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MINERAL POTENTIAL OF THE OKANAGAN-SIMILKAMEEN-BOUNDARY AREA (82E, 82L/SE, SW, 92H/SE, NE)

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INTRODUCTION

This report describes the preliminary phase of the mineral potential evaluation of the Okanagan-Similkameen-Boundary area in the southeast part of the Thompson-Okanagan region of south-central British Columbia. This is part of a province-wide study initiated by the B.C. Ministry of Energy, Mines and Petroleum Resources in May 1992 to provide accurate and credible information to landuse planning processes.

The Okanagan-Similkameen-Boundary area is part of a larger well-mineralized region of complex geology that has good potential for new mineral discoveries. This report attempts to define the areas (mineral assessment tracts) that may be favourable for future mineral development. These areas are the basic units for subsequent qualitative and quantitative mineral potential evaluations.

The evaluation process has two phases. Phase 1 ranks the tracts according to their mineral potential based on historic data. Phase 2 uses predictive methods based on the known and potential resource inventory. The steps in this process are (Kilby, 1994, personal communication); Hoy *et al.*, 1994; Church and Kilby, 1994):

(1) Geological compilation at a scale of 1:250 000.
(2) Define mineral assessment tracts.
(3) Compile mineral deposit data.
(4) Review of geology and mineral inventory data by industry geoscientists.
(5) Phase 1 of the mineral potential assessment.
(6) Estimate the mineral potential of undiscovered deposits in the tracts.
(7) Phase 2 of the mineral potential assessment.

These evaluations are scheduled for completion in 1995.

HISTORY

The Okanagan-Similkameen-Boundary area includes the southeast part of the Thompson-Okanagan planning district, one of several designated planning districts in British Columbia (Figure 1). It corresponds in part with the "Okanagan-Shuswap Region" that was the focus of a broad based economic study sponsored by the British Columbia government in 1971.

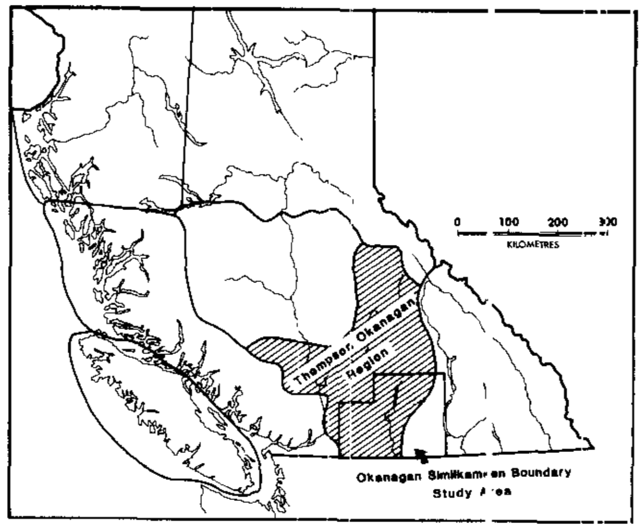

Figure 1. The Okanagan-Similkameen-Boundary study area, southeastern part of the Thompson-Okanagan planning district.

The first comprehensive evaluations of the geology and mineral deposits of the region were by Cairnes (1937), Rice (1947) and Jones (1959). From these studies it was clear that some geological units are mineralized and others are relatively barren. It is also apparent that many types of mineral deposits occur in the region and that each type tends to cluster, forming mineralized tracts or distinctive areas constituting mining camps.

Mineral Deposit Land Use (MDLU) maps were developed in the period 1969 to 1978 at a scale of 1:250 000 to cover most of the province (McCartney *et al.* 1974). This was the first step in estimating mineral potential. The MDLU maps classified areas into five categories, according to mineral exploration potential, ranging from 1, the highest, to 5, the lowest. This classification was based on the frequency of mineral occurrences and the geological environment of the area. The various types of deposits were indicated and metal producers were labelled according to size. A review of the MDLU program by Legun and Matheson (1991) showed that the maps were quite successful. Indeed most new discoveries are within the delineated high-potential areas 1 and 2. In glacial drift covered or unmapped areas some deposits undoubtedly remain undetected.

