COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1963/62

NORSEMAN GEOPHYSICAL SURVEYS, WA 1946 AND 1953

by

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SUMMARY

The results of two geophysical surveys near Norseman, WA are discussed. These surveys were made in the Mararoa (1946) and Iron King (1953) areas.

The results of Mararoa survey suggest that the magnetic method will not give definite information on geological structure in the greenstones. The Iron King orebody appears to be associated with structure in the banded iron formation which can be easily detected by the magnetic method. Very detailed geological information would be required for interpretation of gravity results in the Iron King area.

A preliminary report on the survey in the Mararoa area is included as an appendix.

1. INTRODUCTION

The following geophysical surveys have been made in the Norseman area:

(a) surveys using electrical methods made by the Aerial Geological & Geophysical Survey of northern Australia in 1937 and 1938 in the Princess Royal and Mararoa areas. The results are described by Blazey, Rayner, & Nye (1940),

(b) a survey in the Mararoa area using the magnetic method made by the Bureau of Mineral Resources in 1946. The name 'Mararoa' is used, as the survey area covered the northern extension of the Mararoa reef, although it is some distance north of the original Mararoa workings,

(c) a survey in the Iron King area, using gravity and magnetic methods, made by the Bureau of Mineral Resources in 1953. It was intended that electromagnetic methods should be used on this survey, but the effects of power lines and mining installations made this impossible.

The two last mentioned surveys had an experimental character, and as it appeared that they were not likely to yield conclusive results, they were terminated at an early stage in favour of other surveys urgently required. The results were discussed with interested companies, but no final reports were prepared. A preliminary report on the Mararoa survey was prepared and is attached as an appendix.

Extensive aeromagnetic surveys have been made by the Bureau in Western Australia. The results have given a great deal of information on the distribution of banded iron formations. This information is of great structural interest, and might form the basis for a more systematic approach to prospecting for gold in Western Australia than has hitherto been possible. The results of the surveys mentioned above are of interest, because they provide examples of the types of results to be expected from several geophysical methods. The general geology of the Norseman field is so similar to that of many other Western Australian gold fields that the results may have a wide application to the search for gold deposits in that state. For this reason they are presented here in a unified form.

2. THE NORSEMAN GOLD FIELD

For the purpose of this Record, a detailed description of the geology of the Norseman field is not required. The field was first mapped by Campbell (1906). Later work by several geologists has established the presence of important structural controls on mineralisation. The most recent geological report is by O'Driscoll (1953) who takes account of the later discoveries.

The field lies in a pocket of Precambrian greenstones in the inland granite plateau. The greenstones include lava, tuff, sediments, and intrusives of several types, such as porphyry and dolerite. The sediments include wide and persistent beds of banded iron formation. The regional strike is roughly north and the dip steeply to the west. Near the northern end of the field is a norite dyke about a mile wide and at least 20 miles long, with an easterly strike. Although a major feature of the geology of the field, the norite is younger than the other Precambrian rocks, and appears to have no connexion with mineralisation.

Plate 1 is a locality map of the area around Norseman township, showing the main producing mines and the contours of total magnetic intensity measured by an airborne magnetometer. The contours show two strong and persistent anomalies; one with the regional northerly strike, and due to the main zone of banded iron formations, the other striking east and due to the norite dyke.

The field contains two types of gold-bearing lodes. One consists of quartz veins with a northerly strike, but dipping east at about 45 degrees almost at right angles to the regional dip. Lodes of this type have been the main gold producers of the field, and include the Mararoa and Princess Royal reefs, the present gold producers. O'Driscoll (1953) describes the geology of these reefs and the refined structural analysis that has been used in prospecting them. The other type consists of bedded quartz lodes with sulphide minerals. These are generally closely associated with the banded iron formations and their situation is controlled by minor structural features of these formations. The Iron King deposit is probably of this type. It is a large pyritic deposit closely associated with the banded iron formations, and contains practically no gold. It has been described in detail by Ellis (1953).

