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(Plan Nos.1169, 1170, 1180).

REPORT ON GEIGER-MULLER SURVEY, GREENWOOD'S CAMP AREA, MOUNT PAINTER EAST.

By

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REPORT ON GEIGER-MULLER SURVEY, GREENWOOD'S CAMP AREA, MOUNT PAINTER EAST.

(Report No.1945/9. Plan Nos.1169,1170,1180.)

Introduction.

Greenwood's Camp area is situated approximately ½ mile east-northeast of the East Painter Camp (site of Greenwood's old camp) at the junction of Heighty Creek and an un-named creek along which runs the camel pad to the Mount Painter divide. Geologists C.J. Sullivan and D.E.Gardner made a reconnaissance survey of the area during which they discovered a number of small torbernite occurrences. These were subsequently opened up by potholes or shallow shafts and are known as the Nos.1 and 2 prospects.

The area was later mapped in more detail by E.Broadhurst and K.Llewellyn and during the course of their examination Llewellyn discovered what is now known as the No.5 prospect. As a result of his examination Broadhurst recommended that a Geiger-Muller radiation survey should be made of those parts of the area which he considered most likely to contain torbernite or other uranium minerals. The survey under review was carried out as a result of this recommendation.

Geology of the Area.

The following notes on the geology are based partly on discussions with geologist E.Broadhurst and partly on the writer's observations.

This area is one of rugged topography with sharp ridges and spurs rising to 400 feet or more above creek level. Scree-covered slopes of 30° and over are a common feature of the area, and outcrops are mainly confined to the ridges and spurs or to slopes too steep for the accumulation of scree.

The rocks of this area are chiefly granitic types although in places remnants of sedimentary rocks are present in the brecciated zones.

In places the rocks have been extensively brecciated, the breccia being re-cemented by siliceous solutions which have rendered the breccia resistant to weathering. This has resulted in a large proportion of the outcropping rocks being breccia.

Small areas of hematite occur in the brecciated zones and, as will be shown later, the hematite portions of the breccia are generally the most radio-active.

In places the brecciated zones are intersected by shears and, owing to the softer nature of the sheared material, wide cracks or small gullies running through the ridges occur along the shears. These shears have been mapped only where they intersect the outcrops but from their positions on the plan it is possible that many of them intersect beneath the scree and soil surrounding the outcrops. Such intersections are regarded by Broadhurst as places most favourable for the accumulation or occurrence of uranium minerals, and the survey under review was designed in part to study the radiation from the shears and their likely intersections.

In at least one of these shears, namely on the No.5 prospect torbernite occurs in quantities which development work now in hand might prove to be profitable. This shear is not in brecciated rocks and, unlike the other known uranium occurrences in the Mount Painter district (which are associated with low temperature quartz and hematite), there is little, if any, hematite associated with it. Further, the lode contains some quartz which resembles reef quartz.

There are two possible explanations for the difference between the No.5 shear and the others, namely -

(i) The torbernite has been deposited in and near the shear from circulating meteoric water, the source of the uranium being the scattered bodies of secondary uranium minerals in the breccia which lies relatively close to the deposit.

(ii) This possible explanation is based on a discussion with Mr.P.B.Nye, Assistant Director, Mineral Resources Survey, who visited the area during the course of the survey. He suggests that the quartz may have been introduced under conditions of high temperature and that the No.5 prospect may, in fact, be a primary uranium lode, the torbernite being derived from primary uranium minerals by the ordinary processes of oxidation. An examination of the quartz by Dr.F.L.Stillwell would determine whether the quartz was formed under high or low temperature conditions and so prove if the above explanation is tenable or not.

Torbernite also occurs at scattered places in the breccia where it is generally, if not invariably, associated with hematite occurrences. In a number of such places the torbernite has been leached from the outcropping rocks and only cavities containing a white mineral, believed to be derived from the torbernite, remain. These leached outcrops are, however, radio-active and it is believed that in the leaching process insoluble radio-active salts, such as those of radium, remain in the cavities.

