CASSIAR MAP–AREA

(104P)

By A. Panteleyev

INTRODUCTION

Geological mapping at a scale of 1:15 840 (1 inch = ¼ mile) that began in 1978 in the region south and west of Cassiar mine was extended to the west and north. In 1979 an additional 210 square kilometres of mainly granitic terrane was mapped for total map coverage during 1978 and 1979 of 470 square kilometres. This area encompasses the entire 'Cassiar stock,' a younger (73 Ma) intrusion that forms part of the well-mineralized eastern margin of the composite Cassiar batholith (Fig. 24).

In addition, 36 stream sediment samples (Fig. 25), 9 assay samples, and 92 rock specimens were collected. The 36 stream sediment samples (minus 80 mesh) were analysed for silver, copper, lead, zinc, cobalt, manganese, nickel, uranium, thorium, tungsten, tin, and molybdenum. Together with the 76 samples reported in *Geological Fieldwork, 1978,* they are intended to provide an orientation survey for use in interpreting results of the 1978 Uranium Reconnaissance Program (URP) in McDame (104P) and Jennings River (104O) map-areas (NGR 41-1978, 42-1978; Geological Survey of Canada, Open File Reports 561 and 562, June 1979).

GEOLOGY

This short report is intended to update and augment the more lengthy description of Cassiar map-area in Geological Fieldwork, 1978, pages 51 to 60.

The 'Cassiar stock' is a north-south elongate intrusion approximately 7 by 30 kilometres in size. The distinction between this younger intrusion and the mid-Cretaceous Cassiar batholith to the west can be emphasized by use of the informal name 'Troutline Creek quartz monzonite or adamellite.' In the south and east it intrudes a bedded sedimentary and metasedimentary sequence made up of rocks of the Good Hope (Ingenika), Atan, Kechika, Sandpile, and McDame Groups. These are a shelf assemblage of clastic and carbonate rocks that are overlain by allochthonous volcanic and sedimentary rocks of the Sylvester Group. The bedded rocks have been described by Gabrielse (1963) and are discussed in *Geological Fieldwork, 1978.*

In the southwest the Troutline Creek quartz monzonite is separated from rocks of the Cassiar batholith by a metamorphosed septum of Good Hope rocks, approximately 1 to 2 kilometres in width (Fig. 24). Along the western extremity of the Troutline Creek quartz monzonite the Good Hope rocks are engulfed by batholithic rocks and form a zone of dissected northwesterly trending pendants. To the north of these pendants (north and northeast of Maria Lake) the contact of the Troutline Creek quartz monzonite and Cassiar batholith is largely buried along a creek valley. Where the contact is exposed it is irregular and is defined arbitrarily as the zone in which there is a preponderance of pink porphyritic quartz monzonite dykes in batholithic granodiorite.

In general, the eastern intrusive contact of the Troutline Creek quartz monzonite is sharp and has extensive hornfels and calc-silicate rocks adjacent to it. Skarn and calc-silicate tactite are especially prevalent where calcareous rocks of the upper Good Hope and Atan map units and the Sandpile–McDame map units are intruded. The western contact is more irregular and consists of a multitude of partially assimilated xenoliths of foliated metasedimentary rocks and numerous leucocratic dykes. These granite dykes commonly trend parallel with schistosity and are noteworthy for their content of small red spessartine garnets. Wallrocks are mica schist that locally contains abundant black tourmaline (schorlite).

Two small satellitic intrusions of quartz monzonite porphyry are present north of Cassiar along the eastern margin of the Troutline Creek quartz monzonite. A small stock of diorite is found alongside Highway 37 about 8 kilometres southeast of Cassiar. It intrudes Sylvester volcanic rocks as a plug and might have been a feeder zone for overlying Sylvester volcanic flows.

