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KALGOORLIE DETAILED AEROMAGNETIC SURVEY, WA 1964

by

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RESTRICTED

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1. INTRODUCTION

During June and July of 1964, a detailed aeromagnetic survey was conducted over an area of 65 square miles, immediately north-north-west of Kalgoorlie (see Plate 1). The survey was made at the request of New Consolidated Gold Fields Pty. Ltd. who held Temporary Reserves within the surveyed area, and was supported by the Geological Survey of Western Australia.

Kalgoorlie lies within the East Coolgardie Goldfield of Western Australia and is adjacent to the Golden Mile, the most important gold producing area in Australia.

An important study of the Golden Mile and adjacent areas was undertaken by the Geological Survey of Western Australia and published in Simpson and Gibson (1913), Feldtmann and Farquharson (1913), Honman (1914), Feldtmann (1916) and Stillwell (1929). Since this study there has been nothing of comparable importance published, all subsequent papers have tended to deal with the interpretation of the structure of the Golden Mile. There is no modern description of the lithology of the rocks nor of the metamorphic and metasomatic processes that have been impressed on them. There is no report dealing specifically with the geology of the area surveyed.

The only known previous geophysical work over the survey area was a regional aeromagnetic survey involving the Bureau's DC.3 aircraft. The results of this survey are shown on B.M.R. aeromagnetic contour map number G247-25.

The aim of the detailed aeromagnetic survey was to aid geological mapping in the soil covered portions of the survey area.

2. GEOLOGY

General

The greater part of the Western Australian land mass is made up of Pre-Cambrian igneous rocks or rocks of metamorphic origin resulting from igneous activity and earth movements. These rocks are the home and source of the majority of metallic mineral deposits in the State and have been described by a great number of different authors. These descriptions have all been

studied and combined into one overall description in Prider (1944-45); which has been summarised hereunder, to give the general geology of the area in which the survey took place.

The Older Greenstone Series

The earliest record of Archaeozoic igneous activity is the rocks of the Yilgarn - Kalgoorlie System, the basal system in Western Australia. The best known development of this system is in the Kalgoorlie and Murchison Regions where there is an extensive development of the greenstone phase, associated with which are the most important gold bearing areas in the State.

Here the oldest rocks of volcanic origin form the Older Greenstone Series. They are rocks which are metamorphosed to some extent and in many areas they have suffered regional metasomatism, upon which has been impressed more intensive local metasomatism in the vicinity of ore bodies; this has tended to reduce all varieties to a common end product. From the relic structure it can be seen that the rocks were originally basaltic lava flows (often pillow lavas) with associated fragmental volcanic rocks. The pillow structure of the basaltic rocks has been utilised to determine the stratigraphic order in the highly folded greenstones.

The least altered of these basic lavas are the fine grained amphibolites in which the pyroxene of the original basalts has been replaced by pale green fibrous amphibole. With further metasomatism (propylitisation), the fine grained amphibolites go to fine grained greenstones in which the amphibolite has been replaced by chlorite, while, with progressive metasomatism, there is noticeable replacement of all rock minerals by various carbonates, finally giving "calc schists". In areas of high grade metamorphism, the fine grained amphibolites are represented by hornblende schists (schistose plagioclase amphibolites) with the original basaltic texture completely obscured by recrystallisation. However, in such areas, the pillow structure is still recognisable.

In most of the mining areas of the Central Goldfields the basaltic lavas of the Older Greenstone Series contain intercalated bands of sediments, generally jaspilites.

Thus, the Older Greenstone Series, placed at the base of the geological succession in Western Australia, is a series of basaltic flows of spilitic character with associated basic agglomerates and tuffs and a minor development of sedimentary jaspilites and acid volcanics and their associated tuffs and breccias. In view of the spilitic character and common occurrence of pillow structure, these lavas were probably largely submarine extrusions.

The Whitestone Series

The next phase of the Yilgarn - Kalgoorlie period was characterised by various epochs of volcanicity. Following the Older Greenstone Series is the Black Flag Series, composed of rhyolite and probably trachyte tuffs, tuff-agglomerates and tuff-breccias with occassional thin bands of lava and flow breccias and erosion sediments such as grits, quartzites and mudstones: thus the record is one of explosive volcanism associated with acid extrusions.

The Black Flag Series is overlain unconformably by the Yindarlgoorda Series. This Series consists of andesitic and dacitic lavas and associated agglomerates and tuffs with interbedded erosion sediments.

