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LITHOSTRATIGRAPHY AND STRUCTURAL GEOLOGY OF THE UPPER SWAKOP RIVER AREA EAST OF OKAHANDJA, SWA/NAMIBIA

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ABSTRACT

The upper Swakop River area east of Okahandja has been subdivided into three tectonostratigraphic units. These are the Swakop Terrane in the north and north-west, the Onjona-Eleksie Nappe Complex in the east, and the Onyati Mountains Schist Belt in the central and western parts. The latter are both regarded as part of the Khomas Terrane which is separated from the Swakop Terrane by the Okahandja Lineament. Typical Nosib Group sediments are absent in the mapped area and the pre-Damara basement gneiss is overlain by a -unit of coarse-grained, glassy quartzite, calc-silicate rock, marble and schist belonging to the Swakop Group of the Damara Sequence. This in turn is overlain by a very thick succession of schists of the Kuiseb Formation which represents the uppermost part of the Swakop Group. On the basis of structural and stratigraphic criteria the Kuiseb Formation has been subdivided into the lower, middle, and upper schist. In the west the Kuiseb schists are intruded by syntectonic Damara granites, syn- and post-tectonic pegmatites and the Otjisazu Alkaline Igneous Complex of unknown age. Four phases of intense deformation have resulted in repeated folding, large-scale thrusting, and three penetrative foliations. Thrusts are restricted to the Onjona-Eleksie Nappe Complex, but at least one back thrust has been mapped in the Onyati Mountains Schist Belt. Early D_1 fabrics are restricted to the lower schist unit of the Kuiseb Formation, while the upper schist has only been affected by D_3 deformation. The syntectonic sediments of the upper schist unit are interpreted as fore-arc basin deposits. Complete stratigraphic and structural continuity between the Khomas and the Swakop Terrane to the east-north-east of Okahandja suggests that the choice of the Okahandja Lineament as a terrane boundary is not justified in the upper Swakop River area.

1. INTRODUCTION

The Damara Belt in the area between Okahandja and Steinhausen has been subdivided into four tectonostratigraphic units (Fig. 1). The Ekuja-Otjihangwe Nappe Complex in the east is the lowermost unit and it is separated from the overlying Khomas Terrane by the Hochberg Thrust (Kasch, 1986). Lithostratigraphic and structural considerations suggest that the Ekuja-Otjihangwe Nappe Complex is part of the Hakos-Aus Terrane of Hoffmann (1987). The Onjona-Eleksie Nappe Complex, formerly referred to as Onjona-Vrolikheid Fold Complex (Kasch, 1986), and the overlying Onyati Mountains Schist Belt are regarded as subterranes of the Khomas Terrane (Fig. 1). The rocks in the northern and north-western portion of the area have been regarded as part of the Swakop Terrane which is separated from the Khomas Terrane by the Okahandja Lineament (Hoffmann, 1987).

The structural and metamorphic geology of the eastern portion of the area (referred to as the upper Black Nossob River area) has been described by Kasch (1986, 1987a), while this report deals only with the western and northern portions, viz. the upper Swakop River area (Fig. 1). The pre-Damara basement is essentially made up of gneiss, while the Damara Sequence consists of a lower succession of quartzite and calc-silicate rock, and a very thick upper succession of schist. In the west the latter is intruded by granites and pegmatites. Polyphase deformation has produced isoclinal folds and thrust nappes which have been refolded by open to isoclinal F_3 folds.

Metamorphic isograds and quantitative P-T estimates indicate that in the upper Black Nossob River area middle amphibolite facies conditions prevailed, with temperature increasing and pressure decreasing from south to north (Kasch, 1987a). In the northern and north-western portion of the upper Swakop River area temperature increases northwards at constant pressure in the upper amphibolite facies. In the upper Black Nossob River area the prograde sequence passes through the kyanite stability field, whereas in the west near Okahandja the

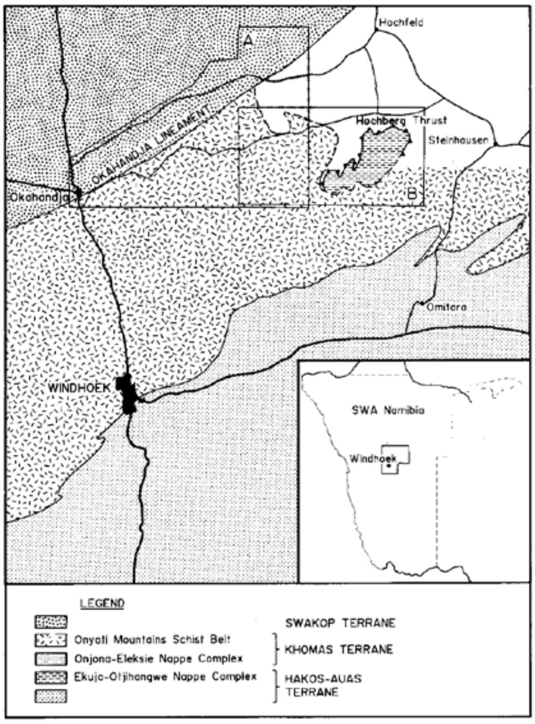


Fig. 1: Tectonostratigraphic terranes and subterranes in the eastern Damara Belt. A = upper Swakop River area; B = upper Black Nossob River area.

pressure is significantly lower and metastable andalusite is found.

2. LITHOSTRATIGRAPHY

To the west-south-west of Okahandja the Okahandja Lineament coincides with a distinct change in stratigraphy and structural style (Blaine, 1977; Miller, 1979, 1983; Sawyer, 1981). To the south of the lineament the Nosib Group and the lower portion of the Swakop Group are invariably absent, whereas to the north the lower Damara Sequence is often well developed. In the upper Swakop River area, however, the Nosib Group and the lower Swakop Group are absent on both sides of the Okahandja Lineament, and the stratigraphy of the Khomas Terrane and the Swakop Terrane is identical. Therefore, the lithostratigraphy of these two terranes will be described together here.

