ECONOMIC GEOLOGY RESEARCH UNIT

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A GENERAL GEOLOGICAL DESCRIPTION OF THE ARCHAEAN GRANITIC TERRANE BETWEEN NELSPRUIT AND BUSHBUCKRIDGE, EASTERN TRANSVAAL

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INFORMATION CIRCULAR No. 111

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by

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ABSTRACT

The Archaean granitic terrane between Nelspruit and Bushbuckridge in the eastern Transvaal has recently been the subject of study under the auspices of the South African Geodynamics Project. Six distinct granitic phases, some of them hitherto unrecognized, are found to underlie the area. These are described as :

(i) The Tonalite Gneisses and Migmatites;
(ii) The Nelspruit Migmatite and Gneiss Terrane;
(iii) The Nelspruit Porphyritic Granite;
(iv) The Hebron Granodiorite;
(v) The Cunning Moor Tonalite; and
(vi) The Mpageni Granite Pluton.

Each granitic type is briefly described and a model is presented which attempts to synthesize the current views on the evolution of the granitic crust in the region.

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I. INTRODUCTION

Geological research in South Africa has, over the last three years, received considerable impetus from its involvement in the Geodynamics Project. One area currently being examined under the auspices of the South African Geodynamics Project is the granitic terrane to the north and south of the Barberton greenstone belt (Figure 1). Whereas in the past, the Barberton greenstone belt itself had been examined in great detail (particularly during the Upper Mantle Project, 1964-1969), the surrounding granitic terrane, with the possible exclusion of Swaziland, has received

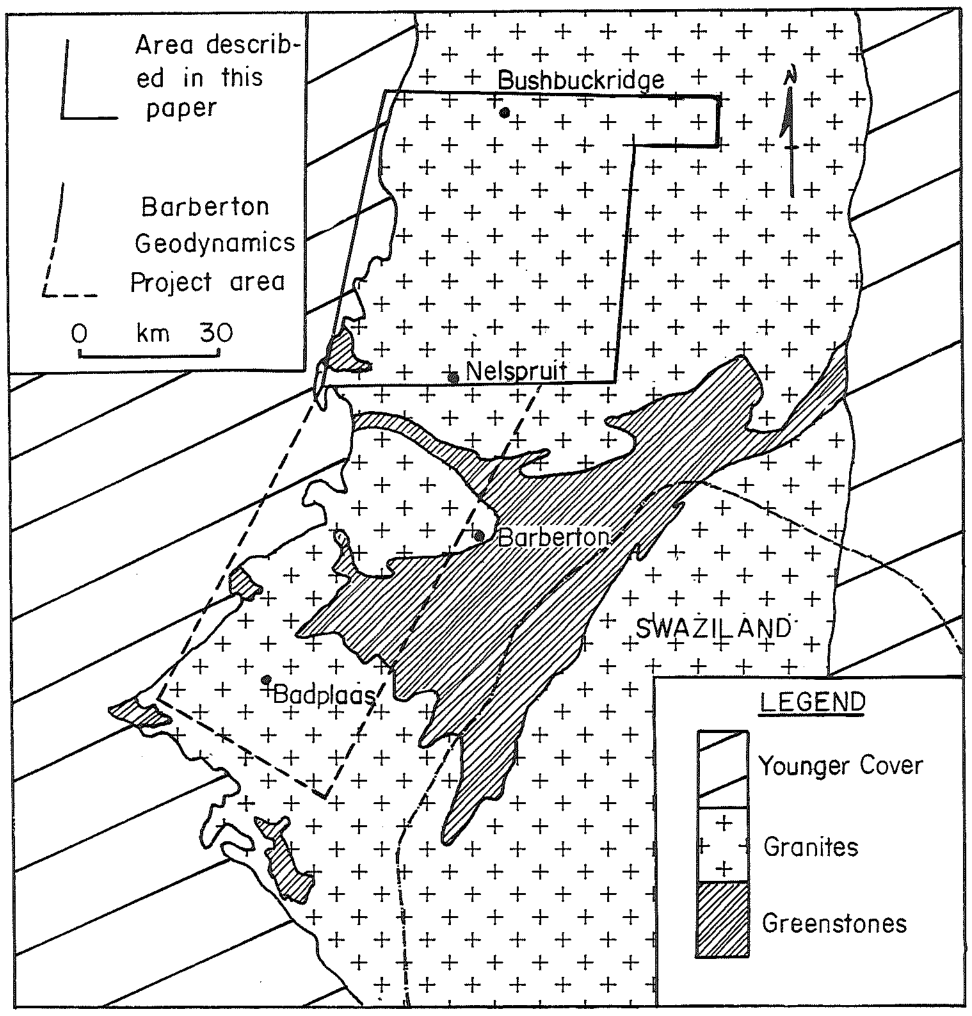

Figure 1 : *Locality map showing the area described in this paper as well as the study strip being investigated as part of the Geodynamics Project in the eastern Transvaal Lowveld.*

only cursory examination. In particular, little was known of the so-called "Nelspruit Migmatites and Gneisses" thought to underlie most of the granitic terrane to the north of the Barberton greenstone belt. As a consequence the author has, over the past two years, been involved in a geological and geochemical investigation of the Archaean granitic terrane between Nelspruit and Bushbuckridge with the view to establishing more about the geological history and development of the region. This paper represents a brief summary of a more detailed examination which constitutes the subject matter of an M.Sc. dissertation entitled : "The geology and geochemistry of the Archaean granite-greenstone terrane between Nelspruit and Bushbuckridge, Eastern Transvaal" (Robb, 1977).

As mentioned previously, the Nelspruit-Bushbuckridge region has received little detailed geological attention and only brief descriptions of the area were made available by Hall (1918), du Toit (1926) and van Eeden (1941). It was du Toit, in fact, who suggested that these granitic rocks form, " ..... the foundation rocks of South Africa". In later years workers from the Geological Survey (Visser, compiler, 1956; Visser and Verwoerd, 1960) described the area in more detail and referred to it specifically as the "Nelspruit Granite".

Following the Upper Mantle Project studies the granitic terrane north of the Barberton greenstone belt was referred to by Viljoen and Viljoen (1969a) as the "Nelspruit Gneisses and Migmatites". These investigators presented a classification of the granitic types in the Barberton region in which all granites were considered to post-date the mafic and ultramafic rocks of the Onverwacht Group. In this classification rocks of tonalitic composition were generally considered to be older than the more potassic granite varieties. Hunter (1973) devised a granite classification similar to that proposed by Viljoen and Viljoen (1969a), but which was based largely on work carried out in Swaziland. This classification also recognized the antiquity of the sodic granitic varieties but differed fundamentally from the earlier classification in that tonalitic gneisses and migmatites were considered to pre-date rocks of the Swaziland Supergroup. These two classifications, therefore, represent standpoints from which the contrasting ideas regarding the nature of the earth's earliest crust in the eastern Transvaal Lowveld may be viewed.

