2. The Rooiberg Felsite Group.

2.1. Field Relationships.

East of Groblersdal the Rooiberg Group occupies a synformal structure which Clubley-Armstrong and Sharpe (1979) and Walraven (1982) respectively termed the Maleoskop and Angewezen basin. The felsites are intruded by a thick sill of Stavoren Granophyre, which separates an upper unit of comparatively unaltered felsites from a lower unit of metafelsites. The metafelsites overlie the upper zone of the Rustenburg Layered Suite along the foot of the escarpment on the farms Weltevreden 165JS and Haakdoringdraai 169JS, and thicken towards the east.

Several investigators have attempted to subdivide the Rooiberg Felsite Group into different stratigraphic units. Von Gruenewaldt (1968) proposed a three-fold division for an area north of Middelburg which he subsequently applied to the area to the east of the study area (Von Gruenewaldt, 1971). The following subdivision was suggested:

1. A lower felsite zone, which is in contact with rocks of the upper zone of the Layered Sequence and therefore consists mostly of metafelsite.

2. A middle felsite zone, consisting of a thin layer of amygdaloidal lava, occurs immediately above the Stavoren Granophyre, which separates it from the lower felsite zone.

3. An upper felsite zone of massive, porphyritic and non-porphyritic varieties, forming the bulk of the felsites outcropping on the Sekhukhune Plateau.

Clubley-Armstrong (1977) suggested a broad subdivision of the felsites in the Loskopdam-Middelburg region, including the areas mapped by Von Gruenewaldt (1968, 1971), into a lower Damwal Formation and an upper Selons River Formation.

Details of Clubley-Armstrong's classification are presented in Table 2.1., where some tentative correlations with Von Gruenewaldt's stratigraphic units are proposed.

Metafelsites, constitute the lowest portion of the Rooiberg felsite. The metamorphosed lavas include dark brown porphyritic types, massive magnetite-rich types and dark brown micrographic types. These are highly recrystallized and partially melted rock types and their original textures are therefore largely obliterated. Flow-banding and agglomeratic textures, however, are still recognizable in these rocks (Fig.2.1 and 2.2).

In the linear metafelsite and granophyre ridge on Weltevreden 165JS and Rietkloof 166JS (Fig.2.3), only a thin layer of metafelsite, dipping at 5° to the west, is present on the western side of the ridge. Micrographophyre is in contact with mafic rocks where metafelsite is absent.

Different stages of recrystallization, reflected by the increasing coarseness of micrographic intergrowth, can be recognized in the metafelsite horizon. Features such as veins of leucocratic microgranite, cutting irregulary through the metafelsite, and veins and pockets of granodiorite with inclusions of metafelsite were observed (Fig.2.4 and 2.5). A detailed description of these features was provided by Von Gruenewaldt (1971) and is therefore not included here.

A thin layer of amygdaloidal felsite, recognized by Von Gruenewaldt (1971) in the area to the east, peters out to the west. This amygdaloidal felsite is the only rocktype representative of the middle felsite zone. It crops out near the contact with granophyre on the farm Hartbeestlaagte 162JS and attains a thickness of 100 metres.

The upper felsite zone, which apparently corresponds to the lower Selons River Formation, represents the bulk

Table 2.1. Correlations of Clubley-Armstrong's (1977) and Von Gruenewaldt's (1968 and 1971) classification of the Roolberg Felsite.

Formation	Member	Loskopdam and Middelburg Clubley-Armstrong (1977)	Zone	North of Middelburg Von Gruenewaldt (1968)	Sekhukhune Plateau Von Gruenewaldt (1971) and this study
SELONSRIVER FORMATION	Klipnek Felsite Member	red porphyritic felsite mainly flowbanded	Upper Felsite Zone		
	Doornkloof Felsite Member	dark, laminated mudstone Union Tin tuff member black felsite and amygdaloidal felsite underlain by porphyritic variety and impersistent pyroclastics		shale, well-bedded	
				purple agglomerate	red-brown porphyritic felsite
		red porphyritic felsite mainly massive with occasional sandstone layers, tuff and quartzite xenoliths		reddish-brown porphyritic felsite	quartzite layer red porphyritic felsite mainly massive with impersistent pyroclastics and quartzite xenoliths
				agglomerate quartzite amygdaloidal felsite	thin amygdaloidal felsite
		sandstone/quartzite layer		dual-marker: quartzite	
DAMWAL FORMATION		agglomerate, sandstone layers black felsite	Middle Felsite Zone	with agglomerate below black and glassy porphyritic felsite	
		large discshaped amygdales		amygdales up to 30 centimeter in diameter	
		black variable felsite mainly porphyritic and pseudospherulitic interbedded with discontinuous layers of black glassy felsite, amygdaloidal felsite, agglomerate, tuff and sandstone		black amygdaloidal felsite pseudospherulitic felsite irregular lenses of quartzite	
		granophyric red felsite micrographic felsite leptite	Lower Felsite Zone	microgranophyre, granophyre and microgranite leptite	microgranophyre, granophyre and microgranite metafelsite (leptite)

