MINERAL RESOURCES DIVISION
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# THE INDUSTRIAL MINERAL POTENTIAL OF KYANITE AND GARNET IN BRITISH COLUMBIA

**By Jennifer Pell**

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# SUMMARY

Within British Columbia, rocks containing garnet and kyanite group minerals are mainly distributed in two linear belts, the Omineca crystalline belt and the Coast Mountain belt; however, within these areas, strata which are sufficiently pelitic to contain major concentrations of these minerals are sporadically distributed. Within the Omineca Belt, garnet and kyanite-enriched strata are found in the Nelson map area (82F), the Vernon map area (82L), the Seymour Arm area (82M), the Canoe River map area (83D) of south-central British Columbia, and in the Mesilinka area (94C) further north. Garnet and kyanite-enriched strata in the Coast Mountain belt are found in the vicinity of Hope - Yale - Harrison Lake - Lytton (92H and I) and in the Prince Rupert - Skeena - Douglas Channel area (103G, H, I, J). Garnet and andalusite are also present in the Insular Belt on southern Vancouver Island (92B, C). Strata within these areas locally contain in excess of 10 to 15 per cent kyanite group minerals and in excess of 25 per cent almandine garnet which are potentially economically interesting concentrations. The economic viability in terms of accessibility, tonnage and beneficiation potential has not been determined. Although not addressed in detail, the potential also exists for secondary placer accumulations to be present in the vicinity of hardrock showings.

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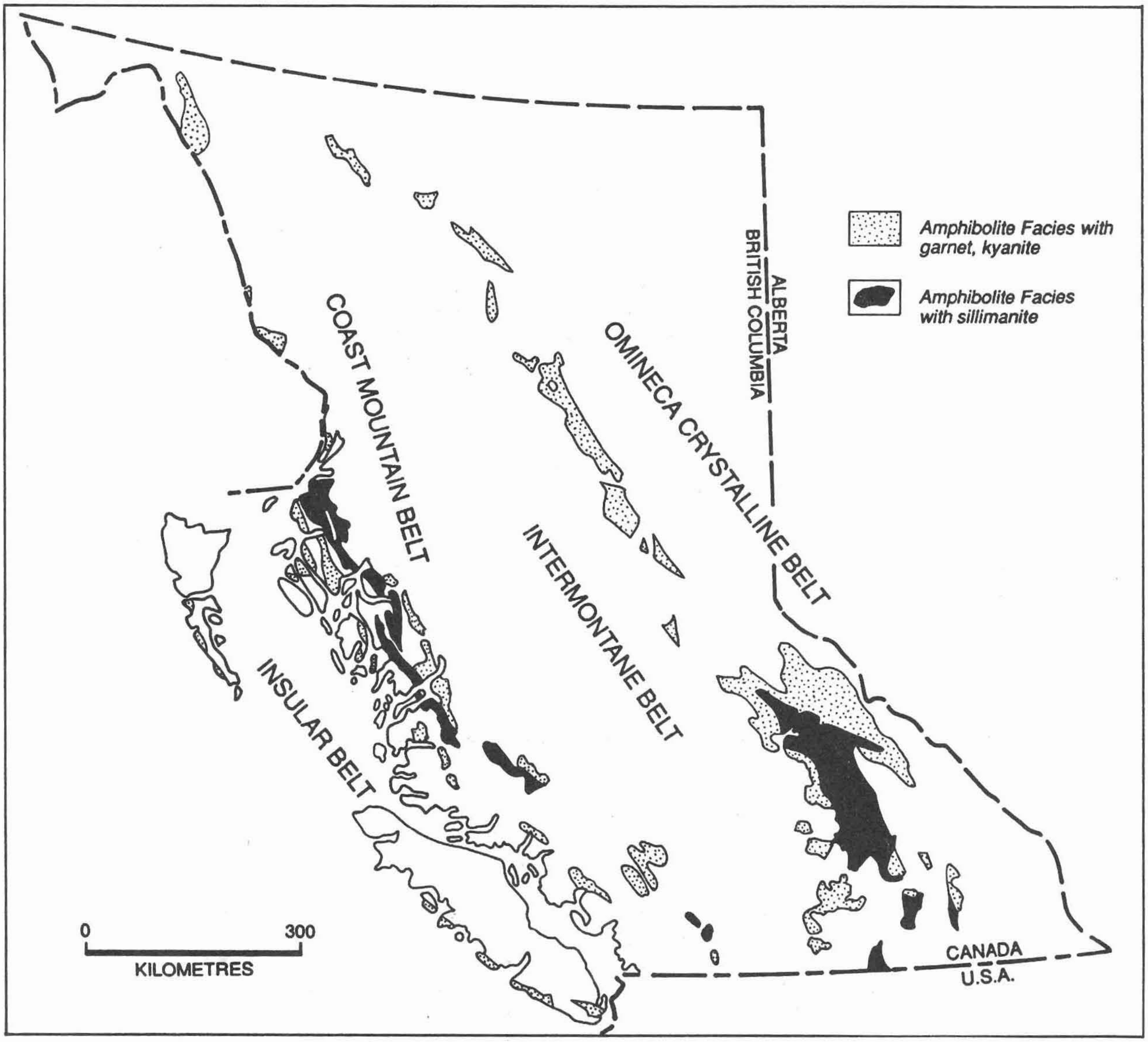


Figure 1. Distribution of amphibolite facies of classical regional metamorphism in British Columbia. From Monger and Hutchison, 1970

# INTRODUCTION

Garnet, kyanite, sillimanite and andalusite are minerals found in contact and amphibolite facies regional metamorphic rocks. In British Columbia such metamorphic rocks are confined mainly to two belts, the eastern Omineca crystalline belt and the western Coast Mountain belt (Figure 1), where they are accompanied by granitic plutons. Garnet, kyanite and the other aluminosilicate minerals which are present throughout these belts have potential industrial applications, although currently there is no production of these commodities in the province of British Columbia, or elsewhere in Canada.

Garnet is used as an abrasive; high-quality garnet, usually the variety almandine, is used in the form of powders and loose grains for grinding and lapping glass, ceramics and other materials. It is also used in coated and bonded abrasives such as sandpaper, and wheels for grinding and finishing wood, metal, rubber and plastic. Lower quality garnet is used for sandblasting aluminum and other soft metals by, among others, the aircraft industry, and for water filtration (Hight, 1983; Smoak, 1985).

Kyanite and the related minerals, sillimanite and andalusite, are prized mainly for their refractory properties. They are used directly, or calcined to form mullite, in the production of high-temperature mortars or cements and castable refractories, kiln furniture, insulating brick, firebrick and similar products. Finely ground kyanite is used in sanitary porcelains, wall tile and miscellaneous special purpose ceramics (Bennett and Castle, 1983; Potter, 1983, 1985). These refractory products are chiefly used by the metallurgical (steel) and glass industries, and secondarily, by the ceramics industry (Varley, 1968).

# GARNET - CURRENT WORLD PRODUCTION AND ECONOMIC CONSIDERATIONS

The United States is the world's leading producer and consumer of garnet, accounting for approximately 75 per cent of the world output and 70 per cent of the world consumption (Smoak, 1983, 1985). The remainder of world production is from Australia, India and the U.S.S.R.; Canada is currently not a garnet producer. In the U.S. there are four producers of garnet, which are located in New York, Maine and Idaho. In the last two areas, only low-quality garnet used for sandblasting and water filtration is produced. The sandblasting industry is increasing its use of garnet which is replacing silica sand and a smelter slag posing potential health problems. The geographic areas in which garnet occurs are widespread, however, commercially attractive industrial garnet occurrences are relatively few.

Hardrock deposits mined in the U.S. grade from 30 to 80 per cent garnet, with crystal sizes reaching in excess of 90 centimetres; however, on average grains are less than 10 centimetres in diameter. The best abrasive garnets are almandines (hardness 7.5), but pyrope, andradite and grossular, which are all softer, are also used (Smoak, 1985). The presence of incipient fractures or mineral inclusions reduces the usefulness of the garnet (Hight, 1983). As with most industrial minerals, location of deposits and transportation costs are factors of paramount importance in determining viability. Studies by the U.S. Bureau of Mines (Smoak, 1985) indicate world reserves should be adequate to supply world demand for garnet at least until the year 2000; any new deposits would therefore have to be extremely high grade, high quality and well located in order to break into the market.

## KYANITE - CURRENT WORLD PRODUCTION AND ECONOMIC CONSIDERATIONS

The United States, the Republic of South Africa and India are the leading world producers of aluminosilicate minerals (Potter, 1983). There is currently no production of sillimanite, andalusite or kyanite in Canada, although, in the past, attempts were made to recover kyanite from schists in the Timiskaming area (Bennett and Castle, 1983). The consumption of kyanite is concentrated in a relatively few highly industrialized areas, which are typically close to the major iron and steel producing regions in northern Europe, the eastern U.S., England and Japan (Bennett and Castle, 1983).

The majority of U.S. production comes from quartzites in Virginia and Georgia which contain 15 to 40 per cent kyanite. No schists are currently being mined for kyanite (Bennett and Castle, 1983); beneficiation of kyanite from schists has traditionally proved problematic, due largely to the presence of iron-rich mineral inclusions. Massive sillimanite is produced from residual deposits in India and coarse sillimanite from schists could potentially be produced; however, the beneficiation of fibrolitic sillimanite is usually impossible. Andalusite is being mined from weathered schists in France and from alluvial deposits in South Africa (Bennett and Castle, 1983).

The potential supply of kyanite group minerals from regional metamorphic terranes vastly exceeds the potential market; an important preliminary consideration in any exploration project is, therefore, the cost of delivering kyanite to the geographically limited markets. Also, grade and size of crystals must be considered; an economic kyanite deposit is one from which a -35 to -28 mesh concentrate can be produced which contains less than 2 per cent combined impurities ($Fe_2O_3$, $TiO_2$, CaO, MgO, etc.) (Bennett and Castle, 1983). As with garnet, studies indicate that an ample supply of kyanite group minerals is likely to exist at least until the year 2000 (Potter, 1985).

# GARNET AND KYANITE LOCALITIES IN BRITISH COLUMBIA

Garnet and kyanite group minerals occur mainly in two belts in the Cordillera, the Omineca crystalline belt and the Coast Mountain belt, with minor occurrences elsewhere (Figure 1). Within these belts, pelitic metasedimentary rocks containing small percentages (less than 5 per cent) of these minerals are extremely abundant. Rocks containing significant concentrations of these minerals, however, are considerably less frequently found. The scope of this study is to identify areas of potential economic grade, for example, greater than 10 to 15 per cent kyanite group minerals and greater than 25 per cent garnet; economic viability as a function of transportation costs, market, beneficiation possibilities and other factors will not be addressed.

Information regarding garnet and kyanite group mineral abundances was compiled through an extensive literature search of journals, Federal and British Columbia Government publications, Open File reports and assessment reports, and from theses and other unpublished information available from The University of British Columbia, the University of Calgary and the Geological Survey of Canada. As well, workers actively involved in the study of metamorphic terranes were interviewed, whenever possible. Maps included in this report were compiled at a scale of 1:250 000 from pre-existing regional government mapping and updated to include recent detailed studies. Ten maps (Figures 2 to 11)are included, showing the geology of areas known to contain significant accumulations of garnet and aluminosilicate minerals. A bibliography of most garnet and kyanite group mineral occurrences in the province is also included.

This report deals with potential hardrock sources of garnet and aluminosilicate minerals. Virtually no information exists in the literature regarding secondary placer concentrations of these minerals. Common sense, however, dictates that the general areas in which hardrock enrichment occurs should also have good potential for placer accumulations; knowing these regions should help in identifying areas which could be prospected for garnet and kyanite placers. Secondary deposits could be economic with considerably lower concentrations of desired mineral species; as little as a few per cent may be all that is necessary, as opposed to 10 to 15 per cent kyanite and 25 to 40 per cent garnet in hardrock sources. Such garnet-rich placers were recently reported by a prospector from the Revelstoke area.

## Southern Shuswap - Nelson Area (82F), Omineca Belt

Coarse metapelitic gneisses containing abundant sillimanite and garnet are reported from the Valhalla and Passmore dome area (Areas 1 and 2, Figure 2), west of Slocan Lake (Reesor, 1965). Valhalla and Passmore are two of a series of domal structures containing gneisses which form part of the core of the Shuswap metamorphic complex. The core of the Valhalla dome comprises orthogneisses (Map unit 1a) which are mantled by hybrid gneisses (Map unit 1B), predominantly metasedimentary in origin. Sillimanite locally comprises 20 to 25 per cent of sillimanite-garnet-biotite gneisses of the hybrid gneiss zone, particularly along the east flank of the Valhalla dome (Area 1, Figure 2) and may be very coarse. In the vicinity of the Passmore dome (Area 2, Figure 2), coarse sillimanite may occur in knots or groups of crystals over 2.5 centimetres long and 1 centimetre wide. These gneisses may also locally contain up to 30 per cent garnet, with an average crystal size of 0.5 centimetre or less. Garnet may also be present in interbedded amphibolitic rocks in amounts up to 40 per cent (Reesor, 1965).

Metamorphosed sedimentary strata, Triassic to Precambrian in age, are exposed on the east flank of the Nelson batholith. East of Ymir (Area 3, Figure 2) a narrow band of Hadrynian Three Sisters Formation strata outcrops in the core of an anticline. Kyanite schists are present in this area that contain up to 15 per cent kyanite porphyroblasts that have an average size of 2.5 by 0.5 centimetres (McAllister, 1950). On the west flank of the Bayonne batholith, west of Kootenay Lake (Area 4, Figure 2) a band of quartz-muscovite-kyanite schist forms the youngest unit of the Helikian Dutch Creek Formation (Leclair, 1983). Kyanite porphyroblasts, up to 5 centimetres long are common in this area (Leclair, 1982). Garnets up to 2 centimetres in diameter are also common in the various pelitic units, flanking the Bayonne batholith (Leclair, 1982).

Coarse-grained kyanite has been reported from the Creston area (McCammon, 1965) in Helikian Purcell Supergroup micaceous quartzites and mica schists with minor pegmatite (Area 5, Figure 2). Kyanite forms clean, bladed crystals in clumps 15 to 20 centimetres in diameter associated with the pegmatites, which occur as irregular masses 0.3 by 1.0 metre to 2 by 10 metres in size. Kyanite is also disseminated throughout the schists and micaceous quartzites, where crystals vary from small needles to 1 by 5 centimetres in size (McCammon, 1964).

Shuswap Lake - Vernon - Okanagan Area (82L), Omineca Belt

In the Vernon map area, metamorphic rocks crop out in the Shuswap, Monashee and Okanagan complexes (Okulitch, 1980). Monashee Complex rocks are exposed in the Thor Odin dome and separated from other strata largely by faults. The Thor Odin dome consists of a core zone comprised of migmatized biotite-quartz-feldspar gneisses, granodiorite gneisses, some aluminosilicate-rich schists and amphibolite. Most core gneisses contain some sillimanite; rare occurrences of kyanite, andalusite and corundum are also reported (Reesor and Moore, 1971). In the southwestern part of the core zone (Area 1, Figure 3) a distinctive mafic, aluminosilicate-rich schist is exposed. The schist is characterized by coarse porphyroblastic garnets, up to 3 centimetres in diameter, and/or very coarse sillimanite aggregates, up to 10 centimetres long (Reesor and Moore, 1971). Sillimanite in these schists can comprise up to at least 15 per cent of the rock and is commonly rimmed by cordierite and corundum. These mafic schist layers are relatively thin, generally in the order of a few metres, but may be traced for nearly 2 kilometres along strike (Reesor and Moore, 1971).

Overlying the core gneisses of the Thor Odin dome is an autochthonous mantling succession which consists of paragneiss, schist, quartzite, marble, calc-silicate schist and amphibolite. In the Mount Odin - Mount Symonds - Mount Fosthall area (Area 2, Figure 3) paragneisses and schists are present which contain abundant coarse garnet and prismatic sillimanite. Typical exposures occur along the southern branch of Ledge Creek. These gneisses and schists may contain up to 15 per cent sillimanite which is present in the form of prismatic crystals up to 10 centimetres long, and abundant garnet porphyroblasts, up to 2.5 centimetres in size (Abraham, 1967; Reesor and Moore, 1971). In the same area, coarse garnet 1 to 2 centimetres in size may comprise up to 30 per cent of some amphibolite layers, but is more commonly present in quantities of 10 per cent or less (Reesor and Moore, 1971). Elsewhere within the Monashee Complex, schists are reported to contain garnets as large as 12 to 13 centimetres in diameter (Jones, 1959). The mantling gneiss succession is continuous to the north with mantling gneisses of the Frenchman Cap area (see below). Near Victor Lake, along the Trans-Canada Highway (Area 3, Figure 3) pelitic schists in the mantling succession locally contain abundant prismatic sillimanite (around 10 per cent), kyanite and garnet (Hill, 1975). North of Clanwilliam, pegmatites in these schists are reported to contain andalusite crystals as large as 4 by 3 centimetres in size. In this area, quartz veins containing bright blue kyanite blades, up to 6 centimetres long, are also common (Hill, 1975).

