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ISOTOPIC AGE RELATIONSHIPS OF PRECAMBRIAN ROCKS IN THE GRANITES - TANAMI REGION, NORTHERN TERRITORY AND WESTERN AUSTRALIA

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CONTENTS

SUMMARY

Using the Rb-Sr and K-Ar dating methods, a number of age constraints have been applied to the metamorphic, igneous, and sedimentary components making up The Granites-Tanami Block and the younger Birrindudu Basin. The basement metamorphic rocks of the Tanami complex are considered, by correlation with the Halls Creek Group of the east Kimberley region, to be Early Proterozoic (older than 1960 m.y.). Four suites of granitic bodies intruding the Tanami complex give Early Proterozoic to early Carpentarian Rb-Sr total-rock isochron ages of 1802 ± 15 m.y. (Winnecke Granophyre; reported elsewhere) 1780 ± 24 m.y. (The Granites Granite), 1770 ± 55 m.y. (Slatey Creek Granite) and 1720 ± 8 m.y. (Lewis Granite). K-Ar and Rb-Sr ages determined on glauconites from the Birrindudu Group show little consistency, which is evidently to partial loss of radiogenic daughter products; however, the preferred K-Ar age of 1560 ± 20 m.y. (mid-Carpentarian) is considered a reasonable minimum estimate for the age of sedimentation and diagenesis.

INTRODUCTION

The Precambrian of The Granites-Tanami region (Fig.1) comprises the basement Granites-Tanami Block, which consists of low-grade metasediments and metavolcanics intruded by several granitic bodies (Fig.2), overlain by mainly clastic, generally gently dipping to flat-lying sediments of the Birrindudu Basin, which consists of the Carpentarian Birrindudu Group and the Adelaidean Redcliff Pound Group (Blake et al., 1975; Blake & Hodgson, in prep.). The Granites-Tanami Block and the surrounding younger Birrindudu Basin straddle part of the state border between the Northern Territory and Western Australia. Precambrian outcrops occur as scattered low ranges - in places overlain by thin remnants of Cambrian volcanic rocks and Palaeozoic and Mesozoic sandstones - and are dispersed among large expanses of Tertiary laterite and Quaternary sand in a semidesert environment.

Owing to the position of The Granites-Tanami region - between the Precambrian Halls Creek Mobile Belt to the northwest, the Victoria River Basin to the north, the Arunta Block to the south and southeast, the Phanerozoic Canning Basin to the west, and the Wiso Basin to the east - a number of inter-regional correlations have been suggested. Poor outcrop in this semidesert environment necessitates large extrapolations in these correlations, and isotopic dating techniques can therefore be gainfully employed to better quantify the geological history, and lead to more exact correlations.

This contribution is a report on Rb-Sr and K-Ar dating studies undertaken on granitic rocks of The Granites-Tanami Block, and on overlying glauconitic sandstones in the Gardiner Sandstone of the Birrindudu Group. These results complement the recent geochronological study by Page & Blake (in prep.), in which the association of 1800 m.y. old acid volcanics and granites in the northeast (Fig. 2) was documented.

Unfortunately the low-grade and weathered metasements and metavolcanics of the Tanami complex, which are clearly the oldest component in the Block, could not be adequately sampled; the ages of the intrusive granites provide only a minimum age for the Tanami complex. For this reason, age data pertaining to the east Kimberley Halls Creek Group, the likely correlative of the Tanami complex, are at first assessed in detail in an attempt to arrive at a reasonable estimate for initial formation of The Granites-Tanami Block.