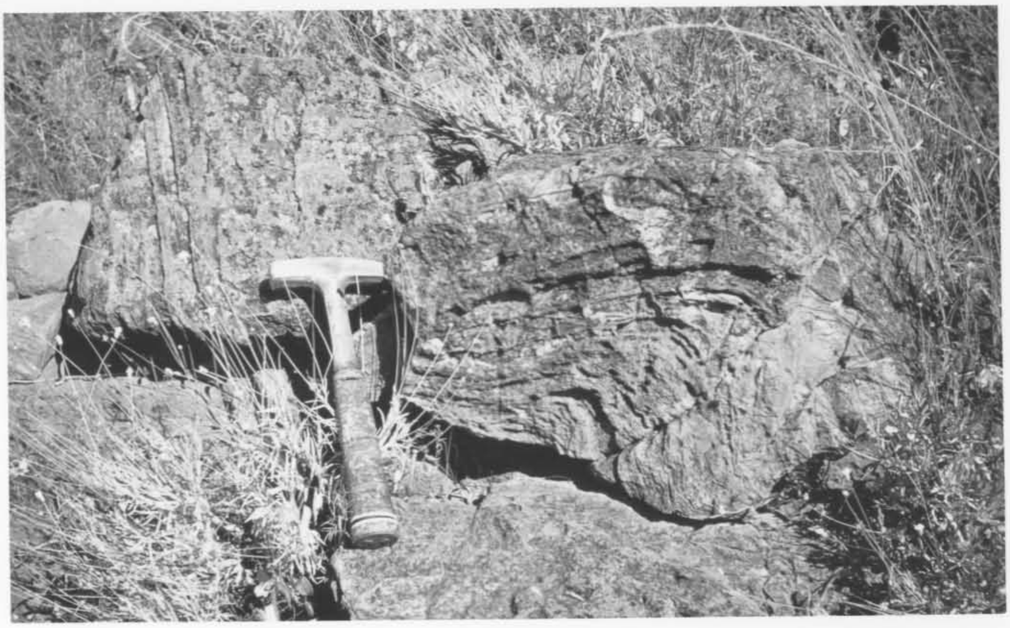

Fig. 2.1.: Flowbanding preserved in metafelsite. Weltevreden 165JS.

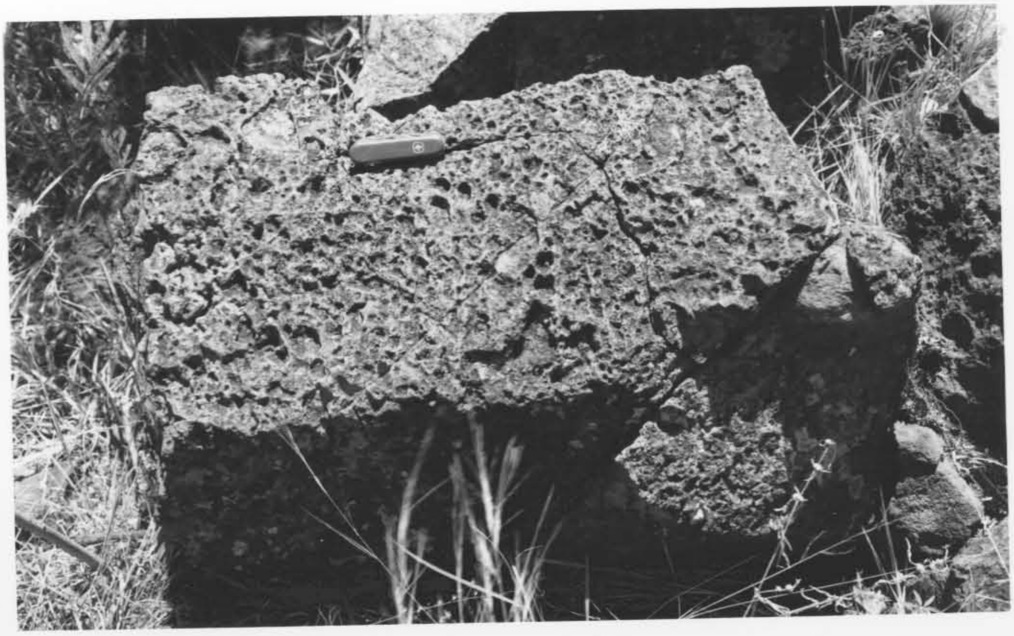

Fig. 2.2.: Agglomeratic textures recognizable in metafelsite. Weltevreden 165JS.