The Kundana Series lies unconformably on the Yindarlgoorda Series; it consists of erosion sediments without any evidence of igneous activity. Thus the widespread volcanism of the early Archaeozoic died out after the extensive eruptions which yielded the Yindarlgoorda volcanics: no further igneous activity is recorded until the intrusion of the Younger Greenstone Series.

The Younger Greenstone Series

The Younger Greenstone Series represents a hypabyssal phase of basic magma intrusion which appears to be the final stage of igneous activity in the Yilgarn - Kalgoorlie times. Rocks of this group, intrusive into all pre-existing formations, are represented in most mining fields in the belt from Norseman through Kalgoorlie to Leonora and Laverton and on to Wiluna. There is evidence of Younger Greenstone at Southern Cross and of minor development in the Yilgarn Goldfield. However, in these areas

the distinct characteristics of the Younger Greenstone are obscured by metamorphism, which is of higher grade in these regions than in the previously mentioned belt. It is only with great difficulty that they can be distinguished from the recrystallised older basalts but this is not nearly so important as it is further east, especially at Kalgoorlie, where they form the country rock for nearly all the important auriferous lodes.

The Younger Greenstone magma appears to have been extensively differentiated prior to intrusion, being represented by earlier ultrabasic intrusions followed by a basic (dolerite phase) and, later, by an intermediate to acid phase. As with the Older Greenstone, there has been considerable alteration of the rocks by post-crystallisation earth movements together with regional and local metasomatism; however the three main phases - ultrabasic, basic, and acid - can usually be recognised, for example, at Kalgoorlie these are :-

(i) Ultrabasic phase - Serpentines and various metasomatised types such as talc-chlorite-carbonate rocks and some fuchsite-carbonate-quartz rocks derived from pyroxenes.

(ii) Basic phase – Various low grade metamorphic products of dolerite and quartz dolerite.

(iii) Intermediate to acid phase - Represented by chloritised hornblende porphyrites and a more acid group of albite porphyries or keratophyres.

The Younger Greenstone period was therefore a period of hypabyssal igneous activity of a basic magma. The earlier, ultrabasic and basic, phases appeared largely as sills or laccoliths (Kalgoorlie and Wiluna) whereas the later acid porphyry phase is represented by dyke intrusions.

The Older Granite Period

The greater part of the southern half of the State is made up of granitic rocks (granites and gneisses) enclosing comparatively narrow north-west trending strips of Yilgarn - Kalgoorlie rocks. Extensive granitisation of a folded complex of Archaeozoic metamorphic rocks has yielded various gneisses, after which the area was intruded by granite stocks. Thus there are two periods of granite emplacements; the earliest period, the Older Granite, is now represented by granitic gneiss while the later period, the Younger Granite, was one of dyke and stock intrusions.

The Younger Granite Period

The latest phase in the development of the granite and gneiss complex was the intrusion of massive granites in the form of stocks and dykes accompanied by pegmatites, aplites and quartz veins. These granites transgress the gneissic structure of the Older Granites and the bedding and schistosity of the Yilgarn - Kalgoolie rocks. Often they enclose xenoliths of older gneisses and sometimes there is such a mixture of the Older and Younger granite phase that it is impossible to separate them in mapping.

The Younger Granite intrusion was accompanied by end phase quartz-felspar and granite porphyries, aplites, pegmatites and quartz veins. Many of these dykes and veins are important for gold, mica, felspar, cassiterite, tantalite, etc.

Probably there are a number of epochs represented by the Younger Granite phase, however, there is no detail on this phase as the rocks outcrop poorly, much of the Younger Granite being soil covered.

Metamorphism

Metamorphic index minerals, sillimanite and kyanite are present in some soils from Bulong and Kanowna, but elsehwere in the vicinity of Kalgoorlie, where there is an extensive development of pelitic and psammopelitic sediments, the metamorphism is of a very low grade. There is no recrystallisation of basic lavas and sedimentary rocks, as there is elsewhere in the State, although the area is strongly folded.

Kalgoorlie is in the centre of an area of approximately 8,000 square miles of rocks of the Yilgarn - Kalgoorlie System. The formations are very strongly (isoclinally) folded, but because of the remoteness from granitic rocks, the rocks show no evidence of constructive metamorphism.

The structure of the Central Goldfields shows that the main folding in the area was along north-west axes. On this structure there is superimposed cross folding on an east-west axis. The pattern of this major folding with minor cross folding may have affected the location and grade of metamorphism and the degree of granitisation.

