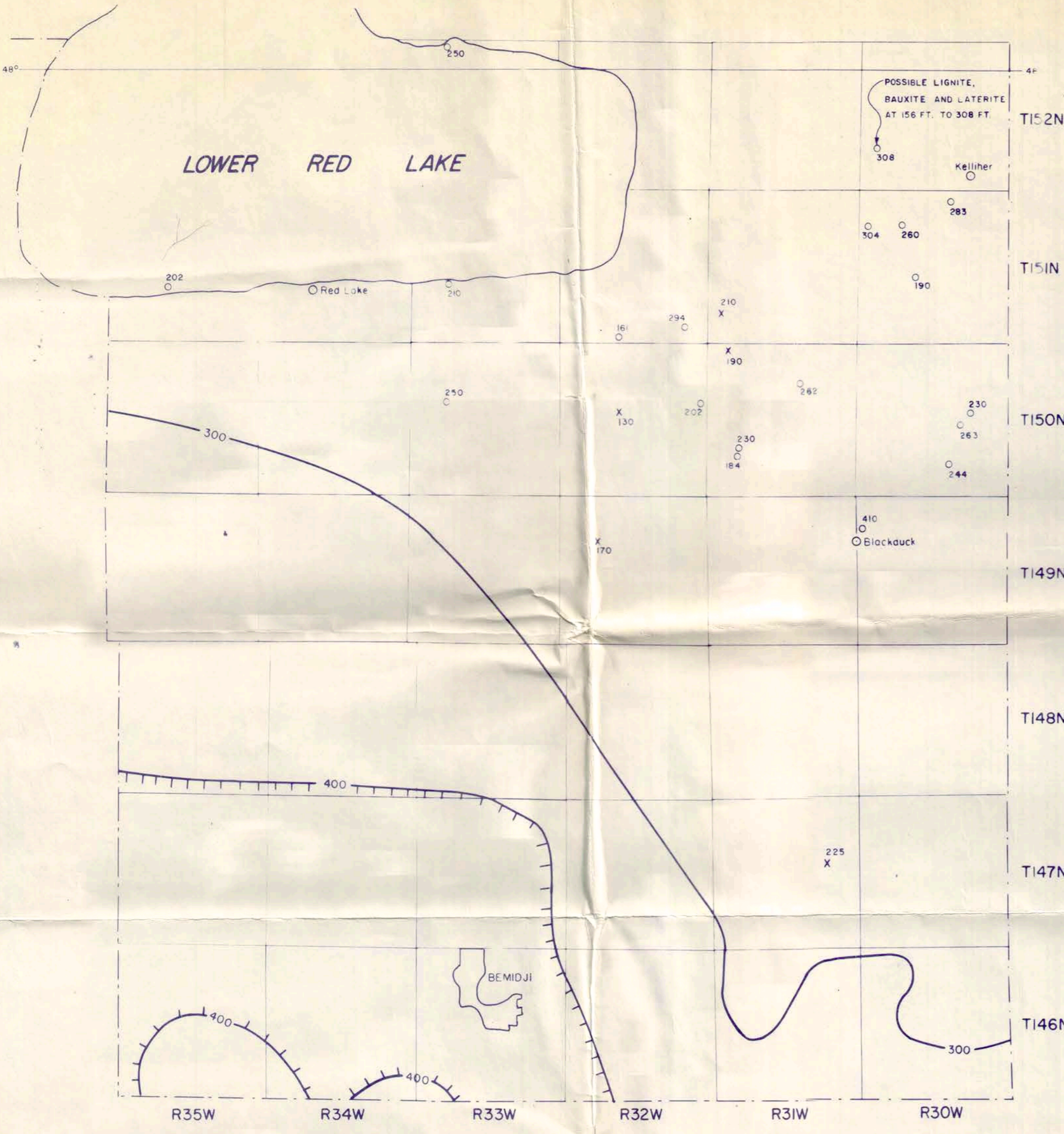


THICKNESS OF QUATERNARY-CRETACEOUS DEPOSITS



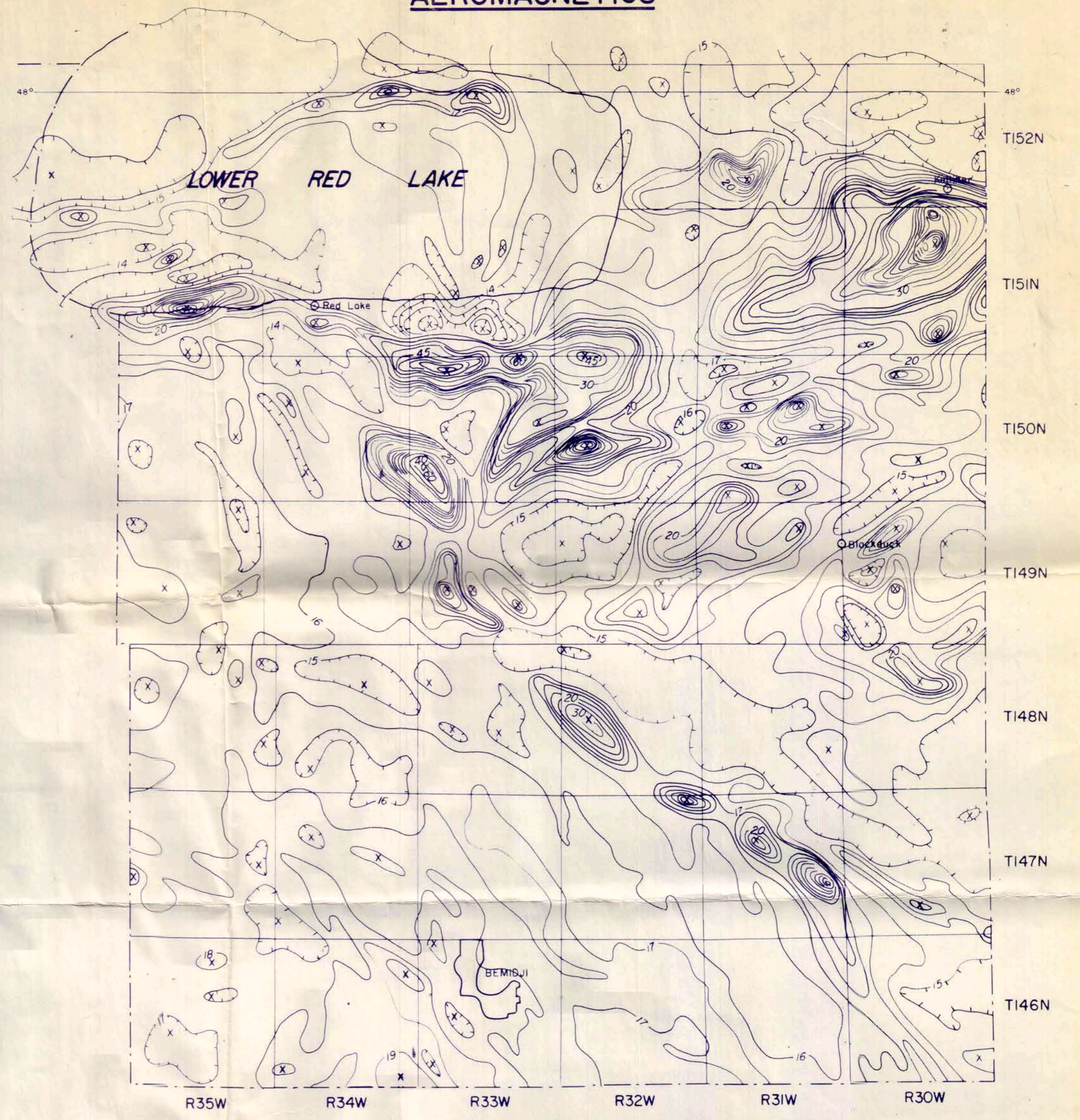
Quaternary and Cretaceous deposits are generally shale and sandstone usually less than 50 feet thick and occur as outcrops. Outcrops are described in references 1 and 2.

