly highly calcareous due to the presence of marine shells and never exceeds 12 m in thickness. This is in complete contrast to the thickness in excess of 80 m as measured for the older conglomerates (Whittingham 1969). The Bredasdorp calcarenites furthermore have a yellowish-grey colour compared to the reddish-brown colour for the underlying noncalcareous conglomerate. Clasts in the latter are clearly of Bokkeveld and Table Mountain derivation.

2. STRATIGRAPHY AND SEDIMENTOLOGY

Reddish-brown rudaceous sediments crop out on the farms Roode Valley 87, Water Schilpad River 84, Patryze Kraal 79, Zout Pans Vlakte 82, Te Vreda 83 in the Waterskilpads River catchment and along the Salt River on Wind Hoek 78 (Fig. 1.2). Interbedded with these conglomerate horizons are layers of siltstone and sandstone, averaging 0,6 m and seldom exceeding 1,0 m in thickness, as well as thin claystone layers, less than 20 cm thick (Figs 2.1 and 2.2). Cross-bedding occurs in places and both upward-fining and upward-coarsening grain-size trends are present. A slight unconformity with the overlying Bredasdorp beds can be observed at various localities on Wind Hoek 78 and along the upper reaches of the De Hoopvlei. The southernmost known occurrence is present on Moerasfontein 169 where it has been exposed in a shallow ditch and where its presence has also been revealed by boreholes drilled through the Late Tertiary calcarenites.