Shuswap Complex rocks in the Vernon map area consist mainly of metasedimentary strata of uncertain affiliation. In the Queest Mountain area, east of Shuswap Lake (Area 4, Figure 3), kyanite prisms, 0.5 to 2.5 centimetres in length, are relatively common in schists, and sillimanite is absent (Jones, 1959). Abundant kyanite has also been reported in schists exposed north of Glanzier Creek, 7 to 8 kilometres east of Armstrong (Cairnes, 1932).

Revelstoke - Frenchman Cap - Big Bend Area (82M, N), Omineca Belt

Coarse, sillimanite and kyanite-rich schists have long been known to exist in the Revelstoke - Frenchman Cap - Big Bend area (O'Grady and Richmond, 1932; Carnochan and Rogers, 1934; Cummings, 1948; Eichelberger, 1953). Metamorphic rocks in this region belong to the Shuswap and Monashee complexes. Predominantly metasedimentary strata comprise the Shuswap Complex, and its margin is defined as the sillimanite isograd. In the north and eastern part of the area (Figure 4), Shuswap rocks are simply high metamorphic grade equivalents of Hadrynian Horsethief Creek Group strata. In the western part of the area, rocks assigned to the Shuswap Complex are of uncertain affiliation, in part they may be Horsethief Creek equivalents, in part they may be metamorphosed equivalents of younger strata.

The Big Bend (Mica Creek) - McNaughton Lake area, located approximately 100 kilometres to the north and northeast of Revelstoke, is underlain by Hadrynian Horsethief Creek Group and Lower Cambrian strata (Figure 4). In the Kinbasket Mountain - Sullivan River area (Area 1, Figure 4) schists of probable Lower Cambrian age contain up to 50 per cent garnet and locally, abundant kyanite associated with large quartz veins and pegmatites (Eichelberger, 1953). In the Trident Mountain area, 15 kilometres east-southeast of Mica Creek (Area 2, Figure 4) kyanite is extremely abundant in pelitic schists and quartz-kyanite segregation veins; kyanite often comprises in excess of 10 per cent of the rock. This area is underlain by the Lower Aluminous Pelite division of the Horsethief Creek Group (Perkins, 1983), a unit which commonly contains abundant aluminosilicate minerals.

The Monashee Complex contains orthogneisses and paragneisses which are exposed in the Frenchman Cap dome (Figure 4). Frenchman Cap is one of a series of domal structures, and, together with the Thor Odin, Valhalla and Pinnacles domes, comprises the core zone of the Omineca crystalline belt. Aphebian orthogneisses (Brown, 1980) predominate in the lowest part of the Monashee Complex and are exposed in the core of the Frenchman Cap dome. These are overlain by an autochthonous cover or mantling succession of clastic and carbonate rocks.

Locally, kyanite may constitute 20 per cent of micaceous schists within the mantling succession, and individual crystals may be over 3 centimetres in length (T. Høy, personal communication, 1987). North of Kirbyville Creek, on the north flank of Frenchman Cap dome (Area 3, Figure 4) pelitic horizons contain abundant, coarse kyanite, some sillimanite and locally, up to 30 per cent garnet. A distinctive amphibolite layer in the same area is reported to contain garnets ranging from 2 to 20 centimetres in size and randomly oriented clusters of kyanite (Scammell, 1985). Kyanite has also been noted (Wheeler, 1965) in schists and gneisses south of Ratchford Creek and west of the headwaters of Perry River (Area 4, Figure 4). In that area, kyanite occurs as crystals from 1 to 2 centimetres in length. Sillimanite is also present in some strata; fibrolite intergrown with biotite may comprise in excess of 10 per cent of the rock. In the Death Rapids - Priest Rapids area, along the west side of the Columbia River approximately 60 kilometres north of Revelstoke (Area 5, Figure 4), kyanite is abundant in quartz veins and pegmatites (O'Grady and Richmond, 1932; Carnochan and Rogers, 1934; Cummings, 1948). Along the southern flank of Frenchman Cap dome, near Eagle Pass Mountain (Area 6, Figure 4), andalusite-sericite schists have recently been found. These schists contain 30 per cent andalusite and some kyanite (up to 8 per cent) in a matrix of predominantly sericite and quartz (C.D.S. Bates, personal communication, 1987 to Z.D. Hora).

### Canoe River - Valemont - Mica Creek Area (83D), Omineca Belt

The Canoe River map area (Figure 5) is predominantly underlain by a sequence of Hadrynian metasedimentary strata, belonging to the Windermere Supergroup (Miette, Horsethief Creek and Kaza groups) and their basement gneisses. Horsethief Creek Group strata in the Canoe River area are locally sufficiently pelitic to produce abundant garnet and aluminosilicate minerals when subjected to high-grade regional metamorphism. In the Cariboo Mountains, north of Azure Lake (Area 1, Figure 5), strata which most likely correlate with the Horsethief Creek Group contain abundant pelitic layers. These pelites locally contain 2 to 15 per cent garnet, 0 to 15 per cent coarse kyanite porphyroblasts and traces to 15 per cent sillimanite, predominantly in the form of fibrolite (Pigage, 1978). In the southeastern Cariboo Mountains, approximately 30 kilometres southwest of Valemont (Area 2 and Area 3, Figure 5), pelitic schists locally contain up to 20 per cent kyanite, up to 15 per cent fibrolitic sillimanite and up to 25 per cent garnet (Pell, 1984). Kyanite grains are commonly in excess of 2 centimetres in length. These extremely aluminous pelitic strata are largely confined to the lower Kaza Group (=Horsethief Creek Group Upper Clastic division, Map Unit 2a), overlying the Horsethief Creek Group Middle Marble division (Map Unit 2b), and underlying a carbonate marker horizon in the lower Kaza Group. Less commonly, aluminous pelitic horizons are present in the Horsethief Creek Group Semipelite-Amphibolite division (Map Unit 2c), immediately underlying the Middle Marble division. Pelitic schists in this region also frequently contain quartz-kyanite-rich segregation lenses.

In the northern Monashee Mountains, approximately 30 kilometres southeast of Valemont, near the headwaters of Howard Creek (Area 4, Figure 5), schists in the Horsethief Creek Group Semipelite-Amphibolite division contain 20 to 25 per cent coarse garnets which range in size from 2 to 6 centimetres in diameter. Kyanite is also present, but not abundant at this locality. Abundant coarse kyanite has been noted in the vicinity of Albreda, on the main line of the Canadian National Railway, approximately 25 kilometres south of Valemont (Cummings, 1948). Elsewhere in the Monashee and Selkirk mountains, the Aluminous Pelite division (Map Unit 2D) of the Horsethief Creek Group crops out. As its name suggests, this unit is characterized by pelites which are aluminous in composition and therefore produce abundant kyanite porphyroblasts and/or sillimanite when subjected to appropriate metamorphic conditions (P.S. Simony, personal communication, 1982). In the Warsaw Mountain area of the northern Selkirk Mountains (Area 5, Figure 5), kyanite is present in localized pelitic horizons near the base of the Semipelite-Amphibolite division (Mitchell, 1976). Kyanite porphyroblasts in these horizons are up to 5 centimetres in length.

### Aiken Lake - Mesilinka River Area (94C), Omineca and Rocky Mountain Belts

Sedimentary and metasedimentary rocks of Hadrynian age, which belong to the Ingenika and Misinchinka groups, underlie much of the Aiken Lake - Mesilinka River area (Roots, 1954; Gabrielse, 1975). Ingenika

Group strata crop out west of the Rocky Mountain Trench (FIgure 6) and include amphibolite facies rocks which were previously assigned to the Tenakihi Group (Roots, 1954) and migmatites of the Wolverine Complex. Misinchinka Group strata are exposed in the Rocky Mountains (Gabrielse, 1975). Pelites, sandstones, quartzites, marbles and amphibolites are present in both groups. The correlation between the Misinchinka and Ingenika strata has not been established (Gabrielse, 1975).

In the Tenakihi Range, near Jim May Creek (Area 1, Figure 6) Ingenika Group rocks (previously assigned to the Tenakihi Group) which are exposed in an anticlinorium, locally contain abundant garnet and kyanite. Garnets are by far the most common porphyroblasts developed. Approximately 2000 metres above the lowest exposed strata, favourable beds, up to 3 metres thick, are reported to contain garnets comprising as much as 50 per cent of the rock volume (Roots, 1954). The garnets may be up to 2.5 centimetres in size, but are more commonly 1 to 3 millimetres in diameter. A few hundred metres stratigraphically above the garnet-rich strata, pelitic layers locally contain approximately 10 per cent kyanite in crystals which are up to 7.5 centimetres in length (Roots, 1954). Minor amounts of sillimanite are present in the lowest stratigraphic units exposed in the Jim May Creek area.

Ingenika Group rocks, exposed near the west side of Williston Lake, north of Ole Creek (Area 2, Figure 6), include micaceous strata in which abundant porphyroblasts of kyanite, more than 2 centimetres long are present (Gabrielse, 1975). Metamorphosed Misinchinka Group rocks are exposed in the Deserters Range, east of the Rocky Mountain Trench. North of Chowika Creek (Area 3, Figure 6) peljtic strata in the kyanite zone contain abundant garnets, 5 to 8 millimetres in diameter, and locally, coarse blades of kyanite (Evenchick, 1985).

Hope - Yale - Harrison Lake - Lytton Area (92H, I), Coast Mountain Belt

Pelitic schists and gneisses crop out in a number of localities in the Hope - Yale - Harrison Lake - Lytton area of southwestern British Columbia, marginal to the Scuzzy, Spuzzum and Chilliwack plutons (Figure 7 and 8). Locally, the schists and gneisses contain abundant kyanite, sillimanite, andalusite and garnet. Two regional-scale map units may be defined, the first comprising predominantly gneisses, variably assigned to the Chilliwack Group, Breakenridge Formation, and the Custer and Skagit gneiss units. The second division consists of schists, amphibolites and phyllites of the Settler Schist and Cairn Needle formations.

In the Kwoiek Needle - Nahatlatch River area (Figure 7), south of Lytton, sillimanite, kyanite, garnet and andalusite are present in phyllites and schists which occur as roof pendants or screens in the Coast Range batholith (Duffell and McTaggart, 1952; Hollister, 1969a, 1969b). The schists may be equivalents of the Settler Schist, exposed to the south. The garnet and aluminosilicate minerals are clearly products of contact metamorphism related to the emplacement of the Coast Range plutons and isograds marking the first appearance of the various aluminosilicate polymorphs can locally be mapped around intrusions (Hollister, 1969a, 1969b). Garnets average 1 millimetre in diameter and commonly comprise up to 15 per cent of the rock (Hollister, 1969a). Aluminosilicate polymorphs commonly are 2 centimetres long and comprise 6 to 7 per cent of the rock (Hollister, 1969a); however, andalusite crystals up to 5 centimetres long are so crowded in certain layers as to form most of the rock (Duffell and McTaggart, 1952). Locally, the aluminosilicates are completely altered to muscovite.

Pelitic gneisses and schists of the Breakenridge and Cairn Needle formations of Upper Paleozoic and Mesozoic age crop out in the Harrison Lake area (Area 1, Figure 8). Locally, gneisses of the Breakenridge Formation are extremely pelitic and may contain up to 50 per cent garnet (average approximately 20 per cent) and up to 40 per cent coarse-grained kyanite (average approximately 15 per cent) (Reamsbottom, 1971, 1974). Schists of the Cairn Needle Formation are also locally pelitic, containing from 4 to 50 per cent garnet, with averages of approximately 10 to 15 per cent, minor kyanite or andalusite and from 0 to 35 per cent sillimanite (Reamsbottom, 1971, 1974).

The Settler Schist, of uncertain age, outcrops in the area between Hope, Yale and Harrison Lake. North of Cogburn Creek (Area 2, Figure 8) it contains up to 23 per cent kyanite porphyroblasts, which may reach 1.5 centimetres in length, and a few per cent of coarse sillimanite in prisms in excess of 4 centimetres long (Lowes, 1972). North of Yale Creek (Area 3, Figure 8) pelitic units within the Settler Schist contain up to 15 per cent sillimanite, up to 11 per cent garnet and a few per cent of kyanite (Bartholomew, 1979). North of Emory Creek (Area 4, Figure 8) streaky pelitic layers within a dominantly quartzo-feldspathic unit contain up to 12 per cent kyanite, 10 per cent sillimanite and 12 per cent garnet (Pigage, 1973). Streaky amphibolites in this area may contain up to 30 per cent garnet (Pigage, 1973). Coarse sillimanite prisms, over 5 centimetres in length, are developed in pelitic schists on Zofka Ridge adjacent to a plutonic contact (Area 5, Figure 8). Within these schists, sillimanite may comprise 14 to 15 per cent of the rock, with garnet accounting for another 22 to 25 per cent (Lowes, 1972). Pelitic gneisses exposed in the Fraser River valley between Hope and Yale (Area 6, Figure 8) may contain from 3 to 25 per cent almandine, 0 to 8 per cent kyanite and 0 to 10 per cent sillimanite (Read, 1960).

Near the International Border, lithologies assigned to the Skagit Gneisses crop out adjacent to the Chilliwack batholith (Areas 7 and 8, Figure8). Garnet and fibrolitic sillimanite are present in biotite gneisses near the summit of Mount Holden (Area 7, Figure 8). The garnets are fairly large (0.5 centimetre), and visibly zoned (Haugerud, 1985). A metre-thick layer of rusty weathering aluminous gneiss crops out on both limbs of a large fold on Mount Daly (Area 8, Figure 8). It contains abundant elongate grey porphyroblasts which are composed of aggregates of sillimanite needles. Small relict kyanite grains are also present (Haugerud, 1985).

### Prince Rupert - Skeena River - Douglas Channel Area (103H, I, J), Coast Mountain Belt

Pelitic schists and gneisses of uncertain age and affiliation occur in abundance as inliers and adjacent to granitic plutons in the Prince Rupert - Skeena River - Douglas Channel - Hecate Strait area of northwestern British Columbia (Figures 9 and 10). The Central Gneiss Complex of the Prince Rupert - Skeena map area contains layers of biotite-garnet-sillimanite-muscovite gneisses (Area 1, Unit 1A, Figure 9) 30 to 300 metres thick in the area south of Mount Ponder and southeast of Redcap Mountain, the area northeast of Kwinamass Peak and north of the headwaters of the Kateen River (Hutchison, 1982). Within this zone sillimanite forms up to 50 per cent of the rock and garnets up to 0.75 centimetre in diameter form an additional 15 to 20 per cent (Hutchison, 1982).

On Highway 16, 1 kilometre east of Kwinitsa, excellent exposures of garnet-sillimanite-biotite-quartz-feldspar gneisses contain 5 to 30 per cent garnet and 5 to 30 per cent sillimanite; the sillimanite generally is present in densely felted layers from 0.2 to 2.5 centimetres thick (Hutchison, 1982). Similar gneisses outcrop along the north and south shores of Khtada Lake, on the ridge top 3 kilometres south of the south end of Khtada Lake, and on the ridge north of Khtada Lake (Hutchison, 1982), apparently forming a continuous zone (Area 2, in Unit 1B, Figure 9).

On Tsimpsean Peninsula, micaceous pelitic schists outcropping along the shores of Tuck Inlet (Area 3, in Unit 2, Figure 9) and near Port Simpson may contain up to 43 per cent garnet porphyroblasts and minor kyanite. On the shores of Tuck Inlet (Area 3, Figure 9) garnet porphyroblasts are up to 5 centimetres in diameter (Hutchison, 1982). A zone of highly aluminous carbonaceous schists outcrops at the north end of Tsimpsean Peninsula (Area 4, in Unit 1d, Figure 9). These schists contain abundant kyanite porphyroblasts which are up to 3 centimetres in length (Snyder, 1980). Numerous other garnet and sillimanite localities are present in the Prince Rupert - Skeena area (Figure 9).

In the Douglas Channel - Kitkiata Inlet area, south of Prince Rupert, extremely garnetiferous schists and gneisses (Area 1, Units 1 and 2, Figure 10) have been reported (Padgham, 1958). Euhedral garnets 0.25 to 2 centimetres in diameter locally comprise from 10 to 50 per cent of the rocks; biotite-garnet schists from the shores of Douglas Channel often contain 50 per cent garnets (Padgham, 1958).

On Hawksbury Island, south of Prince Rupert, kyanite-staurolite-almandine schists are exposed (Area 2, in Unit 2A, Figure 10) which contain up to 20 per cent almandine garnet and up to 20 per cent kyanite (Money, 1959). The garnet is present as subhedral to euhedral grains up to 5 centimetres in diameter or as anhedral to rounded aggregates, 7.5 centimetres in size. Kyanite may be extremely coarse; blades reach 20 by 1 centimetres in size (Money, 1959). The individual kyanite-staurolite-almandine schist units vary from a metre to over 30 metres in thickness and are traceable along strike for up to 2 kilometres (Money, 1959). Sillimanite is reported from only one locality on Hawksbury Island (near Fishtrap Bay, Figure 10), where it is present as rounded knots in gneiss and comprises up to 15 per cent of the rock (Money, 1959).