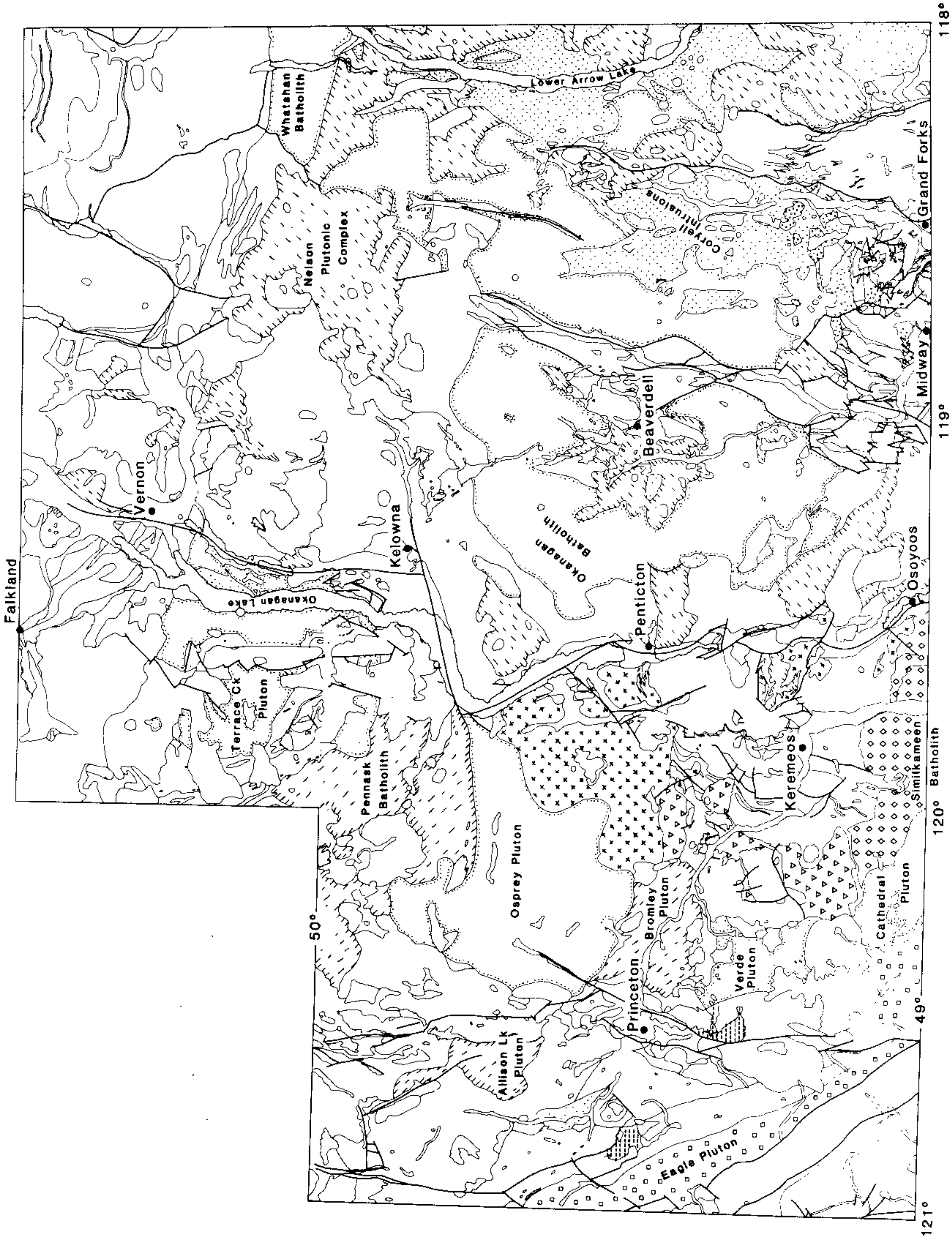

Figure 2. Geology of the Okanagan-Similkameen-Boundary area showing the main granitic batholiths and plutons.

THE GEOLOGICAL MAP

The area covered by this study encompasses the Penticton (82E), Vernon (82L, south half) and Princeton (92H, east half) quadrangles - a total area of about 34 000 square kilometres (Figure 2). Compilation of the geology is based mainly on the publications of Tempelman Kluit (1989) for the Penticton area, Okulitch (1978, 1991) for the Vernon area, Monger (1989) for the Princeton area, the Tectonic Assemblage Map of the Canadian Cordillera by Wheeler and McFeely (1991) and the contributions of more than 90 other authors.

The Okanagan-Similkameen region consists principally of accreted Mesozoic oceanic arc (Pacific plate) terranes in the western part (Nicola Group) and Proterozoic-Paleozoic pericratonic (North American plate) rocks to the east (Monashee-Shuswap Complex). The major boundary between these areas is the Okanagan fault system. The rocks are overprinted by several episodes of metamorphism related to the intrusion of numerous Triassic to Tertiary plutons. Tertiary graben and half-graben (late orogenic) structures infilled with rocks of the Penticton, Princeton and Kamloops groups are associated with the Okanagan fault system and smaller rifts in the Princeton and Kettle River areas.

There are 54 distinctive lithological units on the map, half of which are bedded rocks and half, igneous intrusions. The late Paleozoic and younger part of the stratigraphic column is well represented with an average of two or three units for each epoch; the older rocks are not as readily subdivided because of the scarcity of fossils and the alteration of primary structures by regional metamorphism. The intrusive rocks are mostly Triassic or Jurassic age; a few are Paleozoic, and about one third are Cretaceous or Early Tertiary.

