A Re-interpretation of the Numees-Nama Contact at Aussenkjer, South West Africa

by

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ABSTRACT

The boundary between the Numees Formation and the Nama System at the Orange River on the farm Aussenkjer 147 in South West Africa has been re-defined because previous interpretations were found to be incorrect.

Nama sediments overlie the Numees beds with an angular unconformity indicating a hiatus between the two successions. Another hiatus was found between the Kuibis Series and the Schwarzrand Series of the Nama System.

It is suggested that the Numees Formation be omitted from the Nama System.

INTRODUCTION

Pre-Karroo sedimentary formations with intercalations of glacial deposits overlie the metamorphic basement rocks on the farm Aussenkjer 147 on the east bank of the Orange River near the mouth of the Chamgab River.

Haughton and Frommurze (1936, p.20) mapped these beds as Numees and Nama with a faulted contact between the two, whereas De Villiers (1945, p.140) omitted this fault and described the sediments as a conformable sequence, with the glacial deposits representing a local development at the base of the Nama System. (Martin (1965, p.102) in turn regarded the basal part of the succession as belonging to the Numees Formation followed conformably by rocks of the Nama System. This last interpretation, together with field evidence from the Witputs area, led Martin to propose the inclusion of Numees as a series into the Nama System *(op cit.*, p.106).

The present authors mapped part of the farm Aussenkjer in August, 1970 (Figure 1), and found that Nama sediments overlie the Numees beds with an angular unconformity.

NUMEES FORMATION

The succession begins at the base with a layer of dark green to grey sediment crowded with subangular and rounded inclusions of gneiss, basic lava and quartzite, embedded in a quartzitic or siltstone matrix. This bed varies in thickness between 0,3 and 1,5 m and was deposited on a very irregular floor consisting of basic Marydale lavas and Vioolsdrif granite-gneiss.

No facetted or striated pebbles were found and the sheared basement floor shows no sign of striation. The basal Numees beds in the Richtersveld are composed of undoubted glacial deposits, but this is not conclusive proof that the Aussenkjer sediment is of glacial origin since it has repeatedly been emphasised that not all tillitic-looking rocks of the same approximate age in one region are glacial deposits (Frakes and Crowell, 1970). The term diamictite (Flint *et al.* 1960) is therefore used as it is non-committal as to genesis.

Overlying the basel Numees diamictite is an alternation of dark green to grey siltstone and gritty quartzite with thin intercalations of shale or phyllite. This sequence varies markedly in thickness. On the east bank of the Orange River it measures some 65 m, whereas only 900 m to the north-west along its strike, it is

