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Ministry of Energy, Mines
and Petroleum Resources
Hon. Anne Edwards, Minister

MINERAL RESOURCES DIVISION
Geological Survey Branch

GEOLOGY AND MINERAL RESOURCES OF THE BABINE MOUNTAINS RECREATION AREA

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SUMMARY

The Babine Mountains Recreation Area in west central British Columbia is a candidate for Class A park status. At the request of the Ministry of Environment, Lands and Parks, in accordance with the requirements of Section 19 of the *Mineral Tenure Act*, the Ministry of Energy, Mines and Petroleum Resources has conducted a mineral resource potential study, the results of which are presented herein.

There is concern that potentially economic resources may be included if the area is reclassified from a recreation area to a park without provision to test this possibility by allowing mineral exploration first. The present recreation area boundary encompasses a metal resource-rich region:

- there are twenty-three mineral prospects of which seven are past-producing mines,
- prospects contain identified resources in the ground,
- three of the prospects were found during the course of this study which demonstrates favourable mineral potential for the area.

The early history of mineral exploration in the region is essentially coincident with the population influx of the post fur-trade era. Many of the pioneering explorers, prospectors and miners have lent their names to the mountain peaks, rivers, creeks and trails within the area. Many of the prospects date to the turn of the century. Not surprisingly, the vast majority of the mineral claims predate the establishment of the recreation area.

The Babine Mountains Recreation Area is 15 kilometres northeast of Smithers and covers much of the southern part of the Babine Range (Figure 1). The region is underlain by volcanic and sedimentary rocks 65 to 200 million years old; granitic rocks are the youngest rocks and are generally less than 65 million years old. The rocks accumulated in subaerial to submarine environments, which are analogous to a modern volcanic island-arc, such as the Aleutian volcanic mountain chain of Alaska. The nature and distribution of metallic mineral deposits in the recreation area is a reflection of processes that were active during and after deposition of the hostrocks: these include intrusion of granitic rocks with circulation of metal-rich hydrothermal fluids, and development of faults and fracture zones along which metal-rich hydrothermal fluids were focussed.

Three types of metallic mineral deposits occur within the Babine Mountains Recreation Area (Figure 2): porphyry copper-molybdenum deposits associated with granitic rocks (such as the Big Onion deposit), silver-rich polymetallic veins associated generally with volcanic and sedimentary rocks (such as the Cronin deposit) and copper-silver veins contained in volcanic rocks (as at the Drift prospect).

Historical production of metal has been from silver-rich polymetallic veins and basalt-hosted copper-silver veins: past-producers were mostly small-scale operations because of the small size of the deposits. By comparison, the porphyry copper-molybdenum deposit at the Big Onion dwarfs other mineral deposits in the area (Figure 2).

The evaluation of the mineral resource potential of the recreation area required the integration of all available geological, geochemical and mineral occurrence information. Mineral potential estimates rate the probability that an area contains mineral deposits of a particular type, based on the presence of favourable criteria. Favourable criteria include: the presence of favourable geology (as determined by geological mapping); anomalous concentrations of characteristic base or precious metals in rock or stream-sediment samples; and the nature of known mineral occurrences (such as mineral showings, prospects, developed prospects with identified resources, and past-producers). Areas where favourable criteria overlap (for a particular mineral deposit type) indicate a greater degree of confidence, or an increased likelihood for a mineral deposit to occur: these areas are therefore assigned a higher mineral potential.

Three domains of high to extreme mineral potential were outlined during this study (Figure 1). Domain A has very high potential for silver-rich polymetallic veins, and includes identified metal resources at the Cronin mine, four other past-producers and eight prospects (including three found during this study). The region is centred about a volcanic complex at Mount Cronin, which is thought to be an important source of metals for these deposits (Figure 2): consequently, there is potential for silver-rich polymetallic veins across the central part of the recreation area. Much historical interest in silver-rich polymetallic veins has been focussed at the metal resources that remain underground at the Cronin mine (Table 1). At this time, however, there is little exploration or development of silver-rich polymetallic veins.

Domain B has high to very high potential for basalt-hosted copper-silver veins, and includes two past-producers and three prospects: the domain generally outlines the distribution of the favourable hostrocks to these veins.

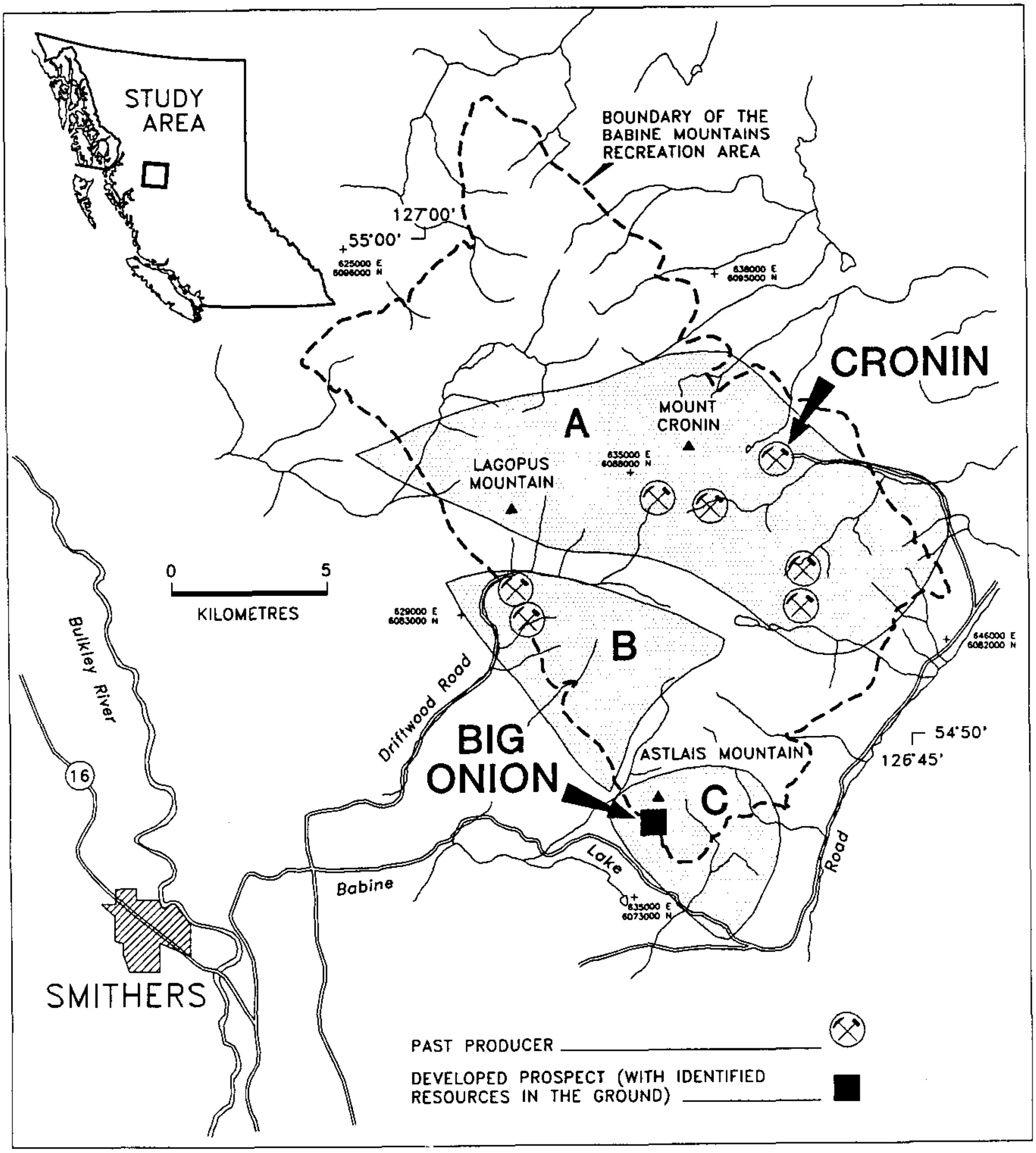

Figure 1. High to extreme mineral potential domains within the Babine Mountains Recreation Area: Domain A has very high potential for silver-rich polymetallic veins, Domain B has high to very high potential for basalt-hosted copper-silver veins and Domain C has extreme potential (or, identified resources in the ground) for porphyry copper-molybdenum-gold-silver mineralization.

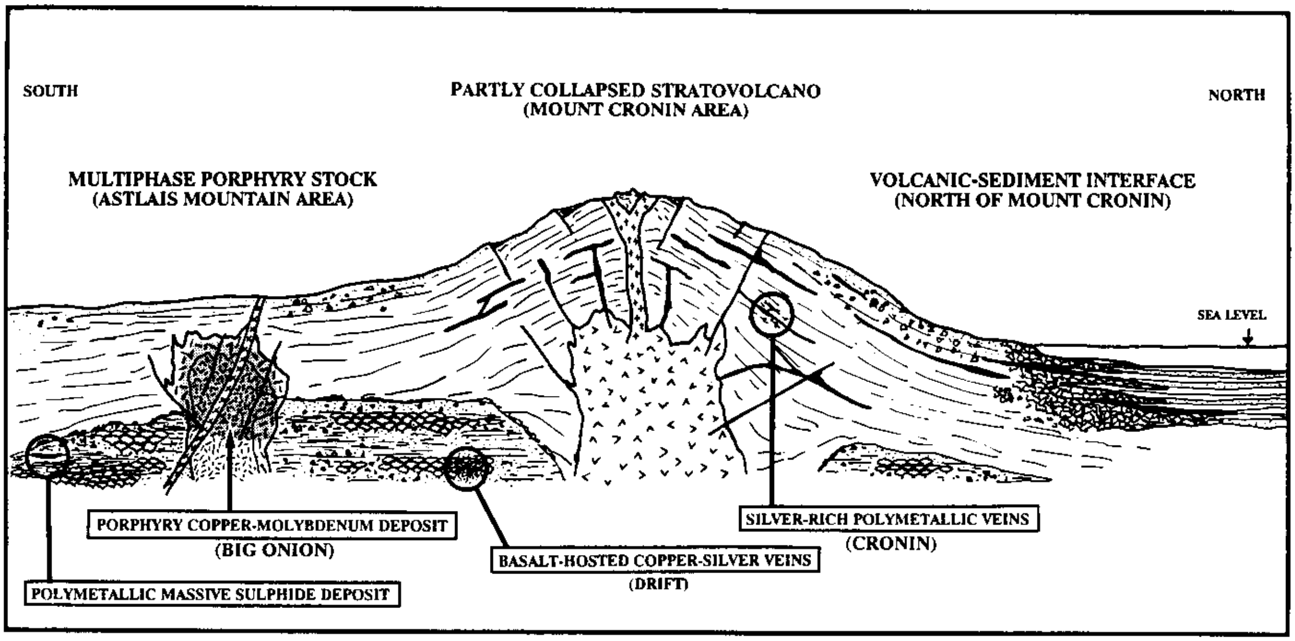

Figure 2. Composite metallogenic model for mineral deposits within and adjacent to the Babine Mountains Recreation Area.

TABLE 1
COMPARATIVE VALUE OF THE BIG ONION AND CRONIN MINERAL DEPOSITS

MINERAL DEPOSIT TYPE	DEPOSIT NAME	ESTIMATED SIZE OF DEPOSIT	GROSS DOLLAR VALUE OF CONTAINED METALS[1]
Porphyry Cu-Mo	BIG ONION	94 441 000 t[2]	$1150 Million (CDN)
Silver-Rich Polymetallic Veins	CRONIN	47 210 t[3]	$13 Million (CDN)

[1]Gross dollar value of metals in the ground before development, mining and extraction costs (net value of extracted metals will be considerably less): see Appendix A for an account of the metals present, the approximate quantities and their gross dollar value.
[2]Calculation by Stock (1977a)
[3]From Melville et al, (1992)

Although there is very good potential for additional copper-silver veins to be found, they are generally small and discontinuous and are not attractive exploration targets at this time.

Domain C has extreme potential (there are identified metal resources in the ground) for porphyry copper-molybdenum-gold-silver mineralization. The domain surrounds the Big Onion deposit and areas to the east and southeast which include one prospect and several alteration zones with high concentrations of copper, molybdenum and gold. The Big Onion deposit is a low-grade, large-tonnage deposit associated with a multiphase igneous pluton in the Astlais Mountain area (Figure 2) and has considerable size and potentially significant value (Table 1). Porphyry deposits have been a major focus of exploration and development in British Columbia in recent years. The proximity of the Big Onion deposit to the town of Smithers is advantageous: if development were to proceed, exploration and development costs could be moderate while the capital invested would boost the local economy.

The present boundary of the Babine Mountains Recreation Area cuts through the middle of the Big Onion deposit (Figure 1) which would make further development of this deposit unlikely. A proposed modification to the boundary excludes the Big Onion deposit and a buffer zone, and recommends the addition of a comparable-sized area of pristine alpine meadow and wetland at the headwaters of Harold Price Creek at northwest end of the recreation area. This latter area has a low mineral potential.

INTRODUCTION

BACKGROUND

The Babine Mountains Recreation Area covers much of the southern part of the Babine Range, 15 kilometres northeast of the town of Smithers in west-central British Columbia (Figure 3). Before the arrival of Europeans, the Babine Range marked the boundary between the territories of the Na'doet'en (Babine People) to the east and the Wet'suwet'en (People of the Watsonquah) to the west (L'Orsa, 1990). The name Babine (French for "hanging lip") was applied by voyageurs of the North West or Hudson's Bay Companies to the lake, river and neighbouring mountains frequented by Indians that wore ornaments (generally wooden labrets) in the lower lip (Dawson, 1881).

The region has an exploration and mining history that began early in the century, and has included base and precious metal production from several mines. Numerous roads and trails within the recreation area were originally built to provide access to mineral deposits in alpine regions; in some cases the cost of trail building was subsidized by the British Columbia government. Many of these trails are still used by both prospectors and hikers to reach the high country.

The region covered by the recreation area was initially within the bounds of the much larger Babine Mountains Integrated Management Unit created in September, 1976 to ensure better land management and to limit the use of all-terrain vehicles in these alpine and subalpine areas. An exception to this was the creation of a special zone in the Ganokwa basin to allow for snowmobiling during winter months (Babine Master Plan Study Team, 1991).

The Babine Mountains Recreation Area was established in April, 1984 as a step towards formal park status, and comprises approximately 32 400 hectares of territory that ranges in elevation from 1065 to 2385 metres above sea level (Figure 3). The boundary was drawn to exclude most of the peripheral land generally lower than 1370 metres elevation where there are stands of commercial timber, thereby avoiding conflict with the forest industry (Babine Master Plan Study Team, 1991). The southern most boundary of the recreation area was deliberately positioned to include Astlais ("Big Onion") and "Little Onion" mountains south of Ganokwa basin, but in doing so unintentionally bisected the Big Onion copper-molybdenum-gold-silver deposit.

The recreation area is open to 1-post claim staking and mineral exploration, as provided for in Section 19 of the *Mineral Tenure Act*. The use of motorized vehicles is strictly prohibited, except under special permit. Snowmobiling, however, is still permitted in the Ganokwa Basin.

SCOPE OF PRESENT STUDY

The British Columbia Ministry of Environment, Lands and Parks (M.E.L.P.) has proposed to upgrade the Babine Mountains Recreation Area to full Class A provincial park status to provide for increased protection of its scenic and wildlife resources and to establish official park boundaries. However, current government policy states that land will not be excluded from the mineral exploration land-base before the mineral resource potential has been evaluated. Thus, in accordance with the formal request of the M.E.L.P., the Geological Survey Branch (G.S.B.) of the Ministry of Energy, Mines and Petroleum Resources has conducted a mineral resource assessment of the recreation area. The field-based component of the project was carried out by a helicopter-supported two-person crew during late July and early August, 1991. Office-based research, compilation and writing continued into the spring of 1992.

The program was designed to augment geological mapping and metallogenic studies in the area by MacIntyre *et al.* (1987) and MacIntyre and Desjardins (1988a, b, and unpublished data): their geological map and database provided the foundation for the project. The north part of the recreation area not included in previous mapping programs was examined during this study, including a small region northwest of the recreation area near the headwaters of Harold Price Creek (Figure 3).

Regionally extensive belts of pyritic and limonite-stained altered rocks were examined and sampled. Rocks with anomalous precious metal concentrations, as identified by previous studies (MacIntyre and Desjardins, 1988b), were re-examined and sampled. Stream-sediment and water samples were collected to supplement the existing Regional Geochemical Survey database for the area.

Field studies also included examination of selected metallic mineral prospects and deposits and general prospecting in areas of favourable geology. During the program three previously undocumented polymetallic vein occurrences were found: these are the Silver King

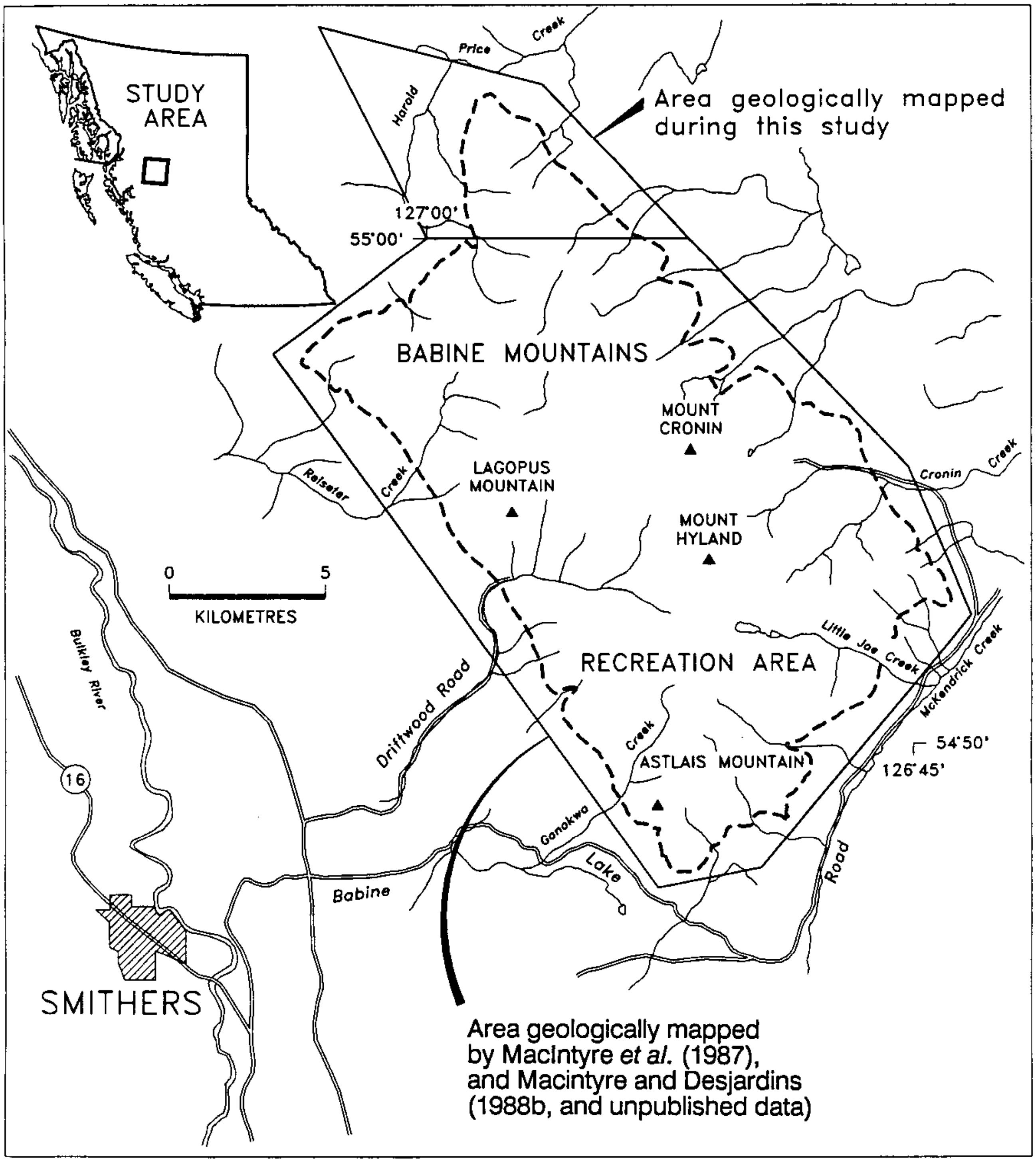

Figure 3. Location of the Babine Mountains Recreation Area (parts of 93L/14E, 15W and 93M/2W), west-central British Columbia.

Lake, Rhyolite and Little Joe Lake South showings. These new showings were mapped in some detail and sampled (Gaba *et al.*, 1992).

PHYSIOGRAPHY AND ACCESS

The Babine Mountains Recreation Area is within the southernmost part of the Skeena Mountains. The Babine Range includes the discontinuous system of mountains that occupies the area between the confluence of the Babine River with the Skeena River and the confluence of the Morice and Bulkley rivers. The recreation area covers most of the southern part of the Babine Range, sometimes referred to as the Cronin Range. The Telkwa Range of the Hazelton Mountains lies to the southwest, beyond the valley of the Bulkley River; to the east is the Nechako Plateau (Holland, 1964).

The Babine Range has been glaciated and eroded, and incised by creeks that flow east to Babine Lake or west to the Bulkley River, both eventually draining into the Skeena River. Perennial snowfields and glaciers are present at higher elevations, supplying meltwater to alpine lakes and streams. Timberline is at about 1500 metres elevation, below which the slopes are heavily timbered with spruce, balsam and poplar.

The main road into the region is the Yellowhead Highway 16, which follows the Bulkley Valley from Houston through Telkwa, Smithers and north to New Hazelton (Figure 3). The recreation area may be reached from Smithers by means of the Babine Lake road and gravel four-wheel-drive roads, which include the Driftwood Creek, Onion Mountain and Cronin Creek Higgins Creek roads: access to the interior of the recreation area is restricted by gates placed at the boundary. A network of hiking trails crosses the southern part of the area and includes the Silver King basin - Cronin Creek trail and the McCabe/Lyons Creek - Little Joe Creek trail system (Blix, 1977). The northwest part of the recreation area, adjacent to Reiseter Creek, is traversed by the Reiseter Lakes trail, whereas the region to the north and east of Reiseter Lakes has no established trails. Helicopter companies, operating out of Smithers, which hold a valid Resource Use Permit for commercial flights within the recreation area provide charter service to more remote regions.

ACKNOWLEDGMENTS

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The author also thanks the professional staff of the Geological Survey Branch and in particular M.L. Malott and D.V. Lefebure for information and assistance. Stream-sediment samples were collected by J.L. Gravel of Bonaventure Management Services. T. Brooks and L. Ledoux of Canadian Helicopters in Smithers provided safe and punctual helicopter service during field studies.

Critical reviews of this report by B. Grant, J.M. Newell, G.P. McLaren and W.J. McMillan greatly improved the focus of its content.

GEOLOGY OF THE BABINE MOUNTAINS RECREATION AREA

The region covered by the Babine Mountains Recreation Area is part of the Stikine Terrane and is underlain by: subaerial to submarine volcanic, volcaniclastic and sedimentary rocks of the Early to Middle Jurassic (*see* Appendix B) Hazelton Group; sedimentary rocks of the Middle to Late Jurassic Bowser Lake Group and Early Cretaceous Skeena Group; and calcalkaline continental volcanic-arc rocks of the Late Cretaceous Kasalka Group. Late Cretaceous to Early Tertiary volcaniclastic rocks occur locally (MacIntyre and Desjardins 1988a). Dikes and stocks of intermediate to felsic igneous rocks are Late Cretaceous to Tertiary in age (Figure 4 in pocket).

STRATIFIED ROCKS

HAZELTON GROUP

The Hazelton Group is an assemblage of continental to volcanic island-arc derivation and is divided into four geological formations: the Sinemurian or older Telkwa Formation, the Late Sinemurian to Pliensbachian Nilkitkwa Formation, the Toarcian to Bajocian Eagle Peak formation (informal) and the Middle Toarcian to Early Callovian Smithers Formation (MacIntyre and Desjardins, 1988a, b; Figure 4).

The Telkwa Formation consists of subaerial and submarine pyroclastic rocks and volcanic flows, with minor intercalated sedimentary rocks, and is the thickest and most extensive formation of the Hazelton Group. The Telkwa Formation within the study area comprises dacitic to basaltic flows and pyroclastic rocks, including massive to amygdaloidal basalt. These rocks are conformably to disconformably overlain by shale, siltstone, conglomerate and minor limestone of the Nilkitkwa Formation. Distinctive brick-red to maroon ash, crystal and lapilli tuff and related epiclastic rocks (with subordinate amygdaloidal basalt) of the Eagle Peak formation overlie the Telkwa Formation and part of the Nilkitkwa Formation (to which the Eagle Peak formation was previously assigned). The Smithers Formation includes fossiliferous feldspathic sandstone and siltstone representative of a marine transgressive sequence that onlaps older volcanic rocks: this is seen in the Higgins Creek area where rocks of the Smithers Formation rest disconformably on amygdaloidal basalt flows of the Eagle Peak formation.

BOWSER LAKE GROUP

The Bowser Lake Group is a series of marine to nonmarine sedimentary rocks which conformably overlie the Smithers Formation. Rocks of the Bowser Lake Group within the study area are represented by the Ashman Formation of predominantly Callovian age, the lowermost part of the Bowser Lake Group (MacIntyre and Desjardins, 1988a, b; Figure 4). The Ashman Formation consists of dark grey siltstone and black argillite, with lesser feldspathic and quartzose sandstone: these rocks are generally phyllitic and tightly folded, and in the absence of fossils are correlated on the basis of stratigraphic position and lithology.

SKEENA GROUP

The Skeena Group is a conformable sequence of Early Cretaceous marine and nonmarine sedimentary and volcanic rocks divided into the Kitsuns Creek, Rocky Ridge and Red Rose formations (informal) (MacIntyre and Desjardins, 1988a, b; Figure 4). These rocks generally do not contain age-diagnostic fossils and are assigned to these formations on the basis of lithology and stratigraphic position. They occur as fault-bounded blocks or as isolated exposures that unconformably overlie Hazelton Group (and possibly Bowser Lake Group) rocks throughout the study area. The Kitsuns Creek formation consists of quartz-pebble and chert-pebble conglomerate, sandstone and shale; these rocks are Neocomian in age if correlation with the type locality is valid. They are overlain by green, red and grey andesitic to basaltic augite-phyric flows and related pyroclastic rocks of the Rocky Ridge formation. Shale, siltstone, micaceous wacke and conglomerate of the Red Rose formation probably sit conformably on volcanic rocks of the Rocky Ridge formation.

KASALKA GROUP

Rocks of the Kasalka Group are exposed in the core of the study area and unconformably or structurally overlie the Skeena Group and older rocks; the Kasalka Group is divided into a lower and upper division (MacIntyre and Desjardins, 1988a, b; Figure 4). The lower division (uKK1) includes heterolithic volcanic conglomerate and breccia, volcanic wacke and tuff, feldspar and augite-phyric amygdaloidal and vesicular flows, air-fall lapilli and crystal tuff and associated epiclastic rocks. The upper division (uKK2) is mainly massive flows of hornblende-feldspar-phyric andesite with related breccias and sub-volcanic intrusions: the contact with volcaniclastic rocks of the lower division is not well exposed but is assumed to be conformable. Rocks of the lower division are probably representative of explosive subaerial volcanism and caldera subsidence, with the upper division a subsequent period of lava eruption and volcanic cone development.

Late Cretaceous to Early Tertiary Rocks

Two fault-bounded panels of bedded tuffaceous and argillaceous rocks northwest of Mount Cronin rest directly on coarse-grained feldspar porphyry (MacIntyre and Desjardins, 1988a, b; Figure 4): the contact is an erosional surface and the rocks appear to have been deposited directly onto the porphyry body. These rocks are thought to be Late Cretaceous or Early Tertiary in age.

PLUTONIC ROCKS

Igneous intrusions within the study area include rhyolite, diorite and granitic rocks (MacIntyre and Desjardins, 1988a, b; Figure 4). They are considered to be part of a Middle Eocene suite known as the Nanika intrusions (Carter, 1981).

Rhyolite and diorite dikes and plugs cut rocks that fringe the region underlain by Late Cretaceous volcanic rocks of the Kasalka Group, centred on Mount Cronin. Rhyolite spatially associated with polymetallic veins along the east side of the study area (such as those at the Cronin mine and Lorraine and Rhyolite prospects) is quite commonly deformed within enclosing Jurassic rocks, suggesting an older age than rhyolite in the Kasalka Group. Rhyolite north of Lagopus Mountain and east of Mount Cronin cuts foliated Early and Upper Cretaceous rocks and therefore post-dates mid-Cretaceous folding and shearing.

Multiphase intrusions are exposed southeast of Astlais Mountain and include quartz feldspar porphyry, quartz diorite porphyry and diorite.

STRUCTURAL GEOLOGY

The structural setting of the Babine Range is similar to that of the basin-and-range physiographic province of the southwest United States. The region is dominated by a series of northwest-trending tilted horsts and grabens: blocks are stepped downwards towards the northwest, where progressively younger stratigraphic levels are preserved (MacIntyre and Desjardins, 1988a, b; Figure 4). Structures within the fault blocks are characterized by asymmetric to overturned, southeast-plunging open folds that are truncated mainly by northeast-trending high-angle faults.

The earliest phase of deformation was probably related to regional compression during Late Cretaceous time, accompanied by folding and uplift. Regional extension is thought to have developed during Late Cretaceous to Early Tertiary time, coincident with extensive volcanism and stratovolcano development. Compression during Tertiary time caused reverse movement along pre-existing high-angle normal faults, and resulted in upward thrusting and folding of fault blocks. The latest event seems to be the development of major east to northeast-trending faults, also probably of Tertiary age, that truncate and offset the dominant northwest-trending structural fabric of the range (MacIntyre and Desjardins, 1988a).

The structural configuration of the region northwest of Mount Cronin seems to reflect volcanism that was active during the Late Cretaceous. The arcuate pattern of inward-dipping faults coincident with a network of radiating high-angle normal faults (Figure 4) may have been the result of volcanic eruption, followed by magma chamber evacuation and collapse (*i.e.*, the formation of a collapse caldera). Dikes of diorite and rhyolite that fringe the Late Cretaceous volcanic centre may have been intruded along peripheral ring fractures (MacIntyre and Desjardins, 1988).

APPRAISAL OF KNOWN MINERAL RESOURCES

EXPLORATION AND MINING: PAST AND PRESENT

Exploration for base and precious metals in the Babine Range has been ongoing since the turn of the century (Appendix C). Early efforts were focussed mainly on high-grade silver-rich veins. The construction of the Grand Trunk Pacific Railway up the Bulkley valley (1910-1914) provided the essential link to economically transport the metal ores to market. Horse trails or rough roads were built to the most promising prospects, and high-grade metal ores were packed out to the railway at Telkwa and shipped mainly to the smelter at Trail.

By 1950 many of the high-grade deposits had been worked on a small scale and had produced modest quantities of direct-shipping base and precious metal ores (Table 2). At about this time, a concentrator was built at the Cronin mine: lead and zinc concentrates (also containing considerable gold, silver, copper and cadmium) were shipped to Trail, and continued almost every year until it closed in 1974 (Table 2). Mineralized material remains underground at the Cronin mine and estimates have been made regarding the quantity present and its metal content (Table 3).

The early 1960s saw a resurgence of exploration interest focussed primarily on porphyry copper-molybdenum properties, particularly the Big Onion prospect. Considerable work has been done on this property, and important copper, molybdenum and precious metal resources have been identified (Table 3).

Mineral exploration interest remains high. Much of the recreation area is covered by mineral claims in good standing (as of September 25, 1991) over all of the known mineral prospects and deposits (Figure 5): most of these claims pre-date the establishment of the recreation area. Mineral claim types include: Crown grants, reverted Crown grants, 2-post and 4-post (modified grid system) claims recorded before the *Mineral Tenure Act* of 1988 was enacted, and 1-post claims subsequent to the Act. The recreation area is presently open to 1-post claim staking; mineral exploration requires a permit, with conditions jointly set by the Ministries of Energy, Mines and Petroleum Resources, and Environment, Lands and Parks.