---

* Not yet approved by SACS

GEOLOGIESE OPNAME VAN SUID-AFRIKA

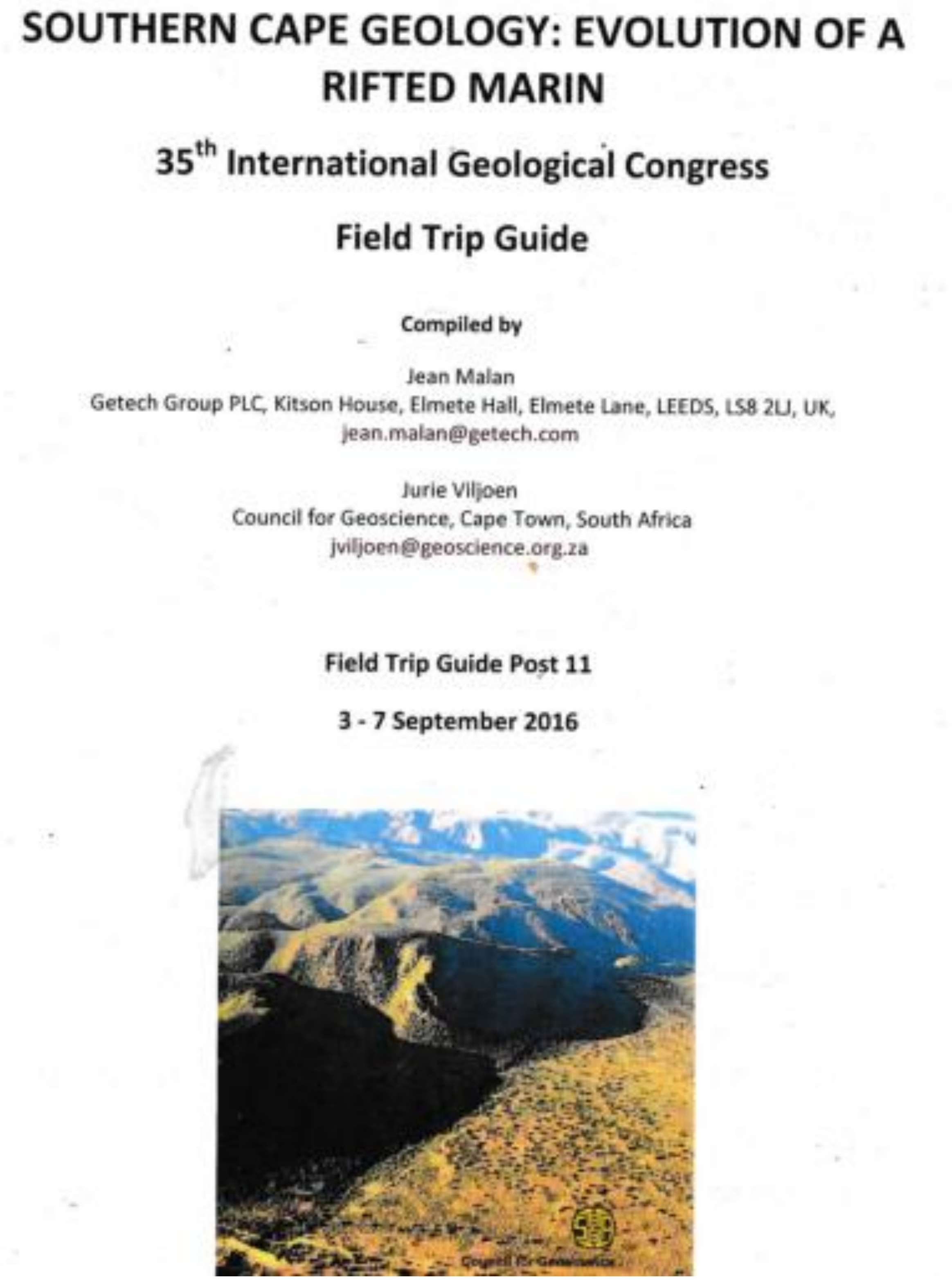
DIE GEOLOGIE VAN DIE GEBIED RIVERSDALE

deur

**J.A. MALAN, M.Sc., J.H.A. VILJOEN, B.Sc.(Hons.),
H.P. SIEGFRIED, M.Sc. en H. de V. WICKENS, M.Sc.**

Toeligting tot Riversdale Blad 3420
Skaal 1:250 000

Staatsdrukker, Pretoria
1994



SOUTHERN CAPE GEOLOGY: EVOLUTION OF A RIFTED MARIN

35th International Geological Congress

Field Trip Guide

Compiled by

Jean Malan
Getech Group PLC, Kitson House, Elmete Hall, Elmete Lane, LEEDS, LS8 2LJ, UK,
jean.malan@getech.com

Jurie Viljoen
Council for Geoscience, Cape Town, South Africa
jviljoen@geoscience.org.za

Field Trip Guide Post 11

3 - 7 September 2016

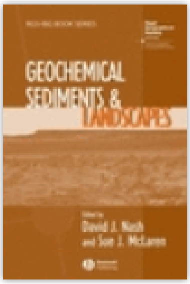
Lithostratigraphy of the Enon Formation (Uitenhage Group), South Africa

R.A. Muir
Department of Geological Sciences, University of Cape Town, Private Bag X3,
Rondebosch 7701, South Africa
e-mail: mrxrob009@myuct.ac.za

E.M. Bordy
Department of Geological Sciences, University of Cape Town, Private Bag X3,
Rondebosch 7701, South Africa
e-mail: emese.bordy@uct.ac.za

J.S.V. Reddering
Council for Geoscience, P.O. Box 5347, Walmer 6065, South Africa
(Deceased)

J.H.A. Viljoen
Council for Geoscience, P.O. Box 572, Bellville 7535, South Africa
e-mail: jviljoen@geocience.org.za



Geochemical Sediments and Landscapes

Editor(s): David J. Nash, Sue J. McLaren
First published: 1 January 2007
Print ISBN: 9781405125192 | Online ISBN: 9780470712917
| DOI: 10.1002/9780470712917

Chapter Four

Silcrete

David J. Nash and J. Stewart Ullyott

4.1 Introduction: Nature and General Characteristics

Silcrete is a term first used by Lamplugh (1902) to describe the products of near-surface processes by which silica accumulates in and/or replaces a soil, sediment, rock or weathered material to form an indurated mass (Watson and Nash, 1997). Silcretes are defined as containing >85 wt.% SiO_2, with many comprising >95 wt.% SiO_2 (Summerfield, 1983a). They are most widespread in Australia, southern Africa and western Europe, with localised occurrences elsewhere (section 4.2). With the exception of biogenic silcretes in Botswana (Shaw et al., 1990), dorbanks in South Africa (Ellis and Schloms, 1982), and duripans in North America (Flach et al., 1969; Chadwick et al., 1989; Dubroeucq and Thiry, 1994), most silcretes are relict features. The majority require stable geomorphological conditions to develop, although the genesis of some silcretes may be related to actively evolving landscapes (Thiry, 1999).

Silcretes exhibit a wide variety of forms (Figure 4.1), but commonly consist of brittle masses or nodules of hard, silica-cemented quartzose sand with a conchoidal or sub-conchoidal fracture. Very hard, fine-grained 'porcellanitic' and cherty varieties also occur (Peterson and von der Borch, 1965; Wopfner, 1983; Schubel and Simonson, 1990; Mišík, 1996), with less well-cemented silcretes common in mid-latitude settings (Summerfield and Goudie, 1980; Thiry et al., 1988a). The silcrete cement (or matrix) can contain a range of silica minerals, of which opal, chalcedony, cryptocrystalline silica and quartz are the most widely documented (section 4.4).