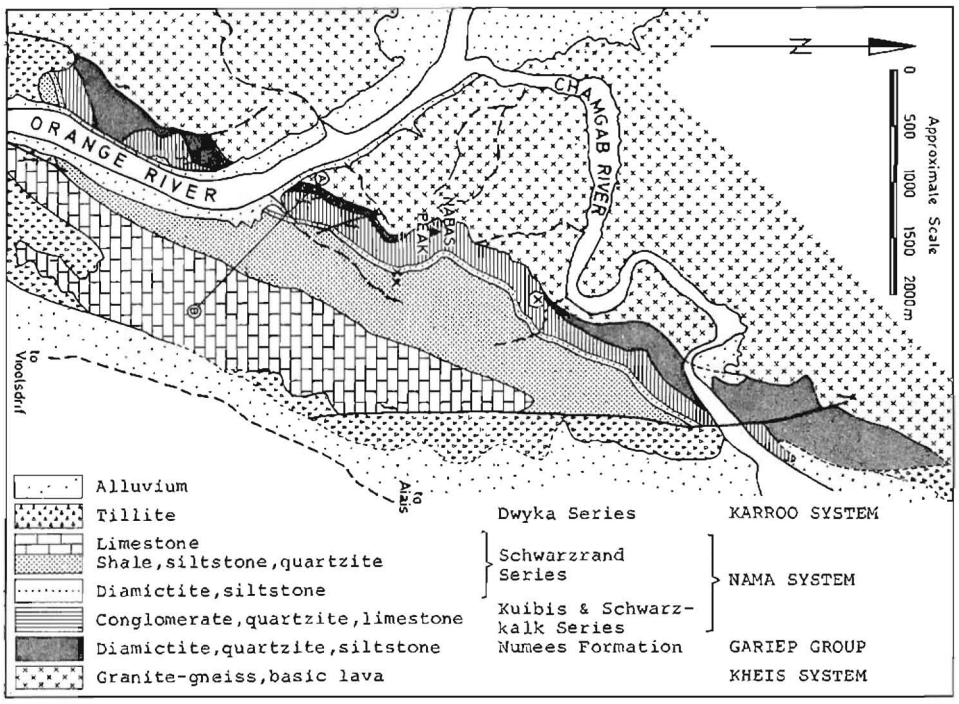

FIGURE 1

Geological sketch map of the area between the Orange and Chamgab Rivers on Aussenkjer, South West Africa. Line A-B refers to the cross-section of Figure 2.

cut off, together with the basal diamictite, by the Nama beds which then come to lie directly on the basement (Figure 1). Along the Chamgab River it again appears under the Nama, attaining a thickness of up to 170 m in places.

The alternation of siltstone and quartzite with thin bands of locally varved shales as observed at Aussenkjer is typical of the uppermost Numees Formation in the Witpüts-Sendelingsdrif area (Martin, 1965, p.102; McMillan, 1968, p.97), and the association of these sediments with a basal diamictite makes it almost certain that pre-Nama sediments along the Orange and Chamgab Rivers are a correlate of the Numees farther west. All previous workers in this area have applied the same correlation.

Following Martin (*op cit.*, p.101) it is suggested that the Aussenkjer Numees was deposited in one of the small shallow basins east of the main trough which were probably never connected with each other.

The Numees Formation follows conformably upon rocks of the late-Precambrian Gariep Group in the Richtersveld (Kröner, 1969) and in the Witpüts-Sendelingsdrif area (Kröner, in prep.). In both these areas there are striking lithological similarities between Gariep Group sediments and Numees strata, and it has been found that all Formations of the Gariep Group, including the Numees, have been deformed during a pre-Nama tectonic event.

NAMA SYSTEM

The sediments of this system overlie the Numees beds with a clearly visible angular unconformity on the east bank of the Orange River (Plate I(a)). This unconformity attains an angle of some 15 to 20 degrees in a small ravine south of Nabas Peak, where the Nama transgresses over the Numees on to the basement. At another locality near the Chamgab River (marked x in Figure 1), the angle of unconformity increases to 20 to 30 degrees whereas the most prominent unconformable contact is found on the south bank of the Chamgab River just after it enters its deeply incised course, where an angle of 74 degrees is formed between the strata of the Numees and the Nama beds.

The stratigraphy of the Nama System at Aussenkjer begins with a well-bedded gritty and partly conglomerate quartzite which, stratigraphically higher up, becomes progressively more cross-bedded and less gritty, containing only scattered small pebbles near the upper contact. The conglomeratic inclusions consist of angular to well-rounded pebbles of vein quartz which are characteristic of the basal beds of the Nama System throughout southern South West Africa. This sequence of quartzite is 44 m thick and is followed by 36 m of bluish-grey dolomitic limestone intercalated with thin layers of quartzite. The contact between the quartzite and the dolomitic limestone is gradational.

Another quartzite, 31 m thick, overlies the dolomitic limestone. This upper quartzite is similar to the lower quartzite in that it is gritty and feldspathic at the base and becomes more mature up the succession. The upper quartzite gradually passes upwards into a shale unit, approximately 6 m thick. The contact between the upper quartzite and the underlying dolomitic limestone is sharp.

