COMINCO LTD.

EXPLORATION
NTS: 116C/8

WESTERN DISTRICT

GEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL REPORT

ON THE PLUTO CLAIM GROUP

DAWSON MINING DISTRICT

SITUATED AT:

LATITUDE: 64°20'N; LONGITUDE: 140°21'W

PERIOD OF WORK:

JUNE 20 TO SEPTEMBER 3, 1979

090750

APRIL 1980

I.A. PATERSON

This report has been examined by the Geological Evaluation Unit and is recommended to the Commissioner to be accepted as representation work in the amount of

$ 24,300

Resident Geologist or
Resident Mining Engineer

Considered as representation work under Section 53 (4) Yukon Quartz Mining Act.

B. R. BAXTER
Supervising Mining Recorder

for Commissioner of Yukon Territory

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COMINCO LTD.

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WESTERN DISTRICT
16 APRIL 1980

GEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL REPORT

ON THE PLUTO CLAIM GROUP

DAWSON MINING DISTRICT

SUMMARY

The Pluto claims are located 54 km northwest of Dawson City, Y.T. and 7 km northeast of a gravel road to Clinton Creek.

The claim group is underlain by a metamorphosed sequence of quartzites, skarn rocks and argillaceous phyllites of Proterozoic and Paleozoic age intruded by three quartz-porphyry stocks. Molybdenite mineralization associated with quartz and quartz + muscovite + pyrite + fluorite stockworks occur both within the intrusions and also in the metasediments between the two southern intrusives. Wolframite occurs in the quartz + muscovite veins, mainly in metasediments. Other minerals, associated with the mineralization include fluorite, apatite, scheelite, ilmenite, galeno-bismutite and tourmaline. Soil sampling delineated an area, 2.3 x 0.8 km, with Mo values of 5 to 330 ppm and W values of 20 to 260 ppm. This area is coincident with the intrusive belt and the visible mineralization.

INTRODUCTION

The Pluto claims were acquired to cover molybdenite-wolframite mineralization associated with three small quartz-feldspar porphyry plugs which intrude the Proterozoic and Paleozoic rocks of the Yukon group.

Work was carried out on the claim group between June 20 and September 13, 1979 by the following personnel:

I.A. Paterson	35 days -	700-409 Granville Street,	Vancouver,	B.C. V6C 1T2
E.G. Olfert	9 days -	"	"	"
M. Seifert	8 days -	"	"	"
A. Wilkins	10 days -	"	"	"
D. O'Brien	20 days -	"	"	"
P. Metcalfe	25 days -	"	"	"

Work included 18.1 km of line cutting, collection of 154 contour soil samples and 689 grid soil samples, running a 35.1 km magnetometer survey and geological mapping at scales of 1:2,500 and 1:5,000.

LOCATION AND ACCESS

The Pluto claims are located 54 km northwest of Dawson City, Y.T. and 7 km northeast of a gravel road to Clinton Creek (Figure 1). The northern boundary of the claim group is 1.5 km from the Yukon River and the southern boundary is only 500 m from the haul road to the Cassiar Creek open pit asbestos mine (now mined out).

TOPOGRAPHY

The topography is hilly with a maximum elevation of 4,400' at Cassiar Dome and is characterized by peaks with rounded tops, and valleys which are narrow and steep sided. The Yukon River lies at the 1,000' level. An uplift of a mature erosion surface in the Late Pliocene resulted in rapid downcutting by small streams and formation of deeply incised V-shaped valleys.

Tree level lies between 2,800' and 3,200' depending on the steepness and aspect of the slope. Slopes facing north tend to be overlain by moss, permafrost and stunted spruce. South facing slopes have only patchy permafrost and the spruce and birch trees are much higher.

TENURE

The following claims, wholly owned by Cominco Ltd., constitute the Pluto claim group:

Claim	Tag Number	Due Date
Pluto 1-54	32612 - 32665	June 18, 1980
Pluto 55-74	47610 - 47629	September 17, 1980
Pluto 76-88	74630 - 47642	September 17, 1980

GEOLOGY

Regional Setting

The Pluto claims are located southwest of the Tintina Fault in the belt of highly deformed and metamorphosed rocks known as the Yukon Crystalline Terrane. In the Dawson area, the metamorphic rocks were subdivided into five units by Green (1972).

- Unit A - is equivalent to the Nasina series of McConnell (1905) and is comprised of quartzite, phyllite, limestone and greenstone.
- Unit B - the Klondike Schist of McConnell (1905) is the main rock type around Dawson City and consists mainly of quartz + muscovite schist with minor chlorite schist.
- Unit C - is found along the Yukon River between Dawson and Fortymile and is comprised mainly of greenstone and rocks lithologically similar to A and B.
- Unit D - is found east of Sixtymile and is comprised mainly of quartz-feldspar-biotite gneiss which appears to have gradational contact with Unit A.
- Unit E - consists of serpentinized ultramafic rocks and related greenstones.

The area is structurally complex and has undergone at least two periods of deformation. The main period of deformation and regional metamorphism is considered to be Early to Middle Triassic (Tempelman-Kluit, 1976). A later deformation involving major overthrusts may be of Lower Cretaceous age (Tempelman-Kluit, 1979).

In the immediate area of the claims (Map 1), Units A and C form the country rock to the intrusives. Unit A occurs mainly on the ridge tops and consists of grey phyllites, quartzites, marble and metabasic rocks. This unit overlies Unit C, consisting mainly of buff quartzites with interbedded chlorite and biotite schists and skarn horizons. The contact between the two units is flat lying and may be either tectonic or stratigraphic.

Two ages of intrusive rock are present in the area. The older suite, considered to be of Cretaceous age by Green (1972) forms plugs up to 9 km in diameter consisting of biotite granodiorite or biotite granite locally containing porphyritic phases. The younger set of intrusives, Late Cretaceous or Early Tertiary in age, is comprised of quartz-feldspar porphyry, and biotite + augite monzonite (Map 2).

Metamorphic Rocks on Pluto Claims

The country rock to the intrusives has been subdivided into five formations. The first three formations belong to Unit C of Green (1972), the fifth formation belong to Unit A, also called the Nasina series (Map 1). Formation 4 may also belong to the Nasina series but insufficient information is known to make a definite correlation.

Formations 1 to 3 are best exposed on the north and west sides of Pluto Creek where they form a series of cliffs. Formation 1 may also occur on the southeast flank of the intrusive. The lowest rocks in the section (Formation 1) consist mainly of buff weathering quartzite with subsidiary quartz + biotite + muscovite schist and gneiss, green chlorite + biotite $\pm$ pyrite $\pm$ pyrrhotite schist and quartz + biotite schist. This formation is at least 100 m in thickness and dips to the north at about 15^{0}. The quartzites are well jointed with joints spaced at 1 m intervals.

