GEOLOGICAL SURVEY OF CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

PAPER 68-70

METALLOGENY OF THE REGION ADJACENT TO THE NORTHERN PART OF THE CASSIAR BATHOLITH, YUKON TERRITORY AND BRITISH COLUMBIA

(Parts of 104O, P and 105B)

(Report and 6 figures)

R. Mulligan

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Price: $1.50 Catalogue No. M44-68-70

Price subject to change without notice

The Queen's Printer
Ottawa, Canada
1969

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Abstract

The northern part of the Cassiar region, in the Yukon-British Columbia boundary country between Watson Lake and Teslin, is an area of extraordinary structural complexity, and of numerous and varied mineral occurrences. The Cassiar asbestos mine is the only major producer but gold is still being won from the old McDame placer field. Several of many small silver-lead-zinc deposits and two of the molybdenite deposits have been intensively explored in recent years. Tungsten deposits of two types are of possible economic interest. Of special metallogenic interest are the numerous minor beryllium and tin occurrences in the district.

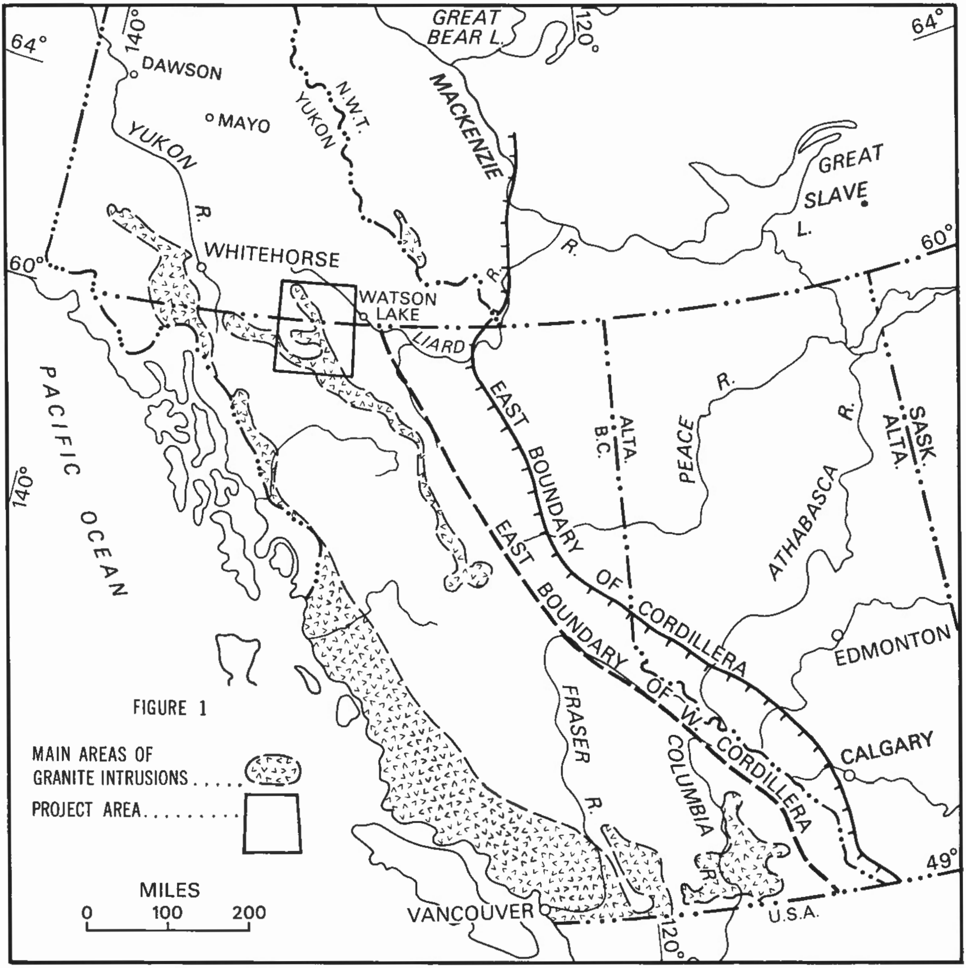

Figure 1. Regional geology

METALLOGENY OF THE REGION ADJACENT TO THE NORTHERN PART OF THE CASSIAR BATHOLITH, YUKON AND BRITISH COLUMBIA

Introduction

The area (Fig. 1) is in the Yukon-British Columbia boundary country between Watson Lake and Teslin, Yukon; and comprises parts of Wolf Lake (105B), Jennings River (104O) and McDame (104P) map-areas.

This area, embracing the northern part of the Cassiar Batholith and its satellites, is outstanding because of the number and variety of mineral occurrences it contains. These include many molybdenum, beryllium, tungsten, and tin occurrences, the placer and lode-gold deposits of McDame Creek, numerous silver-lead-zinc deposits, some copper, chromite, bismuth, and nickel occurrences, and asbestos deposits including the Cassiar asbestos mine.

