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THE FELSIC ALKALINE ROCKS

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by

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ABSTRACT

Mildly alkaline rocks are sparsely scattered in a broad, arcuate zone from Peak Charles (about 100 km southeast of Norseman) in the south, through the Widgiemooltha, Kurnalpi, Edjudina, Laverton, and Sir Samuel 1:250 000 sheets to Lake Teague in the north, about 100 km northeast of Wiluna.

The alkaline rocks are characterized by alkali pyriboles (aegirine, aegirine-augite and alkali amphibole), mesoperthitic alkali feldspar and low quartz content ranging from zero to twenty per cent.

Genetic relations are not clear, but divergent chemical trends suggest that the alkaline rocks are not related to the regionally dominant subalkaline granitoids in a simple manner.

INTRODUCTION

Felsites and granitoid rocks of alkaline affinity are sparsely distributed over much of the central and eastern part of the Eastern Goldfields Province of Western Australia. Although these rocks are variable in texture and mineral assemblage, certain characteristics persist from area to area, suggesting that these widely dispersed assemblages may have a similar origin. Thus they are grouped under the collective term, "the alkaline suite".

Rocks of the alkaline suite in the Eastern Goldfields Province have one of three characteristics: alkaline pyroxene or amphibole, a low proportion of quartz for a felsic rock, or mesoperthitic alkaline feldspar.

Rocks of the alkaline suite constitute a small but widely distributed fraction of samples collected by geologists of the Geological Survey of Western Australia during 1:250 000 scale geological mapping of the Eastern Goldfields Province between 1960 and 1974. Thin sections were prepared from many samples. Results of the study of the thin sections have been used in mapping but have not been reported systematically prior to this paper.

The rocks of the alkaline suite are reported separately from felsic rocks of more normal composition (Libby, 1978a and 1978b) because they seem to form a chemically and petrographically coherent suite distinct from the subalkaline rocks of the area; because they range from fine to coarse texture, hence cannot be easily discussed in either category; and because they may have substantial economic and petrological significance apart from the more abundant subalkaline rocks.

The alkaline rocks of the Eastern Goldfields Province have received little previous attention. Jutson (1915) and Honman and others (1917) briefly described a syenitic body about 9.5 km east of Yerilla homestead, and Berliat (1956) mentioned quartz-poor syenitic rocks near Lake Carey, east of Linden. Trendall (1964) recognized Na-rich pyroxenes and amphiboles in granitic rocks of the Widgiemooltha 1:250 000 sheet. Various small quartz syenite and syenite bodies on the Edjudina sheet were mentioned by Williams and others (1971, p.17). The only report directed specifically at rocks of the alkaline suite is the comprehensive study of the syenitic rocks of the Fitzgerald Peaks in an accompanying paper (Lewis and Gower, 1978).

The alkaline suite in the Eastern Goldfields Province lies between longitudes 121°E and 123°E and extends from the south margin of the Yilgarn Block at about latitude 33°S to the northern margin at about latitude 26°S. Bunting and Williams (1976) and Bunting (personal communication) have reported alkaline rocks north of latitude 28°S.

Most alkaline samples are from a north-trending zone about 70 km wide, constituting the main belt of Figure 1. Localities in the eastern part of

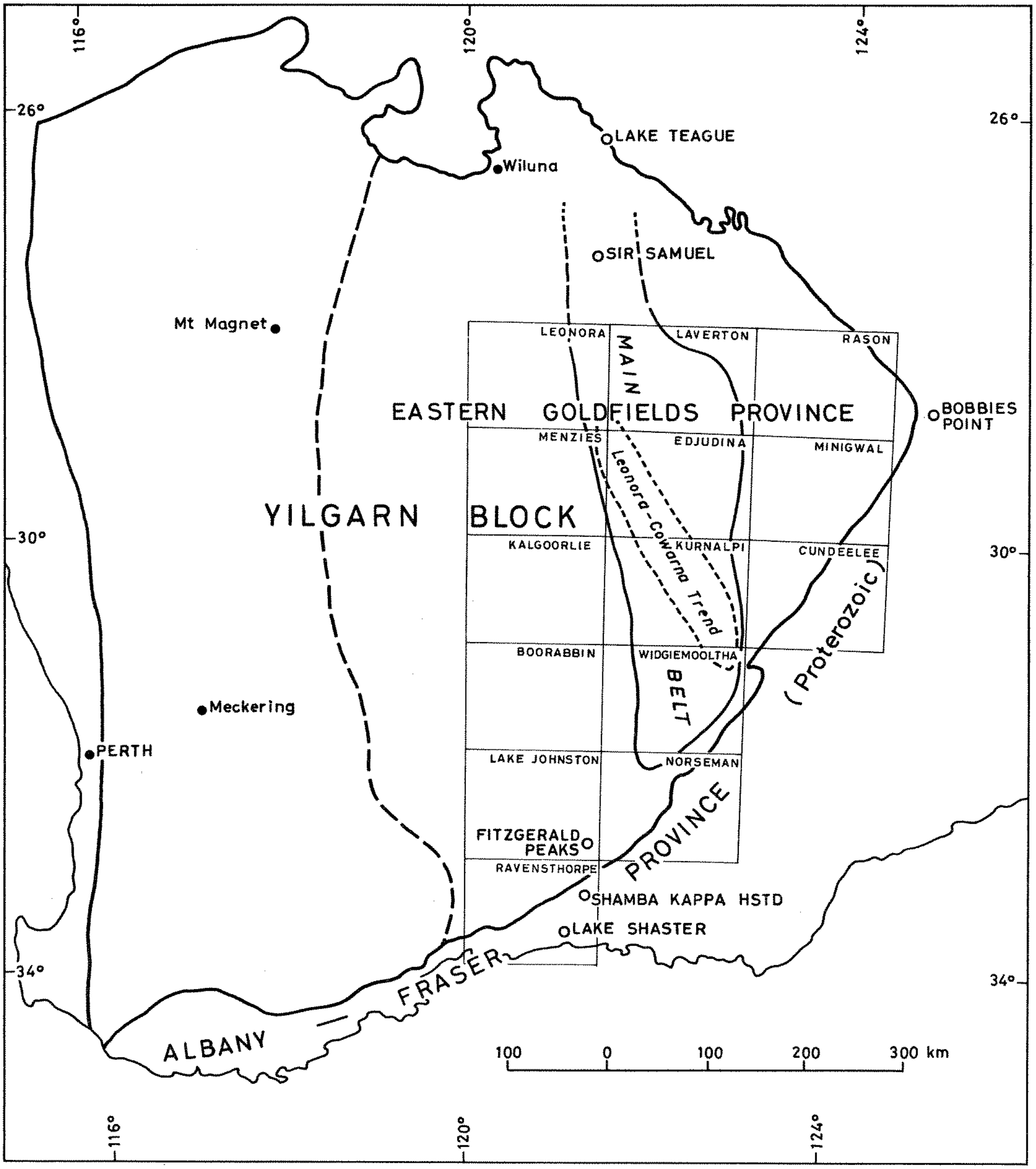

Figure 1. Major localities and trends of alkaline and related rocks in the Eastern Goldfields Province (GSWA 17327)

the Laverton and Edjudina sheets may represent a bifurcation of the main belt or a widening to about 100 km.

The large area of alkaline granite (about 120 km^2) at Fitzgerald Peaks in the southeastern part of the Lake Johnston sheet, lies outside the main belt but within the Yilgarn Block. Outside the Yilgarn Block, in the Proterozoic Albany-Fraser Province, rocks at Lake Shaster, Shamba Kappa homestead and Bobbies Point (Fig.1) have alkaline affinity. If the Fitzgerald Peaks, Shamba Kappa homestead and Lake Shaster localities were included with the main trend it would be arcuate concave to the west.

Most of the samples of alkaline rock available for study came from an area within the main belt about a line between Leonora in the north and Cowarna in the south, the Cowarna-Leonora trend of Figure 1.