The quartzite grades upwards over 10 m into a formation characterized by the presence of green and white streaky skarn rock (Formation 2). Interfoliated with the skarn are biotite $\pm$ chlorite schists, biotite + feldspar augen schists, pyrrhotite bearing quartzites and biotite + amphibole schists. This formation is approximately 20 m thick and it appears to lens out when traced to the west. The skarn rocks contain minor amounts of scheelite along fractures.

The skarn unit grades into gossanous pyrrhotite bearing quartzites (Formation 3) containing interbedded tremolite schist, quartz + muscovite + biotite schist, and purplish quartz + biotite + chlorite + pyrrhotite schist. This unit is best developed on line 13+50N, 7+00E but also occurs on line 9+35N, 6+00W. Minimum thickness is 60 m.

Rocks which are possibly correlated with Formation 2 are found on the eastern side of the main quartz-feldspar porphyry intrusive and are best exposed on line 7+50N, 6+50E where they overlie Formation 4. The main rock type is green to white dense streaky skarn with intercalations of garnet ± magnetite ± amphibole rock and biotite gneiss. The formation is approximately 20 to 30 m in thickness and has gentle dip to the east.

Formation 4 is poorly exposed and located on the southeast flank of the main quartz-feldspar porphyry intrusive. It consists of buff streaky pyrrhotite bearing quartzite with bands of laminated dark green magnetite bearing siltstone or slate. This formation also contains intercalations of dense unfoliated magnetite bearing greenstone and tremolite ± talc schist. On line 1+50N, 5+50E the formation grades downwards into buff weathering quartzite which may be correlated with Formation 1. Because of the presence of magnetite laminae, this formation can be easily traced using a magnetometer (Map 3).

Formation 5 belongs to the Nasina series and is well exposed on the ridge north of Cassiar Dome (Map 1). Typical Nasina rocks consist of grey to black quartz phyllite, black quartzite, limestone and chlorite schist.

The rocks in the area have undergone a complicated and little understood history of deformation. It will be sufficient to say at this stage that the most important structural features on an outcrop scale are the schistosity (S_1) parallel to the bedding (S_0) and the presence of tight recumbent isoclinal folds (F_1) possibly related to regional folds of similar style. In the Nasina rocks, there is evidence that S_1 has been folded by upright isoclinal folds (F_2). Later periods of folding are less intensive and may be related to late uplifts or movement on strike-slip faults.

The rocks in the claim group have undergone two episodes of metamorphism, a regional phase associated with the first deformation and a contact metamorphic phase associated with the intrusives. Regional metamorphic minerals are biotite, and muscovite in pelitic schists and chlorite, biotite and amphibole in basic rocks suggesting a regional metamorphic grade in the upper greenschist to lower amphibolite facies.

In the vicinity of intrusives, rocks have been hornfelsed. This is best displayed along the southern and western contacts of the main intrusive. In calcareous horizons (Unit 2), skarnification has given rise to rocks containing diopside, garnet, magnetite, hornblende and minor scheelite. In the quartz-feldspathic formations the rocks have hornfelsic texture with characteristic toughness and tinkling sound on being hit with the hammer. The formation of magnetite in laminations in siltstones is probably a result of contact metamorphism as magnetite laminations are not seen elsewhere in the Nasina. The area where the magnetite is best developed is low in pyrrhotite and is in marked contrast to other areas surrounding the intrusives where pyrrhotite and pyrite disseminations and fracture fillings are well developed.

Prior to regional metamorphism, Formation 1 was probably a fairly pure quartz sandstone with interbedded pelite and tuff. These sediments were

overlain by a sequence containing impure limestone and pelite which gave rise to the calc-silicate rocks of Unit 2. Unit 3 was probably a quartz sandstone containing calcareous and feldspathic horizons.

The age of the sediments is not known with certainty. Tempelman-Kluit (1976) suggests that the Nasina series spans Ordovician to Devonian time and therefore, Formations 5 and possibly 4 may be of this age. Formations 1 to 3 underlie Formations 4 and 5 and therefore may be of Proterozoic to Cambrian age but the possibility exists that the contact between Formations 3 and 4 is tectonic. This suggestion is supported by the fact that some horizons in Formation 1 are similar lithologically to the Klondike schist, considered to be of Devono-Mississippian age (Tempelman-Kluit, 1976).

Intrusives on Pluto Claims

Four intrusive plugs are present on the claims. The three northern plugs are similar in composition and are mainly composed of quartz-feldspar porphyry with minor quartz + muscovite alteration rock and felsite. The fourth intrusive is of monzonitic composition and lies at the southern end of the grid.

Quartz-Feldspar Porphyry Intrusives

The main body of quartz-feldspar porphyry is best exposed in talus slopes along the banks of Pluto Creek. The body is elliptical in plan, measuring 1200 x 500 m and is elongated in a northeasterly direction. Two subsidiary, poorly exposed quartz-feldspar porphyry intrusives occur 400 m and 1100 m to the northwest of the main body. From sparse float it appears that they are much smaller than the main body as they measure only 300 x 75 m and 300 x 200 m.

Unaltered quartz-feldspar porphyry contains phenocrysts of quartz-feldspar, biotite and more rarely wolframite and ilmenite set in a white equigranular matrix. It may become possible to differentiate a chilled facies of the quartz-feldspar porphyry characterized by a fine-grained ground mass.

In a typical specimen quartz phenocrysts are 1 to 7 mm in diameter, grey to black in colour, subhedral and commonly constitute from 20 to 30% of the rock. Euhedral K-feldspar and subhedral plagioclase phenocrysts constitute 20% and 3% respectively of the rock and range up to 1 cm in length. The ground mass is composed of interlocking euhedral quartz (25%), K-feldspar (10%) and plagioclase (7%), with grains in the 0.05 to 0.10 mm range. Biotite content is low (3%) consisting of ragged flakes rarely exceeding 2 mm in diameter. Accessories include magnetite, ilmenite, hematite and apatite.

Fresh quartz-feldspar porphyry has in places been altered along veins to a brownish rock consisting of quartz (70%), muscovite (25%), iron oxide (5%) and locally fluorite. The porphyritic texture of the quartz-feldspar porphyry can still be discerned even in highly altered specimens. Contacts between the quartz-feldspar porphyry and the alteration phase are sharp, the one grading into the other over 1 cm.

A felsite plug, 150 m in diameter intrudes the quartz-feldspar porphyry at the northeastern corner of the main body. The rock is buff in colour, fine-grained, equigranular and very low in mafics. Some samples contain 3 mm feldspar crystals. This phase has also undergone quartz-muscovite alteration along fractures.