3. RESULTS

Mararoa area

Results of the magnetic survey in the Mararoa area are shown as contours of vertical magnetic intensity in Plate 2. A preliminary report on this survey by Richardson and Dooley is attached as an appendix. This report refers to the report by Blazey et al. (1940), and it is necessary to the understanding of the appendix that the positions of the two surveys be connected. Unfortunately, the survey information on the later survey has been lost. Available records have been examined and have enabled the approximate position of the Northern Star shaft to be fixed, but no other point. However, if it is assumed that the position of the Northern Star shaft is as shown in Plate 2, and that the baseline of the magnetic survey bears approximately magnetically north, the location of Plate 2 is consistant with all available information.

The results show two persistent linear anomalies, one at 100S with an easterly strike, and one with a strike somewhat north of east, at about 2400N, with a considerable number of less-definite anomalies.

The anomaly at 100S is so uniform in strike that it is probably due to some artificial feature such as a pipeline. The cause of the anomaly at 2400N is unknown. Apart from these two anomalies, the magnetic picture is rather confused. Well-defined anomalies with roughly the regional strike occur in the south-western and north-western portions of the layout. The results in the central portion give no impression of a definite strike. The majority of the anomalies along the eastern side of the layout gives a definite impression of a north-westerly strike. The individual anomalies are probably due to magnetic portions of the greenstones but to what extent they give reliable information on the strike of individual formations could only be determined by comparing the results with a very-detailed geological map.

Iron King area

Results of the magnetic survey in the Iron King area are shown as contours of vertical magnetic intensity in Plate 3. The magnetic pattern is completely dominated by the major anomaly due to the banded iron formation. The most striking feature of the results is the narrowing of the contours between 0 and 3000N (geophysical coordinates). This must be due to some peculiarity in the aspect of the banded iron formation that might possibly be identifiable from the results of exploration on the Iron King mine. The significance of the banded iron formation has been discussed by Miles (1953), who remarks that a number of ore deposits appear to have been localised by such changes in aspect. The closeness to the Iron King mine of the effect under consideration suggests that in this case also, the aspect of the banded iron formation has had an influence on the presence of the orebody.

The results of the gravity survey are shown in Plate 4 as Bouguer-anomaly contours with reference to an arbitrary datum. Numerous anomalies are present, but their distribution does not show any clear arrangement. The anomalies appear to be caused by features with different strikes. It is noticeable that there is no definite anomaly associated with the banded-iron formation. A pattern such as this could only be interpreted on the basis of a very complete knowledge of the geology.

4. CONCLUSIONS

The following conclusions can be drawn from the results of the geophysical surveys in the Norseman area:

(a) taking the Mararoa area as typical of orebodies not closely associated with banded iron formation, it does not appear that magnetic surveys can be relied on to give definite information on geological structure in the greenstones,

(b) the Iron King orebody appears to be associated with structure in the banded iron formation, the effect of which is clearly visible in the magnetic results. Such features would be readily detected by magnetic surveys, and a systematic search for them could form the basis of a prospecting campaign. The feature associated with the Iron King orebody is not large enough for its effects to be visible on the aeromagnetic map,

(c) gravity surveys are likely to give results which could only be interpreted on the basis of very-detailed geological information.

5. REFERENCES

BLAZEY, E.L., RAYNER, J.M., and NYE, P.B. 1940 Geophysical report on the Norseman area, Norseman. Aer. Surv. N. Aust., W. Aust.Rep. 38

CAMPBELL, W.D. 1906 The geology and mineral resources of the Norseman district. Bull. geol. Surv. W. Aust. 21

ELLIS, H.A. 1953 Norseman Gold Mines N.L. In GEOLOGY OF AUSTRALIAN ORE DEPOSITS, 5th Emp. Min. Metall. Congr. 1, 150-158. Melbourne, AIMM.

MILES, K.R. 1953 Banded iron formations in Western Australia. Ibid. 159-171.