2.1 The pre-Damara basement

Pre-Damara basement is widely distributed in the Swakop Terrane, but in the eastern Khomas Terrane it is restricted to the Onjona-Eleksie Nappe Complex (cf. Figs 1 and 2). The most common lithotype is a medium-grained, grey to pale pink gneiss which is locally invaded by syntectonic pegmatites. Subordinate amphibolite and banded migmatitic gneiss are present, the latter consisting of alternating bands of coarse-grained leucosome and medium-grained, biotite-rich gneiss.

2.2 The Damara Sequence

The Nosib Group and the lower portion of the Swa-

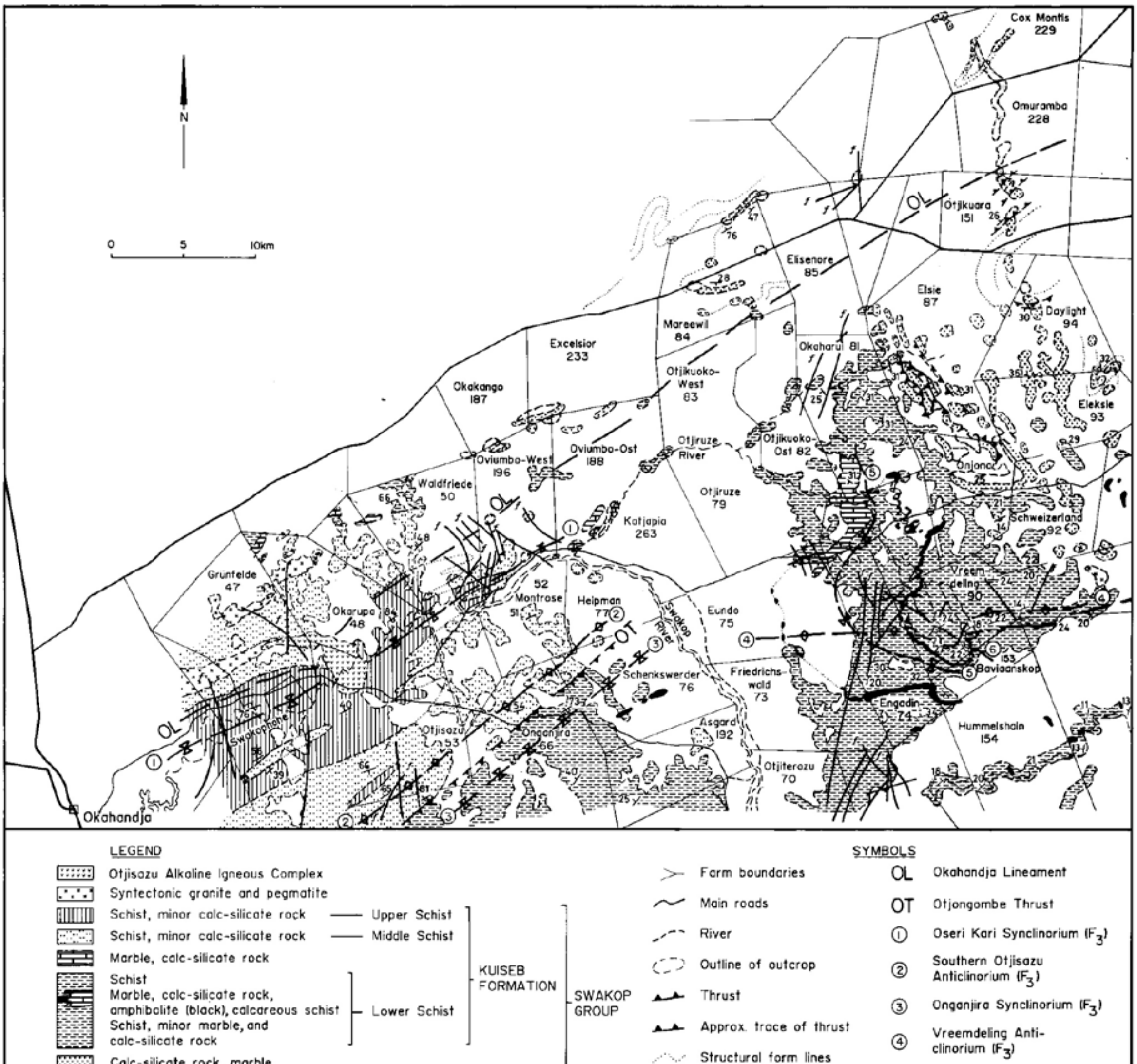


Fig. 2: Geological map of the upper Swakop River area east of Okahandja.

kop Group are not represented in the upper Swakop River area. Instead, a thin but persistent quartzite and a calc-silicate rock unit overlie the basement both in the Khomas Terrane and in the Swakop Terrane. It is difficult to correlate this succession with established lithostratigraphic units of the Damara Sequence elsewhere, but it is overlain by schists of the Kuiseb Formation, which is the uppermost lithological unit of the Damara Sequence (SACS, 1980).

2.2.1 The basal quartzite unit

At the base of the Damara Sequence in the north-eastern portions of the Khomas and Swakop Terranes is a coarse-grained, glassy quartzite which is in places pale green due to the presence of fuchsite. It ranges in thickness from less than a metre up to several tens of metres, but in places it is a few hundred metres thick due to isoclinal folding and thrusting. It forms a very persistent horizon in the area between Okahandja, Steinhausen, and Hochfeld, and it is characterized by a total lack of sedimentary structures.