DESCRIPTION

GENERAL CHARACTERISTICS

Rocks assigned to the alkaline suite in the Eastern Goldfields Province have one or more of the following properties: quartz ranges from zero to 20 per cent; mafic minerals are alkaline pryoxene and/or alkaline amphibole; and feldspar is alkaline and mesoperthitic. The association of these three characteristics is sufficiently general to encourage the belief that where only one characteristic is developed in the felsic granitoids and porphyries the rock is genetically related to others in the alkaline suite. Other, less persistent mineralogical characteristics are an abundance of coarse-grained apatite and abundant development of an orange-coloured sphene.

Quartz usually constitutes between 5 and 20 per cent of the rock, giving a quartz syenite or, more rarely, quartz monzonite composition. A few members of the suite have more than 20 per cent quartz and thus are alkali granite.

The mineral assemblage and textures alone are consistent with assignment to the peralkaline rocks in the nomenclature of Shand (1949, p.229) and the ekeritic suite as described by Barth (1944, p.88-91; 1962, p.198); however, in the few samples which have been chemically analyzed the alkali:alumina ratio is marginally low for proper classification in either of these groups. Still, on the basis of low abundance of quartz and development of alkaline mafic minerals, the suite is mildly alkaline.

The few analyses of alkaline rocks from Fitzgerald Peaks (Lewis and Gower, 1978) and the Sir Samuel sheet (Bunting and Williams, 1976) show that despite the development of alkaline pyroxene and amphibole, the agpaitic ratio (molecular $\frac{Na_2O + K_2O}{Al_2O_3}$) is less than unity. This is in common with many generally accepted alkaline rocks, including 11 of the 32 peralkaline granites listed by Murthy and Venkataraman (1964). Yet the agpaitic ratio is higher (Fig.3) than in associated subalkaline rocks. The alkalinity, measured by agpaitic index or total alkalies, along with relatively low silica, measured by analyzed silica or low values for modal quartz, gives the suite much of its distinctive character.

The unique character of the alkaline suite among felsic rocks of the area is suggested by petrography, but the limited chemical data (Figs 2 and 3) provide even better evidence that the alkaline suite does not form a compositional continuum with the subalkaline rocks. In particular, the plot of agpaitic index versus solidification index (Fig.3) suggests both a divergence of trend and a compositional gap between the alkaline and subalkaline granitoids. The geographic spread of sample localities suggests that the two trends represent two sets of physical conditions or modes of origin of diverse materials rather than two simple crystallization series from two discrete magmas.

The plot of alkalies versus silica in Figure 2 distinguishes the alkaline and subalkaline rocks less powerfully than the plot of agpaitic index versus solidification index in Figure 3. However, in the data from Davy (1976a and 1976b) it is possible that samples 33864, 33815, 33818 and 33835 are in fact also alkaline, as data on silica and alumina, and petrographic data are not available.

The alkaline suite includes both granitic and porphyritic felsitic rocks. With increasing proportion of phenocrysts the felsites grade texturally into granitic rocks. The porphyritic felsites seem clearly igneous and there is little reason to doubt the igneous origin of most of the alkaline granitoids; however, some of the alkaline granitoids, notably certain of the Peak Charles samples and rocks near Twin Peaks, Edjudina

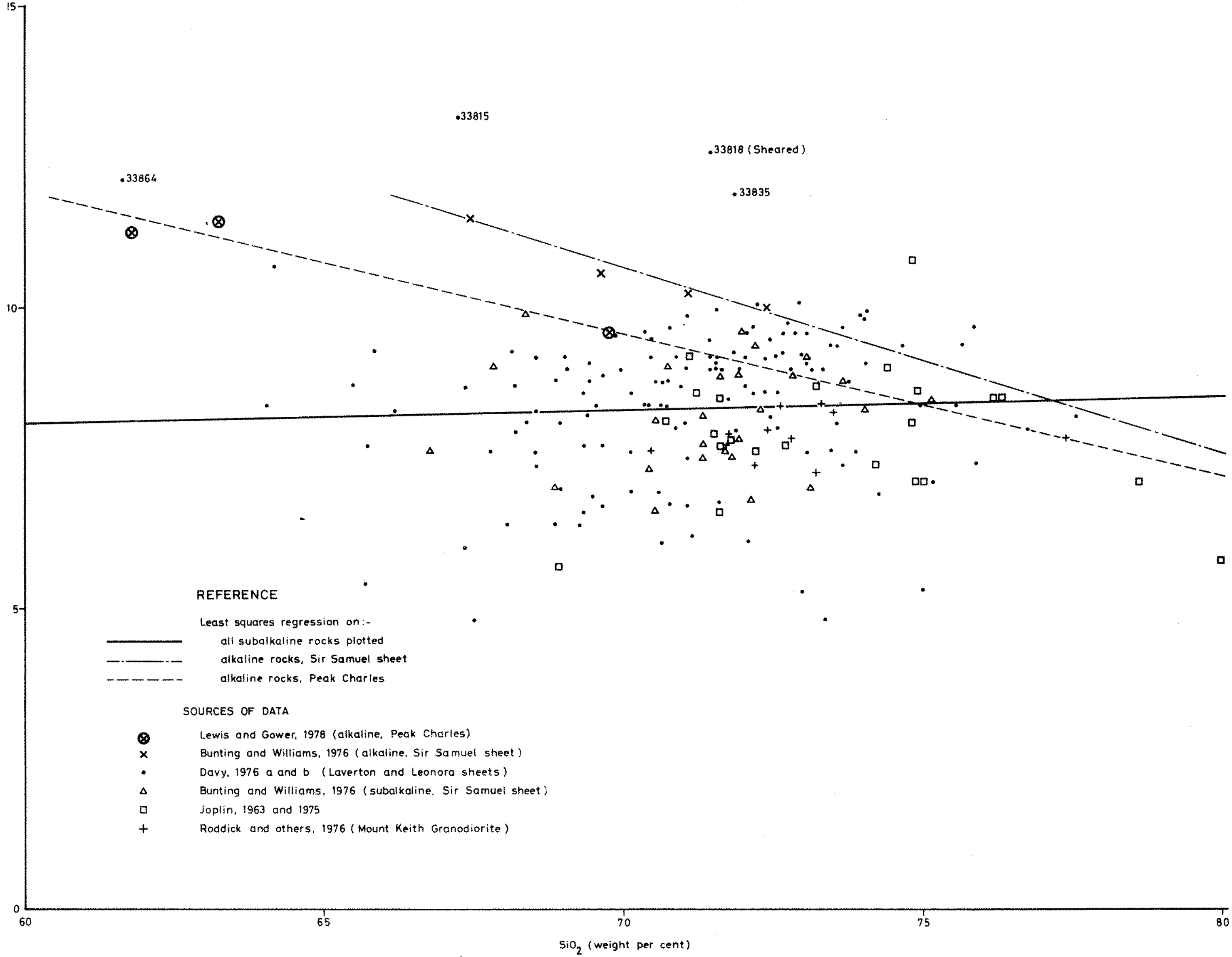

Figure 2. Total alkalies versus silica (weight per cent) for alkaline and subalkaline rocks of the Eastern Goldfields Province (GSWA 17328)

