REPORT ON THE SEMI-DETAILED
SOIL SURVEY, MOUNT ARTHURS AREA
BRITISH COLUMBIA
FOR KELVIN ENERGY LTD.
CALGARY, ALBERTA

BARRINGER

'79-#48-#7160

REPORT ON THE SEMI-DETAILED SOIL SURVEY, MOUNT ARTHURS AREA BRITISH COLUMBIA FOR KELVIN ENERGY LTD. CALGARY, ALBERTA

Claims: SIM 7, JIM 13, MIDWAY 5, 6, 7

Locations: Located on Maps 82E/10, 92E/9 and 82L/15 bounded approximately by longitudes and latitudes in the Greenwood Mining District

PREPARED BY
Howard R. Lahti
Barringer Magenta Limited
304 Carlingview Drive
Rexdale, Ontario
M9W 5G2

DECEMBER, 1978

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SUMMARY

In August 1978, Barringer Magenta conducted a follow-up soil sampling survey over a part of a major stream sediment uranium anomaly that was identified by an earlier semi-detailed reconnaissance stream sediment sampling program (Lahti, 1978A). The survey was done on claims staked or optioned by Kelvin Energy Limited during 1978 that are identified by the following names; Jim 13, Sim 7, and Midway 5, 6, 7.

Two hundred and seventy nine (279) soil and ten (10) rock chip samples, respectively, were collected to try and define the uranium anomaly. All samples were analysed for uranium (fluorimetric), copper, lead, zinc, silver and nickel (atomic absorption). The soil samples were collected from the B horizon at an approximate depth of 20 cm. Helicopter support was used during all phases of the survey.

Threshold values and anomalous levels were selected empirically from frequency histograms of the individual elements. Geochemical anomalies were outlined on the uranium raw data map and ranked according to size, continuity, amplitude, geological and physiographic settings.

Two lenticular class A uranium anomalies were identified trending approximately parallel to the strike of regional fault and shear zones. A single point class B anomaly was also discovered but was downgraded due to a high organic content and the lack of proximal anomalous concentrations of uranium or other elements.

All anomalous uranium results in samples with a high content of organic matter should be viewed with caution. Although the high concentration factor indicates a uranium source other than the leaching of bedrock, the close association between the anomalous uranium value and organic matter should be resolved by additional field studies.

It is recommended that anomalies 1A and 2A be examined by detailed soil sampling, rock chip sampling and detailed study of the geology structure and physiography. All samples should be analysed for uranium. The use of a Uranium Field Kit would assist in a rapid evaluation of the uranium anomalies.

1. INTRODUCTION

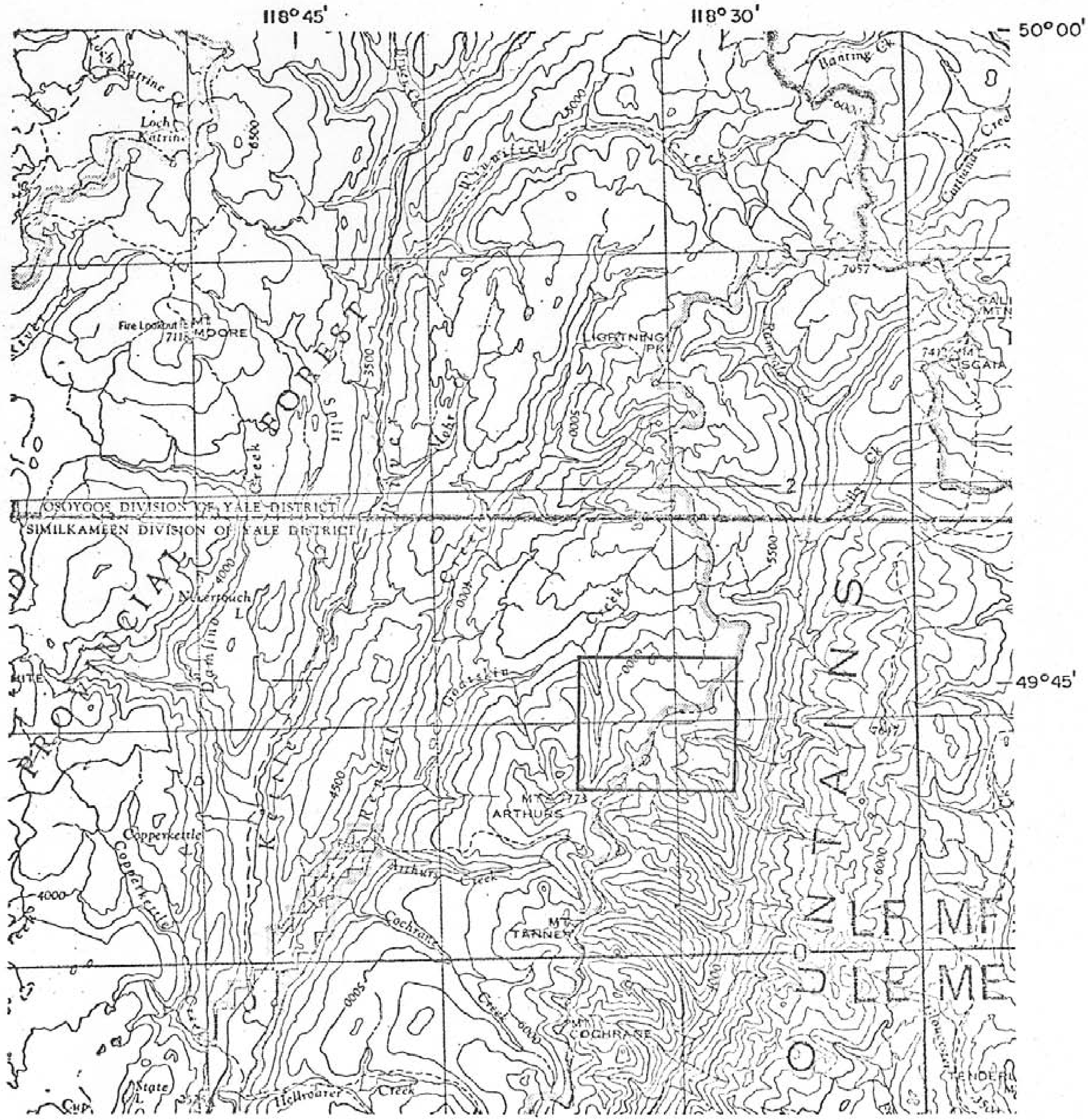
In August 1978, a follow-up soil sampling survey was conducted over part of a major stream sediment uranium anomaly outlined in the Mount Arthurs area. Four widely spaced soil traverses were completed in an area of potential uranium mineralation (see Dwg. 208-42-301). Uranium (fluorimetric), copper, lead, zinc, silver and nickel (atomic absorption) were determined in each sample. The northern most line (Line 4) occurs in an earlier staked claim block (Lahti, 1978A) in the Jim 13 and Sim 7 claims while the other three lines lie in the newly staked Mount Arthurs claim block. The claim statistics are listed in Table 1.

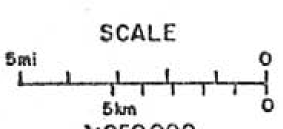
A total of 11 km. of line was sampled at 40 m. intervals. In addition, 10 rock chip samples were collected to obtain information on the bedrock distribution of uranium, copper, lead, zinc, silver and nickel.

Several strong uranium and a few weak to moderate base metal anomalies were outlined. More detailed soil sampling is required to close off the anomalies and determine their significance. This is especially true for anomaly 1A on Line 1 which opens to the south.

1.1 LOCATION AND ACCESS

The semi-detailed reconnaissance stream sediment survey was extended from the Grandby River in the east to the Rendell and the Goatskin Creeks in the west and north, respectively, (Fig. 1). The area is approximately bounded by longitudes 118^{o} 43^{o}, 118^{o} 28^{o} and latitudes 49^{o} 47', 49^{o} 41'. The Mount Arthurs area is found in south-central British Columbia about 75 km. north of the United States-Canada border.





Location Map for

Mount Arthurs Soil Survey Area

N.T.S. REF. 82 E

Fig. 1

Table 1

Claim Statistics for Kettle River Claim Block

Claim No.		No.of Units	Date of Recording	Record No.	Mining Division
MIDWAY	1	15	September 28, 1978	1327	Greenwood
"	2	15	"	1328	"
"	3	18	"	1329	"
"	4	18	"	1330	"
"	5	14	"	1331	"
"	6	14	"	1332	"
"	7	14	"	1333	"
"	8	18	"	1334	"
"	9	18	"	1335	"
"	10	18	"	1336	"
"	11	18	"	1337	"
"	12	18	"	1338	"
"	13	18	"	1339	"
"	14	18	"	1340	"
"	15	18	"	1341	"
"	16	18	"	1342	"
"	17	18	"	1343	"
"	18	18	"	1344	"
"	19	18	"	1345	"
SIM	7	20	June 9, 1978	1112	"
JIM	13	20	June 9, 1978	1134	"

There is a passable gravel road along the Grandby River part way up to the Mount Arthurs area. The remainder of the distance can be traversed by foot or by horse along a trail developed to a point approximately due east of Mount Arthurs. Another trail (horse) extends from the Rendell Creek north of the Mount Arthurs Creek but its condition is not known. Because this route is very difficult to travel, all work done in the Mount Arthurs area was accomplished using a Bell 206-B Jet Ranger helicopter based in Penticton, B.C.

2. GEOLOGY

The predominant rock unit in the Mount Arthurs area consists of non-porphyritic rocks of the Valhalla and Nelson Intrusions (Little, 1957). These rocks have been dated as late Jurassic to Cretaceous. The Valhalla can be distinguished from the Nelson Intrusions by the presence of smokey quartz, the rarity of hornblende and the ollotrimorphic texture in the former.

A large area of Paleozoic (including Upper Proterozoic and Trassic) rocks lie northeast of Mount Arthurs in the northeast to central part of the claim block. This unit consists of paragneiss, basaltic and andesitic lavas, greenstones, tuff, quartzite, limestone and argillite (Little, 1957). The rocks collectively have been put into the Anarchist Group. The above geological units have been outlined on all maps at the back of the report.

