BENNETT PROJECT (104M)

By T. G. Schroeter

INTRODUCTION

During July 1985 the writer spent five field days on a continuing project entailing the examination of mineral prospects with special emphasis on precious-metal bearing prospects in the area between Atlin and Bennett (*see* Fig. 26-1). The writer has examined various showings within the area over the past several years and plans to continue the project in conjunction with an anticipated remapping program by Chris Dodds with the Geological Survey of Canada in 1986.

The well-known Engineer gold mine is situated within the study area; the significant Venus and Skukum gold-silver deposits are located just northwesterly across the British Columbia/Yukon border along geologic and structural trends.

This preliminary report presents a brief description of regional geology and structure in the area as well as a preliminary classification of deposits. A more comprehensive report is planned at a later date.

ACCESS

Access into the area is best gained by helicopter. The Whitehorse-Skagway road (Highway 7) crosses the northwestern portion and the Jakes Corner-Atlin road provides access to the southeastern portion (Fig. 26-1). Access is also by boat from either Atlin or Carcross. In earlier days the White Pass and Yukon Railroad between Whitehorse and Skagway also provided access; however, since 1982 it has been closed indefinitely.

REGIONAL GEOLOGY

The central part of the study area is underlain by the Whitehorse trough which extends southeasterly from south-central Yukon into northwestern British Columbia. Mesozoic strata within the trough are separated from oceanic Upper Paleozoic Atlin terrane to the northeast by the presumed northwesterly striking, northeasterly dipping Nahlin fault and from Upper Paleozoic and older amphibolite to greenschist facies metamorphic rocks and plutons of the Coast Plutonic Complex to the southwest by the presumed northwesterly extension of the sub-vertical Llewellyn fault system.

The Whitehorse trough is a synclinorium with basal Upper Triassic strata of the Stuhini Group, which is equivalent to the Lewes River Group, exposed only along the margins. Lower and Middle Jurassic clastic strata of the Laberge Group dominate the centre of the trough.

Pre-Permian rocks of the Yukon Group consist of a variety of metamorphic rocks of uncertain age, including quartz-plagioclase-orthoclase gneiss, schist, chlorite schist, and amphibole gneiss. They have been correlated with metamorphic and sedimentary rocks of the Omineca Crystalline Belt to the east (Templeman-Kluit, 1976).

Middle to Upper Paleozoic rocks of the Cache Creek Group consist mainly of massive marine limestones in the northeast part of the study area, but include chert, argillite, volcanic greywacke, and serpentinized ultramafic rocks to the east and southeast of Atlin.

The Upper Triassic Stuhini Group consists mainly of an assemblage of mafix flows and associated volcaniclastic rocks interpreted as having formed in a fore arc basin associated with a Perm an to Jurassic island arc terrane adjacent to the east margin of Stikinia during its convergence with North America (Morrison, 1981). Within the study area Bultman (1979) sub-divided this group into the Racine Lake and Tutshi Lake units.

Earliest to late Middle Jurassic rocks of the Laberge Group consist of a thick, repetitive succession of deep-water facies, greywacke, sandstone, siltstone, shale, and conglomerate; these correlate with the Inklin Formation to the southeast.

Middle to possibly Late Cretaceous rocks of the Hutshi Group (Mount Nansen Group) and possibly the Sloko Group unconformably overlie the Mesozoic and older strata. They consist of layers of volcanic rocks, predominantly andesite and rhyolite flows, deposited on a sub-aerial surface of pronounced relief (Bultman, 1979).

The Coast Plutonic Complex of post-Early Jurassic age consists of several phases of granodiorite, quartz diorite, granite, and hybrid rocks in this area. Bultman (1979) noted five separate phases between Ben-My-Chree and Mount Lawson. Included here are Late Cretaceous biotite granites from Tutshi Lake, Racine Lake, and Engineer Mountain, which are discussed in a following section.

A younger, possibly Tertiary, quartz monzonite crops out on Teresa Island and on Atlin Mountain in the southeast corner of the study area.