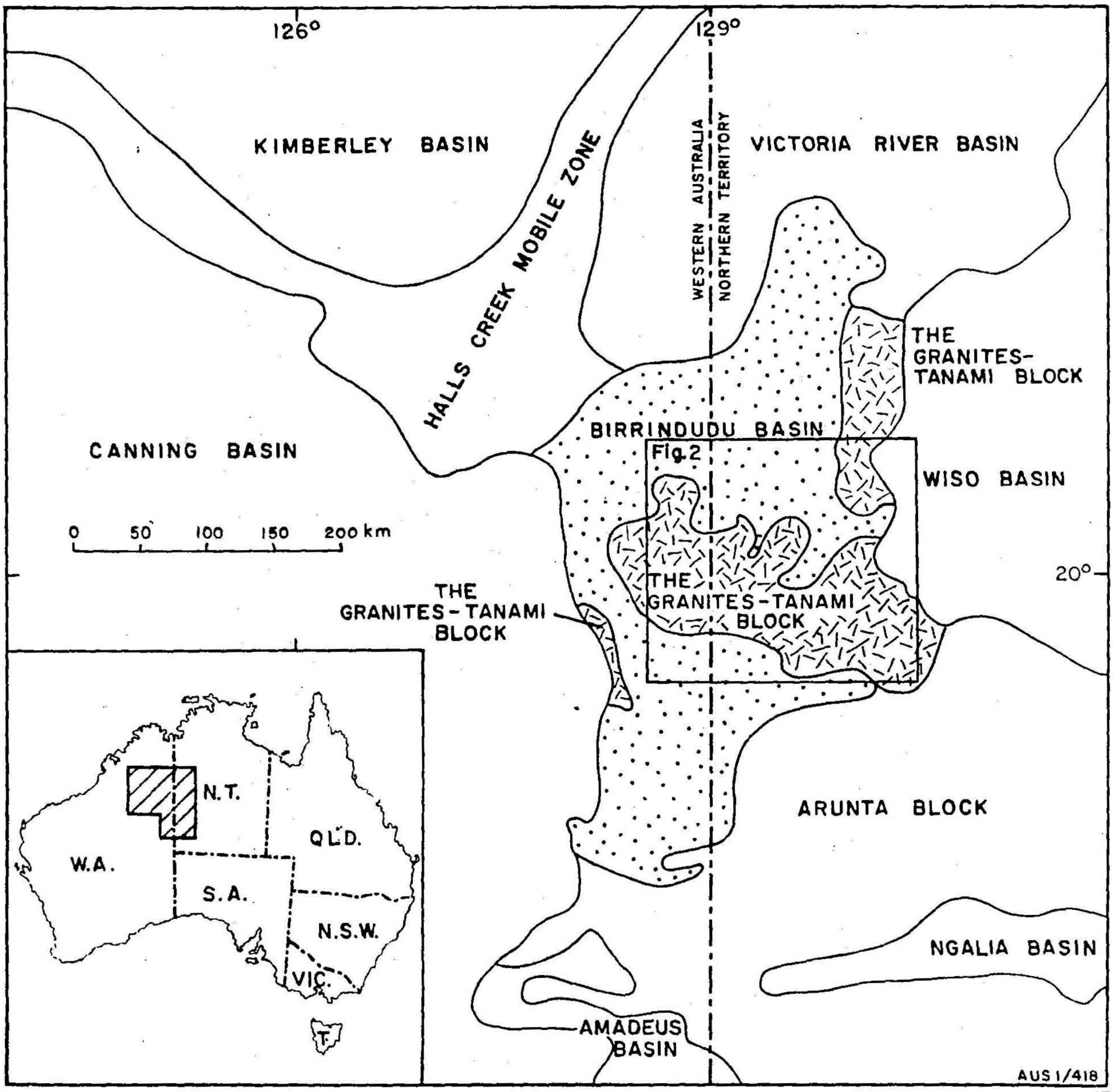
AGE OF THE HALLS CREEK GROUP

The Halls Creek Group is the basement throughout much of the east Kimberley region. It is composed of thightly folded and complexly faulted low-grade metasediments and metavolcanics in which Dow & Gemuts (1969) have mapped four separate formations. The similarities in lithology, regional metamorphism, and deformation between the Halls Creek Group and the Tanami complex suggest that these units are stratigraphically equivalent (Blake et al., 1975; Blake & Hodgson, in prep.).

Rb-Sr studies on the Halls Creek Group and associated intrusions were undertaken by Bofinger (1967a), and subsequently some of these rather anomalous age results have been quoted (Bofinger, 1967b; Compston & Arriens, 1968; Dow & Gemuts, 1969; Gellatly, 1971) leading to a now widely held belief that the rocks may be older than 2700 m.y. (i.e., Archaean). Therefore all the Rb-Sr data relevant to the age of the Halls Creek Group must be reassessed in an attempt to clarify the present status of its age, and hence also the age of its proposed correlative, the Tanami complex.

Limited Rb-Sr data from three formations in the Halls Creek Group (Bofinger, 1967a) yielded the following anomalous age pattern:

Ding Dong Downs Volcanics - one intrusive or extrusive acid volcanic sample has a model Rb-Sr age of 2050 m.y.



Record 1975/102

Fig. 1 Geographical relations of The Granites-Tanami region and surrounding provinces

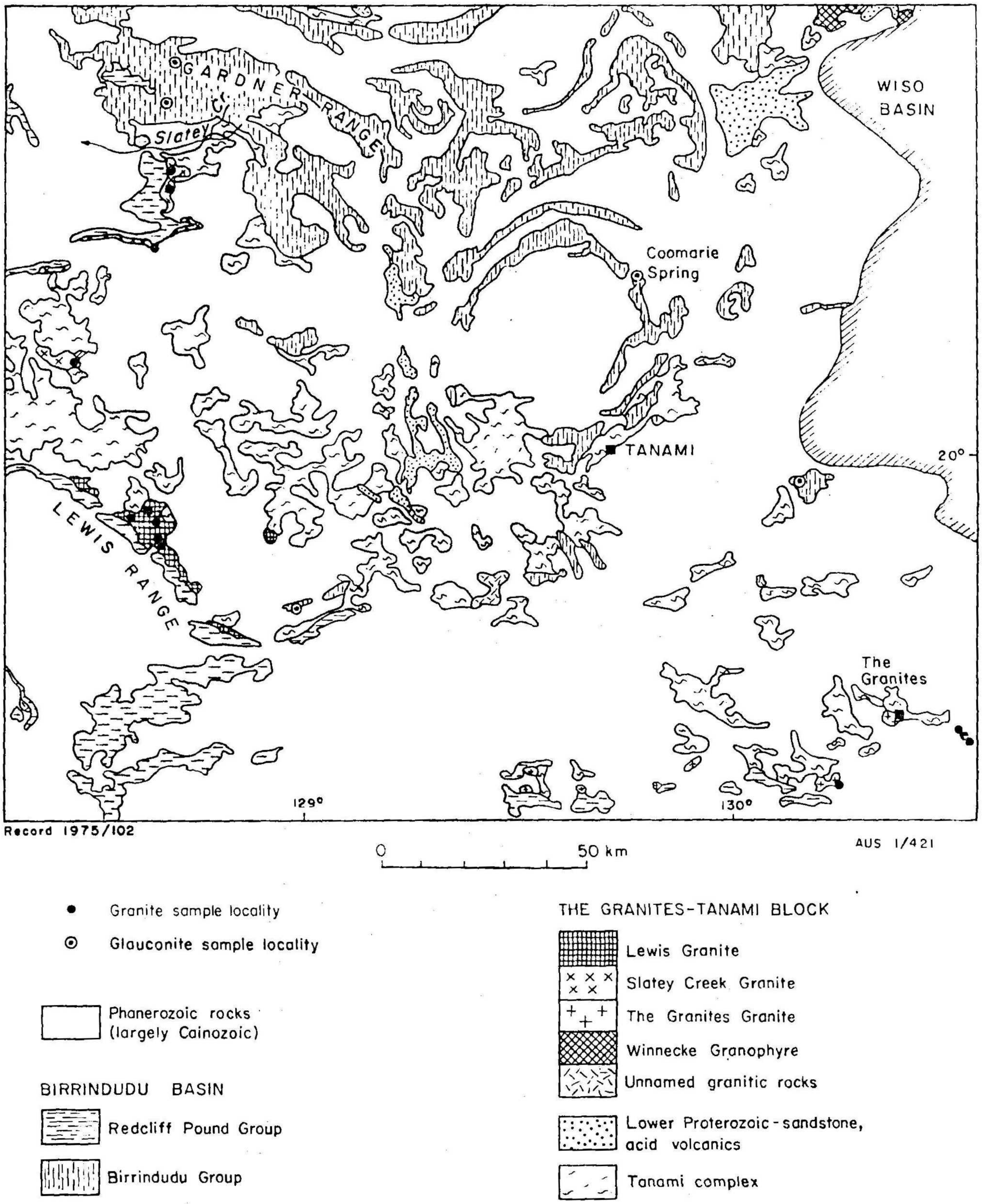


Fig. 2 Simplified geological map of part of The Granites–Tanami region.

