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GEOLOGICAL & GEOCHEMICAL REPORT ON THE
KITSUNS CREEK PROPERTY

OMINECA MINING DIVISION

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Vancouver Office
October, 1965

J.N. Schindler &
R.A. Barker, P. Eng.

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SUMMARY

The Kitsuns Creek Property was staked by Southwest Potash Corporation to cover a new molybdenite occurrence located by the 1964 Central B.C. Prospecting Programme in mid-September of that year.

The present programme and examination, the first systematic work done on the property, was carried out between 4th - 22nd of August, 1965. During this period an extensive programme of geochemical sampling supplemented by geological mapping was performed by a two-man crew on those claims accessible by foot. Two geologists (senior assistants) G. Kendrick and S.J. Carryer, were responsible for the property work and this report is based largely on the results of their work.

A total of one hundred and sixty four geochemical samples were collected. Of these samples 99 were soil, 58 rock chip, 5 water and 2 silt. During the course of the geochemical sampling programme a total of 48,500 line-feet were chained.

Ninety per cent of the Mo values in the soils and rock chips fall in the range 0-30 ppm. Further, of 161 samples analysed for Mo and Cu, only 15 (9.3%) have a Cu/Mo ratio of less than 1.0.

One geochemically anomalous area 1,500 feet by 600 feet with soil values ranging from 24 ppm to 250 ppm Mo was outlined in the Linda #14 claim. The long axis of the anomaly may reflect

an area of widespread molybdenum mineralization, or it may result, in part, from transported molybdenum mineralization originating from a fairly restricted source near the crest of the east-facing slope of Camp Creek valley.

Geologically, the property is underlain predominantly by sedimentary, volcanic and particularly thick intercalations of intermediate tuffaceous rocks of the Hazelton Group. These rocks suffered deformation followed by intrusions of intermediate igneous rocks. A later period of fracturing was succeeded by the introduction of quartz and considerable amounts of pyrite, lesser quantities of chalcopyrite and magnetite, and minor molybdenite and scheelite. Late stage calcite veins represent the last phase of hydrothermal activity in the area.

The conspicuous rusty-brown colouring of the outcrops in the area is the result of oxidation of the above-mentioned sulphides, and subsequent formation of goethite, limonite and hematite. Some malachite staining has been noted in the calcite veins, but nowhere has ferrimolybdite been observed. In fact, molybdenite was noted in minor amounts in only two locations on the entire property.

Alteration in the claim area is restricted to propylitization and no acid igneous rocks or intrusive porphyries have been observed.

CONCLUSIONS

This property is considered to have little potential as a primary or by-product molybdenum producer under current conditions for the following reasons:

1) there is a general lack of molybdenum mineralization at surface and there appears to be little or no possibility of increased molybdenum mineralization with depth.

2) this paucity of visible molybdenum mineralization is coupled with generally low Mo geochemical results, 96.8% of the rock chip and 88.2% of the soil samples have an Mo content between 0 to 30 ppm.

3) although the copper mineralization exposed at surface is decidely better than the molybdenum mineraliztion, it is, nevertheless, of sub-ore grade.

4) there is a general lack of acid igneous rocks and favourably altered areas.

RECOMMENDATIONS

It is recommended that:

1) the Linda number's 16, 14, 7, 10, 12 and Thelma #1 claims be held until it is established which of the geochemical results, those of 1964 or those of 1965 are the more accurate.

2) the remainder of the claims be dropped.

INTRODUCTION

GENERAL STATEMENT

This report is the result of a 19 day evaluation programme conducted on the Kitsuns Creek MoS_2 Property in August 1965. During this period an extensive geochemical sampling programme was carried out along chained lines roughly 500 feet apart wherever topographically feasible. In addition to the geochemical survey, geology and prospecting for metallic mineralization was carried out on the property. All data obtained during the course of this work are included in this report.

LOCATION AND ACCESS

The Kitsuns Creek MoS_2 Property (127°52' west, 54°53' north) is located about six miles west of the headwaters of Kitsuns Creek, approximately 13 airmiles southwest of the termination of the Doughty-Kitseguecla Lake Road. The village of Doughty lies on Highway 16 roughly 14 miles north of Smithers (Figure 1).

Access to the property is by helicopter.

TOPOGRAPHY

Except for a well developed platform lying above 5,500 feet and below 6,300 feet, the topography of the property is very steep and rugged. Relief is of the order of 4000 or 4500 feet (the altitude varies from about 2,000 feet to about 6,500 feet), and a glacier bounds the southwestern edge of the property.

Scree slopes and precipitous cliffs occur at two principal levels:

a) along an east-west line at a height of 5,500 feet

b) along an arête at heights of roughly 6,500 feet at the southern edge of the property.

The tree-line is located at approximately 5,700 feet and snow fields have been noted above the 6,000 foot contour.

HISTORY AND PREVIOUS WORK

The gossan on what is now the Kitsuns Creek MoS_2 Property was located by J.F. Allan of the Central B.C. Prospecting Programme in early August 1964. Ground prospecting on and in the area surrounding the gossan was allocated to B.L. Whelan and his assistant G. Ehman. Their work indicated that visible MoS_2 mineralization is accompanied by soil samples highly anomalous in Mo (200 to 1000 ppm). Accordingly, a block of 42 claims comprised of 24 Linda claims and 18 Thelma claims were staked in August, in the name of Southwest Potash Corporation.

After the claims had been recorded, B.L. Whelan and G. Ehman carried out some geology and geochemistry on the property. Due to an error in the numbering system of the samples, the results of the geochemical survey could not be interpreted.

PROPERTY OWNERSHIP

The property consists of a block of 42 claims comprising of 24 Linda Claims (numbers 1-24 inclusive) and 18 Thelma Claims (numbers 1-18 inclusive) which were located by

J.F. Allan in August, 1964 acting as agent for Southwest Potash Corporation. (See Figure 2)

GEOLOGY

GENERAL GEOLOGY

The property is underlain predominantly by volcanic rocks of the Hazelton Group consisting mainly of acid and intermediate tuffs and flows which have been intruded by a satellitic pluton of the Coast Range Batholithic Complex and of intermediate composition. These rocks are flanked on the north and south by interbanded sedimentary and volcanic rocks thought to be Hazelton in age.

The presence of intrusive rocks in this area has long been known Armstrong (1) though, in former times, the areal extent of these rocks has been somewhat exaggerated. Armstrong (1) also shows these igneous rocks to be breaching the east limb on a north trending anticline whose axis lies four miles west of the property.

PROPERTY GEOLOGY

Petrology

The nature of the volcanic and plutonic rocks underlying the property is difficult to discern because they have suffered intrusive fracturing, shearing and quartz-pyrite veining.

On casual examination these rocks appear to be porphyries of varying heritages, having fairly large feldspar pheno-