Regional metasomatism is a marked feature of some of the Western Australia mining districts, especially the belt extending from Kalgoorlie to Wiluna. This metasomatism has been closely studied at Kalgoorlie where practically all the greenstones (Older and Younger) are regionally albitised and carbonatised. The process was essentially one of propylitisation due to the introduction of carbonic solutions or vapours, probably the late-stage product of the Younger Greenstone magma. This regional metasomatism has been followed by more intense local alteration along zones of weakness by somewhat similar but more siliceous ore solutions, yielding auriferous lode formations which are shear zones that have been intensely metasomatised by the introduction of carbon dioxide, sulphur, silica and potash.

Auriferous Mineralisation

With few exceptions, all the primary metalliferous deposits in Western Australia formed in Precambrian times as an aftermath of igneous activity. Of these, the gold deposits have been by far the most important. In recent years, considerable attention has been given to the study of the relationship between structure and ore deposition. Although the rock structure has undoubtedly been a very important factor controlling the location of ore deposits, the overemphasis on structure has tended to obscure the fact that there must have been a source for the mineralising solutions.

There are two distinct types of ore deposit :-

(i) Sulphide-bearing lode formations associated with extensive silica-carbonate metasomatism of the country rock, as exemplified by the lodes of the Golden Mile at Kalgoorlie.

(ii) Auriferous quartz reefs, which, although they may occur in similar country to (i), are characterised by very slight potash-silica metasomatism of the country rocks. The auriferous bodies of the Yilgarn Goldfield are typical examples of this mineralisation. Closely allied to this type are porphyry dykes traversed by networks of contemporaneous auriferous quartz veinlets.

The more common view as to the source of the gold mineralisation is that all the gold was ultimately related to a granitic magma. However another view is that the sulphide-bearing lode-formations associated with extensive carbonate metasomatism of the country rocks are genetically related to the Younger Greenstone magma whereas the quartz reef type was most probably derived from some granitic magma. The differentiation of the Younger Greenstone magma led to a sodic end-phase which, in addition to yielding albite porphyries, has effected albitisation of the greenstones and this in turn was followed by activity of carbonic solutions or vapours, which caused widespread metasomatic changes in earlier rocks of the series. The final stage of activity of the Younger Greenstone magma was a more intense and rather localised action of such carbonic solutions along shear zones, bringing about the formation of lodes.

On the other hand, the auriferous quartz veins and porphyries appear to be derivatives of a granite magma. For example, in the Yilgarn Goldfield, the auriferous quartz reefs appear to be related to the granite magma which has intruded the folded rocks of the Yilgarn - Kalgoorlie System as batholiths, that is, the Younger Granite.

However, an overall lack of knowledge of the time relationships of the auriferous mineralisation in Western Australia makes it difficult to present any definite theory on the ore genesis.

Proterozoic Igneous Activity

There are two phases of igneous activity in Proterozoic times -

(i) An earlier volcanic phase represented by various lavas and pyroclastics interbedded with the sediments of the Nullagine Series, and

(ii) A later hypabyssal phase represented by dolerite dyke and sill intrusions.

In the southern half of the State, dyke intrusions have been noted which do not appear to be related to the quartz dolerites just mentioned. All that can be said of their age is that they are post gold or post granite. The most prominent of these are the east-north-east trending quartz dolerite dykes occurring in the Central Goldfields region. Where mapped, the dykes

are vertical or steeply dipping and are classified as gabbro, norite or pyroxenite dykes. Recent mapping by the Geological Survey of Western Australia has grouped these dykes together as the Dundas Dyke Suite and dated the intrusions as possibly Lower Proterozoic.

The metamorphism associated with the Proterozoic igneous activity has been of very low grade, being confined mainly to contact metamorphism.

3. RESULTS

The interpretation of the results of the survey was assisted by discussions with geologists of the Geological Survey of Western Australia and of New Consolidated Gold Fields Pty. Ltd. The company provided access to the results of its exploratory drilling in the survey area and this information was of value in the interpretation of the aeromagnetic results.

The primary result of the survey is the magnetic contour map of the survey area shown on Plate 2. This shows the magnetic field at a height of 250 ft. above ground level represented by a series of contour lines drawn with a contour interval of 10 gammas between adjacent lines and an interval of 100 gammas between the lines in heavier type. This contour map clearly delineates three features - (i) a large amplitude magnetic anomaly striking 20° West of North up the centre of the survey area, (ii) a large amplitude magnetic anomaly striking 25° North of East across the northern boundary of the survey area, and (iii) a magnetic anomaly of negative amplitude striking 37° West of North across the survey area.

