GEOLOGY OF THE McDAME TUNGSTEN SKARN PROSPECT

(104P/5)

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INTRODUCTION

The McDame tungsten skarn prospect (MDI No. 104P/004) lies approximately 6 kilometres north of Cassiar in northern British Columbia (Figure 1). Road access is available from Cassiar via the Cassiar Asbestos mine road and a four-wheel-drive track. The property, consisting of 10 claims and 109 units, is presently under option to Shell Canada Resources Ltd. Two main zones of economic interest have been identified: the A zone, on which the Kuhn tungsten-molybdenum skarn showing occurs, and the B zone, which includes the Dead Goat tungsten skarn and the Contact lead-silver vein occurrences (Figure 1).

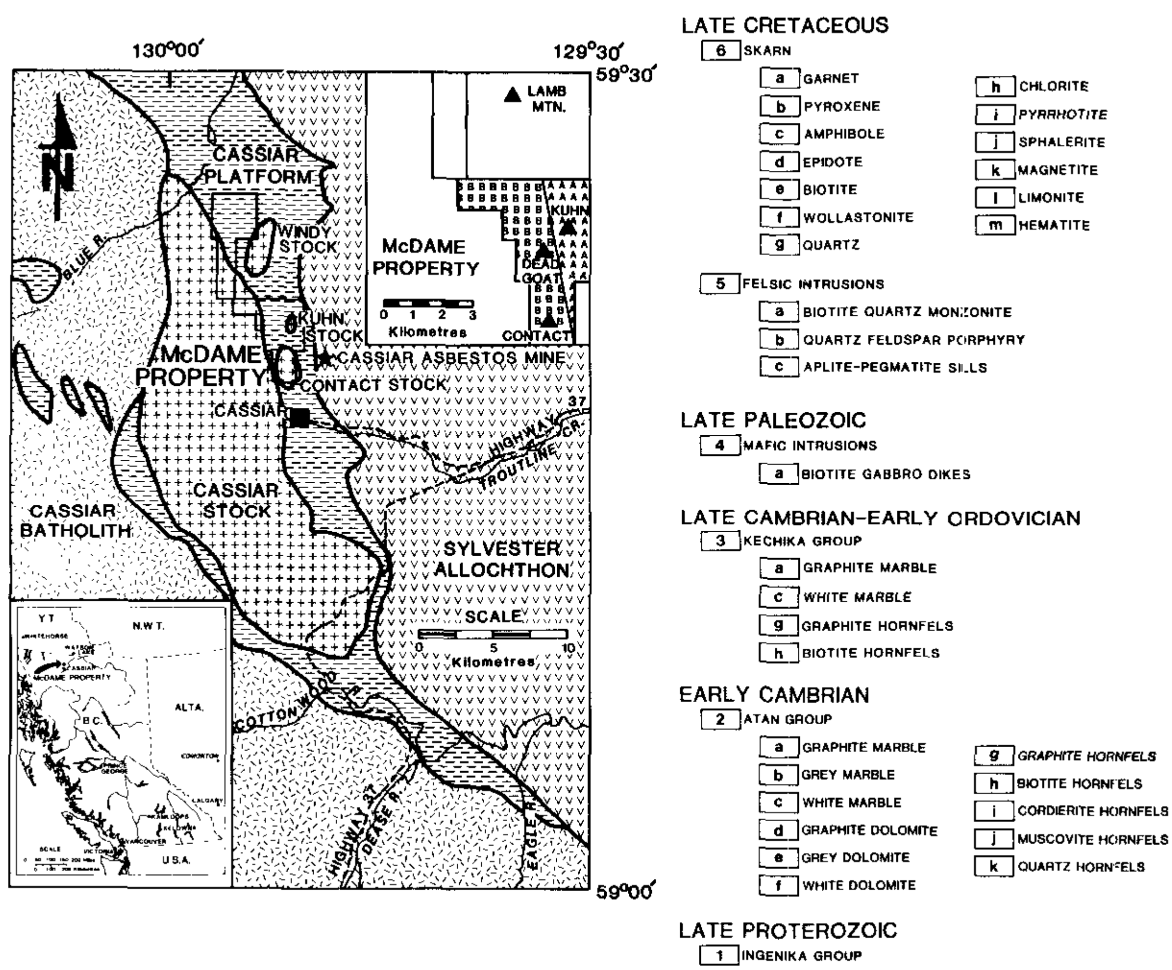

Figure 1. Regional geology of the Cassiar area (modified from Panteleyev, 1978, 1979) and setting of the McDame property.