Biscay Formation - two intrusive or extrusive acid volcanic samples have model ages of 1540 m.y. and 1490 m.y.

Olympic Formation - three shale samples lie on a 1705 m.y. isochron, regarded as the time of faulting; the three point isochron has a high initial Sr^{87}/Sr^{86} of 0.725, but the oldest model age of any of the three samples is 2010 m.y.

Although these results are equivocal, they do suggest a likely maximum estimate of 2000-2100 m.y. (Early Proterozoic) for the age of the Halls Creek Group. There is certainly no evidence from these data to indicate that the rocks could be as old as Archaean.

The Tickalara Metamorphics and concordant gneissic Mabel Downs Granodiorite are regarded as the metamorphosed equivalents of the Halls Creek Group, and samples from both units define an isochron of 1960 $\pm$ 30 m.y. with a low initial Sr^{87}/Sr^{86} of 0.701 $\pm$ 0.001. Bofinger (1967a) considered that this low value could be explained only by complete loss of radiogenic Sr^{87} from all the rocks at 1960 m.y., the time of metamorphism. This view is based partly on the assumption that the Halls Creek Group is much older than 1960 m.y. (i.e.,the assumption that the group is Archaean). Another view, however, is that the metamorphic and gneissic granites had little or not crustal prehistory - that is, that their precursor, the Halls Creek Group, may not have been much older than the 1960 m.y. metamorphism. Even if the 1960 m.y. isochron represents a mixing line which gives an age that is too high and an initial ratio too low, the Tickalara Metamorphics are unlikely to have been derived from rocks much older than 2100-2200 m.y.

In summary, the available data on the Halls Creek Group and on their metamorphosed equivalents do not show any signs of Archaean prehistory; if anything, they suggest that the group has a maximum age of 2200 m.y., and is possibly as young as 2050 m.y.

The most often quoted isotopic evidence for the age of the Halls Creek Group is Bofinger's (1967a) Rb-Sr analysis of a pegmatite intruding the Olympic Formation; duplicate model ages for one pegmatite total-rock sample are 2750 and 2720 m.y., but the highly radiogenically enriched muscovite from this rock has an age of only 1755 m.y. Another pegmatite with the same intrusive relations has a model age of 2250 m.y., but the granites with which these pegmatites are associated have a maximum (model) age of about 2100 m.y. In our view such large discordances render the data almost uninterpretable. Certainly the 2700 m.y. result cannot be legitimately accepted as a minimum age for the Halls Creek Group. If the Halls Creek Group is Archaean, it seems remarkable that no other Archaean intrusives, or rocks with an Archaean isotopic prehistory, have been encountered in Bofinger's (1967a) or any other study of the Kimberley region. The balance of the available geochronological evidence for the Halls Creek Group is considered to point to an Early Proterozoic rather than an Archaean age, and, given the supposed correlation, this Early Proterozoic age (greater than 1960 m.y.) can justifiably be inferred for the age of the Tanami complex, the basement rocks in the Granites-Tanami region.

SAMPLE SELECTION AND ANALYTICAL METHODS

Sampling for Rb-Sr and K-Ar geochronological work was undertaken in 1972. As weathering of the rocks is characteristically deep and intense, and because exposures are generally widely separated, the chief criterion for choosing sampling stations was the availability of fresh exposure. Where possible, a cluster of several samples to give the maximum dispersion in Rb/Sr ratio from each station was collected by drilling and blasting.

The Rb-Sr total-rock isochron technique has been employed in the granite geochronology, and both the K-Ar and Rb-Sr methods have been used in the glauconite age determinations. The K-Ar measurements were made by Dr A.W. Webb (AMDL Report 3473/73) using the following constants:

$$\beta = 4.72 \times 10^{-10} yr^{-1}, \quad e = 0.584 \times 10^{-10} yr^{-1}, \; K^{40} = 0.0119 \text{ atom percent.}$$

The Rb-Sr analytical procedure now followed in the joint ANU/BMR isotopic laboratory was described originally by Compston et al. (1965), but there are now a number of important innovations to the technique that warrant further description, and this is set out below. Aliquots of total rock (-200 mesh) and mineral concentrate (-85 + 120 mesh) are heated to dryness in two stages, firstly in 5 ml hydrofluoric acid, and then in a further 1 ml hydrofluoric acid and five drops (0.25 ml) perchloric acid; the perchloric acid is then fumed off. Between 0.05 and 0.1 g of total-rock sample, depending on the rubidium and strontium contents, is processed; the amount of available mineral concentrates for analysis also ranges from 0.05 to 0.1 g. All chemical processing is done in teflon-ware. A mixed-spike solution enriched in Rb^{85} and Sr^{84} is added to and homogenized with the sample, which is then taken up in 15 ml 6N hydrochloric acid and evaporated to dryness before the rubidium and strontium are isolated by cation exchange. Use of the mixed spike (de Laeter et al., 1973), in which the ratio Rb^{87}/Sr^{84} is known accurately, eliminates the effects of any weighing errors in the subsequent determination of Rb^{87}/Sr^{86} for the isochron analysis. Unlike the mixed Rb^{87}, Sr^{84} spike solution referred to by de Laeter et al. (1973), the spike now used is enriched in Rb^{85} because this isotope is more readily monitored during the strontium isotopic analysis.

Satisfactory ion exchange concentration was achieved by redissolving the sample evaporate in 20 drops (1 ml) 1N hydrochloric acid, and loading this solution onto a Pyrex-glass cation column containing 4 g Dowex AG 50 W - 8x resin of 200-400 mesh and 50-56 percent moisture content. Elution was performed in two steps using 23 + 6 ml 1N hydrochloric acid to collect the rubidium concentrate, followed by 8 + 8 ml 2.5N hydrochloric acid to collect the strontium concentrate. After cleaning the same columns the rubidium concentrate was further purified, again using 23 + 6 ml 1N hydrochloric acid. The strontium concentrate was further purified on a smaller 2 g column which was eluted with 21 ml 1N hydrochloric acid, followed by 6 + 4 ml 2.5N. Recently determined processing blanks are 0.008 µg for strontium; if the dissolution steps are done in an enclosed nitrogen-pressured atmosphere, our blanks are reduced to 0.002 µg and 0.006 µg, respectively.

