CASSIAR MAP–AREA
(104/P)

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INTRODUCTION

A mapping project was initiated in the Cassiar area in response to heightened interest in molybdenum, tungsten, tin, and uranium in the general area and as a result of the discovery of the Logtung tungsten-molybdenum deposit and concentrated exploration for tin-tungsten in the vicinity of Swift River.

An area of 260 square kilometres (100 square miles) was mapped at a scale of 1:15 840. The map-area covers part of the southwest corner of McDame map sheet (NTS 104P) and includes the area between Cassiar mine on the north and Cottonwood River to the south. One hundred and sixty-five rock specimens were collected, 12 assay samples were gathered from mineralized zones, and 76 stream silt samples were taken for analysis.

The intent of the mapping program was to delineate and describe the various intrusive units that make up this portion of the Cassiar batholith. This project will serve as a basis for further studies on the nature of the Cassiar batholith and related mineral deposits.

Detailed mapping and sampling were done around known mineral deposits. Rock suites were collected for analysis to determine the concentration levels of various elements of interest in mineralized environments and the immediately surrounding host terrains. Six samples were taken for K/Ar radiometric dating of intrusive and hydrothermal events.

A detailed silt sampling program was undertaken (one sample per 3.4 square kilometres) to demonstrate the dispersion of ore and related elements around areas of known mineralization. This study is intended to provide an orientation suite that can be used to assist interpretation of results from the 1978 Uranium Reconnaissance Program (URP) in McDame (104P), Jennings River (104O), and Wolf Lake (105B) map-areas where a sampling density of one sample per 12.5 square kilometres was achieved.

Preliminary results are shown on Figures 16 and 17 and in the accompanying table.

GEOLOGY

Intrusive Rocks

The main intrusive mass in the map-area, hereafter referred to informally as the 'Cassiar stock,' appears to be a discrete intrusion that has been emplaced along the eastern margin of the Cassiar batholith. In 1972 the possibility of a separate intrusion in the Cassiar area was indicated by 68.3±2.7 and 71.7±2.6 Ma dates in contrast to a mean 102±3 Ma age for the Cassiar batholith (Christopher, 1972).