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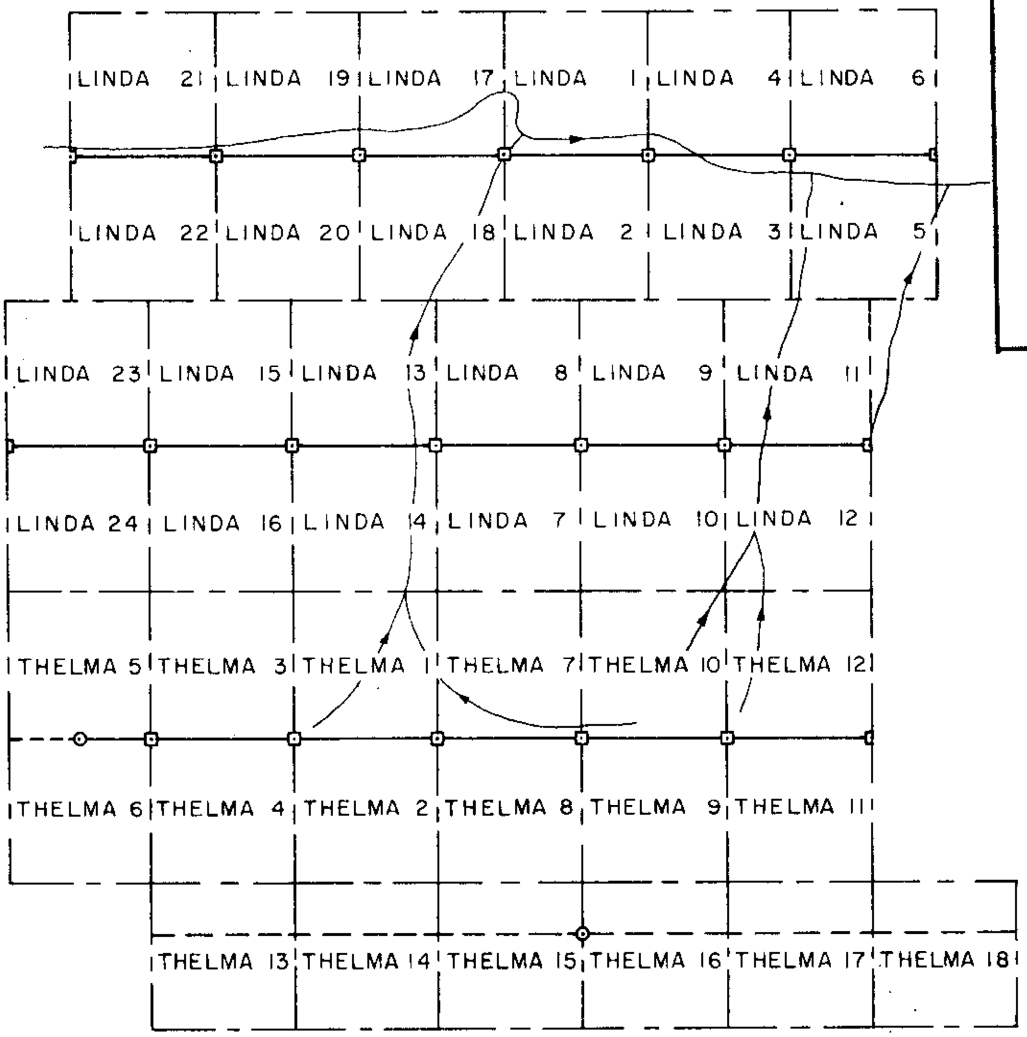


SOUTHWEST POTASH CORPORATION

KITSUNS CREEK MoS_2 PROPERTY

OMINECA M. D. — B. C.

CLAIM MAP

SCALE 1" = 2,000'

Vancouver —

H.P.

FIG. 2

stones and siltstones were deposited in a lacustrine environment since plant remains occur in them. The group to the south contain extensively developed andesite flows with large feldspar phenocrysts (corroded) and altered pyroxene(?) and amphibole(?) crystals.

Sedimentary rocks of a definite volcanic heritage outcrop in claims Linda #23, 15, 24, and 16. These consist of argillites, siltstones (probably silicified ash), conglomerates and agglomerates (flow breccias) which have not been extensively pyritized. (See Figure 3)

Greywacke (siltstones and silicified argillites) outcrops in Claim Thelma 1 and contains MoS_2 in place. The rock has been extensively fractured and veined by quartz, chalcopyrite and pyrite and contains very minor visible MoS_2.

After deformation intrusion and mineralization diorite dykes were intruded, one of which occurs in claim Linda 12. This dyke rock has been partly silicified around the margins.

STRUCTURAL GEOLOGY

Generally speaking, the rocks underlying the property have suffered extensive deformation. Fracturing, shearing and slickensiding are common throughout the area.

A series of closely spaced fractures trending N60°E has been noted in Camp Creek, and a fault (manifest as an extensive breccia zone) has locallized the most easterly north-flowing crysts and an aphanitic groundmass. However, on closer investigation they are seen to be either volcanic tuffs or plutonic rocks of intermediate composition.

The tuffs are very fine grained either leucocratic or mesocratic, containing, on the average, less than 20% quartz, but having abundant feldspar as phenocrysts and as fine crystals in the groundmass. Many of the volcanic rocks are flow breccias, some having fragments over 2 feet long. The designations rhyolitic flow breccia, dacitic tuff and rhyolite may aptly describe these rocks.

Generally, the plutonic rocks are coarse grained intermediate in composition. Syenite, granodiorite and diorite outcrop in the central area but their mutual relationships are not known. Diorite outcropping in Claim Thelma 11 contains pyroxene, possibly the other plutonics contained amphiboles and pyroxenes, but these appear to have all been altered more or less to chlorite and/or epidote with little biotite remaining from the discontinuous reaction.

Andesites or andesitic tuffs are well developed in the south-eastern part of the area, but probably occur as thin rarely developed flows throughout the rest of the region.

The group of interbanded Hazelton sediments and volcanics flanking the extensively developed volcanics to the north is not well exposed. It appears that the sediments mainly sandcreek in claims Linda 11 and Linda 12. Further, this fault has resulted in diorite on the west side of the creek, and granodiorite on the east side of the creek, in being juxtaposed.

The volcanic rocks dip 35° to the southeast with local variations of up to 80° or 90°. These variations are thought to be the result of deformation by local intrusive activity.

The distribution of the syenite, granodiorite, and diorite suggests that these rocks were intruded as small plutons throughout the area. However, no information as to their relative size or as to the nature of their contacts can be given. An intrusion of syenite to the east of Camp Creek with its contact following the course of the Creek has been observed. To the east the pluton is over-lain by andesitic lavas, and the lavas are vertical at the contact where a chilled marginal type of syenite (rhyolitic border facies?) exists.

Intensive quartz, chalcopyrite and pyrite veining is developed throughout the area south of a west-east line joining Linda 23 and 11. Carbonate veining which post-dates quartz and pyritic veining is found in a crescentic area on the west side of Camp Creek in claim Linda 14. Malachite and scheelite with minor amounts of molybdenite and magnetite occur here. Carbonate veining is also found on a west-east line from this occurrence but fades out to the west and east margins of the property. Springs precipitating $CaCO_3$ along their courses exist in claim

Linda 14. These may be aligned along a W-E or a NW-SE fracture system along which hydrothermal solutions percolated to precipitate $CaCO_3$ along pre-existing shears and fractures.

A brief study indicates several sets of joints and fractures trending 100°, 215°, 160° and 80°. Generally, though, the fracturing and jointing is random and shows no preferred orientation.

MINERALIZATION

Fairly intensively developed quartz veining, chalcopyrite and pyrite veining is extensively developed throughout an area south of a line joining Linda 23 and 11 claims.

In the central part of the area (Linda 14 claim) carbonate veining is extensively developed (3-4 veins to the inch) at the creek junction and in outcrops to the west of Camp Creek. The host rock is a brown, fine grained tuff, extensively fractured and sheared, and carrying quartz veining, pyrite and chalcopyrite veins, malachite coatings on fracture surfaces, and minor amounts of molybdenum, magnetite and scheelite (?). Magnetite grains were found both in claims Linda 14 and Thelma 5.

Molybdenum in place was also found in at the northern margin of claim Thelma 8 in a creek bed in quartz and pyrite veined greywacke.

Molybdenum in fact is rare having been found in place at only 2 localities. The pyrite-chalcopyrite stockwork found in the area is more typical of a low grade porphyry copper type of deposit.

GEOCHEMISTRY

GENERAL

The geochemical sampling was carried out along a grid whose disposition was controlled largely by the topography. Wherever feasible lines were spaced 500 feet apart, and sample sites located at 500 foot intervals along each line. The grid lines were chained and tied in with the claim posts and claim lines. A total of 48,500 feet were chained in this manner. (See Figures 4 and 5)

Rock chip samples were collected wherever possible, and where not, soil samples were taken. Also, the main drainage systems on the property were sampled by collecting either stream water or silt samples.

