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A REAPPRAISAL OF THE GEOLOGY OF THE WESTERN MOZAAN BASIN

by

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ABSTRACT

In the Vryheid-Piet Retief area in the southeastern Transvaal the Mozaan Group is the upper, predominantly sedimentary, unit of the 3 000 m.y. old Pongola Supergroup. In this the type area, the Mozaan Group comprises a sequence of arenites and argillites with minor volcanics and has a gradational contact with the underlying Nsuze Group. The Mozaan Group is exposed in two open structural basins produced by interference between northwesterly and easterly fold trends. The succession locally displays evidence of low grade regional metamorphism and an axial cleavage is developed in areas of intense deformation. Contact aureoles are associated with mafic intrusives.

A revised stratigraphic column reveals that the Mozaan Group is approximately 3 000 m thick as compared with a previous estimate of 5 000 m. Regional stratigraphic and textural trends imply a northern provenance for the Vryheid-Piet Retief area which accords with palaeocurrent data.

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I. INTRODUCTION

The Pongola Supergroup is exposed in three main areas namely, Swaziland, the southeastern Transvaal and northern Natal (Fig. 1). The type area for the Pongola Sequence is located in the Vryheid-Piet Retief region where it comprises a lower, mainly volcanic, Nsuze Group, the latter overlain by the predominantly sedimentary Mozaan Group. An age of approximately 3 000 m.y. is indicated for the Pongola Supergroup by the sedimentary contact of the Mozaan Group with the ∿ 3 060 m.y. old Lochiel granite (Hunter, 1974) and the intrusion of the ∿ 2 870 m.y. old Usushwana Complex (Davies et al., 1970). This is also consistent with an age of ∿ 3 090 m.y. obtained from a Nsuze lava in the Nkandla district (Burger and Coertze, 1973).

