MAR 19720002: NORTHEASTERN ALBERTA

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GEOPHYSICAL REPORT

on an

AIRBORNE RADIOMETRIC SURVEY

over the

Alberta Mineral Permits 121, 122, 127 (Blindman)

Situated approximately 70 Miles N.W. of Uranium City

And Alberta Mineral Permits 125, 126, +15 Sections (Summit)
137

Situated

Approximately 65 miles West of Uranium City,

Saskatchewan

On behalf of

SUMMIT OILS LIMITED

by

GEO-X SURVEYS LTD.
Vancouver, B.C.

Instrument Operators

J. Pasche

N. Wilson

Report by

Derek Sutton, M.Sc.

James Cerne, M.Sc.

Norman Dowds, B.A.Sc.

604-685-0312
TELEX 04-50404

GEO-X SURVEYS LTD. 627 HORNBY STREET, VANCOUVER 1, B.C.

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SUMMARY

During the month of August, 1969 an airborne radiometric survey was conducted by Geo-X Surveys Limited of Vancouver, B.C. on behalf of Summit Oils Limited. The survey was flown in an Excaliber 800 aircraft containing an Exploranium DiGRS - 2000, 4-channel gamma ray spectrometer, 35 mm photographic positioning system and radar altimeter. The data were recorded digitally on punched paper tape using Varian SDV 4991 recorders.

Data processing was conducted by Geo-X Surveys personnel in Vancouver. IBM computers were used with Varian, IBM, and other programs. The accompanying maps were plotted on a Computer Industries plotter unit, and show Bi 214 plotted at a contour interval of 3 cps.

This report outlines the field procedure and data processing specifications of the equipment used may be found in Appendix.

INTRODUCTION TO AERORADIOMETRY

Basic Concepts

Radioactivity is the spontaneous disintegration of the nucleus of one or more atoms and the emission of energy and particles of mass. Gamma radiation is a product of the process in which a nucleus in the excited state makes a transition to a lower (and more stable) energy state. The energy difference is emitted as a photon or gamma ray. The gamma spectra of nuclei consists of sharp lines indicating that the nucleus has discrete energy levels and are therefore somewhat characteristic of each individual radioelement. Natural terrestrial radiation is made up of contributions from about 50 naturally occurring radio-isotopes unevenly distributed in rocks and soils. Much terrestrial radiation is supplied by three isotopes. These are potassium -40 (K^{40}), thorium -232 (TH^{232}), and uranium -238 (U^{238}). These radio elements are normally the only ones in sufficient abundance to produce the intensity of gamma flux that might be detected some distance above the ground. Since a particular emission energy is characteristic of a particular radio element, measurement within a narrow energy band can serve to discriminate between these three main sources of gamma radiation.

Detection System

When a gamma ray strikes certain natural or synthetic crystals, (normally a thallium ACTIVATED sodium iodide crystal) a scintillation (a minute flash of light) is produced. The scintillation is converted to electrical energy and is amplified in the photomultiplier tube coupled to the crystal. The brilliance of the scintillation is directly proportional to the energy of the gamma ray. Thus the photomultiplier output may be calibrated to read the gamma ray energy directly. Discriminatory electronic circuitry is used to record 'counts' only if the gamma energy falls within certain ranges ("windows"). The Exploranium DiGRS-2000 has four such windows, the mean energy and window width of each being independently variable. The response of a detector is a complex function of the crystal efficiency and several circuit parameters.

Three crystals, (what size?) each coupled to 3 photomultipliers are employed to record flux from the spectrums of the three most abundant radio elements (K^{40}, Th^{232}, U^{238}) and the total gamma ray count. The three crystals have an "effective aperture" of approximately 800 feet when flown at 300 feet terrain clearance at 110 m.p.h. (Effective aperture defines the major diameter of the eliptical area sampled by the detection system during one sampling period).

Methodology

The layout of the flight pattern and specification of terrain clearance is one area in which there is considerable variability and sometimes divergence of opinion. Of prime importance is knowledge of some of the geological parameters of the anticipated nature of the target. For example, size, shape, attitude, depth, the overburden conditions and local topography will strongly influence the field procedure.

When aerial surveying first commenced, it was intuitively reasoned that, as geophysical targets, uranium deposits should be treated as point sources of radiation. However, because of mechanical and chemical dispersion, one anomalous area in the Texas Coastal Plain containing most of the important uranium deposits, covers tens of square miles.

With respect to terrain clearance, satisfactory agreement between ground and airborne gamma-spectrometry measurements is attainable up to a terrain clearance of 500 feet.

AIRBORNE FIELD PROCEDURE

The survey was flown in a fixed wing aircraft. The gamma-ray spectrometer crystals in their associated temperature and shock-resistant enclosure were mounted in aft section of the aircraft cabin. The electronic equipment associated with the spectrometer, the radar altimeter, camera, chart and digital recorders were all mounted in the aircraft proper.

During survey flights, spectroscopic and altitude data were recorded continuously on analog charts. At one second intervals the same data were recorded on digital tapes along with fiducial numbers. At two second intervals the split-image camera photographed simultaneously (1) the terrain (2) the clock and fiducial display panel. (Thus each terrain photograph is bordered by a photograph of the clock and fiducial number). At thirty second intervals time, job and line identification were recorded on the digital tapes.

During flights the aircraft navigator roughly positions flight lines on mosaics made up of government photographs. Each two seconds the terrain photographing camera is triggered. It is possible to position the flight lines, in the office, by comparing the terrain photographs with the air-photograph mosaic, using the navigators map as a guide.

DATA PROCESSING

The data processing consisted of 4 steps discussed under the following headings:

(1) Flight line positioning

(2) Paper tape editing and magnetic tape generation

(3) Variable selection and grid interpolation

(4) Mathematical analysis, computation, contouring

1. FLIGHT LINE POSITIONING

(a) Photographic Location Data

Terrain photographs taken in flight are bordered by an image of the clock-fiducial display. On each line certain prominent topographical features are recognized by comparing the terrain photograph with an air-photograph mosaic. The fiducial numbers associated with these features are marked on the line and data points evenly distributed along the line between these known positions.

