Figure 1: Regional Geology of the Merry Widow district (after Jeffery, 1962).

DESCRIPTION OF GEOLOGY AND MINERALIZATION

The Merry Widow camp, situated about 40 kilometres southwest of Port McNeill on northern Vancouver Island, lies within the Wrangellia Terrane of the Insular physiographic belt. It contains numerous Fe-Cu-Au skarn and manto occurrences, as well as some major skarn deposits. One of these, the Merry Widow (Fe-Cu-Au-Ag) was mined by Empire Development Co. Ltd. from the Merry Widow, Raven and the Kingfisher open pits (Figures 1, 2 and 3). The other, the Old Sport-Benson Lake deposit (Cu-Fe-Au) was worked by Cominco Ltd. in the 1960's using underground mining methods. It was worked from adits farther north, and a southern portion of the deposit extends southward into the eastern part of the map area but it is not exposed. The mineral occurrences, and production from the mines are listed in Table 1.

GEOLOGY The regional geology, and stratigraphy of the area are shown in Figures 1 and 4 respectively. The oldest rocks in the map area are massive to pillowed volcanics and subvolcanic gabbroic intrusions of the upper Triassic Karmutsen Formation. The volcanics represent tholeiltic basalts deposited in an oceanic environment.

These are conformably overlain by approximately 1000 metres of massive to bedded grey limestone belonging to the upper Triassic Quatsino Formation. Adjacent to the larger intrusions the limestones are altered to white marble.

The Quatsino is uncomformably overlain by the lower Jurassic Bonanza Group; argillites of the Parson Bay Formation, which elsewhere in the district separate the Quatsino and Bonanza successions (Figure 1), appear to be absent in the Merry Widow area. The Bonanza includes andesitic ash and lapilli tuff (Units t and It), breccia (Unit b), greenstone (Unit g) and well-bedded tuffaceous siltstone. One unit, close to the base of the Bonanza, contains irregular-shaped clasts that could be deformed pebbles or tuff fragments.

The area includes two major episodes of intrusive rocks. The oldest, the Keystone suite, is believed to be coeval with the Bonanza Group and probably formed feeders to the tuffs, breccias and greenstones in that succession (Figure 4). It resulted in swarms of minor sills and dykes, as well as some subvertical breccia pipes. The largest pipe, the Keystone intrusion, reaches 600 metres in diameter. The suite comprises fine to medium grained rocks of largely andesitic composition (Figure 5) and subalkalic, tholeiltic affinity (Figures 6 and 7). The breccias contain abundant rounded to subangular xenoliths, mostly less than 3 centimetres, but up to 10 centimetres in diameter. Locally, a subvertical flow foliation is well developed. This foliation is deformed around individual xenoliths, some of which were rolled and milled during intrusion, to produce trails of broken clasts. Xenoliths include massive and flow banded andesite, white, fine grained felsic volcanic rock and rare fragments of limestone and coarse hornblende gabbro. The breccias in the Bonanza Group contain similar clasts; the fine grained felsic volcanic xenoliths in both the Bonanza and the Keystone suite could represent fragments of Paleozoic Sicker Group.

barren and mineralized skarn, and the margins of some intrusions are bleached. These bleached rocks, compared to the unaltered andesite, are enriched in sodium and depleted in iron and The second major intrusive episode resulted in the emplacement of the Coast Copper

Many Keystone suite dykes and sills that cut the Quatsino limestone are associated with

stock. This is mostly a coarse grained, mafic gabbro of subalkalic and tholeitic affinity (Figures 5, 6 and 7). It contains uralitized pyroxene, hornblende, plagioclase, ilmenite, magnetite and apatite. Locally it includes coarse pegmatitic and feldspathic phases.

A distinctive sill-like body of unknown age intrudes the Quatsino limestone in the southern part of the map area. This tholeittic basalt (Figures 5, 6 and 7) contains abundant pyroxene, is characterized by some cumulative layering, and is relatively enriched in magnesium and chromium (Tables 2 and 3).