These three features tend to obscure the less prominent magnetic features and it is necessary to study the magnetic field profiles, used to construct the contour map, in order to obtain more detail. Plate 3 shows the approximate boundaries of the formations that are the source of anomalies on the magnetic field profiles. These boundaries were usually determined by plotting the positions of the points of inflection on the profile curves. The interpretation of the combined contour map and the plot of the points of inflection has been made in terms of the known rock types occurring in the vicinity of the survey area.

Zone 1, in the very west of the survey area, contains a number of low amplitude magnetic anomalies having a variation in strike of 20° to 45° West of North. The total intensity of the magnetic field gradually increases across this zone towards the west. This is due to beds of Kurrawong Conglomerate which are delineated on the magnetic contour map obtained by the DC.3 regional aeromagnetic survey (Map No.G247-25) as a large amplitude anomaly striking 45° West of North just to the West of the surveyed area. From a study of the magnetic field profiles for the DC.3 survey, the low amplitude magnetic anomalies in Zone 1 are most probably due to a northwards continuation of the Binduli Hornblende Porphyries which occur 5 miles south-west of Kalgoorlie across the Kalgoorlie - Coolgardie road.

Adjacent to Zone 1 on the East, is a belt of scattered magnetic anomalies with an overall strike of 20° West of North, marked as Zone 2. From the scattered nature of the magnetic anomalies this zone is interpreted as containing a mixture of acidic and basic minor lava flows, agglomerates, tuff, and possibly erosion sediments and is marked as beds of the Black Flag Series, with the, possibly, basic, lava flows marked as "greenstones".

The dominant feature on the contour map, a large amplitude magnetic anomaly striking 20° West of North up the centre of the survey area, has been classed as Zone 3. This Zone consists of a number of near-parallel beds whose general strike corresponds to that of the Zone. The central bed that gives rise to the large amplitude anomaly is tentatively identified as Hannan's Lake Serpentinite (see Woodall, 1964). In two places along the strike of this bed, the amplitude of the magnetic anomaly decreases and then increases over a short distance. This may represent short sections where the serpentinite has been carbonatised. To the north the amplitude of the magnetic anomaly over this bed drops off sharply but from a study of the magnetic field profiles the bed would appear to continue north perhaps as far as Zone 6. Either the bed is carbonatised over this northern section or it pitches down sharply to the north.

To the south the amplitude of the magnetic anomaly again decreases sharply and this would appear to mark the southern limit of the bed.

At this southern end the bed splits into two limbs and then finishes against some other beds, possibly Younger Greenstone. The actual nature of the southern extremity of the bed is difficult to interpret from the contouring or the magnetic field profiles and the form shown on Plate 3 is only one of a number of possibilities.

Showing up on the magnetic profiles merely as minor peaks on the side of the main anomaly of Zone 3 are the other beds delineated within the Zone. These are tentatively identified as quartz dolerites of the Younger Greenstone Series intruding ~~(black flag beds)~~ shale and/or the meta-basalts of the Older Greenstone Series.

For the sake of completeness, Zone 3 is shown as extending right up to the northern boundary of the survey area. There is not a sufficient area surveyed north of Zone 4 to be certain of this classification. However, a study of the DC.3 magnetic profiles indicated that an anomalous area does extend further north until it is cut-off by the northwards extension of Zone 7.

The possibility that the bed of proposed Hannan's Lake Serpentinite may pitch to the north at its northern end and the manner in which the Younger Greenstone beds bulge out around the bed of Serpentinite suggests that the Serpentinite may represent the core of a tight anticline that strikes 20° west of north. This anticline would have a cross-fold axis somewhere in the vicinity of the carbonatised sections of Hannan's Lake Serpentinite so that the Serpentinite would pitch north at its northern end and very steeply south at its southern end. The apparently complex structure at the southern end of the Serpentinite may represent a drag fold in which the western bed of Younger Greenstone has been folded across to the eastern side of the Serpentinite. Such a structure, a drag fold, pitching south, in Younger Greenstone, would be a particularly favourable spot for the localisation of mineralising solutions.

Although Zone 4 is here treated as distinct from Zone 3 it may, in fact, be part of the sequence in Zone 3. The Zone corresponds to a region of low magnetic field intensity over an outcrop of granitic porphyry rock

which would appear to be an intrusive plug. However, the latest information from the Geological Survey of Western Australia, indicates that this outcrop, and other granitic porphyry rocks in the area, are actually flows within the rock sequence. The presence of this granitic porphyry rock is only indicated by the area of low magnetic field intensity between two magnetic anomalies on either side. The shape of these anomalies defines the boundaries of the basic rocks causing the anomalies while there is no indication from the magnetic field profiles as to the exact boundaries of the granitic porphyry rock. The area of low magnetic field intensity marked as Zone 4 may contain shale and other sediments, as well as the granitic porphyry rock.