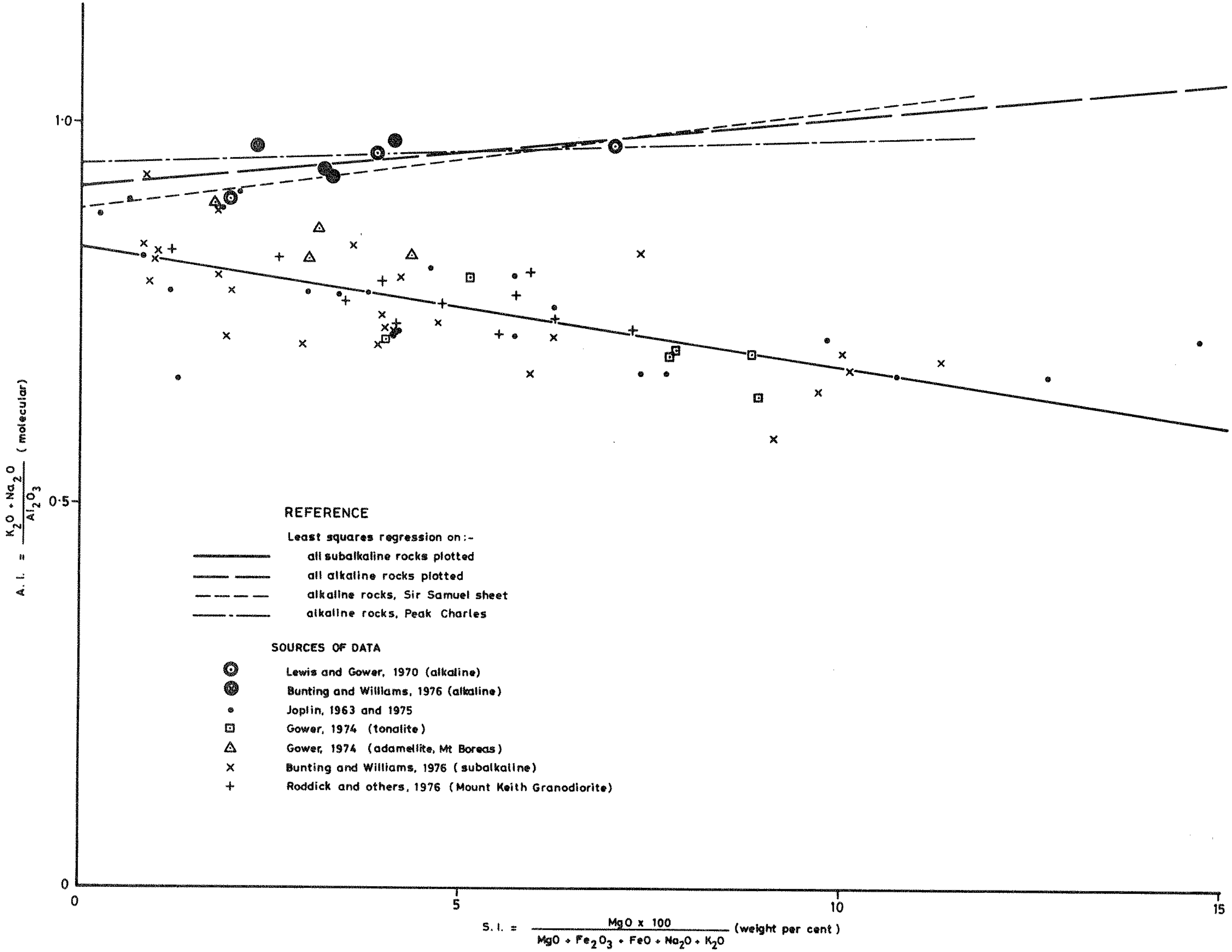

Figure 3. Agpaitic Index (A.I.) versus Solidification Index (S.I.) for alkaline and subalkaline granitoids of the Eastern Goldfields Province (GSWA 17329)

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sheet, have crystalloblastic texture, pronounced mineral grain orientation, and weak compositional layering. These may have retained their igneous alkaline character during metamorphism. Some of the alkaline bodies are heterogeneous with pods, streaks and lenses rich in mafic minerals set in the generally felsic body of the rock (Lewis and Gower, 1978).

REGIONAL DESCRIPTION

THE MAIN BELT

Within the main belt most samples of the alkaline suite are mesoperthitic (Plates I and II), with alkaline amphibole and pyroxene being the characteristic mafic minerals. Many samples have less than 20 per cent quartz and several contain orange sphene.

Pyroxene, without including three samples of doubtful affinity, seems to range from diopside to aegirine. The diopside and the pyroxenes which are optically intermediate between diopside and aegirine are length fast with a moderate extinction angle, a large optic axial angle and a positive optic sign. They range from colourless to green. The aegirine is length slow with a small extinction angle and a large, negative optic axial angle; its colour is yellow-green. Pyroxene with full optical properties of aegirine is restricted to three samples (2346, 6893 and 11099) from the Kurnalpi sheet and two samples (6522B and 6589) from the Widgiemooltha sheet, although pyroxenes with properties between aegirine and diopside (presumably aegirine-augite) are much more widespread. Pyroxene from Fitzgerald Peaks has been analyzed as aegirine-augite (Lewis and Gower, 1978). Sodic pyroxene is illustrated in Plates VI, VII and VIII.

Two granitoid rocks, samples 41475 (Boorabbin sheet) and 29906 (Laverton sheet), contain a green pyroxene but have no other properties of the alkaline suite. Optical properties of this pyroxene are consistent with diopside and the textures of the rocks are coarsely crystalloblastic. The rocks are pyroxene gneisses of doubtful affinity with the alkaline suite, although gradation of hedenbergite granite into peralkaline granite (for example, Bowden and Turner, 1974, p.336) leaves the question of relation to the alkaline suite open.

Amphibole in the alkaline suite of the main belt has a wide range of optical characteristics. In some samples amphibole is pale blue-green and probably is hornblende or actinolite; in other samples it is deep green with a small optic axial angle and strong dispersion, and probably is arfvedsonite. Deep blue to violet-blue riebeckite is abundant in samples 6522A and B from the Widgiemooltha sheet and sample 2346 from the Kurnalpi sheet. Sample 26690 from the Edjudina sheet carries flecks of secondary riebeckite. Alkaline amphibole is illustrated in Plates IV and V.

Pyroxene and/or amphibole is the principal mafic mineral in all but one of the quartz-poor samples of the main belt. The exception is sample 38674 from the east-central part of the Laverton sheet. This is a biotite syenite with dominant potash feldspar, about 40 per cent plagioclase near An_8 and no quartz. This, and the similar (hornblende-) biotite monzonite-syenite from Lake Shaster (Thom and others, 1977) in the Proterozoic Albany-Fraser Province, are the only biotite-rich rocks of syenitic affinity recognized in this study.

The opaque minerals in the alkaline and quartz-poor rocks of the main belt are black under oblique reflected light (?magnetite) except where oxidized to hematite or limonite, probably due to weathering. Apatite seems more abundant than in average granitoid rocks of the Eastern Goldfields Province. The apatite is coarse-grained and forms stubby prismatic crystals or irregular masses. Epidote is a minor secondary mineral in most samples but is abundant in a few. Fluorite was identified in a few samples (for example 24831, Edjudina sheet). Zircon was identified in slightly more than half of the samples, and in some samples it is very coarse grained and anhedral. In some cases it is metamict.

Although six samples contain no quartz and many others have little quartz, no feldspathoids were recognized.

Many samples from the main belt of alkaline rocks are porphyritic, with groundmass ranging from fine to medium-grained. With coarsening of the matrix and increase in the proportion of phenocrysts the porphyritic texture increasingly resembles granitic texture, apparently reflecting textural gradation from alkaline felsites to quartz syenites. This suggests that the porphyritic rocks are closely related to the coarse, even-grained rocks. Probably both are shallow intrusive bodies though some of the felsites may be extrusive. Porphyritic rocks seem absent from the two most heavily sampled areas of alkaline rock - the Fitzgerald Peaks on the Lake

Johnston sheet and in the vicinity of Twin Peaks on the Edjudina sheet.

Four small syenite bodies in the main belt were examined by I.R. Williams in the course of preparation of the Edjudina 1:250 000 sheet (Williams and others, 1976, and personal communication). A body at McAuliffe Well was described earlier by Jutson (1915) and Honman and others (1917). The location of each syenite body is shown on Figure 4. Three of the bodies, at Hamdorf Bore, Tassy Well, and Twelve Mile Well are within a heterogeneous, mainly adamellitic, complex, the Menangina Batholith. The syenites are in the outer margin of the complex in a zone which has an involved history of multiple intrusion. The zone contains igneous rocks ranging from diorite to alkaline granite and a variety of basic rafts and xenoliths in various stages of assimilation. The remaining alkaline body, at McAuliffe Well, is about 5 km northwest of the batholith.