(b) X-Y Location

An arbitrary rectangular coordinate system was superimposed on the flight line data observed by (a) above, with +Y north and +X east. The position of each data point is uniquely described by X (distance east of origin) and Y (distance north of origin)

2. PAPER TAPE EDITING AND MAGNETIC TAPE GENERATION

A listing of the contents of the paper tapes was made using an IBM computer as the data were transferred from paper tape to magnetic tape. The listing was examined and machine and operator errors corrected. A unique "sequence number" was given to each data point and its coordinates (position) calculated. Thus the magnetic data tape consists of a series of "field records", each field record comprising a sequence number, the X,Y coordinates of the point and the data from that point.

3. VARIABLE SELECTION AND GRID INTERPOLATION

The field records described above contain four gamma ray spectrometer data, only one or one combination of which may be mapped at any one time. The variable to be mapped, (Z), is calculated or directly transferred to a work tape whose format is described by: sequence number, X,Y,Z.

The data in the work tape was input to programs obtained from Varian Associates, Palo Alto, California. These programs take the flight line data and by mathematical manipulation interpolate the 'random' linear data points to the intersection point of a uniform grid covering the area. This process also involves a controllable amount of filtering and/or smoothing.

4. MATHEMATICAL ANALYSIS, COMPUTATION, CONTOURING

The interpolated grid obtained by the process described above is most suitable for various forms of computerized mathematical analysis (ie. trend surface removal, Fourier filtering, etc.) or may be directly input to the mapping program. The contour mapping program produces a plot tape which enables maps to be produced off-line on any compatible plotter available. These plots are then checked and title blocks drafted on to produce the final map.

CONCLUSION

The accompanying map is only one of several possible displays of the data. Further presentation and data processing are available upon request.

(Of particular interest might be the display of other channels of the spectroscopic data either singly or in some mathematical relation to one another, ie. Bi/Tl ratio)

Respectfully submitted,

[redacted]

D. Sutton, M.Sc.

[redacted]

J. Cerne, M.Sc.

[redacted]

N. Dowds, B.A.Sc.

APPENDIX

SPECIFICATION OF THE EXPLORANIUM DIGRS - 2000 SPECTROMETER

Crystals — Three 6" x 4" NaI (TI) each coupled to three photomultiplier tubes.

Spectrum Stabilization — Pulse height at output of detector maintained constant by spectrum stabilization using Cesium 137 as reference. Cesium 137 has an ultra-stable single gamma emission at 662 MeV, and half life of 32 years.

Channels — Four. Each independently adjustable for E (peak energy level of channel-count) and E (range of energy level counted)

Approximate values used:

	E	E
Potassium 40	1.47 Mev	150 Kev
Bismuth 214	1.76 Mev	180 Kev
Thallium 208	2.62 Mev	270 Kev
Total count	2.05 Mev	1.2 Kev

Differential Linearity — 1%

Resolution — Better than 8.3% at .662 MeV & 1000 V

Mechanical Configuration - Designed to conform to TID - 20893

Recommended U.S.A. electrical and mechanical standard for nuclear instruments and power supplies.

<u>Temperature Stability</u> - Approximately .1% per °C

All pulse and analog processing circuiting is temperature compensated. Integrated circuits used throughout.

APPENDIX _

INSTRUMENT SPECIFICATIONS

Aircraft

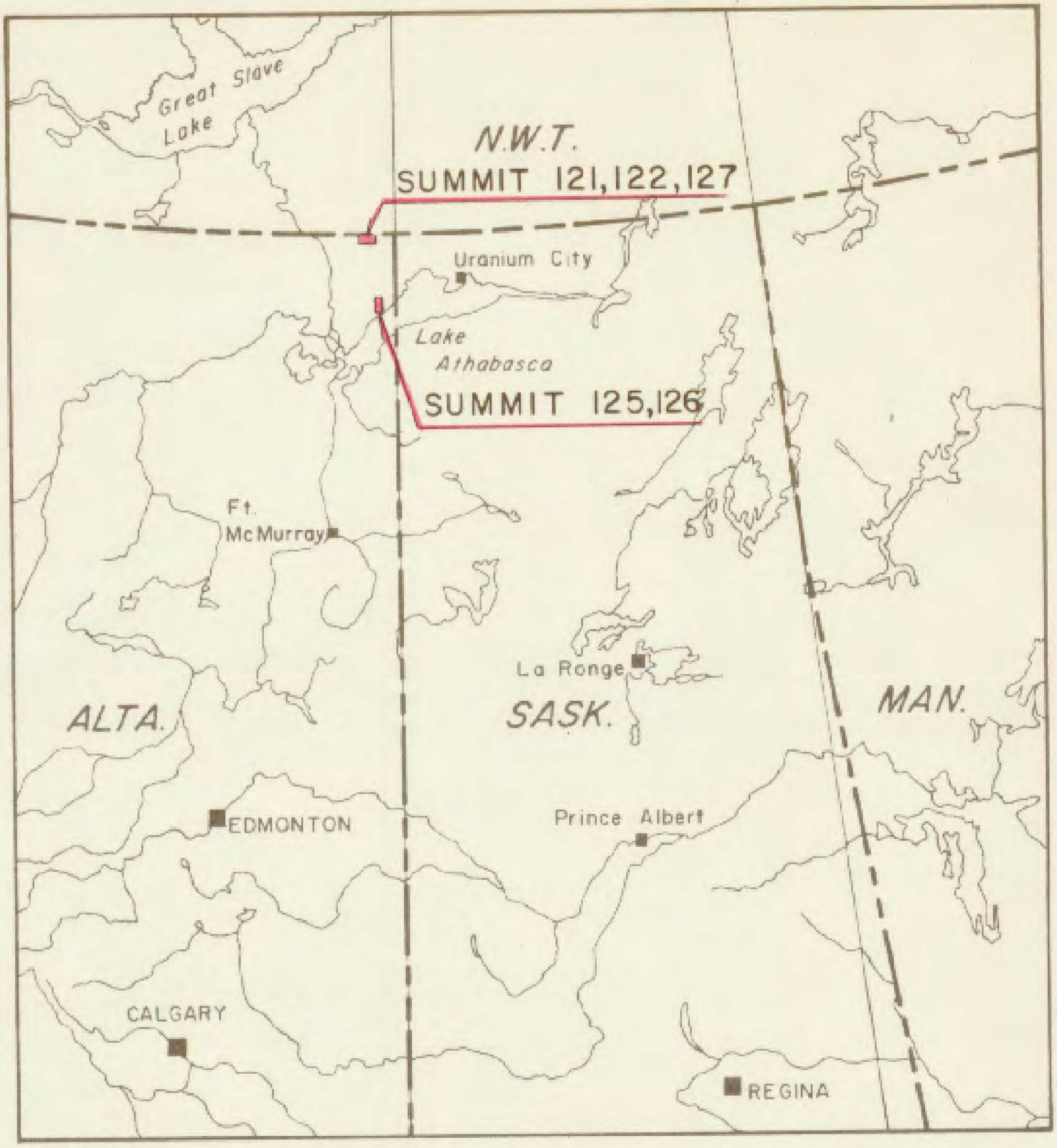
Type and Model:	Excalibur 800 (Beechcraft Twin Bonanza modified by Swearingen Aircraft, San Antonio, Texas)
Power:	Two 400 H.P. Lycoming 10-720-AIA engines.
Gross Weight:	7900 pounds
Empty Weight:	5300 pounds
Useful Load:	2600 pounds
Fuel Capacity:	230 gallons (U.S.)
Performance at 7900 lbs. Gross:	Climb - 1535 feet per minute (at sea level) Cruise - 230 miles per hour. Range - 1200 miles.