A reconnaissance traverse from Mount Arthurs to the Goatskin Creek was accomplished by following the ridges to the east of Mount Arthurs. The primary purpose of the traverse was to examine the gamma radiation from exposed outcrops and especially those cut by strong fracturing or faulting. Also, observations were made on geology and structure. The highest gamma radiation recorded was located to the east of Mount Arthurs in strong north-south shears and faults. Some of the larger faults form scarps up to 15 m. high. It is tentatively concluded that there is high background gamma radiation related with the strong shearing, fracturing and the large north-south faults. The faults which vary from less than a metre to greater than 10 metres were frequently observed up to three kilometres east of Mount Arthurs where the traverse turned south. This traverse cut across a soil traverse line (Line 1) on a ridge separating the Goatskin drainage basin from streams flowing into the Grandby River.

The rock chip data (Table 2) shows the Anarchist Group paragneiss to have a wide range of uranium values; e.g., 0.6 ppm - 26 ppm. In contrast, the two granite gneiss rock samples belonging to the Nelson and Valhalla Instrusions have only 0.2 ppm. The paragneiss of the Anarchist Group has a wide variation in trace element content reflecting the different phases within the paragneiss and possibly weak mineralization. The latter case is typified by sample NLFR-7 which has 26, 29, 245, 3.0 and 21 ppm uranium, lead, zinc, silver and nickel, respectively, suggesting a dramatic change in bedrock trace element concentration or the sample was obtained at or near weak mineralization. Also the large variation in nickel suggests there are mafic or basic phases within the granite paragneiss.

The number of rock samples are too few to make a qualitative assessment of any variation in trace element content between the Anarchist Group of rocks with the Nelson and Valhalla Intrusions.

TABLE 2

ROCK CHIP DATA FOR ANOMALY 2A

Sample Number (NLFR)	Location	U	Cu	Pb	Zn	Ag	Ni	Rock Description
3	NLFS 404 Line 2	.8	3	6	15	<.2	3	Granite gneiss Anarchist Group
4	NLFS 405 Line 2	.6	8	15	80	.4	45	Granite Anarchist Group
5	NLFS 406 Line 2	1.4	7	7	44	<.2	3	Granite Anarchist Group
6	NLFS 407 Line 2	15.0	10	10	50	.4	5	Granite Anarchist Group
7	NLFS 480 Line 4	26	6	29	245	3.0	21	Granite gneiss Anarchist Group
8	NLFS 506 Line 4	.8	8	10	82	.6	16	Intermediate to acidic dyke with hornblende laths Anarchist Group
9	NLFS 529 Line 4	.2	16	15	54	.6	28	Granite gneiss Valhalla
122	NLFS 1276 Line 3	1.4	3	8	40	<.2	2	Granite gneiss (fresh) Anarchist Group
123	NLFS 1323 Line 1	0.2	6	12	90	.4	2	Granite (fresh) Nelson Intrusions
124	NLFS 1359 Line 1	0.2	12	12	77	.4	4	Granite (fresh) Nelson Intrusions

3. TOPOGRAPHY, CLIMATE, DRAINAGE, VEGETATION

3.1 TOPOGRAPHY

Mount Arthurs (2355.5 m.) is located in the approximate centre of the claim block within the north-northeast striking Midway Range Mountains. The area is characterized by deeply dissected valleys formed by the Grandby and Kettle Rivers and the Rendell-Goatskin Creeks. Tributaries of the rivers and major streams have not cut into the land surface as deeply. However, the tributaries draining to the east from the Midway Range Mountains into the Grandby River have carved very deep valleys. Apparently, the Grandby River follows a major fault which has lowered its base level. Rapid down-cutting followed development of the aforementioned steep tributary valleys.

The micro-topography can be very severe with small and innumerable north-south faults forming scarps. Also, in areas with deep glacial till or reworked gravels and sands, streams have usually cut through the surficial deposit forming steep "v" shaped valleys.

3.2 CLIMATE

The climate is wet and cool with the snow level varying greatly with elevation. Frost, snow and hail can occur during any month of the year with snow remaining on the northern slopes until late July. The area is only free from snow for several weeks every year.

3.3 DRAINAGE

The drainage is characterized by a few large, well developed, streams that have numerous small, steep gradient, tributaries. The main streams flow all year but many of the smaller ones are seasonal. Most streams have a very steep gradient at their headwaters but quickly change to a much reduced gradient in the larger valleys. Streams 1 and 2 (Lahti, 1978) flow over or adjacent to the Mount Arthurs soil grid.

The streams are fast flowing with little silt size sediment accumulations in the streambeds. The stream load is predominantly rock flour, rock fragments and water soaked tree litter. Most streams have a pH range of 6.,Q to 6.2.

3.4 VEGETATION

The area above 1820 m. consists of rocky ridges and spurs with numerous peaty bogs and meadows in depressions and flat areas. Stunted fir trees can be found almost to the top of Mount Arthurs. The lower slopes have good stands of fir with an underbrush consisting of alders, willows and a variety of shrubs. Cedar and hemlock are found at lower elevations along the larger streams.

3.5 SOILS

There is a considerable variation in soil type with elevation and the severity of the topography. The zones of restricted drainage provide the greatest influence on soil development. In the large deep valleys at low elevation the soil has developed a 5-15 cm. thick litter horizon with partially decomposed organic matter. The A_1 or leached horizon is not always present. Below this are well developed B_1 and B_2 horizons where colour is variable and dependent on the ground water movement within the soil horizon and the rock type. The usual colour is dark reddish and brown but in areas with high organic carbon content, the soil takes on a greyish tinge. Soils in some of the swampy areas have poorly developed B horizons. Well drained soils in the forests develop a thick (up to 10 cm.) leached horizon. The B horizon in these soils varies from reddish-brown to bright yellow. Also, in well drained soils over tallus slopes, the soil consists primarily of an organic mat with a highly leached mineral soil. No appreciable B horizon has formed and the C zone is represented by partially weathered rock fragments.

4. GEOCHEMISTRY

4.1 GENERAL STATEMENT

The purpose of the soil sampling was to test the area east of stream 2 (Lahti, 1978B) from which two small tributaries gave uranium values of 130 and 138 ppm, respectively. Lines 2, 3 and 4 and a part of Line 1 cover an area draining into stream 2. Line 1 also covers part of the Grandby River watershed. Two hundred and seventy nine (279) soil and 10 rock chip samples were analysed for uranium, copper, lead, zinc, silver and nickel. Details on field methods and laboratory techniques are found in Appendix III.

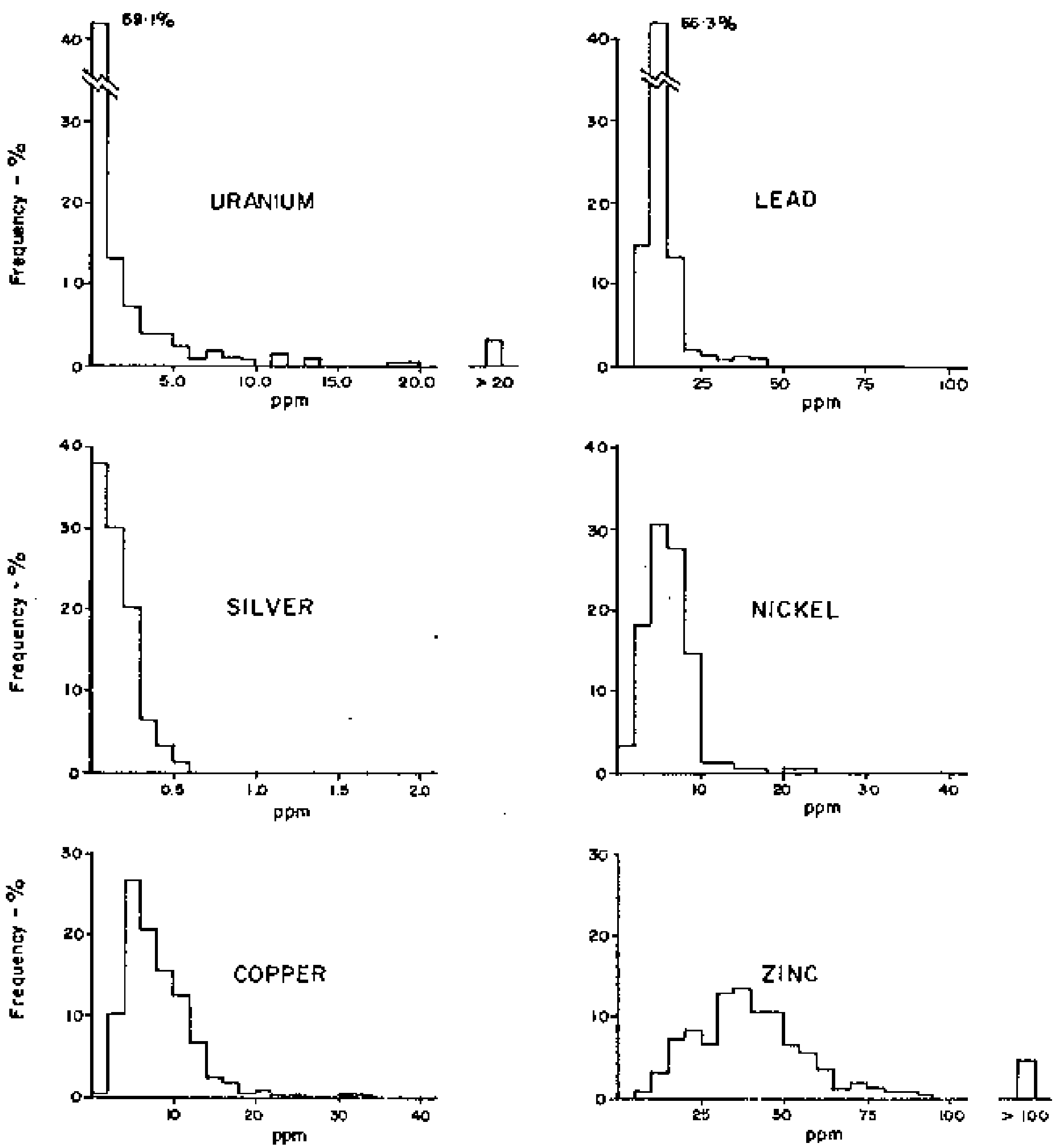
4.2 RESULTS

The results for uranium are plotted on a single element map (1:10,000) prepared from an enlargement of a 1:50,000 topographical map (NTS 82E/10) and are found in the back of the report. Copper, lead, zinc, silver and nickel values are plotted on a separate map of the same scale. The sample location and sample numbers are plotted on a separate map (Dwg. 208-42-301) while claim boundaries are found on all maps. The soil results are listed in Appendix IV; rock samples are listed in Table 2.