Mesoperthite is the dominant feldspar in samples 26649 and 26690 from McAuliffe Well and 24831 from Hamdorf Bore, but is rare in 26650 and 26689 from Tassy Well and is absent in 24821 from Twelve Mile Well. The soda and potash feldspars of samples 24821 and 26689 possibly represent further unmixing of hypersolvus anorthoclase beyond the mesoperthite stage. There is no direct petrographic evidence for such unmixing, though in sample 26689 it could be explained by stress attending severe cataclasis. The total alkaline feldspar (microcline and albite) is greatly in excess of more calcic plagioclase (oligoclase) in all samples. The greatest proportion of oligoclase seen, in sample 24831, is less than 9 per cent of the rock.

The mafic mineral in sample 24821 is pale green amphibole; in sample 26689 both green amphibole and nearly colourless clinopyroxene are present. The principal mafic mineral in samples 26690 and 24831 is aegirine or aegirine-augite, accompanied in 24831 by secondary alkaline amphibole and minor biotite. Aegirine-augite and possible aegirine form both discrete grains and rims around pale green (?diopsidic) pyroxene. The rare amphibole and biotite also may be discrete or associated with the rims of dark green pyroxene.

The main accessory minerals at the four localities are sphene, apatite, opaques and quartz. The samples from Tassy Well and Twelve Mile Well are syenitic, with very little quartz, but have few other mineralogical characteristics of the alkaline suite.

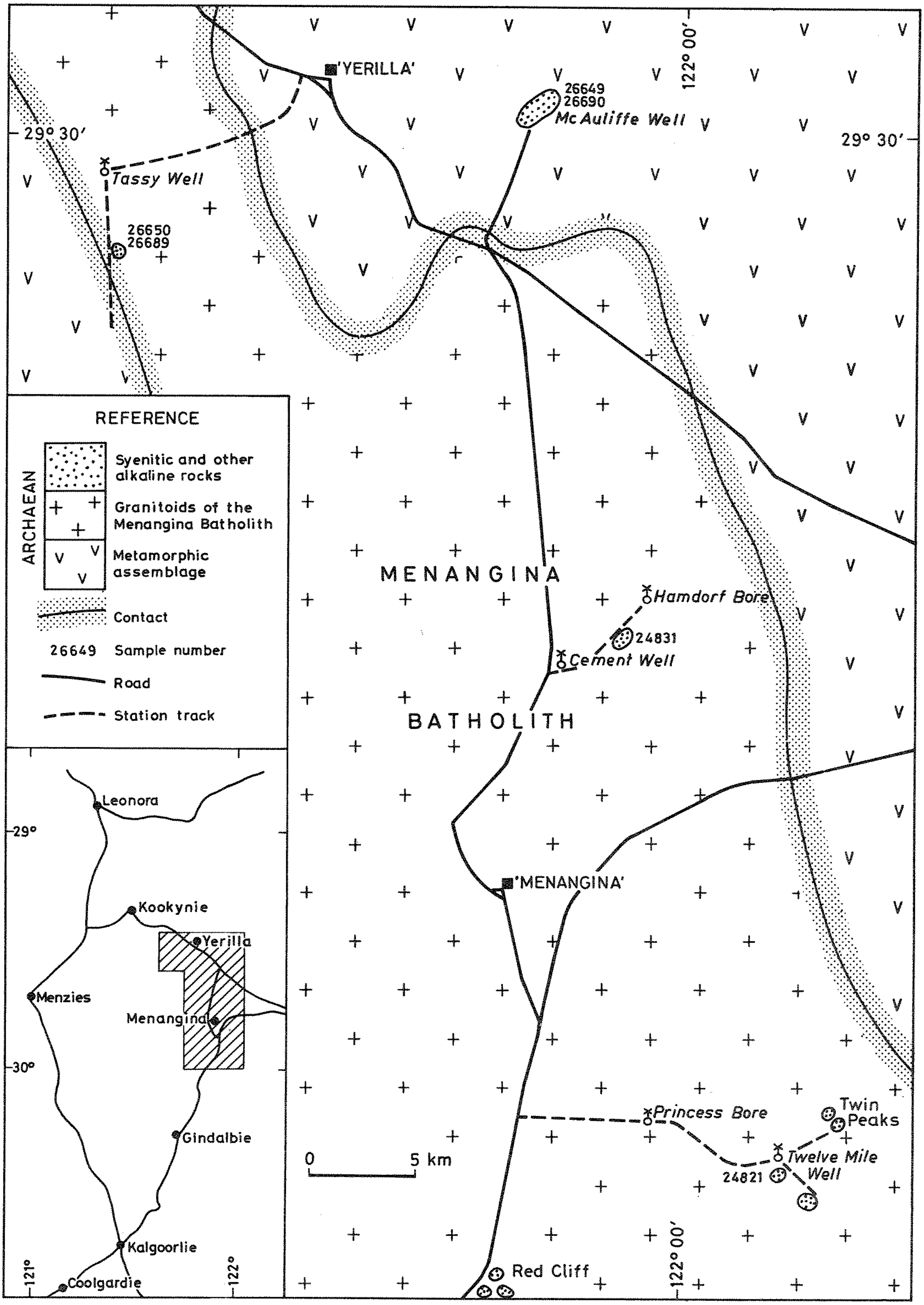

Figure 4. Locality map of Archaean syenites and other alkaline rocks in the Yerilla-Menangina region (GSWA 17330)

Three localities in the eastern part of the Laverton and Edjudina sheets (identified in Figure 5 as Linden syenite, carbonatite, and 38674) possibly should not be included in the main belt due to isolation from other members of the suite; or, perhaps, these constitute a bifurcation of the main belt. Sample 38674 is from a long, dyke-like body east of Laverton. It is low in quartz and has mesoperthitic, hypersolvus textures. The carbonatite is shown on the Kalgoorlie 1:1 000 000 geological series map (Williams, 1976) about 30 km south-southeast of Laverton. Samples were not available from the carbonatite or from the locality at Linden which Berliat (1956, p.24) has described as "... quartz-poor, syenitic varieties (of granite) ... east of Linden, in the vicinity of Lake Carey ..." on the Edjudina sheet.

A survey of scattered alkaline rocks on the continuation of the main belt north of the limit of the study area at latitude 28°S shows that aegirine-rich pyroxene is the characteristic mafic mineral in a suite variously deficient in quartz (with respect to granite) and in part carrying riebeckitic amphibole and hypersolvus alkaline feldspar.

FITZGERALD PEAKS

The pyroxene-quartz syenite of the Fitzgerald Peaks on the Lake Johnston sheet is described in an accompanying article (Lewis and Gower, 1978). Two phases of granitoid are recognized, a biotite adamellite to granodiorite and a pyroxene-bearing quartz syenite to pyroxene granite.

The biotite-rich rock is considered by Lewis and Gower (1978) to be intermediate between the pyroxene-quartz syenite and the regional porphyritic adamellite. Mesoperthite in some samples of the adamellite, and orange sphene suggest an affinity with quartz syenite, but quartz is not notably less than in an average granitoid. Alkaline mafic minerals are missing and in most samples plagioclase is oligoclase.

The pyroxene-quartz syenite is typical of the alkaline suite, varying from pyroxene syenite to pyroxene granite with a range in quartz from nil to about 30 per cent.