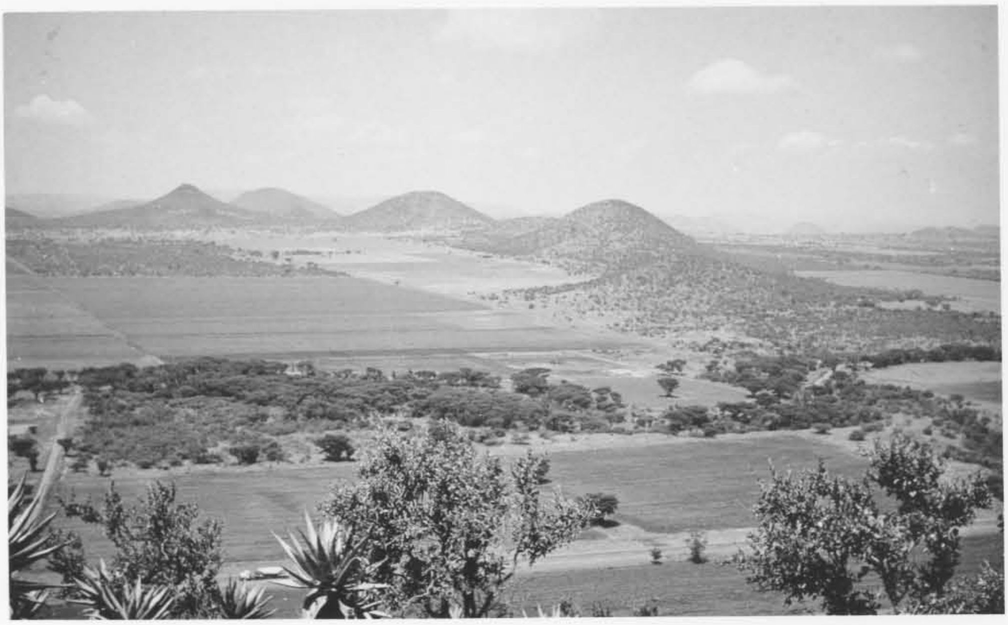

Fig. 2.3.: The metafelsite ridge on Weltevreden 165JS and the three prominent magnetite plugs on Rietkloof 166JS in the background.

Fig. 2.4.: Veins of leucocratic microgranite (to the left of the hammer) cutting irregulary through metafelsite. Weltevreden 165JS.

of the felsites in the Aangewezen basin. These rocks comprise porphyritic and non-porphyritic, massive red and black felsites, sometimes flow-banded (Fig.2.6) and/or amygdalcidal, and interstratified with occasional layers of agglomerate (Fig.2.7) and tuff (Fig.2.8).

Because of the gentle centripetal dips of the felsites in the Aangewezen basin, about 5-10° in the north and 30° in the south, the variety of rock types exposed is limited. This makes it difficult to correlate the sequence with that of areas like Loskopdam, where the dips are steep and a thick succession is exposed.

It should be noted that the metafelsites are not a specific stratigraphic unit in the Rooiberg Group. Depending on the depth at which the layered rocks intruded and on the amount of melting of felsite (Von Gruenewaldt, 1971), the metafelsite unit may be developed at any level in the Rooiberg Group.

2.2. Petrography of the felsite.

The felsites of the Aangewezen basin are mainly massive and porphyritic to glomeroporphyritic with altered plagioclase phenocrysts (0,5 to 3,0 mm) and rare quartz phenocrysts (0,5 to 1,0 mm) set in a fine-grained groundmass. The groundmass is composed of quartz, feldspar, hornblende and opaque particles.

Magnetite is the major opaque mineral and contains exsolution lamellae of ilmenite. Apatite, calcite, rutile, sphene and zircon were found as accessory minerals in these rocks. Most of the accessory phases were analysed with the SEM, because microscopic identification was not possible in the fine-grained groundmass.

Quartz needles (0,5 to 1,0.mm), pseudomorphous after tridymite, are common in some varieties. It is evident that

Fig. 2.5.: Inclusion of metafelsite in granodiorite. Weltevreden 165JS.

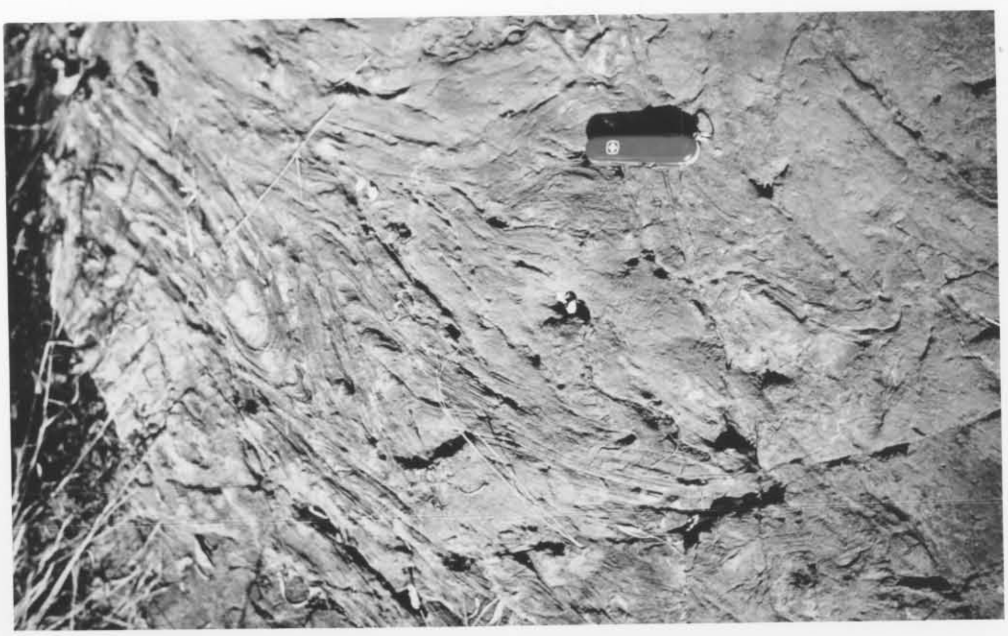

Fig. 2.6.: Intense flowbanding in Rooiberg Felsite. Kwaggavoetpad 163JS.