About ten of these leached outcrops have been opened up by potholes and revealed increasing quantities of torbernite at depth. Two such places are known as the Nos.1 and 2 prospects and are thus indicated on the accompanying plan. The torbernite bodies revealed by this surface prospecting have an areal extent of only a few square yards and they occur at intervals within the brecciated zone.

One of the objects of the Geiger-Muller survey was to see whether or not these torbernite bodies occurred in any regular fashion and to delimit the area of breccia containing them. A knowledge of the extent and distribution of the torbernite bodies was of importance in laying out a programme for testing their ore potentialities at depth.

The principal object of the survey, however, was that of prospecting along and in the vicinity of the known shears particularly with respect to those places where shears might intersect.

Technical Matters.

The radiation survey was carried out between November 22nd and December 16th, 1944 by a party comprising two geophysicists and three student assistants, one of whom was responsible for the bulk of the plane table surveying.

The instrument used for the radiation measurements was a portable Geiger-Muller radiation counter. The surveying was done with a plane table, alidade and staff.

Procedure adopted was that one geophysicist and one assistant operated the radiation counter, one assistant acted as survey staff man while the remaining assistant operated the plane table. The plane table was found to be the best means available for picking up the observation points although the accuracy attained was not of a high order due mainly to the extremely rough terrain and perhaps to some extent on the lack of experience of the operators.

Prior to the arrival of the student assistants, the two geophysicists commenced the radiation survey by laying a steel band (200 ft.) on the ground and reading at points offset from the band by use of a linen tape. The end points of the steel band were later picked up by plane table survey. This method left much to be desired as regards accuracy in defining the position of the observation points with a result that some difficulty was experienced in the preparation of the final plans in fitting the geophysical results to the geological plans prepared by Broadhurst and Llewellyn. In some places viz. near No.2 prospect, the position of a shaft or pothole as picked up during the radiation survey differs slightly from the position as shown on the geological plan. In all such cases however, the shaft or pothole is shown on the accompanying plans in its correct relation to the radiation contours.

Progress was naturally slow owing to the difficult terrain and the high winds which adversely affected the plane table work. A considerable number (say 70 per cent.) of the radiation readings were normal, i.e. they showed no appreciable radio-active content in the rocks. Such readings however, take almost as long to obtain as those of high radiation value. In order to eliminate so much useless work it is suggested that in any future surveys of like kind a rapid reconnaissance of the likely area could be made with a light-weight portable instrument in which the passage of the rays through the Geiger Muller counter could be converted into sound pulses to be heard in headphones. The increase in frequency in the presence of radiating bodies would be readily noticeable and would indicate those parts of an area over which detailed radiation surveys should be carried out. As regards the change in frequency of the sound pulses which the operator would be required to recognise it may be assumed that the detection of radiation values lying within the 6 unit contour on the accompanying plans would be desirable. As the normal count rate of 200 pulses per minute corresponds to 2 units it will be seen that the detection of a three-fold or greater increase in pulse rate would be required.

The Geiger-Muller Radiation Counter used in this survey was an improved model of that used earlier in the "Smiler", "Bentley" and No.6 surveys. Most of the objectionable features in the earlier design had been removed but nevertheless the new instrument was found to be subject to changes in sensitivity due in part to changes in voltage (caused by changes in temperature) of the batteries used. This could not be eliminated but a strict control was maintained by m making use of a standard torbernite sample which was used to determine the instrument sensitivity at frequent intervals. Like the original instrument the improved model made use of a frequency meter to read the impulse rate, i.e. the rate at which the gamma rays cut the Geiger-Muller tube. An initial calibration, made by incorporating a mechanical counter in the circuit, showed that the frequency meter had a linear response.

The readings on the frequency meter thus represent (with a suitable multiplying factor) the number of gamma rays cutting the tube per minute. In preparing the final plans the meter reading has been used as a basis for contouring.