2.2.2 The calc-silicate rock unit

A succession consisting of coarse-grained calc-silicate rock, marble, schist, and occasional amphibolite overlies the glassy quartzite. The calc-silicate rocks are composed mainly of calcic plagioclase (bytownite to labradorite) and yellow-brown to dark green pleochroic hornblende with minor and trace amounts of sphene, epidote, apatite and secondary chlorite. A fair amount of scapolite is present in some calc-silicate rocks and occasionally quartz, calcite, pale green hornblende and oxides are found. The marbles are made up of variable proportions of calcite and dolomite with minor and trace amounts of diopside, pargasitic hornblende, phlogopite, anorthite and occasional quartz. The schists are very similar in composition to the pelitic and psammitic schists of the overlying Kuiseb Formation and the contact between the calc-silicate rock unit and the Kuiseb Formation is often gradational.

2.2.3 The Kuiseb Formation (Upper Khomas Subgroup)

The Kuiseb Formation is a very thick succession of pelitic, semi-pelitic and psammitic schists with minor interlayered amphibolite, calc-silicate rock and marble. The metapelites are composed of variable amounts of biotite, muscovite, quartz, plagioclase, staurolite, garnet, kyanite, sillimanite and andalusite. In the north-west K-feldspar and cordierite are present, while the amount of muscovite and garnet decreases and staurolite, kyanite and andalusite are absent.

On structural and stratigraphic grounds the Kuiseb Formation can be subdivided into three units (Fig. 2), which are referred to as the lower, middle and upper schist. Structural criteria for this subdivision are described in section 3.2. Although the contacts are not always clearly defined in the field, the middle schist is often separated from the lower schist by a unit of marble and calc-silicate rock, while psammitic schists mark the transition between the middle and the upper schist. In addition, a unit of amphibolite, calc-silicate rock, marble and psammitic and calcareous schist is present in the lower schist. The complete succession of the lower and middle Kuiseb schist is present on both sides of the Okahandja Lineament, but the upper schist is restricted largely to the Khomas Terrane (Fig. 2).

2.2.4 Granites and pegmatites

Granites intrude the lower and middle schists of the Kuiseb Formation in the western portion of the upper Swakop River area (Fig. 2). They are moderately foliated and often cut across the regional s_2 foliation. Granite veins are often folded by F_3 folds, indicating that they are syntectonic. The granite on southern Grünfelde 47 is reddish and finer grained than the pale pink, medium-grained granite on northern Grünfelde 47 and Okarupa 48. The modal composition of these granites have not yet been determined.

Syntectonic pegmatites are usually associated with the granites. They resemble those of the upper Black Nossob River area described by Kasch (1986), but no large bodies like those on Zwerveling 91 have been found. Swarms of post-tectonic pegmatites of similar composition to the syntectonic ones have intruded the middle and upper schist of the Oseri Kari Synclinorium on southern Grünfelde 47 and the northern half of Swakophöhe 54. They are too small to be included in the geological map of the study area shown in Fig. 2. These pegmatites are up to several hundred metres long and up to 20 m wide, but generally their width varies between 50 cm and a few metres. They are usually aligned parallel to the s_3 foliation which dips steeply to the north-north-west. However, in the overturned northern limb of the Oseri Kari Synclinorium they are parallel to bedding, which is steeper than s_3.

2.2.5 The Otjisazu Alkaline Igneous Complex

The Otjisazu Alkaline Igneous Complex is a carbonatitic intrusion made up of alkali pyroxenite, sövite, syenite and mafic pegmatite (Gunthorpe and Buerger, 1986). It has intruded the middle and upper schists of the Kuiseb Formation (Fig. 2). According to Gunthorpe and Buerger (1986), this complex has been intruded by pegmatites which they relate to the Donkerhuk Granite, implying a lower Palaeozoic age of emplacement. However, present mapping has indicated that the s_3 foliation and the post-tectonic Damaran pegmatites have been folded close to the contact of the Otjisazu Complex. Both the foliation and the pegmatites are cut by much younger fractures of possible Karoo age which are in turn intruded by relatively small pegmatites. The latter are almost at right angles to the Damaran pegmatites and have also intruded the Otjisazu Alkaline Igneous Complex. Therefore, a Karoo age cannot be ruled out for this intrusion.

3. STRUCTURE

Several phases of intense deformation have resulted in repeated folding, large-scale thrusting, and up to three penetrative foliations in the upper Swakop River area. Thrusts are restricted to the Onjona-Eleksie Nappe Complex, but recently a major thrust, here named the Otjongombe Thrust, has been recognized in the Kuiseb schists of the Onyati Mountains Schist Belt (Kasch, 1987b).

D_2 deformation has been so intense that most D_1 fabric elements have been destroyed. Only very few F_1 folds are preserved in alternating layers of quartz-rich schist and calc-silicate rock of the Kuiseb Formation. They are folded by F_2 folds, which are also restricted to these lithologies in the Kuiseb Formation. However, F_2 folds are most abundant in the basal quartzite unit of the Damara Sequence. Evidence for an s_1 foliation is usually found in quartz-rich schists, where it is preserved in microlithons of s_2 crenulation foliation (Fig. 3b). In pelitic schists and the basement gneiss, s_1 is usually completely transposed into s_2 which is the most penetrative regional foliation. A prominent mineral lineation which is parallel to F_2 fold axes and often folded by F_3 folds, is developed in all parts of the area. Tight to isoclinal, southward vergent F_3 folds (Fig. 3a) are the most abundant structures in the area, and they have folded all earlier structures described above. An example of a F_3 fold folding the s_2 crenulation foliation is illustrated in Fig. 3b. Finally, F_4 minor folds and crenulations are locally developed, but no major structures have been observed.

3.1 The Onjona-Eleksie Nappe Complex

Repetition of pre-Damara basement gneiss and the basal quartzite and calc-silicate rock units of the Damara Sequence in the Onjona-Eleksie Nappe Complex indicates the presence of numerous thrusts (Figs 2 and 5). In the basement gneiss the main penetrative foliation is axial planar to the Onjona Antiform, which is a large, eastward vergent F_2 fold on north-eastern Onjona 89 and Vooruitgaan (formerly part of Elsie 87). Open F_3 and F_4 folds have refolded the Onjona Antiform, but they are not very common in this part of the upper Swakop River area. The regional fabric of the Onjona-Eleksie Nappe Complex is dominated by eastward and south-eastward vergent F_2 major folds and thrusts.