Distinguishing pedogenic and non-pedogenic silcretes in the landscape and geological record

J. Stewart Ullyott [a,*] and David J. Nash [a,b]

[a] School of Environment and Technology, University of Brighton, Brighton BN2 4GJ, United Kingdom

[b] School of Geography, Archaeology and Environmental Studies, University of the Witwatersrand, Private Bag 3, Wits 2050, South Africa

[*] Corresponding author. Tel.: +44 1273 642267; Fax: +44 1273 642285. Email address: j.s.ullyott@brighton.ac.uk (J.S. Ullyott)

ABSTRACT

Silcrete is a type of duricrust formed by the near-surface accumulation of secondary silica within a soil, sediment, rock or weathered material. A variety of models of formation have been put forward, involving silicification in both pedogenic and non-pedogenic settings. The resulting silcrete types differ in terms of their macroscale characteristics, micromorphology, areal extent and behavioural properties. Such differences have significant implications in a range of geological, geomorphological, archaeological and engineering contexts, making the correct identification of silcrete type of considerable importance. This paper reviews the properties of pedogenic, groundwater, drainage-line and pan/lacustrine silcretes, and identifies many characteristics that may be diagnostic. It also discusses a number of more problematic macro- and micro-scale features common to both pedogenic and non-pedogenic silcretes. It concludes with a short checklist to aid the future identification of different silcrete types in the landscape and geological record.

Keywords: Duricrust; groundwater silcrete; pedogenic silcrete; micromorphology; silicification; puddingstone; sarsen

COUNCIL FOR GEOSCIENCE
SOUTH AFRICA

AGE, GENESIS AND SIGNIFICANCE OF SOUTH AFRICAN COASTAL BELT SILCRETES

by

D.L. Roberts

MEMOIR 95

2003

30 COASTAL CENOZOIC DEPOSITS

D.L. Roberts
Council for Geoscience, Bellville
G.A. Botha
Council for Geoscience, Pietermaritzburg
R.R. Maud
School of Geological Sciences, University of KwaZulu-Natal, Durban
J. Pether
De Beers Marine Limited, Cape Town
Present address: P.O. Box 48318, Kommetjie, 7976

INTRODUCTION

Cenozoic deposits of littoral marine, estuarine, fluvial, lacustrine and aeolian origin are developed extensively along the coastal plains of the southern African subcontinent. These deposits are thin overall, due to the buoyancy of this passive coastline over the past 60 million years and the erosional events triggered by at least two pulses of epeirogenic uplift (Partridge and Maud, 1987). In contrast, thick Cenozoic deposits have accumulated offshore in extensional rift basins and as sediment cones at major river mouths (Dingle *et al.*, 1983).

The onshore Cenozoic strata are irregularly distributed around the coastline of the subcontinent (Fig. 1). They overlie a broad coastal plain in southern Mozambique and northern KwaZulu-Natal, with a maximum width of some 60 km, which constricts progressively southwards to Mtunzini. From this locality southwards to Port Edward, Cenozoic deposits are compressed into a narrow belt. Further southwestward, occurrences are sporadic along a lengthy segment of coastline including the "Wild Coast" and as far as the Algoa Bay seaboard. Here, river incision and steep coastal cliffs of pre-Cenozoic strata have interrupted the continuity of dune cordons and inhibited marine incursions. From Algoa Bay to Hermanus, Cenozoic strata are well developed on broad coastal plains, with the exception of the coast east of Plettenberg Bay where high coastal cliffs are again in evidence. Along the west coast, Cenozoic deposits are persistently developed in a narrow corridor from False Bay to the Orange River. They are economically important, bearing diamonds, heavy minerals and phosphate.