TABLE 1. REGIONAL CORRELATION OF GEOLOGICAL UNITS

TECTONIC ELEMENT, AGE AND GROUP	GABRIELSE 1963	PANTELEYEV 1979	MANSY 1978	FRITZ 1980	THIS REPORT
					Unit 6 - skarn
			Contact		
Cassiar Complex Late Cretaceous Cassiar Intrusions	quartz monzonite, granodiorite, granite, porphyry, aplite, pegmatite	porphyritic biotite quartz monzonite Unit A - coarse grained Unit B - mantled Unit C - quartz feldspar porphyry Unit D - medium grained			Unit 5 a) biotite quartz monzonite b) quartz feldspar porphyry c) aplite-pegmatite sills
			Intrusive Contact		
Middle Mesozoic					Unit 4 a) lamprophyre dikes
			Intrusive Contact		
Sylvester Allochthon Devonian- Permian Sylvester Group	greenstones, sediments	Unit E - diorite also greenstones			
			Fault Contact		
Cassiar Platform Cambrian-Ordovician Kechika Group	Upper - black shale, slate, minor limestone Lower - limestone phyllite, minor conglomerate (330-820 m Upper and Lower)	shale, slate		siltstone, shale	Unit 3 a-graphite marble b-white marble g-graphite hornfels n-biotite hornfels (>520 m)
			Conformable Contact		
Cassiar Platform Lower Cambrian Atan Group	Upper - limestone, dolomite, minor shale	Upper - dolomite, marble, limestone, minor slate	quartzite, siltstone, shale, limestone	Rosella Formation limestone, minor dolomite, shale, basal sandstone (693 m)	Unit 2 a-graphite marble b-grey marble c-white marble d-graphite dolomite e-grey dolomite f-white dolomite (< 140 m)
	Lower - quartzite, argillite, slate, shale, siltstone, conglomerate (980 m Upper and Lower)	Lower - hornfels, argillite, quartzite		Boya Formation quartzite, siltstone, shale (400 m)	g-graphite hornfels h-biotite hornfels i-cordierite hornfels j-muscovite hornfels k-quartz hornfels (< 380 m)
			Conformable Contact		
Cassiar Platform Hadrynian-Cambrian Ingenika Group	Good Hope Group limestone, dolomite, quartzite sandstone siltstone, argillite, shale, slate, limestone (> 1310 m)	Good Hope Group Upper - marble, limestone Lower - hornfels, quartzite, phyllite, schist, skarn	Stelkuz Formation shale, siltstone, sandstone (293 m) limestone, dolostone (125 m) redbed limestone, dolostone, slate (86 m) slate, minor limestone (529 m)	siltstone, minor quartzite, shale	Unit 1 i-cordierite hornfels (<400 m) marble, dolomite (100 m) hornfels, marble, skarn (>200 m)

Early prospecting in the Cassiar area concentrated on gold placer and asbestos vein deposits. The Contact vein was explored in 1954 by the Harvest Queen Mill and Elevator Company (McDougall, 1954). Fort Reliance Minerals later attempted to high-grade the vein (Minister of Mines, B.C., Ann. Rept., 1962) and in 1961 discovered the Lamb Mountain (MDI No. 104P/003) tungsten-molybdenum skarn showing north of the McDame property A zone (Cook, et al., 1979). Prospector B. Kuhn restaked the Lamb Mountain prospect in 1977 for Union Carbide and subsequently discovered similar mineralization on strike to the south (the Kuhn and Dead Goat showings on the McDame property).

REGIONAL GEOLOGY

The geology of the Cassiar area has been mapped on a regional scale by Gabrielse (1963) and Panteleyev (1978, 1979). Three major lithotectonic elements have been identified (Figure 1):

(1) Cassiar platform, a miogeoclinal continental terrace wedge developed along the eastern margin of the North American craton in Late Proterozoic to Early Paleozoic times (Monger, et al., 1979).

(2) Sylvester allochthon, an oceanic basin assemblage tectonically emplaced in Middle Mesozoic times (Monger, et al., 1979).

