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LAVERTON - EDJUDINA AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, WESTERN AUSTRALIA 1966

by

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SUMMARY

An airborne magnetic and radiometric survey of the LAVERTON and EDJUDINA 1:250,000 map areas was flown in 1966 to assist the systematic regional geological mapping of the Western Australian Precambrian Shield, and the search for metals.

Virtually the entire magnetic pattern is attributed to differences in magnetic properties between rock units at or near ground level. Geological strikes and the boundaries of major rock units have been interpreted by delineating magnetic trends, by subdividing the area into zones of specified magnetic character, and by assessing the geological significance of these zones by reference to mapped geology.

The area is interpreted to comprise vast heterogeneous acidic igneous masses, with ill-defined more basic regions, which enclose elongated outcrops of interbedded lava and sediment sequences. Both this regional interpretation and a more detailed analysis show good agreement with mapped geology. Areas where geological and magnetic evidence conflict are discussed in some detail. Sixteen fold axes, one cross-fold axis, twelve major dykes (one remanently magnetised), and fourteen faults have been delineated.

Ultrabasic intrusions, which may have some economic importance, cannot be resolved with absolute certainty from the magnetic pattern; however, eleven areas which have a high probability of containing these rocks are recommended for ground investigation.

The radiometric data reveal many high radiometric anomalies which are mainly correlated with granite outcrops. Some granite masses have a greater radioactive content than others. Eighty-three radiometric anomalies satisfying the point-source criteria were detected, and of these, fifty-one are recommended for ground investigation.

1. INTRODUCTION

In 1956 the Bureau of Mineral Resources, Geology and Geophysics (BMR) commenced an extensive programme of airborne magnetic and radiometric surveys in the goldfields region of Western Australia at the request of the Western Australian Department of Mines. The prime objective was to delineate the boundaries of major rock units that could serve as key horizons in the determination of geological structure. By the end of 1964 the 1:250,000 map areas of SOUTHERN CROSS, KALGOORLIE, BARLEE, JACKSON, KURNALPI, WIDGIEMOOLTHA, BOORABBIN, NORSEMAN, LAKE JOHNSTON, MENZIES, and LEONORA had been surveyed.

Between mid-June and mid-August 1966, the BMR continued this programme with the surveying of the LAVERTON and EDJUDINA areas, situated within the Mount Margaret and North Coolgardie Goldfields. This Record presents the results of the 1966 survey.

The survey area, bounded by latitudes 28°00'S and 30°00'S and longitudes 121°30'E and 123°00'E, constitutes a small part of the Archaean Yilgarn Block, a subdivision of the Western Australia Shield (Plate 1). The block is essentially a vast mass of granite and gneiss which encloses lenticular remnants of older rocks, folded about north-north-west axes. These remnants are composed of various inter-bedded lavas and sediments which were intruded by concordant basic and ultrabasic rocks prior to regional folding. The folding was accompanied by intrusion of the granite and by generally low-grade metamorphism. Mineralisation, of which gold has been the most extensively worked, is virtually confined to the folded older rocks.

The objectives of this survey were to aid a programme of systematic regional geological mapping of the Shield and to assist in the search for metals. Regional mapping by the Geological Survey of Western Australia has been mainly directed towards the determination of the basic structure of the Shield and with establishing a relation between such structure and mineralisation. A relation has also been sought between gold-mineralisation and rock-type, and the concept of 'favourable beds' and 'gold lines' is supported in much of the geological literature. Recent investigations by mining companies have been focused on a search for nickel deposits, which could be associated with magnetically detectable ultrabasic rocks.

The co-operation of the Geological Survey of Western Australia, Western Mining Corporation Ltd, and Australian Selection Pty Ltd is gratefully acknowledged.

2. REVIEW OF PREVIOUS GEOPHYSICAL INVESTIGATIONS

Geophysical investigations within the survey area have been conducted by mining companies in a search for base metals and gold. The Western Mining Corporation Ltd has used induced polarisation (IP) techniques in three reserves in the vicinities of Laverton, Morgans, and Eulaminna (Plate 4). The significance of IP anomalies recorded in the Laverton and Morgans areas is not yet fully known but the company has planned a programme of ground magnetic surveying, geological mapping, and diamond drilling of selected IP anomalies to gain further geological control. The processing of the data from the Eulaminna area is incomplete (R. Woodall, pers. comm., and J. H. Lalor, pers. comm.). A geochemical survey was commenced in the Laverton area during 1966 by Western Mining Corporation Ltd (R. Woodall, pers.comm.).

Airborne electromagnetic and magnetic surveys of 420 square miles of country around Murrin Murrin (Plate 4) were flown by Australian Selection Pty Ltd with a line-spacing of ¼-mile and a ground clearance of 400 feet. The airborne INPUT electromagnetic survey was only partially successful owing to the presence of large areas of saline overburden of very low resistivity. The aeromagnetic results showed a very close correlation with mapped geology, and a number of high amplitude anomalies were detected. A considerable amount of ground investigations has followed these surveys (N. Pratt, pers. comm., and P. B. Andrews, pers. comm.).

Since Miles (1953) first advocated the use of the airborne magnetometer to determine aspects of geological structure by delineating banded iron formations (jaspilites), airborne magnetic and radiometric surveys have been flown by the BMR over the nearby areas of KALGOORLIE, SOUTHERN CROSS, BARLEE, and JACKSON (Spence, 1958), KURNALPI and WIDGIEMOOLTHA (Carter, 1959), BOORABBIN and NORSEMAN (Forsyth, 1961), LAKE JOHNSTON (Wells, 1962), and MENZIES and LEONORA (Young and Tipper, 1966). The magnetic data obtained from these surveys, with the exception of the MENZIES and LEONORA area, were interpreted by Quilty (in preparation), who found that significant geological structure could be outlined from contour maps of total magnetic intensity, the interbedded iron-rich rock units being traced as marker beds. A number of major folds and cross-folds were interpreted by Quilty from the arcuate form of the magnetic trends. This interpretation was based on the conclusions of Ellis (1939), who had shown that the jaspilite outcrop pattern in the SOUTHERN CROSS area could be produced by strong folding followed by cross-folding of less intensity prior to peneplanation, such that an 'hour-glass' pattern would be developed at the intersection of an anticline and a syncline.

Quilty (op. cit.) also found that many cross-fold axes were outlined by a series of easterly-trending anomalies, some of which extend over several hundred miles. Two types of cross-trending anomalies were recognised: intense negative anomalies attributed to remanently magnetised near-vertical sheets, and positive anomalies attributed to vertical sheets magnetised in a direction close to that of the Earth's present field. These sheets were interpreted to represent two or more suites of basic intrusives, which possibly occupy tension fissures.

Anomalies due to interbedded formations were stated by Quilty to be of a form consistent with induced magnetisation. This assumption led to the calculation of susceptibility values mainly in the range 0.01 to 0.05 c.g.s. with a few as high as 0.2 c.g.s. Dip angles of the interbedded formations were found to be in the range 80° to 90° in all cases.

The magnetic data presented in profile form from the MENZIES and LEONORA areas were interpreted by Young and Tipper (1966). Some aspects of regional geological structure were delineated by resolving and analysing magnetic trends and by subdividing the area into zones of specified magnetic character. Seven east-west dykes were defined with widths of 1000 ft, near-vertical dips, and depths of burial within 100 ft of the surface. Two of these dykes were interpreted to be remanently magnetised. North-south trending anomalies of the order of 1000 gammas were calculated to represent susceptibility contrasts in the range 0.002 to 0.003 c.g.s. and these were attributed to serpentinite bodies. Larger anomalies approaching the order of 10,000 gammas indicated susceptibility values between 0.025 and 0.040 c.g.s., and these were attributed to jaspilites. Areas showing a relatively flat magnetic field were ascribed to near-homogeneous acidic igneous rocks or to non-magnetic sedimentary sequences.

Interpretation of radiometric data from the goldfields region indicated that most of the anomalies detected may be correlated with granitic outcrops. However, in the Southern Cross - Kalgoorlie region eighty-four anomalies were recommended for ground investigation following a low-level airborne radiometric survey (Mulder, 1960). Sixty-four radiometric anomalies were detected in the MENZIES and LEONORA areas and, of these, forty-seven were considered to warrant ground investigation (Young and Tipper, 1966).

3. GEOLOGY

Introduction

The survey area forms part of the Archaean Yilgarn Block, a subdivision of the Western Australian Precambrian Shield. The broad regional geology of this shield has been given by Forman (1953), Wilson (1958), and Prider (1948, 1954, 1961, and 1965). The general sequence of Precambrian history is as follows. Basalts and minor rhyolite flows were extruded onto an ancient basement surface. Pillow lavas indicate that there was considerable submarine vulcanism. Interbedded shales, greywackes, tuffs, agglomerates, and banded iron formations (jaspilites) show that sedimentation was active during periods of volcanic quiescence. The lavas and sediments were intruded concordantly by gabbros, dolerites, ultrabasic rocks and some minor porphyries. All these rocks were then folded about north-north-west trending axes, contemporaneously with widespread granitic intrusion, pegmatitic and aplitic intrusion, and granitisation and metamorphism of variable grade. The granitic rocks have been dated at 2700 million years (Wilson et al, 1960). Gold mineralisation is probably genetically related to the granite (Campbell, 1965) and in parts of the shield the age of mineralisation has been dated as 2300 to 2400 million years (Wilson et al, 1960). A system of subordinate folding about east-north-east to north-east axes was superimposed on the major folding, and, in at least some parts of the shield, was a significant factor in localising gold mineralisation (Ellis, 1939; McMath, 1953). This cross-folding could be broadly contemporaneous with the major folding. Intrusion of cross-trending dolerite dykes marked the end of Precambrian time.

In much of the geological literature (e.g. Forman, 1953; Low, 1960), sections of the Archaean succession that are predominantly basaltic have been referred to as the Greenstone Phase or the Older Greenstones, and the more sedimentary sequences as the Whitestone Phase or the Whitestones. The prefolding intrusives have been referred to as the Younger Greenstones. A number of writers (e.g. Prider, 1965) have divided the granites into an Older (synkinematic) Granite and a Younger (postkinematic) Granite. Horwitz (1966) stated that there are two granite facies but that they show contradictory age relationships. He considered that the granites are broadly contemporaneous but that in detail they are of several ages. Many of the granites are folded.

The banded iron formations have been described by Miles (1941, 1943a and b, 1946, and 1953), Connolly (1959), and MacLeod (1965).

The geology of the survey area, given below, is based largely on the work of Gibson (1906), Honman (1917), Clarke (1925), Hobson (1939 and 1940), Hobson and Miles (1939 and 1951), Miles (1939c), and Berliat (1955). Reference was also made to the work of Maitland (1903), Jutson (1915 and 1917), and Miles (1939d).

The geological maps produced by Hobson and Miles (1951) and Honman (1917) have been incorporated in Plates 4 to 9 of this Record. Further geological data were obtained from the Geological Map of Western Australia (Western Australia Mines Dept., 1966).

Stratigraphy

The major rock units and their distribution are described in order of decreasing age. It should be remembered, however, that sedimentation commenced well before the end of igneous extrusion and sediments and lavas are generally interbedded.

Basement gneiss. The oldest rocks of the district must necessarily be those of the ancient basement upon which the lavas were extruded. Honman (1917) believed that the basement has been completely changed to granite and gneiss, and he suggested that some of the gneissic areas scattered throughout the granite may be relics of this basement. Although Clarke (1925) found variations within the main mass of the granite, he could find no evidence that the gneissic patches are distinct from, and older than, the normal granite. Hobson (Hobson and Miles, 1950) found granitic pebbles in a conglomerate which is older than any known granite and he stated that these point to an ancient granite which has not been found.

Lavas. The extrusives are basic (basalt or dolerite), intermediate-basic (andesite), and acidic (rhyolite and porphyrite), and many are associated with agglomerates and tuffs. Basic lavas have a relatively much wider distribution, and in the LAVERTON area good outcrops are found near Murrin Murrin, Eulaminna, Mailman Hill, and west of Mount Redcastle (Plate 4). Much of the EDJUDINA area also is composed of basic lavas (Plate 5). They range from fine-grained amphibolites to dolerites and amphibolitic schists. Coarser varieties such as gabbros and epidiorites are thought by Honman (1917) and Berliat (1955) to be local variations of the basalts, as in most cases no defined boundaries were found between the coarse and fine-grained rocks.

Andesitic lavas and associated agglomerates crop out six to eight miles south-south-east of Laverton, where they have been mapped by Clarke (1925).

Outcrops of rhyolite and prophyrite in the EDJUDINA area appear to be flows contemporaneous with the basic lavas with which they are interbedded. The most extensive occurrence is a 1½-mile wide belt north of Yerilla. Clarke (op. cit.) has mapped extensive outcrops of quartz-porphyry immediately east of Mount Weld and four miles west of Mount Crawford, all in the LAVERTON area.

LAVERTON area sediments. Sediments are thought to be extensively developed in the extreme north of the central greenstone belt and in the vicinity of Ida Hill, but outcrops are poor. A half-mile wide band of sediments has been found at Murrin Murrin by Hobson (1939). Elsewhere the sediments appear to have a more limited distribution as narrow bands interjacent with lavas.

Argillaceous, arenaceous, and coarse conglomeratic sediments are all represented. Surprisingly little deep-seated regional metamorphism is shown, most changes being due either to contact metamorphism near intrusions or to dynamic pressures induced during folding.

Included among the sediments are the important jaspilite formations whose sedimentary origin and ease of recognition have allowed their use as key horizons in the determination of structure. Two types are recognised - the ferruginous and the siliceous. Ferruginous types consist of alternating bands of chert, and either iron oxides or hydrated iron oxides. All varieties grade one into the other along strike and all change below the zone of oxidation to bands of essentially fine-grained quartz and granular magnetite. Good outcrops of these jaspilites are found near Laverton, Mount Morgans, and Mount Margaret. The siliceous types consist of alternating bands of white chert and grey graphitic chert. Typical occurrences are at Mount Crawford, Mount Weld, and two to three miles north of Mount Clarke. Certain banded magnetite-grunerite quartzites are thought by Miles (Hobson and Miles, 1951) to be the result of thermal metamorphism, superimposed on regional metamorphism, of the jaspilites.

EDJUDINA area sediments. Honman has subdivided the sediments into the Older Sediments (jaspilites) and the Newer Sediments. As in the LAVERTON area, jaspilite outcrops are more common in the eastern part of the 'greenstone' belt. The Newer Sediments form a continuous outcrop from two to three miles wide. This outcrop strikes south-south-east from Lake Raeside, parallel to the basic lavas, for over thirty miles. The belt consists of two main conglomerate bands, about one mile apart, with which are interbedded arkoses, tuffs, and flows. South of Yilgangi the conglomerates contain lava fragments and in places they approach the composition of agglomerates. Within the sedimentary sequence are some intrusive porphyry dykes, which at Yilgangi contain auriferous quartz-reefs.

Berliat (1955) has mapped an extensive belt of sediments west of Linden, which contains almost all the jaspilite outcrops. Fine-grained schistose rocks are interbedded with arenites.

Ultrabasic intrusives. Ultrabasic sills have been recorded from a number of localities. The principal occurrence in the LAVERTON area is a belt, of up to 1¼ miles wide, which trends north-north-east, parallel to the general strike, from west of Murrin Murrin for five miles to east of the old Anaconda Copper Mine. These rocks have been described by Miles (1951). Other, smaller, ultrabasic intrusions crop out near Murrin Murrin and Eulaminna. They are represented by serpentinised peridotites, serpentinites and minor serpentinised pyroxenite, and talc rock. Peridotites and their derivatives are very common in the EDJUDINA area occurring mainly as serpentinites and dolomites in belts parallel to the jaspilites and basic lavas. There are two principal belts both striking south-south-easterly. One extends discontinuously from Pikes Hollow to Lake Raeside and the second forms a parallel outcrop through Linden. This second belt was not mapped by Berliat (1955) in the Linden district. Patches only of serpentinous rocks were seen half a mile north-east of Mount Linden. A dolomitic phase of ultrabasic rock mapped by Honman (1917) in the south-east corner of the area is believed to be a continuation of the second belt. Other occurrences of serpentinous rock in the EDJUDINA area include the outcrops west of Mount Howe. A larger outcrop to the east of Mount Howe has been mapped by Berliat (1955).