The normal counting rate for the Greenwood's Camp area was found to be equivalent to 2 units on the frequency meter, corresponding to a frequency of approximately 200 rays per minute. Readings as high as 20 units were measured, this frequency being approximately 2,000 rays per minute. In a few isolated cases, (for instance over the outcrop of No.5 lode which contained visible quantities of torbernite), the frequency readings were considerably higher than 20 units but the exact value could not be determined as the readings were beyond the range of the instrument.

During the survey it was found that many of the radiation high spots were extremely local in occurrence and consequently observation points in such areas were spaced at intervals of 5 feet and less. The average spacing of the observation points however was of the order of 10 feet.

Most of the high radiation spots disclosed by the survey were on rock outcrops and were evidently an effect due to radio-active minerals within the rock itself. However, as much of the work was done on scree-covered slopes, it is of importance at this stage to examine the probability of discovery by these means of any torbernite rich zones which might be covered by such material.

In the first place it should be clearly understood that the nature of the radiation measured - namely gamma rays - is such that about one foot of solid rock is sufficient to reduce their intensity to practically nothing. In other words the gamma ray effect measured at the surface has its origin within about a foot of that surface in the case of rocks and perhaps 1.5 to 2 feet in the case of soil or scree material. In the case of soil or scree however, there is the possibility that material shed from a uranium-rich zone may be close to the surface although the zone itself might be covered by a few feet of scree or soil.

This is borne out to some extent in the results obtained near the No.5 prospect. This prospect or lode occurs in a shear which outcrops only in one or two places. An examination of the radiation contours shows a closure of high radiation values along the strike of the lode. The contour lines for lower radiation values, viz. for 3, 4 and 5 units, show a marked tendency to depart from the strike of the lode and in fact have an attenuation downhill from the lode outcrop in a direction at right angles to the ground contour lines, a few of which are shown on Plate 1 in order to illustrate this point. This fact is taken as evidence that the radiation represented by observations between the 3 and 5 contour lines is coming from radio-active material shed from the lode. It is quite probable that had the No.5 prospect been entirely covered by scree its presence could have been detected by virtue of the radio-active material in the scree above, and downhill from, it.

It is possible, however, to visualise a weathering process whereby a radio-active lode and the material shed from it was later completely covered by 2 or more feet of non-active material in which case no radiation effect from it could be detected at the surface.

Results of the Survey.

For the purpose of describing the results, the ground covered by the radiation survey has been divided into three areas wh which are separate portions of the Greenwood's Camp area. These are shown on Plate 3 in their relationship to one another and to the Greenwood's Camp area as a whole.

Area I is in the vicinity of, and includes, the Nos.1 and 2 prospects. Its position relative to the Greenwood's Camp as area as a whole is shown on Plate 3.

The results of the survey are shown in the form of a radiation contour plan (Plate 2). Contour values range from 2 units which might be taken to indicate non-radio-active materials, to over 10 units. The latter value was obtained over an outcrop showing traces of torbernite.

It was in this area that Sullivan and Gardner discovered a number of small torbernite occurrences. The potholes and shafts shown on the plan represent places where these discoveries have been opened up. The radiation survey confirms what the surface prospecting has already suggested, namely, that the radio-active minerals occur as small bodies within the breccia. In the vicinity of the No.2 prospect the following character might be read into the contour pattern.

Within an area some 250 feet by 40 feet of brecciated granitic rock (the rock outcropping here), radiation values, and hence radio-active contents of the breccia, are higher than normal. Within this area are a number of isolated patches of breccia from which the radiation exceeds seven units. The majority of such patches are places where torbernite or leached cavities after torbernite, have been found and it is reasonable to assume that all such areas enclosed by the 7 unit contour line warrant prospecting for torbernite or leached cavities after torbernite.

This value of seven units has been arrived at from a purely empirical relationship between known torbernite occurrences and radiation values but it serves as a basis for assessing the possibilities of high radiation patches found at various places on the area.

Apart from the general attenuation of the moderately high radiation zone in a northeast-southwest direction there is no regular arrangement of the isolated high spots. From their distribution and the nature of the breccia it is suggested that they are small disconnected bodies of torbernite-rich breccia within the main mass of breccia.