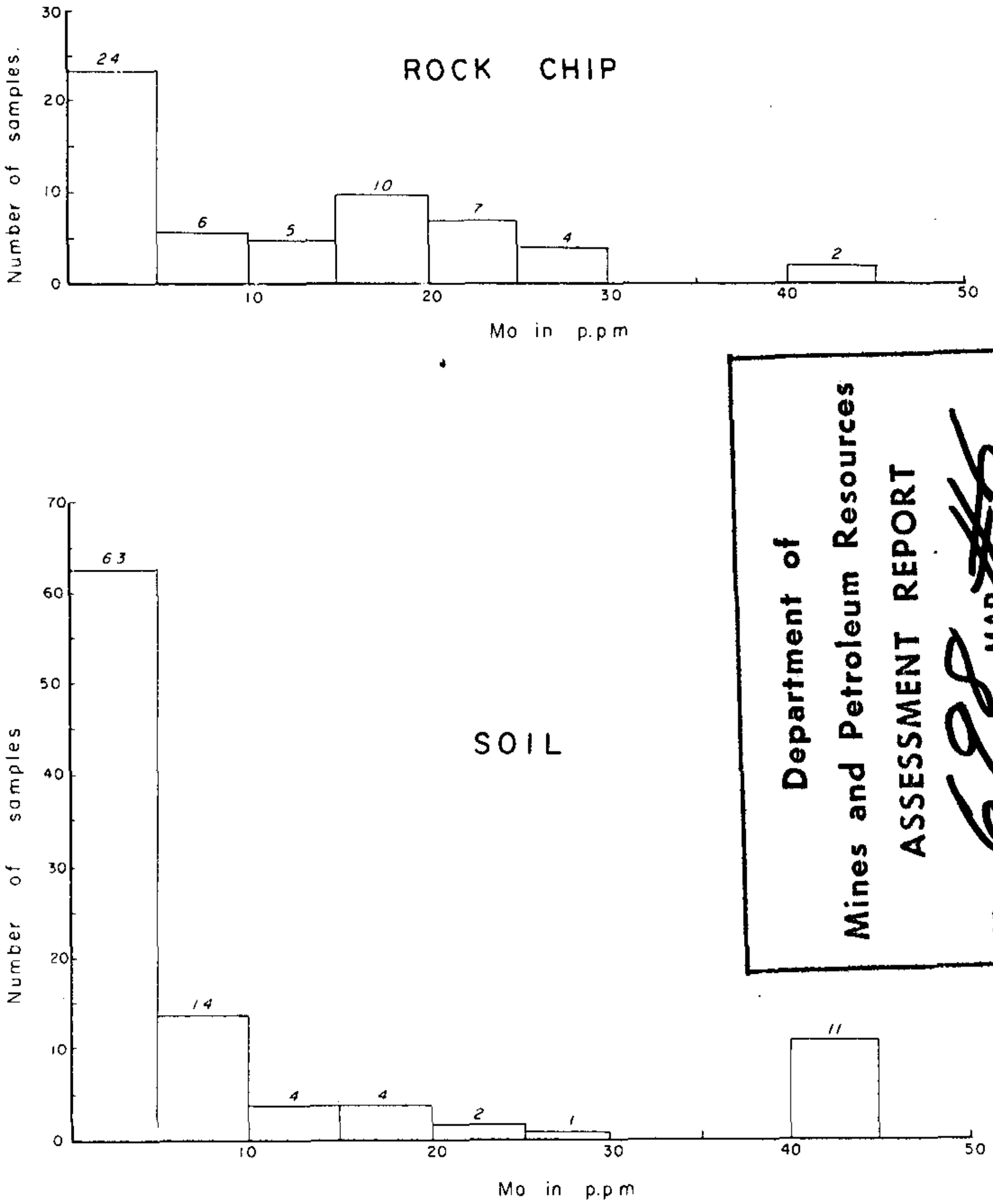
Soil samples were collected from the upper B horizon wherever the soil profile was adequately developed. However, a large part of the soil samples were collected from material derived directly from the breakdown of the underlying country rock, or what would normally be considered the C horizon in a mature soil profile. "Soil" samples were also collected from talus slopes and would be better described by the term "rock flour". No distinction has been made between the various types of soil samples for the purposes of this report.

DISCUSSION OR RESULTS

The geochemically anomalous area in the Linda 14 claim may be explained by minor quantities of visible molybdenite. Mo values for soil and rock chip samples on the rest of the property are generally low, 0 to 30 ppm. (See Figure 4), and as such are taken to represent an area with an elevated background, rather than being indicative of significant molybdenite mineralization. This contention is supported by the fact that the relative acidity of the soils (average pH 5.5, see Table I), and the abundance of iron would tend to inhibit the chemical mobility of any molybdenum present. That is, the Mo content of the soils presents a good reflection of the original molybdenum mineralization.

Copper mineralization is better developed than molybdenum mineralization (only 9.3% of the rock chip and soil samples have a Cu/Mo ratio less than 1.0 (See Table I)). However, the copper mineralization exposed at surface is of sub-ore grade, and generally the Cu values of soil and rock chips are those to be expected for intermediate rocks. (See Figure 5)

At this point it should be noted that although Whelan's results could not be interpreted, soil and rock chip samples collected by him were as much as five times higher than the results obtained this year. It would probably be advisable therefore, to hold certain key claims until it can be determined



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SOUTHWEST POTASH CORPORATION

KITSUNS CREEK MoS_2 PROPERTY

OMINECA M. D. — B. C.

HISTOGRAMS OF Mo VALUES IN ROCK CHIP AND SOIL SAMPLES

FIG. 6

which of the results are the more reliable.

SUMMARY OF WORK AND PERSONNEL INVOLVED

Line Chained - 48,500 feet
Geological Work - Approximately 1.7 square miles
Geochemical Survey - Approximately 2.1 square miles
Geochemical Samples Analysed - 164

Personnel Employed

S.J. Carryer - 718 Granville Street, Vancouver, B.C.
Senior Assistant.

G. Kendrick - c/o Geology Department, University of Toronto, Toronto, Ontario.
Senior Assistant.

I.M. Hedley - 152 Prospect Place, Victoria, B.C.
Junior Assistant.

A.C. Schindler - 598 Grosvenor Avenue, Westmount, Que.
Junior Assistant.

ASSESSMENT WORK CHARGES

Salaries: For one 2 man crew		$529.80
Board: 38 man days at $2.50/man day		95.00
Analyses of Geochemical Samples -		
99 soils at $1.50/sample	$148.50	
58 rock chips estimated at $2.00/sample	116.00	
5 waters estimated at $1.00/sample	5.00	
2 silts estimated at $1.50/sample	3.00	
Sub Total	$272.50	272.50
Preparation of Report (Typing & Drafting)		45.00
Grand Total		$942.30

Vancouver Office
October, 1965.

JN Schindler
J.N. Schindler

RA Barker
R.A. Barker, P. Eng.

TABLE I

GEOCHEMISTRY ANALYTICAL DATA

Sample #		Mo	Cu	THM	pH	Cu/Mo Ratio
CT	482	20	160	>10	-	8
CS	483	0	225	1	5.7	∞
CS	484	15	150	1	-	10
CS	485	0	8	9	-	∞
CS	486	0	200	1	5.7	∞
CT	487	20	900	>10	-	45
CS	488	3	300	9	-	100
CT	489	20	200	1	-	10
CT	490	20	50	1	-	2.5
CT	491	20	70	>10	-	3.5
CS	492	0	0	0	-	-
CS	493	8	300	1	5.4	38
CS	494	0	25	1	-	∞
CS	495	0	8	10	-	∞
CS	496	0	20	10	6.4	∞
CT	497	15	2	1	-	.13
CT	498	15	12	1	-	.8
CS	499	0	12	1	-	∞
CT	500	15	20	1	-	.75
CS	501	0	50	1	-	∞
CS	502	0	50	1	-	∞
CS	503	0	300	Cu interference	7.7	∞
CT	504	15	150	5	-	10
CS	505	0	2	1	-	∞
CS	506	0	280	0	5.0	∞
CS	507	10	250	3	-	25
CT	508					
CS	509	0	40	3	-	∞
CS	510	10	0	1	5.1	0
CS	511	5	0	1	-	0
CS	512	5	100	9	-	20
CS	513	5	280	0	5.4	56
CT	514	10	150	9	-	15
CS	515	0	2	2	-	∞
CS	516	5	0	1	-	0
C	517	-				
CS	518	80	140	0	5.2	1.8
C	519	-				
CT	520	5	20	5	-	4

TABLE I

GEOCHEMISTRY ANALYTICAL DATA

Sample #		Mo	Cu	THM	pH	Cu/Mo Ratio
KW	533	1	-	-	7.2	-
KW	534	0	-	-	7.3	-
KW	535	0	-	-	7.3	-
KT	536	0	50	4	-	∞
KT	537	0	200	5	-	∞
KS	538	0	40	6	-	∞
KS	539	8	160	6	-	20
KT	540	0	50	2	-	∞
KT	541	0	120	4	-	∞
KS	542	8	200	3	5.3	25
KS	543	0	40	7	-	∞
KS	544	0	4	1	-	∞
KT	545	0	8	2	-	∞
KT	546	0	0	3	-	-
KT	547	0	0	0	-	-
KT	548	0	8	1	-	∞
KT	549	0	100	8	-	∞
KT	550	0	80	1	-	∞
KT	551	40	>800	Cu interference		>20
KS	552	40	350	1	5.7	8.8
KS	553	0	100	2	-	∞
KS	554	250	150	0	-	.6
KS	555	24	1200	Cu interference	6.2	50
KS	556	40	750	Cu interference	-	19
KS	557	100	800	Cu interference		8
KS	558	0	20	3	5.7	∞
KS	559	40	300	Cu interference	-	7.5
KT	560	40	320	Cu interference		8
KS	561	80	100	6	-	1.3
KS	562	8	>800	Cu interference	-	>100
KS	563	8	150	4	5.8	19
KS	564	0	40	0	-	∞
KS	565	8	100	7	-	12.5
KT	566	4	240	5	-	60
KT	567	0	240	6	-	∞
KT	568	0	80	4	-	∞
KT	569	2	140	4	-	70
KS	570	16	120	6	5.6	7.5
KS	571	16	70	7	-	4.4
KS	572	8	50	2	-	6.3
KS	573	40	400	Cu interference	6.0	10