This whole succession constitutes the Kuibis Series and the dolomitic limestone band within the above sequence has been traced over an extensive area in the south-west portion of South West Africa (Germs, 1968). De Villiers incorporated these Kuibis beds into his Nabas Series, where Martin assigned them to the Numees Formation.

The Kuibis Series is overlain by a bed of yellowish-brown or bluish Schwarzkalk limestone, up to 1 m thick, which is not generally found in the Aussenkjer sediments and which is not shown on Figure 1 because of its size. On this follows what De Villiers named a "limestone conglomerate" consisting of numerous boulders and pebbles of Schwarzkalk limestone in a calcareous to ferruginous, sandy matrix (Plate I(b)). This layer is variable in thickness and resembles the tillite described by Schwellnus (1941) from the Klein-Karas Mountains. Certain erosion forms on the uppermost Kuibis quartzite in the hills north-east of the Orange River (xx on Figure 1) appear to be similar to the glacial pavements of the Klein-Karas Mountains, but in the former area no striated surfaces have been found.

From recent fieldwork Germs (in prep.) has shown that the glacial valleys found in the Klein-Karas Mountains have cut through the basal Schwarzrand, the the Schwarzkalk, and part of the Upper Kuibis Series. The valleys reflect a period of glaciation which took place just after deposition of a prominent sandstone of the basal Schwarzrand Series. Evidence of this glaciation has also been found east of the Groot-Karas Mountains, near the Fish River Canyon, and in one locality north of Helmeringhausen.

The "limestone conglomerate" on the farm Aussenkjer occurs at the same

stratigraphic position as the tillite described by Schwellnus. Although no striated glacial pavements or pebbles have been found, it is suggested that the "conglomerate" can be correlated with the tillite in the basel Schwarzrand Series in the Klein-Karas Mountains. It follows that the "limestone conglomerate" can be regarded as a diamictite.

At the Orange River the basal Schwarzrand diamictite varies in thickness between 1,30 and 2,20 m and is followed by a bed of greenish-brown shaly siltstone, 2,30-3,00 m thick. This in turn is overlain by another diamictite which is 4,10-6,20 m thick and contains inclusions of limestone, gneiss and quartzite.

It is expedient to group the succession from the lower to the upper diamictite into a glacial stage of the Schwarzrand Series as the intervening siltstone is often absent. The total thickness of the glacial stage in the area between the Orange River and the Chamgab River is variable and ranges between 4 m and 12 m.

Following on the upper diamictite, are approximately 300 m of Schwarzkalk shales, siltstones and quartzites which are followed by more than 400 m of dark blue Schwarzrand limestone, named Huns Limestone by Martin (*op cit.*, p.109).

A schematic section through the whole Numees-Nama succession along the east bank of the Orange River is given in Figure 2.