Most bedding in the Quatsino and Bonanza successions dips westwards at between 20 and 50 degrees. Some open flexure folds are locally developed but tighter folding occurs near the margin of the Coast Copper stock in the Merry Widow pit area. At the pit, a north-northeast plunging, westerly overturned fold and east dipping thrust were identified by Lund (1966) (Figure The fold strikes parallel to the margin of the Coast Copper stock.

Two fault sets are recognized. The oldest, the north-trending Merry Widow fault, may

Benson River fault has an estimated sinistral movement of 1.5 kilometres and an easterly downthrow of 1.2 kilometres (Lund, 1966). The younger fault set produced northeasterly striking structures that do not exhibit major displacement. It includes the Kingfisher, Marten, Gorge and Keystone faults. The Kingfisher fault

represent a splay off the major Benson River fault that passes just east of the map area. The

apparently controlled the distribution of the Kingfisher magnetite orebodies, although minor post mineralization movement also took place along the structure (Lund, 1966). MINERALIZATION

Mineralization in the area comprises skarns and mantos (Table 1). It is largely stratigraphically controlled, being mainly concentrated close to the bottom and top of the Quatsino limestone (Figure 4); similar stratigraphic relationships between the Quatsino and skarns are noted elsewhere in Wrangellia, such as on Texada Island (Webster and Ray, 1990).

Only the Merry Widow deposit outcrops close to the margin of the Coast Copper stock; the remainder of the deposits and occurrences outcrop some distance east of the intrusion. The mineralogy of the Merry Widow, Raven, Kingfisher and Old Sport-Benson Lake deposits is typical of other magnetite-rich skarns in western British Columbia (Sangster, 1969; Meinert, 1984). The mineralization, based on a K-Ar analysis of skarn-related phlogopite, was dated by Carson (1973) at 181 Ma (mid-Jurassic). The extensive Old Sport-Benson Lake skarn lies close to the Quatsino-Karmutsen contact,

and the discontinuous ore lenses dip about 40 degrees westerly. Mineralization is characterized by magnetite, chalcopyrite, bornite, pyrite, lesser pyrrhotite and trace gold in a garnet-epidoteamphibole-carbonate gangue. The garnets vary from brown to yellow-green, and minor albite and potassium feldspar are locally present. Assays of sulphide-bearing grab samples indicate anomalous silver, arsenic and gold (Table 3). The contact between the base of the Bonanza and the underlying Quatsino limestone is

the locus of faulting, extensive skarn alteration, and mineralization responsible for the Merry Widow deposit and the Marten and Bluebird 1 and 2 occurrences. The Marten, Bluebird 1 and Bluebird 2 occurrences appear to represent sulhide-rich manto mineralization (Wilton 1989). They include massive pyrrhotite, pyrite and chalcopyrite, with sporadic arsenopyrite, sphalerite, magnetite, marcasite and cobaltite. Grab samples from the Marten occurrence are enriched in arsenic, silver, bismuth and gold (Table 3).

The Merry Widow and Raven deposits (the latter is now covered by tailings) are hosted by Keystone andesitic intrusion and Bonanza rocks close to their contact with Quatsino limestone and the Coast Copper stock; by contrast the Kingfisher is hosted entirely in limestone (Figure 3). The Kingfisher deposits consist of two steeply plunging, sub-circular pipes of massive magnetite. They reached 50 metres in diameter and were joined at depth (Figure 3). Skarn wallrock alteration is poorly developed compared to the nearby Merry Widow deposit. The Kingfisher deposits are distinct in being structurally controlled along the Kingfisher fault and in containing abundant colloform magnetite. Stevenson and Jeffery (1964) believed this unusual colloform texture indicated deposition of the magnetite as a gel by colloidal processes.