234 Drill hole with thickness in feet of Quaternary-Cretaceous deposits (Refs. 1, 2, and 3)

225 Estimate of Quaternary-Cretaceous thickness in feet by use of airborne electromagnetic data (see also, in this compilation, aeromagnetic or ground horizontal line electromagnetic data file 3)

200 Thickness of Quaternary-Cretaceous deposits in feet from references 1 and 2, adjusted according to current drill hole data

AEROMAGNETICS



EXPLANATION
Aeromagnetic contours from GP-471 (Ref. 1)

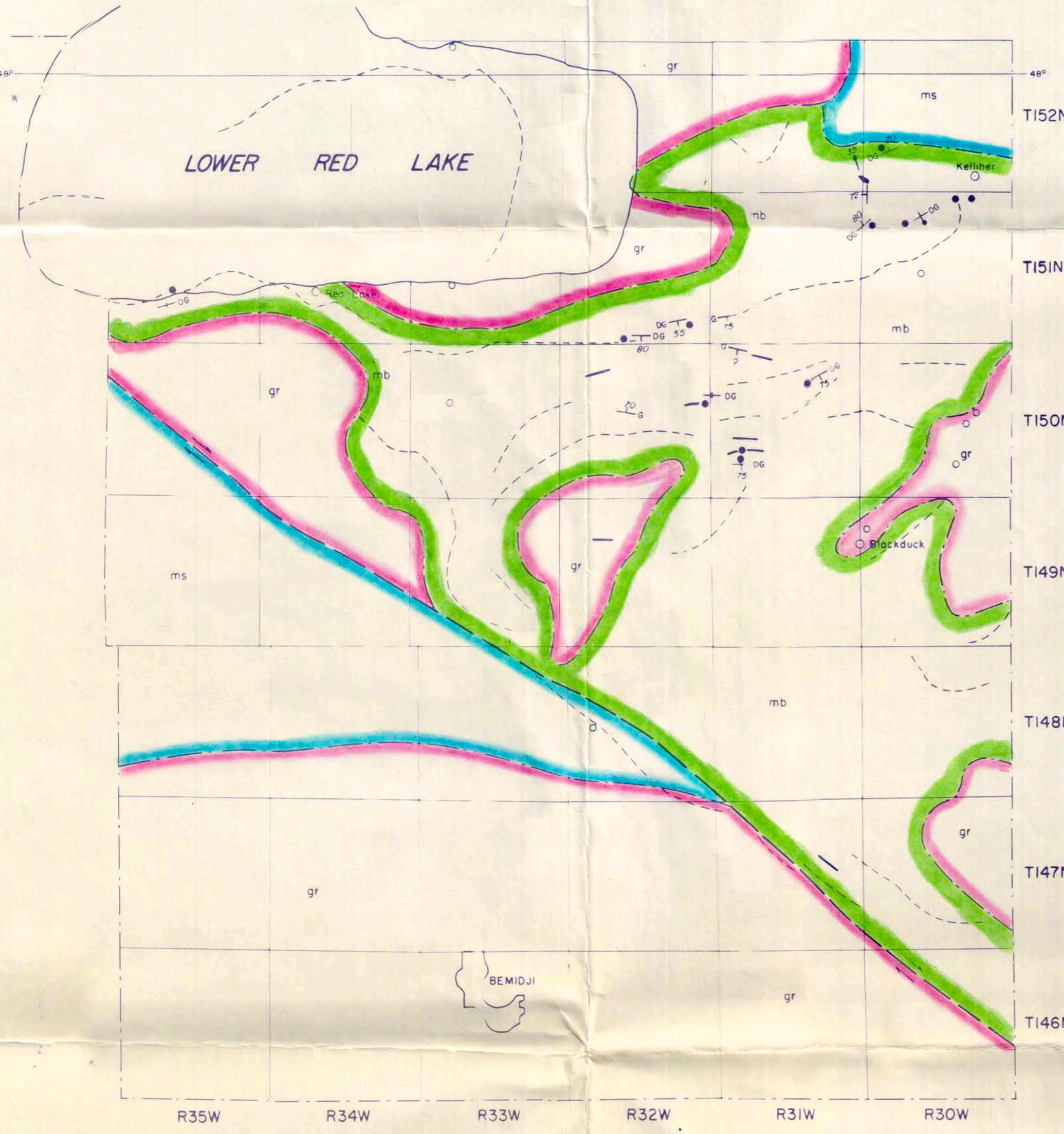
Magnetic contours showing total intensity magnetic field of the earth in hundreds of gammas relative to arbitrary datum. Shaded indicates closed areas of lower magnetic intensity.

x Measured maximum or minimum intensity within closed high or closed low

Total intensity aeromagnetic data were obtained by flight north-south lines spaced one mile apart at altitudes ranging between 900 and 1,100 feet. Data was towed 75 feet below aircraft (Ref. 1)

For detailed maps (1:63,360) of aeromagnetic survey, see References 4 and 7.

PRELIMINARY PRECAMBRIAN GEOLOGY



EXPLANATION

Lower Precambrian

Granite rocks, unfoliated, probably intruded late in orogenic period, probably includes cataclastic of volcanic rocks (Ref. 1)

Metamorphic rocks, unfoliated, dominantly mica schists and biotite schist possibly of volcanogenic derivation

Igneous rocks, unfoliated, dominantly basaltic lavas and associated syenitic rocks, lesser felsic to intermediate rocks, some ultramafic rocks, includes some volcanoclastic rocks, and oxide to sulfide facies iron formation

Contact, inferred largely from aeromagnetic and gravity data

Structural features, inferred horizontal movement, inferred largely from aeromagnetic and gravity data

Trend of airborne magnetic anomaly from aeromagnetic map on this sheet and References 4 and 7

Trend of airborne electromagnetic anomaly (Ref. 3)

Structural features, indicates structure interpreted from diamond core drilling and geophysics - interpreted from geophysics only

Strike-slip fault, direction not determined (Ref. 1)

Normal dip-slip fault, direction not determined (Ref. 1)

Vertical dip-slip fault, direction of dip (Ref. 1)

Swath fault, type of lineation (Ref. 1)