APPENDIX

Instrument Specifications

Camera

Type:	Neyhard Automax 35 m.m. pulse camera
Model:	G-2 with auxiliary data box
Pulse Rate:	Up to 10 frames per second
Film Format:	0.738" x 0.738" square picture with 0.200" x 0.738" data area.
Magazine:	Mitchell 400 foot 35 m.m.
Lenses:	(a) 17 m.m. F/14 Super-Takumar Fish-eye (b) 35 m.m. F/2.0 Super Takumar
Data Box:	(a) 24 hour Accutron Clock (b) Frame counter (c) Available for optional feature
Dimensions (less magazine):	8 3/8" high, 4 1/2" deep, 6 1/4" wide.
Weight (less lens and magazine):	12 lbs.



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MILES (APPROX.)

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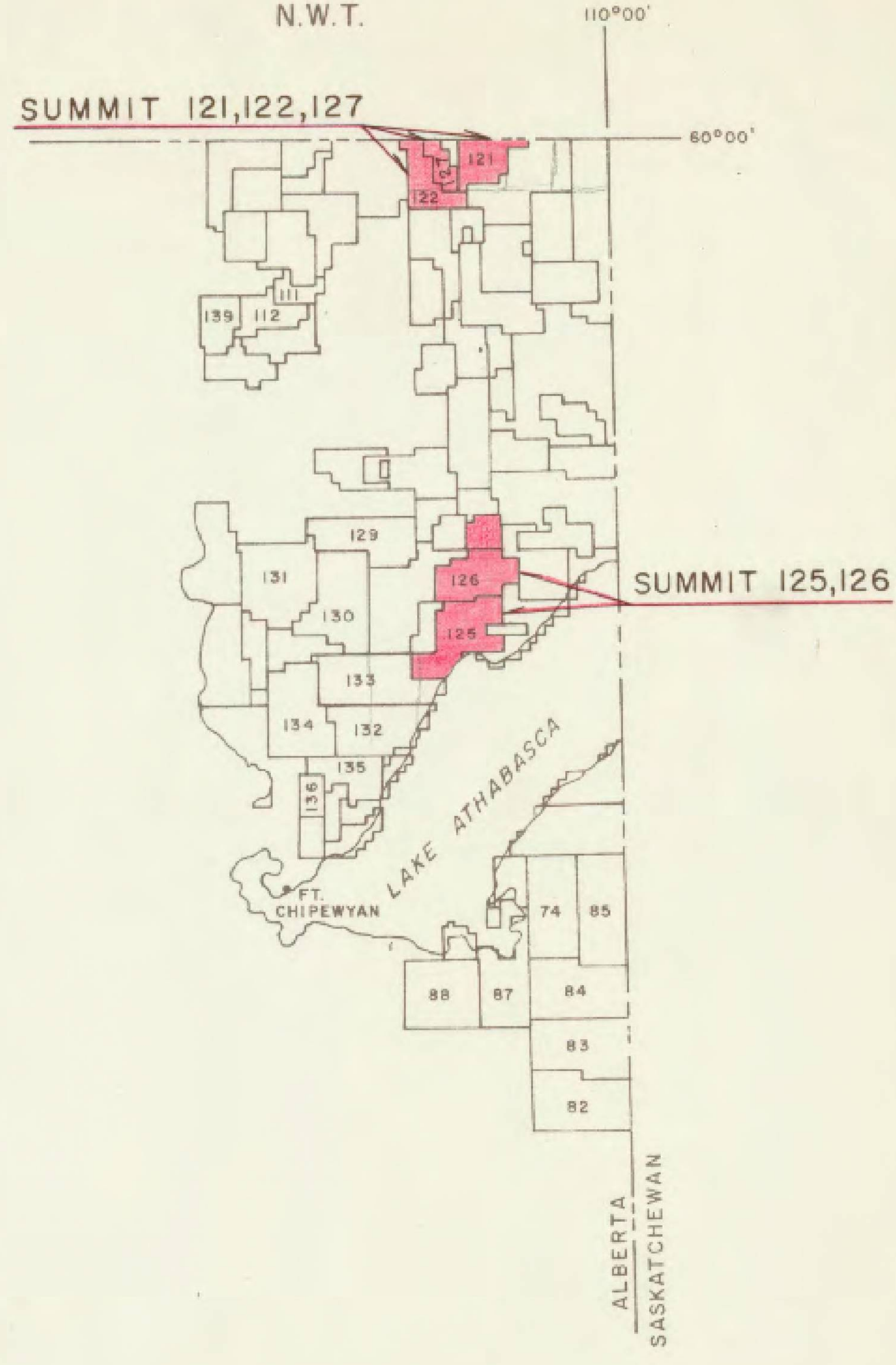
ALBERTA

LOCATION MAP

GEO - X SURVEYS LTD.	Drawn A.N.S.	Dated OCT. 29, 1969	Fig. No.
	Checked	Job No. 1104	1



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N.E. ALBERTA
MINERAL PERMITS

GEO – X SURVEYS LTD.	Drawn T.M.	Dated OCT. 29, 1969	Fig. No. 2
	Checked	Job No. 1104	