The Merry Widow is characterized by abundant coarse crystalline magnetite, some minor colloform magnetite, and sporadic pyrrhotite, pyrite, arsenopyrite, cobaltite, erythrite, sphalerite and gold in a gangue comprising garnet, epidote, actinolite, clinopyroxene, carbonate and quartz. Magnetite ore forms lenses, sheets and discontinuous breccia zones, the latter comprising magnetite-calcite fragments rimmed by coarse garnet. Garnets are generally brown coloured; they typically have isotropic cores of end member andradite grading outwards to anisotropic grossularitic rims (Ettlinger and Ray, 1989). Both the garnet and pyroxene have a low manganese content (Meinert, 1984; Ettlinger and Ray, 1989) that is typical for calcic iron and gold skarns. Locally, albite and potassium feldspar are developed. Gold tends to be found in the sulphide-rich zones, and Dixon (1989) reports it is associated with cobaltite and tellurobismuthite. Gold-rich ore occurs along the hanging wall of the West Pipe dyke (Lund, 1966; Figure 3), a xenolith-bearing Keystone suite intrusion. The Raven Copper occurrence, on the north side of the Merry Widow pit, is another example of gold-sulphide-rich mineralization in the Merry Widow deposit. A chalcopyrite-bearing grab sample contains anomalous gold, silver, zinc, cobalt, arsenic and bismuth (Table 3).

Two theories are suggested for the origin of the skarns and mantos. The most accepted hypothesis is that the mineralization is genetically related to the Coast Copper stock. This suggests (based on the K-Ar dating of the skarn) that the intrusion is mid Jurassic in age. Alternatively, the Keystone intrusions, which are commonly altered to endoskarn and associated with magnetite and sulphides, could be responsible for the skarns. Each hypothesis has different implications for future exploration.

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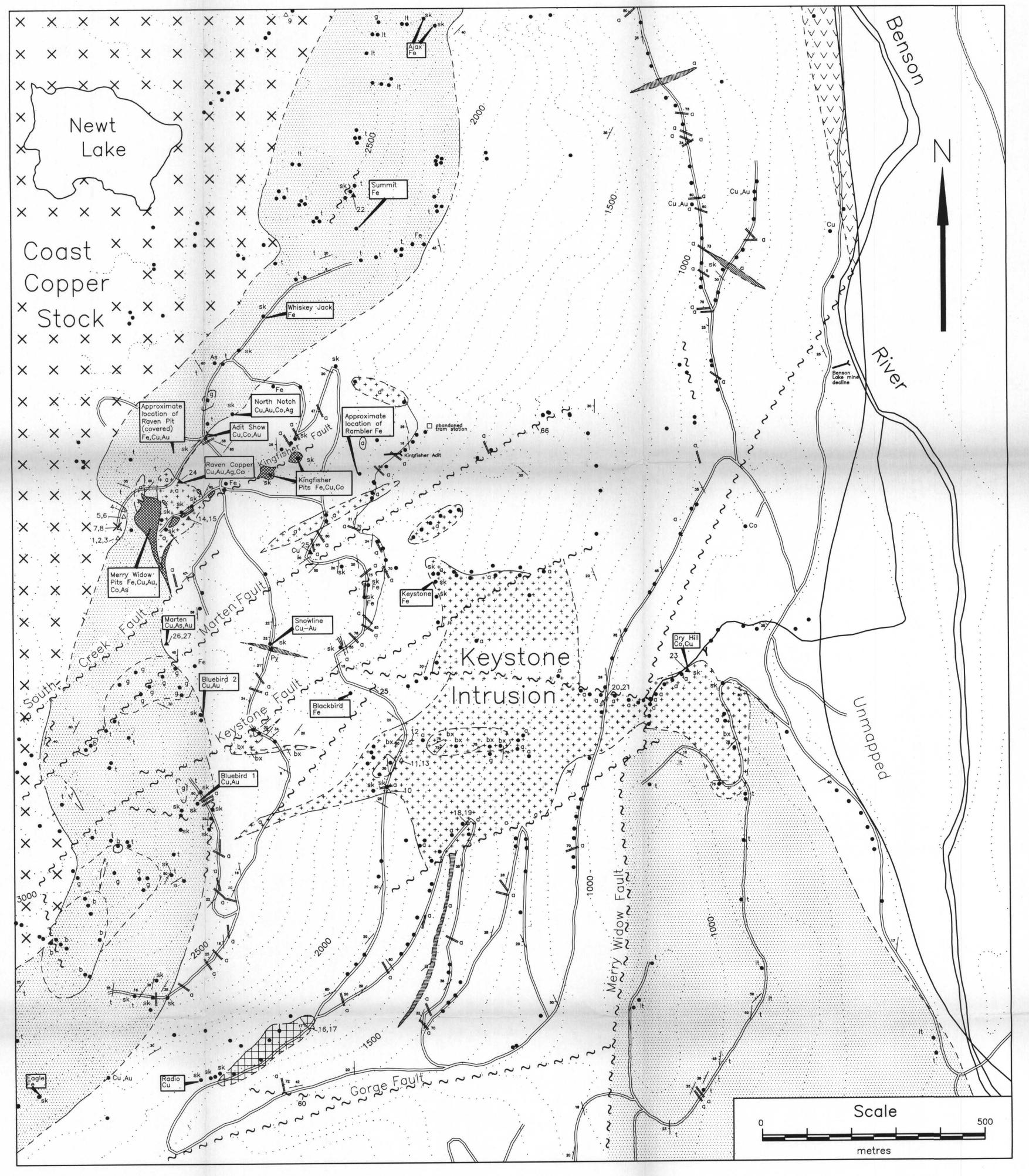
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ACKNOWLEDGEMENTS