TABLE I

GEOCHEMISTRY ANALYTICAL DATA

Sample #		Mo	Cu	THM	pH	Cu/Mo Ratio
KS	574	16	8	8	-	.5
KS	575	4	100	6	-	25
KW	576	1	-	-	7.4	-
KS	577	0	0	3	5.0	-
KS	578	0	0	5	-	-
KS	579	0	8	0	-	∞
KS	580	0	8	0	6.6	∞
KS	581	0	12	2	-	∞
KS	582	0	0	2	-	-
KT	583	4	80	5	-	20
KT	584	0	80	>10	-	∞
KT	585	0	4	0	-	∞
KT	586	0	0	0	-	-
KT	587	0	40	4	-	∞
KS	588	0	8	2	5.7	∞
KL	589	0	6	5	-	∞
KW	590	0	-	-	7.4	-
KS	591	0	200	2	-	∞
KS	592	0	50	6	5.6	∞
KS	593	0	150	3	-	∞
KS	594	24	50	4	-	2.1
KS	595	40	120	0	5.5	3
KT	596	0	40	1	-	∞
KT	597	0	12	2	-	∞
KS	598	4	80	2	4.9	20
KS	599	0	120	>10	-	∞
KT	600	25	40	0	-	1.6
KT	601	15	170	1	-	11.3
KT	602	12	30	2	-	2.5
KS	603	4	0	1	-	0
KT	604	16	100	1	-	6.3
KS	605	4	320	2	-	80
KT	606	10	75	0	-	7.5
KT	607	12	0	2	-	0
KS	608	25	140	3	4.9	5.6
KT	609	16	80	2	-	5
KT	610	16	90	1	-	5.6
KS	611	2	70	4	-	35
KS	612	80	340	>10	-	4.3
KS	613	6	110	4	5.6	18.3

TABLE I

GEOCHEMISTRY ANALYTICAL DATA

Sample #		Mo	Cu	THM	pH	Cu/Mo Ratio
KT	614	25	16	4	-	0.6
KS	615	0	0	2	-	-
KT	616	25	50	1	-	2
KS	617	2	30	3	-	15
KL	618	50	600	Cu interference	6.5	12
KT	619	15	120	>10	-	8
KT	620	6	30	0	-	5
KT	621	20	4	4	-	0.2
KT	622	20	16	1	-	0.8
KS	623	10	300	Cu interference	-	30
KS	624	0	0	1	-	-
KS	625	0	2	1	5.8	∞
KS	626	0	300	Cu interference	-	∞
KT	627	0	16	5	-	∞
KT	628	0	50	2	-	∞
KS	629	0	8	1	-	∞
KS	630	10	0	1	4.3	0
KS	631	0	0	1	-	-
KS	632	0	0	0	-	-
KS	633	2	40	1	4.4	20
KS	634	0	0	1	-	-
KS	635	0	0	1	-	-
KS	636	0	0	1	4.5	-
KS	637	0	0	0	-	-
KS	638	0	30	0	-	∞
KL	639	40	300	Cu interference	-	7.5
KS	640	0	0	0	4.3	-
KT	641	8	0	2	-	0
KT	642	8	40	0	-	5
KL	643	0	12	4	-	∞
KS	644	0	0	4	-	-
KS	645	0	12	2	-	∞
KS	646	0	0	0	4.5	-
KS	647	0	0	4	-	-
KS	648	0	4	0	-	∞
KS	649	0	20	2	4.7	∞
KS	650	0	16	3	-	∞
KL	651	2	4	0	6.9	2
KS	652	0	0	0	-	-
KT	653	0	12	4	-	∞
KT	654	15	16	>10	-	1.1

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TABLE I

GEOCHEMISTRY ANALYTICAL DATA

Sample #		Mo	Cu	THM	pH	Cu/Mo Ratio
KT	655	10	40	5	-	4
KS	656	4	20	2	4.4	5
KT	657	8	40	1	-	5
KS	658	0	0	4	-	-
KS	659	8	180	2	-	22.5
KS	660	6	300	2	5.1	50
KT	661	8	0	1	-	0
KT	662	25	100	1	-	4
KS	663	0	350	4	-	∞
KT	664	8	80	1	-	10

NOTE #1 - Sample Identification

The first letter identifies the collector -
C - Carryer
K - Kendrick
The second letter identifies the sample type -
L - silt
R - rock chip
S - soil
W - water

NOTE #2 - Cu/Mo Ratios

125 out of 161 samples (77.6%) analysed for Mo and Cu have a Cu/Mo ratio greater than 1.0.

15 out of 161 samples (9.3%) analysed for Mo and Cu have a Cu/Mo ratio less than 1.0.

21 out of 161 samples (13.1%) analysed for Mo and Cu contain neither Mo nor Cu.

NOTE #3 - pH Values

37 pH determinations in soils range from 4.3 to 7.7 and have an average value of 5.5.

INTRODUCTION

This report is a detailed description of the geochemical analytical method used by the Southwest Potash Corporation field laboratory in the determination of trace molybdenum in soil, stream sediment, rock chips, and water samples.

The method used is a modification of the classical thiocyanate-stannous chloride colormetric technique. In acid solution in the presence of a suitable reducing agent, such as stannous chloride, thiocyanate reacts with molybdenum to form an amber colour. Such a thiocyanate complex of quinquevalent molybdenum ions is extracted in immiscible organic solvents such as ether or alcohol. The intensity of the coloured complex obeys Lambert-Beer's law and is proportional to the quantity or concentration of molybdenum present.

The reactions are given by the equations:

$$(1)\ Mo^{+5} + m\,CNS^{-} \rightleftharpoons [Mo(CNS)m]^{5-m}\ (\text{colourless})$$

$$(2)\ [Mo(CNS)_m^{5-m}] + (5-m)CNS^{-} \rightleftharpoons Mo(CNS)_5\ (\text{red})$$

Only the quinquevalent molybdenum ion gives a coloured thiocyanate complex. According to Sandell, not all molybdenum is reduced to the quinquevalent form. It is estimated only about two-thirds of the total molybdenum present gives a colour reaction. However, because the standards are treated in the same manner as the unknowns, any error cancels itself out and has no effect on the reported result.

Following a description of the analytical methods, a summary of the 1963 field laboratory is given in the appendix plus some recommendations for improving future laboratory operations.

SAMPLE PREPARATIONS

(a) Soil and Silt

Soil and silt samples when received are commonly wet or moist and must be dried before sieving. Treat the samples in the following steps:

1) Put the sample bags on an aluminum foil tray and place on top of an oil stove. Time required is usually eight hours.

2) Sieve the dried samples with a minus 35-mesh screen onto a one foot square piece of heavy brown paper. Use a new piece of paper every day and clean the sieve with a paint brush between samples.

3) Using a volumetric scoop (calibrated to deliver a given weight of sample) 'weigh' out a known amount (usually 1 gram) of screened sample and transfer it into a marked test tube.

4) Return the remaining fines (pulps) of the sieved sample into its original sample bag.

5) Put the samples in storage boxes if available or string with a piece of twine in batches of about 30 for bulk storage in gunny sacks.

(b) Rock Chips

1) Pour the sample from the bag into the crusher. After the sample has been crushed place the fragments in the pulverizer.

2) Sieve the pulverized sample through a minus 35-mesh screen and proceed through steps 2 to 5 as followed for soil and silt samples. Place the pulp in a Kraft bag for permanent storage.

3) With the use of an airhose clean the crusher and pulverizer before introducing the next sample.