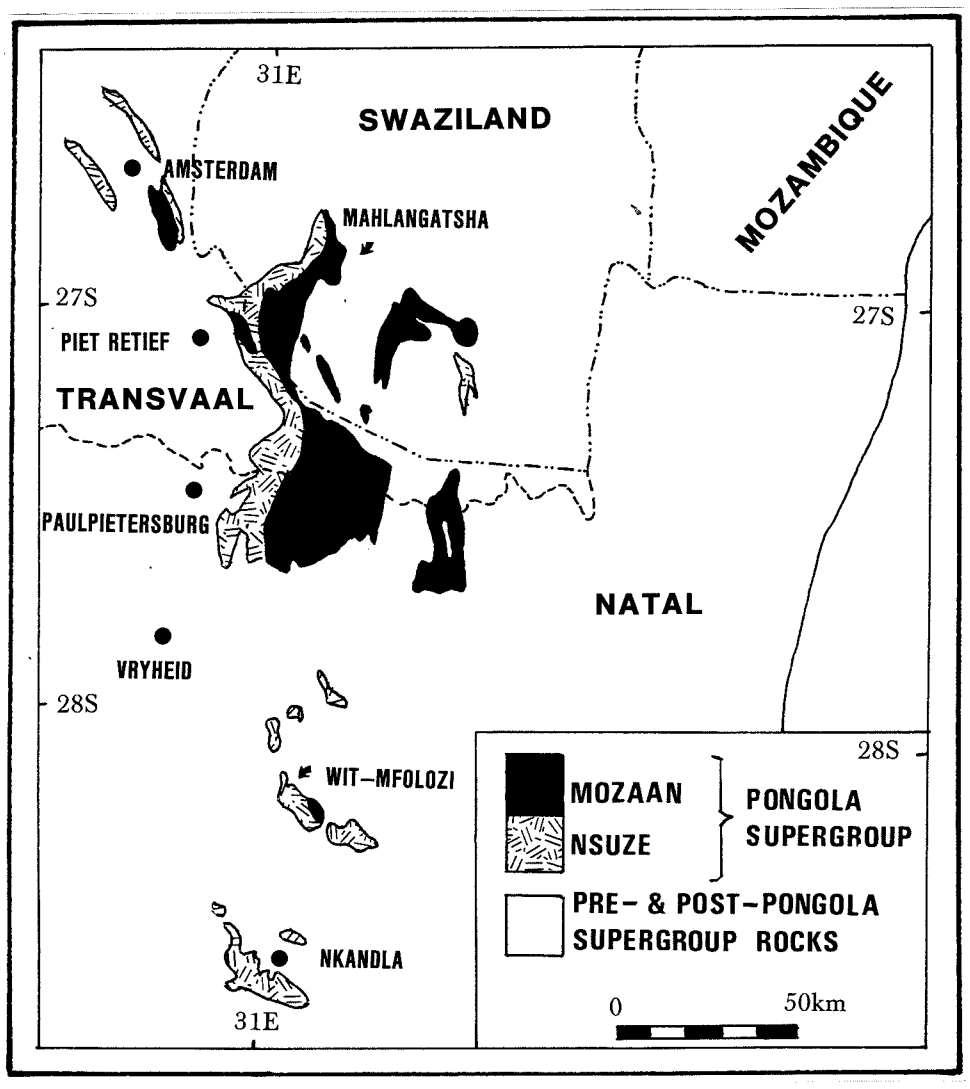


Figure 1 : Map showing the outcrop distribution of the Pongola Supergroup.

From previous stratigraphic studies in the Vryheid-Piet Retief area Humphrey and Krige (1931) concluded that andesitic lavas comprise the bulk of the Nsuze Group. The Nsuze-Mozaan contact was thought to be largely unconformable with only local conformable and faulted relationships. The Mozaan Group was described as a 5 000 m thick sequence of arenaceous and argillaceous sediments with terminal volcanicity.

The present study involved remapping the type area and was undertaken to elucidate the structure and stratigraphy of the Mozaan Group. The relation of the Mozaan rocks to the underlying Nsuze Group was also investigated.

II. GENERAL GEOLOGY

The region investigated occurs southeast of Piet Retief (Fig. 1) and spans the Transvaal-Natal provincial border. The topography of the area has been a controlling influence on the outcrop pattern, particularly southwest of the Pongolo River (Fig. 2).

Although the geological map depicts the Nsuze Group as being undifferentiated, numerous agglomeratic and tuffaceous horizons are developed near the upper contact. These indicate an explosive terminal event to the Nsuze volcanism. On the farm Roodewal west of the Bivane River (Fig. 2) these coarse-grained pyroclastic rocks were previously interpreted as a basal Mozaan conglomerate (Humphrey and Krige, 1931).

The Mozaan Group is well-exposed in the Pongolo-Bivane river valleys, but in the northeast of the map area, much of the outcrop is concealed beneath Dwyka tillite and Recent soil cover. A brief description of the gross lithologies of the Mozaan Sequence is set out below.

A. Arenites

The coarse clastics occur as both tabular and lenticular units bounded by mudstones. The major proportion of these sandstones consist of quartz arenites, the remainder being quartz and arkosic wackes. Microscopically, the quartz arenites are composed of monocrystalline quartz grains with sutured contacts. Occasional polycrystalline quartz and chert clasts are present in addition to both potash and plagioclase feldspars. In areas of limited recrystallization, cross-stratification is preserved which indicates a southerly dipping palaeoslope.

Lenticular conglomerates are intercalated with sandstones on the farms Vergenoegheid and Gunsteling (Fig. 2). These conglomerates contain subangular vein quartz, chert and quartzite clasts in an immature matrix. They also contain limonite pseudomorphs after pyrite.

B. Argillites

The argillaceous units consist of siltstones, mudstones and minor chemical sediments. In the lower third of the Mozaan stratigraphy these deposits tend to be ferruginous, containing disseminated magnetite cubes and interbedded lenses of banded iron-formation. The restriction of iron-rich sediments to the lower stratigraphy suggests that volcanism may have been a controlling factor in the precipitation of iron.