REGIONAL STRUCTURE

The Llewellyn fault system separates the Whitehorse trough from the Coast Plutonic Complex. The trace of the steeply dipping Llewellyn fault passes through the Nelson Lake valley, under Tagish Lake near the mouth of Fantail Creek, and northwesterly to the south end of Tutshi Lake. Several mineral prospects occur along, or are associated with, subsidiary splays of this fault, including the Engineer mine.

The Nahlin fault system separates the Whitehorse trough from oceanic rocks of the Atlin terrane to the northeast. It has a steep northeasterly dip where it crosses Montana Mountain.

The Whitehorse trough has been shortened in a northeast-southwest direction, resulting in closed to open, symmetric, and asymmetric folds with wave lengths ranging up to 10 kilometres. Folding in the Laberge Group is particularly well developed.

The contact with the Coast Plutonic Complex is complex; largely it is faulted, elsewhere it is an unconformity.

ISOTOPIC AGE

Potassium-argon age dates were obtained by Bultman (1979) (*see* Fig. 26-1 for sample locations) and are listed in Table 26-1.

Mineralization in the vicinity of Engineer Mountain and Bee Peak may be genetically related to a hydrothermal event associated with intrusive activity. Similarily, the Hushi Group volcanics may be genetically related to intrusive rocks of the Coast Plutonic Complex, particularly those of Late Cretaceous age.

ECONOMIC GEOLOGY

Engineers working on the White Pass and Yukon Railroad and prospectors first entered the study area in 1878. The famous Klon-

British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1985, Paper 1986-1.

TABLE 26-1
POTASSIUM/ARGON AGE DATES

NO.	LOCATION	ROCK TYPE	APPARENT AGE (Ma)
1	Tutshi Lake	Biotite granite	89.5±2.6
2	Tutshi Lake	Biotite granite	77.9±1.6
3	Racine Lake	Biotite granite	82.0±2.1
4	Racine Lake	Biotite granite	56.2±1.1
5	East of Fantail River	Granodiorite boulder in Inklin conglomerate	180.8±4.7
6	Bee Peak	Hornblende tonalite	80.3±2.4
7	Wann River	Granodiorite	120.2±2.4
8	Wann River	Amphibolite gneiss	165.5±3.3

dike Gold Rush between 1897 and 1898 saw a tremendous influx of prospectors into the area, either on their way to the Klondike gold fields or working their way eastward to the Atlin gold camp. Since 1898, approximately 34 300 kilograms of placer gold has been won from the Atlin gold fields.

However, west of Atlin only small vein-type gold prospects have been worked, with the exception of the well-known Engineer gold mine which produced 597 176 grams of gold from 1913 until 1932.

To the northwest of the study area, the Venus and Skukum properties have outlined sufficient reserves to warrant mining operations under suitable economic conditions.

Many prospects occur within northwesterly trending shear zones, but they do not exhibit widespread alteration. Silicification in the form of quartz veins and/or breccia is commonly an important component of the mineralizing events.

TYPES OF DEPOSITS

GOLD AND GOLD-TELLURIUM-BEARING QUARTZ VEINS WITH TRACE BASE METALS

Engineer (MI 104M-14, 15, 16)

The Engineer deposit was found in 1899 and produced 597 176 grams of gold between 1913 and 1932. Native gold, telluride(s) (probably calaverite), pyrite, and trace allemontite (SbS), arsenopyrite, and needles of berthierite ($FeS{\cdot}Sb_2S_3$), which were identified by X-ray analysis, occur in a gangue of quartz, calcite, and mariposite. Good comb-structures, as well as banding and vugs, characterize quartz veins. Host rocks include shales and greywackes of the Laberge Group.