DIGESTION

Samples of soil, silt and rock chips are digested in a hot water bath. The heat is supplied by a three-burner Coleman stove. Digestion is best done outside the laboratory where the toxic nitric fumes can dissipate into the atmosphere away from both laboratory equipment and personnel.

Digestion is carried out as follows:

1) Measure out volumetrically with leucite scoop 1 gm of the sieved sample and place in a 15 x 125 rimmed test tube.

2) Using an automatic pipette, add 4 ml of diluted (3:1) nitric acid.

3) Digest the samples, a rack at a time for 2 hours.

4) Shake the tubes occasionally to aid digestion.

5) Remove the rack and allow to cool.

6) Using poly wash bottle, fill all tubes up to the 4 ml mark with water.

DETERMINATION

(a) Soil, Silt and Rock Chip

Samples are usually treated in batches of ten and in racks of forty.

1) Using an auto-pipette, transfer a 1 ml aliquot from each digested solution to a marked rimless test tube. Use a smaller aliquot if high molybdenum content is suspected.

NOTE: Clean the auto-pipette thoroughly between each sample by rinsing at least three times with de-mineralized water. Shake the pipette in the air to dry. Contamination could easily occur at this step without suitable rinsing.

2) To each test tube using an automatic pipette, add 2 ml of 10% HCl.

3) Using a spatula, add 0.2 gm of sodium tartrate.

4) Using a burette, add 1.5 ml of KSCN. Shake to mix.

5) Using a burette, add 0.5 ml of $SnCl_2$ solution. Shake to mix.

NOTE: If the iron content of the testing solution is high, a larger amount of $SnCl_2$ solution may be required, ($SnCl_2$ should be added to completely eliminate the blood red colour of the ferric thiocyanate).

6) Using a wash bottle, add water to bring the total volume of the solution up to the 10 ml mark.

7) Using a burette, add <u>exactly</u> 1 ml of ether.

8) Stopper the test tubes with corks and shake vigorously for 45 seconds. It is advisable to number the corks to avoid mixing up tubes.

9) Allow the phases to separate.

10) Compare the colour of the ether layer to that of the molybdenum standards. Colour intensities should be compared and matched against a white background.

CALCULATIONS

(a) Soil, Silt and Rock Chip

The concentration of molybdenum in parts per million (ppm) is calculated from the following factors:

1) The weight of sample used for digestion.
2) Volume of solution for digestion.
3) Volume of aliquot taken for determination.
4) Gamma content of the matched standard.

The concentration in ppm is given by the formula

$$\text{ppm} = \frac{\text{volume digested sample solution(ml)}}{\text{weight of sample (gm)}} \times \frac{\text{value of matched standard (gammas)}}{\text{aliquot of sample(ml)}}$$

= gammas per gram (which equals parts per million)

STANDARDS

(a) Molybdenum Standard Solutions

1) Stock standard concentrated: (100 gammas/ml). Dissolve 0.075 gm of MoO_3 in 20 ml of 10% NaOH. (10 gm of NaOH crystals in 100 ml of water). Dilute to 100 ml. Add diluted HCl until the solution is acid (use pH hydrion paper). Fill to 500 ml mark of the flask. Prepare this solution once a season.

2) Stock standard diluted: (1gamma/ml). Dilute 1 ml of stock standard to 100 ml mark of the volumetric flask. Prepare this diluted solution each time a new standard is made.

(b) Working Molybdenum Standard for Soil, Silt & Rock Chip

Two sets of working standards representing a low and a high range are prepared by diluting the working standard. The amount of standard solution diluted is outlined in the following tables.

Pipette from stock standard solutions the required volumes into a series of 7 test tubes. The amount and concentration of stock standard solution used is outlined in the following tables.

LOW RANGE

STANDARDS	A	B	C	D	E	F	G	H
ml of 1γ/ml standard	0	0.5	1.0	1.5	2.5	3.0	4.0	5.0
Gammas	0	0.5	1.0	1.5	2.5	3.0	4.0	5.0
ppm*	0	2.0	4.0	6.0	10.0	12.0	16.0	20.0

* Concentration based on aliquot representing one quarter of a gram as used in procedure given above.

HIGH RANGE

STANDARDS	I	J	K	L	M	N	O
ml of 100γ/ml standard	0.1	0.2	0.25	0.5	0.8	1.00	1.5
Gammas	10	20	25	50	80	100	150
ppm*	40	80	100	200	320	400	600

Treat the standards as outlined in the procedure given for the unknowns. It is important that the standards and unknowns undergo identical treatment. Cover the standards with a sheet of aluminum foil to shield them against any heat or light when not in use. Prepare new standards at least once every three weeks or sooner if fading is suspected.

PREPARATION OF REAGENTS

The following reagents are used in the test on soil, silt and rock chip samples.

1) 10% HCl: Add 100 ml of concentrated HCl into a 2 litre beaker and dilute to one litre. Store in a poly bottle.

2) Diluted HNO_3: Dilute 750 ml of concentrated HNO_3 to one litre. Store in a poly bottle.

3) Thiocyanate solution: Dissolve 5 gm of KSCN in 100 ml of water. Prepare fresh solution daily.

4) $SnCl_2$ solution: Dissolve 13 gm of $SnCl_2$ in 17 ml of concentrated HCl. Heat the mixture in a hot water bath. Make up to 100 ml with water when crystals have been completely dissolved. Add a piece of metallic tin to ensure stability of $SnCl_2$. Prepare a fresh solution daily.

5) Sodium tartrate - use directly as a solid.

6) Isopropyl ether - use directly but with caution as it is highly inflammable and explosive peroxides may form.

Use de-mineralized water for all reagents, preparations and analytical determinations.

pH DETERMINATION

A line-operated Beckman Model H-2 meter is used in making pH measurements. Following a warm-up period, the meter is calibrated with standard buffer solutions before using and rechecked between every 20 determinations, or every hour whichever comes first.

(a) Soil and Silt

Measurements are made as follows:

1) Pour approximately 15 gm of the sieved sample into a 30 ml poly beaker. Wet the sample with distilled water (use neutral stream water). Do not use de-mineralized water (water passed through a resin de-mineralizer is acidic). Swirl the beaker occasionally during the determination to ensure the sample is in a homogeneous state.

2) Gently insert the electrodes into the dampened sample.

3) Observe the pH reading when the needle reaches a steady state.

4) Discard the tested sample, clean the beaker and electrodes with water. Wipe the electrodes with a cleaning tissue. It is important that the electrodes be thoroughly cleaned after every determination.

(b) Rock Chips

pH determination is not required for rock chip.

WATER DETERMINATION

Water samples require no special preparation preceding the actual analysis . Samples are usually treated in sets of six.

(a) Determination

1) Pour water sample into a separatory funnel up to the 50 ml mark.

2) Using an automatic pipette, add 5 ml of diluted HCl.

3) Using an automatic pipette, add 1 ml of ferric ammonium sulphate solution. Tilt funnel to mix.

4) Using an automatic pipette, add 3 ml of KSCN solution. Tilt funnel to mix.

5) Using an automatic pipette, add 3 ml of $SnCl_2$ solution. Tilt funnel to mix.

6) Using a burette, add 2 ml of ether. Shake for 45 seconds. Release pressure every 10 seconds during shaking.

7) Allow phases to separate.

8) Discard the aqueous (water) layer into a beaker. Stop at 10 ml mark.

9) Drain off the remaining aqueous and the organic phases into a 16 x 150 rimless test tube.

10) Compare the colour of the organic layer to that of the molybdenum standards.

(b) Calculation

The concentration of molybdenum in water is expressed in parts per billion (ppb), i.e., 1/1000 gammas per gram or gammas per 1000 grams. The concentration is calculated using two factors.

1) The initial volume of sample used for determination.

2) The value of the matched standard x 1,000.

The concentration of molybdenum in water is given by the formula:

$$\text{ppb} = \frac{\text{value of the matched standard(gammas)}}{\text{volume of water used for determination(ml)}} \times 1,000$$

$$= \text{gammas per 1000 millilitres(since density of water is equal to 1)}$$

$$= \text{gammas per 1000 grams, or ppb}$$

(c) Standards

1) Pipette 0, 0.25, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 5.0, 8.0 ml of the dilute (1 gamma/ml) stock standard solution into the separatory funnels.

2) Add water to 50 ml mark and proceed with step (2) to step (9) given above for water determinations.

(d) pH Determination

Measurements are taken as follows:

1) Approximately 25 ml of sample is transferred into a 30 ml poly beaker for measurement.

2) Insert the electrode and take a reading.

