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Note: Cretaceous synvolcanic conglomerates on the coastal margin of Namibia related to the break-up of West Gondwana

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Introduction

There have been no previous reports of synvolcanic sediments exposed onshore of the southwestern coast of Africa. However, a sequence of conglomeratic sediments containing basaltic clasts, derived from the Etendeka volcanic rocks, is exposed underneath the Etendeka Formation lavas near Albin beacon (Fig. 1). Previously these sediments were recorded as being of Triassic age (Miller, 1983), but the presence of the basaltic clasts suggests a younger, probable Cretaceous age. This paper describes these rudaceous and sandy rocks from the Albin area which are here interpreted as representing early rift deposits associated with the break -up of West Gondwana.

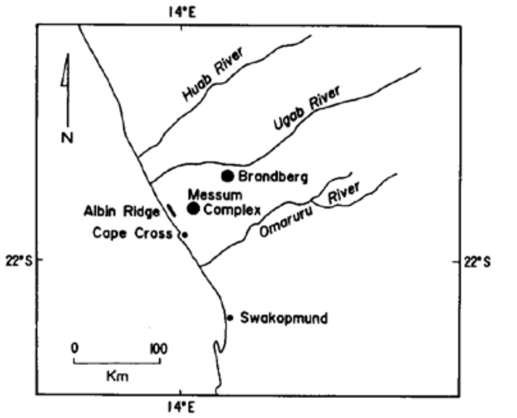

Figure 1: Map of the northern West Coast Recreation area showing the locality of the Albin sediments and lavas as well as other major physiographic features of the area