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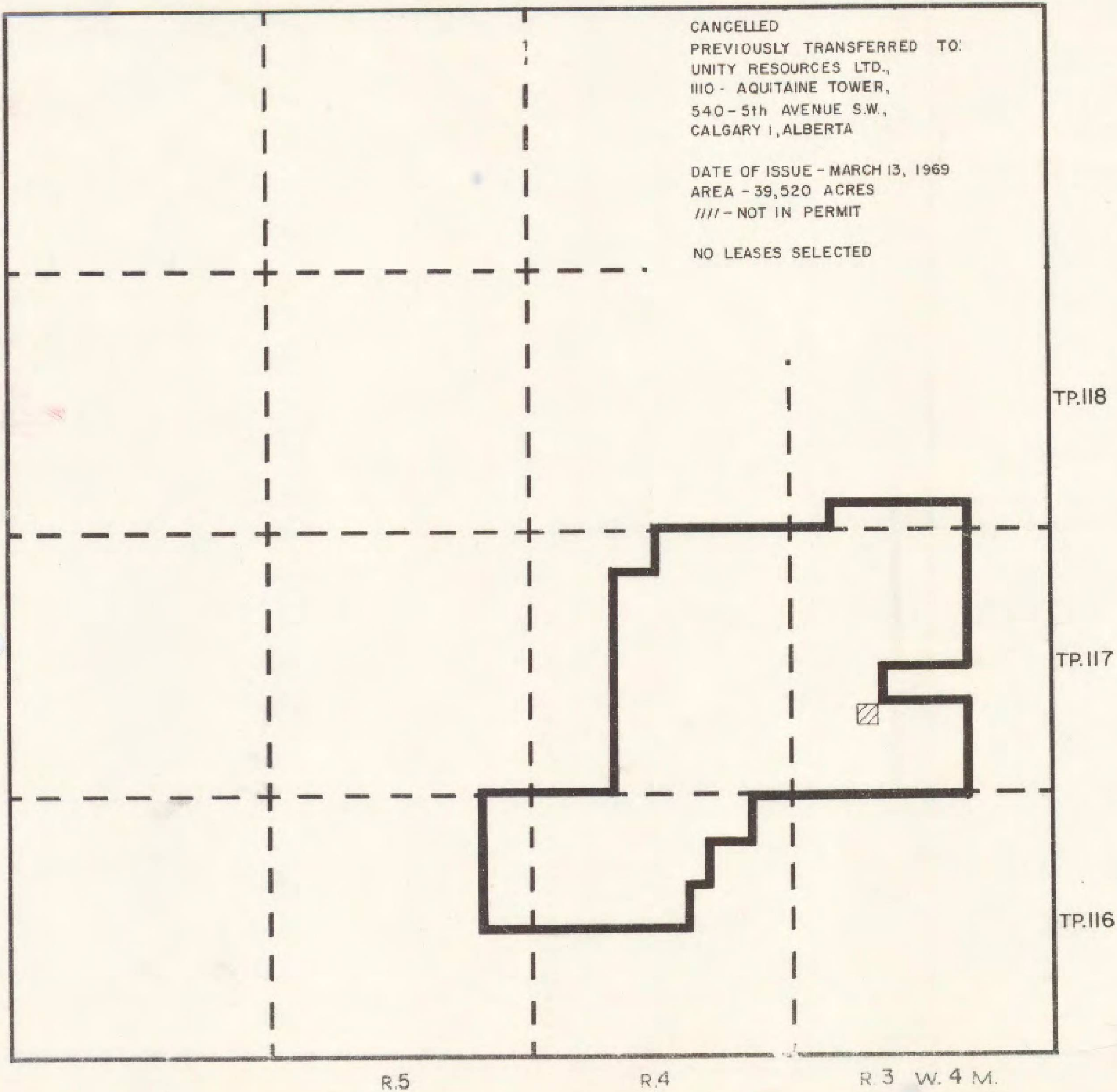

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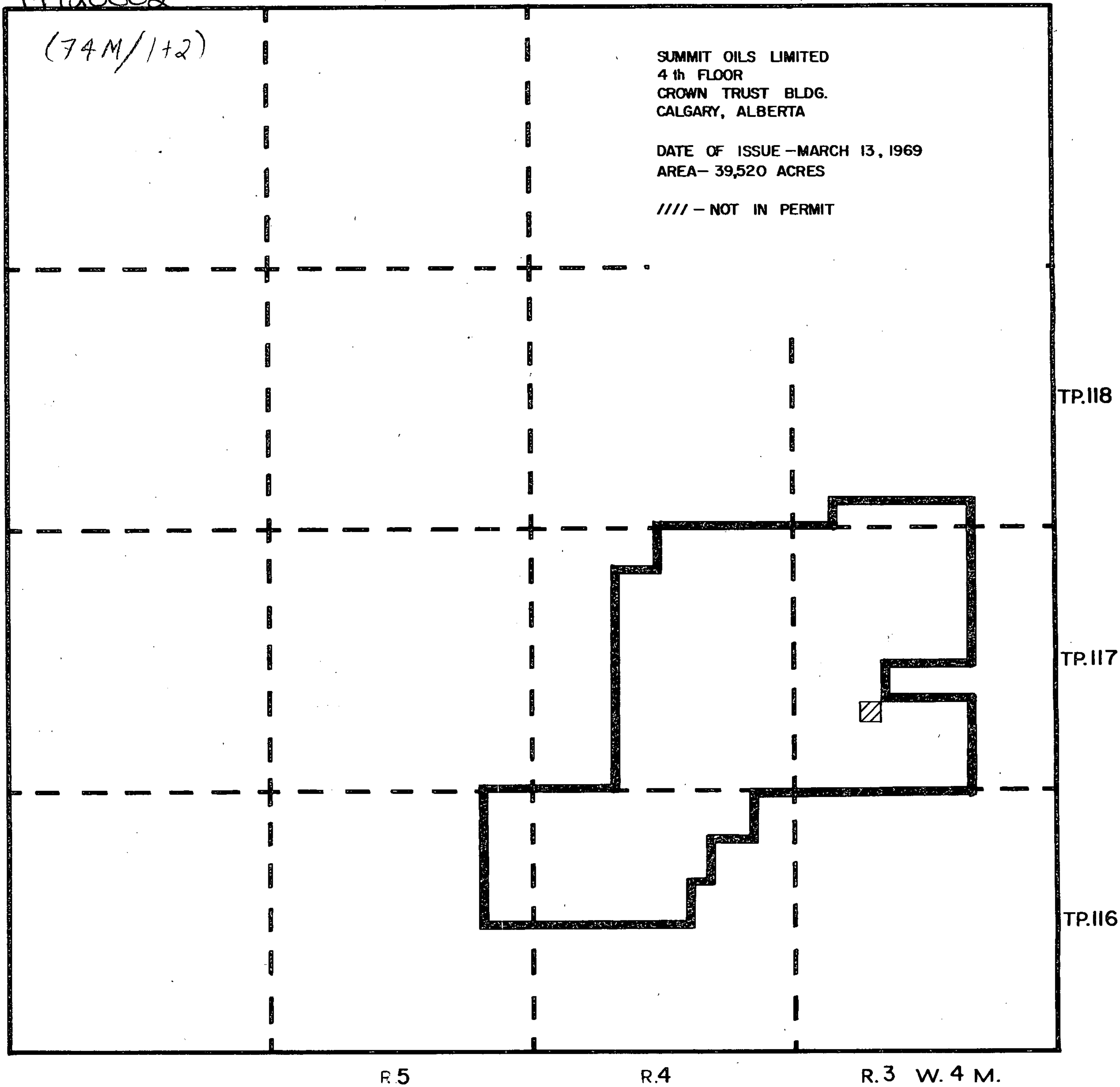
(74M/1+2)