MINERAL DEPOSIT TYPES

There are three distinct types of mineral deposits within the Babine Mountains Recreation Area: porphyry copper-molybdenum deposits associated with quartz-feldspar porphyry and quartz-diorite porphyry intrusions, silver-rich polymetallic veins and basalt-hosted copper-silver veins (Table 4). Certain rocks within the study area have the potential to host polymetallic massive sulphide mineralization, as at the Ascot prospect (MINFILE 093L 024) 6 kilometres southeast of the recreation area. There is no known occurrence of polymetallic massive sulphide within the study area, but it is nevertheless considered an important deposit type for evaluation of mineral resource potential (Table 4).

The majority of mineral occurrences within the recreation area are silver-rich polymetallic veins (Table 5), seven of which are past producers and form a belt across the central part of the study area (Figure 6). Basalt-hosted copper-silver veins cluster mainly in the southwest, whereas porphyry copper-molybdenum prospects are almost exclusively in the south. The northern part of the recreation area is almost completely devoid of mineral occurrences (Figure 6).

Detailed geological descriptions (including production and exploration histories) of all mineral prospects within the Babine Mountains Recreation Area are included in the Ministry of Energy, Mines and Petroleum Resources computerized mineral inventory database (MINFILE) for the Smithers map sheet (NTS 093L). These data are available in hard-copy print-outs or in digital format (standard ASCII format files) on 5 inch floppy diskettes, from Crown Publications Incorporated, Victoria, B.C.

PORPHYRY COPPER-MOLYBDENUM DEPOSITS

Although porphyry copper-molybdenum deposits have not been historically important within the study area, they are the most promising mineral deposit type presently being evaluated.

THE BIG ONION DEPOSIT

The Big Onion prospect, a low-grade large-tonnage calcalkaline porphyry copper-molybdenum deposit, straddles the southern boundary of the recreation area on the south side of Astlais Mountain, 18 kilometres east of Smithers (Figure 6). The property is reached by the Bab-

TABLE 2

HISTORICAL METAL PRODUCTION FROM THE BABINE MOUNTAINS RECREATION AREA*

DEPOSIT TYPE	MINFILE # (093L)	PROPERTY NAME	PERIOD OF PRODUCTION	ORE MINED (TONNES)	GOLD (grams)	SILVER (grams)	COPPER (kg)	LEAD (kg)	ZINC (kg)	CADMIUM (kg)
Silver-Rich Polymetallic Veins	125	Silver Pick	1927, 1936, 1938	23	466	209 230	886	420	836	
	127	Cronin	1917, 1929, 1951-74	25 838	8 772	8 169 918	10 394	1 367 178	1 517 881	18 012
	128	Hyland Basin	1935, 1940	10	342	84 880		3 396	397	
	129	Lorraine	1917	6.4		19 448		3 175		
	201	Silver King	1917, 1927	12	62	41 865	107	3 490	348	
Basalt-Hosted Cu-Ag Veins	131	Drift	1915-18, 1927, 1971	23		132 779	4 711			
	132	Driftwood	1937, 1969	9	93	21 928	109	327	245	
TOTAL				25 921.4	9 735	8 680 048	16 207	1 377 986	1 519 707	18 012

*For details concerning past production *see* Appendix C

TABLE 3

ESTIMATES OF METAL RESOURCES WITHIN THE BABINE MOUNTAINS RECREATION AREA

DEPOSIT TYPE	MINFILE # (093L)	PROPERTY NAME	ESTIMATED RESOURCE TONNAGE	GOLD (g/t)	SILVER (g/t)	COPPER (%)	LEAD (%)	ZINC (%)	MOLYBDENUM (%)
Porphyry Cu-Mo	124	Big Onion	34 790 000 t (indicated)[1] 59 624 000 t (inferred)[1] 94 414 000 t (total)			0.42			0.012
			31 760 000 t (supergene only)[2]	0.064[3]	1.0[3]	0.34[4]			
Silver-Rich Polymetallic	127	Cronin	47 210 t (unclassified)[5]	1.7	428	0.16	8.0	8.0	

[1]Calculations by Stock (1977a)
[2]Estimate of supergene mineralization by McCrossan (1991), being part of the total resource estimate as calculated by Stock (1977a)
[3]Average precious metal content of supergene mineralization (McCrossan, 1991)
[4]A cut-off grade of 0.15 per cent total copper was used in the calculation of the supergene mineralization estimate (McCrossan, 1991)
[5]From Melville et al.,(1992)

TABLE 4

IMPORTANT MINERAL DEPOSIT TYPES WITHIN AND ADJACENT TO THE BABINE MOUNTAINS RECREATION AREA

SYMBOL[1]	DEPOSIT TYPE	METAL ASSEMBLAGE	METALLIC MINERALS	TEXTURES AND STRUCTURES	HOSTROCKS	ALTERATION
●○	Porphyry Cu-Mo	Cu, Mo: (Au, Ag)	cpy, mo, py, cc, cv	stockwork, breccia, veins, disseminations	quartz feldspar porphyry (qfp); quartz diorite porphyry (qdp); diorite (dr)	sericitic, propylitic, silicic, argillic
■□	Silver-Rich Polymetallic Veins	Ag, (Au), Pb, Zn; Cd, Cu, (As, Sb)	py, sp, gn, cpy, boul, tet; apy, frei, po, (native Au)	simple to complex multiphase quartz-sulphide veins; massive veins; breccia zones; fracture fillings; replacements; disseminations	rhyolite porphyry, dacite (rh); argillite, phyllite (muJA); andesite porphyry (uKK1, uKK2)	silicic
▲△	Basalt-Hosted Cu-Ag Veins	Cu, Ag, (Au), Pb, Zn	cpy, born, tet; cc, cv, mal, az (sp, gn)	sheeted quartz veins; silicified zones; breccia zones; disseminations; stockwork	amygdaloidal basalt, basaltic tuff, basaltic andesite, volcanic breccia (lJT, lJTb)	propylitic, argillic
N/A	Polymetallic Massive Sulphides[2]	Zn, Pb, Ba, Cu; As	py, sp, gn, ba; tet	strata-bound massive lenses; disseminations; fracture fillings	limy siltstone, felsic tuff; argillite (lJN); amygdaloidal basalt (lJT, lJTb)	

[1]Different deposit types are represented by symbols on Figure 4
[2]Although there are no known polymetallic massive sulphide prospects within the Babine Mountains Recreation Area, this deposit type occurs only 5 kilometres southwest of the study area in similar stratigraphy and is an important mineral deposit type to consider for a complete understanding of the mineral resource potential of the region.

Abbreviations: apy = arsenopyrite, az = azurite, ba = barite, born = bornite, boul = boulangerite, cc = chalcocite, cpy = chalcopyrite, cv = covellite, frei = freibergite, gn = galena, mal = malachite, mo = molybdenite, po = pyrrhotite, py = pyrite, sp = sphalerite, tet = tetrahedrite.

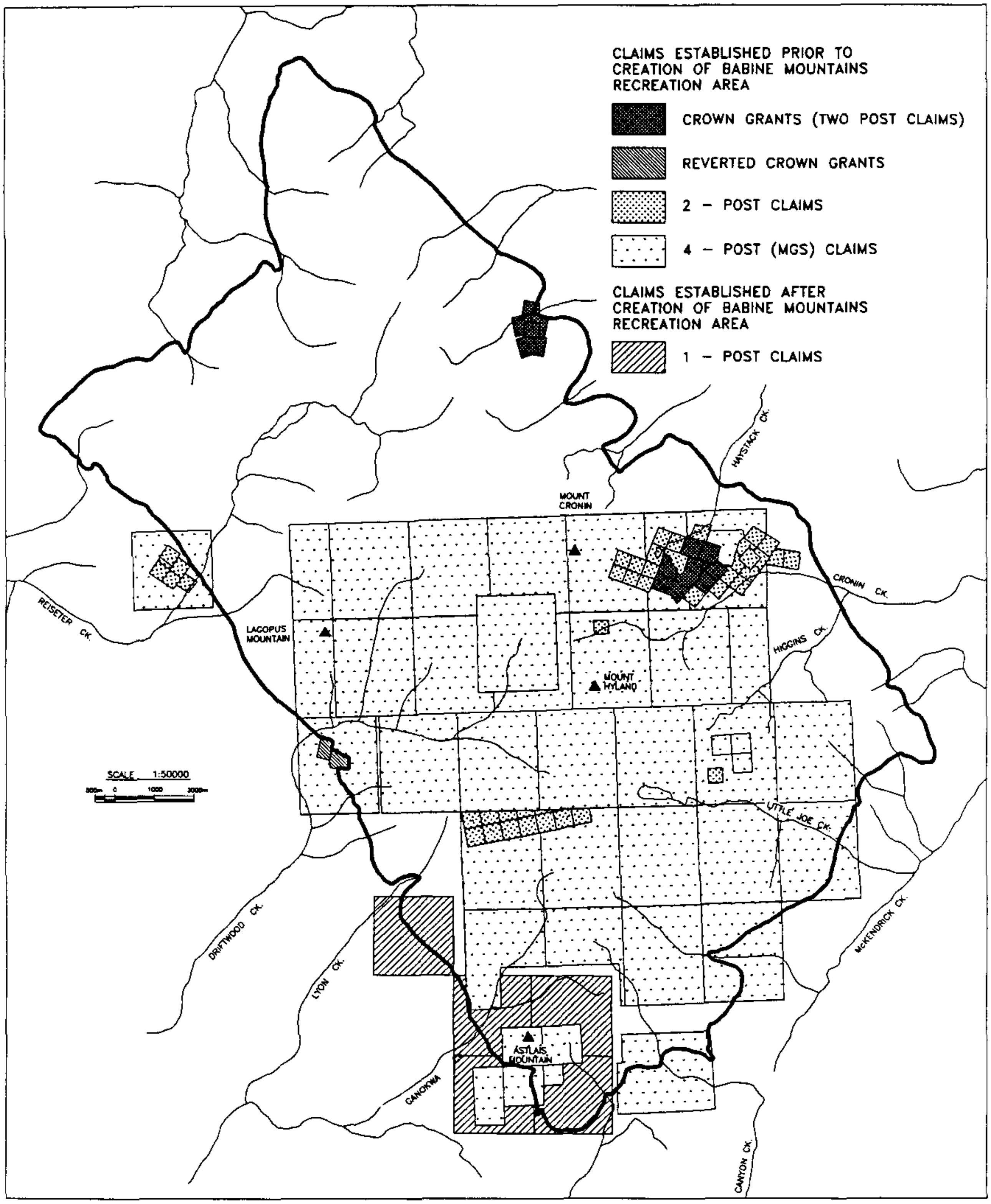


Figure 5. Mineral tenure in the Babine Mountains Recreation Area (as of September 25, 1991).

TABLE 5
KNOWN METALLIC MINERAL OCCURRENCES WITHIN THE BABINE MOUNTAINS RECREATION AREA

DEPOSIT TYPE	MINFILE # (093L)	PROPERTY NAME	COMMODITIES	PROPERTY STATUS
Porphyry Cu-Mo	124	Big Onion	Cu,Mo,[Au,Ag]	developed prospect
	126	Mert	Cu,Mo,[Ag]	showing
	252	Fisher	Cu	showing
Silver-Rich Polymetallic Veins	125	Silver Pick	Ag,[Au],Cu,Zn;Pb	past producer
	127	Cronin	Ag,[Au],Pb,Zn;Cd,Cu	past producer
	127A	Upper Showing	Ag,[Au],Pb,Zn;Cd,Cu	showing
	128	Hyland Basin	Ag,[Au],Pb;Zn	past producer
	129	Lorraine	Ag,Pb;Zn,Cu	past producer
	138	AG	Ag,Pb;Zn	showing
	139	Reiseter Creek	Cu,Pb;Zn	showing
	140	Debenture	Ag,Pb,Zn	prospect
	200	Silver Saddle	Ag,Au,Pb;Cu	showing
	201	Silver King	Ag,[Au],Pb;Zn,Cu	past producer
	249	Native	Ag,Pb,Zn	showing
	316	Silver King Lake	Ag,[Au],Pb,Cu,Zn;Cd	showing
	317	Rhyolite	Au,Ag,Cu;Pb,Zn,Cd	showing
	318	Little Joe Lake South	Ag,[Au],Pb,Zn;Cu,Sb	showing
Basalt-Hosted Cu-Ag Veins	130	Jud	Cu,Ag	showing
	131	Drift	Cu,Ag;Pb	past producer
	132	Driftwood	Ag,[Au],Cu,Pb,Zn	past producer
	165	Shamrock	Ag,Cu	showing
	253	Home	Ag;Cu,Pb,Zn	showing
Unclassified	292	Viking	[Ag,Au]	showing

ine Lake road and a network of four-wheel-drive roads (established during the 1960s diamond drilling programs) that zig-zag up the creek valley to the mountain. The main zones of copper and molybdenum mineralization are within the creek valley between 1065 and 1675 metres elevation, with the bulk of the deposit below treeline (approximately 1460 metres elevation).

Exploration History

The history of exploration at the Big Onion property spans almost 75 years, and includes the efforts of many individuals and exploration firms. The following historical account is extracted from *B.C. Minister of Mines* Annual Reports (various years), Hanson (1925), Sutherland Brown (1967), L'Orsa (1990) and McCrossan (1991).

The original copper showings at the Big Onion were found by local prospector Axel Elmsted and his partners Tommy Haig and Ben Benson in 1917 and were staked as the Cimbria group the following year: they named the nearby iron-stained mountain the Big Onion (now called Astlais Mountain) in allusion to them "peeling the onion", or striking it rich. By 1924, a small camp had been built and two short adits were driven into the mountain side: a lower adit 50 metres long at 1150 metres elevation, and an upper adit 15 metres long at 1170 metres elevation. Mineralization exposed by the adits consisted of disseminated pyrite, chalcopyrite and malachite, with small gash veinlets containing quartz, pyrite, chalcopyrite and specularite. Analyses of samples returned small quantities of copper and traces of gold. Further exploratory work was done on the property by A. Elmsted and B. Mueller up to 1932.

The property remained dormant until 1964 when Jack Helmspeck Sr. restaked the property and optioned it to Noranda Exploration Company Limited. During 1964 and 1965, Noranda carried out mapping and geochemical sampling programs, electromagnetic surveys, bulldozer stripping and 76 metres of diamond drilling in two holes before dropping the option.

In 1965, the Texas Gulf Sulphur Company optioned the property and during 1966 and 1967 completed detailed geological, geochemical, and induced polarization and resistivity surveys, more than 900 metres of bulldozer stripping, and 1217 metres of diamond drilling in seven holes. During this period, claims to the east of the Big Onion (to be later known as the Mert property) were staked by Tro-Buttle Exploration Limited and soil geochemical surveys were conducted as part of the exploration for copper and molybdenum mineralization. The mid-1960s was also a time when many other major exploration companies were busy exploring for porphyry copper in the area: results of these efforts include the discovery of the Bell Copper deposit, as well as other important prospects in the Babine Lake area.

In 1970 and 1971, Blue Rock Mining Corporation Limited/Cyprus Anvil Mining Corporation obtained an option on the Big Onion property and completed 7358 metres of diamond drilling in twenty-two holes.

From 1974 to 1977, Canadian Superior Exploration Limited conducted geological and geophysical surveys on the Big Onion claims and drilled 5003 metres in 67 per-

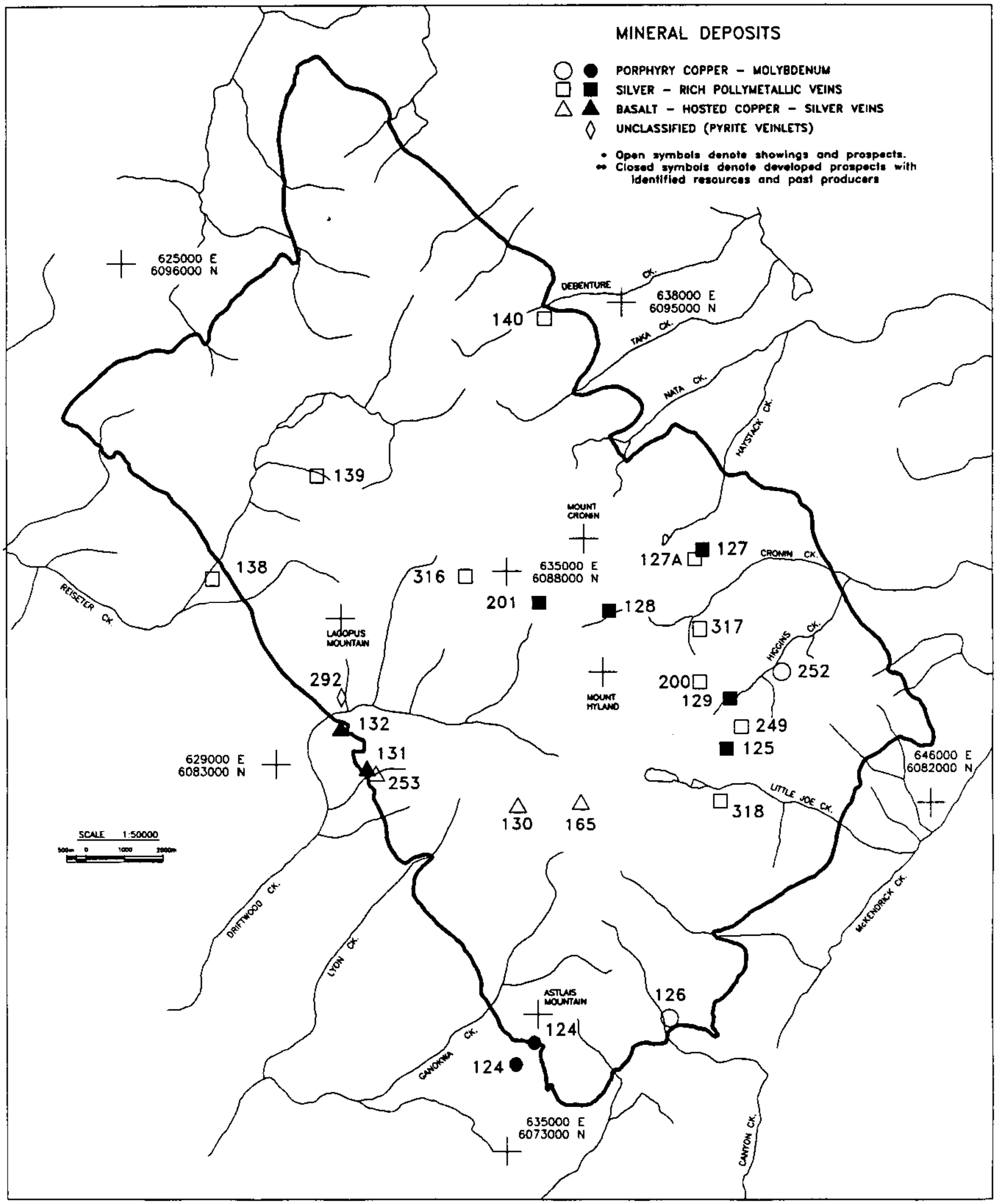


Figure 6. Distribution of mineral occurrences in the Babine Mountains Recreation Area according to mineral deposit type (*see* Table 4): open symbols designate showings or prospects, closed symbols designate developed prospects with identified resources or past producers.

cussion holes and 3058 metres in 21 diamond drill holes. In 1982, the property reverted back to Jack Helmspeck Jr.

Mindoro Corporation optioned the Big Onion property from Jack Helmspeck Jr. in 1990 and Varitech Resources Limited acquired an interest in the property early in 1991. The 1991 diamond drilling program by Varitech consisted of eight holes totalling 1696 metres, and outlined the extent of the supergene (or secondary enrichment) zone as well as the depth of hypogene (or primary) mineralization (McCrossan, 1991).

Geology and Mineralization

Early descriptions of the geology of the Big Onion property include those by Sutherland Brown (1967) and Schroeter (1977a). Mineralization is associated with an irregular northeast-trending stock of quartz-feldspar porphyry (with a core of quartz-diorite porphyry) that intrudes amygdaloidal basalt of the Early Jurassic Telkwa Formation and sedimentary rocks of the Early Jurassic Nilkitkwa Formation (Figure 4). A post-mineralization dike of quartz monzonite porphyry cuts the plutonic rocks southwest of the main concentration of metals: biotite extracted from this dike gave a potassium-argon isotopic age of 48.7±1.9 million years, or an Eocene age (Carter, 1981). The host intrusions of the Big Onion deposit appear to have been emplaced along a northeast-trending fault, subsequently transected and offset by northwest-trending structures (Figure 4): the quartz monzonite porphyry dike appears to occupy late north-trending structure.

Hypogene mineralization consists of disseminated and fracture-controlled chalcopyrite and molybdenite, associated mostly with altered quartz-feldspar porphyry but also with the margins of the altered quartz-diorite porphyry and adjacent altered basalt. Supergene mineralization, most important in the north part of the deposit, consists of chalcocite and covellite, with subordinate bornite and rare native copper (Stock, 1977a; McCrossan, 1991).

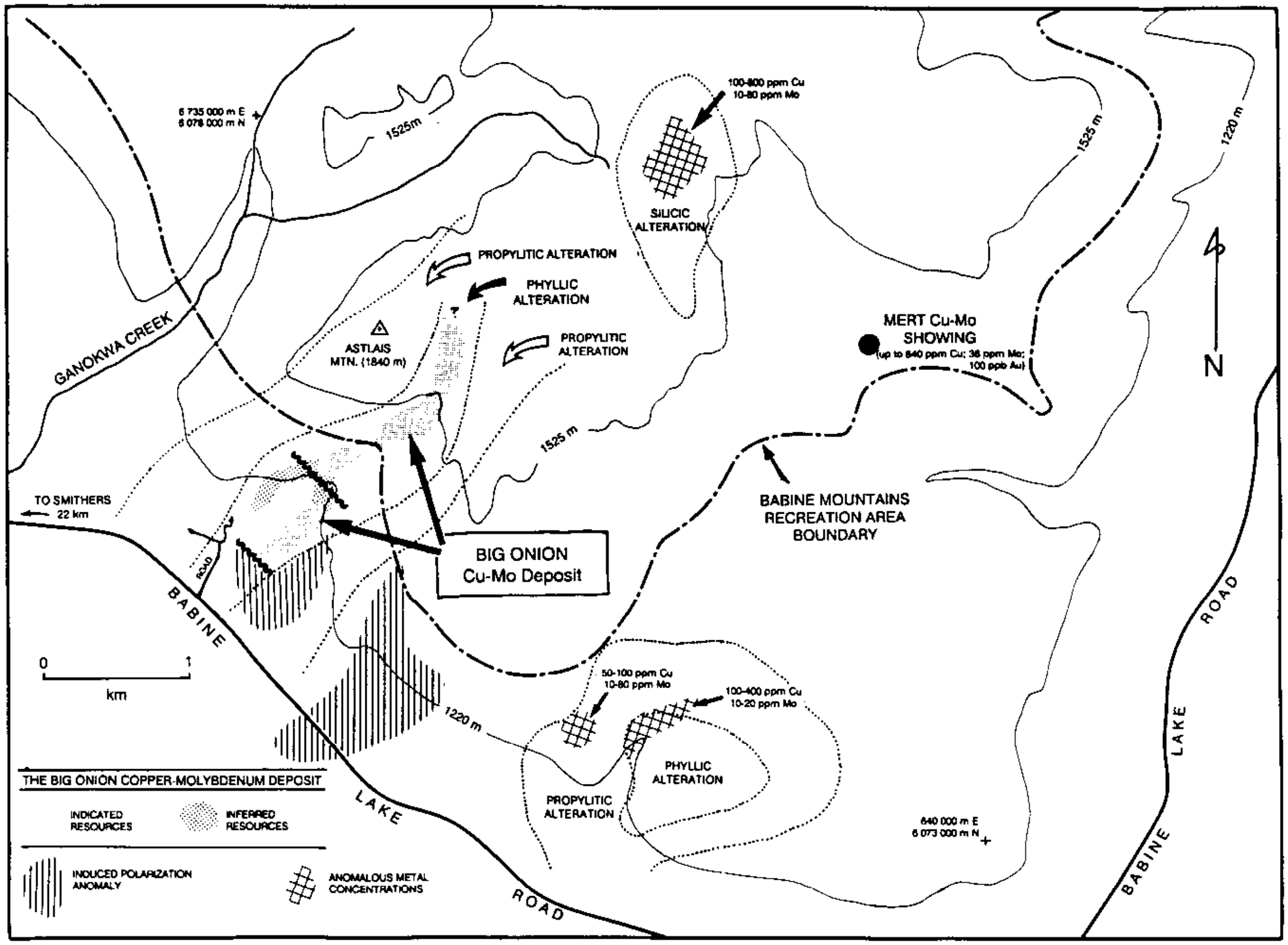


Figure 7. The southern part of the Babine Mountains Recreation Area; distribution of metal resources and alteration at the Big Onion deposit, geophysical anomalies adjacent to the deposit, and anomalous metal concentrations associated with alteration zones nearby [compiled from Depaoli (1977), Stock (1977b) and McCrossan (1991)].

Hostrocks to the metal concentrations, as well as adjacent country rocks, are hydrothermally altered: mineralization is coincident with a phyllic alteration zone characterized by sericite and local quartz stockwork. Propylitic-altered rocks, defined by epidote-calcite-chlorite alteration mineral assemblages fringe the phyllic zone (Figure 7; Stock, 1977a). Pyrite is ubiquitous within and adjacent to the deposit and locally reaches concentrations of 10 per cent. A natural process, oxidation of the pyrite by near-surface groundwater, produces sulphuric acid which tends to acidify streams that drain the valley and leach metals from rocks above the groundwater table. Metals deposited from these solutions have enriched the mineralization just below the groundwater table and have formed the supergene enrichment zones.

Identified Metal Resources and Potential Exploration Targets

In 1977, Canadian Superior calculated a potential resource estimate utilizing 16 707 metres of combined percussion and diamond drill data from the Big Onion deposit (Stock, 1977a; Table 3). Recent work by Varitech has outlined the extent of supergene mineralization and its average gold and silver contents (McCrossan, 1991; Table 3). At present metal prices, the gross dollar value of metal in-the-ground at the Big Onion deposit is estimated at more than $1.1 billion (Appendix A).

Indicated metal resources at the Big Onion deposit are elongate zones that trend northeast coincident with the local structural setting (Figure 7). The apparent dislocation of the two main zones is probably due to late faulting: the area adjacent to the offset contains inferred resources and requires further evaluation to confirm the presence of economic metal concentrations (Figure 7). A northeast extension to the indicated resources has not been explored: silicic altered rocks 1.5 kilometres farther to the northeast with up to 800 ppm copper and 80 ppm molybdenum suggests excellent potential for additional metals along strike of the deposit.

The southwestern extension of the deposit appears to have been truncated or offset by a fault. Because of the lack of exposed rock and the extensive overburden, geophysical techniques, such as induced polarization (I.P.) surveys, have been conducted in the search for a possible extension to the Big Onion deposit, or additional similar mineralization (Figure 7). The I.P. anomalies south of the Big Onion deposit are interpreted to indicate the presence of sulphide mineral concentrations at depth (Depaoli, 1977). These anomalies are considered to be viable exploration targets, but have not yet been tested by diamond drilling.

Porphyry copper-molybdenum mineralization also occurs at the Mert showing, three kilometres northeast of the Big Onion property (Figure 7). Amygdaloidal basalt of the Telkwa Formation is intruded by a small, elongate stock of quartz diorite which contains minor chalcopyrite, pyrite and molybdenite in hairline fractures and quartz veinlets (Guardia, 1970). Anomalous concentrations of copper and molybdenum were first identified by soil and rock geochemical surveys conducted on the claims in 1967 and 1968 by Tro-Buttle Exploration Limited: rock chip samples contain up to 840 ppm copper, 38 ppm molybdenum and 100 ppb gold (Dirom, 1969). A follow-up magnetometer survey by Tro-Buttle in 1970 suggested that the quartz diorite is much more extensive beneath the overburden than previously thought. However, the quartz diorite has not been tested by diamond drilling. The similarity in geological setting and character of the Big Onion and Mert prospects are apparent: any correlation between the two properties, however, is hindered by the lack of outcrop in the intervening area.

The large diorite body south of the Mert property and southeast of the Big Onion property (Figure 4) has a central core of phyllic altered rocks surrounded by propylitic altered rocks (Figure 7; Stock, 1977b). Rock geochemical surveys by Canadian Superior Exploration Limited revealed the presence of up to 400 ppm copper and 80 ppm molybdenum at several locations within the altered zones, but no follow-up work was done.

The potential for additional porphyry copper-molybdenum mineralization within the southern part of the Babine Mountains Recreation Area (between the Big Onion and Mert properties and the large diorite stock) is high (Figure 7): additional geological and geophysical exploration is required to test this poorly-exposed area for concealed metal resources.

Silver-Rich Polymetallic Veins

Most of the metal production in the study area has come from silver-rich polymetallic veins (Tables 2, 5), with the Cronin being the only deposit large enough to warrant its own milling facilities. Silver-rich polymetallic veins are mineralogically complex and consist usually of two or more base metal sulphide and sulphosalt minerals in a quartz (±carbonate) gangue (Table 4). Metals sought were primarily silver (contained as a component in some of the metallic minerals), with significant gold, lead, zinc, copper and cadmium.

These veins are commonly discordant to hostrocks, irregular in attitude and continuity, and pinch and swell along their length. These characteristics make economic assessment difficult without underground exploration. In the early days of mining, adits and drifts were driven along the veins, and small orebodies were encountered where the veins swelled to greater thicknesses.

THE CRONIN MINE

The Cronin mine is on the east flank of Mount Cronin, approximately 28 kilometres northeast of Smithers (Figures 4 and 6). The property is reached by the Babine Lake road and a narrow rough road up the valley of

Cronin Creek. The Cronin mine was the most significant producer of metals in the study area (Table 2). The extensive polymetallic vein system was developed over 60 years by workings that extend more than 170 metres vertically and about 220 metres laterally: development on three levels totals about 1160 metres of drifts and crosscuts and 365 metres of raises (Livgard, 1973).

Exploration and Development History

The Cronin deposit was the first important discovery in the southern Babine Range and drew much attention to the region. Its history of exploration and development is drawn from several sources, including *B.C. Minister of Mines* Annual Reports (various years), Quin (1987) and L'Orsa (1990).

The Dibble showing (later to become known as the Babine Bonanza, or Cronin property) was discovered in 1905 by prospectors from Hazelton. In 1909, the claims were acquired by James Cronin and associates, and between 1910 and 1911 extensive underground exploration was carried out. Trails soon linked the property with Telkwa, Morricetown and the Hudson's Bay Company ranch on Driftwood Creek. Underground exploration resumed in 1914 and continued each summer until 1925, with small amounts of hand-cobbed ore shipped to Telkwa in winter by way of a newly-built sleigh road. The untimely death of James Cronin in 1925 postponed plans of constructing a mill at the mine site, and it was not until 1928 that the property was obtained from Cronin's estate by Babine Bonanza Metals Limited and work continued. By late 1931, conditions brought about by the depression halted further work.

Cronin-Babine Mines Limited was formed in 1948 and surface and underground diamond drilling was done. By 1951, a new road was constructed between the property and the Babine Lake road, and a small shipment of ore was made. The following year a 36 tonne-per-day mill was installed at the mine: 3185 tonnes of ore were processed and concentrate (containing silver, gold, lead, zinc, copper and cadmium) was shipped to the Trail smelter, but low metal prices forced the operations to close by the year's end. Work resumed in 1956 and 1957, and metal concentrates continued to be sent to Trail.

In 1958, the Cronin mine was leased from Cronin-Babine mines by Paul Kindrat: he eventually purchased the mine in 1970. Kindrat Mines Limited was truly a family operation, consisting of Paul as miner, and his wife Alice and kids in charge of the mill. The Kindrats made a living at the mine (and raised a family at the same time) making yearly shipments of metal concentrate to Trail until 1972 when the mine was sold to Hallmark Resources Limited.

Between 1973 and 1974, Hallmark Resources Limited refurbished the mill and camp, constructed a tailings disposal area, carried out underground and surface exploration (exposing the new Upper showing, or Wardell zone), mined and milled ore, and shipped metal concentrate. In 1975, the property was optioned to Coca Minerals Limited who conducted a diamond drilling program to assess the relationship of the Upper showing to the Cronin deposit and assess its open-pit potential. Additional diamond drilling was done in 1983 by Goldsil Mining and Milling Incorporated. Most recently in 1987, Southern Gold Resources Limited acquired an option on the property and carried out geological mapping and sampling over the whole property. The property has since been dormant.