Rubidium isotopic measurements were taken on a 15.25-cm (6-inch)-radius, 90°-sector mass spectrometer; strontium analyses were mad with a Nuclide Analysis Associates (NAA) 30.5-cm (12-inch)-radius 60°-sector machine. Rhenium triple-filament sources were used. Both mass spectrometers employed 6 kV accelerating voltage, Faraday cup collector, and Cary electrometer model 31, and were operated on-line to a HP-2116B computer which also controlled the magnetic-field peak-switching. A Cary electrometer model 401 with one-second switching capacity is now used for the acquisition of the strontium isotopic data on the NAA machine. During the measurement of the Sr^{87}/Sr^{86} ratio, any normal rubidium ($Rb^{85}/Rb^{87} = 2.6$) present in the early stage of the strontium analysis had either entirely disappeared or, where still present, necessitated a correction of generally less than 0.1 percent of Rb^{87}. The ion exchange procedure adopted ensures that spiked rubidium is generally completely separated from the strontium fraction. However, if spiked rubidium is observed at the beginning of the strontium run (owing to some peculiarity affecting the ion exchange process), either the rubidium has to be entirely evaporated from the sample before the isotopes are measured, or an appropriate correction can be made to the measured Sr^{87}/Sr^{86} ratio. Maximum tail corrections required under the Sr^{87} peak were 0.015 percent, and under the Sr^{86} peak, 0.006 percent.

The Sr^{87}/Sr^{86} ratio for the Eimer and Amend standard on the NAA machine is 0.70813 ± 0.00004 (1 sigma; Page & Johnson, 1974), normalized to 8.3752 for the Sr^{88}/Sr^{86} ratio. Further recent measurement of Sr^{87}/Sr^{86} in the standard NBS 70 salt give a mean value of 0.71035 ± 0.00006 (1 sigma). The Rb^{85}/Rb^{87} ratio in natural rubidium is taken as 2.600, and the value of 1.39×10^{-11} yr^{-1} was used for the decay constant of Rb^{87}.

Statistical regression of the Rb-Sr isochrons was carried out using the computer program of McIntyre et al. (1966). The coefficients of variation for Rb^{87}/Sr^{86} and Sr^{87}/Sr^{86} have been taken as 0.5 percent and 0.01 percent respectively. Errors quoted for the analytical data that follow are at the 95 percent confidence level.

INTRUSIVE IGNEOUS ROCKS IN THE GRANITES-TANAMI BLOCK

The Lower Prbterozoic metasediments and metavolcanics of the Tanami complex are intruded by several granitic bodies. Four of these granites have been formally named (Fig. 1): Winnecke Granophyre, Lewis Granite, Slatey Creek Granite, and The Granites Granite (Blake et al., 1975; Blake & Hodgson, in prep.). Rb-Sr total-rock and mineral data for the Winnecke Granophyre and associated acid volcanic rocks in the northeastern part of The Granites-Tanami Block have been reported by Page & Blake (in prep.),and indicate similar ages for explacement and volcanism of a little over 1800 m.y. New isotopic data for the three other intrusive groups in the Block are now considered.

The Lewis Granite, originally mapped by Casey & Wells (1964) and more recently by Blake & Hodgson (in prep.), crops out northeast of the Lewis Range (Fig. 2). The isolated granite outcrops in this region intrude the Tanami complex, and are unconformably overlain by gently dipping sediments of the Lewis Range Sandstone, a basal unit of the Redcliff Pound Group, which is considered by Blake & Hodgson (in prep.) to be Adelaidean (Late Proterozoic) in age. The Rb-Sr age study was undertaken on nine samples from five sites. These rocks are pink to grey porphyritic muscovite adamellites and micro-adamellites, some of which contain biotite. Cross-cutting pegmatite and aplite veins up to 0.5 m thick are common.

The Rb-Sr data are listed in Table 1 and plotted on a conventional isochron diagram in Figure 3. The samples have a good dispersion in Rb^{87}/Sr^{86}, and the nine data points are closely aligned on the isochron, in which all error is attributed to experimental uncertainties. The indicated age is 1720 ± 8 m.y., and the samples have a common initial Sr^{87}/Sr^{86} of 0.7091 ± 0.0010. As the samples were collected over a large area, the model 1 fit of the data is surprisingly good. Four of the samples (73-443 to 445 BB) are from the one site, and their isotopic data again yield a model 1 regression fit with an age of 1695 ± 30 m.y. and an initial Sr^{87}/Sr^{86} of 0.7218 ± 0.0163; the higher errors are due to the smaller number of samples considered.

The Lewis Granite samples and associated pegmatites and aplites were emplaced in Carpentarian time, 1720 ± 8 m.y. ago. The moderately high indicated initial ratio of 0.7091 ± 0.0010 suggests some degree of crustal contamination in the genesis of the granite magma.

The Slatey Creek Granite (Blake & Hodgson, in press) consists of a group of isolated and highly weathered granitic outcrops between the Gardner Range and an area west of Killi Killi Hills. It intrudes the Tanami complex, and in unconformably overlain by gently dipping Carpentarian and younger formations.

Granite fresh enough for dating was collected from only four of many outcrops visited; the generally weathered outcrops precluded the collection of a suite of rocks from any one site. The four samples analysed represent an area of inferred granite outcrop over 50 km long. As expected, the four samples do not fit an isochron (Fig. 4) to within experimental uncertainties (mean square of weighted daviates, MSWD = 25.7), and a model 3 solution with an age of 1770 ± 55 m.y. (initial Sr^{87}/Sr^{86} = 0.709 ± 0.019) is obtained. This result is largely controlled by the duplicated analysis of the most enriched sample (73-452A). Because of the reconnaissance nature of the sampling, firm conclusions cannot be drawn from the data, other than that the Slatey Creek Granite is a lower Carpentarian (Middle Proterozoic) intrusion.