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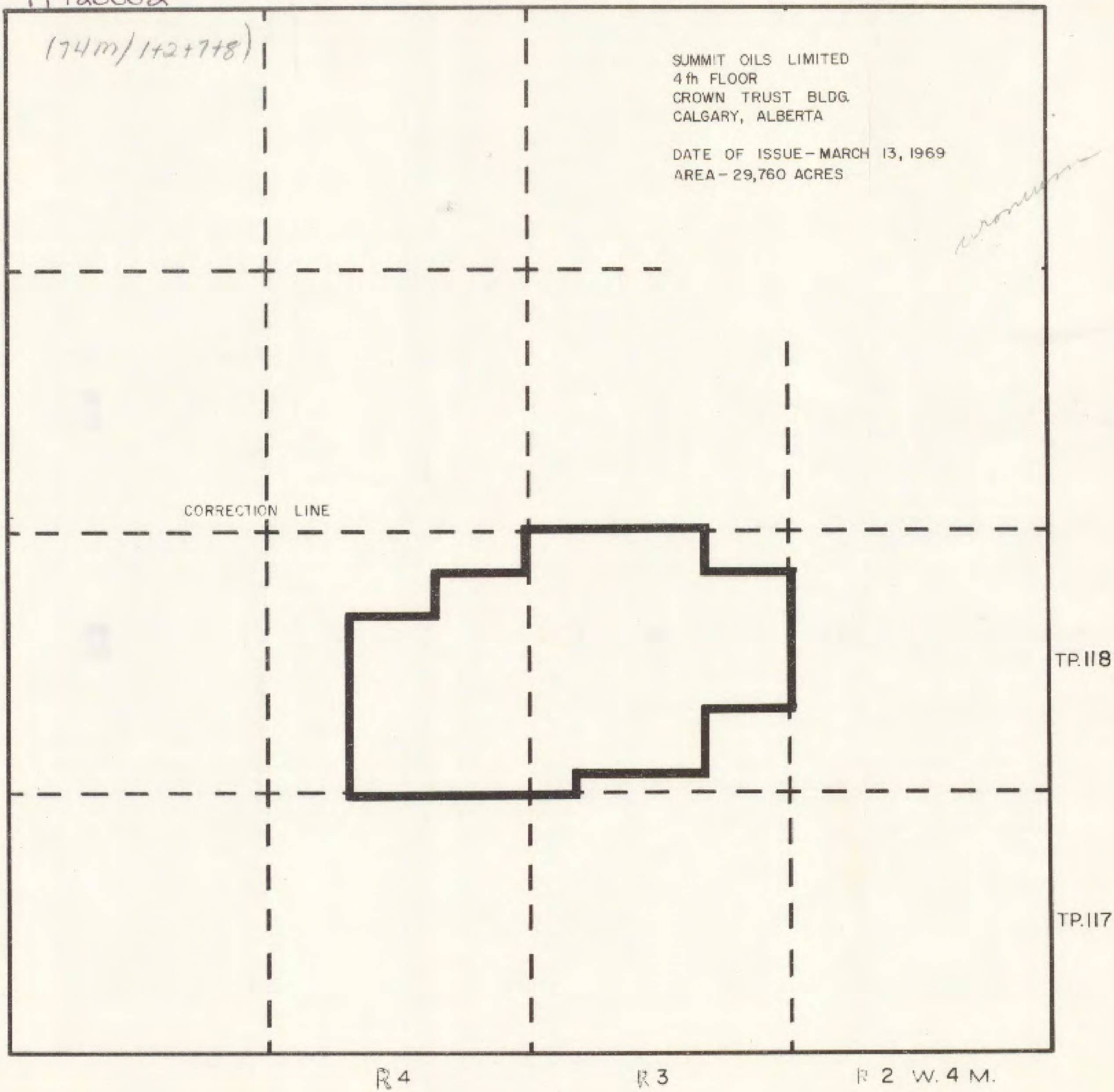