The Troutline Creek quartz monzonite intrusion as shown on Figure 24 consists of three major map units with obvious textural and subtle compositional differences and two dyke types. The major units are megacrystic quartz monzonite porphyry, medium-grained, equigranular to coarse porphyritic quartz monzonite (mantled porphyry), and medium-grained, equigranular border zone quartz monzonite or granite. These three main rock types have gradational relationships. Average composition of the megacrystic and porphyritic quartz monzonite (mantled porphyry) is 34 per cent perthitic K-feldspar, 32 per cent plagioclase, 27 per cent quartz, and 7 per cent mafic minerals with biotite always in excess of hornblende. The equigranular border quartz monzonite forms a chilled contact and grades into megacrystic quartz monzonite porphyry. Along much of the western margin of the intrusion the border zone is leucocratic and is granitic in composition.

The two main dyke types are grey quartz monzonite and quartz feldspar porphyry. They form small bodies within core areas of porphyritic quartz monzonite (mantled porphyry). There appears to be a close genetic relationship between quartz feldspar porphyry and quartz monzonite porphyry in which mantling of K-feldspar phenocrysts by albite is common and well developed. Molybdenite rosettes are present in the quartz feldspar porphyry and molybdenite-bearing fractures and veinlets in the surrounding mantled quartz monzonite. The presence of molybdenite and pyrite as well as micrographic textures in the matrix of both rock types suggest that quartz feldspar porphyry dykes and the enclosing strongly mantled quartz monzonite porphyries are zones of hydrothermal fluid separation and concentration. At Cassiar molybdenum deposit (K/Ar site 1, Fig. 24), quartz feldspar porphyry forms a steeply dipping dyke and a number of smaller dykes and plugs, some with rinds and cappings of quartz-K-feldspar-biotite pegmatite. At Storie molybdenum deposit (K/Ar site 2, Fig. 24), quartz feldspar porphyry forms a number of sheet-like intrusions, each one up to 60 metres in thickness. The dykes have porphyritic borders that grade into quartz porphyry or equigranular, miarolytic pink quartz monzonite in dyke cores.

The coeval and cogenetic relationships of all the quartz monzonite map units and related molybdenum mineralization is suggested by field relations. This is further supported by K/Ar dating (*see* Table 1). The 73.0±2.5 Ma mean age of intrusion/molybdenum mineralization clearly isolates the Troutline Creek quartz monzonite from the approximately 100-million-year-old Cassiar batholith.

Rocks of the Cassiar batholith in the map-area are fine to medium-grained, equigranular to porphyritic granodiorite and quartz monzonite. Average composition is 42 per cent plagioclase, 28 per cent quartz, 21 per cent poikilitic K-feldspar, and 9 per cent mafic minerals, mainly biotite. Porphyritic batholithic rocks are made up of stubby crystals of plagioclase with blocky K-feldspar phenocrysts up to 1.5 centimetres in size in a granular quartz-plagiocase-biotite matrix. Most commonly batholithic rocks are equigranular to slightly porphyritic granular mosaics in which there is a persistent though subtle foliation caused by orientation of biotite grains.