Table 1 Rb-Sr data for granitic rocks from The Granites-Tanami

ANU No.	BMR No. (72.49)	Rock Type	Rb(ppm)	Sr(ppm)	Rb^{87}/Sr^{86}	Sr^{87}/Sr^{86}
LEWIS GRANITE						
73-443	5001	Microadamellite	520.3	16.7	113.675	3.43336
73-444	5002	Microadamellite	533.3	28.3	62.427	2.21575
73-445 B	5003 B	Adamellite	453.3	65.3	21.066	1.22359
73-445 BB	5003 BB	Aplite	706.5	25.8	96.972	3.02305
73-447	5005	Adamellite	311.3	42.7	22.164	1.24754
73-462	2663	Adamellite	511.1	44.4	36.098	1.59123
73-499 B	0003	Pegmatite	600.2	11.2	243.646	6.61438
73-499 C	0003 C	Aplite	691.0	25.9	94.168	2.98831
73-500	2071	Adamellite	147.6	147.7	2.905	0.77919
SLATEY CREEK GRANITE						
73-452 A	5011 A	Adamellite	248.9 249.0	14.7 14.4	55.405 56.660	2.08720 2.11644
73-455 B	5014 B	Aplite	155.7	42.8	10.775	0.98502
73-457	1022	Adamellite	226.8	95.3	6.988	0.88046
73-458	0306	Granodiorite	135.7	405.3	0.9691	0.72889
THE GRANITES GRANITE						
73-485	1492	Adamellite	258.7	148.3	5.100	0.83600
73-486	1493	Adamellite	254.7	138.3	5.388	0.84197
73-487	1494	Adamellite	272.7	56.2	14.517	1.06955
73-493	4210	Adamellite	250.2	144.0	5.078	0.83214
73-492 A	4150A	Aplite	141.0	199.6	2.050	0.75790
73-492 AA	4150 AA	Aplite	167.5	41.3	12.060	1.00801
73-492 B	4150 B	Adamellite	115.9	188.2	1.786	0.75088

Table 2. K-Ar ages of glauconite concentrates from the Gardiner Sandstone Birrindudu Group

Sample No (72.49.-)	K%	Rad. Ar^{40}/K^{40}	$\frac{100 \text{ Rad. } Ar^{40}}{\text{Total } Ar^{40}}$	Age ± 2 s.d.
0087 B	6.168 6.144	0.14120	99.8	1556 ± 20
0476 A	5.759 5.791	0.15108	99.8	1628 ± 20
0764	4.511 4.526	0.14265	99.4	1566 ± 30
1127	5.821 5.844	0.12942	99.6	1465 ± 20
1135	6.563 6.575	0.14221	99.7	1563 ± 20
1500	6.607 6.594	0.13643	99.6	1519 ± 20
5021	4.735) 4.753) 4.800)	0.13513 0.13583	99.2 99.1	1509 ± 30 1515 ± 30