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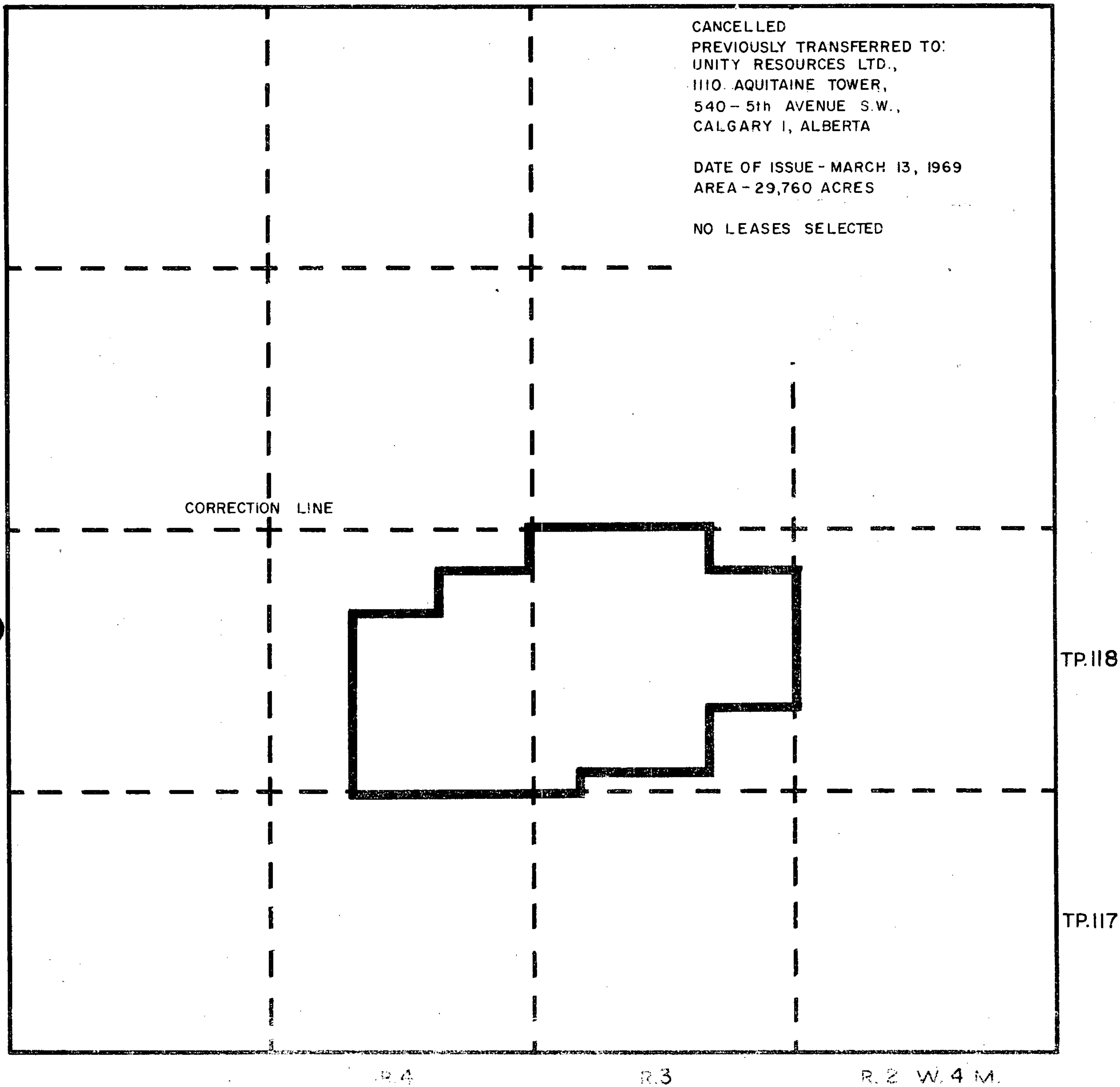

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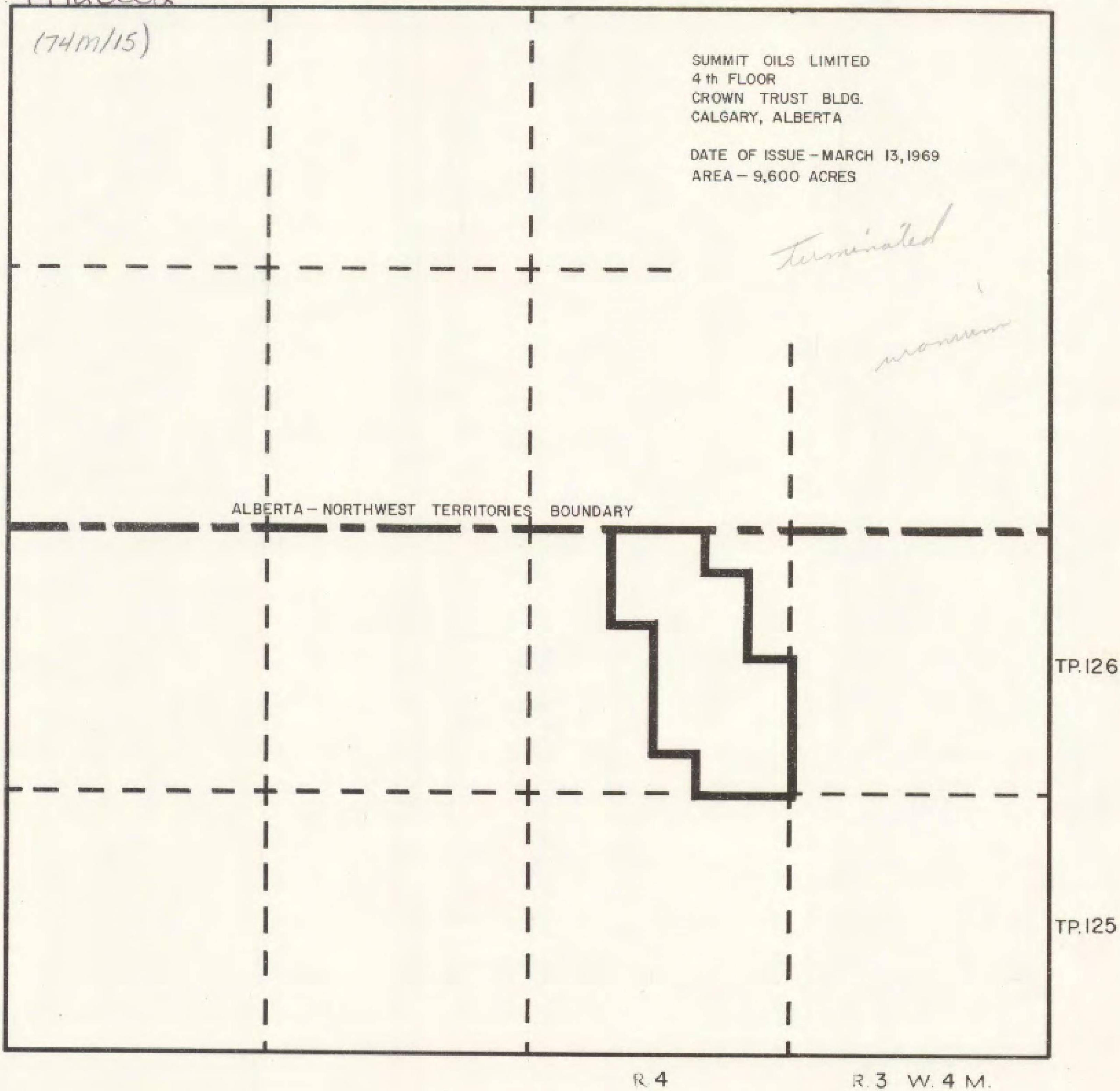