It is an observed fact that these small torbernite bodies
are /generally, if not invariably, associated with occurrences of hematite, although hematite occurs elsewhere in the area with littl or no radio-activity.

The reason for occurrences of torbernite with associated hematite as isolated bodies within the breccia might be suggested by Dr.Stillwell's report on the nature of the mineralisation of the area. Dr.Stillwell states that "the fact that the uranium prospects are associated with ironstone outcrops (which also contain monazite) may be explained as due to the fact that these localities originally marked bodies containing magnetite, monazite and probably with primary uranium minerals. These rocks were in some instances fractured and brecciated and then infiltrated with epithermal quartz solutions which dissolved some of the iron oxides and uranium minerals, reprecipitating them as hematite and secondary uranium minerals, and at the same time cementing the breccia into a particularly resistant rock".

The main point of interest in the above, as far as the present discussion is concerned is that the introduction of hematite and torbernite are intimately associated with the cementing of the breccia.

The distribution of these minerals must have depended, therefore, on the accessibility of the crushed material to the mineralising solutions.

In some places, as for instance in the No.6 workings at Mount Painter main camp, the epithermal solutions found ready access through, and into, a shear or system of shears and depositing there what later became the No.6 orebody. In the absence of such favourable means of access, however, it seems probable that the degree of crushing in the rock was all important in determining where the minerals introduced would be deposited. One can visualise crushing of such a nature as to produce conditions suitable for formation of a series of more or less disconnected bodies of hematite and torbernite such as apparently constitute the No.2 prospect.

Radiation survey results somewhat similar to those described above were obtained over and near the No.1 prospect. Radiation values higher than normal are more restricted in occurrence than at the No.2 prospect, but the general discussion of results in the latter case applies equally well here.

Area 2 is that portion of the Greenwood's Camp area which includes the No.5 prospect and survey pegs Nos.6 and 9. Its position in relation to the Greenwood's Camp area as a whole is shown in Plate 3.

The main purpose in surveying this area was the study of radiation in the vicinity of the shears, particularly near their probable intersections. The results of the radiation survey are shown in the form of a radiation contour plan on Plate 1. With the exception of the shear on which the No.5 prospect is situated, none of the shears proved to be radio-active and, in general, they appear to have no influence at all on the distribution of the radio-active highs.

As at Area 1, radio-active high spots seem to be confined to isolated and disconnected bodies within the main mass of brecciated rocks, with the exception, of course, of the No.5 prospect.

It was an observed fact that many, if not all, of the high spots in the breccia coincided with hematite occurrences. Further, the degree of brecciation as indicated by the size of the angular fragments comprising it, seemed to influence the distribution of the radio-active high in so far as these highs were confined to those portions of the outcrop where the rock fragments were smallest. The lack of activity in the shears is of interest. Many of these shears are stained with manganese and iron oxides which might be taken to indicate that they were channels through which the epithermal solutions which introduced hematite, low-temperature quartz and uranium mineral gained access to the breccia. Had this been so, however, it is, in the writer's opinion, difficult to explain the absence of appreciable radio-activity even when measurements were made in direct contact with the manganese- and iron-stained portions of the shears.

Had these shears been present in the crushed zone at the time of introduction of the radio-active minerals which gave rise to the radiation high spots, it seems highly probable that they would have had a marked influence on the distribution of these radio-active high spots. The reverse, however, seems to be true because the shears, in general, seem to cut across the radio-activity contour pattern without upsetting it to any marked degree. The occurrence of torbernite in the shear on which the No.5 prospect is situated, and the accompanying high radiation values is an exception to this generalisation. In this prospect, the torbernite occurs chiefly as platey encrustations in cracks and on cleavages in the rocks. There appears to be little, if any, hematite, manganese-staining or epithermal quartz in the deposit such as would be expected if the uranium minerals were deposited from epithermal solutions in this shear. Two explanations are advanced to account for the occurrence of torbernite without breccia or hematite. Firstly, that the torbernite in the No.5 prospect may have been deposited from circulating meteoric water, the source of the uranium being the scattered bodies of uranium minerals in the breccia which lies relatively close to the deposit, and secondly, that the No.5 prospect may be a primary uranium lode, the torbernite being derived from uranium minerals by the ordinary processes of oxidation. If either of these explanations could be accepted then the occurrence of radio-active minerals in this shear would not necessarily constitute an exception to the foregoing remarks regarding the lack of radio-activity in the shears.