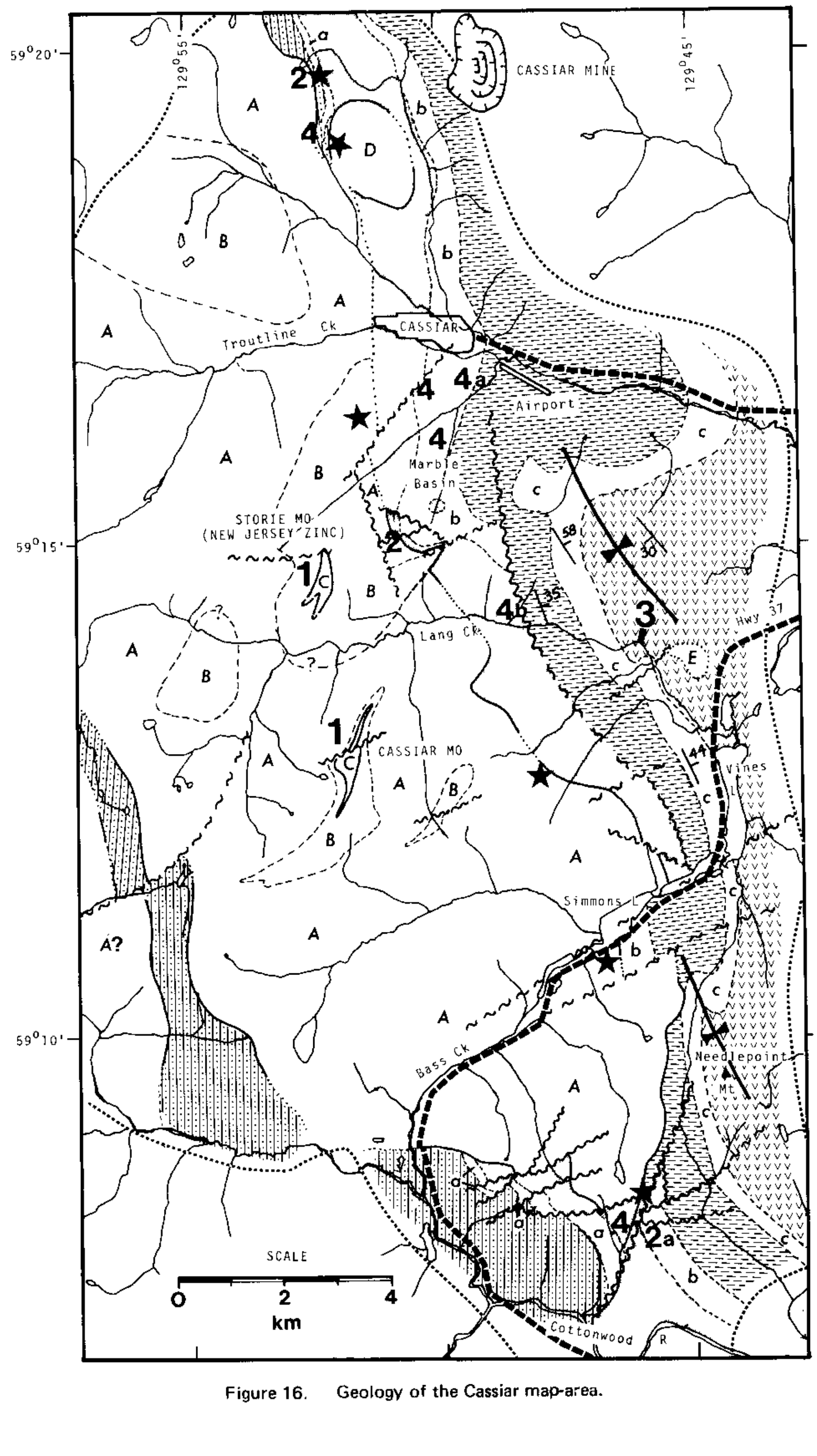

Figure 16. Geology of the Cassiar map-area.

LEGEND

INTRUSIVE ROCKS

CRETACEOUS AND (?) TERTIARY

A COARSE-GRAINED, PORPHYRITIC BIOTITE QUARTZ MONZONITE, CONTAINS RARE HORNBLENDE

B PORPHYRITIC BIOTITE QUARTZ MONZONITE WITH MANTLED K-FELDSPAR, GRADATIONAL WITH MAP UNIT A, IN PART PORPHYRITIC TO EQUIGRANULAR BIOTITE QUARTZ MONZONITE, LOCALLY CONTAINS MUSCOVITE

C QUARTZ PORPHYRY, QUARTZ FELDSPAR PORPHYRY, QUARTZ MONZONITE

D MEDIUM-GRAINED, PORPHYRITIC BIOTITE QUARTZ MONZONITE

PALEOZOIC (?)

E DIORITE

BEDDED ROCKS (AGE AND GROUP NAME AFTER GABRIELSE, 1963)

DEVONIAN AND MISSISSIPPIAN

SYLVESTER GROUP

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, SLATE, CARBONACEOUS AND CALCAREOUS SHALE, PYRITIC AND PYRRHOTITIC BLACK SHALE AND SLATE

LOWER CAMBRIAN

ATAN GROUP

b RUSTY WEATHERING HORNFELS, SPOTTED HORNFELS, SILTSTONE, ARGILLITE, QUARTZITE; UPPER UNIT 'b' GREY, PINK, AND BUFF DOLOMITE GREY AND BLACK CRYSTALLINE LIMESTONE, SKARN, SCAPOLITE MARBLE, MINOR SLATE

PROTEROZOIC

GOOD HOPE GROUP (INGENIKA GROUP)

a LAYERED HORNFELS, MICACEOUS QUARTZITE, PHYLLITE, SKARN, MICA SCHIST, UPPER UNIT 'a' MARBLE, COARSE GRAINED GREY LIMESTONE