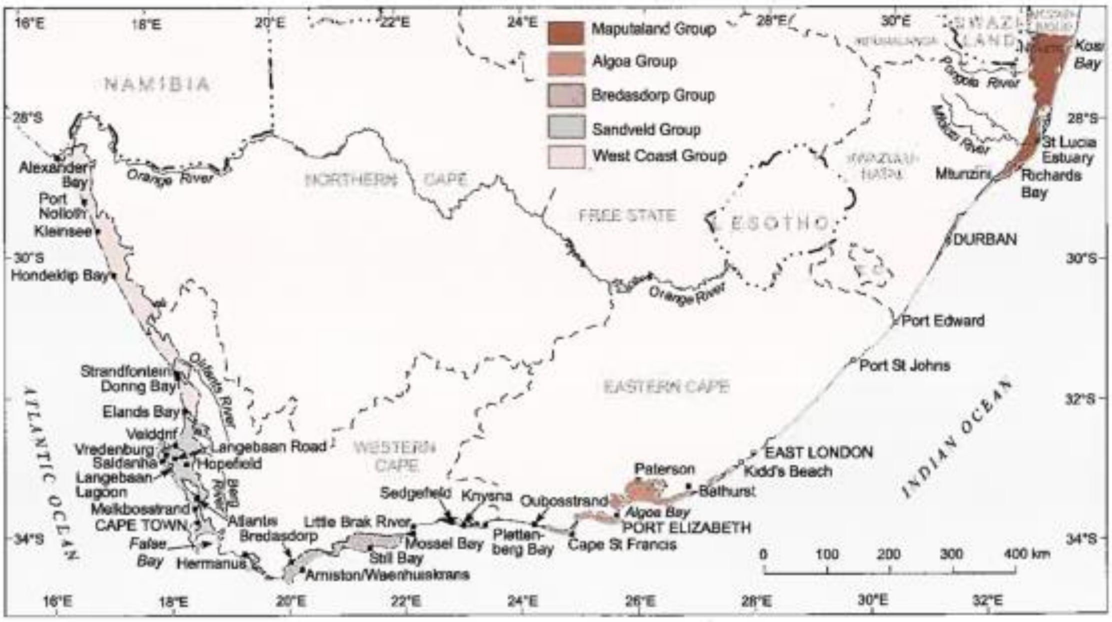
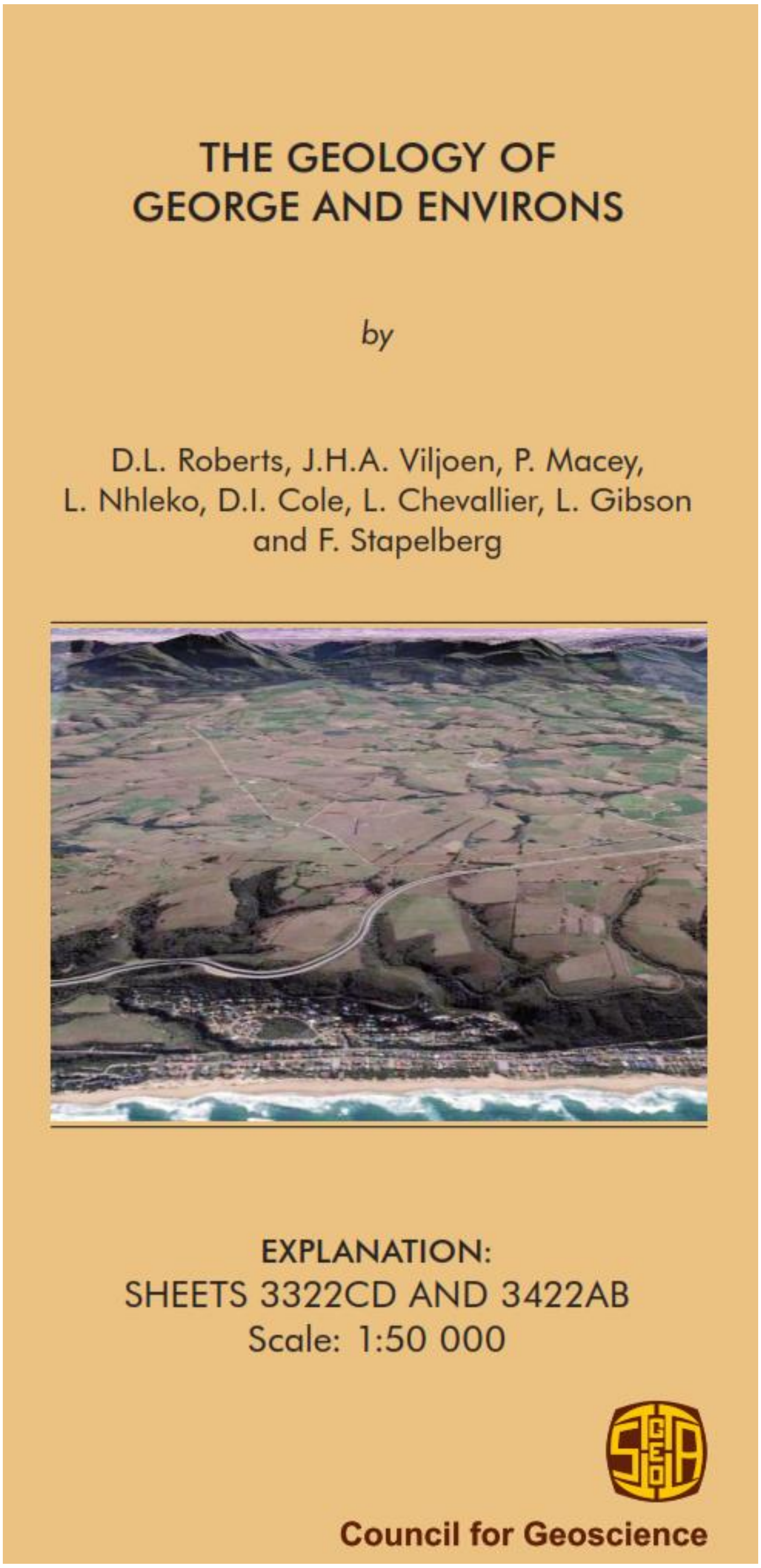