This metallogenic study is an extension of previous and current studies of beryllium and tin occurrences in the district carried out in conjunction with geological mapping of previously unmapped parts of Jennings River area by H. Gabrielse in 1965-67.

The greater part of the information in this report has come from the work of those who have done regional geological mapping in the district (see References). Dr. S.S. Holland of the British Columbia Department of Mines examined a number of mineral deposits and also collaborated with Dr. Hedley in reconnaissance mapping of the Kechika-Turnagain district to the southeast. Thanks are due also to W.N. Plumb of Cassiar asbestos mine for information and ideas regarding metallogeny in the district.

Regional Geology

The area lies mainly within the eastern fringe belt of the Western Cordilleran region (see Fig. 1). This belt is underlain mainly by more or less metamorphosed Proterozoic and early Paleozoic rocks, chiefly sedimentary, in contrast with the late Paleozoic-Mesozoic volcanic-sedimentary assemblages farther west.

The belt contains all the beryllium, most of the known tin and tungsten, and many of the molybdenum occurrences of the Cordilleran region. It also contains most of the dominantly lead-zinc deposits. These mineral deposits are confined mainly to the fringes of the two main eastern zones of

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Project 650012
Ms. received 18 October, 1968
Author's address: Geological Survey of Canada,
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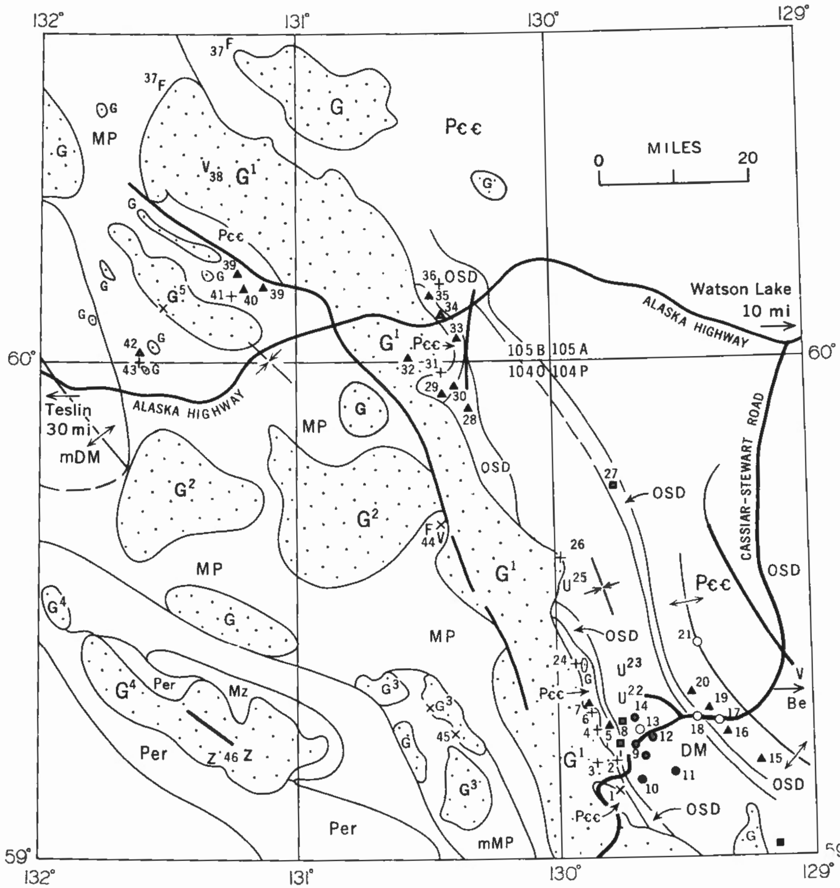

LEGEND

G	Granitic intrusions	v	Pegmatitic
Mz	Mesozoic	+	Quartz Greison Veins
Per	Pennsylvanian? & Permian	×	Skarns
MP	Mississippian & Pennsylvanian	▲	Lead-zinc-silver
mMP	Meta Mississippian & Pennsylvanian	■	Copper ± nickel
DM	Devono-Mississippian	U	Asbestos
mDM	Meta Devono-Mississippian	●	Gold-Quartz Veins
OSD	Ordovician-Devonian	o	Gold Placers
P€€	Proterozoic-Lower Cambrian	F	Fluorite
		Z	Zirconium

Figure 2. Geology and mineral occurrences

granitic intrusions - the Nelson Batholith in the south and the Cassiar-Omineca Batholith in the north. The two zones are also the loci of maximum deformation of the otherwise relatively straight and simple structural pattern of the Canadian Cordillera.