O'DRISCOLL, D. 1953 Operations on the Norseman field. Ibid. 138-149.

APPENDIX

PRELIMINARY REPORT ON THE GEOPHYSICAL SURVEY, MARAROA AREA, NORSEMAN (1946)

by

L.A. Richardson & J.C. Dooley

Geology and Nature of the Problem

The present prospecting of the Mararoa Shear for new orebodies is guided by certain assumed structural factors involving the strike of the greenstone beds intersected by the shear. The problem for the geophysical survey was primarily to trace the course of the Blue Bird greenstone bed northerly from the vicinity of the Blue Bird mine to that of the Northern Star mine. The existence of a drag fold in this bed near to the Northern Star mine was suspected, and if proved and located, the prospecting operations would be localised.

The greater part of the area concerned is soil covered. South of the area the beds are known to strike more or less north-south and dip 50 degrees west. Generally speaking little is known about dip throughout the whole Mararoa area.

The magnetic method was used employing a Watts vertical force variometer with a scale value of 37 gammas per scale division. Some traverses were observed with an Askania vertical force variometer with a scale value of 110 gammas per division but these traverses were repeated using the Watts instrument. A substantial part of the area had been covered by the electromagnetic method in search of shear extensions by the North Australian Survey in 1937 (Blazey et al., 1940).

Survey Results

The magnetic survey covered an area 3600 ft wide, extending 5200 ft northerly from the Blue Bird shaft. The analysis of the results is yet incomplete and this report presents only some of the more obvious results.

The profiles show much irregularity of shallow-seated origin which is probably largely due to erratic magnetisation of the greenstones, a property which is revealed by the magnetic logging of drill core. In soil-covered areas some of this irregularity may be due to magnetic material in overburden.

The outstanding features of the survey results can be summarised as below:

(a) only in the south-western corner of the area is the strike of the greenstones known from geological mapping of actual outcrops. In this part the survey results give clear indication of the greenstone strike in agreement with the known geology,

(b) elsewhere on the area the survey results provide little positive evidence of the strike of the greenstones. Some scattered evidence is obtained from isolated features in the results which may be regarded as markers giving the strike of certain zones in the greenstones. The strikes so obtained are somewhat erratic and some suggest buckling of the greenstone beds on a small scale,

(c) the prominent negative anomaly crossing the area and passing through the Northern Star workings has been traced over a length of 5200 ft and it presumably continues farther west and possibly east. The cause of this anomaly is not known but a possible explanation is a dyke with southerly dip and with reverse permanent magnetisation. The feature responsible appears to be shallow seated and could probably be seen in the upper part of the Northern Star workings,

(d) the positive anomaly centred at about 800E on Traverse 4100N may be related to the conditions giving rise to the electromagnetic anomaly that commences there and extends 800 ft north,

(e) the magnetic logging of drill core from holes numbered S10, 537, 538, 539, 540, 551, S22, S23, S24, S25, S26A, S27 and Crown 7 has revealed the existence of two types of magnetisation in greenstone beds. One is a low magnetisation exhibited by the core from holes 537, 538, 539, 540, 551, S22, and Crown 7 and the other is a stronger magnetisation exhibited by the core in the remaining holes logged. The latter type is irregularly found in the profiles. This subject has yet to be examined more closely together with geological determinations for the drill core concerned. The classification into two types of magnetisation is a broad one and there is probably more than one type of greenstone in each class. In the two short section lines formed by drill holes 22, 23, and 24 and 25, 26A, and 27, the magnetic logging gives no confirmation of the assumed westerly dip of the greenstones, nor does it suggest any other direction of dip in these sections.