The prospecting philosophy for the region proposed by Cairnes (1937) holds that intrusive rocks are the prime source of metallic mineralization (a philosophy that remains valid for most of the important metal deposits in the area). Corollaries to this are that the small intrusive bodies are favourable locations for ore deposits as are roof pendants in the larger intrusions. Bodies of diorite, quartz diorite and alkaline rocks are more favourable for mineralization than bodies of granite and granodiorite.

MINERAL ASSESSMENT TRACTS

Garnett (1971) indicated high priority areas (tracts) of mineral potential for the Okanagan-Similkameen area based on gross lithology, age and structural information. For example, the Nicola Group (Triassic-Jurassic age) and subjacent feeder intrusions form large tracts in the Princeton and Vernon areas especially favourable for mineral exploration, whereas the equally large areas underlain by Tertiary rocks and the Shuswap Metamorphic Complex in the Penticton area have conspicuously fewer mineral occurrences.

In this study the concept of a geological tract is refined somewhat and becomes the basis for more detailed evaluation. A tract is a non-political land unit (defined at a scale of 1:250 000). It is underlain by a an array of variously mineralized geological formations in a structural panel with clear lithological boundaries such as faults or intrusive contacts. A total of 48 tracts have been delineated in the Okanagan-Similkameen-Boundary area (Figure 3, Table 1). Each tract is given a local name and distinctive symbol (*e.g.* "P1h" for Princeton). The tracts range in size from about 30 square kilometres for the Tulameen basin (P2h) to 1560 square kilometres for the Okanagan Highlands (M2). The number of geological units in each tract varies from one (the Anarchist Group) in the Bridesville tract (AN1), to five units in the Lambly Creek tract (H1).

The ranking of tracts is useful to economists and land-use decision makers. Garnett (1971) used a qualitative method of ranking. He chose four ranking levels - (1) areas with currently producing mines, (2) areas of high potential for future mineral production, (3) areas with a geological setting favourable for the discovery of new mineral deposits, (4) areas of uncertain mineral potential with only a few scattered mineral occurrences.

The determination of ranking by Kilby (1994, *personal communication*) begins with the following data:

- Estimated value of known mineral reserves.
- Historical exploration expenditures.
- Value of past production.
- Number of mineral occurrences.

These data are then weighted according to ability to predict sustainable mineral exploration and development.

The mining camps and mineralized tracts are patterned, in Figure 3 of this report, such that increasing pattern density is relative to increasing intensity of mineralization and mineral potential. 'Very high' ranking results from the combination of major mineral production, significant expenditures on exploration and a high frequency of mineral occurrences that is typical of the principal mining areas such as the Hedley camp (noted for gold production), the Beaverdell camp (silver), the Greenwood camp (copper, gold, silver) the Copper Mountain camp (copper), and the Tulameen basin (coal). 'High' ranking is typical of the lesser mining and prospecting areas such the copper deposits in the Axe-Cincinnati belt in the Aspen Grove area, Dusty Mac (gold and silver) in the Penticton area, Chaput (silver, lead and zinc) near Vernon, and the Hydraulic Lake - Blizzard area (uranium). 'Moderate' ranking areas are characterized by favourable geology but negligible mineral production and only scattered mineral occurrences, such as the disseminated copper and molybdenum prospects associated with the Bromley batholith, and the platinum and chromite showings associated with the Tulameen Ultramafic Complex.

Figure 4 shows the distribution of mineral occurrences and the principal mines in the study area.

RESOURCES

The mineral resources of the area are metallic minerals, industrial minerals and coal - of which the first

Figure 3. Mineral assessment tracts (mining camps and mineralized tracts patterned).