Prior to the present study, the Nelspruit gneisses and migmatites were considered to represent a complex suite of essentially potassic rocks underlying most of the granitic terrane extending north of the Barberton Mountain Land. The age of this granitic suite was considered to be between 2,99 and 3,16 b.y. (de Gasparis, 1967; Oosthuyzen, 1970). This paper demonstrates that the Nelspruit-Bushbuckridge area consists, not only of the Nelspruit gneisses and migmatites, but, in addition, a variety of other granitic types previously unrecognized in the area.

II. GEOLOGICAL DESCRIPTION

The area mapped during the course of this study lies between Nelspruit, Bushbuckridge, the Transvaal Drakensberg Escarpment and the Kruger National Park. The area, covering some 2 500 km^2, was mapped on a regional basis with the aid of 1:30 000 aerial photographs.

Six distinct granite types were recognized in the region, these being portrayed in Figure 2. This map attempts, furthermore, to illustrate, not only the granite types, but also the textural variations within them.

A. The Tonalite Gneisses and Migmatites

The tonalite gneisses and migmatites are considered to represent the oldest granite varieties found in the area (Robb, 1977). They occupy limited outcrop areas in the southwestern and southeastern parts of the study region (Figure 2) and are found only in the immediate vicinity of greenstone remnants.

The rocks grouped into this granitic category are invariably gneissic with migmatites developed only in some areas. Where migmatites are developed the distinction between light bands (leucosome) and dark bands (paleosome) is generally apparent and the impression is clearly given that these migmatites may have formed as the result of the interaction between invading tonalitic material and pre-existing greenstone (mafic) material (Plate 1A).

The tonalite gneisses are generally pale-grey leuco-gneisses and are medium-to-fine-grained but may appear recrystallized in the vicinity of shear zones. They consist predominantly of quartz and plagioclase with lesser amounts of microcline and biotite. Much of the latter mineral has been chloritized. Sheared tonalite gneisses consist predominantly of sericite which is generally extremely finely crystalline. The effects of this sericite alteration markedly influences the chemistry of these gneisses, a feature that has been noted by other workers who have described changes in sheared tonalitic rocks (Visser and Verwoerd, 1960; Beach and Fyfe, 1972; Anhaeusser, 1973b). Chemical analyses available for the tonalitic gneisses in the study area (Robb, 1977) demonstrate that the sheared varieties are characterized by significantly higher K_2O concentrations than the unaffected tonalite gneisses. This is demonstrated in Figure 3 which also shows that most of the tonalitic gneisses from the study area fall within the compositional field of tonalites according to the classification of Harpum (1963). The average composition of these gneisses, from the areas east and west of Nelspruit, is given in Column 1, Table 1 .

The sheared tonalite gneisses found in the region exhibit K_2O/Na_2O ratios that are uncharacteristic of tonalites by virtue of their higher than average K_2O contents. To explain this anomaly Beach and Fyfe (1972) maintained that the increase in the K_2O content of mylonitized (sheared) rocks was due to the effects of local potash metasomatism.

B. The Nelspruit Migmatite and Gneiss Terrane

Large areas between Nelspruit and Bushbuckridge are underlain by rocks of generally potassic character but which are also gneissic or migmatitic (Figure 2). The migmatites and gneisses occurring in these areas are distinct, both texturally and chemically, from the tonalite gneisses and migmatites described earlier. They are generally coarser-textured and are also more diffuse in overall appearance than the tonalitic gneisses and migmatites (the distinction between paleosome and leucosome is not always clear - compare Plates 1A and 1B). As with the tonalitic granitic varieties outlined previously the Nelspruit migmatites and gneisses also exhibit a variety of textural-types including rafted, schlieric, folded and layered migmatites.