Fig. 2.7.: Agglomerate. Mooiplaats 121JS.

Fig. 2.8.: Tuff. Hartbeestlaagte 162JS.

they formed by the inversion of tridymite to quartz, because every needle can consist of different orientations of quartz (Fig.2.9). Clusters of quartz needles with the same extinction (Fig.2.10) are also considered to represent quartz after tridymite. In such cases the original small tridymite needles were replaced by quartz, resulting in a group with the same orientation.

Amygdales in the felsites (Fig.2.11) are composed of quartz and rarely calcite. They may be surrounded by spherulites which show characteristic extinction crosses.

Agglomerates are sericitized and it is difficult to make out the original features of these rocks (Fig.2.12).

2.3. Petrography of the metafelsite.

The metafelsites are recrystallized felsites, with the degree of recrystallization depending on the distance from the contact with the rocks of the upper zone. Melting of the rocks has taken place where they were in contact with the magma of the Rustenburg Layered Suite, resulting in the development of granitic veinlets and patches of restite or basic fronts.

The metafelsites may be derived from porphyritic felsites, fine-grained massive felsites with or without flow-banding, amygdaloidal and spherulitic varieties or pyroclastic rocks.

Recrystallization of porphyritic felsite typically produces a granoblastic polygonal groundmass comprising quartz, feldspar, clinopyroxene, chlorite, magnetite and sphene and containing relict altered phenocrysts, presumably altered feldspar (Fig.2.13). The sphene content is variable and in some instances it is only an accessory phase. Hornblende may be a major constituent of the rocks, depending on the metamorphic grade and the original composition of the rock. Other accessory minerals in the metafelsites are apatite, ilmenite,

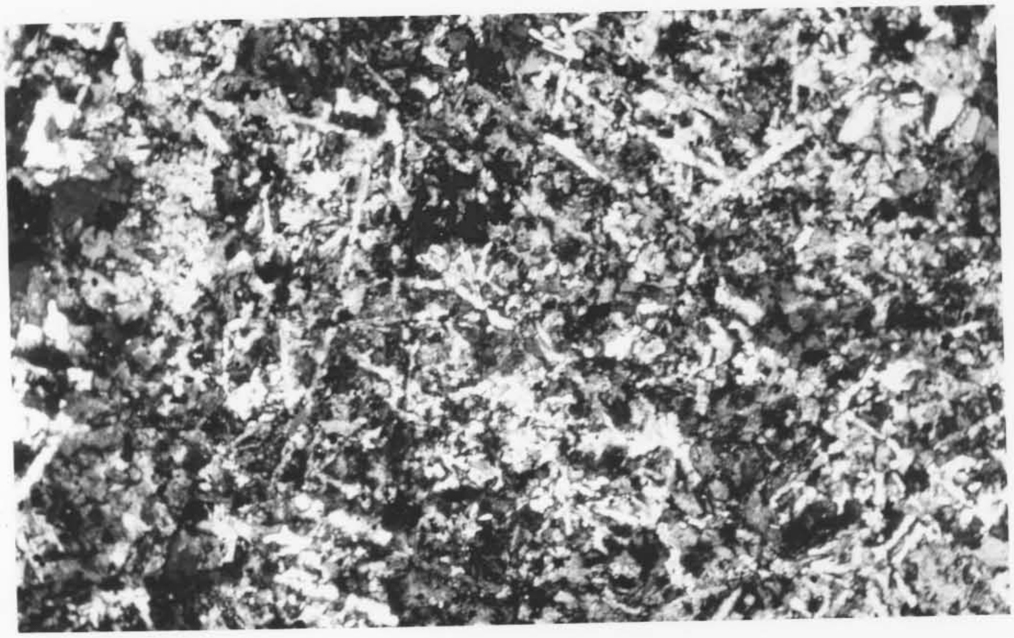

Fig. 2.9.: Tridymite needles in Rooiberg Felsite, where segments with different optical orientations are developed in one needle. F-67. X-Nicols. 63x. Kwaggavoetpad 163JS.

