SUMMARY REPORT - 1979

MOYIE PROJECT - 077-01

Southeastern British Columbia, Idaho/Montana

May, 1980 L. A. Tihor

Vancouver, B. C.

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1. SUMMARY

The Moyie Project was initiated during 1978 to explore the Purcell (Belt) Series between the Sullivan Mine at Kimberley, B. C. and the Coeur de'Alene district in Idaho - Montana. More specifically the goal was to find another large Sullivan-type Pb-Zn-Ag deposit. The program in 1978 consisted of reconnaissance mapping and stream sediment sampling covering an area of about 2500 square miles in Canada and the U.S.A.

An important result of the 1978 work was the rough delineation of a stratigraphic horizon believed to be correlative with the rocks enclosing the Sullivan deposit.

The 1979 program was planned to further refine the results of the earlier work and to turn from a regional to a more detailed examination of the favourable areas. Results of the 1979 season included:

(a) Improved resolution of the location of the favourable Sullivan Time Horizon (STH).

(b) Acquisition by staking of mineral claims enclosing units along the STH.

(c) Intersection by diamond drill hole of a very interesting zone of massive sulphide carrying traces of chalcopyrite and sphalerite and about 1 oz/ton Ag.

Recommendations for 1980 are as follows:

(1) Fly Dighem II air EM with Whaletail configuration over two large area of exposure of the STH as shown on Figure 3.3.

(2) Stake any conductors detected in the Dighem II survey.

(3) Locate all air conductors on the ground. If ground EM surveys are necessary use Crone Pulse EM.

(4) Drill all EM conductors.

2. INTRODUCTION

The Sullivan deposit at Kimberley, B. C., belongs to a distinguished family of huge , rich strataform Pb/Zn/Ag sulphide deposits of Proterozoic age(Fig 2.1). Other members of the family are McArthur River, Mt. Isa and Broken Hill of Australia.

The purpose of the on-going Moyie project is to discover any other Sullivan-type deposits in southeastern B. C. which occur within range of state-of-the-art technology and a reasonable financial investment (Fig. 2.2).

Because of a virtual monopoly by Cominco on exploration for Sullivan-type deposits in SE B. C. relatively little information is available on the nature of the Sullivan deposit and its relationship with its host rocks. A further complication is that most mineral exploration for massive sulphide deposits historically has been aimed at vertically oriented depoists in peneplain topography of Precambrian Shield areas. There are few case histories on the application of geophysical methods to horizontal conductors in mountainous terrain. For these reasons much of the 1979 season was concerned with orientation studies. We tried a number of regional and detailed geological, geochemical and geophysical approaches until we found a system we were happy with.

The 1979 program was successful. We now have a reasonably good understanding of stratigraphic controls on Sullivan-type mineralization; we know which exploration techniques are effective under these conditions and their limitations: we have mapped accurately enough for our purposes the distribution of the favourable horizon and acquired mineral rights to a large block of this ground; and, we discovered a very interesting new massive sulphide occurrence in the Sullivan Time Horizon.

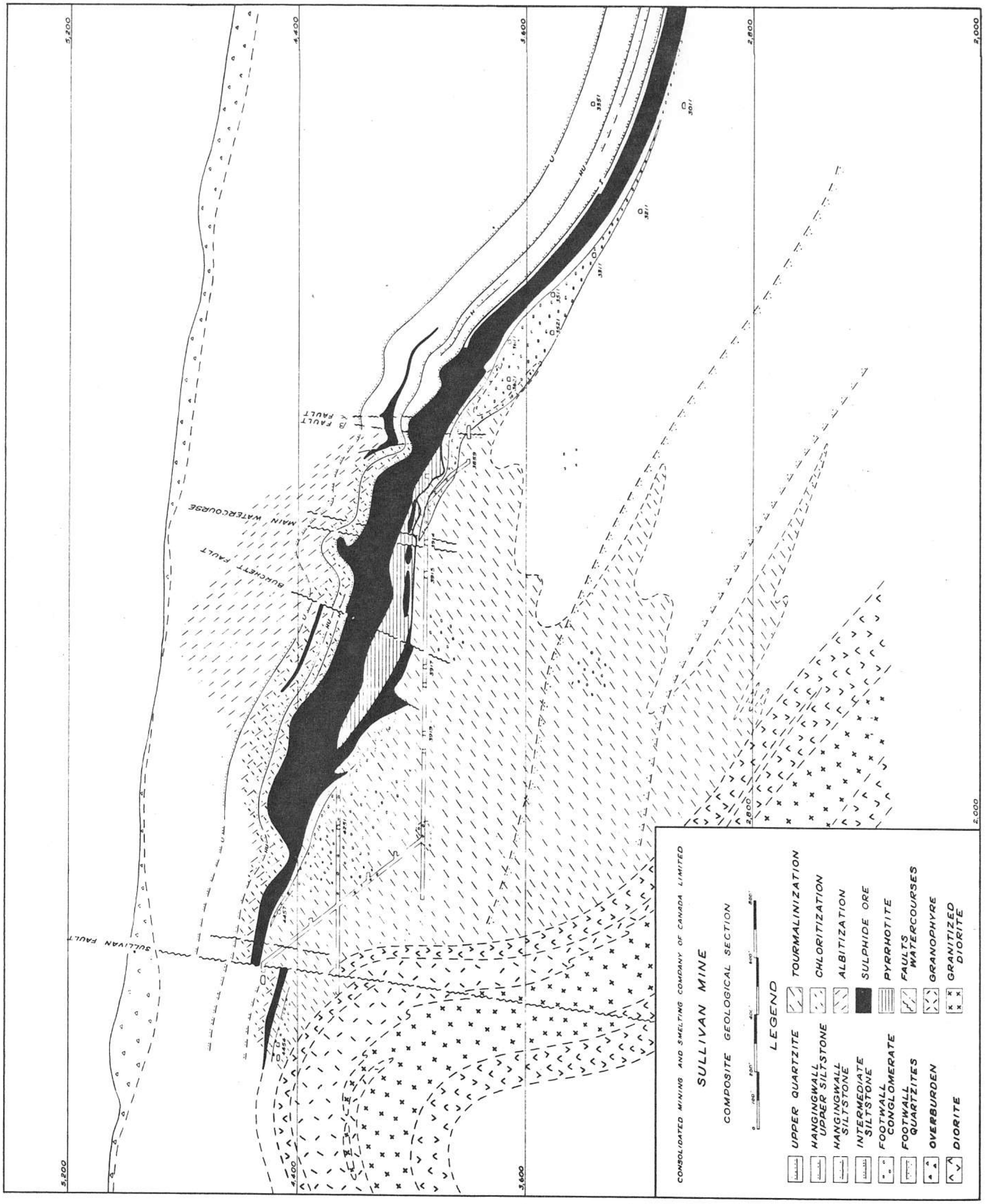


Figure 2.1

Freeze, A.C. (1966): On the Origin of the Sullivan orebody, Kimberley, B.C.
CIM Spec. Vol. 8, pp. 263-295.

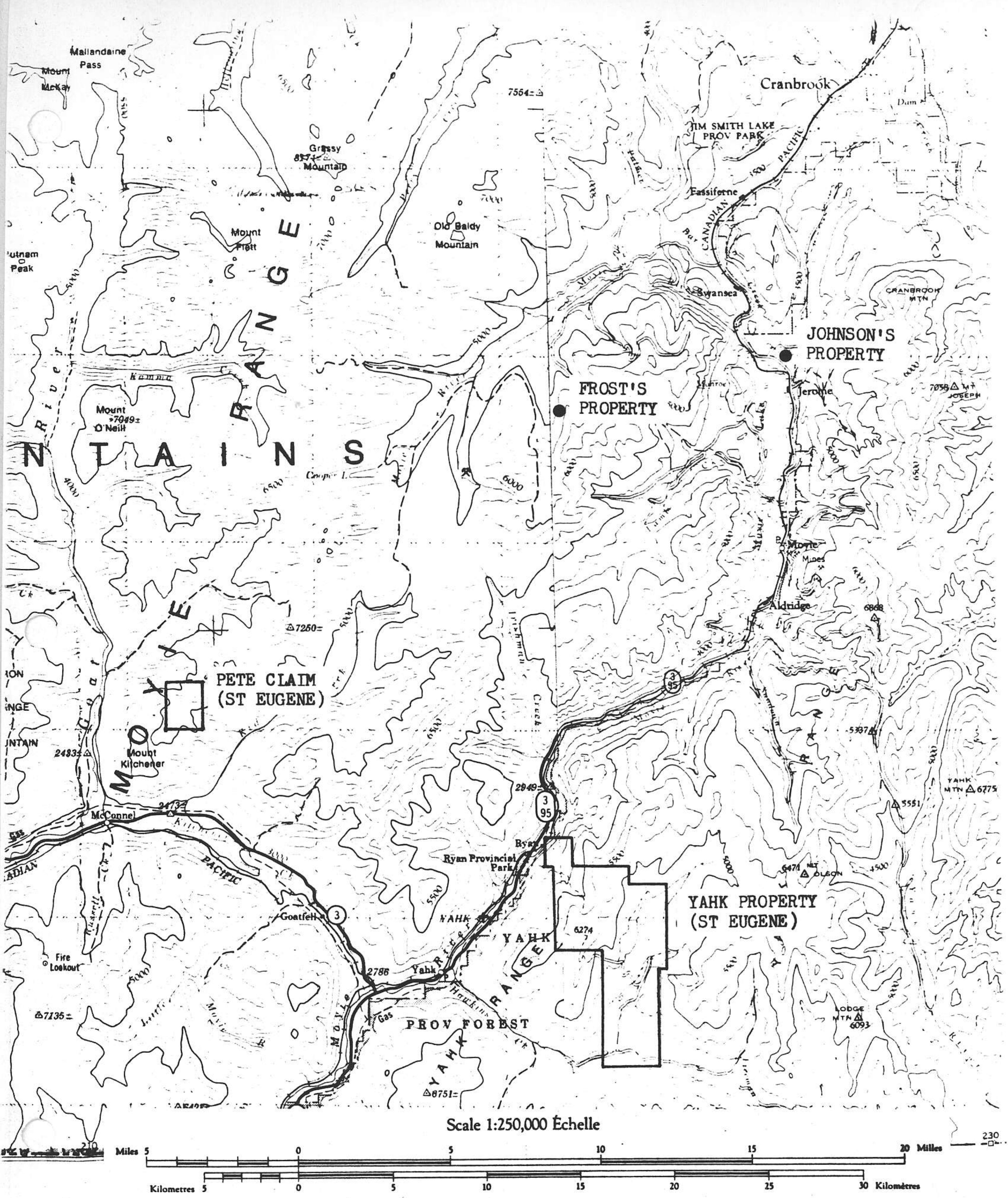


Fig. 2 St Eugene Mining Corp and other properties of interest, Moyie area.

3. GEOLOGY

3.1 General Geology

The Sullivan and similar deposits in southeastern B. C. are believed to occur at or near a specific stratigraphic horizon in Late Precambrian Purcell (Belt) Supergroup sedimentary rocks (Map 1). This horizon which we are calling the Sullivan Time Horizon or STH has been placed by various writers at or stratigraphically just below the facies transition from Lower to Middle Aldridge Formation rocks.

The Aldridge Formation, part of the Lower Purcell Supergroup is largely the product of shallow water sedimentation, probably deltaic, fringing the craton to the east (Fig 3.1, 3.2). Part of the Aldridge, however, contains graded beds and current ripples indicating a southern source and may be interpreted as a turbidite sequence. It is the appearance of turbidites in the sequence that marks the transition from Lower to Middle Aldridge - the Sullivan Time Horizon.

Gabbroic intrusives are common especially in the Lower Aldridge and occur as sills, dykes and rarely as irregular masses.

3.2 The Lower Aldridge Formation

The Lower Aldridge is about 4,000 feet thick in the Purcell range. It consists principally of grey-green, thinly interbedded impure fine-grained quartzite, siltstone, silty argillite and argillite. Naturally eroded outcrop surfaces are rusty weathering. Chemical analyses suggest that Lower Aldridge sediments are chemically similar to normal pelitic sediment and that the rusty outcrop appearance is largely due to readiness with which the iron-bearing minerals weather rather than to high iron content.