477-522.

This work forms part of a major project by the authors, at the B.C.Geological Survey Branch, to study the provinces skarn deposits and occurrences. Special thanks are due to: Jim Laird, prospector, for useful discussions and providing considerable field data; the management and staff of Noranda Exploration Co. Ltd., particularly Dennis Bull and Rick Kemp, for generous support with geochemical analyses; Don Graham of Taywin Resources Ltd. for helpful cooperation; Robert Bennett for hospitality at the field camp; Nick Massey of the B.C. Geological Survey Branch for discussions concerning the regional geology, and Aaron Pettipas for assistance with drafting. Bob Paul and Kenton McNutt provided excellent field support.



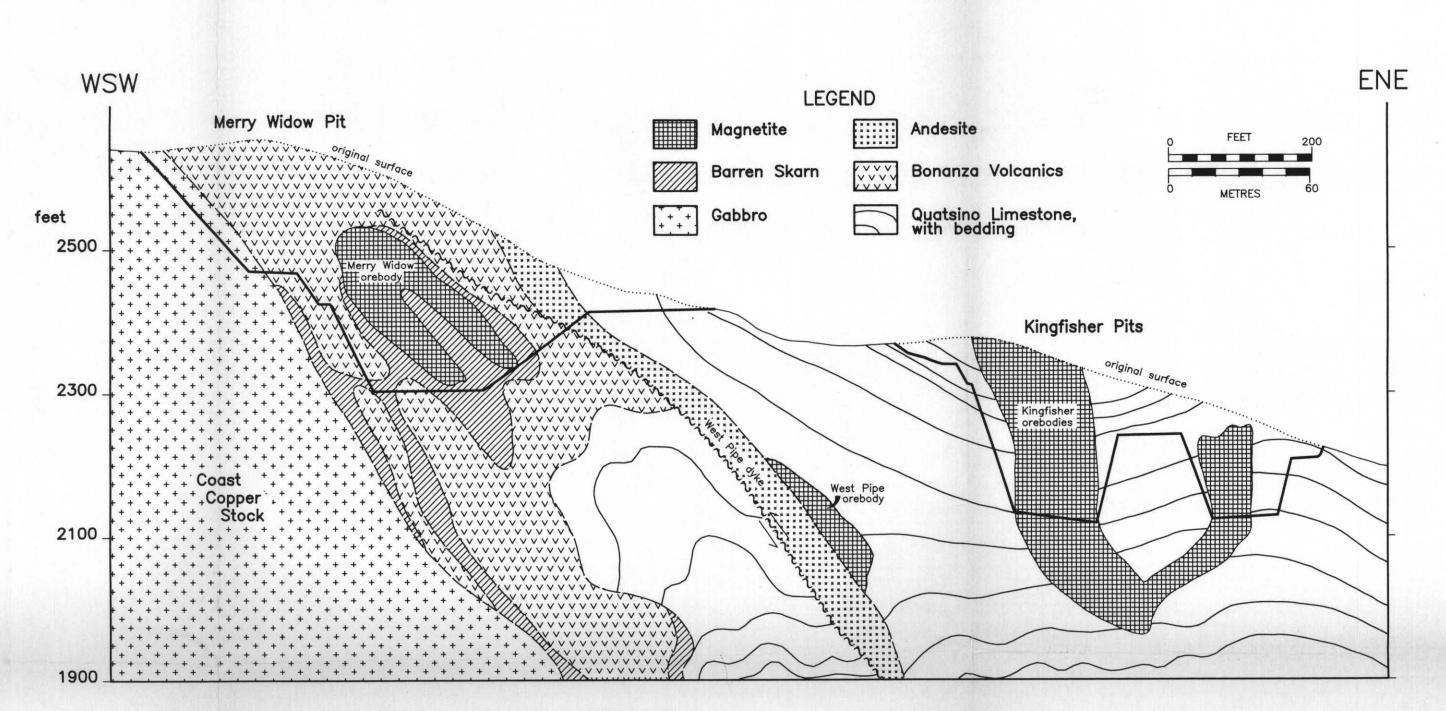


Figure 3: Longitudinal geological section across the Merry Widow-Kingfisher Pits (adapted after Lund, 1966).

ND = not detectable)

Table 1	. Mineral occ	urrences: desc	ription and p	roduction.
	Market	Denseit	Matallia	Minerales

Minfile Number	Name	Deposit type	Metallic elements	Mineralogy	Production
092L 035	Old Sport(L.1480-1486)	skarn	Au, Ag, Cu, Fe	cp, mt, bn, po, py, as, cb, qtz, gt, ep, act, pyx, chi, ser, ab, Kspar, gld	Au: 3 689Kg, Ag: 11 731Kg, Cu: 41 193t, Fe: 488 726t
092L 040	Shamrock	skarn	Fe	mt, gt, py	
092L 042	Ajax(L.1502)	skarn	Fe	mt, gt, chl	