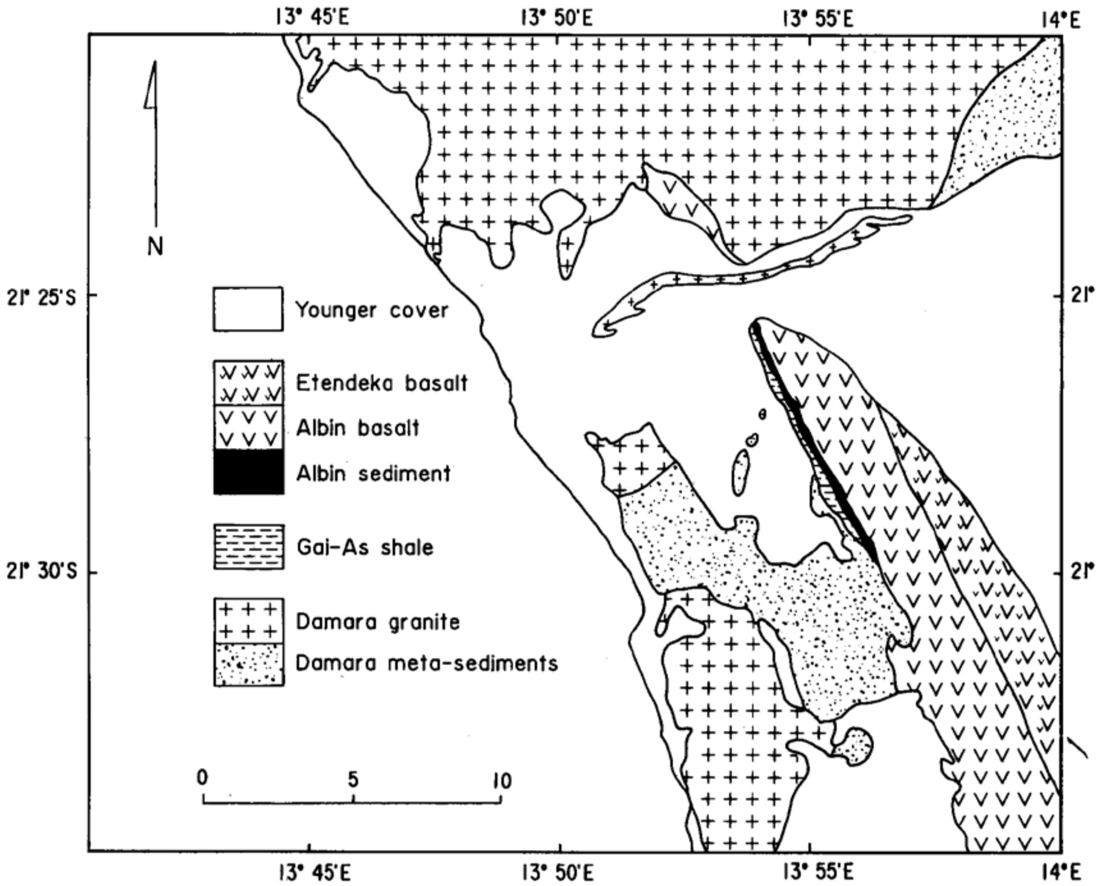

Figure 2: Geological map of the Albin area (modified from the 1:250 000 geological map of Cape Cross, 1983)

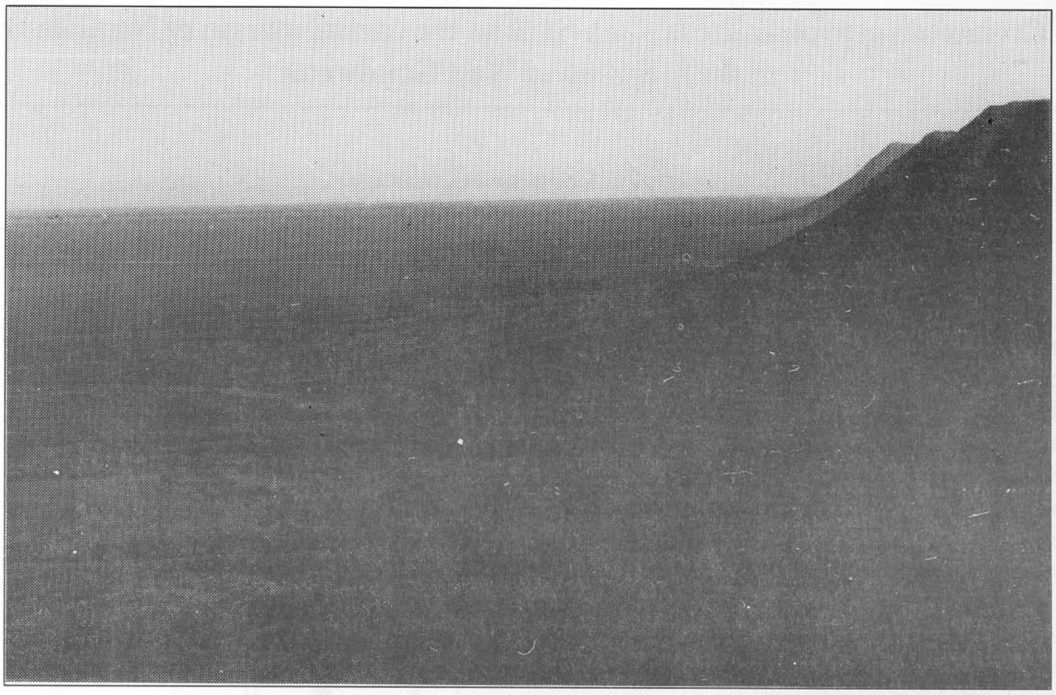

Figure 3: View looking north of the Albin ridge where the conglomerates crop out with the coastal plain developed in the west. The dip of the sequence here is east (right of photograph) and there are no other known exposures of the conglomerates in this area

Description

The conglomerates occur in a narrow 10 km-long belt immediately underlying the Albin lavas (Figs 2 and 3), which are a somewhat more mafic variant of the Tafelberg basaltic magma type of the Etendeka Formation (Erlank *et al*., 1984). The volcanic rocks are strongly altered (Erlank *et al.*, 1984). The sequence dips eastwards at about 25-30° as a result of listric faulting related to break-up. The sediments are intimately intruded by dolerites of the Horing Bay and Tafelberg magma types of Erlank *et al.* (1984) and calcite veining is locally common.