TABLE 1. DESCRIPTION OF MINERAL ASSESSMENT TRACTS

Tract	Tract Name	Units*	Resources	Tract	Tract Name	Units*	Resources
AP	Keremeos	Apex Mountain Group, Cahill (South) pluton, Penticton Group	copper, molybdenum, gold, silver	N2	Coalmont	Nicola Group	veins
AN1	Bridesville	Anarchist Group	podiform chromite	N3	Similkameen Falls	Nicola Group	veins
AN2	McKinney	Anarchist Group	gold quartz veins	N4	Hedley	Nicola Group, Cahill Creek pluton, Sl well Pekens Group, Hedley Intrusions	garnet and gold skarns
B1	Bromley	Bromley pluton, Nicola Group	veins	N5	Aspen Grove	Nicola Group, Allison Lake pluton, Chilcotin Group, Spences Bridge Group,	copper, veins
BR	Greenwood	Brooklyn Group, Attwood Group, Knob Hill Group, Greenwood pluton, Penticton Group	copper gold skarns, polymetallic veins, copper porphyries	N6	Cherryville	Nicola Group, Harper Ranch Group, Chilcotin Group	polymetallic veins
CM	Copper Mountain	Copper Mountain stock, Nicola Group	alkaline porphry copper	N7	Lumby	Nicola Group, Harper Ranch Group, Kamloops Group, Nelson Plutonic Complex, Silver Creek Formation	polymetallic veins
CS	Cathedral	Cathedral Lakes pluton, Similkameen batholith		N8	Vernon	Nicola Group, Harper Ranch Group, Kamloops Group	gypsum and granite quarries
C1	Christina Lake	*Coryell intrusions, Nelson Plutonic* Complex, Valhalla intrusions, Mt Roberts Group	polymetallic skarns, veins	O1	Trout Creek	Osprey Lake batholith, Summers Creek pluton	granite quarries
C2	Kettle River	Ladybird granite, Coryell intrusions, Nelson Plutonic Complex, Penticton Group		OK1	Vaseaux	Okanagan batholith, Valhalla intrusions, Nelson Plutonic Complex, Coryell intrusions, Monashee gneiss	veins
E1	*Granite Mountain*	*Eagle Plutonic Complex*	*veins*	*OK2*	*Isintok*	*Okanagan intrusions, Penticton Group*	*uranium, veins*
FR	Franklin	Harper Ranch Group, Coryell intrusions	polymetallic veins	PN	Pennask	Pennask batholith, Nicola Group, Penticton Group	copper, molybdenum porphyries
H1	Lambly Creek	Harper Ranch Group, Chapperon Group, Terrace Creek batholith, Penticton Group, Lambly Creek basalt	veins	P1e	Penticton	Penticton Group	epithermal gold-silver veins
J1	Skagit	Jackass Mountain Group, Dewdney Creek Formation, Ladner Group		P2e	Rock Creek	Penticton Group, Coryell intrusions, Knob Hill Group, Brooklyn Group, Anarchist Group	epithermal gold-silver veins
K1	Cawston	Kobau Group, Similkameen batholith, Nelson Plutonic Complex, Fairview intrusions, Apex Mountain Group	silver quartz-carbonate veins, nepheline syenite, skarn copper, quartz	P3e	Kelowna	Penticton Group, Terrace Creek batholith, Nicola Group, Lambly Creek basalt	veins
K01	Fosthall	Kootenay assemblage, Fosthall intrusions, Nicola Group	lead, zinc	POh	Princeton I	Princeton Group	zeolites
K02	Sugar Lake	Kootenay assemblage, Harper Ranch Group, Nelson intrusions	veins	P1h	Princeton II	Princeton Group, Nicola Group	coal
LD	*Trapping Creek*	Vahalla intrusion, Monashee gneiss, Chilcotin basalt	*uranium*	*P2h*	*Tulameen I*	*Princeton Group, Chilcotin Group*	coal, kaolinite, bentonite
M1	Damfino	Nelson Plutonic Complex, Monashee gneiss	veins	PS	Manning	Pasayten Group	
M2	Okanagan	Shuswap Complex, Okanagan batholith	granite quarries	S1	Ashnola	Spences Bridge Group	copper, zinc, veins
M3	Grand Forks	Grand Forks gneiss, Tertiary intrusions	uranium pegmatites	S2	Thalia	Spences Bridge Group, Otter intrusions, Princeton Group, Nicola Group	veins
M4	Osoyoos	Vaseaux gneiss, Nelson Plutonic Complex, Anarchist Group	veins	T1h	Tulameen II	Tulameen Ultramafic Complex, Nicola Group	chromite, platinum, dunite
M5	Highlands	Shuswap Complex, Chilcotin Group, Nelson Plutonic Complex, Penticton Group	uranium, granite	TI1	Terrace	Terrace Creek batholith, Penticton Group, *Harper Ranch Group, Coryell intrusions*	gold quartz veins
NO	Lightning Peak	Harper Ranch Group, Valhalla intrusions, Nelson Plutonic Complex	polymetallic veins, skarns	V	Verde Creek	Verde Creek pluton, Princeton Group, Spences Bridge Group	veins
N1	Beaverdell	Nelson Plutonic Complex, Anarchist Group, Penticton Group	silver-bearing quartz-carbonate veins	VH	Edgewood	Valhalla intrusions, Nelson Plutonic Complex, Monashee gneiss	