Near the 60th parallel the granitic core of the Cassiar Mountains breaks up into a number of segments following diverse structural trends. One chain of intrusions extends west to Atlin Lake, almost connecting with the Coast Range Intrusions. The main Cordilleran structural trend is reflected in an intermittent train of elongated granite bodies extending northwest across Teslin (105C) and Quiet Lake (105F) map-areas. Also, at about the 60th parallel, the eastern boundary of the western Cordillera veers abruptly northeast from its generally northwesterly course along the Rocky Mountain Trench, to encompass the masses of granite and crystalline rocks northeast of Watson Lake. This abrupt dislocation may be a result of right-hand strike-slip fault movement along the Tintina Trench, which Roddick (1967) postulated to be about 240 miles. This fault and a subparallel one in the (projected) 'Rocky Mountain Trench' are shown passing across the northeast corner of Wolf Lake (105B) map-sheet.

Local Geology

A generalized map (Fig. 2) in which the formations have been combined into a few arbitrary age groups, illustrates the geological environment of the various types of mineral deposits.

Stratified rocks

The Proterozoic to Mississippian rocks east of the Cassiar Batholith, and in fault-slices west of the batholith, comprise typically unmetamorphosed argillite, quartzite, phyllite, limestone and dolomite with volcanic greenstone abundant in a Devono-Mississippian sequence that occupies the centre of the McDame synclinorium.

West of the batholith, a broad synform encloses Mississippian limestones and overlying or intercalated argillite, quartzite, chert, grit, and conglomerate that presumably overlie the Devono-Mississippian metamorphic complex at the west boundary. This complex of micaceous schist, gneiss, quartzite, and crystalline limestone, with abundant metamorphosed volcanic greenstone, extends northwest across the Teslin map-area (105C), where it is overlain by Mississippian limestone and other rocks similar to those of Unit MP in the Wolf Lake area. However, recent mapping in the Jennings River area has shown that at least some of these limestone bands are of Pennsylvanian age (Gabrielse, in press).

Table 1

Mineral deposits and occurrences

No.	Lat.	Long.	Name/locality Identification	Type	Metal(s) or mineral	Geological Setting	References
1	59°08	129°46	Low Grade Cl, Needlepoint Mt.	magnetite skarn	Be (danalite), Sn	Lower Cambrian limestone-Cassiar granite contact	Holland, 1956 Mulligan in press
2	59°12	129°46	West of Vines Lake	qtz vein	Mo	?	Gabrielse, 1963
3	59°12	129°50	John Hope etc., (S. of Lang Cr)	qtz greisen veins	Mo	Cassiar granite	
4	59°14	129°51	Storie (New Jersey Zinc)	qtz greisen veins	Mo	Cassiar granite, near contact	B.C. Ann. Rept. 1964
5	59°16	129°49	Storie-Marble Basin	replacement veins	Pb, Zn, Ag (Sn)	Lower Cambrian limestone	Gabrielse, 1963, B.C. Ann. Rept. 1955
6	59°19	129°51	Contact	qtz veins	Mo, Bi	Cassiar Gr. (satellite stock)	Gabrielse, 1963, B.C. Ann. Rept. 1955
7			Contact (adit)	replacement-skarn	Pb, Zn, Ag, (Sn)	Lower Cambrian limestone near granite stock	B.C. Ann. Rept. 1955, McDougall, 1954
8	59°14 59°16	129°47 129°47	Lang Creek and N. of Lang Creek	dissemination	Cu (chalcopyr)	Argillite, fault? contact Devono-Mississippian greenstone	B.C. Ann. Rept. 1961
9	59°13	129°39	Vollaug (Table Mt.) etc. (S. of McDame Lake)	qtz-py-tetrahedrite vein	Au, Ag	Devono-Mississippian greenstone etc.	Gabrielse 1963, B.C. Ann. Rept. 1937, 1962
10	59°10	129°40	Turmoil etc., Pooley Creek	qtz-py-tetrahedrite vein	Au	" " , joint system	Gabrielse 1963, B.C. Ann. Rept. 1947, 1961
11	59°11	129°33	Huntergroup Creek	qtz-py-tetrahedrite vein	Au	" " "	Gabrielse 1963
12	59°14	129°38	Nora (McDame Lake)	qtz-py-tetrahedrite vein	Au	" " "	Gabrielse 1963, B.C. Ann. Rept. 1950
13	59°15	129°40	Snow & Quartzrock Creeks	placer	Au		Gabrielse 1963, B.C. Ann. Rept. 1931
14	59°16	129°41	Mac, Hopeful, Cornucopia (Hanna) etc. Quartzrock Creek	qtz-py-tetrahedrite vein	Au, Ag	Devono-Mississippian greenstone etc.	Gabrielse 1963, B.C. Ann. Rept. 1947 1960-64
15	59°12	129°11	Carlick, N. of McDame Post	replacement limestone	Pb, barite	Lower Cambrian limestone felsite dykes	Gabrielse 1963, B.C. Ann. Rept. 1949
16	59°16	129°22	McDame Belle etc. (Venture) McDame Creek	shear-replacement	Pb, Zn, Ag	Lower Cambrian limestone	Gabrielse 1963, Holland 1956
17	59°16	129°20	Mocassin, McDame Creek	placer	Au (Sn)		Gabrielse 1963, B.C. Ann. Rept. 1931
18	59°16	129°25	Centreville, McDame Creek	placer	Au		Gabrielse 1963, B.C. Ann. Rept. 1931
19	59°17	129°27	Reed Claim, Mt. Reed	shear-replacement	Pb, Zn, Ag	Lower Cambrian limestone	Gabrielse 1963, B.C. Ann. Rept. 1956
20	59°20	129°29	Snow, Cobra (Mt. Haskin)	skarn-replacement	Zn, Pb, Ag (Sn)	Lower Cambrian limestone, porphyry sill	Gabrielse 1963, Holland, 1966
21	59°28	129°23	Rosella, Spring Creeks etc. NNE of Mt. Haskin	placer	Au	minor	Gabrielse 1963
22	59°20	129°49	Cassiar Asbestos mine (north of town)	ultramafic	Asbestos	serpentinite in Devono-Mississippian greenstone fault	Gabrielse 1963