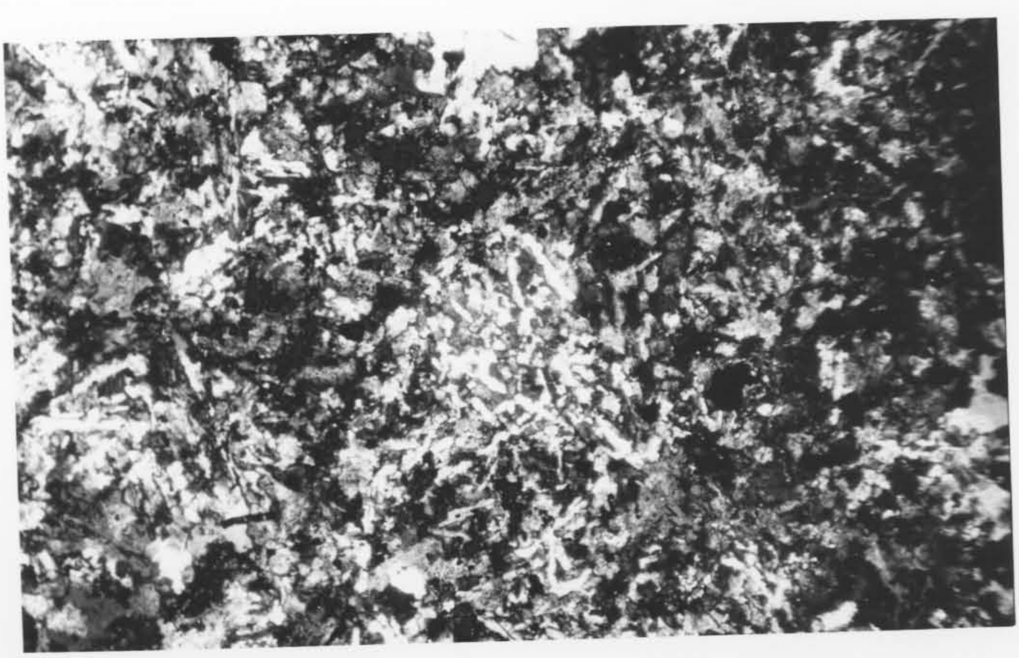

Fig. 2.10.: A group of tridymite needles with uniform extinction in Rooiberg Felsite, representing a secondary quartz grain. F-60. X-Nicols. 63x. Kwaggavoetpad 163JS.

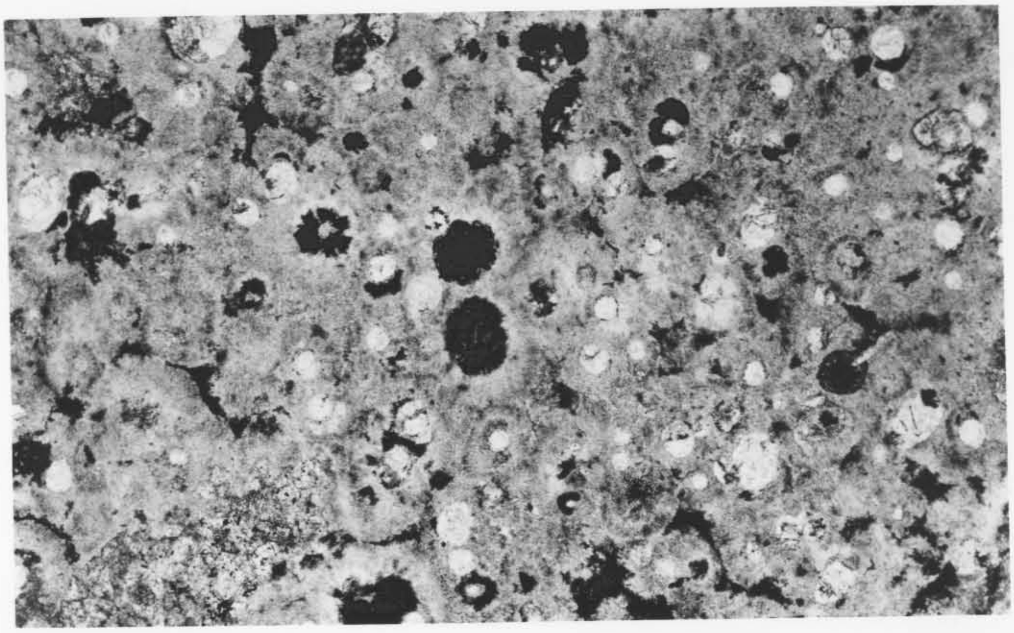

Fig. 2.11.: Spherulites around amygdales in felsite. F-80. 25x. Kwaggavoetpad 163JS.

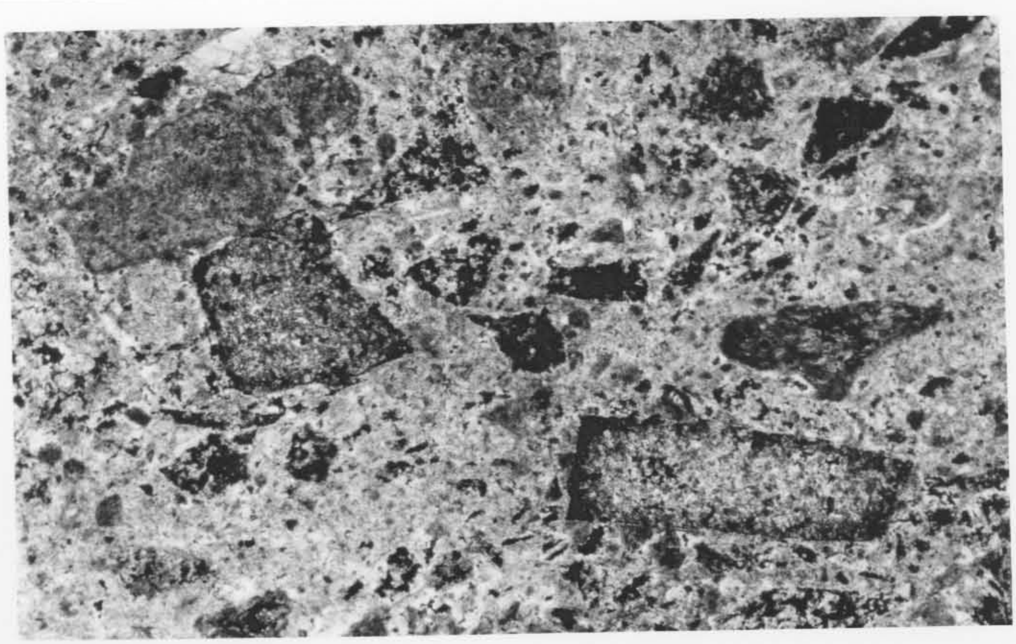

Fig. 2.12.: Agglomerate. F-81. 25x. Kwaggavoetpad 163JS.

pyrite and zircon.