Small-scale F_2 folds are rare in the basement gneiss, but they are very common in the basal quartzite of the Damara Sequence. F_2 fold axes in the Onjona-Eleksie Nappe Complex plunge in various directions and clearly define a great circle (Fig. 4a). The plane containing the F_2 fold axes at 253/28 is subparallel to the mean orientation of the s_2 foliation at 246/32. This implies that the F_2 folds have been rotated within their own axial plane, indicating intense progressive simple shear deformation (cf. Escher and Watterson, 1974).

The Onjona Antiform has folded a major thrust, which climbs from basement on the western limb of the antiform to the basal quartzite unit of the Damara Sequence on the eastern limb (Fig. 5). This structure is interpreted as an antiformal stack (Fig. 6), which is a special type of duplex (Boyer and Elliott, 1982). The Vooruitgaan Thrust on the western limb is the roof thrust to this antiformal stack, and at the same time it is the floor thrust to the Vooruitgaan Duplex described below. This thrust also climbs up stratigraphically from north-west to south-east, and in the south it separates the Onjona-Eleksie Nappe Complex from the overlying Onyati Mountains Schist Belt. The eastward and south-eastward climbing ramps together with the prominent

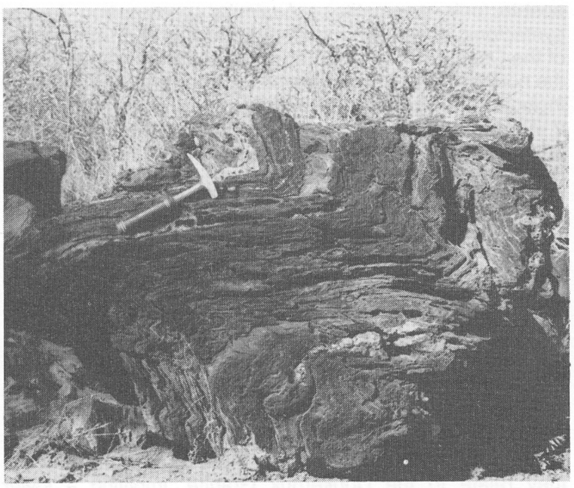


Fig. 3: (a) Typical southward vergent F_3 fold in Kuiseb Formation Schists of the Onyati Mountains Schist Belt.

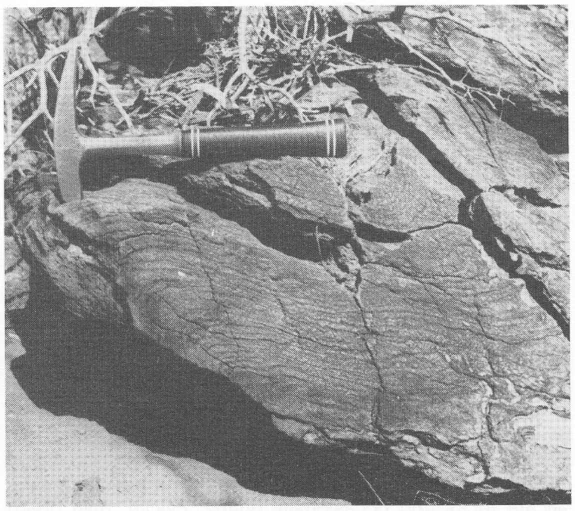
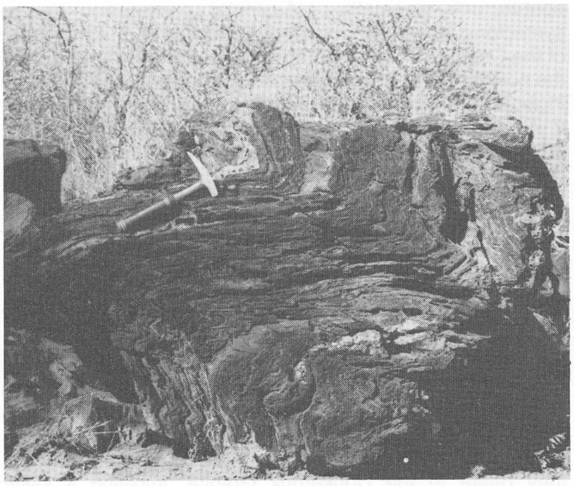


Fig. 3: (b) F_3 fold folding s_2 crenulation foliation with relic s_1 in microlithons.



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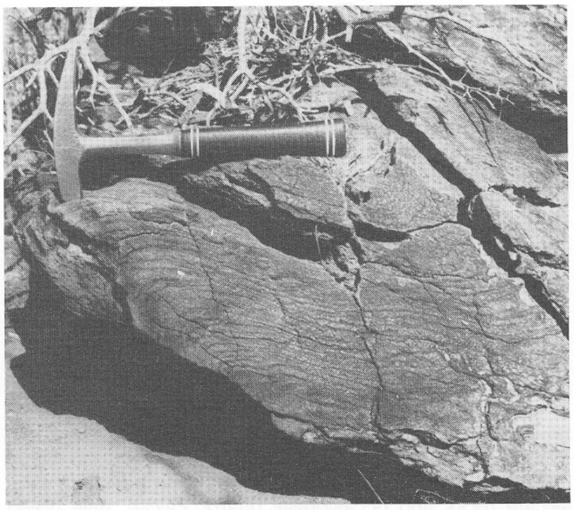

Fig. 3: (b) F_3 fold folding s_2 crenulation foliation with relic s_1 in microlithons.

west-north-westward plunging mineral and stretching lineations in the Onjona-Eleksie Nappe Complex (Fig. 4b) indicate that thrusting was towards the east-south-east. Lateral and oblique ramps are thought to be primarily responsible for the domal shape of the Onjona Antiform, but interference with westward plunging F_3 folds may have enhanced this shape.