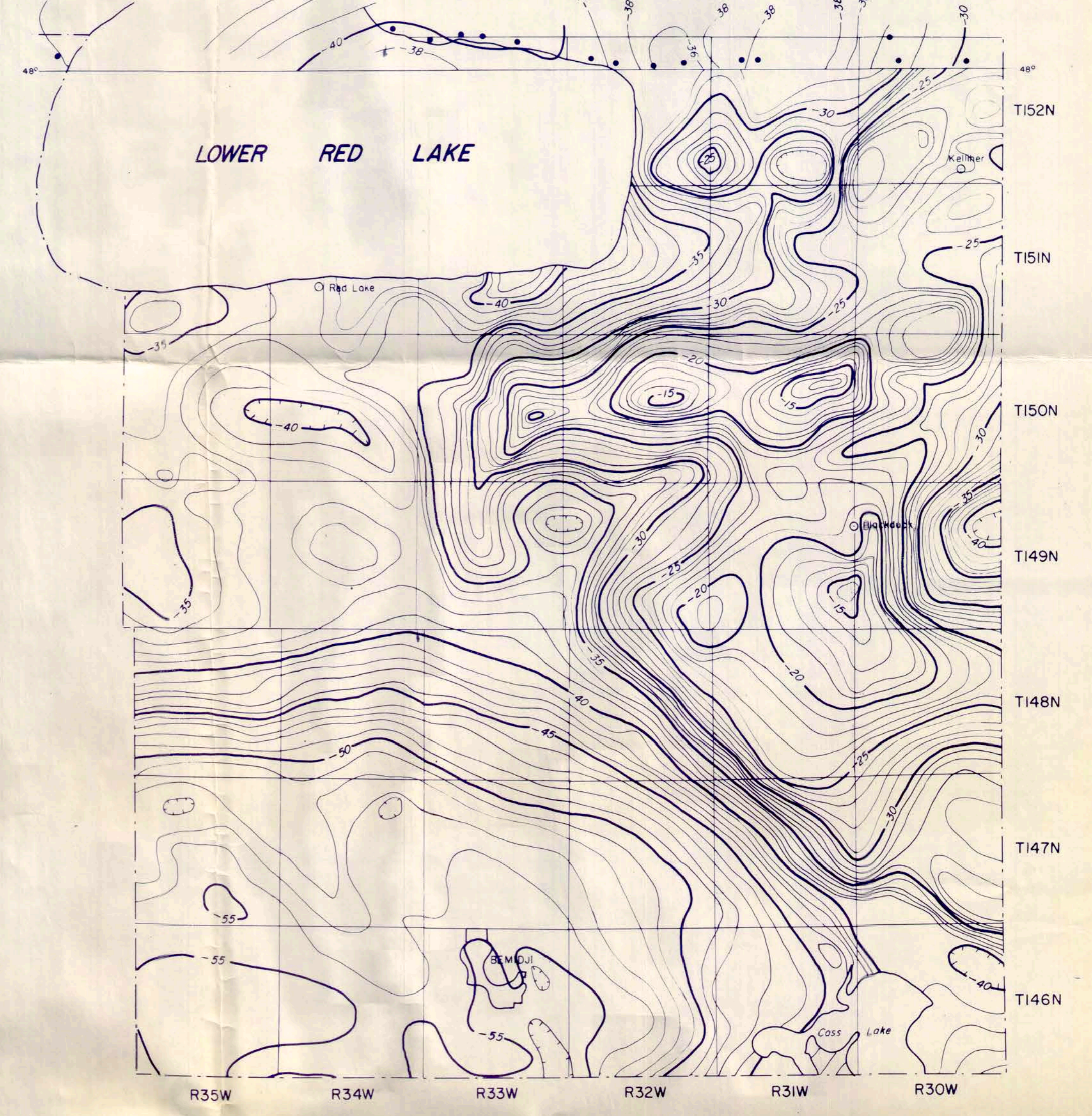
Rock outcrop (Ref. 1)

Drill holes from reference 1 and 2

Diamond drill hole, vertical and inclined, core file at Division of Minerals - Drill Core Library, Hibbing, Minnesota or U.S. Bureau of Mines, Minnesota

Diamond core drilling in southern Beltrami County has encountered Precambrian rocks to depths over 10,000 feet (Ref. 1)

SIMPLE BOUGUER GRAVITY



EXPLANATION

Gravity from L. McGinnis, C. Durfee and J. Kola, 1973 (Ref. 6), north of 48 degrees latitude; and L. D. McGinnis, D. A. Steff, and C. P. Brin, 1975 (Ref. 5), south of 48 degrees latitude, Minnesota Geological Survey

Gravity contours, 1 milligal contour interval north of 48 degrees and 1 milligal south of 48 degrees; assumed density 2.67 grams per cubic centimeter

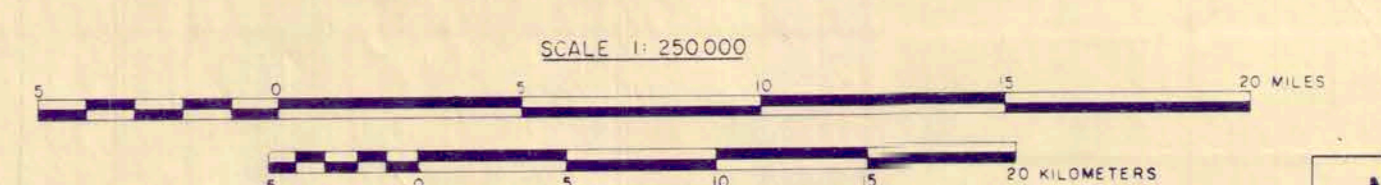
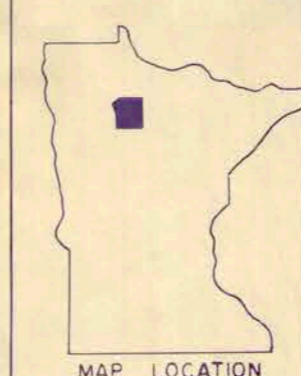
Gravity station

- REFERENCES
1. Rath, G. J., Schwartz, G. M., and Gilbert, F. P., 1964, Aeromagnetic and Geologic Map of Northwestern Minnesota, U.S. Geological Survey.
 2. Kroll, H. E., Water, F. C., and Weyer, R. W., 1970, Water Resources of the Red Lake River Watershed, Northwestern Minnesota, Geologic Investigations Atlas HA-344, U.S. Geological Survey.
 3. Division of Minerals, Minnesota Department of Natural Resources, Files.
 4. Henderson, J. P., Hill, W. L., and Buschke, J. L., 1959, Total Intensity Aeromagnetic Map of the Southern Part of Beltrami County, Minnesota, Geophysical Investigations, U.S. Geological Survey.
 5. Ginn, A. W., Steff, D. A., and Brin, C. P., 1975, Simple Bouguer Gravity Map of Minnesota - Beltrami Sheet, Open File Map, Minnesota Geological Survey.
 6. McGinnis, L., Durfee, C., and Kola, J., 1973, Simple Bouguer Gravity Map of Minnesota - Roseau Sheet, "Open File Map", Minnesota Geological Survey.
 7. Buschke, J. L., Book, R. P., Henderson, J. P., Jr., and Schwartz, G. M., 1957, Aeromagnetic and Geologic Map of North-Central Beltrami and Northwestern Clearwater Counties, Minnesota, Geophysical Investigations Map GP-137, U.S. Geological Survey.
 8. Rath, G. J., 1963, Preliminary Geologic Map of the Southern Part of Beltrami County, Minnesota, Unpublished Document, Minnesota Geological Survey.
 9. Kroll, H. E., and Weyer, R. W., 1970, Water Resources of the Red Lake River Watershed, North-Central Minnesota, Geophysical Investigations Atlas HA-344, U.S. Geological Survey.
 10. Steff, D. A., and Brin, C. P., 1975, Precambrian Geology of Roseau Sheet, Minnesota, Open File Map, Minnesota Geological Survey.
- See for maps on this sheet from U.S. Geological Survey, Beltrami and Roseau 1:250,000 topographic maps.

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINERALS

MINERAL COMPILATION OF SOUTHERN BELTRAMI COUNTY

By D.G. Meneke and W.H. Listerud
D.G. Meneke, Supervisor of Minerals Exploration



EXPLANATION

- Boundary of Indian Reservation
- Boundary of National Forest
- Boundary of area offered by the State of Minnesota for Cu-Ni leasing
- Terminated State of Minnesota Cu-Ni lease - number identifies lease in "data and drill core table"
- Shaft - see Summary of Outcrops
- Diamond drill hole, arrow indicates direction of inclined hole
- Outcrop area

Base for map on this sheet from Minnesota Highway Department 1:125,000 General Highway Maps.