Petrographic studies of the fine-grained clastics reveal the presence of quartz, chlorite, sericite, epidote and occasional chloritoid. This paragenesis, and the absence of andalusite, indicates that the Mozaan has been subjected to low grade regional metamorphism (Winkler, 1967). Andalusite does, however, occur commonly in the Amsterdam area (Humphrey and Krige, 1931) suggesting that metamorphic grades are not uniform throughout the Mozaan Group.

C. Volcanics

Two volcanic units are exposed in the upper Mozaan Group (Fig. 2). Both horizons are highly altered and consist of saussuritized networks of plagioclase laths in an aphanitic groundmass. Lenticular felsic agglomerates and tuffaceous sandstones suggest that the volcanics have intermediate to felsic affinities.

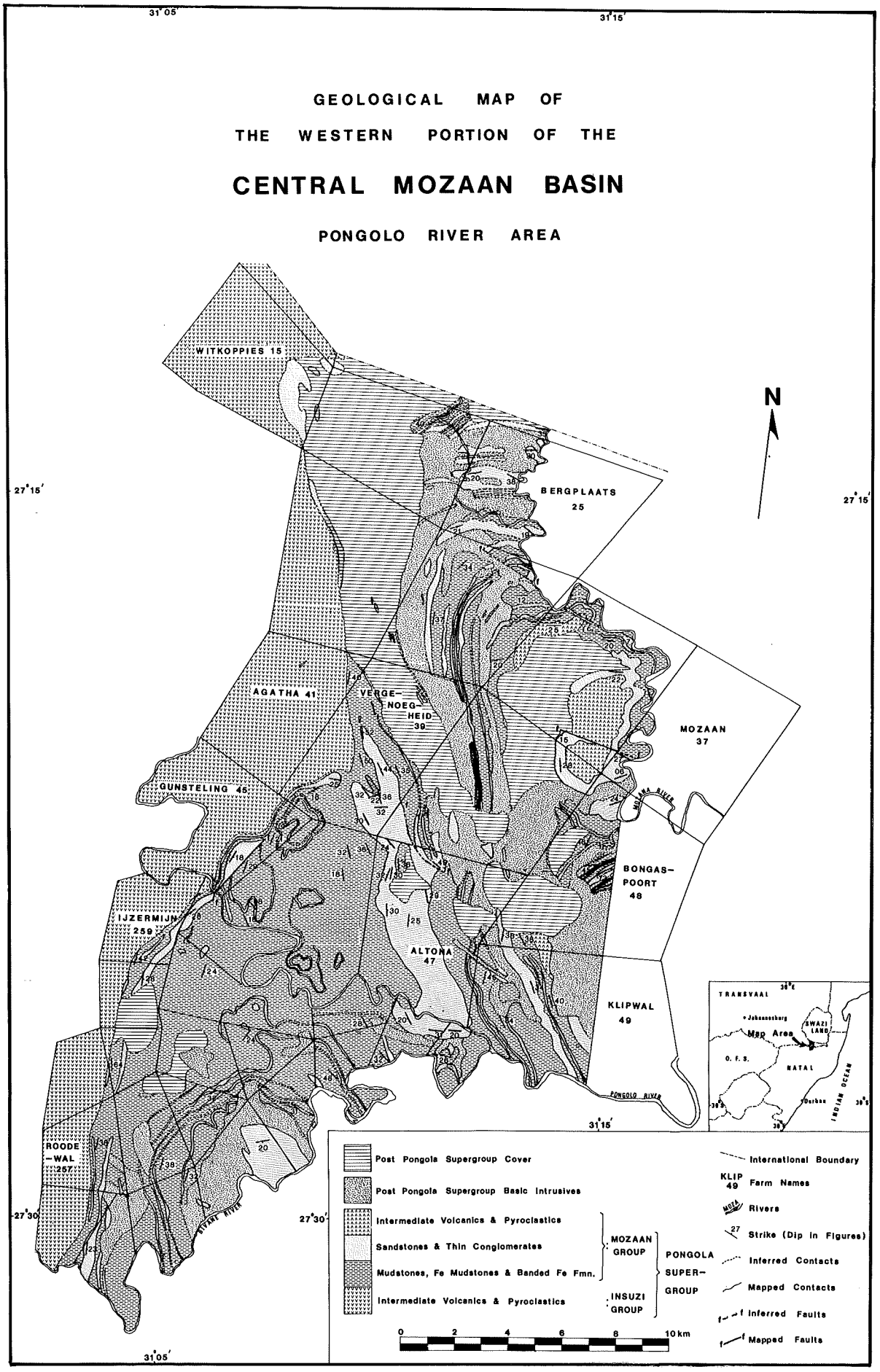
D. Intrusives

The Mozaan Group has been subjected to two episodes of mafic intrusion. The older diabases are probably related to the Usushwana igneous event, whereas the younger dolerites cross-cut Dwyka tillite. Discrimination of these two phases in the field is not always possible due to secondary alteration.

Surrounding the mafic intrusions are metamorphic aureoles which are best developed in the argillites of the Mozaan Group. Sillimanite may occur in the contact zone of the larger bodies indicating emplacement temperatures in excess of 600°C (Winkler, 1967). Away from the intrusions, spotted slates have been recognized, the latter passing into baked shales. The arenites have developed a glassy appearance due to recrystallization but are poor indicators of metamorphic conditions.

III. NSUZE-MOZAAN RELATION