SYMBOLS

MINERAL DEPOSITS

1 Mo DEPOSITS ★ Mo OCCURRENCES

2 W IN SKARN AND CUPRIFEROUS PYRRHOTITE REPLACEMENTS

2a SKARN WITH SOME Be AND W

3 LANG CREEK Cu MASSIVE SULPHIDE

4 VEINS Ag, Pb, Zn WITH MANGANIFEROUS MAGNETITE

4a PYRITIC Ag, Pb, Zn, Au, Sn

4b AURIFEROUS PYRRHOTITE, ARSENOPYRITE

LIMIT OF MAPPING

MAJOR ROADS

FAULTS

MAP UNIT BOUNDARY (DISCONFORMITY)

INTRUSIVE CONTACT DEFINITE, GRADATIONAL INDEFINITE

FOLD AXIS

30 BEDDING ATTITUDE

This mapping project has shown that the 'Cassiar stock' is separated at least locally from the Cassiar batholith on the west by a screen of metamorphic rocks generally 1 kilometre or less in width that has been mapped from Cottonwood River near Bass Creek (Fig. 16), approximately 8 kilometres to the north and has been observed to extend at least an additional 8 kilometres northward. The full extent of the 'Cassiar stock' to the north of the area mapped is uncertain but a dimension of 33 by 7 kilometres from the Cottonwood River northward to the Blue River is possible. The southern two-thirds of the proposed 'Cassiar stock' is shown on Figure 16.

The 'Cassiar stock' is composed mainly of coarse-grained quartz monzonite and porphyritic quartz monzonite in which aplite dykes are common and pegmatite pods are present but are rare overall. The main quartz monzonite megacrystic phase (map unit A) contains both biotite and hornblende with biotite in excess of hornblende in a coarse granular fabric of quartz and feldspar with K-feldspar phenocrysts ranging from 2 to 4 centimetres in size.

Within map unit A are zones of finer grained porphyritic quartz monzonite and equigranular quartz monzonite. These rocks are shown as map unit B and have gradational contacts with map unit A. Rocks of map unit B (textural variants of map unit A) are present as either mantled porphyries in which oliogoclase commonly forms rims on K-feldspar phenocrysts or as medium-grained equigranular quartz monzonite. The mantled porphyritic quartz monzonite is compositionally equivalent to map unit A and is present in the areas of the two main molybdenum deposits (Storie molybdenum and Cassiar molybdenum). Equigranular medium-grained quartz monzonite contains some muscovite in addition to biotite and is present in two areas: one west of the head of Lang Creek; the other northwest of Cassiar and north of Troutline Creek. Similar equigranular quartz monzonite forms along the margin of the stock in a chilled border zone up to 300 metres in width. In some parts of the border zone gneissic inclusions are common and where these are common the quartz monzonite is usually leucocratic and contains minute spessartine garnets.

Map unit C occupies a small area relative to map units A and B but is nevertheless the most important rock unit in the map-area as the main molybdenum deposits are associated with it. Map unit C consists of quartz feldspar porphyry and quartz porphyry which have chilled contacts with equigranular to porphyritic quartz monzonite and mantled porphyry of map unit B. A small amount of equigranular, fine-grained, grey to pink quartz monzonite that is similar to quartz monzonite of map unit B is found on the flanks of the quartz porphyry and quartz feldspar porphyry intrusions. It is included in map unit C because it shows an intrusive rather than gradational relationship to mantled quartz monzonite porphyry of map unit B.

Intrusive rocks of map unit D are similar to the finer grained and mantled quartz monzonite porphyries of map unit B but because they form a separate small stock have been designated a separate map unit.

Map unit E consists of a small body of fine to medium-grained diorite that intrudes Sylvester rocks between Lang Creek and Highway 37. It is suggested here that this might be a Paleozoic intrusion that is synchronous with other small diorite and hornblendite dykes or sills that make up part of the Sylvester Group.

Bedded Rocks

Bedded rocks are readily subdivided into six lithologically distinct but structurally conformable map units. These have been described by Gabrielse (1963) as the Good Hope (now Ingenika), Atan, Kechika, Sandpile, McDame, and Sylvester Groups which range in age from Proterozoic to Devono/Mississippian. Except for Sylvester rocks which appear to be an allochthonous volcanic terrane (Monger, Souther, and Gabrielse, 1972), the other rocks are a shelf assemblage of fine-grained quartzite, shale, and carbonates.