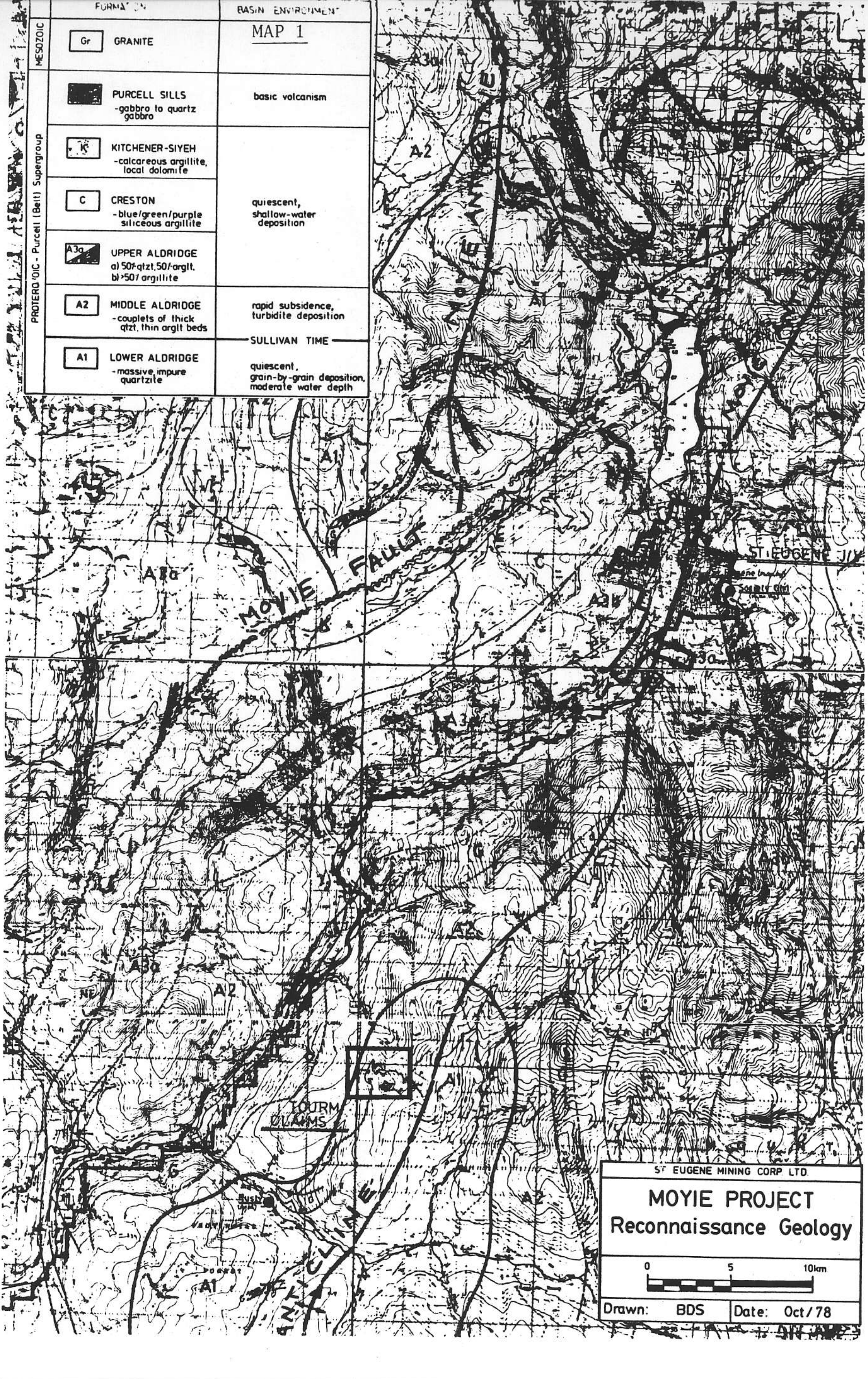

BASIN ENVIRONMENT
MAP 1
MESOZOIC
Gr
GRANITE
PROTEROZOIC - Purcell (Belt) Supergroup
PURCELL SILLS
-gabbro to quartz gabbro
basic volcanism
K
KITCHENER-SIYEH
-calcareous argillite, local dolomite
C
CRESTON
-blue/green/purple siliceous argillite
quiescent, shallow-water deposition
A3a
UPPER ALDRIDGE
a) 50% qtzt, 50% arglt.
b) >50% argillite
A2
MIDDLE ALDRIDGE
-couplets of thick qtzt, thin arglt beds
rapid subsidence, turbidite deposition
SULLIVAN TIME
A1
LOWER ALDRIDGE
-massive, impure quartzite
quiescent, grain-by-grain deposition, moderate water depth
MOYIE FAULT
ST. EUGENE J/V
TOURM CLAIMS
ANTICLINE
ST EUGENE MINING CORP. LTD.
MOYIE PROJECT
Reconnaissance Geology
0
5
10km
Drawn: BDS
Date: Oct/78

TABLE 1. Production From Conformable Lead-Zinc Deposits in the Aldridge Formation, Kimberley Area, B. C. (to December 1972, inclusive. Figures in metric tons unless otherwise noted.)

Deposit	Pb	Zn	Cu	Cd	Sn	Ag (kg)	Au (kg)	Reference
Kootenay King	680	900	—	—	—	—	—	(1)
North Star	21.8×10^3	?	—	—	—	—	—	(1), (2)
Stemwinder*	950	4.0×10^3	—	—	—	—	—	(1), (2)
Vulcan	—	—	—	—	—	—	—	(1)
Sullivan	$6{,}433 \times 10^3$	$5{,}577 \times 10^3$	4.1×10^3	1.9×10^3	8.8×10^3	$6{,}700 \times 10^3$	140	(3), (4)

References: (1) Leech and Wanless, 1962; (2) Schofield, 1915; (3) Minister of Mines Annual Report, 1972; (4) Little et al., 1970.
* Relationships at Stemwinder are in question; it may not be a conformable deposit.

banding of the deposit, where present, are essentially parallel to and conformable with stratification in the enclosing rocks (Stanton and Rafter, 1966).

The Kimberley area is within a belt of middle Proterozoic (Helikian) sedimentary and volcanic rocks in the Purcell mountain range of southeastern British Columbia and extending into adjacent areas of Idaho and Montana (Fig. 1). Detailed descriptions of the stratigraphy and distribution of Purcell rocks in the area have been published by Rice (1937), Reesor (1957), Price (1964), Gabrielse (1972), Smith and Barnes (1966), Harrison (1972), and Harrison et al. (1974) and are summarized in Table 2. The orebody is enclosed in beds of the Aldridge Formation, in the Purcell Supergroup. (The Purcell Supergroup is equivalent to rocks referred to the Belt Supergroup in the northwestern United States.) The Lower Purcell sequence is largely the product of shallow-water sedimentation, probably deltaic, fringing the craton to the east. Unlike other Lower Purcell sedimentary rocks, the Aldridge Formation contains graded beds and current markings indicating a southern source and may be interpreted as a turbidite sequence (Bishop et al., 1970; Edmunds, 1973a).

The mineralogy of the Aldridge Formation is

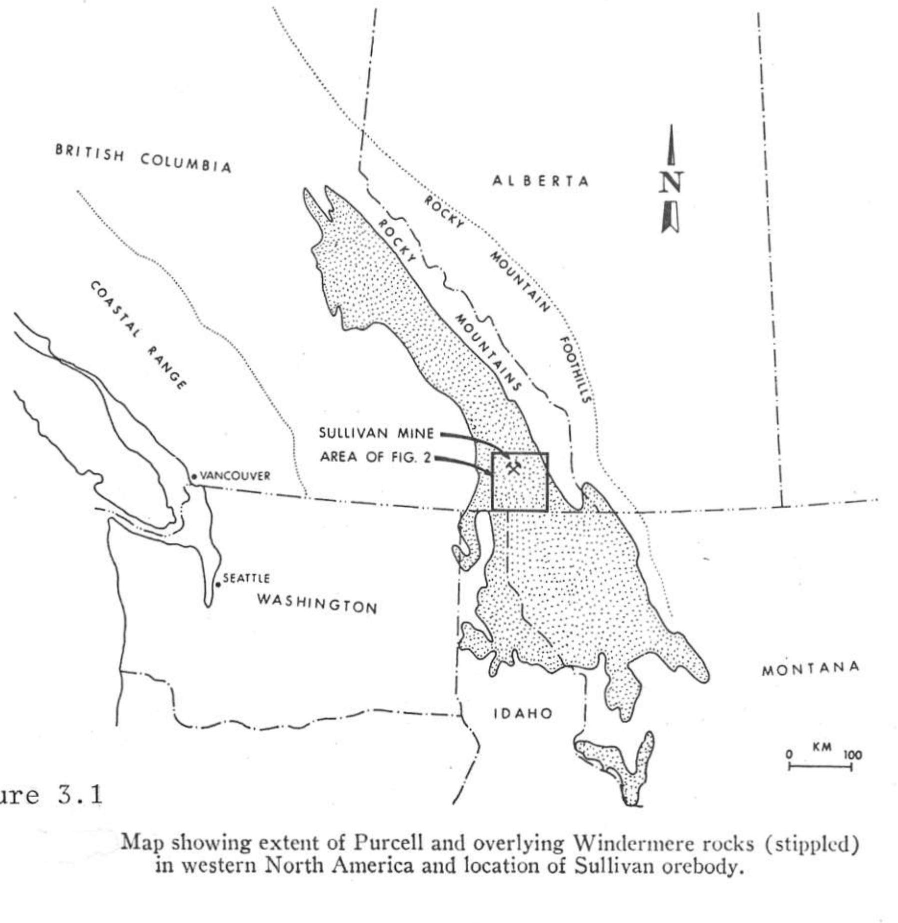


Figure 3.1

Map showing extent of Purcell and overlying Windermere rocks (stippled) in western North America and location of Sullivan orebody.

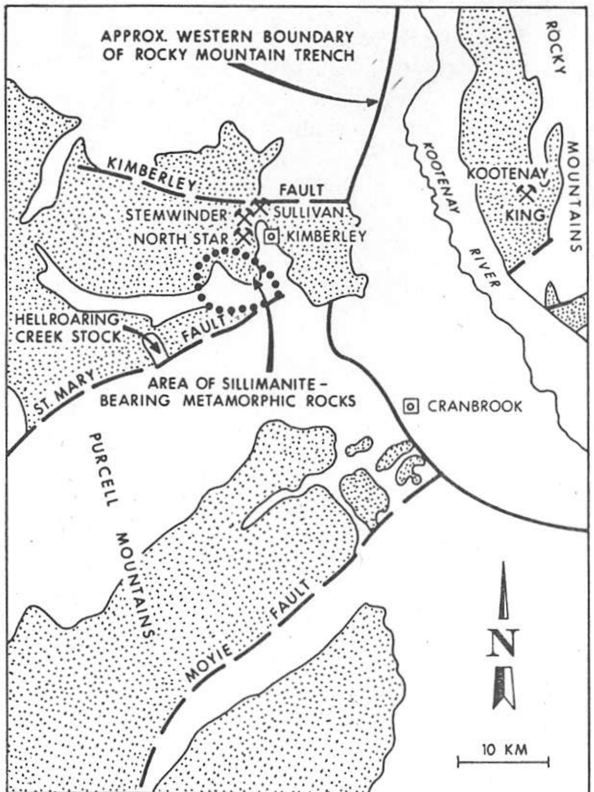


Figure 3.2

FIG. 2. Cranbrook area, British Columbia, showing extent of Aldridge Formation (stippled) and other geological features of interest. Known stratiform lead-zinc deposits marked with crosses (modified from LeCouteur, 1973).

Precambrian geochronology

Figure 3 is a summary, compiled from the literature, of the results of the considerable effort that has been made in both the U.S.A. and Canada to date Precambrian events affecting Purcell and equivalent rocks. Although we do not propose to review this work, some of the major problems in geochronology must be mentioned because they are pertinent to an interpretation of the orebody within its geological setting.

The tabulation (Fig. 3) indicates that Purcell and equivalent sedimentary rocks are between 1,700 and 850 m.y. old (Harrison, 1972; Harrison et al., 1974). The maximum age is well defined by older rocks and the minimum age by the East Kootenay orogeny, which deformed and metamorphosed the sequence. This time interval also brackets other major events affecting the area; specifically the pegmatite-granodiorite intrusion at Hellroaring Creek, the stratiform lead-zinc deposits of the Aldridge Formation, and, most notably, the Purcell intrusions, which were emplaced in two or three stages that appear to span almost the entire interval of sedimentation. The lead model age calculations reported in Figure 3 represent only an approximation of the true age of emplacement (Richards, 1971). All three of the lead isotope studies referred to suggest that the lead in the stratiform deposits of the Aldridge Formation is isotopically uniform. In vein deposits the lead is comparatively radiogenic and suggests a Mesozoic-Cenozoic age of emplacement for some veins and a Proterozoic age for others. Precambrian lead isotope studies from this area have been reviewed succinctly by Thompson and Panteleyev (1976).

A significant question still exists regarding the relationship of the Hellroaring Creek pegmatite-granodiorite body, the two or three ages of Purcell sills, the Aldridge Formation, and the age of the Sullivan orebody. The sill at the Hellroaring Creek stock

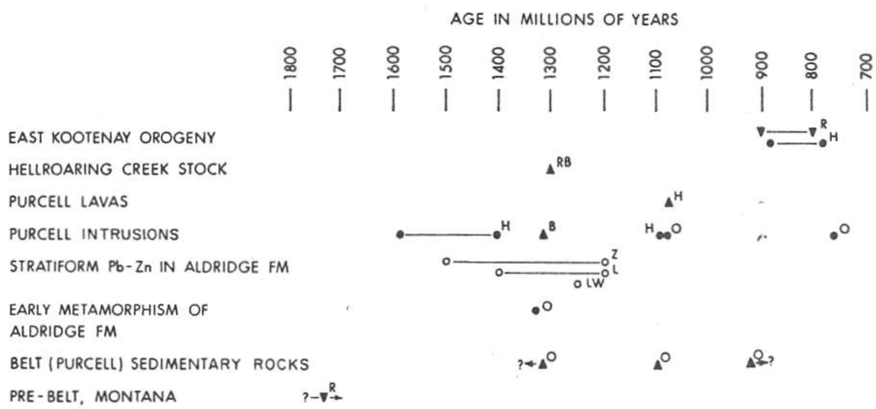


FIG. 3. Published geochronological data pertinent to the Aldridge Formation. Analyses of Rb-Sr shown as triangles, K-Ar as filled circles, Pb/Pb as open circles, and U-Pb from zircons as inverted triangles.

B = Bishop (1973), H = Hunt (1962), L = LeCouteur (1973), LW = Leech and Wanless (1962), O = Obradovich and Peterman (1968), R = Reid et al. (1973), RB = Ryan and Blenkinsop (1971), Z = Zartman and Stacey (1971).

Cross-bedding and scour channels are common structures in the Lower Aldridge whereas graded bedding and load structures are rare. Lenses of intraformational conglomerate are fairly common near the top of this member, ie, near the STH (confirmed, pers. comm. J. Hamilton, Sullivan Mine staff).

3.3 Middle Aldridge Formation

The Middle Aldridge consists mainly of alternating sequences of primarilly quartzitic and siltstone composition. Each sequence varies from 10 to 50 m. in thickness and some have cycles within cycles. The quartzitic sequences typically contain graded beds of fine grained impure quartzite and siltstone that are separated by thin partings of argillite. Load structures such as flame structures are common. The siltstone sequences have a large argillaceous component and commonly siltstone beds grade upward into argillite tops. Pyrite is common constituting up to 12% of argillaceous beds as thin lamellae or as stratabound veinlets. Northward, in the area of Kimberley pyrrhotite occupies this position and pyrite is rare. Ripple marks, scour channels cross-bedding and other structures indicative of deposition in shallow water are rare in Middle Aldridge rocks.