092L 043	Summit(L.1554)	skarn	Fe	mt,	
092L 044	Merry Widow 5(L.1533-1543)	skarn	Fe, Cu, Au, Zn, Co	mt, cp, sl, as, po, ct, ery, cb, mc, py, qtz, gt, Kspar, ep, act, cob, ab, pyx, gld, tlb	Fe: 1 683 507t
092L 045	Kingfisher(L.1532)	skarn	Fe	mt, cb, gt, pyx	
092L 046	Raven (L.1542)	skarn	Fe, Cu, Au, Ag, Zn	mt, py, po, cp, sl, gt, ep, act, pyx, chl, cb, gld	
092L 047	Whiskey Jack (L.1529)	skarn	Fe	mt, gt, ep, act, chl, pyx	
092L 048	Rambler(L.1537)	skarn	Fe	mt, gt, ep, act, chl, pyx	
092L 049	Keystone (L.1534)	skarn	Fe	mt, gt, ep, act, chl, pyx,	
092L 050	Marten	manto	Fe, Cu, Zn, Co, Au	mt, as, sl, cp, po, cb, cob, chl, ep, pyx, gld	
092L 051	Snowline (L.1535)	skarn	Fe	mt	
092L 091	Benson Lake (L. 15555, 1557)	skarn	Cu, Fe, Au, Ag	cp, bn, mt, py, po, as, gld, cc, qtz, gt, ep, act, pyx, chl	Au: 63Kg, Ag: 488Kg, Cu: 1 237t
092L 115	Dry Hill	sheared skarn	Co, Cu	cob, cp, py, ery, gt, ep, serp, qtz, gpt	
092L 322	Happy Jack	skarn	Cu, Fe	cp, mt	
092L 114	Eagle	skarn	Fe	mt	
	Bluebird 1	manto	Fe, Cu, Zn, Au	mc, cob, ct, mt, ep, chl, cb, py, sl, gld, cb	
	Bluebird 2	manto	Fe, Cu, Zn, Au,	mc, cob, ct, mt, ep, chl, cb, py, sl, gld, cb	
	Raven Copper	skarn	Cu, Fe, Zn, Au, Co	mt, cp, po, py, sl, as, cob, pyx, cc, gt, ep, gld	
	North Notch	skarn	Au, Co, Cu, Fe, Ag	cp, mt, cob	
	Radio	skarn	Cu, Fe	cp, po	