A second duplex, referred to here as the Vooruitgaan Duplex, is located on the western limb of the Onjona Antiform on the farm Vooruitgaan (Fig. 5). All the subsidiary thrusts within this duplex climb from the Vooruitgaan Thrust in the basement into the Damara cover sequence. Since none of the thrusts appear to climb up into the Kuiseb schists, the roof thrust is probably located at or near the boundary between the calc-silicate rock unit and the overlying Kuiseb Formation. Therefore, the roof thrust of the Vooruitgaan, Duplex also separates the Onjona-Eleksie Nappe Complex from the Onyati Mountains Schist Belt.

A third duplex is situated to the east of the Onjona Antiform on the farms Eleksie 93 and Daylight 94 (Fig. 5), but is unfortunately not very well exposed.

3.2 The Onyati Mountains Schist Belt

Tight to isoclinal, southward vergent F_2 and F_3 folds are common in the Onyati Mountains Schist Belt. However, intense D_3 deformation has obliterated many F_2

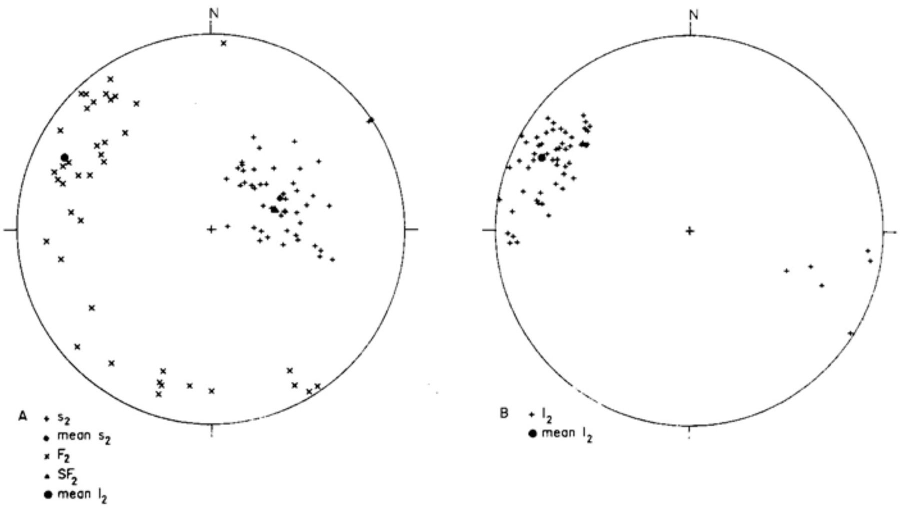

Fig. 4: Structural data on lower hemisphere of a Schmidt equal-area net for the Onjona-Eleksie Nappe Complex. Poles have been plotted to the s_2 foliation and the plane containing the F_2 fold axes (SF_2).

(a) F_2 fold axes defining a great circle (SF_2 = 253/28) which coincides with the mean orientation of s_2 (246/32).

(b) Plots of l_2 mineral lineations with a mean orientation of 296/17.