The Nsuze-Mozaan contact has been investigated as far south as the Bivane River (Fig. 2). This study has indicated that the transition between the two groups is broadly gradational. It is marked by an upward decrease in pyroclastics and the simultaneous development of lenticular sandstones. The facies equivalence between volcanics and sediments and the absence of a basal conglomerate, such as the one developed at Denny Dalton (Matthews, 1967), therefore argue against an unconformity between the Nsuze and Mozaan groups in the type area.


31°05'
31°15'
GEOLOGICAL MAP OF
THE WESTERN PORTION OF THE
CENTRAL MOZAAN BASIN
PONGOLO RIVER AREA
N
27°15'
27°30'
WITKOPPIES 15
BERGPLAATS 25
AGATHA 41
VERGE-NOEG-HEID 39
MOZAAN 37
GUNSTELING 45
BONGAS-POORT 48
IJZERMIJN 259
ALTONA 47
KLIPWAL 49
ROODE-WAL 267
MOZAAN RIVER
PONGOLO RIVER
BIVANE RIVER
TRANSVAAL
Johannesburg
SWAZI LAND
Map Area
O. F. S.
NATAL
Durban
INDIAN OCEAN
Post Pongola Supergroup Cover
Post Pongola Supergroup Basic Intrusives
Intermediate Volcanics & Pyroclastics
Sandstones & Thin Conglomerates
Mudstones, Fe Mudstones & Banded Fe Fmn.
MOZAAN GROUP
Intermediate Volcanics & Pyroclastics
INSUZI GROUP
PONGOLA SUPER-GROUP
0 2 4 6 8 10 km
International Boundary
KLIP 49 Farm Names
Rivers
Strike (Dip in Figures)
Inferred Contacts
Mapped Contacts
Inferred Faults
Mapped Faults

Although a foliation is often developed in the contact zone, there is no conclusive evidence for a faulted contact as was suggested by Humphrey and Krige (1931). It is speculated that the foliation referred to above formed during folding of the Pongola Supergroup in response to differences in mechanical properties.