Garnet and sillimanite occur in a number of other localities in the Douglas Channel - Hecate Strait area (Figure 10; Roddick, 1970). In particular, east of Kiltuish Inlet and Kiltuish River (Area 3, in Unit 2, Figure 10) schists contain abundant garnet and, commonly, sillimanite (Roddick, 1970). On the west coast of Banks Island, south of Grief Point, garnet-biotite-quartz schists crop out (Area 4, in Unit 2B, Figure 10). Some of the garnets in these schists reach up to 2.5 centimetres in length, and are strongly flattened parallel to schistosity (Roddick, 1970). In the Atan Peak area (Area 5, in Unit 2A, Figure 10) andalusite is present in quartz-biotite schists adjacent to intrusive rocks. Locally, the andalusite forms porphyroblasts up to 10 centimetres in length and comprises a major constituent of the schists (Evenchick, 1979).

Vancouver Island (92B, C), Insular Belt

Aluminosilicate-rich pelitic schists of the Leech River Unit are exposed on southern Vancouver Island, outcropping between the Leech River and San Juan faults near Port Renfrew and Langford (Figure 11). The Leech River Unit, of Triassic to Cretaceous age, is largely comprised of argillites and metagreywackes, with some metavolcanics (Muller, 1981). Metamorphic grade increases from north to south across the unit; the exposed southern one-third to one-half of the unit contains staurolite and andalusite (Figure 11). Within pelitic strata, andalusite is abundant and may be present as porphyroblasts from 12 to 20 centimetres long (Rusmore, 1982; Grove, 1984). Areas of particular note are the Sombrio River and Valentine Mountain vicinities (Figure 11). Locally, retrograde alteration results in the replacement of andalusite by chlorite and muscovite (Fairchild and Cowan, 1982). Garnet may also be present in these schists in moderate abundance (Fairchild and Cowan, 1982).

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NTS: 82F (1), 82G (4, 5)
Minerals: garnet

Eichelberger, F. (1953): Report on Kyanite Deposits, Kinbasket Lake, British Columbia, Unpublished Report for Yellow Creek Mica, Ltd.
NTS: 82N (13), 82M (16) adjacent
Minerals: kyanite

Elsby, D.C. (1985): Structure and Deformation across the Quesnellia-Omineca Terrane Boundary, Mount Perseus Area, East-central British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 178 pages.
NTS: 93A (7, 8)
Minerals: garnet

Engi, J.E. (1984): Structure and Metamorphism North of Quesnel Lake and East of Niagara Creek, Cariboo Mountains, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 137 pages.
NTS: 93A (9)
Minerals: garnet, kyanite, sillimanite

Evenchick, C.A. (1979): Stratigraphy, Structure and Metamorphism of the Atna Peak Area, British Columbia, Unpublished B.Sc. Thesis, Carleton University, 54 pages.
NTS: 103H (16)
Minerals: andalusite, garnet

_____ (1982): Stratigraphy, Structure and Metamorphism in Deserters Range, Northern Rocky Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 82-1A, pages 325-328.
NTS: 93C (15)
Minerals: kyanite, garnet

Evenchick, C.A. (1983): Stratigraphy, Structure and Metamorphism in the Sifton Ranges, Cassiar Mountains, Northern British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 83-1A, pages 221-224.
NTS: 94E (9, 15, 16)
Minerals: garnet, kyanite, sillimanite

_____ (1985): Stratigraphy, Metamorphism and their Tectonic Implications in the Sifton and Deserters Ranges, Cassiar and Northern Rocky Mountains, Northern British Columbia, Unpublished Ph.D. Thesis, Queen's University, 197 pages.
NTS: 94C (15) and 94E (16)
Minerals: andalusite, sillimanite, kyanite, garnet

Fairchild, L.H. (1979): The Leech River Unit and Leech River Fault, Southern Vancouver Island, British Columbia, Unpublished M.Sc. Thesis, University of Washington, Seattle, 170 pages.
NTS: 92B (5, 12)
Minerals: garnet, andalusite

Fairchild, L.H. and Cowan, D.S. (1982): Structure, Petrology and Tectonic History of the Leech River Complex Northwest of Victoria, Vancouver Island, British Columbia, Canadian Journal of Earth Sciences, Volume 19, pages 1817-1835.
NTS: 92B (5, 12)
Minerals: andalusite, garnet

Fletcher, C.J.N. (1972): Structure and Metamorphism of Penfold Creek Area, near Quesnel Lake, Central British Columbia, Unpublished Ph.D. Thesis, The University of British Columbia, 123 pages.
NTS: 93A (6, 7, 10, 11)
Minerals: garnet, kyanite, sillimanite

Fletcher, C.J.N. and Greenwood, H.J. (1979): Metamorphism and Structure of Penfold Creek Area, near Quesnel Lake, British Columbia, Journal of Petrology, Volume 20, pages 743-794.
NTS: 93A (6, 7, 10, 11)
Minerals: garnet, kyanite, sillimanite

Franzen, J.P. (1974): Structural Analysis in the Selkirk Fan Axis near Argonaut Mountain, Southeast British Columbia, Unpublished M.Sc. Thesis, Carleton University, 55 pages.
NTS: 82M (9, 16)
Minerals: garnet, kyanite, sillimanite

Froese, E. (1970): Chemical Petrology of some Pelitic Gneisses and Migmatites from the Thor-Odin Area, British Columbia, Canadian Journal of Earth Sciences, Volume 7, pages 164-175.
NTS: 82L
Minerals: garnet, sillimanite

Fyles, J.T. (1960): Big Bend Columbia River - Geological Reconnaissance of the Columbia River between Bluewater Creek and Mica Creek in British Columbia, Minister of Mines, B.C., Annual Report, 1959, pages 90-105.
NTS: 82M
Minerals: kyanite, garnet

_____ (1967): Geology of the Ainsworth-Kaslo Area, British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 53, 134 pages.
NTS: 82F (10, 15)
Minerals: garnet, kyanite, sillimanite

Fyles, J.T. and Hewlett, C.G. (1959): Stratigraphy and Structure of the Salmo Lead-zinc Area, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 41, 172 pages.
NTS 82F (3)
Minerals: garnet

Fyson, W.K. (1970): Structural Relations in Metamorphic Rocks, Shuswap Lake Area, British Columbia, Geological Association of Canada, Special Paper Number 6, pages 107-122.
NTS: 82L (5, 6, 7, 10, 11, 12, 13, 14, 15), 82M (2, 3, 4)
Minerals: sillimanite, garnet

Gabrielse, H. (1963): McDame Map-area, Cassiar District, British Columbia, Geological Survey of Canada, Memoir 319.
NTS: 104P
Minerals: garnet

_____ (1975): Geology of Fort Grahame E1/2 Map-area, British Columbia, Geological Survey of Canada, Paper 75-33, 8 pages.
NTS: 94C (E1/2)
Minerals: garnet, kyanite

Gabrielse, H. and Dodds, C.J. (1982): Faulting and Plutonism in Northwestern Cry Lake and Adjacent Map-areas, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 82-1A, pages 321-323.
NTS: 104I, 104P, 104O, 104J
Minerals: garnet

Gabrielse, H., Dodds, C.J. and Mansy, J.L. (1977): Operation Finlay, British Columbia, in Report of Activities, Part A, Geological Survey of Canada, Paper 77-1A, pages 243-246.
NTS: 94E, 94F (W1/2), 94L
Minerals: garnet, kyanite

Gabrielse, H. and Mansy, J.L. (1980): Structural Style in Northeastern Cry Lake Map-area, North-central British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, pages 33-35.
NTS: 104I (9, 16), 104L (12)
Minerals: andalusite

Getsinger, J.S. (1982): Metamorphism and Structure of Three Ladies Mountain Area, Cariboo Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 82-1A, pages 317-220.
NTS: 93A (10, 11, 14, 15)
Minerals: garnet, kyanite, sill

_____ (1985): Geology of the Three Ladies Mountain, Mount Stevenson Area, Quesnel Highland, British Columbia, Unpublished Ph.D. Thesis, The University of British Columbia, 239 pages.
NTS: 93A (10, 11, 14, 15)
Minerals: garnet, kyanite, sillimanite

Ghent, E.D. (1975): Temperature, Pressure and Mixed-volatile Equilibria attending Metamorphism of Staurolite-kyanite-bearing Assemblages, Esplanade Range, British Columbia, Geological Society of America, Bulletin 1986, pages 1654-1660.
NTS: 82N (12)
Minerals: garnet, kyanite

Ghent, E.D., Knitter, C.C., Raeside, R.P. and Stout, M.Z. (1982): Geothermometry and Geochemistry of Pelitic Rocks, Upper Kyanite and Sillimanite Zones, Mica Creek Area, British Columbia, Canadian Mineralogist, Volume 20, pages 295-305.
NTS: 83D (1, 2), 82M (15, 16)
Minerals: garnet, sillimanite, kyanite

Ghent, E.D., Robbins, D.B. and Stout, M.Z. (1979): Geothermometry, Geobarometry and Fluid Compositions of Metamorphosed Calc-silicates and Pelites, Mica Creek, British Columbia, American Mineralogist, Volume 64, pages 874-885.
NTS: 83D
Minerals: garnet, kyanite

Ghent, E.D., Simony, P.S. and Knitter, C.C. (1980): Geometry and Pressure-temperature Significance of the Kyanite-sillimanite Isograd in the Mica Creek Area, British Columbia, Contributions to Mineralogy and Petrology, Volume 74, pages 67-73.
NTS: 83D (2), 82M (15)
Minerals: kyanite, sillimanite

Ghent, E.D., Simony, P.S., Mitchell, P. J., Robbins, D. and Wagner, J. (1977): Structure and Metamorphism in Southeast Canoe River, British Columbia, Geological Survey of Canada, Paper 77-1C, pages 13-17.
NTS: 83D (1, 2, 7)
Minerals: garnet, sillimanite, kyanite

Ghent, E.D., Stout, M.Z. and Raeside, R.P. (1983): Plagioclase-clinopyroxene-garnet-quartz Equilibria and the Geobarometry and Geothermometry of Garnet Amphibolites from Mica Creek, British Columbia, Canadian Journal of Earth Sciences, Volume 20, pages 699-706.
NTS: 82M (15), 83D (2)
Minerals: garnet, kyanite, sillimanite

Glover, J.K. (1978): Geology of the Summit Creek Map-area, Southern Kootenay Arc, British Columbia, Unpublished Ph.D. Thesis, Queen's University, 144 pages.
NTS: 82F (2)
Minerals: garnet, kyanite, sillimanite, andalusite

Grove, E.W. (1955): A Study of Contact Metamorphism at Harrison Ridge, Harrison Hotsprings, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 100 pages.
NTS: 92H (4, 5)
Minerals: garnet, andalusite

_____ (1965): Observatory Inlet, Granby Bay Area, British Columbia, Minister of Mines, B.C., Annual Report, 1964, pages 57-58.
NTS: 103P (5)
Minerals: andalusite

_____ (1984): Geological Report on the Valentine Mountain Property, British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Assessment Report 12642.
NTS: 92B (12W)
Minerals: andalusite, garnet

Gunning, H.C. (1929): Geology and Mineral Deposits of Big Bend Map-area, British Columbia, Geological Survey of Canada, Summary Report, 1928, pages 136-190.
NTS: 82M (8)
Minerals: andalusite, garnet

Halwas, D.B. and Simony, P.S. (1986): The Castlegar Gneiss Complex, Southern British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 86-1A, pages 583-587.
NTS: 82F (4, 5)
Minerals: garnet, sillimanite

Haugerud, R.A. (1985): Geology of the Hozameen Group and the Ross Lake Shear Zone, Maselpanik Area, North Cascades, Southwest British Columbia, Unpublished Ph.D. Thesis, University of Washington, Seattle, 268 pages.
NTS: 92H (3)
Minerals: garnet, kyanite, sillimanite

Hedley, M.S. (1952): Geology and Ore Deposits of the Sandon Area, Slocan Mining Camp, British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 29, 130 pages.
NTS: 82F (14) and into 82K (3)
Minerals: garnet

Hedley, M.S. and Holland, S.S. (1941): Reconnaissance in the Area of Turnagain and Upper Kechika Rivers, Northern British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 12, 52 pages.
NTS: 94L and 104I
Minerals: garnet

Hill, R.P. (1975): Structural and Petrological Studies in the Shuswap Metamorphic Complex near Revelstoke, British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 147 pages.
NTS: 82L (16), 82M (1)
Minerals: garnet, kyanite, sillimanite, andalusite

Hoadley, J.W. (1953): Geology and Mineral Deposits of the Nimpkish Area, Vancouver Island, British Columbia, Geological Survey of Canada, Memoir 272, 82 pages.
NTS: 92E (15), 92L (2, 7)
Minerals: garnet (skarn)

Hollister, L.S. (1969a): Contact Metamorphism in the Kwoiek Area of British Columbia; An End Member of the Metamorphic Process, Geological Society of America, Bulletin 80, pages 2465-2494.
NTS: 92I
Minerals: garnet, andalusite, sillimanite, kyanite

_____ (1969b): Metastable Paragenetic Sequence of Andalusite, Kyanite, and Sillimanite, Kwoiek Area, British Columbia, American Journal of Science, Volume 267, pages 352-370.
NTS: 92I (4)
Minerals: garnet, andalusite, kyanite, sillimanite

Høy, T. (1974): Structure and Metamorphism of Kootenay Arc Rocks around Riondel, British Columbia, Unpublished Ph.D. Thesis, Queen's University, 201 pages.
NTS 82F (15)
Minerals: garnet, sillimanite

_____ (1980): Geology of the Riondel Area, Central Kootenay Arc, Southeastern British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 73, 89 pages.
NTS: 82F (10, 15)
Minerals: garnet, kyanite, sillimanite

Hutchison, W.W. (1967): Prince Rupert and Skeena Map-area, British Columbia, Geological Survey of Canada, Paper 66-33, 27 pages and Map 12-1966.
NTS: 103I (W1/2) and 103E (E1/2)
Minerals: garnet, sillimanite

_____ (1970): Metamorphic Framework and Plutonic Styles in the Prince Rupert Region of the Central Coast Mountains, British Columbia, Canadian Journal of Earth Sciences, Volume 7, pages 376-405.
NTS: 103I
Minerals: kyanite, sillimanite

_____ (1982): The Geology of the Prince Rupert-Skeena Map-area, British Columbia, Geological Survey of Canada, Memoir 394, 116 pages.
NTS: 103I (W1/2) and 103J (E1/2)
Minerals: garnet, sillimanite, kyanite, andalusite

Hyndman, D.W. (1965): Petrology and Structure of the Nakusp Map-area, British Columbia, Geological Survey of Canada, Bulletin 161, 95 pages, including Map 1234A.
NTS: 82K (4), 82F (13)
Minerals: garnet, sillimanite, kyanite

Jones, A.G. (1959): Vernon Map-area, British Columbia, Geological Survey of Canada, Memoir 296, 186 pages.
NTS: 82L
Minerals: sillimanite, garnet, kyanite

Jones, J.W. (1969): Low-grade Metamorphism of Proterozoic Rocks from the Esplanade Range, British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 112 pages.
NTS: 82N (11, 12)
Minerals: garnet

_____ (1972a): A study of some Low-grade Regional Metamorphic Rocks from the Omineca Crystalline Belt, British Columbia, Unpublished Ph.D. Thesis, University of Calgary, 127 pages.
NTS: 82N (11, 12)
Minerals: garnet

_____ (1972b): An Almandine Garnet Isograd in the Rogers Pass Area, British Columbia: The Nature of the Reaction and an Estimation of the Physical Conditions during its Formation, Contributions to Mineralogy and Petrology, Volume 37, pages 291-306.
NTS: 82N (5)
Minerals: garnet

Journeay, J.M. (1986): Stratigraphy, Internal Strain and Thermo-tectonic Evolution of Northern Frenchman Cap Dome: An Exhumed Duplex Structure, Omineca Hinterland, Southeast Canadian Cordillera, British Columbia, Unpublished Ph.D. Thesis, Queen's University, 399 pages.
NTS: 82M (7)
Minerals: garnet, kyanite, sillimanite, andalusite

Journeay, J.M. and Brown, R.L. (1986): Major Tectonic Boundaries of the Omineca Belt in Southern British Columbia: A progress report, in Current Research, Part A, Geological Survey of Canada, Paper 86-1A, pages 81-88.
NTS: 82M, L
Minerals: kyanite, sillimanite

Kerr, F.A. (1948): Lower Stikine and Iskut River Areas, British Columbia, Compiled by H.C. Cooke, Geological Survey of Canada, Memoir 246, 84 pages.
NTS: 104B, 104F, 104G
Minerals: garnet, sillimanite, kyanite, andalusite