The frequency histograms for each element are found in Fig. 2.

4.3 INTERPRETATION

Thresholds and anomalous levels were selected from the histograms and are listed in Table 3. Areas of anomalous uranium are outlined on the uranium raw data and interpretation map (Dwg. 208-42-302).



FREQUENCY DISTRIBUTION OF URANIUM, LEAD, SILVER, NICKEL, COPPER AND ZINC IN SOILS ANOMALY 2A, MT. ARTHURS AREA.

FIG. 2

On the uranium interpretation map, the geochemical features have been identified by a number-letter code. The number part indicates the order in which the anomaly should be followed up and the letter indicates the relative strength of the anomaly considering the size, continuity, amplitude and geological setting. Thus, anomalies with an "A" are rated the highest. Generally, further work may be done on 'C' class anomalies if additional geophysical, geological information or other information becomes available.

4.3.1 Uranium

The overall distribution of uranium shows several north-south trending zones 80 to 300 m. wide and up to 3 km. long. Parts of two zones have first order anomalous uranium values and are identified as 1A and 2A (Dwg. 208-42-302). The traverses have a spacing of 700 to 800 m. so the indicated trend of the anomalous zones is tentative.

The prime uranium targets are located on Line 1 near the watershed divide between the Goatskin Creek and Grandby River and Line 3 adjacent to streams 1 and 2. The uranium values in both locations exceed the local threshold values of 6.0 ppm by a factor of up to 8 times and are located within lenticular zones which have third and fourth order values. The soil grid lies entirely within an area of granitic rocks, the Nelson and Valhalla intrusives and the older Paleozoic paragneiss. Rock chip samples collected within the area of the soil grid, from these two younger intrusives (Nelson and Valhalla) have a low uranium concentration of 0.2 ppm (Table 2). Rock chip samples from the Paleozoic gneiss (Anarchist Group) range from 0.2 - 26 ppm uranium with samples collected near soil sample NLFS-407 and NLFS-408, having values of 15 and 26 ppm uranium, respectively.

The limited rock geochemical data must be considered as a guide only. From the limited information, it is suspected that the main uranium source is related to the regional north-south striking faults and shear zones which cut all rocks. However, because anomalies 1A and 2A are on a very widespread grid, they should be delineated further with a much tighter 50 to 100 m. grid. It is also possible that the source of the uranium anomalies is local high background concentration of uranium in the silicate lattice of the rock forming minerals, or "contact type" uranium mineralization along the boundary of the younger granites and the older paragneiss, similar to the Midnight Mine in Washington State.

Anomaly 3B is a single point anomaly on the western end of Line 1 adjacent to stream 2 (Dwg. 208-42-302). This anomaly has been downgraded because of its limited extent and possible enrichment of the uranium by organic matter on the streambank.

TABLE 3

THRESHOLD AND ANOMALOUS LEVELS FOR URANIUM, COPPER, LEAD, ZINC, SILVER AND NICKEL

Element	Threshold (ppm)	Fourth Order Anomalous (ppm)	Third Order Anomalous (ppm)	Second Order Anomalous (ppm)	First Order Anomalous (ppm)
U	3.0	3.1 - 6.0	6.1 - 9.0	9.1 - 20	> 20
Cu	18	---	---	19 - 40	> 40
Pb	20	---	---	21 - 40	> 40
Zn	65	---	---	66 - 100	>100
Ag	1.0	---	---	1.1 - 2.0	> 20
Ni	10	---	11 - 20	21 - 40	> 40

However, 178 ppm uranium represents a large enrichment factor and additional sampling should be undertaken to verify the amplitude and extent of this anomaly.

The areas of first and second order anomalous uranium values in soils are quite closely coincident with high organic content (although this converse is not true, there are many high organic soils without anomalous uranium). Uranium is well known to be highly mobile in the surface environment under climatic conditions similar to those found within the survey area. This results in leaching of uranium from soils and near surface rock (particularly open fractures). This uranium migrates hydromorphically in near surface run-off and ground water and accumulates particularly on organic matter, in local areas of reducing conditions. The most common sites for deposition are stream sediments and organic rich areas in soils (bogs, seepage zones, breaks in slope, etc.). This mobility and migration can result in a significant distortion of the uranium anomalies in soils such that the strongest anomalies may well occur in organic rich areas and not directly over mineralization. In fact, with near surface leaching, soil and surface bedrock anomalies directly over mineralization can be very subtle. It is important to take this aspect of the geochemistry of uranium into consideration during interpretation of soil grid data. Pitting and profile sampling can be very useful in evaluating this problem. Characteristically values drop off very rapidly with depth in profile samples over seepage anomalies. Conversely, directly over mineralization values remain about the same or increase with depth.

Anomaly 4C is a north-south striking lens-like zone about 250 m. east of anomaly 1A and crosses Lines 2 and 3 and is extrapolated to extend past stream 1 to Line 4. The third and fourth order uranium values probably indicate a weakly mineralized zone or a zone of secondary concentration by soil forming processes such as an accumulation of organic carbon. However, a more detailed follow-up program would be needed to separate uranium anomalies due to mineralization from those due to other causes.

Other small, less significant, uranium anomalies also occur, especially along the east half of Line 1. None of these weak uranium features are considered significant at this time but if additional geochemical, geophysical, geological or other information becomes available or if follow-up of anomalies 1A, 2A and 3B give positive results, then all these features should be reassessed.

4.3.2 Copper, Lead, Zinc, Silver and Nickel Geochemical Features

The copper, lead, zinc, silver and nickel geochemical features have not been classified but one feature, at the extreme east of Line 1, contains a significant number of anomalous zinc values (Table 3) that are 2 to 3 times the local threshold value of 65 ppm and occurs within the Nelson Intrusive rocks. Within this broad zone occur smaller second and third order copper-nickel, nickel and lead-copper anomalies (Dwg. 208-42-303). Although this geochemical feature is strong and coherent, it is not thought to be indicative of economic mineralization.

There are several other geochemical features which have first to third order anomalous values in lead and/or zinc. These are judged to reflect rock type changes within the Valhalla, Nelson granite gneiss, Paleozoic rocks of the Anarchist Groups or minor uneconomic mineralization in shear zones or faults. None of these features are considered important at this time but should be reassessed depending on budget constraints or the acquisition of important new geological, geophysical or geochemical information. None of the copper, lead, zinc, silver or nickel anomalies show any significant coincidence with uranium anomalies.

5. CONCLUSIONS

1. The best uranium anomalies, 1A and 2B, and also the weaker anomaly 4C appear to be related to mineralization in north-south shears or faults which cut all rock types. The possibility of the uranium source being local concentrations in the rock forming minerals or "contact type" mineralization similar to Midnight Mine cannot be ignored on the basis of the available information.
2. The faults and shears generally produce topographic lineations, i.e.; linear swamps, stream channels or valley bottoms. These are all natural accumulation points for organic matter, a powerful scavenger for uranium. Uranium is known to be very mobile under these climatic conditions, which has undoubtedly resulted in distortion of soil anomalies. This aspect of uranium geochemistry must be taken into consideration when interpreting soil data. It is also quite possible that surface rocks will be depleted in uranium due to leaching.
3. Anomaly 3B is thought to be due to uranium concentrated by organic matter close to stream 2. However, this strongly anomalous value (178 ppm) does indicate a source rich in uranium within the area from which groundwater can move to this sample location.
4. Other anomalies are not considered important at this time and have not been rated.
5. The best base metal (zinc) anomaly occurs at the extreme eastern end of Line 1 and has several partially coincident copper, nickel or lead anomalies. This multi-element anomaly is not considered important from a base metal point of view at this time but should be re-examined if additional geochemical, geophysical, geological or other information becomes available.

6. No significant direct correlation was found between uranium and copper, lead, zinc, silver and nickel. However, it may be pertinent to note that at the Midnight Mine, a zoning of copper and nickel and direct correlation with lead has been noted. When more detailed information is available on the distribution of these elements, then interpretation could be more important.

6. RECOMMENDATIONS

Due to the suspected distortion of the soil anomalies by hydromorphic movement of uranium, follow-up work should be undertaken in two phases. The first phase would consist of fill-in sampling between the widely spaced traverse lines and the second phase, soil grid, pitting and trenching would be undertaken based on the results obtained during the first phase of work. The first phase is designed to cover not only areas over and adjacent to anomalies 1A, 2A and 3B but also the intervening well drained soils up slope where the uranium source could be hidden. Based on these conclusions, recommendations are made as follows:

1. Fill-in soil sampling at 40 metre intervals on lines 200 metres apart between the existing lines and at least 600 metres further to the north and south to close off the uranium anomalies. The southern extension of this anomaly extends into a major anomalous area to the south as outlined in the detailed stream sediment survey of the Mount Arthurs area (Lahti, 1978B). The soil samples should be collected from the B horizon (± 20 cm.) and the organic carbon content visually estimated and recorded. The samples should be analysed for uranium, copper, lead and nickel. The uranium field kit could be used to advantage during this phase of work to rapidly identify uranium soil anomalies.
2. Rock chip samples should be collected every 100 metres as outcrop permits. In addition to analysing for copper, lead and nickel by atomic absorption and uranium by the fluorimetric method, the anomalous rock samples should be treated with several different extractions to determine the mode of occurance of the uranium.