IV. STRUCTURAL GEOLOGY

In the Vryheid-Piet Retief region, the Mozaan Group is exposed in two roughly elliptical structural basins (Fig. 3). These basins, one in the northeast (Hartland) and the other in the southwest (Piensrand), were produced by the intersection of northwesterly and east-northeasterly trending synclines. The basins are separated by the relatively tight Altona anticline, which has a north-northwesterly trending axis (F_1). The double plunge of this anticlinal axis is due to interference by an easterly trending phase of folding (F_2). This contrasts with the refolding of the Mozaan Group in the Mahlangatsha area of Swaziland (Hunter, 1963), where the main northeast axis (F_1) has been deformed about later northwesterly axial surfaces (F_2). This may reflect a recurrence of folding about two dominant trends.

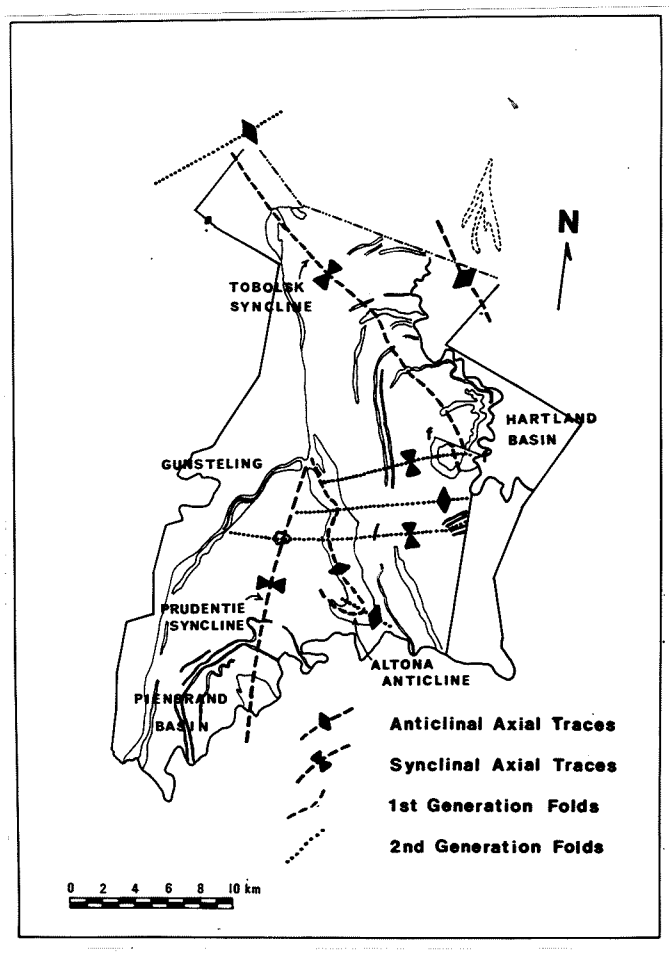


Figure 3 : Structural map showing the major trends in the study area.

The low frequency of foliated Mozaan strata is attributed to the lack of intensity of the regional tectonism. However, in areas of increased strain, such as in the Altona anticline, a slatey cleavage is developed in the hinge zone.

An earlier structural interpretation of the type area concluded that the Hartland and Piensrand basins were separated by a major fault which trended north-northwest (Humphrey and Krige, 1931). This fault, which truncated the western limb of the Altona anticline, made stratigraphic correlation between the basins impossible. However, recent mapping (Fig. 2) could not confirm the presence of this fault and it is suggested here that there *is* stratigraphic continuity between the basins via the Altona anticline.

V. STRATIGRAPHY OF THE MOZAAN GROUP

The 5 000 m thick type section established by Humphrey and Krige (1931) for the Mozaan Group was a composite section based on long-range lithologic and thickness similarities. The structural interpretation presented in this paper suggests that the basal Mozaan stratigraphy is exposed in the denuded core of the Altona anticline (Fig. 2). Consequently, a complete stratigraphic section

through the sequence is preserved in the Hartland structural basin. Although this section is not continuous, the lateral persistence of individual units allows the construction of a representative column (Fig. 4).