3) Discard the sample; wash down and dry the electrodes.

(e) Preparation of Reagents

In addition to some reagents already mentioned on the previous pages the following are needed in the water test.

1) Ammonium sulfate solution: Dissolve 1 gm of ferric ammonium sulfate crystals in 100 ml of water. Warm the mixture in a water bath. Prepare fresh solution once every five days.

2) KSCN solution: Dissolve 10 gm of KSCN crystals in 100 ml of water. KSCN dissolves in cold water. Prepare fresh solution daily.

3) $SnCl_2$ solution: Heat 30 gm of $SnCl_2$ in 50 ml of concentrated HCl in a water bath till a clear solution appears. Dilute the solution to 300 ml. Insert a piece of metallic tin to stabilize the solution. Prepare fresh solution daily.

4) Diluted HCl: Dilute 800 ml of concentrated to one litre.

GENERAL REMARKS

Hazardous Reagents

Many of the reagents used in geochemical analyses are either poisonous or toxic. Some are hazardous because they are imflammable. Careless handling of concentrated acids may result in severe skin burns or eye damage. Some volatile organic compounds may produce permanent liver, lung or kidney damage after prolonged exposure. To avoid or minimize these dangers, a laboratory should be well ventilated at all times. No single rule can serve as an absolute safeguard against injury as it is basically a matter of common sense in taking precautions.

Where hazardous chemicals are involved, stock bottles should be kept away from possible dangers, i.e., fire and heating area, and if possible, be stored in a separate place.

Fire extinguishers should be within easy reach at all times. Plenty of water should always be readily available in case of acid burns on the skin. Lastly, smoking, eating, drinking and horseplay should be prohibited in the laboratory.

Contamination

Contamination is an ever present danger. Cleanliness of all apparatus and working stations minimizes the possibility of contamination. Common reagents like dithizone and some organic compounds are extremely sensitive to metals and to commercial products which employ metals as catalysts. A trace of these foreign metals blended in with the testing solutions seriously affect analytical results. Tap water, commercial soaps or detergents for cleaning glassware are commonly loaded with heavy metals. Glassware should be allowed to dry in air rather than wiped with paper towels. To constantly check on contamination a blank sample and a known sample should be run daily or whenever new equipment or solutions are introduced.

Interferences

The thiocyanate-stannous chloride method of separation for molybdenum makes no allowance for certain metal interferences. Possible interfering metals include rhenium, titanium, rhodium, vanadium, uranyl complex, cobalt, and tungsten. Of these, only tungsten is provided for in the procedure. Fortunately most of the other metals do not generally occur in sufficient concentration to cause serious interference. The colours produced by some of these metals are from unstable complexes and quickly fade away. Other interference products are recognized easily because of their distinctive yellow, green, or blue colours.

Organization

The laboratory is systematically divided into a series of working stations along the benches. Each working station is equipped with the necessary reagents and apparatus to carry out a given part of the analytical procedure with the minimum of physical movement by the operator. If more than one operator participates in the procedure, the sequence is planned so that they will not interfere with each other. Streamlining the procedural layout increases the efficiency and productivity of the laboratory many fold.

Conway Chun

SOUTHWEST POTASH CORPORATION

GEOCHEMICAL LABORATORY PROCEDURES

FOR ANALYSIS OF COPPER

INTRODUCTION

The following is a detailed description of the biquinoline analytical method used by the Southwest Potash Corporation Geochemical Laboratory in the determination of trace amounts of copper in soil, stream sediment and rock chip samples.

All soil, stream sediment and rock chip samples submitted to the laboratory are analyzed first for trace molybdenum and then for trace copper. Therefore, it is possible to streamline the procedure for copper, and treat both molybdenum and copper as one sample during the steps of sample preparation and digestion (these procedures have been described in detail in an earlier section). The copper brought into solution by the hot dilute nitric acid (3:1) attack is used to provide the aliquot required in step (1) under Procedure in this section of the report.

THE BIQUINOLINE METHOD:

(A) Preparation of equipment and reagents:

(1) Mark the top of 10 cords 0, 4, 10, 20, 30, 40, 60, 80, 120, 200.

(These denote the ppm values of copper of 1/2 ml of aliquot).

(2) Mark the top of 10 corks from A to K (I is not used). Two sets of these corks are required.

(3) Mark 20 test tubes at 10 ml, mark with a diamond working pencil. These test tubes are for determination.

(4) Calibrate 2 ml capacity auto-pipette at 1/2 ml.

(5) Copper buffer: Dissolve 400 gm of sodium acetate, 100 gm of sodium tartrate and 20 gm of hydroxylamine hydrochloride in one litre of demineralized water. Use a 2-1/2 litre poly beaker as a mixer. Warm solution in a water bath until all crystal has been dissolved.

(6) Adjust copper buffer solution to a pH of 6.5. Add either concentrated hydrochloric acid or sodium carbonate solid if necessary to bring the solution to the desired pH.

(7) 2,2' - biquinoline solution: Dissolve 0.50 gm of

biquinoline powder with two litres of iso-amyl alcohol in a 2-1/2 litre poly beaker. Warm solution in a hot water bath with constatn stirring. Make up to 2-1/2 litres.

NOTE: 1,1,1-Trichloroethane is a better solvent for biquinoline as amyl alcohol has a very unpleasant odor.

(B) Procedure:

(1) Using a auto-pipette, transfer 1/2 ml aliquot into a marked test tube.

Note: Use a small aliquot if high copper content is suspected. Rinse the auto-pipette thoroughly each time used.

(2) Add copper buffer from a wash bottle to the 10 ml mark of the test tube.

(3) Using a burrette add 2 ml of biquinoline solution.

(4) Stopper the test tubes with the marked corks and shake vigorously for 45 seconds.

(5) Allow phases to separate.

(6) Start another batch of ten while waiting the phases to separate.

(7) Compare the organic phase to the prepared copper standards.

(C) Copper Standards and calculations:

(1) Stock solution (100 gammas/ml):

Dissolve 0.20 gm of cupric sulphate in 100 ml of water and 50 ml of 1 Normal HCl. Dilute to 500 ml with mineral free water in a volumetric flask. Store in a poly reagent bottle. Prepare this stock solution once a year.

(2) Working solution (4 gammas/ml):

Pipette 4 ml of the stock solution into a 100 ml volumetric flask and add water to mark. Prepare this solution whenever a fresh set of copper standards is made. Once every week is preferred.

(3) To prepare a set of copper standards, pipette the working solution into a series of marked test tubes (see table) and proceed from step (2) through step (5) of the copper procedure.

Standards	1	2	3	4	5	6	7	8	9	10
ml	0	0.10	0.25	0.50	0.75	1.00	1.50	2.00	3.00	5.00
gammas	0	0.50	1.25	2.50	3.75	5.00	7.50	10.00	15.00	25.00
ppm	0	4.0	10.0	20.0	30.0	40.0	60.0	80.0	120.0	200.0

(4) The ppm values indicated above in the table are assuming the copper procedure used 1/2 ml aliquot from the same digestion solution as the

the molybdenum determination.

(5) Use the formula below for calculating a new concentration if desired.

ppm = gammas per gram =

$$= \frac{\text{volume sample solution (ml)}}{\text{weight of sample (gm)}} \times \frac{\text{value of matched standard (gammas)}}{\text{aliquot of sample (ml)}}.$$