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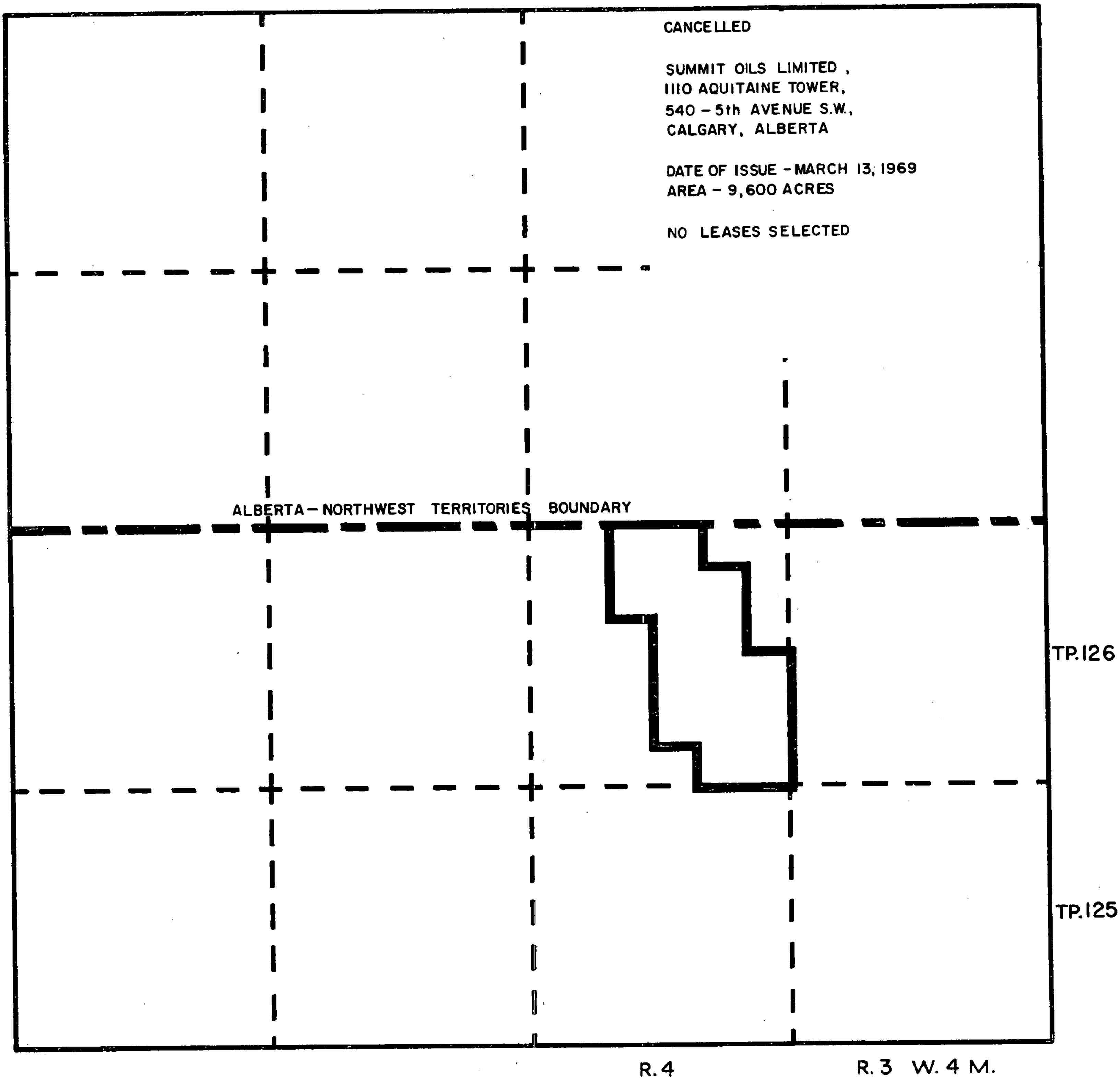