Care must be taken to examine the surface rock samples for the destruction of primary uranium movements by leaching, leaving behind only the uranium bound in silicate and similar lattices or secondary uranium associated with iron oxides or other amorphous compounds.

3. In conjunction with the above geochemical studies, airphoto interpretation of the structural patterns and detailed geology within the entire Mount Arthurs area should be undertaken.
4. Consideration should also be given to a geophysical E.M. and magnetic survey to assist in geological mapping and to outline major structures and any conductors.
5. The second phase of work would be to determine if the strongest uranium soil anomalies are in situ or have been transported hydromorphically to seepage zones, breaks in slope or swampy depressions. Pitting and trenching with analysis of profile samples plus detailed observation of the ground hydrology should be used to separate hydromorphic from in situ anomalies. In interpretation of the data from recommendation 1 above, it is important to give at least as much importance to subtle uranium anomalies on well drained ground as strong anomalies in poorly drained. Work should continue until it is confidently felt that the source of the uranium has been located and the effects of surface leaching has been resolved.
6. Following the completion of the program in 1-5 above, if drilling is undertaken in this area, an important aspect of the drilling program will be to evaluate the degree of surface leaching of uranium.

REFERENCES

1. Lahti, H.R. (1978A): Report on the Semi-Detailed Reconnaissance Stream Sediment Survey, Kettle River Area, British Columbia. Private report for Kelvin Energy Ltd., Calgary, Alberta.

2. Lahti, H.R. (1978B): Report on the Semi-Detailed Stream Sediment Survey, Mount Arthurs Area, British Columbia. Private report for Kelvin Energy Ltd., Calgary, Alberta.

3. Little, H.W. (1957): Geology of Kettle River (East Half), Geological Survey of Canada, Map 6-1957.

APPENDIX I

STATEMENT OF QUALIFICATIONS

I, Howard Reino Lahti of Toronto, do certify that:

1. I graduated from the University of New Brunswick, Fredericton, New Brunswick in May, 1978 with a Doctor of Philosophy in Geology (Applied Geochemistry).

2. I graduated from the University of New Brunswick with a B.Sc. in Geology in 1968 and M.Sc. in Geology (Applied Geochemistry) 1971.

3. I have worked with Barringer Magenta Limited of Toronto, Ontario since June 1975 as a geologist/geochemist.

4. I have worked as a geologist, geochemist or attended university since 1964.

5. I am a Member of the Association of Exploration Geochemists.

Howard Lahti

H.R. Lahti, Ph.D.
Geologist-Geochemist
Barringer Magenta Limited

APPENDIX II

ASSESSMENT REPORT

Statement of Cost:

a) Days Worked at Mount Arthurs

Supervisor: H. Lahti, August	6 days
Geochemical Technician:	
G. White, August	5 days
Junior Sampling Assistant:	
R. Balford, August	6 days
Junior Sampling Assistant:	
K. Wisser, August	6 days
Junior Sampling Assistant:	
D. Pyke, August	6 days
Camp Guard: D. Moroke, August	1 day
Consultants: I. Thomson, August,	3 days
P. Bradshaw, August	1 day

b) Cost of Wages

Supervisor, 6 days @ $220/day =	$ 1,320.00
Geochemical Technician, 5 days	
@ $119/day =	$ 595.00
Junior Sampling Assistants, 18 days	
@ $96/day =	$ 1,728.00
Consultants (2), 4 days @ $300/day =	$ 1,200.00
Camp Guard, 1 day @ $25 =	$ 25.00
	$ 4,868.00

c) Food and Accommodation

i) Field Camp:

Charges: $ 7.00 per day per person - food
$13.00 per day per person for rental of tents, etc.
$20.00

30 crew days x $20 =	$ 600.00
ii) Accommodations and Food at Vernon Lodge, 4 days @ $43/day =	$ 172.00
	$ 772.00

d) Instrument Rental

i) 2 Exploranium Model GR-101A $225/month	$ 87.08
ii) Spectrometer, GAD-6 =	$ 338.24
iii) Radio Telephone =	$ 121.91
	$ 547.23

e) Geochemical Analysis

i) Rock Chip Samples, $8.90/sample for U, Cu, Pb, Zn, Ag, Mo or Ni 10 x $8.90 =	$ 89.00
ii) Soil Sampling, $7.30/sample for U, Cu, Pb, Zn, Ag, Mo or Ni $7.30 x 280 =	$ 2,051.30
	$ 2,140.30

f) Transportation

i) Truck Rental, 6 days @ $51/day =	$ 306.00
ii) 3/4 Ton Pick-up (to close down camp) =	$ 38.31
iii) Helicopter Support 8.1 hours @ $399.30/hour =	$ 3,234.33
	$ 3,578.64

g) Cost of Report Preparation

i) Drafting and Compilation:	
Compilation: P. Lawrence =	$ 274.40
Drafting: R. Marcroft =	$ 274.40
Data Graphics: M. Herz =	$ 300.00
Materials =	$ 200.00
ii) Report Writing =	$ 1,760.55
	$ 2,643.65

h) Miscellaneous Costs:

telephone, telex, sample shipment, miscellaneous materials and accommodation =	$ 1,039.29
TOTAL CHARGES	$15,589.11

APPENDIX III
FIELD METHODS

1. Soil Sampling

Soil samples were collected by using a grub-hoe. The soil sample was collected from the B horizon generally at a depth of $\pm$ 20 cm. Approximately 250-500 grams of soil were placed in high wet-strength Kraft paper bags (6 cm. x 9 cm.). The soil traverses were placed at 700-800 m. intervals approximately perpendicular to stream 2 and parallel to the anomalous tributaries. Samples were collected every 40 m. with direction measured by compass and distance by pacing. The sample site was marked by a 1 m. length of orange fluorescent flagging tape with the metreage and/or sample number marked on with a water proof marking pen. The whole of the traverse was blazed using small lengths of the same material. Occasionally, samples could not be collected due to the severity of the topography. In other areas of extensive outcrop or tallus slope, composite rock chip samples were collected.

2. Rock Chip Sampling

In conjunction with the soil sampling, rock chip samples were collected where outcrops permitted. The rock chip samples consisted of 3 to 5 rock fragments collected from an area 50 to 100 m^2. About 250 grams of material were placed in a high wet-strength Kraft paper bag (6 cm. x 9 cm.).

3. Laboratory Techniques

All of the soil sample analyses were done in Barringer Magenta Limited laboratories at Calgary, Alberta and Rexdale, Ontario. The samples were first oven dried at a temperature of 45°C. The samples were then sieved through an 80 mesh nylon screen. A .500 gram portion of this was placed in a glass test tube and perchloric-nitric acid was added. The test tube was then placed in an aluminum heating jacket and heated for 4 hours. After cooling and diluting to the final volume, the solution then was directly aspirated into a Varian Techtron atomic absorption spectrophotometer from which copper, lead, zinc, silver and molybdenum concentrations were read directly in ppm. The uranium was determined fluorimetrically by using the following procedure. A .250 gram sample was weighed into a glass test tube and 5 ml. of nitric acid was added. The samples were digested on a sand bath for 2-1/2 hours. After cooling and diluting to the final volume, an aliquot of solution was pipetted onto a platinum dish and evaporated to dryness. Flux was added to the dish and then fused with the sample. After cooling, the disc was then compared with fresh standards using a Jarrell-Ash Fluorometer.

The limit of detection for copper, lead, zinc, silver, nickel and uranium are 1, 1, 1, .2, 1 and .2, respectively.

Rock chip samples were prepared by first crushing the sample in a rock crusher and putting it through a pulverizer. The resulting sample was then put through a -200 mesh nylon sieve and treated in the same manner as a soil sample as described above.

APPENDIX IV

ANALYTICAL DATA

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm
NLFR-3	3	6	15	<.2	3	0.8
4	8	15	80	0.4	45	0.6
5	7	7	44	<.2	3	1.4
6	10	10	50	0.4	5	15.0
7	6	29	245	3.0	21	26.0
8	8	10	82	0.6	16	0.8
9	16	15	54	0.6	28	0.2
-122	3	8	40	<.2	2	1.4
123A	6	12	90	.4	2	0.2
123B	3	9	44	<.2	2	0.8
124	12	12	77	.4	4	0.2