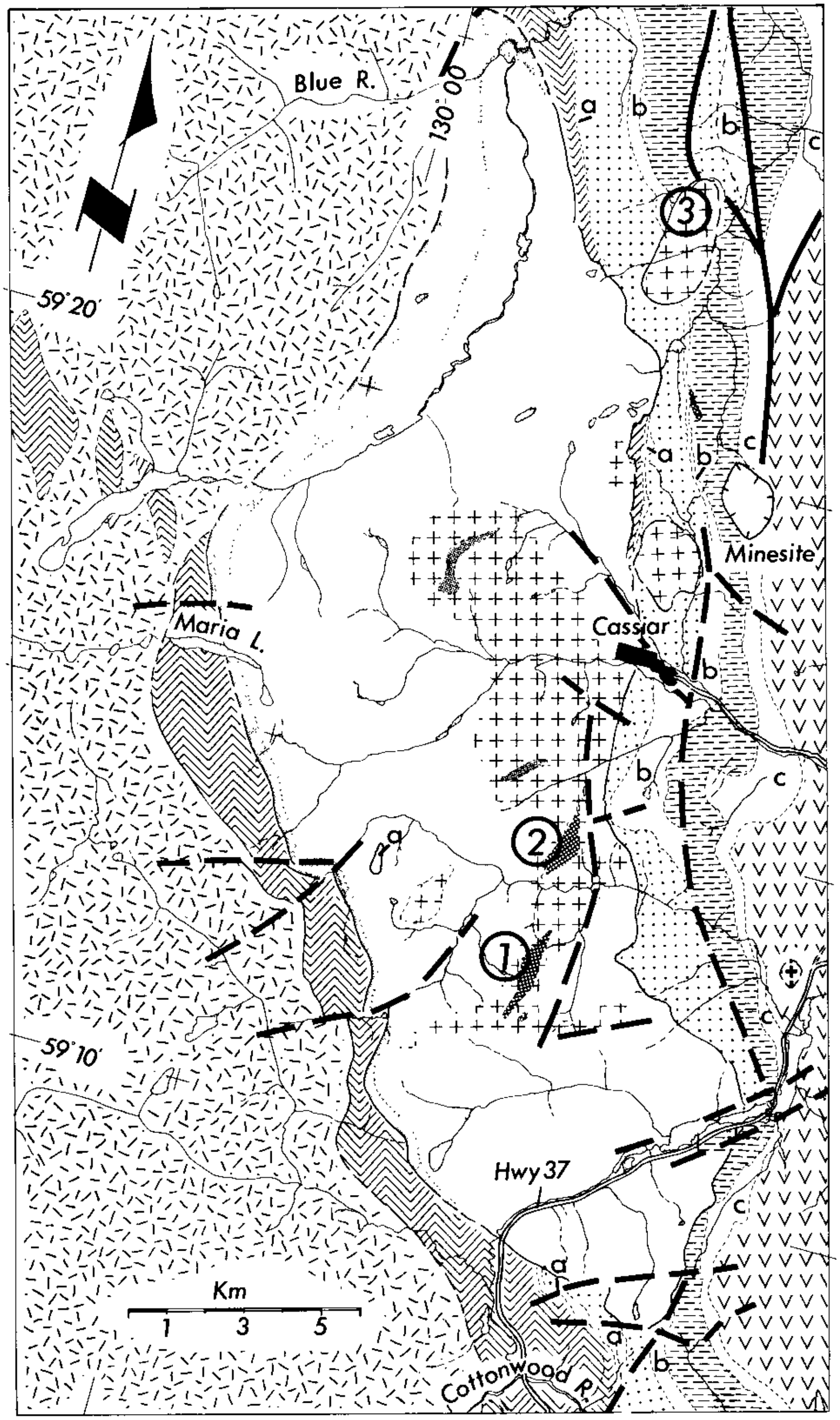

Figure 24. Geology of Cassiar map-area.

LEGEND

BEDDED ROCKS

DEVONIAN AND MISSISSIPPIAN

SYLVESTER GROUP

V V V SILTSTONE, SLATE, BLACK CHERT, GREENSTONE

ORDOVICIAN AND DEVONIAN

SANDPILE AND McDAME GROUPS (UNDIVIDED)

c **McDAME**: BLACK FETID DOLOMITE AND LIMESTONE, LIMESTONE
SANDPILE: GREY AND BUFF DOLOMITE, SANDY DOLOMITE, GREY AND PURPLE QUARTZITE

CAMBRIAN AND ORDOVICIAN

KECHIKA GROUP

▤ SHALE, CALCAREOUS SHALE, MINOR SLATE AND LOCAL CALC-SILICATE HORNFELS

LOWER CAMBRIAN

ATAN GROUP

b RUSTY WEATHERING CORDIERITE AND BIOTITE HORNFELS, SPOTTED HORNFELS, SILTSTONE, QUARTZITE; UPPER UNIT 'b': GREY, PINK, AND BUFF DOLOMITE, GREY AND BLACK LIMESTONE, MARBLE, SKARN, MINOR SLATE