Basic intrusives (pre-folding). These have a wide distribution particularly in the LAVERTON area, but outcrops are frequently small and entirely surrounded by soil-covered areas. Outcrops are exceptionally good, however, in the vicinity of Murrin Murrin and Eulaminna, where sills form outcrops up to seven miles long and from 700 ft to 1½ miles wide. The sills are gabbroic and doleritic, generally partially uralitised. Elsewhere uralitisation and recrystallisation are more complete, producing epidiorites and amphibolites.

In the EDJUDINA area the basic intrusives are extensively developed in the north but become less common towards the south. A prominent outcrop strikes parallel to, and is close to, the serpentinite band through Pike's Hollow. Pyke Hill is a typical outcrop of epidiorite. Berliat (1955) has mapped a large area of basic intrusive, described as predominantly amphibolites, between Linden townsite and Lake Carey. Honman (1917) and Berliat (1955) believe that some epidiorites could represent extreme metamorphism and recrystallisation of basic extrusives. Hobson has found, however, that near Murrin Murrin and Eulaminna, the boundaries between intrusives and lava are very well defined.

Basic pegmatites, very coarse-grained end-phases of dolerite-gabbro magma, are found in several localities.

Acidic intrusives. A large number of different petrographic types has been recognised in the survey area, and together they form a considerable proportion of the country. Granites may be subdivided into massive and gneissic types. The commonest varieties of the massive type are potassic and sodic biotite-granites. In the EDJUDINA area there are three distinct granitic belts. The central belt, believed by Honman to be the youngest, is variable in composition. Much of its central portion is a biotite-granite, but close to its contact with the older basic rocks the granite is more basic, at times approaching the composition of syenite. Most of the more basic granite in this belt, however, should more correctly be termed granodiorite (Honman, op. cit.). Berliat (1955) found no mineralogical difference between those parts of the eastern and central granite belts that he inspected, both being described as medium to coarse-grained massive biotite-granite. Much of the LAVERTON area is believed to be composed of granitic rocks but both syenites and granodiorites also have been observed.

Gneisses do not form extensive areas of outcrops, and in the LAVERTON area they are generally confined to localities near the junction of granite and the older rocks. They include cataclastic gneisses, granulated by pressure, and injection gneisses caused by the penetration and replacement of basic schists by granitic magma. Gneisses in the EDJUDINA area are confined to the two older granitic belts and are described by Honman as remnants of the older basement.

A feature of the area is the abundance of porphyry dykes, both sheared and massive, which intrude the 'greenstones'. They are especially numerous at Linden (Plate 5); and at Mount Gooses and immediately east of Mount Morgans (Plate 4) they probably constitute a quarter to half of the country. Elsewhere they are more common near granite contacts. Honman has tentatively described them as apophyses from the younger granite, but Hobson (Hobson and Miles, 1951) suggests that some are narrow zones of granitised 'greenstone'.

Other acidic rock types found in smaller bodies include aplites, pegmatites, and quartz reefs.

Basic intrusives (post-folding). The younger basic intrusives include various dolerites and lamprophyres and a basaltic breccia. The relative ages of the dolerites and lamprophyres is not known but both are believed to post-date the granite. They are thought to have a limited occurrence in the survey area. One dyke has been observed by Maitland (1903) on an island in Lake Raeside east of Yerilla (Plate 5). A similar dyke intrudes granite about five miles south of Yarri.

Recent deposits. Alluvium and aeolian deposits cover much of the country, and their thickness could exceed 100 ft in places. A number of hills in the area are capped with recent horizontal quartzites and conglomerates.

Structural geology

Folding. The older Archaean rocks are folded into a series of anticlines and synclines, which pitch and trend generally south-south easterly, and which occasionally show overturning.

Five such folds have been recognised in the LAVERTON area; the Erlistoun, Margaret, and Benalla Anticlines and the Laverton and Redcastle Synclines (Hobson and Miles, 1951). The degree of southerly pitch is variable and there are a number of local pitch-reversals.

The axes of the Erlistoun Anticline and Laverton Syncline are well defined. The western limb of the former fold is known to be overturned. The position of the Margaret Anticlinal axis is reasonably well fixed. In the vicinity of Mount Margaret the jaspilites dip southwards at angles between 50° and 80°. This fold is considerably broader than the Erlistoun Anticline. The Redcastle Syncline, although less well defined, appears to be a broad fold generally resembling the Margaret Anticline. The north-north-west strike in the vicinity of Mount Morgans appears to persist as far as Yundamindera (Plate 5). On the western limb there is a well defined north-north-easterly strike in the general area of Murrin Murrin and west of there. The Benalla Anticline, in the extreme west of the area, is not well defined. Miles (1939c) has mapped two east-north-east trending major cross-folds in the centre and south of the LAVERTON area, and a number of minor cross-fold axes.

Two distinct folds have been recognised in the EDJUDINA area. Honman (1917) believed that an anticlinal axis is represented by the Edjudina - Mount Millicent jaspilites. He has shown that the two ultrabasic outcrops which pass through Pike's

Hollow and Linden, are parellel to, and equidistant either side of, the jaspilites. The peridotites therefore are believed to have been intruded along a single horizon in the 'greenstone' series, along the east and west limbs of the anticline. However, Berliat (1955) stated that the only satisfactory explanation to account for the rock distribution in the area he mapped is a large synclinal structure whose axis is represented by the jaspilites. Berliat also found strong evidence for the overturning of the eastern limb. A regional southerly plunge was inferred from the plunge of numerous drag folds in the jaspilites. A number of minor parallel anticlines and synclines and minor cross-folds were recognised and mapped by Berliat, who showed the jaspilites dipping at various attitudes between 65° to the west through vertical to 65° to the east. A second major fold axis passing close to Yilgangi represents a synclinal structure in which the conglomerates occur (Honman, 1917).

Faulting. No large-scale faulting was observed in the LAVERTON area by Hobson, although a number of shear planes, crossing the general north-north-west trend at right angles, were interpreted by Clarke from trend changes in jaspilite outcrops. In the EDJUDINA area two large fault planes striking north-west have been mapped by Honman and named the Mount Celia - Yundamindera Fault and the Edjudina - Yerilla Fault. The latter is not shown on the Geological Map of Western Australia (Western Australian Mines Dept, 1966).

Mineralisation

Gold and silver. The mineral most extensively worked is gold, which in some places is associated with silver obtained as a by-product. Approximately two million fine ounces of gold have been won from the survey area and about 90% of this came from the LAVERTON area. In the EDJUDINA area the gold-bearing reefs occur almost exclusively in the 'greenstone' belts, but if in granite, the 'greenstone' contact is never far away. Honman considered it significant that almost all the mining centres in the EDJUDINA area are close to the two major fault planes. Berliat (1955) has cited two deposits which could have an association with the position of cross-fold axes, but he stated that the relationship cannot be conclusively proved.

In the LAVERTON area the principal production has been from lodes consisting of mineralised jaspilites. The next largest production came from quartz reefs in schists of varying types including metasediments, and the third largest production came from orebodies occurring at the junction of two rock types. At Murrin Murrin a little gold was won from reefs in basic lavas. Hobson (Hobson and Miles, 1951) recognised a relationship between ore-deposition and folding in the LAVERTON area. He stated that the principal producing centres of Laverton, Mount Morgans, and Murrin Murrin are associated with steep southerly pitching folds. There is no evidence, however, to suggest that the mining centres are associated with minor cross-folds.

Details of the geology and production of individual mining centres have been given by Jackson (1905), Gibson (1906), Honman (1917), Hobson (1938), Matheson (1938 and 1939), Miles (1938, 1939a and b, and 1940), and Hobson and Miles (1951).

There is virtually no mining activity in the survey area at present.

Copper and pyrites. Between 1899 and 1908 nearly 48,000 tons of copper ore were produced in the area, principally from Eulaminna, but also from Murrin Murrin. Pyrites was won from both localities. The mining geology of the Anaconda Mine (Eulaminna) has been described by Woodward (1908a and b) and by Clarke (1925). The rock containing the orebodies is mainly fine-grained greenstone. The richness of the lode was variable, the ore carrying from 1% to 40% copper.

In the EDJUDINA area, the only evidence for copper mineralisation is some staining in an amphibolite alongside serpentinite at Linden.

Nickel. Interest is currently being shown in the area as a possible source of nickel, associated with the weathering of ultrabasic intrusives. There has been no production to date.

Other minerals. Honman has suggested that tin could be present in the tourmaline-bearing pegmatites at the contacts of the central granodioritic belt of the EDJUDINA area. There is a widespread occurrence of actinolitic asbestos in the serpentinous rocks of the area.

Manganese has been found about twelve miles south-south-east of Laverton, possibly associated with jaspilite (Tomich, 1955). The deposit is estimated to have approximately 21,000 tons of proven ore and 15,000 tons of untested ore. The richest sample analysed indicated 47% metallic manganese.

4. MAGNETIC RESULTS AND INTERPRETATION

The magnetic data are displayed in Plates 2, 3, 4, and 5. Plates 2 and 3 show all profiles of total magnetic intensity reduced to an east-west scale of 1:250,000 and related to a series of east-west lines which approximate the flight paths. A north-south scale of 1:62,500 has been employed to improve data presentation. The profiles are accurately positioned with respect to longitude near longitudes 121°52'E and 122°38'E. For the reduction of the original profiles by pantography, the aircraft's ground speed was considered constant along any one traverse. Departures from this constant speed introduce a positional error in the presentation of the data, which is manifested by a herring-bone pattern in the magnetic trends and zonal boundaries. The probable positional error, of + $\frac{1}{4}$ mile, is a function of distance from the control longitudes. The approximate magnetic intensity scale of 500 gammas to the inch was too large to show satisfactorily the intense anomalies detected in the EDJUDINA area (Plates 3 and 5). These anomalies have been further reduced to an approximate scale of 5000 gammas to the inch.

Plates 4 and 5 show every fourth profile together with the geological mapping to facilitate correlation.

The interpretation of the magnetic data is given in Plates 6 and 7. Virtually the entire magnetic pattern reflects near-surface lithological variations. An initial qualitative analysis of the data, involving the delineation of magnetic trends and the sub-division of the area into magnetic zones, was considered to be of particular value in satisfying the primary objective of the survey, namely to assist subsequent geological mapping. The magnetic parameters used as criteria to determine the zone-type are the degree of anomaly continuity from line to line (linearity) and the dominant amplitude range representative of each zone. The specified amplitude ranges were chosen by a qualitative inspection of the overall anomaly pattern. An understanding of the limitations of such a classification is a prerequisite for assessing the geological significance of the zones. Accordingly these limitations are discussed in Appendix 1 together with the techniques employed in the quantitative interpretation of the magnetic data.

Analysis of magnetic trends

Plates 6 and 7 show a large number of magnetic trends, most of which extend for several miles, with some up to 30 miles long. The trends are concentrated in, though by no means confined to, the 'greenstone' belts, and the direction of the trends shows good agreement with mapped geological strikes. These observations confirm that much of the 'greenstone' belts comprise regular, alternate bands of at least two very dissimilar rock types, which can be traced along strike for many miles. It is also apparent that, beyond the flexures due to positional inaccuracy of the data, changes in trend direction closely follow folding of the strata.

Anomalies whose trends have been delineated may be quantitatively interpreted if their form is simple. A random selection of such anomalies has been analysed. Virtually all depth determinations indicate that the magnetic bodies have apices between 500 and 850 ft below the plane of observation. Most of their calculated widths were in the range 700 to 2500 ft, and all the bodies were calculated to dip more steeply than 55°.

LAVERTON area. In the eastern third of this area the dominant trend-direction is north-west. In the north-central part, the trends converge to the south as far as dyke F where they begin to diverge. In the southern half of the area, the trends conform to a broadly arcuate pattern. The north-north-east geological strike to the west and north of Murrin Murrin is reflected by the magnetic trends.

EDJUDINA area. In the north-west quadrant a few trends are curved into a broad arc similar to the pattern observed in the south of the LAVERTON area. Elsewhere in the EDJUDINA area the regional trend-direction is north-north-west veering to northerly in the northern part of the area. In the south-eastern quadrant there is a regional convergence of trends towards the south-east. The overall trend pattern is very similar to that of the mapped geological strikes.

Magnetic zones and their significance

Tabulated below are the zone-types and a brief description of their magnetic character. The anomaly-range quoted for each zone-type includes most, but not necessarily all, of the anomalies in any zone of that type.

Zone type	Anomaly range	Magnetic linearity
1	less than 50 gammas	poor
2	50 to 100 gammas	poor
3	100 to 200 gammas	poor
4	greater than 200 gammas	poor
5	less than 100 gammas	good
6	100 to 250 gammas	good
7	250 to 500 gammas	good
8	greater than 500 gammas	good

Type-1 zones are attributed to either non-ferromagnetic sedimentary sequences or near-homogeneous acidic igneous masses. Irregularly shaped type-1 zones, surrounded by zones of types 2 and 3, almost certainly represent the igneous masses, whereas the more regularly shaped type-1 zones, elongated in the direction of geological strike and occurring between zones of types 5, 6, 7, and 8 are likely to signify the sedimentary sequences interjacent with more iron-rich strata. No other magnetic factors can distinguish between these two rock groups. The Newer Sediments, for example, cause a perfectly flat magnetic field across the outcrop width, but a similar magnetic pattern is associated with the rhyolite outcrop north of Yerilla. Most of the rhyolite flows and concentrations of porphyry dykes are probably included in type-1 zones. As expected, most of the area occupied by type-2 zones is mapped as granite or probable granite. The random low-order magnetic disturbance representative of type-2 zones is characteristic of an acidic plutonic mass which has a broad homogeneity and a detailed random heterogeneity.

Type-3 zones are found primarily in granitic areas but also within the 'greenstone' belts. Most of these zones are interpreted to represent the more basic varieties of granite, described by Honamn (1917) and Hobson and Miles (1951) as granodiorite and syenite. The increase in basicity could be due to regional metamorphism or to an assimilation of pre-existing basic rock which has obliterated original structural lineations. More gneissic sections within the granitic masses are probably included within type-3 zones. It is noted that in the EDJUDINA area the central granite mass is reflected by zones of types 1 and 2, whereas large type-3 zones are seen in the area of the western and eastern granites. It was in these latter granites that Honman (1917) observed gneissic areas.

The boundaries between zones of types 1 and 2, and between zones of types 2 and 3, are often indistinct, and small sections of one zone can in fact be more representative of other zones, although their small areal extent prevents more detailed zoning. These facts tend to support the concept of a vast mass of acidic igneous rock which is variable in composition in a detailed sense, yet which can show ill-defined regions of generally increased basicity.

It is recognised that not all type-3 zones can be equated with acidic igneous rock. Some can be due to typical 'greenstone' facies with any linearity being unrecognisable owing to reasons discussed in Appendix 1.

Zones of type 4, characterised by random high-order magnetic disturbance, are typical of irregularly shaped major basic and ultrabasic intrusives. The possibility of structurally complex basic lavas and jaspilites with no recognisable lineations should not be discounted.

It is impossible to equate zones of types 5 or 6 with any one specific rock-type. They undoubtedly represent narrow elongated bodies of moderate susceptibility, mainly within the range 0.0003 to 0.001 c.g.s. The increase in anomaly amplitude from a zone of type 5 to a zone of type 6 is probably due to a combination of increased basicity and greater width of the magnetic bodies. Many zones of both types coincide with large areas of outcropping 'greenstone', where they probably represent series of intermediate and basic lava flows interjacent with narrow bands of metamorphosed and/or unmetamorphosed sediments. Some type-5 zones occupy areas mapped as granite and gneiss. Lineations within the granite are probably due mainly to relict structures in material partially assimilated by granitic magma. Injection gneisses, dykes, and basic pegmatites are likely to be included in type-5 zones.

Type-7 zones are generally of considerable length and the enclosed trend-lines are usually continuous for many miles. Nearly all of these zones coincide with areas mapped as 'greenstone', and most are ascribed to interbedded basic lavas and sediments. The proportion of lavas in type-7 zones is greater than that in zones of types 5 and 6. Some of the anomalies are undoubtedly due to banded iron formations, and the possible occurrence of prismatic bodies of basic and ultrabasic intrusives should not be discounted. Where these zones occur over areas mapped as granite it is considered that mapping modifications will be proved necessary by subsequent ground work.