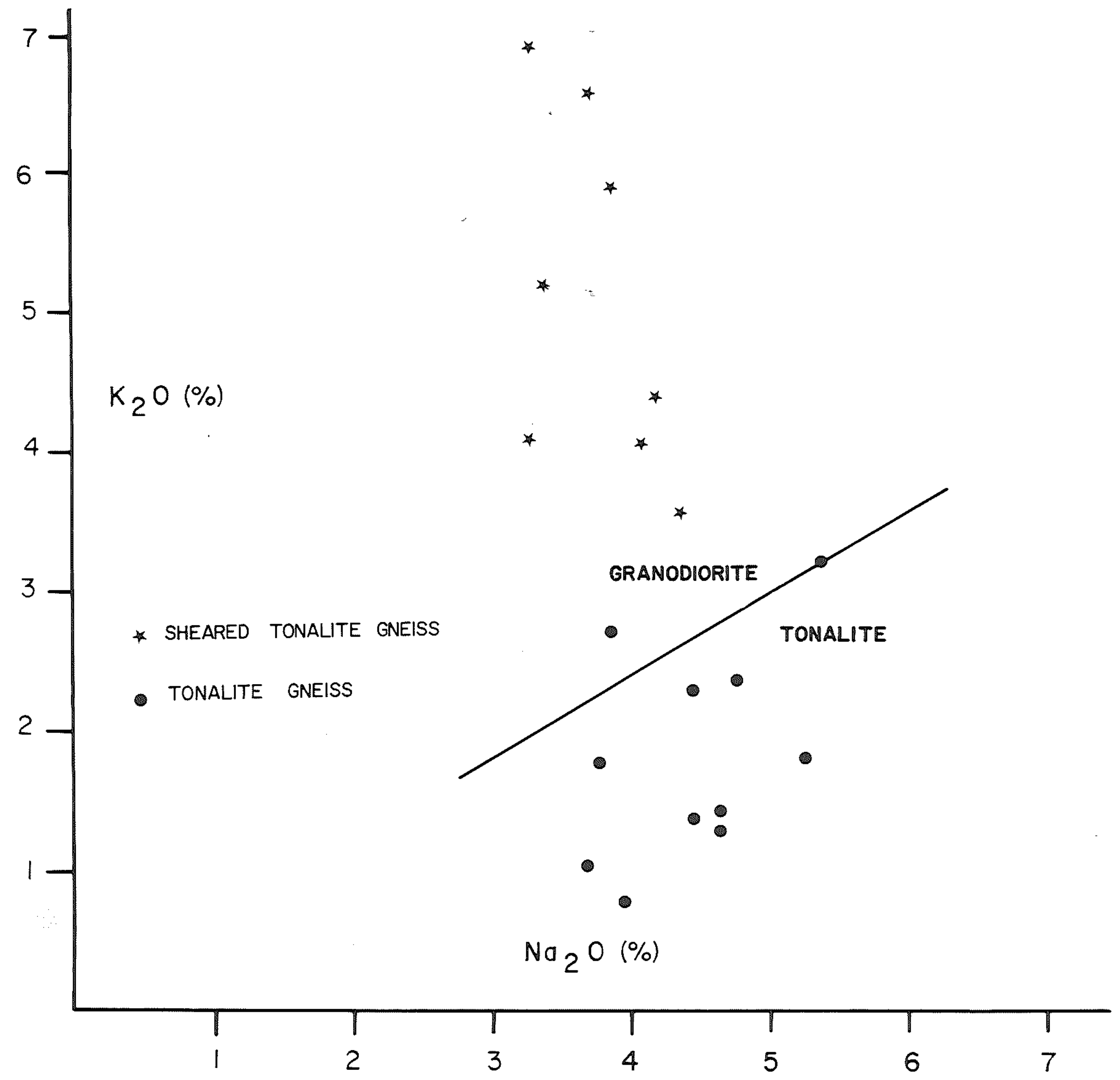

Figure 3 : *K_2O v Na_2O plot of samples from the Tonalite Gneisses and Migmatites (data from Robb, 1977).*

The leucosomes of the Nelspruit migmatites and gneisses consist predominantly of plagioclase, microcline and quartz, with minor amounts of biotite. The paleosomes generally contain prominent amounts of biotite with varying amounts of quartz and plagioclase. The felsic mineralogy of the paleosomes is considered to reflect the degree of "granitization" undergone by the mafic portions of the migmatites.

The chemical distinction between the Nelspruit Migmatite and Gneiss Terrane and the older Tonalite Gneisses and Migmatites is reflected in their respective K_2O/Na_2O ratios (compare Columns 1 and 2, Table 1). In addition, the available chemical analyses from the Nelspruit migmatites and gneisses demonstrates that there is a marked variation from sample to sample of some elements, particularly silica, total iron, magnesium, and potassium (Robb, 1977, p. 60). This variation is probably due to :

(i) the heterogeneous nature of the migmatite samples analyzed, and

(ii) the apparently differing degrees of "granitization" exhibited by the various migmatite types.

The range in compositions of the migmatites and gneiss are illustrated in the K_2O v Na_2O diagram (Figure 4) where a continuum of compositions extending from tonalitic through to granitic (*sensu stricto*) is portrayed. The average composition of Nelspruit migmatites and gneiss (excluding the paleosomes) is given in Table 1, Column 2.

The origin of migmatites has always posed a problem in the geological literature and the Nelspruit migmatites provide no exception. Considered simply, migmatites can form in two ways; firstly, by metamorphic differentiation whereby the paleosome and leucosome are segregated *in situ* (i.e. venitic in origin) and, secondly, by the intrusion of externally derived felsic material into pre-existing mafic material (i.e. arteritic in origin). The Nelspruit migmatites and gneisses were described by Viljoen and Viljoen (1969b) who favoured an arteritic origin for this suite of rocks, the latter involving metasomatic transformation by K-rich fluids or "ichors". A mass balance

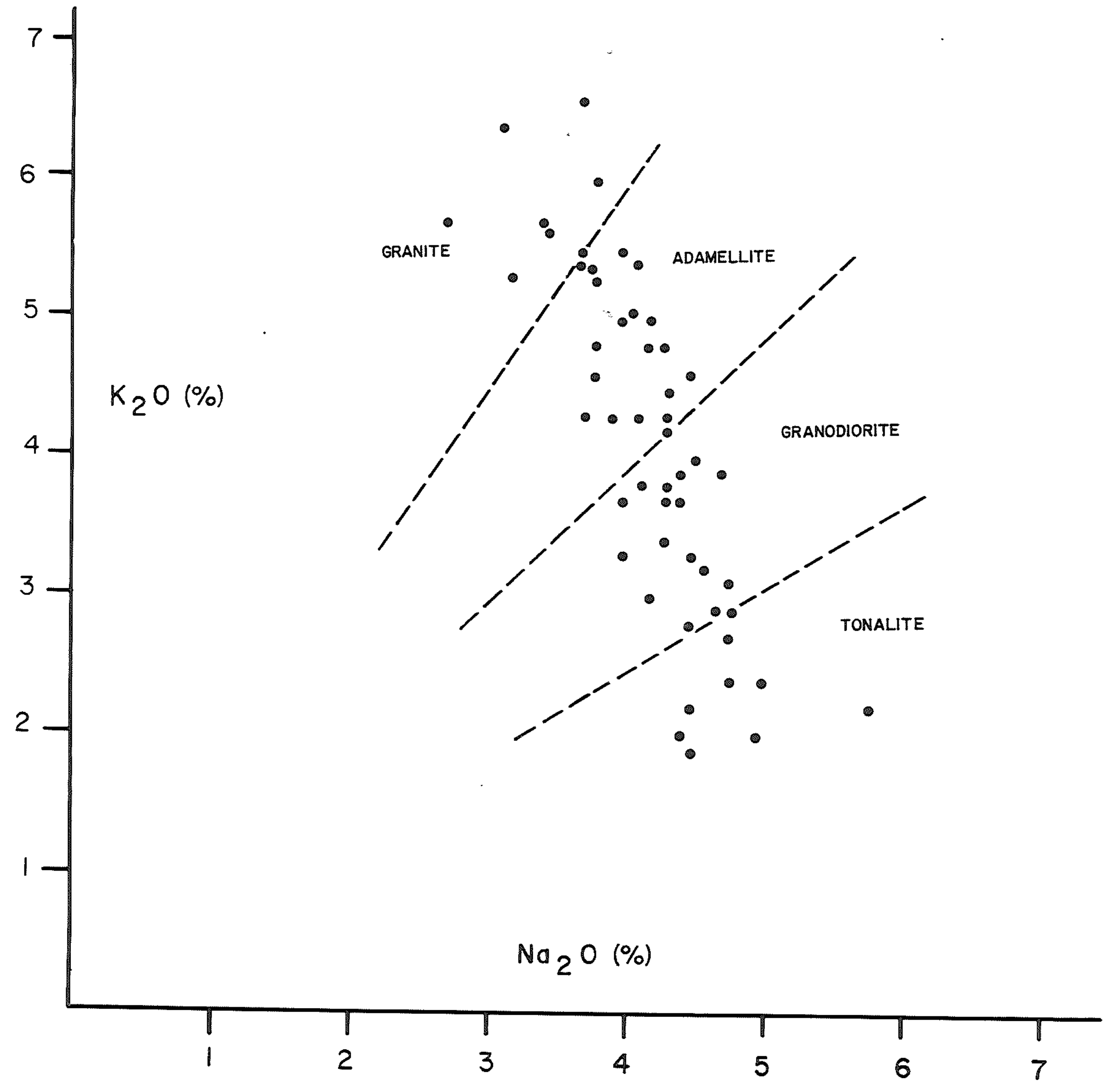

Figure 4 : *K_2O v Na_2O plot of samples from the Nelspruit Migmatite and Gneiss Terrane (data from Robb, 1977).*

experiment carried out by the writer on the migmatites and gneisses (Robb, 1977) tends to support an arteritic origin for these rocks but, rather than resorting to metasomatism as the process of formation, it is suggested that the migmatites may have developed as a result of the intrusion of a discrete granitic magma. Furthermore, it is suggested that this magma may be related to the Nelspruit Porphyritic Granite, and hence the Nelspruit Migmatite and Gneiss Terrane may be considered as being cogenetic with the former (see later).