PROTEROZOIC

GOOD HOPE (INGENIKA) GROUP

a LAYERED CALC-SILICATE HORNFELS, CORDIERITE AND BIOTITE HORNFELS, MICACEOUS QUARTZITE, PHYLLITE, MICA SCHIST; UPPER UNIT 'a': MARBLE, GREY LIMESTONE, DOLOMITE, MINOR SKARN

INTRUSIVE ROCKS

CASSIAR STOCK (73±2.5 Ma)

☐ MEGACRYSTIC HORNBLENDE BIOTITE QUARTZ MONZONITE PORPHYRY

☐ EQUIGRANULAR MEDIUM-GRAINED TO PORPHYRITIC QUARTZ MONZONITE AND GRANITE (BORDER ZONE)

+ + + BIOTITE QUARTZ MONZONITE PORPHYRY; MANTLED K-FELDSPAR AND PORPHYRITIC TO EQUIGRANULAR MEDIUM-GRAINED QUARTZ MONZONITE, CONTAINS SOME MUSCOVITE (GRADATIONAL WITH MEGACRYSTIC ROCKS)

▓ QUARTZ FELDSPAR PORPHYRY (PINK QUARTZ MONZONITE TO GRANITE DYKES WITH ASSOCIATED *MOLYBDENUM*)

▦ GREY FINE TO MEDIUM-GRAINED QUARTZ MONZONITE (DYKES)

CASSIAR BATHOLITH (~100 Ma)

▧ FINE TO MEDIUM-GRAINED PORPHYRITIC GRANODIORITE AND QUARTZ MONZONITE (MINERAL ALIGNMENT AND FOLIATION EVIDENT)

PALEOZOIC (?)

✚ DIORITE (SYLVESTER INTRUSION)

SYMBOLS

MAJOR ROAD . . . . 〰

FAULT, NORMAL, REVERSE . . . . ▬ ▬ ▬ ▬ ▬▬▬

INTRUSIVE CONTACT DEFINED, APPROXIMATE . —— — —

K/Ar SAMPLE SITE (MAIN Mo PROSPECTS) . . . . ①

TABLE 1. K/Ar ANALYTICAL DATA, CASSIAR STOCK

Sample No.	Location	Material Analysed	% K	Ar^{*40} (10^{-6} cc STP/g)	$\frac{Ar^{*40}}{\text{Total } Ar^{*40}}$	Apparent Age (Ma)
(1) 78AP–60a	Cassiar Mo (location 1) mineralized greisen	muscovite (hydromuscovite ?)	8.42±0.02 (2)	24.618	97.9	73.7±2.6
(2) 78AP–43	Cassiar Mo (location 1) porphyry dyke	biotite	7.78±0.03 (2)	22.720	93.4	73.6±2.5
(3) 78AP–127	Storie Mo (location 2) mineralized vein	muscovite	8.77±0.02 (3)	25.440	92.7	71.4±2.5
(4) 78AP–126	Storie Mo (location 2) porphyry dyke	biotite	7.69±0.03 (2)	22.110	92.8	72.5±2.5
(5) 78AP–158	Lamb Mtn. (Windy) (location 3) porphyritic stock	biotite	7.92±0.03 (2)	23.236	89.7	73.9±2.5

NOTES

% K determined by the Analytical Laboratory, Ministry of Energy, Mines and Petroleum Resources; number in parenthesis refers to number of K analyses.

Ar determination and age calculation by J. E. Harakal, University of British Columbia.

Constants used: $\lambda = 0.584 \times 10^{-10} yr^{-1}$; λ^{6} $4.72 \times 10^{-10} yr^{-1}$; $K^{40}/K = 1.19 \times 10^{-4}$ (sample 3)
$\lambda = 0.581 \times 10^{-10} yr^{-1}$; λ^{6} $4.96 \times 10^{-10} yr^{-1}$; $K^{40}/K = 1.167 \times 10^{-4}$ (samples 1, 2, 4, 5)

MINERALIZATION

The following discussion can be added to the description of the 15 main mineral deposits and occurrences in the Cassiar map-area reported in *Geological Fieldwork, 1978,* pages 55 to 57.