Krage, S.M. (1984): Metamorphic and Fluid Inclusion Study of Amphibolite-grade Rocks, West Scotia, British Columbia, Unpublished M.A. Thesis, Bryn Mawr College, Pennsylvania, 98 pages.
NTS: 103I (4)
Minerals: kyanite, sillimanite, garnet

Lane, L.S. (1977): Structure and Stratigraphy, Goldstream River-Downie Creek Area, Selkirk Mountains, British Columbia, Unpublished M.Sc. Thesis, Carleton University, 140 pages.
NTS: 82M (1, 8)
Minerals: garnet

_____ (1984): Deformation History of the Monashee Decollement and the Columbia River Fault Zone, British Columbia, Unpublished Ph.D. Thesis, Carleton University, 240 pages.
NTS: 82M (1, 8)
Minerals: garnet, andalusite, sillimanite, kyanite

Leask, G. (1984): Geology of the Carbide Carbonate Hosted Ag-Zn-Pb Deposit, Shuswap Terrane, East Central British Columbia, Unpublished B.A.Sc. Thesis, The University of British Columbia, 38 pages.
NTS: 82M (10E)
Minerals: garnet, sillimanite

Leatherbarrow, W.L. (1981): Metamorphism of Pelitic Rocks from the Northern Selkirk Mountains, Southeastern British Columbia, Unpublished Ph.D. Thesis, Carleton University, 218 pages.
NTS: 82M (9, 16), 83D (1)
Minerals: garnet, kyanite, sillimanite

Leatherbarrow, R.W. and Brown, R.L. (1978): Metamorphism of the Northern Selkirk Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 78-1A, pages 81-82.
NTS: 82M (9, 16)
Minerals: garnet, kyanite, sillimanite

Leclair, A.D. (1982): Preliminary Results on the Stratigraphy, Structure and Metamorphism of Central Kootenay Arc Rocks, Southeastern British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 82-1A, pages 45-49.
NTS: 82F (7. 10)
Minerals: garnet, kyanite, sillimanite

_____ (1983): Stratigraphy and Structural Implications of Central Kootenay Arc Rocks, Southeastern British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 83-1A, pages 235-240.
NTS: 82F (7, 10)
Minerals: kyanite

Van der Leeden, J. (1976): Stratigraphy, Structure and Metamorphism in the Northern Selkirk Mountains, Southwest of Argonaut Mountain, Southeastern British Columbia, Unpublished M.Sc. Thesis, Carleton University, 129 pages.
NTS: 82M (9, 16)
Minerals: garnet, kyanite, sillimanite

Leonard, R. (1984): Metamorphism, Structure and Stratigraphy around the Mount Blackman Gneiss, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 84-1A, pages 121-127.
NTS: 83D (7, 10)
Minerals: garnet, kyanite, sillimanite

Lewis, P.D. (1987): Polyphase Deformation and Metamorphism in the Western Cariboo Mountains, near Ogden Peak, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 146 pages.
NTS: 93A (10)
Minerals: garnet, kyanite

Little, H.W. (1960): Nelson Map-area, West Half, British Columbia, Geological Survey of Canada, Memoir 308, 205 pages.
NTS: 82F W1/2
Minerals: garnet, kyanite

_____ (1982): Geology of the Rossland-Trail Map-area, British Columbia, Geological Survey of Canada, Paper 79-26, 38 pages.
NTS 82F (4)
Minerals: garnet, kyanite

Livingston, K.W. (1968): Geology of the Crawford Bay Map-area, Unpublished M.Sc. Thesis, The University of British Columbia, 87 pages.
NTS: 82F (10, 15)
Minerals: garnet, sillimanite

Lord, C.S. (1948): McConnell Creek Map-area, Cassiar District, British Columbia, Geological Survey of Canada, Memoir 251, 72 pages.
NTS: 94D E1/2 (1, 2, 7, 8, 9, 10, 15, 16)
Minerals: garnet in pegmatite

Lowes, B.E. (1967): Chilliwack Group, Harrison Lake Area, British Columbia, Geological Survey of Canada, Paper 67-1A, pages 74-75.
NTS: 92H (5)
Minerals: kyanite

_____ (1972): Metamorphic Petrology and Structural Geology of the Area East of Harrison Lake, British Columbia, Unpublished Ph.D. Thesis, University of Washington, Seattle, 161 pages.
NTS: 92H (5, 6, 11, 12)
Minerals: andalusite, kyanite, sillimanite, garnet

MacDonald, A.S. (1973): The Salmo Lead Zinc Deposits: A Study of their Deformation and Metamorphic Features, Unpublished Ph.D. Thesis, The University of British Columbia, 225 pages.
NTS: 82F (3)
Minerals: andalusite, garnet, (grossular)

Mansy, J.L. (1980): Structure of the Turnagain River Pendant in Northern Cry Lake Map-area, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, pages 351-352.
NTS: 104I (9)
Minerals: garnet

Mansy, J.L. and Dodds, C.J. (1976): Stratigraphy, Structure and Metamorphism in Northern and Central Swannell Ranges, in Report of Activities, Part A, Geological Survey of Canada, Paper 76-1A, pages 91-92.
NTS: 94E (1, 2, 7, 8)
Minerals: garnet, kyanite, sillimanite

Mathews, W.H. (1953): Geology of the Sheep Creek Camp, British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 31, 94 pages.
NTS 82F (3)
Minerals: andalusite, garnet

_____ (1981): Early Cenozoic Resetting of Potassium-argon Dates and Geothermal History, North Okanagan Area, British Columbia, Canadian Journal of Earth Sciences, Volume 18, pages 1310-1319.
NTS: 82L (7, 10, 11)
Minerals: sillimanite

McAllister, A.L. (1950): Geology of the Ymir Map-area, British Columbia, Unpublished Ph.D. Thesis, McGill University, 259 pages.
NTS: 82F (6) E1/2
Minerals: garnet, kyanite, andalusite, sillimanite

McCammon, J.W. (1964): Kyanite, Minister of Mines, B.C., Annual Report, 1963, pages 185-186.
NTS: 82F (2)
Minerals: kyanite

McDonough, M.R. (1984): Structural Evolution and Metamorphism of Basement Gneisses and Hadrynian Cover, Bulldog Creek Area, British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 162 pages.
NTS: 83D (10, 11)
Minerals: garnet, kyanite

McDonough, M.R. and Simony, P.S. (1984): Basement Gneisses and Hadrynian Metasediments near Bulldog Creek, Selwyn Range, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 84-1A, pages 99-102.
NTS: 83D (10)
Minerals: sillimanite, garnet, kyanite

McDonough, M.R. and Simony, P.S. (1986): Geology of the Northern Selwyn Range, Western Main Ranges, Rocky Mountains, British Columbia, Preliminary Report, in Current Research, Part A, Geological Survey of Canada, Paper 86-1A, pages 619-626.
NTS: 83D (10, 14, 15)
Minerals: garnet

McMillan, W.J. (1966): Geology of Vedder Mountain, near Chilliwack, British Columbia, Unpublished M.A.Sc. Thesis, The University of British Columbia, 59 pages.
NTS: 92G (1)
Minerals: garnet

_____ (1969): Petrology and Structure of the West Flank, Frenchman's Cap Dome, near Revelstoke, British Columbia, Unpublished Ph.D. Thesis, Carleton University, 150 pages.
NTS: 82M (7, 10)
Minerals: garnet, kyanite, sillimanite, andalusite

_____ (1973): Petrology and Structure of the West Flank, Frenchman's Cap Dome, near Revelstoke, British Columbia, Geological Survey of Canada, Paper 71-29, 88 pages.
NTS: 82M (7, 10)
Minerals: sillimanite, kyanite, garnet, andalusite

McMullin, D.W.A. and Greenwood, H.J. (1986): Metamorphic Pressures and Temperatures in the Barkerville and Cariboo Terranes, Quesnel Lake, British Columbia; Preliminary Results, in Current Research, Part B, Geological Survey of Canada, Paper 86-1B, pages 727-732.
NTS: 93A
Minerals: garnet, kyanite, sillimanite

McTaggart, K.C. and Thompson, R.M. (1967): Geology of part of the Northern Cascades in Southern British Columbia, Canadian Journal of Earth Sciences, Volume 4, pages 1199-1228.
NTS: 92H (3, 6, 11)
Minerals: kyanite, sillimanite

Meilliez, F. (1972): Structure of the Southern Solitude Range (Rocky Mountains), British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 113 pages.
NTS: 82N (13, 14)
Minerals: garnet

Mitchell, W.J. (1976): Structure and Stratigraphy of the Warsaw Mountain Area, British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 164 pages.
NTS: 83D (1)
Minerals: garnet, kyanite

Money, P.L. (1959): The Geology of Hawkesbury Island, Skeena Mining Division, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 159 pages.
NTS: 103H (10, 11)
Minerals: kyanite, garnet, sillimanite

Monger, J.W.H. (1970): Hope Map-area, West Half, British Columbia, Geological Survey of Canada, Paper 69-47, pages 31-37.
NTS: 92H (W 1/2)
Minerals: garnet, kyanite, sillimanite

_____ (1986): Geology between Harrison Lake and Fraser River, Hope Map-area, Southwestern British Columbia, in Current Research, Part B, Geological Survey of Canada, Paper 86-1B, pages 699-706.
NTS: 92H (5, 6, 12)
Minerals: kyanite, sillimanite

Montgomery, J.R. (1985): Structural Relations of the Southern Quesnel Lake Gneiss, Isosceles Mountain Area, Southwest Cariboo Mountains, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 96 pages.
NTS: 93A (7)
Minerals: garnet, kyanite, sillimanite

Montgomery, S.L. (1978): Structural and Metamorphic History of the Lake Dunford Map-area, Cariboo Mountains, British Columbia: Ophiolite Obduction in the Southeast Canadian Cordillera, Unpublished M.Sc. Thesis, Cornell University, Ithica, New York, 170 pages.
NTS: 93A (1)
Minerals: garnet, kyanite, sillimanite

Morrison, M.L. (1979): Structure and Petrology of the Southern Portion of the Malton Gneiss, British Columbia, in Current Research, Part B, Geological Survey of Canada, Paper 79-1B, pages 407-410.
NTS: 83D (6, 7, 10, 11)
Minerals: kyanite

Morrison, M.L. (1982): Structure and Petrology of the Malton Gneiss Complex, British Columbia, Unpublished Ph.D. Thesis, University of Calgary, 303 pages.
NTS: 83D (6, 7)
Minerals: garnet, kyanite, sillimanite

Mountjoy, E.W. and Forest, R. (1986): Revised Structural Interpretation, Selwyn Range, between Ptarmigan and Hugh Allan Creeks, British Columbia: An Antiformal Stack of Thrusts, in Current Research, Part A, Geological Survey of Canada, Paper 86-1A, pages 177-183.
NTS: 83D (9, 10, 15, 16)
Minerals: garnet

Mountjoy, E.W., Forest, R. and Leonard, R. (1985): Structure and Stratigraphy of the Miette Group, Selwyn Range, between Ptarmigan and Hugh Allan Creeks, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 85-1A, pages 485-490.
NTS: 83D (9, 10, 15, 16)
Minerals: garnet

Muller, J.E. (1975): Victoria Map-area, British Columbia, Geological Survey of Canada, Paper 75-1, Part A, pages 21-26.
NTS: 92B (W 1/2)
Minerals: garnet, andalusite

Murphy, D.C. (1984): A Note on Faulting in the Southern Rocky Mountain Trench between McBride and Canoe Reach, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 84-1A, pages 627-630.
NTS: 83D (11, 13, 14), 83E (4), 93H (1, 8)
Minerals: garnet, kyanite

_____ (1986): Stratigraphy and Structure of the East-central Cariboo Mountains, British Columbia and Implications for the Geological Evolution of the Southeastern Canadian Cordillera, Unpublished Ph.D. Thesis, Carleton University, 187 pages.
NTS: 83D (13, 14), 83E (4), 93H (1)
Minerals: garnet, kyanite

_____ (1987): Suprastructure/infrastructure Transition, East-central Cariboo Mountains, British Columbia; Geometry, Kinematics and Tectonic Implications, Journal of Structural Geology, Volume 9, Number 1, pages 13-29.
NTS: 83D (13), 83E (4), 93H (1)
Minerals: garnet, kyanite

Murphy, D.C. and Journeay, J.M. (1982): Structural Style in the Premier Range, Cariboo Mountains, Southern British Columbia: Preliminary Results, in Current Research, Part A, Geological Survey of Canada, Paper 82-1A, pages 289-292.
NTS: 83D (11, 12, 13, 14)
Minerals: garnet, kyanite

Murphy, D.C. and Rees, C.J. (1983): Structural Transition and Stratigraphy in the Cariboo Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 83-1A, pages 245-252.
NTS: 83D (13), 83E (4), 93H (1)
Minerals: garnet, kyanite

Nielson, K.C. (1978): Tectonic Setting of the Northern Okanagan Valley at Mara Lake, British Columbia, Unpublished Ph.D. Thesis, The University of British Columbia, 150 pages.
NTS: 82L NE (10, 11, 14, 15)
Minerals: garnet, sillimanite

O'Grady, B.T. (1934): Cyanite in Eastern Mineral Survey District (No. 5), British Columbia, Minister of MInes, B.C., Annual Report, 1933, page A211.
NTS: 82M
Minerals: kyanite

O'Grady, B.T. and Richmond, A.M (1932): Cyanite in Eastern Mineral Survey District, British Columbia, Minister of Mines, B.C., Annual Report, 1931, pages A148-A149.
NTS: 82M (8NW, 10SE)
Minerals: kyanite

Oke, C. (1982): Structure and Metamorphism of Precambrian Basement and its Cover in the Mount Blackman Area, British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 123 pages.
NTS: 83D (7, 10)
Minerals: garnet, kyanite

Oke, C. and Simony, P.S. (1981): Basement Gneisses of the Western Rocky Mountains, Hugh Allan Creek Area, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, pages 181-184.
NTS: 83D (7)
Minerals: garnet, kyanite

Outtrim, C.P. (1973): The Metamorphism of the Barriere Formation in the Vicinity of the Baldie Batholith, British Columbia, Unpublished B.A.Sc. Thesis, The University of British Columbia, 40 pages.
NTS: 82M (5)
Minerals: garnet-skarn, garnet-regional

Padgham, W.A. (1958): The Geology of the Ecstall-Quaal Rivers Area, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 202 pages.
NTS: 103H (11, 14)
Minerals: garnet

Parrish, R.R. (1976): Structure, Metamorphism and Geochronology of the Northern Wolverine Complex near Chase Mountain, Aiken Lake Map-area, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 89 pages.
NTS: 94C (6, 11)
Minerals: kyanite, sillimanite

_____ (1979): Geology and Tectonics of the Northern Wolverine Complex, British Columbia, Canadian Journal of Earth Sciences, Volume 16, pages 1428-1438.
NTS: 94C (6, 11)
Minerals: kyanite, sillimanite

_____ (1981): Geology of the Nemo Lakes Belt, Northern Valhalla Range, Southeast British Columbia, Canadian Journal of Earth Sciences, Volume 18, pages 944-958.
NTS: 82F (13)
Minerals: garnet, sillimanite, kyanite

Parrish, R.R., Carr, S.D. and Brown, R.L. (1985): Valhalla Gneiss Complex, Southeast British Columbia: 1984 Field Work, in Current Research, Part A, Geological Survey of Canada, Paper 85-1A, pages 81-87.
NTS: 82F (5, 12)
Minerals: sillimanite

Pell, J. (1984): Stratigraphy, Structure and Metamorphism of Hadrynian Strata in the Southeastern Cariboo Mountains, British Columbia, Unpublished Ph.D. Thesis, University of Calgary, 185 pages.
NTS: 83D (3, 5, 6, 11, 12)
Minerals: garnet, kyanite, sillimanite

Pell, J. and Simony, P.S. (1981): Stratigraphy, Structure and Metamorphism in the Southern Cariboo Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, pages 227-230.
NTS: 83D (3, 6)
Minerals: garnet, kyanite, sillimanite

Pell, J. and Simony, P.S. (1982): Hadrynian Horsethief Creek Group/Kaza Group Correlations in the Southern Cariboo Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 82-1A, pages 305-308.
NTS: 83D (5, 6, 11, 12)
Minerals: garnet, kyanite, sillimanite

Pell, J. and Simony, P.S. (1984): Stratigraphy of the Hadrynian Kaza Group between the Azure and North Thompson Rivers, Cariboo Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 84-1A, pages 95-98.
NTS: 83D (12)
Minerals: garnet

Perkins, M.J. (1983): Structural Geology and Stratigraphy, Big Bend of the Columbia River, Selkirk Mountains, British Columbia, Unpublished Ph.D. Thesis, Carleton University, 238 pages.
NTS: 82M (15, 16)
Minerals: garnet, kyanite