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS 372	9	10	16	0.8	5	20.0				
373	8	13	37	0.4	5	1.6				
374	9	13	42	0.4	6	1.4				
375	9	13	38	0.2	6	1.4				
376	11	12	40	0.6	6	3.4				
377	9	13	46	0.6	7	2.4				
378	9	13	46	0.6	7	2.4				
379	10	12	52	0.4	8	3.8				
380	9	13	49	0.2	7	6.4				
381	10	16	49	0.6	5	7.2				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-382	12	14	54	0.6	6	5.6				
383	8	20	29	0.4	4	5.0				
384	6	13	23	0.4	3	2.4				
385	7	11	55	0.4	5	5.0				
386	14	16	63	0.8	7	8.2				
387	5	13	16	0.4	3	1.6				
388	6	11	31	0.4	3	0.4				
389	8	12	20	0.4	3	0.6				
390	6	11	25	0.8	4	0.8				
391	4	12	23	0.2	2	0.6				
392	10	16	25	0.4	6	8.0				
393	6	16	24	0.2	5	0.2				
394	7	11	19	0.2	2	0.2				
395	7	17	22	0.6	4	3.2				
396	7	10	28	0.4	5	0.6				
397	7	13	42	0.4	6	0.8				
398	9	14	27	0.2	5	0.4				
399	5	11	26	<.2	3	0.8				
400	5	11	22	0.4	3	0.2				
401	4	13	21	<.2	3	0.2				
402	6	15	27	0.2	5	0.6				
403	8	11	21	0.8	6	0.2				
404	7	12	16	0.4	3	0.6				
405	5	11	33	0.2	5	0.8				
406	4	10	24	0.2	4	0.2				
407	7	13	23	0.6	7	0.6				
408	4	12	15	0.4	4	0.2				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-409	7	17	55	0.6	8	0.4				
410	17	7	29	0.2	2	0.2				
411	3	7	7	<.2	2	3.2				
412	12	13	38	1.0	7	0.2				
413	3	7	15	0.2	2	0.2				
414	3	6	17	0.2	2	0.4				
415	7	15	14	1.0	5	0.4				
416	5	9	21	0.6	3	0.2				
417	2	6	9	<.2	1	0.2				
418	5	11	15	0.6	3	0.4				
419	7	12	15	0.6	5	1.0				
420	8	12	43	0.4	6	0.4				
421	6	11	35	0.8	6	0.6				
422	5	12	39	1.0	6	0.4				
423	8	12	53	0.8	8	178				
424	5	11	30	<.2	4	2.6				
425	6	10	28	0.4	5	0.6				
426	6	15	42	0.4	10	0.4				
427	8	17	58	0.8	9	4.8				
428	6	13	39	0.8	7	0.6				
429	9	12	55	0.6	9	0.4				
430	3	10	34	0.6	5	0.4				
431	4	10	32	0.6	4	0.6				
432	3	11	32	0.4	4	1.0				
433	4	11	35	0.6	4	0.2				
434	6	13	19	0.4	4	0.2				
435	8	13	20	1.2	6	0.2				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-436	4	9	32	0.4	3	0.2				
437	5	13	37	0.6	5	0.2				
438	5	14	33	0.6	5	0.4				
439	4	13	35	0.6	4	0.4				
440	4	13	42	0.6	5	0.4				
441	4	11	27	0.4	3	0.2				
442	5	13	39	0.6	5	0.6				
443	3	13	33	0.6	4	0.2				
444	5	12	45	0.4	5	0.6				
445	5	9	39	0.2	4	0.6				
446	6	15	31	0.2	5	0.8				
447	5	11	40	0.2	4	0.4				
448	5	10	19	<.2	3	0.4				
449	4	12	39	<.2	4	0.4				
450	5	13	42	<.2	5	0.2				
451	5	10	34	0.4	5	0.4				
452	8	12	48	0.2	8	0.4				
453	5	12	39	0.4	6	0.6				
454	5	11	16	0.4	4	0.4				
455	13	12	87	1.0	9	0.6				
456	6	7	40	0.2	4	1.0				
457	9	10	25	0.4	2	0.2				
458	5	9	17	0.4	3	0.2				
459	8	11	31	0.6	5	1.0				
460	5	7	11	0.6	5	0.4				
461	8	12	35	0.4	6	0.6				
462	7	12	24	0.2	5	0.4				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-463	10	12	20	1.2	5	22.0				
464	11	11	44	0.8	8	13.2				
465	7	15	29	0.4	10	1.6				
466	5	13	17	0.2	3	11.2				
467	7	12	24	0.6	4	18.6				
468	11	12	19	0.2	4	8.0				
469	11	11	22	0.6	5	40.0				
470	12	14	50	0.2	6	10.0				
471	7	13	18	0.2	3	3.6				
472	10	14	25	0.8	6	11.8				
473	5	14	23	0.2	3	0.4				
474	10	15	51	0.4	6	2.8				
475	10	14	43	0.4	5	2.4				
476	13	13	54	0.2	5	1.4				
477	13	15	40	0.4	5	1.0				
478	12	12	54	0.6	6	2.6				
479	11	15	54	0.2	6	0.8				
480	14	16	58	1.0	10	3.8				
481	10	15	27	0.8	7	0.8				
482	20	15	45	1.2	10	11.8				
483	17	17	52	1.0	10	4.0				
484	13	12	30	1.0	8	8.2				
485	9	13	37	0.4	8	2.0				
486	7	13	34	0.6	7	1.4				
487	11	13	22	0.2	5	1.6				
488	12	16	36	0.6	9	0.8				
489	10	15	32	0.4	6	1.2				

Geochemical Laboratory Report /

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
JLFS-490	17	13	27	0.6	7	1.0				
491	11	9	18	0.4	5	1.6				
492	8	11	37	0.6	8	1.4				
493	12	13	40	0.8	9	1.8				
494	10	13	44	0.6	8	1.2				
495	9	11	35	0.4	7	1.2				
496	10	13	40	0.6	10	1.2				
497	10	13	45	0.4	10	1.0				
498	14	14	48	0.8	10	1.6				
499	11	16	56	0.6	10	1.4				
500	7	12	33	0.4	8	1.2				
501	8	13	40	0.4	8	0.4				
502	8	15	38	0.6	8	1.2				
503	5	16	25	<.2	5	0.4				
504	13	15	51	0.8	12	5.0				
505	12	14	48	1.0	13	4.2				
506	8	12	34	0.6	7	1.2				
507	10	13	40	0.2	7	0.8				
508	8	9	34	0.4	9	0.4				
509	6	10	39	0.4	7	0.4				
510	7	12	44	0.6	9	0.4				
511	6	11	45	0.4	9	0.4				
512	6	12	46	0.4	10	0.4				
513	8	13	69	0.8	11	2.0				
514	6	10	50	0.6	8	0.8				
515	8	12	64	0.8	11	3.0				
516	7	10	50	0.4	9	2.6				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-525	6	11	38	1.0	7	0.6				
526	7	12	56	0.6	8	0.4				
527	6	12	60	0.6	7	0.4				
528	5	11	74	0.6	9	0.6				
529	7	9	50	0.6	7	0.8				
530	7	13	50	0.8	8	0.6				
531	7	11	56	0.6	10	1.2				
532	7	11	57	0.6	8	0.8				
533	5	9	44	0.6	7	0.8				
517	5	8	45	0.4	8	0.2				
518	5	10	46	0.4	9	0.4				
519	6	9	49	0.2	8	0.6				
520	6	9	50	0.4	9	0.8				
521	7	11	49	0.6	10	0.6				
522	7	10	50	0.4	9	0.8				
523	5	8	43	0.2	8	0.4				
524	4	8	30	0.4	6	4.0				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-1270	12	11	37	.2	7	0.6				
1271	18	10	64	.6	10	0.2				
1272	15	15	62	.2	18	0.2				
1273	33	17	140	.4	14	0.2				
1274	25	19	82	.4	10	0.4				
1275	21	13	59	.2	8	0.6				
1276	14	16	77	<.2	9	0.2				
1277	12	11	57	.2	8	0.4				
1278	N.S.	--	--	--	--	--				
1279	13	15	59	< .2	8	2.4				
1280	12	12	43	.4	6	2.2				
1281	12	15	62	.2	8	2.4				
1282	11	17	66	.6	8	4.2				
1283	11	18	59	.6	8	2.2				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-1284	15	18	46	.4	8	5.6				
1285	10	15	45	.4	8	2.4				
1286	11	9	16	.8	4	14.0				
1287	8	12	37	.4	6	4.0				
1288	12	14	50	.4	9	4.2				
1289	6	13	38	<.2	6	0.2				
1290	5	12	32	.2	5	0.4				
1291	5	13	36	<.2	6	0.8				
1292	5	13	33	<.2	6	1.0				
1293	8	11	42	<.2	6	5.4				
1294	5	11	45	<.2	6	1.2				
1295	9	15	65	.4	7	4.2				
1296	6	13	64	<.2	7	0.6				
1297	6	13	55	.2	8	1.4				
1298	5	14	51	<.2	7	0.4				
1299	6	12	51	<.2	5	0.4				
1300	5	16	41	.2	7	0.6				
1301	4	13	36	<.2	5	0.6				
1302	5	12	39	<.2	6	0.2				
1303	3	13	31	.2	5	0.2				
1304	4	13	33	.2	5	0.2				
1305	5	13	41	<.2	7	0.6				
1306	6	15	38	.4	5	0.4				
1307	4	13	39	.2	5	0.4				
1308	4	15	30	.4	4	0.6				
1309	5	14	23	.4	6	1.0				
1310	4	12	39	.2	6	0.8				