Molybdenite is the main mineral of current economic interest. The two main porphyry molybdenum deposits are shown on Figure 24 as K/Ar sites 1 (Cassiar molybdenum deposit) and K/Ar site 2 (Storie or New Jersey zinc-molybdenum deposit). K/Ar site 3 is Lamb Mountain (Fort Reliance Star Group) or Windy tungsten-molybdenum skarn deposit.

At Cassiar and Storie molybdenum prospects molybdenite mineralization is related to a single younger quartz feldspar porphyry that forms plugs or sheet-like dykes. The hydrothermal environment indicated is relatively dry and high temperature and produced a molybdenum-tungsten-tin-fluorine-beryllium association related to stockwork greisen and pegmatite development. Molybdenite at the Cassiar molybdenum prospect is widespread but scattered and low grade overall although small greisen pods and fracture zones have spectacular grades. At Storie molybdenum deposit a large low-grade surface deposit has been indicated by diamond drilling. Potential for additional tonnage of better grade material in both deposits is at some considerable depth. These molybdenum prospects might respond to detailed geological and lithogeochemical investigations using models of overlapping ore and alteration 'shells' such as those described at Climax and Henderson deposits, Colorado. Direct comparison can be made with Glacier Gulch deposit near Smithers, British Columbia (Bright and Jonson, 1976) and with Adanac deposit near Atlin, British Columbia (White, *et al.*, 1976) where molybdenum mineralization is related to buried intrusions.

Lamb Mountain tungsten-molybdenum occurrence (K/Ar site 3, Fig. 24) is part of an extensive skarn zone formed in Atan carbonate rocks (map unit b, Fig. 24). Skarn with scheelite and greisen pods with molybdenite are found along the intrusive contact of a small quartz monzonite porphyry stock. Mineralized skarn is close to the northern and western contacts of the small stock but can be traced for at least 2 kilometres to the south of the intrusion where skarn appears to be related to a small porphyry dyke that also carries some molybdenite. Skarn in the Atan carbonate map unit displays lateral zoning. At the intrusive contact of the stock a magnetite-garnet tactite has formed; further from the contact garnet-pyroxene skarn with pyrrhotite lenses is present; and at some distance from the intrusion the skarn contains abundant tremolite. Some scheelite is present in the magnetite tactite and pyrrhotite lenses in garnet-pyroxene skarn. Two chip samples across 3 metres from trenches in tactite contain 0.2 per cent WO_3, 0.07 per cent copper, 0.01 per cent zinc, and 0.01 per cent tin. A sample from pyrrhotite-rich garnet-pyroxene skarn reported in *Geological Fieldwork, 1978,* page 56, has similar values.

Some skarn development with sphalerite and molybdenite is also seen in the upper Good Hope (map unit a) to the west of Cassiar minesite. To the north the same thin Good Hope carbonate unit contains some magnetite tactite and skarn with gold, silver, and bismuth values (location near silt sample sites 93 and 94, Fig. 25).

The tin occurrence discovered in 1978 on the northern bank of Lang Creek (location 4b, *Geological Fieldwork, 1978,* p. 57) has been confirmed to contain at least 1.5 per cent tin, all as cassiterite. It appears to be a vein-like replacement in a fault zone. Where exposed the mineralized zone contains abundant arsenopyrite and marcasite in a fault breccia developed over a width of 3 to 4 metres.

GEOCHEMICAL DATA

Analytical data are shown in Table 2. Locations of the 76 stream sediment samples from 1978 are shown as dots on Figure 24 and the 36 sample sites from 1979 are shown as diamonds with corresponding numbers. Summary statistics for all 112 stream sediment samples are given in Table 3.