At a few localities within the quartz-feldspar porphyry breccias were found which contained angular fragments of quartz-feldspar porphyry and felsite in a matrix of quartz and feldspar. The breccia is locally altered to quartz-muscovite rock. This rock type occurs mainly around 4+50N, 1+00E. It may be associated with a northeasterly striking fault which was inferred from the presence of an airphoto linear.

The western contact of the intrusive is well exposed and is sharp. A few veins of quartz-feldspar porphyry penetrate the country rock. At some places along the contact (e.g. line 9+35N, 2+50E) xenoliths of grey-black quartz + biotite gneiss occur in both quartz-feldspar porphyry and felsite. The poorly exposed southeastern contact follows an airphoto linear for much of its length and may be faulted.

Thin dykes of quartz-feldspar porphyry and quartz muscovite alteration rock are common between the main intrusion and the smaller intrusives to the northwest. The dykes are seldom greater than 1 m in thickness.

Monzonite

A monzonite intrusion approximately 1100 m in diameter is centred 1000 m southwest of 0+00 on the grid. This intrusive is only partly unroofed and is surrounded and overlain by a hornfels zone in the Nasina metasediments. The monzonite contains magnetite and gives rise to a prominent 800 gamma magnetic anomaly on the aeromagnetic map.

The monzonite is dark grey in colour, equigranular and medium-grained. In thin section it is seen to contain 40% orthoclase, 25% plagioclase, 5% quartz, 10% biotite, 15% augite and 5% magnetite. Euhedral plagioclase, 1.0 to 2.5 mm in length is set in a groundmass of euhedral potash feldspar. Graphic intergrowth of the feldspars is present. Biotite, locally altered to chlorite is closely associated with augite and opaque minerals.

The contact of the intrusive is sharp and dykes were not observed in the country rock. The hornfels zone is approximately 500 m wide and contains abundant pyrite and pyrrhotite.

The relative ages of the monzonite and the quartz-feldspar porphyry are unknown. Other quartz-feldspar porphyry intrusives in the Yukon Crystalline Terrane (e.g. in the Mount Nansen area) are considered to be Early Eocene in age (i.e. 50-60 Ma) and belong to the Nisling Range Alaskite suite (Tempelman-Kluit, 1976). The presence of a small outlier of Carmacks Group (Eocene?) volcanic rocks 10 km northwest of the Pluto stock tends to support the inferred Tertiary age for the stock.

MAGNETOMETER SURVEY (Map 4)

A magnetic survey was carried out at 50 m intervals on the Pluto grid using a Geometrics base station recorder and a Scintrex MP2 total field magnetometer.

Results showed magnetic relief of up to 4000 gammas on the southern part of the grid. This anomaly is largely due to the presence of laminated magnetite bearing siltstone, quartzite and calc-silicate rocks which lie in the contact aureoles of the monzonite and the quartz-feldspar porphyry intrusives. An anomaly with similar origin is located on the eastern part of the grid extending from 9+35N; 5+00E to 1+50N, 7+00E where it appears to connect with the first mentioned anomaly. The anomalies on lines 7+50N, 6+50W and 9+35N, 6+00W are ascribed to the presence of a pyrrhotite bearing quartzite with interfoliated tremolite schist. This unit also occurs in the eastern section of lines 12+00N and 13+50N where it is also associated with anomalies with up to 1800 gammas maximum relief.

The northern grid has a fairly flat magnetic relief compared with the southern grid. A distinct anomaly is present on line 22+50N, where a 1500 gamma anomaly occurs on line 22+50N, 4+00W. This area is underlain by chlorite schist.

GEOCHEMISTRY

Soil sampling was carried out during July and August. Grid samples were taken at 50 m intervals along lines with 150 m spacing. A total of 843 samples were gathered including 689 grid soils and 154 contour soils.

Well developed residual soil profiles are present in higher areas where the topography is not too steep. Soils are up to 1 m in depth. Samples were taken from the B horizon where possible. Near rock outcrops, the C horizon was sampled. In the steep sided valleys, consistent soil profiles are not present because of slope wash, solifluction and ground creep. On north facing slopes, permafrost stabilizes the soil and reduces groundwater flow and geochemical mobility. Samples, from these slopes are only obtained with difficulty because the deeper parts of the thick moss cover are in permafrost.

Sample Preparation and Analyses

All samples were analysed by the Cominco Exploration Laboratory in Vancouver. Samples were dried and sieved and the minus 80 mesh fraction was used for analyses. Copper, lead and zinc values were determined using a hot aqua regia solution for extraction and analysing the sample by atomic absorption techniques. Values for tungsten were determined using a pyrosulphate fusion technique for extraction and then analysing the sample by colourimetry.

Mo Soil Geochemistry (Map 4)

Background Mo values outside the influence of the intrusives are generally less than 2 ppm. The 5 ppm Mo contour roughly approximates the

limits of contact metamorphism and alteration associated with the intrusives and encloses an area 2.3 km x 0.8 km in extent. In two areas, on the eastern and southeastern flanks of the intrusive, skarn zones contain scheelite and magnetite which may have acted as a source for some of the molybdenum. The highest Mo values (between 50 and 300 ppm) occur in the valley of Pluto Creek. The anomaly is caused by hydromorphic and/or mechanical dispersion of molybdenite occurring in veins in quartzite and quartz-feldspar porphyry. At higher elevations, Mo values in soils drop off to between 5 and 15 ppm and rock or boulder exposures becomes scarce or absent.

W Soil Geochemistry (Map 4)

Background values for W are generally less than 5 ppm in areas remote from the intrusives. Three anomalous areas have been outlined using the 10 ppm W contour. Within the zones, values are erratic, ranging from 3 to 220 ppm W and meaningful contours at greater values than 10 ppm cannot be drawn. This probably reflects mechanical dispersion of wolframite and scheelite grains: hydromorphic dispersion would not be consistent with insoluble nature of the minerals.

The anomaly at 18+00N is probably caused by the presence of wolframite in the contact zone of the northern intrusive. The anomaly to the west and northwest of Pluto Creek is caused by the occurrence of wolframite in veins in quartzites and disseminated scheelite in a calc-silicate skarn zone. The anomaly in the southeastern flanks of the intrusive originates from minor scheelite in magnetite bearing skarn.

Cu Soil Geochemistry (Map 4)

The Cu background is generally less than 20 ppm. Anomalous zones with values between 40 ppm and 146 ppm Cu occur on the periphery of the main quartz-feldspar porphyry on the northwestern and southern flanks. Quartzites in these areas contain abundant pyrrhotite with minor chalcopyrite and this probably represents the source for the copper.