Geology and Mineralization

The Cronin deposit consists of an array of polymetallic veins within a multiphase rhyolite rhyolite-porphyry plug or dome that has irregular borders into surrounding argillite, sandstone, conglomerate and sericite schist of the Middle to Late Jurassic Ashman Formation (Figure 4; Schroeter, 1977b). Several styles of mineralization comprise the deposit and include quartz-sulphide veins, massive sulphide veins, breccia zones, fracture fillings and disseminations. Metallic minerals are mostly sphalerite and galena, with pyrite, chalcopyrite, boulangerite, freibergite, tetrahedrite and arsenopyrite (Livgard, 1973). The major veins strike northeast and dip approximately 50 degrees to the northwest: some are up to 0.6 metres thick and continuous for as much as 75 metres along strike. Most of the veins are in a zone closely adjacent to the northwest margin of the rhyolite complex and many of the more productive veins are at the rhyolite-shale contact (Quin, 1987).

Similar mineralization has been exposed on surface on the Homestake claim to the southwest of the Cronin workings: this showing, known as the Upper showing (or Wardell vein), is regarded as part of the Cronin vein system. The Upper showing vein is 3 metres thick along a strike length of 95 metres (Livgard, 1973). In 1975, a surface diamond-drilling program designed to test the open-pit potential of the Upper showing (and presumably extensions of veins from the Cronin workings) succeeded in identifying a small high-grade deposit, but no large tonnage was outlined (Quin, 1987).

Identified Metal Resources

Several tonnage and grade estimates have been made of metal resources that remain underground within the Cronin mine and near surface at the Upper showing: these are tabulated by Quin (1987) but contain no indication as to how the calculations were done. The most reliable estimate at this time comes from data collected by MINFILE and the Smithers District Office (Melville *et al.*, 1992) as shown in Table 3. The resource estimate is based, to a large extent, on the amount of "mineable leavings" (McKinstry, 1948) that remain underground from previous operations. Assuming the resource estimate is accurate, the gross dollar value of metals in the ground at the Cronin deposit and Upper showing is estimated at more than $13 million (Appendix A).

Basalt-Hosted Copper-Silver Veins

Less productive although historically important mineral deposits are the basalt-hosted copper-silver veins (Table 4). These deposits, though generally small, are very rich in silver and copper (Table 2). Mineralization consists of irregular sheeted quartz veins, stringer zones and breccias, within amygdaloidal basalt and flow-top breccia of the Lower Jurassic Telkwa Formation. The veins contain an abundance of copper and silver-bearing sulphide and sulphosalt minerals as high grade pods and fracture fillings.

Basalt-hosted copper-silver veins are almost exclusively confined to rocks of the Telkwa Formation and may be informally referred to as stratabound deposits: they are likely products of late-stage volcanic-hydrothermal activity. Small copper-silver vein showings of this type are relatively abundant throughout rocks of the Telkwa Formation in the Telkwa and Babine ranges (D.G. MacIntyre, personal communication, 1991).

Polymetallic Massive Sulphide Deposits

As previously stated, there are no known polymetallic massive sulphide occurrences within the Babine Mountain Recreation Area, but is an important deposit type to consider for resource evaluation. Southeast of the study area at the Ascot prospect (MINFILE 093L 024), polymetallic massive sulphides are hosted by limy siltstone and felsic tuff of the Lower Jurassic Nilkitkwa Formation (MacIntyre *et al.*, 1987). The sulphide concentrations, which contain abundant base metals but only a trace of precious metals, occur as massive lenses to disseminations within the sedimentary rocks close to the underlying Early Jurassic Telkwa Formation basalts. The stratabound nature of the deposit and its proximity to volcanic rocks are characteristic of volcanogenic massive sulphide deposits. Comparable rock sequences, present within the study area (Figure 4), might also host similar metal concentrations.

POTENTIAL FOR UNDISCOVERED MINERAL RESOURCES

GENERAL STATEMENT

The field-based component of this study gathered information to help assess the potential for undiscovered mineral resources within the recreation area: the data collected augment that from previous studies (MacIntyre *et al.*, 1987; MacIntyre and Desjardins, 1988a, b). Although the region has been prospected and explored during the past 90 years, there is still the possibility that some mineral wealth has escaped detection. The goal here is to identify areas with significant mineral potential to ensure that the region is adequately tested before it is considered for reclassification as park land with no mineral exploration allowed.

The methods used in the field to identify areas of potential exploration interest include: geological mapping; lithogeochemical (rock-chip) sampling of almost all rock types represented in the study area, including zones of altered rocks; stream-sediment sampling; and prospecting of regions deemed favourable for mineral deposits based on information gathered from previously published literature, observations in the field, and personal communication with persons engaged or previously engaged in geological fieldwork in the area. Previously published data from geophysical surveys completed in the study area were also examined.

GEOLOGICAL MAPPING

The purpose of geological mapping is not only to document the nature, distribution and stratigraphic order of rocks, as well as their structural configuration, but also to evaluate their relationship to the various mineral resources they contain. In this way, areas of favourable geology for any particular mineral deposit type are outlined with reasonable confidence.

This project was fortunate to have access to recent data and maps, produced by a 1:20 000-scale geological mapping program that covered most of the study area (MacIntyre and Desjardins, 1988a, b and unpublished data). Geological mapping during the present study was limited to the northern part of the recreation area which was outside the area covered by the previous mapping program.

LITHOGEOCHEMICAL SAMPLING

A total of 239 rock samples was collected from the study area during previous (MacIntyre and Desjardins 1988a, b and unpublished data) and present investigations (Figure 8). These samples were analyzed for gold, silver, copper, lead, zinc, molybdenum, cadmium, arsenic and antimony (Appendix D). The database is augmented by lithogeochemical data from assessment work done by Canadian Superior Exploration Limited in the area of the Big Onion property (Stock, 1977b).

More than half the samples collected during this study were from regionally extensive pyritic and limonite-stained altered rocks that form spectacular red-brown gossans across the central part of the study area (Figure 9). These zones are essentially bleached sericitic schists and phyllites derived from volcanic and sedimentary rocks of the Late Cretaceous Kasalka Group. The rocks contain abundant disseminated pyrite, much of which has altered to limonite: oxidation of the pyrite to produce sulphuric acid has probably leached much of the original metal content from the rock. The rocks also exhibit breccia textures and are locally veined by quartz and epidote. The alteration zones, which are a few hundred metres thick, are semicontinuous for several kilometres along a west-northwest strike. They are coincident with shear zones of probable Late Cretaceous age that are truncated by northeast-trending Tertiary faults (Figure 4).

Most of the samples taken from the pyritic and limonite-stained altered rocks contain only background levels of base and precious metals. However, a previously undocumented polymetallic vein (the Silver King Lake prospect: Figure 6, Table 5) was found during the course of sampling (Gaba *et al.*, 1992). In addition, twelve samples contain anomalous metal concentrations (considered to be anomalous by visual inspection of the complete lithogeochemical database) indicative of silver-rich polymetallic veins (Appendix D). Further examination of smaller alteration zones of this type to the east resulted in the discovery of other polymetallic veins at the Little Joe Lake South prospect (Figure 6, Table 5; Gaba *et al.*, 1992). Thus, the sampling program confirmed the presence of at least scattered base and precious metal concentrations within the altered rocks. The altered rocks have not been tested at depth by diamond drilling and

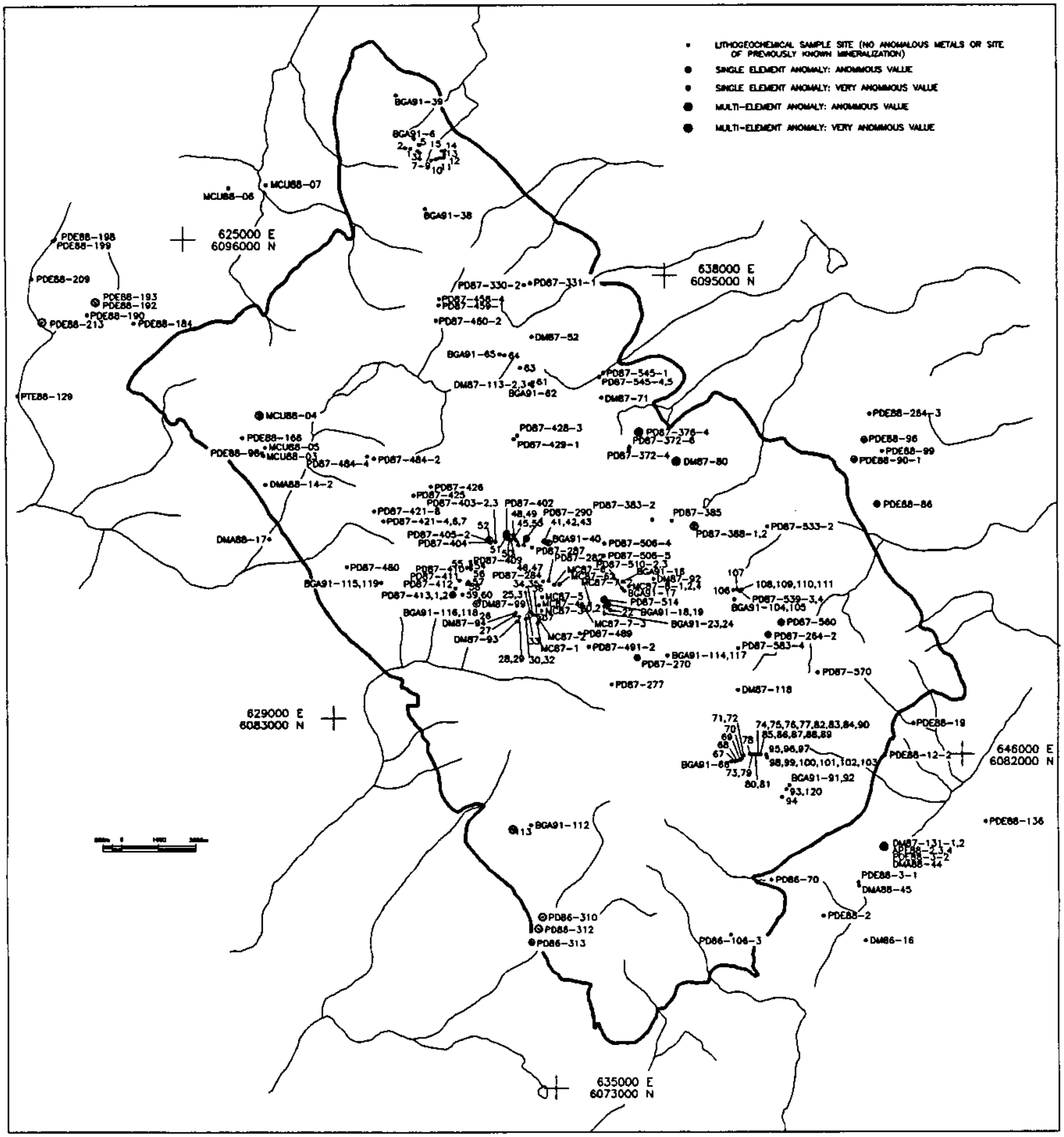


Figure 8. Lithogeochemical sample sites in the Babine Mountains Recreation Area.

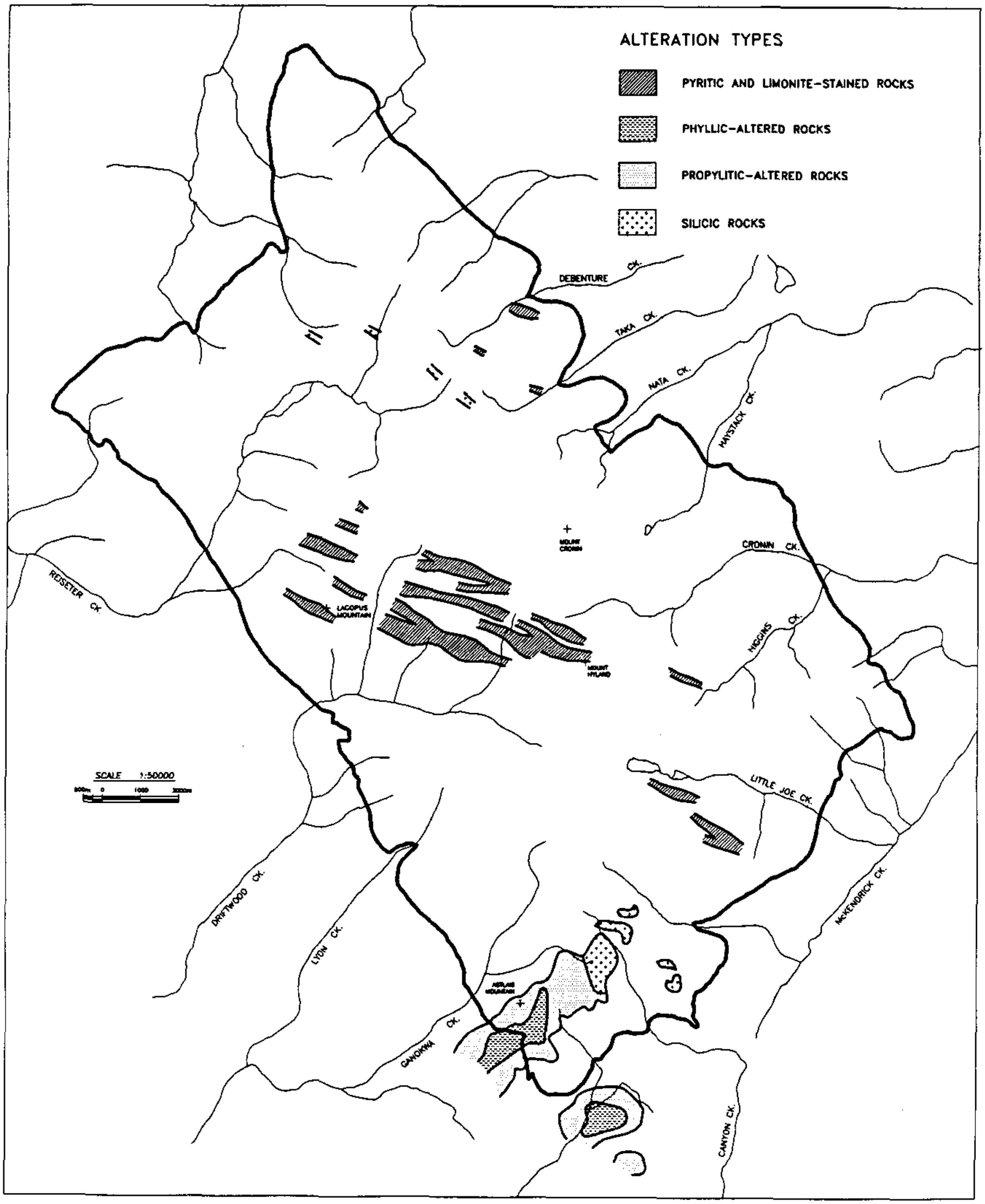


Figure 9. Distribution of altered rocks within the Babine Mountains Recreation Area [in part from Stock (1977b) and MacIntyre and Desjardins (1988b)].

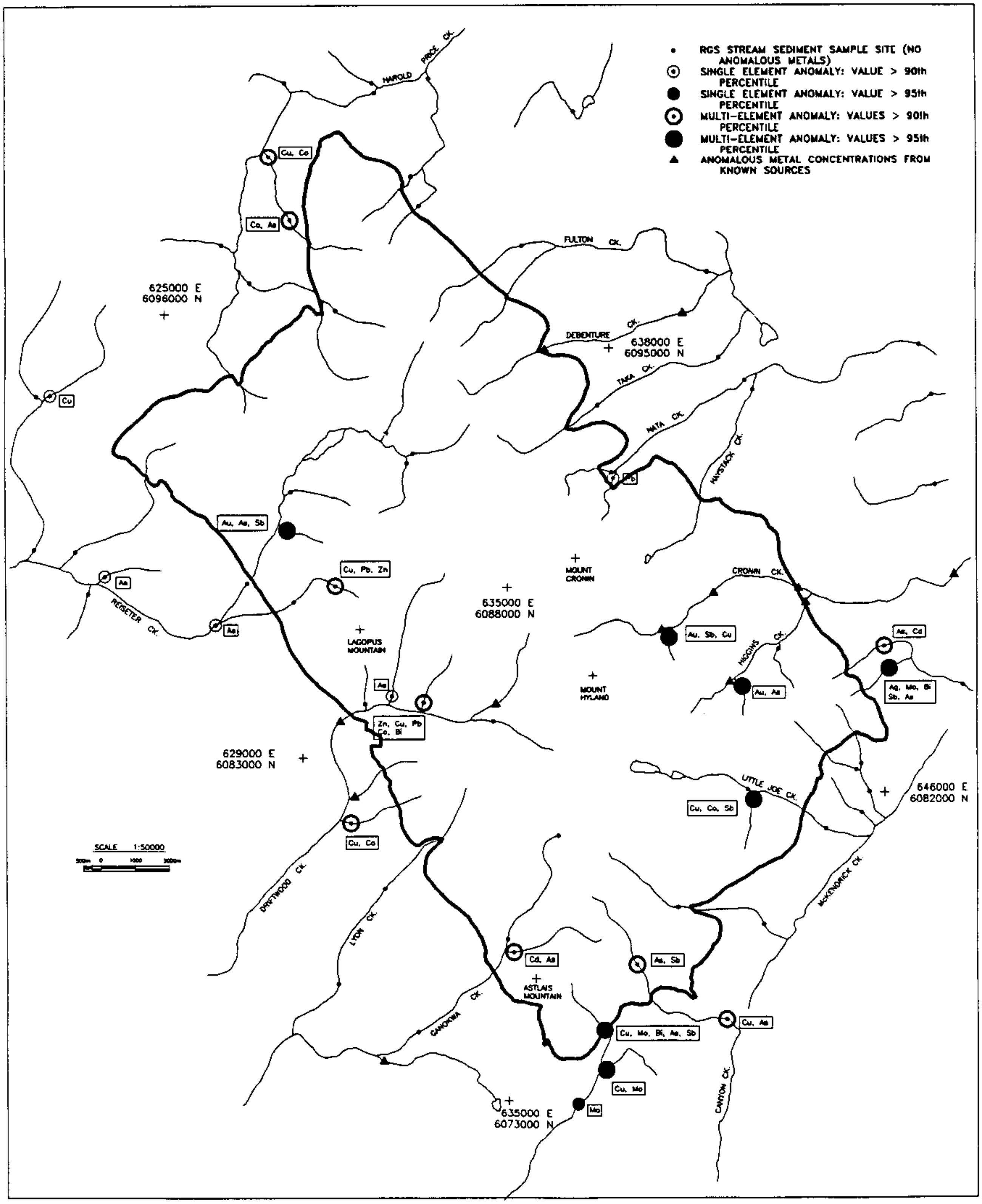


Figure 10. Stream-sediment sample sites in the Babine Mountains Recreation Area.

may contain more significant metal concentrations beneath the leached rocks exposed at surface.

In the north-central part of the study area, scattered exposures of Kasalka Group volcanic rocks are locally very silicic and may define a fault zone along which alteration has taken place (MacIntyre and Desjardins, 1988). However, no metals of interest are associated with these rocks.

Follow-up examination of a site initially sampled in 1987 (MacIntyre and Desjardins, 1988b) resulted in the location of previously undocumented polymetallic veins at the Rhyolite showing (Figure 6, Table 5; Gaba *et al.*, 1992). The veins are similar in character to other polymetallic veins in the area, but are unique because they contain up to 13 grams per tonne gold (partly as native metal - the only locality so far known within the study area!).

Geological mapping by Stock (1977b) on and adjacent to the Big Onion property documents the style and distribution of alteration associated with the deposit (Figures 7 and 9). Lithogeochemical sampling (also by Stock) shows that the distribution of copper and molybdenum is generally coincident with phyllic alteration associated with the Big Onion deposit; metals are also associated with phyllic-altered diorite to the southeast. However, an inherent problem with surface sampling of these types of deposits is the extensive metal leaching that occurs in rocks at or near the surface (as previously discussed), and resources beneath the surface might not be detected.

Samples were also collected regionally from rock outcrop not visibly altered: ten samples returned anomalous metal concentrations indicative of silver-rich polymetallic veins, four samples returned anomalous concentrations of metals characteristic of copper-silver veins and three samples returned anomalous concentrations suggestive of polymetallic massive sulphide mineralization (Appendix D).

Overall, lithogeochemical sampling is an effective tool in delineating areas of anomalous metal concentrations: several localities contain previously undocumented mineralization and represent the high degree of mineral resource potential that still exists in parts of the recreation area.

STREAM-SEDIMENT GEOCHEMICAL SURVEY

Stream-sediment and water samples were collected from 39 sites throughout the Babine Mountains Recreation Area and analyzed according to standards set by the Regional Geochemical Survey program of the Ministry of Energy, Mines and Petroleum Resources (*e.g.*, Matysek *et al.*, 1990). This data complements previously collected data in the area to bring the sample site density to approximately 1 site per 6 square kilometres (Figure 10; Appendix E).

The composition of stream sediments is generally representative of the rocks they were derived from within a drainage basin. However, more than one rock type is typically drained by any particular stream. Prior to statistical analysis of data, each sample is designated as draining a single geological formation (the most dominant within the drainage basin). The data can then be statistically manipulated to provide the mean, median, mode, range, standard deviation and various percentile values for each element according to geological formation (Appendix E). This is necessary because the background concentrations of metals are different for different rock types (anomalous-*looking* values may not necessarily be, and vise versa). In this way, anomalous concentrations of metals (values 90th percentile = anomalous; values 95th percentile = very anomalous) are identified, and in most cases the character of the anomalous metal assemblage can be attributed to a particular mineral deposit type (Table 4) that the drainage basin potentially has within its boundaries.

Some samples from drainage basins where mining-related disturbances are present contain exceedingly large concentrations of metals. These analyses were noted and excluded from criteria used for mineral resource potential evaluation.

Twenty-two stream-sediment samples contain anomalous or very anomalous concentrations of metals: these include single and multi-element assemblages (Figure 10). The watersheds above the sample sites, therefore, are favourable areas to explore for mineral deposits (of the type indicated by the character of the metal assemblage) and represent areas of high mineral potential.

GEOPHYSICAL SURVEYS

In some areas, geophysical surveys provide additional information about the physical properties of rocks, phenomena beneath the surface, or dominant structural trends which may be important in evaluating the geological favourability of an area for mineral deposits. Interpretation of geophysical anomalies requires knowledge of the geological character of the region. By using various geophysical techniques, geological formations that are favourable hosts to particular mineral deposit types can be traced beneath surface cover and exploration targets outlined (as done by induced polarization geophysical surveys southeast of the Big Onion, *see* Figure 7).

Regional airborne magnetic surveys (part of a province-wide program by the provincial and federal governments) have been carried out in the study area (Figure 11). The anomalies expressed by the magnetic contours are dependent on the variable magnetic intensities of the

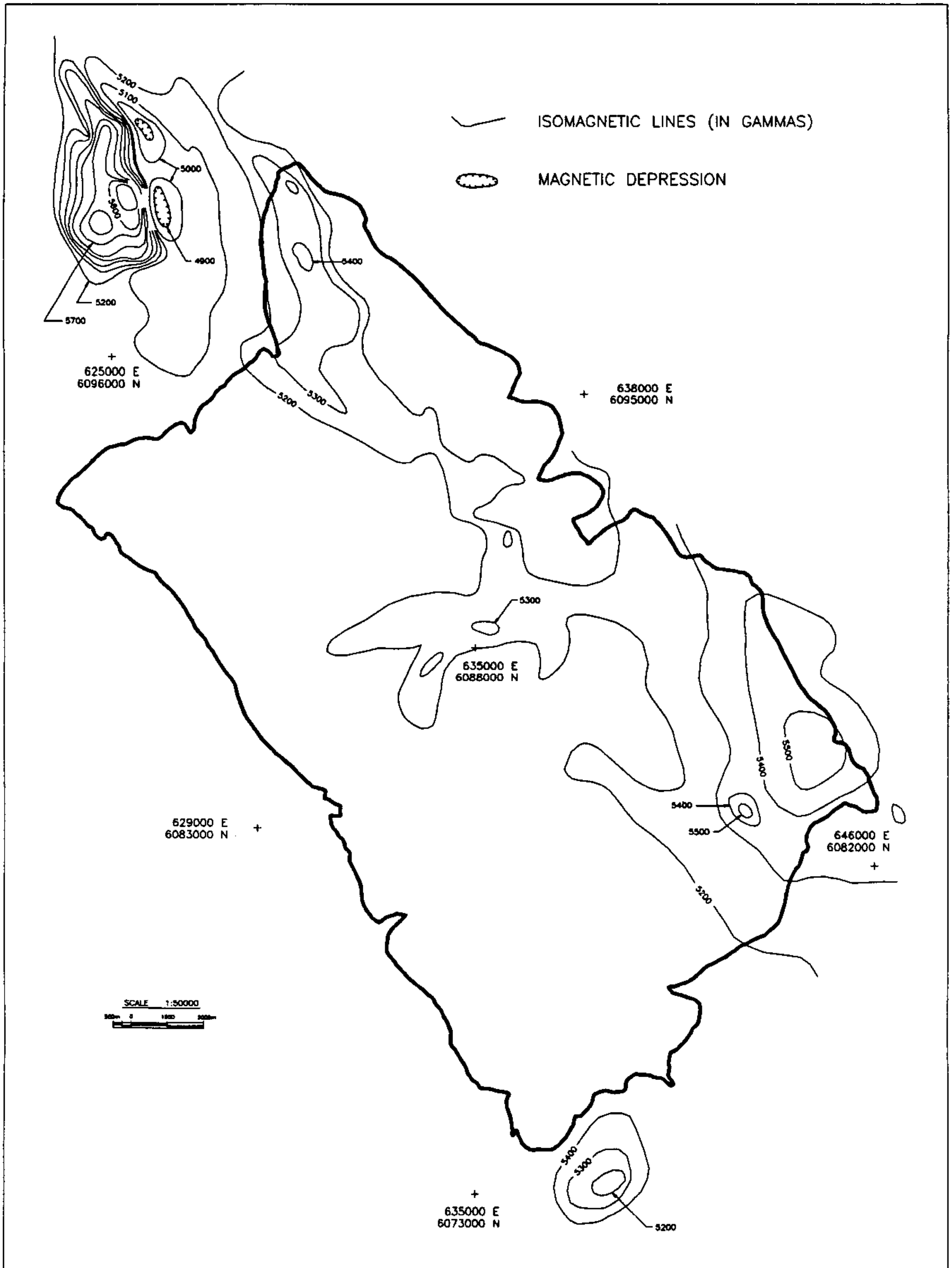
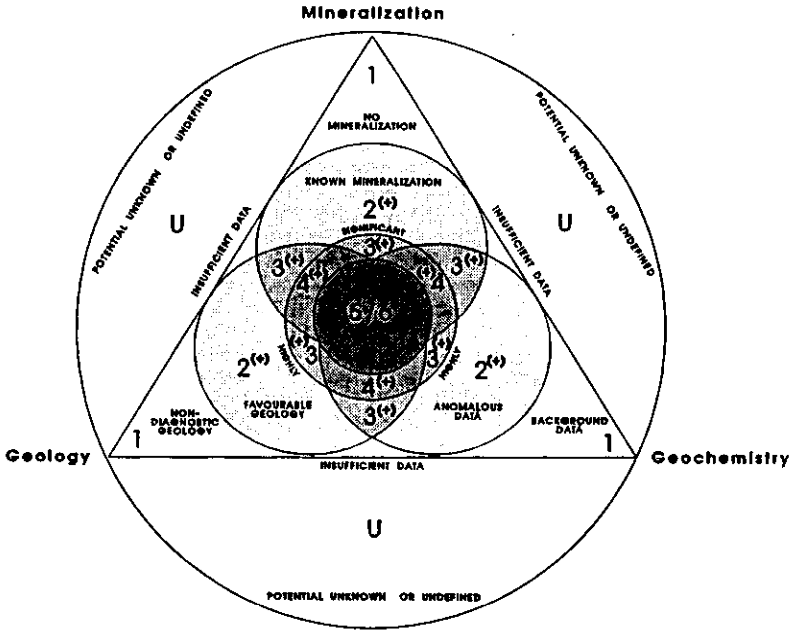


Figure 11. Airborne magnetic survey of the Babine Mountains Recreation Area (flight altitude is 300 metres above ground level). Compiled from *Geological Survey of Canada* Aeromagnetic Maps 5243G, 5244G, 5318G and 5319G.



DIAGRAMATIC CLASSIFICATION SCHEME OF METALLIC MINERAL POTENTIAL.
(Modified from McLaren, 1990).

QUALITATIVE DESCRIPTIONS OF MINERAL POTENTIAL RATINGS*

Class	Mineral Potential	Description
6	**Extreme**	**Known deposits (developed prospects) with identified resources in the ground.** Very favourable geological data from all three criteria fields; very high degree of confidence in designation. Continued exploration highly probable; potential for mine development is high.
5	**Very High**	**Known prospects, developed prospects or past producing mines (with undefined resources in the ground) in highly favourable metallogenic environment.** Very favourable geological data from all three criteria fields; very high degree of confidence in designation. Future exploration highly probable.
4	**High**	**Highly favourable metallogenic environment;** mineral showings are generally present. Very favourable geological data from two criteria fields; high degree of confidence in designation. Future exploration expected.
3	**Moderately High**	**Favourable metallogenic environment.** Very favourable geological data from one criteria field, or favourable geological data from two criteria fields; high degree of confidence in designation. Future exploration likely; good potential for upgrading of classification.
2	**Moderate**	**Moderately favourable metallogenic environment.** Favourable geological data from one criteria field; moderate degree of confidence in designation. Future reconnaissance exploration to be expected; potential for upgrading of classification.
1	**Low**	**Current geological data is nondiagnostic** (no favourable geological data); moderate to high degree of confidence in designation. Future exploration not anticipated.
U	**Unknown**	**Current data is either outdated or insufficiently detailed** for a reasoned determination of mineral potential. High degree of confidence in designation. Future exploration could occur in parts of the area.

*After McLaren (1990 and personal communication, 1992)

Figure 12. Classification of mineral resource potential.

TABLE 6
SUMMARY OF CRITERIA USED TO ASSESS PORPHYRY COPPER-MOLYBDENUM DEPOSIT POTENTIAL

CRITERIA FIELD	OUTLINE/SYMBOL	DESCRIPTION	RATING	AREA OF INFLUENCE
FAVOURABLE GEOLOGY		Late Cretaceous to Early Tertiary quartz diorite porphyry (qdp), quartz feldspar porphyry (qfp) and diorite (dr)	2_G, 2_G^+	outline of rock distribution
		Propylitic, sericitic and silicic alteration zones	2_{GA}, 2_{GA}^+	outline of alteration zones
		Coincidence of alteration zones with favourable host rocks	3_G, 3_G^+	outline of overlap
ANOMALOUS GEOCHEMISTRY		RGS stream sediment samples with Cu±Mo±Au±Ag:		
	▲	Single element anomaly defined by value > 95th percentile	2_A^+	outline of drainage basin
	▲	Multi-element anomaly defined by values > 90th percentile	3_A	outline of drainage basin
	▲	Multi-element anomaly defined by values > 95th percentile	3_A^+	outline of drainage basin
		Lithogeochemical samples with Cu±Mo±Au±Ag:		
	⊙ ▼	Multi-element anomaly defined by very anomalous values*	3_A^+	200 metres radius
KNOWN MINERALIZATION	●	Mineral showing	2_M to 4	500 metres radius
	■	Developed prospect	6	500 to 1000 metres radius

*Multi-element anomalies delineated by lithogeochemical sampling in the area of the Big Onion prospect are from Stock (1977b). These anomalies are defined by a large number of anomalous samples rather than single anomalous samples, and therefore individual sample sites are not indicated.