Of the total 112 samples, 70 are from granitic source terranes and the remaining 42 are from the thermal aureole and bedded rocks. This distinction in source terranes is readily evident in the data as two fundamental associations can be recognized: molybdenum, tungsten, tin, and uranium related to the Troutline Creek quartz monzonite intrusion and lead, zinc, silver, cobalt, nickel, and copper related to bedded rocks.

When elements are examined individually, molybdenum most clearly defines the areas of quartz feldspar porphyry dyke intrusions and the faulted and fractured zones surrounding them. These are the sites of known porphyry-type molybdenum mineralization in the southern half of the Troutline Creek quartz monzonite intrusion. Uranium and tin are concentrated in drainages throughout the stock and therefore indicate high background values in quartz monzonite. For example, uranium in silts from the Troutline Creek quartz monzonite has a mean concentration of 41 ppm, outside the stock the mean value is 13 ppm. Similarly the average tin content of quartz monzonite is consistently 5 to 10 ppm whereas outside the stock tin content is generally less than 5 ppm. However, unlike uranium which appears to have a homogeneous distribution through the quartz monzonite, tin can also be related to specific mineralized sources such as stanniferous lead-zinc-silver veins and certain skarn zones.

Tungsten in comparison has scattered high values (>10 ppm) in silts derived from quartz monzonite. Maximum concentration (>25 ppm tungsten) can be readily seen to be derived from two mineralized sources: porphyry molybdenum deposits (Cassiar and Storie molybdenum prospects) and skarns in Atan and Good Hope carbonates along the eastern margin of Troutline Creek quartz monzonite.