In the MENZIES - LEONORA area (Young and Tipper, 1966), very high amplitude anomalies were conveniently grouped into two distinct categories, those of the order of 1000 gammas, interpreted as being due to serpentinite bodies, and those many times greater in amplitude, ascribed to banded iron formations. This simplification is considered invalid in the LAVERTON and EDJUDINA areas, where zones of type 8 include anomalies representative of each part of the range 500 gammas to 10,000 gammas. The extremely high anomalies of many thousands of gammas are certainly due to banded iron formations. Susceptibility determinations of up to 0.05 c.g.s. indicate a high magnetite content. However, the anomalies that are associated with banded iron formations vary considerably in amplitude along strike, decreasing in places to a few gammas only. Thus the lithology and/or width of the formations are extremely variable, and this is in agreement with accepted geological concepts. It is incorrect, therefore, to ascribe anomalies of the order of 1000 gammas to serpentinites only. Conversely, anomalies of over 2000 gammas were detected over some of the known ultrabasic outcrops. Very long type-8 zones, containing only one or two trend-lines, are probably due to banded iron formations, whereas wide zones containing many trend-lines of limited length are more likely to represent a variety of rock-types including banded iron formations, basic lavas and extrusives, and ultrabasic intrusives.

Comparison of zonal configuration, magnetic trends, and mapped geology

Based on the interpreted zone-type/rock-type correlation discussed above, it is possible to assess the agreement between mapped and interpreted geology and to note the areas where conflicting geological and magnetic evidence will necessitate clarification by subsequent mapping.

LAVERTON area (Plate 6). In the north-eastern quadrant of the area, the region mapped as granite is reasonably well defined by zones of types 1, 2, 3, and 5. The type-3 zone in the extreme north-east corner is undoubtedly due to rock that is more basic than that to the west. The zone encloses a mapped 'greenstone' outcrop, which is not clearly defined in the magnetic pattern. The zone possibly represents an assimilation or metamorphism of pre-existing basic rock by granite, which has largely obliterated any structural lineations. The type-2 zones to the west are interpreted as normal granite. Two large type-5 zones, containing many magnetic trends, possibly represent the product of partial assimilation of interbedded 'greenstones' such that original lineations remain recognisable. This interpretation if supported by the facts that the zonal boundaries are ill-defined, the zones have a general level of magnetic intensity above that of the surrounding zones, and the magnetic trends, although recognisable, are not well defined. The type-3 zone containing Adam Range is not well-defined and probably represents a slightly more basic variety of granite or gneiss. The western boundary of this zone, however, is well-defined by a type-7 zone and this boundary coincides approximately with the mapped 'greenstone'/granite contact. To the north, a type-1 zone is interpreted to represent homogeneous granite in the east and sediments in the west. This sedimentary belt continues north-westerly to east of Cox's Find.

The north-north-westerly trending type-7 zone that includes Cox's Find is typical of interbedded narrow bodies of basic lavas and sediments. The zone constitutes two arms, which join to the south and which are continuous to south of Laverton Downs Homestead, indicating that no granite 'bridge' exists between the western and eastern granite masses. Between the two arms of this zone a region of relatively flat field, represented by a type-5 zone, signifies a belt of sediments containing a single iron-rich formation.

In the north-western quadrant of the map area, the magnetic pattern associated with the granite reveals similar regions of increased basicity. The western granite as a whole appears to be more basic than the eastern granite, in that much of it is occupied by type-3 zones. They are very similar to the type-3 zone in the north-east corner of the map area and they are ascribed to a similar geological environment.

The two narrow north-north-west trending type-5 zones, to the west and east of Mount Boreas, are most probably due to basic dykes of post-granite age.

The boundary of the type-2 zone in the extreme north-western corner is very well defined. If the adjacent type-3 zones are found to represent assimilation of basic rock by granitic magma, then the type-2 zone represents either an assimilation of acidic rock and/or sediments, or an acidic intrusion which postdated the granitisation and assimilation within the type-3 zones.

A feature of the north-western quadrant are two large type-4 zones. The larger of the two, in the vicinity of Mount Zephyr and Nambi, bifurcates to the south to form two similar bands separated by a type-2 zone. In the north of the type-4 zone, over a 'greenstone' outcrop, the magnetic pattern is shown by profiles 23 to 31 (Plate 2) to be considerably disturbed. The anomalies of up to 1000 gammas show very little continuity between adjacent lines, and the causative magnetic bodies are therefore interpreted as either irregularly shaped basic and ultrabasic intrusives or basic lavas and sediments of very variable strike and limited length. Contrary to the geological mapping, it is unlikely that any of this zone represents granite. The smaller type-4 zone situated at the western boundary of the area contains mainly complex anomalies exhibiting poorer resolution than that observed in the larger type-4 zone. The magnetic bodies in the western zone are interpreted to be more closely spaced at the expense of the intervening non-magnetic strata. The magnetic pattern is consistent with the effect of high-grade metamorphism of basic rocks.

The mapped 'greenstone' outcrop that forms a north-south 'tongue' passing immediately east of Mount Redcliffe is not well defined magnetically, and the lack of magnetic trends is not understood.

In the south-west quadrant of the area there is considerable variation in trend-direction, and the zonal configuration is relatively complex. The dominant magnetic feature forms a north-north-east trending type-8 zone which extends from the EDJUDINA area to line 52, where it continues as a type-7 zone veering north-north-westerly to the west of Korong homestead. A second type-7 zone, convergent with the former, trends south-east through Korong homestead to be terminated abruptly four miles further south. The part of the type-8 zone in the vicinity of Murrin Murrin and Eulaminna is known from the geological mapping of Hobson (Hobson and Miles, 1951) to be due to a variety of rock-types including ultrabasic rocks, andesitic and basaltic lavas, and various basic intrusives. At least some of these rock-types undoubtedly continue for the full extent of the type-8 zone. The greater outcrop width and the probably greater susceptibility of the ultrabasic outcrops suggest that these intrusives produce the highest anomalies. These anomalies (above 800 gammas) were detected as far north as line 52. To the west of this zone the only significant magnetic trends are enclosed in two narrow type-8 zones and a broader type-5 zone. The excellent linearity and high amplitudes within the type-8 zones are typical of banded iron formations. The type-5 zone bifurcates to the south of Mertondale homestead and is interpreted as two very similar successions of probable basic lavas interjacent with sediments.

The granitic mass mapped to the west and south of Mertondale homestead is considered to be confined within the boundaries of the type-1 zones. The granites north of Mount Flora are represented by zones of types 2 and 3 and are therefore interpreted to be broadly similar to the granite in the north-west quadrant of the map area.

A mapped outcrop of sediments (As) in the south-west corner has good correlation with a type-1 zone, and the lithology of the sediments is therefore quite dissimilar to that of the similarly mapped outcrop west of Mount Redcliffe.

Much of the mapped 'greenstones' in the south-western quadrant of the map area is reflected by zones of types 1, 2, and 3. The lack of magnetic trends is characteristic more of granitic rocks than typical 'greenstones'. This suggests that granite possibly underlies a veneer of 'greenstones' through much of this area. A granitic outcrop east of Mount Kowtah coincides with a type-1 zone. This is surrounded on its western and northern boundaries by a type-6 zone, which probably signifies folded basic lavas.

East of the longitude through Mount Morgans, in the southern half of the area, the zonal pattern over the 'greenstones' is formed mainly by zones of types 6, 7, and 8 separated by type-1 zones. The latter are either narrow and parellel-sided or irregularly shaped. The narrow type-1 zones at least are interpreted as being due to sedimentary sequences concordant with the lavas and banded iron formations represented by the zones of types 6, 7, and 8. The type-8 zones show good agreement with mapped banded iron formations and some, e.g. the zone trending southerly from Mound Weld homestead, indicate the continuity of these formations beneath Cainozoic cover. The pattern of alternating 'trended' zones and 'non-trended' zones continues to the east beyond the limit of the mapped 'greenstone'. A number of type-6 zones situated over mapped granite are interpreted to signify basic rocks within the 'greenstone' sequence, indicating that further mapping is required. The type-6 zone commencing north of Burtville encloses a number of magnetic trends which pass through, and join, three small outcrops mapped as granite. The pronounced lineations within these outcrops are more indicative of granitic schists or injection gneisses. A granitic component is supported by the detection of high gamma radiation in this region.

The type-3 zone between dyke E and fault 3 is situated over an area mapped as 'greenstone'. The lack of trends suggests that the strata are structurally complex, although the western part of the zone could represent granite. The near-circular type-1 zone, situated south of fault 3, probably signifies a granite cupola. The three type-5 zones in the south-eastern quadrant, and that to the west of White Cliffs homestead, are all long, narrow, linear, and parallel. They are also parallel to two similar zones in the north-western quadrant and are similarly interpreted to represent basic dykes which postdate the granite.

Zones of types 2 and 3 occupy the remaining area in the south-eastern quadrant mapped as granite. The more basic varieties of the granite, represented by the type-3 zones, are confined to the extreme east and south-east.

Four zones of type 4 have been recognised in the south-eastern quadrant, three in areas mapped as 'greenstones', and a fourth in granitic country. The northernmost zone, centred approximately sixteen miles east-north-east of Laverton, is of particular interest in that the anomalies have amplitudes of up to 2000 gammas, considerably higher than those which typify banded iron formations in the LAVERTON area. The anomaly pattern, as seen on profiles 40 to 45, is typical of an extensive irregular mass, or masses, of ultrabasic rock and the zone therefore warrants ground investigation. The second type-4 zone centred $7\frac{1}{2}$ miles south-west of Burtville, has a similar magnetic pattern. The dominant complex anomaly of over 2000 gammas is interpreted to be due to an irregularly shaped boss of ultrabasic rock with an overall radius of one mile. This zone also warrants ground investigation. The third zone, situated to the east of that described above, contains an anomaly of much smaller amplitude. A probable source of this zone is a 'greenstone' inlier, composed of basic lavas. The southernmost type-4 zone is more clearly seen in the EDJUDINA area and is discussed under that heading.

EDJUDINA area. The eastern granite mass is reflected largely by zones of types 1, 2, and 3. Although the zonal boundaries are ill-defined, the two type-3 zones in the extreme north and south undoubtedly contain more basic and more variable rock types. As in the LAVERTON area, these zones can signify basement gneisses, or an assimilation of basic rock by granitic magma, or granoriorite/syenite. The type-2 zones are attributed to normal granite, and those type-1 zones situated over mapped granite are ascribed in the main to a more homogeneous variety. Rhyolite flows could be widespread where the magnetic field is particularly flat. A type-4 zone in the extreme north-eastern corner of the area coincides with a mapped 'greenstone' outcrop; however, the zone's poor linearity is not understood. The geological environment associated with a similar zone to the south is also in doubt.

A number of type-5 zones are resolved within the eastern granite mass. Although some are possibly due to dykes, their general parallelism with the 'greenstones' suggests that they represent relict structures in basic rock which has been only partially assimilated by the granite. The north-west trending type-5 zone between dyke M and fault 7 is interpreted as a dyke. The type-6 zones mapped as granite are interpreted to be part of the 'greenstone' sequence.

Much of the main greenstone belt in the central part of the area is reflected by broad north-north-westerly trending type-1 zones, separating narrow zones of types 5, 6, 7, and 8. The type-1 zones are attributed mainly to extensive sedimentary sequences, which possibly contain rhyolitic and andesitic flows. South of the Mount Celia - Yundamindera fault, type-8 zones are ascribed to highly magnetitic banded iron formations. There is magnetic evidence to suggest that some sections of the formations have limited depth extent.

The magnetic trends closely follow the two known outcrops, and from this correlation, the remaining type-8 zones in this region are interpreted to represent further banded iron formations. At the Mount Celia - Yundamindera fault the main type-8 zone stops abruptly and is replaced along strike by a type-7 zone. The decrease in anomaly amplitude is accompanied by a change in anomaly shape, which is interpreted to signify an increase of 700 ft in the depth of burial of the causative body. The magnetic anomalies associated with banded iron formations north of the fault are much smaller than those to the south, indicating a difference in lithology.

The broad well-defined type-8 zone that trends northwards from this fault to the LAVERTON area is unlikely to represent a faulted continuation of the southern type-8 zone. The lower amplitude anomalies and somewhat poorer linearity are more characteristic of basic and ultrabasic intrusives than of banded iron formations. The magnetic trends within this zone follow the mapped serpentinite bodies for much of their outcrop length. The eastern mapped serpentinite is reflected by zones of types 5 and 6 as far north as Linden. North of fault 7 the mapped outcrop is included in a broad type-4 zone which trends northerly to dyke K. This zone, which contains complex anomalies of up to 1500 gammas, is interpreted as an irregularly shaped ultrabasic intrusion and therefore warrants ground investigation. Five other type-4 zones are delineated in the central 'greenstone' belt. The largest zone, which continues into the LAVERTON area, is not fully understood. An outcrop of banded iron formation of very variable strike is situated within this zone, suggesting that the lack of magnetic trends is due to structural deformation of the 'greenstones'. There is, nevertheless, a strong possibility that ultrabasic rocks occur in this zone. A smaller, similar zone is situated to the west, on the eastern edge of Lake Carey. The small type-4 zone north-east of Mount Linden is probably due to a basic boss. The zone north-west of Mount Linden, bounded to the north by fault 7, could be due to basic lavas and is not recommended for ground investigation. The southernmost type-4 zone, centred eight miles south-east of Mount Percy, encloses a complex anomaly of 1300 gammas. The zone is typical of an ultrabasic intrusion and contains part of a mapped serpentinite body. To the north, this body is interpreted as the source of a type-5 zone. The magnetic anomaly defining this zone is calculated to be due to an outcropping vertical prism 1000 ft wide. The greater width of the type-4 zone and the high amplitudes of the contained anomalies are possibly due to multiple intrusions or to repetition of the one body by isoclinal folding.

The remaining zones of types 5, 6, 7, and 8 in the central 'greenstone' belt, not already discussed, are interpreted as being bedded formations of increasing basicity from sediments to basic lavas and intrusions. As the banded iron formations are known to vary in lithology along strike, producing very little magnetic effect in some areas, they also could be the cause of some of these zones.

The central granite mass is thought by Honman (1917) to be younger than the western and eastern granites. The central granite is interpreted to be confined to zones of types 1 and 2 and therefore does not contain the more basic gneisses and granites so common elsewhere in the survey area. The type-1 zone in the south is separated from the type-2 zone by an east-west trending 'greenstone' tongue, which probably extends for the full width of the associated type-3 zone. A second large type-3 zone in the vicinity of Mount Percy is interpreted as a largely sedimentary 'greenstone' sequence which extends the full width of the zone. The narrow granitic belt to the south, within the type-1 zone, is magnetically indistinguishable from the adjacent greenstones.

The western 'greenstone' belt which trends north-north-west from the south-central part of the area to the north-western corner has an associated magnetic pattern which differs in many aspects from that of the central 'greenstone' belt. Very intense anomalies, which characterise many of the banded iron formations in the central belt, are totally absent, and in only three small areas are the anomalies of sufficient amplitude to warrant zones of type 8. Of these, only in the zone south-west of Mount Remarkable homestead do the anomalies have the simple form and good linearity which typify banded iron formations. The three other type-8 zones have more the character of basic intrusives. The mapped banded iron formation north of Yilganga is reflected by a type-6 zone.

A second difference between the two 'greenstone' belts is that a greater proportion of the western belt is occupied by zones of types 5, 6, and 7. These zones are attributed to lavas and intrusives of varying basicity, and the proportion of sediments is therefore considered lower in this belt.

In a number of localities, zones enclosing magnetic trends extend beyond the mapped 'greenstone'/granite contact. The arcuate type-7 zone north-east of Mount Kildare strongly suggests that the central granite does not extend to the north-west as far as is shown on the geological map. Similarly, it is considered most unlikely that the granite extends more than a few miles west of Mount Remarkable and certainly not as far west as the rhyolite outcrop. This outcrop is reflected by an extremely well defined type-1 zone, characterised by a particularly flat field. The rhyolite is therefore interpreted to continue northwards as far as dyke K. The outcrop's southern boundary is less clearly defined but it continues at least as far as dyke L. A second type-1 zone east of Glenorn homestead has a very similar magnetic pattern and could represent a faulted continuation of the rhyolites. The north-north-west trending rhyolite outcrop five miles west of Edjudina homestead has a totally different associated magnetic field, which is variable within the outcrop area. Further mapping is necessary to clarify these discrepancies.

The major part of the belt of Newer Sediments (Ac), east of Yilgangi, has an associated flat magnetic field. The type-1 zone that coincides with the outcrop southwards from Lake Raeside narrows at Yilgangi and terminates six miles further south against a north-north-west trending type-5 zone. To the east, the sediments are terminated by zones of types 3 and 5. In the extreme south of the area the sedimentary belt coincides with a second type-1 zone. If the type-5 zone that separates the two type-1 zones is found to represent a basic intrusive postdating the Newer Sediments, then the sedimentary belt could be continuous as mapped by Honman. It is not clear what proportion of the type-1 zone, which traverses Lake Rebecca, can be attributed to the Newer Sediments. Further mapping will be required to determine the significance of this zone.