**Formations in column three are given in order of importance*

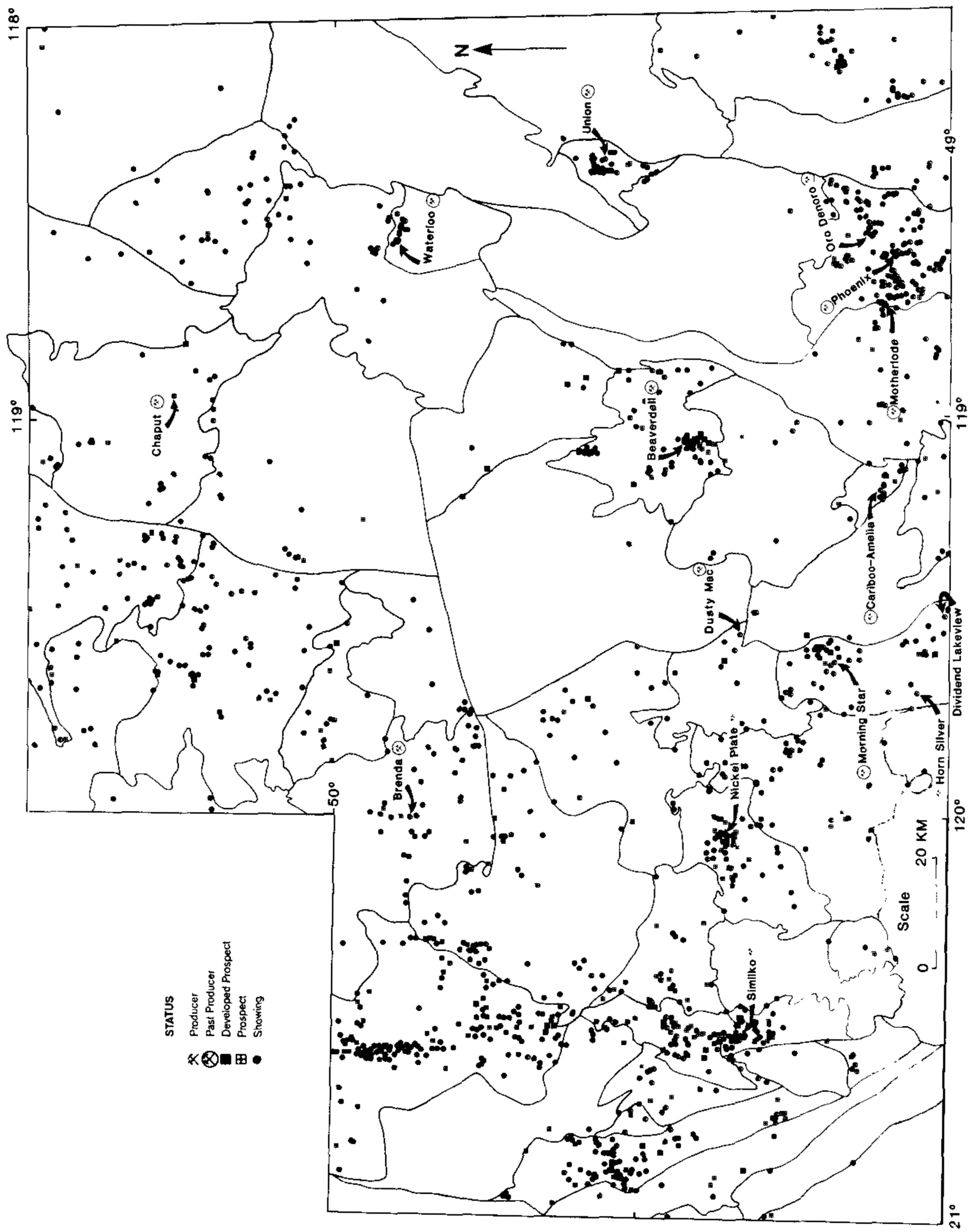

Figure 4. Location of principal mines and mineral occurrences.

is the most important. The principal metals are gold, silver, copper, lead and zinc (Figure 5). Gold is generally associated with silver; copper with molybdenum; and silver with lead and zinc. These metal combinations are common world-wide associations.

GOLD CAMPS

Most precious metal occurrences are in the southern part of the study area (Figure 5B). Gold clusters mainly in the Hedley and Greenwood camps in the Similkameen (southwest) and Boundary (southeast) areas, respectively.

The Hedley camp, which includes the Nickel Plate and adjoining Hedley Mascot mines, is one of the principal mining districts in British Columbia. Between 1904 and 1955 the Nickel Plate alone produced almost 49 tonnes of gold from underground workings. In 1987 Corona Corporation (formerly Mascot Gold Mines Ltd.) reopened the mine as a 2450 tonnes per day open-pit operation with ore reserves of 5.1 million tonnes averaging 2.98 grams per tonne gold. The gold is intimately associated with arsenopyrite and bismuth tellurides and hosted by pyroxene-rich skarn formed as a result of the intrusion of Hedley dioritic sills and dikes into Nicola limestone and siltstone (Ray and Dawson, 1994).

Camp McKinney is the most important of several mining areas where gold-bearing quartz veins are the main type of deposit. The Cariboo-Amelia mine, the largest producer in the camp, is recorded as having yielded over a million dollars in gold from 1895 to 1903 inclusive. It seems probable that further discoveries of note will be made in the area, however, the old workings are collapsed and there is little information to guide modern exploration other than to note that the hostrocks are assigned to the Anarchist Group (Cairnes, 1937).