24	59°24	129°54	Langhurst, Lamb Mt.	qtz-greisen veins	Mo	Cassiar granite (stock?), also skarn	B.C. Ann. Rept. 1961
25	59°33	129°59	West of Blue River	ultramafic	Ni, Cr	Dunite lenses, minor	Gabrielse 1963
26	59°36	129°59	West of Blue River	qtz veins	Mo	Cassiar granite, minor	
27	59°45	129°46	Northwest of Blue River	dissemination	Cu	Silurian? or Devono-Mississippian greenstone fault	Gabrielse 1963
28	59°55	130°20	Silvertip (Silverknife) mine (Tootsee River)	shear-replacement	Pb, Zn, Ag (Sn)	Devonian limestone, contact Devono-Mississippian argillite, near fault	B.C. Ann. Rept. 1961-62-66
29	59°55	130°25	Rancheria (Amy, Gem) mine (Tootsee River)	shear-replacement	Pb, Zn, Ag (Sn)	Lower Cambrian limestone, contact argillite	Holland, 1966
30	59°58	130°24	Nancy Group	gossan	Pb, Zn	Devonian limestone, contact argillite	
31	59°59	130°26		qtz vein	Mo	Cassiar granite	
32	60°00	130°33	Freer Creek (Holiday Ransom)	qtz veins	Pb, Ag	Cassiar granite	Poole 1956, B. C. Ann. Rept. 1949
33	60°03	130°22	Star Group West Tootsee River	replacement-shear	Pb, Ag (Sn)	Lower Cambrian limestone near granite contact	Poole 1956
34	60°05	130°26	Sterling Group	replacement-shear	Pb, Ag, Zn	Lower Cambrian limestone near granite contact	Poole 1956
35	60°07	130°26	Luck Group	replacement-shear	Pb, Zn, Ag (Sn)	Lower Cambrian limestone	Green 1963
36	60°08	130°26	Yukon Tungsten (mine)	qtz-greisen veins	W, Sn (wolframite, cassiterite)	Cambro-Ordovician? limy phyllite	Poole 1956, Green 1966
37			North of Cassiar Batholith	qtz veins, replacement limestone	Fluorite		Poole, et al. 1960
38	60°22	131°20	South of Ice Lakes	pegmatite	Beryl	Dykes in Cassiar granite	Poole, 1956
39	60°11 60°10	131°13 131°06	Atom and Bar Groups	skarn-replacements	Zn	Mississippian-Pennsylvanian calcareous, near diorite	Poole, 1956, 1960
40	60°09	131°13	BOM Group	replacement-vein-skarn	Pb, An, Ag (Sn)	Mississippian-Pennsylvanian calcareous, near granite stock	Poole 1956, 1960; Green 1966
41	60°08	131°15		qtz-tourmaline veins	Sn (cassiterite)	Mississippian-Pennsylvanian hfels, near Seagull Granite	Poole, et al. 1960
42	60°01	131°35	Logjam (Pure Silver) mine	qtz veins	Pb, Ag, Zn (Sn)	Diorite, near granite stock	Poole 1956, 1960; Green 1966, Findlay 1967
43	60°00	131°36	Logjam Creek	qtz veins	Beryl	Granite dykes and stock	Poole 1956, Mulligan, in press
44	59°39	130°28	Blue Light, SE Jennings Lakes (104 O (NW))	skarns, pegmatite, replacement	W (scheelite), Beryl, Sn, Fluorite	calcareous and gneiss, near Cassiar Granite	
45	59°18±	130°31±	Ash Mountain area, 104 O (SE)	silicate skarns	Sn (in garnet, epidote, ferroactinolite)	calcareous metamorphics near granite bodies	Watson and Matthews 1944, Mulligan and Jambor 1968
46	59°12 59°13	131°19 131°10	Atsutla Range, 104 O (SW)	rhyolite dykes	Zr (zircon, riebeckite, acmite)	cut granite batholith	Matthews and Watson 1953

The metamorphic rocks (mMP) in the south-central area, are micaceous schist, quartzite, and crystalline limestone, called the Oblique Creek Formation by Watson and Mathews. They lack the prominent greenstone components of the Devono-Mississippian metamorphic complex, and may be younger.