The next region to the east of Zone 3 has been marked Zone 5. The magnetic anomalies on this Zone have been attributed to Greenstones while the intermediate beds are probably composed of shale, tuff, and greywacke as this has been mapped farther south within the township of Kalgoorlie.

The northern part of Zone 5 consists simply of two northerly trending beds of rock causing slight magnetic highs amongst some beds that have no magnetic effect. The containing rocks are possibly tuff, shale or greywacke as these types of rocks have been detected in the locality. The western bed, considered to be metabasalt of the Older Greenstone Series, showed up as a low amplitude magnetic anomaly of the order of 6 to 10 gammas at the very lowest limit of detectability of the magnetometer. Thus the boundary shown on Plate 3 can only be taken as an indication of the approximate position of this bed. The eastern bed, considered to be meta-quartz-dolerite of the Younger Greenstone Series, showed up as an anomaly of the order of 20 gammas in amplitude. It is apparently cut off at its northern limit by Zone 7; in the southerly direction the bed possibly branches into two limbs which branch again into a multitude of minor limbs further south. At the southern boundary of the survey area this multitude of minor limbs of Younger Greenstone prove to be offshoots of a semicircular

feature that gives rise to a large amplitude magnetic anomaly. This semi-circular structure is the known northern extremity of the "North End", which is the eastern limb of Greenstone at Kalgoorlie containing the Hannan's North and Mount Charlotte Mines. The Greenstones of the North End strike north until they reach the southern boundary of the survey area. At this position, the Greenstone beds are folded round through 180° and strike south down into the town of Kalgoorlie.

The Greenstones of the North End contain an unusually large percentage of ilmenite which is obvious in hand specimens of the rock. This ilmenite is possibly the major cause of the large amplitude magnetic anomaly detected over the "North End" by the DC.3 survey. The semicircular structure at the south of Zone 5 gives rise to a large amplitude magnetic anomaly and this may also be due to an abundance of ilmenite in the Greenstones forming this structure. However, the west limb of the semicircular structure must either suffer a sudden change in character as it strikes south or must be faulted away as the DC.3 magnetic profiles show only a low amplitude magnetic anomaly over the town of Kalgoorlie in the expected position of this western limb.

From a study of the DC.3 profiles and the aerial photographs, the greenstones in Zone 5 are part of the Greenstone beds containing the North End and the Golden Mile. They continue south of Kalgoorlie in a south-south-easterly direction for a distance of 44 miles, past Hannan's Lake and on through Mt. Shea, Feysville, Mt. Goddard and Red Hill. The abovementioned western limb shows no sign whatsoever of joining with the southern extension of the Greenstone Beds of Zone 3. The Beds of Zone 3 are considered to be entirely separate from the abovementioned Beds containing the Golden Mile. From Zone 3 they continue south on a south-south-easterly strike passing west of Kalgoorlie, where they are known locally as the Abbatoirs Greenstone, and on through Yilmia Hill, 32 miles to the south. They are approximately parallel to and are 3 to 8 miles west of the Greenstone Beds containing the Golden Mile. On a small scale these two beds of Greenstone are considered to be two entirely separate beds, however, on a regional scale they could possibly be

two limbs of a major fold. Neither this survey nor the DC.3 survey appears to have provided any information on such a possibility.

Zone 5 contains two large amplitude magnetic anomalies. One of these, at the very south of the Zone, has been explained as a fold in the Kalgoorlie North-End structure. The other, which occurs about one mile further north, at this stage, cannot be positively identified. It is a relatively small, approximately triangular block whose long axis strikes east-north-east in contrast to the general north-north-west strike appropriate to the survey area. On the aerial photographs its presence is indicated by a dark patch which, presumably, is due to lateritic rubble, the normal weathered, surface expression of the Greenstones. From the amplitude of the magnetic anomaly, this block could be either an intrusion of Hannan's Lake Serpentinite, as described in Zone 3, or a block faulted away from the semi-circular structure occurring immediately south.