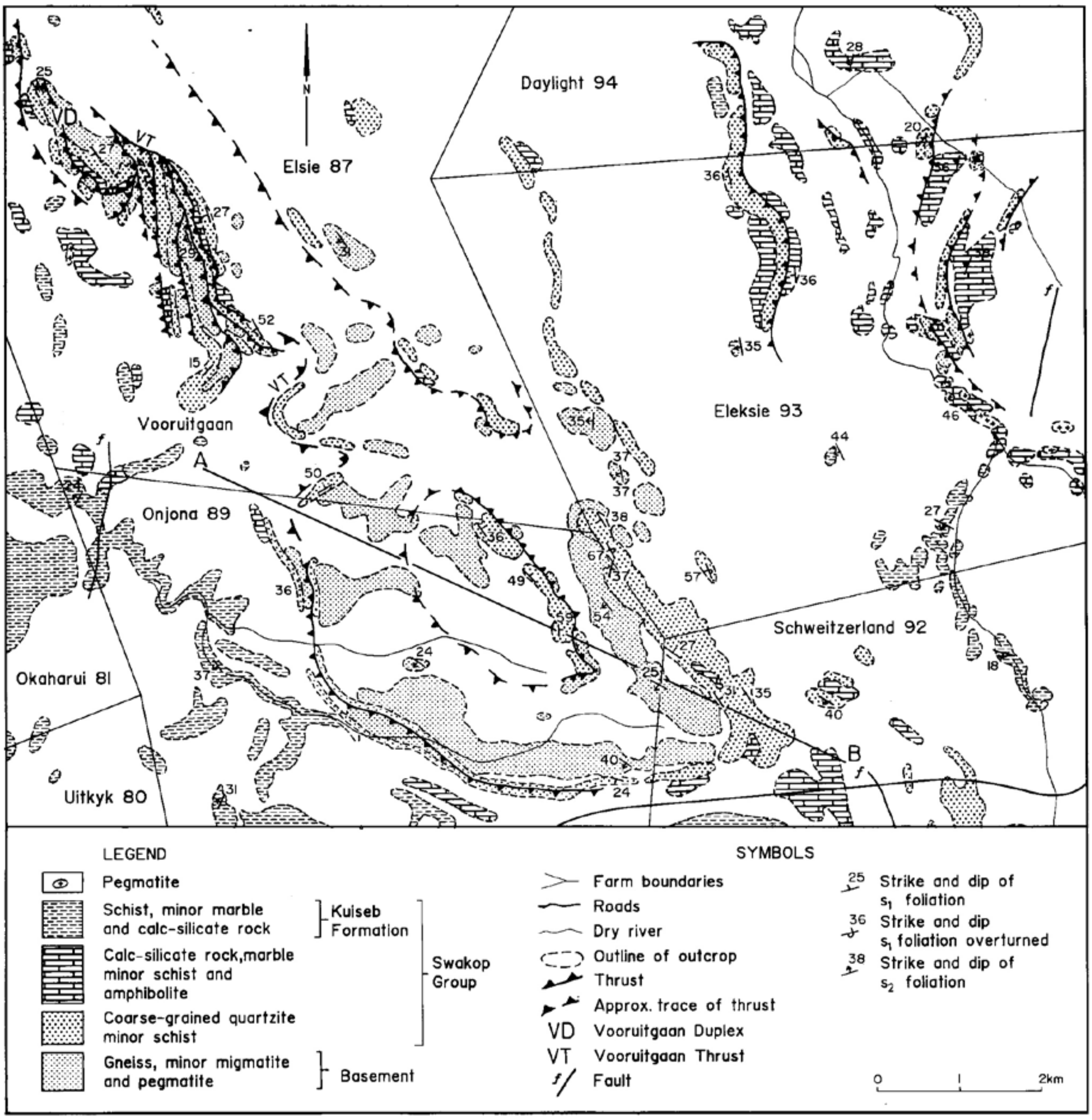

Fig. 5: Geological map of the area around the Onjona Antiform including the Vooruitgaan duplex on south-west Elsie 87.

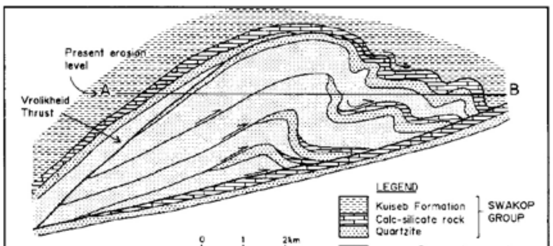

Fig. 6: Cross-section of the Onjona Antiform. The thrusts below the present erosion level are inferred.

folds and the regional fabric is dominated by large F_3 folds like the Oseri Kari Synclinorium in the west and the Vreemdeling Antiform in the east (Fig. 2). The only F_2 major fold preserved in the Onyati Mountains Schist Belt is the Engadin Synform located to the south-west of the Onjona Antiform. In contrast to most F_2 minor folds, the Engadin Synform is eastward vergent and its fold axis strikes roughly north-south. It is refolded by the Vreemdeling Antiform (Fig. 2), which in turn is folded by an open, north-westward plunging F_4 fold on western Vreemdeling 90.

The F_2 folds usually plunge at a low to moderate angle to the west (Figs 7a and 8). However, many examples were found where F_2 fold axes are rotated within their own axial plane indicating intense progressive simple shear deformation (cf. Escher and Watterson, 1974). The best examples are found on western Baviaanskop 153 (see Kasch, 1986, p. 124), which is located within the fold closure of the Engadin Synform. A prominent mineral lineation on western Baviaanskop 153, which is interpreted as a stretching lineation, plunges to the west-north-west (Kasch, 1986). This is parallel to the mineral stretching lineations in the Onjona Antiform (see Fig. 4b).

The Engadin Synform and the Onjona Antiform suggest that the initial orientation of the F_2 folds was approximately north-south. During progressive simple shear deformation the fold axes were rotated into the direction of tectonic transport, which is indicated by a prominent mineral lineation (e.g. Fig. 4b). This reorientation of F_2 fold axes has been more extensive in the schists of the Onyati Mountains Schist Belt than in the quartzites and calc-silicate rocks of the Onjona-Eleksie Nappe Complex.

The large Oseri Kari Synclinorium in the western portion of the study area is an open F_3 fold plunging to the west-south-west or east-north-east (Fig. 7c). Associated with it is a fanning foliation with a mean orientation of 339/86 (Fig. 7d), suggesting that the axial plane is subvertical. The Southern Otjisazu Anticlinorium to the south is tighter and southward vergent with s_3 dipping at a moderate angle towards the north-north-west (Fig. 7b). Finally, in the eastern portion of the upper Swakop River area F_3 folds are tight to isoclinal and s_3 dips at a low to moderate angle to the north and north-north-west (Fig. 3b). F_3 folds usually plunge to the west-south-west (Fig. 7), but east of Schenckswerder 76 and Otjiruze 79 and south of Elisenore 85 they plunge mainly to the