Pigage, L.C. (1973): Metamorphism Southwest of Yale, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 95 pages.
NTS: 92H (11, 12)
Minerals: garnet, kyanite, andalusite, sillimanite

_____ (1978): Metamorphism and Deformation on the Northeast Margin of the Shuswap Metamorphic Complex, Azure Lake, British Columbia, Unpublished Ph.D. Thesis, The University of British Columbia, 289 pages.
NTS: 83D (5, 12), 93A (8, 9)
Minerals: garnet, kyanite, sillimanite

Poulton, T.P. (1970): Stratigraphy and Sedimentology, Horsethief Creek Formation, Northern Dogtooth Mountains, British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 162 pages.
NTS: 82N (2, 5, 6)
Minerals: garnet

Preto, V.A. (1966): Grand Forks, West Half (82E/1, W1/2) Map-area, British Columbia, Geological Survey of Canada, Paper 66-1, page 78.
NTS: 82E (1)
Minerals: sillimanite

Preto, V.A. (1967): Grand Forks W1/2 Map-area, Geological Survey of Canada, Paper 67-1A, pages 84-86.
NTS: 82E (1)
Minerals: sillimanite, garnet

_____ (1970): Structure and Petrology of the Grand Forks Group, British Columbia, Geological Survey of Canada, Paper 69-22, 80 pages.
NTS: 82E (1) W1/2
Minerals: sillimanite, garnet

Psutka, J.F. (1978): Structural Setting of the Downie Slide, Northeast Flank of Frenchmans Cap Gneiss Dome, Shuswap Complex, Southeastern British Columbia, M.Sc. Thesis, Carleton University, 80 pages.
NTS: 82M (7, 8, 10)
Minerals: garnet, kyanite, sillimanite

Raeside, R.P. (1982): Structure, Metamorphism and Migmatization of the Scrip Range, Mica Creek, British Columbia, Unpublished Ph.D. Thesis, University of Calgary, 204 pages.
NTS: 83D (2)
Minerals: garnet, sillimanite, kyanite, andalusite

Raeside, R.P. and Simony, P.S. (1983): Stratigraphy and Deformational History of the Scrip Nappe, Monashee Mountains, British Columbia, Canadian Journal of Earth Sciences, Volume 20, pages 639-650.
NTS: 82M (15, 16), 83D (1, 2)
Minerals: kyanite, sillimanite

Ray, G.E., Dawson, G.L. and Simpson, R. (1987): The Geology and Controls of Skarn Mineralization in the Hedley Gold Camp, Southeast British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1986, Paper 1987-1, pages 65-79.
NTS: 92H (8), 82E (5)
Minerals: garnet

Read, P.B. (1960): The Geology of the Fraser Valley between Hope and Emory Creek, British Columbia, Unpublished M.A.Sc. Thesis, The University of British Columbia, 145 pages.
NTS: 92H (6), 92H (11)
Minerals: garnet, kyanite, sillimanite

_____ (1966): Petrology and Structure of Poplar Creek Map-area, British Columbia, Unpublished Ph.D. Thesis, University of California, Berkeley, 191 pages.
NTS: 82K (6, 11)
Minerals: garnet

_____ (1979): Relationship between the Shuswap Metamorphic Complex and Kootenay Arc, Vernon East-half, Southern British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, pages 37-40.
NTS: 82K, 82L, 82M
Minerals: garnet, sillimanite

_____ (1980): Stratigraphy and Structure: Thor-Odin to Frenchmans Cap "Domes", Vernon East-half Map-area, Southern British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, pages 19-25.
NTS: 82L (16), 82M (1)
Minerals: garnet, sillimanite

Read, P.B. and Okulitch, A.V. (1977): The Triassic Unconformity of South-central British Columbia, Canadian Journal of Earth Sciences, Volume 14, pages 606-638.
NTS: 82E (5), 82L (3, 5, 6)
Minerals: kyanite, sillimanite

Reamsbottom, S.B. (1971): Geology of the Mount Breakenridge Area, Harrison Lake, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 162 pages.
NTS: 92H (12, 13)
Minerals: garnet, andalusite, kyanite, sillimanite

_____ (1974): Geology and Metamorphism of the Mount Breakenridge Area, Harrison Lake, British Columbia, Unpublished Ph.D. Thesis, The University of British Columbia, 155 pages.
NTS: 92H (12)
Minerals: garnet, kyanite, sillimanite, andalusite

Reddy, D.G. and Godwin, C.I. (1987): Geology of the Bend Zn-Pb-Ag Massive Sulphide Prospect, Southeast British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1986, Paper 1987-1, pages 47-52.
NTS: 83D (1)
Minerals: garnet

Reesor, J.E. (1957): Lardeau E1/2, British Columbia, Geological Survey of Canada, Map 12-1957.
NTS: 82E (E1/2)
Minerals: garnet, kyanite, sillimanite

_____ (1958): Dewar Creek Map-area, with Special Emphasis on the White Creek Batholith, British Columbia, Geological Survey of Canada, Memoir 292, 78 pages.
NTS: 82F (16)
Minerals: garnet, sillimanite

_____ (1965): Structural Evolution and Plutonism in Valhalla Gneiss Complex, British Columbia, Geological Survey of Canada, Bulletin 129, 128 pages.
NTS: 82F (11, 12, 13, 14)
Minerals: sillimanite, garnet

_____ (1966): The Thor-Odin Gneiss Dome, Monashee Mountains, Southern British Columbia, Geological Survey of Canada, Paper 66-1, pages 78-79.
NTS: 82L
Minerals: garnet, sillimanite

_____ (1973): Geology of the Lardeau Map-area, E1/2, British Columbia, Geological Survey of Canada, Memoir 369, 129 pages.
NTS: 82K E1/2
Minerals: garnet, kyanite, andalusite, sillimanite

Reesor, J.E. and Moore, J.M. Jr. (1971): Petrology and Structure of Thor-Odin Dome, Shuswap Metamorphic Complex, British Columbia, Geological Survey of Canada, Bulletin 195, 149 pages.
NTS: 82L (8, 9)
Minerals: kyanite, andalusite, sillimanite, garnet

Reinsbakken, A. (1970): Detailed Geological Mapping and Interpretation of the Grand Forks-Eholt Area, Boundary District, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 112 pages.
NTS: 82E (1, 2)
Minerals: garnet, sillimanite

Rice, H.M.A. (1937): Cranbrook Map-area, British Columbia, Geological Survey of Canada, Memoir 207, 67 pages.
NTS: 82G
Minerals: garnet, sillimanite

_____ (1941): Nelson Map-area, East half, British Columbia, Geological Survey of Canada, Memoir 228, 86 pages.
NTS: 82F, 82E1/2 (1, 2, 7, 8, 9, 10, 15, 16)
Minerals: garnet, sillimanite, kyanite

Robbins, D.B. (1976): Metamorphism and Structure of the Encampment Creek Area, British Columbia, Unpublished M.Sc. Thesis, University of Calgary, 171 pages.
NTS: 83D (2)
Minerals: garnet, kyanite

Roddick, J.A. (1965): Vancouver, North Coquitlam, and Pitt Lake Map-areas, British Columbia, Geological Survey of Canada, Memoir 335, 276 pages.
NTS: 92G (6, 7)
Minerals: garnet, sillimanite

_____ (1970): Douglas Channel-Hecate Strait Map-area, British Columbia, Geological Survey of Canada, Paper 70-41, 56 pages.
NTS: 103H and 103G (E3/8)
Minerals: garnet, sillimanite, kyanite

_____ (1975): Coast Mountain Project, Pemberton West-half Map-area, British Columbia, Geological Survey of Canada, Paper 75-1A, Part A, pages 37-40.
NTS: 92J (W1/2)
Minerals: garnet, sillimanite, andalusite

Roddick, J.A., Baer, A.J. and Hutchison, W.W (1966): Coast Mountain Project, British Columbia, Geological Survey of Canada, Paper 66-1, pages 80-85.
NTS: 103A, 103G, 103H, 103I, 103J and 93D
Minerals: garnet

Roots, E.F. (1947): Geology of the Aiken Lake Map-Area, British Columbia, Unpublished M.A.Sc. Thesis, The University of British Columbia, 59 pages.
NTS: 94C W1/2
Minerals: garnet

_____ (1949): Geology and Mineral Deposits of the Aiken Lake Map-area, British Columbia, Unpublished Ph.D. Thesis, Princeton University, 627 pages.
NTS: 94C W1/2
Minerals: garnet, sillimanite, kyanite

_____ (1954): Geology and Mineral Deposits of the Aiken Lake Map-area, British Columbia, Geological Survey of Canada, Memoir 274, 246 pages.
NTS: 94C W1/2 (3, 4, 5, 6, 11, 12, 13, 14)
Minerals: garnet, kyanite, sillimanite

Ross, J.V., Lewis, P.D. and Garwin, S.L. (1987): Geology of the Quesnel Lake Region, Central British Columbia: Geometry and Implications, in Geological Society of America, Abstracts with Programs 19, Cordilleran Section Meeting, Hilo, Hawaii, page 445.
NTS: 93A
Minerals: kyanite, sillimanite

Rusmore, M.E. (1982): Structure and Petrology of Pre-Tertiary Rocks near Port Renfrew, Vancouver Island, British Columbia, Unpublished M.Sc. Thesis, University of Washington, Seattle, 124 pages.
NTS: 92C (9, 10)
Minerals garnet, andalusite

Ryan, B.D. (1973): Structural Geology and Rb-Sr Geochronology of the Anarchist Mountain Area, South-central British Columbia, Unpublished Ph.D. Thesis, The University of British Columbia, 256 pages.
NTS: 82E (3, 4)
Minerals: garnet, sillimanite

Scammell, R.J. (1985): Stratigraphy and Structure of the Northwest Flank of Frenchman Cap Dome, Monashee Complex, British Columbia; Preliminary Results, in Current Research, Part A, Geological Survey of Canada, Paper 85-1A, pages 311-316.
NTS: 82M (10)
Minerals: garnet, kyanite

Sears, J.W. and Price, R.A. (1977): Structural Geology of the Albert Peak Area, Southeastern British Columbia, in Report of Activities, Part B, Geological Survey of Canada, Paper 77-1B, pages 261-263.
NTS: 82K (13), 82N (4)
Minerals: garnet, andalusite, sillimanite

Sevigny, J.H. and Ghent, E.D. (1986): Metamorphism in the Northern Adams River Area, Northeastern Shuswap Complex, Monashee Mountains, British Columbia, in Current Research, Part B, Geological Survey of Canada, Paper 86-1B, pages 693-698.
NTS: 83D (2, 3)
Minerals: garnet, sillimanite

Shaw, D.A. (1980): Structural Setting of the Adamant Pluton, Northern Selkirk Mountains, British Columbia, Unpublished Ph.D. Thesis, Carleton University, 209 pages.
NTS: 82N (12, 13), 82M (9, 16)
Minerals: kyanite, garnet, sillimanite

Simony, P.S. (1979): Pre-Carboniferous Basement near Trail, British Columbia, Canadian Journal of Earth Sciences, Volume 16, pages 1-11.
NTS: 82F (4) and 82F (5)
Minerals: garnet, sillimanite, kyanite

Simpson, Y.R. (1970): Geology of the Gibraltar-Pollyanna Group Copper Deposit, British Columbia, Unpublished B.A.Sc. Thesis, The University of British Columbia, 43 pages.
NTS: 93B (8, 9)
Minerals: garnet (skarn), garnet (greenshist)

Snyder, J.G. (1980): A Metamorphic and Structural Study of the Port Simpson Area, British Columbia, Unpublished M.A. Thesis, Bryn Mawr College, Pennsylvania, 88 pages.
NTS: 103J (9)
Minerals: garnet, kyanite

Souther, J.G. (1960): Tulsequah, Geological Survey of Canada, Map 6-1960.
NTS: 104K
Minerals: garnet

_____ (1971): Geology and Mineral Deposits of the Tulsequah Map-area, British Columbia, Geological Survey of Canada, Memoir 362, 84 pages.
NTS: 104K
Minerals: garnet

Struik, L.C. (1982): Bedrock Geology, Spanish Lake and Adjoining Areas, British Columbia, Geological Survey of Canada, Open File 920.
NTS: 93A (10, 11, 14, 15)
Minerals: garnet, sillimanite

_____ (1985): Dextral Strike-slip through Wells Grey Provincial Park, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 85-1A, pages 305-309.
NTS: 83D (5, 12), 93A (8, 9)
Minerals: kyanite, sillimanite

_____ (1986): A Regional East-dipping Thrust Places Hadrynian onto Probable Paleozoic Rocks in Cariboo Mountains, British Columbia, in Current Research, Part A, Geological Survey of Canada, Paper 86-1A, pages 589-594.
NTS: 93H (SE), 92A (NE) and 83D (NW)
Minerals: garnet, kyanite

Stuart, R.A. (1960): Geology of the Kemano-Tahtsa Area, British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 42, 59 pages.
NTS: 93E
Minerals: garnet

Sutherland Brown, A. (1960): Geology of the Rocher Deboule Range, British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 43, 78 pages.
NTS: 93M
Minerals: garnet, sillimanite

Thompson, R.I. (1972): Geology of the Akolkolex River Area, near Revelstoke, British Columbia, Unpublished Ph.D. Thesis, Queen's University, 125 pages.
NTS: 82K (13), 82M (16), 82N (4)
Minerals: garnet, kyanite, sillimanite

_____ (1978): Geology of the Akolkolex River Area, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 60, 84 pages.
NTS: 82K (13), 82M (16), 82N (4)
Minerals: garnet, kyanite, sillimanite

Tippett, C.R. (1976): A Structural and Stratigraphic Cross-section through the Selkirk Fan Axis, Selkirk Mountains, Southeastern British Columbia, Unpublished M.Sc. Thesis, Carleton University, 166 pages.
NTS: 82N (12)
Minerals: garnet, kyanite

Watson, K. DeP. (1948): The Squaw Creek-Rainy Hollow Area, Northern British Columbia, B.C. Ministry of Energy, Mines and Petroleum Resources, Bulletin 25, 74 pages.
NTS: 114P
Minerals: garnet (skarn and in pelites)

Wheeler, J.O. (1961): Rogers Pass, British Columbia, Geological Survey of Canada, Map 4-1961.
NTS: 82N (W1/2)
Minerals: garnet, kyanite

_____ (1963): Rogers Pass Map-area, British Columbia and Alberta, Geological Survey of Canada, Paper 62-32, 32 pages.
NTS: 82N (W1/2)
Minerals: garnet, andalusite, kyanite, sillimanite

_____ (1965): Big Bend Map-area, British Columbia, Geological Survey of Canada, Paper, 64-32, 37 pages.
NTS: 82M (E1/2)
Minerals: kyanite, sillimanite, garnet

Winzer, S.R. (1973): Metamorphism and Chemical Equilibrium in Some Rocks from the Central Kootenay Arc, British Columbia, Unpublished Ph.D. Thesis, University of Alberta, 335 pages.
NTS: 82F (10, 15)
Minerals: garnet, sillimanite, kyanite

Zajac, J.S. (1960): The Geology of Vulcan Ridge, Dewar Creek Area, British Columbia, Unpublished M.Sc. Thesis, The University of British Columbia, 71 pages.
NTS: 82F (9, 16)
Minerals: garnet

## LEGEND

Location of Significant Metamorphic Minerals

- ● Garnet
- ■ Kyanite
- ▲ Sillimanite
- Zones where above minerals are present in abundance
- Garnet isograd
- Sillimanite isograd
- Fault

### LITHOLOGIES

- **8** Alluvium
- **7** TRIASSIC AND YOUNGER
  Undifferentiated sedimentary and volcanic strata includes Slocan, Kaslo and Ymir Groups
- **6b** UPPER CARBONIFEROUS AND TRIASSIC – Milford Group
  Slate, argillite, chert, limestone, schist, some greenstone (includes Active Formation)
- **6a** CARBONIFEROUS – Mount Roberts Formation
  Argillaceous quartzite, greenstone, limestone, paragneiss
- **5** ORDOVICIAN TO PRECAMBRIAN(?) Lardeau Series
  Micaceous and chloritic schists, quartzite, limestone, paragneiss
- **4** CAMBRIAN
  Quartzite, limestone, dolomite, slate; includes Eager, Cranbrook, Badshot, Nelway, Quartzite Range, Reno and Liab Formations
- **3b** WINDERMERE
  Grit, quartzite, schist, conglomerate, limestone; includes Horsethief Creek and Three Sisters Formations
- **3a** WINDERMERE
  Greenstone, argillite and phyllite, diamictite, minor limestone; includes Toby, Irene and Monk Formations
- **2c** PURCELL (UPPER) Mount Nelson and Dutch Creek Formations
  Argillite, magnesian limestone, quartzite; 2cs muscovite-quartz-kyanite schist
- **2b** PURCELL (LOWER) Kitchener-Siyeh and Creston Formations
  Green, purple, grey argillaceous quartzite and argillite; varicoloured magnesian limestone
- **2a** PURCELL (LOWER) Aldridge Formation
  Grey, rusty weathering argillaceous quartzite and argillite
- **1c** PRECAMBRIAN
  Mixed gneisses, granitic and granodioritic gneiss, both orthogneiss and paragneiss
- **1b** Hybrid gneiss; intimately intermixed metasedimentary and leucogranitic gneisses, pegmatite, migmatite, amphibolite, marble
- **1a** Veined granodiorite gneiss
- **A** PLUTONIC ROCKS
- **B** Foliated orthogneisses (Castlegar and Trail Gneisses)