Zone 6 has been interpreted as a dyke because it has the magnetic characteristics and the strike of features occurring on the DC.3 contour maps for Kurnalpi, Boorabbin, Widgiemooltha, Lake Johnston and Norseman (see B.M.R. Catalogue of publications) which have been attributed to dykes of the Dundas Dyke Suite. The Zone has a strike of 25° south of west and along this strike in a west-south-westerly direction there is a known area of outcrop of a dyke of the Dundas Dyke Suite. This occurs on the west side of White Flag Lake; the dyke is 2 miles long, 2 chains wide and has chilled margins composed of an olivine - hypersthene - dolerite rock (Cleverly, 1964). As mentioned below, this dyke is cut by the reversely magnetised dyke forming Zone 7, but cuts all the other formations in the survey area with which it has an intersection.

The eastern boundary of Zone 5 is formed by Zone 7, a prominent negative amplitude magnetic anomaly on the magnetic contour map. This feature is interpreted as a reversely magnetised dyke cutting across the survey area with a strike of 37° west of north. A study of the DC.3 magnetic field contour maps for Kalgoorlie and Kurnalpi (Map Nos.G247-25, G302-7) showed that this feature extends from a position midway between Grant's Patch and Paddington, in a south-easterly direction for a distance of at least 40 miles, down to south of Golden Ridge.

This dyke is considered to be the youngest Precambrian feature in the survey area. It is not cut by any of the other beds in the survey area, in particular, it cuts across Zone 6 (discussed above). Also, the fact that the dyke has retained its thermoremanent magnetisation would indicate that the dyke is probably younger than Precambrian in age. However, a similar, reversely magnetised dyke occurs in the Mount Isa Group in North-Western Queensland which appears to be of Proterozoic age. Hence, this dyke is possibly also of Proterozoic age, as previously, the last volcanic activity in the area was considered to be the intrusion of the Dundas Dyke Suite classified as Lower (?) Proterozoic in age.

Finally, the triangular area to the north-east of the survey area has been marked as Zone 8. The interpretation of this area is very indefinite as the magnetic anomalies are not well defined. The amplitudes of the magnetic anomalies were of a similar order of magnitude to the noise level being recorded by the magnetometer, making the interpretation from either contours or profiles rather uncertain. Along the west side of Lake Gidgee, a magnetic feature has been identified as being due to conglomerate beds which are known to outcrop along this side of the Lake. Further south, a magnetic feature has been tentatively identified as due to highly altered serpentinite rock. However, although a small outcrop of this highly altered serpentinite is known to occur within the position marked for the magnetic feature, the rock has been described as a quartz-carbonate-fuchsite rock containing so much quartz and carbonate that a magnetic anomaly would not be expected over this rock.

Three north trending, narrow dykes have been marked within Zone 8. They appear as low amplitude, sharp anomalies on the magnetic profiles so the sources are presumably narrow, near-surface bodies. The manner in which these sources appear to cut across the general strike of the other features indicates that the sources may be north striking dykes although no such dykes have been mapped in the vicinity of the survey area.

Just south of the magnetic feature marked as highly altered serpentinite there are other magnetic features having similar strike. However, there is no known outcrop of these features and no identification can be suggested at this stage.

In the very south of Zone 8 there is a magnetic feature that has been marked as Younger Greenstone. This feature is obvious on the aerial photographs and inspection on the ground revealed the typical ironstone capping indicative of underlying Greenstone. Further surveying would be necessary to the south west of this feature to determine whether this Greenstone is part of the North-End structure or part of an entirely separate Greenstone structure lying to the east of the dyke of Zone 7.

4. CONCLUSIONS

The detailed aeromagnetic survey has clearly delineated the positions of the sub-alluvial geological contacts between beds of contrasting magnetic susceptibility. The geological identification of these beds has been suggested. However, positive identification of the beds must eventually depend on the results of a drilling programme, aimed at penetrating the unweathered zone.

No mineralisation was detected by the survey, but the possibility of a drag fold in the structure of Zone 3 warrants further investigation as such a structure might be very favourable for mineralisation.

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APPENDIX

Survey specifications

Detector altitude: 250 feet above ground level.

Line spacing : One tenth of a mile between adjacent flight lines.

Line direction : The flight lines were flown on a heading of 64° and 244° for the southern three-quarters of the survey area and a heading of 75° for the northern quarter of the survey area.

Recorder Sensitivity: 1st recorder - 20 gammas per inch,
2nd recorder - 2,000 gammas per inch.

Equipment

Magnetometer : B.M.R. proton precession type MNS 1.

Recorders : 2 X Mosely Autograph,
1 X Texas Instruments (2 channel).

Camera : Modified Vinten frame, 35 m.m., 186° field of view.