TABLE 26-2
LAWSON PROPERTY SAMPLE ASSAY RESULTS

SAMPLE NO.	ROCK DESCRIPTION	Au ppm	Ag ppm	Cu %	Pb %	Zn %
30089	Quartz vein with altered wallrock plus 2% pyrite (lower adit)	24.7	<10	ND	ND	ND
30090	10 cm quartz vein with 10% pyrite plus silver black metallic? mineral (Blacksmith dump)	31	27	0.017	1.46	0.013
30091	7.62 cm quartz vein with 10% pyrite (Blacksmith dump)	0.3	<10	ND	ND	ND
30092	5 cm quartz vein with 15% banded pyrite (Blacksmith dump)	15.8	55	ND	ND	ND
30093	5 cm quartz vein with 15% banded pyrite (Blacksmith dump)	167	62	ND	ND	ND
30094	10 cm quartz vein with 10% banded pyrite plus 3% galena (Blacksmith dump)	34	16	0.13	2.75	6.50
30095	Quartz vein with 75% pyrite and 0.5% galena (Blacksmith dump)	71	33	0.27	0.55	0.078
30096	3.8 cm quartz vein with 10% pyrite (Incline dump)	40	18	ND	ND	ND
30097	Silicified schist with 5% disseminated pyrite (Incline dump)	2.7	<10	ND	ND	ND
30098	5 cm quartz vein breccia with 2% pyrite and 10% galena (Incline dump)	<0.3	113	0.16	7.76	14.1
30099	7.62 cm quartz vein with 3% galena, 3% sphalerite, and 1% pyrite (Incline dump)	33	25	0.16	3.25	3.65
30100	7.62 cm quartz vein with 20% banded pyrite and 3% galena (Incline dump)	71	40	0.054	2.90	3.65
30101	Quartz vein with 15% spalerite, 3% galena, and 1% pyrite (Incline dump)	11	12	0.17	3.05	15.6
30102	Quartz vein with 6% sphalerite, 2% galena, and 4% pyrite (Incline dump)	3.4	<10	0.08	1.25	6.70
30103	Quartz vein with 5% galena, 20% spalerite, and 2% pyrite (Incline dump)	17.8	22	0.30	6.85	22.8
30104	Quartz vein with 10% pyrite (Incline dump)	3.2	11	ND	ND	ND
30105	Quartz breccia with 10% galena, 25% sphalerite, and 10% pyrite (Incline dump)	2	25	0.076	8.85	25.1
30106	7.62 cm quartz vein with 5% pyrite, 8% galena, and 4% sphalerite (Incline dump)	96	63	0.66	7.90	4.10
30107	10 cm quartz vein with 5% pyrite (approximately 17 metres in Incline dump)	297	120	ND	ND	ND

TABLE 26-3
BEN-MY-CHREE SAMPLE ASSAY RESULTS

SAMPLE NO.	ROCK DESCRIPTION	Au ppm	Ag ppm	Cu %	Pb %	Zn %
30052	Quartz-calcite vein with 3% galena	3.4	1 147	0.054	2.10	0.013
30053	Quartz vein with 2% pyrite	<0.3	<10	0.012	0.025	0.0035
30054	Quartz vein with 2% pyrite + minor galena + malachite	11	736	0.27	7.65	0.0019
30055	Foliated diorite with disseminated chalcopyrite	0.3	184	0.60	0.27	0.61
30056	Quartz vein with 4% galena and pyrite	11	450	0.14	4.25	0.037
30057	Foliated diorite with disseminated chalcopyrite	1.7	1 621	1.41	1.57	0.25
30058	Quartz veinlet with 2% galena + 2% pyrite	14.4	3 774	0.33	2.10	0.06

Note: Samples collected from 1 860-metre elevation, except 30057 and 30058, which are taken from 1 830-metre elevation

Happy Sullivan (MI 104M-13)

The Happy Sullivan prospect was also discovered in 1899. During the winter of 1984-85 De Baca Resources Inc. completed an 80-metre-long adit near elevation 1 128 metres which tested irregular quartz veining with high-grade gold values. The veins are within a shear zone which measures about 42 metres in width and greater than 3.2 kilometres in length; it strikes northerly. The mineralogy and geologic setting is similar to that at the Engineer mine, however, locally there is up to 20 per cent arsenopyrite and dendritic crystals of native gold have been found (Assessment Report 7923).

Skukum

The Main zone of the Mount Skukum deposit, in the Yukon, has reserves estimated at 148 980 tonnes grading 24.98 grams per tonne gold and 20.5 grams per tonne silver. Additional reserves exist in the Brandy zone. The quartz-calcite vein of the Main zone has been traced for 200 metres; its width averages 5 metres and it continues to a vertical depth of at least 80 metres. Gold occurs principally in electrum and sulphides are uncommon.