3.4 The Sullivan Time Horizon

The STH, the host of the Sullivan mine is considered to be the stratigraphic horizon at which shallow water sediments (Lower Aldridge) give way to deep water sediments (Middle Aldridge). Other indications of the STH are the occurrence of (a) many lenses of intra formational conglomerate, and, (b) bedded deposits of tourmalinite.

Map 1 shows our understanding of the distribution of the STH at the end of 1978. Presently we feel that a more useful sketch would show the distribution of that portion of the STH believed to be within reach of modern geophyiscal equipment, specifically Dighem II air EM. This is shown as the cross-hatched area in Figure 3.3.

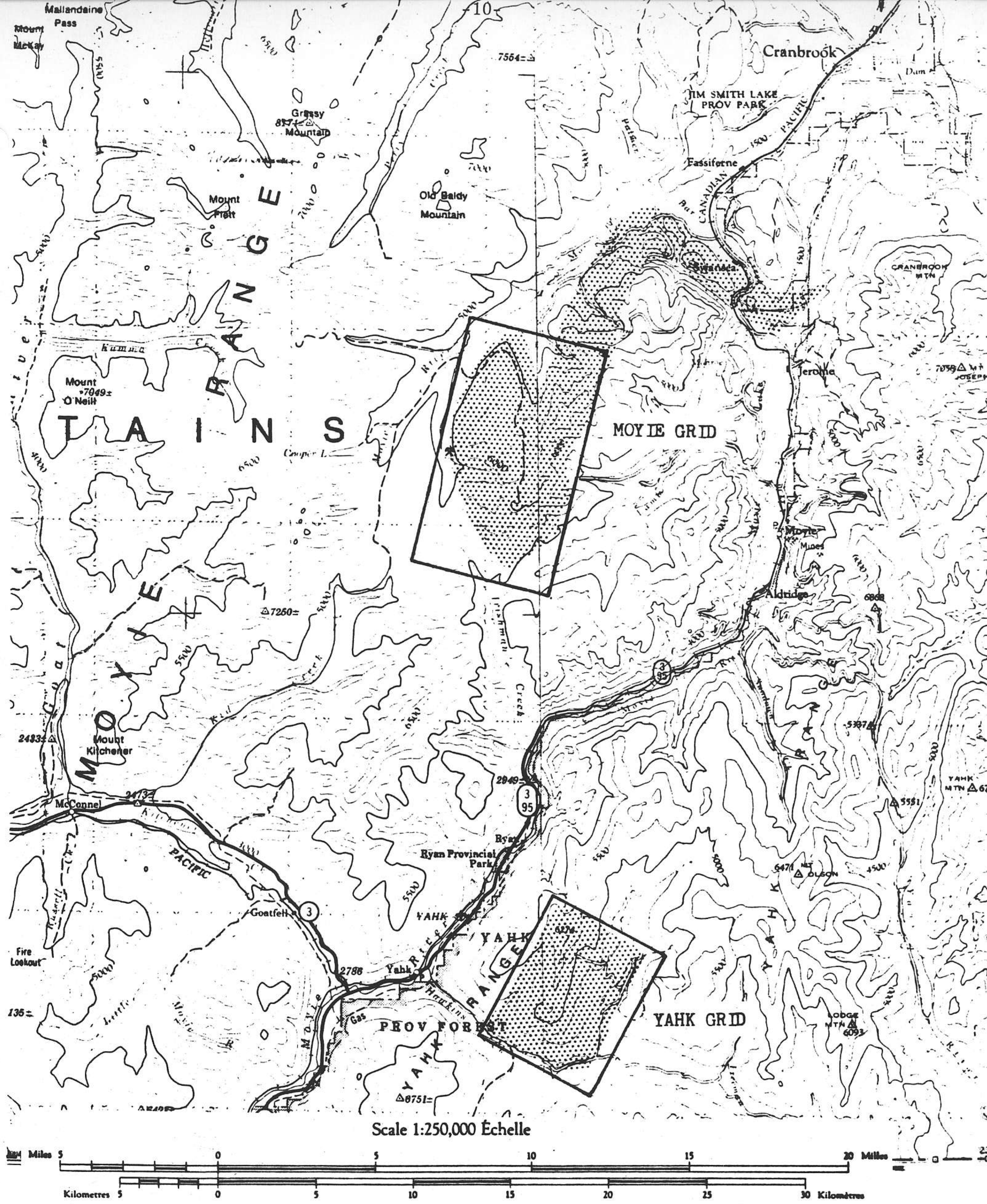


Figure 3.3 Location map showing areas planned for DIGHEM II EM surveys, summer 1980. Stippled areas represent probable extent of Sullivan Time Horizon within

3.5 Intraformational Conglomerate

Discontinuous lenses of intraformational conglomerate are common near the top of the Lower Aldridge. Some of these deposits are up to 3 miles long and one thousand feet thick. Typically they are composed of a chaotic conglomeration of locally derived boulders of all shapes sizes and degrees of sphericity. Occasionally they occur with deposits of tourmaline and are mineralized such that sometimes cobbles are composed of tourmaline in a siltstone matrix and other times the matrix is tourmaline-rich and the cobles relatively unaffected. The best known occurrence of conglomerate is in part of the footwall of the Sullivan deposit.

Intraformational conglomerate seems to be a good indicator of close proximity to the STH.

3.5 Tourmalinite

A pipe-like tourmaline alteration zone occupies an area of the Sullivan footwall about two-thirds the size of the orebody. In hand specimen this rock is hard, black or brown in colour and resembles a chert, which it is called at the mine. Primary sedimentary features such as pyrrhotite lagunae, conglomerate clasts and silty beds are faithfully preserved. The tourmaline occurs as a felted mass constituting up to about 40% of the rock.

Other known occurrences of apparently bedded tourmaline rock are on Mt. Mahon and in float at the confluence of Tourm Creek and Cold Creek east of Yahk, B. C. Both of these occurrences also contain intraformational conglomerate.

What is the significance of the tourmaline? In the locations just mentioned the tourmaline seems to occur on or near the STH. However, occurrences are known at Peterson Creek, at Goatfell, at Kingsgate and in the Hellroaring Creek granitoid stock, all locations apparently remote from the STH. The presence of abundant tourmaline probably only indicates that a remobilization of elements, specifically boron took place. That is, that likely a conduit and a heat source were locally present at one time. If these indications coincide with the location of the STH then an interesting situation is indeed present and the area must be explored intensively. Such is the case in the area of our Yahk property at Mt. Mahon and Cold Creek.

4. GEOPHYSICAL METHODS

4.1 Introduction

After locating the favourable Lower - Middle Aldridge contact as closely as possible using geologic criteria, the more promising portions were surveyed with ground geophysics. This was done to determine if the favourable horizon could be traced geophysically through areas of poor rock exposure and, secondly, to locate any anomalies which could represent massive sulphides. Electromagnetic and magnetic methods were used.

4.2 Electromagnetic

4.2.1 Instrumentation

Because of the huge area to be surveyed the technique to be used had to be quick and relatively inexpensive. This prohibited methods involving heavy equipment, long station times and those requiring cut survey lines. The Geonics EM-16 very Low Frequency (VLF) system seemed the most suitable for our purposes. It is a light weight, portable one-man system allowing a single operator to simultaneously establish a pace-and-compass grid and carry out the EM survey.

4.2.2 Interpretation

The EM-16 is a difficult survey to interpret for two reasons. There is a paucity of well controlled case studies to draw on as guides in interpretation, especially in the case of horizontal conductors.

Secondly, the system operates at a relatively high frequency ($\sim$20 KHz). At high frequencies the electromagnetic field is influenced by poor to moderate conductors such as certain types of overburden, disseminated iron sulphide or graphite zones and conductive shear zones. The effects of these are difficult to distinguish from those which might be produced by massive sulphides.

To minimize these problems we carried out scaled-down model studies in the field using a large sheet of aluminum foil in various attitudes to simulate a tabular, conductive mineral deposit. This produced a set of electromagnetic profiles which could later be applied to full scale actual exploration surveys.

To represent a flat-lying conductor a sheet of aluminum foil 2 m. by 3 m. in size was laid flat on the ground in a location previously determined to be electromagnetically non-anomalous. The strike of the conductor was NNE and dip was easterly and adjustable by varying the vertical distant between foil and consecutive readings. The Seattle transmitter was used and for consistency all readings were taken with the transmitter on the operators left side. In addition, the regional contribution was removed by determining background for both in phase and quadrature in the absence of the foil and adjusting the survey readings to eliminate background effects. The effective easterly dip of the background electromagnetic field in the model study was about 4^{o}.

It can be seen (Fig 4.1(a)) that when the dip of the conductor is less than the effective dip of the field in the same direction the plotted profile shows a negative in-phase component and a positive quadrature component with small reversals at each side of the conductor. However, when the conductor dips at an angle greater than that of the field (Fig 4.1 (b)) the in-phase component becomes strongly positive and the quadrature strongly negative. In addition, on the up-dip side there is a small reversal, while on the down-dip side there is a gradual trailing off to background.

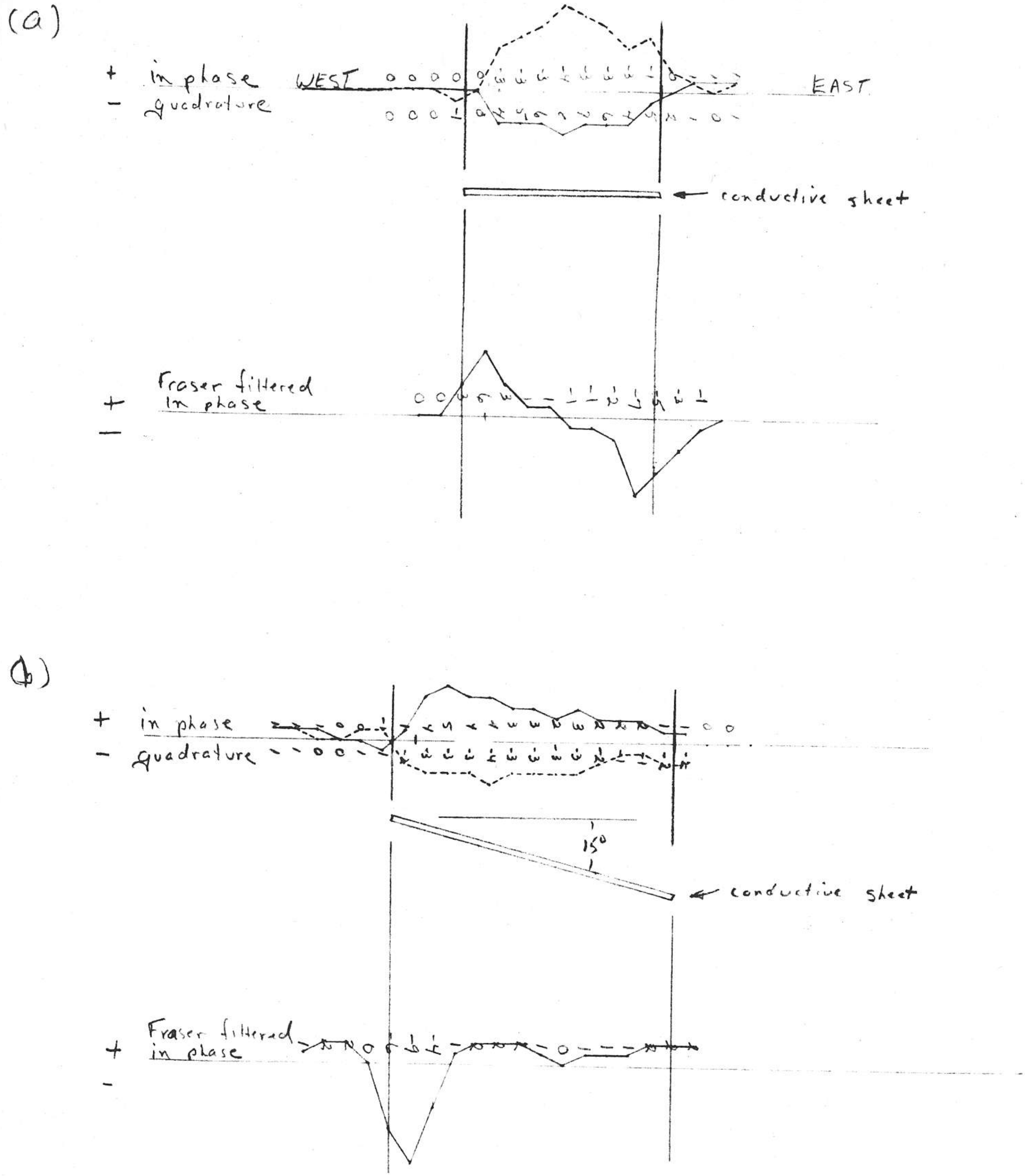


Fig 4.1 EM-16 model studies on flat lying conductors
Background EM field has 4° Easterly dipping component

A serious weakness of this system is apparent here. If a thin conductor dips perfectly parallel to the dip of the transmitted EM field the primary field will not be deflected. That is, the survey will completely miss the conductor. This is a problem common to all systems having the transmitter effectively at an infinite distance from the target conductor, hence producing a near horizontal field with parallel planar lines of force near the conductor. This problem must always be kept in mind when searching for flat-lying conductors.