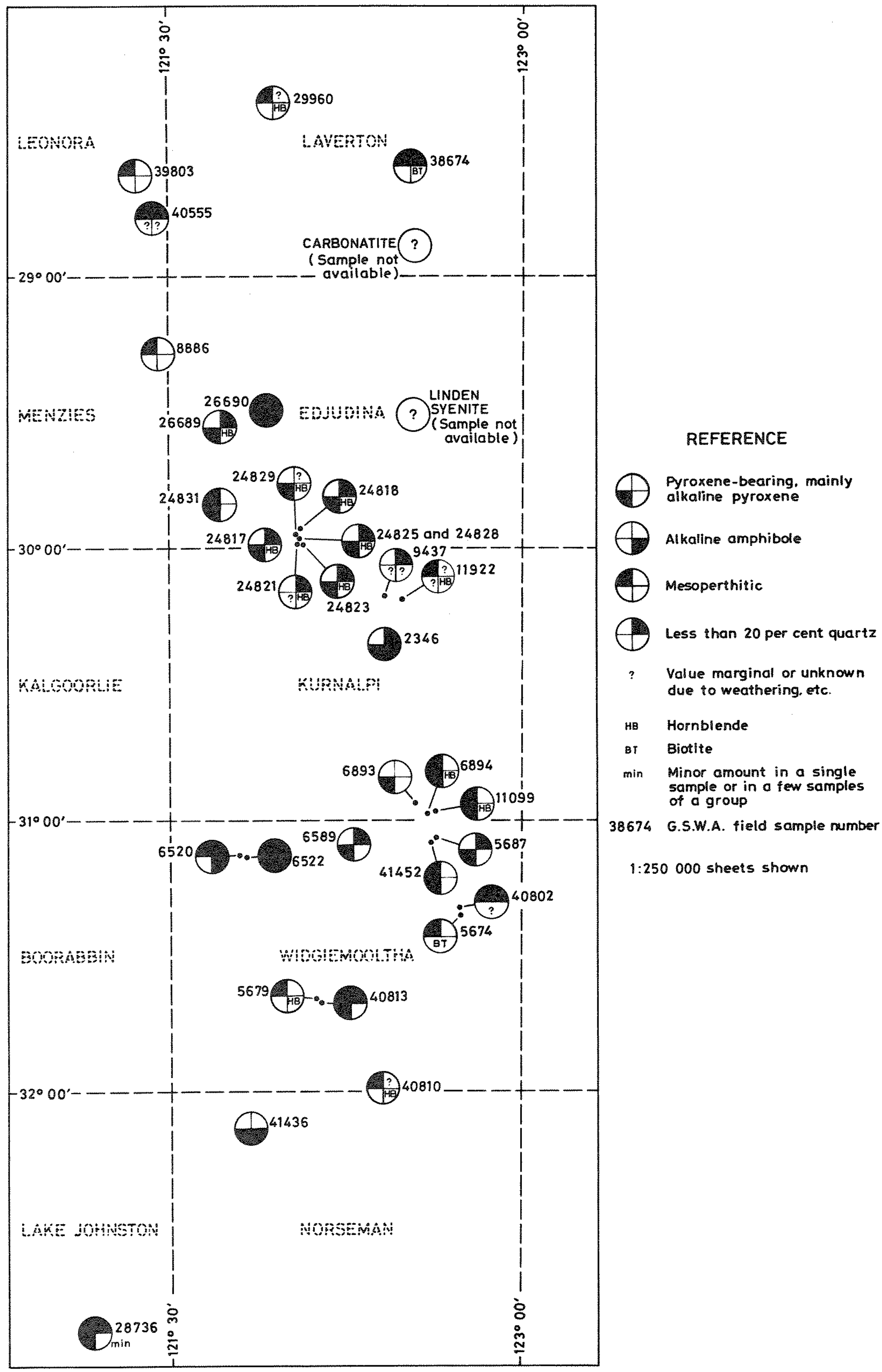

Figure 5. Distribution of rocks of the alkaline suite (GSWA 17331)

Feldspar commonly is mesoperthitic though proportions of sodic and potassic components are variable. Where feldspar phases are separate, plagioclase is albite. Pyroxene is aegirine-augite. Coarse-grained sphene with patchy orange pleochroism is common. Hypersolvus crystallization is implied by the texture of alkali feldspar.

LOCALITIES OUTSIDE THE YILGARN BLOCK

Three localities of alkaline rock well outside the main belt, in the Proterozoic Albany-Fraser Province may be unrelated to the alkaline suite of the Yilgarn Block. At Bobbies Point (Fig.1), on the Neale sheet, a sheared and partly recrystallized porphyritic rhyolite contains abundant minute groundmass needles of riebeckite. These rocks were discussed by van de Graaff and Bunting (1975).

At Lake Shaster, west of Esperance on the Ravensthorpe sheet (Fig.1), a hornblende-biotite-andesine monzonite is clearly alkaline but is of doubtful affinity with the alkaline suite of the Eastern Goldfields Province.

Chemical data in preparation for publication indicate that the monzonite ranges from silica saturated to slightly nepheline normative. The rocks have been described by Thom and others (1977), who also described an additional occurrence of syenite from the Proterozoic mobile belt, near Shamba Kappa homestead (Fig.1), mentioning a similarity between the syenite at Shamba Kappa and the quartz syenite at Fitzgerald Peaks.

FINE-GRAINED AND SERIATE ALKALINE ROCKS

Most of the alkaline rocks of the Eastern Goldfields Province are phaneritic but a few samples, especially from the Widgiemooltha sheet, have a fine-grained matrix, and others have an irregular grain size distribution which distinguishes them from normal phaneritic rocks. The special problems associated with these rocks seem to merit consideration apart from the phaneritic samples.

TEXTURE

Subtle differences in texture are important in interpreting the alkaline suite and in differentiating it from the subalkaline felsic suite. As terminology for the inequigranular rocks has not always been consistent, some common terms are defined here as used in this work. The term porphyritic is applied to rocks with apparently an igneous texture in which euhedral or subhedral grains (phenocrysts) are set in a finer groundmass. The phenocrysts (for example, plagioclase) must be represented in the groundmass by the same mineral (plagioclase), though the composition may be different (for example, andesine versus oligoclase). The phenocrysts must not grade regularly from coarse to fine; that is, the size distribution is bimodal, not seriate.

Inequigranular is the general term for rocks characterized by a wide range in grain size and includes porphyritic and seriate textures as well as texture in which relatively coarse grains of a mineral are set in a groundmass free of that mineral. In rocks with seriate texture one or more minerals grade through a substantial range of sizes without prominent clustering around one or two sizes.

The texture of rocks of the alkaline suite are systematically different from the textures of the more abundant subalkaline rocks in the Eastern Goldfields Province. The distinction between phenocrysts and matrix is less clear and matrix textures can be less easily classified than those of the porphyries of more normal composition (cf. Libby, 1978a). The origin of the porphyritic texture in the alkaline suite probably is different from that in the subalkaline rocks.

The textural variation among fine-grained rocks of the alkaline suite is quite remarkable. In sample 5764 (Widgiemooltha sheet) the size of albite and strongly perthitic microcline grains ranges evenly downward from about 3 mm. In sample 6522A (Widgiemooltha sheet), very coarse grains of mesoperthite are set in a matrix of medium or coarse-grained perthite with interstitial quartz, riebeckite and fine-grained feldspar. Sample 6893B from the Kurnalpi sheet is a medium-grained quartz-microcline-albite rock with green clinopyroxene and riebeckite. It has a texture which strongly suggests severe recrystallization. In sample 9138 from the Kalgoorlie sheet plagioclase phenocrysts and finer feathery, bluish amphibole grains are set in a microlitic and microgranular groundmass. Although very little of the suite is micrographophyric, an exception is sample 9143 (Kalgoorlie sheet). Here, small phenocrysts (about 1 mm) of quartz and alkali feldspar are set in a micrographophyric groundmass with complex spheroidal felsic masses and rather idiomorphic but intergrown (?perthitic) alkali feldspar. In sample 40555A from the Leonora sheet phenocrysts of mesoperthitic alkali feldspar are set in an unusual even-grained (about 1.5 mm) irregular intergrowth of alkali feldspar. Minor brecciation and fine granulation follows many small fractures.