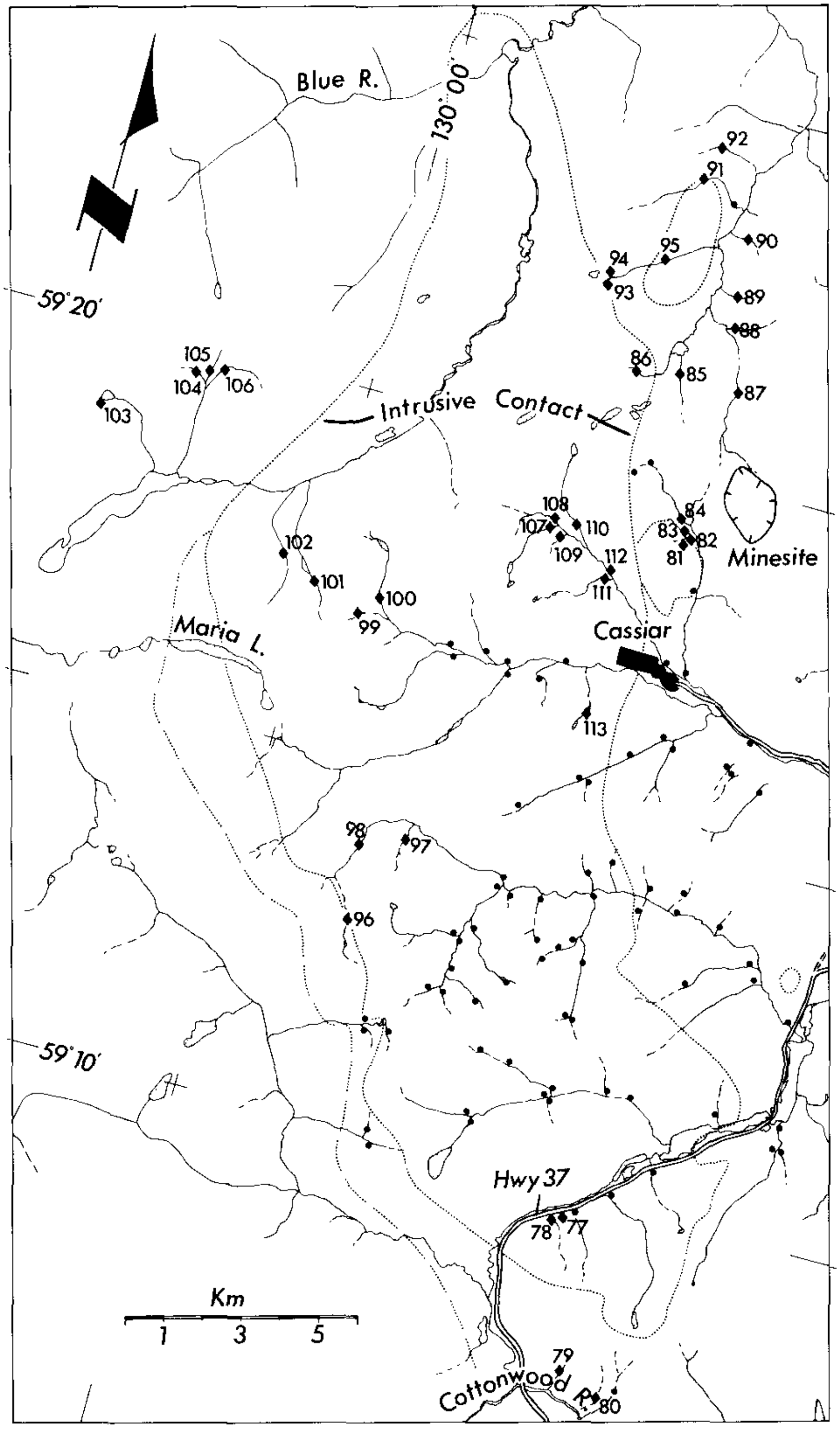

Figure 25. Silt sample location, Cassiar map-area; 1979 sample sites are shown as diamonds, 1978 sites are dots.

TABLE 2. ANALYTICAL DATA, CASSIAR SILT SAMPLES, 1979
(IN PPM)

	Ag	Cu	Pb	Zn	Co	Mn	Ni	U	Th	W	Sn	Mo
S– 77	<0.5	19	10	75	8	432	25	17	17	14	<3	7
78	0.8	13	82	127	6	1 020	13	30	75	13	7	5
79	<0.5	33	19	103	21	577	48	7	21	13	4	<1
80	0.7	26	33	113	17	533	39	5	19	9	<3	<1
81	0.7	28	10	86	13	385	18	5	22	26	5	2
82	<0.5	30	32	164	17	775	26	13	27	11	6	3
83	<0.5	34	15	120	23	672	50	23	26	9	5	5
84	1.5	50	18	368	18	1 830	115	10	16	11	<3	8
85	<0.5	56	12	172	22	1 015	40	8	20	62	8	7
86	<0.5	11	10	54	3	417	11	46	20	12	6	5
87	0.6	61	15	273	30	787	452	10	9	9	<3	3
88	0.6	51	20	270	8	323	70	6	6	11	<3	4
89	0.5	27	21	267	9	307	67	8	25	27	<3	2
90	0.6	29	17	259	8	193	79	9	9	14	<3	10
91	<0.5	29	7	56	18	497	35	14	10	14	<3	6
92	0.5	68	13	98	29	570	58	8	19	22	3	<1
93	<0.5	14	20	125	5	1 470	6	53	33	15	10	5
94*	5.5	400	6	33	2	195	2	N.A.	N.A.	93	7	17
95	<0.5	39	30	165	18	697	37	39	27	11	4	7
96	<0.5	14	18	90	7	301	20	23	26	<6	4	5
97	<0.5	18	22	102	11	856	21	30	25	<6	4	5
98	0.5	15	16	80	7	394	21	32	26	<6	4	8
99	0.6	11	15	81	6	615	13	52	26	7	6	3
100	0.8	9	14	91	8	940	27	237	20	14	4	8
101	0.9	8	9	45	5	334	7	30	19	<6	4	3
102	0.8	11	9	73	6	477	15	73	23	11	4	3
103	<0.5	42	25	139	21	943	44	24	20	<6	7	2
104	<0.5	11	8	40	5	337	8	16	20	<6	3	<1
105	0.7	7	7	49	6	273	6	25	20	<6	4	4
106	<0.5	9	9	50	5	325	6	31	47	<6	5	<1
107	<0.5	8	8	38	5	379	26	103	17	<6	4	3
108	<0.5	8	7	29	2	240	11	34	15	<6	3	3
109	0.6	7	5	10	1	112	2	8	11	<6	<3	<1
110	<0.5	8	17	61	5	479	9	34	20	12	6	2
111	0.6	6	11	36	3	213	17	44	25	12	7	6
112	<0.5	7	8	39	3	292	11	25	24	<6	6	6
113	0.6	27	17	90	8	675	35	152	51	54	7	33
$\bar{x}$ ARITH.	0.4	23.4	16.9	112.2	10.8	574	41.2	35.7	23.3	11.8	4.2	4.9
SD	0.34	17.2	13.2	82.8	7.8	362	74.6	45.4	12.7	13.4	2.4	5.4
MEDIAN	<0.5	16.0	15.0	94.0	7.0	455	25.5	24.5	20.0	<6	4.0	4.0