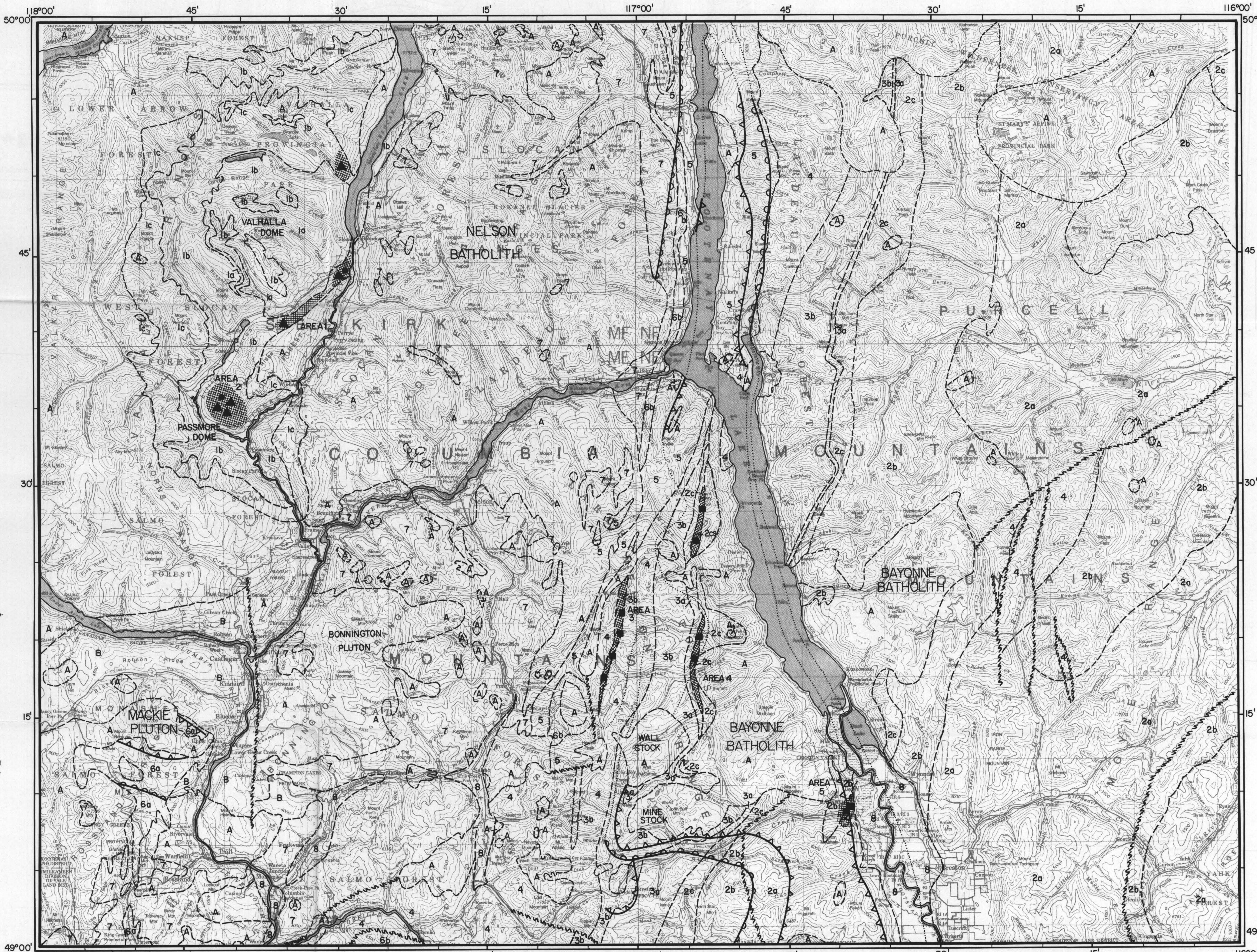



FIGURE 2
MAP I

*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

Compiled from Glover, 1978; Leclair, 1983; Little, 1956; 1960; McAllister, 1950; Reesor, 1965; Rice, 1941; Simony, 1979.

NELSON
82F
1:250 000


Province of British Columbia — Ministry of Energy, Mines and Petroleum Resources

Energy, Mines and Resources Canada — Énergie, Mines et Ressources Canada

This project is a contribution to the Canada – British Columbia Mineral Development Agreement, 1985 – 1990

## LEGEND

Locations of Significant Metamorphic Minerals

- ● Garnet
- ■ Kyanite
- ▲ Sillimanite
- ◆ Andalusite
- Zones where above minerals are present in abundance
- Fault

### LITHOLOGIES

**6** Tertiary volcanics and sediments; includes the Kamloops Group

**5** PALEOZOIC AND MESOZOIC
Undifferentiated sedimentary and volcanic strata; unmetamorphosed to weakly metamorphosed, includes Eagle Bay Formation, Milford Group, Slide Mountain Group, Kaslo Group, Slocan Group and Nicola Group

**4** PALEOZOIC AND MESOZOIC
Okanagan Plutonic and Metamorphic Complex; hornblende and biotite gneiss, paragneiss, schist, marble, quartzite, quartz mica schist, amphibolite; may be metamorphosed equivalents of Carboniferous and older strata

**3** CAMBRIAN AND ORDORICIAN
Silver Creek and Chase Quartzite Formations; quartz-biotite, sericite and garnet schists, minor quartzo- feldspathic biotite gneiss, quartzite, marble, amphibolite pegmatite; locally pelitic schists with kyanite

**2** PROTEROZOIC AND ?PALEOZOIC
Shuswap Complex; Granitic gneiss, paragneiss, schist (commonly garnet and sillimanite bearing); minor quartzite, marble, amphibolite

**Ib** PRECAMBRIAN MONASHEE COMPLEX
Mantling gneiss succession; quartz-mica paragneiss and schist minor quartzite, amphibolite, calc silicate gneiss, marble

**Ia** PRECAMBRIAN MONASHEE COMPLEX
Core gneisses; migmatized paragneiss and orthogneiss, includes quartz-biotite-feldspar gneisses; minor amphibolite, quartzite, mafic aluminosilicate schist

### PLUTONIC ROCKS

**A** Granite, quartz monzonite, granodiorite

**B** LITTLE SHUSWAP GNEISS
Leucocratic granitic, quartz monzonitic, granodioritic and minor dioritic gneisses

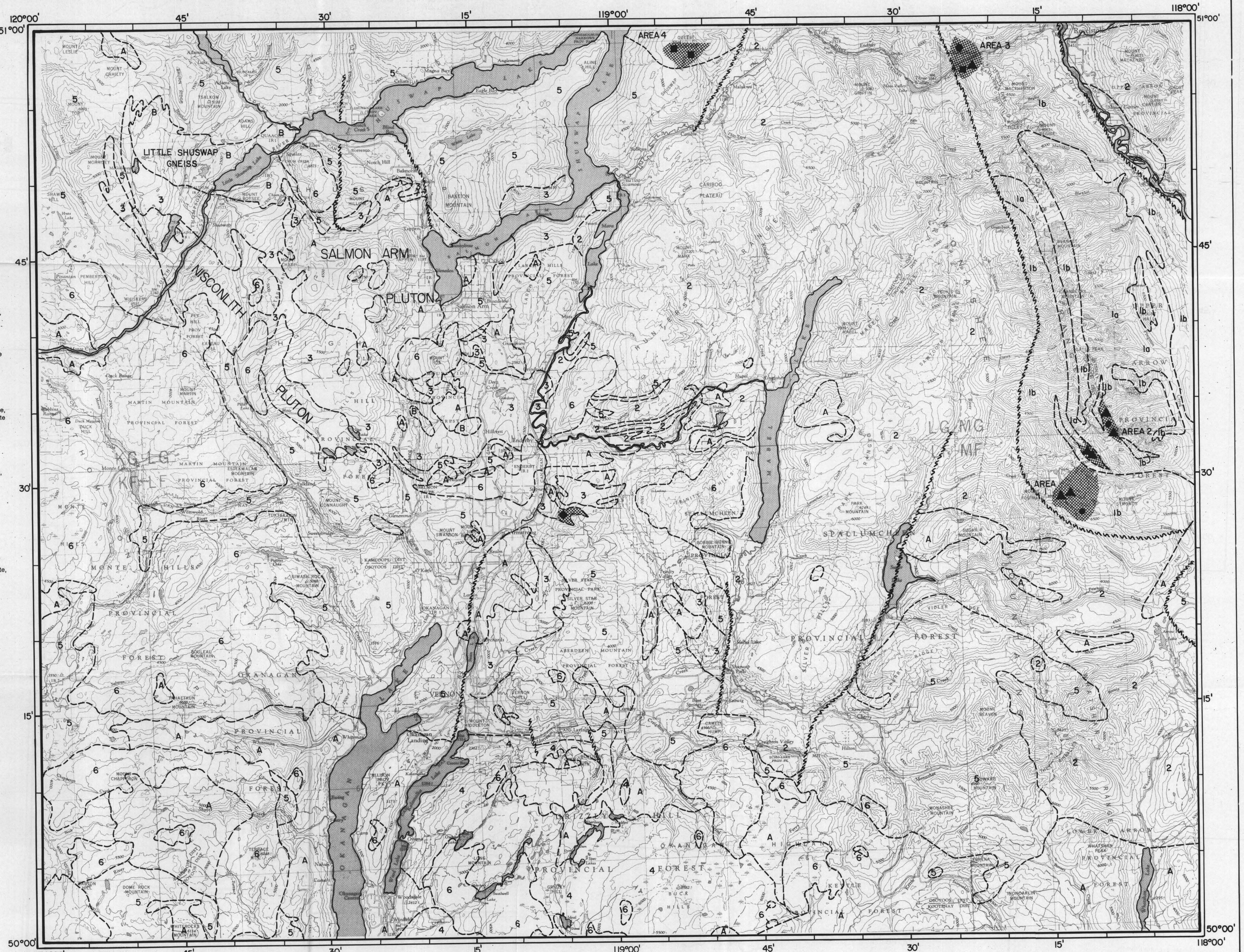
*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

FIGURE 3
MAP 2

Compiled from Okulitch, 1980; Jones, 1959; Reesor and Moore, 1971.




VERNON
82L
1:250 000


Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources
Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada
This project is a contribution to the Canada – British Columbia Mineral Development Agreement, 1985 – 1990

## LEGEND

Locations of Significant Metamorphic Minerals

- ● Garnet
- ■ Kyanite
- ▲ Sillimanite
- ◆ Andalusite
- Areas where above minerals are present in abundance
- Garnet isograd
- Sillimanite isograd
- Fault

### LITHOLOGIES

- 6 — Alluvium
- 5 — TERTIARY: Sediments and volcanics
- 4 — PERMIAN OR EARLIER: Undivided greenstone, chlorite schist, phyllite, limestone, phyllite, metaconglomerate, minor quartz-mica schist and amphibolite; includes Antler and Eagle Bay Formations
- 3b — LOWER CAMBRIAN AND LATER(?): Lardeau Group. Schist, slate, phyllite, quartzite, limestone, pebble conglomerate
- 3a — LOWER CAMBRIAN: Sandstone, slate, limestone, quartzite, quartz-mica schist includes Donald and Badshot Formations, Hamill Group
- 2a — WINDERMERE: Horsethief Creek Group, pelite, psammite, quartzite, grit, some limestone and amphibolite, undifferentiated; 2a, aluminous pelite unit; $2a_2$, semipelite-amphibolite unit
- 2 — SHUSWAP COMPLEX: Metamorphosed strata, in part equivalent to Horsethief Creek Group
- 1b — MONASHEE COMPLEX: Mantling gneisses, paragneiss and schist; quartzite, calcsilicate gneiss, marble, amphibolite
- 1a — Monashee Complex: Core orthogneisses

### PLUTONIC ROCKS

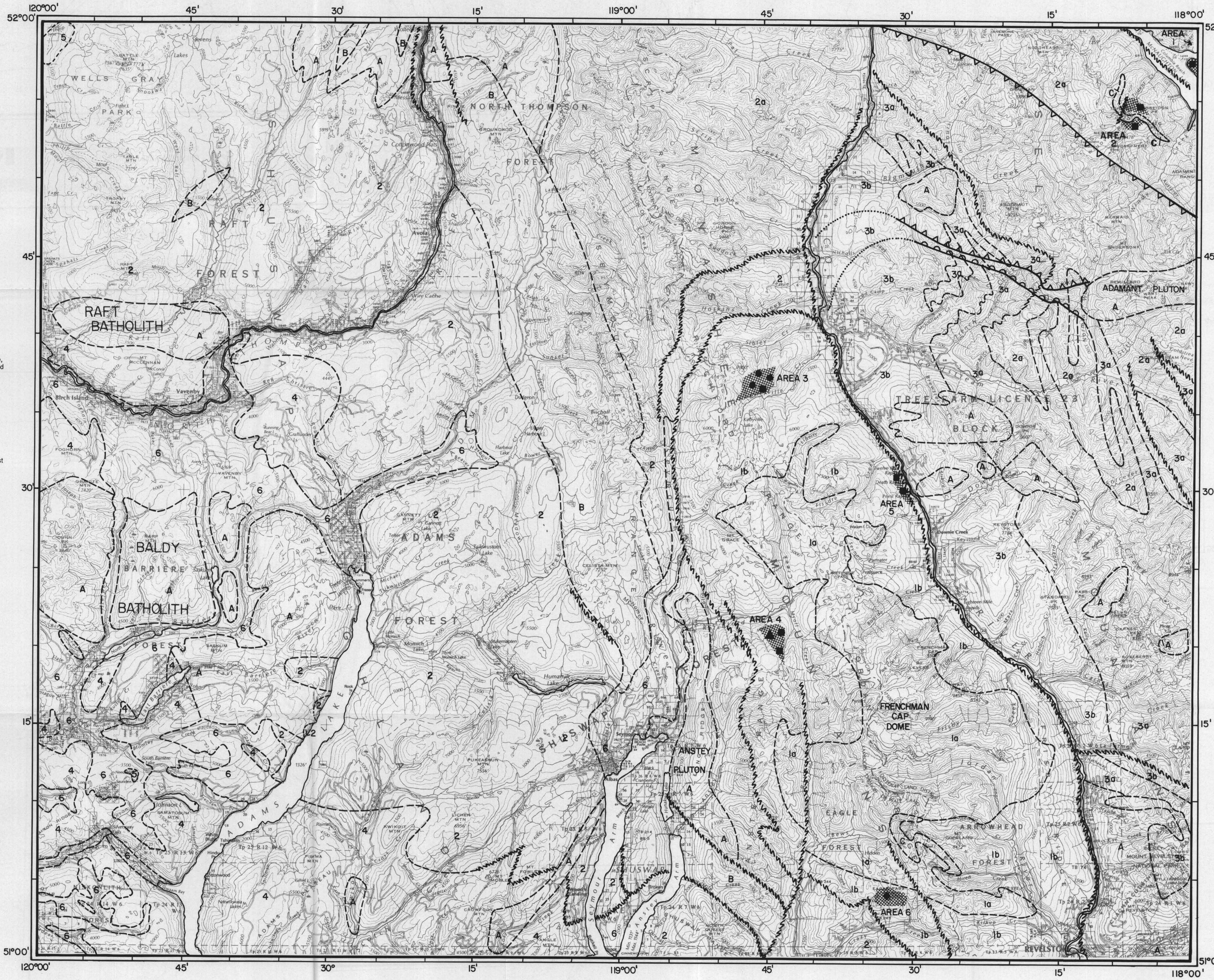
- A — Granite, quartz monzonite, granodiorite
- B — Foliated biotite and hornblende granodiorite and granodiorite gneiss
- C — Nepheline syenite gneisses, Precambrian and Devonian

*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

FIGURE 4
MAP 3




Compiled from Campbell, 1964; Journeay, 1986; Wheeler, 1965.