Geochemical Laboratory Report

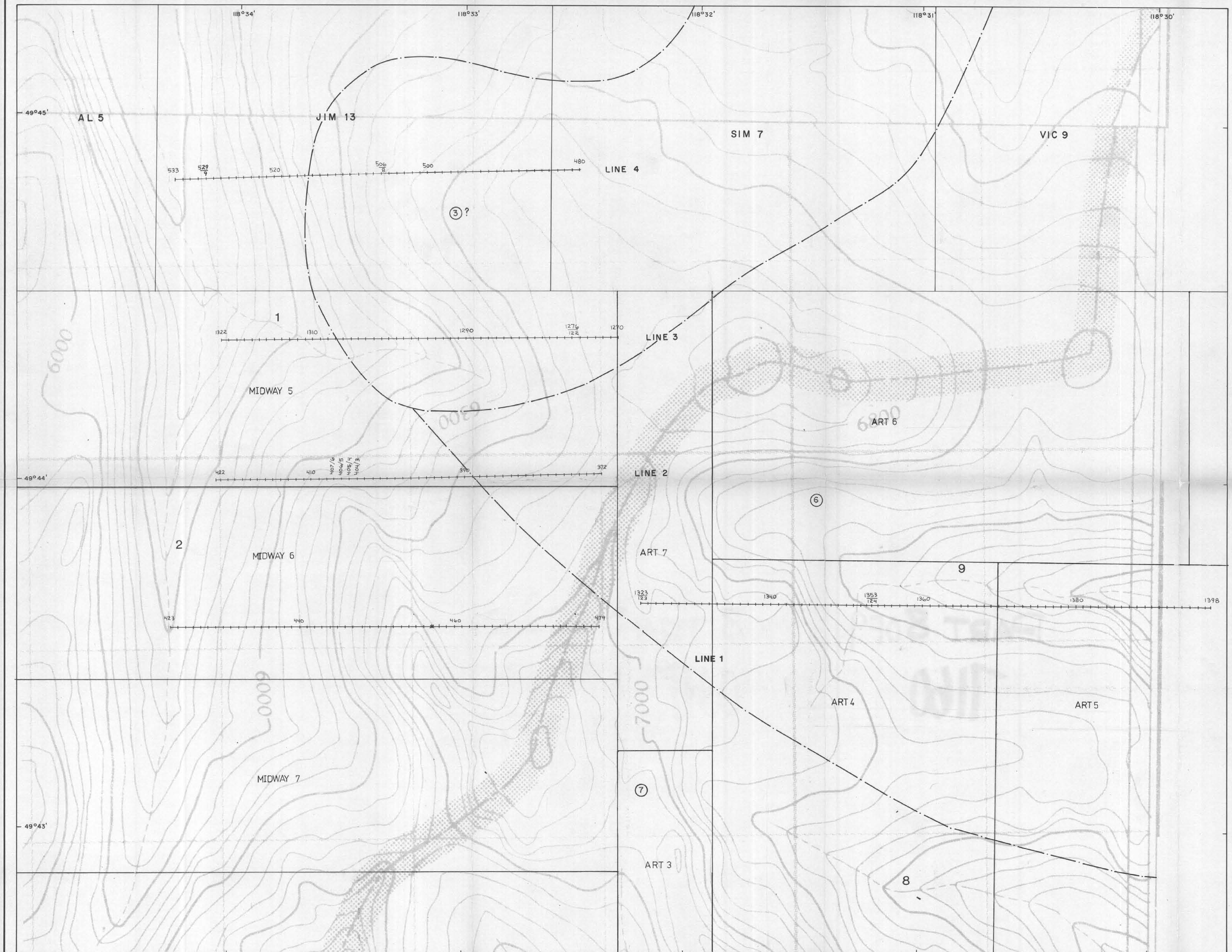
Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-1311	12	15	52	.4	10	50.0				
1312	5	16	43	.2	6	11.6				
1313	7	14	50	.2	8	10.0				
1314	8	13	50	.2	9	30.0				
1315	8	14	30	.4	2	28.0				
1316	4	12	42	.4	7	8.6				
1317	4	14	35	<.2	4	0.2				
1318	8	16	31	.6	6	0.2				
1319	6	15	54	.2	8	0.8				
1320	6	13	68	.2	10	0.2				
1321	5	12	49	.2	9	0.8				
1322	7	15	82	<.2	7	0.2				
1323	14	17	37	.2	5	0.4				
1324	10	16	165	<.2	7	0.6				
1325	17	17	79	.2	7	19.2				
1326	13	12	79	<.2	6	0.4				
1327	8	15	32	<.2	5	0.4				
1328	9	13	20	<.2	4	0.4				
1329	6	9	14	<.2	3	0.6				
1330	10	18	21	<.2	4	0.6				
1331	10	15	40	<.2	8	2.8				
1332	11	36	79	<.2	5	0.4				
1333	10	38	48	<.2	8	0.2				
1334	9	20	35	<.2	5	0.2				
1335	7	13	31	< .2	4	0.6				
1336	11	17	75	.4	8	3.0				
1337	6	14	17	.4	4	1.2				

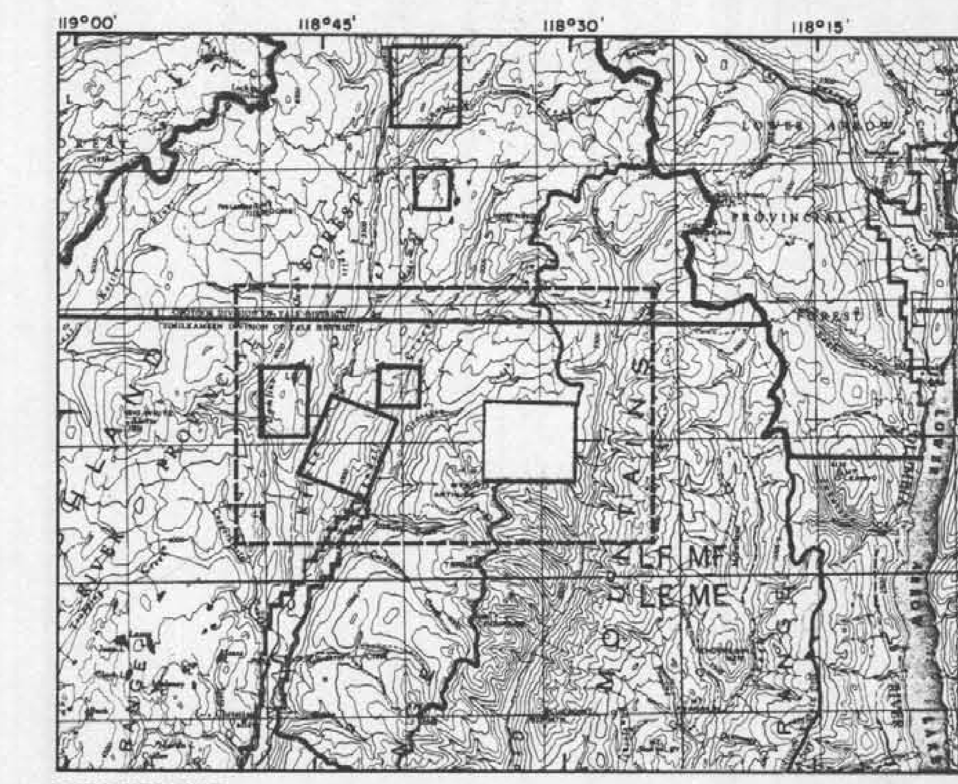
Geochemical Laboratory Report /

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-1338	12	12	48	.2	6	1.4				
1339	6	16	33	.4	4	1.2				
1340	7	12	72	.4	7	3.0				
1341	12	14	60	.4	7	2.8				
1342	14	19	115	.6	9	1.0				
1353	15	27	38	.4	6	4.6				
1354	10	25	45	.4	6	5.4				
1355	9	25	33	.4	5	3.4				
1356	8	16	15	.2	4	3.4				
1357	8	22	20	<.2	4	1.2				
1358	10	13	23	<.2	5	1.0				
1359	3	10	18	<.2	2	0.2				
1360	N.S.	--	--	--	--	--				
1361	3	31	46	.6	7	0.4				
1362	5	27	35	<.2	5	0.6				
1363	7	13	32	.4	5	0.8				
1364	11	13	60	.2	10	2.0				
1365	5	11	28	.2	5	0.8				
1366	6	10	29	.4	6	0.4				
1367	13	11	35	.4	7	3.0				
1368	4	10	15	.2	3	0.2				
1369	9	13	49	.2	6	1.4				
1370	12	11	31	.4	7	1.6				
1371	13	13	62	.4	10	0.6				
1372	10	11	52	.6	8	2.6				
1373	8	13	38	.4	6	1.6				
1374	10	19	58	.2	8	0.4				

Geochemical Laboratory Report

Sample Number	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Ni ppm	U ppm				
NLFS-1375	11	45	59	.2	7	1.8				
1376	12	43	62	.2	8	3.4				
1377	13	27	60	.4	8	1.4				
1378	10	15	42	.4	4	0.2				
1379	6	12	43	.2	5	0.8				
1380	7	11	46	<.2	7	0.6				
1381	9	19	73	.2	8	0.6				
1382	11	17	71	.4	8	4.6				
1383	23	25	130	.6	21	2.6				
1384	22	26	165	.4	24	5.4				
1385	10	16	89	.2	8	3.0				
1386	12	13	65	<.2	6	0.4				
1387	11	18	40	<.2	4	0.6				
1388	N.S.	--	--	--	--	--				
1389	10	15	115	.6	13	0.4				
1390	13	16	93	.6	16	0.8				
1391	9	18	130	.4	8	5.4				
1392	13	15	130	.6	10	4.4				
1393	15	21	125	.4	7	1.2				
1394	14	20	150	.6	9	6.0				
1395	16	33	165	.6	10	1.0				
1396	31	40	140	.6	9	6.2				
1397	9	10	44	.2	5	1.0				
1398	15	12	49	.2	5	7.2				





LOCATION MAP 1:500,000

N

A

Surveyed and compiled by
BARRINGER MAGENTA LTD.
Toronto, Canada

LEGEND

Soil / Rock — Line or sampled stream with Sample number

Soil / Rock — element value in p.p.m.

JIM 8 — Claim boundary with name and number

⑦ — Inferred geological boundary and unit number (Little, H.W., 1957)

5 — Stream number

PART 8 OF 9

KELVIN ENERGY LIMITED
KETTLE RIVER AREA, B.C.