Pb Soil Geochemistry (Map 4)

Background values for Pb in soils are generally less than 30 ppm. There are four areas considered anomalous on the Pluto grid. The first, with Pb values between 50 and 420 ppm is located at the south end of the grid and is believed to be associated with the contact zone of the monzonite intrusive. The second area with Pb values in the 50-100 ppm range occurs on the hillside to the west of 7+50N and is probably caused by the presence of Pb-bearing minerals in veins. Galenobismutite ($PbBi_2S_4$) was identified in one sample. The third area, with Pb values in the 50 to 100 ppm range is located on the north side of Pluto Creek (13+00N, 6+00E). The anomaly is presumably related to the occurrence of scheelite bearing skarn rocks overlain by pyrrhotite bearing quartzites. The fourth anomaly occurs at 15+00N, 7+00E and overlies the northern quartz-feldspar porphyry intrusive.

Zn Soil Geochemistry (Map 4)

Background Zn values are generally less than 100 ppm in soils. The main anomaly, with Zn values greater than 300 ppm Zn occurs on the north

slopes of Pluto Creek and probably originates from high background Zn values in pyrrhotite bearing quartzite with interfoliated tremolite schist. This anomaly is coincident with Cu and Pb anomalies. The remaining anomalies are poorly defined and show much lower values. Zinc values tend to increase towards the monzonite intrusive and there is some suggestion of a zinc rich halo to the main quartz-feldspar porphyry intrusive.

MINERALIZATION

Molybdenite and tungsten bearing float and outcrops have been found on the Pluto property. Most of the occurrences are of float from well exposed talus slopes in the valley of Pluto Creek. The remaining occurrences are from outcrops on the northwest side of Pluto Creek or from float which is almost in situ.

The mineralization occurs in veins in the main quartz-feldspar porphyry intrusive and also in the metasediments. A summary of the vein mineral assemblages follows.

(a) Veins in Quartz-Feldspar Porphyry

1. quartz $\pm$ molybdenum $\pm$ pyrite (common)
2. quartz + muscovite $\pm$ molybdenite $\pm$ pyrite $\pm$ fluorite $\pm$ Mn oxides

(b) Veins in Quartzite

1. quartz $\pm$ muscovite $\pm$ molybdenite $\pm$ beryl $\pm$ wolframite $\pm$ fluorite
2. quartz + muscovite + wolframite
3. quartz + galenobismutite
4. quartz + tourmaline

(c) Veins in Calc-Silicate

1. scheelite
2. molybdenite + powellite (?) + fluorite + apatite + gypsum (?)

CONCLUSIONS

1. Molybdenite, wolframite and scheelite bearing float and outcrops have been found on the claims.

2. The mineralization is of the stockwork type and is associated with a belt of three Cretaceous or Tertiary leucocratic quartz-feldspar porphyry plugs which intrude Precambrian or Paleozoic quartzite and limestone.

3. Soil sampling delineated an area 2.3 x 0.8 km, with Mo values of 5 to 330 ppm and W values of 10 to 260 ppm. This area is approximately coincident with the intrusive belt and the visible mineralization.

4. Other minerals associated with the vein mineralization include fluorite, tourmaline, apatite, scheelite, ilmenite and galenobismutite.

RECOMMENDATIONS

(a) Diamond drilling to test bedrock grade where mineralized float is common.

(b) 12 km of linecutting on the northern part of the grid.

(c) Trenching using D8 bulldozer on the northern grid.

Report by: I.A. Paterson
I.A. Paterson
Project Geologist

Endorsed by: R.Y. Watanabe
R.Y. Watanabe
Senior Geologist

Approved for Release by:
G. Harden, Manager
Exploration
Western District

IAP:gmk

Distribution:

Mining Recorder (2)
Western District (1)
Administration (1)

REFERENCES

Green, L.H., 1972, Geology of Nash Creek, Larsen Creek, and Dawson Map Areas, Yukon Territory. Geological Survey of Canada, Bulletin 364, 155 p.

McConnell, R.G., 1905, Report on the Klondike Gold Fields, Geological Survey Canada, Annual Report (new series); Volume XIV, 1901, Pt. B. 71 pp; also as separate publication no. 884; reprinted in Bostock, 1957, pp. 64-113.

Tempelman-Kluit, D.J., 1976, The Yukon Crystalline Terrane: Enigma in the Canadian Cordillera. Geological Society American Bulletin, Vol. 87, September, p. 1343-1357.

Tempelman-Kluit, D.J., 1979, Five occurrences of transported synorogenic clastic rocks in Yukon Territory. Geological Survey Canada, Paper 79-1A, p. 1-12.

APPENDIX I

IN THE MATTER OF THE ACT RESPECTING QUARTZ MINING IN THE YUKON TERRITORY AND IN THE MATTER OF A GEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL PROGRAMME CARRIED OUT ON PORTIONS OF THE PLUTO MINERAL CLAIM GROUP LOCATED 54 KILOMETRES NORTHWEST OF DAWSON CITY IN THE DAWSON MINING DIVISION OF THE YUKON TERRITORY

N.T.S. 116 C/8

A F F I D A V I T

I, Ian A. Paterson, of the City of Vancouver, in the Province of British Columbia, make oath and say:-

1. That I am employed as a project geologist by Cominco Ltd., and, as such, have a personal knowledge of the facts to which I hereinafter depose;

2. That annexed hereto and marked as "Exhibit A" to this my affidavit is a true copy of expenditures on a geological, geochemical and geophysical survey carried out on the Pluto mineral claims 4, 6, 8, 10, 12, 14, 16, 21 to 34, 41 to 52;

3. That the said expenditures were incurred between the 20th day of June and the 3rd day of September, 1979, for the purpose of mineral exploration on the above noted claim group.

Sworn Before Me at the City of Vancouver, in the Province of British Columbia this 16th day of ~~April~~ May, 1980.

Catherine a Wood
A Notary Public In and For the Province of British Columbia

Signed: Ian A Paterson
I.A. Paterson
Project Geologist

EXHIBIT "A"

GEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL REPORT

ON PORTIONS OF THE PLUTO MINERAL CLAIMS

SITUATED AT: 64°20'N LATITUDE; 140°21'W LONGITUDE

SALARIES:		
I.A. Paterson - 35 days	$ 5,845	
E.G. Olfert - 9 days	1,116	
P. Metcalfe - 8 days	744	
D. O'Brien - 10 days	690	
M. Seifert - 20 days	1,480	
A. Wilkins - 25 days	1,825	$11,700.00
TRANSPORTATION:		
Helicopter - 4.8 hrs. @ $335/hr.	1,608	
- 8.2 hrs. @ $400/hr.	3,280	4,888.00
CAMP COSTS:		
Food, Equipment - 107 man days @ $18/day		1,926.00
ANALYTICAL COSTS:		
843 samples analysed for Cu, Pb, Zn, Mo, W @ $7.30/each		6,153.90
MAGNETOMETER AND BASE STATION RENTAL:		300.00
LINECUTTING:		
18.1 km		2,880.00
		$27,847.90

Signed: Ian A Paterson
I.A. Paterson
Project Geologist

This is Exhibit "A" to the Affidavit of I.A. Paterson of Expenditures relating to the Geological, Geochemical and Geophysical program described before me this 16th day of ~~April~~ May, 1980, A.D.