The Permian and Mesozoic rocks of the southwest corner are unmetamorphosed argillite, greywacke, chert, limestone and andesitic volcanic rocks, part of a central eugeosynclinal trough of Yukon and northern British Columbia.

Tertiary to Recent basaltic volcanic rocks, including many unmodified cinder cones, are rather abundant in parts of Jennings River map-area. Drift and alluvial deposits also cover broad areas.

Intrusive rocks

The intrusive rocks of the district include ultramafics of unknown post-Devono-Mississippian and post-Permian ages, dioritic border zones and satellites of some granitic batholiths, and granitic rocks of Jurassic to early Tertiary age.

The main Cassiar Batholith (G^1) and the large bodies in 104 O south of lat. 60°N. (G^2) are composed of granodiorite and granite, with biotite quartz monzonite predominant. Muscovite granite and alaskite phases and aplite and pegmatite dykes are not abundant, but are prominent in some parts of the Cassiar Batholith. Muscovite granite is especially prominent in a foliated cataclastic zone four miles wide along the southwest fault contact of the Cassiar Batholith.

The small bodies (G^3) in the south-central area (mMP) are mainly granite with miarolitic and aplite phases.

Granitoid rocks of the southwest corner (G^4) are granodiorite and granite in the broad southeastern part, with large areas of miarolitic granite and local occurrences of pegmatite, aplite, syenite, and rhyolite dykes. Diorite inclusions are abundant, and diorite and quartz diorite also comprise most of the narrow northwestern part of the granitoid area.

The Seagull Batholith (G^5) is the most distinctive intrusion in the project area. It and satellite stocks are composed of massive leucocratic granite, with alaskite phases and abundant miarolitic cavities. Fluorite is a common accessory, and tourmaline-quartz concentrations are characteristic. Topaz has been found as large crystals in some miarolitic cavities. The Seagull is younger than the Cassiar Batholith and was probably emplaced at shallower depth. A well-developed metamorphic aureole includes tourmaline, axinite, and vesuvianite-bearing contact skarns. Dioritic stocks and sheets are common near the batholith, and some are in gradational contact with granitic satellites.

The largest and most important ultramafic bodies are in, and probably genetically related to, the greenstone east of Cassiar Batholith, in the general area of the Cassiar asbestos mine.

Structure

The Cassiar Batholith occupies a generally anticlinal zone but the east contact lies at a slight angle to the regional trend of bordering rocks. In addition to the main fold axes shown in Figure 2, an anticlinal area is occupied by the Horseranch Range metamorphic complex, which lies in the McDame (104 P) map-area, just east of the area depicted in Figure 2.

The main fault-zones that have been defined are shown in Figure 2. The most conspicuous of these is the complex zone of faults extending along and near the southwest border of Cassiar Batholith. Another fault coincides in part with the western limit of the granitoid rocks in the southwest corner. Longitudinal, oblique, and transverse faults are especially numerous in the area east of the McDame synclinorium in 104 P, and the southeast corner of 105 B. Innumerable other faults have affected the distribution of the bedded and intrusive rocks throughout the project area, and faults have undoubtedly exerted a major control on the emplacement of mineral deposits.

Economic Geology

The mineral deposits and occurrences are symbolized according to type-categories in Figure 2, and identified by number in Table 1.

Deposits associated with ultramafic rocks (22, 23, 25)

The only important producing mine in the area is the Cassiar asbestos mine (22) which lies near the faulted contact of an ultramafic body just within the contact metamorphic aureole of the Cassiar Batholith. Numerous other serpentinite bodies contain narrow chrysotile asbestos veins but so far no additional deposits of economic importance have been found. The ultramafic rocks also contain minor occurrences of chromite and of nickel, and most of the ultramafic bodies of the McDame synclinorium contain about 0.2 per cent Ni according to spectrographic analyses.

Copper-bearing disseminated sulphide deposits (8, 27)

These are generally emplaced in Cambro-Ordovician rocks but are near or in contact with greenstone bodies which also contain copper. The two bodies represented by (8) are on or near a fault at about the base of the greenstone unit. The southern body (on Lang Creek), at least, contains chalcopyrite with pyrrhotite and magnetite.