Two type-4 zones have been delineated in the western 'greenstone' belt. Both define areas where the magnetic pattern is typical of major basic or ultrabasic intrusions and both warrant ground investigations.

The magnetic pattern observed over the mapped 'greenstone' in the north-western corner of the area, west of Mount Kilkenny, is not typical of 'grenstones'. The region comprises zones of types 1, 2, and 3, which usually signify granites. The lack of magnetic trends is not understood but a contributing factor could be widespread granite at shallow depth. The 'greenstone' belt ten miles west of Yerilla is also not defined by the magnetic pattern. The type-1 zone that extends westwards beyond the map area clearly defines an area of very flat field. Its irregular shape and magnetic characteristics suggest a rhyolitic mass similar to that north of Yerilla.

The western granite mass is mainly reflected by zones of types 2 and 3, which are again interpreted to represent respectively normal granite and either gneissic rocks or more basic varieties of granite. The magnetic trends in the large type-6 zone are interpreted to signify relict structures in assimilated material. The significance of the two type-4 zones in this belt is not fully understood. They possibly represent more basic sections of gneissic basement as there is no clear correlation between the western type-4 zone and the 'greenstone' belt mapped in the extreme south-west corner of the area.

<u>Major transverse dykes</u>

Twelve major dykes striking slightly north of east have been interpreted from the magnetic data. As they are approximately parallel to the flight lines, they cause a wide section of magnetic disturbance on the line profiles. For this reason their positions cannot be accurately determined from these profiles alone. The tie profiles, although fifteen miles apart, have been used to provide more accurate positional control. Some ambiguity is introduced by the wide tie interval but with the combined use of line and tie data, the dyke positions as shown in Plates 6 and 7 are probably correct.

In the LAVERTON area (Plate 6), all nine dykes appear to be magnetised in the direction of the Earth's present field. A high degree of parallelism between the dykes has been observed in that dykes H, D, E, and F strike at 077°, dykes A, B, and G at 080°, and dykes C and J at 085°. This does not necessarily imply that there were three distinct periods of intrusion. On the assumption of induced magnetisation, the dykes are calculated to have widths of 550 to 950 ft (average of 700 ft), dip-angles between 70° and 85° to the south, and susceptibility contrasts within the range 0.0011 and 0.0047 c.g.s. Depth calculations show that all dykes are within 100 ft of the surface. The susceptibility calculations offer no support for or against contemporaneity of the dykes.

In the EDJUDINA area (Plate 7) three dykes were detected. The negative anomaly which clearly delineates dyke K indicates that this body has a large remanent magnetisation component oriented in a direction markedly different from that of the Earth's present field. The dyke is calculated to be approximately 900 ft wide and within 100 ft of ground level. Its depth of burial is particularly shallow where intersected by tie 16. It is not possible to determine both the direction of magnetisation and the dip of the dyke from the anomaly form; however, each of these parameters may be determined only by assuming a value of the other. If this dyke is similarly inclined as the other dykes in this region, a large component of the remanent magnetisation would be in a direction opposite to that of the Earth's field at present, and dyke K would be thus an example of the now generally accepted field-reversal hypothesis. If such is the case, dyke K could not have been intruded simultaneously with the other dykes.

Dykes L and M are very similar to those delineated in the LAVERTON area. Both dykes dip steeply to the south, are approximately 800 ft wide, and have susceptibilities in the range 0.002 to 0.0051 c.g.s. Dyke L traverses Lake Raeside close to where Maitland (1903) found evidence of late stage doleritic intrusion.

Structure

Interpreted fold axes and faults are shown in Plates 6 and 7. Much of the zonal repetition in both map areas is probably due to further folding.

LAVERTON area (Plate 6). Nine fold axes have been delineated. Two colinear axes in the 'greenstone' belt north of fault 3 are parallel to, and approximately coincident with, the mapped Erlistoun Anticlinal axis. Anomaly complexity in this region precludes reliable dip analysis and the sense of the folds cannot be determined. The southerly convergence of the type-7 zones defining the northern fold is indicative of either a southerly pitching anticline or a northerly pitching syncline. The northerly convergence of the zones defining the southern colinear fold indicate the opposite alternatives. Assuming that the folds are either both anticlines or both synclines, then a pitch reversal has occurred between the two fold axes, and a cross-fold axis is therefore interpreted to traverse the 'greenstone' belt a few miles north of Laverton Downs homestead. This cross-fold is flanked by major east-west dykes. As its direction cannot be accurately determined, its location in Plate 6 is approximately only. A third parallel fold axis is interpreted from the northerly convergence of type-4 zones in the vicinity of Mount Zephyr.

The fold axis that passes close to Mertondale homestead is interpreted from an anomaly repetition which is clearly seen on lines 47 to 53 as a 'mirror-image' configuration with respect to the fold axis. The vertical dip of the causative bodies signifies isoclinal folding; the sense of the fold cannot be determined, therefore, from the magnetic data. A similar fold is evident west of Korong homestead. Both folds are truncated to the north by major dykes.

The Laverton Syncline and the Margaret Anticline are each reflected by a convergence of trends and similar zones. The southerly plunging Mount Margaret Anticline is particularly well defined by arcuate zones of types 6, 7, and 8, but in the vicinity of Mount Gooses the axial position, interpreted from the zonal configuration, differs from that shown in the geological map. Dip analyses confirm that the Mount Margaret fold is anticlinal.

The Redcastle Syncline is reflected by a pronounced northerly convergence of trends and zones, which confirms its southerly plunge. Its interpreted axial position is considered to be fairly accurate.

Six miles west of Mount Flora, folding is evident from a pronounced arcuate type-8 zone, which is clearly delineated from the magnetic profiles of lines 53, 54, and 55.

Three near-colinear faults have been interpreted in the LAVERTON area, each from a colinear termination of trends and zones. Fault 3 in particular is well defined and many magnetic bodies terminate abruptly at the fault plane. In addition to these faults, there has possibly been movement along the fracture planes now occupied by dykes C, D, and H.

EDJUDINA area (Plate 7). The banded iron formation south of the Mount Celia - Yundamindera fault, have been strongly folded. The steep dips of the bodies and the extremely steep slopes of the associated intense anomalies prevent accurate dip analysis, and calculated values of dip are not consistent. Folds in this region are interpreted from the convergence of type-8 zones.

An elongated type-6 zone immediately west of the Newer Sediments (Ac) outcrop is interpreted to represent a fold axis. A second sedimentary belt probably exists therefore between Mount Boyce and this fold axis.

The convergence of type-6 zones south-west of Mount Percy is interpreted as evidence for folding.

One of the three folds detected north of the Mount Celia - Yundamindera fault was interpreted from a northerly convergence of type-5 zones eight miles north-west of Mount Linden. This fold coincides with one mapped by Berliat (1955). The second fold axis, determined from a strongly arcuate type-7 zone east of Mount Kildare, forms a continuation of a fold axis delineated in the LAVERTON area. Lavas and sediments are interpreted to be folded about a large granitic intrusion. The third fold, to the immediate east, is based on the interpretation that the type-6 zone, north-west of Yundamindera, represents a folded continuation of the rocks in the type-7 zone.

Eleven faults were interpreted, ten of which approximately coincide with either mapped faults or interpreted dykes. Faults 4, 8, 9, and 12 represent those sections of the Mount Celia - Yundamindera fault where magnetic evidence supports the mapping. Fault 8 is interpreted from the colinear termination of a number of zones. Of particular interest is the type-8 zone containing Mount Millicent. This zone is terminated at the fault and replaced along strike by a type-7 zone. The decrease in anomaly amplitude north - wards across the fault plane at this point is accompanied by a change of anomaly shape, signifying a change in depth to source rock. The anomalies south of the fault are ascribed to sources at or near the surface; the anomaly defining the type-7 zone is interpreted as being due to a body 700 to 900 ft below ground level. Faults 10, 11, 13, and 14 represent sections of the mapped Edjudina - Yerilla fault, which are supported by magnetic evidence. The drag fold associated with this mapped fault in the vicinity of interpreted fault 14, is well reflected by a double magnetic trend parallel to the fold axis.

Faulting along fractures now occupied by major dykes is generally difficult to determine from the magnetic data; the magnetic disturbance, due to the dykes, tends to mask the magnetic effect of other bodies in the vicinity of the dykes. Faults 5 and 6, however, are shown with some confidence.

5. RADIOMETRIC RESULTS AND INTERPRETATION

Radiometric data were recorded by two scintillometers, each adjusted for a specific purpose. The inboard scintillometer, set with a 10-second time constant, was used to record broad fluctuations of radiometric intensity across the area to assist geological mapping. The outboard scintillometer, set with a 1-second time constant, was used to detect localised sources of radioactivity.

Inboard scintillometer

A contour presentation of the radiometric data, superimposed on the mapped geology, is shown in Plates 8 (LAVERTON) and 9 (EDJUDINA). Some smoothing of the contours was necessary to minimise contour distortions introduced by a combination of errors. These include: parallax error due to delay in instrument response resulting from the 10-second time constant; temperature-affected instrumental drift; variation in instrument sensitivity; and a positional error identical to that of the magnetic data. These errors have not been fully eliminated as shown by two unreal east-west features at latitudes 28°53'S and 29°17'S. The generally flat terrain minimised errors due to variations in aircraft ground-clearance.

An observed correlation between the radiometric contours and the drainage pattern should be appreciated before comparing the contour map with mapped and interpreted geology. Figure 1 illustrates the conclusive relationship between radiometric intensity and salt pans and lakes in this area. In both Figures 1A and 1B the location of the salt lake or pan is well defined by a character change in the radioaltimeter trace from noisy to smooth, this being a function of the reflective properties of undulating terrain and a flat salt pan or water covered area. In Figure 1A both scintillograph traces show radiometric 'plateaux', which coincide with the salt pan and which are attributed to concentrations of mainly potassic salts derived from potassic granite. In Figure 1B a section of the radioaltimeter trace is similarly very smooth. Each of the corresponding sections of the scintillograph profiles can be subdivided into a radiometric 'plateau' and a radiometric 'trough'. The 'plateau' is again attributed to a dry pan of potassic salts, and the 'trough' is interpreted to represent a water-covered pan, the water absorbing much of the gamma radiation. Examples of this correlation are seen in Plates 8 and 9. Very low radiometric values were recorded over much of Lake Carey and Lake Raeside, where water is known to cover the salt. Conversely, the northern part of Lake

Rebecca, the south-eastern part of Lake Carey, and the two lakes south-west of Menangina and Yarri homesteads, are all associated with radiometric 'highs'. Ground observations, made during the course of the 1966 survey, confirmed that the radiometric 'high' shown south-west of Menangina homestead, is due to saline deposits on the surface of a salt pan. Of the remaining salt lakes associated with readiometric 'highs', the south-eastern part of Lake Carey, at least, was observed during flight to be dry.

In the following comparison of the radiometric contour pattern with mapped and interpreted geology, the anomalies correlated with salt lakes and pans have been ignored.

Most of the radiometric 'highs' are correlated with mapped granitic outcrops or outcrops inferred from hilly terrain in areas mapped as probable granite underlying soil. The highest anomalies in the EDJUDINA area were detected in the south-west quadrant, over and to the south-south-east of the Donkey Rocks and north-east of Menangina homestead. Ground scintillometer investigations confirmed that the outcropping medium-grained granite at the Donkey Rocks has a radioactive content significantly greater than that of the surrounding soil covered regions. The other radiometric 'highs' in the south-west quadrant are attributed to similar rock outcrops.

Three closed contours of 125 counts per second (c.p.s.), which form a northerly trending 'high' midway between Yarri and Yerilla homesteads, occur over mapped 'greenstones'. However, they also occur in a magnetic zone of type 2, which is interpreted to be due to normal granite. Most of the remaining 'highs' in the EDJUDINA area are located in the eastern and central granite masses. There is a slight but inconclusive relationship between two closed 100 c.p.s. contours and the rhyolite outcrop 12 miles west-north-west of Linden.

Most of the highest anomalies in the LAVERTON area are in the east and north. The major feature is a discontinuous north-north-west to north trending radiometric 'ridge' centred 4 miles east of Laverton Downs homestead. Many of the individual maxima constituting this ridge coincide with mapped outcrops of granite. From joint magnetic and radiometric data this feature is interpreted to be due to a belt of gneiss containing interbedded granitic and basic material.

The radiometric 'highs' south of Erlistoun homestead, west of Moung Korong, north of Mount Flora, and in the vicinities of Mount Boreas, Adam Range, Borodale Creek, and White Cliffs homestead are all correlated with granite outcrops. The anomaly of 225 c.p.s. east of Mount Morgans was detected over mapped 'greenstones' but is situated in a magnetic zone of type 1 and is attributed to granite.

Recorded radiometric values within the range 0 to 100 c.p.s. have only a regional and inconclusive correlation with mapped and interpreted geology. The eastern granite in the EDJUDINA area appears to be less radioactive than the western granite, whilst the central granite has a general level above both of these.

The differences can also be explained, however, by different thicknesses of overburden. In the north-eastern quadrant of the LAVERTON area the general intensity is very low, but anomaly amplitudes recorded over definite granite outcrops are very great. These facts, together with the complete absence of any detailed relationship between contours and either geological strike or rock-type, are interpreted to signify that the contour configuration within the range 0 to 100 c.p.s. is primarily the result of thickness variation in overburden. Their value to geological mapping is confined to assistance in locating areas where geological samples in situ may be more readily obtained.

Outboard scintillometer

Eighty-three anomalies from restricted sources are listed in Tables 1 and 2 of Appendix 2 and are shown in Plates 8 and 9. The criteria used in selecting these anomalies are discussed in Appendix 1. The anomalies are classified into four categories, A, B, C, and D, examples of which are illustrated in Figure 2. Only anomalies of types A and B are recommended for ground investigations, as those of types C and D might prove very difficult to detect by ground work and their significance is marginal.

Some of the anomalies of types A and B are correlated with salt lakes and do not warrant investigation. These are Nos. 45, 56, 69, 79, and 83. The remaining anomalies of types A and B, which warrant investigation, total twenty-five in the LAVERTON area and twenty-six in the EDJUDINA area. Of these fifty-one anomalies, forty-one are situated in magnetic zones of types 1, 2, or 3, which are attributed mainly to granite and gneiss. These restricted sources are possibly small granite outcrops protruding through soil cover, but their full significance can be determined only by subsequent ground work.

It is noted that many anomalies are in groups, e.g. Nos. 14, 16, and 17, Nos. 31, 33, 35, and 36, and Nos. 71, 72, 73, and 75. These groups probably represent areas where soil cover is locally thin.

Anomalies 7 and 23 are situated in a belt of high gamma ray intensity, which by reference to magnetic data is interpreted to represent alternating bands of granitic and basic material.

Anomalies 6, 9, 32, 44, 42, and 54 are situated in magnetic zones of types 5, anomaly 67 is in a type-6 zone, and anomaly 18 is in a type-4 zone. Their significance is not known.

6. CONCLUSIONS AND RECOMMENDATIONS

A generally good agreement exists between the magnetic data and the geological mapping of the Geological Survey of Western Australia. In particular, magnetic trends follow variations in geological strike and can therefore be used to delineate folds and faults. The magnetic zones show a general correlation with major rock-types. Many of the limitations of this correlation may be eliminated by a review of the interpretation included in this Record when contour maps of total magnetic intensity become available. It is recommended that Plates 6 and 7 be used extensively in the subsequent mapping of the area. Trends and zones should be used to extrapolate observed zone-type and lithology correlations into areas where soil cover hampers ground investigation. The interpreted folds and faults require examination in detail, and the cross-trending intrusives should be examined and sampled.

Considerable assistance is offered to the search for mineralisation, particularly nickeliferous. The interpreted structure given in this Record should prove valuable when combined with current concepts of ore-genesis, with respect to locating gold mineralisation. Banded iron formations, which are the usual host rocks for gold mineralisation in the LAVERTON area, are likely to be included in the type-7 zone west of Mount Gooses (Plate 6). Any nickel mineralisation in the area would most probably be associated with ultrabasic rocks. Although these do not produce a distinctive magnetic pattern, ground investigation is recommended in a number of localities where the magnetic data indicate that ultrabasic rocks are more likely to be found. These localities are listed below, not in their order of importance.