Thus, variety in texture is perhaps a characteristic of the alkaline suite.

RELATION BETWEEN PHENOCRYSTS AND MATRIX

The distinction between phenocrysts and matrix in many rocks of the alkaline suite is not clear. Phenocrysts constitute 90 per cent of some of the alkaline rocks (samples 40802 and 41428 from the Widgiemooltha sheet) other samples (6522A, Widgiemooltha sheet) have a matrix with a grain size (1 to 2 mm) intermediate between coarse phenocrysts and very fine-grained groundmass; still other samples (6520 and 41452 from the Widgiemooltha sheet; 11099, Kurnalpi sheet; 24831 and 26689, Edjudina sheet) are seriate, having a broad but evenly graded range in grain size.

Commonly, where the distinction between phenocrysts and groundmass is clear, the rock has been disturbed. Sample 5586 (Widgiemooltha sheet) has a good size contrast but a mylonitic matrix. Another sample (6520, Widgiemooltha sheet) which seems initially to have good contrast is in fact seriate. Again, in sample 26689 (Edjudina sheet) very coarse-grained potassium feldspar and coarse-grained plagioclase are set in a fine-grained groundmass, but the amphibole, which probably is secondary, is strongly oriented. Sample 41427 (Widgiemooltha sheet) is a more typical porphyritic felsite but still the contrast between phenocrysts and matrix is less clear than in the common (subalkaline) felsites of the area.

Most typically there is only one phase of feldspar among the phenocrysts and this is mesoperthite. In the matrix, however, the alkali feldspars commonly are differentiated into discrete albite grains and microcline grains which are not perthitic. These may be unmixed or, more likely considering the perthitic character of the phenocrysts, have crystallized in the two-feldspar field. Again, there are exceptions in which groundmass feldspar is a single phase or in which there are two phases among the phenocrysts.

Samples 6522B, 40813 and 41427 (Widgiemooltha sheet) are typical of the suite. In sample 41427 coarse-grained mesoperthite and green clinopyroxene are set in a matrix of anhedral and in part intergrown microcline and albite. On a fine scale matrix grains are intergrown with the margins of the phenocrysts, a relationship typical of this suite. In contrast, albite is present among the phenocrysts in several samples. In samples 6589, 6599, and 41428 (Widgiemooltha sheet) albite phenocrysts are dominant but strongly perthitic phenocrysts of potassium feldspar are present. In sample 40802 (Widgiemooltha sheet) there are scattered albite phenocrysts among dominant mesoperthite phenocrysts, but more common are albite rims on the mesoperthite phenocrysts. Locally, the interface between mesoperthite core and albite rim is rounded, as though the mesoperthite had been partly resorbed prior to crystallization of albite as a separate phase.

As with textures as a whole, generalizations about matrix-groundmass relationships are difficult, but crystallization of phenocrysts at temperatures above the solvus seem characteristic though not universal in the alkaline suite, whereas hypersolvus crystallization of the matrix seems less common.

AGE

Little evidence of the age of the alkaline suite is available. Most plutonic ages in the Eastern Goldfields Province are in the vicinity of 2 600 m.y. Only one date is from a unit which may belong to the alkaline suite. Turek (1966, p.59) reported a Rb:Sr age of 1 670 m.y. with an initial ratio of 0.7473 from a two-point microcline - whole rock isochron on a microcline-quartz rock. The sample is from Peak Charles, one of the Fitzgerald Peaks, on the Lake Johnston 1:250 000 sheet. Much of the rock at the Fitzgerald Peaks is pyroxene-quartz syenite (Gower and Bunting, 1976; Lewis and Gower, 1978). Thus the dated sample may be from the alkaline suite. The date was dismissed by Turek as being affected by loss of ^{87}Rb

on field evidence that the rock is Archaean. However, acceptance of the possibility of a Proterozoic age for the alkaline suite in the Yilgarn Block would remove the Archaean constraint. Preliminary recent (de Laeter and Lewis, 1978) Rb:Sr dating of the Peak Charles syenitic rocks indicates a date near 2 500 m.y.

North of the study area, on the Sir Samuel 1:250 000 sheet, quartz syenitic rocks have been found to be intruded by potassic adamellite of the Mount Boreas type (Bunting and Williams, 1976, p.18-19). The Mount Boreas adamellite has been dated on the Laverton sheet at 2 480 $\pm$ 30 m.y., suggesting an Archaean age for the alkaline suite.

Monzonite at Lake Shaster and pyroxene-bearing quartz-syenitic rocks near Shamba Kappa on the Ravensthorpe sheet (Thom and others, 1977) would be included in the main belt if a major province boundary were not between these localities and the main belt, suggesting that the main belt may in fact be continuous into the Albany-Fraser Province and thus be of Proterozoic age.

Bunting (personal communication) has indicated that syenite typical of the alkaline suite crops out in the circular Lake Teague structure a few kilometres north of the north limit of general Archaean outcrop on the Nabberu sheet. It either cuts Proterozoic rocks or has been elevated from Archaean rocks which can be expected to be at modest depth in the area. A programme of dating rocks of the Lake Teague structure is in progress.

The riebeckite rhyolite at Bobbies Point in the Proterozoic Albany-Fraser Province has provided a single-point, whole rock model age of 1 190 m.y., assuming an $^{87}Sr/^{86}Sr$ initial ratio of 0.703 (Bunting and others, 1976, sample 40598A). However, this rock probably is unrelated to the alkaline suite of the main belt in the Yilgarn Block.

Data on the age of the alkaline suite of the Eastern Goldfields Province is ambiguous and evidence is contradictory. The age of the suite may or may not be homogeneous and may be Archaean or Proterozoic.

SUMMARY

A belt less than 100 km wide and more than 500 km long through the Eastern Goldfields Province is characterized by widely scattered bodies of fine to coarse-grained felsic rock with alkaline pyroxene or amphibole, generally less than 20 per cent quartz and commonly with hypersolvus alkali feldspar. Hypersolvus feldspars, alkaline mafic minerals, and chemical trends divergent to those of associated subalkaline rocks suggest a history distinct from that of the regionally dominant subalkaline granitic and felsitic suites.

It is probably too early to decide whether the alkaline suite has originated by local contamination at high crustal levels, deeper contamination and magmatic evolution, in association with deep fracturing, or by other means. It is also premature to suggest whether the suite may have been associated with late Archaean rifting, though the dimensions of the belt do not preclude such an origin. Further field and chemical data are being collected in an attempt to answer some of these broader questions.

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APPENDIX

LOCATION OF SAMPLES

Samples are located according to 1:250 000 sheets and the Australian Transverse Mercator Grid, in yards. The first digit of each coordinate indicates hundreds of thousands of yards. Four-digit coordinates have a precision of 100 yards, three-digit coordinates, 1 000 yards. Accuracy is less. Letter suffixes on sample numbers have been omitted.