Gold-quartz veins (9, 10, 11, 12, 14)

Gold and silver-bearing quartz-pyrite-tetrahedrite veins are numerous in a north-trending belt in the western part of the McDame greenstone belt. They strike east to northeast and dip steeply, conforming with a prevailing joint trend. Greenstone wall-rocks of gold-bearing veins have been pyritized and carbonatized, and alteration of these has produced gossans. Several have been worked on a small scale and one over 3,000 feet long (Vollaug, No. 9 south) was extensively explored by diamond-drilling. It follows a definite fault, and has a distinctive banded structure.

Gold placer deposits

The placers of the McDame Creek valley and Quartzrock Creek have yielded about two million dollars in gold, mostly before 1900. They have been worked intermittently since, and two were in operation within the last few years. Most of the work on McDame Creek has been near the mouths of tributary streams, and probably indicates reconcentration from an old high level bench channel along the east-flowing section of McDame Creek. The gold was undoubtedly derived from gold-quartz veins such as those previously mentioned. Another minor group of gold placer properties (20) lies to the northeast in streams rising near the east contact of the greenstone belt.

Lead-zinc-silver veins and replacements

This is the most widespread and characteristic type of deposit. Most of the known deposits are east of Cassiar Batholith, commonly in Lower Cambrian or Precambrian limestone flanking the McDame synclinorium. Those on the southwest flank are within the contact aureole of Cassiar Batholith, and contain more or less magnetite. These and the few deposits within the batholith appear to be generally higher in silver content. Several (5, 30, 33) have gossans that are rich in manganese minerals, but this does not seem to be invariably related to silver content. One such gossan (30) is especially rich in secondary zinc silicates. Two deposits, the Rancheria (29) and the Silvertip (28) have been partly developed by underground work. The Rancheria deposit is within a pronounced embayment in the granite contact, and the Silvertip is near a major fault. The Silvertip and the Nancy (28) are emplaced in Devonian limestone.

The deposits on the east flank of the synclinorium are spatially related to small sills and dykes of fine granitic porphyry. These deposits are generally higher in zinc than lead. They form a well-defined mineralized belt extending from Mount Haskins (20) southeast to Dease River (15).

West of Cassiar Batholith in the Wolf Lake area (105 B), two minor deposits (39) – chiefly of sphalerite – are in skarn intercalated in hornfels along the contact of a large diorite body. The nearby B.O.M. group (40) is also partly in skarn but is associated with small stocks of Seagull-type granite. The skarn contains tourmaline and other boron minerals and the deposits are somewhat richer in lead and silver. The H.B. ("Logjam", "Pure Silver") deposit (42), west of the Seagull Batholith, is mainly within a diorite body and is more definitely a vein type deposit, with values principally in lead and silver. It has been explored by underground work in recent years.

Molybdenite-quartz-greisen veins

Molybdenum-bearing veins, mostly small, (2, 3, 4, 6, 8, 24, 31) are common along the east contact of Cassiar Batholith, and in part within the endocontact zone. Two of these (3, 4) have been intensively explored in recent years. These deposits are commonly in groups of small discontinuous veins. Molybdenite is present also at the Yukon Tungsten property (36).

Tungsten deposits

The Yukon Tungsten (36), is a typical wolframite-quartz-greisen vein deposit with accessory fluorite and cassiterite, and minor molybdenite, chalcopyrite, sphalerite, and galena. A number of greisen-bordered small quartz veins dip at low angles in contorted limy phyllite. The largest is vuggy, with comb structure and coarse euhedral quartz crystals. An adit has been driven on the property and a mill was built about 1953 but production was apparently negligible. Wolframite also occurs with beryl in quartz veins in granite at locality 43.

Scheelite occurs at locality 44 as crystals up to several inches across in skarn interleaved with grey augen-gneiss, both of which are cut by irregular pegmatite dykes. At locality 45 a little scheelite was reported (Watson and Mathews, 1944) in quartz veins cutting skarn.

Beryllium occurrences

Beryllium occurrences, all minor, are of three distinct types. Pegmatite dykes and segregation associated with aplite are fairly abundant in an area in the northern part of the Cassiar Batholith (38), and they carry scattered beryl crystals. A few crystals have been noted in pegmatite dykes in the east endocontact zone south of the Alaska Highway. Beryl is fairly common in parts of some pegmatites near the west contact at locality 44. Beryl occurs in many pegmatite dykes cutting the schists of the Horseranch Range metamorphic complex in the McDame (104 P) area, just east of the area covered by Figure 2.

Quartz-greisen veins in and near a small stock of Seagull-type granite at locality 43 contain small beryl crystals, along with fluorite and minor wolframite and bismuth minerals. Some of the molybdenite-bearing veins at locality 4 contain beryl crystals.