4.3 Magnetic

4.3.1 Instrumentation

Many massive sulphide deposits of various types and rock associations have an anomalous magnetic expression , due either to magnetite or, more commonly, magnetic pyrrhotite. The Sullivan mine is no exception. But, although pyrrhotite is a major constituent of Sullivan ore, the magnetic anomalies over the deposit are much less pronounced than might be expected. This is because only a small part of the pyrrhotite is of the magnetic variety. For this reason we chose to use a Barringer proton magnetometer which is roughly 20 times more sensitive than most portable fluxgate mags.

4.3.2 Interpretation

Interpretation of ground magnetometer results is fairly straight-forward. There are abundant case histories and model studies in the literature. Therefore, the topic will not be covered any further here.

5. GEOCHEMICAL METHODS

5.1 Introduction

Three different geochemical techniques were used in this project two regional and one detailed. During 1978 stream sediment samples were taken from most of the creeks in the project area and analyzed for Cu-Pb-Zn-Cd-Ag. During 1979 we sampled the same streams for a study of metal distribution in heavy mineral fractions. These were analyzed for Cu-Pb-Zn-Cd-Ag-Mo-Sn. After we had acquired a reasonably good understanding of the distribution of the STH we carried out an intensive study of Cu-Pb-Zn-Ag distribution in soils overlying the favourable horizon.

These methods all showed some degree of success in that they all produced a number of geochemical anomalies. However, the correlation between methods and with known mineral occurrences was poor .

5.2 Regional Stream Sediment Geochemical Survey

This survey performed in 1978 and earlier produced 7 anomalous zones (Map #2). During 1979 we examined the source areas of the streams in the following anomalous areas.

A. Peterson Creek Area: no economic mineralization was found on the Pete Claim, staked by us the previous year to cover this anomaly. We did however find a weakly anomalous Pb-Zn-Ag soil anomaly on the claim. This work will be discussed later under the section covering detailed property examinations. It is likely that most of the anomalous metals detected in Peterson Creek originated from two low grade Pb-Zn occurrences just southeast of our claim. These have been staked and explored in the past by Mercury Explorations and Cominco.

B. Northwest Peak area, Montana: Northing of interest was found here. The anomalous metal values probably originated from a locally mineralized gabbro sill containing disseminated chalcopyrite and pyrrhotite.

C. Yahk Area: We could find no mineralization in this area to explain this anomaly.

F & G Moyie area: except for their proximity to the defunct St. Eugene and Society Girl mines we found no source of these anomalous values.

B, D and E were not examined.

5.3 Regional Heavy Mineral Geochemical Survey

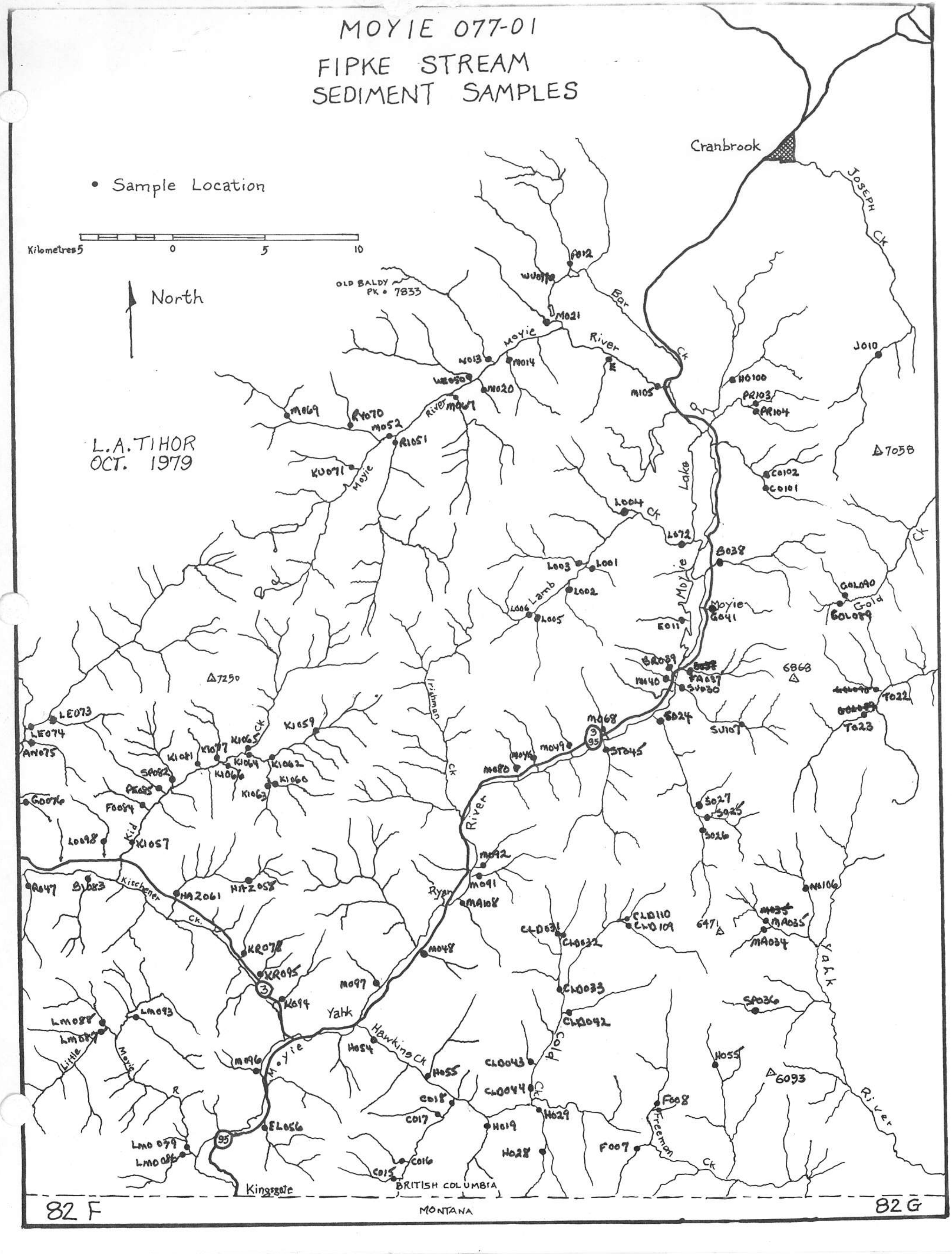
During 1979 large (10 kg) sand samples were taken from the active channels of most of the streams in the study area (Fig 5.1). These samples were sieved and separated using gravity and electromagnetic methods into 18 different separates by Chuck Fipke of C. F. Minerals Research Ltd., Kelowna, B. C. Based on Fipke's pilot studies and other case histories in the literature, we chose two fractions, heavy non-magnetic -60 mesh (HN-60) and heavy paramagnetic -60 mesh (HP-60) for our chemical analyses. We analyzed the HN-60 for Cu-Pb-Zn-Cd-Ag-Mo-Sn. The analysts, Bondar Clegg reported that the samples were too small to give any amount of confidence to the values for Sn and that they should be disregarded entirely. Except for Mo. the other elements did show some anomalous areas but the correlation between elements and with known mineralized areas was poor (Fig 5.2, 5.3 a-e) (Note: known mineralized areas are shown as crosses on Figure 5.2c and 5.3c).

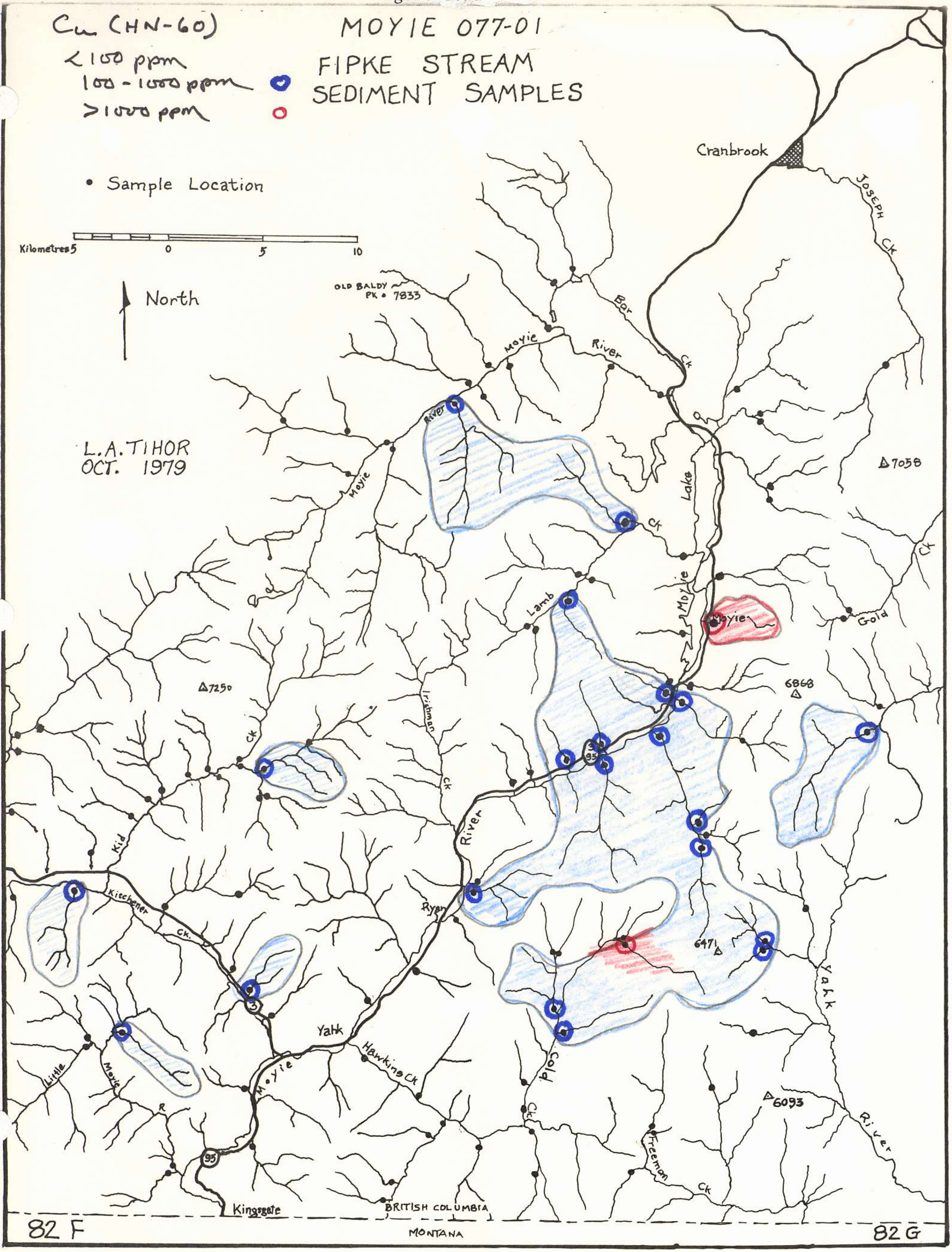
The analyses of the HP-60 separates produced similar results; i.e., poor correlation between elements, or with known mineral occurrences, or even with the same element in the HN-60 fraction.

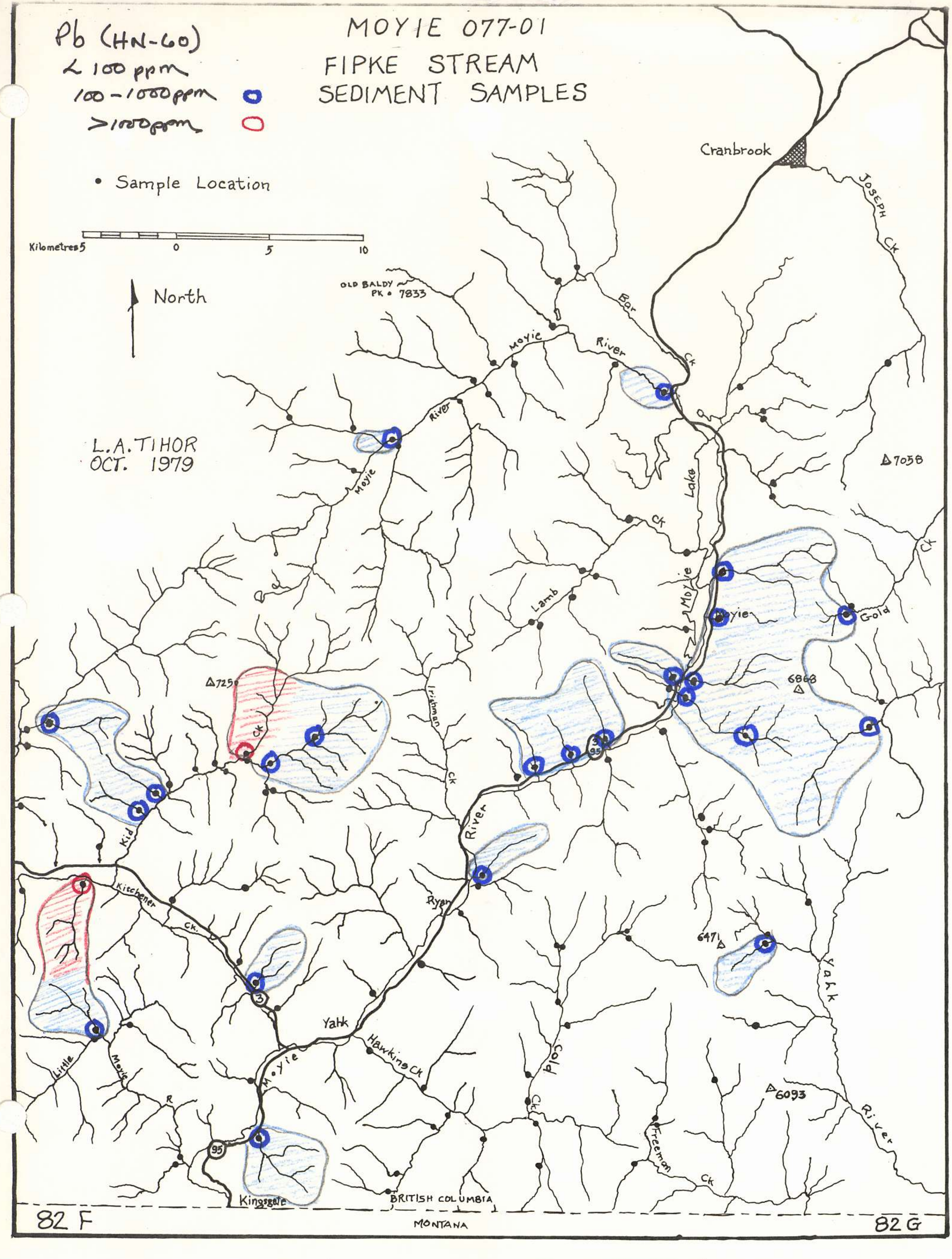
In Fig 5.4 we have combined the number of anomalous values at each station using both HN-60 and HP-60 regardless of the strength of the anomalous value. The totals were contoured. This map shows a better correlation with known mineral occurrences than the others but it is still not good.