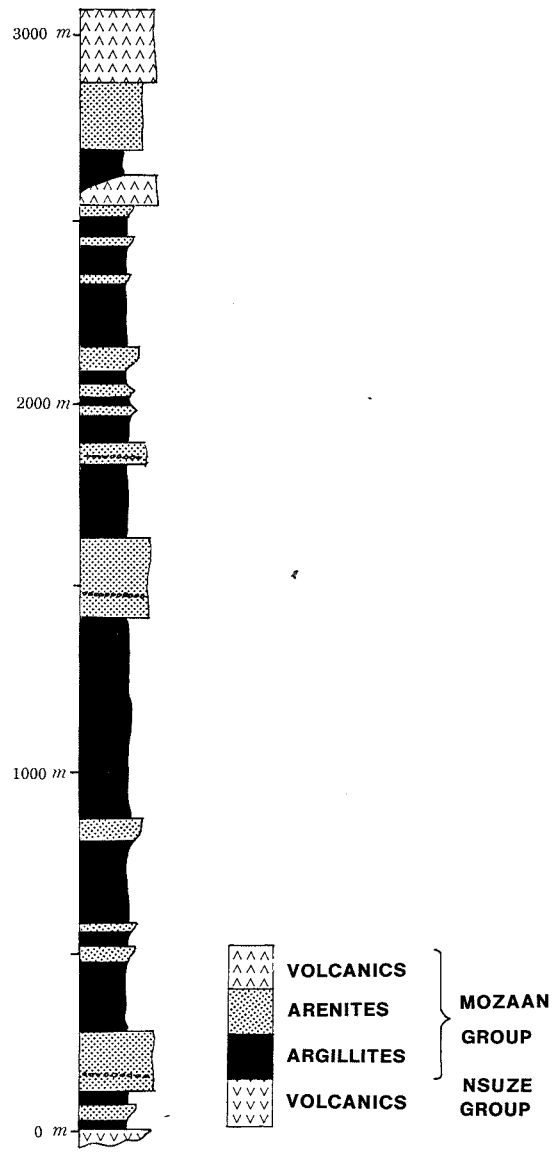


Figure 4 : *Stratigraphic column showing the gross textural trends in the Mozaan Group type area.*

Within this 3 000 m thick type section a number of textural cycles are recognized. The upward-coarsening sequences, from mudstones at the base, to quartz arenites at the top, are interpreted as prograding shorelines. Minor upward-fining successions probably represent prograding tidalites, whereas conglomeratic fluvial deposits have sharp upper and lower contacts with the bounding shelf argillites. Each major progradational event was apparently succeeded by a rapid marine transgression. In terms of the interpretations presented, there is a conspicuous absence of an evolutionary trend to the infilling of the Mozaan depository. This is attributed to the tectonic environment prevailing at the time of deposition.

A comparison of stratigraphic thicknesses from the documented Mozaan outcrops (Humphrey and Krige, 1931; Winter, 1962; Hunter, 1963; Matthews, 1967) infers that the Vryheid-Piet Retief area was near the depositional axis of the basin (Fig. 5). Consequently, the Hartland structural basin is established as the type area since here, the Mozaan Group attains maximum thickness and preservation and contains all the representative lithologies.

Textural trends within the Mozaan basin display a fining southwards from Swaziland to the type area (Fig. 6). This is consistent with a southerly palaeoslope, as indicated by palaeocurrent data, and an east-west trending basin margin.

VI. CONCLUSIONS

Re-interpretation of the geology of the western Mozaan basin has led to the development of a 3 000 m type section. Palaeocurrent, stratigraphic and textural trends indicate that the Mozaan clastics were derived from a northern source area. Deposition within the basin was