SUMMARY OF DIAMOND DRILL HOLES

*DDH #1	Specular or metallic hematite iron-formation
*IB-1	Intermediate volcanics
*IB-2	Andesite
*IBD-1	Volcaniclastics (some brecciated) with graphitic zones and interbedded fine-grained to lapilli tuff
*IBD-2	Andesite (with traces of massive Cu) and graphite
*IBD-3	Latic porphyry graphite (with up to 20% py), mafic dikes, chloritic volcanics, chert, basalt, andesite breccia (with traces of cp and sp), feldspar porphyry, and mafic tuff
RL25	Dolomitic or sideritic volcanics (with up to 20% earthy hematite), diabase dike, graphitic zones, intermediate crystal tuff, and iron-formation (30% magnetite-hematite, with up to 20-30% py)
RL28-1	Gabbro (with traces of cp), graphitic chert, and pyroxene-peridotite (some serpentinized)
RL31	Volcaniclastics, very fine-grained to lapilli tuffs (some intermediate), graphitic zones, and andesite to basalt
RL39	Volcaniclastics (some with cherty zones and up to 30% py), biotite lamprophyre dike, mafic dike, graphite, chlorite (with traces of cp), intermediate to felsic lava, intermediate lapilli tuff and agglomerate (to 5 inches), and mafic lava
RL42-1	Fine-grained intermediate volcanics (some cherty, up to 10% py), graphitic zones, and coarse-grained to lapilli tuff
RL43-1	Intermediate to mafic volcanics (with graphitic zones, and traces of cp and sp), gabbro (with traces of cp), very fine-grained to lapilli felsic tuff (with traces of cp and sp)

All rocks greenschist facies or higher grade metamorphism.
 Cretaceous weathering extends to depths over 150 feet in some areas.
 Drill cores filed at Division of Minerals - Drill Core Library, Hibbing, Minnesota unless specified () in which case they are filed at the U. S. Bureau of Mines, Minneapolis, Minnesota.

***DATA AND DRILL CORES FROM TERMINATED STATE CU-NI LEASES FILED AT THE DIVISION OF MINERALS, HIBBING, MINNESOTA**

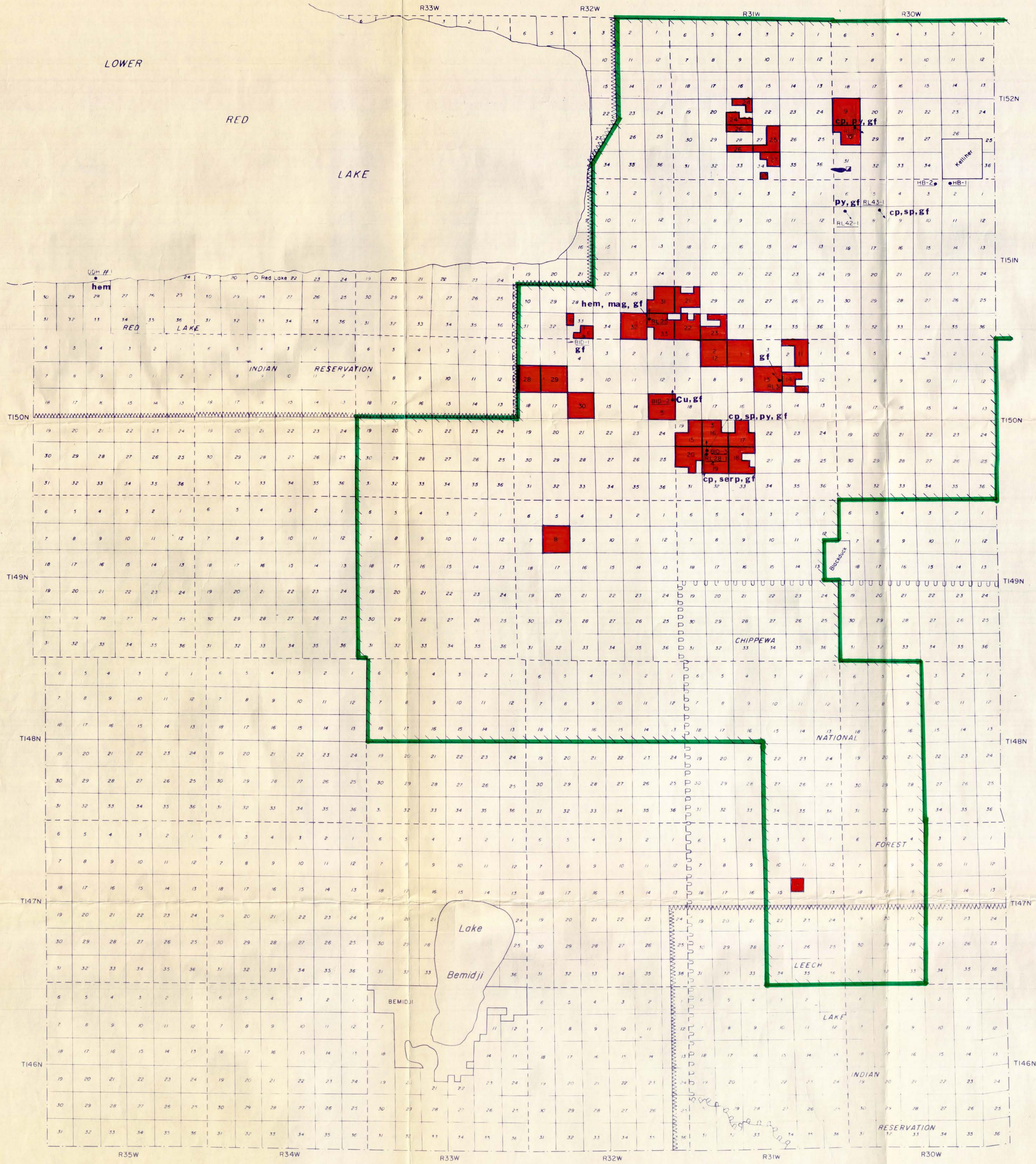
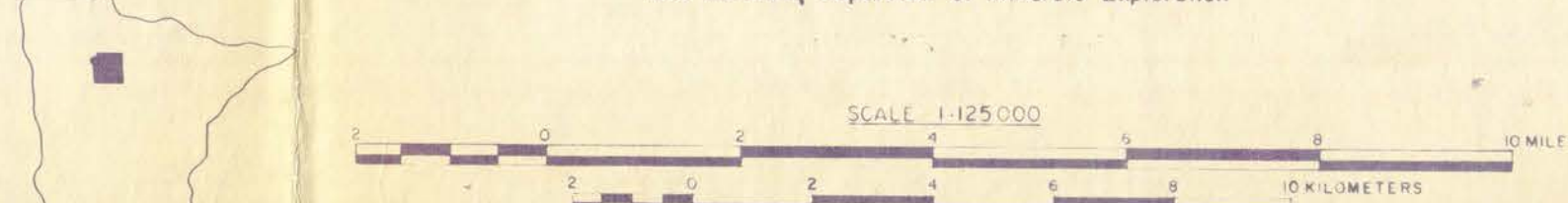
MAP INDEX NUMBER	MINING COMPANY	ALBANYE MAGNETICS	ALBANYE ELECTROMAGNETICS	GROUND MAGNETICS	VERTICAL LOOP ELECTROMAGNETICS	HORIZONTAL LOOP ELECTROMAGNETICS	INDUCED POLARIZATION	GRAVITY	DIAMOND DRILLING			YEAR LEASED	
									WIRE NUMBER	LOG	ASSAYS		
1	Ridge Mining Co.	.73	.73	.74	.74	.74	.74	.74				.CN-7910	1973
2	Ridge Mining Co.	.73	.73	.74	.74	.74	.74	.74				.CN-7911	1973
3	Ridge Mining Co.	.73	.73	.74	.74	.74	.74	.74				.CN-7912	1973
4	Ridge Mining Co.	.73	.73	.74	.74	.74	.74	.74				.CN-7913	1973
5	Ridge Mining Co.	.73	.73	.74	.74	.74	.74	.74				.CN-7914	1973
6	Ridge Mining Co.	.73	.73	.74	.74	.74	.74	.74				.CN-7915	1973
7	Ridge Mining Co.	.73	.73	.74	.74	.74	.74	.74				.CN-7916	1973
8	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7840	1971
9	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7841	1971
10	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7842	1971
11	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7843	1971
12	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7844	1971
13	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7845	1971
14	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7846	1971
15	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7847	1971
16	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7848	1971
17	Humble Oil & Refining Co.	.No	.Data									.CN-7849	1971
18	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7850	1971
19	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7851	1971
20	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7852	1971
21	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7853	1971
22	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7854	1971
23	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7855	1971
24	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7856	1971
25	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7857	1971
26	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7858	1971
27	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7859	1971
28	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7860	1971
29	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7861	1971
30	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7862	1971
31	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7863	1971
32	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7864	1971
33	Humble Oil & Refining Co.	.71	.71	.72	.72	.72	.72	.72				.CN-7864	1971