Zone-type	Locality
4	In the vicinity of Mount Zephyr (Plate 6)
8	North of the Murrin - Eulaminna ultrabasic belt, to line 52 (Plate 6)
4	16 miles east-north-east of Laverton, south of fault 3 (Plate 6)
4	7½ miles south-west of Burtville (Plate 6)
8	South of Pyke Hill (Plate 7)
4	North-west of Linden and bounded by faults 6 and 7 (Plate 7)
4	Approximately 8 miles east of Lake Carey (Plates 6 and 7)
4	North of dyke K on the eastern edge of Lake Carey (Plate 7)
4	8 miles south-east of Mount Percy (Plate 7)
4	8 miles east of Yerilla homestead (Plate 7)
4	South of Mount Boyce (Plate 7)

The major copper mineralisation is in greenstones in the vicinity of Eulaminna (Plate 4), where a belt of highly disturbed magnetic field trends north-north-east to line 52. The significance, if any, of this observation should be investigated during the course of subsequent geological mapping or the search for nickel.

The radiometric data recorded by the inboard scintillometer show some relationship with the drainage pattern. By ignoring the anomalies associated with salt lakes, the residual data should be of use in mapping granite outcrops and in locating areas where granite samples may be obtained for subsequent petrographic examination.

Eighty-three radiometric anomalies satisfying the 'point-source' criteria were detected. Their significance will be determined only by ground investigation; however, of these, only fifty-one are considered worthy of inspection.

The geophysical methods and the interpretation procedures employed during this survey appear to have satisfied the basic survey objectives with respect to current geological mapping. The importance of their continued application in the goldfields region of Western Australia may now be enhanced if this survey assists in the search for economic nickel deposits.

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APPENDIX 1

INTERPRETATION PROCEDURE

Qualitative magnetic interpretation

The magnetic data have been qualitatively analysed by delineating magnetic trends and zones. A magnetic trend by definition joins the peak positions of anomalies which are attributed to one continuous magnetic body, such that the trend parallels the strike of the causative body. Except for perfectly symmetrical anomalies, however, a trend will not be coincident with the apical axis of the body. This axis will generally be situated towards the negative part of the anomaly by an amount which is a function of the body's dip and strike angles.

Magnetic zones are based on the criteria of the degree of magnetic linearity and the dominant anomaly amplitude range. These criteria, whilst being generally satisfactory for distinguishing between contrasting rock types, do introduce limitations to zonal significance when the zones are derived from profile data only. These limitations must be considered when attempting to equate zones and geology. The linearity criterion is used to distinguish between formations containing similar percentages of ferromagnetic material yet of greatly differing genesis and mineral potential. A series of interbedded lavas and sediments, for example, can produce anomalies with amplitudes equal to those produced by irregular masses of ultrabasic rock contained in granite. The magnetic trend criterion would generally clearly differentiate between the two cases. Recognition of anomaly trends, however, requires a reasonably large angle between geological strike and the flight path direction; thus a type-3 zone could in fact represent a perfectly regular interbedded sequence striking near-parallel to the flight paths. Magnetic trends are difficult to delineate also when two or more strike directions are represented in the one region, and in areas of small-scale structural deformation.

Significance of the amplitude criterion should be assessed with the knowledge that amplitude is a function not only of magnetic susceptibility contrasts but also of width, depth, and strike of the body. To be able to equate zones and lithology more accurately, the zones would need to be based on susceptibility values calculated for each anomaly, but time does not allow for this procedure.

Certain structural features have been qualitatively interpreted from zonal configuration. Faults were interpreted from the colinear termination of magnetic zones and trends or by abrupt changes in trend-directions. Where a folded sequence contains one or more magnetic horizons, the fold has been interpreted from a repetition of zones and individual anomalies. Where possible, dip analyses have been used to determine the sense of the folds.

Quantitative magnetic interpretation

Quantitative interpretation involved the determination of depths, widths, dip-angles, and apparent susceptibility contrasts of selected anomalies and, with the single exception of dyke K, was based on the assumption that the magnetisation is wholly induced. As the magnetic data are in preliminary form containing an inherent positional inaccuracy, quantitative interpretation was restricted to those anomalies where the local magnetic trend-direction could be accurately measured.

Depths of magnetic bodies below detector level were obtained by several methods. With anomalies of simple form showing no partial resolution, depths were rapidly calculated using the half-maximum-slope technique advocated by Peters (1949) and extended by Moo (1965). With anomalies not of simple form, a method of matching the profile with a series of standard curves was considered more reliable and those constructed by Gay (1963) were used. The depth of burial of magnetic bodies was obtained by subtracting the recorded aircraft's ground clearance from the total calculated detector-to-body distance. Widths were obtained by measuring the horizontal distance between the two inflection points on the limbs of an anomaly. This method is quite accurate except where the actual width is less than twice the detector-to-body distance, in which case the calculated width represents a maximum value. Where practical, more accurate width determinations were made by reference to Gay (1963) and Moo (1965).

Susceptibility contrasts were calculated using standard formulae given by Reford and Sumner (1964). The values calculated for banded iron formations must be regarded as very approximate. The amplitude of an anomaly associated with iron formation depends on many factors which are considered in the calculations, but it is dependent also on the arrangement of magnetite in the rock. A considerable susceptibility anisotropy can exist in banded iron formations. Jahren (1963) has shown that layered iron rock can have a susceptibility as much as three times greater parallel to the layers than at right angles to them. Also, the 'along-the-layer' susceptibility of a bedded sample containing 1% magnetite was found to be three times as great as that of a homogeneous sample of the same overall magnetite content (Jahren, op. cit.).

Dip angles were obtained using the techniques of Gay (1963) and Moo (1965).

Interpretation of outboard radiometric data

For an anomaly to be resolved from the normal gamma ray background noise, the amplitude must be statistically significant. The acceptance level is three times the standard deviation (S.D.) of the background noise. Two distinct types of gamma ray background noise are recognised. 'Statistical noise' is a statistical variation of the recorded gamma ray intensity from a homogeneous source. The standard deviation of the count rate is given by:

$$S.D. = \sqrt{\frac{N}{2T}}$$

where N is the count rate and T is the time constant of the counter.

'Geological noise' is a variation of the gamma ray intensity from a heterogeneous source which is often simulated by variations in overburden above a homogeneous source. The envelopes containing both forms of background noise have a height of four times the standard deviation of that noise.

Examples of anomalies of different categories are shown in Figure 2.

Anomaly shape is a function of source configuration and location relative to the detector. The width of an anomaly at half-peak amplitude (w) is related to these factors, and the acceptance limits set are:

$$3 \text{ seconds} \ngtr w \ngtr 4 \text{ seconds}$$

This width criterion results in the acceptance of a continuous series of sources, limited by those of 300 ft radius centred on the flight path, and point-sources located 300 ft from the flight path.

APPENDIX 2

OUTBOARD RADIOMETRIC ANOMALIES

Table 1 - LAVERTON

Anomaly No.	Line No.	Fiducial No.	Half-peak width (secs)	Amplitude x S.D.	Classification
1	3 E	0691.0	3.5	6	B
2	4 W	0804.0	3.0	9	B
3	8 W	0438.0	3.0	4	D
4	8 W	0399.5	3.0	3	C
5	8 W	0286.0	3.5	4	A
6	15 E	0683.5	4.0	5	A
7	21 E	2138.0	4.0	9	A
8	23 E	0153.5	4.0	7	D
9	24 W	0268.5	4.0	8	B
10	26 W	0956.5	3.0	4	A
11	30 W	1869.0	3.5	5	B
12	32 W	0332.5	3.5	9	D
13	33 E	0616.0	3.5	3	C
14	34 W	0720.0	3.0	6	B
15	35 E	0978.0	3.0	3	D
16	35 E	1119.5	3.0	6	A
17	36 W	1239.0	4.0	4	A
18	39 E	1966.0	4.0	6	B
19	39 E	2056.0	4.0	5	B
20	39 E	2127.0	4.0	6	B
21	43 E	1143.5	3.5	4	D
22	45 E	1501.0	3.5	5	B
23	47 E	2114.0	4.0	4	A
24	50 E	0538.0	4.0	4	D
25	51 W	0747.0	3.0	6	B
26	57 W	0365.5	3.0	6	D
27	58 E	0790.0	3.0	3	A
28	58 E	0689.5	4.0	4	A
29	61 W	1368.0	3.5	5	C
30	63 W	1912.0	3.5	5	A

Anomaly No.	Line No.	Fiducial No.	Half-peak width (secs)	Amplitude x S.D.	Classification
31	63 W	1869.0	4.0	8	A
32	64 E	0226.0	3.5	4	A
33	64 E	0286.0	3.0	6	A
34	65 W	0361.5	3.5	4	C
35	65 W	0325.5	3.5	6	A
36	68 E	1263.0	3.0	7	A

Table 2 - EDJUDINA

Anomaly No.	Line No.	Fiducial No.	Half-peak width (secs)	Amplitude x S.D.	Classification
37	73 E	0714.0	3.5	6	D
38	76 W	1753.0	3.5	6	C
39	79 E	1009.5	3.0	4	A
40	83 E	0094.0	3.5	5	A
41	86 W	1328.5	4.0	5	A
42	87 E	1135.0	3.5	5	B
43	89 E	0589.0	3.0	5	D
44	89 E	0650.0	3.5	3	A
45	90 W	0428.5	4.0	7	A
46	90 W	0390.0	3.0	4	D
47	90 W	0367.0	3.0	7	D
48	91 E	0043.5	3.0	5	B
49	93 E	1650.5	3.0	4	A
50	94 W	1438.5	4.0	4	A
51	94 W	1245.5	3.0	6	A
52	95 E	1121.0	3.5	5	C
53	96 W	0932.5	3.0	6	A
54	96 W	0845.0	4.0	9	A
55	99 E	0125.5	4.0	4	A
56	99 E	0158.0	4.0	5	A
57	100 E	1285.5	3.0	8	D
58	103 W	0572.0	3.0	5	A
59	103 W	0382.5	3.0	6	B
60	105 E	2025.5	4.0	8	A
61	106 W	1791.0	4.0	4	A
62	107 E	1535.5	4.0	4	D
63	108 W	1446.0	3.0	7	D
64	109 E	1005.0	3.5	6	C
65	110 W	0919.5	3.0	6	D

Anomaly No.	Line No.	Fiducial No.	Half-peak width (secs)	Amplitude x S.D.	Classification
66	110 W	0730.0	3.5	8	A
67	111 E	0516.0	4.0	6	A
68	115 E	0652.5	3.0	4	B
69	117 W	2053.0	4.0	11	A
70	123 W	0282.5	3.5	5	A
71	126 E	0535.0	4.0	9	A
72	127 W	0431.5	3.5	5	A
73	128 E	0043.0	4.0	15	A
74	128 E	0100.0	3.5	4	A
75	129 W	0934.5	4.0	10	A
76	130 E	0562.0	3.0	4	A
77	130 E	0594.0	3.0	10	D
78	136 E	0767.0	4.0	6	C
79	136 E	0828.0	3.5	10	B
80	137 W	0673.5	4.0	12	C
81	138 E	0278.0	4.0	8	C
82	139 W	0238.0	4.0	8	C
83	140 E	0226.5	4.0	6	A

APPENDIX 3

OPERATIONAL DETAILS

Staff

Party Leader	: D. B. Tipper	
Geophysicist	: R. A. Gerdes	
Senior Radio Technician	: P. M. Ryan	
Geophysical Assistants	: K. A. Mort	
	D. Park	
	C. I. Parkinson	
Drafting Assistant	: P. Kersulis	
Pilots	: Captain G. B. Litchfield	T.A.A.
	First Officer D. A. Spiers	T.A.A.
Aircraft Maintenance Engineers	: E. Routley	T.A.A.
	P. Derrick	T.A.A.

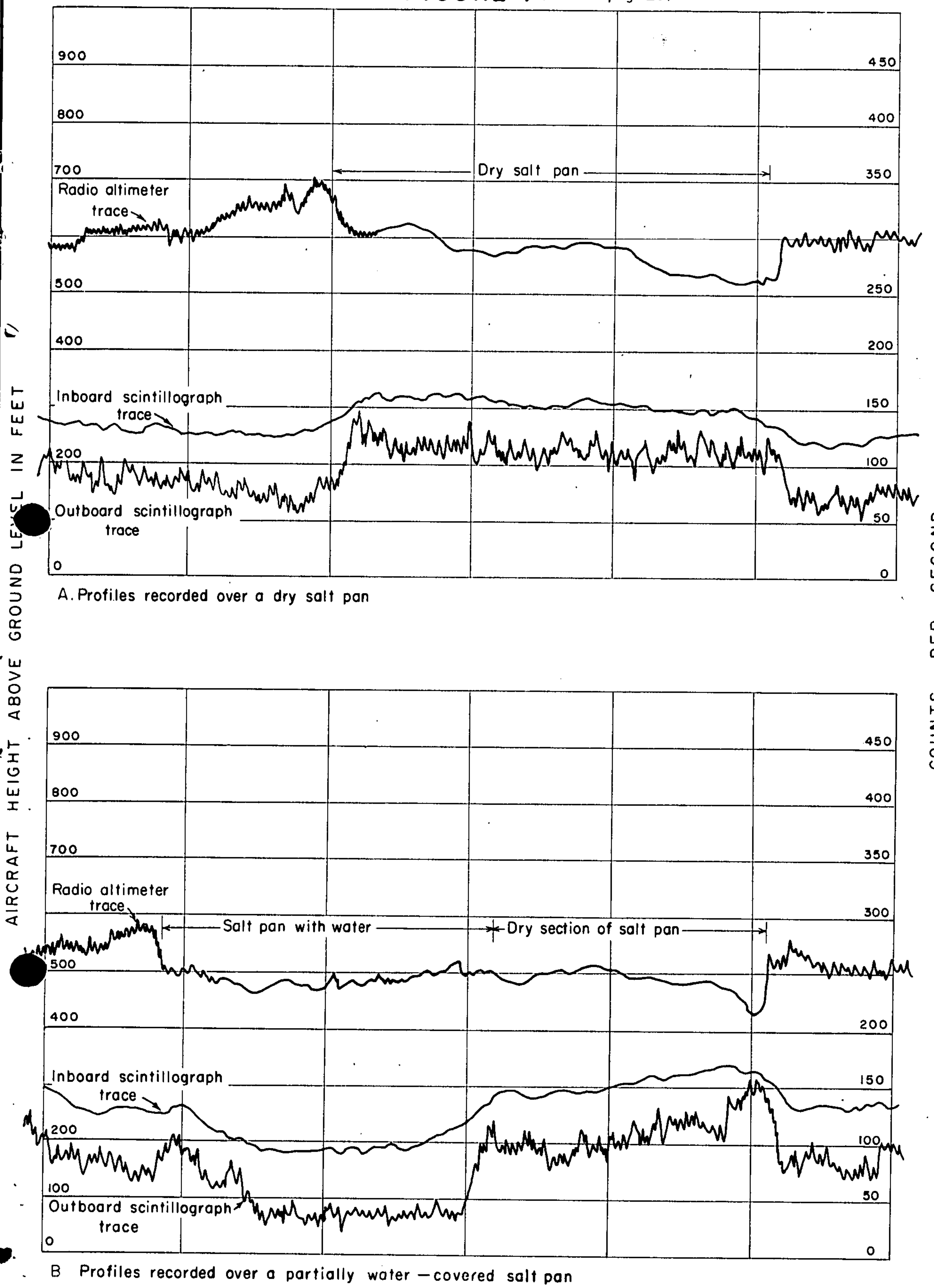
Equipment

Aircraft	: D.C.3 VH-MIN
Magnetometer	: MFS-5 saturable core fluxgate, tail boom installation and coupled to Speedomax and digital recorders
Scintillometers	: Twin crystal MEL scintillation detector heads inboard. Single detector head outboard, suspended by a cable 290 ft below the aircraft. Outputs to De Var recorder
Camera	: 35-mm strip camera of BMR design
Radio altimeter	: STR30B, frequency modulated type, output coupled to De Var recorder
Air position indicator	: Track recorded by integration of aircraft heading and air-speed, on a De Var recorder
Magnetic storm monitor	: MFD-3 saturable core fluxgate magnetometer, ground installation, output coupled to an Esterline-Angus recorder

Survey specifications

Altitude	: 500 ft above ground level
Line spacing	: 1 mile
Line orientation	: East and west
Tie system	: Single north-south ties spaced 15 miles apart. Double ties near eastern and western boundaries of each 1:250,000 map area
Navigation control	: Aerial photographs
Recorder sensitivities	: MFS-5 100 gammas/inch
	MFD-3 20 gammas/inch
	Scintillometers 50 c.p.s./cm
	Radio altimeter 100 ft/cm
Scintillometer time constants	: Inboard 10 seconds
	Outboard 1 second