(3) Cassiar complex, a Late Mesozoic plutonic complex, probably related to anatexis of continental crust (Tempelman-Kluit, 1979).

Gabrielse (1963) showed that the Cassiar complex lies in the core of a northwest-trending anticlinorium flanked on the east by the Cassiar platform, which forms the southeast-plunging McDame synclinorium. The Sylvester allochthon now occupies the core of the synclinorium (Figure 1).

PROPERTY GEOLOGY

Rocks on the McDame property have been subdivided into six main units (Table 1). Lower Hadrynian to Lower Ordovician Ingenika, Atan and Kechika Group metasedimentary rocks (Units 1 to 3 respectively) are crosscut by minor Mesozoic mafic intrusions (Unit 4) and Late Mesozoic felsic intrusions (Unit 5). Skarn (Unit 6) occurs along favourable stratigraphic horizons in the metasedimentary rocks near the felsic intrusions.

The stratigraphy forms the upright and steeply east-dipping western limb of the McDame synclinorium. Minor folding was observed but the main foliation, lineation, and fracture directions correspond respectively with the axial plane, fold axis, and a-c joints of the McDame synclinorium. Only one fault with an apparent left-hand strike offset of about 120 metres was mapped in the A zone (Figure 2).

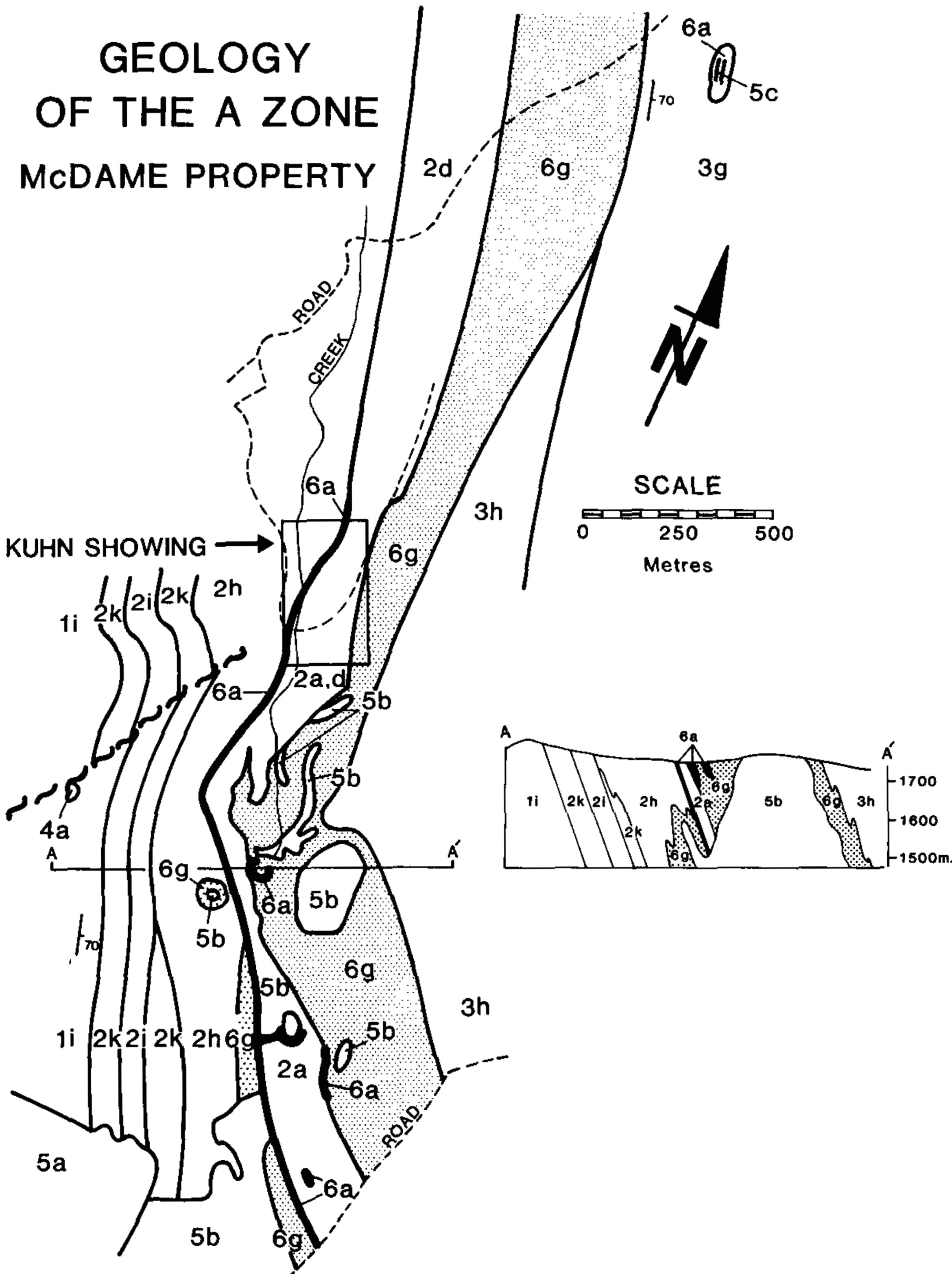

Figure 2. Geology of the A zone.

INGENIKA GROUP

Ingenika Group rocks underlie the B zone and contain the Dead Goat and Contact showings (Figure 1). These rocks represent the westernmost exposures of stratified rocks on the McDame property and are divided into three metasedimentary units. From west to east these are:

(1) interbanded biotite hornfels, white marble, and garnet-pyroxene skarn; these form the country rocks in contact with felsic intrusive rocks of the Cassiar stock to the west.

(2) banded graphite marble and massive grey marble that make up a carbonate band which contains rare patches of zebra-textured graphitic dolomite and pods of concentrically banded structures up to 20 centimetres across (stromatoporoids ?).

(3) spotted cordierite hornfels (Unit 1i, Figure 2) that forms a thick unit with minor biotite and muscovite hornfels bands and rare white marble bands.

These three rock bands correlate respectively with the redbed, carbonate, and clastic layers in the upper part of the Stelkuz Formation mapped by Mansy (Mansy, et al., 1978; Mansy, 1979) elsewhere in the Cassiar Mountains (Table 1).