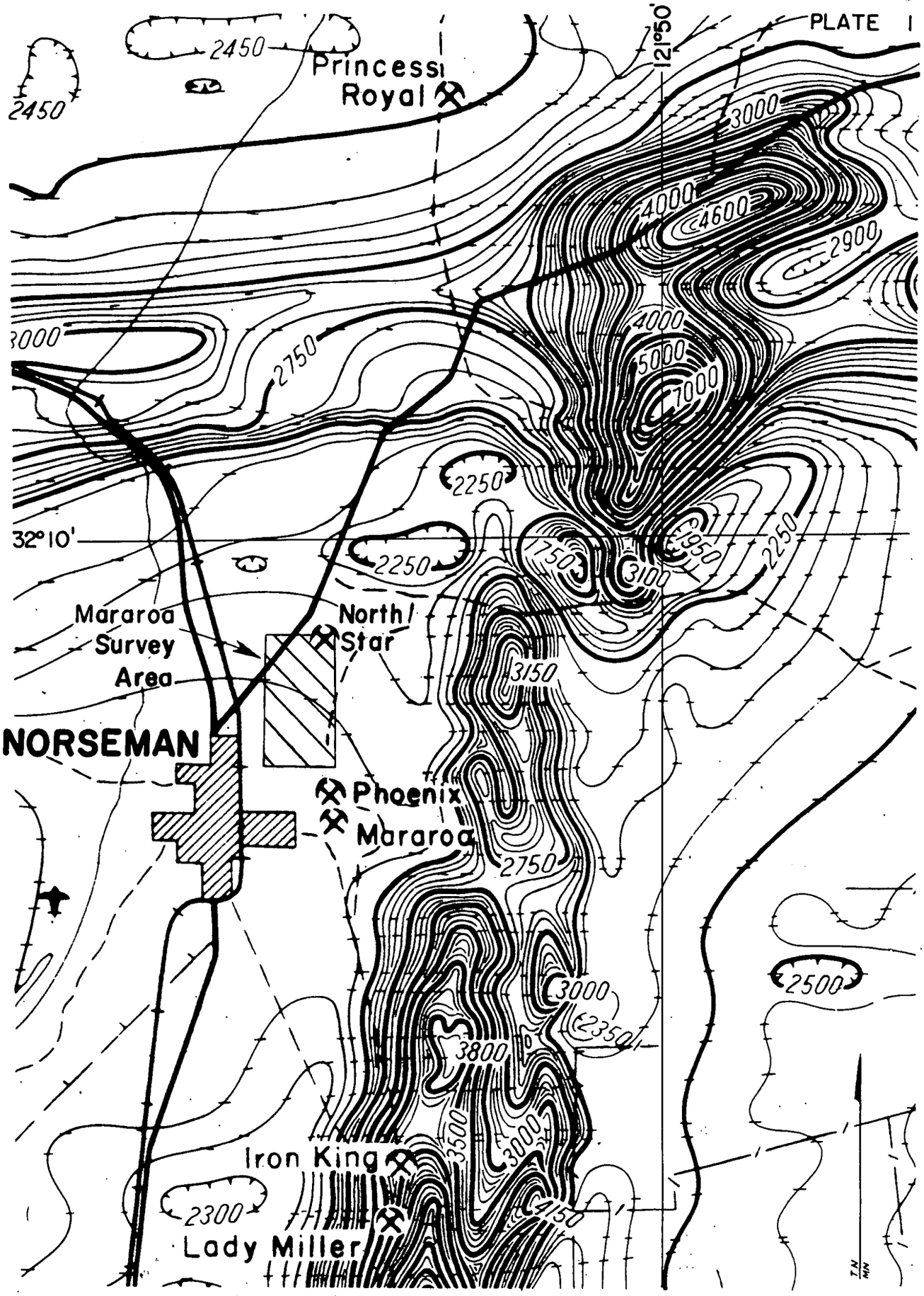
Conclusions

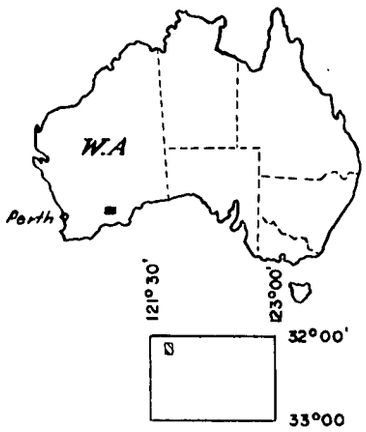
The results over the small area of outcrops in the south-western corner of the area where the geology is known give clear indication of the greenstone strike. Elsewhere the results appear to give unsatisfactory evidence of the greenstone strike and therefore the presence or absence of folding in the vicinity of the Northern Star mine is undetermined.

