O T H E R I N V E S T I G A T I O N S

RECENT MINERAL RESOURCE ASSESSMENT STUDIES IN BRITISH COLUMBIA

By K. E. Northcote
K. E. Northcote & Associates Ltd., Agassiz, British Columbia
and
W. R. Smyth and H. R. Schmitt
B.C. Ministry of Energy, Mines and Petroleum Resources

INTRODUCTION

A number of mineral resource assessment studies were undertaken in 1982 to assist government planning and decision making on land use issues. They were conducted in response to specific requests from Lands, Parks and Housing to create provincial parks, and from Forests and Municipal Affairs for coordinated land use planning programs. The aim of the studies was to identify areas favourable for mineral deposit discoveries and to ensure that the planning process does not alienate such areas from exploration and mining. Summaries of four assessments are presented because they might be of use to the exploration industry in identifying and rating exploration target areas. Figure 68 also shows the location of other planning areas for which assessment reports are in preparation.

All the studies were office-based and carried out by K. E. Northcote under contract to the Ministry of Energy, Mines and Petroleum Resources. Since their completion, two of us (W. R. Smyth and H. R. Schmitt) joined the Ministry and have revised and added to the original reports. The reports will be released as open files after they have been submitted to the planning teams.

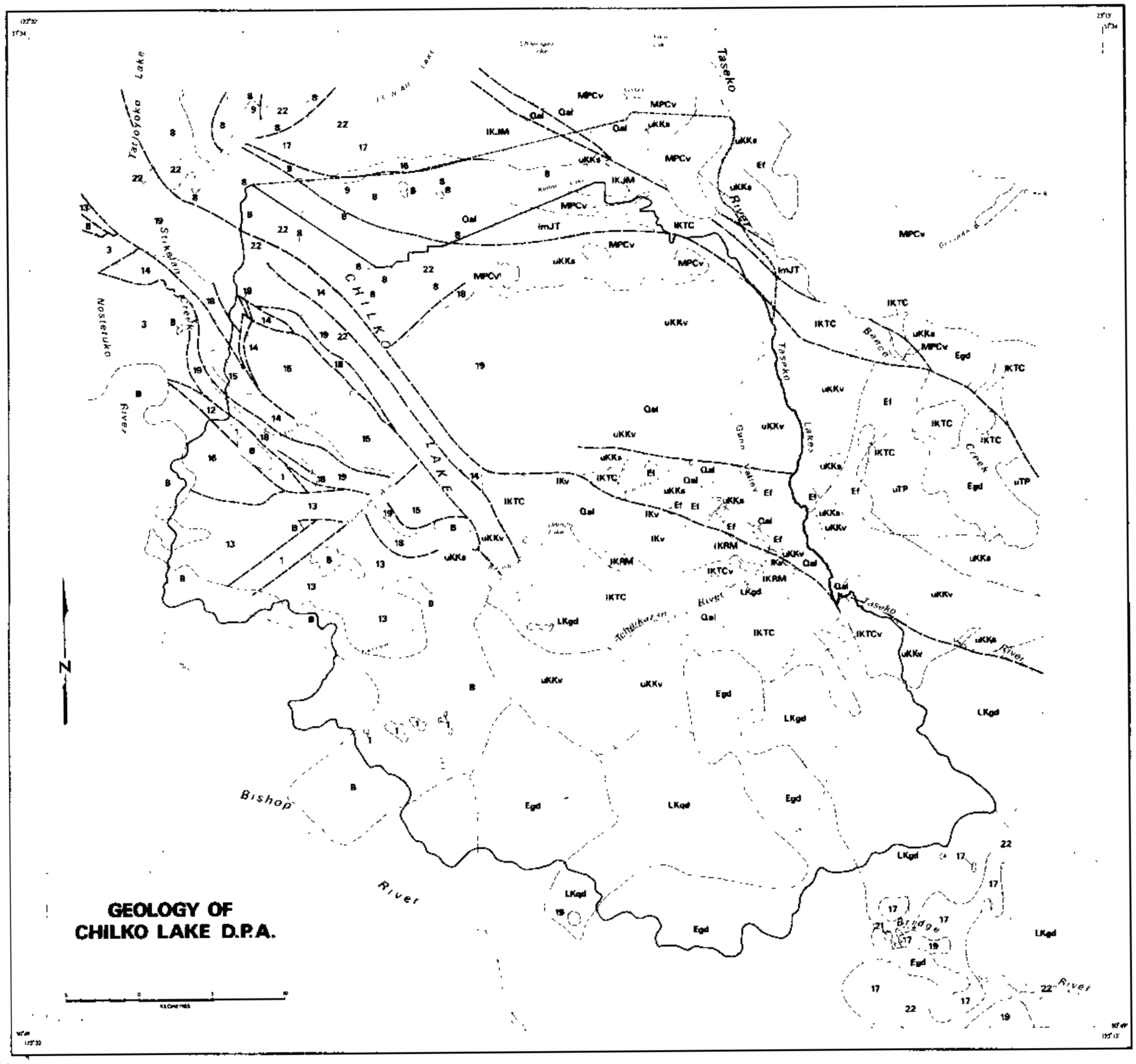
METHODS

Mineral potential assessments of the planning areas are qualitative. Mineral potential ratings ranging from high (1) to low (5) were assigned to the different geological units or packages in a study area. The rating of each package was based on the occurrence of known mineral deposits and its perceived potential for hosting undiscovered mineral resources. The types of mineral deposits that may be found are discussed in the text and their potential values estimated.

Parameters used to classify mineral potential include:

(1) Favourable geological environments for mineralization.

(2) Production history of properties in the area and/or in similar geologic environments elsewhere.



GEOLOGY SIMPLIFIED FROM:

Cummings, J. M. (1939). Reconnaissance along Proposed Tunnel from Chilko Lake to Bishop River, *B.C. Ministry of Energy, Mines & Pet. Res.*, Property Files.
Tipper, H. W. (1969). Mount Waddington, *Geol. Surv., Canada*, Paper 68–33, 1:126 720.
Tipper, H. W. (1978). Taseko Lakes, *Geol. Surv., Canada*, Open File Map 534, 1:250 000.
Woodsworth, G. J. (1977). Pemberton, *Geol. Surv., Canada* Open File Map 482, 1:250 000

Figure 69. Geology of Chilko Lake Deferred Planning Area.

ROCK UNITS OCCURRING IN CHILKO LAKE D.P.A.

GEOLOGICAL SURVEY OF CANADA, OPEN FILE 534, NTS 92O		*GEOLOGICAL SURVEY OF CANADA, PAPER 68–33, NTS 92N*	
QUARTERNARY			
PLEISTOCENE AND RECENT		PLEISTOCENE AND RECENT	
Qal	TILL, GRAVEL, SAND, CLAY, SILT	22	TILL, GRAVEL, SAND, ALLUVIUM
CENOZOIC			
UPPER MIOCENE AND/OR PLIOCENE CHILKOTIN GROUP			
MPCv	VOLCANIC ROCKS		
MESOZOIC			
UPPER CRETACEOUS (CENOMANIAN) KINGSVALE GROUP		UPPER CRETACEOUS (CENOMANIAN AND (?) LATER KINGSVALE GROUP	
uKKv	VOLCANIC ROCKS	19	VOLCANIC ROCKS
uKKs	SEDIMENTARY ROCKS	18	SEDIMENTARY ROCKS
LOWER CRETACEOUS (APTIAN AND ALBIAN) TAYLOR CREEK GROUP		LOWER CRETACEOUS (APTIAN) TAYLOR CREEK GROUP	
lKTC	SEDIMENTARY ROCKS	16	SEDIMENTARY ROCKS
lKTCv	VOLCANIC ROCKS		
LOWER CRETACEOUS (APTIAN AND ALBIAN) JACKASS MOUNTAIN GROUP		LOWER CRETACEOUS (ALBIAN) JACKASS MOUNTAIN GROUP	
lKJM	SEDIMENTARY ROCKS	17	SEDIMENTARY ROCKS
LOWER CRETACEOUS (HAUTERIVIAN)		CRETACEOUS (HAUTERIVIAN AND (?) YOUNGER)	
lKv	*VOLCANIC ROCKS*	15	*VOLCANIC ROCKS*
		14	SEDIMENTARY ROCKS
		13	VOLCANIC ROCKS
		12	SEDIMENTARY ROCKS
JURASSIC AND CRETACEOUS RELAY MOUNTAIN GROUP *(BERRIASIAN TO BARREMIAN)*		LATE JURASSIC TO EARLY CRETACEOUS *(OXFORDIAN TO BERRIASIAN)*	
lKRM	SEDIMENTARY ROCKS	9	SEDIMENTARY ROCKS
UPPER TRIASSIC TO MIDDLE JURASSIC *(SINEMURIAN TO MIDDLE BAJOCIAN)*		(HETTANGIAN (?), SINEMURIAN, BAJOCIAN, AND *CALLOVIAN)*	
lmJT	SEDIMENTARY ROCKS	8	SEDIMENTARY ROCKS
		BAJOCIAN AND (?) CALLOVIAN	
		7	VOLCANIC ROCKS
UPPER TRIASSIC (KARNIAN AND (?) NORIAN) PIONEER FORMATION		TRIASSIC (KARNIAN (?) AND EARLY NORIAN)	
uTP	VOLCANIC AND SEDIMENTARY ROCKS	3	*SEDIMENTARY ROCKS*
		(KARNIAN)	
		1	VOLCANIC ROCKS
PLUTONIC ROCKS			
TERTIARY			
LKgd	GRANODIORITE	B	
LKqd	FELSITE FELDSPAR PORPHYRY		
LATE CRETACEOUS AND/OR EARLY TERTIARY COAST PLUTONIC ROCKS			
Egd	GRANODIORITE	B	
Ef	QUARTZ DIORITE		

(3) Known mineral occurrences, regardless of present economic viability, because:
   (a) overburden may cover the best mineralized zones
   (b) mineralization is three-dimensional; higher grade mineralization may occur at depth

(4) Past and present mining exploration activity; this is shown by the number and location of present and former mineral claims, Crown grants, placer leases, etc.