* Year indicates when survey was conducted

**MINNESOTA DEPARTMENT OF NATURAL RESOURCES
 DIVISION OF MINERALS**

**MINERAL COMPILATION OF SOUTHERN
 BELTRAMI COUNTY**

By D.G. Meineke and W.H. Lister
 D.G. Meineke, Supervisor of Minerals Exploration



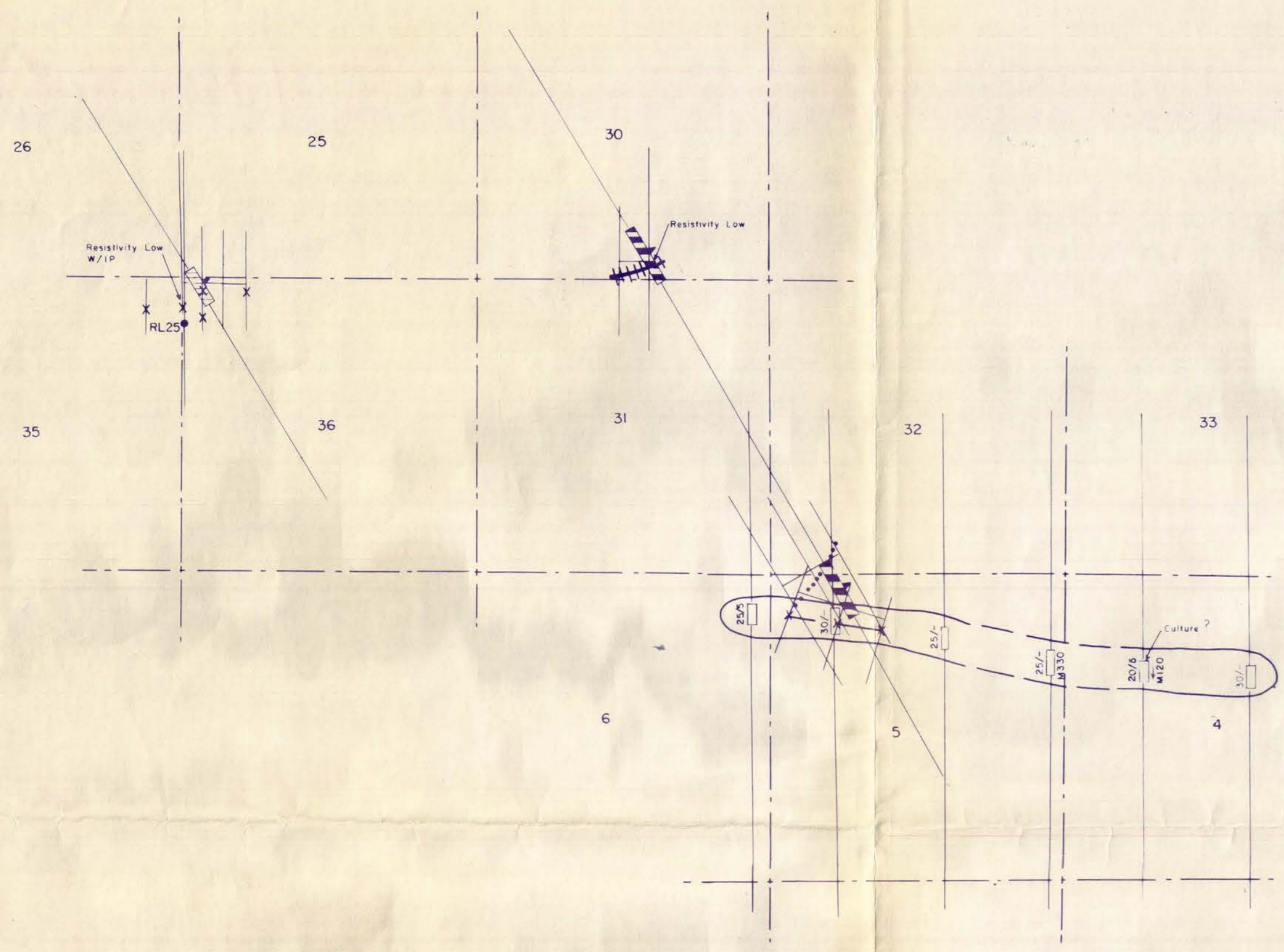
SUMMARY OF OUTCROPS

Outcrops located in Section 31, Township 152 North, Range 30 West and Section 36, Township 152 North, Range 31 West.
 Section 36
 Fine-grained pillowed to massive metabasalt, with granitic dikes.
 Section 31
 The western most outcrops are the same as Section 36 but includes a pyroxene plagioclase dike and quartz veins. The eastern most outcrops are mainly pillowed metabasalt, highly sheared, stretched with interbedded lapilli tuff (tuff fragments lighter in color than matrix). A gold prospect shaft is located in pillowed metabasalt, with quartz and granitic stringers. A granitic porphyry is located ten feet east of the shaft.