The thickness of the conglomerates varies from about

Figure 4: A palaeosol (shown between heavy lines in the photograph) occurs at the contact between the Permian Gai-as Formation and the conglomerates. The palaeosol consists of brick red calcareous nodules

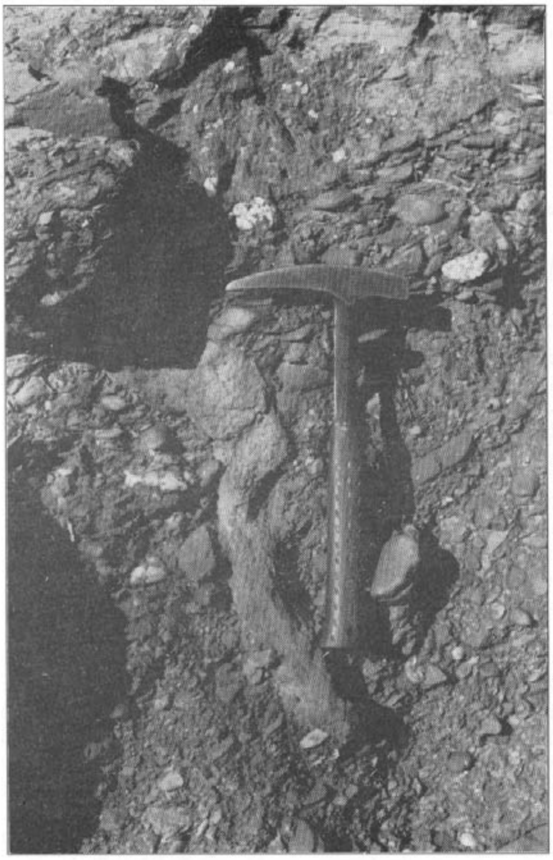

Figure 5: Sandstone dyke in conglomerate underlying sediments similar in composition to the Etjo Sandstone. The coarse grain size of the conglomerates contrasts sharply with the medium grain size of the dyke and of the overlying material, which also contains isolated pebbles of milky quartz

10 to 60 m. In the northern part of the outcrop area they directly overlie red beds which have a palaeosol developed at the contact (Fig. 4). These red mudstones are possible equivalents of the Permian Gai-as Formation which crops out in the Huab basin. In the south they rest directly upon folded meta-greywackes and schists of the Neo-Proterozoic Damara Sequence.

Near the top of the sequence, interbedded beds which have a texture and mineralogy similar to the fluvial facies of the Etjo Sandstone Formation occur sporadically. These beds comprise well-sorted and rounded sands containing feldspar and quartz. In places there are larger pebbles of vein quartz up to 3 cm in diameter (Fig. 5). Sandstone dykes penetrating down into the underlying conglomerate are associated with these sands (Fig. 5).

In the south, bedding is better developed in the conglomerates than in the north. An imbrication and a horizontal orientation of clasts are occasionally developed but neither is common. Maximum clast size is 70 cm and the conglomerate is both matrix- and clast-supported. Clasts dominantly consist of material derived from the Damara Sequence with metagreywacke clasts being most abundant. Quartz vein material, granitic and schist clasts also occur, as do clasts of Karoo sandstones and basalt (Fig. 6). Rounding is poor in the schist clasts, but the other clast types are generally well rounded. No systematic variation in clast size was observed from north to south. Individual beds in the south are normally graded.

Figure 6 (below): Large basaltic clasts up to 0.5 m in long dimension comprise up to 5% of the clast population. A large clast occurs in the centre of this photograph and two other smaller ones are arrowed

The basalt clasts

Basaltic clasts are often amygdaloidal and vary in abundance from less than 1% to about 10% of the clast population. Maximum clast size observed was 50 cm. The clasts are highly altered and very little fresh material remains. The clasts occur sporadically from close to the base of the conglomerates to the top of the sequence.

Interpretation

The presence in the conglomerate of basaltic clasts which are petrographically similar to the overlying Etendeka volcanic rocks indicates that deposition of the conglomerate was coeval with the early stages of volcanism. This age is reinforced by the presence of sediments similar in texture and composition to the aeolian Etjo sandstone, which elsewhere underlies and is interbedded with the volcanics (Hodgson; 1972, Milner, 1988, Horsthemke *et al.*, 1990), indicating that deposition of the wind-blown sand was also contemporaneous with the early stages of volcanism.