The abundance of sphene in the metafelsites is probably caused by the replacement of magnetite by sphene. The sphene usually forms rims around magnetite (Fig.2.14), but in some cases the magnetite is completely replaced. Sphene rims and magnetite grains are closely associated with apatite (Fig.2.15).

Microprobe analyses revealed the magnetite rimmed by sphene to contain about twice the TiO_2 concentration of their unrimmed counterparts (Appendix 1). Magnetite grains rimmed by sphene are always larger (>0,2 mm in diameter) than the unrimmed grains. It is considered that the large magnetite grains with sphene rims were present in the rock before metamorphism and that they reacted in the presence of H_2O with CaO to form sphene. The small grains of Ti-poor magnetite crystallized in the original Fe-rich glassy groundmass during metamorphism.

A similar feature was observed by Janardan Rao et al. (1973) in the Hyderabad Granites, Andhra Pradesh, India. However, in this case the sphene coronas formed by metamorphic reaction involving the breakdown of hornblende to plagioclase with the release of iron to form magnetite and release of Ca and Ti to form the sphene coronas around the magnetite. They concluded that the rims of sphene around magnetite originated during regional metamorphism at elevated temperatures in a water deficient environment.

The clinopyroxene in the metafelsite which, together with magnetite, quartz and feldspars forms a granoblastic polygonal texture (Fig.2.13), is considered to have formed as a result of the metamorphic breakdown of hornblende and biotite. Microprobe analyses of the clinopyroxenes show that these are normal salites (Appendix 1).

Pool textures consisting of quartz and feldspar surrounded

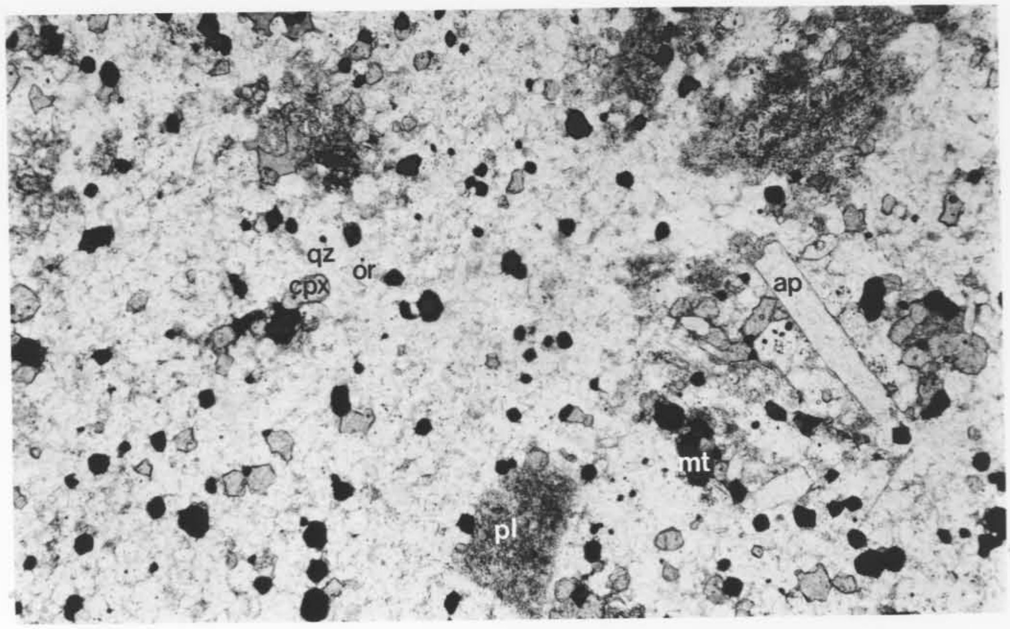

Fig. 2.13.: Granoblastic polygonal texture in metafelsite composed of altered plagioclase phenocrysts (pl), clinopyroxene (cpx), magnetite (mt) and apatite phenocrysts (ap). The white areas are represented by quartz (qz) and K-feldspar (or). GR-80. 63x. Haakdoorndraai 169JS.