Good Hope (Ingenika) rocks are mainly impure quartzite and are extensively metamorphosed to cordierite hornfels or micaceous schists. The upper part of the Good Hope map unit consists of a transitional zone of thinly interbedded siltstone and limestone which is now extensively recrystallized to a banded calc-silicate rock. This is overlain by an uppermost unit of coarsely crystalline limestone. Atan rocks in the map-area consist of a lower unit of rusty weathering biotite and spotted hornfels and an upper unit of dolomite and marmorized limestone. Near the intrusive contact these rocks form skarn and banded epidote-rich tactite zones. Further from the intrusive contact needles of scapolite are common in marble. Kechika rocks are black shale and slate; Sandpile rocks are mainly sandy dolomite; and McDame rocks are platy dolomite, dolomite breccia, and limestone. In the single locality observed where McDame limestone was intruded, a tremolite-epidote tactite zone generally less than 3 metres wide was formed.

The three major carbonate units: Upper Good Hope, Upper Atan, and combined Sandpile—McDame (map units a, b, c) form unmistakable, well-exposed, persistent exposures in the map-area that are useful marker units. These bedded units can be seen on Figure 16 to trend parallel to the Cassiar stock and therefore contact metamorphic effects are consistently more pronounced in the Good Hope and Atan rocks. All map units dip eastward although two broad synclines and closely folded Atan rocks near the intrusive contact were noted. All recognized faults had normal movement; some may have considerable lateral displacement. Repetition of Kechika, Sandpile, McDame, and basal Sylvester map units in the vicinity of Cassiar mine dictates that thrust faults are present but these were not studied.

Mineral Deposits

At least 15 mineral deposits and noteworthy occurrences of diverse types are known in Cassiar map-area.

The most important are two molybdenum deposits: Storie (New Jersey Zinc) deposit and the Cassiar molybdenum deposit. Both have been extensively explored; Storie deposit by 7 796 metres of diamond drilling and Cassiar molybdenum deposit by an 885-metre adit and 457 metres of drilling. The deposits have similar geological settings. They are both related to small dyke-like bodies. Cassiar molybdenum is associated with a northeasterly trending, steeply dipping, dyke-like body up to 360 metres wide and the Storie molybdenum deposit with a series of northerly to northeasterly, gently northwesterly dipping sheets. Three intrusive phases are recognized: a coarse-grained, porphyritic quartz monzonite (in part mantled porphyry) host rock, a fine-grained equigranular to medium-grained weakly porphyritic quartz monzonite, and small bodies of quartz porphyry or quartz feldspar porphyry.

Molybdenite is concentrated near intrusive contacts in fractures, rare quartz veinlets, and is disseminated as scattered flakes and rosettes in the weakly miarolitic youngest porphyry intrusions. Locally at Cassiar molybdenum deposit small high-grade zones with spectacular molybdenite crystals have formed in greisen pods developed along the borders of quartz porphyry dykes. Most commonly fractures with molybdenite contain some pyrite and quartz although 'dry' fractures with molybdenite and pyrite or molybdenite alone as rosettes are present. Rarely molybdenite forms coarse flaky vein selvages in vuggy quartz veinlets that also may contain K-feldspar or yellow fluorite.

At Storie molybdenum deposit molybdenite is present as disseminations throughout the youngest fine-granular porphyry dyke as well as in fractures and some quartz veins in the coarser grained quartz monzonites. Fractures commonly contain muscovite and have K-feldspar envelopes. Where muscovite is abundant and coarse grained, purple fluorite is commonly present. A K/Ar radiometric date of 71.4±2.5 Ma has recently been obtained from sericite from one such mineralized vein. Rare vuggy quartz veins with green beryl crystals are also present locally.

Both of these molybdenum deposits lack significant breccia zones and large-scale quartz stockworks or vein systems are absent. The environment of mineralization is one in which molybdenum is intimately associated with the small dyke-like intrusions that are the more highly differentiated phases of the surrounding quartz monzonite. Molybdenum mineralization appears to have taken place in a high-temperature vapour-dominated environment with low overall water content. Therefore, the relatively small amount of hydrothermal fluid that was evolved was restricted to fractures proximal to the youngest intrusions.