ATAN GROUP

Atan Group rocks underlie the western part of the A zone and contain the Kuhn showing (Figure 1). The strata are conformable with the Ingenika Group and consist of two metasedimentary units. From west to east these are:

(1) interbanded hornfels that form a thick band which includes the following lithologies:

> Banded biotite hornfels, Unit 2h, is rusty weathering, brown, and very fine grained, with minor cordierite, quartz, or muscovite hornfels layers.
>
> Spotted cordierite hornfels, Unit 2i, is rusty weathering, brown to grey, foliated, very fine grained, and porphyroblastic, with minor biotite or quartz hornfels; disseminated pyrrhotite is common.
>
> Foliated muscovite hornfels, Unit 2j, is bleached weathering, tan, and aphanitic, and generally forms partings in quartz hornfels.
>
> Massive quartz hornfels, Unit 2k, is rusty weathering, white, and very fine grained, with moderate muscovite hornfels bands and minor cordierite or biotite hornfels bands; quartz-tourmaline veins and pods are common.

(2) interbanded marble and dolomite form a carbonate band which includes the following lithologies:

Banded graphite marble, Unit 2a, is grey weathering, black to white, and medium grained, with moderate grey or white marble bands and rare hornfels bands.

Massive grey marble, Unit 2b, is grey weathering and medium grained and is almost pure calcite.

Massive white marble, Unit 2c, is grey weathering and coarse grained and occurs as bleached fracture envelopes or bands within the other marbles.

Zebra graphite dolomite, Unit 2d, is tan weathering, black to white, fine grained and sucrosic, with moderate grey or white dolomite bands, minor marble or hornfels bands, and rare dolomite breccias or nodular pods; the breccias contain concentrically layered structures (stromatoporoids ?) and the pods contain elongate ovoid structures up to 5 centimetres long (Archeocyathids ?); well-developed zebra texture is characteristic of this rock.

Mottled grey dolomite, Unit 2e, is tan weathering, fine grained, and sucrosic and is almost pure dolomite.

Massive white dolomite, Unit 2f, is tan weathering, fine grained, and sucrosic and occurs as bleached fracture envelopes or bands within the other dolomite.

Banded graphite hornfels, Unit 2g, is grey weathering, black, and aphanitic and forms rare bands within marble or dolomite; disseminated pyrrhotite is common.