Prospecting the radio-active highs should be based on the premises that areas enclosed by the 7 unit contours may contain appreciable amounts of uranium minerals. To facilitate the location of such places on the ground, a number of indication pegs have been placed in the positions indicated on the radiation contour plan. In the area under discussion, namely Area 2, the indication pegs so placed are G.M.7 to G.M.12 inclusive. They are case wood pegs approximately 3 inches wide by 15 inches long and are held in place by cairns of stones. The appropriate number has been written on each.

Area 3 lies due south of Area 2 and includes survey pegs Nos.10 and 11. Its position relative to Areas 1 and 2 can be seen on the locality plan, Plate 3.

Broadhurst has mapped a portion of this area as containing ironstone outcrops and he has shown two shears which cut across the area. The recognised association of hematite and radio-active mineralisation led to Broadhurst's recommendation for a radiation survey of the area.

The results of the radiation survey are shown on Plate 1 in the form of a contour plan. As at Area 2, the shears, in general, were non-active and appear to have little influence on the contour pattern. At the southwestern end of the main shear, however, near survey peg No.11, radiation values rise to approximately 10 units on the shear. A small amount of torbernite and leached cavities after torbernite are visible in the wall rocks of the shear at this point.

The pattern of high radiation zones is similar to that of Area 2 in that they have no systematic arrangement. The association of these high zones with hematite occurrences is more marked in this case than on either Areas 1 or 2, the hematite being for the most part the massive dark variety such as is found in the outcrop of the No.6 workings at Mount Painter main camp. On the other hand, this massive hematite is not uniformly active as an examination of the contour pattern will show. Portions of the hematite outcrop as mapped by Broadhurst lies between the 2 unit and 3 unit contour lines, or in other words, it has an activity only slightly greater then non-active rocks.

As in the case of the other areas, testing is recommended over those portions of the surface bounded by the 7 unit contour lines. To facilitate the location of such places, a number of indication pegs, numbered from G.M.1 to G.M.6, have been placed on the area, their position relative to the high spots being shown on the contour plan, Plate 2.

Conclusions.

The most important results of the gamma-radiation survey may be summed up as follows:-

A. The Breccia.

(1) High radiation values were obtained at isolated and disconnected places within the breccia.

(2) The occurrence and distribution of the high radiation patches in the breccia suggest small bodies of uranium-rich breccia within the main mass of breccia.

B. The Shears.

(1) The distribution of the radio-active highs is not influenced by the occurrence of shears.

(2) It is believed that if the shears had been channels through which radio-active minerals gained access to the breccia, their activity would have been higher than was found to be the case.

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24th January.1945.