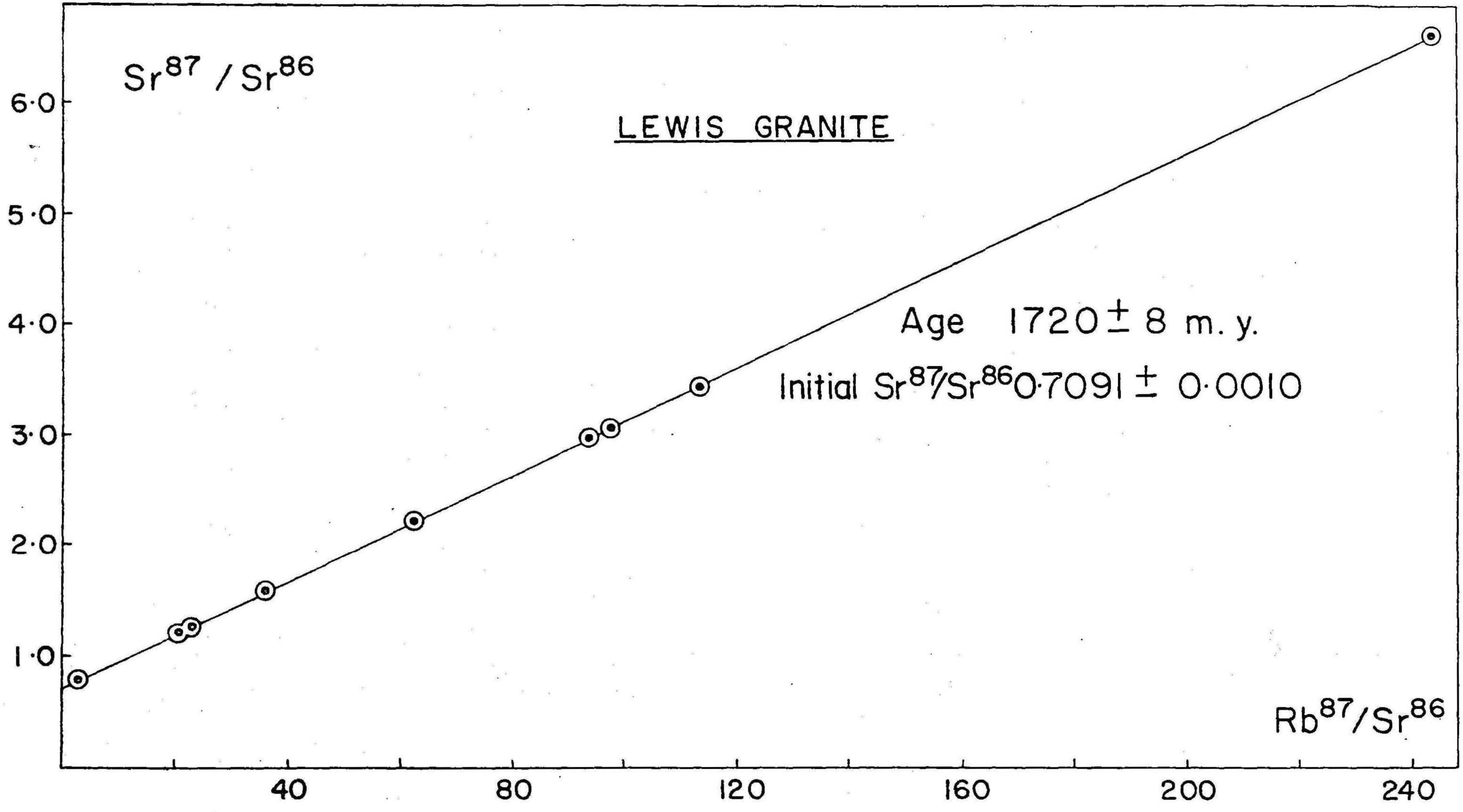


Fig. 3 Rb-Sr isochron for the Lewis Granite

Record 1975/102

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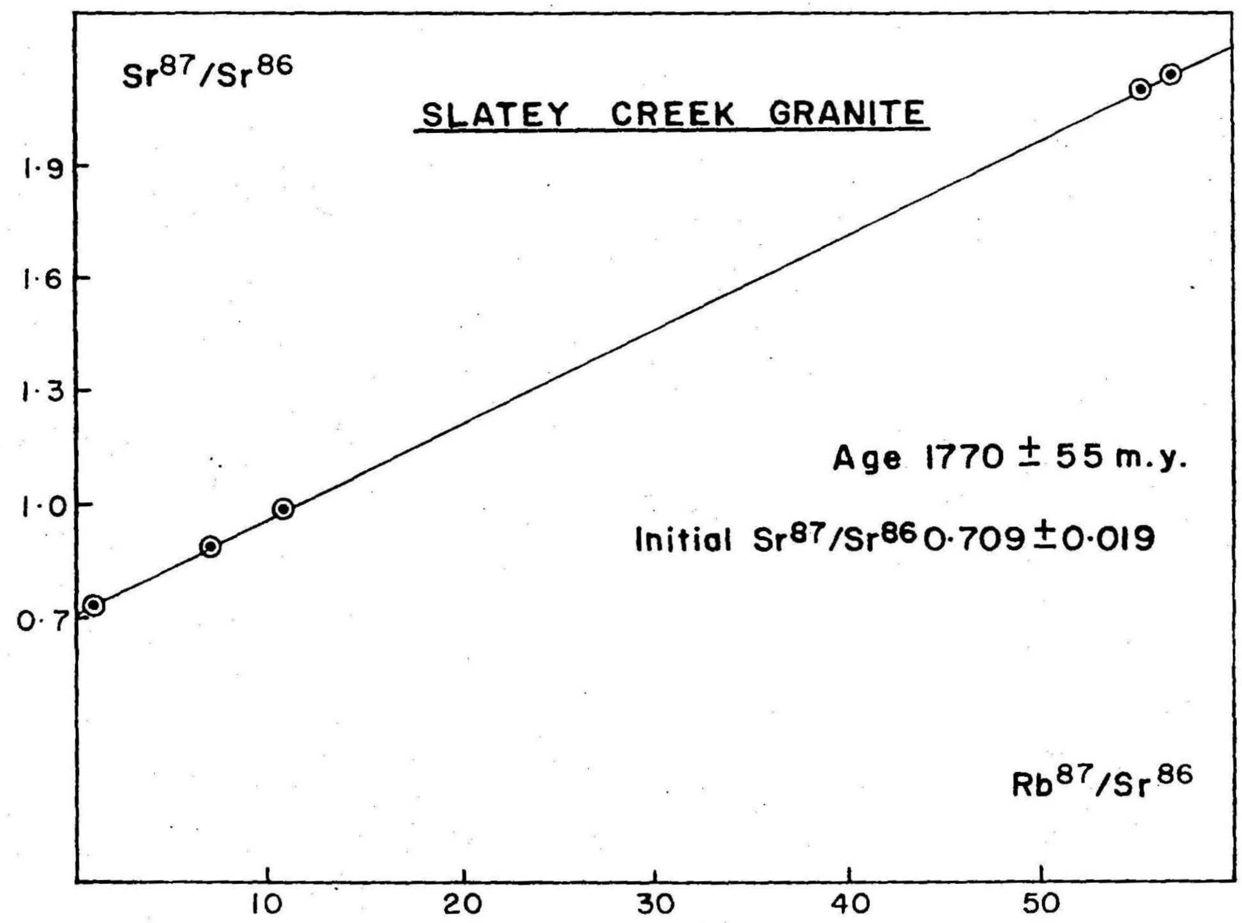

Fig. 4 Rb-Sr isochron for the Slatey Creek Granite

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There is a suggestion that it is older than the Lewis Granite farther south, but the precision of the Slatey Creek Granite data is not good enough to allow an adequate check on this.

The Granites Granite (Blake & Hodgson, in prep.) has the same stratigraphic relations to the Tanami complex metamorphic rocks and overlying sediments as do the Lewis and Slatey Creek Granites. The Granites Granite is exposed in the southeastern part of The Granites-Tanami Block, where it forms both scattered tors and unweathered granite and weathered exposures in gullies.

Seven samples have been analysed from two areas of outcrop (Fig. 2) 23 km east-southeast and 23 km south-southwest of the abandoned gold mining settlement at The Granites. They contain less mica, and more basic than the Lewis or Slatey Creek Granites. Nevertheless, The Granites Granite data (Fig. 5) show a reasonable spread in Rb^{87}/Sr^{86}, and define a model 3 isochron (MSWD = 3.1) with an age of 1780 $\pm$ 24 m.y. and initial Sr^{87}/Sr^{86} of 0.7066 $\pm$ 0.0019. The model 3 solution suggests that small variations in the initial Sr^{87}/Sr^{86} between the samples would account for their observed fit to the isochron.

The early Carpentarian ages of The Granites Granite and Slatey Creek Granite are experimentally indistinguishable and, together with their similar initial Sr^{87}/Sr^{86} ratios, suggest that the two granites may be comagmatic. The Granites Granite is, however, clearly older than the Lewis Granite. The 1800 m.y. Winnecke Granophyre, the only other dated intrusion in The Granites-Tanami Block, can now also be correlated in time with The Granites Granite and Slatey Creek Granite. A future major and trace element analytical study of the four granite domains of The Granites-Tanami Block may be able to more closely define the genetic similarities and differences inferred from the Rb-Sr isotopic data.

AGE OF THE BIRRINDUDU GROUP

The Birrindudu Group is the lower of the two groups of sedimentary rocks that constitute the Birrindudu Basin, which unconformably overlies the granites, volcanics, and metamorphics of The Granites-Tanami Block (Fig. 2). The Gardiner Sandstone (Blake et al., 1975) is the oldest formation of the Birrindudu Group, and has a maximum thickness of about 3000 m. Glauconitic sandstone horizons about 10 m thick occur in several places within 50 m of the top of the formation, and seven samples from four different outcrop areas (Fig. 2) were chosen for isotopic dating. The sandstones have an average grainsize of about 0.5 mm, and are cemented by authigenic overgrowths of quartz. Apart from quartz - the main constituent - and iron-stained glauconite, the sandstone also contains minor detrital feldspar, lithic fragments, and tourmaline.