The Fairview camp closely resembles Camp McKinney. The ore deposits are erratic quartz veins (with some sulphide mineralization) in schistose Kobau Group cut by Oliver and Fairview granitic stocks (Mader *et al.* (1989). Among the numerous properties in the area, only the Morning Star and Stemwinder mines had significant production. In the period 1898 to 1949 inclusive these deposits yielded 0.5 tonne of gold and 5.2 tonnes of silver. It is interesting to note that although the principal veins were more than 600 metres long, underground development was carried to depths of less than 100 metres. It may be that technological advances will allow deeper exploration and additional future production from these properties.

The Dusty Mac mine was distinctive in that it was an open-pit operation on a Tertiary quartz breccia - epithermal vein system. Gold, silver and a small amount of sulphides occur in a silicified lens on a gently dipping fault zone in the Penticton Group (Church, 1973). Production for the period 1969 to 1976 amounted to 10.5 tonnes of silver, 0.6 tonne of gold and minor copper and zinc.

SILVER CAMPS

The Beaverdell camp is centred on a quartz-carbonate vein system (Figures 4 and 5B) that was a continuous producer of silver, gold, lead and zinc from 1913 to 1991. The Sally property was the principal producer prior to 1911; this was followed by the Wellington and Rob Roy from 1919 to 1925. The Highland Bell mine, an amalgamation of properties including the Bell and Highland Lass, achieved a total production from 1913 to 1990 of 1074.3 tonnes of silver, 0.519 tonne of gold, 11.6 tonnes of lead and 13.9 tonnes of zinc. The ore occurs in veins and fractures in altered granodiorites and granites of the West Kettle batholith near the contact with the Permo-Carboniferous Anarchist Group.

The Horn Silver (Utica) mine is known for significant silver and minor gold, lead and zinc production (like the mines in the Beaverdell area). The principal deposit is a faulted, gently dipping, sulphide-bearing quartz-carbonate vein system. The hostrock is an altered phase of the Kruger syenite that is a border facies of the Middle Jurassic Similkameen batholith. Production from this mine for the period 1915 to 1968 was 127.2 tonnes of silver, 0.3 tonne of gold, 0.3 tonne of lead and 0.4 tonne of zinc.

COPPER CAMPS

The Copper Mountain camp is a prime copper, gold and silver producer. The Copper Mountain (Similco) and Ingerbelle mines account for most of the production from 33 localities in the area for which there are records of copper shipments. Orebodies in the camp occur principally in Nicola volcanic rocks peripheral to the Copper Mountain stock. The orebodies are skarns transitional to porphyry types, developed both by underground and open pit mining methods. Localization and concentration of sulphides is largely controlled by a north-trending fracture system (Preto, 1972). Production from the Copper Mountain mine for the period 1903 to 1990 amounted to 543 382 tonnes of copper, 12.5 tonnes of gold and 230.7 tonnes of silver; production from the Ingerbelle mine for the period 1972 to 1979 is recorded as 156 628 tonnes of copper, 7.3 tonnes of gold and 29.3 tonnes of silver (MINFILE).

The Brenda mine was the most significant large-tonnage low-grade mining operation in the region. The mine is underlain by border phases of the Pennask batholith just east of a large pendant of Nicola Group rocks. The mineralization is porphyry type consisting of a reticulation of sulphide-bearing quartz-carbonate veinlets in altered quartz diorite and porphyritic granodiorite (Carr, 1968). Total production from this deposit in the period 1970 to 1990 was 2.3 tonnes of gold, 148 tonnes of silver, 276 227 tonnes of copper and 67 929 tonnes of molybdenum.

The Greenwood mining camp is a world-class copper-gold-silver producer. The Phoenix, Motherlode and Oro Denoro mines, the largest of 26 producers in the