C. The Nelspruit Porphyritic Granite

Most of the Archaean granitic terrane between Nelspruit and Bushbuckridge is underlain by the Nelspruit Porphyritic Granite (Figure 2) which is a massive, coarse-grained, grey-to-pink rock characterized by the almost ubiquitous presence of large microcline megacrysts. Three sub-divisions of the porphyritic granite are recognized in the field :

(i) an intensely porphyritic granite where large euhedral-to-subhedral microcline megacrysts may measure up to 30 mm in length and occupy in excess of 25 per cent of the volume of the rock (Plate 1C);

(ii) porphyritic granite in which the megacrysts are smaller than in the first category and are not so prominently developed and,

(iii) granites in which only a few, small, microcline megacrysts may be developed. The distribution of these textural varieties is portrayed in the regional geological map of the area (Figure 2). The second category of porphyritic granite outlined above occupies the major portion of the outcrop area whereas the slightly porphyritic granites occur in only one small area approximately 8 km to the south-southwest of White River. The best development of intensely porphyritic granite occurs in an arc-shaped belt immediately south of White River. It should,

TABLE 1

AVERAGE ANALYSES OF THE SIX PRINCIPAL GRANITE TYPES REPRESENTATIVE OF THE ARCHAEAN GRANITIC TERRANE IN THE NELSPRUIT - BUSHBUCKRIDGE AREA, EASTERN TRANSVAAL

	1	2	3	4	5	6
SiO_2	68,53	67,59	69,72	67,70	68,97	71,50
TiO_2	0,31	0,32	0,32	0,42	0,36	0,19
Al_2O_3	17,70	15,59	15,52	15,83	15,80	14,22
Fe_2O_3	2,92	2,39	2,18	2,83	2,52	2,31
MnO	0,06	0,05	0,05	0,05	0,06	0,05
MgO	1,81	1,29	0,95	1,72	1,61	1,11
CaO	2,56	2,29	2,02	2,41	2,72	1,51
Na_2O	4,36	3,95	4,31	4,22	4,98	4,27
K_2O	1,54	3,93	3,65	3,18	2,13	4,99
P_2O_5	0,01	0,08	0,04	0,11	0,01	0,08
L.O.I.	1,23	0,55	0,48	0,59	0,45	0,49
Totals	101,03	97,99	99,24	99,03	99,61	100,72
K_2O/Na_2O	0,35	0,99	0,85	0,75	0,43	1,17

[Note : Total iron as Fe_2O_3.
L.O.I. - Loss on ignition]

Columns : 1. Tonalite Gneisses and Migmatites (Average of 5 analyses)
2. Nelspruit Migmatite and Gneiss Terrane (Average of 9 analyses)
3. Nelspruit Porphyritic Granite (Average of 18 analyses)
4. Hebron Granodiorite (Average of 9 analyses)
5. Cunning Moor Tonalite (Average of 9 analyses)
6. Mpageni Granite Pluton (1 analysis)

Columns 1 - 5 after Robb (1977)
Column 6 after Visser and Verwoerd (1960)

furthermore, be noted that areas displaying intensely porphyritic textures also occur within the Nelspruit Migmatite and Gneiss Terrane, a feature indicating one of the similarities between the latter granitic subdivision and the porphyritic granite variety.

The Nelspruit Porphyritic Granite consists predominantly of microcline, plagioclase, quartz and biotite. The microcline generally occurs as large megacrysts but may also occur as finer, interstitial grains. The microcline megacrysts are markedly poikilitic and contain inclusions of plagioclase, quartz and biotite.

The Nelspruit Porphyritic Granite, like the Nelspruit migmatites and gneisses discussed earlier, is characterized by an unusually wide range in chemical composition. A K_2O v Na_2O plot of samples from the Nelspruit Porphyritic Granite (Figure 5) shows the existence of a continuum of compositions, from tonalitic through to granitic (*sensu stricto*), in a rock type which is characterized throughout by a very similar textural appearance. Further examination revealed that the trace element concentrations of this granite also exhibit wide compositional ranges, the pattern of which, it is maintained, is characteristic of a granite which has undergone fractional crystallization. This suggested mode of crystallization has been examined by McCarthy and Robb (1977) and has been found to adequately explain the wide range of major and trace element concentrations exhibited by this seemingly uniform granite type. McCarthy and Robb (1977) suggested that the