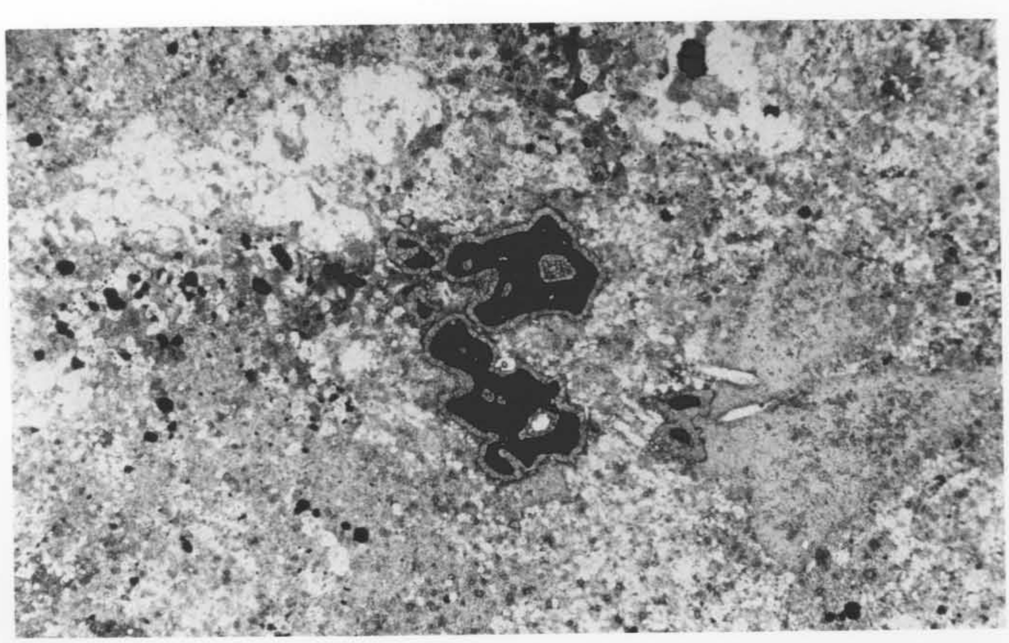

Fig. 2.14.: Sphene rim around magnetite in metafelsite. GR-86. 25x. Haakdoorndraai 169JS.

by areas enriched in mafic minerals were observed in some sections (Fig.2.16). These may have formed by melting of felsite, where the areas rich in mafic minerals represent the restite and the pools of quartz and feldspar areas of incipient melting, which may eventually have coalesced to form the veins of leucogranite that cut irregularly through the metafelsite.

Micrographic varieties of the metafelsite (Fig.2.17) tend to become coarser towards the contact with the layered rocks (Von Gruenewaldt 1968). The development of micrographic intergrowths seems to depend on the nature of the source rock. Where the source rock was spherulitic it could have produced a micrographic intergrowth on metamorphism, whereas a glassy source rock probably produced a granitic or granoblastic polygonal texture. They differ from the Stavoren Granophyre in that they contain an irregular intergrowth without the hourglass texture or radiating fringe texture (see Chapter 3.2), which characterizes the latter. Because most samples contain corroded and very altered phenocrysts of plagioclase and clinopyroxene as major constituents, and a different type of quartz-feldspar intergrowth compared to the Stavoren Granophyre, these rocks are considered to have originated by metamorphism of porphyritic felsite by the Layered Suite. They are the equivalents of the so-called micrographic felsites of Von Gruenewaldt (1968).

Similar, fayalite-bearing micrographic varieties are present on Loskop Suid 53JS, where they overlie the Nebo Granite. The presence of fayalite in these rocks may point to a different origin, as this mineral was not found elsewhere in the felsites or the metafelsites.

Some metafelsites are rich in mafic minerals (Fig.2.18), like clinopyroxene and chlorite; the chlorite in such rocks is probably of retrograde metamorphic origin.

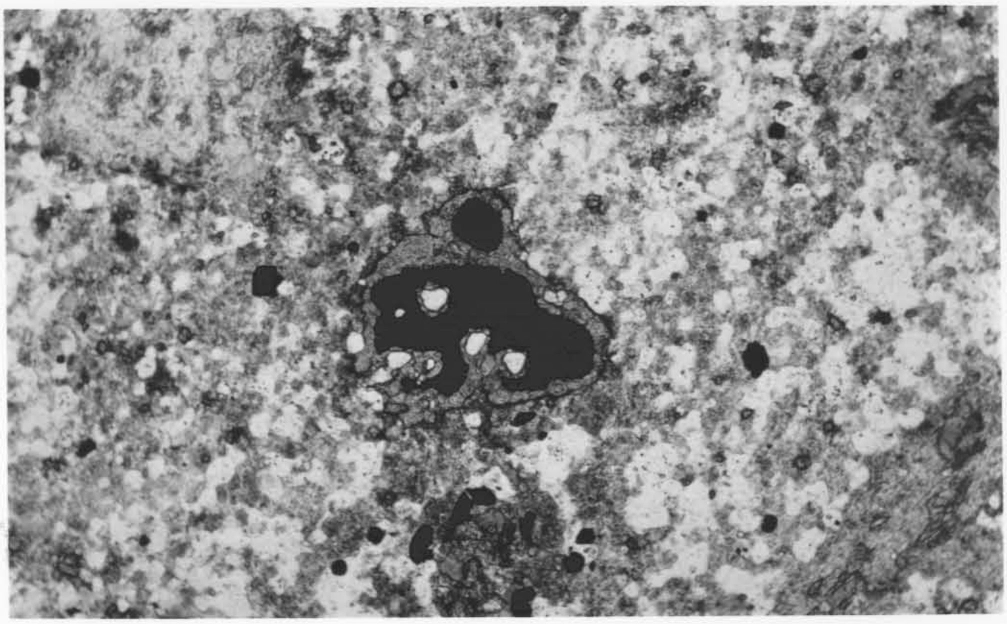

Fig. 2.15.: Magnetite rimmed by sphene with which apatite is closely associated. Metafelsite. GR-86. 63x. Haakdoorndraai 169JS.