SEYMOUR ARM
82M
1:250 000

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LEGEND

Locations of Significant Metamorphic Minerals

- Garnet
- Kyanite
- Sillimanite
- Zones where above minerals are present in abundance
- Garnet-in isograd
- Kyanite-in isograd
- Sillimanite-in, kyanite present
- Sillimanite only, no kyanite
- Thrust fault
- Fault

LITHOLOGIES

6 Alluvium

CAMBRIAN

5 Gog Group; McNaughton, Mahto and Mural Formations: quartzite, limestone

CAMBRIAN OR HADRYNIAN

4 Cunningham Formation: limestone

3 Isaac Formation: shale, calcareous shale

HADRYNIAN – WINDERMERE SUPER GROUP

2a Horsethief Creek Group; Upper Clastic Unit, Kaza Group, Middle Miette Group: granule conglomerate, psammite, minor pelite and carbonate

2b Horsethief Creek Group, Middle Marble Unit

2c Horsethief Creek Group, Semipelite-Amphibolite Unit: minor pelite also present

2d Horsethief Creek Group, Aluminous Pelite Unit: aluminosilicate indicator minerals commonly developed

2e Horsethief Creek Group, Lower Grit Unit: granule conglomerate, conglomerate, psammite, minor pelite and semipelite

2 UNDIFFERENTIATED WINDERMERE SUPERGROUP

1 HADRYNIAN OR OLDER
Basement Gneisses

A Plutonic Rocks
granodiorite to quartz monzonite

B Foliated diorite to granodiorite gneiss


FIGURE 5
MAP 4

*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

Compiled from Campbell, 1968; Craw, 1977; Currie and Simony, 1987; Dechesne et. al., 1984; Doucet et. al., 1985; Ghent et. al., 1977; McDonough and Simony, 1984; Mitchell, 1976; Murphy, 1984; Oke and Simony, 1981; Pell, 1984; Pigage, 1978; Raeside, 1982; Sevigny and Ghent, 1986.

CANOE RIVER 83D
1:250 000

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## LEGEND

Location of Metamorphic Minerals

- Garnet
- Kyanite
- Zones where above minerals are present in abundance
- Garnet isograd
- Kyanite isograd
- Sillimanite isograd
- Fault
- Thrust fault

LITHOLOGIES

6 — Alluvium

5 — CRETACEOUS OR TERTIARY
Sustut Group, Sifton Formation sediments

4 — PALEOZOIC AND MESOZOIC
Undifferentiated sedimentary and volcanic strata, unmetamorphosed to weakly metamorphosed; includes Takla, Cache Creek and other strata

3 — UPPER PROTEROZOIC AND LOWER CAMBRIAN
Misinchinka Group: slate, phyllite and schist; calcareous sericite schist; schistose siltstone, grit, pebble conglomerate, diamichte; 3a, limestone

2 — HADRYNIAN – Ingenika Group
Quartz chlorite schist and phyllite, quartzite, conglomerate, amphibolite, marble and metamorphosed equivalents. 2a, limestone, marble; 2b, quartzite; 2c, garnet, kyanite and/or sillimanite bearing strata, formerly referred to as Tenakihi Group; 2d, feldspathic quartzite, quartz-mica-feldspar gneiss, migmatite, leucogranite silicated marble, skarn and amphibolite; highly metamorphosed equivalents of units 2, 2a and 2b; considered part of Wolverine Complex; 2e, feldspathic quartzite, quartz-mica-feldspar gneiss, migmatite, includes some lit-par-lit gneiss; highly metamorphosed equivalent of unit 2c; considered part of Wolverine Complex; 2f, foliated granodiorite, leucogranite

1 — HADRYNIAN
Granitic gneiss

A — Plutonic Rocks
granodiorite to quartz monzonite

B — Foliated diorite to granodiorite gneiss

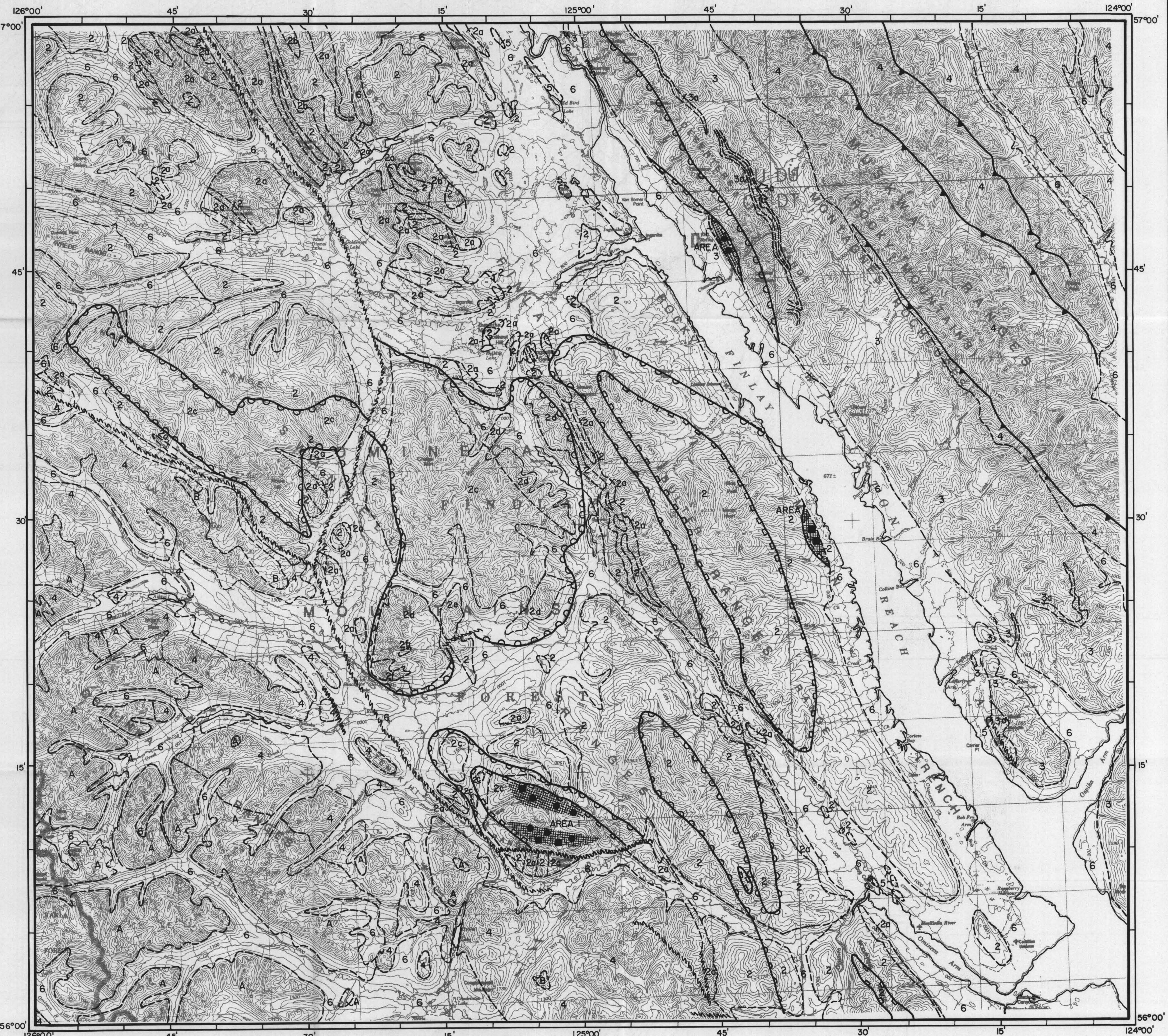


FIGURE 6
MAP 5

*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

Compiled from Evenchick, 1985; Gabrielse, 1975; Roots, 1954.

MESILINKA RIVER
94C
1:250 000


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## LEGEND

Locations of Significant Metamorphic Minerals

- ● Garnet
- ◆ Andalusite
- ■ Kyanite
- ▲ Sillimanite
- Zones where above minerals are present in abundance
- Fault

LITHOLOGIES

[5] Alluvium

[4] EOCENE AND MIOCENE OR LATER
Basalts, rhyolites, sandstones, shales, conglomerates, coal; includes Tranquille and Coldwater beds

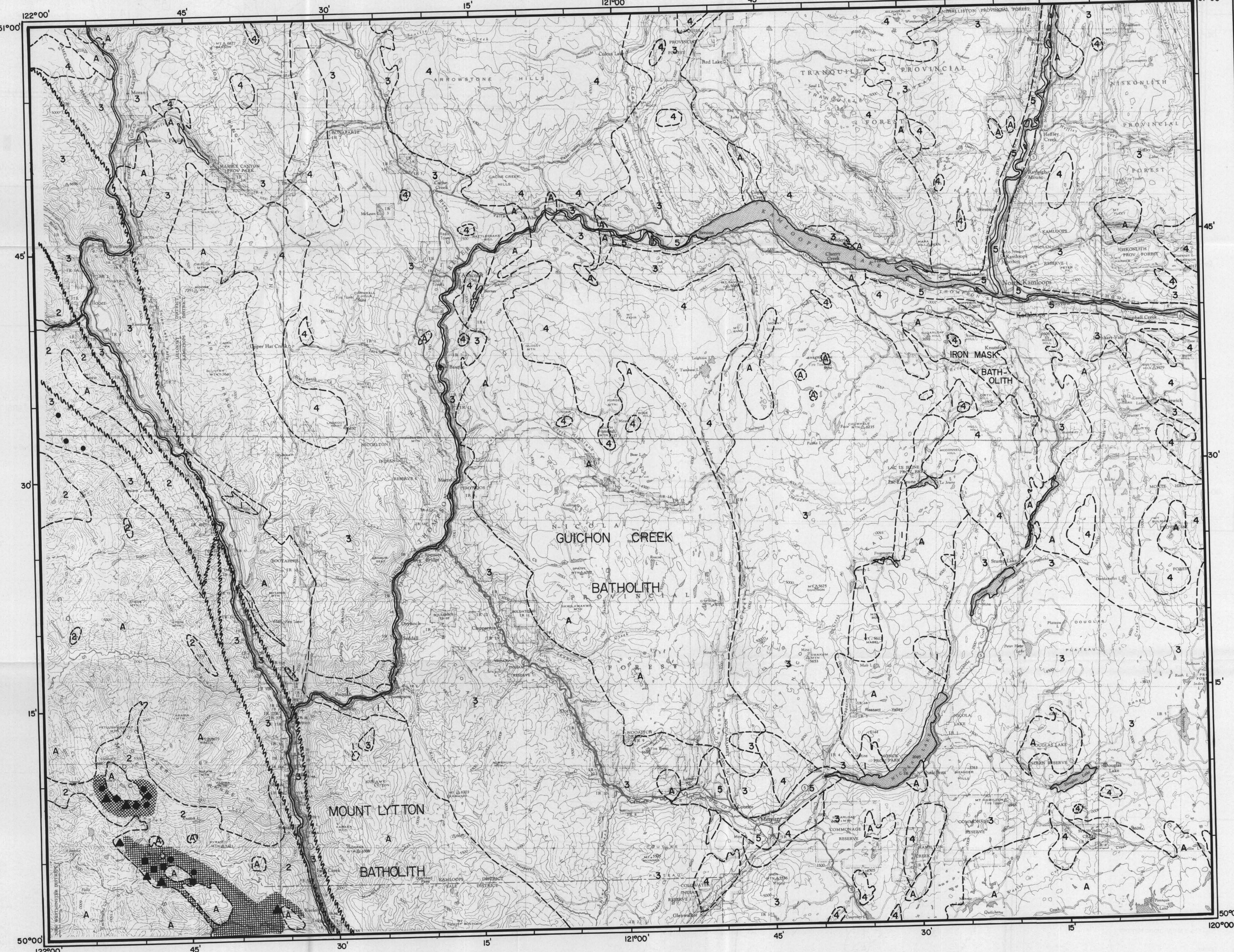
[3] PALEOZOIC TO MESOZOIC
Undifferentiated unmetamorphosed or weakly metamorphosed sediments and volcanics; includes Cache Creek, Nicola, Brew, Lillooet, Jackass Mountain, Spences Bridge and Kingsvale Groups

[2] AGE UNCERTAIN (TRIASSIC OR EARLIER)
Slate, phyllite, argillite, schist, quartzite, greywacke, limestone, conglomerate, greenstone; locally thermally metamorphosed and containing garnet and aluminosilicates

[1] AGE UNCERTAIN
Chlorite schist, quartz mica schist, amphibolite, commonly gneissic

PLUTONIC ROCKS

[A] Granites to diorites to syenites belonging to the Coast Intrusions and Copper Creek Intrusions




*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

FIGURE 7
MAP 6

Compiled from Cockfield, 1948; Duffell and McTaggart, 1952; Hollister, 1967a and b.

ASHCROFT
92I
1:250 000

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## LEGEND

Locations of Significant Metamorphic Minerals

- ● Garnet
- ■ Kyanite
- ▲ Sillimanite
- Zones where above minerals are present in abundance
- Fault

### LITHOLOGIES

**6** Alluvium

**5** TERTIARY SEDIMENTS AND VOLCANICS
Including Coquihalla Group, Princeton Group and Skagit Formation

**4** PALEOZOIC AND MESOZOIC
Undifferentiated sedimentary and volcanic rocks, unmetamorphosed to weakly metamorphosed; includes Hozameen, Chilliwack, Nicola, Ladner, Dewdney Creek, Jackass Mountain, Pasayten and Kingsvale groups

**3** AGE UNKNOWN
Ultramafic rocks, serpentinites, pyroxenites, etc.

**2** AGE UNKNOWN
Schist, amphibolite and phyllite; includes Settler Schist and Cairn Needle Formation; 2a, graphitic and quartzose phyllite; 2b, schist, amphibolite and their migmatitic equivalents; 2c, amphibolite, hornblendite and quartz diorite

**1** AGE UNKNOWN
Pelitic and migmatitic gneisses, includes Custer and Skagit gneisses, and Breakenridge Formation. In part, may be metamorphic equivalent of Chilliwack Group

### PLUTONIC ROCKS

**B** JURASSIC OR LATER
Peridotite, pyroxenite, gabbro

**A** JURASSIC AND LATER
Granodiorite, quartz diorite minor gabbro and syeno-gabbro

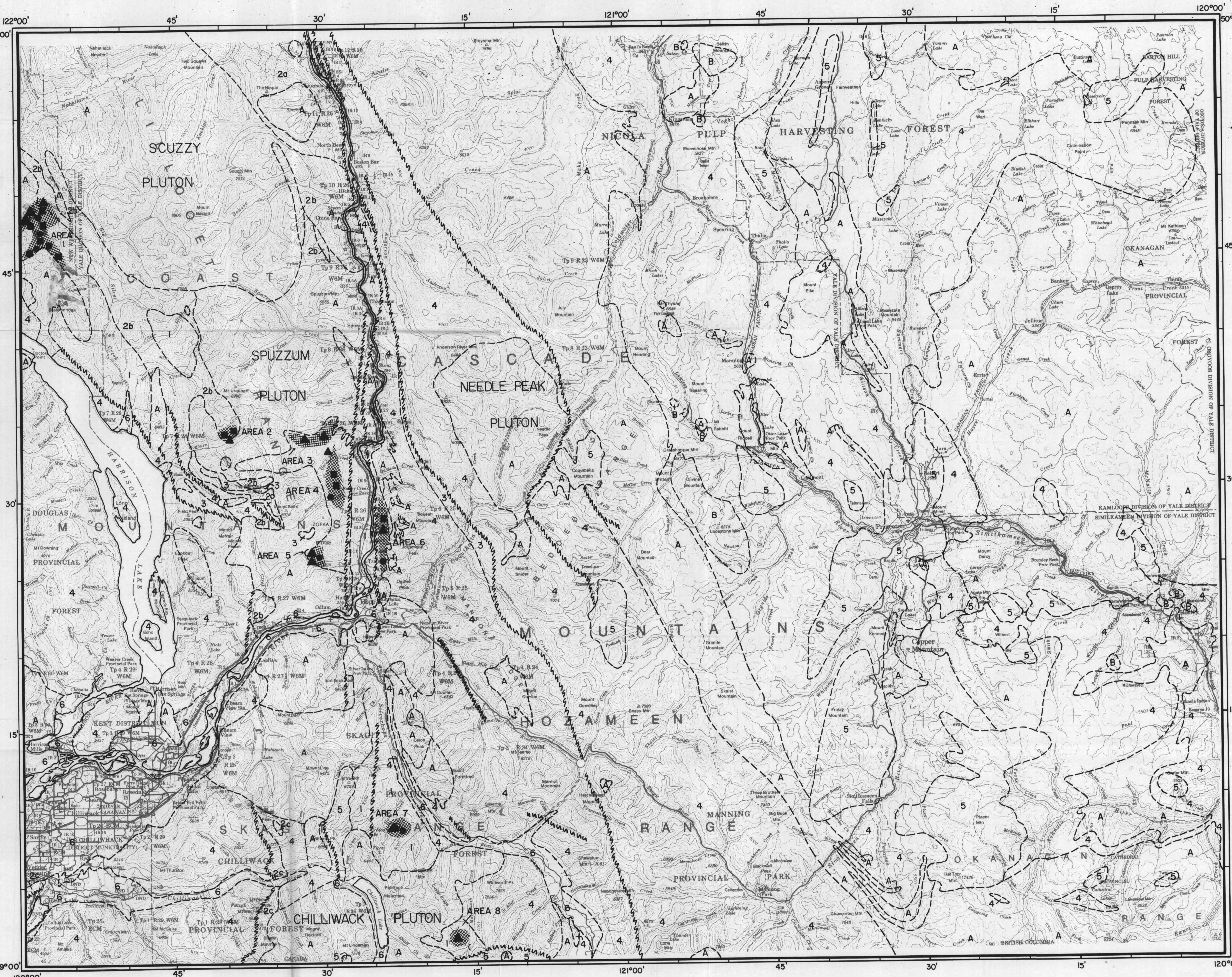


FIGURE 8

MAP 7

*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

Compiled from Bartholomew, 1979; Haugerud, 1985; Lowes, 1972; Pigage, 1973; Read, 1960; Reamsbottom, 1971; 1974; Monger, 1970; and Rice, 1960.