Table 2. Wholerock geochemistry of intrusive rocks (oxides, LOI, and Sum in %, other elements in ppm),

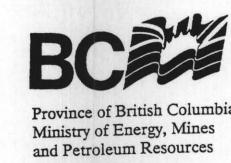
No. on Fig. 2	SiO ₂	TiO ₂	Al ₂ O ₃	Fe ₂ O ₃ *	MnO	MgO	CaO	Na ₂ O	K ₂ O	Cr ₂ O ₃	P ₂ O ₅	LOI	Ва	Sr	Zr	Y	Nb	La	Sum.
1 2 3 3 4 5 6 6 7 7 8 8 9 9 10 11 11 12 13 14 15 16 17 18 18 19 19 19 19 19 19 19 19 19 19 19 19 19	44.86 47.81 50.74 43.71 52.74 45.68 46.53 62.01 50.01 68.06 51.82 57.47 67.75 55.55 59.76 61.52 60.85 60.21	2.73 3.00 1.64 3.68 0.97 2.59 2.70 0.87 1.48 0.22 2.25 1.53 0.22 2.11 0.78 1.51 1.90 0.53 0.65 0.71	13.50 16.32 16.54 14.08 13.75 13.52 13.76 17.53 15.68 14.41 15.54 14.11 17.24 15.86 13.45 16.61 16.05 16.68 16.88	17.10 12.42 7.96 17.45 7.06 15.97 15.38 3.41 11.37 4.71 13.29 6.48 4.69 11.86 3.13 6.93 10.53 7.75 8.17 4.78 7.79	0.26 0.25 0.18 0.33 0.21 0.24 0.11 0.19 0.10 0.22 0.11 0.07 0.13 0.07 0.20 0.20 0.20 0.20 0.20 0.21 0.20 0.20	6.92 3.75 4.98 4.74 4.93 6.97 6.29 1.35 6.08 0.46 3.95 2.06 0.68 2.76 1.89 3.94 10.07 1.25 1.50 2.17	11.22 10.06 13.38 9.75 12.31 11.40 10.96 5.42 9.07 2.69 7.03 6.76 3.06 6.69 8.06 11.46 9.27 4.53 5.60 7.61 5.23	2.05 3.49 2.64 2.93 3.75 2.22 2.39 7.93 3.03 5.33 3.13 4.71 5.34 4.23 6.79 3.74 2.64 5.02 4.73 6.23 4.75	0.31 0.50 0.63 0.30 0.80 0.18 0.55 1.68 1.31 2.21 1.41 1.26 0.44 1.34 1.07 1.04 0.82 0.27 0.67	<0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002 <0.002	0.16 1.41 0.19 2.04 2.12 0.05 0.18 0.22 0.18 0.12 0.61 0.16 0.87 0.60 0.25 0.46 0.43 0.42 0.47	0.8 0.9 1.0 0.8 1.2 0.7 2.7 0.2 0.8 2.0 1.0 0.9 0.3 1.1 1.2 2.0 0.7 0.7	74 117 155 61 136 60 85 62 115 383 289 634 285 272 78 155 244 258 253 129 214	331 545 629 426 664 319 343 167 342 460 450 795 561 410 863 1260 820 550 558 1381 745	20 16 35 20 26 20 23 392 29 194 108 129 197 196 123 51 58 136 138 135 130	12 22 13 24 30 12 13 50 12 26 32 34 25 50 27 19 10 25 24 25	<20 <20 <20 <20 <20 <20 <20 <20 <20 <20	19 6 10 12 17 49 2 15 2 20 4 18 28 25 16 27 28 23	99.97 100.00 100.00 99.88 99.95 99.80 99.74 99.83 99.76 100.00 99.95 100.01 99.97 100.00 100.00 99.83 99.62 99.73 99.85 99.71 99.70