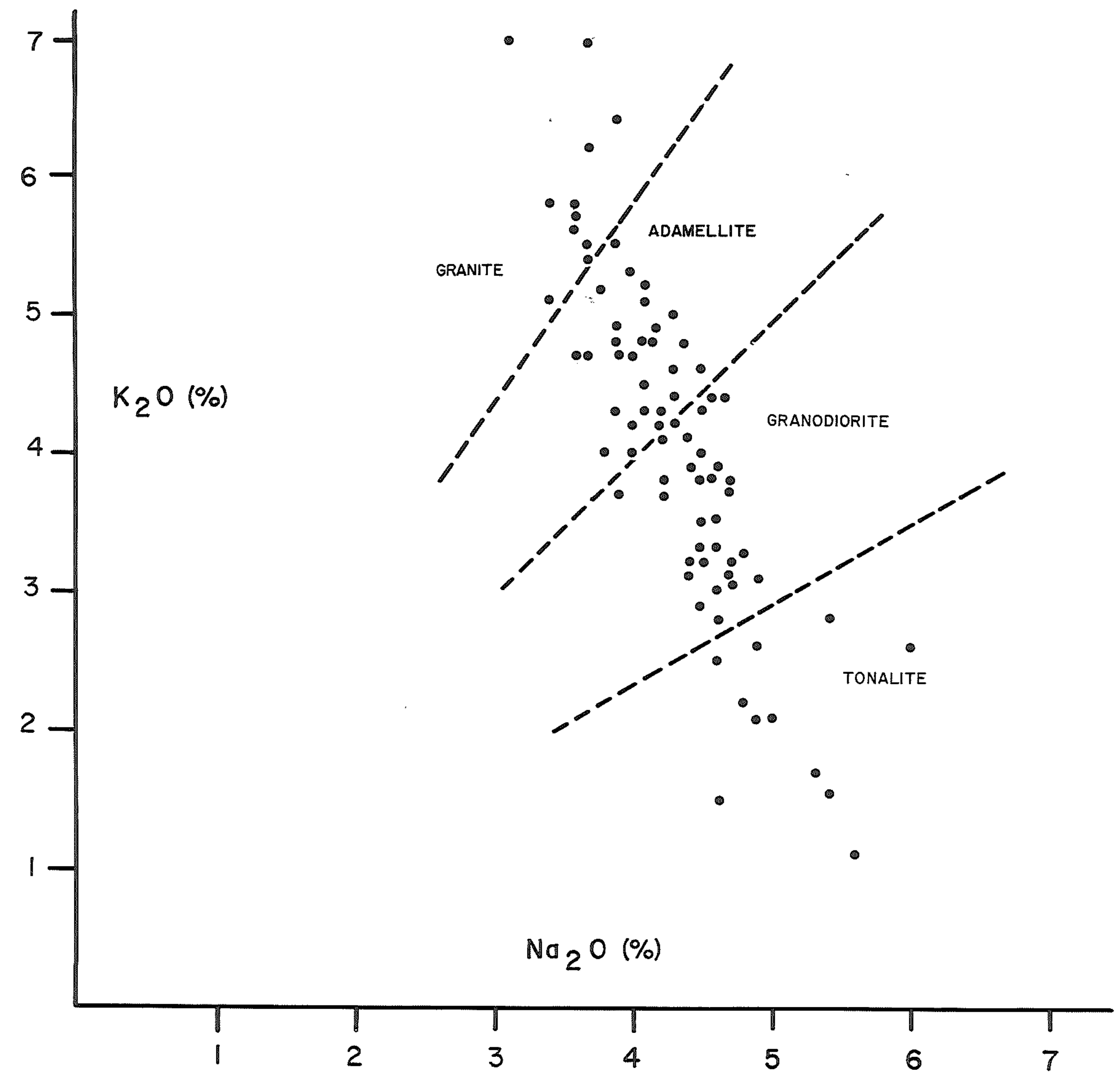

Figure 5 : *K_2O v Na_2O plot of samples from the Nelspruit Porphyritic Granite (data from Robb, 1977).*

Nelspruit Porphyritic Granite cooled very slowly allowing the initial crystallization of plagioclase and quartz to take place with the introduction of K-felspar on the liquidus only at a later stage in the crystallization history of the rock. Such a step-wise crystallization of granitic magma would have a marked effect on the major, and particularly the trace element distribution in the resulting solid. The regional distribution of major and trace elements also appears to have been influenced by this form of fractional crystallization in the Nelspruit Porphyritic Granite (Robb, 1977).

D. The Hebron Granodiorite

The Hebron Granodiorite is totally dissimilar to any other granite type in the area mapped, being massive, medium-grained, blue-grey in colour, and generally devoid of megacrysts. In the field the Hebron Granodiorite outcrops in two distinctive ways :

(i) as a discrete pluton-like body occurring to the NNW of White River (Figure 2), and

(ii) as veins and dykelets within the Nelspruit Porphyritic Granite.

In the latter case the Hebron Granodiorite occurs in bimodal association with the porphyritic granite (Figure 2). In the areas of bimodal development the Hebron Granodiorite appears to have intruded the porphyritic granite and hence is considered to post-date the latter. Plate 1D shows veins of Hebron Granodiorite intruding and apparently rafting off portions of coarser-grained porphyritic granite. It is considered that the pluton-like unimodal outcrop area, situated approximately 18 km northwest of White River, represents the focus of intrusion of the Hebron granodiorite body whereas the bimodal areas appear to have involved only localized veining, the latter accompanying the main intrusive event.

The Hebron Granodiorite consists predominantly of plagioclase, quartz and biotite, with lesser amounts of microcline and muscovite. Petrographically, little or no distinction exists between the granodiorites from the unimodal outcrop areas compared to those from the bimodal areas. The Hebron Granodiorite is also relatively homogeneous chemically, when compared with the Nelspruit Porphyritic Granite. The average composition of the Hebron body is given in Table 1, Column 4, and it is evident on the K_2O v Na_2O plot (Figure 6) that most of the samples analyzed cluster within the granodiorite field but are also transitional into the adamellite field. It is further apparent in this diagram that little chemical distinction exists between the granodiorites from the unimodal and bimodal outcrop areas.