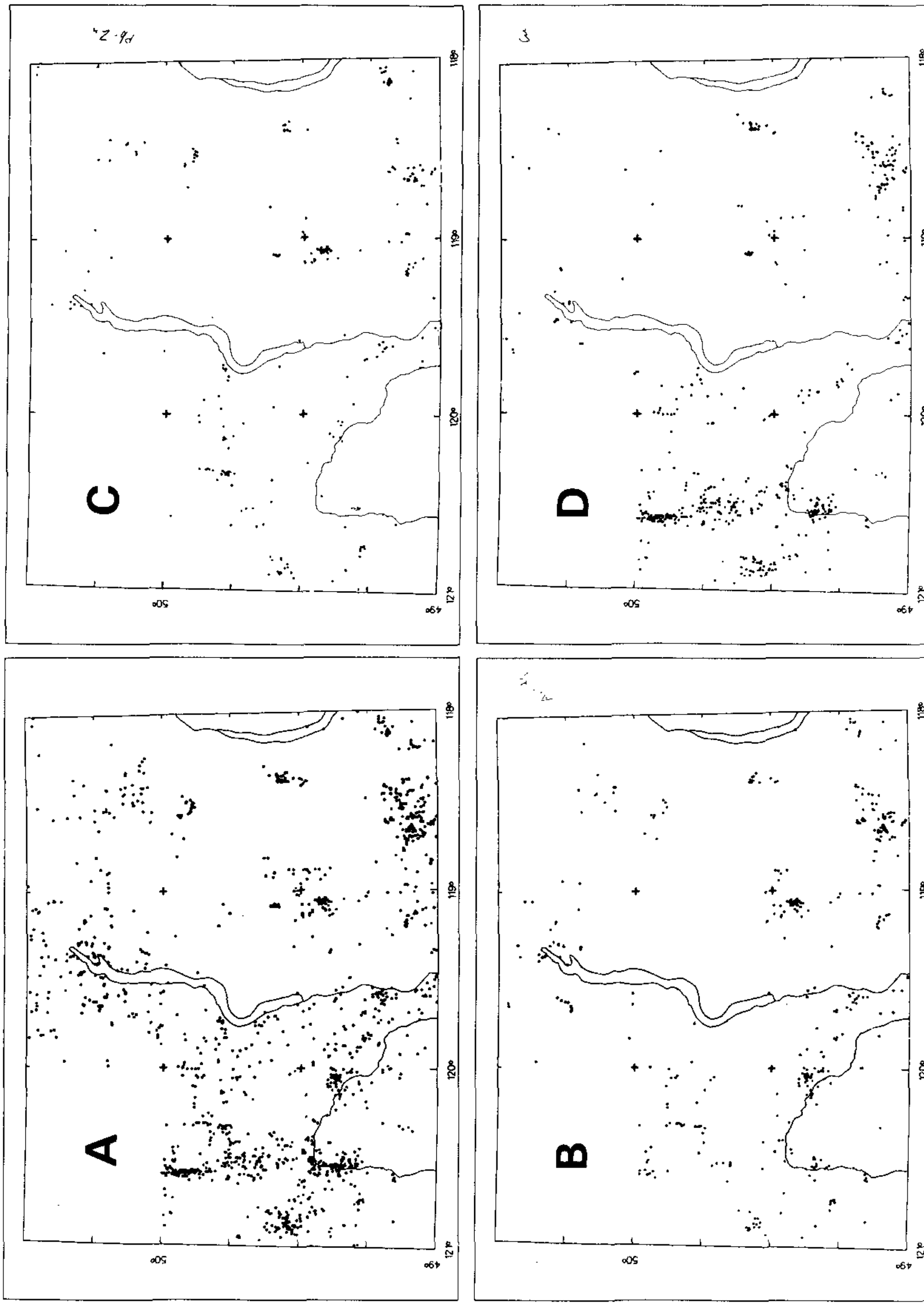

Figure 5. Distribution of mineral occurrences (A); showing gold and silver (B); lead and zinc (C) and copper (D).

area, are copper skarn deposits developed in Triassic limestone. To a lesser extent production has been derived from gold and silver-bearing quartz veins containing a minor amount of lead and zinc. Total production from the camp is 32 044 173 tonnes of ore that yielded 38.3 tonnes of gold, 283.1 tonnes of silver, 270 945 tonnes of copper, 966 tonnes of lead and 329 tonnes of zinc (Church 1986).

LEAD-ZINC (SILVER) CAMPS

The Franklin camp is comprised of about 25 mineral occurrences in Anarchist volcanic and metasedimentary rocks (Drysdale, 1915). These are principally skarn deposits related to the Nelson and Valhalla granitic plutons, veins and segregations in the multiphase Averill alkali complex and polymetallic veins related to Tertiary faulting. The Union mine is the largest producer in the area. During the period 1913 to 1946 this mine produced 1.7 tonnes of gold, 42.9 tonnes of silver, 12.7 tonnes of copper, 168.5 tonnes of lead and 299.5 tonnes of zinc.

The Lightning Peak mining camp consists of polymetallic vein systems and skarns. The area is underlain by remnants of metavolcanic and metasedimentary rocks of the Anarchist Group which have been intruded by Nelson granitic stocks (Cairnes, 1931). The area has witnessed intermittent production from 1903 to 1983. The Waterloo mine, the largest operation, has produced 2.6 kilograms of gold, 1586 kilograms of silver, 5 kilograms of copper, 14 tonnes of lead and 37 tonnes of zinc.

The Chaput mine worked a polymetallic quartz vein system in folded Nicola metasedimentary rocks near a small Cretaceous granodiorite stock. Production from this mine for the period 1968 to 1976 was 1.7 tonnes of silver, 72.2 tonnes of lead and 50.8 tonnes of zinc.

The Skookum occurrence is similar to Chaput but smaller. Polymetallic quartz veins are developed in Nicola volcanic and metasedimentary rocks. Production from this deposit for the period 1936 to 1969 amounted to 84.4 kilograms of silver, 1.2 kilograms of gold, 45 kilograms of copper and 3.15 kilograms of lead.