The size of known and potential deposits in each rating class is expressed on the basis of estimated total value of contained metal. Classifications are as follows: (A) large (greater than $1 billion); (B) medium ($50 million to $1 billion); (C) small ($1 million to $50 million).

Each report includes the following:

(1) A geological compilation map at 1:250 000 scale or smaller.

(2) A mineral occurrence map constructed from the Ministry's MINFILE, which categorizes occurrences according to size and type of minerals present.

(3) A map showing the distribution of mineral claims that are in good standing.

(4) A mineral potential map.

(5) A bibliography of regional and economic geology reports for the study area.

(6) A discussion of the geology of the area with emphasis on major map units, structural features, and geological environments perceived to have metallogenic significance.

(7) A discussion of the potential types of mineral deposits expected in each unit and estimates of their potential values.

(8) Depending on the options available to the planning team, recommendations for future fieldwork.

CHILKO LAKE PLANNING AREA (92N, O)

INTRODUCTION

The Chilko Lake Deferred Planning Area (DPA on figures) lies at the eastern edge of the Coast Range approximately 240 kilometres north of Vancouver and 150 kilometres southwest of Williams Lake (Fig. 68). The area extends from Stikelan Creek on the west to Taseko Lakes on the east and from the north end of Chilko Lake southward to Stanley Peak (Fig. 69). It encompasses more than 2 000 square kilometres with parts accessible by gravel road from the Chilcotin Highway to the north.

GEOLOGY

The planning area straddles the boundary between the Coast Plutonic Complex on the southwest and the Intermontane Belt on the northeast. Figure 69 is a compilation of the geology of the planning area after Tipper (1969, 1978) and Woodsworth (1977). The Intermontane Belt in the area consists of three, northwest-southeast-trending, fault-bounded blocks of Triassic to Cretaceous sedimentary and volcanic rocks. Andesitic flows and associated tuffs and breccias constitute the bulk of the volcanic rocks and these are intercalated with waterlain tuffs, siltstones, shales, minor sandstone, and carbonate rocks. These are unconformably overlain by scattered outliers of Miocene and Pliocene plateau lavas. Plutonic rocks emplaced in Cretaceous and Tertiary times are granodiorite, quartz diorite, and diorite. They form the main mass of the Coast Mountains and lie mainly southwest of the study area. However, throughout the area related dykes, stocks, and sills intrude the volcanic and sedimentary rocks.

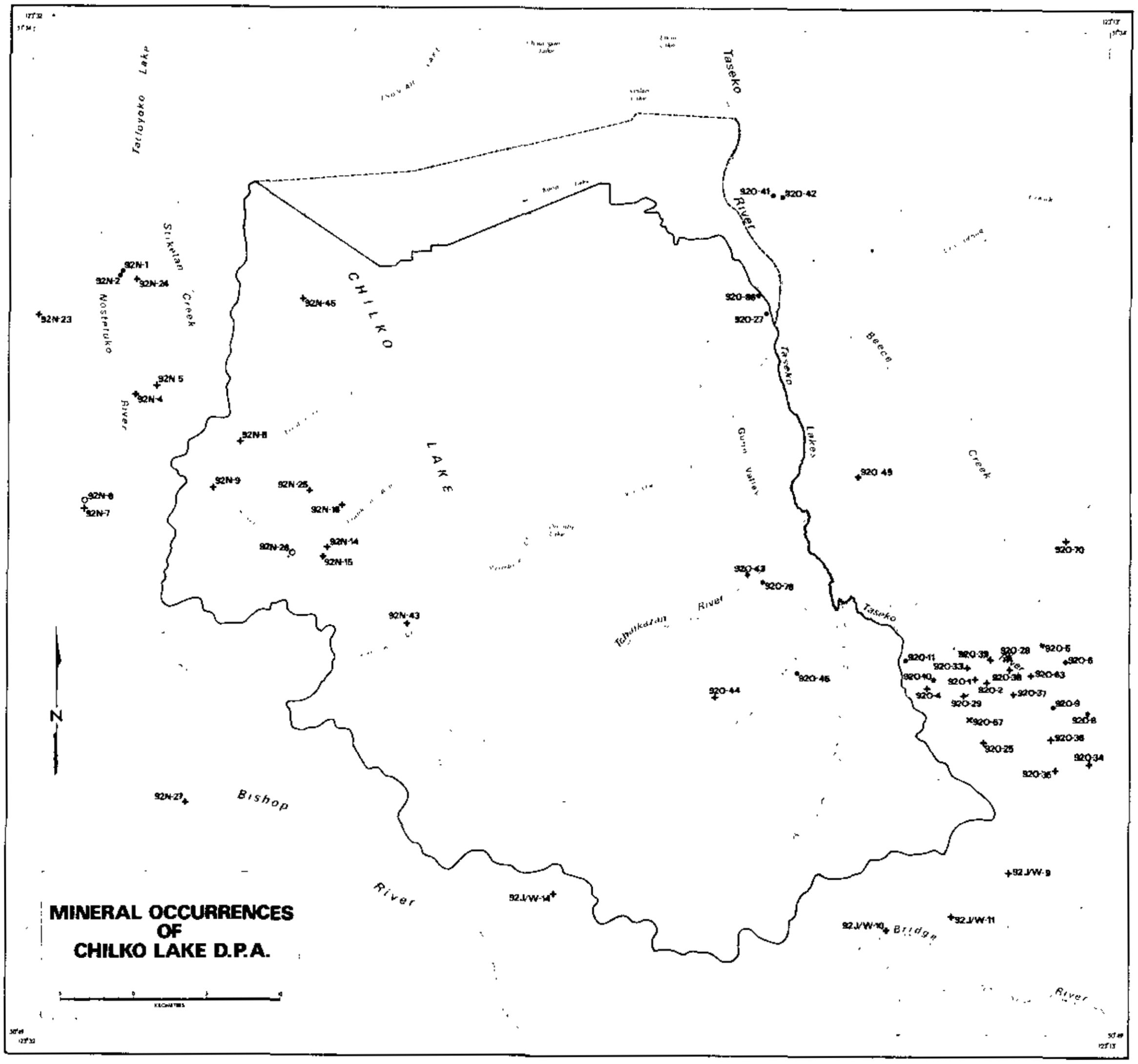
MINERALIZATION

Most of the known mineral occurrences (Fig. 70) are found in volcanic and sedimentary rocks at or close to plutonic contacts and within the plutons. A significant porphyry-type copper-molybdenum prospect is hosted by a granodiorite intrusion and adjacent volcanic rocks at Tchaikazan River in the southeast part of the planning area. The volcanic rocks structurally above this pluton are cut by quartz veins that host free gold and telluride minerals. These veins were discovered by H. Warren in 1945 and have been re-examined and drilled on many occasions since. The Pellaire prospect (Fig. 70), located about 7 kilometres southeast of the Tchaikazan property, consists of pyrite, chalcopyrite, gold, silver, and bornite mineralization in shattered quartz veins that cut a granodiorite intrusion.

A number of molybdenum and tungsten occurrences have been known since 1910 at the northwest end of Franklyn Arm of Chilko Lake. Skarn-type mineralization occurs in Triassic limestones and limy sedimentary rocks near contact with granodiorite intrusions. The best known is the Daisie prospect (92N/2b, Fig. 70) which contains chalcopyrite, pyrrhotite, molybdenite, silver, and scheelite mineralization.

MINERAL DEPOSIT MODELS AND MINERAL POTENTIAL RATINGS

Several geologic environments identified in the planning area are favourable hosts for a variety of mineral deposits.



MINERAL OCCURRENCES

NTS 92O

Mineral Occurrences Within Chilko Lake Deferred Planning Area

NO 92O-	NAME	PRODUCT(S)
27	VICK CASH	Au, Cu, Ag
43	EGGS TCHAIKAZAN CHARLIE	Cu Mo Au, Ag
44	ZEN REX	Cu Mo
45	HI DO (PELLAIRE)	Au Ag Cu
76	WARREN CHARLIE	Au, Ag Cu
86	TASEKO RIVER	hydromagnesite

Mineral Occurrences Outside Chilko Lake Deferred Planning Area

1	MOHAWK TASEKO	Cu Mo, Au, Ag, Zn Pb
2	MOTHERLODE, TASEKO MOHAWK	Cu, Au, Ag
4	SPOKANE TASEKO	Cu, Ag, Au
5	BATTLEMENT CREEK	Fe
6	RAE CREEK	Fe
8	DENAIN CREEK	Fe
9	FORREST WHALE MTN	Fe
10	LIMONITE McCLURE MTN	Fe
11	CHILCOTIN McCLURE MTN	Fe
25	ROWBOTTOM, NW BILL	Cu Mo
28	TAYLOR WINDFALL BUZZER	Au Ag, Cu, Pb Zn talc
29	PHAIR	Cu, Ag, Au
33	EMPRESS TASEKO SPOKANE MOHAWK	Cu, Au
34	MM, TAYLOR MOUNTAIN, MAD MAJOR	Cu Mo
35	MM WESTSIDE MAD MAJOR	Cu Mo
36	MM CANYON	Cu Mo
37	TOP	Mo Cu
38	BUZZER TASEKO	Cu Au Mo
39	BUR TASEKO 49 KM GRANITE	Cu Mo
41, 42	FISH LAKE 88 89 VICCAL - MARY STUART	Cu, Au
49	BANNER CHITA	Cu Mo
63	TEEK ARD	Cu
67	MASSENA	Au Ag
70	GRAB (VIC ?)	Cu Pb Zn