The K-Ar ages (Table 2) range from 1465 to 1628 m.y. These results are difficult to interpret because some of the glauconite concentrates used in the K-Ar work could not be adequately purified. This is certainly so for 0476A, in which inherited radiogenic argon in the feldspathic impurities may have contributed to its much older age. Three of the glauconite K-Ar ages are, however, closely grouped at around 1560 m.y., which because their potassium contents have a 40 percent range, is probably geologically significant. The youngest glauconite age of 1465 m.y. probably reflects some loss of radiogenic argon. The two glauconites from Coomarie Spring (1500, 5021) are also younger, but are in good agreement at 1519 m.y. and 1512 m.y.; as they too have quite different potassium contents, their ages may be geologically meaningful or may reflect partial differential outgassing of argon.

From these limited K-Ar data, there are two tentative groups of ages; one at about 1560 ± 20 m.y.; the other at about 1516 ± 20 m.y. These ages would normally be regarded as probable minimum estimates of the time of glauconite diagenesis in the specific areas from which the samples were collected.

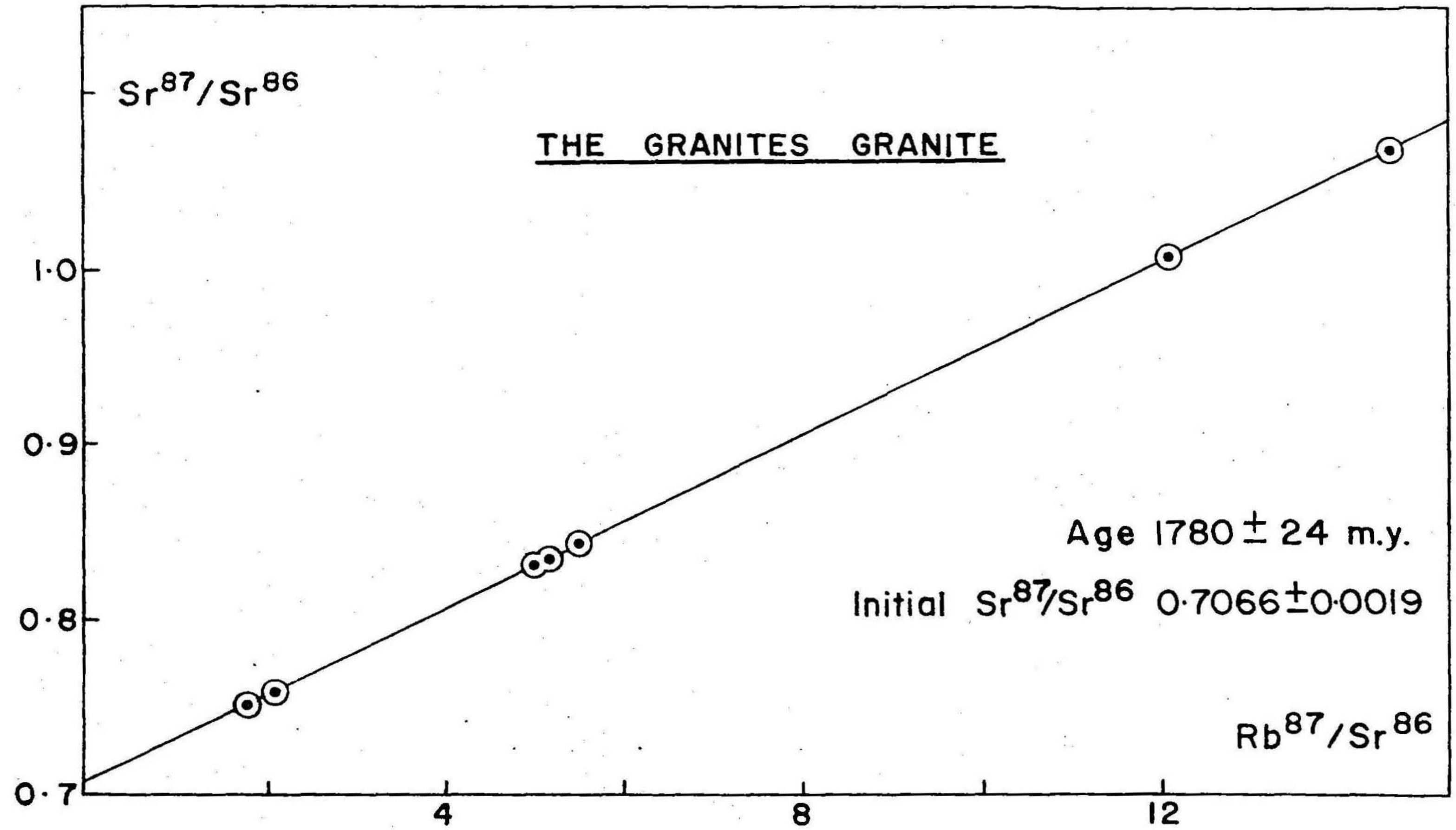

Fig. 5 Rb–Sr isochron for The Granites Granite

Record 1975 / 102

M(Pt)252

Six of the seven glauconites were subsequently hand-picked to 100 percent purity and analysed by the Rb-Sr isotope dilution procedure. The data (Table 3) are plotted on a conventional isochron diagram (Fig. 6). The glauconite points do not lie on a single isochron: the two samples from Coomarie Springs (1500, 5021) fall markedly below the isochron which joins the other four samples, and were excluded from the regression. The age derived from this isochron, 1500 ± 108 m.y. (initial Sr^{87}/Sr^{86} = 0.731 ± 0.016), is consistent with the preferred K-Ar age of 1560 ± 20 m.y. given by some of the same samples. The two Coomarie Spring glauconites have quite discordant younger model Rb-Sr ages (1461 and 1405 m.y.), which are significantly younger than their K-Ar ages, and have probably lost part of their radiogenic strontium; if so, then they might also have lost radiogenic argon, and the two apparently concordant K-Ar ages (1519 m.y., 1512 m.y.) must now be considered as younger than the age of glauconite formation.