FIGURE I (To face page 23)



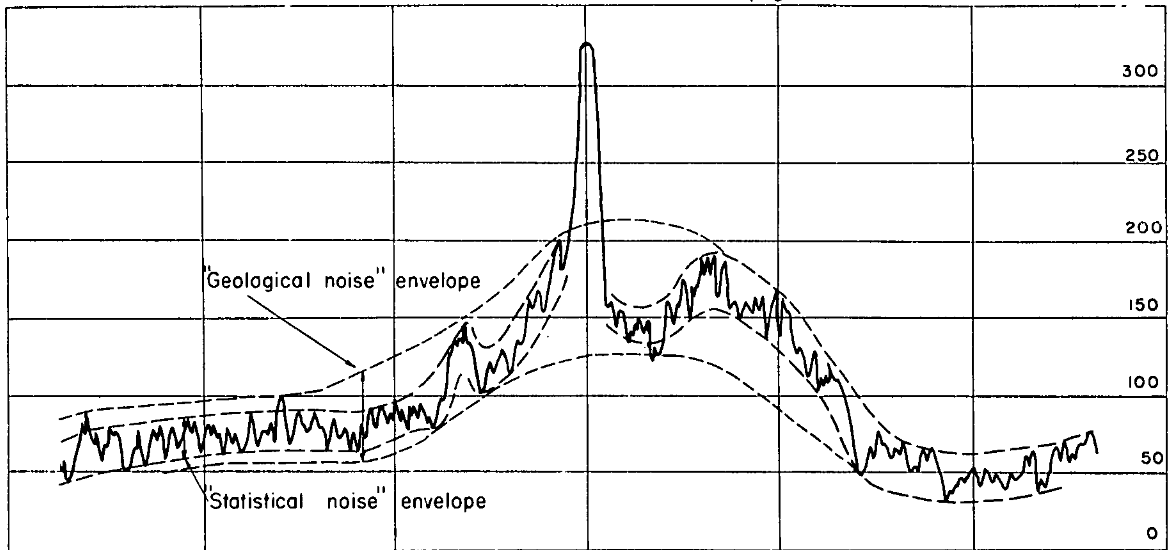
AIRBORNE SURVEY, LAVERTON — EDJUDINA WA 1966

CORRELATION OF RADIOMETRIC INTENSITY, SALT PANS AND LAKES

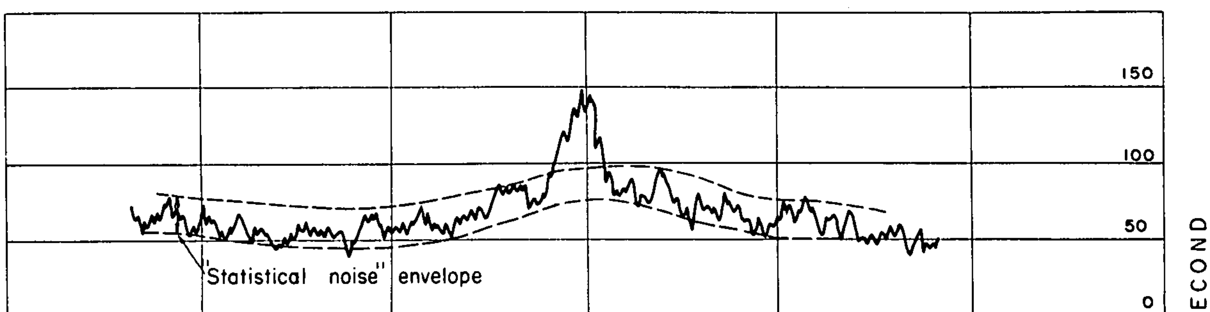
TO ACCOMPANY RECORD No. 1967/65

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics **H 51/B1-76**

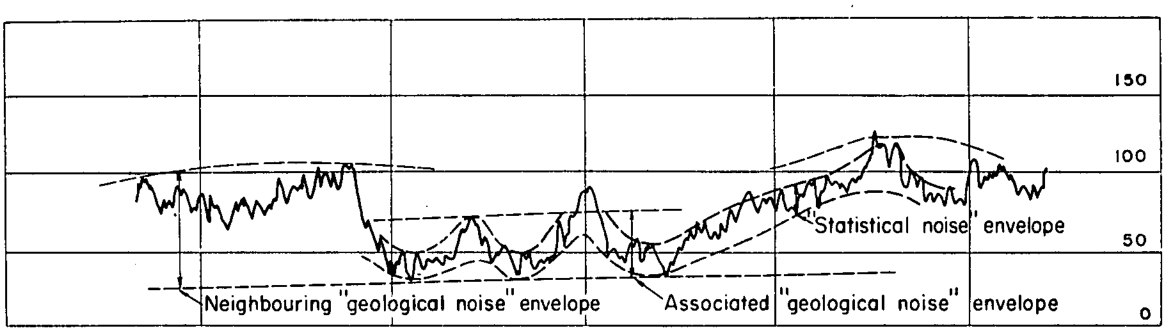
FIGURE 2 (To face page 34)



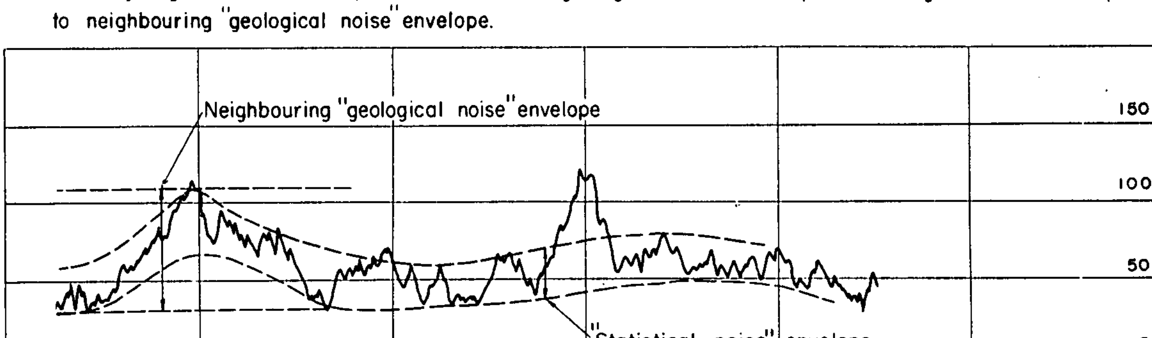
A Anomaly significant with respect to "geological noise" envelope.



B. Anomaly significant with respect to "statistical noise" envelope.



C. Anomaly significant with respect to associated "geological noise" envelope but insignificant with respect to neighbouring "geological noise" envelope.



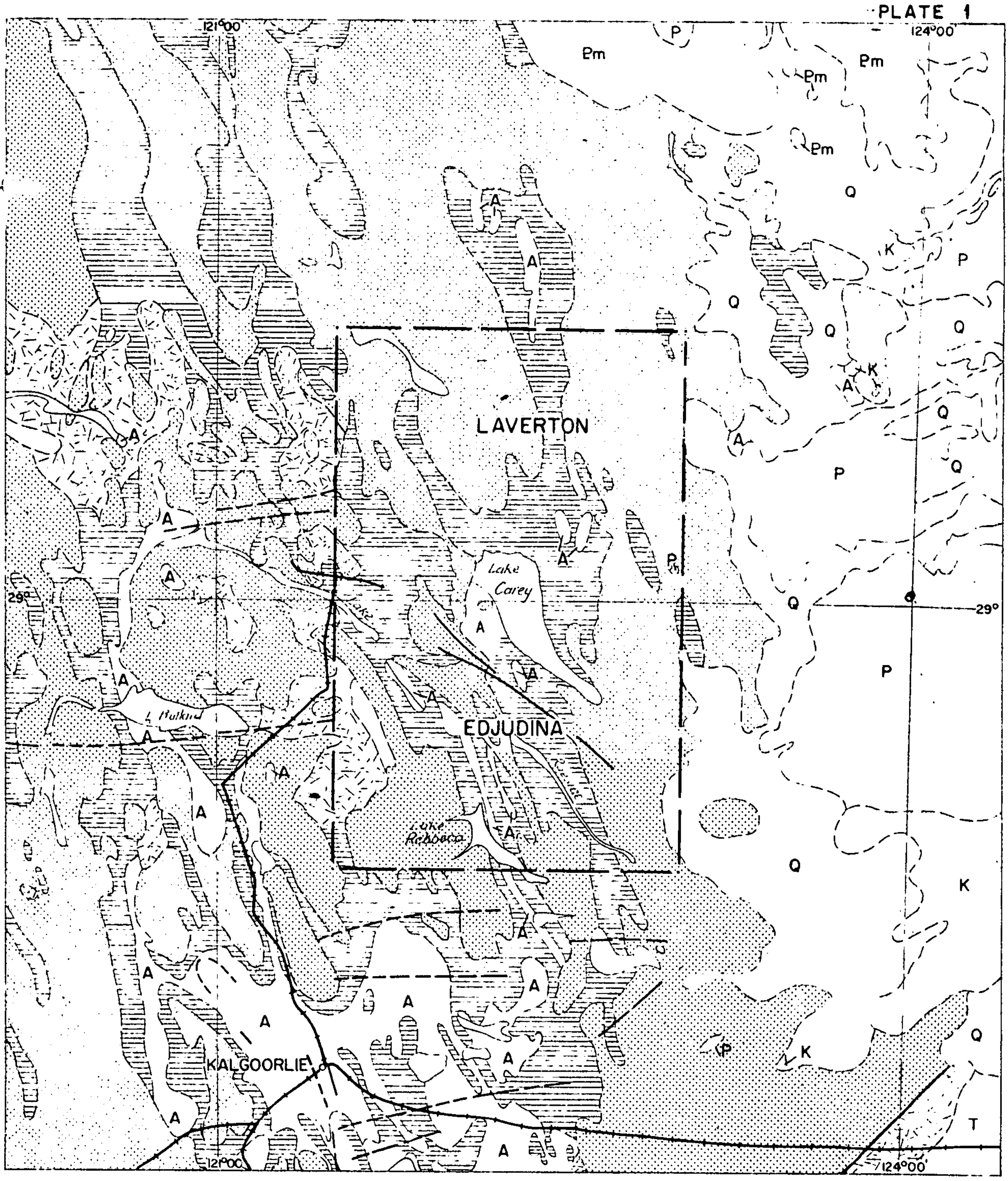
D. Anomaly significant with respect to associated "statistical noise" envelope but insignificant with respect to neighbouring "geological noise" envelope.

AIRBORNE SURVEY, LAVERTON — EDJUDINA WA 1966

TYPES OF RADIOMETRIC ANOMALIES

TO ACCOMPANY RECORD No. 1967/65

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/B1—74



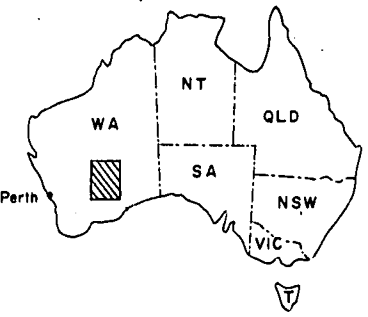
AIRBORNE SURVEY, LAVERTON-EDJUDINA, WA, 1966

LOCALITY MAP

50 0 50 100 150 MILES

50 0 50 100 150 200 KILOMETRES

LEGEND



Q	Quaternary sedimentary rocks
T	Tertiary sedimentary rocks
K	Cretaceous sedimentary rocks
P	Permian sedimentary rocks
Pm	Middle Proterozoic sedimentary and volcanic rocks
A	Archaean sedimentary rocks
	Archaean sedimentary rocks, contains basic igneous rocks
	Archaean granite
	Basic dykes and sills of undetermined Precambrian age
	Zones of high grade metamorphism and zones of migmatite and gneiss
	Geological boundary
	Fault
	Survey area boundary

Geology after Geological Survey of Western Australia

TO ACCOMPANY RECORD No 1967/65

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/B1-75

LAVERTON
WESTERN AUSTRALIA

PLATE 2

AIRBORNE SURVEY, LAVERTON—EDJUDINA WA 1966

TOTAL MAGNETIC INTENSITY PROFILES

EAST–WEST SCALE

MILES / KILOMETRES

LOCATION DIAGRAM

INDEX TO ADJOINING SHEETS

SIR SAMUEL	DUKETON	THROSSEL
LEONORA	LAVERTON	RASON

APPROX PROFILE SCALE

1000 gammas

500

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED ONE MILE APART. THE FLIGHT-LINES ARE IDEALISED, AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± ½ MILE.

THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 80 GAMMAS PER MILE.

EDJUDINA
WESTERN AUSTRALIA

PLATE 3

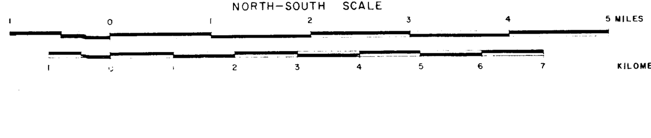
LOCATION DIAGRAM

INDEX TO ADJOINING SHEETS

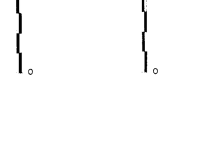
LEONORA	LAVERTON	RASON
MENZIES	EDJUDINA	MINIGWAL
KALGOORLIE	KURNALPI	CUNDEELEE

AIRBORNE SURVEY, LAVERTON—EDJUDINA WA, 1966

TOTAL MAGNETIC INTENSITY PROFILES



APPROX. PROFILE SCALES



EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED ONE MILE APART. THE FLIGHT-LINES ARE IDEALISED AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± ½ MILE.

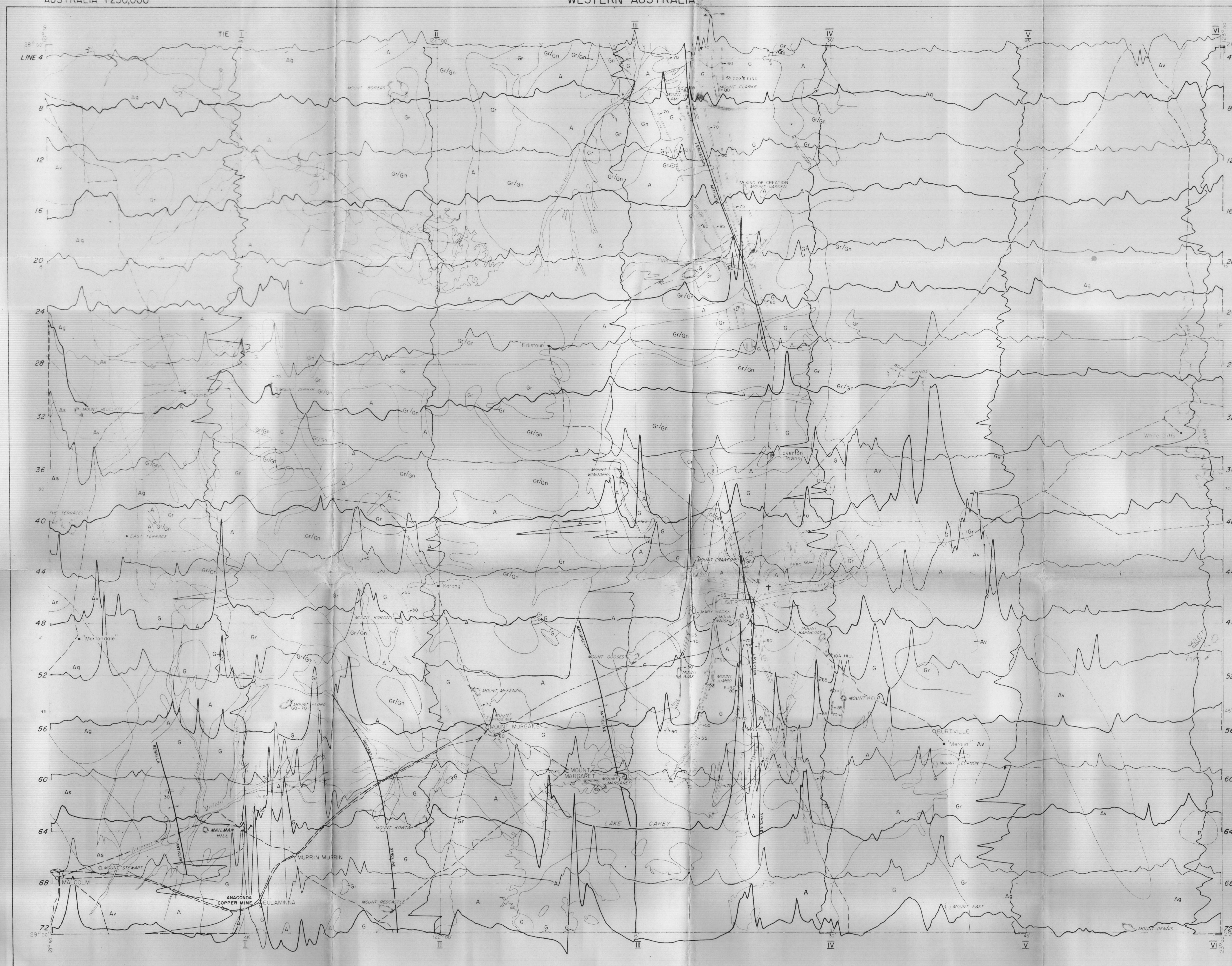
THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 8.0 GAMMAS PER MILE.