The heavy mineral separate method seems to have no advantages over the stream sediment technique. It does have a tremendous disadvantage in its extremely high cost per sample. I cannot recommend further use of this method.

Figure 5.1


MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
• Sample Location
Kilometres 5 0 5 10
North
L.A. TIHOR
OCT. 1979
OLD BALDY PK • 7833
Cranbrook
Joseph Ck
Bar River
Moyie Lake
Moyie
Lamb Ck
Irishman Ck
Moyie River
Kid Ck
Kitchener Ck.
Ryan
Yahk
Hawkins Ck
Cold Ck
Freeman Ck
Yahk River
Little Moyie R
Gold Ck
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G
7250
7058
6868
6471
6093


Cu (HN-60)
<100 ppm
100 - 1000 ppm
>1000 ppm
MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
• Sample Location
Kilometres 5 0 5 10
North
L.A. TIHOR
OCT. 1979
Cranbrook
JOSEPH Ck
OLD BALDY PK • 7833
Moyie River
Bar Ck
Lake
Moyie
Lamb
Gold
6868
7058
7250
Irishman Ck
River
Ryan
Kid
Kitchener Ck.
6471
Yahk
Hawkins Ck
Cold Ck
Yahk River
6093
Freeman Ck
Little Moyie R
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G


Pb (HN-60)
< 100 ppm
100 - 1000 ppm
> 1000 ppm
MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
Sample Location
Kilometres 5 0 5 10
North
L.A. TIHOR
OCT. 1979
Cranbrook
Joseph Ck
OLD BALDY PK 7833
Moyie River
Bar Ck
Moyie Lake
Lamb Ck
Irishman Ck
Moyie
Gold Ck
7058
6868
7250
Kid Ck
Kitchener Ck.
Ryan
Yahk
Hawkins Ck
Cold Ck
Little Moyie R
Yahk River
6471
6093
Freeman Ck
Kingsgate
BRITISH COLUMBIA
MONTANA
3
95
82 F
82 G

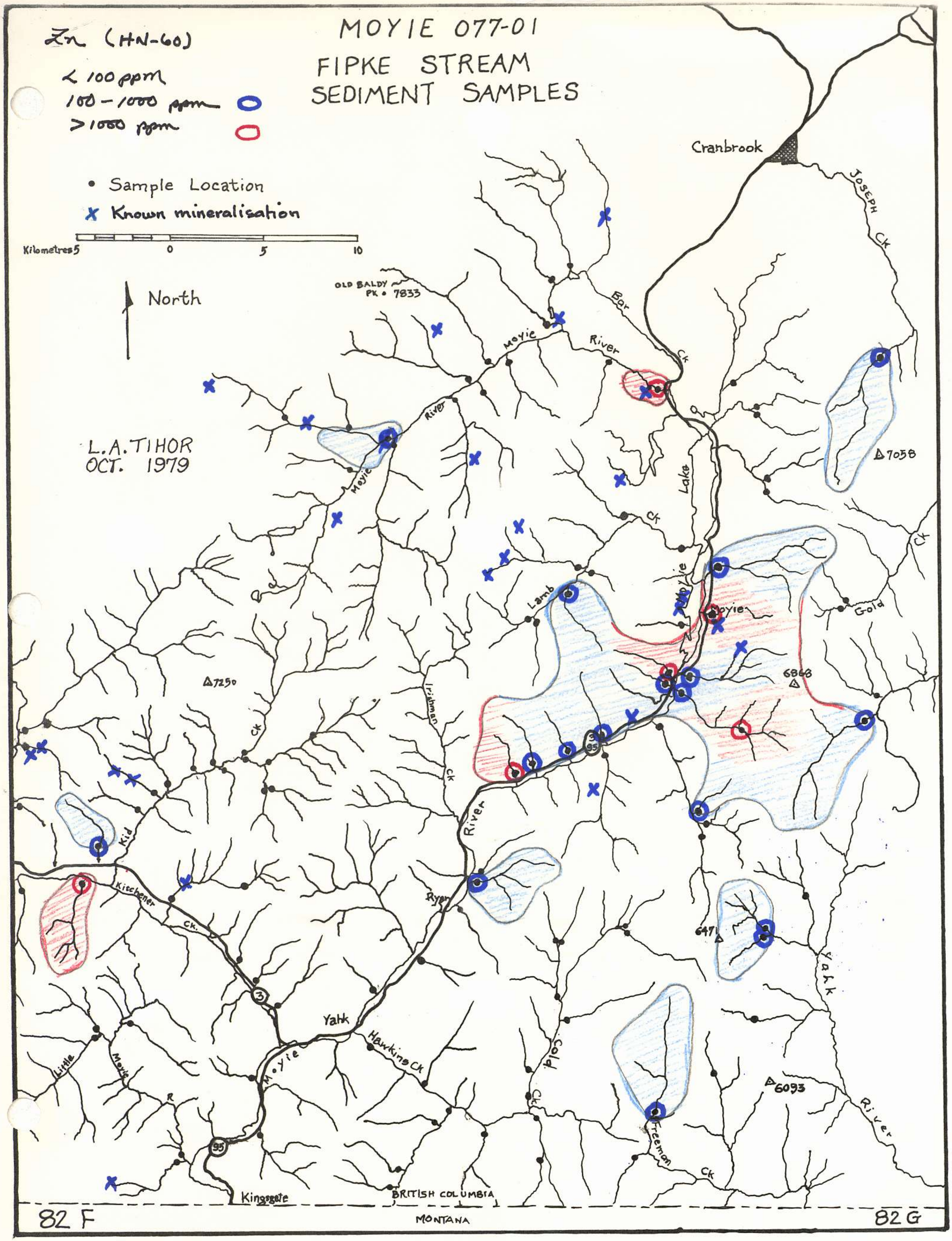
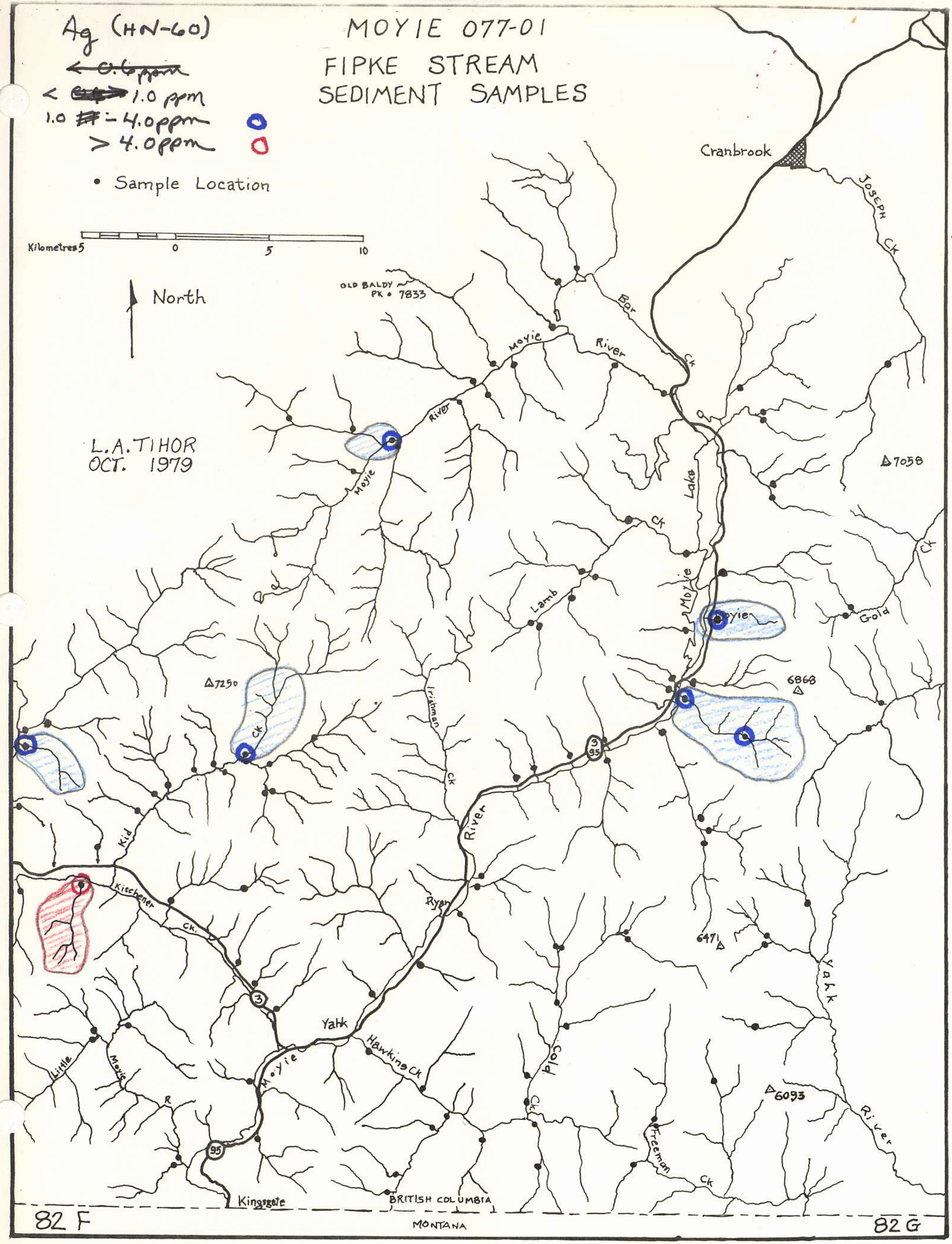

MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
Zn (HN-60)
< 100 ppm
100 – 1000 ppm
> 1000 ppm
• Sample Location
x Known mineralisation
Kilometres 5
0
5
10
North
L.A. TIHOR
OCT. 1979
Cranbrook
Joseph Ck
OLD BALDY PK • 7833
Bar River Ck
Moyie River
Moyie Lake
Ck
Lamb
Moyie
Gold
Ck
6868
7058
7250
Irishman Ck
Ck
River
Kid
Kitchener Ck.
Ryan
6471
Yahk
Yahk
Hawkins Ck
Cold Ck
Moyie
Little Moyie R
Freeman Ck
6093
River
3
95
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G

Figure 5.2d


Ag (HN-60)
< 1.0 ppm
1.0 - 4.0ppm
> 4.0ppm
• Sample Location
MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
Kilometres 5
0
5
10
North
L.A. TIHOR
OCT. 1979
OLD BALDY PK • 7833
Cranbrook
JOSEPH CK
Moyie
River
Bar
Ck
Lake
Lamb
Moyie
Gold
Ck
△7058
△7250
△6868
Irishman
Ck
Kid
Kitchener
Ck.
River
Ryan
6471 △
Yahk
Yahk
Moyie
Hawkins Ck
Little
Moyie
R
Cold
Ck
Freeman
Ck
△6093
River
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G
3
95
3
95