NTS 92N

Mineral Occurrences Within Chilko Lake Deferred Planning Area

NO 92N	NAME	PRODUCT(S)
8	RUM 66	Cu Mo
9	RUM 2	Cu Mo
14	NORFA 18	Cu Mo
15	NORFA 20	Cu Mo
16	CINDY	Cu
25	Occurrence	Cu
26	DUCHARME COPPER QUEEN, DAISIE RONCAN	Cu Mo Zn W, Ag
43	Occurrence	Cu
45	ALEXIS	Cu Hg

Mineral Occurrences Outside Chilko Lake Deferred Planning Area

1	SPOKANE	Cu
2	MORRIS MINE	Au Ag Sb
4	BEN 37	Cu Mo
5	BEN 28	Cu Mo
6	BLUE 33 38	Cu Mo
7	BLUE 32	Cu, Mo
23	HOM	Cu
24	ICT	Sb Ag Au
27	SG SAM	Cu

NTS 92J

Mineral Occurrences Outside Chilko Lake Deferred Planning Area

NO 92J	NAME	PRODUCT(S)
9	NICHOL RAELODE	Cu Mo
10	BR	Cu
11	GRISWOLD RUSSNOR MEL	Cu Ag Au Mo
14	AUTUMN	Cu, Mo

ABBREVIATIONS

Ag	silver	Mo	molybdenum
Au	gold	Pb	lead
Cu	copper	Sb	antimony
Fe	iron	W	tungsten
Hg	mercury	Zn	zinc

Figure 70. Mineral occurrences of Chilko Lake Deferred Planning Area.

(1) Porphyry Copper-Molybdenum (Gold) Deposits

Based on the Tchaikazan River prospect and the presence of other porphyry-type prospects that occur in geologically similar environments adjacent to the area, parts of the study area are judged to have high potential for porphyry-type deposits. The Fish Lake deposit, 6 kilometres to the northeast of the study area, contains 180 000 000 tonnes of 0.25 per cent copper and 0.51 grams gold per tonne (Wolfhard, 1976) and the Poison Mountain prospect, 56 kilometres to the east, contains 170 000 000 tonnes of 0.34 per cent copper and 0.016 per cent molybdenum, and 0.34 grams gold per tonne (Seraphim and Rainboth, 1976). The most likely areas for porphyry-type mineralization are within, at the margins, and adjacent to post-tectonic intrusions. In the study area, units displaying these characteristics have been assigned a 2B rating (Fig. 71), the highest assigned in the area.

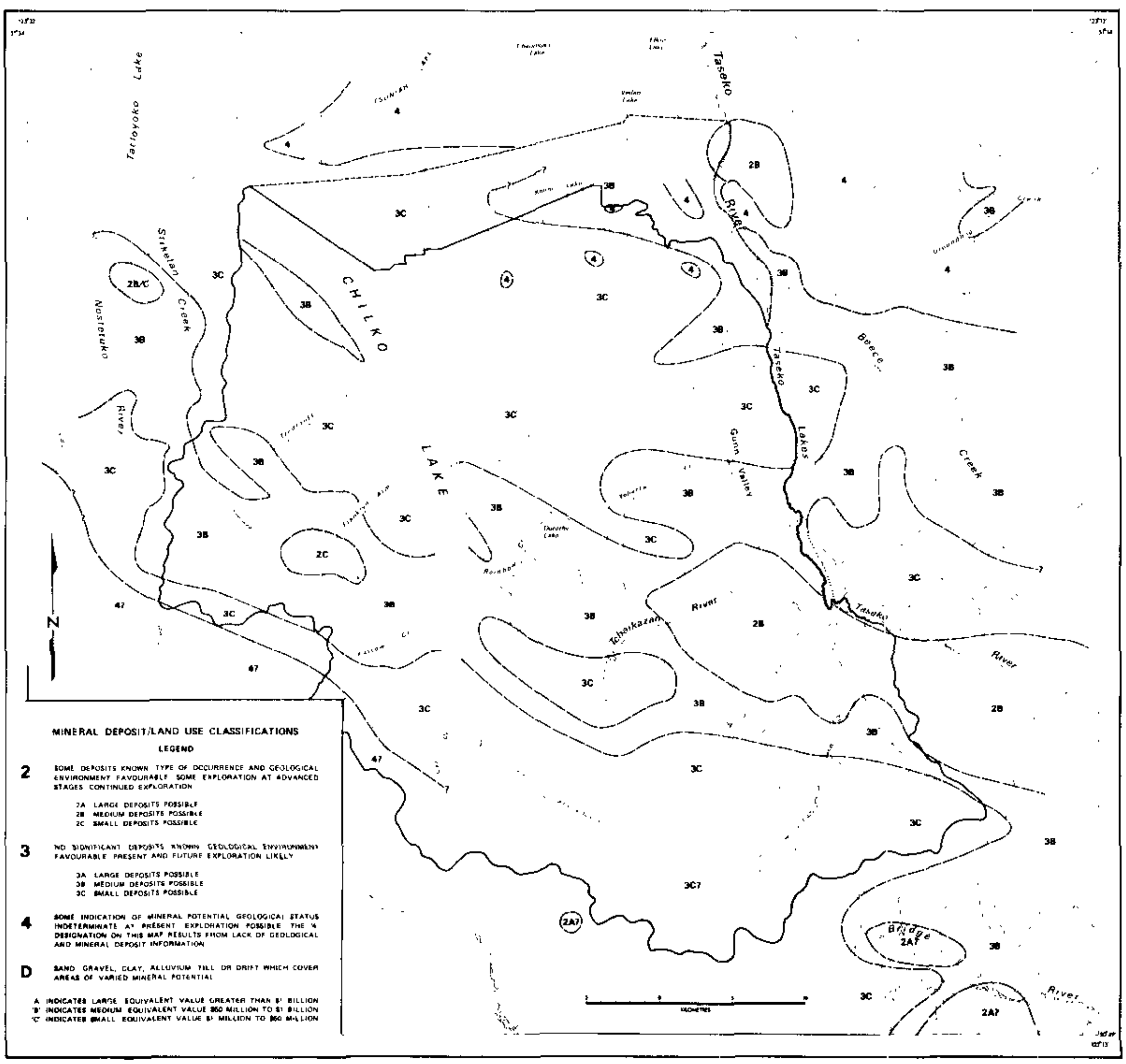


Figure 71. Mineral potential of Chilko Lake Deferred Planning Area.

(2) Gold-Silver Epithermal Vein Deposits

The Warren-Charlie prospects on Tchaikazan River are examples of epithermal gold-silver vein deposits related to intrusions of the Coast Plutonic Complex. Precious metal vein deposits of volcanogenic origin are in calc-alkalic volcanic sequences in other areas, particularly close to faults and siliceous volcanic centres. Most of the study area is underlain by volcanic rocks with this favourable geologic environment but because occurrences of this type are unknown in the area, these units are assigned a moderate (3B or 3C) potential.

The Alexis occurrence, located on the west side of Chilko Lake (Fig. 70), is a limonitic breccia stained with malachite in volcanic rocks close to a major fault. The trace of the fault zone is assigned a moderate (3B) potential for precious metal vein deposits (Fig. 71).

(3) Skarn Deposits

Areas containing carbonate-rich rocks have moderate potential for discovery of additional copper, molybdenum, tungsten, silver, and gold contact metasomatic deposits of the Daisie type. However, outside of the Franklyn Arm area existing geological maps do not report other areas of limestone in proximity to intrusions. Consequently only the Franklyn Arm area is assigned a high (2C) potential.

(4) Others

Areas of Tertiary volcanic rocks are assigned a low (4) mineral potential. Environments may exist for epithermal vein deposits or for basal-type uranium deposits at erosional unconformities below the volcanic rocks but no such deposits are known. Suitable environments may also exist for Carlin-type gold deposits associated with carbonate-bearing sequences. There is no information to support this possibility but it should be borne in mind while conducting mineral exploration in the area.

KAKWA PLANNING AREA (93H, I)

INTRODUCTION

The Kakwa Planning Area, located along the eastern slope of the Rocky Mountains, is bounded on the east by the Alberta border and on the south and west by the drainage divide between the Arctic and Pacific drainage systems (Fig. 68). The area covers approximately 33 750 hectares. A road built in 1982 to gain access to a quartzite prospect at Babette Lake is the only road into the area. The area is characterized by high rugged mountains, glaciers, and rockwalls interspersed with wooded valleys and small glacial lakes.

GEOLOGY

The planning area lies within the Rocky Mountain Fold and Thrust Belt and is characterized by a thick sequence of Late Precambrian to Lower Cretaceous miogeoclinal and platformal carbonate and clastic rocks (Fig. 72). The clastic rocks include conglomerates through sandstones and quartzites, and siltstones to shales and argillites with some carbonaceous and coaly members in the upper part of the sequence. The carbonate rocks range from calcareous shales to shaly limestones, and massive limestones to dolomites. The rock units have been compressed and displaced northeastward by a series of thrust faults.