The other molybdenum occurrences shown by stars on Figure 16 are minor showings. In the intrusive rocks molybdenite occurs from south to north as rare flakes in weakly porphyritic quartz monzonite, with arsenopyrite in fractured coarsely porphyritic quartz monzonite, as flakes at the margin of a 1-metre-wide spherical pegmatite pod in porphyritic quartz monzonite, and in a quartz vein. In the other two occurrences molybdenite is present as minute grains on fractures in banded Atan calc-silicate rock and in the northern occurrence as rosettes with pyrrhotite in a skarn in Good Hope rocks.

Scheelite is common in small amounts in many garnet-pyroxene skarns that have formed at and near the main intrusive contact with Good Hope (Proterozoic) and Atan (Lower Cambrian) rocks. Nine check analyses show that concentration ranges in the range of 0.01 to 0.02 per cent WO_3 are widespread in these skarns. Scheelite is also present in massive pyrrhotite lenses that form replacement bodies in quartz monzonite adjacent to the intrusive contact (for example, 3 kilometres west of Cassiar mine) or form in tactite zones along the intrusive contact. The strongest scheelite concentration observed (not shown on Fig. 16) is in calc-silicate bands in Atan carbonates on Lamb Mountain approximately 8 kilometres northwest of Cassiar minesite. At Lamb Mountain one band of mineralized skarn was determined to contain 0.13 per cent WO_3 and 0.02 per cent copper and zinc across a width of 4.5 metres. The pyrrhotite-rich skarn band is near but separated from a small fine-grained porphyritic quartz monzonite intrusion by about 130 metres of crystalline limestone and a 10-metre-wide band of tremolite-rich barren skarn. Molybdenite is present in greisen veins at the intrusive contact. A number of other skarn bands further from the intrusion than the one sampled contain minor scheelite.

Another type of minor tungsten occurrence was discovered 1.5 kilometres east of Storie molybdenum deposit in which quartz veinlets in Atan hornfels contain scheelite near the intrusive contact with quartz monzonite. The quartz-veined hornfels is overlain by barren, thinly banded epidote-garnet skarn that was formed at the base of the Atan carbonate upper map unit. Along strike to the north and east the banded skarn contains lenses up to 8 metres in thickness of massive magnetite, pyrrhotite, and minor quartz, wollastonite, and tremolite. These contain generally 0.03 per cent or less WO_3 and base metal values (Cu, Pb, Zn, Sn, Bi). A similar magnetite-rich skarn lens southwest of Needlepoint Mountain (the Lowgrade deposit, shown as 2a on Fig. 16) was found by J. J. McDougall in 1954 to contain Be in helvite. Later, danalite was identified as the major beryllium-bearing mineral (Thompson, 1957). Tin content in the nine skarn samples tested for tungsten ranges from trace to a maximum of .04 per cent.

The Lang Creek copper deposit (occurrence 3 in Fig. 16) (Annual Report of the Minister of Mines and Petroleum Resources, 1961) is a small, shallow-dipping massive sulphide lens. It is up to 2 metres in thickness and is conformable with an argillite unit interbedded with greenstone near the base of the Sylvester assemblage. A sample across the exposed 1.0-metre sulphide layer assayed 1.7 ppm gold, 36 ppm silver, 1.84 per cent copper, 0.12 per cent lead, and 0.77 per cent zinc. Despite its small size this deposit is important in that it demonstrates the presence of massive sulphides in Sylvester rocks, an assemblage that might have been neglected during past exploration.

Veins are abundant in the map-area with silver-bearing lead-zinc veins being most prevalent. Quartz veins with free gold are restricted to Sylvester rocks to the east of the map-area and will be examined in detail during the 1979 field season. Silver-lead-zinc veins with manganiferous magnetite (shown as 4 on Fig. 16) are found at the Wiseman property southwest of Needlepoint Mountain, in the Marble Basin area, and in the Contact deposit west of Cassiar mine. These veins are associated with east-westerly trending faults and fracture zones in carbonate rocks of the Good Hope and Atan upper map units. Similar veins, but containing abundant pyrite instead of magnetite and having tin in the order of 0.15 per cent Sn, occur south of Cassiar. The pyrite-rich stanniferous lead-zinc-silver veins might be deeper equivalents to the magnetite-bearing veins as they occur in Atan hornfels or at the base of the Upper Atan carbonate unit.