The Dividend-Lakeview mine is a significant polymetallic skarn deposit developed in micaceous quartzite, chlorite schist, limestone and greenstone units of the Kobau Group near the margin of the Osoyoos batholith. From 1907 to 1939 a total of 0.5 tonne of gold, 0.088 tonne of silver, 73 tonnes of copper, 71 tonnes of lead and 71 kilograms of zinc were produced (Ettlinger and Ray, 1989).

OTHER COMMODITIES

Other important mineral commodities in the region include coal, uranium, dolomite, gypsum, silica and granite.

The principal coal mines worked major deposits in the Princeton and Tulameen basins. The product was soft thermal coal from the limnic sedimentary formations of the Princeton Group. Numerous small mines in the Princeton area began production in 1910 and continued through 1961 producing 1.6 million tonnes of coal. Production from the nearby Tulameen deposit occurred intermittently between 1915 and 1957, yielding more than 2.6 million tonnes (Matheson *et al.*, *1994)*.

The Dolo claim near Rock Creek is a notable local source of dolomite. This is a pod, estimated to contain 15.4 million tonnes of fine-grained white dolomite, occurring in hornblende gneiss and schist of the Anarchist Group. Total production from this property for the period 1972 to 1988 is reported to be 60 000 tonnes (Fischl, 1992).

The Gypo silica deposit at Oliver was first explored in 1926. The deposit is a large quartz lens in a porphyritic phase of the Oliver granite. Mining operations were intermittent at first then continuous from 1953 to 1968. Initially the quartz was shipped for smelter flux. Total production to the end of 1968 is estimated to be approximately 600 000 tonnes (Foye, 1987).

The Falkland gypsum deposits occur as a series of lenses in a succession of sheared Harper Ranch tuffs and argillites. The main period of mining was from 1926 to 1956 during which time 1.125 million tonnes of gypsum was produced (Butrenchuk, 1991).

Granite has been produced at several localities in the Okanagan-Similkameen region; there was significant demand for granite throughout Brish Columbia from 1911 to 1916, and 1952 and 1966. In the Vernon area a few hundred cubic metres of granite was shipped from the Lefroy quarry (1910-1912) near Okanagan Landing on the east side of Okanagan Lake and subsequently (until 1950) from the larger Vernon Granite and Marble Works quarry a few kilometres to the south (Carr, 1955). In the Kelowna area about 50 tonnes of granite has been quarried (1972 to recent) from the Starr claims on Little White Mountain. This is the 'Pacific Pearl' grey granite from the Late Cretaceous to Early Tertiary Okanagan batholith (Z.D. Hora, personal communications, 1993). There is a new quarry on the Dobo claims located about 40 kilometres west of Summerland. Here, a few hundred tonnes of 'Pacific Rose' red granite has recently been quarried from the Middle Jurassic Osprey Lake batholith. The Beaverdell granite has yielded about 90 tonnes of pink porphyry from a Tertiary stock (located 12 kilometres south of Beaverdell on Highway 33).

Basal uranium deposits occur at Hydraulic Lake, east of Kelowna and on the Blizzard property northeast of Beaverdell - the latter being the more important occurrence. At Blizzard the uranium is found in basal conglomerate, sandstone and shale below Chilcotin basalt lava flows. Basement rocks include Nelson and Valhalla granitic rocks and some Tertiary volcanics assigned to the Penticton Group. The ore reserves are estimated to be 2.2 million tonnes grading 0.182% uranium (Canadian Mining Journal, April 1979).

CONCLUSIONS

The Okanagan-Similkameen-Bounary district is part of a broad, well mineralized region in south-central British Columbia. The district is actually a quilt of mining camps and less favourably endowed mineralized tracts. Examples of areas with high mineral potential must include the Copper Mountain and Hedley camps that are currently active and record major precious and base metal production. Areas with high to intermediate potential are underlain by some of the large granitic batholiths such as the Osprey Lake and Pennask bodies that locally feature large, low-grade metal deposits (*e.g.* the Brenda porphyry). Coal deposits in the Tulameen and Princeton basins also have important potential. These basins retain major coal reserves for future exploitation. The production of industrial minerals and building stone from the district is commonly from areas not otherwise mineralized and having low potential for metal deposits - granite quarries, for example, are mostly free of quartz veins, alteration and sulphide mineralization.

This report describes the preliminary phase in assessing the mineral potential of the district - geological compilation, tract selection and ranking. The final phase in this process will employ subjective probability methods to estimate the unknown resource in each tract by drawing upon government and industry expertise in mineral commodities and local geology. In this process the writer is cognizant that mineable reserves increase with increases in commodity prices, improved infrastructure such as access to mining sites and new technology that makes it possible to produce economically from areas that could not be mined previously. Reserves are reduced by ongoing production, decreases in commodity prices, increases in mining or transportation costs, increased availability of substitute products, increased taxation or government regulations that restrict production.

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