The identity of the feature responsible for the negative anomaly crossing the area could probably be determined in the upper parts of the Northern Star workings.

It is possible that an extensive programme of magnetic logging applied to the core from underground holes would furnish useful data on bedding of the greenstones.

PLATE 1





GEOPHYSICAL SURVEYS, NORSEMAN AREA. W.A

LOCALITY MAP
and
TOTAL MAGNETIC INTENSITY
MEASURED BY AIRBORNE MAGNETOMETER

MILES

1 0 1 2

MAGNETIC CONTOUR INTERVAL 50 GAMMAS

REFERENCE TO AUSTRALIA STANDARD MAP SERIES: NORSEMAN

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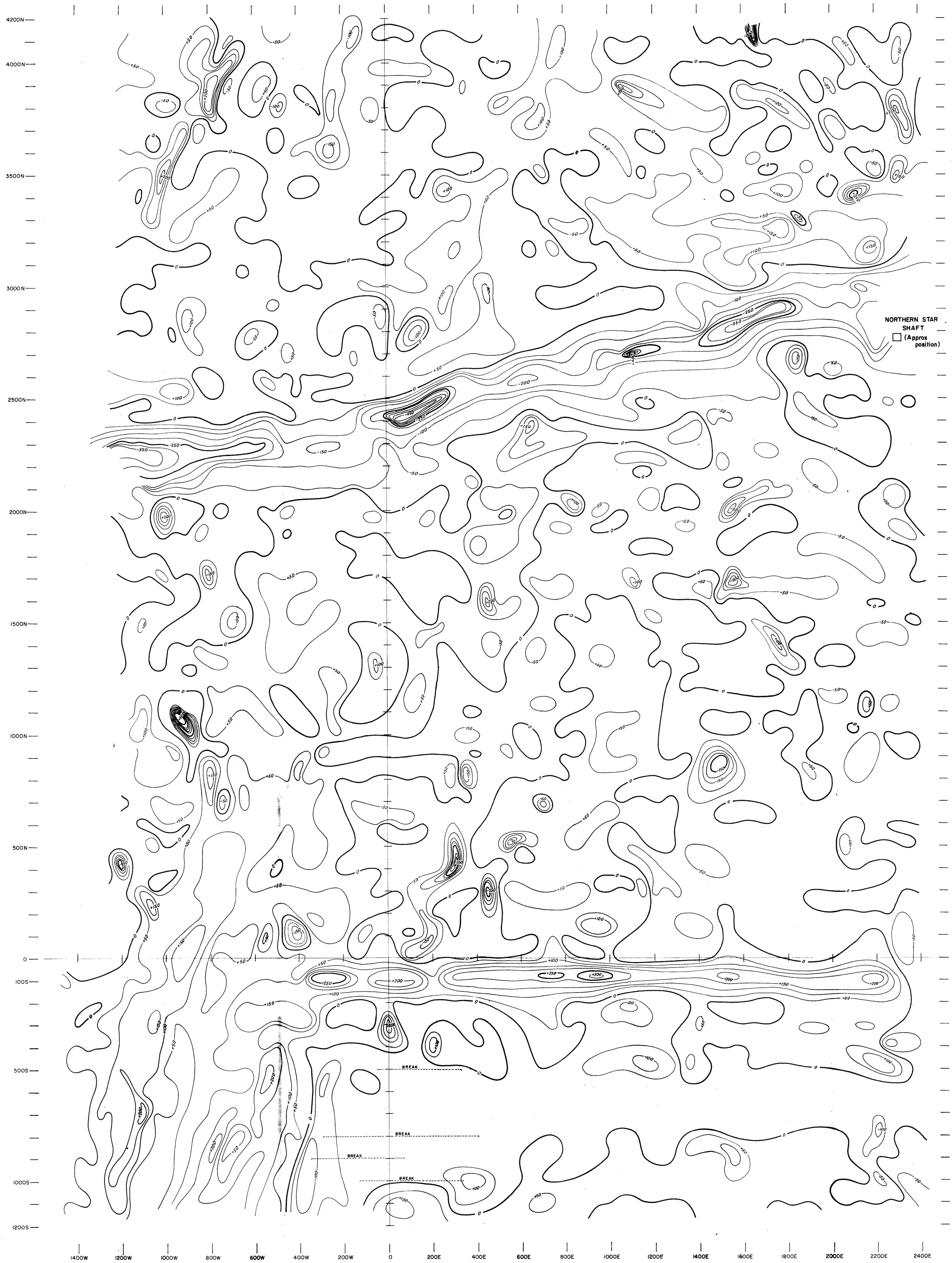
PLATE 2