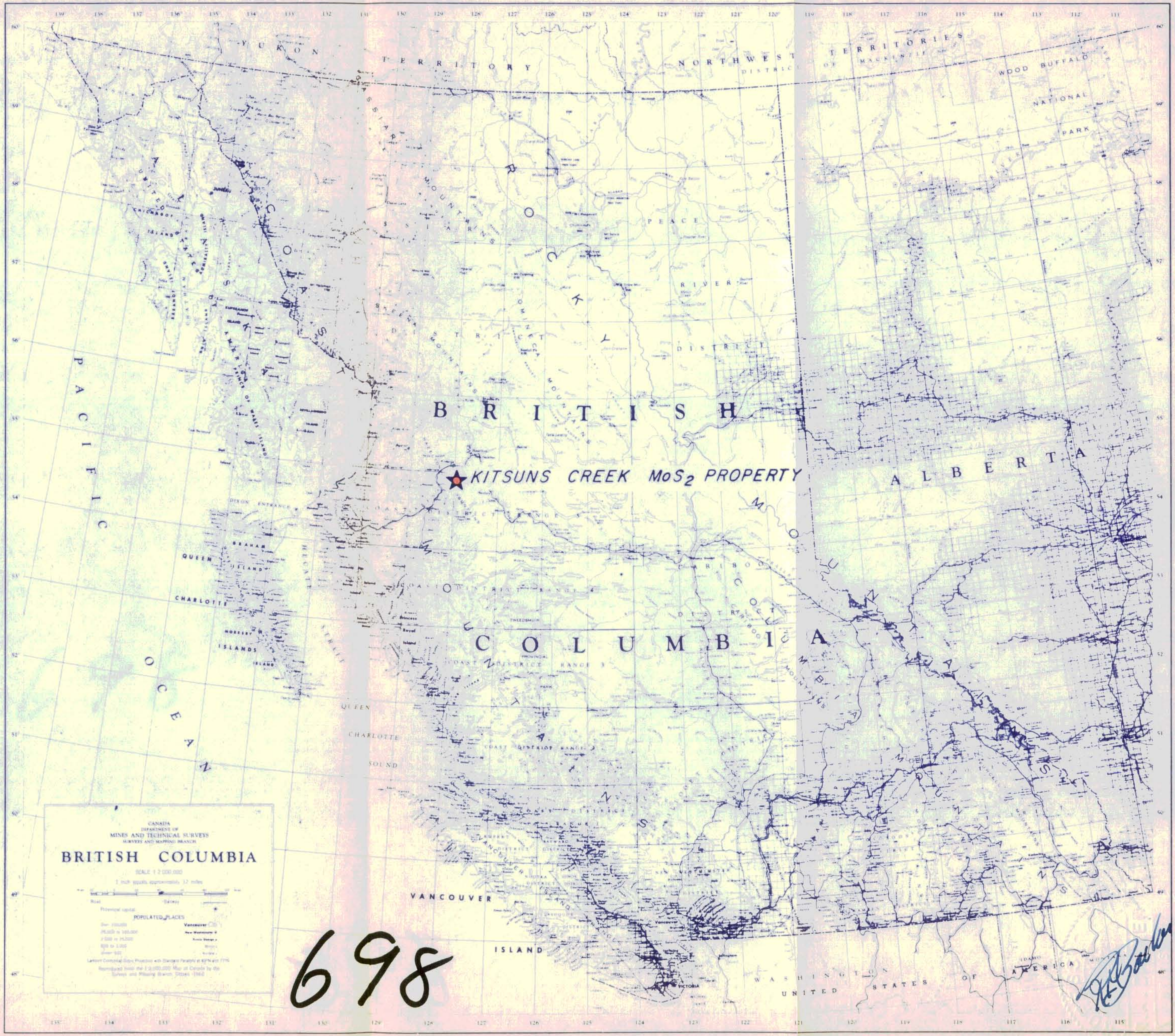
Ju Schindler

REFERENCE

Armstrong, J.E., 1944, Preliminary Map Smithers, B.C., G.S.C. Paper 44-23, Ottawa.

APPENDIX 1

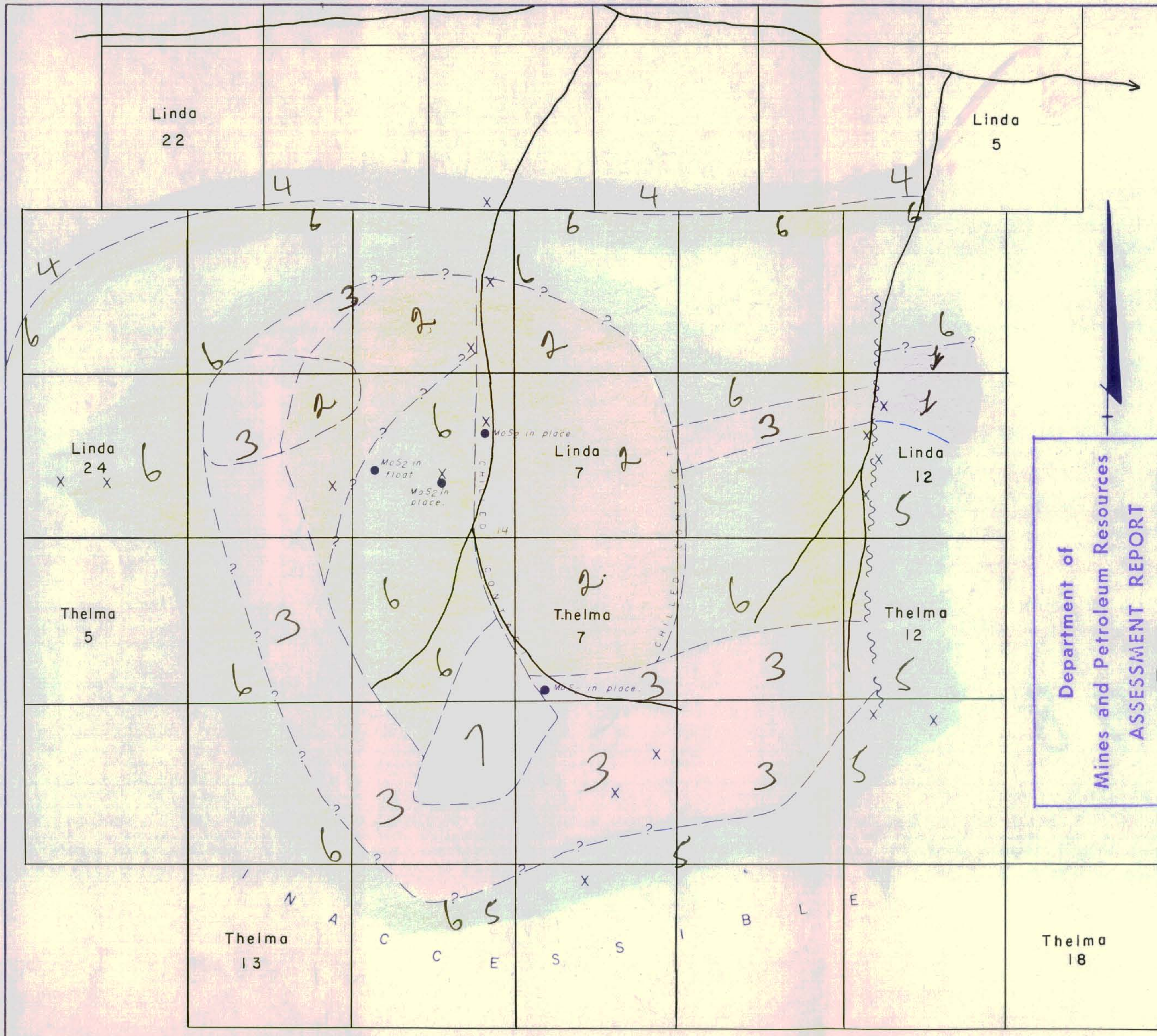
Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 698 MAP #1



698

LOCATION MAP

FIG. 1



LEGEND

- 7 Greywacke.
- 6 Acid tuffs.
- 5 Intermediate tuffs.
- 4 Interbedded sediments with andesitic flows.
- 3 Diorite.
- 2 Syenite.
- 1 Granodiorite.

SYMBOLS

- Geological contact (defined, assumed.)
- Fault.
- x Handspecimen location.