BOORABBIN	
41475	445-/436-
EDJUDINA	
24817	4970/2869
24818	5142/2937
24821	5115/2880
24823	5130/2881
24825	5123/2897
24828	5123/2897
24829	5110/2911
24831	4764/3049
26649	Not available
26650	Not available
26689	478-/339-
26690	497-/347-
KALGOORLIE	
9138	393-/295-
9143	395-/247-
KURNALPI	
2346	242-/550-
6893	563-/173-
5894	563-/173-
9437	550-/264-
11099	571-/167-
11922	557-/262-
LAKE JOHNSTON	
28736	417-/936-
LAVERTON	
29960	5025/4826
38674	564-/456-
LEONORA	
39803	4390/4510
40555	447-/434-
MENZIES	
8886	450-/372-
NORSEMAN	
41436	502-/026-
WIDGIEMOOLTHA	
5586	4880/1215
5674	5823/1230
5679	5181/0852
5687	5719/1570
6520	483-/149-
6522	Not available
6589	5344/1545
6599	4607/1252
40802	4607/1252
40810	5460/438-
40813	520-/084-
41427	520-/084-
41428	573-/145-
41452	570-/155-
NEALE	
40598A	258-/408-

P L A T E S

PART III

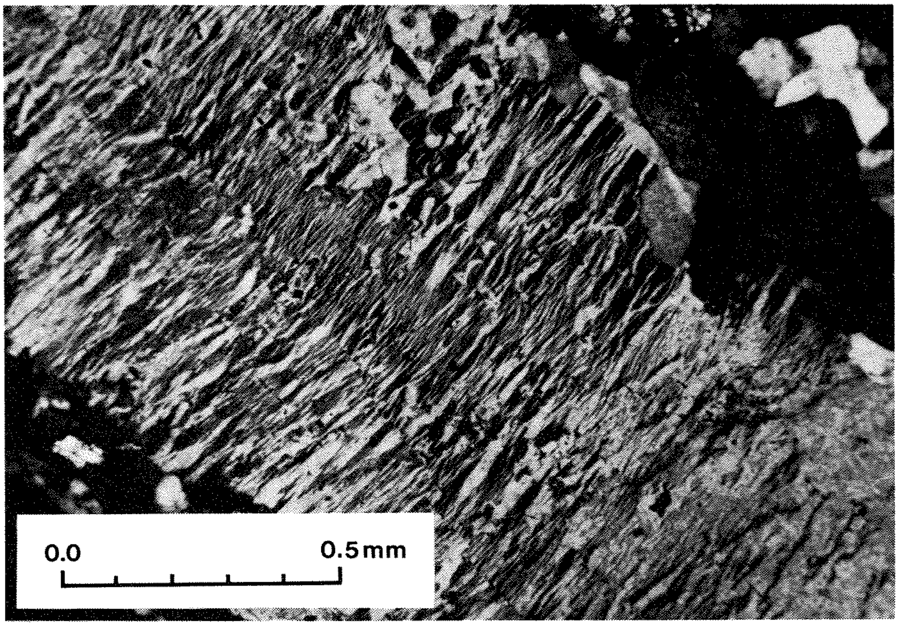

Plate I. Mesoperthite.

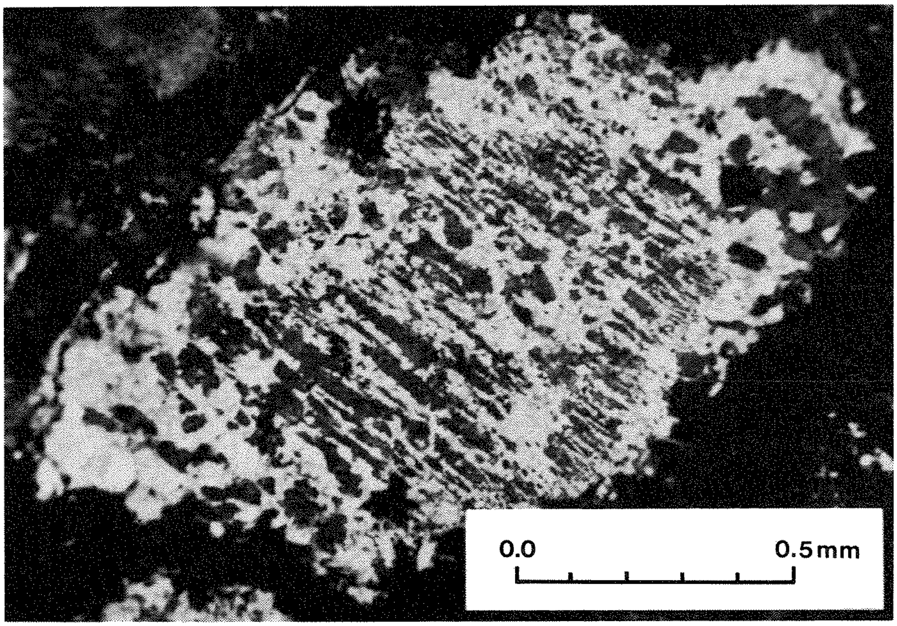

Plate II. Mesoperthite.

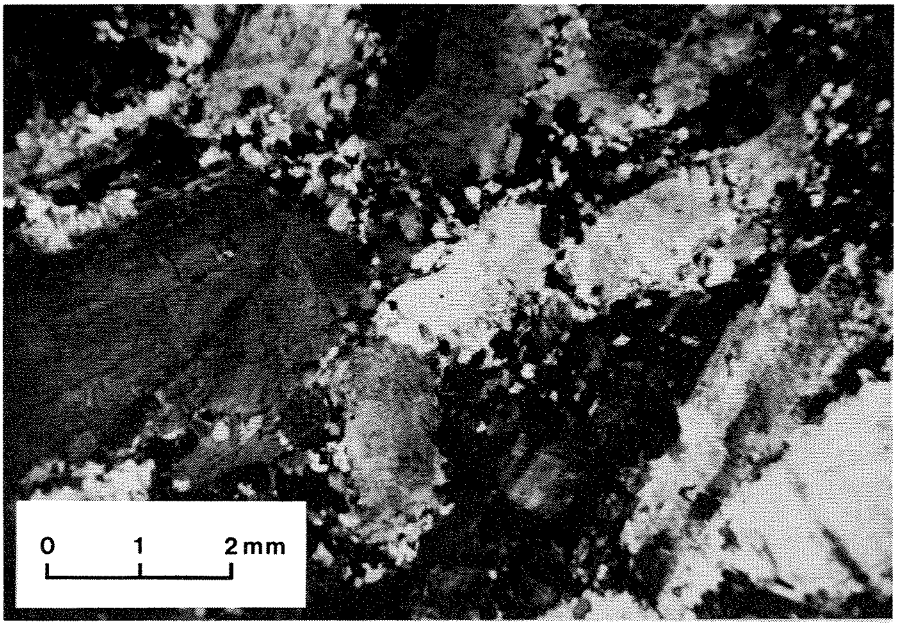

Plate III. Matrix-phenocryst relations in an alkaline rock.

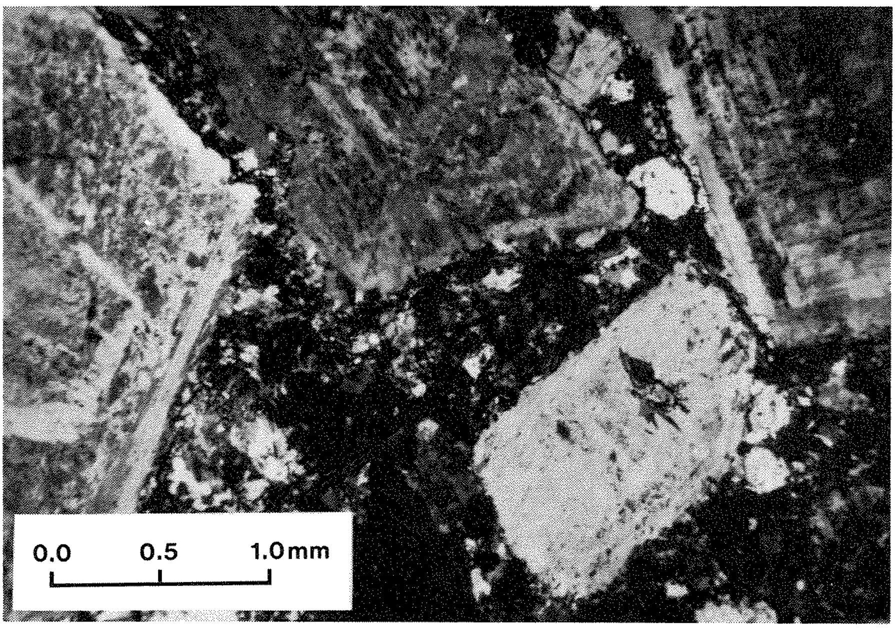

Plate IV. Alkaline amphibole interstitial to phenocrysts in porphyritic alkaline rock.

