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A LATE QUATERNARY LAKE IN THE CENTRAL NAMIB DESERT, SOUTHERN AFRICA, AND SOME IMPLICATIONS

M. J. SELBY¹, C. H. HENDY¹ and MARY K. SEELY²

¹ School of Science, University of Waikato, Private Bag, Hamilton (New Zealand)

² Namib Desert Research Station, P.O. Box 953, Walvis Bay 9190 (South West Africa)

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Narabeb.
carbonates

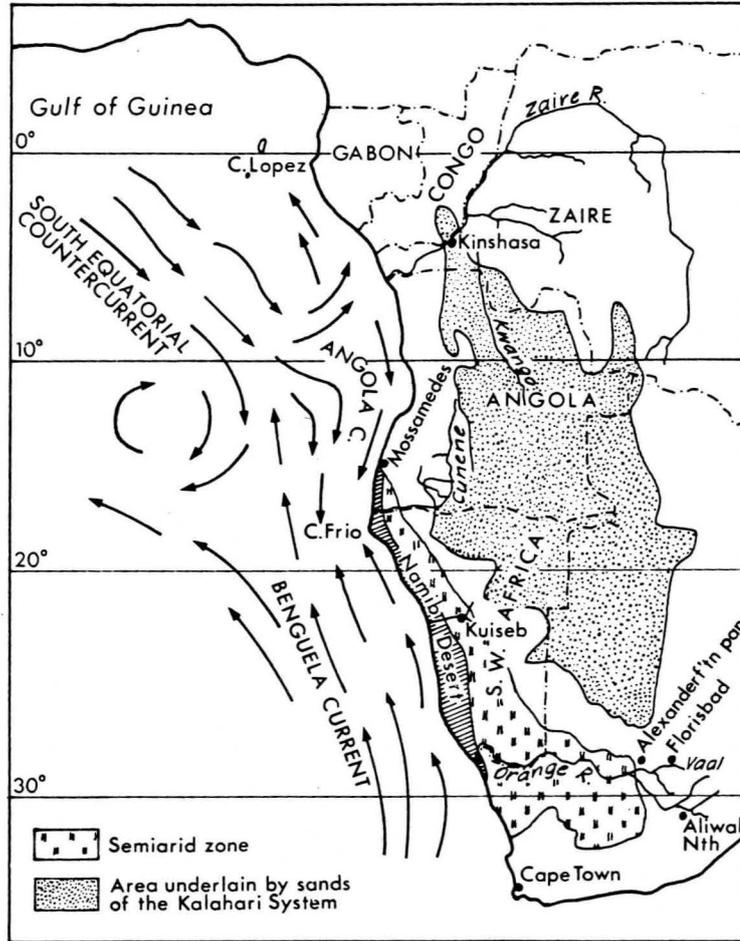
ABSTRACT

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Lake bed carbonates from Narabeb in the central Namib Desert have been dated by the ²³⁴U/²³⁰Th method at between 210 000 and 240 000 years. Their survival on the ground surface implies that the climate has been arid since this time, and this is interpreted as confirming the hypothesis that the Benguela Current has maintained its influence over the climate of this area throughout the last two glacials.

INTRODUCTION

Late Quaternary climatic reconstructions for southwestern Africa have, until now, depended largely upon the implications of evidence derived from areas outside the Namib Desert — especially from the southwestern Cape, the Vaal Valley and other headwater regions of the Orange River, and from northern Angola (Fig.1). This evidence has been reviewed by Van Zinderen Bakker and Butzer (1973) and by Van Zinderen Bakker (1976). The evidence from continental areas is interpreted as indicating that in glacial times the Benguela Current, which largely controls the arid climate of southwestern Africa, had a greater vigour and an even more aridifying effect upon the coastal regions than it had in interglacial times. It is also hypothesised that the area of upwelling of Antarctic Intermediate Water which forms the Benguela Current is extended northwards into the Angola Basin in glacial periods, and this hypothesis seems to be substantiated by studies of ocean sediment cores from the eastern Equatorial Atlantic Ocean (Gardner and Hays, 1976). Thus the observations of De Ploey (1965) that arid conditions, as indicated by actively wind-blown sand of the Kalahari System, were extended in late Glacial times to the Kwango Valley, and as far north as Kinshasa and the lower reaches of the Zaire River, are probably explained by the observed expansion of the Benguela Current.



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Fig.1. Locations from which evidence of climatic change in southern Africa has been obtained: the arid areas and the Benguela Current.

Namib - arid for last 200 000 yrs

It is less clear, however, what happened in the southern and central Namib Desert during the period of northward extension of arid conditions, for the limit of winter rainfall may also have migrated northwards into the Namib. We present here evidence that, although there have been minor local and brief increases of rainfall in the central Namib, in the last 200 000 years there has been no major wet period and that the central Namib has remained arid and under the influence of the Benguela Current in that time.

THE NAMIB DESERT

The Namib Desert extends from the Olifants River in the south to just north of Mossamedes in Angola, and from the Atlantic coast eastwards to the foot of the Great Escarpment, generally a distance of about 80 to 140 km.

The central Namib is crossed by the incised valley of the Kuiseb River which becomes progressively less entrenched away from the Escarpment. Flow occurs in the upper Kuiseb Valley every year and reaches as far as Gobabeb nearly every year but it reaches the sea, on average, only once in about eight or nine years (Stengel, 1964). Also entering the central Namib is the Tsondab River which now terminates in Tsondab Vlei, although fluvial gravels forming the main desert surface seawards of Tsondab Vlei suggest that the river once reached the coast.