A unique vein-type occurrence on the north bank of Lang Creek is shown as 4b. It consists of a 3 to 4-metre-wide replacement zone with pyrrhotite and arsenopyrite in a fault zone that separates Atan rocks from Kechika black shales. A sample from this mineralized fault zone across a 3.3-metre width contains 2 ppm gold, 22 ppm silver, 0.11 per cent copper, 0.03 per cent lead, 0.005 per cent zinc, 0.04 per cent bismuth, and 1.5 per cent tin.

Minor mineralization (not shown on Fig. 16) consists of widespread scattered fine grains of pyrrhotite and traces of chalcopyrite in Good Hope and Atan hornfels. Kechika rocks contain units with abundant very fine-grained pyrrhotite. One locality with traces of sphalerite is known in the road cut immediately east of Simmons Lake. Generally sulphide minerals in Kechika rocks are so fine grained that they cannot be seen by eye but they are accentuated where the rocks are recrystallized to hornfels.

GEOCHEMICAL DATA

Geochemical data for the 76 sample sites are shown on Figure 17 and listed on the accompanying table. Clearly the sample suite is highly anomalous in molybdenum, uranium, tungsten, lead, and zinc. However, the main source of molybdenum, uranium, tungsten (and also tin) can be identified and confined to the

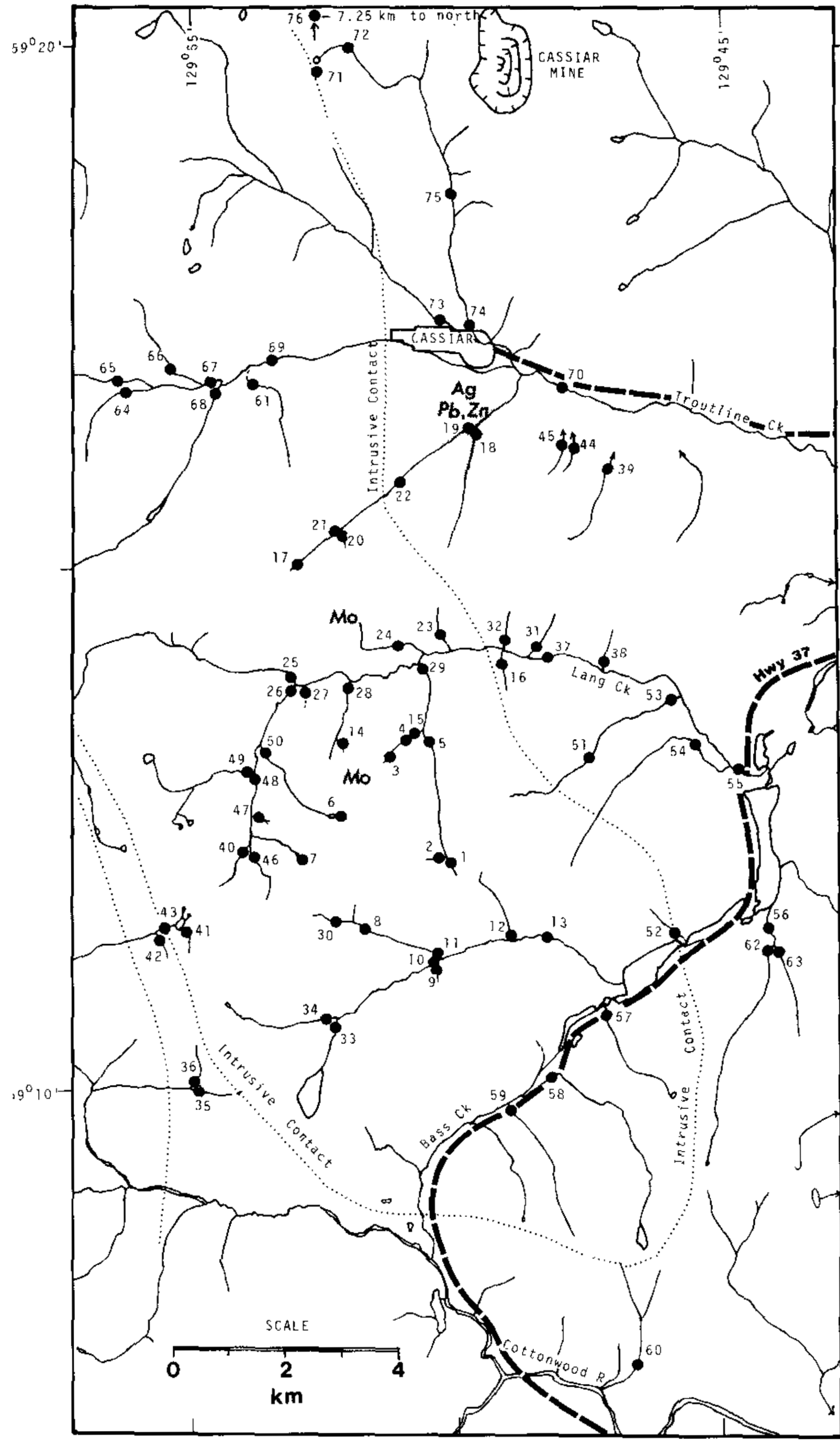

Figure 17. Silt sample location (1978), Cassiar map-area.