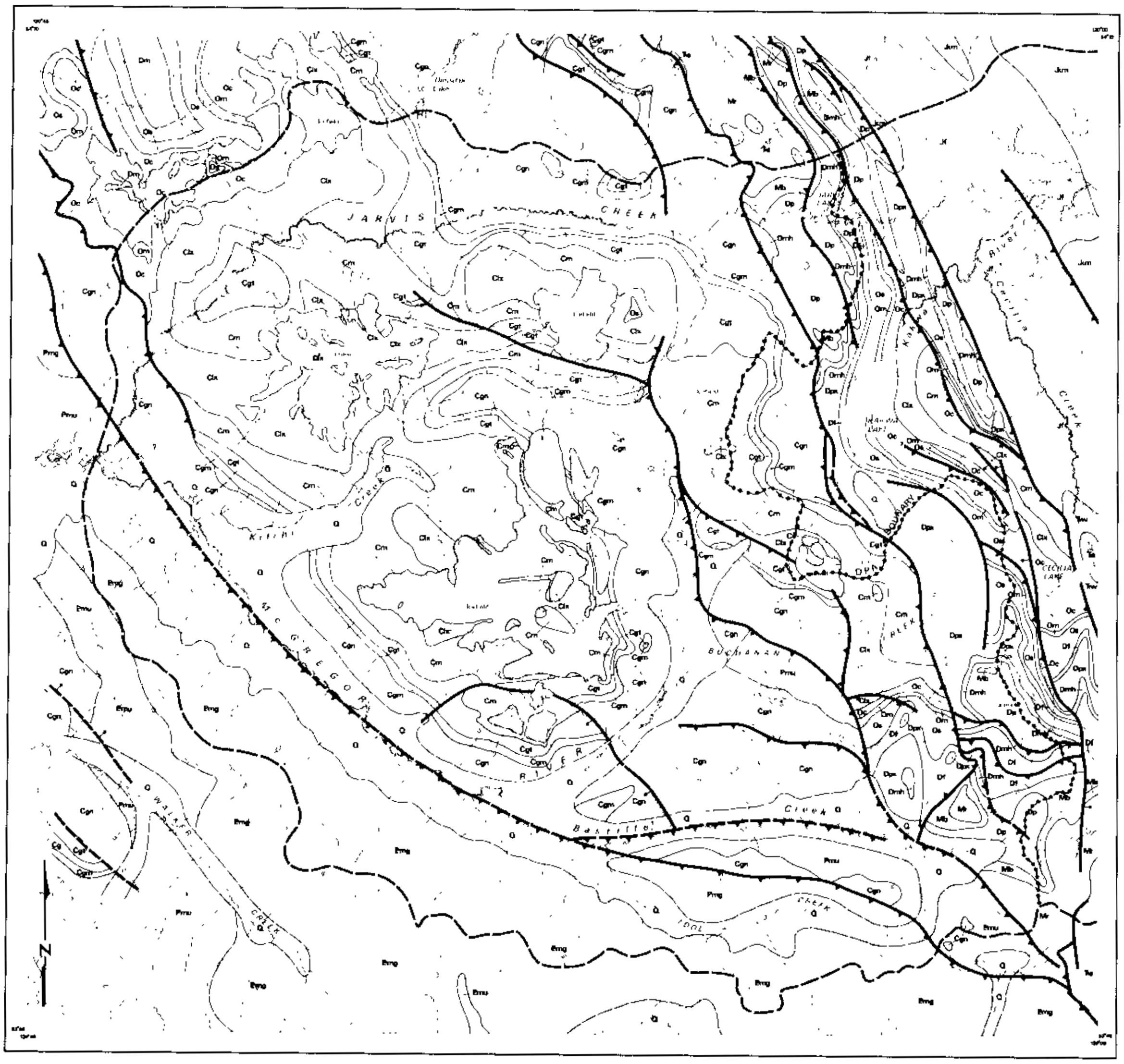
Exploration companies have not been active in the area, partly because of poor access and partly because the geology is known only on a regional basis from reconnaissance mapping by the Geological Survey of Canada (Campbell, *et al.*, 1973; Taylor and Scott, 1979). From these surveys the geology appears to be typical of the Rocky Mountain Fold and Thrust Belt. Without the benefit of mineral exploration reports on the area, the following discussion on the mineral potential relies heavily on comparisons with analagous geological settings outside the planning area that host mineral deposits.

METALLIC MINERAL DEPOSIT MODELS AND MINERAL POTENTIAL RATING

(1) Carbonate-Hosted Lead-Zinc Deposits

A major lead-zinc deposit (Robb Lake) and 16 smaller occurrences have been discovered in platformal carbonate rocks of the Rocky Mountain Fold and Thrust Belt in northeastern British Columbia. These deposits occur in Devonian dolomites and limestones at a facies change or 'shale out' from massive carbonate rocks in the southeast to shaly carbonate rocks in the northwest (Macqueen and Thompson, 1978). In the Kakwa Planning Area the upper Devonian Palliser Formation undergoes a similar change and, by analogy, is an excellent reconnaissance target. The Robb Lake deposit, which occurs in a similar geologic environment 360 kilometres to the northwest, contains approximately 6.1 million tonnes of 7.3 per cent combined lead and zinc, giving a gross value of about $350 million. For this reason, the Palliser Formation is designated as 3B on the mineral potential map (Fig. 73), indicating moderate potential for finding a medium-sized deposit.

Potential also exists for Mississippi Valley-type lead-zinc deposits in the massive carbonate rocks that crop out extensively in the study area. Although the Cambrian Mural Formation hosts lead-zinc mineralization outside of the study area, no metallotects have been recognized in the area for this type of deposit. Consequently the carbonate units are designated as moderate potential (3) with no size classification.



LEGEND

QUATERNARY

PLEISTOCENE AND RECENT

[Q] ALLUVIUM AND GLACIAL DEPOSITS

JURASSIC AND CRETACEOUS

MINNES GROUP

[Jkm] SANDSTONE SILTSTONE SHALE COAL

JURASSIC

FERNIE GROUP

[Jf] PHOSPHATIC AND SIDERITIC SHALE SILTSTONE AND MINOR SANDSTONE

TRIASSIC

[Rs] SULPHUR MOUNTAIN FORMATION DOLOMITIC AND CALCAREOUS SILTSTONE MINOR LIMESTONE DOLOMITE SHALE AND SANDSTONE

MIDDLE AND UPPER TRIASSIC

[Rw] WHITEHORSE FORMATION LIMESTONE AND DOLOMITE

CARBONIFEROUS AND PERMIAN

[Mr] RUNDLE, HANNIGAN BELCOURT, RANGER CANYON AND MOWITCH FORMATIONS LIMESTONE DOLOMITE SANDSTONE CHERT

[Mb] BANFF FORMATION BROWN CALCAREOUS SILTSTONE LIMESTONE AND SHALE

DEVONIAN

UPPER DEVONIAN

[Dp] PALLISER FORMATION LIMESTONE DOLOMITE MINOR SHALE

[Dmh] MOUNT HAWK SOUTHESK AND SASSENACH FORMATIONS LIMESTONE ARGILLACEOUS LIMESTONE DOLOMITE MINOR SHALE

[Dpx] PEDRIX FORMATION BLACK SHALE

MIDDLE DEVONIAN

[Df/Dm] FLUME FORMATION Df LIMESTONE
Dm LIMESTONE ARGILLACEOUS LIMESTONE QUARTZITE

ORDOVICIAN

UPPER ORDOVICIAN

[Ob] BEAVERFOOT FORMATION LIMESTONE DOLOMITE BASAL QUARTZITE

MIDDLE ORDOVICIAN

[Os] SKOKI FORMATION ONCOLITIC DOLOMITE MINOR SANDSTONE

LOWER ORDOVICIAN

[Om] MONKMAN QUARTZITE ORTHOQUARTZITE

[Oc] CHUSHINA FORMATION LIMESTONE ARGILLACEOUS LIMESTONE MINOR SHALE

CAMBRIAN

UPPER CAMBRIAN

[Clx] LYNX FORMATION LIMESTONE NODULAR LIMESTONE DOLOMITE

MIDDLE CAMBRIAN

[Cm] SNAKE INDIAN TITKANA, AND ARCTOMYS FORMATIONS DOLOMITIC SILTSTONE DOLOMITE AND SHALE

LOWER CAMBRIAN

[Cgt] MAHTO FORMATION QUARTZITE

[Cgm] MURAL FORMATION LIMESTONE MINOR SHALE

[Cgn] McNAUGHTON FORMATION QUARTZITE PEBBLE CONGLOMERATE SILTSTONE ARGILLITE AND SHALE

(Cgt, Cgm, Cgn:) [Cg] GOG GROUP

PRECAMBRIAN (HADRYNIAN)

UPPER MIETTE GROUP

[Pmu] ARGILLITE SILTSTONE MINOR SANDSTONE AND CARBONATES

MIDDLE MIETTE GROUP

[Pmg] PEBBLE CONGLOMERATE ARGILLITE DIAMICTITE MINOR LIMESTONE

SYMBOLS

FAULT DEFINED ASSUMED

THRUST FAULT

NORMAL FAULT BALL ON DOWNTHROWN SIDE

GEOLOGICAL CONTACT DEFINED ASSUMED

ICEFIELD BOUNDARY

DEFERRED AREA PLAN BOUNDARY

STUDY AREA BOUNDARY

GEOLOGICAL INFORMATION FROM

TAYLOR G.C. AND STOTT D.F. (1979) *GEOL SURV CANADA* OPEN FILE MAP 630 (93I) 1:125 000

CAMPBELL R.B. MOUNTJOY E.W. AND YOUNG F.G. (1973) *GEOL SURV CANADA* PAPER 72-35 MAP 1356A McBRIDE (93H) 1:250 000

Figure 72. Geology of Kakwa Lake Deferred Planning Area.