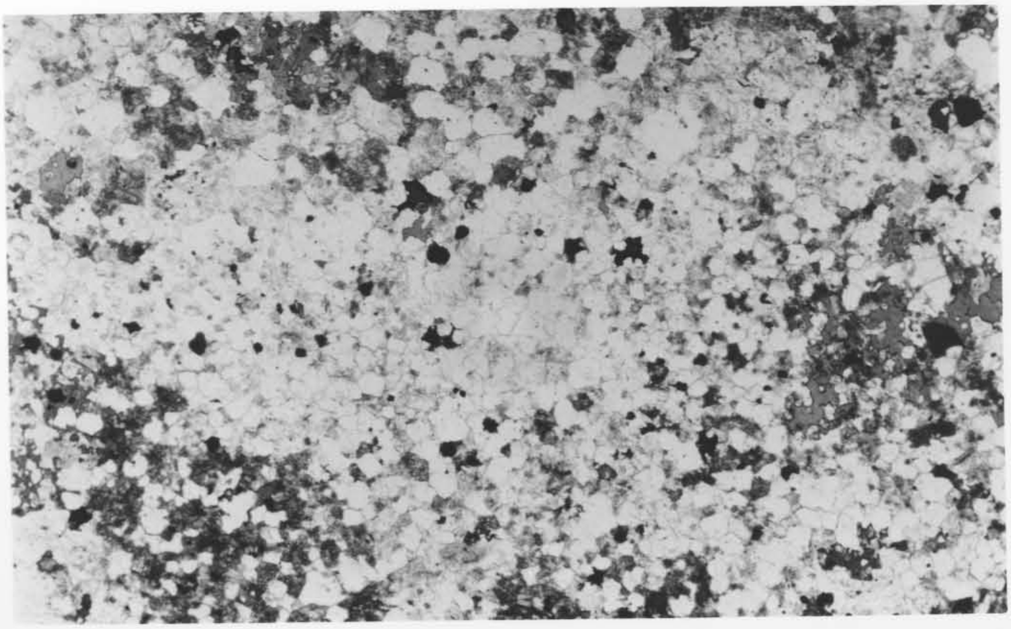

Fig. 2.16.: K-feldspar-quartz pool texture in metafelsite. GR-55. 25x. Weltevreden 165JS.

Fig. 2.17.: Micrographic intergrowth in metafelsite. GR-48. X-Nicols. 25x. Weltevreden 165JS.

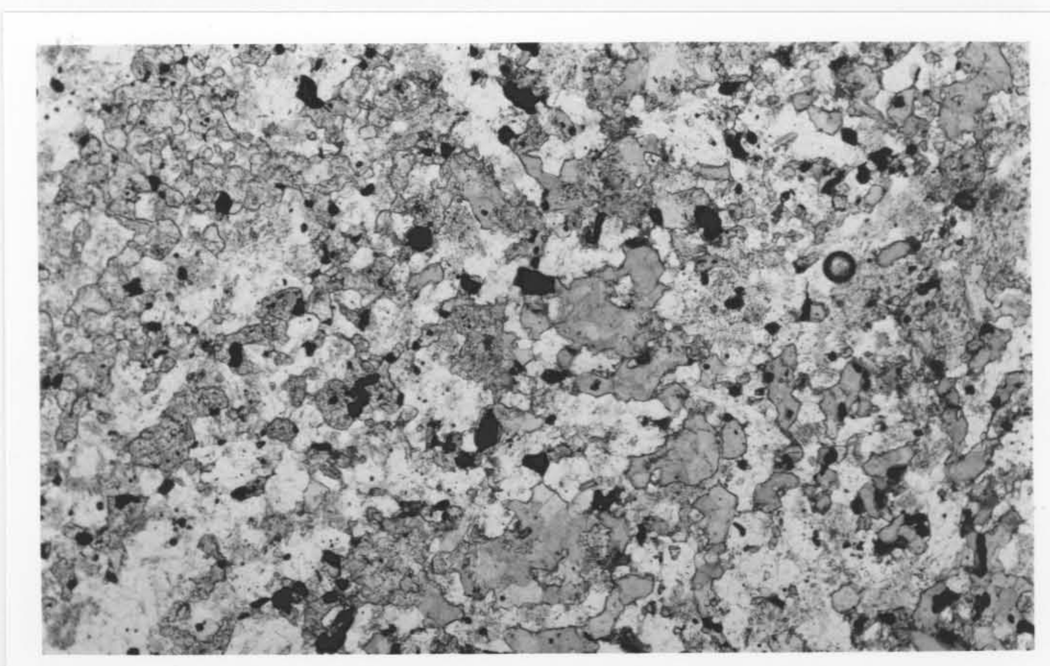

Fig. 2.18.: Chlorite- and clinopyroxene-rich metafelsite. GR-43. 63x. Weltevreden 165JS.