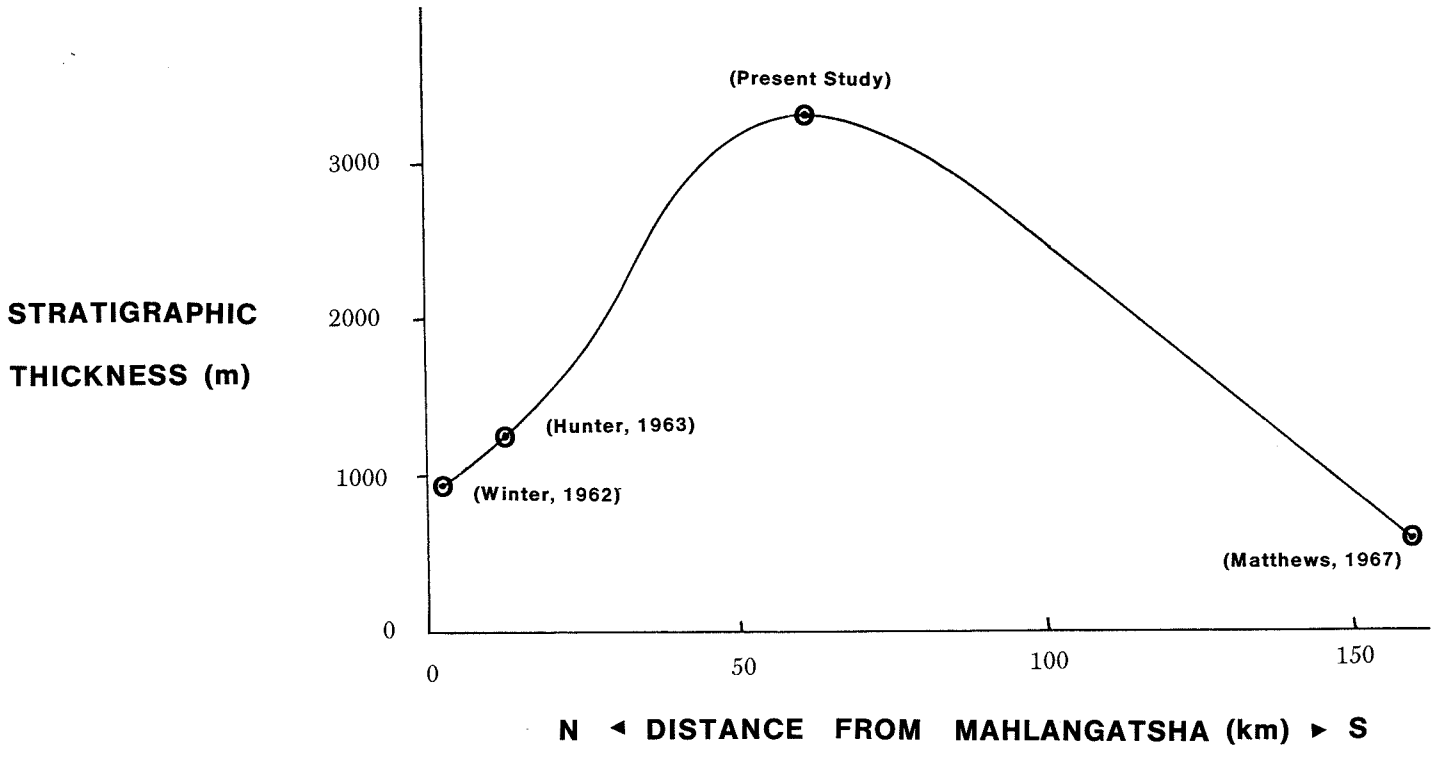


Figure 5 : Stratigraphic thickness trends for the documented Mozaan Group exposures.