A model for the deposition of the conglomerates and the sands contemporaneous with the eruption of the volcanic rocks is presented in Figure 7. Rifting and volcanism began over a rising mantle plume (cf. White and McKenzie, 1989) with early faulting and uplift exposing older sediments and granites of the Karoo and Damara Sequences to erosion. Subsequent deposition of this material occurred in an alluvial fan environment. Volcanism was not widespread during these early stages of continental break-up and although the lavas did provide material, the bulk of the clasts are derived from older Karoo sediments and Damara granites, greywackes, schists and quartz veins. During deposition of the conglomerate, sedimentation of the Etjo Formation continued, albeit on a reduced scale. The sandstone dykes developed in fissures which possibly formed during earthquake movements related to break-up. Similar sandstone dykes which underlie the sandstone cap of the Gamsberg were interpreted by Schalk (1984) and Martin (pers. comm., 1985) as being caused by earthquake movement. Ultimately the rift shoulder was swamped by the continental flood basalt volcanism of Etendeka age and sedimentation ceased. The most intense phase of volcanism has been dated as occurring between 130-135 Ma (Milner, 1992), and the intimate association of the conglomerates with the basal lavas suggests a similar age for these sediments.

Conclusions

Further north in the Kharu-gaiseb area conglomerates of possible Cretaceous age have been reported by Ward and Martin (1987). These deposits consist entirely of basaltic clasts which are interpreted to have been shed eastwards off a rift shoulder and clearly postdate the Etendeka volcanism. The conglomerates on the Albin ridge which were deposited in a proximal environment are the first described onshore synvolcanic sedimentary succession on the coastal margin of Namibia. Further seismic work inland of the Albin ridge may provide more information on the sediments.

Acknowledgements

The late Peter Betton, Julian Marsh and Simon Milner provided the initial field stimulus to look closer at these unusual sediments. John Ward gave positive and critical commentary on the first version of this note. Simon Milner gave belated but much needed criticism.

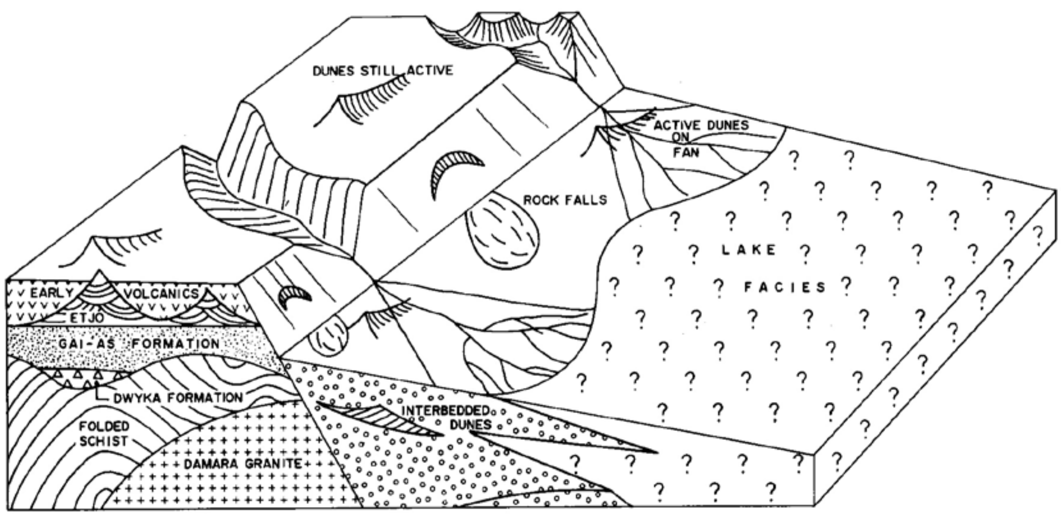

Figure 7: Diagram illustrating possible elements of the palaeogeography of the Albin area during deposition of the conglomerates. Volcanism and deposition of the conglomerates and the Etjo Formation were also contemporaneous. See text for full discussion

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