From the available evidence, the preferred age for the Gardiner Sandstone is considered to be that given by the three glauconites which have a pooled age of 1560 ± 20 m.y. This is a minimum estimate and is consistent with the Rb-Sr isochron age of four of the glauconites. Three of the other samples are considered to exhibit a pattern of radiogenic argon and strontium loss, and the remaining sample has impurities of feldspathic material which may have contributed to an age that is too great.

CONCLUSIONS

1. Metamorphic rocks of the Tanami complex, the oldest rocks of The Granites-Tanami Block, are considered to be Early Proterozoic (older than 1960 m.y.) on the basis of extrapolations to the east Kimberley Halls Creek Group. There is little justification for assigning an Archaean age (as has been done in the past) to either the Halls Creek Group or the Tanami complex.

2. Granites which intrude the Tanami complex were apparently emplaced during two episodes: as far as can be discerned from Rb-Sr ages, the older group - comprising the Slatery Creek Granite, The Granites Granite, and Winnecke Granophyre - is 1770-1800 m.y. old; the Lewis Granite is somewhat younger at about 1720 m.y. old.

3. Glauconite in the Gardiner Sandstone of the Birrindudu Group gives a spread of K-Ar and Rb-Sr ages, probable due primarily to loss of radiogenic daughter products. An age of 1560 $\pm$ 20 m.y., given by three K-Ar determinations on different samples, is considered to be the best estimate for the age of deposition for the Gardiner Sandstone. This mid-Carpentarian age is consistent with the early Carpentarian ages of the basement granites which are overlain by the Birrindudu Group.

Table 3. Rb-Sr data for glauconites from the Gardiner Sandstone Birrindudu Group

Sample No. (72.49.-)	Rb (ppm)	Sr (ppm)	Rb^{87}/Sr^{86}	Sr^{87}/Sr^{86}
0087 B	347.1	62.9	16.471	1.06978
0476 A	319.8	168.4	5.559	0.84941
1127	294.6	13.4	73.132	2.26256
1135	372.2	9.7	144.822	3.84788
1500	344.3	13.4	87.096	2.48664
5021	278.5	26.5	32.206	1.33522

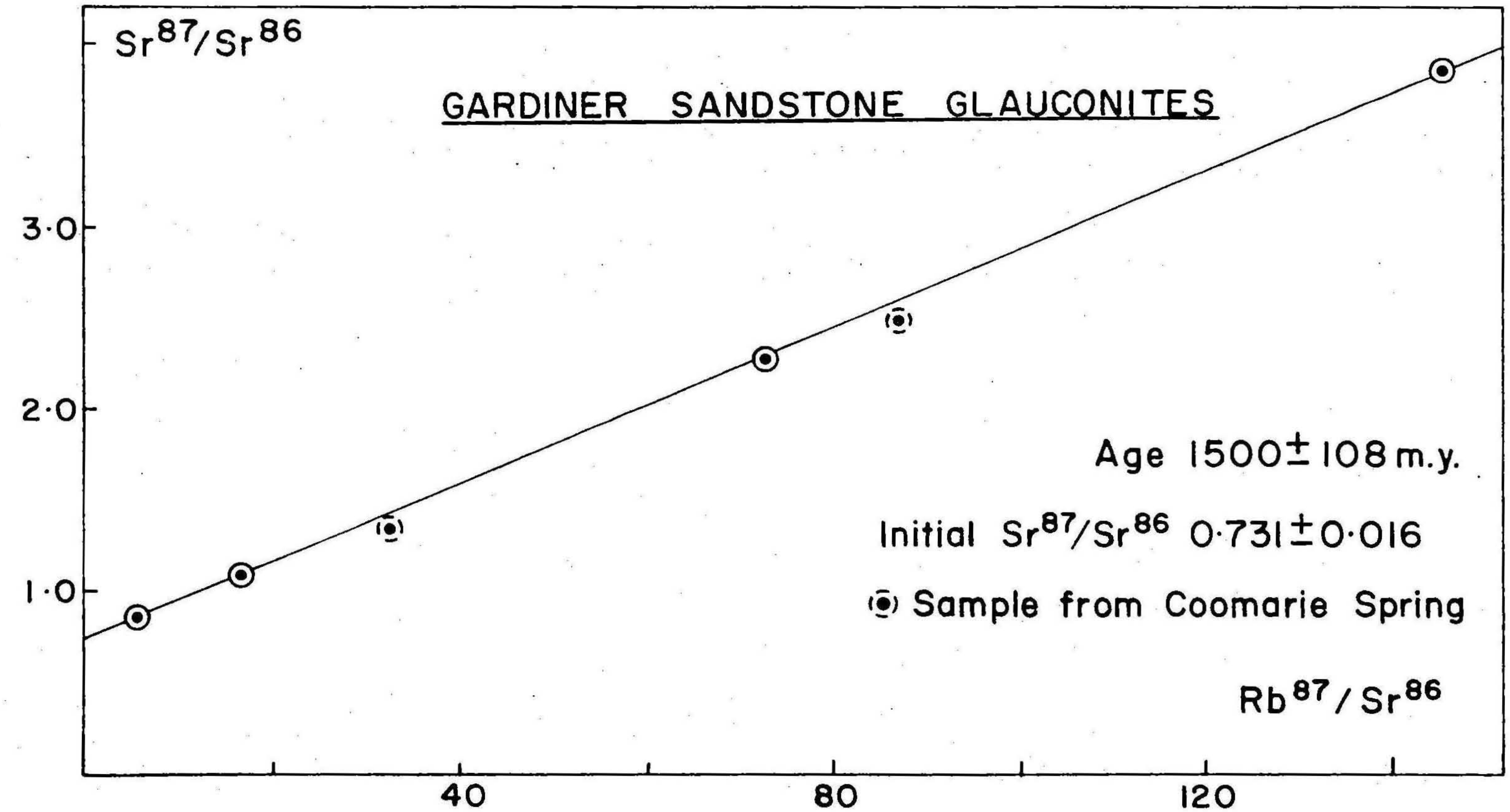

Fig. 6 Rb–Sr isochron for Gardiner Sandstone glauconites.

Record 1975/102 M(Pt)253

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