(2) Clastic-Hosted Sulphide Deposits

Barite-lead-zinc deposits hosted by Devonian-Mississippian clastic rocks are a major type of deposit in the miogeoclinal rocks of the Rocky Mountain Fold and Thrust Belt (MacIntyre, 1982). Although known deposits in the Kechika Trough of northeastern British Columbia are restricted to the western half of the Rocky Mountain Fold and Thrust Belt, potential exists for discovering this type of deposit in the shale units of the study area. By analogy with the age of the host rocks of the known deposits, Devonian shales in the study area are assigned a moderate potential (3); other shales are assigned a lower designation (4) (Fig. 73).

Much of the western part of the study area is underlain by Cambrian quartzites and sandstones of the McNaughton and Mahto Formations. Although these and other quartzites in the study area are assigned a low potential (4), stratabound lead-zinc-silver mineralization occurs in rocks of similar age and setting in other mountain belts, for example, Laisvall, Sweden (Rickard, *et al.*, 1979).

INDUSTRIAL MINERAL AND MATERIAL POTENTIAL

(1) Quartzite

Good quality quartzite for industrial use for building stone and as a source of silica occurs in the McNaughton Formation throughout the study area. The quartzite is massive with uniform beds up to 8 metres thick. A quartzite quarry at Wishaw Lake near Babette Lake is under development. This site was chosen largely because it is more accessible than many other prospective sites. Preliminary market surveys by the developer indicate that the quartzite has many desirable and aesthetic properties for use as building stone.

(2) Gypsum

Good quality gypsum 15 metres thick occurs in the middle part of the Whitehorse Formation 7 kilometres east of the planning area (Govett, 1961). This formation crops out at the eastern margin of the planning area around Cecilia Lake; its gypsum potential is untested.

(3) Phosphate

Phosphate deposits were discovered recently about 30 kilometres northeast of the study area in the Triassic Sulphur Mountain Formation (Heffernan, 1980). This formation extends into the study area where its potential is unknown.

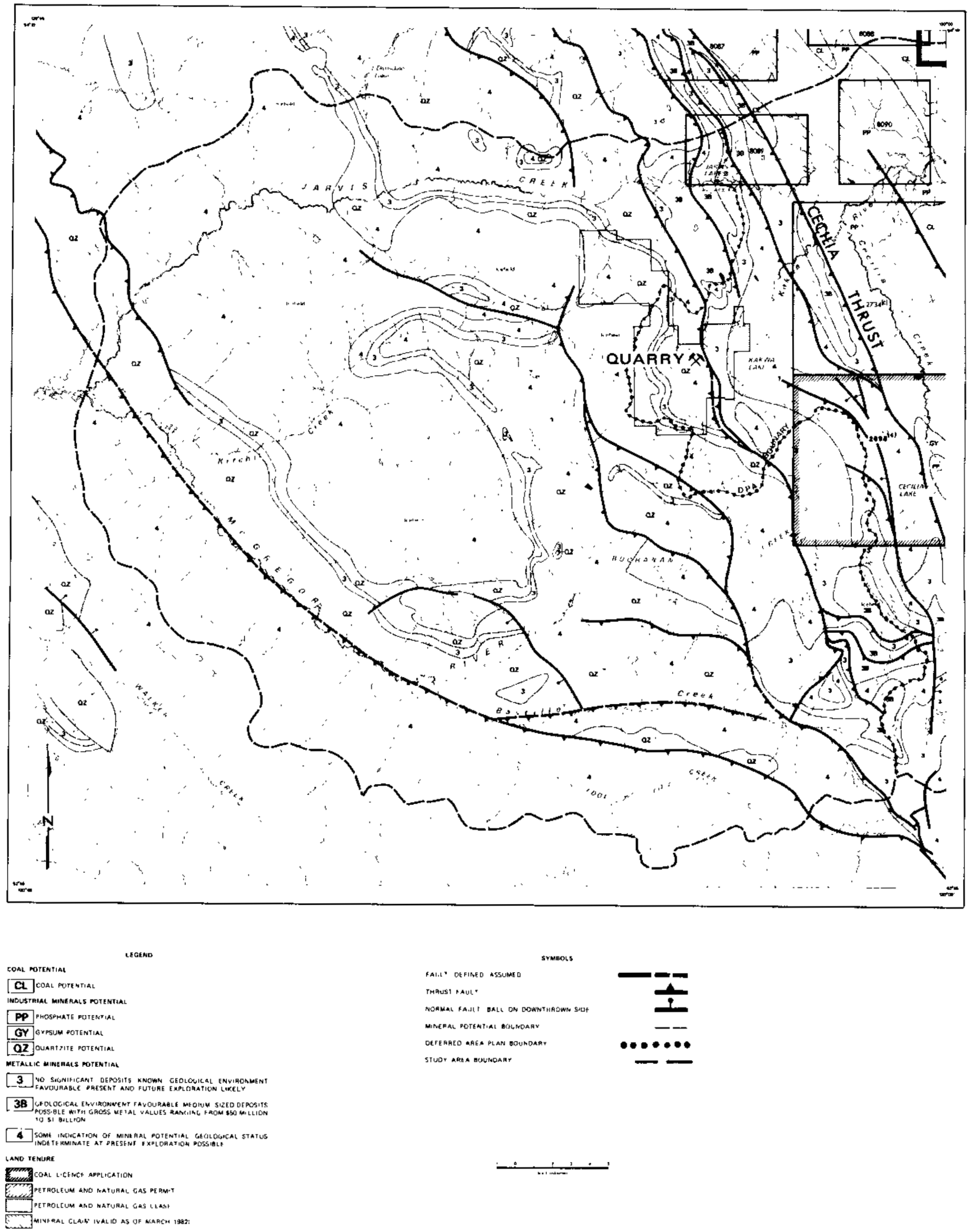


Figure 73. Mineral potential of Kakwa Lake Deferred Planning Area.

ENERGY RESOURCE POTENTIAL

The Petroleum Resources Division assessed the energy resource potential of the study area in a separate report that is summarized briefly here.

(1) Petroleum and Natural Gas

Favourable areas for petroleum and natural gas accumulations occur in the Fernie Group and under the Cecilia Thrust Plate. In the Kakwa Planning Area, leases and permits partly cover areas of interest but detailed exploration has yet to be undertaken.

(2) Coal

The southern limit of the Peace River Coalfield, currently under development to the northwest, crosses the northeast corner of the planning area. Coal licences extend from the study area northwestward along strike (Fig. 73). Detailed exploration has yet to be undertaken on licences adjacent to and in the study area but it is underlain by the coal-bearing Minnes Group.

SUMMARY

The Kakwa Planning Area presents a good example of the difficulties involved in assessing the mineral potential of an area with only a broad regional geological data base and no detailed private exploration reports. In this case the Ministry of Energy, Mines and Petroleum Resources recommended to the planning team that a ground assessment of the mineral potential (mapping, stream geochemistry, lithogeochemistry) should be carried out prior to any land use decision that would withdraw land from exploration and mining.

FLOURMILLS PLANNING AREA (93A/1W, 92P/16W)

INTRODUCTION

Flourmills Deferred Planning Area (Fig. 68) centres on latitute 52 degrees 06 minutes north and longitude 120 degrees 20 minutes west. The planning area encompasses 9 000 hectares of the southern portion of the Quesnel Highlands, a highly dissected plateau of moderate relief. It is bounded to the north, east, and south by Wells Gray Provincial Park, and on the west by Spanish Creek. Elevations range from 1 100 metres along Spanish Creek to more than 2 100 metres on Wells Gray Provincial Park boundary. Pleistocene glaciation rounded peaks and left extensive valley bottom till deposits. Several well-preserved, post-glacial volcanic cones, cinder deposits, and flows that lie near the eastern boundary of the planning area provided the impetus for a proposal by the Ministry of Lands, Parks and Housing to annex all, or part of, the planning area to Wells Gray Provincial Park.