Radio Altimeter : AN/APN - 1.

Method

A correction for diurnal variation was applied by flying a baseline at the beginning and end of each survey flight. The baseline for the survey was a section, 9,650 feet long, of east-west striking fence just south of Kurrawang Lake. The standard level for the mean of the magnetic field readings along this baseline was 58,300 gammas. The diurnal correction was applied on the assumption that the diurnal magnetic field varied in a linear manner during any one survey flight. No total magnetic field recorder was available to check this proposition.

Notification of magnetic storms was given by B.M.R. Mundaring Observatory.

The airborne magnetometer records accepted for survey data showed a noise envelope of approximately 10 to 20 gammas.

The basis of the interpretation was that the position of the points of inflection on the magnetic profiles represented the contact between two formations of different magnetic susceptibility. This premise implies that a point source would be represented as having a

finite width. Thus the width of narrow bodies will have been overestimated on the interpretation diagram (Plate 3).

Personnel

Personnel engaged in the survey were :-

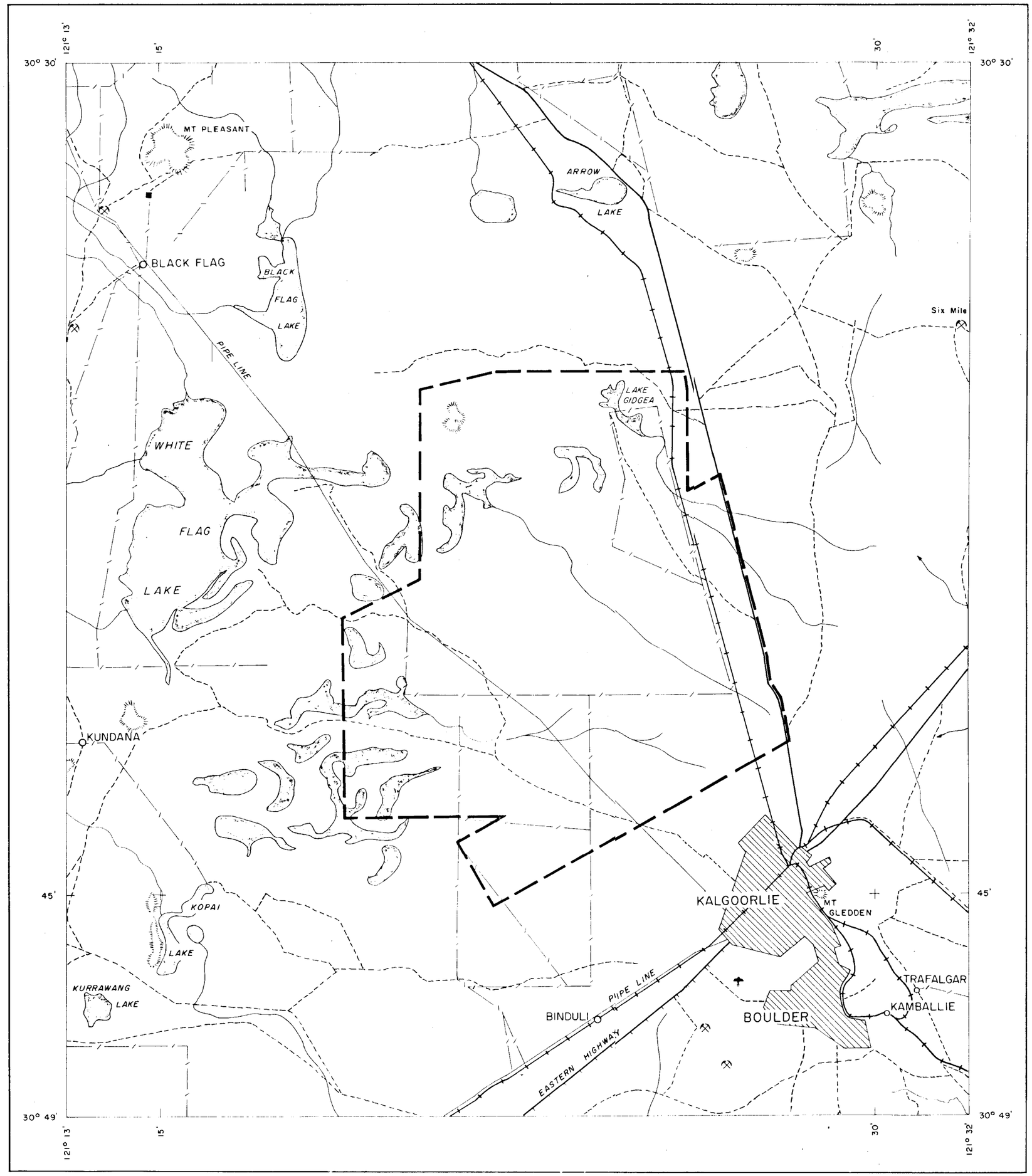
B.M.R :

B.A. Dockery, W.A. Finney, A.S. Scherl, P. Zerial, C.J. Braybrook, B. Tregellas.