TABLE 7
SUMMARY OF CRITERIA USED TO ASSESS SILVER-RICH POLYMETALLIC VEIN POTENTIAL

CRITERIA FIELD	OUTLINE/SYMBOL	DESCRIPTION	RATING	AREA OF INFLUENCE
FAVOURABLE GEOLOGY		Middle to Upper Jurassic Ashman Formation (muJA) / rhyolite	2_G, 2_G^+	outline of rock distribution
		Upper Cretaceous Kasalka Group (uKK1, uKK2) and associated dikes	2_G, 2_G^+	outline of rock distribution
		Pyritic-limonitic alteration zones	2_{GA}, 2_{GA}^+	outline of alteration zones
		Coincidence of alteration zones with favourable host rocks	3_G, 3_G^+	outline of overlap
ANOMALOUS GEOCHEMISTRY		RGS stream sediment samples with Ag±Au±Pb±Zn±Cd±Cu±As±Sb:		
	△	Single element anomaly defined by value > 90th percentile	2_A	outline of drainage basin
	▲	Multi-element anomaly defined by values > 90th percentile	3_A	outline of drainage basin
	▲	Multi-element anomaly defined by values > 95th percentile	3_A^+	outline of drainage basin
		Lithogeochemical samples with Ag±Au±Pb±Zn±Cd±Cu±As±Sb:		
	▽	Single element anomaly defined by anomalous value	2_A	200 metres radius
	⊙ ▼	Multi-element anomaly defined by anomalous values	3_A	200 metres radius
	▼	Multi-element anomaly defined by very anomalous values	3_A^+	200 metres radius
KNOWN MINERALIZATION	● ■	Mineral showing; mineral prospect	2_M to 5	500 metres radius
	⊗	Past producer	5	500 to 1000 metres radius
	⊗	Past producer with identified resources in the ground	6	500 to 1000 metres radius

TABLE 8
SUMMARY OF CRITERIA USED TO ASSESS BASALT-HOSTED COPPER-SILVER VEIN POTENTIAL

CRITERIA FIELD	OUTLINE/SYMBOL	DESCRIPTION	RATING	AREA OF INFLUENCE
FAVOURABLE GEOLOGY		Lower to Middle Jurassic Telkwa Formation (lJT, lJTb)	2_G, 2_G^+	outline of rock distribution
ANOMALOUS GEOCHEMISTRY		RGS stream sediment samples with Cu±Ag±Au±Pb±Zn:		
	▲	Multi-element anomaly defined by values > 90th percentile	3_A	outline of drainage basin
		Lithogeochemical samples with Cu±Ag±Au±Pb±Zn:		
	▽	Single element anomaly defined by anomalous value	2_A	200 metres radius
	⊙ ▼	Single element anomaly defined by very anomalous value	2_A^+	200 metres radius
	▼	Multi-element anomaly defined by anomalous values	3_A	200 metres radius
KNOWN MINERALIZATION	●	Mineral showing	2_M to 5	500 metres radius
	⊗	Past producer	5	500 to 1000 metres radius

underlying rock, and may be due to conditions near the surface, or at unknown depths.

The anomaly immediately northwest of the recreation area is a steep magnetic high (Figure 11): this anomaly coincides with a ridge of augite porphyritic basalt (a rock type with a high magnetic susceptibility; Figure 4). The magnetic depression along the eastern margin of the magnetic high is attributed to a precipitous escarpment, or the abrupt absence of the augite porphyritic basalt.

There is another broad anomaly just south of the study area which coincides with a large diorite stock (Figure 4). A similar anomaly along the eastern boundary of the study area is not as readily explained by the nature of the exposed bedrock: it may indicate a similar igneous stock at depth.

Overall, the airborne magnetic survey does not offer any information with regard to areas which might be favourable for mineral resources.

MINERAL RESOURCE POTENTIAL

Mineral Potential Classification

Systematic integration of geological, geochemical and mineral occurrence data is the basis upon which mineral resource potential is determined (McLaren, 1990). Mineral potential is a rating of the likelihood that an area contains mineral deposits, based on the presence of favourable criteria which are indicative of the mineral deposit types of concern (*see* Table 4). Favourable criteria are defined as: the geological setting (as determined by mapping); anomalous concentrations of base or precious metals in bedrock or stream sediments (as identified by lithogeochemical or stream-sediment sampling); and known mineral occurrences (such as showings, prospects, developed prospects with identified resources and past-producers).

A numerical system of mineral potential classification was devised by McLaren (1990): favourable criteria of more than one type (applicable to a specific mineral deposit type) combine to define regions of higher mineral potential (Figure 12). Mineral potential maps were prepared for each deposit type and then combined into a composite mineral resource potential map for the study area.

Mineral Resource Potential: By Deposit Type

Mineral resource potential has been determined for each of the mineral deposit types within and adjacent to the study area: porphyry copper-molybdenum deposits, silver-rich polymetallic veins, basalt-hosted copper-silver veins, and polymetallic massive sulphide deposits. Summaries of the criteria used to assess each of the deposit types are outlined in Tables 6 to 9, and are accompanied by maps (Figures 13 to 16) showing the ratings of potential for each mineral deposit type.

Areas of favourable geology (*i.e.*, favourable hostrocks) are designated as 2_G or 2_G^+ : plus signs are used to indicate more favourable data. Areas of favourable rock alteration, a subclass of favourable geology, is designated as 2_{GA} or 2_{GA}^+. Areas of favourable geology and alteration that overlap are designated as 3_G or 3_G^+. The area of influence is the outline of the distribution of favourable hostrocks or alteration zones.

Areas of favourable geochemistry include sites from which stream-sediment samples and lithogeochemical (or rock) samples were taken that contain anomalous concentrations of characteristic base or precious metals. Anomalous stream sediment analyses which are greater than the 90th percentile for the specific data group (according to the metal assemblage and dominant rock formation within the drainage basin) are designated 2_A or 2_A^+, depending on the number and identity of anomalous metals and their individual concentrations; those analyses greater than the 95th percentile are designated 3_A or 3_A^+. The area of influence for anomalous stream sediment analyses is the drainage basin above the site where the sample was collected.

Anomalous lithogeochemical analyses (according to the characteristic metal assemblage) are designated 2_A, 2_A^+, 3_A, or 3_A^+, depending on how anomalous the

TABLE 9

SUMMARY OF CRITERIA USED TO ASSESS POLYMETALLIC MASSIVE SULPHIDE DEPOSIT POTENTIAL

CRITERIA FIELD	OUTLINE/SYMBOL	DESCRIPTION	RATING	AREA OF INFLUENCE
FAVOURABLE GEOLOGY		Lower Jurassic Nilkitkwa Formation (lJN) and upper parts of the underlying Telkwa Formation (lJT, lJTb)	2_G, 2_G^+	outline of rock distribution
ANOMALOUS GEOCHEMISTRY	(▿) ▿	Lithogeochemical samples with Zn±Pb±Ba±Cu±As: Single element anomaly defined by anomalous value	2_A	200 metres radius
KNOWN MINERALIZATION		no known mineralization of this type within the study area		

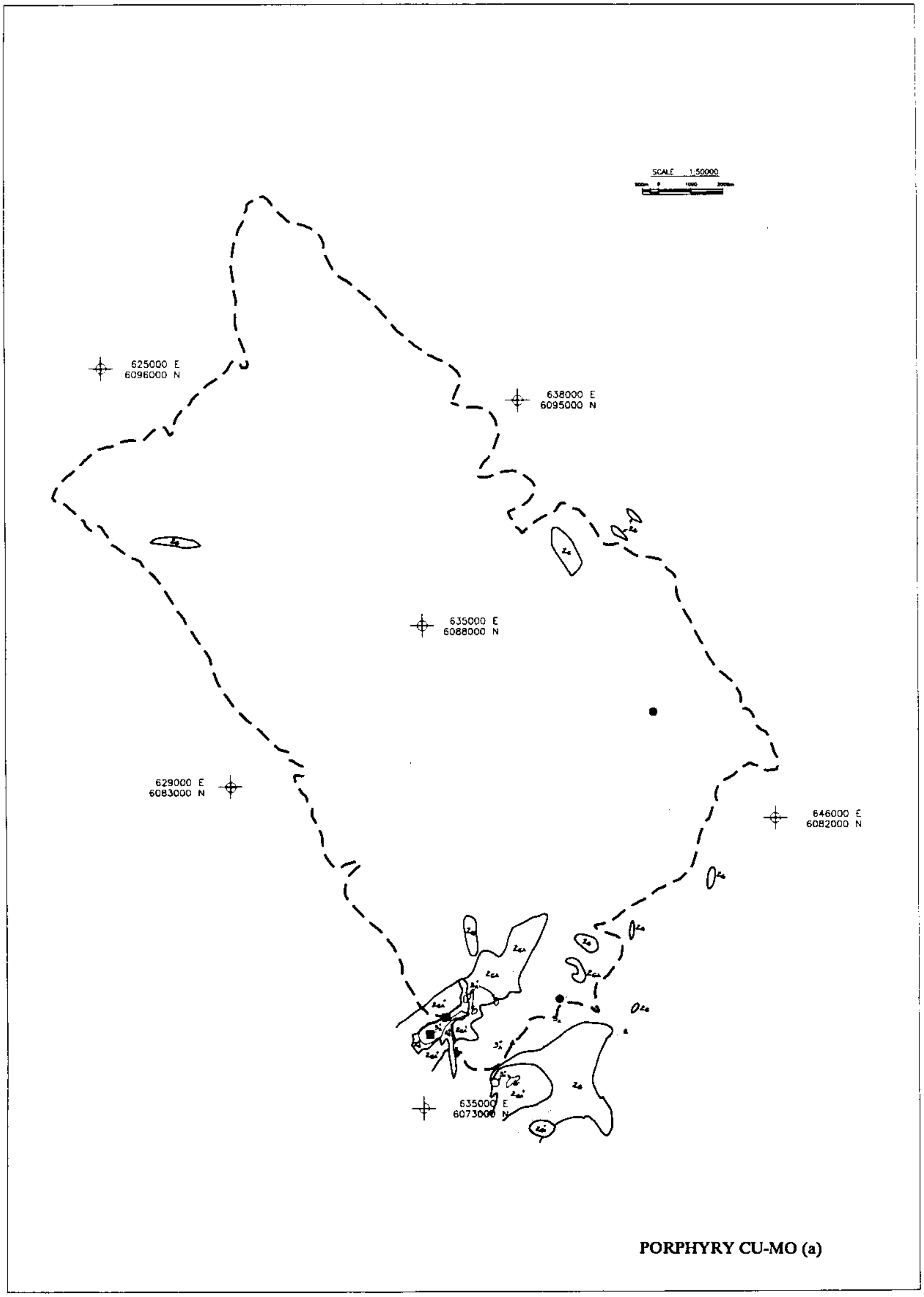
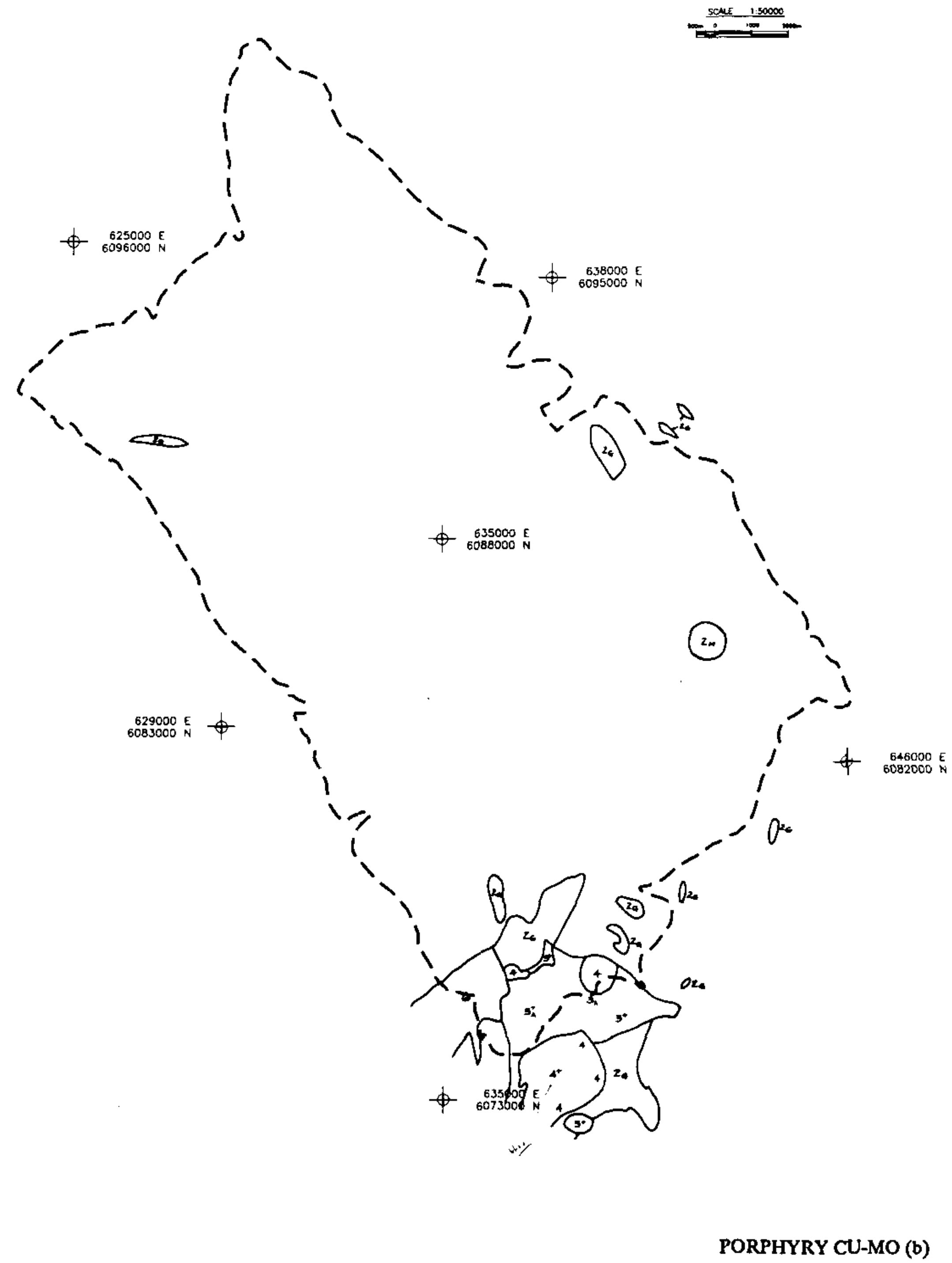


Figure 13. Porphyry copper-molybdenum deposit potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 6 for explanation of symbols).



PORPHYRY CU-MO (b)

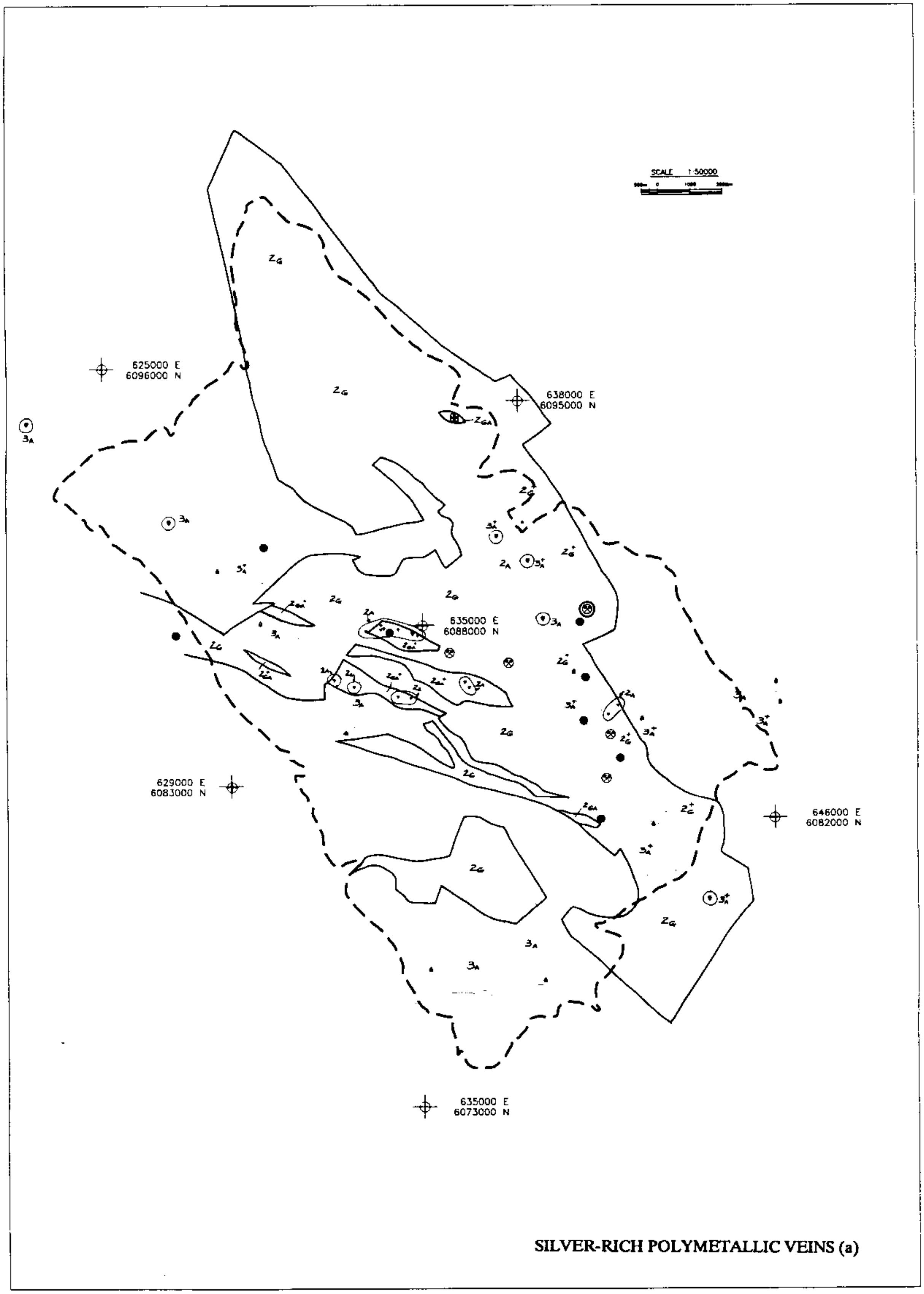
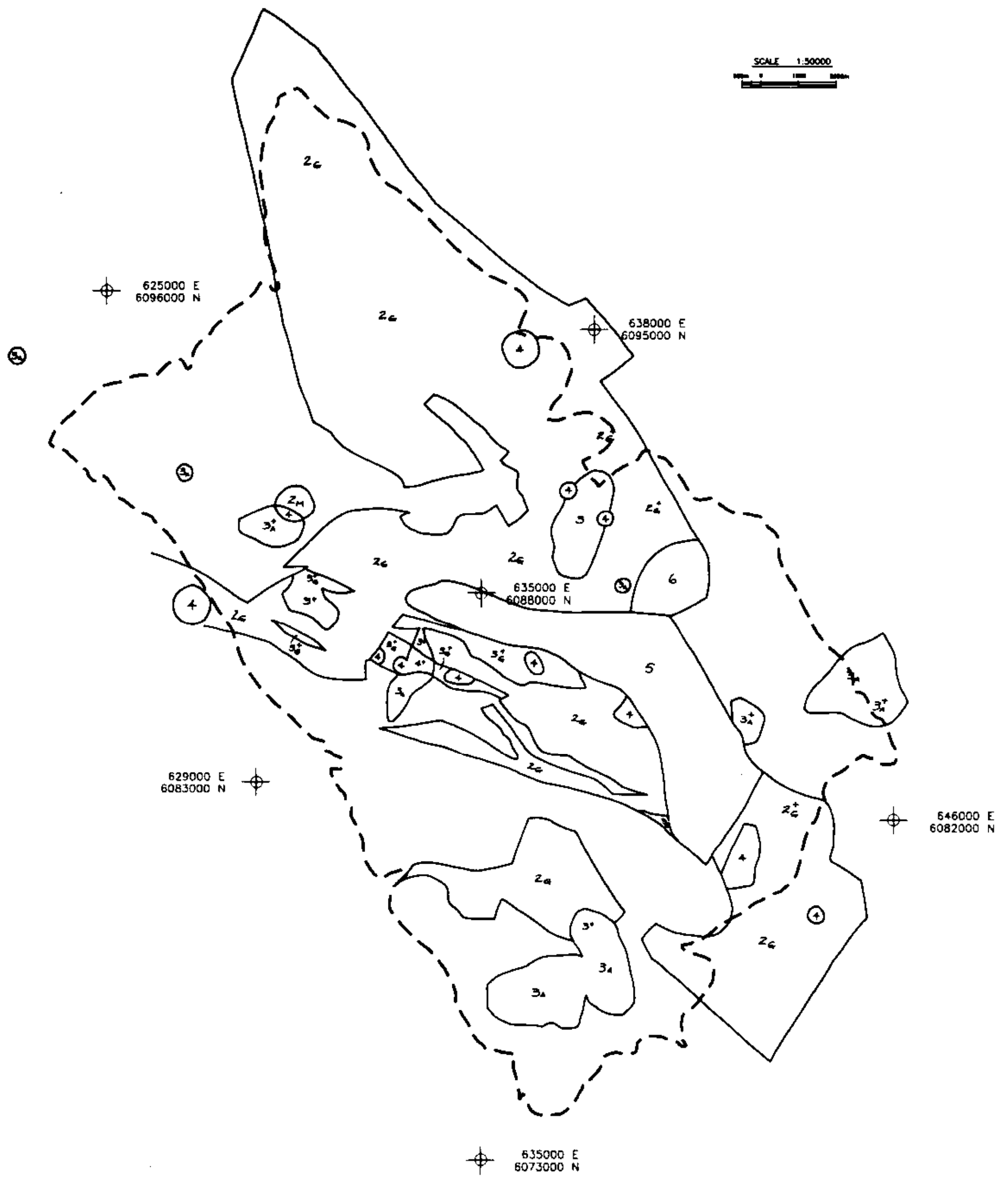


Figure 14. Silver-rich polymetallic vein potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 7 for explanation of symbols).



SILVER-RICH POLYMETALLIC VEINS (b)

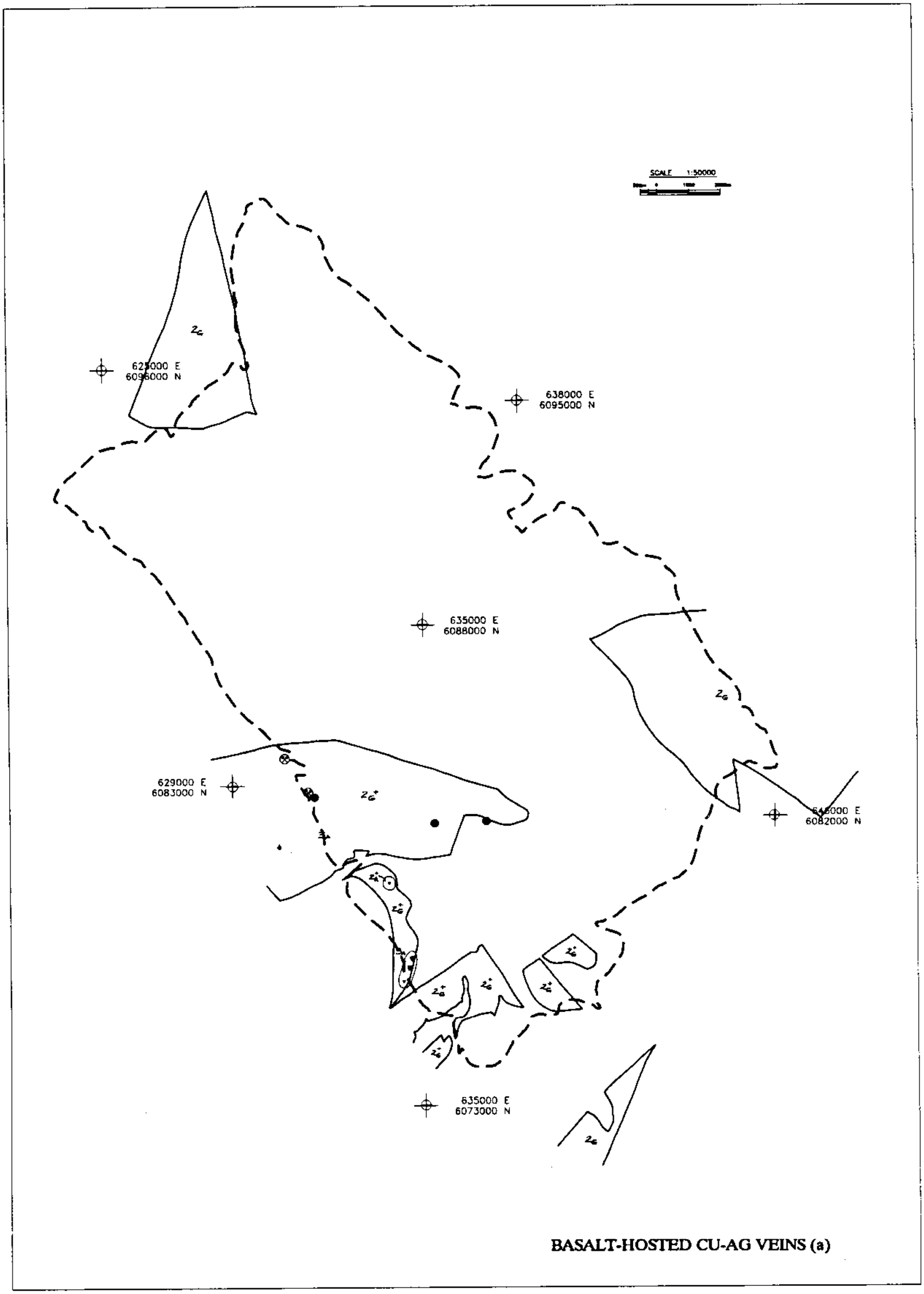
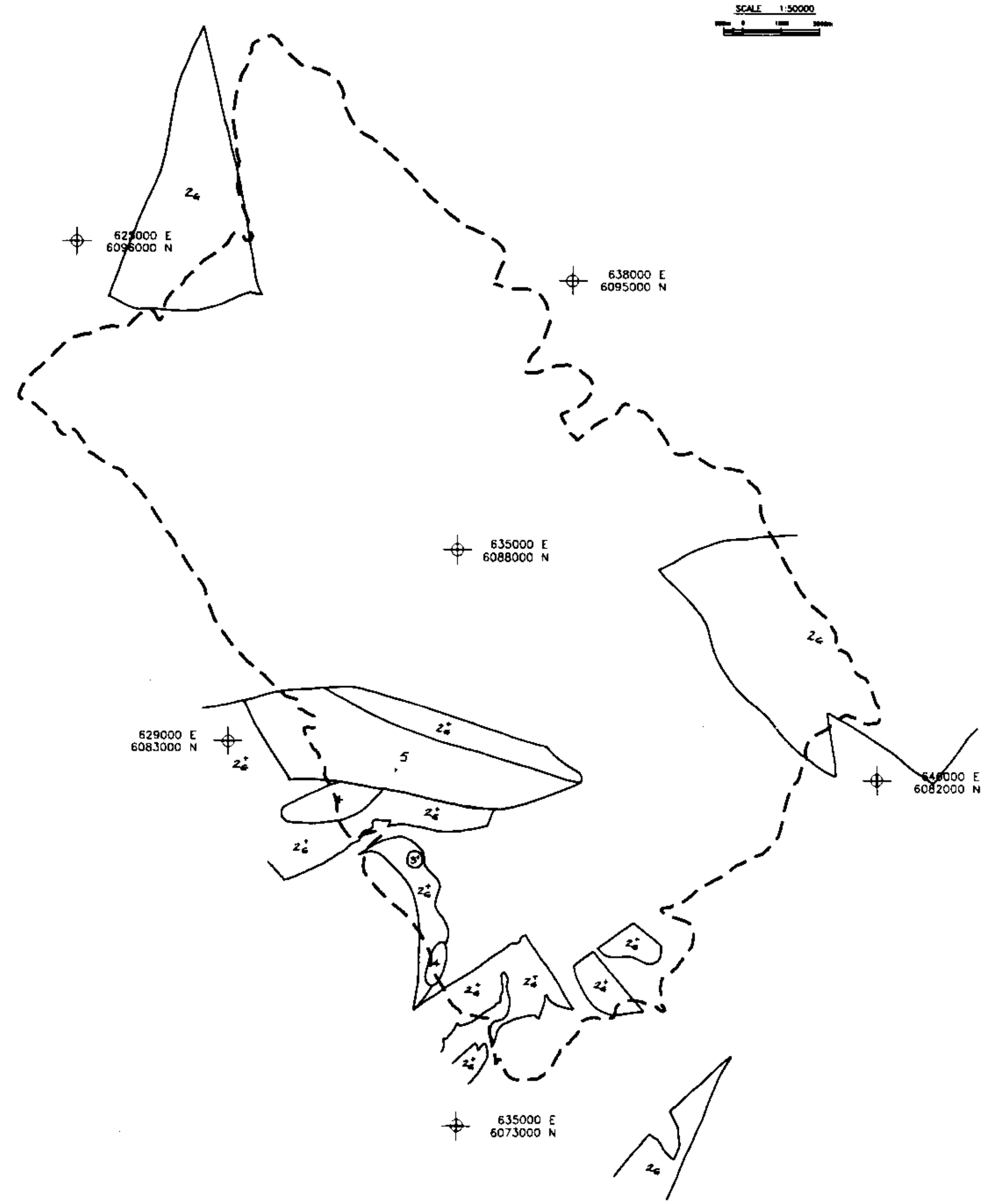


Figure 15. Basalt-hosted copper-silver vein potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 8 for explanation of symbols).