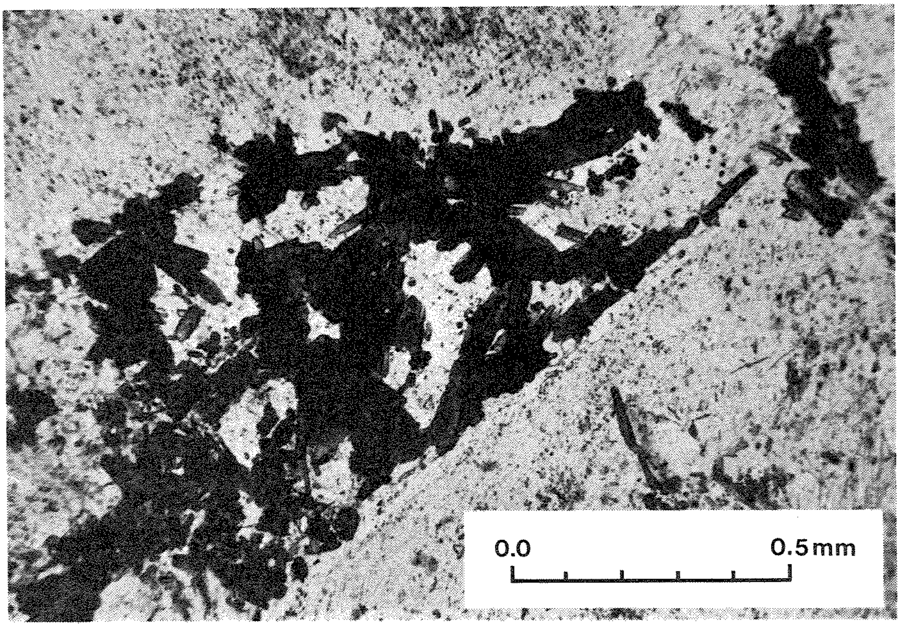

Plate V. Alkaline amphibole, probably secondary, interstitial to feldspar in alkaline rock.

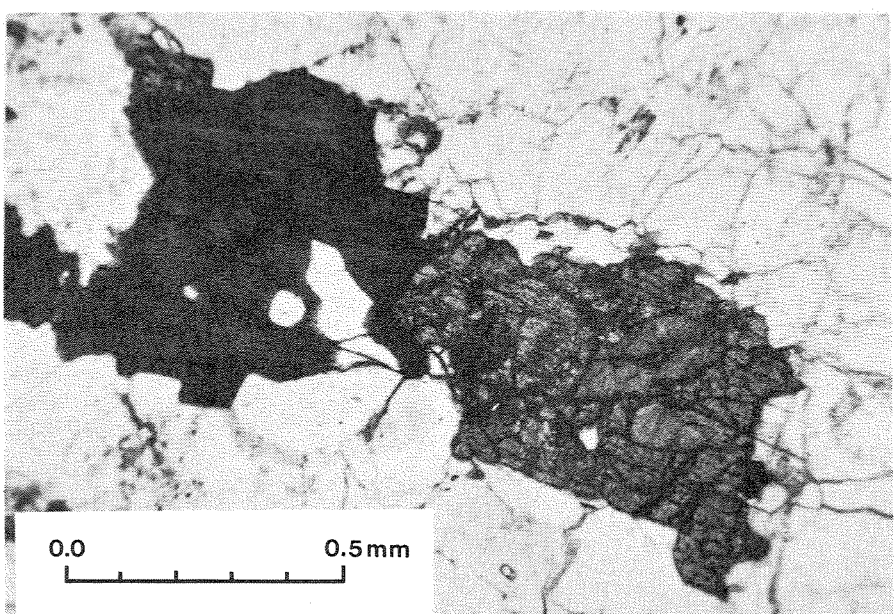

Plate VI. Sodic pyroxene in an alkaline granitoid.

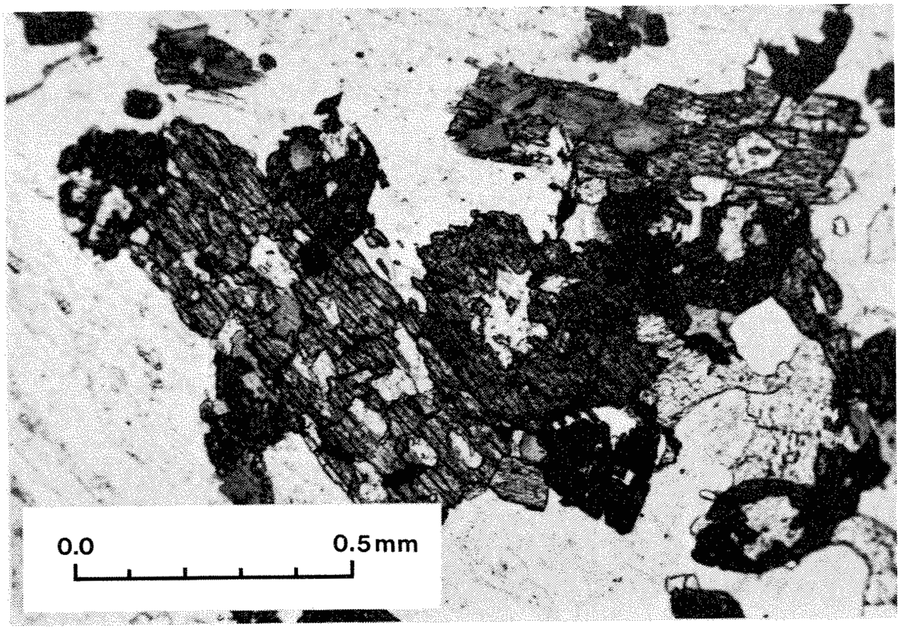

Plate VII. Sodic pyroxene in an alkaline granitoid.

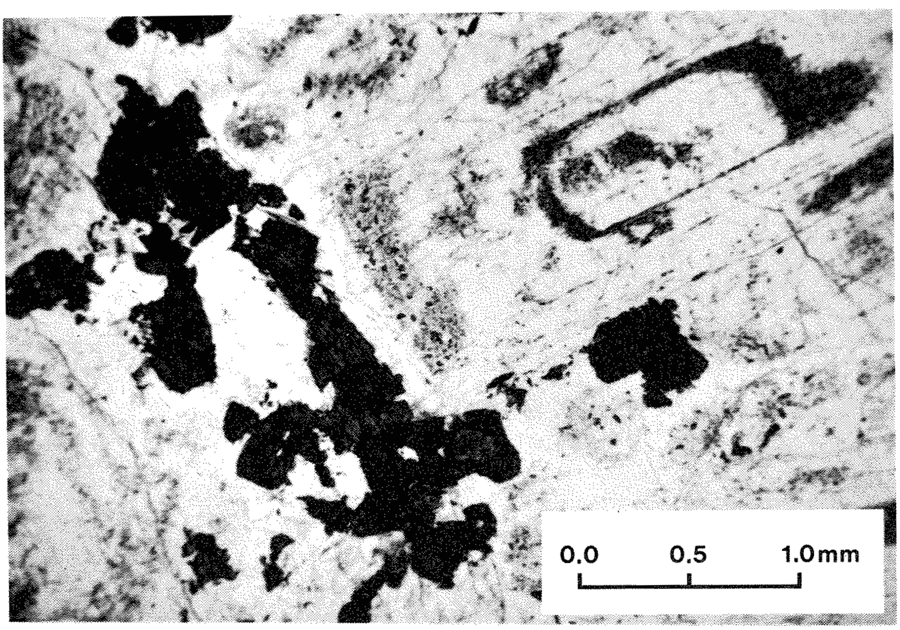

Plate VIII. Sodic pyroxene in an alkaline granitoid.