The two metasedimentary units of the Atan Group are lithologically similar to clastic and carbonate sedimentary rocks of the Boya and Rosella Formations as mapped by Fritz (1978, 1980) elsewhere in the Cassiar Mountains (Table 1).

KECHIKA GROUP

Kechika Group rocks underlie the eastern part of the A zone (Figure 1). The rocks are conformable with the Atan Group and consist of banded hornfels, with minor marble, including the following lithologies:

Banded graphitic hornfels, Unit 3g, is similar to Unit 2g.

Banded biotite hornfels, Unit 3h, is similar to Unit 2h.

Banded graphitic marble, Unit 3a, is similar to Unit 2a.

Massive white marble, Unit 3c, is similar to Unit 2c.

These rocks are lithologically comparable with clastic and carbonate rocks of the Kechika Group as mapped by Gabrielse (1963) and Panteleyev (1978, 1979, 1980) near Cassiar (Table 1).

MAFIC INTRUSIONS

Mafic intrusions occur as dykes cutting the older stratified rocks (Figure 2):

> Massive lamprophyre dykes, Unit 4a, are green, very fine grained, and subophitic to porphyritic with biotite; chilled margins; in places, there is a strong foliation.

Fractures in the lamprophyre occasionally contain skarn surrounded by bleached envelopes, suggesting that the mafic intrusions are older than skarn. They are probably of Middle Mesozoic age.

FELSIC INTRUSIONS

Felsic intrusions occur as four discrete stocks on the McDame property (Figure 1) and contain three different lithologies:

> Biotite quartz monzonite, Unit 5a, is pink, coarse grained, and porphyritic with K-feldspar mantled by Na-feldspar (rapakivi texture). This unit is typical of the Cassiar and Contact stocks.
>
> Quartz feldspar porphyry, Unit 5b, is grey, fine grained, and strongly jointed; biotite and hornblende are accessory minerals in the Kuhn stock and quartz-muscovite patches occur in the Windy stock.
>
> Aplite and pegmatite sills, Unit 5c, are white, fine to coarse grained, and equigranular; they cut both the sedimentary and other plutonic rocks.

Units 5a and 5b and lithologically comparable with Panteleyev's (1978) Units B and C respectively as mapped in the Cassiar area (Table 1).

SKARN

Skarn forms several bands on the McDame property (Figure 2) and is classified into six main facies:

(1) Massive calc-silicate skarn occurs as semi-continuous zones up to 10 metres thick along the western contacts of the carbonate bands in the Ingenika and Atan Groups. This skarn type also forms lenses along the eastern contacts of the two carbonate bands and within the carbonates themselves. The following lithologies were observed:

Massive garnet skarn, Unit 6a, is red to brown and coarse grained, with a faint banding occasionally apparent from variations in grain size and mineralogy. This unit is the most common massive calc-silicate skarn on the property.

Massive pyroxene skarn, Unit 6b, is green to white and coarse grained; it generally occurs in the A zone as narrow bands in garnet skarn or as bands separating garnet skarn from country rocks.

Massive amphibole skarn, Unit 6c, is white and very coarse grained and occurs as small pods in dolomite near quartz feldspar porphyry dykes in the A zone.

Massive epidote skarn, Unit 6d, is green and medium grained and forms rare bands associated with garnet skarn and quartz skarn in the A zone.

Spotted biotite skarn, Unit 6e, is variable in colour and grain size; it occurs as rare bands in the A zone between Atan Group marble and hornfels where garnet skarn is absent.

Banded wollastonite skarn, Unit 6f, is white and very coarse grained; it is found only in one outcrop of Kechika graphite hornfels and white marble at the north end of the A zone.

(2) Banded calc-silicate skarn forms two major bands on the McDame property:

Banded quartz skarn, Unit 6g, is light coloured and aphanitic to fine grained; textures in this unit reflect original features. Quartz skarn in Kechika Group hornfels forms narrow, bleached quartz and calc-silicate-rich envelopes on bedding plane and a-c joint fractures. Where fracture density is high, the original rock can be bleached throughout; near the Kuhn stock, the quartz skarn forms a distinct alteration halo and the Kechika Group rocks are generally brecciated, with banded quartz skarn to biotite hornfels fragments enclosed in a siliceous matrix containing disseminated sulphides; two other minor quartz skarn zones occur in Atan Group hornfels in the southern part of the A zone and are associated with quartz feldspar porphyry dykes. Banded calc-silicate skarn within the Ingenika Group in the B zone discrete fine-grained calc-silicate bands with bleached quartz-rich envelopes and remnant biotite hornfels and white marble bands.