*All samples have <0.3 ppm Au except sample S - 94; S 94 is a soil sample and is not included in the summary statistics, it contains 0.5 per cent Bi which interferes with U, Th determination, also 5.5 ppm Au.

Analyses by Analytical Laboratory, Ministry of Energy, Mines and Petroleum Resources
Ag, Cu, Pb, Zn, Co, Ni by atomic absorption spectrometry, U, Th, W, Sn, Mo by X ray fluorescence

TABLE 3. SUMMARY STATISTICS, 1978 AND 1979, SILT SAMPLES, N = 112

[1978 Series S–1 to S–76 (*see* Geological Fieldwork, 1978, pp. 58, 59); 1979 Series S–77 to S–113, excluding S–94; samples below detection limit are assigned values of 1 ppm (0.1 ppm for Ag)]

	Ag	Cu	Pb	Zn	Co	Mn	Ni	U	W	Sn	Mo
Mean ($\bar{x}$)	0.34	21.8	23.7	153	8.9	519	32.4	31.5	11.1	5.5	11.5
Standard deviation (σ_{n-1})	0.22	35.0	41.0	271	5.7	285	51.4	36.2	15.2	5.8	20.9
Detection limit	0.4	2	2	2	2	10	2	2	6	3	1

It is interesting to compare geochemical patterns around Cassiar molybdenum deposit (K/Ar site 1, Fig. 24) with those at Storie molybdenum deposit (K/Ar site 2, Fig. 24). At Cassiar molybdenum deposit, molybdenum, tungsten, uranium, and to a lesser degree tin (and probably fluorine which was not determined) form a broad anomaly that is coincident with the known molybdenite mineralization and favourable porphyritic rocks. In contrast at Storie molybdenum there is a multi-element association in a more complex, zoned area of mineralization. In the centre and coincident with the sheet-like quartz feldspar porphyry dykes is a tungsten-molybdenum-tin (probably fluorine, beryllium) and lesser uranium anomaly. This is partially overlapped and surrounded by a lead, zinc, silver, copper, and manganese anomaly, probably derived largely from peripheral veins.

The main sources for lead in the map-area are major stanniferous lead-zinc-silver veins and manganiferous magnetite silver-lead veins to the south of Cassiar townsite. A secondary source for lead is rocks from the top of the Kechika succession or basal McDame. Main sources for zinc and silver are Kechika black shales (and possibly also McDame black shales) as well as skarn deposits along the eastern contact of the Troutline Creek quartz monzonite. Cobalt concentration coincides with pyrrhotite development in skarn zones. Nickel has a high concentration (>70 ppm) in Kechika black shales. Maximum cobalt and nickel are found in silts from a creek cutting through ultrabasic rocks north of Cassiar minesite.

Copper is anomalously low throughout the Troutline Creek quartz monzonite but has slight concentration in skarn deposits, Kechika black shale, and in areas with pyrrhotite disseminations and lenses in hornfels of the Good Hope Group. The main source for copper in the Cassiar map-area is Sylvester volcanic rocks.

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