GEOCHEMICAL SURVEY

ANOMALY 2A
SOIL TRAVERSE FOLLOW-UP

SAMPLE LOCATION AND NUMBER

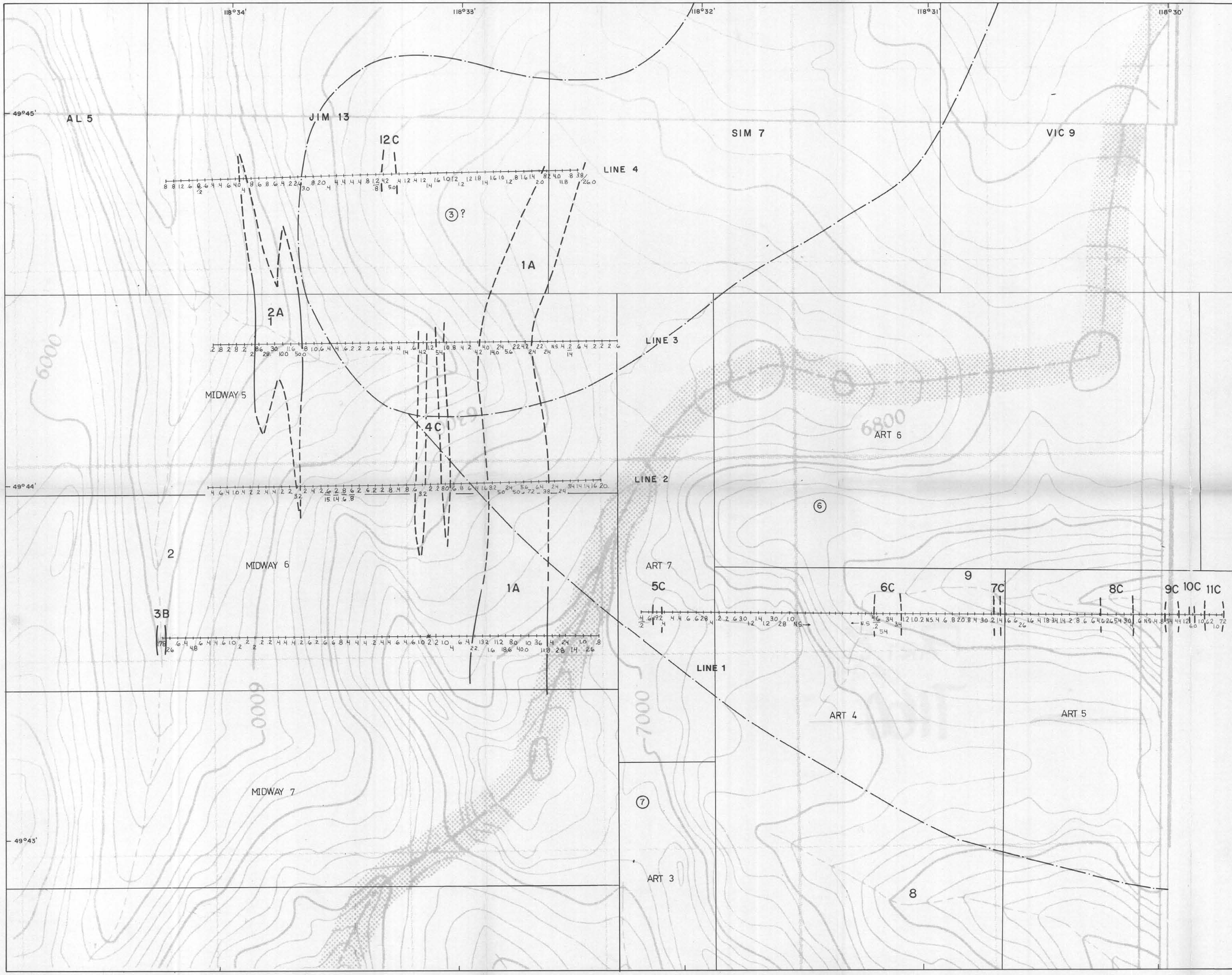
SCALE 1:10,000

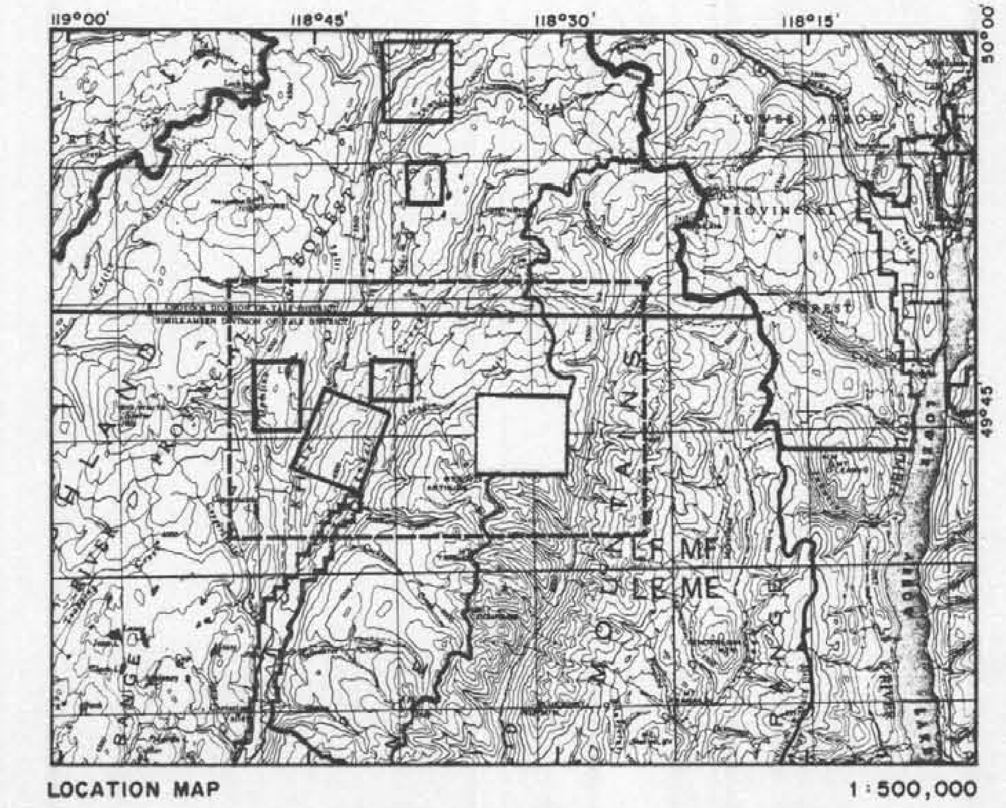
FEET 0 1000 2000 3000

METRES 0 250 500 750 1000

AUGUST-SEPTEMBER 1978
N.T.S. REF. 82-E 10,15

DRG. 208-42-302





N

A

Surveyed and compiled by
BARRINGER MAGENTA LTD.
Toronto, Canada

LEGEND

Soil, Rock — Line or sampled stream with Sample number

Soil, Rock — element value in p.p.m.

JIM 8 — Claim boundary with name and number

(7) 5 — Inferred geological boundary and unit number (Little, H.W., 1957)

5 — Stream number

1st order anomaly

2nd order anomaly

PART 8 OF 9

MINERAL RESOURCES ... ASSESSMENT REPORT

7160

KELVIN ENERGY LIMITED
KETTLE RIVER AREA, B.C.