Fig. 1 Distribution of coastal Cenozoic sediments in South Africa.



THE GEOLOGY OF GEORGE AND ENVIRONS

by

D.L. Roberts, J.H.A. Viljoen, P. Macey,
L. Nhleko, D.I. Cole, L. Chevallier, L. Gibson
and F. Stapelberg

EXPLANATION:
SHEETS 3322CD AND 3422AB
Scale: 1:50 000

Council for Geoscience

2008

Geological Society, London, Special Publications

Volume 11
1983

Table of Contents

Table of Contents (PDF)

Index by author

Front Matter

Geochemistry of weathering profile silcretes, southern Cape Province, South Africa

M. A. Summerfield

SUMMARY: Silcrete of Cenozoic age associated with deep weathering profiles occurs on residual surfaces along the coastal belt of southern Cape Province. Petrographic and geochemical evidence indicates loss of aluminium and enrichment of silica and titanium during silcrete formation. Silica released locally within the weathering profile was apparently precipitated in a zone of restricted drainage close to the water-table where a low pH environment allowed the removal of aluminium and the migration and concentration of titanium. Silcrete formation probably occurred in a humid tropical or subtropical environment with minimal local relief.

The numerous reports of silcrete now available in the literature indicate the wide range of sedimentological and environmental settings with which it is associated (Langford-Smith 1978; Summerfield 1983). Work in southern Africa and north-west Europe has indicated that silcretes associated with kaolinitic weathering profiles possess a typical suite of petrographic and geochemical characteristics, including authigenic glaebules (Brewer 1964, pp. 259–60), colloform features and relatively high concentrations of TiO_2 ($>0.2\%$), which are not present in non-weathering profile occurrences (Summerfield 1978, 1979, 1982).

In southern Africa, non-weathering profile silcretes, including silicified sands, pan sediments, calcrete and bedrock, occur predominantly in the Kalahari Basin in Botswana, northern Cape Province and eastern Namibia (Summerfield, 1982). This paper describes the weathering profile silcretes of southern Africa, which are confined to a relatively narrow coastal belt (Cape coastal zone) extending from the Oliphants River valley in the west to the Transkei in the east (Fig. 1). A limited number of non-weathering profile silcretes also occur within this area but these are considered elsewhere (Summerfield 1981). There have been a number of previous studies of silcrete in the Cape coastal zone, but none of these have provided detailed geochemical data on associated weathering profile materials (Bosazza 1936, 1939; Frankel 1952; Frankel & Kent 1938; Mountain 1946, 1951). Moreover, the interpretations of silica geochemistry in these studies were based on earlier erroneous notions about the nature and behaviour of silica in earth surface environments (Summerfield 1981). A more recent preliminary investigation of a number of occurrences by Smale (1973) also appears to have been influenced in its genetic interpretations by the earlier ideas of Frankel & Kent (1938), who emphasized the role of capillary rise and the presence of percolating soil waters containing NaCl in the formation of silcrete.