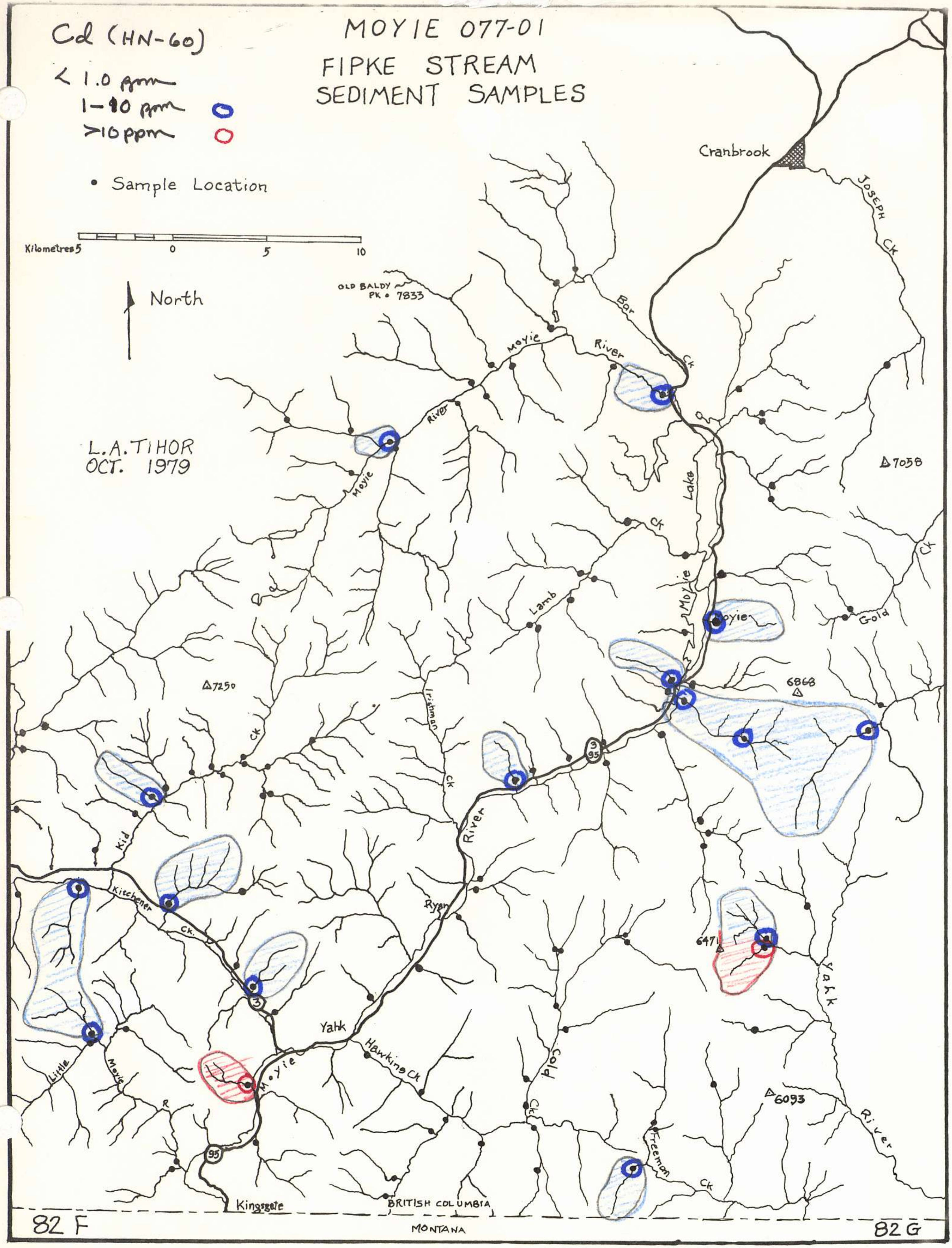
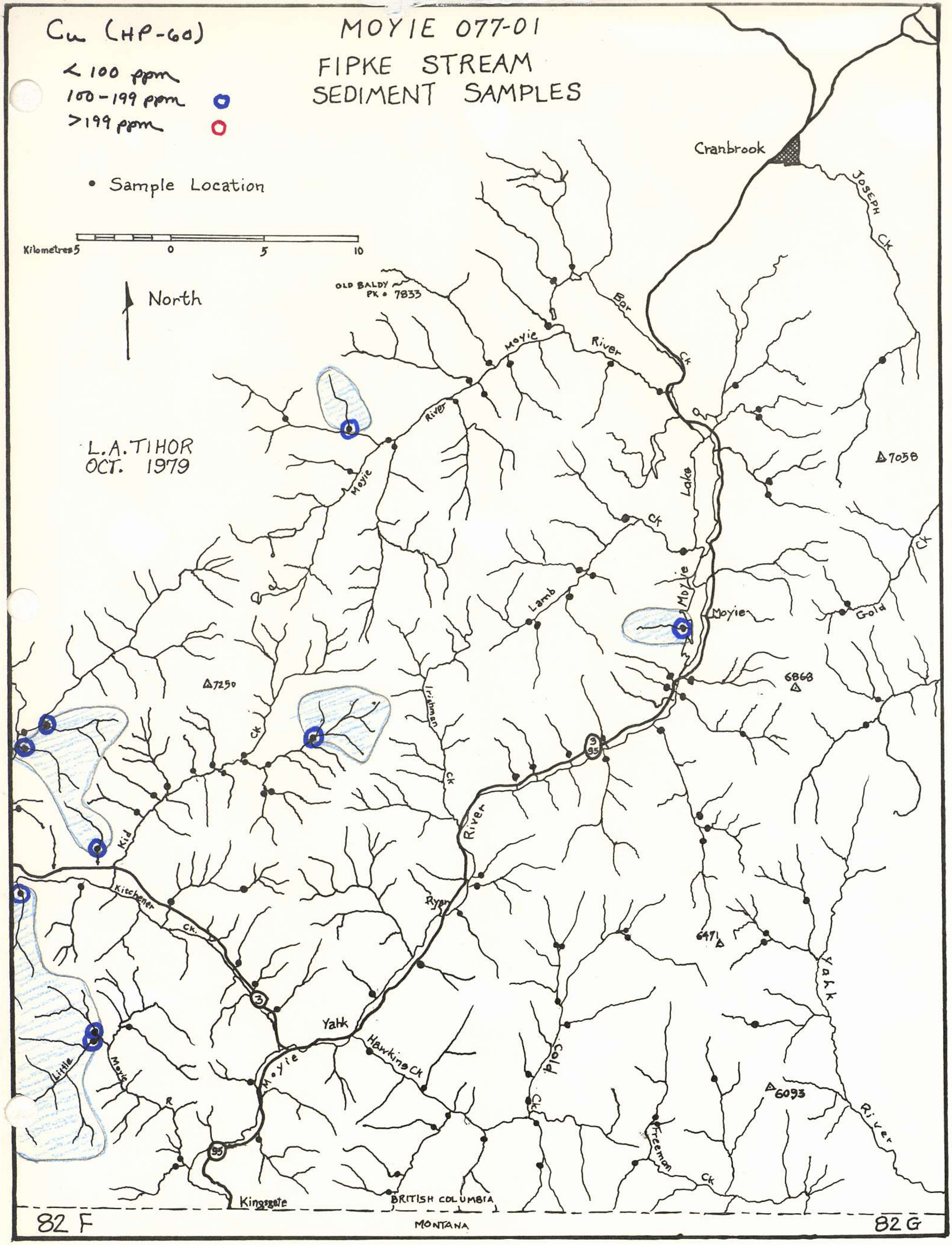
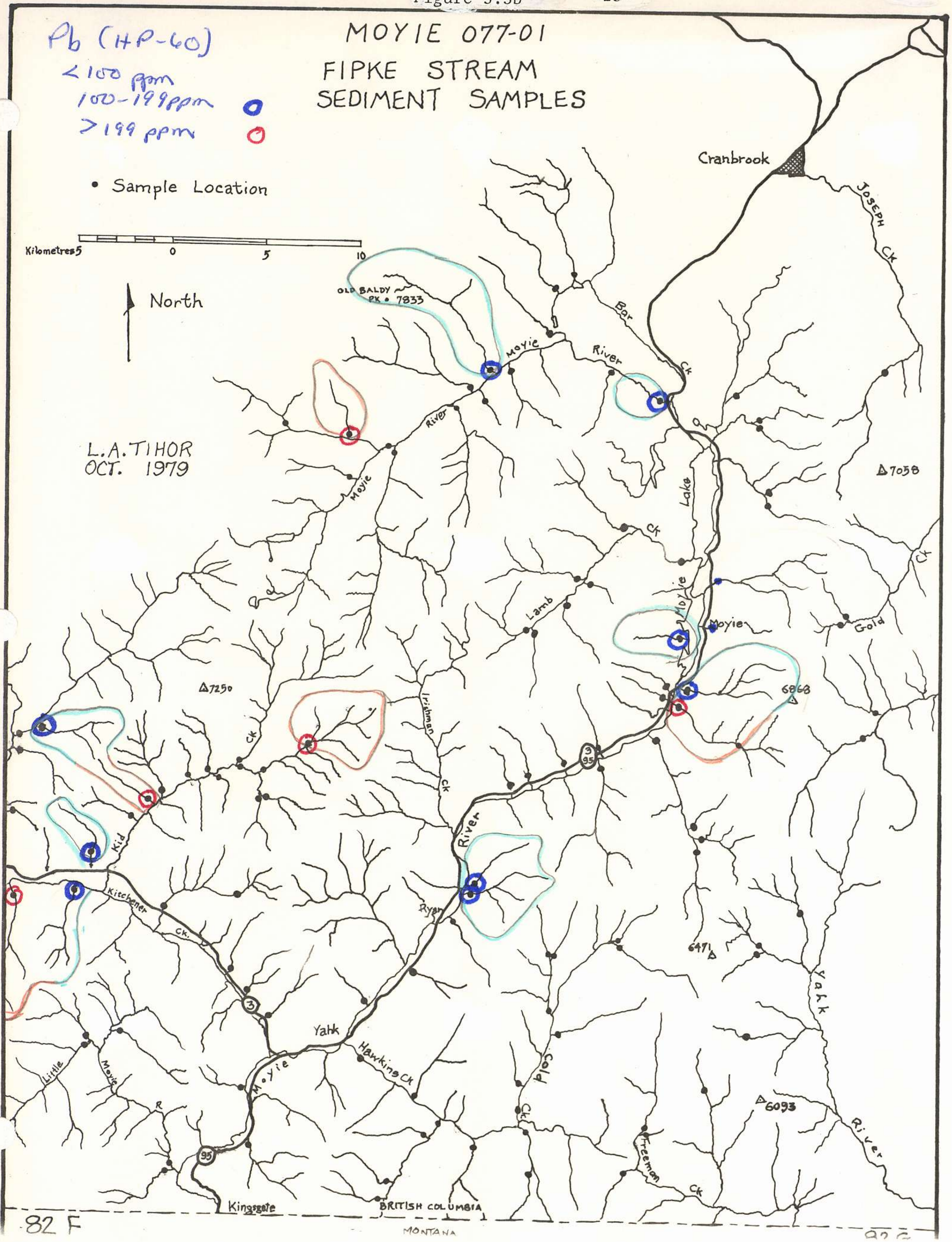

MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
Cd (HN-60)
< 1.0 ppm
1-10 ppm
>10 ppm
• Sample Location
Kilometres 5 0 5 10
North
L.A. TIHOR
OCT. 1979
OLD BALDY PK • 7833
Cranbrook
JOSEPH CK
Bar Ck
Moyie River
Moyie
Lake
Ck
Lamb
Moyie
Gold
Ck
△7058
6868
△7250
Irishman Ck
Ck
Kid
Kitchener Ck.
River
Ryan
3
95
Yahk
Hawkins Ck
6471
Yahk River
Moyie
Little Moyie R
Cold Ck
Freeman Ck
△6093
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G

Figure 5.3a


Cu (HP-60)
< 100 ppm
100 - 199 ppm
>199 ppm
• Sample Location
Kilometres 5 0 5 10
North
MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
L.A. TIHOR
OCT. 1979
OLD BALDY PK • 7833
Cranbrook
Joseph Ck
Bor Ck
Moyie River
Lake Ck
Lamb
Moyie
Gold
Ck
Irishman Ck
Kid Ck
Kitchener Ck.
Ryan
Yahk
Hawkins Ck
Cold Ck
Freeman Ck
Yahk River
Little Moyie R
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G
7058
7250
6868
6471
6093
3
95


MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
Pb (HP-60)
<100 ppm
100-199 ppm
>199 ppm
• Sample Location
Kilometres 5
0
5
10
North
L.A. TIHOR
OCT. 1979
Cranbrook
JOSEPH
Ck
OLD BALDY PK • 7833
Moyie
River
Bar
River
Ck
Lake
Ck
Moyie
Moyie
Gold
Ck
Lamb
Irishman
Ck
Ck
River
Kid
Kitchener
Ck.
Ryan
Yahk
Hawkins Ck
Moyie
Little
Moyie
R
Cold
Ck
Freeman
Ck
Yahk
River
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
7058
7250
6868
6471
6093
3
95
3
95