ANALYTICAL DATA: CASSIAR SILTS, 1978

	Ag ppm	Cu ppm	Pb ppm	Zn ppm	Co ppm	Mn ppm	Ni ppm	U ppm	W ppm	Sn ppm	Mc ppm
8– 1	<0.3	8	13	51	7	550	8	60	2	5	14
2	0.3	13	6	24	5	313	3	21	2	5	14
3	0.3	12	14	53	8	640	6	34	16	6	50
4	0.3	14	17	66	8	591	7	42	26	5	103
5	0.3	11	18	41	7	394	6	36	12	7	39
6	<0.3	18	21	41	11	355	8	59	15	5	152
7	0.3	20	19	45	13	339	8	30	26	5	73
8	0.3	9	11	29	6	254	4	33	11	5	32
9	0.3	4	6	35	5	291	4	45	2	4	10
10	0.3	4	6	36	6	301	6	35	13	7	11
11	0.3	7	8	36	7	315	3	26	20	10	13
12	0.3	4	8	41	6	389	7	103	2	6	2
13	0.3	4	6	29	3	266	4	24	8	7	8
14	0.3	18	8	26	7	348	11	231	10	5	14
15	0.3	12	15	56	7	463	8	30	34	5	70
16	0.3	40	19	203	14	395	64	7	3	1	6
17	0.3	6	17	136	7	514	14	29	12	10	6
18	0.6	14	374	535	7	1 426	21	1	3	14	1
19	0.4	15	168	365	6	910	17	11	14	9	2
20	0.4	22	71	315	12	926	78	48	45	11	55
21	<0.3	6	21	315	6	404	21	37	87	10	15
22	0.3	19	83	273	6	823	14	9	22	3	4
23	0.3	38	87	146	6	933	12	12	66	14	14
24	0.6	29	119	273	7	1 280	14	61	74	15	58
25	<0.3	7	3	53	7	560	12	22	4	5	4
26	0.3	5	10	40	6	402	6	25	12	6	8
27	0.3	9	10	30	7	704	14	64	32	3	26
28	0.3	12	8	29	9	516	8	35	3	7	18
29	0.3	7	7	35	7	348	5	45	14	6	15
30	0.3	6	9	44	7	396	3	28	18	6	9
31	<0.3	45	18	355	12	346	82	7	2	1	15
32	0.3	11	9	38	6	250	12	10	18	5	1
33	0.3	6	7	41	4	659	9	34	2	5	7
34	0.3	8	12	48	5	427	10	N. A.	N. A.	N. A.	13
35	0.5	17	33	169	11	738	24	27	2	5	16
36	<0.3	25	15	90	11	564	32	14	6	1	1
37	0.3	5	12	31	4	212	5	15	2	6	5
38	0.4	26	15	2 580	6	297	172	5	2	2	2
39	0.5	33	31	355	9	293	57	6	5	3	7
40	<0.3	4	22	65	7	469	9	57	7	10	9
41	0.3	16	22	133	12	947	22	85	3	5	17
42	0.3	40	11	91	18	658	35	5	3	2	10
43	0.3	10	3	57	7	324	18	17	2	3	1
44	0.5	31	74	271	8	384	47	6	2	5	4
45	0.4	52	35	383	12	382	78	10	3	1	7
46	0.4	7	23	46	8	427	6	30	5	7	14
47	<0.3	6	8	37	6	371	9	34	16	4	26
48	0.3	4	13	33	4	249	5	31	12	6	8
49	0.4	4	13	37	4	398	5	18	2	5	1
50	0.3	6	3	35	6	348	9	13	2	5	17
51	<0.3	23	16	279	10	461	40	75	2	6	3
52	0.3	14	3	125	7	344	29	16	2	5	1
53	0.3	12	14	147	8	347	19	22	2	4	1
54	0.3	9	11	97	7	262	13	37	2	6	1
55	0.3	39	12	66	5	313	13	13	2	4	4
56	0.3	48	31	551	14	736	61	5	2	5	1
57	0.3	6	11	60	4	387	7	26	3	9	1
58	0.3	4	31	103	4	698	4	35	3	8	2
59	0.3	7	10	69	3	469	10	23	2	7	1