Kuiseb

The rainfall of the central Namib is very slight, with an annual average at the coast of about 15 mm: it increases inland, being about 23 mm near Gobabeb (Schulze, 1969).

The southern Namib is a dune desert with high and very long dune ridges extending northwards over a largely gravel plain. With the exceptions of a few minor dunes near the coast, the dune ridges terminate at the Kuiseb Canyon. North of the Kuiseb the desert surface is a rocky plain upon which there are exposed extensive sheets of calcrete which vary in thickness from 1 to 30 m. As calcrete requires an annual precipitation of 350–400 mm for its formation (Goudie, 1973) it appears that the climate has been considerably wetter for an extended period(s) at some time in the past, but the age of these calcrete deposits is unknown.

CARBONATES FROM LAKE BEDS AT NARABEB

At Narabeb in the dune field of the Namib Desert about 47 km inland from the Atlantic coast and 20 km south of the Kuiseb River bed, at $23^{\circ}41'S$ and $14^{\circ}47'E$, is an interdune area with calcium carbonate precipitates marking the shoreline and bed of a former shallow lake (Fig.2). The lake had

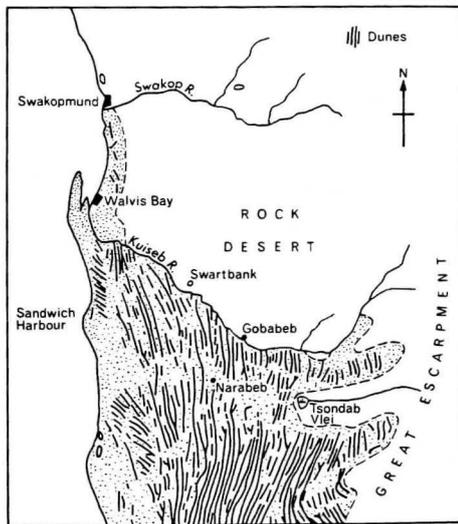


Fig.2. Location of sites in the central Namib.

average dimensions of about 0.5 and 2 km, with a depth of less than 1m. Around the perimeter of the lake there occur scrapers and other human artifacts. The presence of a lake in an area now extremely arid implies greater rainfall at some time in the past.

Three samples of the lake carbonates have been analysed by the $^{234}\text{U}/^{230}\text{Th}$ method. The carbonate samples were dissolved in nitric acid and equilibrated with a spike of ^{232}U in radiometric equilibrium with ^{228}Th . U and Th fractions were isolated and recovered from the solution. The purified U and Th fractions were solvent extracted using TTA in benzene and evaporated on to stainless steel planchettes oxidised in a propane/air flame, and counted for 24 h using 450-mm² surface barrier detectors and 256 channel analysers. Corrections to the spectra for background, tail contribution, the contribution of ^{226}Ra to the ^{230}Th peak, and ^{232}Th derived ^{228}Th have been made. The undissolved fraction of the original sample was weighed and dried to determine the percent carbonate. Data are presented in Table I.

TABLE I

 $^{234}\text{U}/^{230}\text{Th}$ ages of Namib Desert lake carbonates

Sample No.:	76-68	76-80	76-81
%CaCO ₃ :	68	44	69
ppm U:	4.7	6.1	4.0
$^{234}\text{U}/^{238}\text{U}$	1.76	1.95	1.76
σ	0.03	0.07	0.04
$^{230}\text{Th}/^{234}\text{U}$	1.029	0.960	1.25
σ	0.041	0.025	0.06
$^{232}\text{Th}/^{234}\text{U}$	0.14	0.13	0.09
σ	0.01	0.005	0.03
Age	260 000	210 000	excess
σ	25 000	15 000	—

σ denotes standard deviation.

One sample contained excess thorium. The other two samples contained some ^{232}Th which indicates that some ^{230}Th may have been present at the time of formation, thus making the $^{234}\text{U}/^{230}\text{Th}$ ages too old. The results of two analyses show that there is a 95% chance that the age lies between 210 000 and 240 000 years.

CONCLUSIONS

The lake at Narabeb was shallow and presumably did not persist for many

carbonate
210 - 240 000 yrs old

years. Its existence does, however, imply either an extraordinary storm event or, more probably, a period of considerably increased rainfall. Similar lake-bed deposits exist east of Narabeb close to the escarpment forming the eastern boundary of the Namib: ages for these beds may indicate the frequency of late Pleistocene "pluvial" events in the area. The survival of the lake beds indicates that long-term aridity is a characteristic of the central Namib Desert and that there have been no major widespread or prolonged pluvial periods in the last 200 000 years. This interpretation provides general support for the hypothesis that the Benguela Current has existed without diminution through at least the last two glacials of temperate latitudes. It also suggests that if the Benguela Current was forced northwards in full glacial times its southern limit was still south of the central Namib.

Because the lake at Narabeb lies across the gravel sheet extending seawards from Tsondab Vlei, and directly in the path of any outflow from the Vlei, it indicates that the Tsondab River has not reached as far west as Narabeb since the lake was formed. This confirms the indications of aridity throughout the last 200 000 years.

The artifacts lying on the surface of the Narabeb lake beds are necessarily of the same age as, or younger, than the lake, but because they are not embedded in the carbonate deposits they are not unequivocally dated by the lake beds, although it seems most probable that they are of the same age.

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