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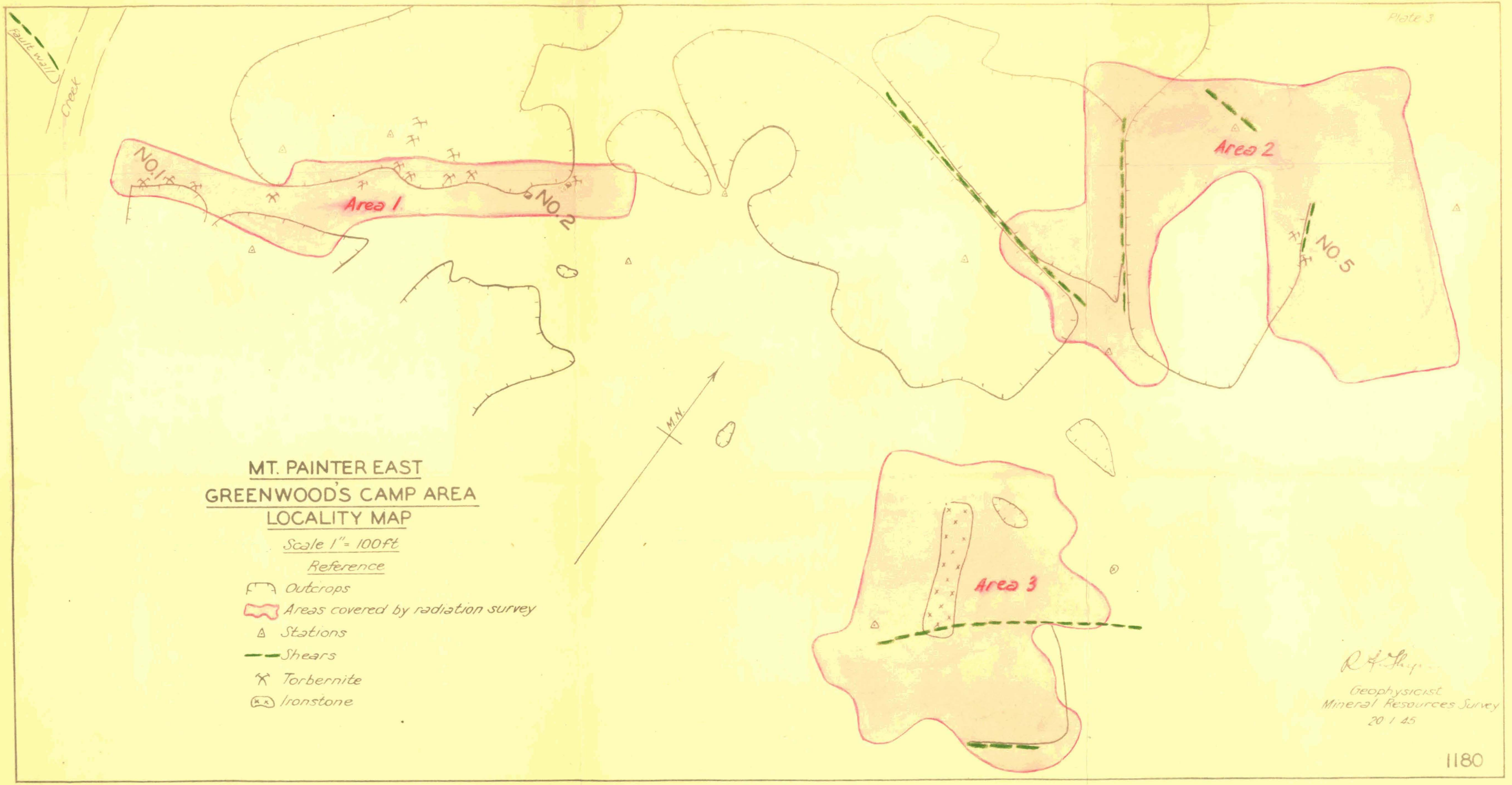