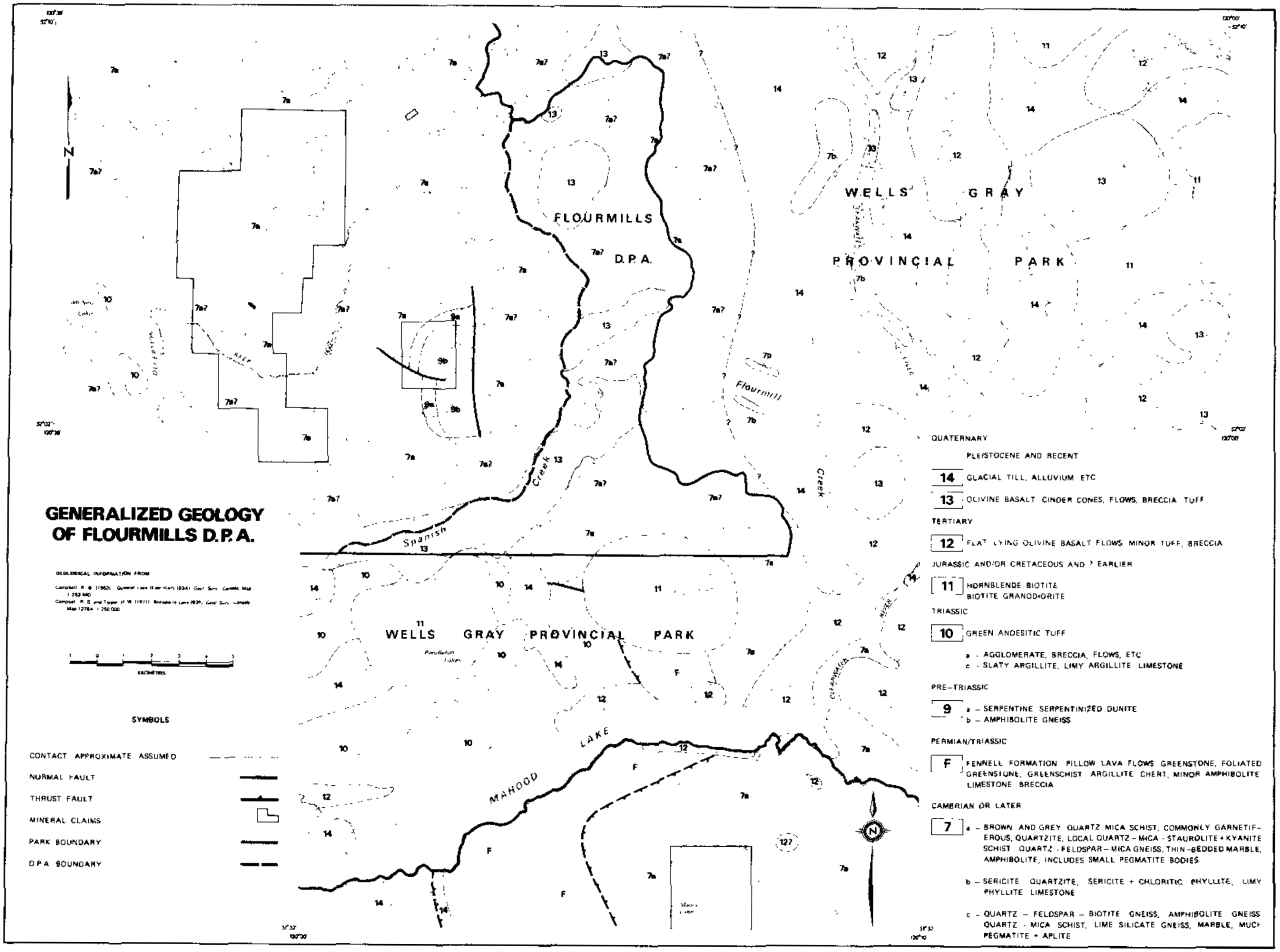


Figure 74. Generalized geology of Flourmills Deferred Planning Area.

GEOLOGY

Figure 74 is a generalized geologic map of the region surrounding the Flourmills Deferred Planning Area. The area is underlain predominantly by Lower Cambrian and younger metamorphosed rocks of the Snowshoe Formation of the Cariboo Group (unit 7a). Dominant lithologies are brown and grey quartz-mica schist, quartzite, thin-bedded marble, quartz-feldspar mica gneiss, and amphibolite pegmatite (Campbell, 1963; Campbell and Tipper, 1971). Along the southern boundary, these rocks and a minor area of Triassic Nicola Group metasedimentary rocks are intruded by Jurassic and/or Cretaceous monzonite to granodiorite plutons, which, by proximity, might correspond to the nearby Raft and Baldy batholiths. Superimposed on the general geologic pattern just described are Miocene to Recent volcanic flows culminating in a number of well-preserved cones and blocky lava flows. These are found in the northwest and central to southwestern part of the planning area. Pervasive glacial deposits and recent alluvium limit rock exposures.

MINERALIZATION

There are no metallic mineral occurrences in the Flourmills Deferred Planning Area. Scoria and ash deposits were investigated by a private company, Tri-Ag Resources Ltd., but no results are documented to provide an indication of economic value. A mica deposit associated with pegmatites of the Snowshoe Formation adjacent to the northwest boundary was investigated in 1930, but has received little recent attention.

MINERAL DEPOSIT MODELS

By analogy with geological environments and mineral deposits adjacent to the planning area, a variety of mineralization possibilities exist for Flourmills Deferred Planning Area:

(1) Porphyry-style molybdenum or copper mineralization related to Jurassic/Cretaceous plutons.

(2) Tungsten-bearing skarn mineralization associated with Snowshoe Formation-hosted Jurassic/Cretaceous plutons.

(3) Disseminated gold mineralization in iron-carbonate-rich Triassic phyllites. These rocks may extend southeast from the Crooked Lake-MacKay River Valley.

MINERAL POTENTIAL

Figure 75 shows mineral potential for the region surrounding Flourmills Deferred Planning Area. Mineral potential was considered to be low prior to about 1980. Regional exploration work, initiated after publication of Federal-Provincial regional geochemical silt sample data for NTS 92P and 93A, raised the designation of mineral potential from low to moderate.

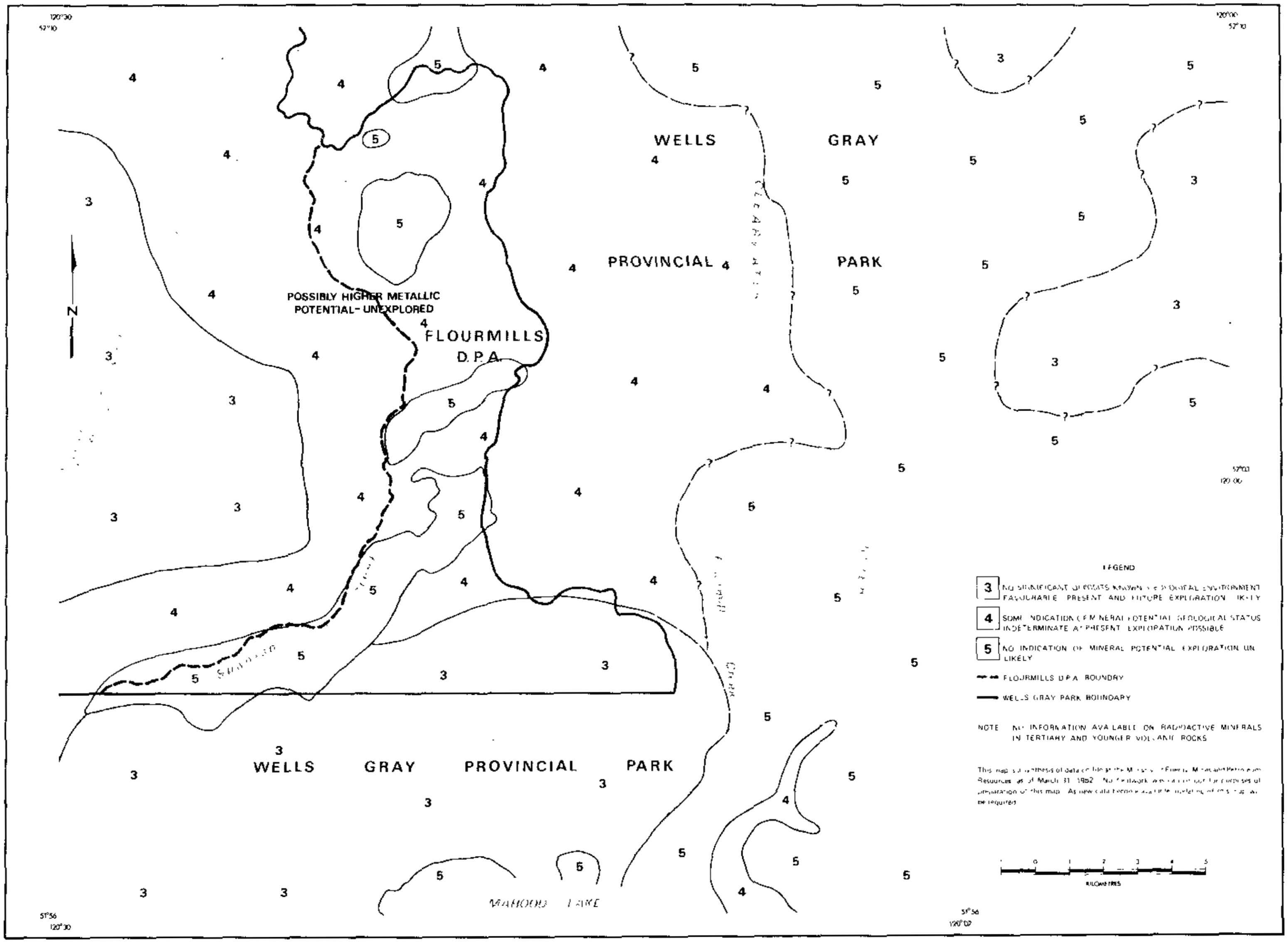


Figure 75. Metallic mineral potential of Flourmills Deferred Planning Area.

Highest mineral potential for porphyry and skarn mineralization exists in the south where a number of stocks intrude the Snowshoe Formation. Central and northern parts of the planning area that are underlain by Snowshoe Formation require detailed geologic mapping to determine whether gold-bearing geologic environments extend southeast from Crooked Lake-MacKay River into the planning area. Consequently, these rocks are designated as having indeterminate mineral potential. Areas covered by post-glacial volcanic cones and lava flows are considered to have low metallic mineral potential.

GEOTHERMAL POTENTIAL

Exploration for geothermal resources is in its infancy in British Columbia; the Flourmills area has not been investigated. Deep-seated structures controlled Tertiary to Recent volcanism in the area. Therefore, while geothermal energy potential presently is unknown, it could be high.