(3) Vein sulphide skarn fills fractures in Atan Group dolomites in the A zone north of the Kuhn showing and includes: vein chlorite skarn, and Unit 6h which is green and fine grained, with disseminated and vein pyrrhotite and pyrite.

(4) Massive sulphide skarn forms pods and veins up to 1 metre thick in massive garnet or pyroxene skarn. The following units are defined:

Massive pyrrhotite skarn, Unit 6i, that is bronze and coarse grained, with minor disseminated chalcopyrite; this is the most common type of massive sulphide skarn.

Massive sphalerite skarn, Unit 6j, which is black and coarse grained and commonly intergrown with pyrrhotite; sphalerite is most common south of the Kuhn and Dead Goat showings in the A and B zones.

(5) Vein oxide skarn forms a unique set of fracture fillings in Atan Group dolomites north of the Kuhn showing in the A zone and includes banded magnetite skarn, Unit 6k, which is black to green and fine grained and commonly contains sulphide and calc-silicate minerals. This facies locally forms bands between dolomite and massive garnet or pyroxene skarn.

(6) Gossan oxide skarn is simply the weathering product of massive and vein sulphide and oxide skarns and consists of the following:

Goethite skarn, Unit 6i, is yellow to brown, fine grained, and earthy.

Hematite skarn, Unit 6m, is red to brown, fine grained, and earthy.

MINERALIZATION

Mineralogy and texture vary in both the A and B zones. At the Kuhn showing, scheelite, powellite, and molybdenite, associated with minor pyrrhotite, pyrite, calcite, quartz, and fluorite, form coarse-grained disseminations and veins in massive garnet and pyroxene skarn. North of the Kuhn showing, powellite and scheelite occur as fine-grained disseminations and veins within vein chlorite and magnetite skarn. South of the Kuhn showing, significant disseminated scheelite is found with massive pyrrhotite skarn, but only minor scheelite is found in the more sphalerite-rich skarn toward the south end of the A zone. A similar change in mineralogy occurs in the B zone. Significant disseminated scheelite occurs in massive garnet, pyroxene, and pyrrhotite skarns at the Dead Goat showing, but only minor scheelite is found with massive pyrrhotite and sphalerite skarns toward the south end of the B zone.

CONCLUSIONS

On a regional scale (Figure 1) metamorphism, metasomatism, and mineralization in the Cassiar area are all spatially related to felsic intrusions. These intrusive rocks are acidic, porphyritic, and jointed. They represent high-level, late differentiates of granitic magma. On property scale, skarn and ore minerals are concentrated along favourable stratigraphic horizons (Figure 2). The country rocks are interbedded clastic and carbonate beds typical of continental shelf sedimentary rocks in a cratonic environment.

Mineralized zones containing tungsten-molybdenum, tungsten-copper, and tungsten-zinc occur within massive calc-silicate and sulphide skarn along major marble-hornfels contacts in the Ingenika and Atan Groups. Banded calc-silicate skarn forms several zones, normally barren of mineralization, in hornfels of the Ingenika, Atan, and Kechika Groups adjacent to the Cassiar and Kuhn stocks. Minor amounts of tungsten mineralization are contained in vein sulphide and oxide skarns that fill fractures within Atan Group dolomites.

Detailed study of these skarn deposits is in progress. However, field mapping indicates the following to be significant exploration parameters:

(1) Favourable country rocks are composed of interbedded carbonate and clastic sedimentary rocks that contain major elements such as silica and calcium that are necessary for skarn formation. Bleached hornfels zones are a potential source of iron, zinc, and sulphur and bleached marble and dolomite are potential sources of sulphur.

(2) Favourable intrusive rocks are felsic stocks of anatectic origin. These are capable of supplying lithophile and atmophile elements such as tungsten, molybdenum, fluorite, oxygen, and sulphur to the mineralizing fluids (Godwin, et al., 1980).