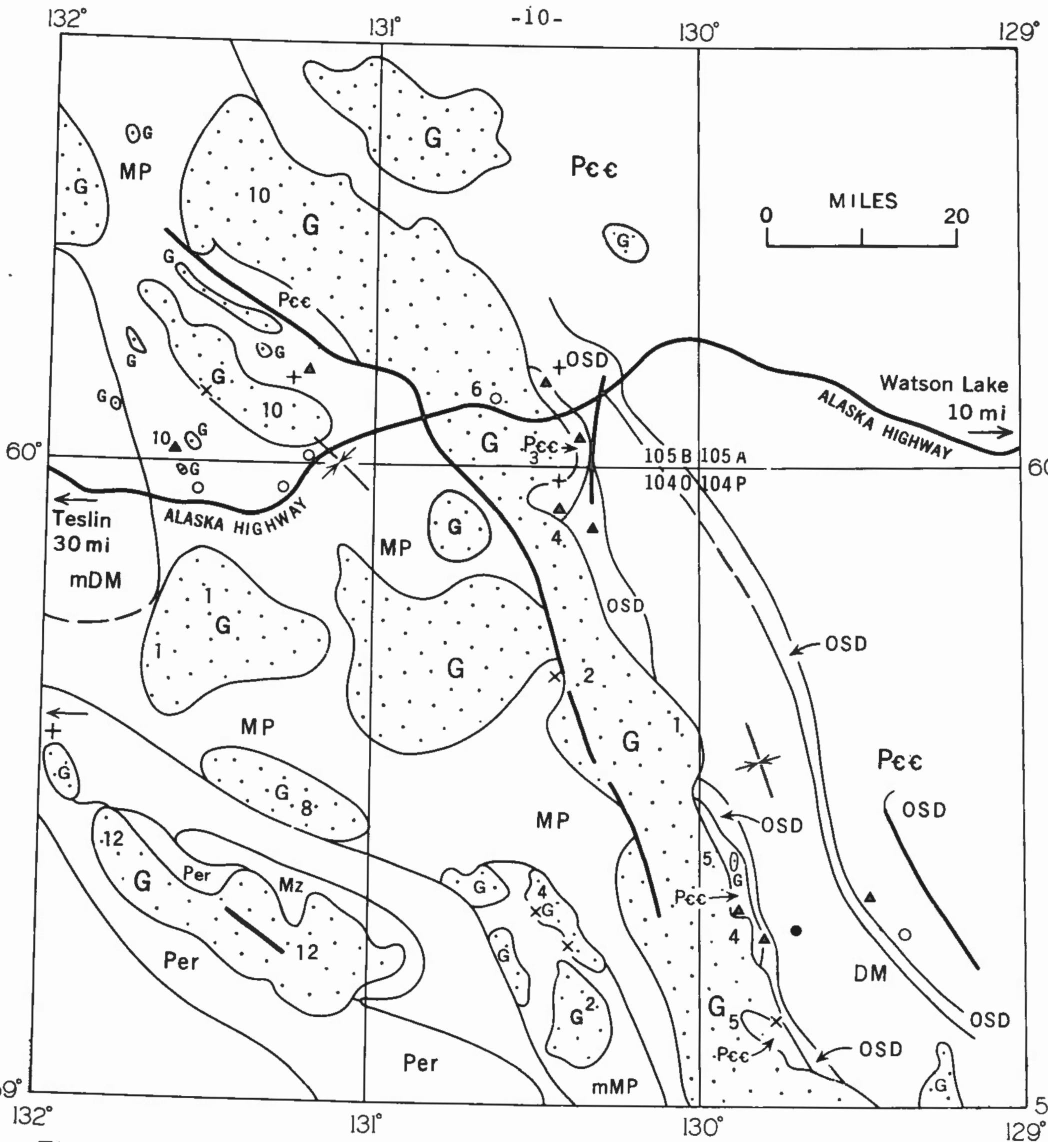

Figure 3. Tin concentration. Tin .05-.5 per cent in symbolized occurrences; ppm in granite.

The helvite-danalite bearing magnetite skarn near Needlepoint Mountain (1) is the only one of its type known in Canada. Fluorite, chlorite, and garnet accompany the beryllium mineral in the central magnetite-rich part of the skarn, which extends about 300 feet along a granite contact. Several other tactites in the district contain vesuvianite with a small beryllium content.

Fluorite, zirconium

Fluorite is present in some abundance in replacements in limestone near the northern extremity of the Cassiar Batholith (37) and in quartz veins near the granite body northeast of it. Another small body is associated with scheelite-bearing skarn at locality 44.

The zirconium occurrences (Z) in the southwestern part of 104 O (46) (Mathews and Watson, 1944) are spherulitic alkali rhyolite dykes cutting granite, and contain small amounts of zirconium-rich riebeckite and acmite. Zircon is found only in pseudomorphs after altered riebeckite.

Tin occurrences (see Fig. 3)

Like beryllium, tin occurs in more than trace amount in various types of deposit.

Cassiterite accompanies wolframite in the quartz-greisen veins of the Yukon Tungsten mine (36). A similar deposit lies about 50 miles west of the map-boundary. Cassiterite has been identified in small quartz-tourmaline veins bordering the Seagull Batholith (41).