SUMMARY AND RECOMMENDATIONS

Flourmills Deferred Planning Area covers 9 000 hectares of relatively unexplored land in the southern Quesnel Highlands. Recent exploration adjacent to the planning area indicates that mineral potential may be considerably higher than previously thought. Untested mineralization possibilities include molybdenum-copper porphyries, tungsten-bearing skarns, and disseminated stratabound gold.

Industrial mineral potential is mainly for scoria, ash, and mica. The economics of these commodities, particularly scoria and ash, are dependent on proximity to ready markets.

Geothermal energy potential, which is generally high in areas of recent volcanic activity, is untested but may prove to be significant.

At present, it is strongly emphasized that the current level of geologic knowledge for the Flourmills Deferred Planning Area needs enhancement by more detailed geological, geochemical, and geothermal surveys to permit consideration and endorsement of proposals to alienate land from exploration and development.

SOUTH MORESBY PLANNING AREA (103B, C; 102O)

INTRODUCTION

The South Moresby Planning Area is located on the Queen Charlotte Islands approximately 200 kilometres southwest of Prince Rupert. The planning area covers 145 270 hectares and includes all land and adjacent islands south of an east-west-trending boundary south of Tangil Peninsula. The

Queen Charlotte Ranges are the dominant physiographic unit, with the San Christoval Ranges forming the major subdivision. Elevations range from sea level to more than 1 100 metres. Alpine conditions extend locally to near sea level.

During the Pleistocene, Moresby and adjacent islands were intensively glaciated as evidenced by widespread and varied glacial features in mountainous areas. Some paleoecologists think there were glacial refugia because nunataks existed even during the maximum stage of glaciation.

Daily flights from Vancouver to Sandspit and twice-weekly ferry service from Prince Rupert provide access to the Queen Charlottes. Access to the planning area is by boat, seaplane, or helicopter. Limited access by logging roads is available on parts of Lyell Island and old mining roads and trails are still discernible near Jedway.

The Environment and Land Use Committee (ELUC) initiated the South Moresby Resource Planning Program in 1979 in response to numerous proposals by public interest groups for establishment of a large wilderness park, and in response to native Haida concerns about proposed logging on Burnaby Island. The Environment and Land Use Committee terms of reference called for a five-year multiple land use allocation plan to be produced. Mineral resources were among the many issues that the planning team addressed. The Ministry of Energy, Mines and Petroleum Resources' major input to the planning program during the last two and one-half years consisted of the following:

(1) District Geologist or Mineral Land Use Geologist participated in monthly meetings.

(2) Mineral Potential Evaluation Report (1981) prepared by K. E. Northcote of Bema Industries Ltd.

(3) Mineral Resources Technical Report, including an economic evaluation, written by K. E. Northcote of K. E. Northcote & Associates Ltd., and Resource Data and Analysis Division.

(4) Close liaison kept with mining companies actively working in the area and the British Columbia and Yukon Chamber of Mines.

(5) Proposals for one sizeable and two small ecological reserves evaluated.

The planning program meetings will conclude in early 1983. Following a final set of public meetings, a series of land use options supported by extensive resource evaluations will be presented to the Environment and Land Use Committee. A policy decision will follow.

GEOLOGY

A. Sutherland Brown, from 1958 to 1963, geologically mapped the Queen Charlotte Islands at a scale of 1:125 000. The results of his work, which are documented in Bulletin No. 54, are the basis for all subsequent geological studies and mining exploration on the islands. Recent exploration for gold deposits that are similar to the Cinola deposit on Graham Island provide further detailed geologic data.

The stratigraphic section on Moresby Island is fairly complete and similar to that of the other Queen Charlotte Islands. Three major periods of volcanic activity are separated by four periods of deposition of fossiliferous marine sedimentary rocks. Two periods of plutonism are present, Late Jurassic syntectonic intrusions and Late Tertiary post-tectonic intrusions. Volcanic and plutonic rocks have evolved with time, from basic to acidic, from quartz poor to quartz rich (Sutherland Brown, 1968).

A continuous linkage of northwestward-trending fault systems dissects the islands. These major crustal fractures dominated the tectonic development and control the distribution of rock types. The Rennell-Louscoone fault zone, active predominantly from Late Jurassic to Cretaceous time, extends throughout the planning area from Lyell Island in the north to Kunghit Island in the south (Fig. 76).

A diversity of geologic environments for mineral deposit formation exist. The wide variety of volcanic and sedimentary rocks; the syntectonic and post-tectonic plutons, dykes and sills; and the large deep-seated faults on Moresby and adjacent islands can all create environments favourable for mineral deposition.

MINERALIZATION AND MINERAL DEPOSIT MODELS

Francis Poole discovered chalcopyrite and magnetite mineralization in South Moresby Planning Area in 1862 in the vicinity of Skincuttle Inlet. For the next 80 years exploration intensity fluctuated and there was limited production of primarily copper-bearing ores.

(1) Contact Metasomatic Deposits

From the late 1940's to 1970 attention focused on exploration and development of contact metasomatic (replacement) iron-copper deposits with accompanying gold and silver values. The following features typify these deposits:

(a) Proximal to the contact of massive limestone of the Kunga Formation with altered basalts of the Karmutsen Formation.

(b) Adjacent to a plutonic body.

(c) Faulting, pre-ore diorite porphyry and abundant post-ore dykes.

(d) Brecciation and common presence of a skarn envelope.

(e) Orebodies occur in tabular-lensoid to pipe-like deposits that are concordant or discordant to bedding and consist of massive magnetite with variable amounts of chalcopyrite, pyrite, and pyrrhotite.

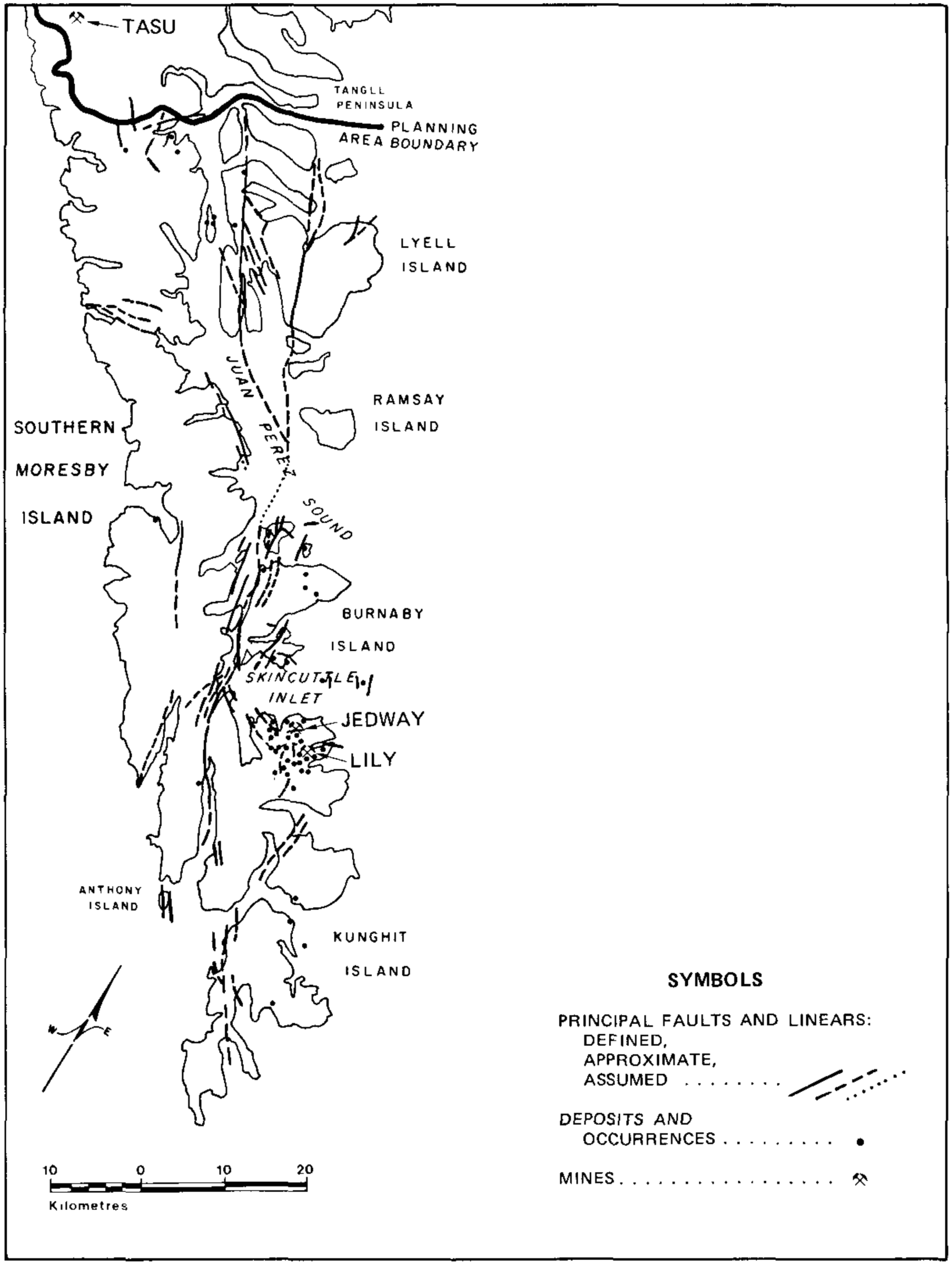


Figure 76. Major faults and linears showing relationship to known mineral deposits and occurrences, South Moresby Planning Area.