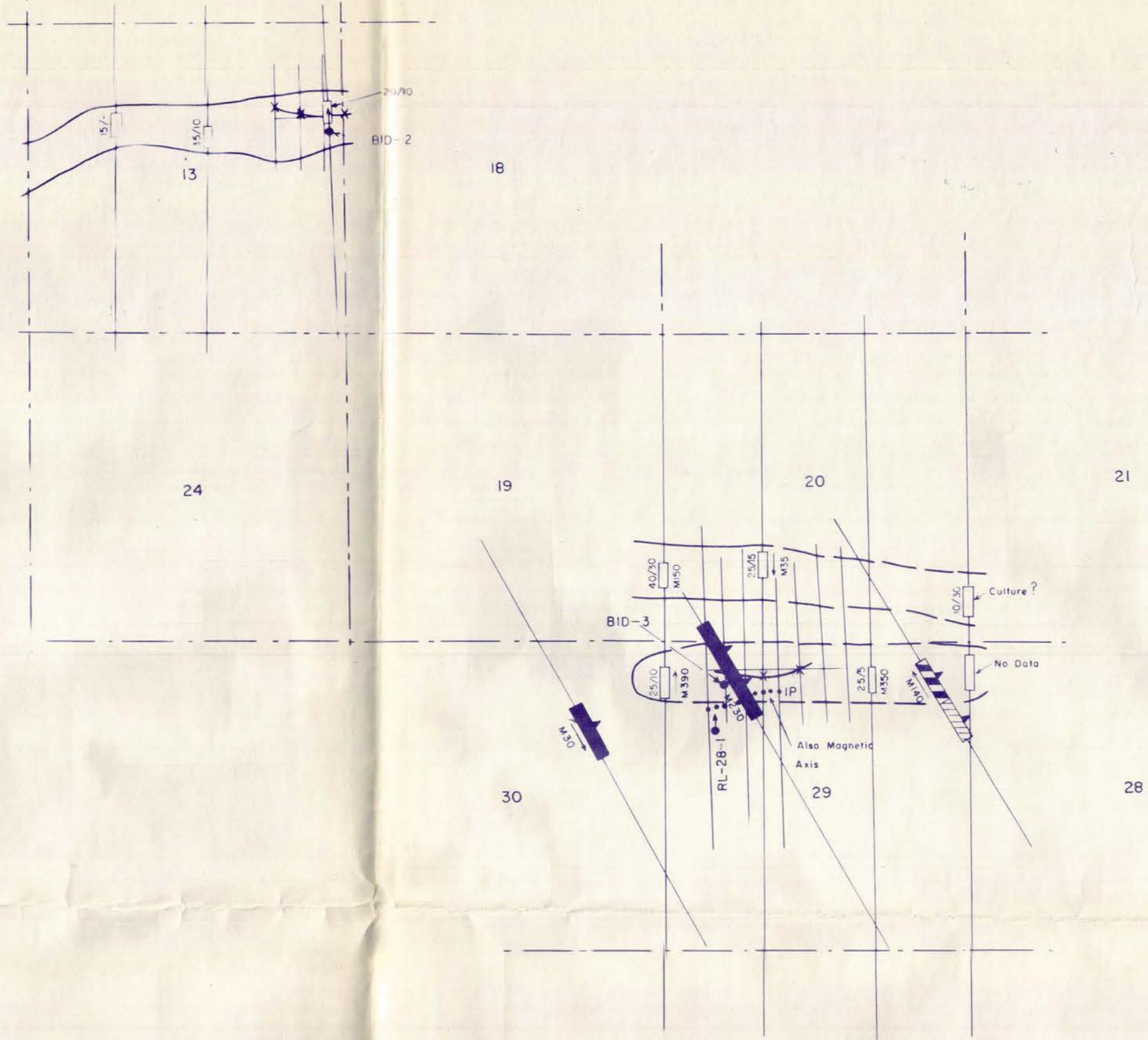
METAL AND MINERAL ABBREVIATIONS

- cp - Chalcopryite
- Cu - Native Copper
- gf - Graphite
- hem - Hematite
- mag - Magnetite
- py - Pyrite (>5%)
- serp - Serpentine
- sp - Sphalerite