Tin is a minor but essential component of andradite garnet, epidote, and ferroactinolite in some silicate skarns at locality 45 in the southeastern part of 104 O. Tin is also present in magnetite skarns at localities 1 and 44, and in lesser amount in some tourmaline-axinite-vesuvianite skarns near the Seagull Batholith.

Most of the lead-zinc-silver deposits contain several hundredths of one per cent tin, and some contain more than 0.1 per cent. Stannite and stanniferous ludwigite-type borate minerals have been identified by Gower in one (40) and cassiterite in another (20). Pan concentrates from streams in the district show significant differences in tin concentration. Granites of the area are not tin-rich but there appears to be a general increase southwestward from the Cassiar Batholith.

Conclusion

From the foregoing brief summary of geology and mineral occurrences it may be concluded that the district has both the ingredients and the indications of a potentially productive mineral district. The ingredients are favourable lithologies, abundant and varied intrusions, and strong fracture zones in an area of extraordinarily severe deformation. The area has been explored only in a haphazard way and, considering the number and variety of known mineral occurrences in terms of extent of exposures, it seems highly probable that more promising deposits remain to be discovered.

The Lower Cambrian limestone is evidently a favourable host for silver-lead-zinc deposits but carbonate formations of other ages are not excluded. The ultramafic and other basic rocks are promising hosts for asbestos, nickel and chromium. Copper is commonly associated with greenstone but is not likely to be found in abundance in this metallogenic belt. The contact zones of major granitic bodies and the satellite stocks are particularly favourable, especially for rare-element minerals. Possibly the most favourable, and relatively neglected of these are the west contact zone of the Cassiar Batholith and the complex of granitic rocks of the Atsutla Range, in the southwest corner of the area.

Selected Bibliography

Annual reports of the British Columbia Department of Mines

Findlay, D.C.
1967: The mineral industry of Yukon Territory and southwestern District of MacKenzie; Geol. Surv. Can., Paper 67-40.

Gabrielse, H.
1963: McDame map-area, Cassiar District, British Columbia; Geol. Surv. Can., Mem. 319.

1966: Operation Selwyn, p.44, in Report of Activities, May to October 1965; Geol. Surv. Can., Paper 66-1.

1967: Operation Selwyn, pp.47-48, in Report of Activities, May to October 1966; Geol. Surv. Can., Paper 67-1, Pt. A.

(in press): Jennings River map-area, British Columbia; Geol. Surv. Can., Paper 68-55.

Gower, J.
1952: The Seagull Batholith and its metamorphic aureole; unpubl. M.A.Sc. thesis, Univ. British Columbia.

Green, L.H.
1963: Mineral industry of Yukon Territory and southwestern District of MacKenzie, 1962; Geol. Surv. Can., Paper 63-38.

Holland, S.S.
1956: Low grade claims; B.C. Dept. Mines, Ann. Rept., 1955, p. 11.

____ Cassiar Beryl; B.C. Dept. Mines, Ann. Rept., 1955, p. 9.

1966: Amy (Rancheria Mining Co. Ltd.) B.C. Dept. Mines, Ann. Rept., 1965, p. 10.

____ Snow, Cobra (Fort Reliance Minerals Ltd.); B.C. Dept. Mines, Ann. Rept., 1965, p. 12.

____ McDame Belle, Bar, Yellowjack, etc. (Ventures Mining Ltd.); B.C. Dept. Mines, Ann. Rept., 1965, p. 14.

Mathews, W.H. and Watson, K. deP.
1953: Spherulitic alkali rhyolite dykes in the Atsutla Range, northern British Columbia; Am. Mineralogist, vol. 38, pp. 432-447.

McDougall, J.J.
1954: The telescoped silver-lead-zinc deposits of the Contact Group mineral claims, McDame map-area, British Columbia; unpubl. M.Sc. thesis, Univ. British Columbia.

Mulligan, R.
1966: Geology of Canadian tin occurrences; Geol. Surv. Can., Paper 64-54.

(in press): Geology of Canadian beryllium occurrences; Geol. Surv. Can., Ec. Geol. Rept. 23.

Mulligan, R. and Jambor, J.L.
1968: Tin-bearing silicates from skarn in the Cassiar District, British Columbia; Can. Mineralogist., vol. 9, pp. 358-370.

Poole, W.H.
1956: Geology of the Cassiar Mountains in the vicinity of the Yukon-B.C. Boundary; Ph.D. Thesis, Princeton University.

Poole, W.H., Green, L.H. and Roddick, J.A.
1960: Wolf Lake, Yukon Territory; Geol. Surv. Can., Map 10-1960.

Roddick, J.A.
1967: Tintina Trench; Jour. Geol., vol. 75, pp. 23-33.

Watson, K. de P. and Mathews, W.H.
1944: The Tuya-Teslin area; B.C. Dept. Mines, Bull. 19, pp. 41-43.