Deborah A. Hoe
A Notary Public In and For the
Province of British Columbia

COMINCO LTD.

EXPLORATION

WESTERN DISTRICT
16 APRIL 1980

STATEMENT OF QUALIFICATIONS

I, Ian A. Paterson, with business address at 700-409 Granville Street, Vancouver, British Columbia, do hereby certify that I have supervised the field work and have assessed and interpreted the data resulting from this geological, geochemical and geophysical survey on the Pluto Mineral claims.

I also certify that:

1. I graduated from the University of Aberdeen, Scotland with a B.Sc. (Hons.) degree in 1967.

2. I graduated from the University of British Columbia with a Ph.D. degree in 1973.

3. I am a registered Professional Engineer of the Province of British Columbia, a Fellow of the Geological Association of Canada and a member of the Canadian Institute of Mining and Metallurgy.

4. I have been engaged in my profession since my graduation in 1973.

Respectfully Submitted:

Ian A Paterson

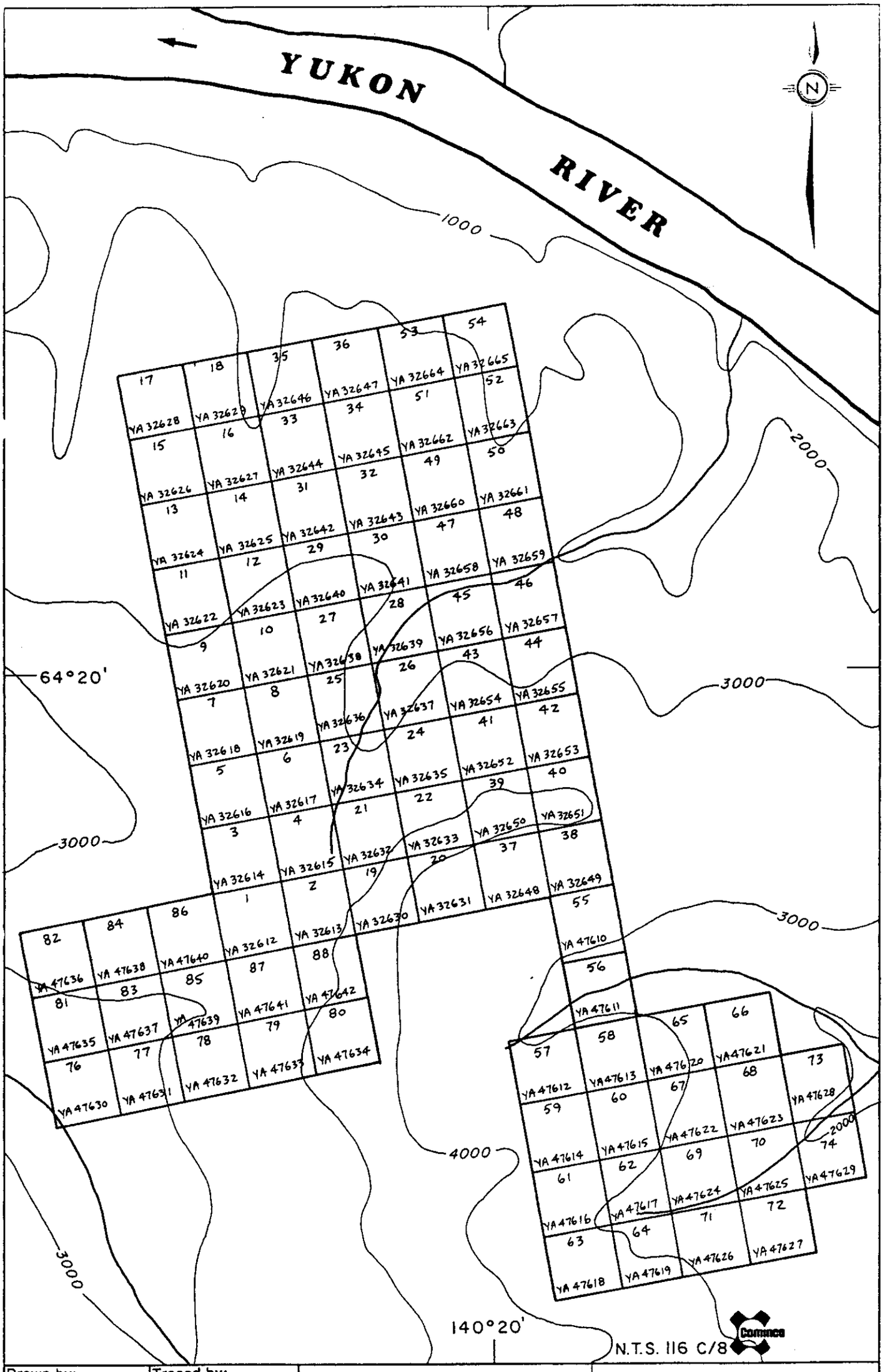
Ian A. Paterson
Project Geologist

. . .2

Ian A. Paterson was responsible for supervising the geological, geochemical and geophysical program described herein. Dr. Paterson received his B.Sc. (Hons.) degree from the University of Aberdeen, Scotland in 1967 and his Ph.D. degree from the University of British Columbia in 1973. He has worked with Cominco Ltd. on a permanent basis since February 4, 1974. I consider him a competent geologist.

Signed:

G. Marsden, Manager
Exploration
Western District



Drawn by:		Traced by:	
Revised by	Date	Revised by	Date

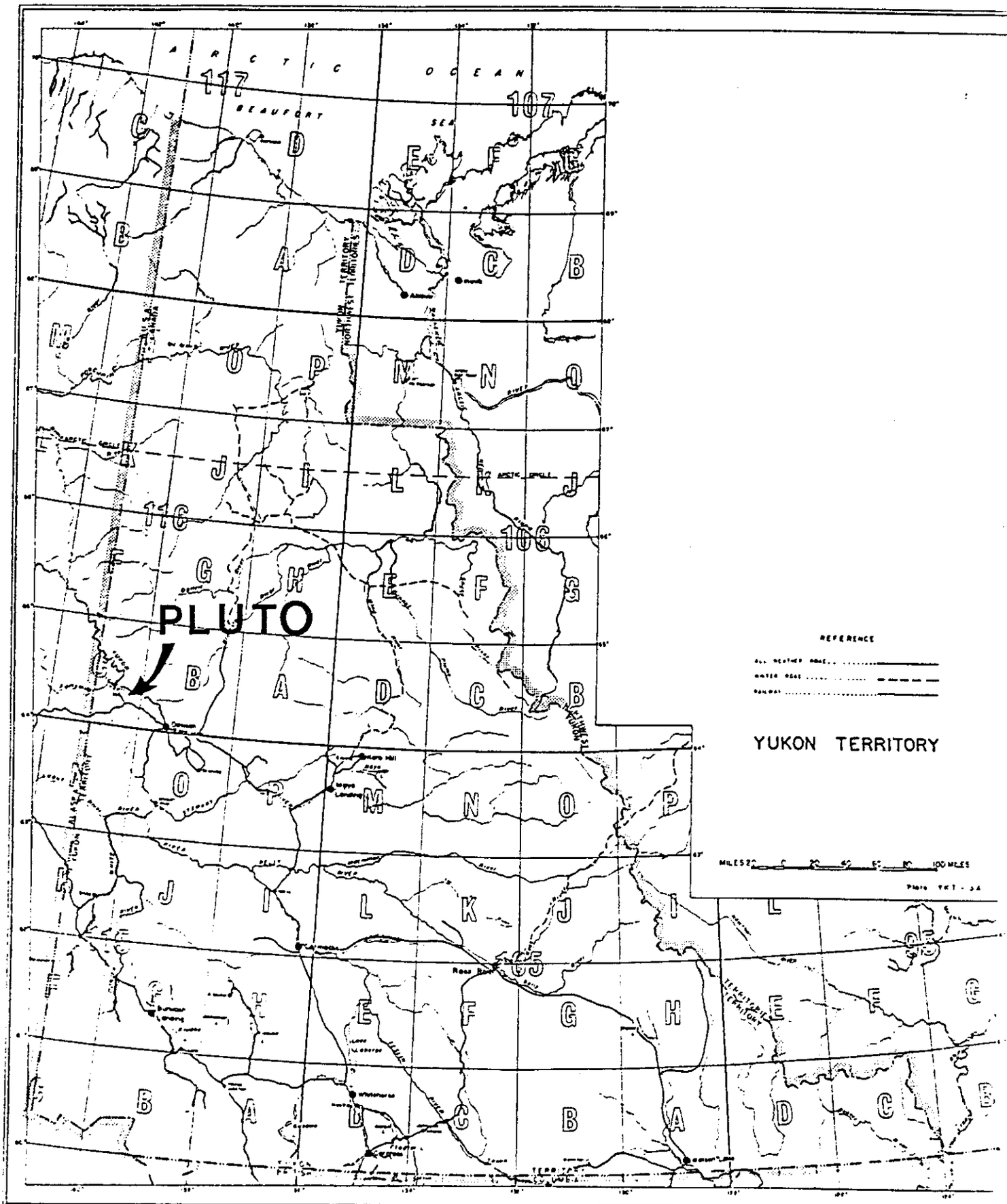
LOCATION MAP

PLUTO CLAIMS 1-74, 76-88

Scale: 1" = 1/2 mile | Date: 14-5-1980 | Plate: 2

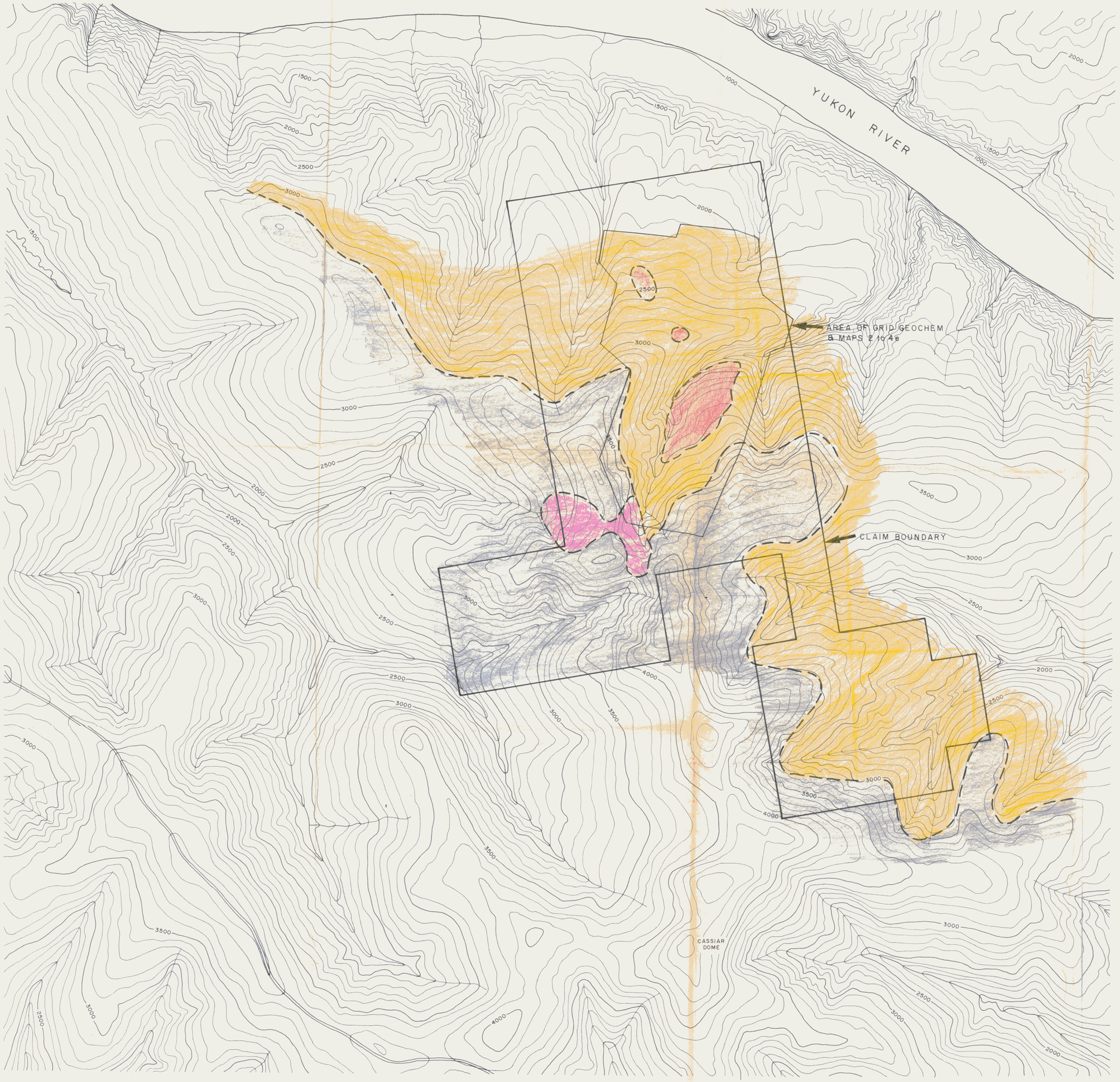
NCI - 112A - CL

210-0610



Drawn by	Traced by
Revised by Date	Revised by Date

Pluto claims – Location



LEGEND

TERTIARY

- Biotite-augite monzonite
- Quartz-feldspar porphyry

PALEOZOIC

- Nasina quartzite, phyllite, limestone

PALEOZOIC or PROTEROZOIC

- Quartzite, biotite-chlorite schist

— — — Approximate geological contact

HBP

PLUTO CLAIMS

116 C/8

Drawn by:		Traced by:	
Revised by	Date	Revised by	Date

REGIONAL GEOLOGY

Scale: 1:20,000 | Date: | Plate: 1

NCI - 117 - C.L.