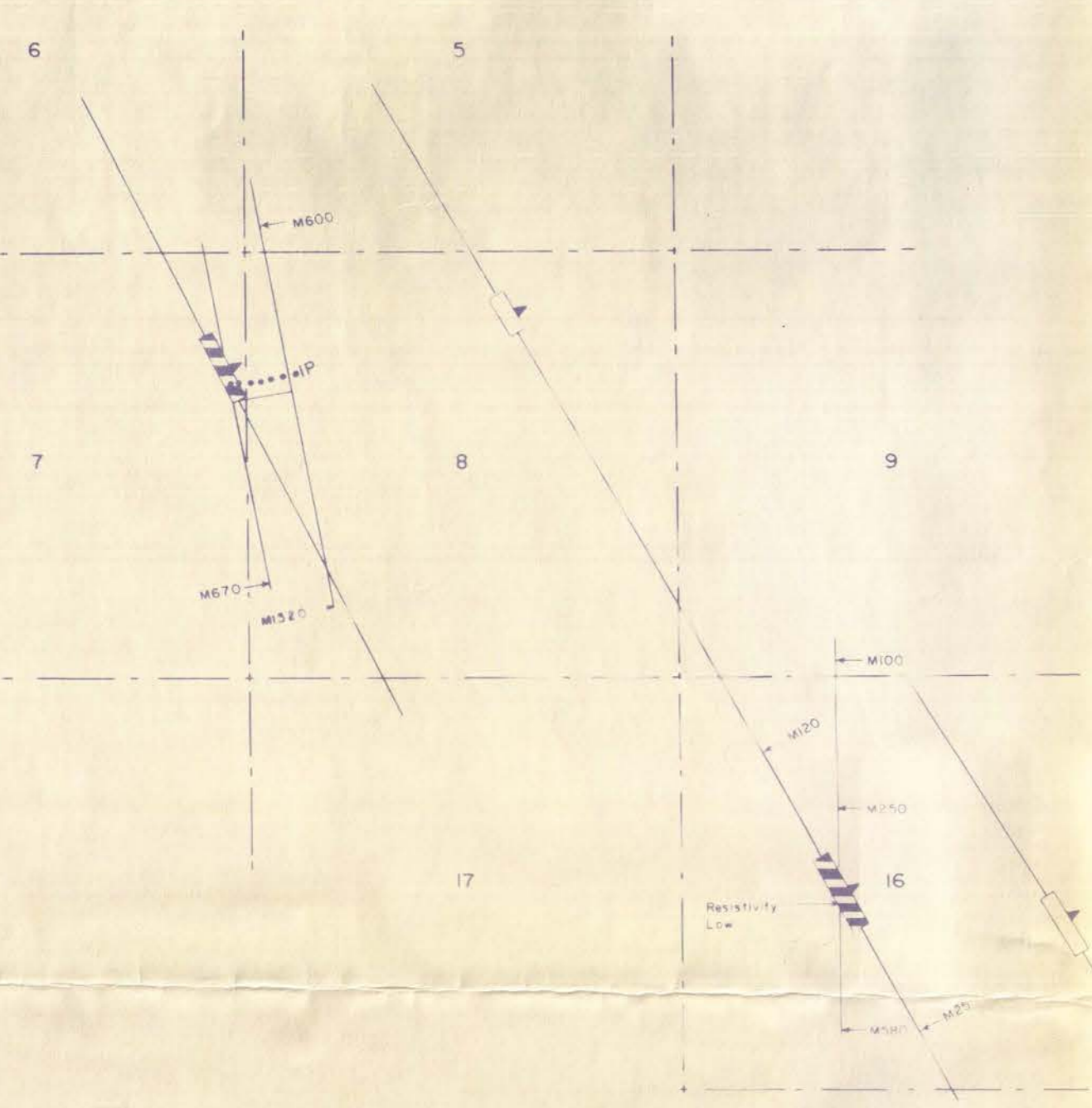
Ts150 & 151N-Rs31 & 32W



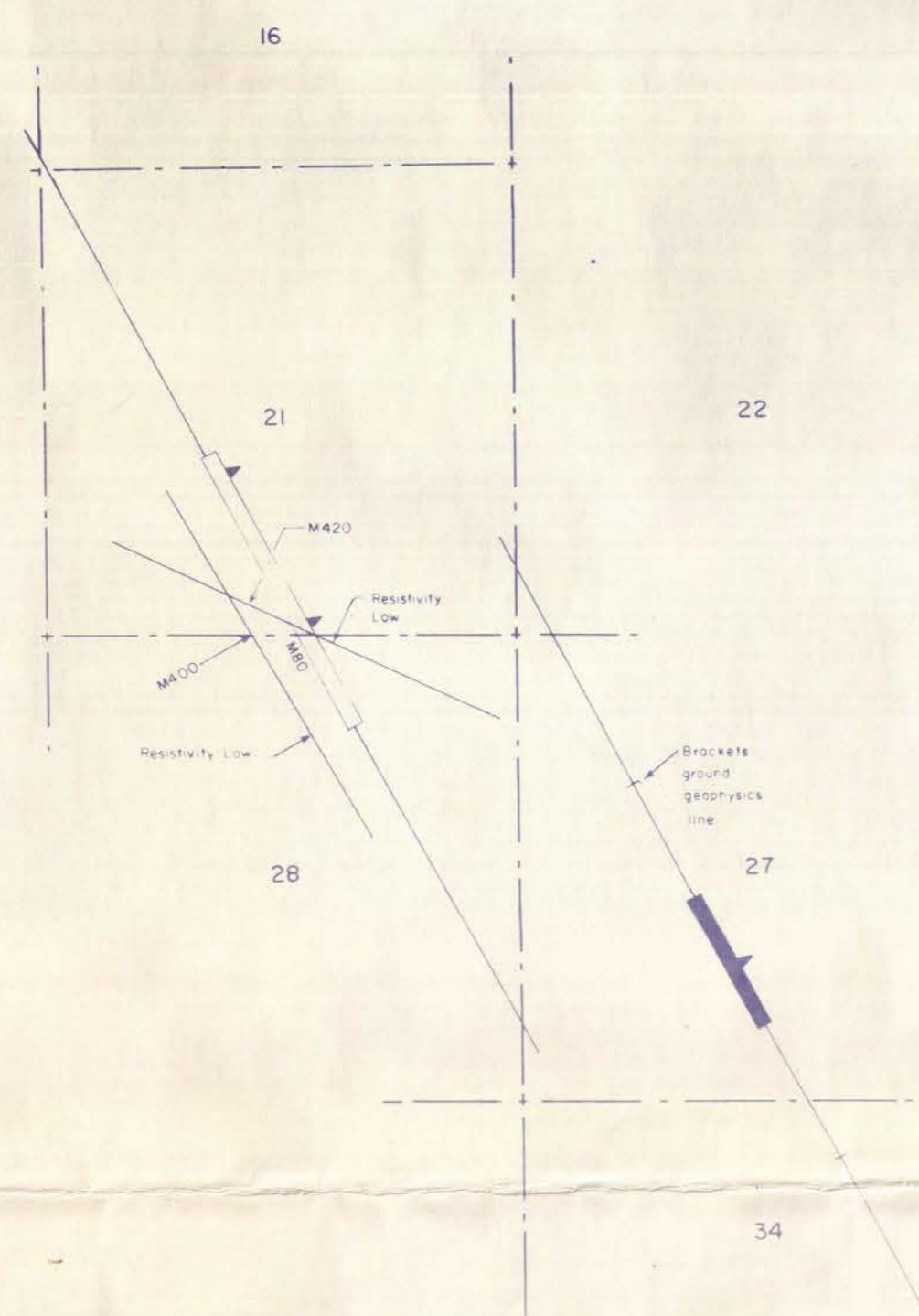
T150N-Rs31 & 32W



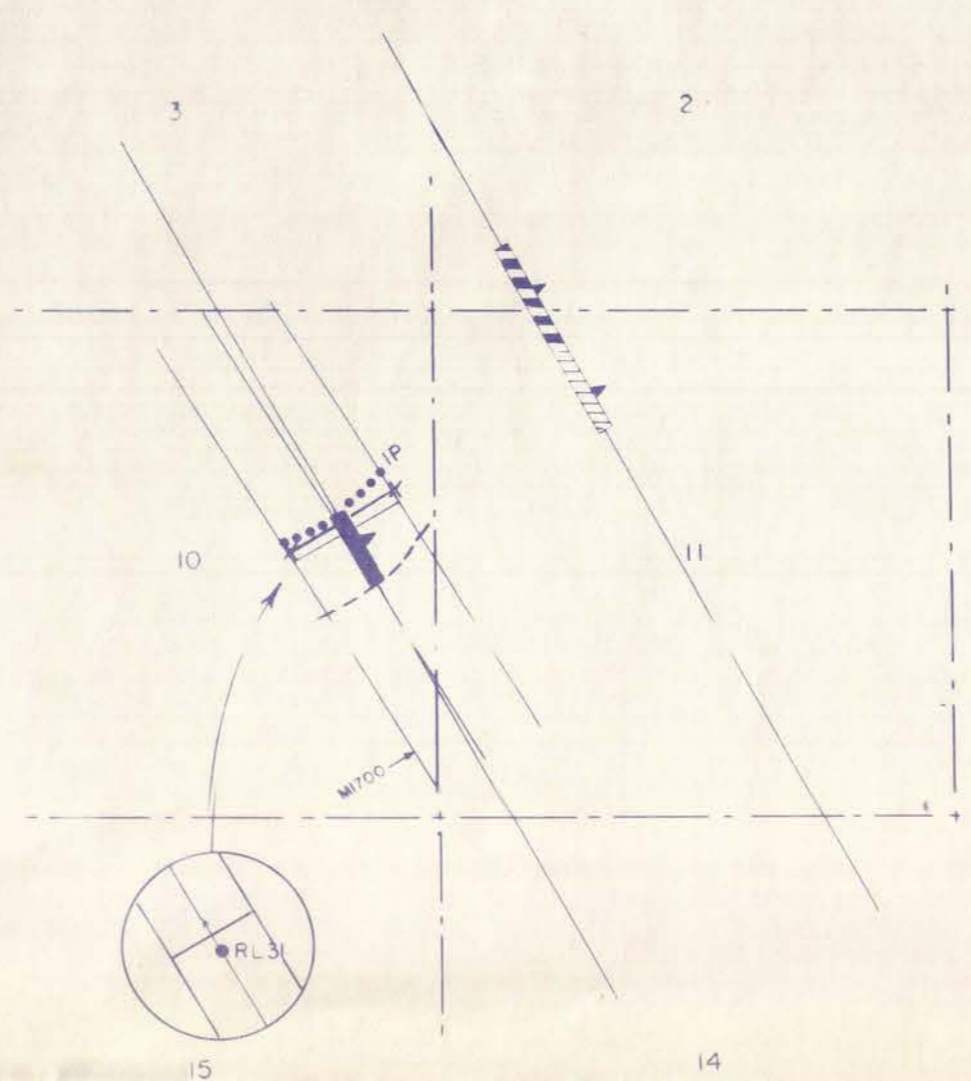
T150N-R32W



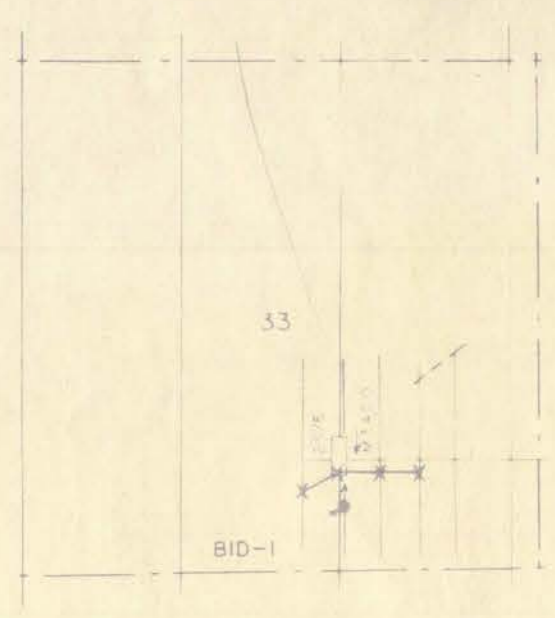
T152N-R31W



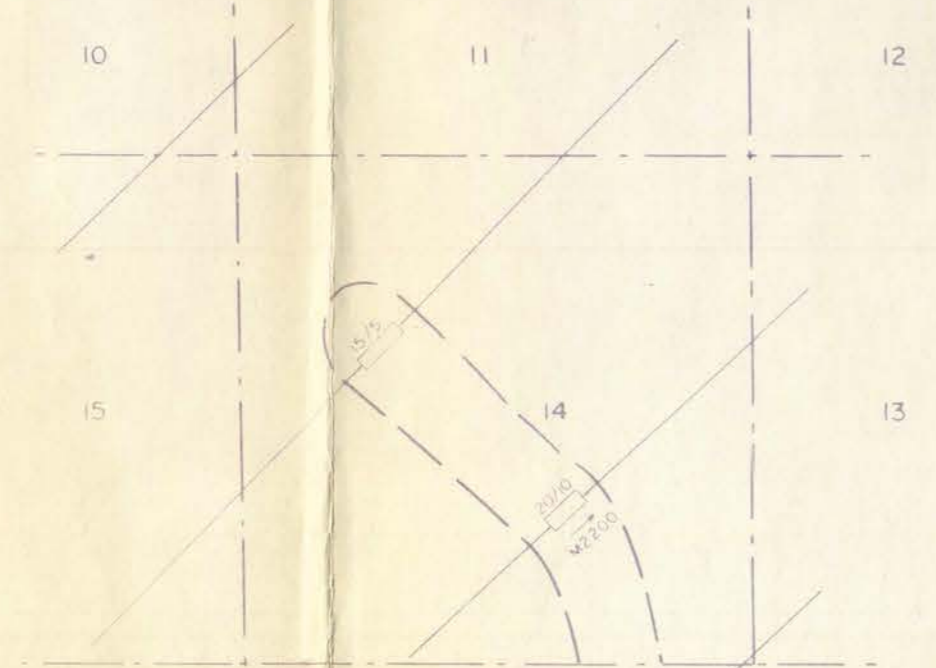
T150N-R31W



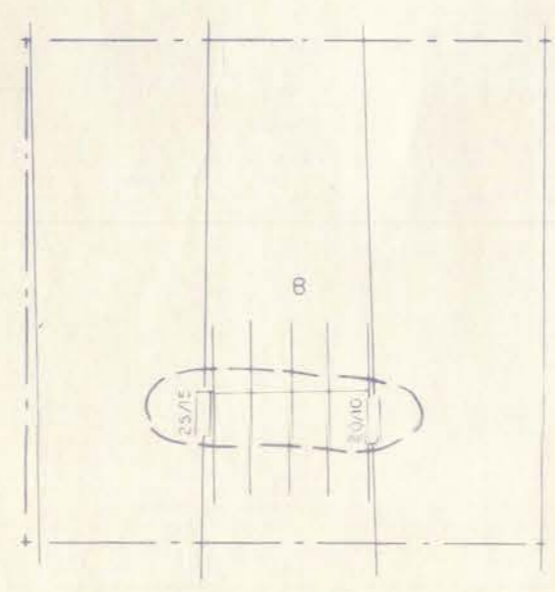
T151N-R32W



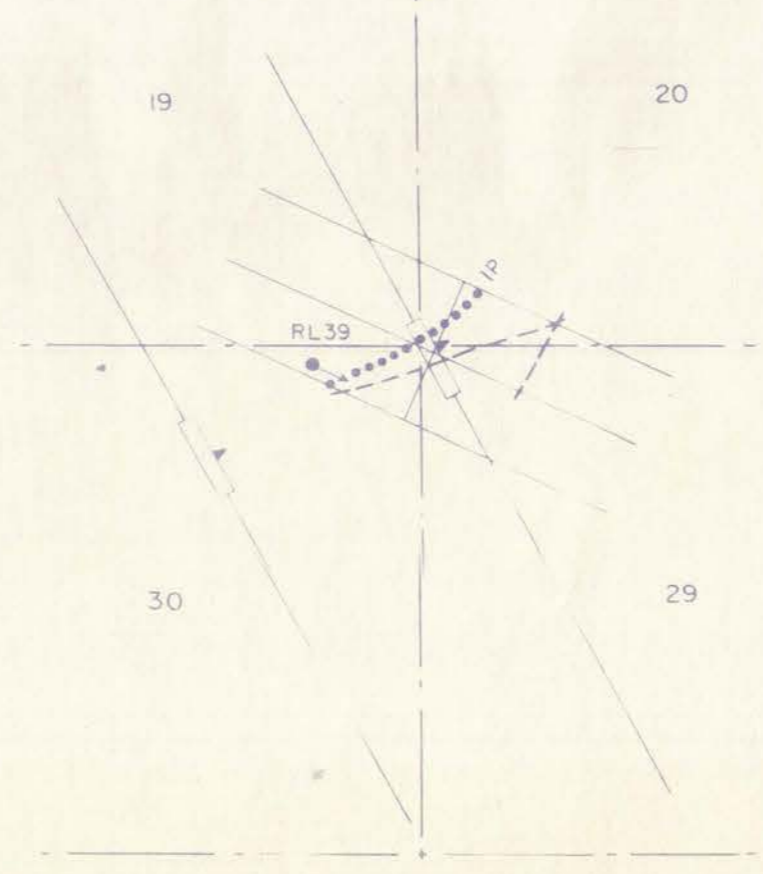
T147N-R31W



T149N-R32W



T152N-R30W



EXPLANATION

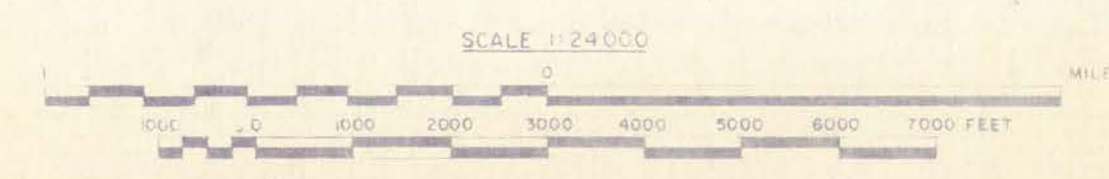
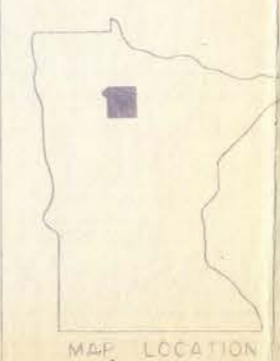
- Section line
- 36 Section number
- RL39 Diamond drill hole arrow indicates direction of inclined hole
- Ground Geophysics
- Geophysical grid
- X Vertical loop EM cross over
- Vertical loop EM conductor axis
- Horizontal loop EM conductor axis
- Trend of magnetic anomaly
- Magnetic anomaly, in gammas, on grid line
- Trend of resistivity low
- Trend of resistivity low, with associated anomalous IP chargeability
- Aero Canno Airborne Survey
- Survey by Spartan Aero Limited using a Canadian Aero Service Limited EM unit.
- Conductor, length of rectangle indicates conductor width
- 25/5 In phase/quadrature, in ppm
- M900 Coincident magnetic anomaly, in gammas
- M200 Offset magnetic anomaly, in gammas
- Outline of conductor
- INPUT Airborne Survey
- Survey by Geotrex Limited using a Barringer Research Limited, INPUT Mark V EM system.
- Peak indicates maximum of anomaly, rectangle length is width of anomaly at half the maximum value
- 6 channel response
- 5 channel response
- 4 channel response
- 3 channel response
- 2 channel response
- 1 channel response
- M200 Coincident magnetic anomaly, in gammas
- M200 Offset magnetic anomaly in gammas
- Magnetic anomaly in gammas, along flight line not related to INPUT anomaly

Geophysical data from terminated State of Minnesota Co. PI leases. The extent of airborne flight lines shown for the various areas of southern Beltrami County on this map, represents the total of all airborne electromagnetic data available for this compilation.

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MINERAL COMPILATION OF SOUTHERN BELTRAMI COUNTY

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1976