Plate 3
Fault wall
Creek
NO.1
NO.2
Area 1
Area 2
NO.5
Area 3
M.N.
MT. PAINTER EAST
GREENWOOD'S CAMP AREA
LOCALITY MAP
Scale 1" = 100ft
Reference
Outcrops
Areas covered by radiation survey
Stations
Shears
Torbernite
Ironstone
Geophysicist
Mineral Resources Survey
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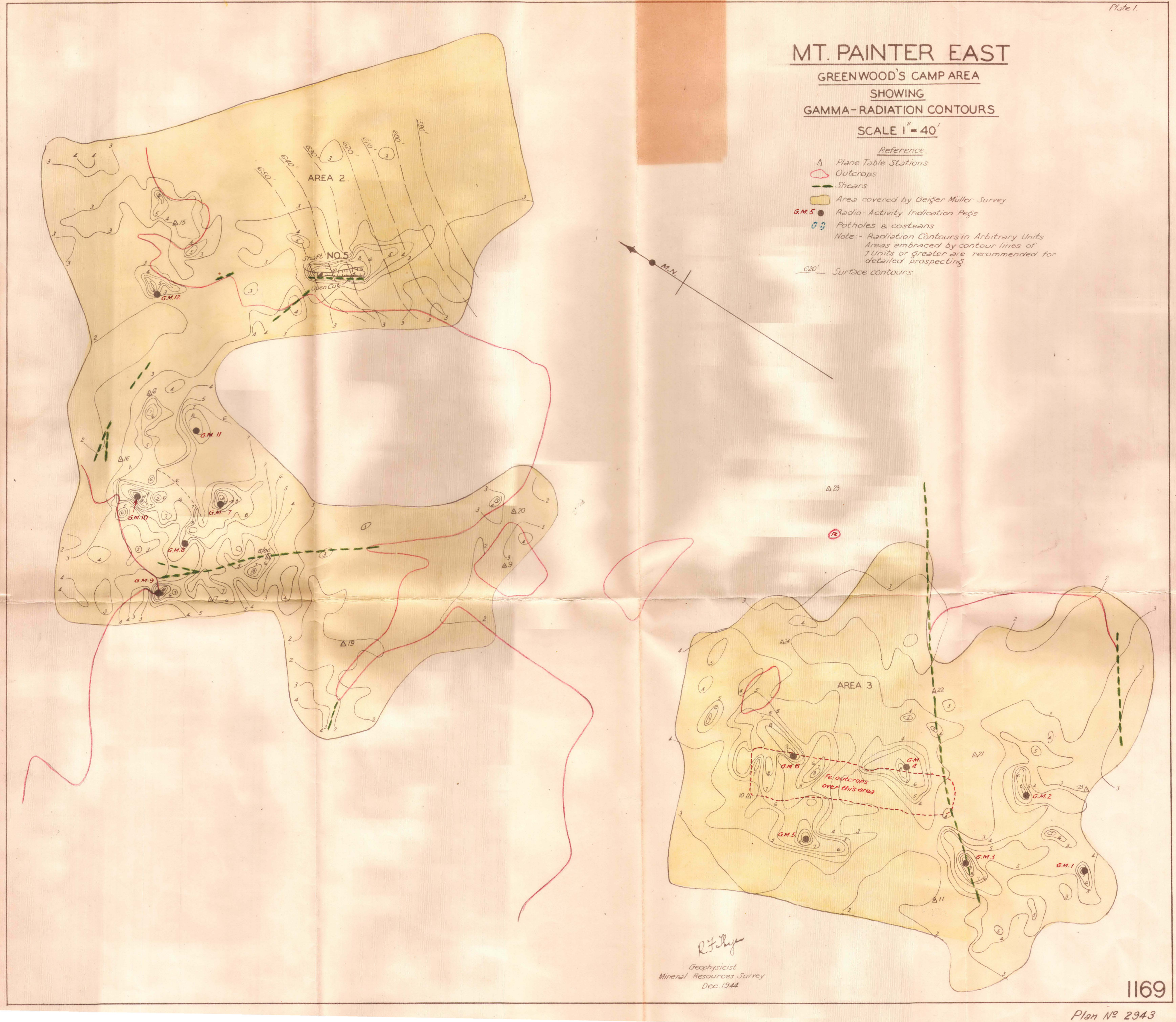
Plate I.
MT. PAINTER EAST
GREENWOOD'S CAMP AREA
SHOWING
GAMMA-RADIATION CONTOURS
SCALE 1" = 40'
Reference
Plane Table Stations
Outcrops
Shears
Area covered by Geiger Muller Survey
G.M.5 Radio-Activity Indication Pegs
Potholes & costeans
Note:- Radiation Contours in Arbitrary Units