TO ACCOMPANY RECORD No 1967/65

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/B1-28

LAVERTON
WESTERN AUSTRALIA

AUSTRALIA 1:250,000



BASED ON H51/BO-10
BASED ON H51/BI-70
BASED ON H51/BI-71

GEOLOGICAL LEGEND

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103

RECENT	A	Alluvium
ARCHAEAN	Gr	Granite with some granodiorite and syenite
	Gn	Gneiss
	Gr/Gn	Mainly sandy soil which probably largely overlies granite and/or gneiss
	G	Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism
	60	Banded iron formations, with dip
		Axis of major anticlinal fold
		Axis of major synclinal fold
		Geological boundary

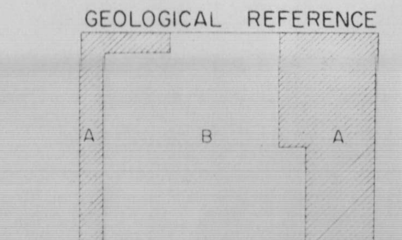
AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966

PALAEOZOIC	P	Marine and continental sedimentary rocks
PRECAMBRIAN UNDETERMINED ARCHAEAN	Av	Sedimentary rocks containing basic igneous rocks
	Ag	Granite
	As	Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss
		Geological boundary

TOPOGRAPHICAL LEGEND

- River or creek
- Road or track
- Railway (abandoned)
- Named place
- Hill feature
- Homestead
- Mining group

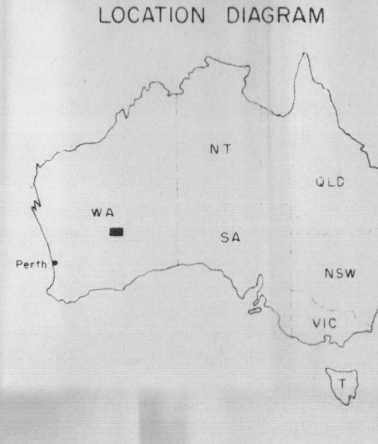
GEOLOGICAL REFERENCE



A Geological Map of Western Australia 1966

B Geological Survey of Western Australia Bulletin 103

LOCATION DIAGRAM



1°10'
True North
Mag North

INDEX TO ADJOINING SHEETS

SIR SAMUEL	DUKETON	THROSSELL
LEONORA	**LAVERTON**	RASON
MENZIES	EDJUDINA	MINIGWAL

AIRBORNE SURVEY, LAVERTON-EDJUDINA WA, 1966

TOTAL MAGNETIC INTENSITY PROFILES AND GEOLOGY

MILES 5 0 5 10 15 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

APPROX PROFILE SCALE

1000 gammas
500
0

EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED ONE MILE APART. THE FLIGHT-LINES ARE IDEALISED AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± ½ MILE.

PROFILES RECORDED AT INTERVALS OF 4 MILES ARE SHOWN ON THE MAP.

THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 8·0 GAMMAS PER MILE.

TO ACCOMPANY RECORD No 1967/65

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/BI-66

AUSTRALIA 1:250000

EDJUDINA
WESTERN AUSTRALIA

BASED ON H51/BO-7
BASED ON H51/B1-27
BASED ON H51/B1-65

AIRBORNE SURVEY, LAVERTON–EDJUDINA W.A. 1966

TOTAL MAGNETIC INTENSITY PROFILES AND GEOLOGY

GEOLOGICAL LEGEND

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103

RECENT	A	Alluvium
ARCHAEAN	Gr	Granite with some granodiorite and syenite
	Gr/Gn	Mainly sandy soil which probably largely overlies granite and/or gneiss
	G	Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism
	60	Banded iron formations, with dip
		Geological boundary

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 73

RECENT	Qt	Quartzite
PRECAMBRIAN(?)	gd	Porphyritic granite, granodiorite and syenite
	Ab	Granite with some gneiss
	sp	Peridotites and derivatives
	Ac	Conglomerate, arkose and tuff
	rh	Rhyolite, sheared porphyry and porphyrite
	gn	Mainly basic lavas with interbedded sediments and intrusives. Variable grade of metamorphism
	qfe	Banded iron formations
		Fault planes
		Axis of anticlinal fold
		Geological boundary

AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966

CAINOZOIC	Q	Marine and continental sedimentary rocks
ARCHAEAN	Av	Sedimentary rocks containing basic igneous rocks
	Ag	Granite
PRECAMBRIAN UNDETERMINED	As	Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss
		Geological boundary

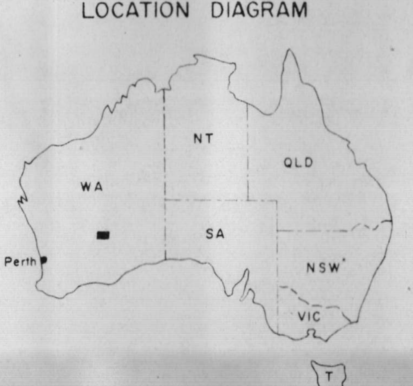
GEOLOGICAL REFERENCE

A Geological Survey of Western Australia Bulletin 73
B Geological Survey of Western Australia Bulletin 103
C Geological Map of Western Australia 1966

TOPOGRAPHICAL LEGEND

- River or creek
- Road or track
- Named place
- Homestead
- Rock feature
- Mining group

LOCATION DIAGRAM



True North
Mag North
1°10'

INDEX TO ADJOINING SHEETS

LEONORA	LAVERTON	RASON
MENZIES	EDJUDINA	MINIGWAL
KALGOORLIE	KURNALPI	CUNDEELEE

0 5 10 15 20 MILES
5 0 5 10 15 20 25 30 KILOMETRES

APPROX. PROFILE SCALES

Full-line profile: 1000 gammas, 500, 0
Broken-line profile: 10,000 gammas, 5000, 0

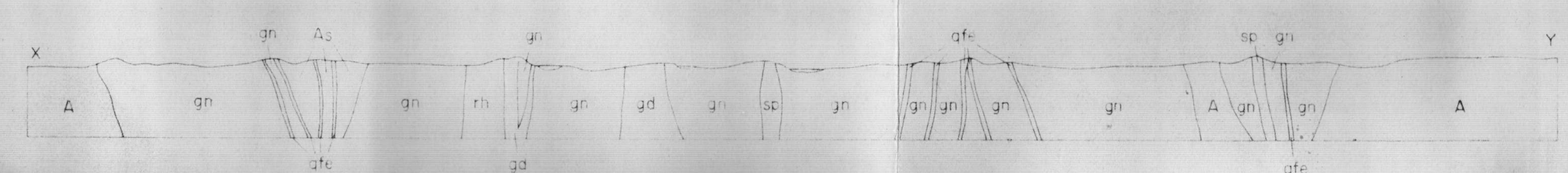
EXPLANATORY NOTES

THE SURVEY WAS MADE WITH A DC3 AIRCRAFT AT AN ALTITUDE OF 500 FEET ABOVE GROUND LEVEL ALONG LINES SPACED ONE MILE APART. THE FLIGHT-LINES ARE IDEALISED AND SERVE AS BASELINES TO THE PROFILES. THEY APPROXIMATE THE ACTUAL FLIGHT PATH WITH A PROBABLE ERROR OF ± ½ MILE.

PROFILES RECORDED AT INTERVALS OF 4 MILES ARE SHOWN ON THE MAP.

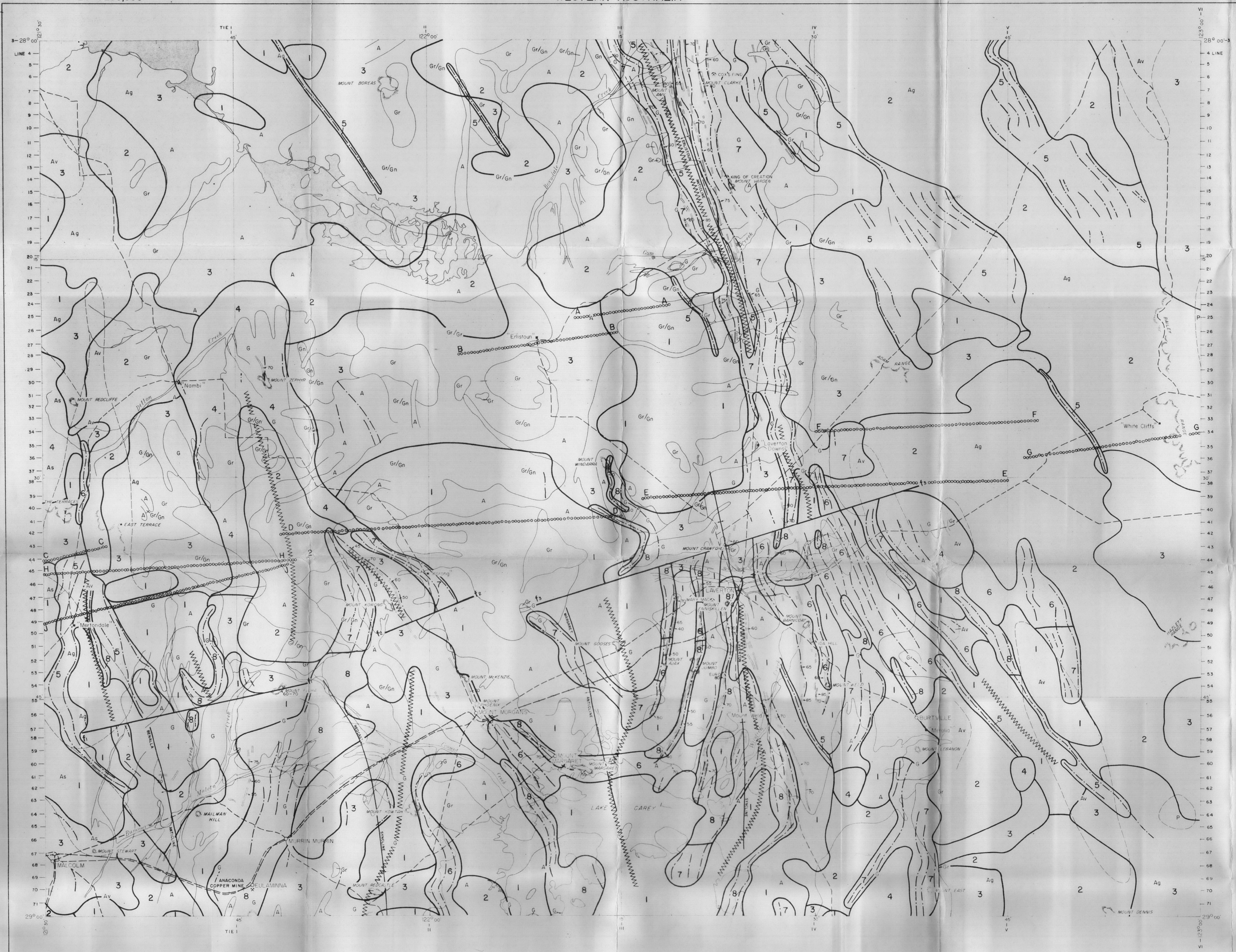
THE PROFILES HAVE BEEN CORRECTED FOR THE SOUTH COMPONENT OF A REGIONAL GRADIENT IN TOTAL MAGNETIC INTENSITY. THIS COMPONENT AMOUNTS TO 8·0 GAMMAS PER MILE.

SECTION X–Y



AUSTRALIA 1:250,000

LAVERTON
WESTERN AUSTRALIA



GEOLOGICAL LEGEND

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103

RECENT	A	Alluvium
ARCHAEAN	Gr	Granite with some granodiorite and syenite
ARCHAEAN	Gn	Gneiss
ARCHAEAN	Gr/Gn	Mainly sandy soil which probably largely overlies granite and/or gneiss
ARCHAEAN	G	Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism

- Banded iron formations, with dip (60)
- Axis of major anticlinal fold
- Axis of major synclinal fold
- Geological boundary

AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966

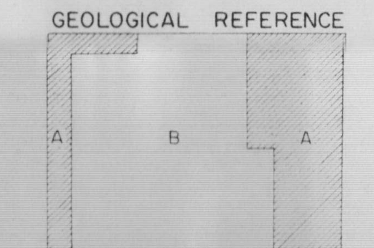
PALAEOZOIC	P	Marine and continental sedimentary rocks
PRECAMBRIAN UNDETERMINED ARCHAEAN	Av	Sedimentary rocks containing basic igneous rocks
PRECAMBRIAN UNDETERMINED ARCHAEAN	Ag	Granite
PRECAMBRIAN UNDETERMINED	As	Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss

- Geological boundary

TOPOGRAPHICAL LEGEND

- River or creek
- Road or track
- Railway (abandoned)
- Named place
- Hill feature
- Homestead
- Mining group

GEOLOGICAL REFERENCE

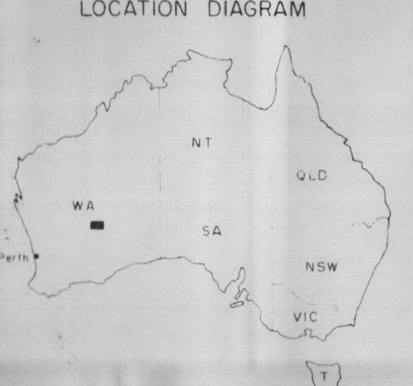


A Geological Map of Western Australia 1966

B Geological Survey of Western Australia Bulletin 103

BASED ON H51/B0-10
BASED ON H51/B1-77

LOCATION DIAGRAM



True North
Mag North
1°10'

INDEX TO ADJOINING SHEETS

SIR SAMUEL	DUKETON	THROSSELL
LEONORA	LAVERTON	RASON
MENZIES	EDJUDINA	MINIGWAL

AIRBORNE SURVEY, LAVERTON–EDJUDINA WA, 1966

MAGNETIC INTERPRETATION AND GEOLOGY

MILES 5 0 5 10 15 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

GEOPHYSICAL LEGEND

- Magnetic trend
- A A Dyke, induced magnetisation
- (3) Magnetic zone
- f2 f2 Interpreted fault
- Fold axis