GOLD-SILVER QUARTZ VEINS WITH BASE METALS

Lawson (MI 104M-6, 7)

The Lawson gold prospect consists of a gold-bearing quartz vein that has been traced intermittently along a horizontal length of 920 metres and over a vertical distance of greater than 460 metres. The vein averages 1.1 metres in thickness and contains pyrite plus minor chalcopyrite, galena, sphalerite, and native gold. The vein cuts hornblende (± chlorite) schists and feldspar porphyry of the Yukon Group. During 1985, the writer examined and sampled the Incline, Blacksmith, and Lower (caved) adit levels. Assay results are listed in Table 26-2.

Ben-My-Chree (MI 104-11)

Pyrite plus minor chalcopyrite occur in quartz veins within Coast Plutonic Complex rocks. Results of grab samples taken in 1985 are listed in Table 26-3. Another example of this type of showing is on the Rupert claims (MI-104M-8).

GOLD-COBALT ± SKARN ± As Bi

TP

The TP prospect, located on the southwest flank of Teepee Peak was visited during 1983 while Trigg, Woolett Consultants were working on the property on behalf of their client, Texaco Canada Resources Ltd. The property is underlain by pre-Permian gneisses schists, and minor marble of the Yukon Group which are unconformably overlain by Upper Triassic volcanic rocks of the Stuhini Group. These rocks are cut by intrusions of several ages that range in composition from granodiorite to hornblendite. Locally marble has been replaced by garnetiferous magnetite, amphibole, calc-silicate, and calcite skarns. The Main showing has been traced 200 metres in a northwesterly direction; it has an average width of 15 metres. Mineralization consists of native gold, erythrite and cobaltite, and minor arsenopyrite in two fracture zones which coincide with skarn. The strong northwesterly Teepee fault may have been important for mineralization.

Assays of samples taken by the writer in 1983 from the Main showing are listed in Table 26-4.

In addition, an XRD report on the garnet showed sub-equal amounts of the end members andradite and grossularite.

ARSENOPYRITE-STIBNITE VEINS

Ben

The Ben prospect, located approximately 10 kilometres north-northeast of Bennett, was examined in 1983. Two northwesterly trending faul zones (Ben and Paddy), each approximately 6 metres

TABLE 26-4
TP SAMPLE ASSAY RESULTS

LAB NO.	ROCK TYPE	Au ppm	Ag ppm	Cu %	Pb %	Zn %	Co %	Ni %	As %	Bi %
28562M	Cobalt-arsenopyrite skarn	30.2	<10	0.012	0.04	ND	3.27	1.24	6.57	2.27
28563M	Massive magnetite	0.7	<10	0.003	0.01	0.013	0.079	0.005	7.76	0.06
28564M	Banded cobalt-arsenopyrite	32.2	90	0.011	0.01	0.01	16.3	0.017	21.5	1.09
28565M	Cobalt-arsenopyrite	24.3	<10	0.006	0.025	0.009	7.87	0.022	10.2	1.05
28567M	Massive cobalt-arsenopyrite	35	57	0.035	0.07	0.18	0.37	0.018	32	0.18

TABLE 26-5
BEN SAMPLE ASSAY RESULTS

LAB NO.	ROCK TYPE	Au ppm	Ag ppm	Cu %	Pb %	Zn %	As %	Sb %	Bi %
28581M	Chalcopyrite-sphalerite in contorted gneiss	0.3	80	0.21	0.14	4.1	ND	65 ppm	<0.02
28582M	Chalcopyrite-sphalerite-stibnite in gneiss	<0.3	710	0.041	0.97	1.2	2.7	0.43	<0.02
28583M	Arsenopyrite-pyrite-stibnite in gneiss	3.4	769	0.02	ND	ND	10.6	3.50	<0.02
28584M	Pyrite-galena-sphalerite	18.2	684	0.02	8.15	0.83	24.8	0.6	0.08
28585M	Massive stibnite + sphalerite + chalcopyrite in bleached silicified rock	<0.3	929	0.017	8.00	29.2	ND	16.8	<0.02
28586M	Gneiss	1.7	158	0.019	1.16	1.48	4.89	0.62	<0.02

wide, host gold-silver mineralization. Four different styles of mineralization exist:

(1) Quartz veins (less than 1 metre in width) containing pyrite, arsenopyrite, galena, sphalerite, stibnite, chalcopyrite, and rare siderite hosted by either schists and gneisses of the Yukon Group or volcanic rocks of the Stuhini Group.
(2) A cobalt mineral, pyrite, and massive arsenopyrite in shears.
(3) A stratabound disseminated sulphide zone (approximately 1 metre wide) containing galena, sphalerite, stibnite, arsenopyrite, pyrite, and pyrrhotite in gneisses adjacent to a shear zone.
(4) A pyrrhotite-bearing amphibole skarn.