Areas embraced by contour lines of 7 Units or greater are recommended for detailed prospecting
620' Surface contours
M.N.
AREA 2.
Shaft NO.5
Open Cut
G.M.12
G.M.11
G.M.10
G.M.7
G.M.8
G.M.9
AREA 3
G.M.6
G.M.4
Fe outcrops over this area
G.M.5
G.M.3
G.M.2
G.M.1
Geophysicist
Mineral Resources Survey
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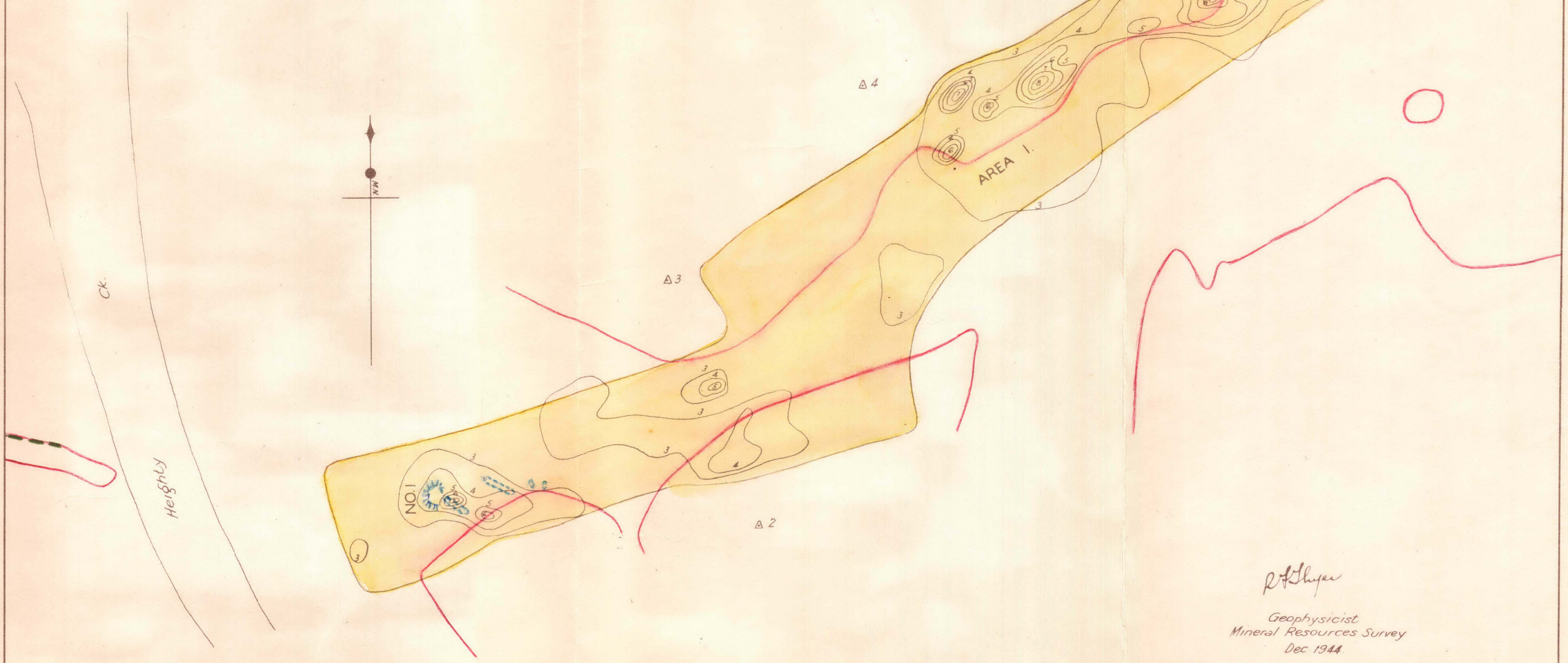
Plan Nº 2943

MT. PAINTER EAST

PORTION OF GREENWOOD'S CAMP AREA
SHOWING
GAMMA - RADIATION CONTOURS
SCALE 1" = 40'

FOR REFERENCE SEE PLATE I.



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Dec 1944

1170

Plan Nº 2494