BASALT-HOSTED CU-AG VEINS (b)

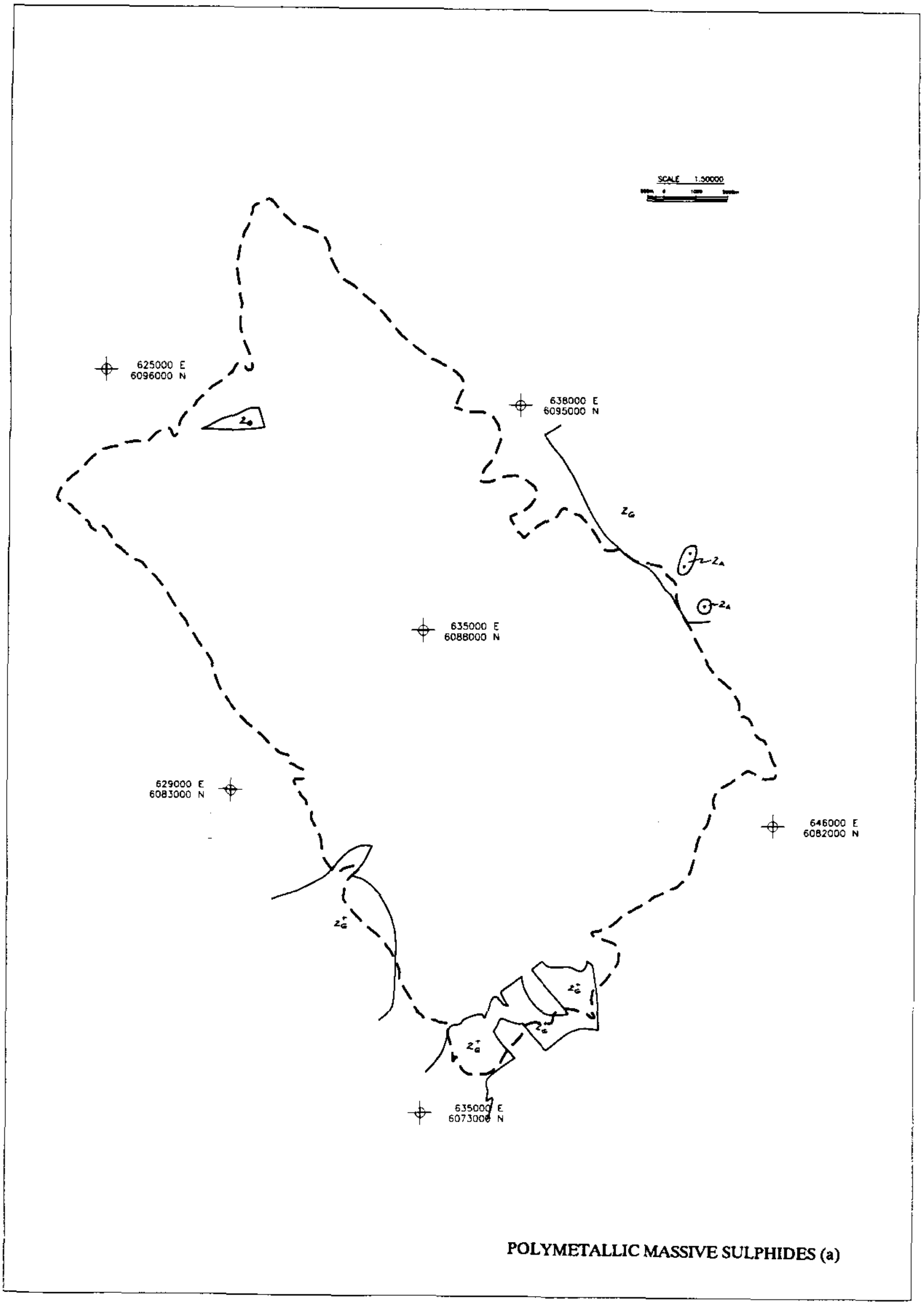
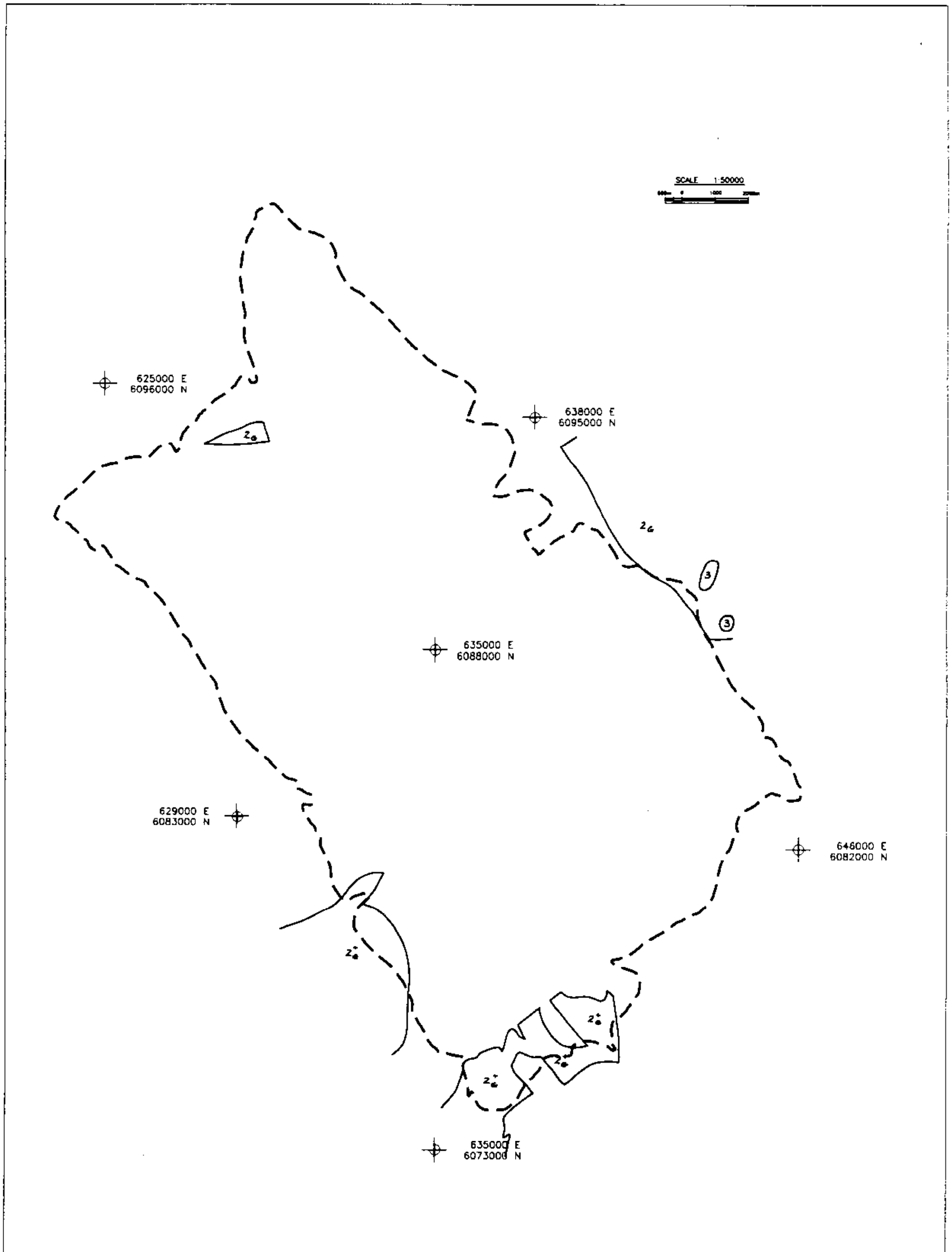


Figure 16. Polymetallic massive sulphide deposit potential: a) ratings as defined by individual criteria fields, and b) the final assigned ratings incorporating criteria field overlap (*see* Table 9 for explanation of symbols).



POLYMETALLIC MASSIVE SULPHIDES (b)

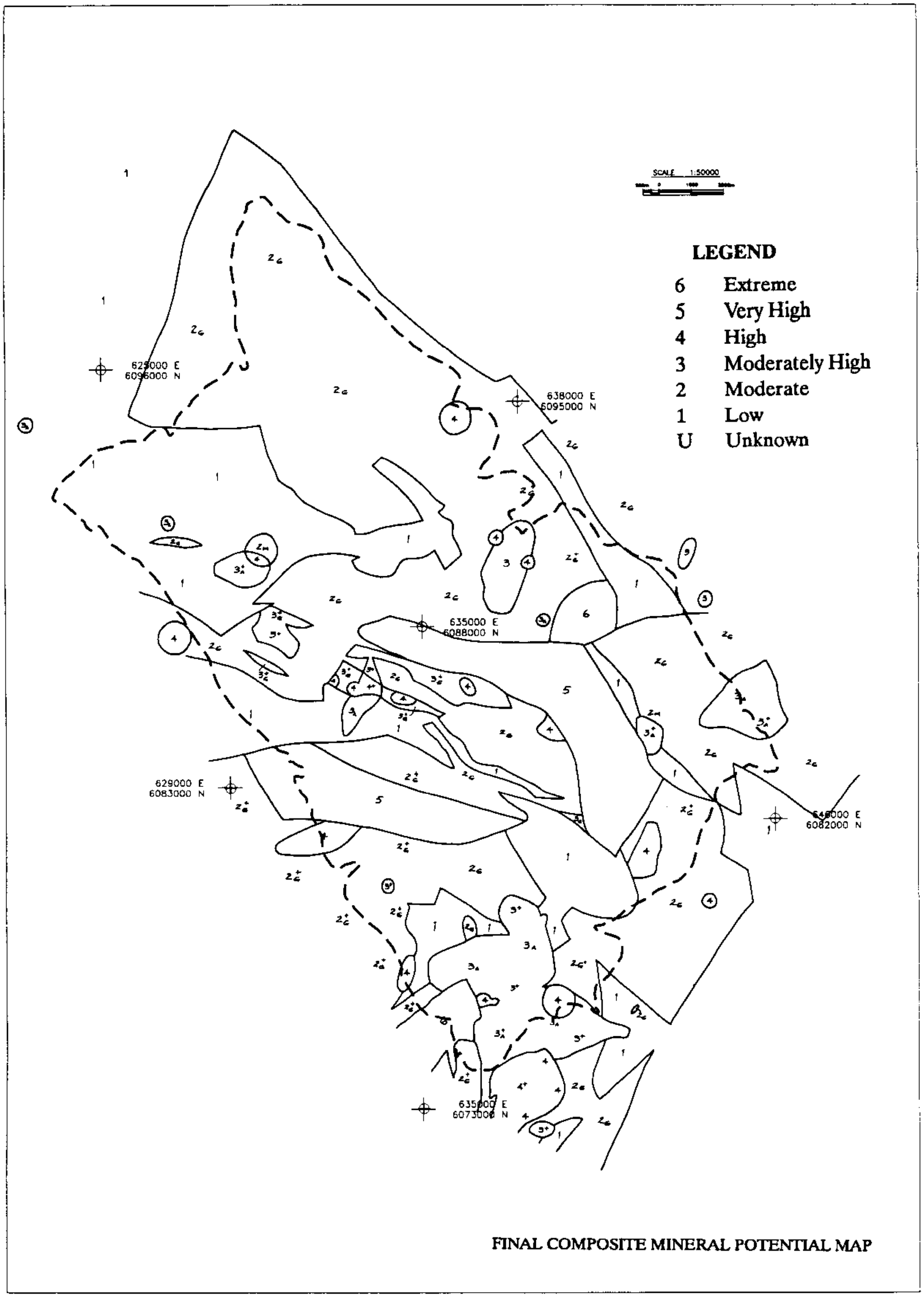


Figure 17. Composite mineral resource potential of the Babine Mountains Recreation Area (*see* Figure 12 for an outline of the classification of mineral resource potential).

analyses are (determined by visual inspection of the regional data set). An anomalous sample is assigned a radius of influence of 200 metres.

Known mineralization is categorized according to its status: mineral showings, prospects, developed prospects with identified resources and past-producers. Mineral showings and prospects are designated as 2_M, $2_M{}^+$, 3_M or $3_M{}^+$, and are assigned a radius of influence of 500 metres. Past-producers are designated as high as 5, with an area of influence of 500 to 1000 metres radius. Developed prospects with identified resources have the greatest degree of significance and are designated as 6, with an area of influence of 500 to 1000 metres radius: this category includes past-producers that have identified mineral resources (such as the Cronin mine).

Areas of mineral potential, as defined by the distribution of favourable criteria, are shown for each mineral deposit type in Figures 13a to 16a. Areas where favourable criteria overlap indicate a greater degree of confidence, or an increased likelihood for a mineral deposit of a particular type to occur. A higher degree of mineral potential is therefore assigned to the region of overlap (Figure 12). This is shown for each of the mineral deposit types in Figures 13b to 16b. Areas in which favourable criteria overlap are designated 3, 3^+, 4 or 4^+, depending on the degree of confidence of the overlapping data (Figure 12). Mineral potential designations of 5 and 6 indicate areas where all three favourable criteria are present, and are generally assigned to areas with significant mineral occurrences, past-producers or developed prospects with identified resources: the latter is most significant because of its high potential for mine development. Areas in which no favourable criteria have been identified are designated as 1.

Mineral Resource Potential of the Babine Mountains Recreation Area

Data presented in the mineral potential maps for each mineral deposit type (Figures 13b to 16b) are superimposed into one final composite mineral resource potential map for the study area (Figure 17).

An area of extreme mineral potential (Class 6) surrounds the identified copper and molybdenum resources at the Big Onion deposit in the south part of the recreation area (Figure 17). The region east and southeast of the Big Onion deposit also has indications of high mineral potential (Class 3 to 4) as defined by the presence of favourable geology (hostrocks and alteration), favourable geochemistry and a copper-molybdenum showing. Combined, these areas outline a domain of very high mineral resource potential for porphyry copper-molybdenum that covers the southern tip of the recreation area (Figures 13b and 17).

The Cronin mine and its identified resource of silver-rich polymetallic vein mineralization define an area of extreme mineral potential (Class 6) in the east-central part of the recreation area (Figure 17). This area is closely adjacent to a central belt of very high mineral potential (Class 5) for silver-rich polymetallic veins, based on the presence of very favourable geology (favourable hostrocks plus alteration), favourable geochemistry, and numerous vein showings (including three new veins found during this study) and past-producers. The regions immediately to the south and west also have smaller areas of high mineral potential (Class 3 and 4) defined by overlapping favourable geochemical data and geology. Together, these areas define a broad domain of high to very high mineral resource potential for silver-rich polymetallic veins within the central part of the recreation area (Figures 14b and 17).

The west-central belt of very high mineral potential (Class 5) is based mainly on favourable geology and contained copper-silver vein showings and past-producers (Figure 17). Favourable geology and geochemistry south of this belt outline small areas of high mineral potential (Class 3 and 4). These areas together form a domain of high to very high mineral resource potential for basalt-hosted copper-silver veins within the south-central and southwestern part of the recreation area (Figures 15b and 17).

CONCLUDING REMARKS

90 YEARS OF EXPLORATION: ARE THERE STILL UNDISCOVERED MINERAL RESOURCES?

A mineral resource potential study such as this attempts to summarize the geological database as it is presently known. Examination and analysis of exposed bedrock does not always yield information on possible resources at depth: a thorough investigation of resource potential would ideally include geophysical surveys and diamond drilling to test for mineral resources below the surface.

Surface prospecting and sampling during the course of this study revealed three geologically significant previously undocumented polymetallic vein showings (Gaba *et al.*, 1992). During the present economic climate, showings such as these (and others in the study area) might not be pursued by the mining industry, but with changes in economic circumstances or exploration strategies in the future, may be considered as viable exploration targets. The significance of these new-found showings to this study is twofold: new mineral showings can still be found after 90 years of prospecting activity in the area, and new showings (along with previously known showings and favourable geology and geochemistry) help to delineate domains with high mineral potential that require further exploration.

Regionally extensive belts of pyritic and limonite-stained altered rocks, mainly within the central part of the study area, contain scattered anomalous concentrations of base or precious metals (as determined by lithogeochemical sampling). A plausible reason that metals are not more widespread within the altered rocks is that the pre-existing metals have been leached from the rocks by near-surface groundwater acidified by the natural oxidation of pyrite. Adequate evaluation would require more exploration and testing, possibly followed by drilling.

THE BIG ONION DEPOSIT: PART OF BRITISH COLUMBIA'S MINERAL RESOURCE INVENTORY

An identified resource of copper and molybdenum (with accessory gold and silver) continues to be evaluated at the Big Onion property. Further exploration serves not only to better constrain the grade and distribution of the resource, but may lead to additional discoveries in favourable peripheral environments. The proximity of the Big Onion deposit to the town of Smithers is advantageous in keeping down the cost of exploration and development. At the same time, if development were to proceed, Smithers would undoubtedly gain economic benefits from the project. Under these circumstances the Big Onion deposit should not be alienated from future exploration and possible development.

THE BOUNDARY QUESTION AND MULTI-USE LAND MANAGEMENT

The present boundary of the Babine Mountains Recreation Area generally follows the 1370 metre elevation contour. This boundary was chosen to exclude stands of merchantable timber (at lower elevations), thus avoiding possible land-use disputes with the forest industry (Babine Master Plan Study Team, 1991). In addition, exceptions to recreation area rules were made for snowmobile use in the Ganowkwa basin, a rapidly expanding recreation that attracts many people from out-of-town and boosts the local economy during the winter months. In contrast, the recreation area boundary cuts through the middle of the Big Onion copper-molybdenum-gold-silver deposit, the most promising mineral property presently being explored in the area.

The Smithers Exploration Group, an affiliation of prospectors, geologists, geophysicists and service groups and individuals associated with the mineral exploration industry in northwestern British Columbia, subsequently submitted their concerns to the Babine Mountains Recreation Area - Park Candidate Master Plan Study Team. Their recommendations included a proposed area boundary that excludes the Big Onion deposit and a sufficiently large area around the property to protect mining interests and future exploration access to an identified metal resource (Smithers Exploration Group, 1991). Further, to achieve balance, they proposed that the northern boundary be extended so as to include a comparable sized area of land with low mineral potential.

The region northwest of the recreation area at the headwaters of Harold Price Creek was examined during the field-based part of this study to investigate the feasibility of the Smithers Exploration Group submission. The area is underlain by rocks that are not likely hosts of metallic mineral deposits: this is exemplified by the lack of mineral showings and rock alteration in the area. The region is ideally suited as an addition to the recreation area in exchange for the exclusion of the Big Onion deposit and environs. This area, to the northwest, has low mineral resource potential and therefore it is concluded that the Smithers Exploration Group's proposal should be given serious consideration.

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APPENDICES

APPENDIX A

ESTIMATED GROSS DOLLAR VALUES[1] OF THE BIG ONION AND CRONIN MINERAL DEPOSITS

DEPOSIT TYPE	PROPERTY NAME	ESTIMATED TONNAGE	GOLD kg; $Million	SILVER kg; $Million	COPPER 10^6 kg; $Million	LEAD 10^6 kg; $Million	ZINC 10^6 kg; $Million	MOLYBDENUM 10^6 kg; $Million
Porphyry Cu-Mo	BIG ONION	94 441 000 t[2]	2033; $27.4[3]	31760; $4.8[3]	396.5; $1050			11.3; $67.4
Silver-Rich Poly-metallic Veins	CRONIN	47 210 t[4]	80.2; $1.1	20205; $3.0	0.07; $0.2	3.8; $3.4	3.8; $5.2	

[1]Gross value of metal in the ground (before development, mining and extraction costs) according to average metal prices (in Canadian dollars) for the third quarter of 1991: gold $13.50 per gram, silver $0.15 per gram, copper $2.65 per kilogram, lead $0.90 per kilogram, zinc $1.37 per kilogram and molybdenum $5.95 per kilogram; the quantity of recoverable metals will be less than the estimated gross metal content of the deposit

[2]Calculation by Stock (1977a)

[3]Estimated precious metal content of the 31 760 000 t supergene zone

[4]From Melville et al., (1992)

APPENDIX B

GEOLOGIC TIME SCALE - BRITISH COLUMBIA GEOLOGICAL SURVEY BRANCH

Phanerozoic data derived from:
1) W.B.Harland et al. (1990)
PreCambrian data from:
1) Lumbers & Card (Geology, Vol. 20 1991)

PHANEROZOIC

CENOZOIC

PERIOD		EPOCH		STAGE	Ma Age
QUATERNARY		Holocene			0.01
		Pleistocene		Calabrian	1.64
TERTIARY	NEOGENE	PLIOCENE	L	Piacenzian	3.40± 1.35
			E	Zanclian	5.2 ± 1.5
		MIOCENE	L	Messinian	6.7 ± 2.3
			L	Tortonian	10.4 ± 1.5
			M	Serravallian	14.2 ± 1.8
			M	Langhian	16.3 ± 1
			E	Burdigalian	21.5 ± 1.8
			E	Aquitanian	23.3 ± 1
	PALEOGENE	OLIGOCENE	L	Chattian	29.3 ± 1.5
			E	Rupelian	35.4 ± 1.4
		EOCENE	L	Priabonian	38.6 ± 1.5
				Bartonian	42.1 ± 1.8
			M	Lutetian	50 ± 1.5
			E	Ypresian	56.5 ± 1.4
		PALEOCENE	L	Thanetian	60.5 ± 2.3
			E	Danian	65 ± 2

MESOZOIC

PERIOD	EPOCH	STAGE	Ma Age
CRETACEOUS			65.0 ± 2
	Late	Maastrichtian	74.0 ± 3
		Campanian	83 ± 4
		Santonian	86.6 ± 3
		Coniacian	88.5 ± 2
		Turonian	90.4 ± 2
		Cenomanian	97.0 ± 2
	Early	Albian	112 ± 2
		Aptian	124.5 ± 13
		Barremian	131.8 ± 8
		Hauterivian	135.0 ± 8
		Valanginian	140.7 ± 13
		Berriasian	145.6 ± 9.5
JURASSIC	Late	Tithonian	152.1 ± 11.5
		Kimmeridgian	154.7 ± 6.5
		Oxfordian	157.1 ± 8
	Middle	Callovian	161.3 ± 7
		Bathonian	166.1 ± 7
		Bajocian	173.5 ± 11.5
		Aalenian	178 ± 11
	Early	Toarcian	187 ± 15
		Pliensbachian	194.5 ± 5
		Sinemurian	203.5 ± 6.5
		Hettangian	208 ± 7.5
TRIASSIC	Late	Norian	223.4 ± 9.5
		Carnian	235 ± 4
	Middle	Ladinian	239.5 ± 6.5
		Anisian	241.1 ± 8
	Early	Spathian	(242)
		Smithian	(243)
		Dienerian	(244)
		Griesbachian	245 ± 9.5

PALEOZOIC

PERIOD		EPOCH	STAGE	Ma Age
PERMIAN				245 ± 9.5
		Late	Changhsingian	247.5 ± 11
			Dzhulfian	250 ± 12
			Capitanian	252.5 ± 13
			Wordian	255 ± 12
		Early	Roadian	260 ± 11
			Artinskian	269 ± 11
			Sakmarian	281.5 ± 13
			Asselian	290 ± 9
CARBONIFEROUS	PENNSYLVANIAN	Late	Gzhelian	295 ± 6.5
			Kasimovian	303 ± 5
			Moscovian	311.5 ± 9.5
			Bashkirian	323 ± 9
	MISSISSIPPIAN	Early	Serpukhovian	333 ± 8
			Visean	349.5 ± 4.5
			Tournaisian	362.5 ± 5.5
DEVONIAN		Late	Famennian	367 ± 5
			Frasnian	377.5 ± 10
		Middle	Givetian	
			Eifelian	381 ± 11
		Early	Emsian	386 ± 5.3
			Siegenian/Pragian	390.5 ± 12
			Gedinnian/Lochkovian	396.3 ± 11; 408.5 ± 4.5
SILURIAN		Late	Pridolian	411 ± 4
			Ludlovian	424 ± 4
		Early	Wenlockian	430.4 ± 9
			Llandoverian	439 ± 7
ORDOVICIAN		Late	Gamachian	(445)
			Richmondian	(452)
			Maysvillian	(458)
			Edenian	464 ± 7.5
		Middle	Trentonian	(467)
			Blackriverian	(470)
			Chazyan	(473)
			Whiterockian	476 ± 7.5
		Early	Canadian	510 ± 9.5
CAMBRIAN		Late	Trempealeauan	(512)
			Franconian	(515)
			Dresbachian	517.2 ± 17
		Middle		536 ± 5.5
		Early	Waucoban	(553)
			Placentian	570 ± 15

PRECAMBRIAN

EON	ERA		PERIOD	Ma Age
PROTEROZOIC				570
	Hadrynian (late)	Neoproterozoic	Neoproterozoic III	650
			Cryogenian	850
			Tonian	1000
	Helikian (middle)	Mesoproterozoic	Stenian	1200
			Ectasian	1400
			Calymmian	1600
	Aphebian (early)	Paleoproterozoic	Statherian	1800
			Orosirian	2050
			Rhyacian	2300
			Siderian	2500
ARCHEAN	Neoarchaean (late)			2800
	Mesoarchaean (middle)			3200
	Paleoarchaean (early)			3600
	Eoarchaean (earliest)			

base not defined

208 ± 18 isotopic age for stage boundary & uncertainty; (239) interpolated isotopic age for stage boundary

APPENDIX C

Chronological History of Exploration and Mining in the Babine Mountains Recreation Area (1866-1991)

1866 The Collins Overland Telegraph line (Western Union Telegraph Company) was constructed along the Watsonquah River, shortly thereafter renamed the Bulkley River after Colonel Bulkley (Engineer-in-Chief of the operation).

1878 H.J. Cambie, Canadian Pacific Railway, briefly reviewed the Bulkley Valley and its agricultural possibilities in connection with explorations of proposed railway routes.

1879 G.M. Dawson, Geological Survey of Canada, made an exploratory trip across the Babine Range up the Suskwa River and over the height of land to Babine Lake.

1898 The Collins Overland Telegraph trail along the Bulkley Valley was used as a route to the Klondike gold fields by a rush of prospectors; copper-gold veins and coal seams were reported from the region.

1903 Assessment work was done on the *Eldorado* claim (Harvey Mountain area)

1905 W.F. Robertson, Provincial Mineralogist, explored the region and visited mineral claims on Harvey Mountain; the *Dibble (or Babine-Bonanza)* veins were discovered by prospectors from Hazelton; claims were staked in Ganokwa basin.

1906 W.W. Leach, Geological Survey of Canada, began scientific geological examinations (1906-1910).

1908 Prospecting and exploratory work was done on at least 25 mineral properties within the Babine Range, with the hopes that the construction of a line of the Grand Trunk Pacific Railway would be built throughout the length of the Bulkley Valley.

1909 The railway now assured, miners flocked in and considerable work was done on more than 20 mineral prospects; surface and underground work (drifting) was done on the *Pack Train (or Drift)* property (by P. Harvey); the *Dibble (or Babine-Bonanza)* group was acquired by the Babine-Bonanza Mining Company (J. Cronin and Associates) and work began.

1910 Construction on the railway began (1910-1914); extensive underground work began on the *Babine-Bonanza* - considerable interest in this silver property drew attention to the region.

1911 Considerable work was done on existing mineral properties, particularly the *Babine-Bonanza* - trails from Telkwa, Morricetown, and Hudson's Bay Company ranch (on Driftwood Creek) to the *Babine-Bonanza* area were in use; about 42 new claims were recorded.

1912 Fourty-eight new claims were recorded.

1913 The town of Smithers was founded; silver-lead veins on the *Debenture* group were explored by drifting (by Ritzins and Morton); 71 new claims were recorded.

1914 Underground development continued on the *Debenture* (by Ritzins and Morton) and the *Babine-Bonanza* properties; 46 new claims were recorded.

1916 Seventy-two new claims were recorded.

1917 A sleigh road linking the *Babine-Bonanza* to the railway at Telkwa was completed (with a grant from the Mines Development Fund) and 72 tonnes of hand-cobbed silver-lead ore were brought out: to date 762 metres of shafts and tunnels had been put in - all work was by hand as no machinery was on the site; 6 tonnes of silver-lead ore was produced from the *Victoria (or Lorraine)* group; 6 tonnes of high-grade silver ore was shipped from the *Silver King* property.

1918 The *Cimbria (or Big Onion)* group was staked (by A. Elmsted and associates); underground development continued at the *Victoria* group (by P.J. Higgins); 23 tonnes of hand-cobbed silver-copper ore was brought out (1915-1918) from the *Harvey (or Drift)* group (by C.G. Harvey and W.J. Larkworthy); surface and underground exploration (drifting) was done at the *Social (or Jud)* group (by A.P. McCabe and P. McPhee).

1919 Construction of the McCabe trail to the *Social* group and the Harvey Mountain trail to the *Harvey* group was completed (both built with grants from the Mines Development Fund); underground development continued at the *Harvey* (by C.G. Harvey and W.J. Larkworthy) and *Silver King* groups, and work continued at the *Babine-Bonanza* property.

1920 Extensions were added to the McCabe trail (with grants from the Mines Development Fund) and included the Silver King basin trail to the *Silver King* group, and a trail to the *Victoria (or Lorraine)* group (now part of the Little Joe trail); underground development continued at the *Babine-Bonanza* property (by Babine-Bonanza Mining and Milling Company).

1921 Underground development continued at the *Babine-Bonanza*, *Driftwood* (by J.T. Driscoll), *Harvey* and *Silver King* (by P.J. Higgins) groups.

1922 Underground development commenced at the *Hyland Basin* (by M. Cain and T. King) and *Little Joe (or Silver Pick)* (by M. Cain and T. King) groups; underground development continued at the *Silver King* (by W. Foley and E. Lee), *Victoria* (by P.J. Higgins) and *Social* groups.

1923 Underground development continued at the *Babine-Bonanza*, *Hyland Basin* (by J.F. Duthie) and *Little Joe* (by M. Cain and T. King) groups.

1924 G. Hanson, Geological Survey of Canada, carried out the first systematic geological mapping of the southern Babine Range, including mineral prospect examination; underground work continued at the *Silver King* (by P.J. Higgins), *Victoria* (by P.J. Higgins), *Rainbow (or Driftwood)*, *Hyland Basin* (by J.F. Duthie) and *Little Joe* (by M. Cane and T. King) groups; underground work (drifting) was carried out at the *Cimbria* (or *Big Onion*) property (by A. Elmsted and associates).

1925 Underground development continued at the *Silver King* (by P.J. Higgins and associates), *Hyland Basin* (by Gale and Milligan), *Harvey* (by C.G. Harvey) and *Little Joe* (by M. Cain and T. King) groups; J. Cronin, manager of the *Babine-Bonanza* property died of injuries received in 1923 when his horse fell on him.

1926 Construction of the Little Joe Creek trail (built with a grant from the Mines Development Fund) now linked the *Little Joe* group with the *Babine-Bonanza* sleigh road; underground development continued at the *Silver King*, *Hyland Basin*, *Victoria*, *Silver Saddle*, *Little Joe* and *Harvey* (by C.G. Harvey) groups.

1927 Six tonnes of hand-sorted silver ore were shipped from the *Silver King* property; 9 tonnes of silver ore was taken out of the *Little Joe* property; 4.5 tonnes of silver-copper ore was shipped from the *Harvey* property; underground development (drifting) continued at the *Cimbria (or Big Onion)* group (by A. Elmsted).

1928 The *Babine-Bonanza* group was acquired by Babine-Bonanaza Metals Limited and underground operations continued; continued underground development (drifting) at the *Victoria* group (by Lorraine Copper-Silver Mines Limited).

1929 A new trail from the Little Joe Creek trail to the *Victoria* group was built; underground work continued at the *Victoria* (by Lorraine Copper-Silver Mines Limited), *Rainbow*, *Harvey* (by Consolidated Mining and Smelting Company of Canada Limited), and *Little Joe* properties; underground development continued at the *Babine-Bonanza* property and 27 tonnes of hand-sorted silver-lead ore were shipped (by Babine-Bonanza Metals Limited); trenching was done on the *Silver Saddle* property (by A.T. Harrer and B.F. Messner).

1930 Underground development continued at the *Rainbow*, *Silver King* (by Omineca Silver King Mining Company Limited), *Victoria* (by Lorraine Copper-Silver Mines Limited) and *Babine-Bonanza* groups.

1931 Underground work continued at the *Babine-Bonanza*, *Silver King* (by Omineca Silver King Mining Company Limited), *Victoria* (by Lorraine Copper-Silver Mines Limited) and *Little Joe* (by T. King) groups.

1932 Work continued at the *Rainbow* and *Cimbria* (by A. Elmsted and B. Mueller) groups.

1935 Six tonnes of hand-sorted silver ore were packed out of the *Hyland Basin* property.

1936 Nine tonnes of hand-sorted silver ore were packed out of the *Silver Pick (or Little Joe)* property (by J.J. Herman).

1937 Nine tonnes of hand-sorted silver ore were packed out of the *Skookum (or Silver King)* group (by J. Baker); 9 tonnes of hand-sorted silver-copper-gold ore were packed out from the *Rainbow* group (by F.H. Johnson).

1938 Five tonnes of hand-sorted silver ore were shipped from the *Little Joe* property (by A. Elmsted).

1939 Camp construction commenced at the *Silver King* property (by La Marr Gold Mines Limited).

1940 Surface and underground work was done at the *Silver King* group (by La Marr Gold Mines Limited); 4 tonnes of hand-sorted silver ore were shipped from the *Hyland Basin* group (by H.W. Agnew and Associates).

1948 Underground and surface diamond drilling was done at the *Babine-Bonanza* (by Cronin Babine Mines Limited), and a 112-kilogram sample sent for metallurgical tests.

1950 Construction began on a new road between the *Babine-Bonanza* group and the recently completed Chapman Lake road (now known as the Babine Lake road), with plans for installing a mill on the property.

1951 The new road was completed, many of the new mine buildings were constructed and 55 tonnes of previously stockpiled ore was shipped from the *Babine-Bonanza* property; surface work continued at the *Lorraine* (by Yellowknife Gold Mines Limited) and *Hyland Basin* (by Yellowknife Gold Mines Limited) properties.

1952 Parts of the *Cronin (or Babine-Bonanza)* property were rehabilitated, a road from the mine to the mill site was built and several buildings completed, including a 36 tonne-per-day mill (by Cronin Babine Mines Limited); 3185 tonnes of ore were milled (concentrates containing silver, gold, lead, zinc, copper and cadmium were shipped to the Trail smelter), but operations ceased by the year end due to low base metal prices.

1956 Work resumed at the *Cronin mine* (by New Cronin Babine Mines Limited), including underground development, and 3811 tonnes of ore were milled.

1957 Underground work at the *Cronin mine* continued, and 5370 tonnes of ore were milled.

1958 A road was built up Higgins Creek joining the *Lorraine* property to the *Cronin mine* road; some underground work was done at the *Lorraine*; the *Cronin mine* was leased from New Cronin Babine Mines Limited by P. Kindrat, who with his family operated the mine each summer until 1972 when it was sold to Hallmark Resources Limited: 112 tonnes of unmilled ore and 8 tonnes of lead concentrate were shipped from the *Cronin mine*.

1959 Seventy-four tonnes of lead concentrate and 60 tonnes of zinc concentrate were shipped from the *Cronin mine* (operated by the Kindrat family).

1960 Seventy-two tonnes of lead concentrate and 60 tonnes of zinc concentrate were shipped from the *Cronin mine*.

1961 Seventy-three tonnes of lead concentrate and 84 tonnes of zinc concentrate were shipped from the *Cronin mine*.

1962 Three hundred and sixty-three tonnes of ore was mined at the *Cronin mine*, but no concentrates shipped.

1963 Underground development and exploration (diamond drilling) continued at the *Cronin mine*, and 25 tonnes of lead concentrate and 33 tonnes of zinc concentrate were shipped.