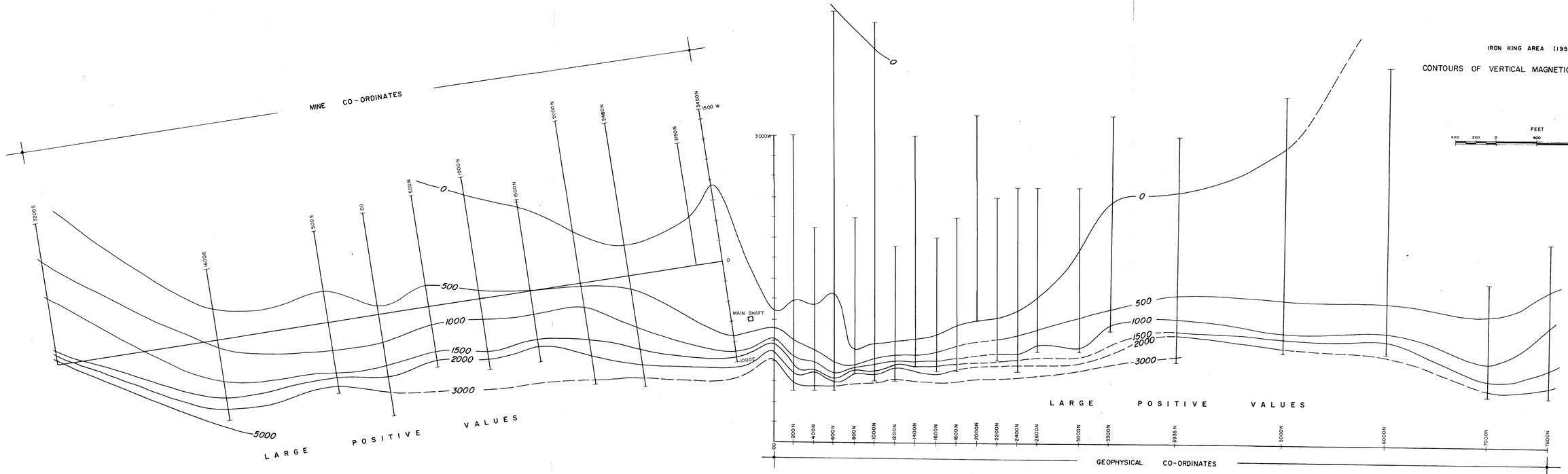


MARAROA AREA (1946)