Jedway, the best known of these deposits inside the planning area, produced over 2 million tonnes of iron concentrate from 1962 to 1968 with a value of more than $21 million and provided direct employment for up to 150 workers. Significant reserves remain in other nearby deposits.

(2) Gold Deposits

The discovery of the Cinola gold deposit on Graham Island by Efrem Specogna and John Trico in 1970 stimulated a widespread search for similar deposits. They occur in silicified deep-seated faults and shear zones and are interpreted as variations of the Carlin Nevada-type of deposit. Exploration concentrated first on Graham Island around the original discovery and then, predictably, spread to similar geologic environments on Moresby and adjacent islands.

The Cinola gold deposit is located on the west side of the Sandspit fault where Haida sandstone and shale are structurally overlain by Early Tertiary volcanic rocks. Poorly lithified Mio-Pliocene sandstone, shale, and conglomerate of the Skonun Formation occur on the east side of the fault. Rhyolite porphyry crosscuts sedimentary units. Gold and silver mineralization is localized in intensely silicified rocks and quartz veins that appear to be spatially related to the rhyolite porphyry. Barr (1980) published estimates of reserves that ranged up to 22 million tonnes averaging 2.49 grams gold per tonne; recent company reports state reserves in the order of 41 million tonnes with 1.9 grams gold per tonne.

Gold exploration in the planning area involves a fairly wide variety of rock types but a narrow range of mineralizing environments. The following are significant as exploration guides:

(a) Silicification and quartz veining accompanied by sulphides proximal to deep-seated faults, shear zones, and major fault splays. Major fault systems traverse the Queen Charlotte Islands from northwest to southeast (Sutherland Brown, 1968).

(b) Silicification and sulphide mineralization that is associated with Tertiary (?) andesitic to rhyolitic dyke swarms.

(c) Silicification in brecciated rhyolitic rocks near eruptive or collapse centres; these likely targets are areas of Tertiary (Massett) volcanism. Dyke swarms within these volcanic rocks might also be significant.

Companies discovered significant mineralization on northern Lyell Island and on Moresby Island north of Bigsby Inlet. Some mineralized zones may extend more than 1 kilometre along well-defined fault structures. Exploration for gold deposits in the planning area is in its early stages; we anticipate much more to follow.

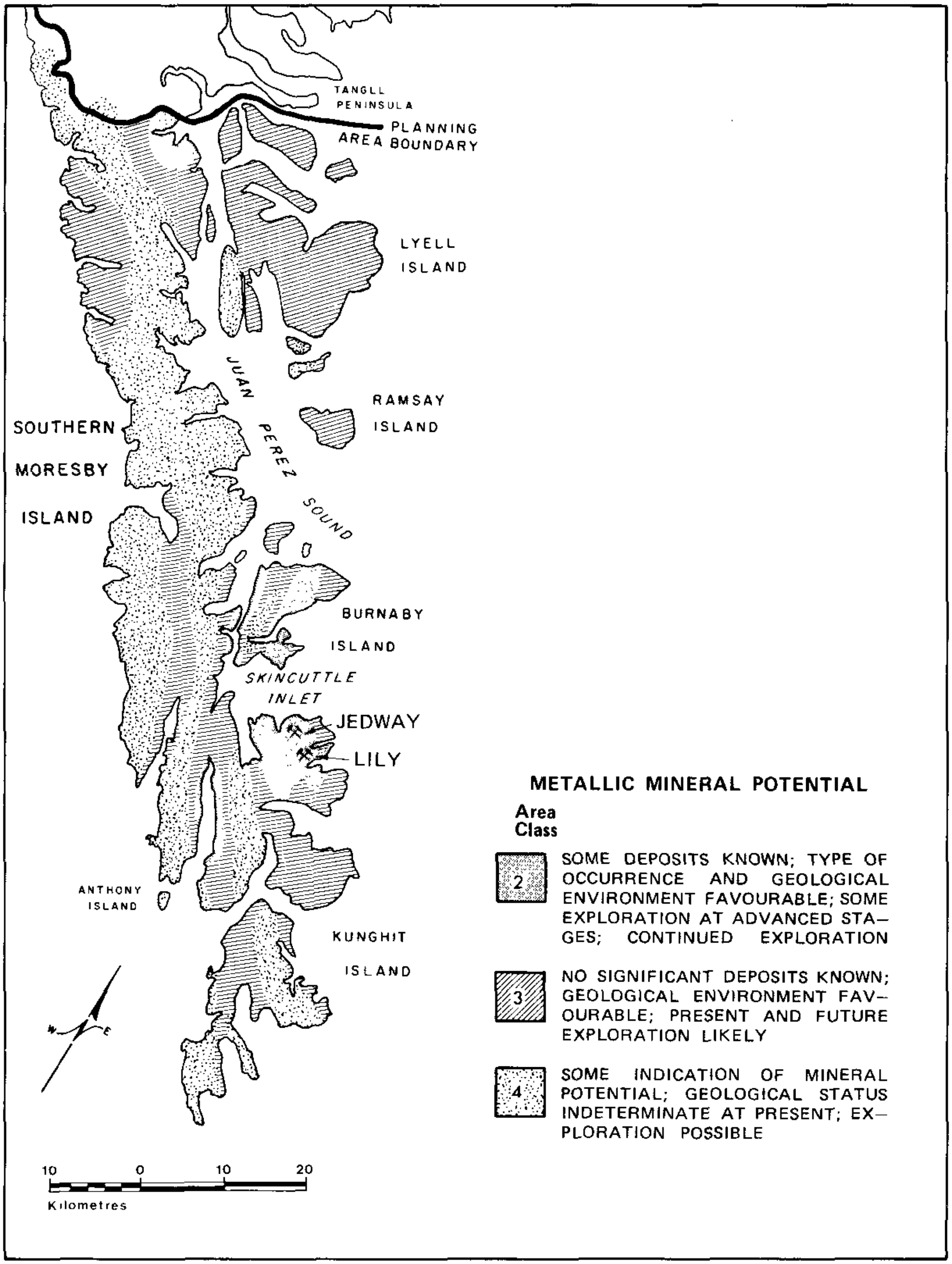


Figure 77. Metallic mineral potential of South Moresby Planning Area.

(3) Volcanogenic Massive Sulphide Deposits

Massive volcanogenic sulphide deposits and gold mineralization may occur in the predominantly acid submarine volcanic sequence of the Yakoun Formation. This possibility remains virtually untested, partly because areas underlain by the Yakoun Formation are not extensive.

(4) Post-Tectonic Porphyry Systems and Gold-Bearing Veins

Post-tectonic intrusions merit exploration for differentiated copper and molybdenum porphyry systems as well as gold deposits. The Catface porphyry copper-molybdenum deposit and Zeballos gold-bearing quartz veins on Vancouver Island are examples of mineralization related to similar post-tectonic intrusions in a similar geologic terrane.

(5) Other Possibilities

Other potentially economic types of mineralization include copper and lesser vanadium in amygdules in the tops of Karmutsen volcanic flows, and paleoplacer deposits proximal to areas of gold mineralization.

MINERAL POTENTIAL

In 1981, under contract to the Ministry, K. E. Northcote, then with Bema Industries Ltd., prepared a mineral potential map at scale 1:125 000 for the planning area. The map was compiled from Ministry files and information provided by industry. General concepts of mineral potential outlined earlier were utilized. A reduced, slightly modified version of this map is presented on Figure 77.

Mineral potential is summarized as follows:

(1) All areas where Kunga or interlava limestones are in contact with Karmutsen volcanic rocks, and are cut by or are close to intrusions, are considered to be areas of high (2) potential for iron, copper, gold, and silver mineralization in the form of contact meta-somatic deposits.

(2) Areas that are underlain by any of the features described previously under 'Gold Deposits' are classified as having high to moderate potential (3 to 2) for gold deposits. Ongoing exploration will necessitate periodic map revisions; some Class 4 areas will become Class 3, and some Class 3, Class 2.

(3) Areas underlain by the Yakoun Formation and post-tectonic intrusions are classified as having moderate potential (3) for volcanogenic massive sulphide deposits and porphyry systems respectively. Syn-tectonic intrusions are assigned low mineral potential (4). Deep emplacement and lack of differentiation make them unfavourable exploration targets.

SUMMARY AND RECOMMENDATIONS

For 120 years the South Moresby Planning Area has experienced varying intensities of mineral exploration and production of ore. Prior to 1980 most of the mineral exploration concentrated on searching for contact metasomatic (copper, iron, gold, and silver) deposits. Exploration for these kinds of deposits has reached a mature stage, as attested by the number of known properties in this geologic environment. Even now, considerable scope exists for expanding known reserves. In the early 1960's more than $1 million was spent exploring for such deposits in the Skincuttle Inlet area and culminated in the mining of the Jedway iron deposit. It is probable that producers will develop new mines from these kinds of deposits on southern Moresby Island or Burnaby Island in the future. Geologic environments which may host contact metasomatic deposits should, therefore, be protected from alienation.

Discovery of Cinola (gold) deposit on Graham Island stimulated exploration in similar geological environments in the planning area. Work is in its initial stages but results obtained to date in areas such as Lyell Island, have proved encouraging. Exploration in the near future will likely be focused on areas close to the major fault systems that extend southeasterly through the length of the planning area.

The South Moresby Planning Area program presented a major resource planning challenge. Many areas of high mineral potential and undeveloped deposits coincide with areas of high scenic, ecological, and core recreation potential. The main thrust of this Ministry's involvement has been to document resource values, analyse conflicts with other resources, and ensure that mineral resources are fully considered in the range of options presented for a decision.

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