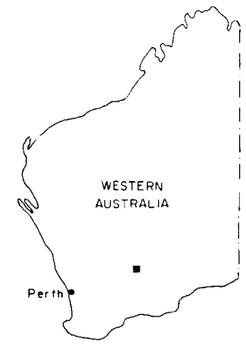
T.A.A :

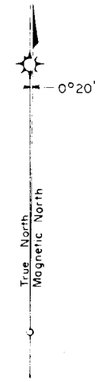
F/O G.B. Litchfield.

PLATE I



LOCATION DIAGRAM





LEGEND

- River or creek
- Highway or main road
- Road or track
- Railway
- Fence
- Telegraph line
- Named place
- Homestead
- Hill feature
- Aerodrome
- Mine
- Survey area boundary

DETAILED AEROMAGNETIC SURVEY

KALGOORLIE

WESTERN AUSTRALIA

LOCALITY MAP

MILES 2 0 2 4 6 MILES

KILOMETRES 5 0 5 KILOMETRES

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H51/BI-17-1

To Accompany Record No

PLATE 2

121° 17' APPROX.
121° 20'
121° 25'
121° 29' APPROX.
30° 35' APPROX.
30° 40'
30° 45' APPROX.

BLACK FLAG LAKE
WHITE FLAG LAKE
LAKE GIDGEE
DAM
PIPE LINE
MENZIES-KALGOORLIE ROAD
RIFLE RANGE
KALGOORLIE

DETAILED AEROMAGNETIC SURVEY, 1964

KALGOORLIE

WESTERN AUSTRALIA

TOTAL MAGNETIC INTENSITY CONTOURS

0°20'
True North
Mag. North

MILES 1 0 1 MILES

KILOMETRES 1 0 1 KILOMETRES

MAGNETIC CONTOUR INTERVAL 10 GAMMAS

GEOPHYSICAL LEGEND

Magnetic contours

Magnetic "Low"

NOTE:- The magnetic data have not been corrected for the regional magnetic gradient.

TOPOGRAPHICAL LEGEND

River or creek

Highway or main road

Road or track

Railway

Fence

NOTE:- This map was compiled by direct plotting from uncontrolled aerial photographs.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/BI-30

To Accompany Record No.

PLATE 3

121° 17' APPROX.
121° 20'
121° 25'
121° 29' APPROX.
30° 35' APPROX.
30° 45' APPROX.

BLACK FLAG LAKE
WHITE FLAG LAKE
DAM
CONGLOMERATE
LAKE
GIDGEA
DYKE
UNKNOWN
GRANITIC PORPHYRY ROCK
HIGHLY ALTERED SERPENTINITE
MENZIES-KALGOORLIE ROAD
YOUNGER GREENSTONE
YOUNGER GREENSTONE (?)
OLDER GREENSTONE
GREENSTONE
SHALE
GREENSTONE (?)
PIPE
HANNANS LAKE SERPENTINITE
SHALE OR META-BASALT
SHALE, TUFF OR GREYWACKE
YOUNGER
OLDER
BLACK FLAG BEDS
LINE
HORNBLENDE BEARING PORPHYRY ROCK
HORNBLENDE ETC.
RIFLE RANGE
KALGOORLIE

1 2 3 4 5 6 7 8

0°20'
Mag. North
True North

DETAILED AEROMAGNETIC SURVEY, 1964

KALGOORLIE

WESTERN AUSTRALIA

GEOPHYSICAL INTERPRETATION

MILES 1 0 1 MILES

KILOMETRES 1 0 1 KILOMETRES

GEOPHYSICAL LEGEND

- Zone boundary
- ⑥ Zone number
- Boundary of magnetic feature
- Inferred boundary of magnetic feature

TOPOGRAPHICAL LEGEND

- River or creek
- Highway or main road
- Road or track
- Railway
- Fence

NOTE:- This map was compiled by direct plotting from uncontrolled aerial photographs.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H51/B1-31

To Accompany Record No.