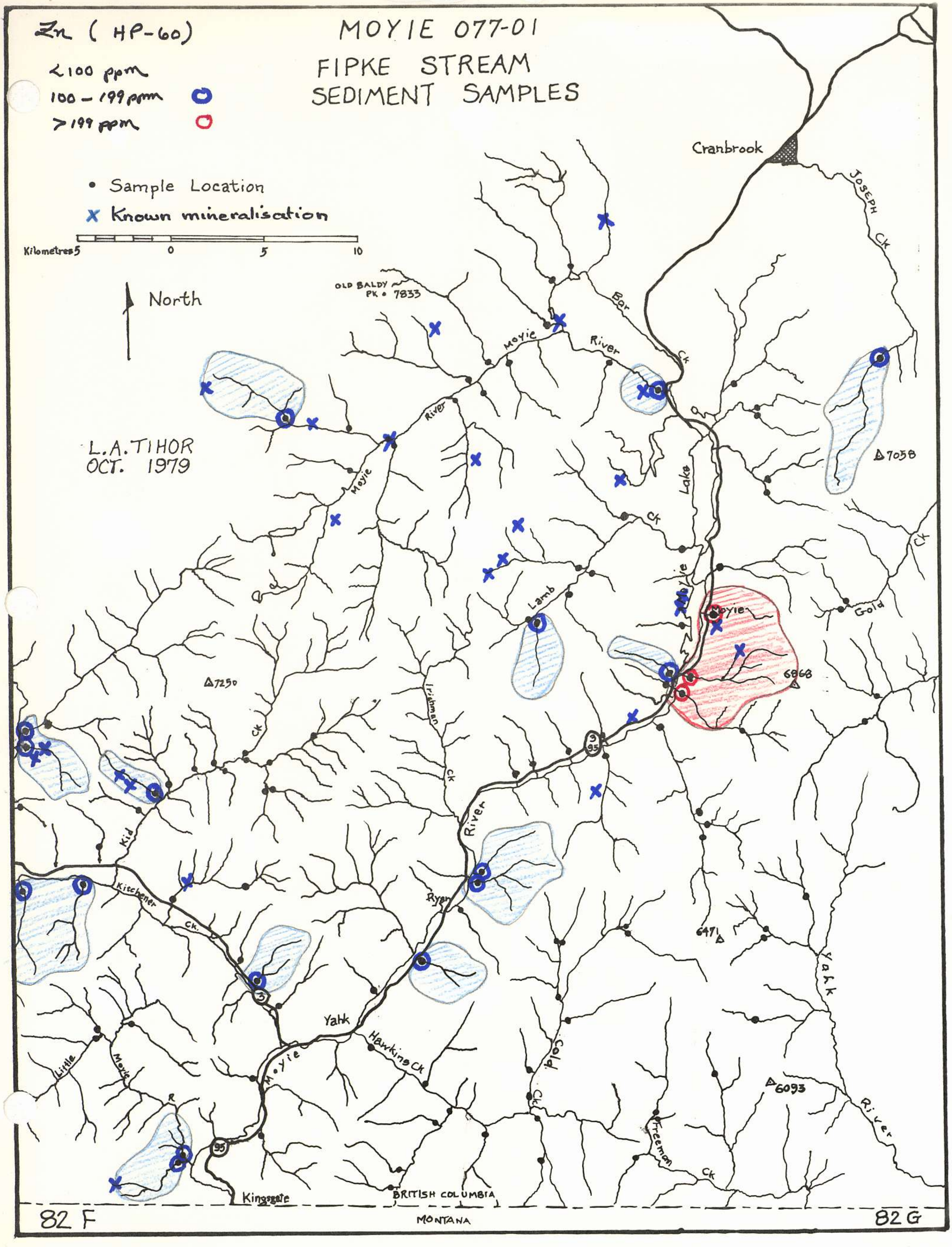
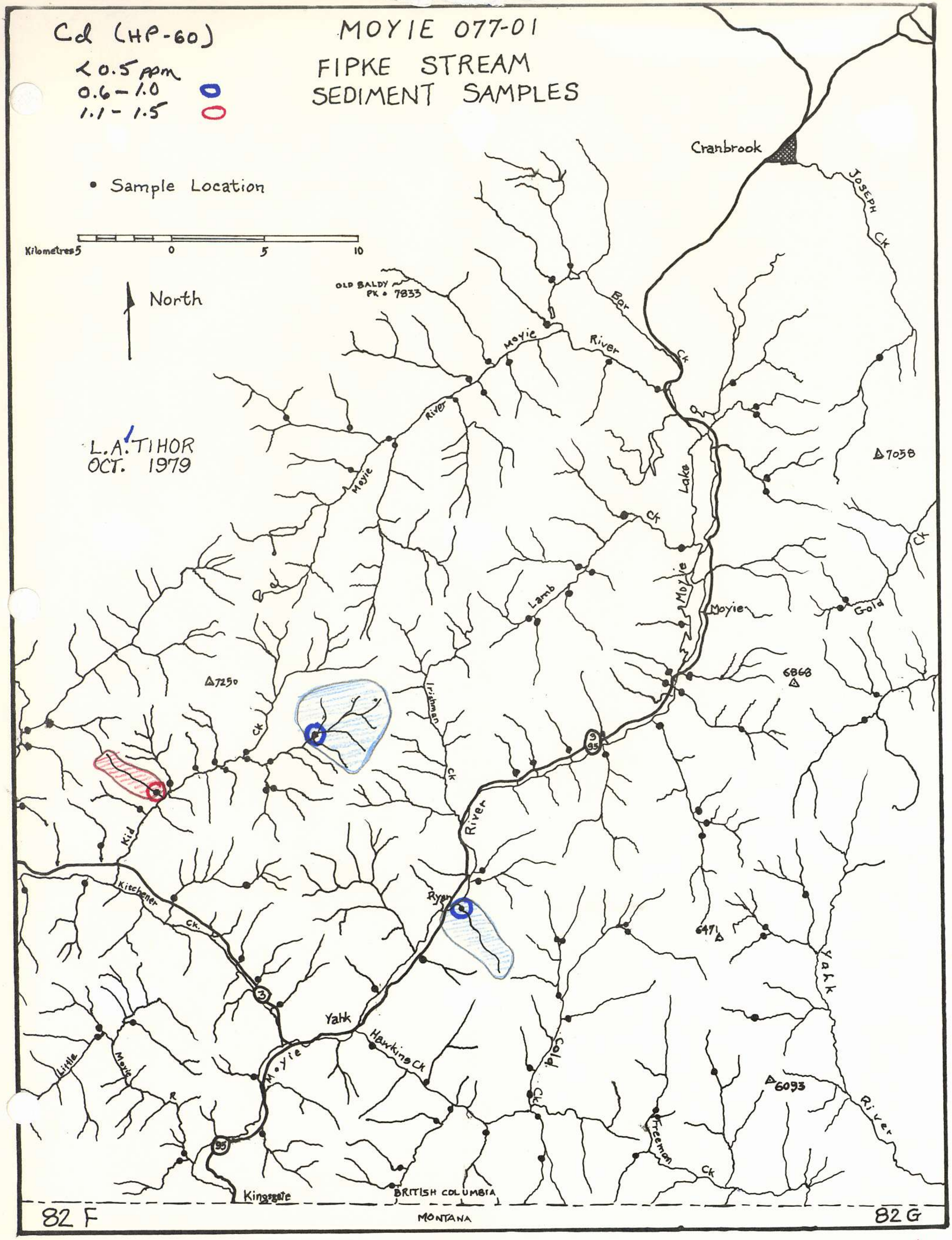
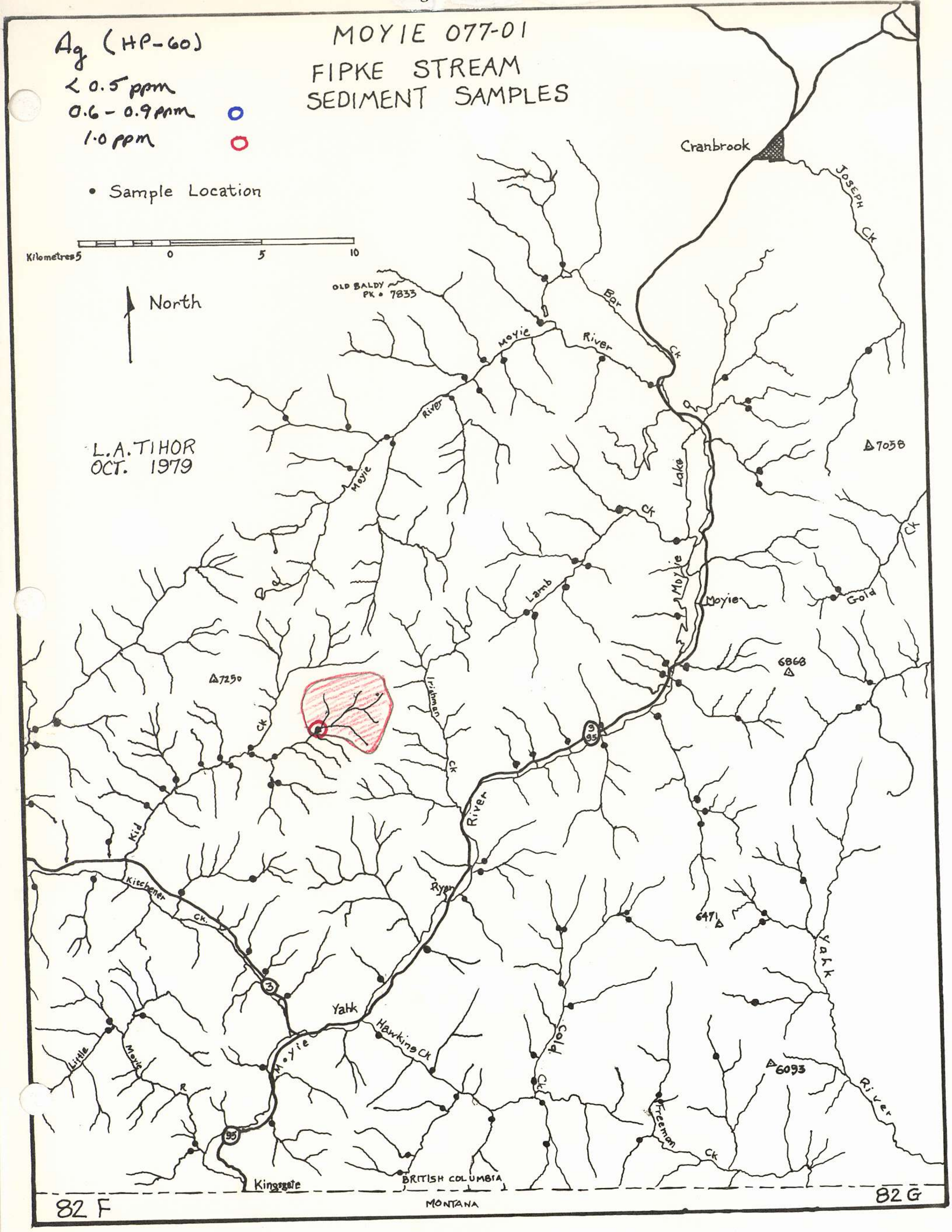
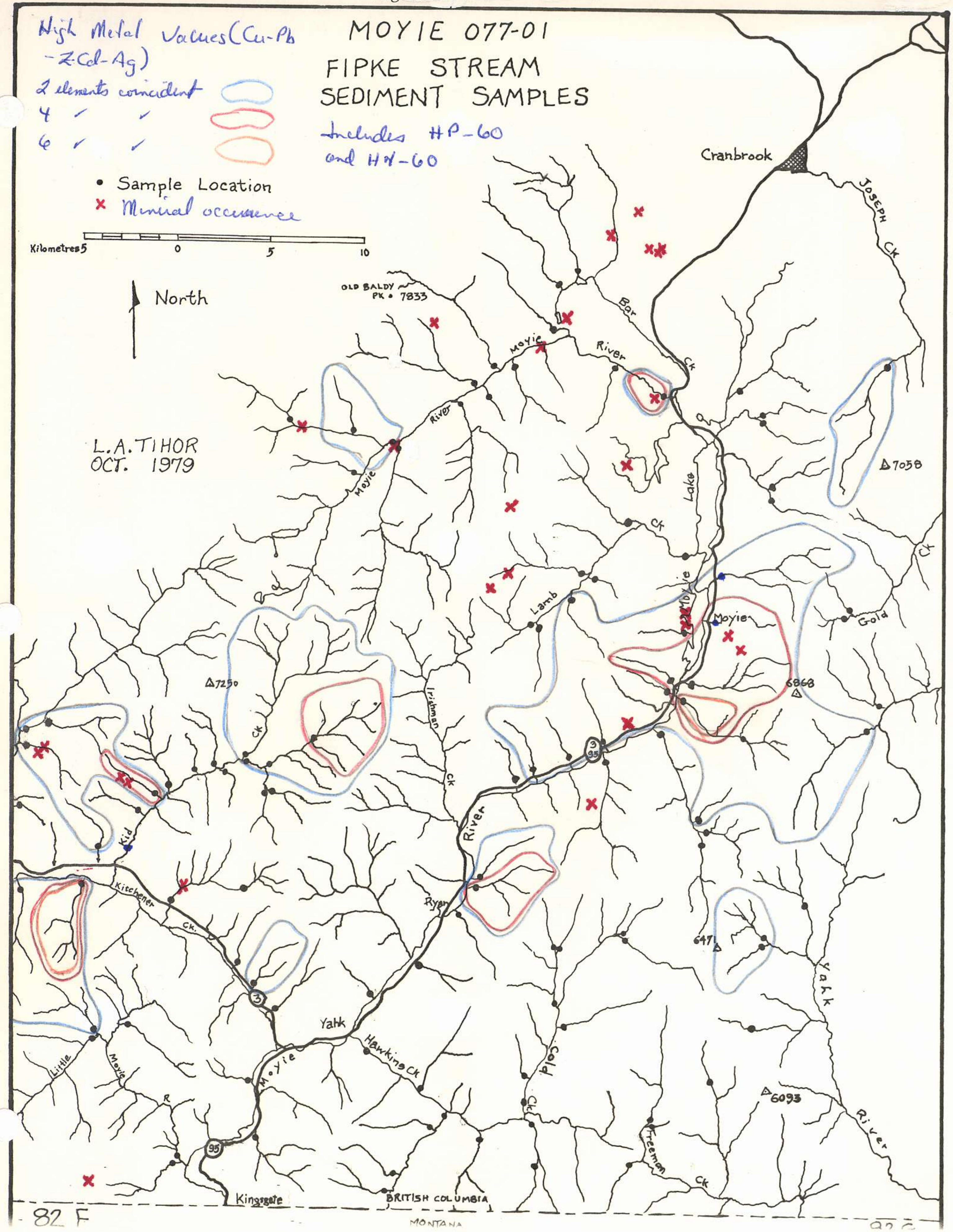

Zn (HP-60)
<100 ppm
100 – 199 ppm
>199 ppm
MOYIE 077-01
FIPKE STREAM SEDIMENT SAMPLES
• Sample Location
x Known mineralisation
Kilometres 5 0 5 10
North
L.A. TIHOR
OCT. 1979
OLD BALDY PK • 7833
Cranbrook
Joseph Ck
Bar River Ck
Moyie River
Lake
Ck
Moyie
Lamb
Gold
Irishman Ck
Kid
Ck
7250
7058
6868
6471
6093
Ryan
River
Kitchener Ck.
Yahk
Hawkins Ck
Cold Ck
Freeman Ck
Yahk River
Little Moyie R
95
3
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G

Figure 5.3d


Cd (HP-60)
<0.5 ppm
0.6 – 1.0
1.1 – 1.5
MOYIE 077-01
FIPKE STREAM
SEDIMENT SAMPLES
• Sample Location
Kilometres 5
0
5
10
North
L.A. TIHOR
OCT. 1979
Cranbrook
JOSEPH CK
OLD BALDY PK • 7833
Bar Ck
Moyie River
River
Moyie
Lake
Ck
Moyie
Lamb
Moyie
Gold
Ck
7058
7250
6868
Irishman Ck
Ck
River
Kid
Kitchener Ck.
Ryan
6471
Yahk
Yahk
Hawkins Ck
Moyie
Little
Moyie
R
Cold Ck
6093
River
Freeman Ck
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G
3
95



MOYIE 077-01
FIPKE STREAM SEDIMENT SAMPLES
Ag (HP-60)
< 0.5 ppm
0.6 - 0.9 ppm
1.0 ppm
• Sample Location
Kilometres 5 0 5 10
North
L.A. TIHOR
OCT. 1979
OLD BALDY PK • 7833
Cranbrook
Joseph Ck
Bar Ck
Moyie River
Moyie
Lake
Ck
Lamb
Moyie
Gold
Irishman Ck
7058
6868
7250
6471
6093
Ck
Kid
Kitchener Ck.
River
Ryan
Yahk
Hawkins Ck
Yahk River
Cold Ck
Freeman Ck
Little Moyie R
Moyie
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F
82 G
3
95


High Metal Values (Cu-Pb-Zn-Cd-Ag)
2 elements coincident
4
6
MOYIE 077-01
FIPKE STREAM SEDIMENT SAMPLES
Includes HP-60 and HY-60
• Sample Location
× Mineral occurrence
Kilometres 5 0 5 10
North
L.A. TIHOR
OCT. 1979
Cranbrook
JOSEPH CK
OLD BALDY PK • 7833
Moyie River
Bar Ck
Lake
Ck
Lamb
Moyie
Gold
Δ7058
Δ7250
6868
Irishman Ck
Kid
Kitchener Ck.
Ryan
River
3
95
Yahk
Hawkins Ck
Little Moyie R
Cold Ck
Freeman Ck
Yahk River
6471
Δ6093
Kingsgate
BRITISH COLUMBIA
MONTANA
82 F

5.4 Detailed Soil Geochemical Surveys

Soil geochemical surveys were carried out along roads, streams and along surveyed grid lines as one of our methods of detailed exploration of the Sullivan Time Horizon. Along streams and ravines we sampled the base of the slope along both sides of the depression taking care not to include stream sediment. When following roads we sampled just off the road on the up-slope side. We attempted to include only mineral soil in each sample. Spacing between sample stations varied from 20 to 100 m. depending on the specific purpose of the survey. We analyzed routinely for Cu-Pb-Zn-Ag and some samples for Cd as well.