GEOCHEMICAL SURVEY

ANOMALY 2A
SOIL TRAVERSE FOLLOW-UP

URANIUM DATA & INTERPRETATION MAP

SCALE 1:10,000

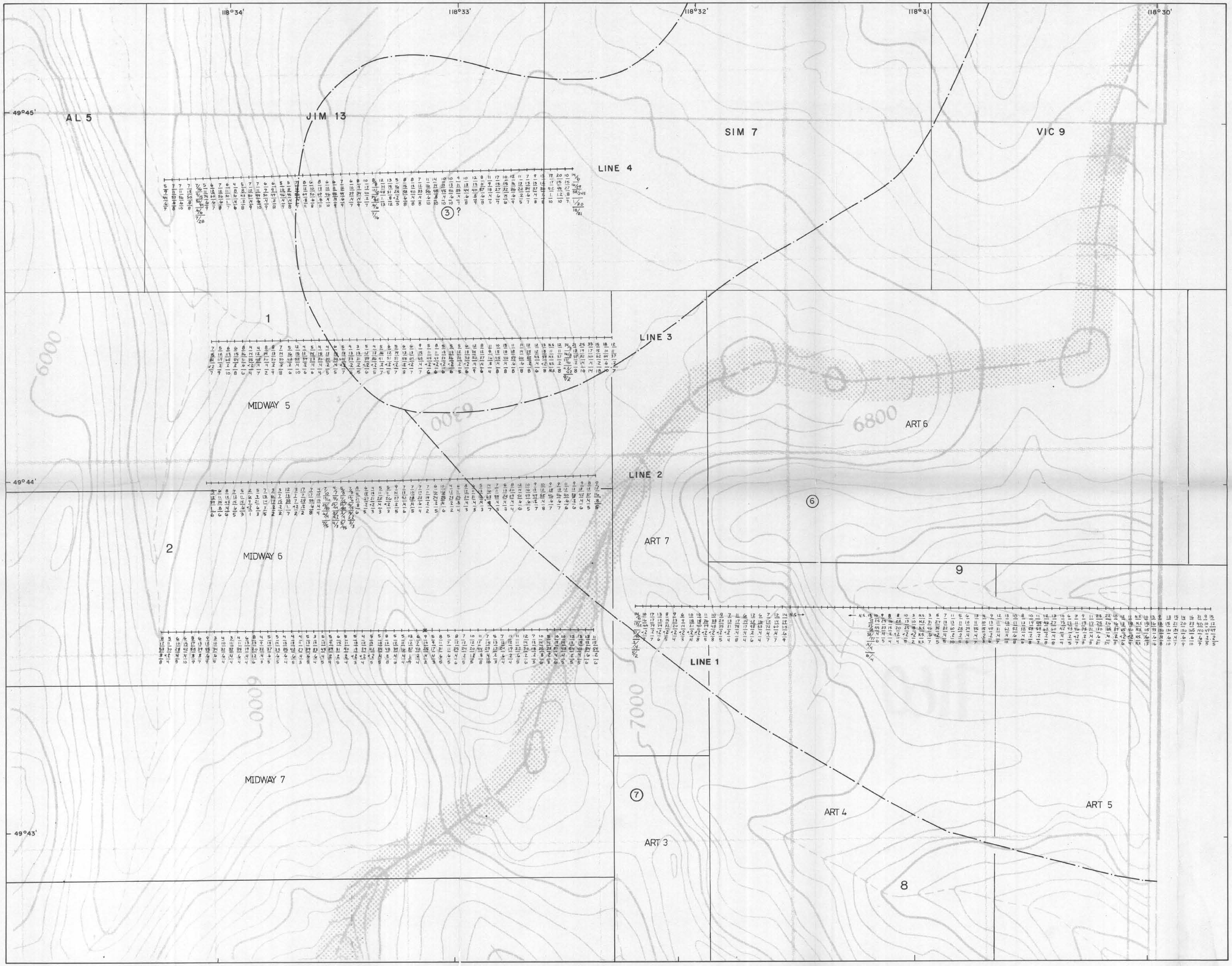
FEET 0 1000 2000 3000

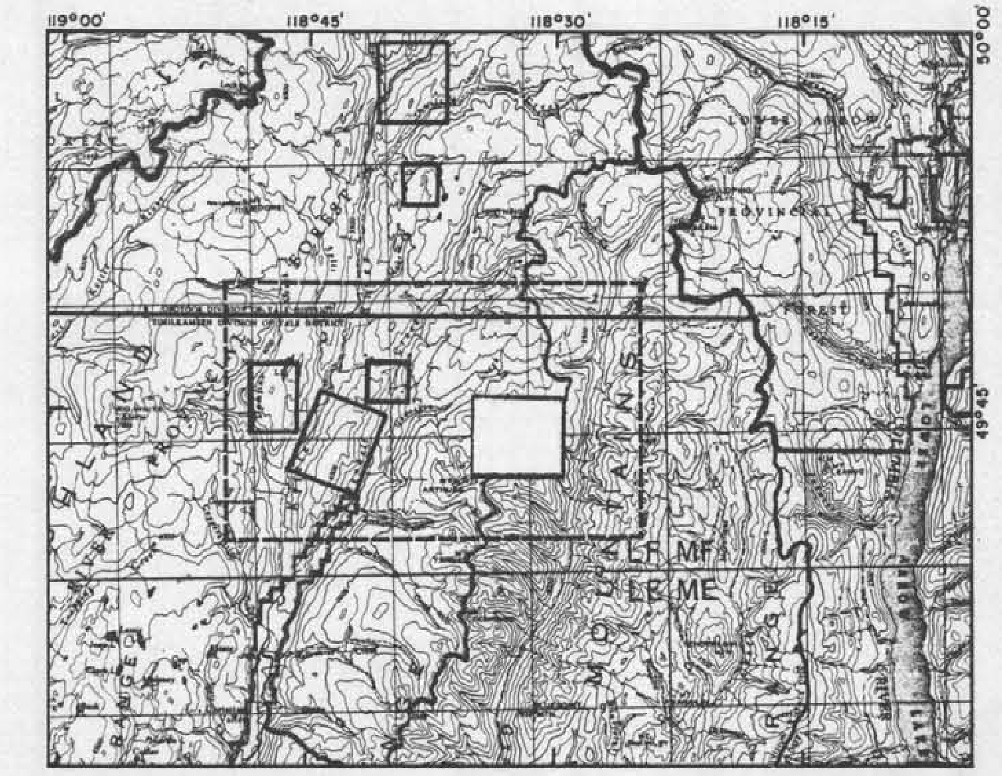
METRES 0 250 500 750 1000

AUGUST-SEPTEMBER 1978

N.T.S. REF. 82-E 10,15

DRG. 208-42-302





LOCATION MAP 1:500,000

N

A

Surveyed and compiled by
BARRINGER MAGENTA LTD.
Toronto, Canada

LEGEND

Soil 8 / Rock 12 — Line or sampled stream with Sample number

Soil 10/25 Rock — element value in p.p.m.

JIM 8 — Claim boundary with name and number

(7) — Inferred geological boundary and unit number (Little, H.W., 1957)

5 — Stream number

PART 8 OF 9

MINERAL RESOURCES BRANCH ASSESSMENT REPORT

7160

KELVIN ENERGY LIMITED
KETTLE RIVER AREA, B.C.

GEOCHEMICAL SURVEY

ANOMALY 2A
SOIL TRAVERSE FOLLOW-UP

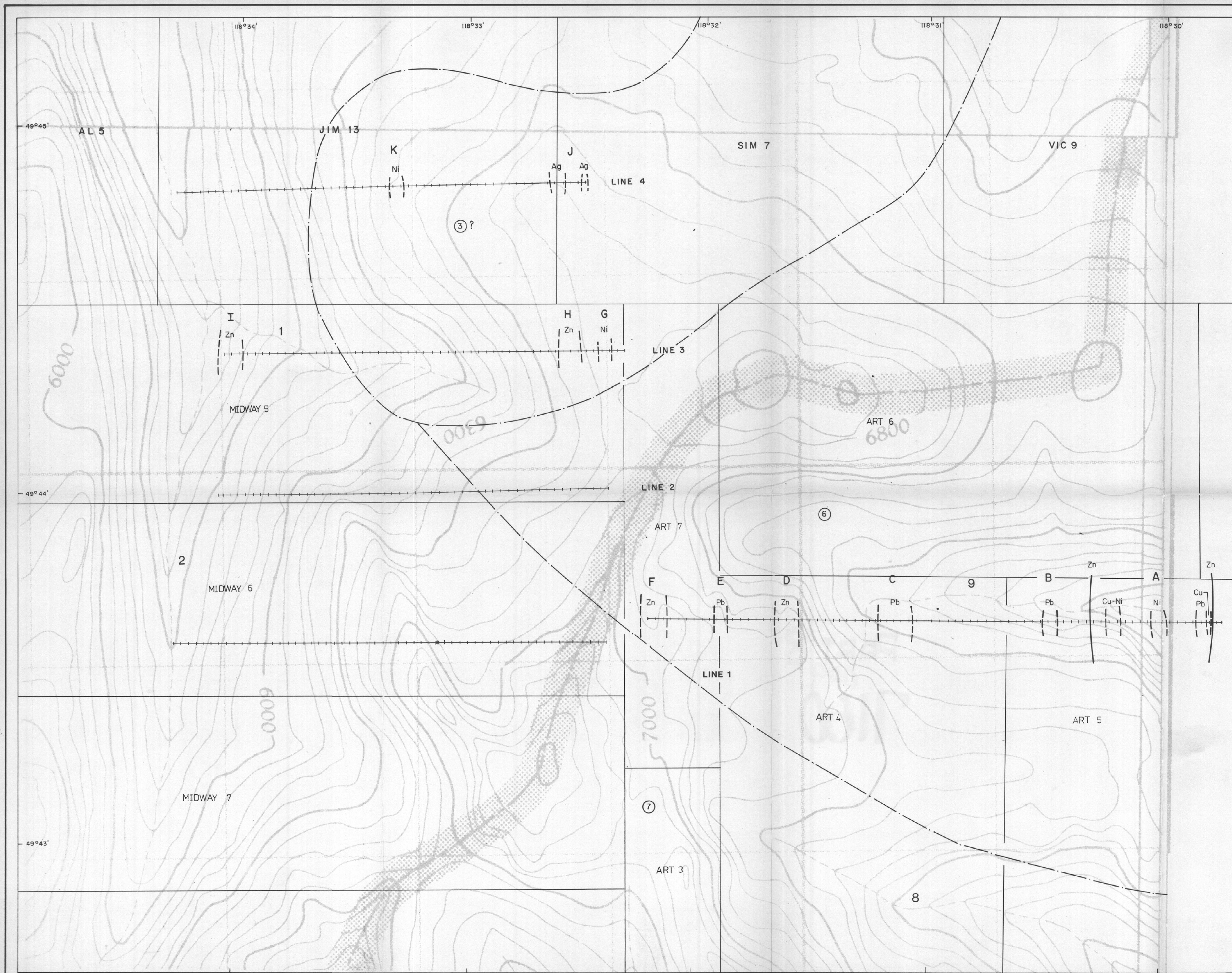
COPPER/LEAD/ZINC/SILVER/NICKEL

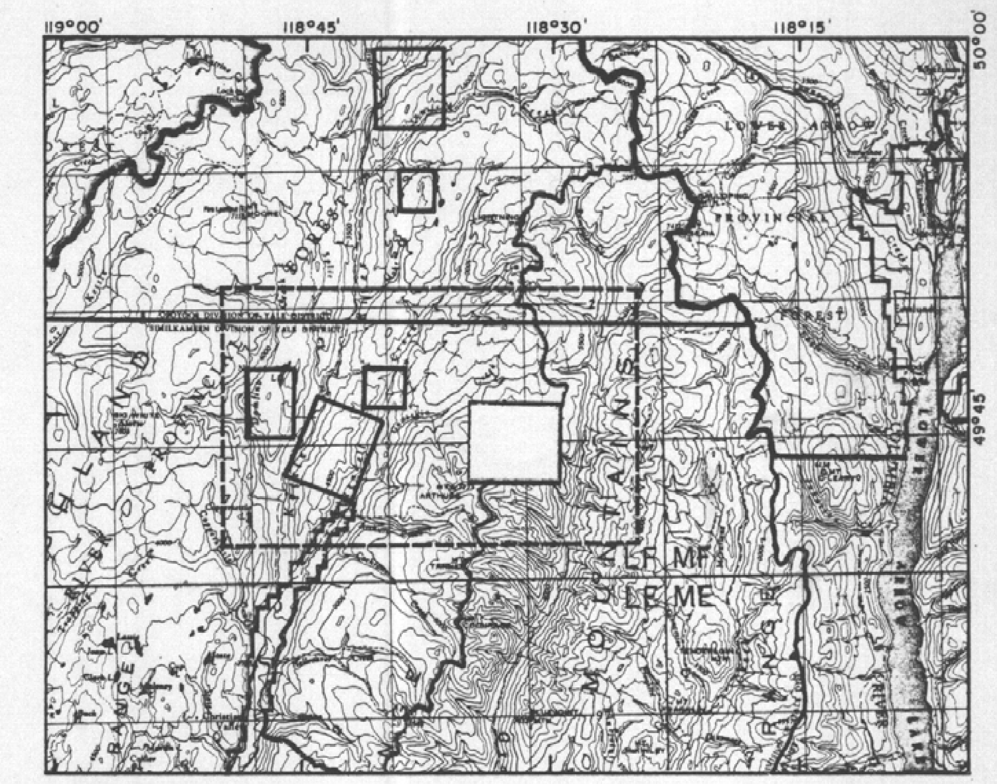
SCALE 1:10,000

FEET 0 1000 2000 3000

METRES 0 250 500 750 1000

AUGUST-SEPTEMBER 1978
N.T.S. REF. 82-E 10, 15





N
A

Surveyed and compiled by
BARRINGER MAGENTA LTD.
Toronto, Canada

LEGEND

Soil / Rock / Soil / Rock — Line or sampled stream with — Sample number — element value in p.p.m.

JIM 8 — Claim boundary with name and number

⑦ 5 — Inferred geological boundary and unit number (Little, H.W., 1957) — Stream number

1st order anomaly

2nd order anomaly

PART 8 OF 9

MINERAL RESOURCES BRANCH ASSESSMENT REPORT

7160

KELVIN ENERGY LIMITED
KETTLE RIVER AREA, B.C.

GEOCHEMICAL SURVEY

ANOMALY 2A
SOIL TRAVERSE FOLLOW-UP

BASE METAL INTERPRETATION MAP

SCALE 1:10,000

FEET 0 1000 2000 3000

METRES 0 250 500 750 1000

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