As with most silcrete occurrences, the age of the Cape coastal zone silcretes has only been estimated by uncertain stratigraphic correlation with fossiliferous deposits. On the basis of cor-

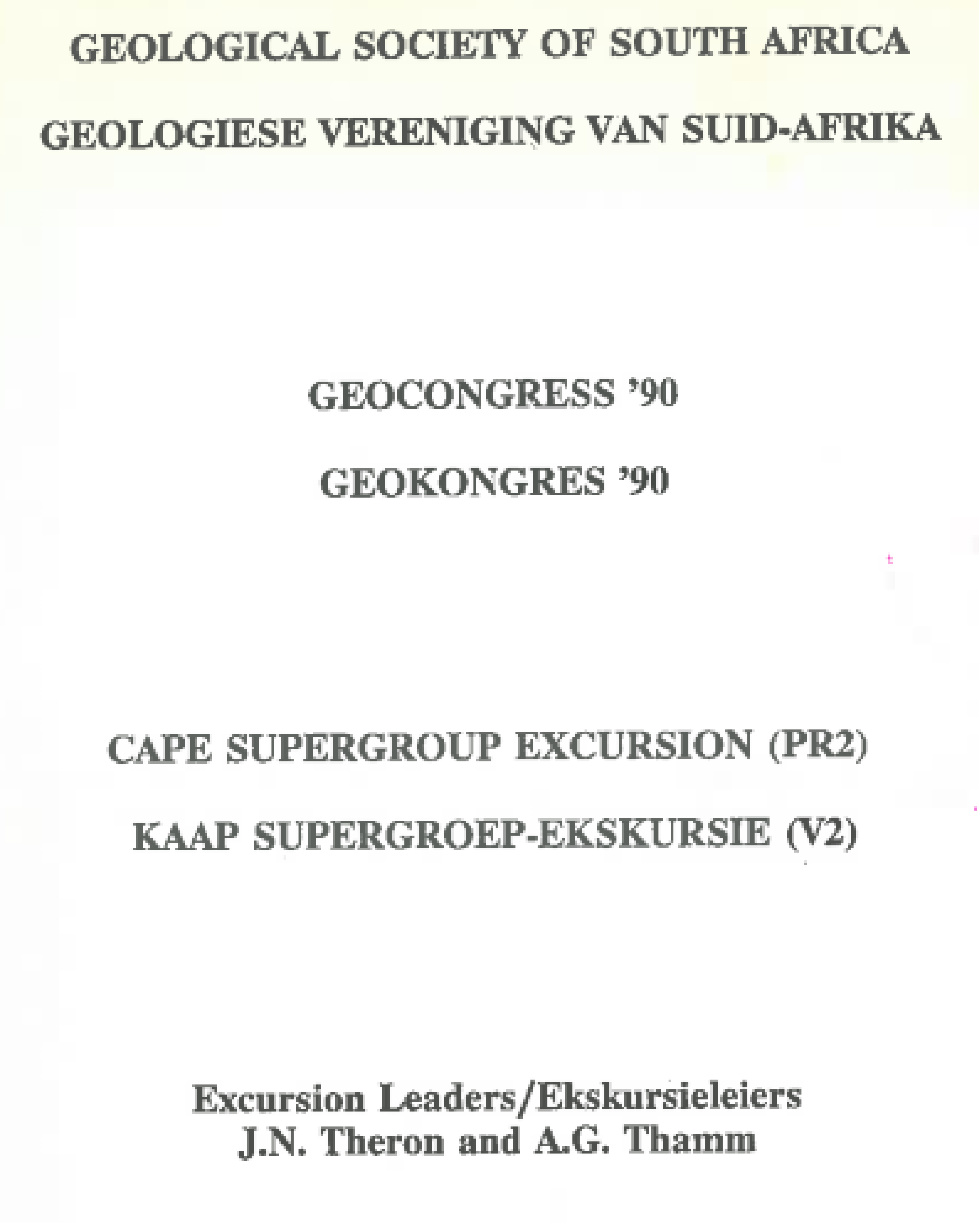
THE STRATIGRAPHY AND SEDIMENTATION OF THE BOKKEVELD GROUP

by J.N. THERON, M.Sc.

Thesis presented for the Degree of Doctor
of Science at the University of Stellenbosch.

PROMOTORS : PROFESSOR P.G. SÖHNGE
DR. J.F. TRUSWELL

Submitted March 1972.