TO ACCOMPANY RECORD No. 1967/65

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/B1-78

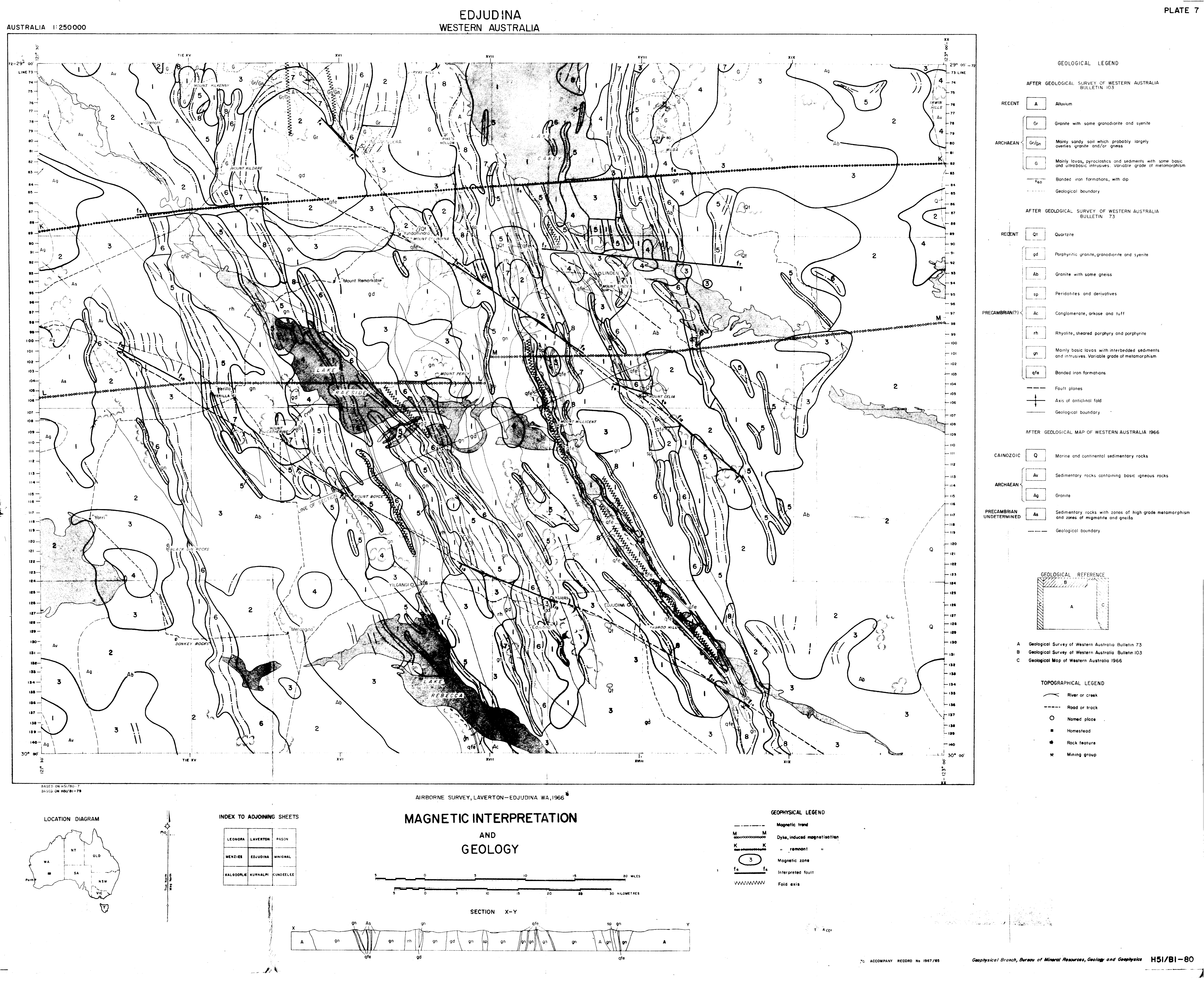


PLATE 7
AUSTRALIA 1:250 000
EDJUDINA
WESTERN AUSTRALIA
GEOLOGICAL LEGEND
AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103
RECENT
A Alluvium
ARCHAEAN
Gr Granite with some granodiorite and syenite
Gr/Gn Mainly sandy soil which probably largely overlies granite and/or gneiss
G Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism
Banded iron formations, with dip
Geological boundary
AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 73
RECENT
Qt Quartzite
PRECAMBRIAN(?)
gd Porphyritic granite, granodiorite and syenite
Ab Granite with some gneiss
sp Peridotites and derivatives
Ac Conglomerate, arkose and tuff
rh Rhyolite, sheared porphyry and porphyrite
gn Mainly basic lavas with interbedded sediments and intrusives. Variable grade of metamorphism
qfe Banded iron formations
Fault planes
Axis of anticlinal fold
Geological boundary
AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966
CAINOZOIC
Q Marine and continental sedimentary rocks
ARCHAEAN
Av Sedimentary rocks containing basic igneous rocks
Ag Granite
PRECAMBRIAN UNDETERMINED
As Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss
Geological boundary
GEOLOGICAL REFERENCE
A Geological Survey of Western Australia Bulletin 73
B Geological Survey of Western Australia Bulletin 103
C Geological Map of Western Australia 1966
TOPOGRAPHICAL LEGEND
River or creek
Road or track
Named place
Homestead
Rock feature
Mining group
LAKE RAESIDE
LAKE REBECCA
MOUNT KILKENNY
MOUNT KILDARE
Mount Remarkable
MOUNT PERCY
MOUNT CATHERINE
MOUNT BOYCE
MOUNT CELIA
MOUNT MILLICENT
MOUNT LINDEN
LINDEN
YILGANGI
EDJUDINA
Menangina
DONKEY ROCKS
BLACK SWAN ROCKS
Yarri
Glenorn
Yundamindra
IRWIN HILLS
LINE OF SECTION
BASED ON H51/80-7
BASED ON H51/81-79
LOCATION DIAGRAM
WA
NT
QLD
SA
NSW
VIC
INDEX TO ADJOINING SHEETS
LEONORA
LAVERTON
RASON
MENZIES
EDJUDINA
MINIGWAL
KALGOORLIE
KURNALPI
CUNDEELEE
AIRBORNE SURVEY, LAVERTON–EDJUDINA WA, 1966
MAGNETIC INTERPRETATION
AND
GEOLOGY
20 MILES
30 KILOMETRES
SECTION X–Y
GEOPHYSICAL LEGEND
Magnetic trend
Dyke, induced magnetisation
" remanent "
Magnetic zone
Interpreted fault
Fold axis
TO ACCOMPANY RECORD No 1967/85
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics
H51/B1–80

PLATE 8

AUSTRALIA 1:250,000

LAVERTON
WESTERN AUSTRALIA

GEOLOGICAL LEGEND

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103

RECENT

A — Alluvium

ARCHAEAN

Gr — Granite with some granodiorite and syenite

Gn — Gneiss

Gr/Gn — Mainly sandy soil which probably largely overlies granite and/or gneiss

G — Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism

60 — Banded iron formations, with dip

Axis of major anticlinal fold

Axis of major synclinal fold

Geological boundary

AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966

PALAEOZOIC

P — Marine and continental sedimentary rocks

PRECAMBRIAN UNDETERMINED ARCHAEAN

Av — Sedimentary rocks containing basic igneous rocks

Ag — Granite

As — Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss

Geological boundary

TOPOGRAPHICAL LEGEND

River or creek

Road or track

Railway (abandoned)

Named place

Hill feature

Homestead

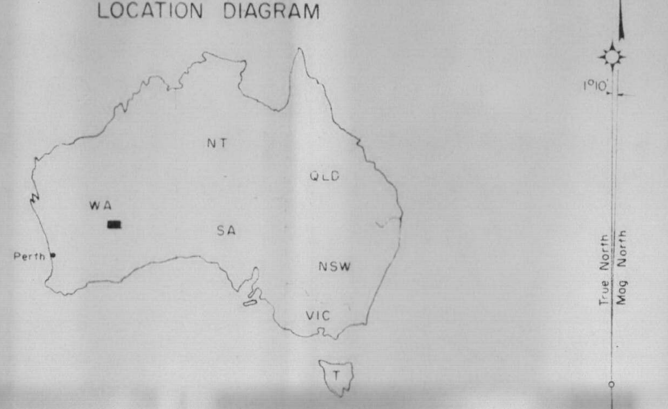
Mining site

GEOLOGICAL REFERENCE

A Geological Map of Western Australia 1966

B Geological Survey of Western Australia Bulletin 103

LOCATION DIAGRAM



INDEX TO ADJOINING SHEETS

SIR SAMUEL	DUKETON	THROSSELL
LEONORA	LAVERTON	RASON
MENZIES	EDJUDINA	MINIGWAL

AIRBORNE SURVEY, LAVERTON–EDJUDINA WA, 1966

RADIOMETRIC RESULTS
AND
GEOLOGY

MILES 5 0 5 10 15 20 MILES

KILOMETRES 5 0 5 10 15 20 25 30 KILOMETRES

GEOPHYSICAL LEGEND

75 / 100 / 125 — Radiometric contours, counts per second

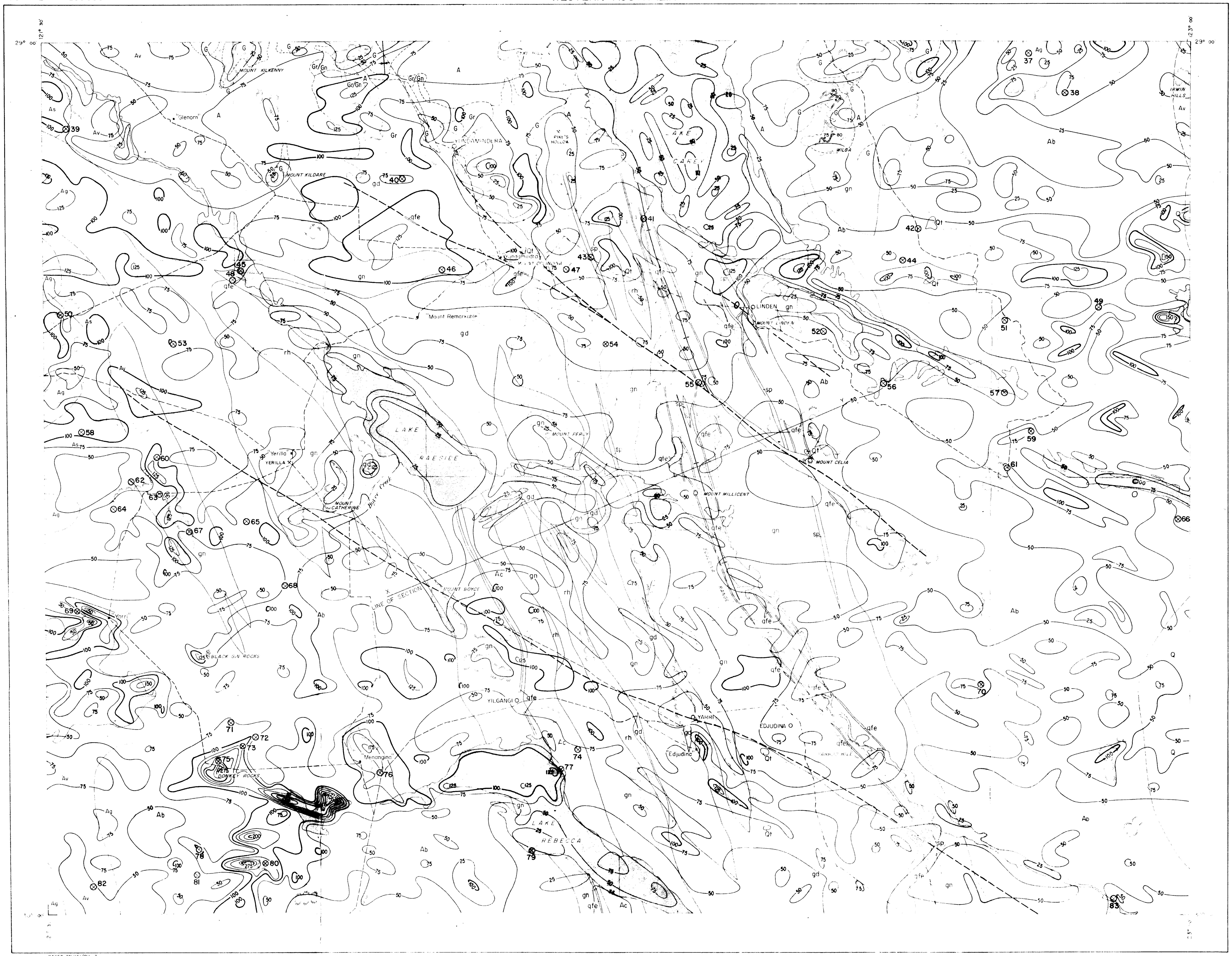
10 ⊗ — Radiometric anomaly restricted source (Anomalies are numbered for reference only)

COMPANY RECORD No 1967/65

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/B1-68

AUSTRALIA 1:250000

EDJUDINA
WESTERN AUSTRALIA



BASED ON H51/BI-7
BASED ON H51/BI-73

GEOLOGICAL LEGEND

AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 103

RECENT	A	Alluvium
ARCHAEAN	Gr	Granite with some granodiorite and syenite
	Gr/Gn	Mainly sandy soil which probably largely overlies granite and/or gneiss
	G	Mainly lavas, pyroclastics and sediments with some basic and ultrabasic intrusives. Variable grade of metamorphism
	60	Banded iron formations, with dip
		Geological boundary

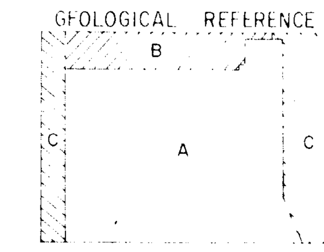
AFTER GEOLOGICAL SURVEY OF WESTERN AUSTRALIA BULLETIN 73

RECENT	Qt	Quartzite
PRECAMBRIAN(?)	gd	Porphyritic granite, granodiorite and syenite
	Ab	Granite with some gneiss
	sp	Peridotites and derivatives
	Ac	Conglomerate, arkose and tuff
	rh	Rhyolite, sheared porphyry and porphyrite
	gn	Mainly basic lavas with interbedded sediments and intrusives. Variable grade of metamorphism
	qfe	Banded iron formations
		Fault planes
		Axis of anticlinal fold
		Geological boundary

AFTER GEOLOGICAL MAP OF WESTERN AUSTRALIA 1966

CAINOZOIC	Q	Marine and continental sedimentary rocks
ARCHAEAN	Av	Sedimentary rocks containing basic igneous rocks
	Ag	Granite
PRECAMBRIAN UNDETERMINED	As	Sedimentary rocks with zones of high grade metamorphism and zones of migmatite and gneiss
		Geological boundary

GEOLOGICAL REFERENCE

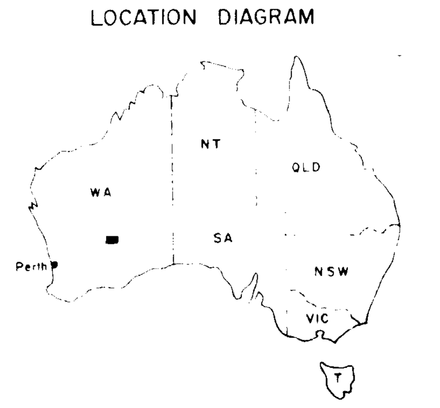


A Geological Survey of Western Australia Bulletin 73
B Geological Survey of Western Australia Bulletin 103
C Geological Map of Western Australia 1966

TOPOGRAPHICAL LEGEND

- River or creek
- Road or track
- Named place
- Homestead
- Rock feature
- Mining group

LOCATION DIAGRAM

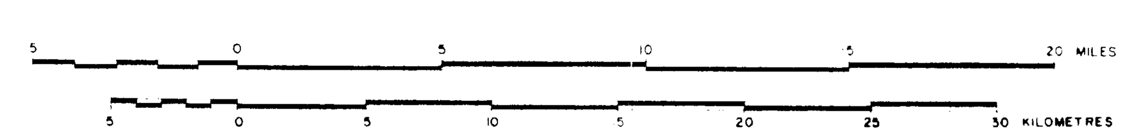


INDEX TO ADJOINING SHEETS

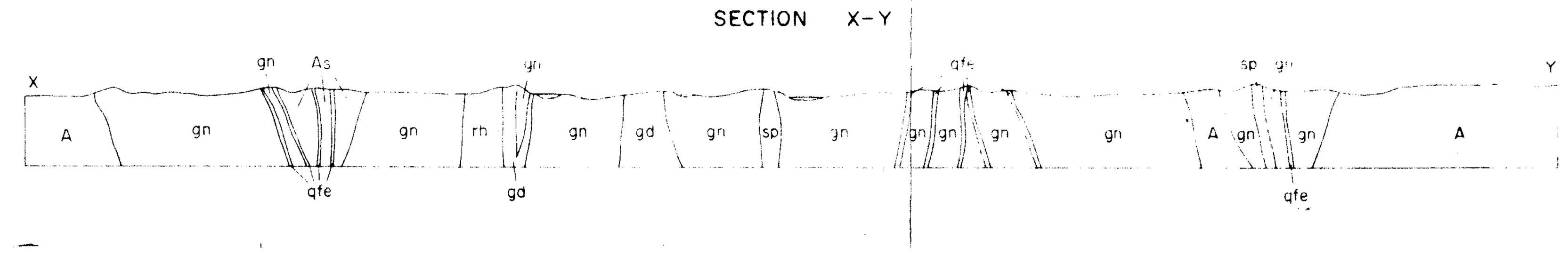
LEONORA	LAVERTON	RASON
MENZIES	EDJUDINA	MINIGWAL
KALGOORLIE	KURNALPI	CUNDEELEE

AIRBORNE SURVEY, LAVERTON–EDJUDINA WA, 1966

RADIOMETRIC RESULTS
AND
GEOLOGY



SECTION X–Y



GEOPHYSICAL LEGEND

75 / 100 / 125	Radiometric contours, counts per second
40 ⊗	Radiometric anomaly restricted source (Anomalies are numbered for reference only)