1964 Underground development and exploration (diamond drilling) continued at the *Cronin mine*, and 41 tonnes of lead concentrate and 72 tonnes of zinc concentrate were shipped; underground development and camp construction commenced at the *Debenture* group (by Native Mines Limited); trenching, geophysics, and diamond drilling at the *Astlais (or Big Onion)* property began (by Noranda Exploration Company Limited).

1965 Underground development continued at the *Cronin mine*, and 99 tonnes of lead concentrate and 138 tonnes of zinc concentrate were shipped.

1966 Eighty-three tonnes of lead concentrate and 124 tonnes of zinc concentrate were shipped from the *Cronin mine* (by the newly formed Kindrat Mines Limited); underground development and exploration (diamond drilling) continued at the *Lorraine* property (by Native Mines Limited); bulldozer stripping and road building, geophysics and diamond drilling were carried out at the *Big Onion* property (by Texas Gulf Sulphur Company); geochemical sampling and trenching were done at the *Rainbow (or Driftwood)* property (by Reindeer Mines Limited).

1967 Fifty-one tonnes of lead concentrate and 76 tonnes of zinc concentrate recovered from ore mined from surface pit and underground were shipped from the *Cronin mine* ; exploration (diamond drilling) continued at the *Big Onion* property (by Texas Gulf Sulphur Company); road construction and trenching was done on the *Mert* group (northeast of the *Big Onion* property) (by Tro-Buttle Exploration Limited); geochemical sampling was done on the *Debenture* property (by Wanda Mines and Exploration Limited).

1968 Surface exploration continued at the *Mert* group (by Tro-Buttle Exploration Limited) and the *Rainbow* group (by D.W. Small and Associates).

1969 Twenty-two tonnes of lead concentrate and 25 tonnes of zinc concentrate recovered from ore from surface pits and old dumps were shipped from the *Cronin mine*; 13.5 tonnes of high-grade copper-silver ore was shipped from the *Rainbow* property (by J. Millhouse).

1970 H. Tipper, Geological Survey of Canada, began reconnaissance geological mapping in the Smithers map area (1969-1970); seventy-nine tonnes of lead concentrate and 94 tonnes of zinc concentrate were shipped from the *Cronin mine* (some surface exploration was also done); surface exploration (geophysics and geochemistry) continued at the *Big Onion* property (by Blue Rock Mining Corporation Limited); surface exploration (geophysics) continued at the *Mert* group (by Tro-Buttle Exploration Limited); trenching and diamond drilling was done on the *Jud (or Social)* group (by Rockwell Resources Limited).

1971 Eighty-three tonnes of lead concentrate and 113 tonnes of zinc concentrate recovered from ore from surface pits and underground were shipped from the *Cronin mine*; underground mapping at the *Drift (or Harvey)* group was completed and 4.5 tonnes of high-grade silver-copper ore were shipped out (by Driftwood Mines Limited).

1972 Underground development continued at the *Cronin mine*, and 69 tonnes of lead concentrate and 74 tonnes of zinc concentrate were shipped; bulldozer trenching was done on the *Drift* property (by Driftwood Mines Limited).

1973 Construction at the *Cronin mine* included: a tailings disposal area, upgraded camp facilities and restored mill; surface exploration (exposing the new *Upper showing*) and underground development continued at the *Cronin mine*, and 78 tonnes of lead concentrate and 73 tonnes of zinc concentrate were shipped (by Hallmark Resources Limited).

1974 Underground development continued at the *Cronin mine*, and 36 tonnes of lead concentrate and 64 tonnes of zinc concentrate were shipped; exploration (geophysics and diamond drilling) continued at the *Big Onion* property (by Canadian Superior Exploration Limited).

1975 Surface diamond drilling (to test the open-pit potential of the *Upper showing*) and surface and underground surveying were done at the *Cronin mine* (by Coca Metals Limited); surface diamond and percussion drilling and geochemical surveys were done at the *Big Onion* property (by Canadian Superior Exploration Limited).

1976 Surface diamond and percussion drilling, geochemical surveys and geological mapping continued at the *Big Onion* property (by Canadian Superior Exploration Limited); trenching was carried out on the *Driftwood (or Rainbow)* group (by P.J. Huber and L.B. Warren).

1977 Geochemical surveys, geological mapping and geophysics continued at the *Big Onion* property (by Canadian Superior Exploration Limited); a geochemical survey was carried out on the *Driftwood (or Rainbow)* group (by Petra Gem Explorations Limited); trenching was done on the *Native* group (by J.M. Hutter); geological mapping and underground sampling was done at the *Cronin mine* (by Hallmark Resources Limited).

1981 Surface diamond drilling was done at the *Silver King* property (by Silver Hill mines); underground sampling was carried out at the *Cronin mine* (by Hallmark Resources Limited).

1983 Underground sampling and surface diamond drilling was done at the *Cronin mine* (by Goldsil Mining and Milling Incorporated).

1984 The Babine Mountains Recreation Area was established by Order-In-Council #676, under management of the Ministry of Parks; trenching was carried out at the *AG (or Silver Box)* property (by Van Silver Holdings Limited).

1985 Underground exploration (drifting) was done at the *Silver King* property (by Silver Hill Mines).

1986 D. MacIntyre, P. Desjardins and others, British Columbia Geological Survey Branch, initiated geological mapping and mineral deposit studies in the southern Babine Range.

1987 Geological mapping, geochemical sampling and geophysical surveys were done on the *Cronin mine* property (by Southern Gold Resources Limited); geochemical sampling was carried out at the *Big Onion* property (by Noranda Exploration Company Limited).

1988 The Mineral Tenure Act became effective and made provisions for exploration within recreation areas: work done outside a claim (access, etc.) is subject to both a Ministry of Parks Resource Use Permit and a Mines Act approval. Any work within a claim must be authorized under a Resource Use Permit and Mines Reclamation Permit containing conditions agreeable to both ministries. Later in the year Order-In-Council #151 was passed, protecting all mineral claims located within a recreation area from forfeiture for a period of one year after the date a Resource Use Permit is issued under the Park Act; geophysical surveys were done on the *Cronin mine* property (by Southern Gold Resources Limited).

1991 Order-In-Council #151 was rescinded by Order-In-Council #185 which gave title holders until 31 October, 1992 to comply with Section 25 of the Mineral Tenure Act: this was necessary because of problems in the issuance of Resource Use Permits; surface diamond drilling was done on the *Big Onion* property (by Mindoro Corporation and Varitech Resources Limited).

Sources of information: British Columbia Ministry of Mines Annual Reports (1898-1968); Geology, Exploration and Mining in British Columbia (1969-1988); Morice (1904); L'Orsa (1990); unpublished Assessment Reports and other company reports.

APPENDIX D

Lithogeochemical Analyses

Rock-chip samples collected from the study area in 1986, 1987 and 1988 (sample numbers 1 to 119) were analyzed by the Ministry of Energy, Mines and Petroleum Resources, Geological Survey Branch Analytical Sciences Laboratory. Samples were jaw crushed, split and then ring pulverized in a tungsten-carbide mill. Silver, copper, lead, zinc, molybdenum, arsenic and antimony were determined by atomic absorption spectrophotometry. Gold was determined by fire assay with atomic absorption finish, in part by Acme Analytical Laboratories, Vancouver, B.C.

Rock-chip samples collected in 1991 (samples 120 to 243) were processed as above and analyzed by the Analytical Sciences Laboratory for Ag, Cu, Pb, Zn and Cd by atomic absorption spectrophotometry. In addition, Au, Mo, As and Sb were determined by neutron activation by Actlabs, Ancaster, Ontario; samples with high gold concentrations were re-analysed by fire assay with atomic absorption finish by Chemex Laboratories Limited, North Vancouver, B.C.

All elements are expressed in parts per million, except gold which is in parts per billion. Detection limits are as follows:

Element	Method	Detection Limit (ppm)
Au (1986)	fa/aas	17 (ppb)
Au (1987)	fa/aas	20 (ppb)
Au (1988)	fa/aas	1 (ppb)
Au (1991)	na	5 (ppb)
Au (1991)	fa/aas	1 (ppb)
Ag (1986)	aas	0.6
Ag (1987)	aas	0.5
Ag (1991)	aas	0.5 (samples 120-158)
Ag (1991)	aas	0.4 (samples 159-243)
Cu	aas	2
Pb (1986-88)	aas	5
Pb (1991)	aas	4
Zn	aas	2
Mo (1986-88)	aas	5
Mo (1991)	na	5
Cd	aas	0.5
As (1986)	aas	20
As (1988)	aas	50
As (1991)	na	2
Sb (1986)	aas	5
Sb (1991)	na	0.2

Abbreviations: aas = atomic absorption spectrophotometry, fa/aas = fire assay/ atomic absorption spectrophotometry, na = neutron activation.

NO.	MAP	ID	UTME	UTMN	AU	AG	CU	PB	ZN	MO	CD	AS	SB	SAMPLE
1	93L15	DM86-16	643343	6076894	-17	-10.0	11.00	6.00	38.00	3		-20.0	-10.0	ALTERED VOLCANIC ROCK (FLOAT)
2	93L15	PD86-70	640806	6078547	-17	-10.0	13.00	11.00	51.00	6		-20.0	-10.0	ALTERED SILTSTONE
3	93L15	PD86-106-3	639696	6077050	-17	-10.0	34.00	12.00	70.00	4		35.0	-10.0	ALTERED FELSIC TUFF
4	93L15	PD86-310	634580	6077560	105	1.0	25.00	31.00	123.00	-5		290.0	-5.0	ALTERED VOLCANIC ROCK
5	93L15	PD86-312	634485	6077253	137	-0.6	20.00	18.00	452.00	-5		-25.0	-5.0	ALTERED VOLCANIC ROCK
6	93L15	PD86-313	634287	6076865	-20	-0.6	146.00	7.00	61.00	-5		-25.0	-5.0	ALTERED VOLCANIC ROCK
7	93L15	DM87-52	634435	6093371	-20	-0.5	23.00	12.00	50.00					LIMONITIC/PYRITIC SCHIST
8	93L15	DM87-71	636271	6091672	40	0.8	9.00	5.00	20.00					QUARTZ VEIN
9	93L15	DM87-80	638332	6089968	650	420.0	2200.00	8.00	107.00					LIMONITIC SCHIST (MAL)
10	93L15	DM87-92	637657	6086782	-20	-0.5	17.00	8.00	112.00					LIMONITIC SCHIST
11	93L15	DM87-93	633948	6085553	-20	0.5	13.00	42.00	113.00					QUARTZ VEIN
12	93L15	DM87-94	633934	6085891	-20	-0.5	9.00	12.00	72.00					LIMONITIC SCHIST
13	93L15	DM87-99	632735	6086206	-20	-0.5	2.00	8.00	4.00					LEACHED SCHIST
14	93L15	DM87-113-2	634426	6092178	-20	-0.5	26.00	51.00	69.00					LIMONITIC TUFF
15	93L15	DM87-113-3	634426	6092178	-20	-0.5	37.00	18.00	56.00					LIMONITIC TUFF
16	93L15	DM87-118	639763	6083909	-20	-0.5	7.00	25.00	40.00					QUARTZ VEIN (FLOAT)
17	93L15	DM87-131-1	643885	6079468	494	-0.5	6.00	-5.00	393.00					SILICIC VOLCANIC ROCK
18	93L15	DM87-131-2	643885	6079468	-20	-0.5	3.00	-5.00	12.00					SILICIC VOLCANIC ROCK
19	93L15	MC87-1	634550	6085600	-20	-0.5	19.00	-5.00	111.00	-5				LIMONITIC SCHIST
20	93L15	MC87-2	634600	6085650	-20	-0.5	27.00	23.00	108.00	7				LIMONITIC SCHIST
21	93L15	MC87-3	634700	6085850	-20	-0.5	10.00	12.00	70.00	10				LIMONITIC SCHIST
22	93L15	MC87-4	634700	6085850	-20	-0.5	50.00	16.00	71.00	-5				LIMONITIC SCHIST
23	93L15	MC87-5	634720	6086300	-20	-0.5	52.00	11.00	50.00	5				LIMONITIC SCHIST
24	93L15	MC87-6-1	635000	6086300	-20	-0.5	41.00	20.00	65.00	-5				LIMONITIC SCHIST
25	93L15	MC87-6-2	635150	6086570	-20	-0.5	18.00	21.00	64.00	5				LIMONITIC SCHIST
26	93L15	MC87-7-2	635950	6086200	-20	-0.5	41.00	15.00	114.00	-5				LIMONITIC SCHIST
27	93L15	MC87-7-3	635700	6086200	-20	-0.5	30.00	11.00	59.00	-5				LIMONITIC SCHIST
28	93L15	MC87-8-1	637000	6086650	-20	-0.5	17.00	12.00	61.00	7				LIMONITIC SCHIST
29	93L15	MC87-8-2	637000	6086650	20	-0.5	48.00	10.00	55.00	-5				LIMONITIC SCHIST
30	93L15	MC87-8-4	637000	6086650	-20	-0.5	13.00	18.00	58.00	-5				LIMONITIC SCHIST
31	93L15	PD87-264-2	640800	6085219	-20	0.4	20.00	91.00	230.00					LIMONITIC SCHIST
32	93L15	PD87-270	637231	6084602	80	-0.4	210.00	7.00	10.00					LIMONITIC TUFF
33	93L15	PD87-277	636545	6083910	-20	-0.4	15.00	10.00	66.00					ALTERED ANDESITE
34	93L15	PD87-282	634821	6086702	-20	-0.4	27.00	13.00	63.00					ALTERED ANDESITE
35	93L15	PD87-284	634668	6086694	50	-0.4	13.00	17.00	24.00					PYRITIC SCHIST
36	93L15	PD87-287	634426	6087614	-20	0.5	17.00	22.00	33.00					PYRITIC SCHIST
37	93L15	PD87-290	634238	6087860	130	-0.4	8.00	18.00	69.00					PYRITIC SCHIST
38	93L15	PD87-330-2	634254	6094783	-20	-0.5	23.00	37.00	99.00	-5				PYRITIC SCHIST
39	93L15	PD87-331-1	634317	6094816	90	-0.5	28.00	56.00	85.00					ALTERED ANDESITE
40	93L15	PD87-372-4	636959	6090176	-20	-0.5	32.00	13.00	150.00					SILICIC/LIMONITIC SCHIST
41	93L15	PD87-372-6	636959	6090176	-20	-0.5	24.00	15.00	64.00					LIMONITIC SCHIST
42	93L15	PD87-376-4	637378	6090779	-20	4.0	3600.00	758.00	557.00					LIMONITIC SCHIST (CPY, MAL)
43	93L15	PD87-383-2	637668	6088342	-20	0.6	8.00	13.00	62.00					LIMONITIC QUARTZ VEIN

NO.	MAP	ID	UTME	UTMN	AU	AG	CU	PB	ZN	MO	CD	AS	SB	SAMPLE
44	93L15	PD87-385	638217	6088304	-20	0.7	6.00	15.00	66.00					RHYOLITE
45	93L15	PD87-388-1	639065	6088218	-20	3.0	106.00	123.00	335.00					SERICITIC/LIMONITIC SCHIST
46	93L15	PD87-388-2	639065	6088218	90	-0.5	3.00	8.00	32.00					QUARTZ VEIN
47	93L15	PD87-402	633715	6088009	-20	2.0	20.00	93.00	38.00					PYRITIC SCHIST
48	93L15	PD87-403-2	633344	6088119	-20	0.8	13.00	62.00	47.00					PYRITIC ANDESITE
49	93L15	PD87-403-3	633344	6088119	-20	0.5	2.00	12.00	12.00					SILICIC ANDESITE
50	93L15	PD87-404	633214	6087767	-20	0.6	15.00	33.00	63.00					PYRITIC SCHIST
51	93L15	PD87-405-2	633118	6087805	-20	-0.5	2.00	10.00	3.00					SILICIC VOLCANIC ROCK
52	93L15	PD87-409	632768	6087284	-20	-0.5	9.00	10.00	90.00					PYRITIC SCHIST
53	93L15	PD87-410	632642	6087111	-20	-0.5	28.00	12.00	112.00					ALTERED PYRITIC ANDESITE
54	93L15	PD87-411	632430	6086713	-20	-0.5	15.00	12.00	22.00					LIMONITIC SCHIST
55	93L15	PD87-412	632312	6086482	-20	-0.5	11.00	15.00	56.00					ALTERED BASALT
56	93L15	PD87-413-1	632212	6086303	-20	-0.5	13.00	12.00	47.00					QUARTZ VEIN
57	93L15	PD87-413-2	632212	6086303	-20	-0.5	10.00	12.00	214.00					SERICITIC/LIMONITIC SCHIST
58	93L15	PD87-421-4	630400	6088200	-20	-0.5	24.00	22.00	155.00	18				LIMONITIC SCHIST
59	93L15	PD87-421-6	630400	6088200	-20	-0.5	21.00	12.00	36.00	-5				LIMONITIC SCHIST
60	93L15	PD421-7	630400	6088200	-20	-0.5	8.00	11.00	25.00	5				LIMONITIC SCHIST
61	93L15	PD87-421-8	630400	6088200	-20	-0.5	12.00	18.00	52.00	-5				LIMONITIC SCHIST
62	93L15	PD87-425	631000	6088900	-20	-0.5	13.00	13.00	42.00	-5				PYRITIC SCHIST
63	93L15	PD87-426	631700	6089300	-20	-0.5	15.00	11.00	39.00	-5				PYRITIC SCHIST
64	93L15	PD87-428-3	633878	6090672	-20	-0.5	26.00	13.00	84.00	-5				LIMONITIC SCHIST
65	93L15	PD87-429-1	633879	6090609	-20	-0.5	41.00	101.00	141.00	5				LIMONITIC SCHIST
66	93L15	PD87-458-4	631969	6094379	-20	-0.5	19.00	19.00	63.00	-5				PYRITIC SCHIST
67	93L15	PD87-459	631913	6094233	-20	-0.5	35.00	19.00	54.00	-5				QUARTZ VEIN
68	93L15	PD87-460-2	631888	6094163	-20	-0.5	31.00	12.00	81.00	8				ALTERED TUFF
69	93L15	PD87-480	629380	6087149	-20	-0.5	15.00	16.00	80.00	5				ALTERED TUFF
70	93L15	PD87-484-2	630103	6090150	-20	1.0	6.00	130.00	70.00	-5				QUARTZ VEIN
71	93L15	PD87-484-4	630103	6090150	-20	0.5	21.00	47.00	135.00	5				PYRITIC SILTSTONE
72	93L15	PD87-489	635695	6085373	-20	-0.5	19.00	16.00	54.00	9				LIMONITIC SCHIST
73	93L15	PD87-491-2	635832	6084936	-20	-0.5	21.00	10.00	76.00	-5				ALTERED TUFF
74	93L15	PD87-506-4	636379	6087668	-20	-0.5	4.00	13.00	105.00	6				ALTERED ANDESITE
75	93L15	PD87-506-5	636379	6087668	-20	-0.5	3.00	9.00	32.00	15				ALTERED VOLCANIC ROCK (FLOAT)
76	93L15	PD87-510-2	636838	6086520	-20	-0.5	7.00	73.00	19.00	6				LIMONITIC SCHIST
77	93L15	PD87-510-3	636838	6086520	-20	-0.5	33.00	12.00	58.00	-5				LIMONITIC SCHIST
78	93L15	PD87-514	636319	6086198	120	-0.5	7.00	54.00	21.00	5				SILICIC VOLCANIC ROCK
79	93L15	PD87-533-2	640757	6088258	-20	1.0	90.00	29.00	240.00	-5				ALTERED RHYOLITE
80	93L15	PD87-539-3	639910	6086528	1410	2.0	59.00	15.00	79.00	-5				PY-RHYOLITE (RHYOLITE SHOWING)
81	93L15	PD87-539-4	639910	6086528	4320	2.0	37.00	25.00	90.00	-5				PY SCHIST (RHYOLITE SHOWING)
82	93L15	PD87-545-1	636365	6092412	-20	0.5	51.00	12.00	102.00	-5				SERICITIC/PYRITIC SCHIST
83	93L15	PD87-545-4	636258	6092297	-20	-0.5	38.00	16.00	78.00	8				LIMONITIC SCHIST
84	93L15	PD87-545-5	636258	6092297	-20	-0.5	35.00	18.00	110.00	-5				LIMONITIC SCHIST
85	93L15	PD87-560	641142	6085644	-20	-0.5	4.00	17.00	226.00	-5				QUARTZ VEIN
86	93L15	PD87-570	642173	6084281	-20	0.5	23.00	27.00	75.00	-5				LIMONITIC SCHIST

NO.	MAP	ID	UTME	UTMN	AU	AG	CU	PB	ZN	MO	CD	AS	SB	SAMPLE
87	93L15	PD87-583-4	640223	6084971	-20	-0.5	5.00	-5.00	16.00	-5				LIMONITIC SCHIST
88	93L14	DMA88-14-2	627159	6089343	1	0.5	8.00	13.00	10.00			-50.0	-15.0	QUARTZ VEIN
89	93L14	DMA88-17	627233	6087847	1510	59.0	286.00	5100.00	5900.00			1100.0	320.0	QUARTZ VEIN (AG SHOWING)
90	93L15	DMA88-44	643885	6079468	21	-0.5	30.00	84.00	310.00	-8			-25.0	ALTERED VOLCANIC ROCK
91	93L15	DMA88-45	643163	6078388	2	-0.5	33.00	5.00	68.00	-8			-25.0	ALTERED VOLCANIC ROCK
92	93L14	MCU88-3	627111	6090226	1	-0.5	2.00	42.00	23.00			-50.0	-15.0	QUARTZ VEIN
93	93L14	MCU88-4	627155	6091231	1	-0.5	117.00	9.00	220.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
94	93L14	MCU88-5	627212	6090224	1	-0.5	3.00	7.00	12.00			-50.0	-15.0	QUARTZ VEIN
95	93M03	MCU88-6	626231	6097211	8	-0.5	47.00	34.00	108.00			140.0	-15.0	SANDSTONE
96	93M03	MCU88-7	627243	6097442	1	-0.5	37.00	17.00	80.00			-50.0	-15.0	SANDSTONE
97	93L15	PDE88-2	642217	6077572	3	-0.5	3.00	7.00	31.00			-50.0	-15.0	QUARTZ VEIN
98	93L15	PDE88-3-1	643156	6078466	1	-0.5	17.00	10.00	86.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
99	93L15	PDE88-3-2	643885	6079468	29	-0.6	12.00	9.00	87.00					SILTSTONE
100	93L15	PDE88-12-2	643884	6081941	1	-0.5	59.00	5.00	148.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
101	93L15	PDE88-19	644656	6082808	2	-0.5	2.00	39.00	60.00			-50.0	-15.0	QUARTZ VEIN
102	93L15	PDE88-86	643704	6088761	1	-0.5	197.00	15.00	148.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
103	93L15	PDE88-90-1	643087	6089985	2	-0.5	34.00	29.00	218.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
104	93L15	PDE88-96	643366	6090511	2	-0.5	143.00	7.00	50.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
105	93L15	PDE88-99	643854	6090217	1	-0.5	7.00	15.00	138.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
106	93L14	PDE88-166	626559	6090623	2	-0.5	59.00	14.00	74.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
107	93L14	PDE88-184	623637	6093727	1	-0.5	22.00	13.00	77.00			-50.0	-15.0	SANDSTONE
108	93L14	PDE88-190	622353	6093935	1	-0.5	73.00	48.00	78.00			-50.0	-15.0	SANDSTONE
109	93L14	PDE88-192	622612	6094203	2	-0.5	52.00	9.00	120.00			-50.0	-15.0	ALTERED VOLCANIC ROCK
110	93L14	PDE88-193	622656	6094235	4	-0.5	150.00	165.00	253.00			72.0	-15.0	QUARTZ VEIN
111	93L14	PDE88-198	621528	6096058	4	-0.5	26.00	17.00	82.00			-50.0	-15.0	SILTSTONE
112	93L14	PDE88-199	621497	6096013	112	-0.5	17.00	24.00	68.00			-50.0	-15.0	QUARTZ VEIN
113	93L14	PDE88-209	620858	6094923	2	-0.5	40.00	17.00	118.00			-50.0	-15.0	SILTSTONE
114	93L14	PDE88-213	621133	6093758	6	2.0	2300.00	17.00	248.00			-50.0	337.0	QUARTZ VEIN
115	93L15	PDE88-264-3	643503	6091209	14	0.6	9.00	3.00	24.00				-25.0	TUFF
116	93L14	PTE88-129	620505	6091751		1.0	14.00	60.00	33.00			-50.0	-15.0	QUARTZ VEIN
117	93L15	APE88-2	643885	6079468	37	-0.6	3.00	5.00	27.00					SILTSTONE
118	93L15	APE88-3	643885	6079468	33	-0.6	4.00	5.00	29.00					SILTSTONE
119	93L15	APE88-4	643885	6079468	37	-0.6	5.00	7.00	147.00					SILTSTONE
120	93M02	BGA91-1	631158	6098542	6	-0.5	19.00	7.00	60.00	-5	-0.3	8.0	5.5	ALTERED ANDESITE
121	93M02	BGA91-2	630995	6098571	-5	-0.5	32.00	7.00	63.00	-5	-0.3	5.0	1.6	ALTERED ANDESITE
122	93M02	BGA91-3	631331	6098470	-5	-0.5	28.00	3.00	88.00	-5	-0.3	3.0	0.4	LIMONITIC ANDESITE
123	93M02	BGA91-4	631391	6098419	-5	-0.5	8.00	11.00	131.00	-5	0.4	9.0	14.0	ALTERED ANDESITE
124	93M02	BGA91-5	631381	6098647	-5	-0.5	46.00	9.00	133.00	7	0.4	25.0	0.6	LIMONITIC ANDESITE
125	93M02	BGA91-6	631224	6098838	5	-0.5	9.00	8.00	85.00	5	-0.3	10.0	19.0	QUARTZ-VEINED ANDESITE
126	93M02	BGA91-7	631711	6098203	-5	-0.5	49.00	8.00	81.00	-5	-0.3	8.0	2.6	LIMONITIC ANDESITE
127	93M02	BGA91-8	631711	6098203	-5	-0.5	13.00	13.00	33.00	-5	-0.3	4.0	1.6	ALTERED ANDESITE
128	93M02	BGA91-9	631710	6098203	-5	-0.5	24.00	12.00	50.00	-5	-0.3	8.0	2.3	EPIDOTE-ALTERED ANDESITE
129	93M02	BGA91-10	631818	6098217	-5	-0.5	27.00	8.00	72.00	-5	-0.3	3.0	0.5	ANKERITE-VEINED ANDESITE

NO.	MAP	ID	UTME	UTMN	AU	AG	CU	PB	ZN	MO	CD	AS	SB	SAMPLE
130	93M02	BGA91-11	631917	6098244	-5	-0.5	6.00	12.00	132.00	-5	-0.3	9.0	33.0	QTZ-ANK VEINED ANDESITE
131	E3M02	BGA91-12	632048	6098281	-5	-0.5	12.00	11.00	145.00	-5	0.3	2.0	1.9	LIMONITIC ANDESITE
132	93M02	BGA91-13	632033	6098357	-5	-0.5	122.00	14.00	52.00	-5	1.7	5.0	5.1	LIMONITIC ANDESITE
133	93M02	BGA91-14	632077	6098490	-5	-0.5	6.00	8.00	58.00	-5	-0.3	6.0	14.0	CHLORITIC ANDESITE
134	93M02	BGA91-15	631983	6098457	5	-0.5	57.00	10.00	112.00	-5	-0.3	4.0	0.6	LIMONITIC ANDESITE
135	93L15	BGA91-16	636832	6086736	10	-0.5	12.00	18.00	12.00	-5	-0.3	16.0	3.1	LIMONITIC SCHIST
136	93L15	BGA91-17	636878	6086495	-5	-0.5	17.00	15.00	25.00	-5	-0.3	12.0	1.5	SERICITIC/PYRITIC SCHIST
137	93L15	BGA91-18	636429	6086130	-5	-0.5	8.00	7.00	16.00	-5	-0.3	9.0	1.9	LIMONITIC QUARTZ VEIN
138	93L15	BGA91-19	636432	6086131	-5	-0.5	14.00	10.00	168.00	-5	-0.3	25.0	5.0	PYRITIC SCHIST
139	93L15	BGA91-20	636419	6086047	-5	-0.5	2.00	7.00	13.00	-5	0.3	5.0	1.1	LIMONITIC QUARTZ VEIN
140	93L15	BGA91-21	636424	6086045	-5	-0.5	16.00	9.00	49.00	-5	-0.3	6.0	3.5	SERICITE SCHIST
141	93L15	BGA91-22	636476	6085986	-5	-0.5	24.00	15.00	19.00	-5	-0.3	10.0	6.1	PYRITIC SCHIST
142	93L15	BGA91-23	636345	6085887	-5	-0.5	21.00	10.00	30.00	-5	-0.3	31.0	2.3	PYRITIC SCHIST
143	93L15	BGA91-24	636290	6085898	-5	-0.5	35.00	35.00	49.00	5	-0.3	34.0	6.0	PYRITIC SCHIST
144	93L15	BGA91-25	634341	6085951	-5	-0.5	4.00	3.00	8.00	-5	0.4	15.0	1.0	QUARTZ VEIN
145	93L15	BGA91-26	633932	6085950	-5	-0.5	14.00	15.00	93.00	-5	-0.3	15.0	0.9	LIMONITIC SCHIST
146	93L15	BGA91-27	633892	6085838	-5	-0.5	12.00	5.00	34.00	-5	-0.3	15.0	8.1	LIMONITIC SCHIST
147	93L15	BGA91-28	633984	6085800	-5	-0.5	19.00	7.00	22.00	-5	-0.3	5.0	1.8	LIM-ANK QUARTZ VEIN
148	93L15	BGA91-29	634040	6085794	12	-0.5	20.00	7.00	61.00	-5	-0.3	14.0	2.4	LIMONITIC SCHIST
149	93L15	BGA91-30	634145	6085734	-5	-0.5	39.00	21.00	136.00	-5	-0.3	27.0	8.8	LIMONITIC SCHIST
150	93L15	BGA91-31	634269	6085957	-5	-0.5	9.00	9.00	20.00	-5	-0.3	23.0	1.7	LIMONITIC-SILICIC SCHIST
151	93L15	BGA91-32	634214	6085731	-5	-0.5	9.00	7.00	33.00	-5	-0.3	6.0	4.4	LIMONITIC-SILICIC SCHIST
152	93L15	BGA91-33	634290	6085828	-5	0.7	9.00	240.00	76.00	-5	-0.3	38.0	6.4	BLEACHED PHYLLITE
153	93L15	BGA91-34	634378	6085868	-5	-0.5	7.00	-3.00	16.00	-5	-0.3	13.0	0.5	LIMONITIC QUARTZ VEIN
154	93L15	BGA91-35	634412	6085837	-5	-0.5	11.00	25.00	50.00	-5	-0.3	44.0	6.2	LIMONITIC SCHIST
155	93L15	BGA91-36	634488	6085838	-5	-0.5	28.00	25.00	65.00	-5	-0.3	59.0	4.7	LIMONITIC SCHIST
156	93L15	BGA91-37	634569	6085794	-5	-0.5	11.00	16.00	166.00	-5	-0.3	47.0	3.4	LIMONITIC-SILICIC PHYLLITE
157	93M02	BGA91-38	631508	6096903	26	-0.5	12.00	18.00	68.00	-5	-0.3	23.0	3.8	SILICIC ANDESITE
158	93M02	BGA91-39	630785	6100080	-5	-0.5	17.00	6.00	46.00	-5	-0.3	4.0	0.9	CARBONATE-ALTERED ANDESITE
159	93L15	BGA91-40	634835	6087778	8	0.4	16.00	23.00	170.00	-5	-0.3	26.0	2.9	LIMONITIC ANDESITE
160	93L15	BGA91-41	634733	6087833	-5	-0.4	10.00	6.00	11.00	-5	0.3	7.0	1.1	QUARTZ VEIN (SPEC)
161	93L15	BGA91-42	634735	6087832	-5	-0.4	12.00	3.00	193.00	-5	3.4	8.0	1.6	QUARTZ VEIN (SPEC)
162	93L15	BGA91-43	634721	6087834	-5	-0.4	11.00	3.00	10.00	-5	0.3	8.0	1.1	QUARTZ VEIN (SPEC)
163	93L15	BGA91-44	633948	6087892	11	16.0	564.00	15900.00	370.00	-5	13.0	11.0	12.0	SILVER KING LAKE SHOWING/VEIN
164	93L15	BGA91-45	633879	6087943	-5	-0.4	18.00	21.00	41.00	-5	-0.3	37.0	1.7	LIMONITIC SCHIST
165	93L15	BGA91-46	633850	6087885	-5	-0.4	14.00	9.00	40.00	-5	0.3	36.0	2.1	LIMONITIC SCHIST
166	93L15	BGA91-47	633779	6087869	-5	0.4	20.00	12.00	59.00	-5	-0.3	72.0	2.4	LIMONITIC/PYRITIC SCHIST
167	93L15	BGA91-48	633891	6088163	-5	1.3	17.00	11.00	15.00	7	-0.3	53.0	5.0	PYRITIC RHYOLITE
168	93L15	BGA91-49	633891	6088163	-5	-0.4	19.00	12.00	17.00	8	-0.3	35.0	3.1	PYRITIC RHYOLITE
169	93L15	BGA91-50	633787	6087950	-5	0.4	34.00	15.00	13.00	-5	-0.3	120.0	1.5	PYRITIC/LIMONITIC ANDESITE
170	93L15	BGA91-51	633700	6087986	-5	1.2	24.00	17.00	10.00	9	-0.3	230.0	5.1	LIMONITIC SCHIST
171	93L15	BGA91-52	633214	6087881	-5	-0.4	17.00	5.00	107.00	-5	-0.3	170.0	1.3	PYRITIC/LIMONITIC ANDESITE
172	93L15	BGA91-53	633876	6087957	-5	-0.4	21.00	-3.00	83.00	-5	-0.3	10.0	0.7	RIBBONED QUARTZ VEIN