LEGEND

CRETACEOUS – TERTIARY INTRUSIVES

7 — Augite + biotite monzonite

6a | 6b — 6a Quartz + feldspar ± biotite porphyry; quartz + muscovite altered porphyry
6b Felsite

PALEOZOIC

NASINA GROUP

5 — Grey graphitic quartz + muscovite phyllite

4 — Buff, streaky pyrrhotite quartzite; laminated, dark green, magnetite bearing siltstone or slate; tremolite ± talc schist

PALEOZOIC OR PROTEROZOIC

3a | 3b — 3a Pyrrhotite quartzite, interfoliated tremolite schist, quartz + muscovite + biotite schist, minor skarn
3b Mainly dark green chlorite + amphibole schist

2 — Green – white streaky skarn with interfoliated biotite + chlorite + feldspar augen schist

1 — Buff quartzite grading to quartz + muscovite + biotite gneiss interfoliated quartz + biotite schist, and biotite + chlorite ± pyrite schist

SYMBOLS

- outcrop boundary
- boundary of talus
- isolated boulders or chips from geochem. hole
- geologic contact – approximate, inferred
- limit of mapping and/or outcrop and boulders
- 20 — strike and dip of foliation
- molybdenite occurrence
- x wolframite occurrence
- scheelite occurrence
- tourmaline occurrence
- limit of molybdenite occurrences
- limit of wolframite occurrences
- spot height in metres
- claim post

0 100 200 300 400 500
METRES

PLUTO CLAIMS

116 C/8

Drawn by: IAP	Traced by:
Revised by / Date	Revised by / Date

GEOLOGY
and
MINERAL OCCURRENCES

Scale: 1:5000 | Date: FEB., 1980 | Plate: 2

IAP.

NCI – 118 – C.L.

FORM 210 0670

LEGEND

>60,000	purple	
59,000 – 59,999	red 2	
58,400 – 58,999	red 1	
58,200 – 58,399	blue	
58,000 – 58,199	brown	
57,800 – 57,999	dark green	
57,600 – 57,799	pale green	
57,400 – 57,599	yellow	
< 57,400	white	

Note: (1) All plotted values are in gammas and are prefixed by 5 unless otherwise indicated

(2) Contours shown in gammas X10

(3) Survey carried out using Scintrex MP2 total field magnetometer

Contact of quartz feldspar porphyry

Claim post

+ 1218 Spot height (in metres)

0 100 200 300 400 500
METRES

PLUTO CLAIMS

116 C/8

Drawn by: I.A.P. Traced by:

Revised by	Date	Revised by	Date

MAGNETOMETER SURVEY

Scale: 1:5000 Date: JAN., 1980 Plate: 3

FORM 212 0670

NCI - 118 - C.L.

LEGEND

- > 100 ppm Mo
- 50 - 99 ppm Mo
- 20 - 49 ppm Mo
- 5 - 19 ppm Mo
- grid soil sample
- contour soil sample
- X silt sample
- intrusive contact
- claim post
- + spot height in metres

0 100 200 300 400 500
METRES

PLUTO CLAIMS

116 C/8

Drawn by: IAP	Traced by:
Revised by / Date	Revised by / Date

GEOCHEMISTRY
Mo

Scale: 1:5000 | Date: JAN., 1980 | Plate: 4a

IAP.

NCI - 118 - C.L.

FORM 210 0670

LEGEND

- > 50 ppm W
- 25 - 49 ppm W
- 15 - 24 ppm W
- grid soil sample
- contour soil sample
- X silt sample
- ..... intrusive contact
- claim post
- + spot height in metres

0 100 200 300 400 500
METRES

PLUTO CLAIMS

116 C/8

Drawn by: IAP	Traced by:
Revised by / Date	Revised by / Date

GEOCHEMISTRY
W

Scale: 1:5000 | Date: JAN., 1980 | Plate: 4b

IAP.

NCI - 118 - C.L.

FORM 210 0670

LEGEND

- > 20 ppm Cu
- > 40 ppm Cu
- > 80 ppm Cu
- grid soil sample
- contour soil sample
- x silt sample
- intrusive contact
- claim post
- + spot height in metres