Assays of samples taken by the writer are listed in Table 26-5.

ANTIMONY VEINS

Lakefront (MI 104M-5)

Bedded quartz-stibnite veins with traces of galena averaging 1 metre in thickness occur in Laberge Group shales. Approximately 40 tonnes of ore is scattered on the shore of Atlin Lake below a caved adit.

DISSEMINATED AND VEIN ARSENOPYRITE PLUS MINOR GALENA AND SPHALERITE

Moon Lake

The Moon Lake silver prospect consists of disseminated arsenopyrite, pyrite, galena, and sphalerite in a sheared granodiorite and is similar to the Big Thing prospect on Montana Mountain in the Yukon. Assays of samples taken in 1983 from the Moon Lake prospect are shown in Table 26-6.

The setting of these prospects suggests that magmatic waters may have been involved in their formations.

ARSENOPYRITE-PYRITE-GALENA-SPHALERITE ± PYRARGYRITE ± TETRAHEDRITE QUARTZ VEINS

Venus

The Venus gold-silver prospect is located on the southeast flank of Montana Mountain just north of the British Columbia/Yukon border. Arsenopyrite, pyrite, galena, sphalerite, with rare realgar, orpiment, yukonite, kankite, quenstedtite, pyrargyrite, and tetrahedrite occur in quartz ± ankerite ± chlorite ± illite ± calcite veins in Hutshi Group (Mount Nansen Group) andesitic volcanic rocks. Mineralization is known over a vertical length of 397 metres with an average width of 1 metre. The style of mineralization probably represents a transition zone between mesothermal and epithermal types.

Reserves are estimated at 61 676 tonnes grading 10.97 grams per tonne gold, 305.14 grams per tonne silver, 2.5 per cent lead, 1.5 per cent zinc, plus 13 605 tonnes grading 14.4 grams per tonne gold, 360 grams per tonne silver, 2.7 per cent lead, 1.3 per cent zinc from 2 850 level, plus 12 154 tonnes grading 5.83 grams per tonne gold and 147.4 grams per tonne silver stockpiled from development of the upper levels (Lori Walton, personal communication, 1985).

OTHER DEPOSIT TYPES

Several other deposit types have been found. Pyrite-pyrrhotite-chalcopyrite-galena-bearing skarn and disseminated sphalerite in flow-banded rhyolite occur at the Selly showing (Needlands and Strain, 1982). There are also cupriferous gold-silver veins at the Petty (MI-104N-4), Dundee (MI-104N-3), and Great Northern (MI-104M-27) showings.

ORE DEPOSIT MODELLING

Preliminary investigations indicate that precious-metal-bearing mineralization ranges from mesothermal to epithermal in style and

TABLE 26-6
MOON LAKE SAMPLE ASSAY RESULTS

LAB NO.	ROCK TYPE	Au ppm	Ag ppm	Cu %	Pb %	Zn %	As %
28554M	Quartz vein with tetrahedrite	0.3	490	0.096	1.39	0.26	1.37
28555M	Altered granodiorite with arsenopyrite and pyrite	0.3	25	0.042	0.40	1.69	3.21
28556M	Altered granodiorite	<0.3	27	0.013	0.17	0.13	0.16
28557M	Altered granodiorite with disseminated arsenopyrite, galena, and sphalerite	<0.3	55	0.008	0.71	0.44	2.39
28558M	As above	<0.3	29	0.018	0.45	0.30	0.16

that it is structurally controlled by northwesterly trending fractures. There may also be a genetic association with Upper Cretaceous to Tertiary plutonic and/or volcanic activity.

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