CONTOURS OF VERTICAL MAGNETIC INTENSITY

To Accompany Record No 1963/62

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS 151/87-2



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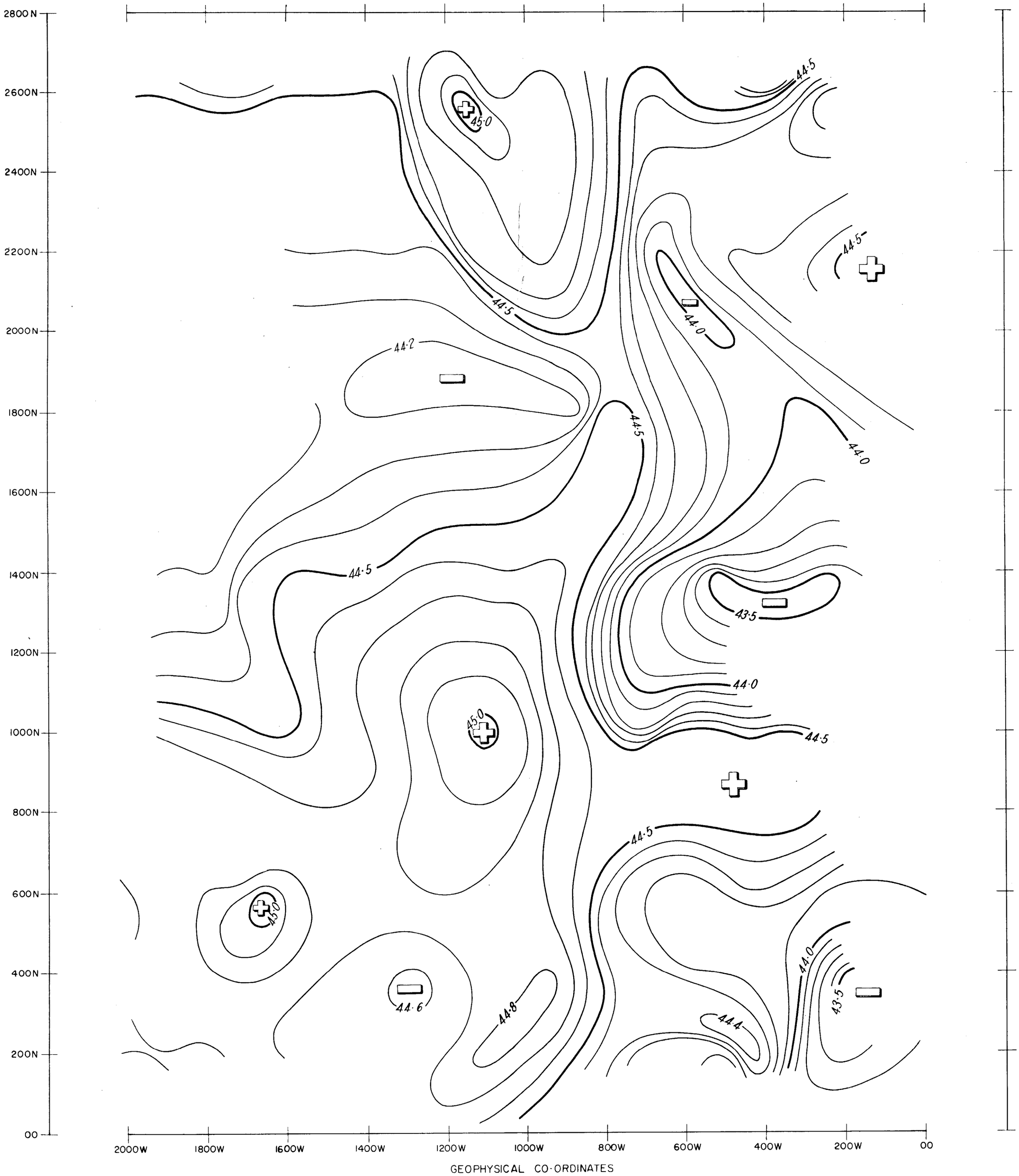
GEOPHYSICAL SURVEYS AT NORSEMAN, W.A. 1953

PLATE 4



FEET

200 100 0 200 400 600

CONTOUR INTERVAL 0·1 MILLIGAL

IRON KING AREA

BOUGUER ANOMALY CONTOURS

DATUM ARBITRARY

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