The great majority of samples contained only background amounts of metals. We did however encounter two anomalous areas: a small weak anomaly near the confluence of Manson Creek and Moyie River north of Yahk, and, an excellent, well-defined Zn anomaly on the Yahk claim. This anomaly will be discussed in more detail later. Diamond drilling near the end of the season showed that overburden in the area of interest varied from 0 to 60 m. in thickness and averaged more than 30 m. For this reason it is quite possible that in areas of thick overburden surficial soils would not reflect the presence of an ore deposit below. I emphasize that a negative soil geochem survey in this area does not speak badly of the underlying rock whereas a positive result must be followed up.

6. PROPERTY ACQUISITION AND EVALUATION

6.1 Introduction

Over the last two years St. Eugene Mining Corporation Ltd. has steadily acquired ground by staking in the project area as our understanding of its mineral potential developed. In late 1978 claims were staked in Montana (NW Claims) and on Peterson Creek, B. C. (Pete Claims) to cover source areas of stream sediment anomalies; just east of Yahk (Rusty Claims) on a limonite zone ; and on Mt. Mahon (Tourm Claim) to protect a tourmaline occurrence. In 1979 we added the Manson, Hope, Ryan, Moyie, Yahk, Cold, Alder, Spruce, Larch, Pine and Mead Claims to cover the extrapolated extent of the Sullivan Time Horizon in the vicinity of Mt. Mahon and Cold Creek. Some detailed exploration was carried out on each of these claims.

6.2 NW Claims, Montana - 2400 acres

A block of 120 claims was staked to cover the source area of a well-defined Cu-Ni-Zn stream sediment anomaly (geochem zone B, Map 2). Follow-up work consisted of 3 days prospecting and geological investigation. Rock exposure is unusually good on these claims making it unlikely that anything significant was missed.

All outcrops examined appeared to represent units belonging to the Lower Aldridge Formation or gabbroic bodies intrusive into these rocks. The anomalous stream sediment values were invariably down-slope from outcrops or extrapolated locations of a mineralized gabbroic sill. Mineralization in the sill consisted of rusty patches of disseminated chalcopyrite (<1%) and pyrrhotite (<2%). The potential for Sullivan-type deposits on this ground is considered to be low and no further work can be recommended for this property at this time. It is likely, however, that the STH strikes N-S at about 1 to 2 miles east of the NW claims, and, that may be a good area to check at some future time.

6.3 Rusty Claims (2 units, Yahk area, B. C., 82F-1/E)

Two contiguous 2 post claims were staked in 1978 on a limonite-rich sheared zone. Detailed soil geochemistry carried out that year showed nothing of interest. No work was done on this ground during 1979 and the claims were allowed to lapse.

6.4 Pete Claims (20 units, Peterson Creek area, B. C. 82F-1/W)

This claim was staked in 1978 to cover the source area of a well0defined Pb-Zn-Ag-Cd anomaly (geochem zoneA, map 2). During 1978 we carried out fairly detailed soil geochemical, stream sediment geochemical, EM-16 and proton mag surveys on this ground. A bulldozer was hired to clean up the old access road.

Stream sediment sampling confirmed the anomalous values of the previous year.

Soil geochem sampling produced a weak Pb-Zn anomaly in the SE corner of the claim and roughly coincident with the valley of Peterson Creek. Some angular tourmaline boulders were found in the creek. EM-16 and Mag produced nothing of interest.

We do not have enough data yet to either get excited about this ground or write it off. The geochem data is weakly encouraging, as is the occurrence of tourmaline. But, the rock resembles Upper Aldridge and Creston Formation - far from the STH. More detailed geological and prospecting work could be done here. However, this property should be given a much lower priority than ground located on the STH.

6.5 Tourm Claim (20 units, Mt. Mahon area, B. C. 82G-4/W)

A 20 unit claim was staked in 1978 to protect a zone of intense tourmalinization believed to be adjacent to the Lower Aldridge-Middle Aldridge contact, the STH.

During 1979 the claim was geologically mapped in detail and a small amount of soil geochemical surveying was done. Rock exposure is excellent on Mt. Mahon from the tourmaline horizon upward. The exposed rock appeared to all belong to the Middle Aldridge Formation. None of the stratigraphy underlying the tourmaline is visible. However, extrapolation from drill hole data on the adjacent Yahk Claim suggests that the rocks below the tourmaline should be part of the Lower Aldridge. This would put the tourmaline on the STH. Another interesting observation is that the tourmaline seems to occur in two distinct horizons separated by about 30 m. of siltstone. This is reminiscent of the Sullivan ore deposit in which many strataform ore zones are separated by beds of siltstone.

The minor amount of soil geochemistry showed nothing of interest.

A few lines of EM-16 and Mag showed a weak conductive and weakly magnetic response roughly stratigraphically coincident with a level just below the tourmaline horizon, but, this has not yet been followed up rigorously.

The Tourm Claim is a very interesting piece of ground, especially since our drill hole intersection of massive sulphides on the adjacent Yahk Claim. This area warrants detailed geophysical follow-up with high quality equipment such as Dighem II air EM and/or Crone Pulse EM. The east slope of Mt. Mahon should also be subjected to a detailed soil geochemical survey as supplement to geophysical work.

6.6 Manson Claim (9 units, Manson Creek Area, B. C. 82G 4/W)

The Manson Claim was staked in 1979 to protect the down dip extension of the Mt. Mahon tourmaline zone as well as a reconnaissance EM-16 anomaly. Detailed geologic mapping, soil geochemical, EM-16 and proton mag surveys were done.

The geologic mapping suggests that all of the exposed sedimentary rocks on the claim belong to the Middle Aldridge Formation. It also delineated a large discordant gabbroic body which may be a wide dyke.

A number of EM-16 anomalies were found. However, most are either insignificant in amplitude or continuity or they show characteristics of being topographically generated. The best example of the latter is between stations 2+80 W and 5+00 W on L 5S, 1+00 W and 5+00 W on L 6S, 1+00 W and 4+00 W on L 7S and 1+00 W and 3+00 W on L 8S. This anomaly has a wavelength averaging more than 300 m. suggesting a possible conductor at greater than 150 m. depth. But, the amplitude of the anomaly is too great to be consistent with such an interpretation. The anomaly is centred on a southwest facing slope of greater than 30^{o} and is likely only reflecting the side of the hill. There are no EM-16 results on this claim that may be interpreted as being due to a massive sulphide deposit.

The proton magnetometer survey has outlined a moderate sized weak but coherent magnetic anomaly centred between stations 2+00 W and 3+40 W on L 4S and 1+20 W and 3+20W on L 5S. The contours of this anomaly are quite steep, suggesting a near surface source. The anomaly is located near the southern boundary of the gabbroic dyke mentioned earlier. This relationship, the relative weakness of the anomaly and the lack of a well-defined, shallow-source EM anomaly suggest that this mag anomaly is due to disseminated magnetic mineralization, magnetite or pyrrhotite, along the southern contact of the dyke with Middle Aldridge sediments.

There is nothing to suggest that a Sullivan-type deposit exists on the Manson claim within a hundred metres or so of surface. No further work is recommended on this claim for the immediate future.

6.7 Ryan Claim (12 units, Upper Manson Creek area, 82G 4/W)

The Ryan Claim was staked in 1979 to provide continuity between the Tourm and Manson Claims. A small amount of soil geochem and proton mag work revealed nothing of interest. The EM-16 showed the extension of the broad topographically generated anomaly referred to on the Manson Claim. The small amount of outcrop exposure includes Middle Aldridge sediments and gabbroic intrusive rocks.

6.8 Hope Claim (20 units, North of Mt. Mahon, 82G 4/W)

The Hope claim was staked in 1979 to protect the down-dip extension of the tourmaline horizon on the Tourm claim. Only a small amount of soil geochem surveying was done on this claim. Results were negative. The Hope Claim should be retained for protection purposes and for proper assessment at a later date.

6.9 Yahk Claim (18 units, east of Mt. Mahon, 82G 4/W)

This claim was staked in 1979 to cover a soil geochemical anomaly and the stratigraphic extension of the tourmaline zone. This piece of ground has excellent potential for producing a Sullivan-type deposit. EM-16 and soil geochemistry showed excellent coincident anomalies.

Detailed soil geochem surveying delineated a nice coherent zinc anomaly 1100 m. long by 300 m. in width. The strongest part of the anomaly coincides with an excellent EM-16 anomaly 400 m. long by 200 m. wide. The in phase and quadrature profiles of the EM anomaly are consistent with the model for a horizontal conductor dipping easterly at an angle slightly greater than that of the undeflected primary field. The primary field here seems to dip easterly at a very shallow angle, probably less than 5^{o}. The few outcrops found in the Yahk Claim show easterly dipping bedding at about 10^{o}. The evidence is consistent with the existence on this claim of a large tabular stratiform conductive body containing anomalous amounts of zinc. Roughly the centre of the anomaly was drilled (YA-6). At about 23m. a stockwork of massive pyrite stringers was intersected. The sulphides continued for about 8 m. and contained one massive section 15 cm. thick with traces of chalcopyrite and sphalerite and assaying about 1 oz/ton Ag. Due to equipment failure the mag survey was not completed. However, the part we finished showed no correlative mag anomaly.

There was, however, a weak, elongate mag anomaly with a weak correlative EM-16 anomaly about 600 m. north of drill hole YA-6. This anomaly was also drilled (YA-7). No signficant sulphides were found here. But, a narrow gabbroic dyke was passed through at the target depth. The dyke was the likely source of the anomalies.

The Yahk Claim must be explored further, with great care and the best equipment available. Since the casing was left in hole YA-6 mise-a-la-masse geophysics may be used to trace the sulphide body. A weakness of this method is that it would show only that part of a sulphide body which is in electrical continuity with the part intersected by the drill hole. Crone Pulse EM is the method I recommend for this work. It does not require perfect electical continuity throughout the body and it is an easy method to interpret. The Yahk Claim is the best bet for an ore deposit.

6.10 Larch Claim (20 units, Cold Creek area, 82G 4/W)

The Larch Claim was staked in 1979 to cover a number of large coherent EM-16 anomalies suggestive of horizontal conductors, a weak proton mag anomaly coincident with one of these conductors, and, the area of abundant tourmaline float at the confluence of Cold Creek and Tourm Creek.

The EM anomalies were all on the east side of Cold Creek. Four of them were drilled (YA-2, 3, 4, 5) and invariably they were found to be horizontal, pyrite-rich, silty argillite horizons in Middle Aldridge rocks. The mag anomaly was drilled (YA-1). It was caused by a thick gabbroic body with at least two strong sheared zones.

A hole was drilled (YA-9) beside Tourm Creek about 100 m. upstream from Cold Creek in an attempt to find the source of the tourmaline boulders. The hole collared at 40 m. in Lower Aldridge rocks! It appears that at this location the source of the tourmaline, the STH, had been eroded away.

The geologic interpretation for the Larch claim is as follows. The location of Cold Creek probably represents a fault with the east side dropped at least 150 m. relative to the west. For this reason, no further work is recommended for the immediate future for the area east of Cold Creek. On the west side of Cold Creek, however, the STH likely occurs within 40 m. of the surface and roughly parallels the ground surface up the east side of Mt. Mahon until it emerges as the tourmaline zone on Mt. Mahon. Obviously more detailed work is recommended for the part of the Larch Claim which is west of Cold Creek. This is true of the whole of the east side of Mt. Mahon including ground not yet covered by our claims.

6.11 Other Claims (Cold Creek area, 82G 4/W)

During 1979 a number of other claims were staked to provide continity between the above claims and to protect the extrapolated location of the STH. These include the Moyie Claim (3 units), Cold Claim (16 units), Alder Claim (20 units) and Mead Claim (12 units). A Small amount of exploration was done on each of these claims with negative results.

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2) Ethier, V. G., F. A. Campbell, R. A. Both and H. R. Krouse, 1976, Geological setting of the Sullivan Orebody and estimates of temperatures and pressure of metamorphism, Economic Geology V 71 pp. 1570-1588.

3) Bishop, D. T., H. G. Morris and F. R. Edmunds, 1970, Turbidites and depositional features in the lower Belt-Purcell Supergroup (abs). G. S.A. Abstracts with Programs, V 2 No. 7 p. 497.