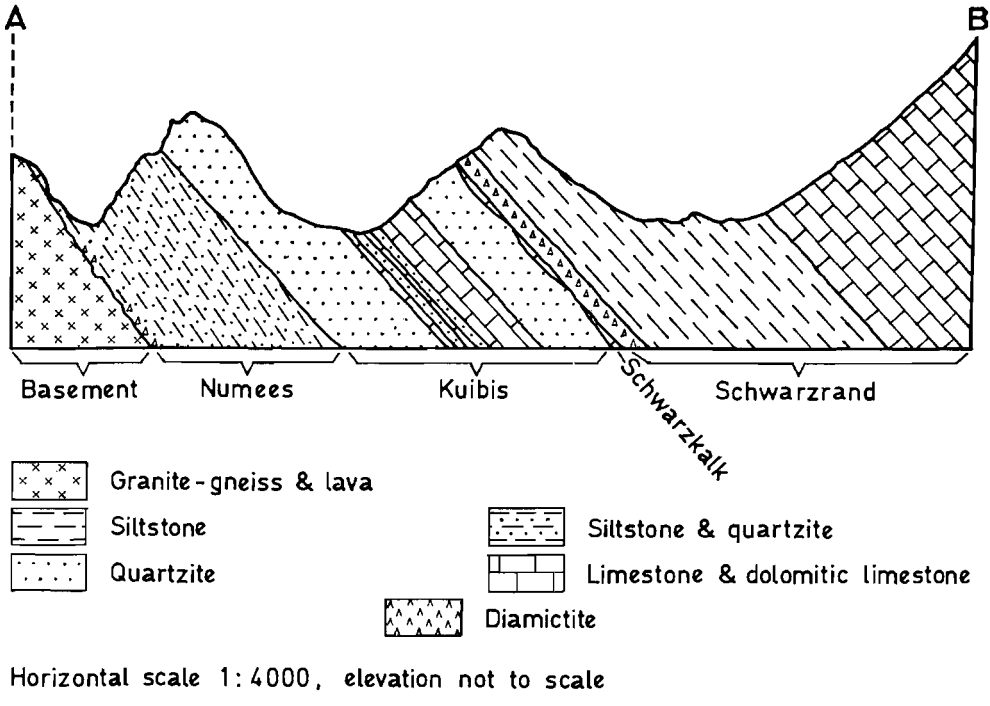

FIGURE 2

Schematic cross-section through the Numees-Nama succession along the Orange River on Aussenkjer.

RELATIONSHIP BETWEEN THE NUMEES FORMATION AND THE NAMA SYSTEM

The wedging out of the Numees sediments between Nabas Peak and the Orange River delineates the approximate boundary of a small basin into which Numees sediments were deposited. This basin crossed the Orange River in a south-south-westerly direction, as Numees beds have also been found under the Nama in the Richtersveld. Here they were mapped partly as Kuibis sediments by De Villiers (1945).

Another such basin is situated to the north-west of Nabas Peak where Numees diamictite and the quartzite-siltstone sequence appear again underneath the Kuibis quartzite and can be followed for more than 3,5 km to the north-north-east (Figure 1).

In a ravine near the Chamgab River (x on Figure 1) the unconformable relationship between Numees and Nama is well exposed. Here the field evidence suggests that the Numees beds were deposited into an erosional gully within the basement rocks and syn- to post-Numees shear movements in the Vioolsdrif granite-gneiss gave rise to slump folding in the sediments.

The Kuibis quartzite was then deposited on the already deformed older beds thus giving rise to a prominent angular unconformity. In the deeper part of this Numees-Nama basin, however, the relationship is often para-conformable and gives the impression of continuous sedimentation.

Both Numees and Nama beds were subjected to gentle post-Nama folding. Differential shear along vertical or sub-vertical surfaces within the basement complex was transmitted into the overlying cover rocks and gave rise to fold axes in the Numees and Nama sediments which are trending north-south to north-east/south-west. Post-Karroo faulting is evident at various localities.

The absolute age of both Numees and Nama is still not known. Felsic lavas in the Gariep sediments near Rosh Pinar yielded an age of 719 $\pm$28 My (De Villiers, 1968, p.34), whereas in the Richtersveld the Numees is truncated by the Kuboos Pluton which was dated at 550 My. The Numees beds are therefore between 719 and 550 My old. The Nama, on the other hand, is cut by the Bremen Pluton which, according to Martin (1965, p.113) may be of the same age as the Kuboos granite. Therefore an upper age limit of 500 My may be correct for the Nama System.

CONCLUSIONS

The Nama System overlies the Numees Formation with an angular unconformity at Aussenkjer, suggesting a hiatus between deposition of the two sedimentary units.

It is therefore suggested that the Numees beds be not incorporated into the Nama System as proposed by Martin (1965, p.106) and as shown on the Geological Map of South Africa, 1970 edition.

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PLATE I(a)

Low-angle unconformity between Numees siltstone and Kuibis quartzite (Nama System) on east bank of Orange River.

PLATE I(b)

Basal Schwarzrand diamictite with abundant inclusions of Schwarzkalk limestone. Note pencil in centre of photograph for scale. Locality: East bank of Orange River.