No on Fig. 2.	Мо	Cu	Pb	Zn	Ag	Ni	Со	As	Au	Cd	Sb	Bi	Cr	W
22	1	27	15	30	0.1	5	11	29	ND	0.2	2	2	73	1
23	251	64	2	15	0.5	152	4860	7494	ND	0.4	2	2	48	1
24	1	> 10%	2	3511	194.9	21	1875	1947	23	37.8	2	19	8	1
25	17	3160	20	9	3.5	9	851	171	ND	0.8	2	42	9	1
26	1	5716	9	56	8.6	1	360	16210	ND	0.9	6	41	30	1
27	1	7368	406	792	13.0	2	12	119	2	6.6	2	57	13	1
28	1	67405	2	227	1.6	12	125	25	4	5.6	2	2	29	1
29	1	86563	4	124	38.6	9	307	89	ND	6.2	6	11	28	1
30	1	63007	2	60	16.6	9	42	30	ND	5.2	2	2	94	1

Analyses completed at Acme Analytical Laboratories Limited, Vancouver, B.C.: sample 22 = Summit occurrence; sample 23 = Dry Hill occurrence; sample 24 = Raven Copper (Merry Widow pit);

sample 25 = small pyrrhotite vein, 400 metres northeast of Marten occurrence; sample 29-30 = Old Sport-Benson Lake deposit (location not shown on Fig. 2).

Table 3. Trace element analyses of mineralized samples, Merry Widow area (all values in ppm except where stated in %,





OF. 1991-8

Geological Survey Branch

OPEN FILE MAP 1991-8

GEOLOGY AND MINERAL OCCURRENCES OF THE MERRY WIDOW SKARN CAMP, NORTHERN VANCOUVER ISLAND

> G.E. RAY AND I.C.L. WEBSTER SCALE 1: 5 000

NTS 92L/6

LEGEND AGE UNKNOWN

LAYERED BASALTIC SILL **EARLY TO MIDDLE JURASSIC**

ISLAND PLUTONIC SUITE COAST COPPER STOCK

> MINOR GABBROIC INTRUSION RELATED TO COAST COPPER STOCK LARGE ANDESITIC BRECCIA PIPES; MAJOR SILLS AND DYKES; LOCALLY XENOLITHIC

MINOR ANDESITIC INTRUSIONS (SILLS AND DYKES) a = MASSIVE ANDESITE, WITH LOCAL MINOR XENOLITHS bx = ANDESITIC BRECCIA WITH ABUNDANT XENOLITHS (LOCALLY FLOW FOLIATED)

LOWER JURASSIC **BONANZA GROUP** t = ASH TUFFS, TUFFACEOUS SEDIMENTS, It = LAPILLI TUFFS b = BRECCIA (POSSIBLE LAPILLI TUFFS OR INTRUSIVE BRECCIA)

QUATSINO FORMATION

MASSIVE TO BEDDED LIMESTONE

g = GREENSTONE (POSSIBLE FLOWS OR SUBVOLCANIC INTRUSIONS) **UPPER TRIASSIC VANCOUVER GROUP**

KARMUTSEN FORMATION BASALTIC FLOWS, SUBVOLCANIC INTRUSIONS SYMBOLS .Bedding; tops known Bedding; tops unknown Intrusive flow foliation

..Cummulative layering ..Geological contact; defined, assumed ...Dyke or sill (with dip - where recorded) ..Fault (with dip - where recorded) .. Contour (100 foot interval) .Outcrop visited ..Whole rock sample location ..Trace element assay sample loation