GEOLOGICAL SOCIETY OF SOUTH AFRICA

GEOLOGIESE VERENIGING VAN SUID-AFRIKA

GEOCONGRESS '90

GEOKONGRES '90

CAPE SUPERGROUP EXCURSION (PR2)

KAAP SUPERGROEP-EKSKURSIE (V2)

Excursion Leaders/Ekskursieleiers
J.N. Theron and A.G. Thamm

Journal of Archaeological Science: Reports xxx (2016) xxx-xxx

Contents lists available at ScienceDirect

Journal of Archaeological Science: Reports

journal homepage: www.elsevier.com

ELSEVIER

Silcretes: Insights into the occurrences and formation of materials sourced for stone tool making

Médard Thiry[a], [*], Anthony Milnes[b]

[a] *MINES ParisTech, PSL Research University, Centre de Géosciences, 35 rue St Honoré, 77300 Fontainebleau, France*
[b] *Department of Earth Sciences, The University of Adelaide, South Australia 5005, Australia*

ARTICLE INFO

Article history:
Received 9 February 2016
Received in revised form 30 July 2016
Accepted 16 August 2016
Available online xxx

Keywords:
Silicification
Silcrete
Petrography
Mineralogy
Landscapes
Prehistoric tools

ABSTRACT

Silcretes are clearly observed and abundant as components of paleolandscapes on several continents. Mechanisms for the formation of several varieties of silcrete, with specific relationships to paleolandscapes, are described. Each type of silcrete displays particular morphological features in its profile in the paleo-regolith, and these features provide pointers to its origin via mechanisms of *absolute* or *relative* accumulation of silica in specific environments relating to groundwater or soil-water hydrology. The characters of silcrete varieties that may have triggered the interest of prehistoric peoples to exploit them for manufacturing stone tools, and which control knappability, include granulometry and the specific nature of silica cements. The successions of silica precipitation and recrystallisation events are clearly evident as a complex of micromorphological features that provide clues to the hydrological environment and its geochemistry at the time or times of silicification. Examples are given of the distribution of different silcrete facies, which could have had differing values for exploitation for stone tool production, in modern-day landscapes in France and Australia.

1. Introduction

There is a wealth of literature on silcretes in both the geological sciences and the archaeological sciences. In geology it ranges from initial compilations of knowledge like that edited by Langford-Smith (1978) to the comprehensive overview of Nash and Ullyott (2007). In archaeology in Australia the studies described by Holdaway and Fanning (2014) also provide a review of current knowledge and a foundation for future research. The science pertaining to silcretes has actually advanced in parallel in both scientific fields with only limited cross-reference, except perhaps for the work of Webb and his colleagues (Webb and Domanski, 2008). In geology the early work focussed on field observations and relationships, and progressed to petrographic and mineralogical studies, from which hypotheses were generated about origin and palaeoenvironmental conditions. From our geological perspective, some studies of stone tools in archaeological science had a 'primitive' view of silcrete, such as that expressed in Mulvaney & Kamminga (1999, p 213), but others developed a sophisticated understanding of the rock mechanical properties of silcrete and other siliceous materials (Domanski et al., 1994), and some also used petrographic/micromorphological fabrics and textures (e.g. Summerfield, 1983) to characterize silcrete artefacts and proffer ideas about their provenance. But the connection with step-by-step advances in our understanding of the complex of processes and environmental conditions that have led to the formation of silcretes has not been maintained and the aim of this paper is to at least partly address this situation.

In the first instance, we should be clear about terminology. There are several definitions of the term 'silcrete' but we prefer something along the lines of that proposed by Eggleton (2001), namely;

> *Strongly silicified, indurated regolith, generally of low permeability, commonly having a conchoidal fracture with a vitreous lustre. Represents the complete or near-complete silicification of regolith by the transformation of precursor silica or silicates and/or the infilling of available voids, including fractures. On a macroscopic scale, some silcretes are dense and massive, but others may be nodular, columnar, blocky, or cellular with boxwork structure. On a microscopic scale, the fabric, mineralogy and composition of silcretes may reflect those of the parent material, but also indicate the changes experienced by, as well as the general environments of, silicification.*

The key component of the definition, from our perspective, is the phrase '*strongly indurated, silicified regolith*'. Thus, silica-rich secondary materials including flint, chert, agate, chalcedony, and precious and common opal are not silcretes, though there may be a spatial and temporal association with some forms of silcrete. Sandstone, quartzite and some forms of porcellanite and jasper (as defined, for example, in Gary et al., 1973) that have formed specifically as a result of secondary silicification of the regolith are silcretes, but those resulting from diagenetic alteration or metamorphism are not. Red-brown hardpans (Chartres, 1985; Wright, 1983) are not silcretes because they are generally not '*strongly indurated*' by silica.

---

[*] Corresponding author.
Email address: medard.thiry@mines-paristech.fr (M. Thiry)

http://dx.doi.org/10.1016/j.jasrep.2016.08.015
2352-409/© 2016 Published by Elsevier Ltd.

