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Z2. Geology

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

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

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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

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-

1987

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

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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

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LITHOSTRATIGRAPHY OF THE WAENHUISKRANS FORMATION (BREDASDORP GROUP)

J. A. Malan

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LITHOSTRATIGRAPHY OF THE DE HOOPVLEI FORMATION (BREDASDORP GROUP)

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LITHOSTRATIGRAPHY OF THE KLEIN BRAK FORMATION (BREDASDORP GROUP)

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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.

* Not yet approved by SACS

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.

SOUTHERN CAPE GEOLOGY: EVOLUTION OF A RIFTED MARIN

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

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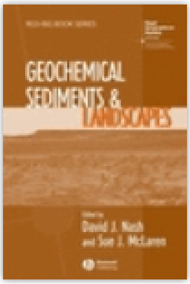

Geochemical Sediments and Landscapes

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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).

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

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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.

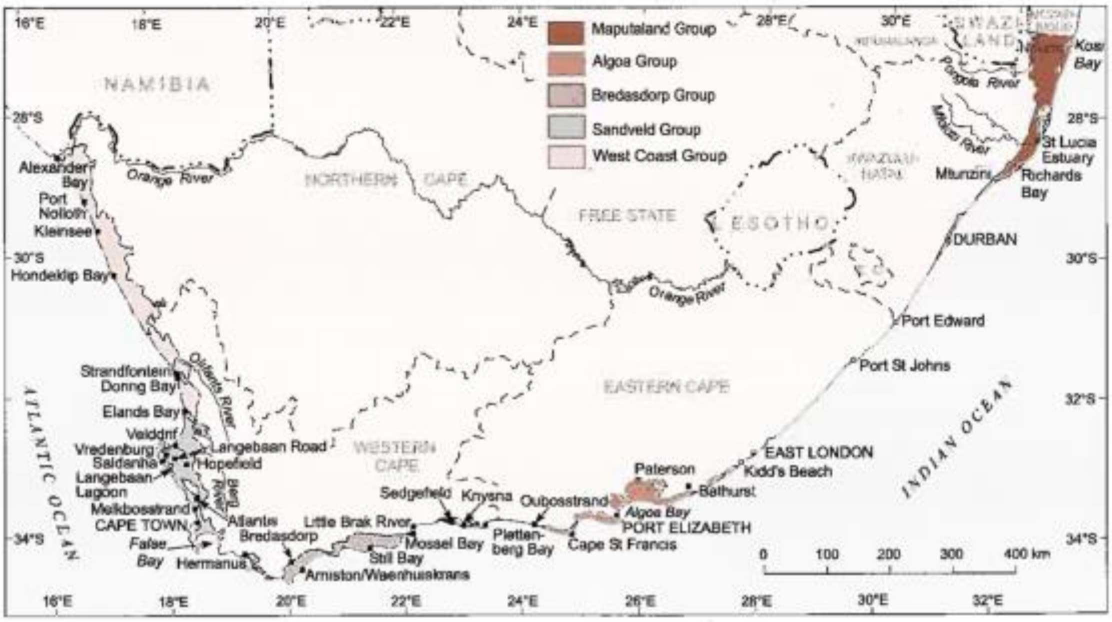

Fig. 1 *Distribution of coastal Cenozoic sediments in South Africa.*

Geological Society, London, Special Publications

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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

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