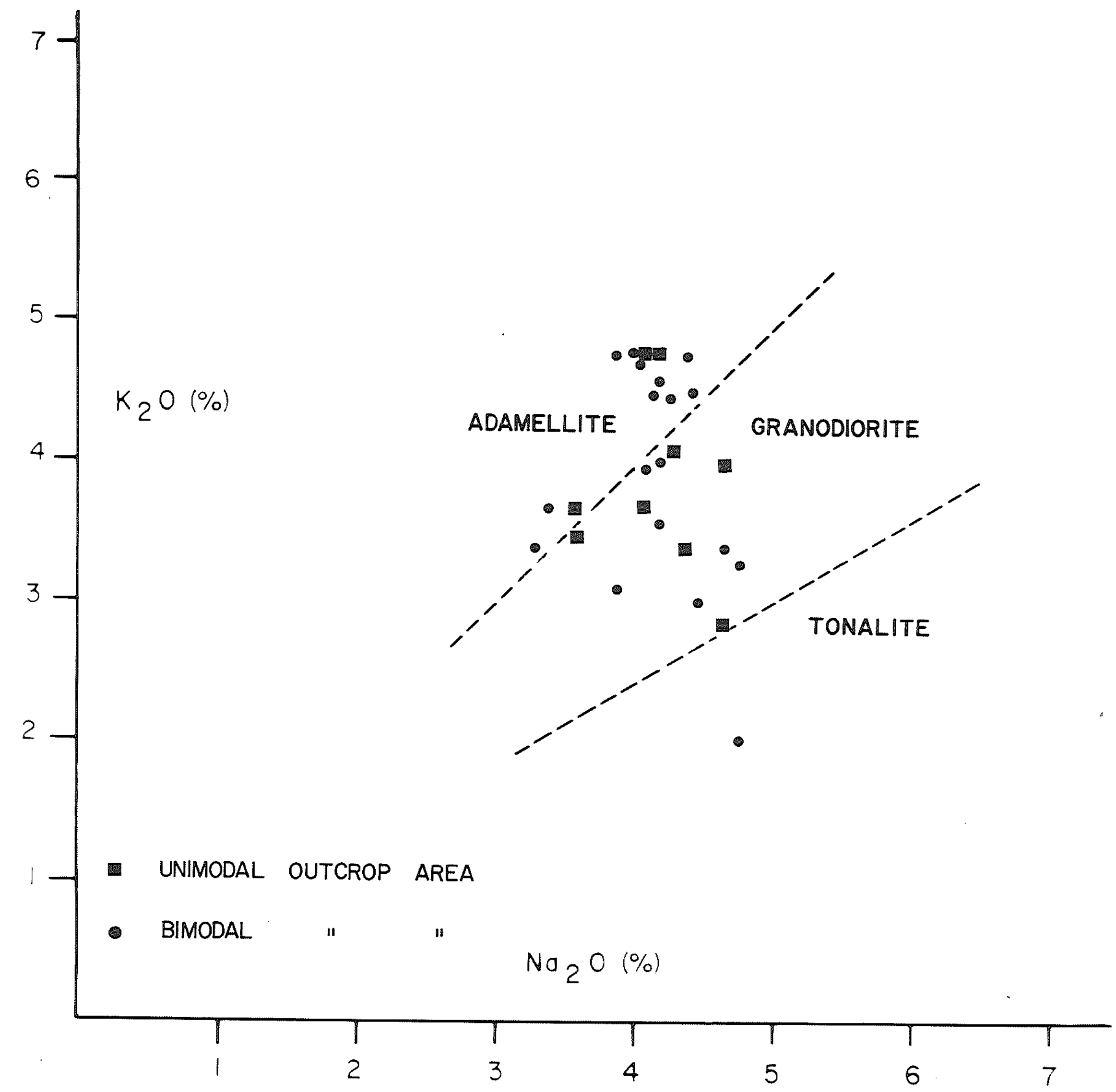

Figure 6 : *K_2O v Na_2O plot of samples from the Hebron Granodiorite (data from Robb, 1977).*

E. The Cunning Moor Tonalite

The Cunning Moor Tonalite occupies distinctive, flat, low-lying terrain in the northeastern portion of the area mapped (Figure 2, Plate 1E). Outcrops are generally poor, and the field relationships between the Cunning Moor Tonalite, the Nelspruit Migmatite and Gneiss Terrane and the Nelspruit Porphyritic Granite are not clear. The evidence available suggests, however, that the Cunning Moor Tonalite post-dates the porphyritic granite as well as the migmatites and gneisses. These relationships are further supported by preliminary age determinations (see later, and Robb, 1977).

By comparison with other Archaean tonalites encountered in the Barberton region (the latter being usually gneissic or migmatitic in appearance) the Cunning Moor Tonalite is a massive, medium-to-coarse-grained rock generally exhibiting an equigranular texture. Thin-section examinations revealed that the rocks consist predominantly of plagioclase and quartz with lesser amounts of microcline and biotite. The rock also commonly contains large (up to 3 mm in length), euhedral, poikilitic, grains of sphene.

The average composition of the Cunning Moor body is tonalitic according to Harpum's classification, with a K_2O/Na_2O ratio of 0,45 (Table 1, Column 5). Variations in composition also exist in this body, as is evident in the K_2O v Na_2O plot shown in Figure 7. Some samples fall within the granodiorite and even adamellitic fields but the majority of analyses cluster well within the tonalite field. The overall compositional spread appears to be related to variations in the microcline content of the rock, the latter mineral sometimes occurring as small, scattered, phenocrysts.

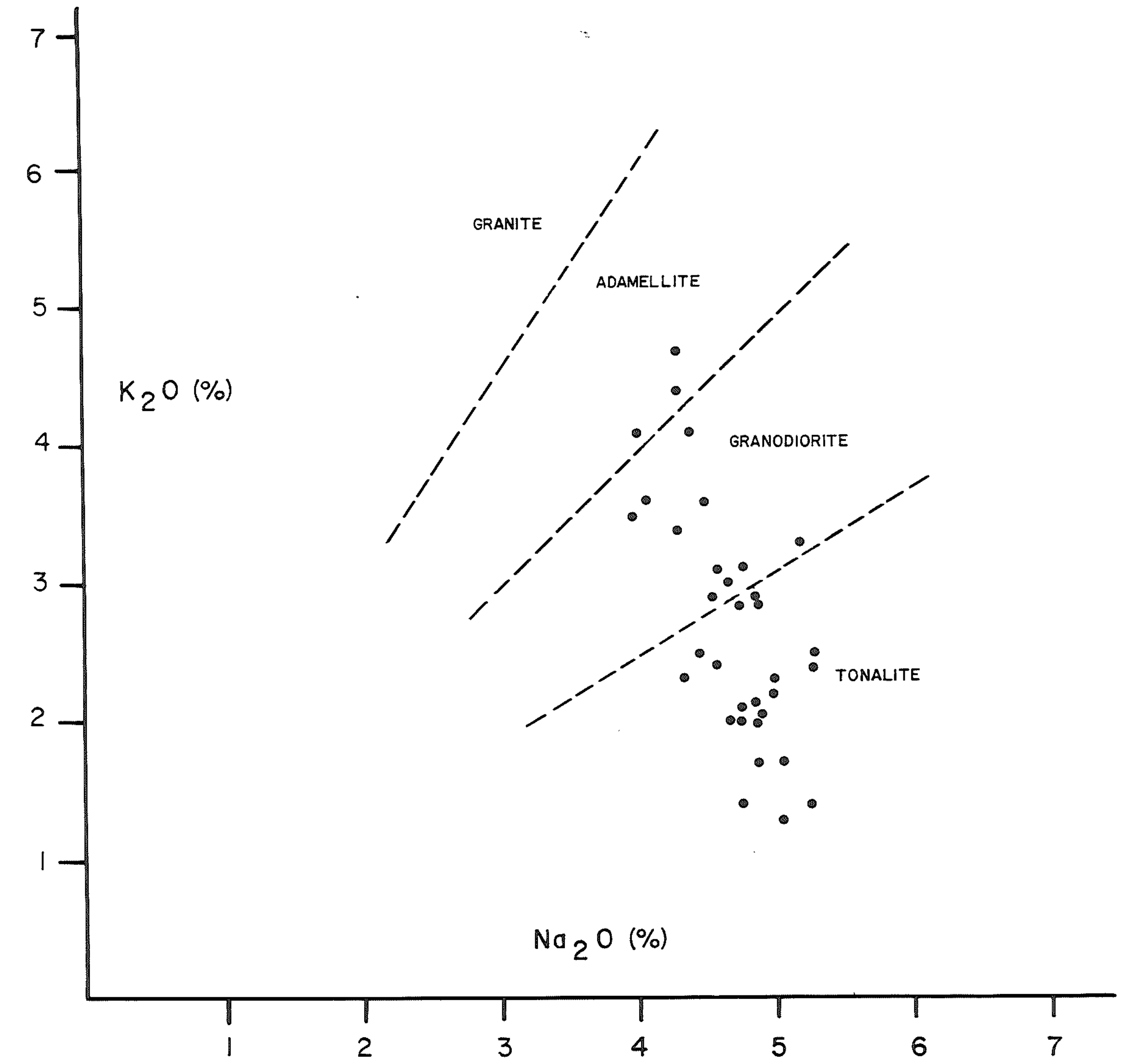

Figure 7 : *K_2O v Na_2O plot of samples from the Cunning Moor Tonalite (data from Robb, 1977).*