60	0.3	24	31	87	13	484	44	8	6	7	1
61	0.3	2	13	26	3	287	8	18	6	5	2
62	0.3	34	61	551	13	832	52	14	9	8	1
63	<0.3	53	51	1 905	17	1 018	137	9	6	1	1
64	0 3	5	4	41	3	320	18	18	2	5	1
65	0.3	7	14	55	6	361	10	62	2	6	1
66	0.3	7	6	59	4	419	14	31	2	4	1
67	0.3	4	3	31	4	249	12	19	2	3	1
68	0.3	7	4	49	6	684	18	20	2	4	3
69	0.3	5	10	43	4	503	22	21	2	4	1
70	0.5	25	28	179	10	461	91	8	2	2	4
71	0.3	352	24	195	29	682	77	8	14	6	10
72	0.3	34	54	205	13	400	42	24	3	6	10
73	<0 3	3	8	55	7	349	42	21	2	4	3
74	0.3	52	16	313	15	499	130	5	2	1	8
75	0.8	46	11	438	13	367	135	6	2	2	16
76	<0.3	26	7	53	14	417	29	5	2	5	1
$\bar{x}$ ARITH.	0.19	21 0	26.8	185	8.1	492	27.9	29.5	10.4	5.5	14.4
SD	0.16	40.7	48.4	368	4.2	237	34.8	30.7	16.0	2.9	24.5
MEDIAN	<D.L.	10.5	13.0	58	7.0	410	13.0	24.0	4.0	5.0	8.0

Analyses by Analytical Laboratory, Ministry of Energy, Mines and Petroleum Resources.
Ag, Cu, Pb, Zn, Co, Mn, Ni, by atomic absorption spectrometry, U, W, Sn, Mo, by X-ray fluorescence.
Sn checked colorimetrically; U checked by gamma-ray spectrometry.

Cassiar and Storie molybdenum deposits. Mean uranium content in silts from intrusive sources is 39 ppm compared to about 12 ppm from bedded rocks. Zinc is concentrated in black shales of the Kechika Group. Lead correlates with zinc in black shale hosts but is also derived from major vein occurrences and probably numerous small veinlets peripheral to molybdenum deposits in granitic rocks. Tin is derived from the greisen-rich zones at Storie molybdenum deposit but is also related to lead-zinc veins. It is noteworthy that anomalous associations of tin-lead-zinc in Granite Creek (samples 17 to 22) indicate that more veins are present in this region than have been discovered to date.

Copper is low overall and notably depleted in the intrusive terrains. All samples with copper enrichment can be related to minor chalcopyrite occurrences in Good Hope and Atan hornfels, Sylvester greenstone, or chalcocite occurrences in McDame rocks as noted by Gabrielse (1963). Some malachite and azurite in McDame carbonate rocks is probably formed from copper leached out of overlying Sylvester greenstones.

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