(3) Extensive skarn development in hornfels (for example quartz skarn) indicates proximity to favourable intrusive rocks whereas skarn between marble and hornfels (for example, garnet skarn) defines favourable stratigraphic horizons.

(4) Minor tungsten-zinc mineralization within massive skarn (for example, pyrrhotite skarn) may mark the distal end of a zoned hydrothermal system which contains proximal tungsten-molybdenum mineralization.

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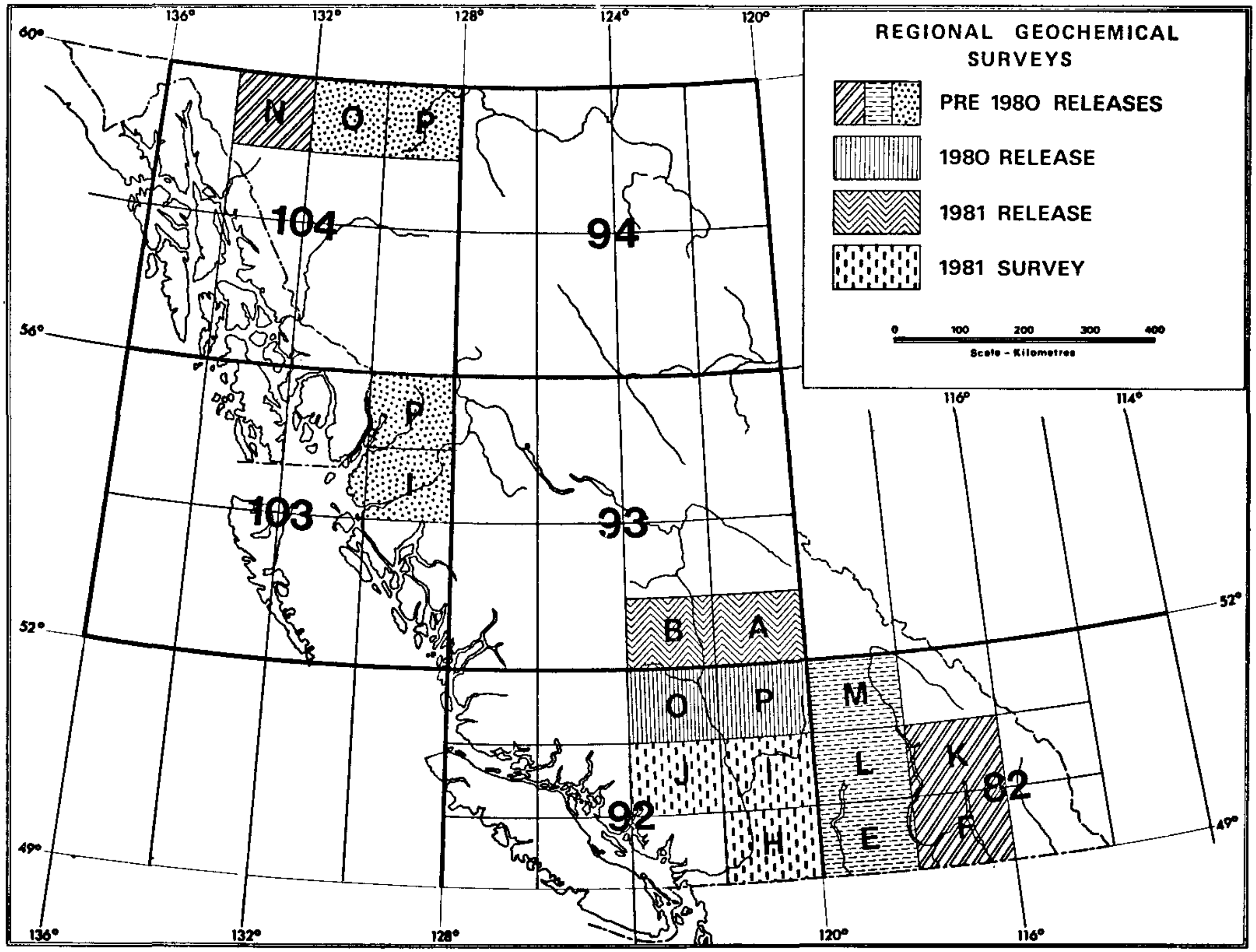

Figure 1. Index map - regional geochemical surveys.