F. The Mpageni Granite Pluton

The Mpageni Granite pluton is situated in the southeastern portion of the study area, approximately 20 km due east of Nelspruit, where it occupies a small, topographically-distinct, pluton-like body (Figure 2, Plate 1F). The Mpageni pluton consists of a pinkish, coarse-grained, potassic granite which clearly intrudes the surrounding Nelspruit Migmatite and Gneiss Terrane. As details of this body exist in the literature little further work was undertaken on the pluton during the course of the Geodynamics Project study. The interested reader is therefore referred to the work of Visser, compiler (1956), Visser and Verwoerd (1960), de Gasparis (1967), Viljoen and Viljoen (1969a), Oosthuyzen (1970), and Condie and Hunter (1976).

Briefly, the Mpageni Granite represents one of the youngest intrusive bodies in the Archaean granitic terrane of the Barberton region, having been dated at between 2,81 and 2,55 b.y. old. The granite is potassic in composition (Table 1, Column 6) and is considered to have formed as a result of the fractional crystallization of a granodioritic magma in the lower crust.

III. A MODEL OF THE EVOLUTION OF THE ARCHAEAN GRANITIC CRUST BETWEEN NELSPRUIT AND BUSHBUCKRIDGE

In an attempt to review and synthesize the regional findings relating to the history and evolution of the Archaean granitic crust in the area between Nelspruit and Bushbuckridge, a simplified model portraying the events in the region has been devised. Apart from the new information that has become available (Robb, 1977), and outlined briefly in the earlier sections of this paper, the model draws upon the findings (particularly the Rb-Sr isotope studies) of other workers in this area.

Provisional Rb-Sr age determinations for three of the rock-types described in the area have been carried out at the Bernard Price Institute for Geophysical Research, University of the Witwatersrand, by Mrs. E. Barton and have provided useful information in helping to confirm many of the geological relationships described earlier. In addition, initial $^{87}Sr/^{86}Sr$ ratios have proved to be of assistance in attempts that have been made to understand the origin and genesis of the granite types involved. Rb-Sr isochrons are available for the Nelspruit Porphyritic Granite, the Hebron Granodiorite and the Cunning Moor Tonalite and these results will be made available in a later publication that will deal more specifically with the geochronological aspects of this study.

The model devised for the evolution of the granitic crust in the Nelspruit-Bushbuckridge area involves three separate and distinct events which are diagrammatically represented in Figure 8. The earliest granitic event recorded in the area mapped is represented by the Tonalite Gneisses and Migmatites which occur juxtaposed with still older synformal greenstone belt remnants. In this model the view is adopted that the tonalitic gneisses intruded the greenstone remnants in a manner similar to those described elsewhere in the Barberton Mountain Land (Anhaeusser et al., 1969; Anhaeusser, 1973a; Viljoen and Viljoen, 1969a, b). From the work of Barker et al. (1976) and Condie and Hunter (1976), it appears that the early tonalite gneisses, which in most Archaean terranes represent the first traces of granitic material, are derived from the partial melting of basaltic rocks at mantle depths. This conclusion is based on rare-earth and trace element modelling and it is expected that low initial $^{87}Sr/^{86}Sr$ ratios will characterize this material. The intrusion of the tonalitic magmas in the Barberton region appear to have taken place between 3,4 b.y. (or earlier) and 3,2 b.y. ago according to the work of Oosthuyzen (1970). This event is schematically represented in Figure 8(a).

The next stage in the development of the Archaean granitic terrane in the area took place approximately 3,2 b.y. ago and involved the widespread introduction of potassic magma into the earth's crust, the latter being represented by the Nelspruit Porphyritic Granite. This granite is characterized by a moderately low initial $^{87}Sr/^{86}Sr$ ratio (Robb, 1977, p. 104), and appears, therefore, to have resulted from processes associated with the mantle or lower crust. It is possible that this magma may have been produced from the differentiation of uncontaminated felsic material at depth. The enormous size or volume of granite associated with this intrusive event appears to have enabled the body to cool slowly, thereby resulting in the fractional crystallization of its mineral constituents (McCarthy and Robb, 1977). This effect is reflected in the wide compositional variation described earlier (Figure 5). As mentioned previously, it is considered that the Nelspruit Migmatite and Gneiss Terrane and the Nelspruit Porphyritic Granite are cogenetic. In terms of the model, the former of these two granitic assemblages probably developed as a result of the interaction between the invading granitic magma and the pre-existing tonalitic-greenstone crust. This arteritic-type origin for the migmatites and gneisses might account for their distribution near the margins of the porphyritic granite mass or "batholith", as shown schematically in Figure 8(b). The preliminary Rb-Sr results (E. Barton, personal communication, 1977), indicate that the Hebron Granodiorite is approximately the same age as the Nelspruit Porphyritic Granite (although it is known from field evidence to intrude the latter), and it also possesses a low initial $^{87}Sr/^{86}Sr$ ratio. This suggests that the Hebron Granodiorite may also have been mantle-derived during an event that was broadly synchronous with the formation of the Nelspruit Porphyritic Granite (Figure 8(b)).

The third and final stage in the development of the Archaean granitic crust in the Nelspruit-Bushbuckridge region appears to have taken place between 3,2 and 2,6 b.y. ago. During this period, discrete bodies such as the Mpageni Granite and the Cunning Moor Tonalite were introduced into the earth's upper crust. The Cunning Moor Tonalite is anomalous in the Barberton region as it represents the sole example of a tonalitic granite mass that appears to have developed late in the "granite series" found in the region. Both the Mpageni Granite and the Cunning Moor Tonalite are characterized by high initial $^{87}Sr/^{86}Sr$ ratios (Mpageni Granite, R_O = 0,7065, de Gasparis, 1967), which suggests that they may be the products of reworking of pre-existing crustal material (Figure 8(c)). These last-mentioned granite types therefore appear to have had a fundamentally different origin from their more ancient tonalitic or granitic counterparts in that they seem to be related to crustal processes rather than to processes taking place in the mantle.

In short, the model proposed for the formation or evolution of the granitic crust in the Nelspruit-Bushbuckridge area implies that the processes of granite formation in the Archaean may be secularly dependent, involving initially, the partial melting of mantle-derived material, and latterly, the reworking of pre-existing crustal material.