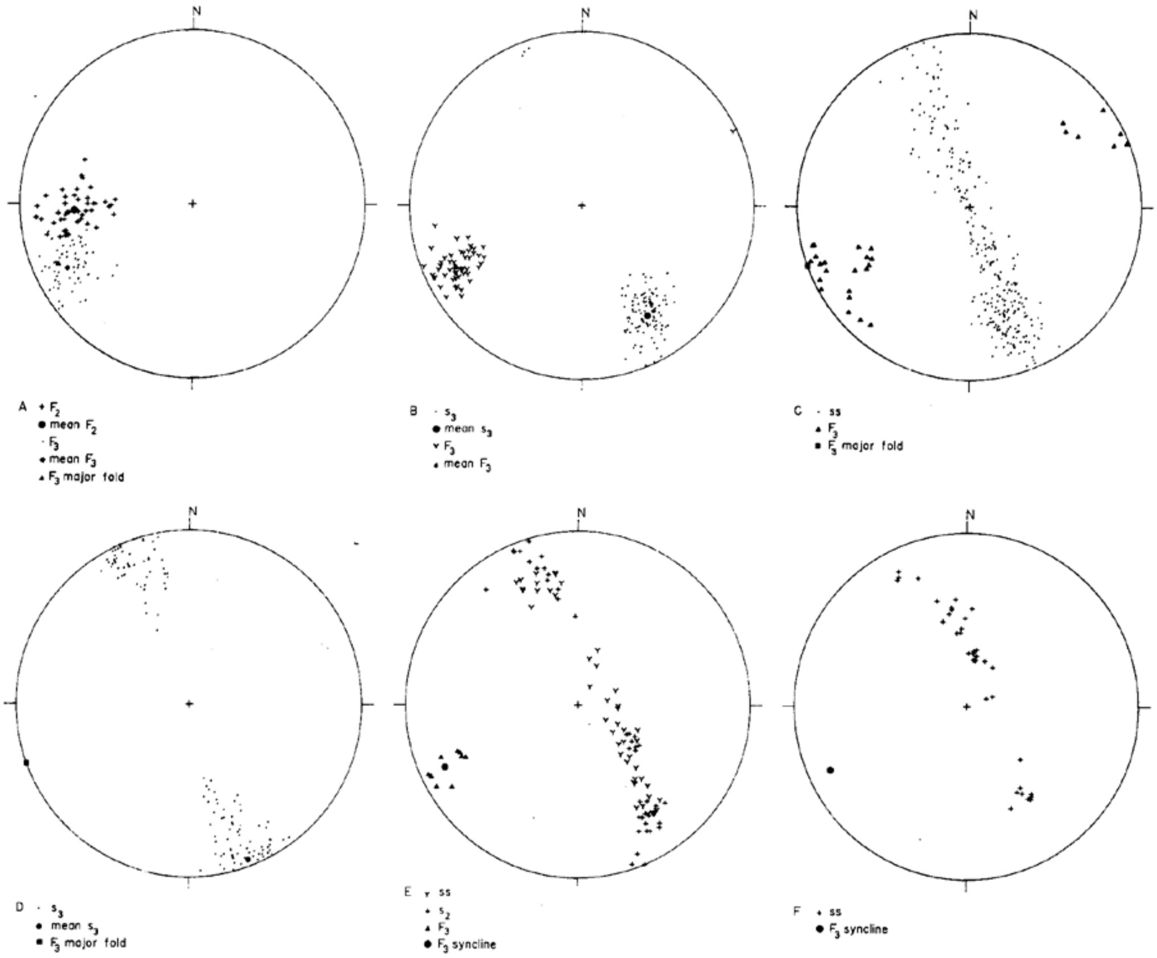

Fig. 7: Structural data on lower hemisphere of a Schmidt equal-area net for the Onyati Mountains Schist Belt. Poles have been plotted to bedding (ss) and foliation planes (s_2 and s_3).

(a) F_2 and F_3 fold axes for lower schist in the area around Onganjira 66 in the south. Mean F_2 = 267/32, mean F_3 = 243/20, F_3 major fold = 246/16.

(b) F_3 fold axes and s_3 foliation for middle schist in the Southern Otjisazu Anticlinorium. Mean F_3 = 244/20, mean s_3 = 329/63.

(c) Bedding (ss) and F_3 fold axes for the Oseri Kari Synclinorium. F_3 major fold = 250/00.

(d) F_3 fold axis (250/00) and s_3 foliations for the Oseri Kari Synclinorium.

(e) F_3 fold axes, bedding (ss), and s_2 foliations in middle schist of a F_3 syncline within the Southern Otjisazu Anticlinorium. Fold axis of syncline = 245/16.

(f) Bedding (ss) in upper schist of the same F_3 syncline as that in Fig. 7e. Fold axis of syncline = 245/14.

west (Fig. 8). F_3 folds have folded the regional s_2 crenulation foliation (Fig. 3) and, where present, they have folded F_2 folds and mineral lineations.

All the fabric elements described earlier are found in the lower schist unit of the Kuiseb Formation, which is exposed in the southern and eastern portions of the upper Swakop River area. The earliest foliation in the middle schist is the equivalent of the s_2 foliation in the lower schist. In the lower schist bedding is usually completely overprinted by s_1 and s_2 foliations, and F_2 and F_3 folds are commonly found. In the area around Onganjira 66 F_2 folds plunge to the west and F_3 folds plunge to the west-south-west (Fig. 7a). In contrast bedding is often preserved in the middle schist unit, but folds corresponding to the F_2 folds of the lower schist are rare. Most folds encountered in the middle schist have folded bedding and the earliest foliation (s_2) in this unit. They plunge towards the west-south-west (Fig. 7b), which is parallel to the F_3 folds in the lower schist.

The upper schist unit is restricted to the core of the Oseri Kari Synclinorium and it has only been affected by the regional D_3 deformation. Bedding is well preserved and the only foliation present is equivalent to s_3 in the lower schist. The fold axis of the Oseri Kari Synclinorium (Fig. 7c), which was obtained from 256 bedding readings in the upper schist unit, compares well with the regional F_3 fold axes in the lower and middle schist of the western portion of the study area (Fig. 7a, b). In the south the F_3 fold axis obtained from bedding and s_2 foliations in the middle schist is identical to that obtained from bedding in the upper schist of the same syncline (Fig. 7e, f).

In the southern portion of the upper Swakop River area the lower schist has been thrust over the middle schist over a distance of several kilometres (Fig. 2). This thrust, which has been named the Otjongombe Thrust by Kasch (1987b), does not reappear on the northern limb of the Otjisazu Anticlinorium. Therefore, it climbs up stratigraphy from south-east towards north-west, suggesting that overthrusting was towards the north-west rather than towards south-east. This thrust has not been mapped in detail, but it appears to be a thrust zone or duplex rather than a single thrust.

Although s_2 is not always recognized in the uppermost portion of the middle schist unit, the contact between the middle and the upper schist is well defined in places. At least one outcrop was found where s_2 in the middle schist appears to be truncated against bedding in the upper schist, suggesting possible separation by an unconformity.