ELSEVIER

Quaternary Science Reviews

Volume 8, Issue 3, 1989, Pages 283-293

The Cenozoic history of the coastal landscape of the southern Cape province, South Africa: A review

R.N. Thwaites *, E.O. Jacobs

Show more

Recent advances in silcrete research and their implications for the origin and palaeoenvironmental significance of sarsens

J. Stewart Ullyott*, David J. Nash* and Paul A. Shaw†

ULLYOTT, J. S., NASH, D. J. & SHAW, P. A. 1998. Recent advances in silcrete research and their implications for the origin and palaeoenvironmental significance of sarsens. *Proceedings of the Geologists' Association*, **109**, 255–270. Sarsens and puddingstones have long been recognised as varieties of silcrete and were, until recently, considered to have formed under hot sub-tropical or tropical climates in tectonically stable, low relief landscapes during the early Palaeogene. This paper provides a summary of the major advances in silcrete research since the most recent review of sarsen development and focuses upon models of silcrete genesis derived from studies in France, Australia and the Kalahari region of southern Africa. These models include silcretes which formed within soil profiles by pedogenic processes (pedogenic silcretes), those which formed in zones of groundwater outflow or water table fluctuation in association with drainage-lines or in lacustrine settings (groundwater or drainage-line silcretes), and more complex cases where silcretes developed through the interaction of more than one set of processes through time (multiphase and intergrade silcretes). Each of these models is subsequently placed within a landscape context through consideration of a series of case studies. The implications of this recent research for the interpretation of UK sarsens and puddingstones are discussed. The importance of identifying the mode or modes of origin of any silicified remnant materials before drawing any conclusions concerning their age, extent and possible palaeoenvironmental significance is stressed.

* *Earth and Environmental Science Research Unit, University of Brighton, Cockcroft Building, Lewes Road, Brighton BN2 4GJ.*
† *Department of Environmental Science, University of Luton, Park Square, Luton LU1 3JU.*

1. INTRODUCTION

There has been a long tradition of interest in sarsens and puddingstones amongst members of the Geologists' Association and this has persisted to the present day (e.g. Robinson, 1994). This paper is partially inspired by a recent article by John Hepworth (1997, *Geologists' Association Circular*, **922**) which resurrected the debate on the relationship between sarsens and puddingstones and other silcretes elsewhere in the world, and their role in landscape evolution in the southern UK. This contribution also reflects continuing silcrete research currently being undertaken by the authors on both sarsens in the UK and silcretes in southern Africa.

The term sarsen is now well established in the UK geological literature, to describe displaced siliceous boulders consisting of silica-cemented sands which occur on the chalklands and on various Cenozoic formations in southern England (Summerfield, 1979). It is generally accepted that puddingstones, consisting of silica-cemented rounded or angular pebbles/cobbles, are the conglomeratic equivalent of sarsens (e.g. Sherlock & Pocock, 1924; Davies & Baines, 1953; Summerfield, 1979; Summerfield & Goudie, 1980). It has been established for some time that sarsens and puddingstones are fragments of silcrete duricrusts and, as such, they are potentially analogous to silcretes occurring elsewhere in the world (Kerr, 1955; Summerfield, 1979; Summerfield & Goudie, 1980). This assumption has formed the basis of the majority of studies and is the premise upon which this paper is founded.

Although the literature on sarsens and puddingstones is plentiful, there is comparatively little detailed work concerning their petrology or micromorphological variability (Whalley & Chartres, 1976). The more influential work has concentrated on their distribution (e.g. Boswell, 1916; Davies & Baines, 1953; Bowen & Smith, 1977); on geomorphological aspects (Clark, Lewin & Small, 1967; Williams, 1968; Small, Clark & Lewin, 1970; Small, 1980) or on reconnaissance sampling from a number of often widely separated sites (e.g. Summerfield & Goudie, 1980; Summerfield & Whalley, 1980). While this gives some idea of what is present, there have been no in-depth studies of the type which has allowed detailed interpretation of the genesis and significance of silcretes in some other parts of the world.

The seminal work of Summerfield & Goudie (1980) assessed silcrete research up to the 1980s and its bearing on the questions of sarsen origin and palaeoenvironmental interpretation. Since then silcrete research has advanced considerably and, although comparatively little has been published on UK sarsens, much work has been done in other parts of the world, particularly the Paris Basin, Australia and southern Africa. This paper aims to provide a brief review of the major advances in silcrete research since Summerfield & Goudie (1980) and assess the possible

Proceedings of the Geologists' Association, **109**, 255–270.