HOPE
92H
1:250 000


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## LEGEND

Locations of Significant Metamorphic Minerals

- ● Garnet
- ■ Kyanite
- ▲ Sillimanite
- Zones where above minerals are present in abundance
- Fault

## LITHOLOGIES

**4** Alluvium

**3** TERTIARY(?) TO PALEOZOIC(?)
Undifferentiated unmetamorphosed to weakly metamorphosed volcanic and sedimentary rocks

**2** EARLY MESOZOIC(?) AND/OR PALEOZOIC(?)
Metasedimentary rocks of amphibolite facies: 2a, rusty weathering muscovite ± biotite ± garnet ± amphibole schist; minor amphibolite and micaceous quartzite; 2b, feldspathic schist, impure quartzite and hornblende schist; 2c, dark greenish grey hornblende ± biotite ± garnet schist and impure quartzite with rare intercalated marble; 2d, black to dark grey graphite schist with local interbedded conglomerate, greywacke and marble; 2e, Mount Morse felsic rocks of uncertain origin; 2f, marble

PALEOZOIC(?)
Central Gneiss Complex

**Ia** Dominantly buff grey leucogneiss and migmatite

**Ib** Dominantly grey biotite ± hornblende gneiss, amphibolite, minor sillimanite ± garnet gneiss

**Ic** Work Channel amphibolite

**Id** Dominantly biotite hornblende gneiss, amphibolite and minor migmatite, rare biotite ± muscovite ± garnet ± kyanite schist and gneiss

**Ie** Migmatitic plutonic rock

TERTIARY AND OLDER
**A** Plutonic rocks, quartz monzonites to gabbros, minor ultrabasic rocks

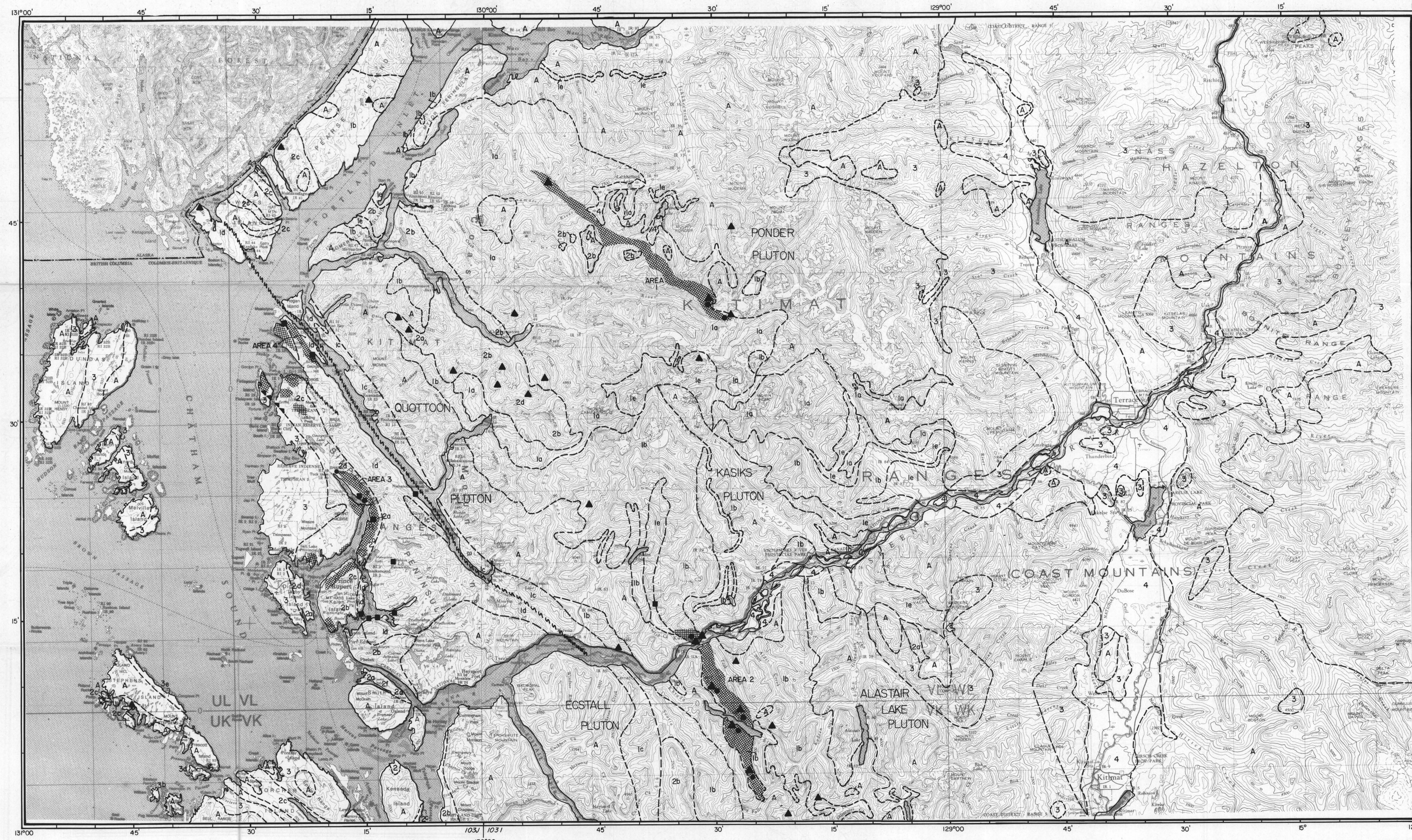
*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

FIGURE 9
MAP 8

Compiled from Duffell and Souther (1964); Hutchison (1982) and Snyder (1980)




PRINCE RUPERT-TERRACE
1:250 000
103I, 103JE½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## LEGEND

Locations of Significant Metamorphic Minerals

- ● Garnet
- ■ Kyanite
- ▲ Sillimanite
- ◆ Andalusite
- Zones where above minerals are present in abundance
- Fault

LITHOLOGIES

4 Alluvium

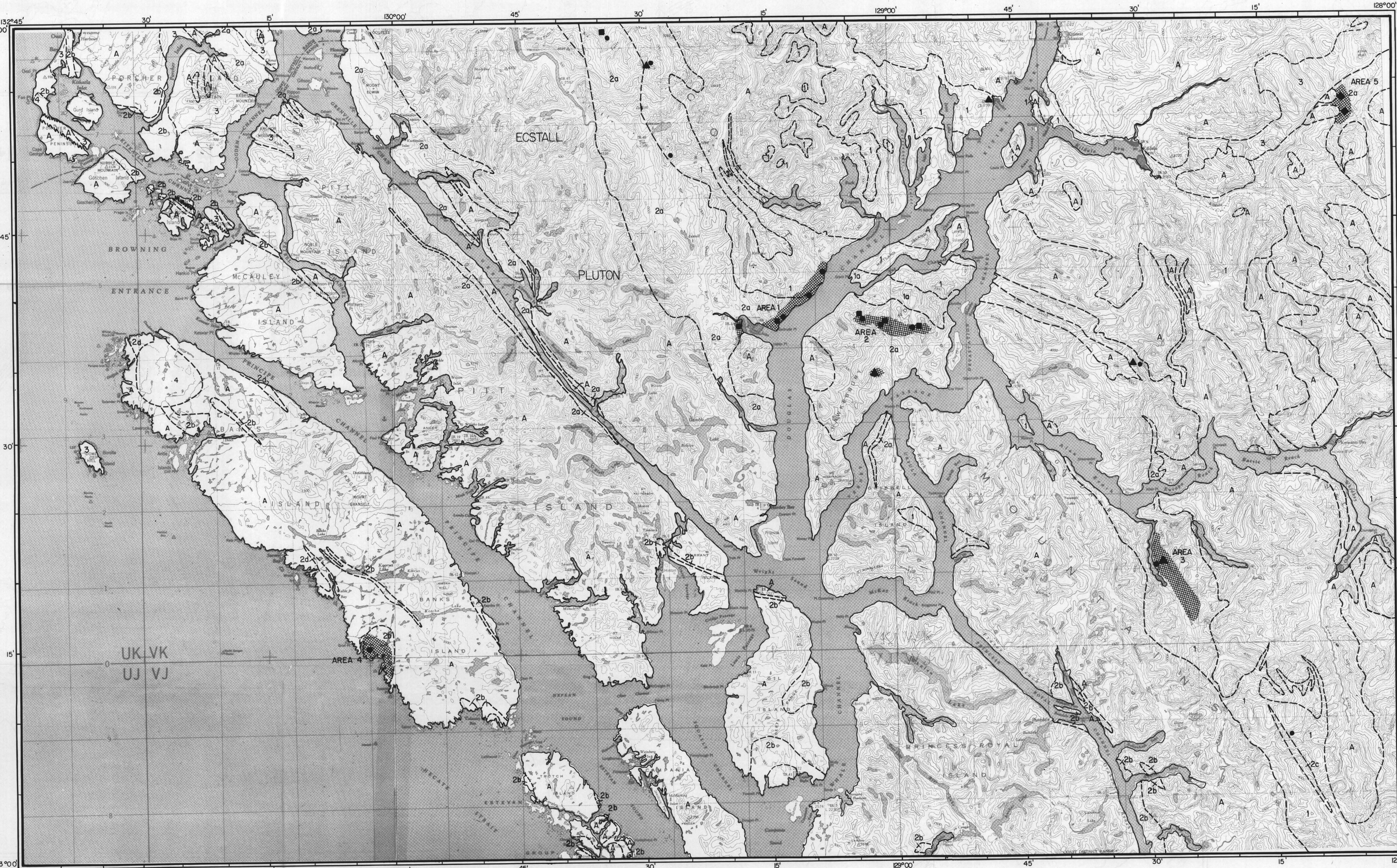
3 LOWER JURASSIC(?) TO UPPER TRIASSIC(?)
Unmetamorphosed to weakly metamorphosed volcanics and sediments

2 PERMIAN(?) AND/OR OLDER
Mainly metasediments: 2a, hornblende-biotite-plagioclase amphibolite and schist; biotite schist (locally garnetiferous), kyanite-staurolite-almandine mica schist, sericite-epidote schist, sillimanite-quartz-plagioclase gneiss, graphitic schist, quartzite, crystalline limestone; conglomerate; lit-par-lit gneiss, agmatite and minor granitic rock; 2b, mainly laminated micaceous quartzite, crystalline limestone, skarn, schist; 2c, mainly massive to thick bedded crystalline limestone; 2d, mainly thin bedded crystalline limestone, skarn, intercalated quartzite and schist

1 Granitoid gneiss, gneissic quartz diorite, rusty fine grained gneiss and schist, migmatite; minor garnet-sillimanite-biotite schist, crystalline limestone, diopsidic skarn, garnet-staurolite-kyanite schist; 1a, agmatite

PLUTONIC ROCKS (AGES UNCERTAIN)

A Quartz monzonites to gabbros, some gabbro-diorite-migmatite and gneissic diorite migmatite




*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

FIGURE 10
MAP 9

Compiled from Money (1959), Padgham (1958), and Roddick (1970).

# DOUGLAS CHANNEL AND HECATE STRAIT
103G, E⅜, 103H
1:250 000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## LEGEND

Locations of Significant Metamorphic Minerals

- Andalusite
- Zone where important minerals may be present in abundance
- Andalusite isograd
- Fault

### LITHOLOGIES

#### PALEOZOIC, MESOZOIC AND CENOZOIC

**4** Undifferentiated unmetamorphosed of weakly metamorphosed volcanic and sedimentary strata

**3** EOCENE AND OLDER

Basalts, gabbros, quartz-diorite includes Metchosin Volcanics, Sooke Gabbro and Catface Intrusions

**2** TRIASSIC TO CRETACEOUS

Leech River Formation: a, metagreywacke unit; b, argillite-metagrey wacke unit; c, chert-argillite-volcanic unit

**1** LOWER DEVONIAN AND OLDER

Metamorphosed intrusions, orthogneisses; includes Saltspring Intrusions, Wark and Colquitz gneisses

#### PLUTONIC ROCKS

**A** Lower to Middle Jurassic Island Intrusions granodiorite, quartz-diorite

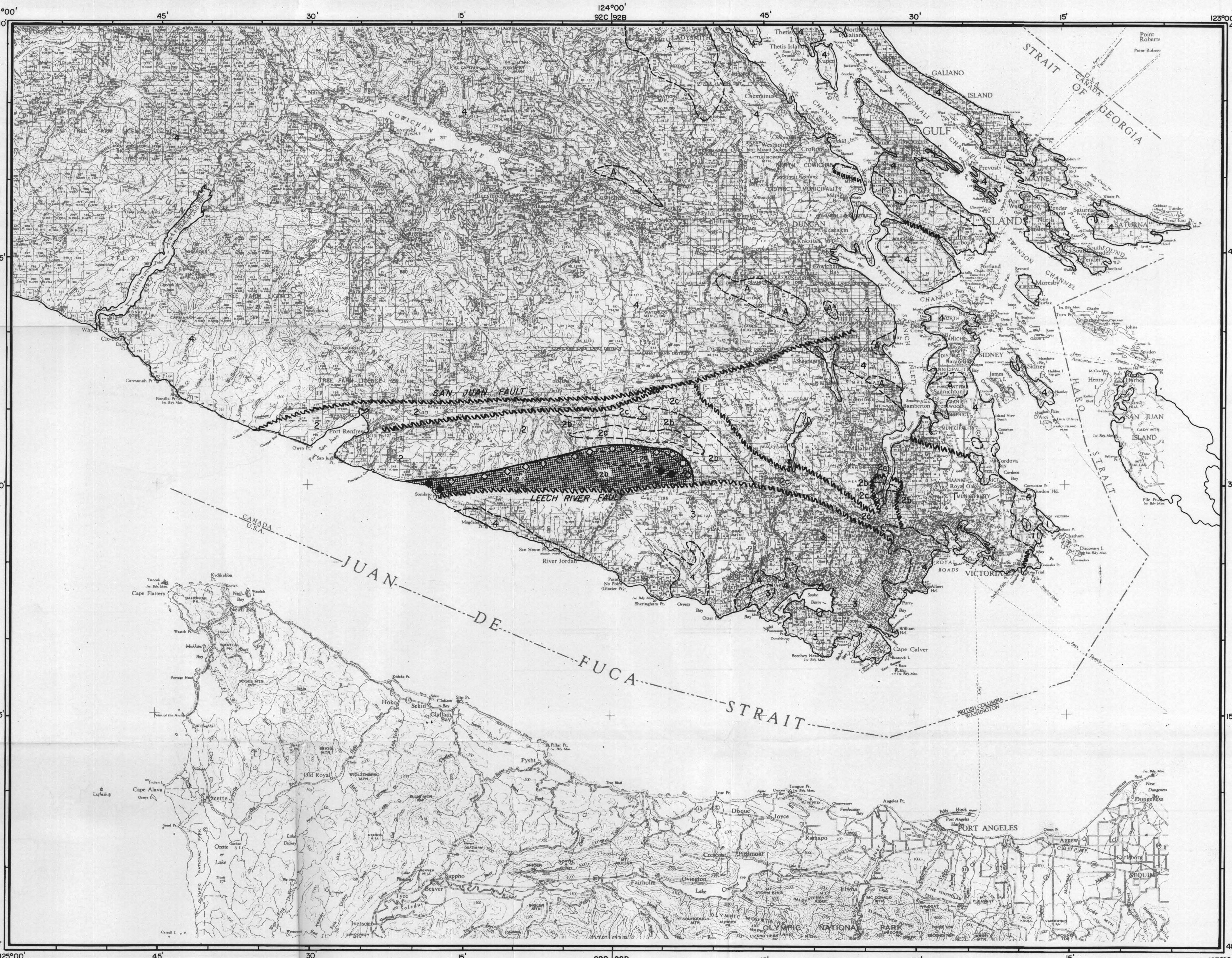


FIGURE 11
MAP 10

*To accompany Open File 1988-26*

**INDUSTRIAL MINERAL POTENTIAL OF GARNET AND KYANITE IN BRITISH COLUMBIA**

By Jennifer Pell

Compiled from Fairchild and Cowan, 1982; Muller, 1977; 1983; Rusmore, 1982.

VICTORIA (W½); 92B (W½) AND
CAPE FLATTERY (E½); 92C (E½)
1:250 000


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