3.3 The Swakop Terrane and the Okahandja Lineament

No evidence for thrusts or F_1 has been found in the Swakop Terrane. F_2 folds are confined to the basal quartzite and the calc-silicate rock unit of the Damara Sequence, where they have folded an earlier s_1 foliation. In the lower schist of the Kuiseb Formation s_1 is occasionally preserved in microlithons of s_2, which is the most penetrative foliation. The regional fabric is dominated by large F_3 folds plunging to the west-south-west and a prominent s_3 foliation dipping to the north-north-west (Fig. 9). Open F_4 minor folds which plunge steeply towards the north-west (Fig. 9b) have folded the s_2 and s_3 foliations on Grünfelde 47 and Okarupa 48.

Due to poor exposures in the north-east, the Okahandja Lineament could only be located in a river on southern Omuramba 228 (Fig. 2). Here it is either a large fault with downthrow to the south or a F_3 monocline which may be related to a major fault at depth. At the lineament itself there are numerous tight to isoclinal F_3 folds and a penetrative s_3 foliation, which dips steeply to the north-north-west. In the west near Okahandja the

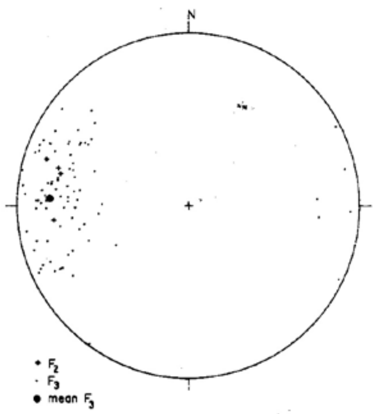

Fig. 8: F_2 and F_3 fold axes in lower schist of the south-eastern Onyati Mountains Schist Belt. Mean F_3 = 273/20.

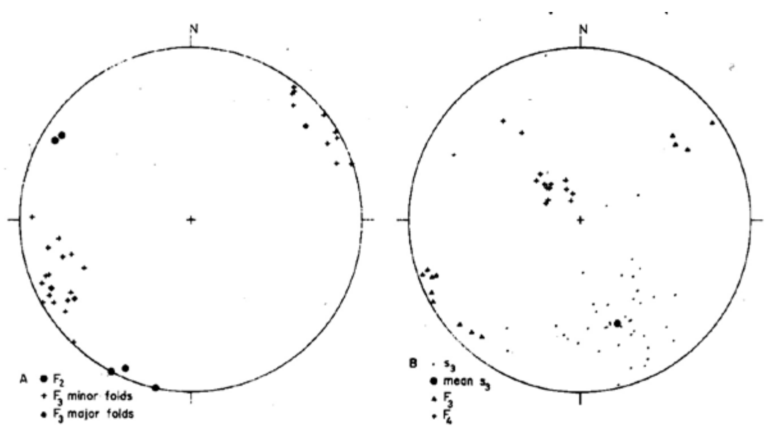

Fig. 9: Structural data on lower hemisphere of a Schmidt equal-area net for the eastern Swakop Terrane.

(a) F_2 and F_3 fold axes in the north-eastern portion of the upper Swakop River area.

(b) F_3 and F_4 fold axes and s_3 foliations in lower and middle schist on Grünfelde 47. Poles have been plotted to s_3 foliation. Mean s_3 = 340/54.

lineament separates upright F_3 folds of the Oseri Kari Synclinorium to the south (Fig. 7d) from southward vergent F_3 folds to the north (Fig. 9b).

4. DISCUSSION

To the west of the upper Swakop River area the Okahandja Lineament has been shown to be a fundamental tectonic and stratigraphic boundary (Miller, 1979) which separates the Khomas Terrane from the Swakop Terrane (Hoffmann, 1987). According to Miller (1983) its present surface expression is that of a large- F_3 monocline. It also coincides with late Nosib block faulting and has been interpreted as a major zone of crustal weakness.

This study has shown, however, that in the area east of Okahandja the stratigraphy and structural geology is the same on either side of the Okahandja Lineament. It is, therefore, unlikely that the lineament coincides with syndepositional block faulting. The only important difference is that no thrusts have been recognized in the Swakop Terrane. The choice of the Okahandja Lineament as a terrane boundary (cf. Schermer *et al*., 1984) is, therefore, not justified for the area to the east-north-east of Okahandja. It is suggested that in the upper Swakop River area the Khomas and Swakop Terranes form a single terrane and that the Okahandja Lineament became active for the first time during or just before the third phase of deformation.

The structure of the Damara Belt between Okahandja and Steinhausen can be interpreted in terms of a plate tectonic model. West-north-westward subduction resulted in intense deformation of basement and Damaran sediments in the Khomas Terrane. Thrusting at the base of the eastern Khomas Terrane produced the Onjona-Eleksie Nappe Complex, while the overlying Kuiseb schists were tightly folded. However, at least one major back thrust, the Otjongombe Thrust, propagated upwards into the Kuiseb schists. Between this thrust and the Okahandja Lineament a fore-arc basin developed into which the syntectonic sediments of the upper schist unit were deposited (Fig. 10). This fore-arc basin model is similar to that proposed by Blaine (1977).

Continental collision of the Congo and Kalahari Cratons resulted in abduction of the Khomas Terrane onto the northern edge of the Kalahari Craton and consequent large-scale thrusting in the Ekuja-Otjihangwe Nappe Complex and the Hakos-Auas Terrane (Kasch, 1986).

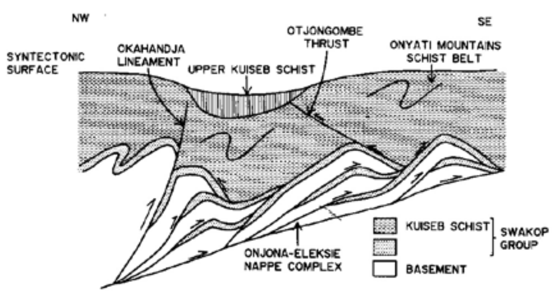

Fig. 10: Idealized, schematic north-west–south-east section of the upper Swakop River area east of Okahandja.

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