0 100 200 300 400 500
METRES

PLUTO CLAIMS

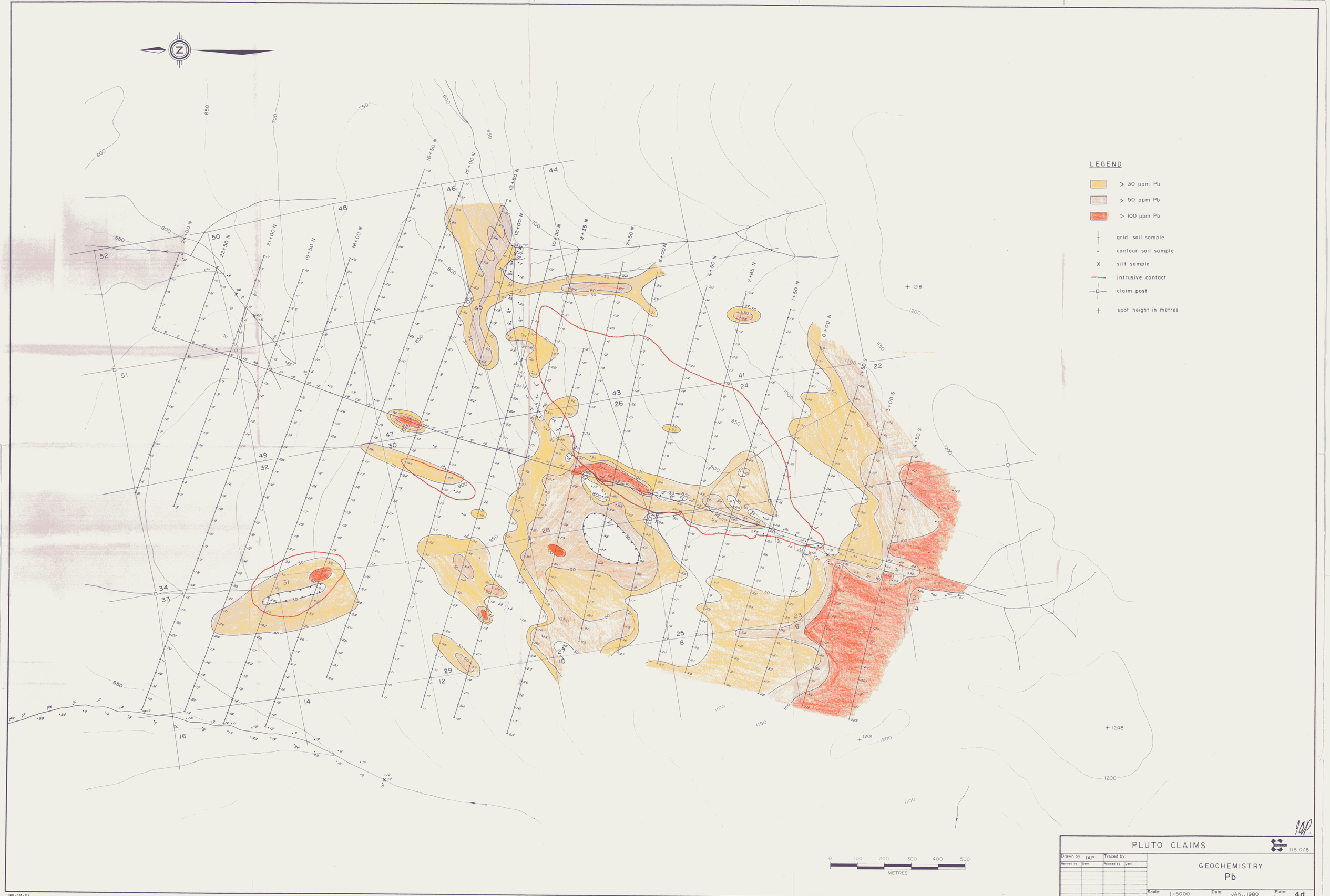
116 C/8

Drawn by: IAP	Traced by:
Revised by / Date	Revised by / Date

GEOCHEMISTRY
Cu

Scale: 1:5000 | Date: JAN., 1980 | Plate: 4c

FORM 210 0670



PLUTO CLAIMS

116 C/8

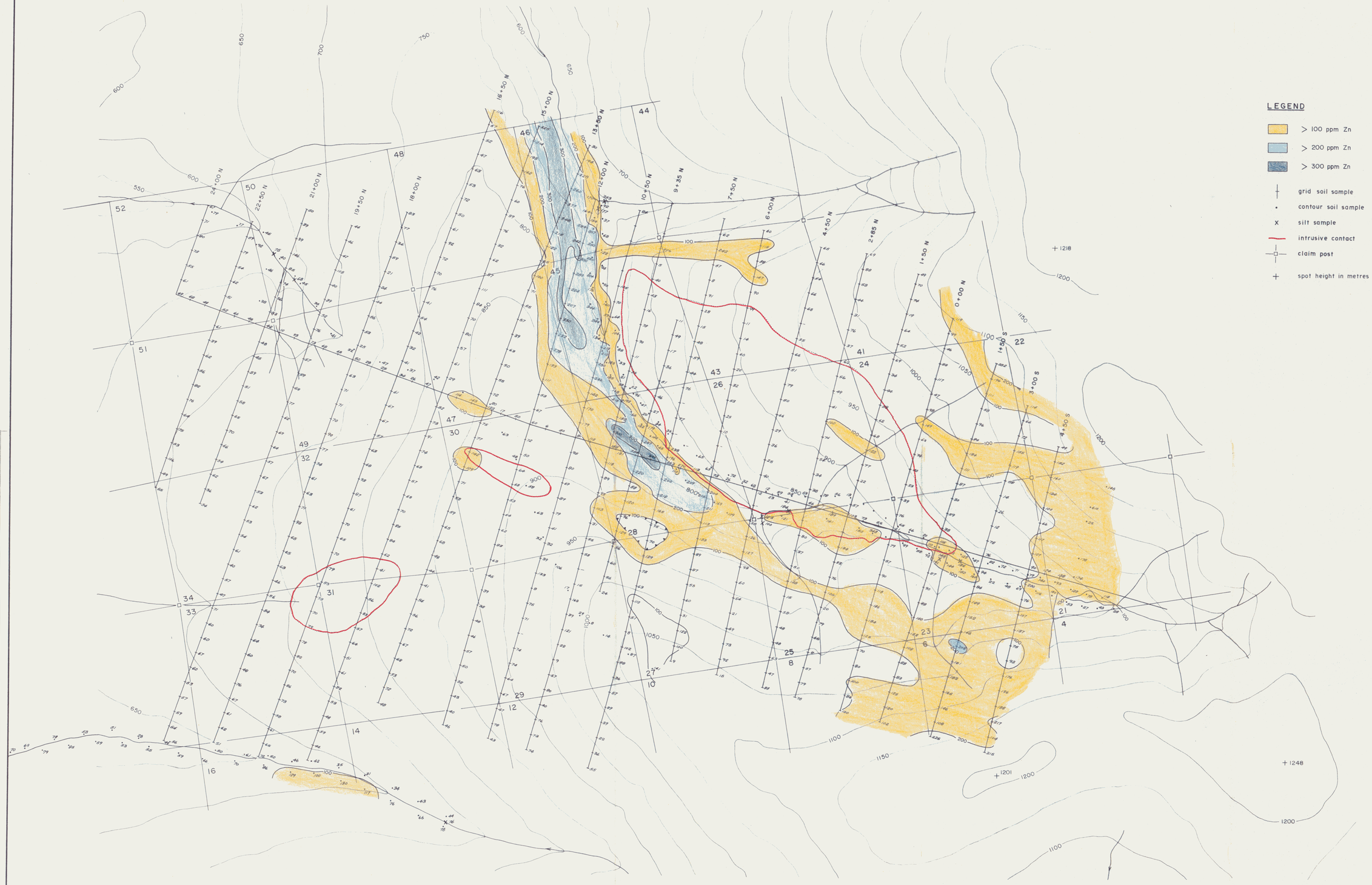
Drawn by: IAP | Traced by:

GEOCHEMISTRY
Pb

Scale: 1:5000 | Date: JAN., 1980 | Plate: 4d

NGI - 116 - C 1.

FORM 210 0670



PLUTO CLAIMS

116 C/8

Drawn by: IAP	Traced by:
Revised by / Date	Revised by / Date

GEOCHEMISTRY

Zn

Scale: 1:5000 | Date: JAN., 1980 | Plate: 4e

NGI - 118 - C.L.