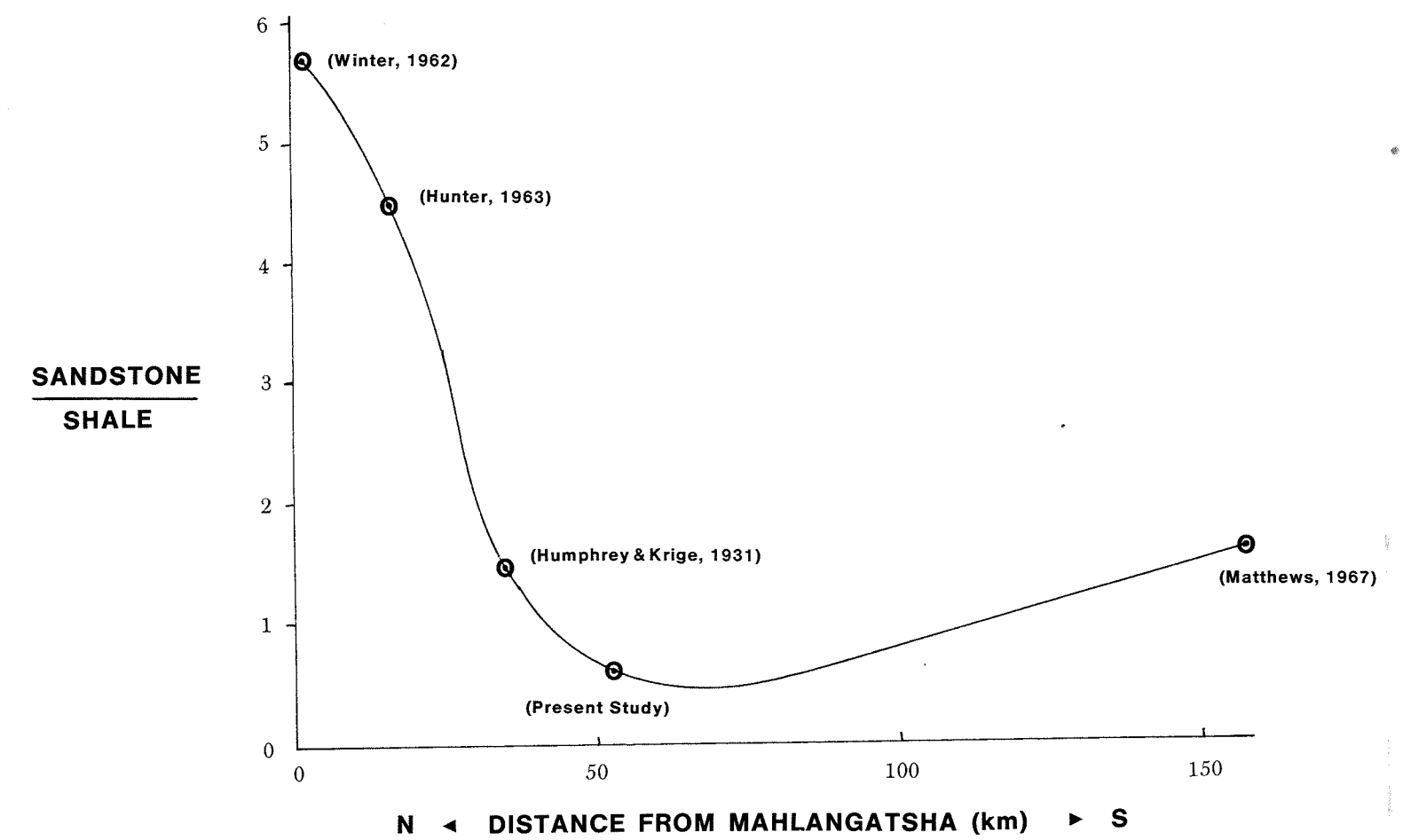


Figure 6 : Textural trends within the Mozaan basin.

influenced by a series of rapid transgressions followed by periods of progradation. The syntectonic regime is thought to have been the controlling factor in the depositional environment, since the rate of progradation probably determined whether marginal marine or continental deposits overlay shelf sediments.

The type section coincides with the maximum stratigraphic development for the Mozaan Group, suggesting that this area was situated close to the depositional axis. Here, the transition from the volcanic Nsuze Group to the predominantly clastic Mozaan Group is apparently conformable. Further south, in the Wit-Mfolozi inlier, local unconformable relationships exist (Matthews, 1967), which are possibly related to a closer approach to the basin edge.

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