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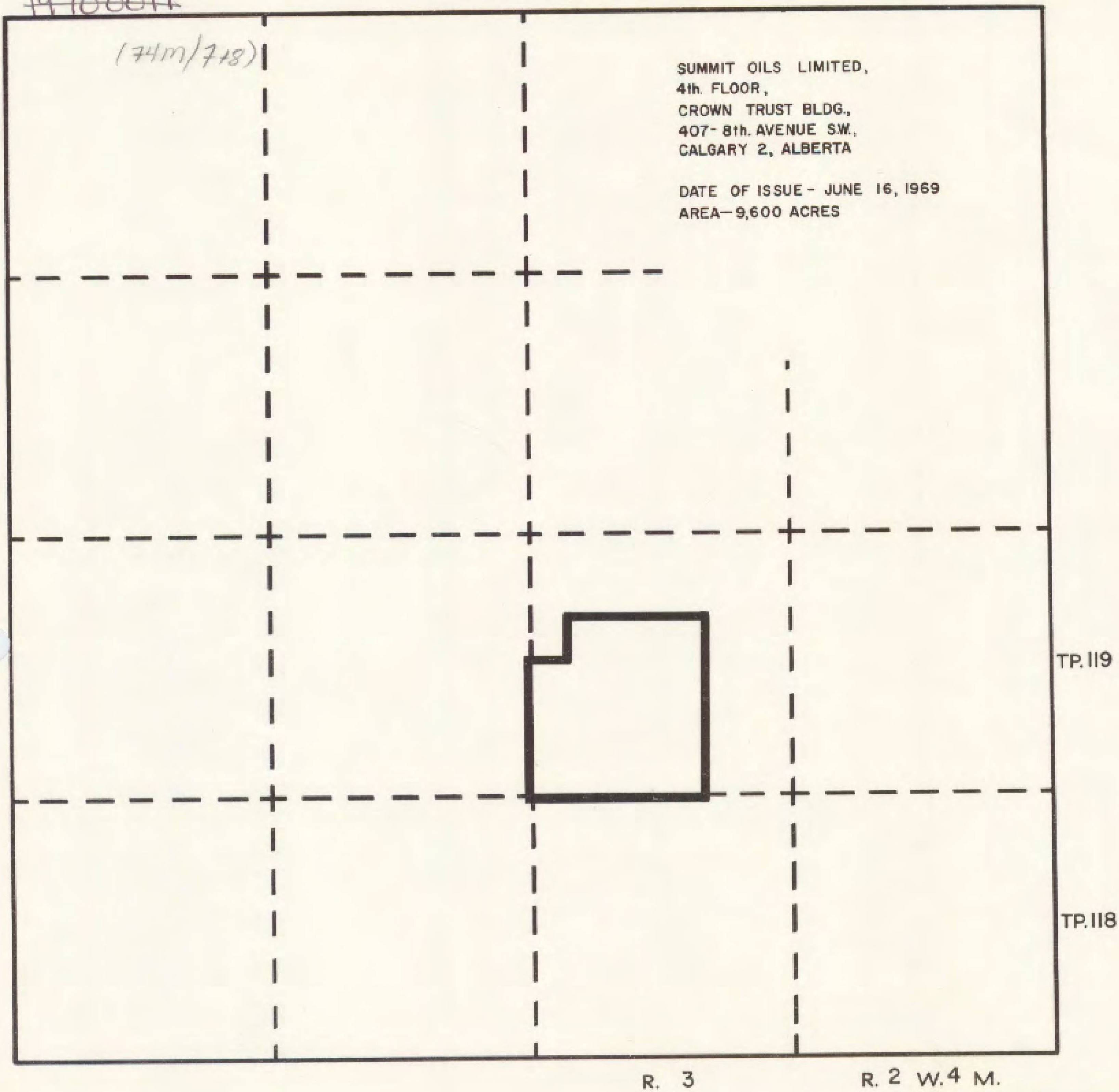

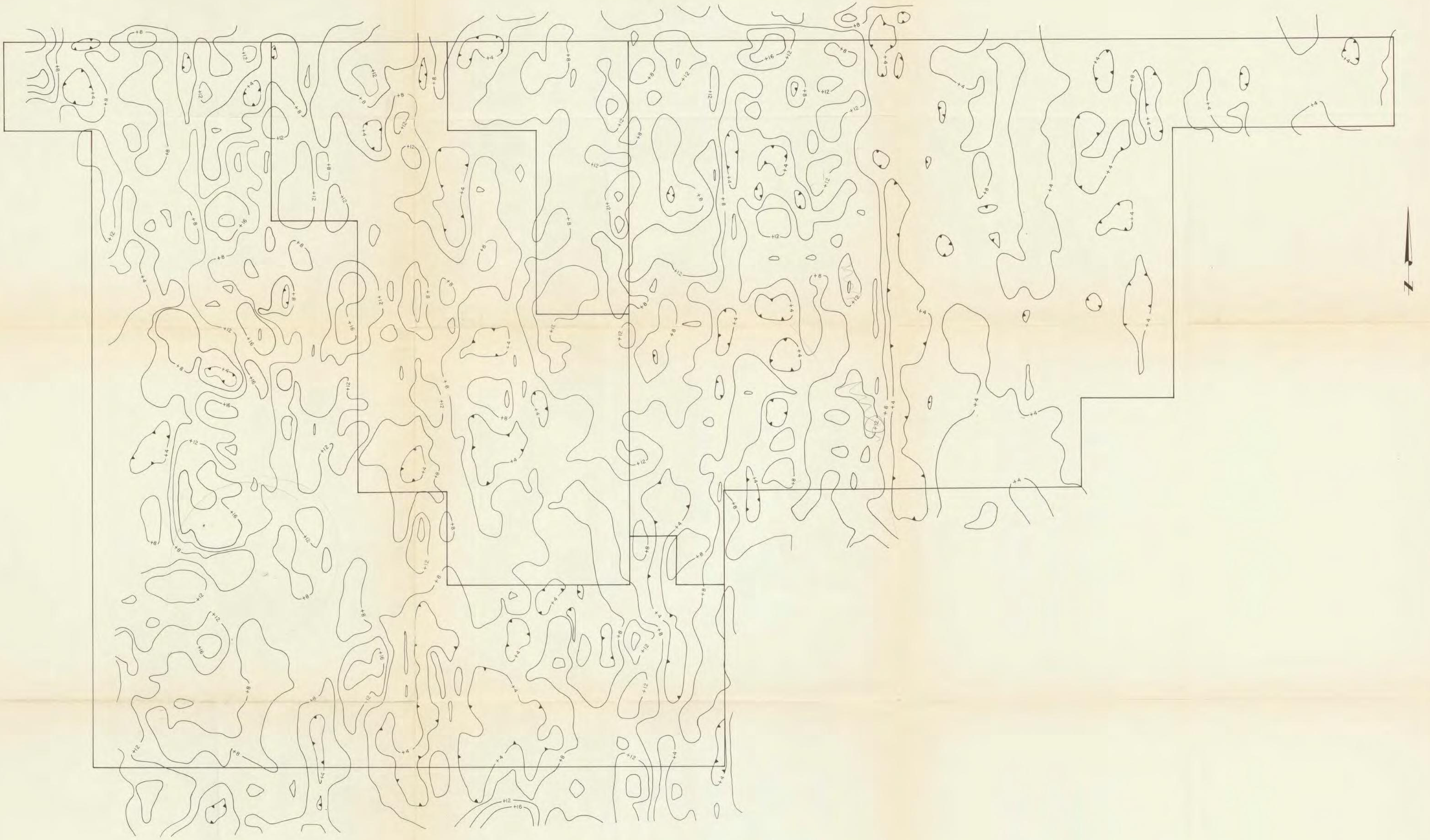

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PERMITS – 121, 122, 127
BISMUTH 214
CONTOUR INT.: 4 C.P.S.

DRAWN	CROSS CANADA COMP.	JOB NO	FIG NO
DATED	OCT 28, 1969	1104	4
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NOTE

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PERMITS -121, 122, 127

FLIGHT LINE LAYOUT

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DRAWN	A.N.S.	JOB NO.	FIG. NO.
DATED	OCT 29, 1969	1104	3
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