NO.	MAP	ID	UTME	UTMN	AU	AG	CU	PB	ZN	MO	CD	AS	SB	SAMPLE
173	93L15	BGA91-54	632725	6087242	-5	-0.4	25.00	14.00	69.00	-5	-0.3	28.0	1.9	SERICITE-CHLORITE SCHIST
174	93L15	BGA91-55	632626	6087143	-5	-0.4	20.00	9.00	140.00	-5	-0.3	34.0	4.8	CHLORITE-SERICITE SCHIST
175	93L15	BGA91-56	632677	6087083	9	-0.4	16.00	8.00	100.00	-5	-0.3	62.0	11.0	PYRITIC ANDESITE
176	93L15	BGA91-57	632629	6086751	-5	-0.4	16.00	9.00	70.00	-5	-0.3	28.0	1.2	PYRITIC SCHIST
177	93L15	BGA91-58	632597	6086698	-5	-0.4	22.00	8.00	86.00	-5	-0.3	23.0	1.3	PYRITIC SER-CHLOR SCHIST
178	93L15	BGA91-59	632472	6086430	-5	-0.4	9.00	11.00	7.00	-5	-0.3	22.0	3.0	PYRITIC SERICITE SCHIST
179	93L15	BGA91-60	632486	6086351	-5	-0.4	19.00	8.00	84.00	-5	-0.3	21.0	1.7	PYRITIC SERICITE SCHIST
180	93L15	BGA91-61	634406	6092181	-5	-0.4	25.00	8.00	41.00	5	-0.3	17.0	0.6	SILICIC ANDESITE
181	93L15	BGA91-62	634399	6092090	5	-0.4	17.00	8.00	62.00	-5	-0.3	4.0	-0.2	SILICIC ANDESITE
182	93L15	BGA91-63	634054	6092575	-5	-0.4	25.00	11.00	51.00	-5	-0.3	3.0	0.3	SILICIC ANDESITE
183	93L15	BGA91-64	633673	6092915	-5	-0.4	68.00	11.00	110.00	-5	-0.3	8.0	0.4	SILICIC ANDESITE
184	93L15	BGA91-65	633518	6092959	-5	-0.4	24.00	8.00	60.00	-5	-0.3	18.0	2.3	SILICIC ANDESITE
185	93L15	BGA91-66	639757	6081859	8	-0.4	18.00	8.00	90.00	-5	-0.3	5.0	1.5	PYRITIC ANDESITE
186	93L15	BGA91-67	639870	6081851	-5	-0.4	47.00	14.00	225.00	-5	4.1	3.0	0.7	RIBBONED QUARTZ VEIN
187	93L15	BGA91-68	639921	6081862	-5	-0.4	17.00	5.00	44.00	-5	-0.3	2.0	0.8	LIMONITIC QUARTZ VEIN
188	93L15	BGA91-69	639981	6081885	-5	-0.4	14.00	5.00	36.00	-5	0.3	-2.0	1.6	LIMONITIC QUARTZ VEIN
189	93L15	BGA91-70	640046	6081934	-5	-0.4	8.00	8.00	54.00	-5	-0.3	4.0	0.9	LIMONITIC QUARTZ VEIN
190	93L15	BGA91-71	640090	6081979	-5	-0.4	5.00	9.00	28.00	-5	0.3	2.0	1.4	LIMONITIC QUARTZ VEIN
191	93L15	BGA91-72	640119	6082007	-5	-0.4	18.00	17.00	35.00	-5	-0.3	10.0	1.7	LIMONITIC QUARTZ VEIN
192	93L15	BGA91-73	640313	6082042	-5	0.4	19.00	18.00	163.00	-5	1.0	3.0	3.9	LIMONITIC SCHIST
193	93L15	BGA91-74	640522	6082037	5	10.0	66.00	4050.00	3800.00	-5	22.0	8.0	220.0	74-77 LITTLE JOE LAKE S VEINS
194	93L15	BGA91-75	640521	6082031	-5	0.4	16.00	18.00	163.00	-5	0.6	-2.0	20.0	QUARTZ VEIN
195	93L15	BGA91-76	640521	6082032	-12	32.0	163.00	25300.00	1350.00	-5	10.0	-2.0	1400.0	QUARTZ VEIN
196	93L15	BGA91-77	640522	6082034	-5	0.6	4.00	16.00	39.00	-5	-0.3	3.0	2.5	QUARTZ VEIN
197	93L15	BGA91-78	640246	6082036	-5	-0.4	20.00	15.00	60.00	-5	-0.3	14.0	1.9	QUARTZ VEIN
198	93L15	BGA91-79	640356	6082007	-5	-0.4	16.00	39.00	66.00	-5	0.5	-2.0	2.3	LIMONITIC QUARTZ VEIN
199	93L15	BGA91-80	640387	6082013	-5	-0.4	3.00	27.00	23.00	-5	0.3	-2.0	1.7	LIMONITIC QUARTZ VEIN
200	93L15	BGA91-81	640414	6082028	-5	-0.4	3.00	11.00	15.00	-5	0.3	3.0	1.5	LIMONITIC QUARTZ VEIN
201	93L15	BGA91-82	640471	6082032	-5	-0.4	11.00	19.00	71.00	-5	-0.3	4.0	4.2	82-90 LITTLE JOE LAKE S VEINS
202	93L15	BGA91-83	640515	6082028	-38	17.0	413.00	18300.00	10700.00	-7	60.0	110.0	4100.0	QUARTZ VEIN
203	93L15	BGA91-84	640516	6082030	-36	28.0	73.00	18000.00	2650.00	-9	22.0	-8.0	5600.0	QUARTZ VEIN
204	93L15	BGA91-85	640575	6082018	-5	-0.4	4.00	15.00	34.00	-5	-0.3	4.0	2.1	QUARTZ VEIN
205	93L15	BGA91-86	640575	6082018	12	0.6	15.00	30.00	83.00	10	0.5	15.0	3.1	QUARTZ VEIN
206	93L15	BGA91-87	640575	6082018	-5	0.4	19.00	63.00	70.00	-5	0.4	4.0	1.7	QUARTZ VEIN
207	93L15	BGA91-88	640573	6082017	-5	0.4	53.00	66.00	22.00	-5	0.3	3.0	3.4	QUARTZ VEIN
208	93L15	BGA91-89	640573	6082017	-5	-0.4	3.00	66.00	57.00	-5	0.3	-2.0	2.3	QUARTZ VEIN
209	93L15	BGA91-90	640516	6082034	-5	95.0	112.00	82500.00	1400.00	-5	11.0	-2.0	580.0	QUARTZ VEIN
210	93L15	BGA91-91	641351	6081206	-2	0.4	2.00	5.00	10.00	2	-0.3	1.0	0.3	LIMONITIC QUARTZ VEIN
211	93L15	BGA91-92	641348	6081205	-2	-0.4	3.00	6.00	29.00	1	-0.3	6.5	1.0	PYRITIC RHYOLITE
212	93L15	BGA91-93	641265	6081092	-2	-0.4	3.00	5.00	26.00	3	-0.3	1.5	0.4	RIBBONED QUARTZ VEIN
213	93L15	BGA91-94	641143	6080872	-2	-0.4	5.00	15.00	33.00	2	-0.3	10.0	2.1	QUARTZ VEIN
214	93L15	BGA91-95	640697	6082011	26	11.0	53.00	6000.00	3550.00	4	31.0	2.9	8.7	95-103 LITTLE JOE LAKE S VEINS
215	93L15	BGA91-96	640697	6082011	15	6.0	110.00	1800.00	34000.00	-1	300.0	2.0	6.7	QUARTZ VEIN

NO.	MAP	ID	UTME	UTMN	AU	AG	CU	PB	ZN	MO	CD	AS	SB	SAMPLE
216	93L15	BGA91-97	640694	6082012	-2	0.4	9.00	228.00	98.00	4	1.5	2.1	2.7	QUARTZ VEIN
217	93L15	BGA91-98	640705	6081949	-2	2.0	10.00	687.00	470.00	-1	3.0	1.9	5.8	QUARTZ VEIN
218	93L15	BGA91-99	640706	6081950	2	6.0	36.00	869.00	1200.00	-1	3.7	18.0	0.0	QUARTZ VEIN
219	93L15	BGA91-100	640706	6081950	5	3.5	69.00	168.00	730.00	-1	2.9	6.1	40.0	QUARTZ VEIN
220	93L15	BGA91-101	640705	6081950	-2	-0.4	3.00	20.00	135.00	2	1.0	5.1	2.6	QUARTZ VEIN
221	93L15	BGA91-102	640706	6081951	2	1.4	7.00	38.00	43.00	-1	0.3	5.7	5.0	QUARTZ VEIN
222	93L15	BGA91-103	640718	6081944	52	26.0	337.00	2500.00	26000.00	3	140.0	77.0	110.0	QUARTZ VEIN
223	93L15	BGA91-104	639844	6086250	4	-0.4	24.00	5.00	133.00	3	0.3	7.8	0.4	QUARTZ VEIN
224	93L15	BGA91-105	639843	6086250	23	-0.4	4.00	3.00	47.00	-1	-0.3	310.0	-0.1	CHLOR-ANK QUARTZ VEIN
225	93L15	BGA91-106	639824	6086498	-2	-0.4	5.00	6.00	53.00	-1	-0.3	12.0	0.8	RHYOLITE
226	93L15	BGA91-107	639910	6086507	2	-0.4	15.00	9.00	134.00	0	0.6	22.0	1.3	RHYOLITE
227	93L15	BGA91-108	640061	6086515	5370	12.0	213.00	54.00	68.00	-6	0.3	62000.0	36.0	108-111 RHYOLITE SHOWING
228	93L15	BGA91-108FA	640061	6086515	3950									FIRE ASSAY OF BGA91-108
229	93L15	BGA91-109	640055	6086518	11600	7.0	555.00	33.00	138.00	-6	2.0	140000.0	8.6	SULPHIDE-QUARTZ VEIN
230	93L15	BGA91-109FA	640055	6086518	94900									FIRE ASSAY OF BGA91-109
231	93L15	BGA91-110	640056	6086501	12800	38.0	273.00	138.00	28.00	-10	-0.3	99000.0	30.0	SULPHIDE-QUARTZ STOCKWORK
232	93L15	BGA91-110FA	640056	6086501	13200									FIRE ASSAY OF BGA91-110
233	93L15	BGA91-111	640055	6086500	12300	86.0	10900.00	50.00	1200.00	-4	24.0	31000.0	98.0	SULPHIDE VEIN (FLOAT)
234	93L15	BGA91-111FA	640055	6086500	10500									FIRE ASSAY OF BGA91-111
235	93L15	BGA91-112	634303	6080162	12	-0.4	27.00	5.00	54.00	-1	-0.3	70.0	0.7	SILTSTONE
236	93L15	BGA91-113	633846	6080017	17	0.4	1700.00	3.00	9.00	3	-0.3	14.0	0.3	QUARTZ VEIN
237	93L15	BGA91-114	638013	6084724	2	0.4	7.00	15.00	32.00	-5	-0.3	8.4	1.1	RHYOLITE
238	93L15	BGA91-115	630242	6086717	-2	-0.4	13.00	6.00	52.00	-5	-0.3	7.8	1.5	LIMONITIC SCHIST
239	93L15	BGA91-116	632855	6086163	-2	-0.4	67.00	16.00	30.00	4	-0.3	160.0	5.0	SERICITE SCHIST
240	93L15	BGA91-117	638042	6084726	5	0.4	6.00	30.00	31.00	7	-0.3	49.0	2.7	PYRITIC RHYOLITE
241	93L15	BGA91-118	632857	6086158	-2	-0.4	15.00	38.00	88.00	-5	-0.3	27.0	16.0	SERICITIC SCHIST
242	93L15	BGA91-119	630255	6086730	-2	-0.4	12.00	6.00	133.00	-1	-0.3	11.0	2.7	SERICITIC SCHIST
243	93L15	BGA91-120	641251	6081112	7	-0.4	34.00	20.00	79.00	-1	-0.3	11.0	2.7	PYRITIC SCHIST

APPENDIX E

Stream-Sediment Geochemical Analyses

A reconnaissance stream-sediment (and water) geochemical survey was conducted in the Babine Mountains Recreation Area from August 23 to 25, 1991 by J.L. Gravel of Bonaventure Management Services. A total of 39 streams were sampled: methods used to collect and analyze the sediment samples were in accordance with standards set by the RGS program of the Ministry of Energy, Mines and Petroleum Resources (e.g., Matysek *et al.*, 1990) . These data compliment previously released RGS data in 1983 (Hazelton Map Sheet NTS 93M: Geological Survey of Canada Open File 1000) and 1986 (Smithers Map Sheet NTS 93L: Geological Survey of Canada Open File 1361).

Geological formations listed for each sample site (FORM) are the dominant bedrock type within each drainage basin. Statistical manipulation of data utilized the Geological Survey Branch's "Geochemical Applications Software Package".

Samples collected in 1991 were analysed by Chemex Labs Limited, North Vancouver (atomic absorption spectrophotometry) and Actlabs Activation Laboratories Limited, Ancaster, Ontario (neutron activation).

All elements are expressed in parts per million, except gold which is in parts per billion. Analytical methods and detection limits for elements determined are as follows (from Jackaman *et al.*, 1992):

ANALYTICAL METHODS AND SPECIFICATIONS FOR ROUTINE RGS SUITE OF ELEMENTS

Element	Detection Limits	Sample Weight	Digestion Technique	Determination Method	
Cadmium	0.2 ppm	1 g	3 mL HNO_3 let sit overnight, add 1 mL HCl in 90°C water bath, for 2 hrs. cool, add 2 mL H_2O, wait 2 hrs.	A A S	atomic absorption spectrophotometry using air-acetylene burner and standard solutions for calibration, background corrections made for Pb, Ni, Co, Ag, Cd
Cobalt	2 ppm				
Copper	2 ppm				
Iron	0.02 %				
Lead	2 ppm				
Manganese	5 ppm				
Nickel	2 ppm				
Silver	0.2 ppm				
Zinc	2 ppm				
Molybdenum	1 ppm	0.5 g	Al added to above solution		
Barium	10 ppm	1 g	HNO_3 - HCl - HF taken to dryness, hot HCl added to leach residue		
Vanadium	5 ppm				
Chromium	5 ppm				
Bismuth	0.2 ppm	2 g	HCl - $KClO_2$ digestion, KI added to reduce Fe, MIBK and TOPO for extraction	A A S - H	organic layer analyzed by atomic absorption spectrophotometry with background correction
Antimony	0.2 ppm				
Tin	1 ppm	1 g	sintered with NH_4I, HCl and ascorbic acid leach	A A S	atomic absorption spectrophotometry
Arsenic	1 ppm	0.5 g	add 2 mL KI and dilute HCl to 0.8M HNO_3 • 0.2M HCl	A A S - H	2 mL borohydride solution added to produce AsH_3 gas which is passed through heated quartz tube in the light path of atomic absorption spectrophotometer
Mercury	10 ppb	0.5 g	20 mL HNO_3 • 1 mL HCl	A A S - F	10% stannous sulphate added to evolve mercury vapour, determined by atomic absorption spectrometry
Tungsten	1 ppm	0.5 g	K_2SO_4 fusion, HCl leach	C O L O R	colorimetric: reduced tungsten complexed with toluene 3, 4 dithiol
Fluorine	40 ppm	0.25 g	$NaCO_3$ - KNO_3 fusion, H_2O leach	I O N	citric acid added and diluted with water, fluorine determined with specific ion electrode
Uranium	0.5 ppm	1 g	nil	N A D N C	neutron activation with delayed neutron counting
LOI	0.1 %	0.5 g	ash sample at 500°C	G R A V	weight difference
pH - water	0.1 pH unit	25 mL	nil	G C E	glass - calomel electrode system
U - water	0.05 ppb	5 mL	add 0.5 mL fluran solution	L I F	place in Scintrex UA-3
F - water	20 ppb	25 mL	nil	I O N	fluorine ion specific electrode

ADDITIONAL ELEMENTS ANALYZED BY INNA

Element	Detection Limit	Element	Detection Limit
Gold	2 ppb	Molybdenum	1 ppm
Antimony	0.1 ppm	Nickel	10 ppm
Arsenic	0.5 ppm	Rubidium	5 ppm
Barium	100 ppm	Samarium	0.5 ppm
Bromine	0.5 ppm	Scandium	0.5 ppm
Cerium	10 ppm	Sodium	0.1 %
Cesium	0.5 ppm	Tantalum	0.5 ppm
Chromium	5 ppm	Terbium	0.5 ppm
Cobalt	5 ppm	Thorium	0.5 ppm
Hafnium	1 ppm	Tungsten	2 ppm
Iron	0.2 %	Uranium	0.2 ppm
Lanthanum	5 ppm	Ytterbium	2 ppm
Lutetium	0.2 ppm	Zirconium	200 ppm

MAP	ID	UTME	UTMN	FORM	PH	ZN	CU	PB	NI	CO	AG	MN	MO	CD	V	BI	AU	SB	AS
93L15	861185	641126	6075322	mJS	6.9	110	50	14	20	13	0.2	800	1	0.1	40	-1.0	6	3.9	71.0
93L15	861186	642732	6077961	muJA	6.8	117	34	10	48	14	0.1	840	1	0.1	32	-1.0	1	2.1	18.0
93L15	861187	644141	6080852	muJA	6.9	110	29	13	40	13	0.1	600	1	0.1	34	-1.0	14	2.4	14.0
93L15	861188	644141	6080852	muJA	6.8	122	32	14	40	13	0.1	660	1	0.1	32	-1.0	11	1.5	12.0
93L15	861189	645246	6081453	IK	6.6	113	25	18	19	10	0.1	710	1	0.1	34	-1.0	1	2.8	20.0
93L15	861194	648285	6085038	lJ	6.6	89	7	7	16	6	0.1	550	1	0.1	32	-1.0	3	0.9	12.0
93L15	861195	637147	6072713	dr	6.9	121	48	15	18	9	0.1	680	5	0.1	40	-1.0	11	2.9	50.0
93L15	861244	632510	6074962	lJ	7.1	84	23	6	21	9	0.1	590	1	0.1	38	-1.0	1	1.6	31.0
93L15	861245	629750	6075930	lJ	7.4	91	23	6	20	13	0.3	510	1	0.1	47	-1.0	1	1.2	12.0
93L15	861246	631562	6079201	lJ	7.5	137	34	11	19	13	0.1	780	1	0.2	64	-1.0	2	2.6	13.0
93L15	861255	648334	6088615	lJ	7.3	257	23	92	19	11	0.3	640	1	2.4	35	-1.0	20	4.8	51.0
93L15	861256	648334	6088615	lJ	7.2	285	27	102	20	12	0.8	640	1	2.5	34	-1.0	7	4.3	54.0
93L15	861257	647306	6093500	lJ	7.0	108	19	18	20	15	0.1	2000	1	0.1	42	-1.0	2	1.5	9.0
93L15	861258	647019	6094951	lJ	7.2	88	18	9	21	13	0.1	350	1	0.1	42	-1.0	1	1.8	8.0
93L15	861259	647329	6090881	lJ	7.0	78	17	9	13	10	0.1	940	1	0.1	45	-1.0	1	1.4	9.0
93L15	861260	641733	6093793	lJ	7.1	95	21	14	26	10	0.2	510	1	0.1	39	-1.0	2	2.3	8.0
93L15	861262	642035	6093444	lJ	7.0	115	27	11	16	11	0.2	520	1	0.1	42	-1.0	2	4.1	16.0
93L15	861263	643861	6087366	lJ	6.5	204	30	36	18	13	0.3	1100	1	0.6	30	-1.0	30	2.2	10.0
93L15	861264	643515	6087847	lJ	6.8	806	49	532	26	14	3.0	720	1	9.3	26	-1.0	75	27.5	60.0
93L15	861265	640332	6087188	muJA	6.9	235	53	212	34	17	3.7	680	1	1.4	28	-1.0	610	18.5	40.0
93L15	861266	631757	6074007	lJ	7.4	95	270	9	25	29	0.1	6200	4	0.1	33	-1.0	2	0.9	18.0
93L15	861374	634509	6084392	IK	6.9	825	42	66	92	31	0.7	6200	1	6.7	34	-1.0	12	3.8	30.0
93L15	861375	634540	6083999	muJA	7.0	92	33	15	23	13	0.2	580	1	0.1	34	-1.0	1	1.8	10.0
93L15	861376	632497	6084718	uKK	6.8	138	36	19	27	16	0.4	760	2	0.7	22	-1.0	1	1.3	30.0
93L15	861377	630090	6083781	uKK	6.9	266	37	24	38	18	0.3	2200	1	1.9	29	-1.0	1	2.2	14.0
93L15	861400	635284	6076780	mJS	7.3	180	38	15	22	11	0.5	1200	1	0.8	39	-1.0	5	2.8	57.0
93L15	861424	640649	6094427	uKK	6.9	85	17	13	24	10	0.1	260	1	0.6	37	-1.0	1	0.9	4.0
93L15	861425	640272	6095874	uKK	7.7	82	20	14	23	12	0.1	530	1	0.9	43	-1.0	2	1.2	4.0
93L15	861602	634660	6076937	mJS	7.4	119	24	9	23	11	0.1	480	1	0.1	39	-1.0	1	1.8	33.0
93L15	861782	628800	6087600	uKK	6.9	100	29	11	30	13	0.1	700	2	0.1	25	-1.0	1	0.5	13.0
93L15	861783	631787	6092167	uKK	-1.0	80	23	15	22	11	0.1	630	1	0.1	34	-1.0	1	1.8	11.0
93L15	861784	631897	6091701	IK	6.8	94	26	14	32	14	0.1	890	1	0.1	35	-1.0	1	1.3	12.0
93L15	861786	628299	6089650	IK	7.3	98	34	11	48	14	0.1	720	1	0.1	33	-1.0	1	1.1	17.0
93L14	861780	627432	6094650	IK	8.0	110	29	9	41	12	0.1	570	1	0.1	35	-1.0	1	2.7	9.0
93L14	861946	621217	6093650	IK	8.3	93	40	11	31	14	0.1	700	1	0.1	43	-1.0	1	1.6	9.0
93L14	861947	621715	6093595	IK	7.9	119	49	12	52	17	0.1	800	1	0.1	40	-1.0	5	1.6	10.0
93L14	861948	621175	6089069	IK	8.2	105	42	12	43	14	0.1	740	1	0.1	42	-1.0	1	1.3	10.0
93L14	861949	623429	6088320	uKK	7.6	94	27	15	34	11	0.1	640	1	0.1	38	-1.0	1	3.0	29.0
93L14	861951	622489	6087707	IK	-1.0	95	36	14	22	13	0.1	800	1	0.1	42	-1.0	1	2.7	17.0
93L14	861954	626073	6086660	uKK	7.6	100	29	20	33	11	0.1	740	1	0.1	30	-1.0	1	2.5	29.0
93L14	861955	626073	6086660	uKK	7.4	104	30	21	34	12	0.1	840	1	0.1	33	-1.0	1	3.0	33.0
93M02	833170	637199	6102202	mJS	6.9	109	17	4	32	15	0.2	679	1	-1.0	-1	-1.0	2	3.0	25.0
93M02	833173	632803	6103051	uKK	7.4	90	26	5	34	16	0.1	855	1	-1.0	-1	-1.0	3	4.1	20.0

MAP	ID	UTME	UTMN	FORM	PH	ZN	CU	PB	NI	CO	AG	MN	MO	CD	V	BI	AU	SB	AS
93M02	833174	631079	6102828	uKK	7.5	83	28	6	22	15	0.1	763	1	-1.0	-1	-1.0	3	6.4	23.0
93M02	833175	631201	6102501	uKK	7.6	116	50	6	60	20	0.1	833	1	-1.0	-1	-1.0	5	5.5	40.0
93M02	833176	628900	6102600	uKK	7.8	66	24	6	15	16	0.1	838	1	-1.0	-1	-1.0	3	7.4	18.0
93M02	833177	628200	6101000	lJ	7.7	106	44	5	39	20	0.1	878	1	-1.0	-1	-1.0	2	4.7	23.0
93M03	833178	626900	6098200	lJ	7.5	86	36	6	28	17	0.1	866	1	-1.0	-1	-1.0	5	2.2	13.0
93M02	833179	635906	6098342	uKK	7.5	68	27	5	27	15	0.1	827	1	-1.0	-1	-1.0	2	6.3	16.0
93M02	833180	641102	6097244	uKK	7.6	80	19	8	26	13	0.1	720	1	-1.0	-1	-1.0	2	4.3	14.0
93L15	911002	641870	6085147	lJ	7.6	144	40	20	21	16	0.2	1450	1	0.2	31	0.2	27	4.0	89.0
93L15	911003	641548	6085237	muJA	7.5	372	43	105	42	15	1.7	1150	1	2.4	34	0.1	12	7.0	36.0
93L15	911004	642963	6086179	lJ	7.6	165	18	12	5	9	0.1	1700	1	0.1	19	0.1	2	5.0	8.0
93L15	911005	646145	6085616	lJ	8.0	140	37	19	16	9	1.5	1000	4	0.5	49	0.4	8	7.0	70.0
93L15	911007	646025	6086288	lJ	7.5	160	27	17	13	9	0.2	910	1	0.6	54	0.3	2	6.0	54.0
93L15	911008	646025	6086288	lJ	8.1	160	29	15	13	9	0.1	920	1	0.6	52	0.3	2	5.0	54.0
93L15	911009	645354	6081385	lJ	7.7	106	23	10	21	11	0.1	920	1	0.1	51	0.1	2	4.0	27.0
93L15	911010	645223	6082647	lJ	7.4	124	22	18	16	11	0.1	1150	1	0.2	50	0.1	3	5.0	44.0
93L15	911011	645383	6082810	lJ	7.4	128	23	13	16	11	0.1	1100	1	0.3	47	0.2	2	5.0	32.0
93L15	911012	637833	6073840	dr	8.0	125	53	16	17	14	0.1	1200	6	0.2	55	0.3	2	7.0	50.0
93L15	911013	637804	6075042	mJS	8.0	140	60	13	12	11	0.1	1200	3	0.2	40	0.5	4	9.0	240.0
93L15	911014	638798	6076928	mJS	8.1	148	40	17	22	13	0.1	1600	1	0.1	38	0.1	10	8.0	140.0
93L15	911015	632562	6084592	lK	-1.0	212	49	25	37	32	0.1	1200	1	0.4	19	0.4	5	6.0	43.0
93L15	911016	630844	6084560	lK	8.3	94	17	15	19	13	0.1	880	1	0.1	22	0.1	4	5.0	43.0
93L15	911017	630515	6081884	lJ	8.4	140	43	30	17	14	0.1	870	1	0.4	63	0.1	2	8.0	56.0
93L15	911018	630401	6081083	lJ	8.5	140	48	10	17	17	0.1	885	1	0.1	55	0.1	2	5.0	20.0
93L15	911019	636475	6080757	muJA	7.6	110	33	5	26	13	0.1	1200	1	0.1	32	0.1	2	4.0	39.0
93L15	911020	639993	6078627	muJA	7.7	125	27	6	43	15	0.1	1400	1	0.1	30	0.1	2	3.0	32.0
93L15	911022	642185	6081831	muJA	7.5	202	55	11	95	35	0.1	1550	1	0.1	28	0.1	2	10.0	16.0
93L15	911023	642030	6082074	uKK	7.4	175	43	16	55	22	0.1	1600	1	0.3	23	0.2	2	4.0	18.0
93L15	911024	639538	6086721	uKK	7.6	290	55	190	32	15	12.0	970	1	1.7	28	0.1	3	3.0	18.0
93L15	911025	639694	6086622	muJA	7.6	174	58	13	85	23	0.1	1800	1	0.5	33	0.1	184	16.0	35.0
93L15	911026	640695	6090607	muJA	7.5	97	25	13	23	14	0.1	880	1	0.1	50	0.1	2	4.0	22.0
93L15	911027	638173	6091216	uKK	7.6	102	30	31	28	14	0.1	760	1	0.1	52	0.1	2	3.0	15.0
93L15	911028	638102	6091387	uKK	7.5	112	33	27	30	14	0.1	845	1	0.1	53	0.1	4	3.0	15.0
93L15	911029	637677	6093322	uKK	7.6	118	30	16	26	14	0.1	1150	1	0.1	38	0.1	2	5.0	17.0
93L15	911030	637677	6093322	uKK	7.5	128	31	23	30	15	0.1	1300	1	0.1	43	0.1	2	5.0	18.0
93L15	911031	636114	6095014	uKK	7.9	120	40	38	25	17	0.1	900	1	0.4	45	0.8	2	5.0	15.0
93L15	911032	635057	6096513	uKK	8.0	56	25	11	19	13	0.1	560	1	0.1	28	0.1	3	4.0	10.0
93M02	911033	632234	6100022	uKK	7.4	87	22	6	23	12	0.1	1500	1	0.1	57	0.1	2	3.0	17.0
93M02	911034	632454	6099200	uKK	7.5	80	22	7	22	12	0.1	710	1	0.1	67	0.1	2	4.0	13.0
93L15	911035	630017	6096125	uKK	7.8	85	21	10	19	14	0.1	1200	1	0.1	38	0.1	6	4.0	16.0
93L15	911037	629618	6096070	lJ	6.1	100	28	9	22	13	0.1	870	1	0.1	39	0.1	2	4.0	23.0
93M03	911038	627468	6096935	lJ	8.0	75	22	8	22	13	0.1	740	1	0.1	40	0.1	2	4.0	18.0
93M03	911039	628654	6098778	uKK	8.0	87	33	5	32	19	0.1	870	1	0.1	45	0.1	2	3.0	44.0
93L15	911040	632251	6091935	uKK	7.8	106	28	10	33	16	0.1	1000	1	0.1	36	0.1	2	2.0	17.0

MAP	ID	UTME	UTMN	FORM	PH	ZN	CU	PB	NI	CO	AG	MN	MO	CD	V	BI	AU	SB	AS
93L15	911042	628581	6089687	lK	8.1	104	40	8	25	16	0.1	610	1	0.1	20	0.2	11	9.0	120.0
93L14	911043	627381	6088113	lK	7.8	115	40	9	42	14	0.1	1200	1	0.1	37	0.1	2	4.0	40.0
93L15	911044	629961	6088072	uKK	7.6	145	50	30	20	14	0.1	1700	1	0.3	32	0.2	2	3.0	24.0
93L14	911045	622329	6089102	lK	8.0	95	27	11	41	12	0.1	630	1	0.1	45	0.1	2	2.0	10.0

Stream-Sediment Geochemical Analyses:

Statistical Summary of Data by Element and Geological Formation:

Arsenic (ppm)

```
      ppm                                                              N       %    Cum%

   6.8 -|
       -|*                                                             1     2.1     2.1
   9.5 -|
       -|*****                                                         4     8.5    10.6
  13.5 -|
       -|***************                                              14    29.8    40.4
  19.1 -|
       -|*********                                                     8    17.0    57.4
  26.9 -|
       -|******                                                        5    10.6    68.1
  38.0 -|
       -|*********                                                     8    17.0    85.1
  53.7 -|
       -|****                                                          3     6.4    91.5
  75.9 -|
       -|*                                                             1     2.1    93.6
 107.2 -|
       -|***                                                           2     4.3    97.9
 151.4 -|
       -|                                                              0     0.0    97.9
 213.8 -|                                       Logarithmic
       -|*                                       Histogram             1     2.1   100.0
 302.0 -|
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100 %

                      Percentage of Values
```

	All	uKK	lJ
N	47	19	13
N > DL	47	19	13
Missing	0	0	0
Mean	36.98	19.47	36.69
Median	23.00	17.00	27.00
Mode	18.00	15.00	23.00
Range	232.0	34.0	81.0
St Dev	40.32	8.59	24.28
Coef Var	1.090	0.441	0.662
Log Mean	1.434	1.260	1.473
Geo Mean	27.18	18.20	29.73
Log StDv	0.310	0.153	0.302
Log CVar	0.216	0.122	0.205
Percntls			
Minimum	8.0	10.0	8.0
10th	13.0	13.0	8.0
20th	15.0	15.0	18.0
30th	17.0	15.0	20.0
40th	18.0	16.0	23.0
50th	23.0	17.0	27.0
60th	27.0	17.0	32.0
70th	39.0	18.0	44.0
80th	44.0	20.0	54.0
85th	50.0	23.0	56.0
90th	56.0	24.0	70.0
95th	120.0	40.0	70.0
98th	140.0	44.0	89.0
99th	240.0	44.0	89.0
Maximum	240.0	44.0	89.0

Element Statistics
Variable - Arsenic [As]
Number of Values - 47
Units - ppm
Detection Limit - 0.5
Analytical Method - INAA

Antimony (ppm)

```
      ppm                                                          N     %   Cum%

  1.7 -|
      -|***                                                        2   4.3    4.3
  2.0 -|
      -|*                                                          1   2.1    6.4
  2.5 -|
      -|*********                                                  8  17.0   23.4
  3.1 -|
      -|                                                           0   0.0   23.4
  3.8 -|
      -|**************                                            13  27.7   51.1
  4.7 -|
      -|**********                                                 9  19.1   70.2
  5.8 -|
      -|********                                                   7  14.9   85.1
  7.1 -|
      -|****                                                       3   6.4   91.5
  8.7 -|
      -|****                                                       3   6.4   97.9
 10.7 -|
      -|                                                           0   0.0   97.9
 13.2 -|                                        Logarithmic
      -|*                                        Histogram         1   2.1  100.0
 16.2 -|
       +----+----+----+----+----+----+----+----+----+----+
       0   10   20   30   40   50   60   70   80   90  100 %

                   Percentage of Values
```

	All	uKK	lJ
N	47	19	13
N > DL	47	19	13
Missing	0	0	0
Mean	5.13	4.21	4.92
Median	4.30	4.00	5.00
Mode	4.00	3.00	4.00
Range	14.0	5.4	5.8
St Dev	2.51	1.42	1.47
Coef Var	0.489	0.336	0.299
Log Mean	0.669	0.602	0.673
Geo Mean	4.66	4.00	4.71
Log StDv	0.186	0.144	0.137
Log CVar	0.279	0.240	0.204
Percntls			
Minimum	2.0	2.0	2.2
10th	3.0	3.0	2.2
20th	3.0	3.0	4.0
30th	4.0	3.0	4.0
40th	4.0	4.0	4.0
50th	4.3	4.0	5.0
60th	5.0	4.0	5.0
70th	5.5	4.3	5.0
80th	7.0	5.0	5.0
85th	7.0	5.5	6.0
90th	8.0	6.3	7.0
95th	9.0	6.4	7.0
98th	10.0	7.4	8.0
99th	16.0	7.4	8.0
Maximum	16.0	7.4	8.0

Element Statistics
Variable - Antimony [Sb]
Number of Values - 47
Units - ppm
Detection Limit - 0.1
Analytical Method - INAA

```
 ppb                                                        N      %    Cum%

   1 -|
     -|*************                                       21   24.7   24.7
   2 -|
     -|********************                                34   40.0   64.7
   3 -|
     -|*********                                           15   17.6   82.4
   5 -|
     -|***                                                  4    4.7   87.1
  10 -|
     -|***                                                  5    5.9   92.9
  20 -|
     -|**                                                   3    3.5   96.5
  38 -|
     -|                                                     0    0.0   96.5
  72 -|
     -|*                                                    1    1.2   97.6
 138 -|
     -|*                                                    1    1.2   98.8
 263 -|
     -|                                                     0    0.0   98.8
 501 -|                                  Logarithmic
     -|*                                  Histogram         1    1.2  100.0
 955 -|
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100 %

               Percentage of Values
```

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	64	20	22	7	8
Missing	0	0	0	0	0
Mean	13.9	2.3	7.8	3.4	83.0
Median	2.0	2.0	2.0	1.0	2.0
Mode	2.0	2.0	2.0	1.0	2.0
Range	609	5	74	11	609
St Dev	68.88	1.23	15.79	3.74	193.63
Coef Var	4.949	0.543	2.023	1.090	2.333
Log Mean	0.457	0.299	0.494	0.337	0.848
Geo Mean	2.9	2.0	3.1	2.2	7.0
Log StDv	0.507	0.221	0.494	0.409	0.974
Log CVar	1.110	0.738	1.001	1.214	1.150
Percntls					
Minimum	1	1	1	1	1
10th	1	1	1	1	1
20th	1	1	2	1	1
30th	2	2	2	1	2
40th	2	2	2	1	2
50th	2	2	2	1	2
60th	2	2	2	2	2
70th	3	2	2	4	12
80th	5	3	5	5	14
85th	6	3	8	5	184
90th	12	3	20	11	184
95th	27	5	30	11	610
98th	75	5	30	12	610
99th	184	6	75	12	610
Maximum	610	6	75	12	610

Element Statistics
Variable - Gold [Au]
Number of Values - 85
Units - ppb
Detection Limit - 1
Analytical Method - FA-NA

Gold (ppb)

Histograms are not calculated for variables with fewer than 15 samples above the detection limit.

Element Statistics
Variable - Bismuth [Bi]
Number of Values - 38
Units - ppm
Detection Limit - 0.2
Analytical Method - AAS

	All	uKK	lJ
N	38	13	11
N > DL	6	1	2
Missing	47	14	15
Mean	0.17	0.17	0.16
Median	0.10	0.10	0.10
Mode	0.10	0.10	0.10
Range	0.7	0.7	0.3
St Dev	0.15	0.19	0.10
Coef Var	0.863	1.141	0.628
Log Mean	-0.861	-0.884	-0.847
Geo Mean	0.14	0.13	0.14
Log StDv	0.244	0.262	0.227
Log CVar	-0.284	-0.296	-0.268
Percntls			
Minimum	0.1	0.1	0.1
10th	0.1	0.1	0.1
20th	0.1	0.1	0.1
30th	0.1	0.1	0.1
40th	0.1	0.1	0.1
50th	0.1	0.1	0.1
60th	0.1	0.1	0.1
70th	0.1	0.1	0.2
80th	0.2	0.1	0.2
85th	0.2	0.2	0.2
90th	0.3	0.2	0.3
95th	0.4	0.2	0.3
98th	0.5	0.8	0.4
99th	0.8	0.8	0.4
Maximum	0.8	0.8	0.4

Bismuth (ppm)

```
ppm                                                           N     %    Cum%

19 -|
   -|**                                                       3   3.9    3.9
21 -|
   -|**                                                       3   3.9    7.9
23 -|
   -|**                                                       2   2.6   10.5
26 -|
   -|****                                                     5   6.6   17.1
30 -|
   -|********                                                11  14.5   31.6
33 -|
   -|********                                                12  15.8   47.4
37 -|
   -|**********                                              14  18.4   65.8
42 -|
   -|********                                                11  14.5   80.3
47 -|
   -|*****                                                    7   9.2   89.5
52 -|
   -|****                                                     5   6.6   96.1
59 -|                                   Logarithmic
   -|**                                  Histogram            2   2.6   98.7
66 -|
    +----+----+----+----+----+----+----+----+----+----+
    0   10   20   30   40   50   60   70   80   90  100 %

              Percentage of Values
```

	All	lJ	uKK	lK	muJA
N	76	24	21	14	10
N > DL	76	24	21	14	10
Missing	9	2	6	0	0
Mean	38.4	42.2	38.1	34.4	33.5
Median	38.0	42.0	37.0	35.0	32.0
Mode	34.0	42.0	38.0	34.0	34.0
Range	48	45	45	26	22
St Dev	10.33	11.05	11.83	8.51	6.24
Coef Var	0.269	0.262	0.310	0.248	0.186
Log Mean	1.569	1.610	1.562	1.521	1.519
Geo Mean	37.1	40.7	36.5	33.2	33.1
Log StDv	0.119	0.123	0.131	0.124	0.071
Log CVar	0.076	0.076	0.084	0.082	0.047
Percntls					
Minimum	19	19	22	19	28
10th	26	26	23	19	28
20th	30	32	28	22	28
30th	33	35	29	33	30
40th	34	39	32	34	32
50th	38	42	37	35	32
60th	40	42	38	35	33
70th	42	47	43	40	34
80th	45	50	45	42	34
85th	50	51	52	42	34
90th	52	55	53	43	34
95th	55	63	57	43	50
98th	63	64	67	45	50
99th	64	64	67	45	50
Maximum	67	64	67	45	50

Element Statistics
Variable - Vanadium (V)
Number of Values - 76
Units - ppm
Detection Limit - 5
Analytical Method - AAS

Vanadium (ppm)

```
         ppm                                                       N      %   Cum%

   0.1 -|
       -|*********************************                        50   65.8   65.8
   0.1 -|
       -|                                                          0    0.0   65.8
   0.2 -|
       -|******                                                    8   10.5   76.3
   0.3 -|
       -|**                                                        3    3.9   80.3
   0.5 -|
       -|****                                                      6    7.9   88.2
   0.8 -|
       -|**                                                        2    2.6   90.8
   1.2 -|
       -|**                                                        3    3.9   94.7
   1.9 -|
       -|**                                                        2    2.6   97.4
   3.0 -|
       -|                                                          0    0.0   97.4
   4.8 -|
       -|*                                                         1    1.3   98.7
   7.6 -|                                      Logarithmic
       -|*                                      Histogram          1    1.3  100.0
  12.0 -|
        +----+----+----+----+----+----+----+----+----+----+
        0   10   20   30   40   50   60   70   80   90  100 %

                      Percentage of Values
```

	All	1J	uKK	1K	muJA
N	76	24	21	14	10
N > DL	21	7	8	2	3
Missing	9	2	6	0	0
Mean	0.51	0.67	0.39	0.59	0.50
Median	0.10	0.10	0.10	0.10	0.10
Mode	0.10	0.10	0.10	0.10	0.10
Range	9.2	9.2	1.8	6.6	2.3
St Dev	1.35	1.90	0.52	1.76	0.78
Coef Var	2.619	2.831	1.360	2.968	1.569
Log Mean	-0.719	-0.684	-0.684	-0.827	-0.677
Geo Mean	0.19	0.21	0.21	0.15	0.21
Log StDv	0.475	0.508	0.453	0.502	0.544
Log CVar	-0.662	-0.744	-0.663	-0.608	-0.804
Percntls					
Minimum	0.1	0.1	0.1	0.1	0.1
10th	0.1	0.1	0.1	0.1	0.1
20th	0.1	0.1	0.1	0.1	0.1
30th	0.1	0.1	0.1	0.1	0.1
40th	0.1	0.1	0.1	0.1	0.1
50th	0.1	0.1	0.1	0.1	0.1
60th	0.1	0.1	0.1	0.1	0.1
70th	0.2	0.2	0.3	0.1	0.1
80th	0.4	0.4	0.6	0.1	0.5
85th	0.6	0.5	0.7	0.1	1.4
90th	0.8	0.6	0.9	0.4	1.4
95th	1.9	2.4	1.7	0.4	2.4
98th	2.4	9.3	1.9	6.7	2.4
99th	6.7	9.3	1.9	6.7	2.4
Maximum	9.3	9.3	1.9	6.7	2.4

Element Statistics
Variable - Cadmium [Cd]
Number of Values - 76
Units - ppm
Detection Limit - 0.2
Analytical Method - AAS

Cadmium (ppm)

Histograms are not calculated for variables with fewer than 15 samples above the detection limit.

Element Statistics
Variable - Molybdenum [Mo]
Number of Values - 85
Units - ppm
Detection Limit - 1
Analytical Method - AAS

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	7	2	2	0	0
Missing	0	0	0	0	0
Mean	1.2	1.1	1.2	1.0	1.0
Median	1.0	1.0	1.0	1.0	1.0
Mode	1.0	1.0	1.0	1.0	1.0
Range	5	1	3	0	0
St Dev	0.85	0.27	0.82	0.00	0.00
Coef Var	0.695	0.248	0.662	0.000	0.000
Log Mean	0.044	0.022	0.046	0.000	0.000
Geo Mean	1.1	1.1	1.1	1.0	1.0
Log StDv	0.157	0.080	0.164	0.000	0.000
Log CVar	3.560	3.652	3.557	0.000	0.000
Percntls					
Minimum	1	1	1	1	1
10th	1	1	1	1	1
20th	1	1	1	1	1
30th	1	1	1	1	1
40th	1	1	1	1	1
50th	1	1	1	1	1
60th	1	1	1	1	1
70th	1	1	1	1	1
80th	1	1	1	1	1
85th	1	1	1	1	1
90th	1	1	1	1	1
95th	3	2	4	1	1
98th	4	2	4	1	1
99th	5	2	4	1	1
Maximum	6	2	4	1	1

Molybdenum (ppm)

```
 ppm                                                        N      %   Cum%

 245 -|
     -|*                                                    1    1.2    1.2
 339 -|
     -|*                                                    1    1.2    2.4
 468 -|
     -|**********                                          16   18.8   21.2
 646 -|
     -|*********************                               35   41.2   62.4
 891 -|
     -|************                                        19   22.4   84.7
1230 -|
     -|****                                                 6    7.1   91.8
1698 -|
     -|***                                                  5    5.9   97.6
2344 -|
     -|                                                     0    0.0   97.6
3236 -|
     -|                                                     0    0.0   97.6
4467 -|
     -|                                                     0    0.0   97.6
6166 -|                                   Logarithmic
     -|**                                  Histogram        2    2.4  100.0
8511 -|
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100 %

                 Percentage of Values
```

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	85	27	26	14	10
Missing	0	0	0	0	0
Mean	1046.8	928.2	1105.7	1189.3	1068.0
Median	845.0	833.0	870.0	740.0	880.0
Mode	1200.0	760.0	510.0	800.0	580.0
Range	5940	1940	5850	5630	1220
St Dev	884.08	408.57	1102.91	1454.94	421.32
Coef Var	0.845	0.440	0.997	1.223	0.394
Log Mean	2.954	2.932	2.955	2.958	2.997
Geo Mean	899.2	854.3	902.6	908.2	994.1
Log StDv	0.209	0.180	0.240	0.259	0.175
Log CVar	0.071	0.062	0.081	0.087	0.058
Percntls					
Minimum	260	260	350	570	580
10th	560	560	510	570	580
20th	640	640	550	630	600
30th	720	720	720	700	680
40th	763	760	780	720	840
50th	845	833	870	740	880
60th	880	845	910	800	1150
70th	1000	900	940	880	1200
80th	1200	1150	1100	890	1400
85th	1200	1200	1150	1200	1550
90th	1600	1500	1450	1200	1550
95th	1800	1700	2000	1200	1800
98th	2200	1700	2000	6200	1800
99th	6200	2200	6200	6200	1800
Maximum	6200	2200	6200	6200	1800

Element Statistics
Variable - Manganese (Mn)
Number of Values - 85
Units - ppm
Detection Limit - 5
Analytical Method - AAS

Manganese (ppm)

Histograms are not calculated for variables with fewer than 15 samples above the detection limit.

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	12	3	5	1	2
Missing	0	0	0	0	0
Mean	0.38	0.56	0.30	0.14	0.63
Median	0.10	0.10	0.10	0.10	0.10
Mode	0.10	0.10	0.10	0.10	0.10
Range	11.9	11.9	2.9	0.6	3.6
St Dev	1.39	2.29	0.61	0.16	1.19
Coef Var	3.604	4.090	2.023	1.122	1.887
Log Mean	-0.839	-0.883	-0.797	-0.940	-0.690
Geo Mean	0.14	0.13	0.16	0.11	0.20
Log StDv	0.390	0.418	0.376	0.226	0.587
Log CVar	-0.465	-0.473	-0.472	-0.241	-0.851
Percntls					
Minimum	0.1	0.1	0.1	0.1	0.1
10th	0.1	0.1	0.1	0.1	0.1
20th	0.1	0.1	0.1	0.1	0.1
30th	0.1	0.1	0.1	0.1	0.1
40th	0.1	0.1	0.1	0.1	0.1
50th	0.1	0.1	0.1	0.1	0.1
60th	0.1	0.1	0.1	0.1	0.1
70th	0.1	0.1	0.2	0.1	0.1
80th	0.2	0.1	0.2	0.1	0.2
85th	0.2	0.1	0.3	0.1	1.7
90th	0.3	0.1	0.3	0.1	1.7
95th	1.5	0.4	1.5	0.1	3.7
98th	3.0	0.4	1.5	0.7	3.7
99th	3.7	12.0	3.0	0.7	3.7
Maximum	12.0	12.0	3.0	0.7	3.7

Element Statistics
Variable - Silver [Ag]
Number of Values - 85
Units - ppm
Detection Limit - 0.2
Analytical Method - AAS

Silver (ppm)

```
ppm                                                      N     %    Cum%

 5 -|
   -|*                                                   1   1.2   1.2
 7 -|
   -|                                                    0   0.0   1.2
 8 -|
   -|***                                                 5   5.9   7.1
10 -|
   -|*********                                          15  17.6  24.7
11 -|
   -|*************                                      21  24.7  49.4
14 -|
   -|*****************                                  28  32.9  82.4
17 -|
   -|*****                                               7   8.2  90.6
20 -|
   -|***                                                 4   4.7  95.3
24 -|
   -|                                                    0   0.0  95.3
29 -|
   -|**                                                  3   3.5  98.8
35 -|                                   Logarithmic
   -|*                                   Histogram       1   1.2 100.0
42 -|
    +----+----+----+----+----+----+----+----+----+----+
    0   10   20   30   40   50   60   70   80   90  100 %

               Percentage of Values
```

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	85	27	26	14	10
Missing	0	0	0	0	0
Mean	14.4	14.6	13.0	16.1	17.2
Median	14.0	14.0	13.0	14.0	14.0
Mode	13.0	14.0	13.0	14.0	13.0
Range	29	12	23	22	22
St Dev	4.86	2.90	4.49	6.72	6.94
Coef Var	0.337	0.199	0.346	0.417	0.404
Log Mean	1.140	1.155	1.092	1.182	1.212
Geo Mean	13.8	14.3	12.3	15.2	16.3
Log StDv	0.124	0.084	0.134	0.145	0.139
Log CVar	0.109	0.073	0.123	0.123	0.114
Percntls					
Minimum	6	10	6	10	13
10th	10	11	9	10	13
20th	11	12	9	12	13
30th	12	13	11	13	13
40th	13	14	11	14	14
50th	14	14	13	14	14
60th	14	15	13	14	15
70th	15	16	13	14	15
80th	16	16	15	16	17
85th	17	17	16	17	23
90th	19	18	17	31	23
95th	23	20	20	31	35
98th	31	20	20	32	35
99th	32	22	29	32	35
Maximum	35	22	29	32	35

Element Statistics
Variable - Cobalt [Co]
Number of Values - 85
Units - ppm
Detection Limit - 2
Analytical Method - AAS

Cobalt (ppm)

```
 ppm                                                                N      %   Cum%
   4 -|
     -|*                                                            1    1.2    1.2
   6 -|
     -|                                                             0    0.0    1.2
   8 -|
     -|                                                             0    0.0    1.2
  10 -|
     -|**                                                           3    3.5    4.7
  14 -|
     -|**********                                                  17   20.0   24.7
  19 -|
     -|***************                                             25   29.4   54.1
  26 -|
     -|*************                                               21   24.7   78.8
  35 -|
     -|******                                                      10   11.8   90.6
  47 -|
     -|***                                                          5    5.9   96.5
  63 -|
     -|*                                                            1    1.2   97.6
  85 -|                                          Logarithmic
     -|**                                         Histogram         2    2.4  100.0
 115 -|
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100 %

                     Percentage of Values
```

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	85	27	26	14	10
Missing	0	0	0	0	0
Mean	29.0	28.9	19.7	38.9	45.9
Median	24.0	27.0	19.0	37.0	40.0
Mode	22.0	22.0	16.0	19.0	23.0
Range	90	45	34	73	72
St Dev	15.76	9.97	6.19	18.59	24.92
Coef Var	0.544	0.345	0.314	0.478	0.543
Log Mean	1.414	1.439	1.272	1.550	1.612
Geo Mean	25.9	27.5	18.7	35.5	40.9
Log StDv	0.199	0.132	0.157	0.187	0.214
Log CVar	0.141	0.092	0.124	0.121	0.133
Percntls					
Minimum	5	15	5	19	23
10th	16	19	13	19	23
20th	19	22	16	22	23
30th	21	23	16	25	26
40th	22	25	17	32	34
50th	24	27	19	37	40
60th	26	28	21	41	42
70th	32	32	21	42	43
80th	37	33	22	43	48
85th	41	34	25	48	85
90th	43	34	26	52	85
95th	55	55	28	52	95
98th	85	55	28	92	95
99th	92	60	39	92	95
Maximum	95	60	39	92	95

Element Statistics
Variable - Nickel [Ni]
Number of Values - 85
Units - ppm
Detection Limit - 2
Analytical Method - AAS

Nickel (ppm)

Lead (ppm)

```
  ppm                                                     N     %    Cum%

    3 -|
      -|****                                              6   7.1    7.1
    5 -|
      -|********                                         13  15.3   22.4
    9 -|
      -|********************                             34  40.0   62.4
   14 -|
      -|***********                                      18  21.2   83.5
   23 -|
      -|*****                                             7   8.2   91.8
   37 -|
      -|*                                                 1   1.2   92.9
   60 -|
      -|**                                                2   2.4   95.3
   98 -|
      -|*                                                 1   1.2   96.5
  158 -|
      -|**                                                2   2.4   98.8
  257 -|
      -|                                                  0   0.0   98.8
  417 -|                                   Logarithmic
      -|*                                   Histogram     1   1.2  100.0
  676 -|
       +----+----+----+----+----+----+----+----+----+----+
       0   10   20   30   40   50   60   70   80   90  100 %

                     Percentage of Values
```

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	85	27	26	14	10
Missing	0	0	0	0	0
Mean	26.4	20.9	36.0	16.8	40.3
Median	13.0	13.0	11.0	12.0	13.0
Mode	6.0	6.0	9.0	11.0	13.0
Range	528	185	527	58	207
St Dev	64.23	34.97	102.59	14.82	67.28
Coef Var	2.435	1.674	2.847	0.883	1.670
Log Mean	1.145	1.121	1.156	1.145	1.238
Geo Mean	14.0	13.2	14.3	14.0	17.3
Log StDv	0.367	0.352	0.424	0.233	0.521
Log CVar	0.320	0.314	0.366	0.203	0.421
Percntls					
Minimum	4	5	5	8	5
10th	6	5	6	8	5
20th	8	6	7	9	6
30th	9	7	9	11	10
40th	11	10	9	11	11
50th	13	13	11	12	13
60th	14	15	13	12	13
70th	16	16	17	14	13
80th	19	24	19	15	15
85th	24	27	20	18	105
90th	31	30	30	25	105
95th	92	38	92	25	212
98th	190	38	92	66	212
99th	212	190	532	66	212
Maximum	532	190	532	66	212

Element Statistics
Variable - Lead [Pb]
Number of Values - 85
Units - ppm
Detection Limit - 2
Analytical Method - AAS

```
 ppm                                                      N      %    Cum%

   5 -|
     -|*                                                  1    1.2    1.2
   7 -|
     -|                                                   0    0.0    1.2
  10 -|
     -|                                                   0    0.0    1.2
  15 -|
     -|*******                                           11   12.9   14.1
  22 -|
     -|********************                              33   38.8   52.9
  32 -|
     -|***************                                   25   29.4   82.4
  46 -|
     -|*********                                         14   16.5   98.8
  66 -|
     -|                                                   0    0.0   98.8
  95 -|
     -|                                                   0    0.0   98.8
 138 -|
     -|                                                   0    0.0   98.8
 200 -|                                   Logarithmic
     -|*                                   Histogram      1    1.2  100.0
 288 -|
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100 %

                  Percentage of Values
```

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	85	27	26	14	10
Missing	0	0	0	0	0
Mean	35.4	30.5	37.4	35.4	39.0
Median	30.0	28.0	23.0	36.0	33.0
Mode	23.0	22.0	23.0	40.0	33.0
Range	263	38	263	32	33
St Dev	28.19	9.89	48.59	9.48	12.32
Coef Var	0.796	0.324	1.300	0.268	0.316
Log Mean	1.497	1.465	1.454	1.533	1.572
Geo Mean	31.4	29.1	28.4	34.1	37.3
Log StDv	0.192	0.132	0.268	0.130	0.134
Log CVar	0.128	0.090	0.184	0.085	0.085
Percntls					
Minimum	7	17	7	17	25
10th	19	20	18	17	25
20th	23	22	19	26	27
30th	25	24	22	27	29
40th	27	27	23	34	33
50th	30	28	23	36	33
60th	34	29	28	40	34
70th	40	33	34	40	43
80th	43	37	40	42	53
85th	48	40	43	42	55
90th	50	43	44	49	55
95th	55	50	49	49	58
98th	58	50	49	49	58
99th	60	55	270	49	58
Maximum	270	55	270	49	58

Element Statistics
Variable - Copper [Cu]
Number of Values - 85
Units - ppm
Detection Limit - 2
Analytical Method - AAS

Copper (ppm)

```
 ppm                                                      N     %   Cum%

  52 -|
     -|**                                                 3   3.5    3.5
  69 -|
     -|**********                                        17  20.0   23.5
  91 -|
     -|**********************                            36  42.4   65.9
 120 -|
     -|*********                                         14  16.5   82.4
 158 -|
     -|*****                                              7   8.2   90.6
 209 -|
     -|***                                                4   4.7   95.3
 275 -|
     -|*                                                  1   1.2   96.5
 363 -|
     -|*                                                  1   1.2   97.6
 479 -|
     -|                                                   0   0.0   97.6
 631 -|
     -|**                                                 2   2.4  100.0
 832 -|                                     Logarithmic
     -|                                      Histogram
1096 -|
      +----+----+----+----+----+----+----+----+----+----+
      0   10   20   30   40   50   60   70   80   90  100 %

                  Percentage of Values
```

	All	uKK	lJ	lK	muJA
N	85	27	26	14	10
N > DL	85	27	26	14	10
Missing	0	0	0	0	0
Mean	139.2	111.5	148.5	162.3	163.4
Median	110.0	94.0	108.0	104.0	117.0
Mode	95.0	80.0	140.0	94.0	110.0
Range	769	234	731	732	280
St Dev	117.73	54.49	140.34	193.14	87.61
Coef Var	0.846	0.489	0.945	1.190	0.536
Log Mean	2.081	2.013	2.098	2.098	2.169
Geo Mean	120.4	102.9	125.5	125.3	147.4
Log StDv	0.196	0.164	0.210	0.253	0.197
Log CVar	0.094	0.082	0.100	0.120	0.091
Percntls					
Minimum	56	56	75	93	92
10th	82	68	84	93	92
20th	88	80	88	94	97
30th	95	83	95	95	110
40th	100	87	100	98	110
50th	110	94	108	104	117
60th	116	100	128	105	125
70th	125	112	140	113	174
80th	144	120	144	115	202
85th	165	138	160	119	235
90th	204	145	165	212	235
95th	266	266	257	212	372
98th	372	266	257	825	372
99th	806	290	806	825	372
Maximum	825	290	806	825	372

Element Statistics
Variable - Zinc [Zn]
Number of Values - 85
Units - ppm
Detection Limit - 2
Analytical Method - AAS

Zinc (ppm)

Ministry of Energy, Mines and Petroleum Resources

Geological Survey Branch

PAPER 1992-5 (1)

GEOLOGY AND MINERAL RESOURCES OF THE BABINE MOUNTAINS RECREATION AREA

NTS 93L/14,15; 93M/2,3

By D. G. MACINTYRE, P. J. DESJARDINS
D. A. BROWN, R. G. GABA

Scale 1 : 50 000

0 1 2 3 4
Kilometres

LEGEND

SEDIMENTARY AND VOLCANIC ROCKS

UPPER CRETACEOUS AND LOWER TERTIARY

uKTs	*Tuffaceous siltstones, argillites and chert, with lapilli tuff and tuffaceous siltstone at base: well bedded.*

UPPER CRETACEOUS

KASALKA GROUP

uKK2	*Volcanic breccia and lapilli tuff with hornblende-feldspar porphyritic andesite clasts: green to grey and thick bedded; grey, greenish grey and maroon crystal tuff and ash tuff, with minor mudstone and volcanic breccia: thick bedded to slightly laminated; massive grey to maroon porphyritic hornblende-feldspar andesite with local breccia.*
uKK1	*Volcanic heterolithic pebble conglomerate and tuffaceous sandstone: maroon and green; lahar deposits with feldspar porphyry clasts, epiclastic sandstone and siltstone, and crowded feldspar porphyry flows: orange to yellow weathering, medium to thick bedded; augite phyric basalt, locally vesicular and amygdaloidal, with minor flow breccia: green to maroon, massive to thick bedded; lapilli tuff with maroon and green volcanic clasts: massive to thick bedded; maroon to red ash flow tuff, volcanic breccia, lapilli tuff, volcanic conglomerate, porphyritic andesite and lahar deposits: maroon, green and cream coloured matrix and clasts, locally silicic, massive to thick bedded.*

LOWER CRETACEOUS

SKEENA GROUP

lKS	*Undifferentiated Skeena Group.*
lKRR	*Red Rose formation: grey siltstone, sandstone and pebble conglomerate with orange weathering tuffaceous siltstoneand dark grey shale: dolomitic, flaser to wavy bedded.*
lKv	*Rocky Ridge formation: green and maroon tuff with minor augite phyric basalt flows and phyllite.*
lKK	*Kitsuns Creek formation: polymictic pebble conglomerate with quartz, chert, argillite and grey tuff clasts, dark grey sandstone and shale interbeds: micaceous, carbonaceous plant impressions, medium to thin bedded.*

MIDDLE TO UPPER JURASSIC

BOWSER LAKE GROUP

muJA	*Ashman Formation: black shale, siltstone, quartzose wacke and pebble conglomerate: medium to thin bedded.*

LOWER TO MIDDLE JURASSIC

HAZELTON GROUP

mJS	*Smithers Formation: fossiliferous siltstone, sandstone and pebble conglomerate: greenish grey, glaconitic and well bedded.*
lJe	*Eagle Peak formation: bright red to brick red crystal-lithic tuff, tuffaceous mudstone, lapilli tuff: red volcaniclastic sediments include subordinate andesite to rhyolite, breccia, tuff, marl and basalt.*
lJN	*Nilkitkwa Formation: dark grey calcareous siltstone with brown pebble conglomerate and minor limestone.*
lJT	*Telkwa Formation: green and maroon lapilli and crystal tuff, volcanic breccia, porphyritic andesite flows, with minor rhyolite: massive to thick bedded.*
lJTb	*Green and maroon augite phyric amygdaloidal basalt with red epiclastic or tuff interbeds: massive to thick bedded.*

INTRUSIVE ROCKS

LATE CRETACEOUS TO EARLY TERTIARY

rh	*Rhyolite and dacite; locally quartz porphyritic.*
qmp	*Quartz monzonite porphyry.*
dr	*Diorite.*
qfp	*Quartz feldspar porphyry.*
qdp	*Quartz diorite porphyry.*

SYMBOLS

GEOLOGICAL BOUNDARY
THRUST FAULT
NORMAL FAULT
BEDDING (INCLINED, VERTICAL)
FOLIATION (INCLINED, VERTICAL)
MINOR FOLD AXIS
SYNCLINE
ANTICLINE

GABA FIG2.DWG