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 698 MAP #3

698

SOUTHWEST POTASH CORPORATION

KITSUNS CREEK MoS_2 PROPERTY

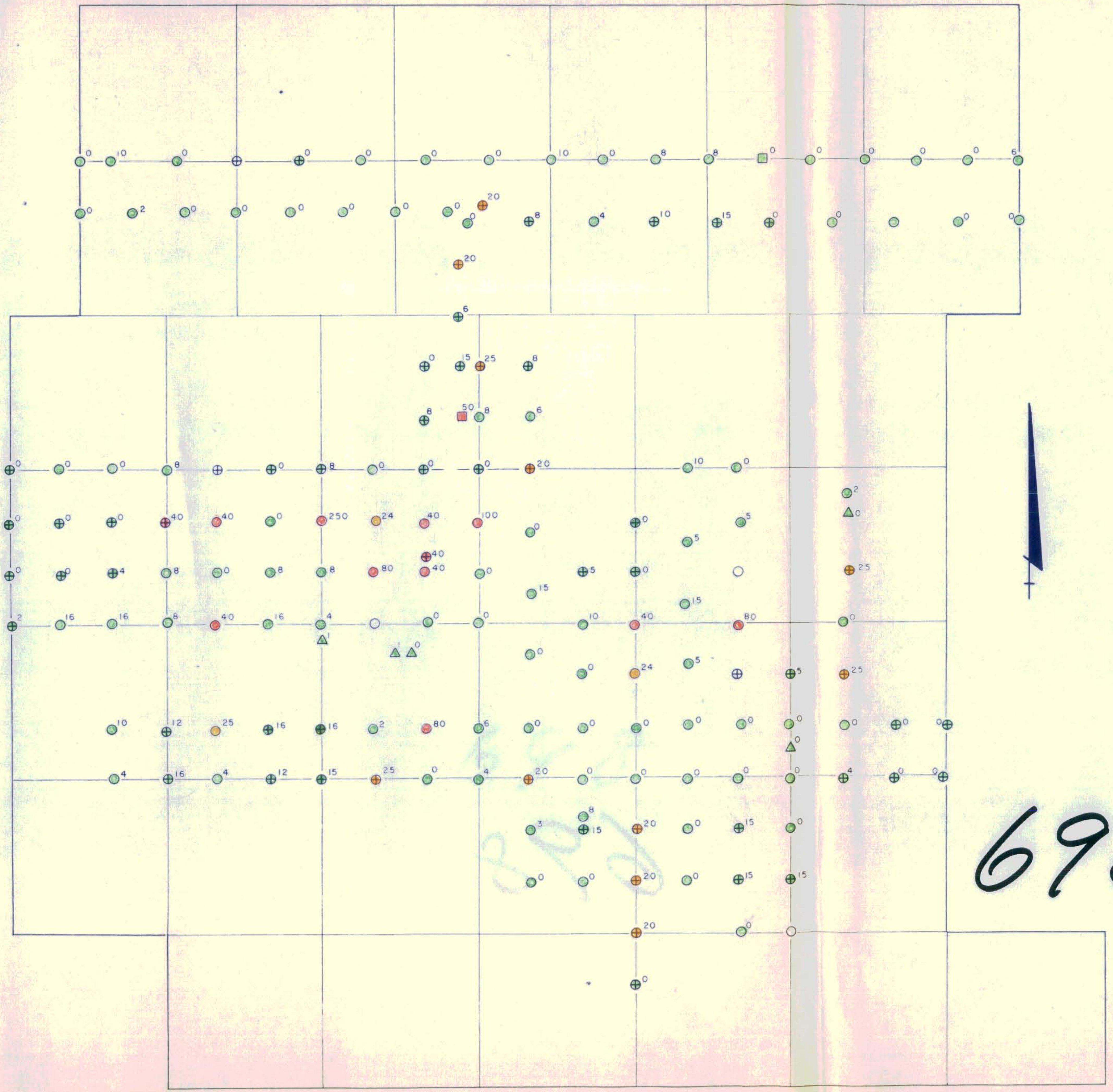
OMINECA M.D. — B.C.

GEOLOGICAL MAP

SCALE 1" = 1000'

Vancouver – W.S.

FIG. 3



LEGEND

SOIL SAMPLES (p.p.m. Mo).	●	0 - 19	*Background.*
	●	20 - 35	*Positive..*
	●	> 35	*Anomalous.*
ROCK CHIP SAMPLES (p.p.m. Mo).	⊕	0 - 19	*Background.*
	⊕	20 - 35	*Positive .*
	⊕	> 35	*Anomalous .*
SILT SAMPLES (p.p.m. Mo)	■	< 10	*Background.*
	■	> 10	*Anomalous.*
WATER SAMPLES (p.p.b. Mo)	▲	< 4	*Background.*
	▲	> 4	*Anomalous.*

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 698 MAP #4

698

SOUTHWEST POTASH CORPORATION

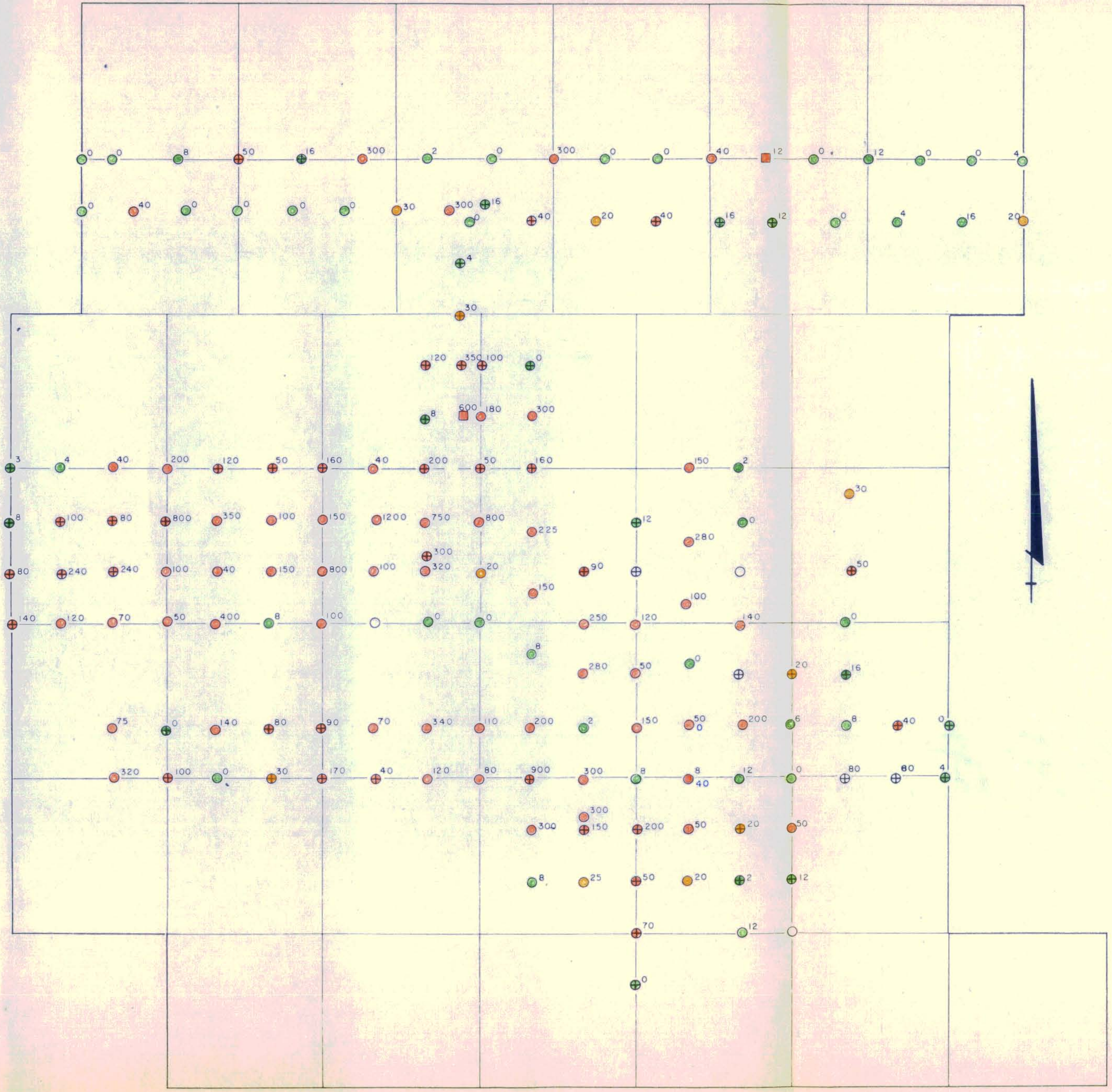
KITSUNS CREEK MoS_2 PROPERTY

OMINECA M.D. — B.C.

GEOCHEMICAL MAP
Mo RESULTS

SCALE 1" = 1,000'

FIG. 4



LEGEND

SOIL SAMPLES (p.p.m. Cu).	🟢	0 – 19	*Background.*
	🟠	20 – 35	*Positive.*
	🔴	> 35	*Anomalous.*
ROCK CHIP SAMPLES (p.p.m. Cu).	⊕	0 – 19	*Background.*
	⊕	20 – 35	*Positive.*
	⊕	> 35	*Anomalous.*
SILT SAMPLES (p.p.m. Cu).	🟩	< 10	*Background.*
	🟥	> 10	*Anomalous.*

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 698 MAP #5

698

SOUTHWEST POTASH CORPORATION

KITSUNS CREEK MoS_2 PROPERTY

OMINECA M.D. — B.C.

GEOCHEMICAL MAP
Cu RESULTS

SCALE 1" = 1,000'

FIG. 5