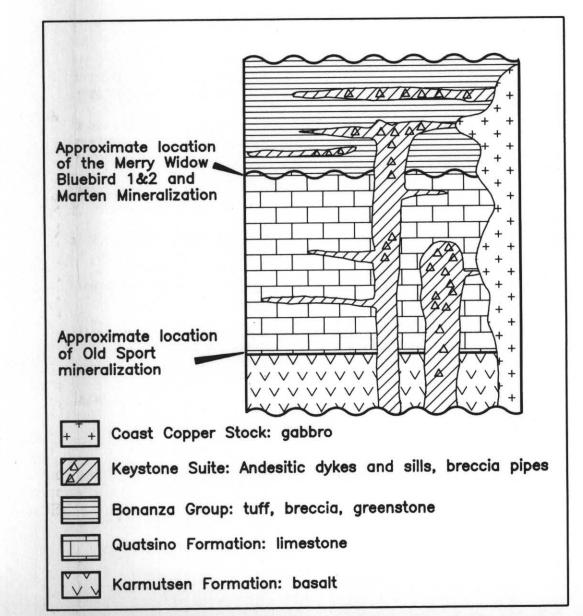


Figure 4: Schematic stratigraphic column, Merry Widow area.

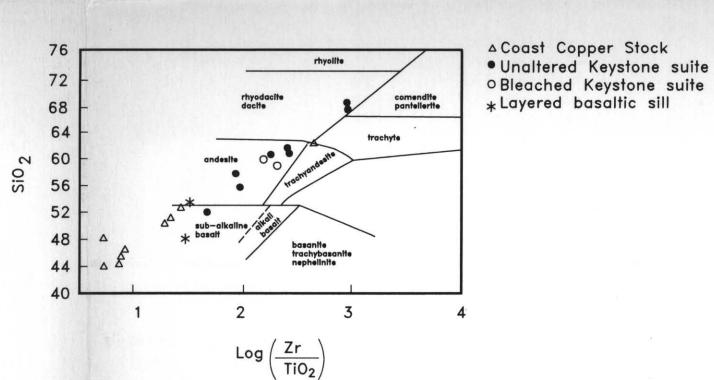


Figure 5: Plot of SiO₂ vs. log (Zr/TiO₂) (after Floyd and Winchester, 1978) of intrusive rock samples, Merry Widow area.

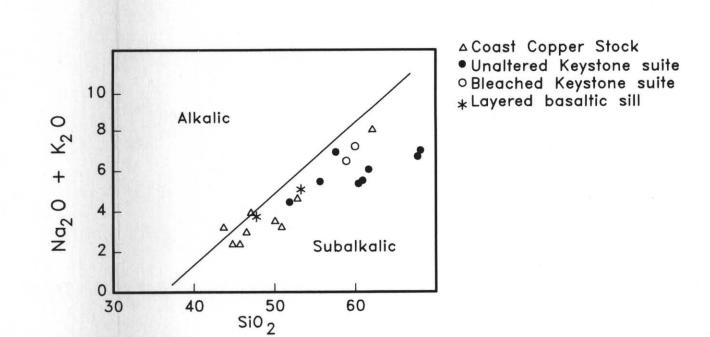


Figure 6: Alkali-silica plot (after MacDonald, 1968) of intrusive rock samples, Merry Widow area.

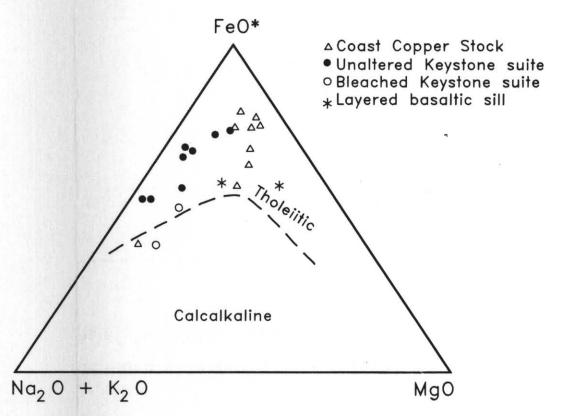


Figure 7: AFM plot of intrusive rock samples, Merry Widow area.