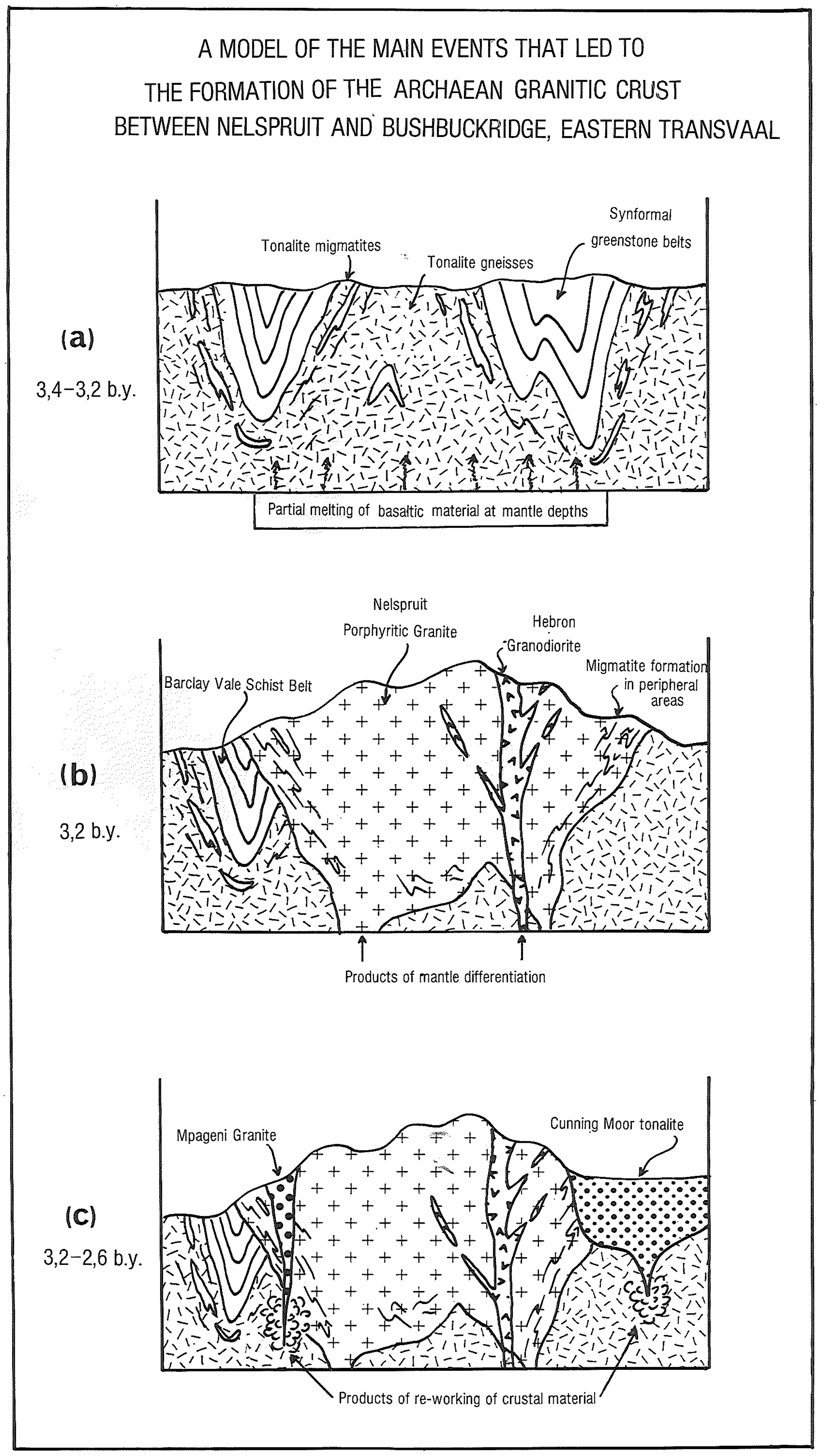

Figure 8 : *A schematic diagram depicting the main events that led to the formation of the granitic crust between Nelspruit and Bushbuckridge, eastern Transvaal Lowveld.*

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PLATE 1

A. Outcrop of folded migmatite in the Tonalite Gneisses and Migmatites from a locality 17 km west of Nelspruit. The dark, mafic material (paleosome) represents a relic fold apparently intruded (in a lit-par-lit manner) by tonalitic material (leucosome).

B. Outcrop of layered or stromatic migmatites within the Nelspruit Migmatite and Gneiss Terrane. Leucosomes are essentially granitic in composition and contacts between paleosomes and leucosomes are diffuse. Locality, 10 km north of Nelspruit.

C. Intensely porphyritic granite (the Nelspruit Porphyritic Granite) with large randomly orientated euhedral microcline megacrysts, some of which may measure up to 40 mm in length. Locality, 15 km west of White River.

D. Outcrop showing the relationship between the finer-grained, intrusive, Hebron Granodiorite and the Nelspruit Porphyritic Granite. The Hebron Granodiorite appears to have rafted-off portions of the porphyritic granite. Locality, 25 km north of White River.

E. A view, looking east, of the hilly terrain underlain by the Nelspruit Porphyritic Granite (far distance) and the flat, low-lying countryside occupied by the Cunning Moor Tonalite (foreground). The prominent peak in the Nelspruit Porphyritic Granite is known locally as Legogotu (Lion's Head).

F. The topographically distinctive Mpageni Granite Pluton situated approximately 25 km due east of Nelspruit. Photograph taken in the Crocodile River gorge looking east.

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PLATE I

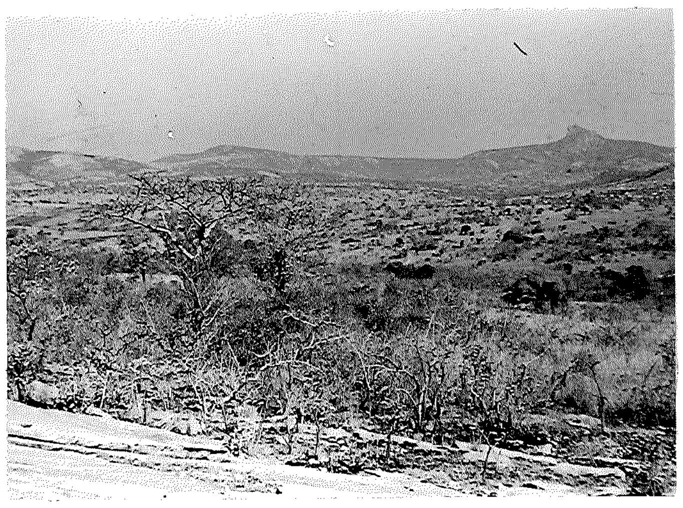
A

B

C

D

E



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