82M 150

005024

GEOLOGY OF THE CARBIDE

CARBONATE HOSTED Ag-Zn-Pb DEPOSIT,

SHUSWAP TERRANE,

EAST CENTRAL B.C.

by

GORDON LEASK

NTS: 82M/10E; lat. 51.5 north, 119.0 west

REVELSTOKE MINING DIVISION

April, 1984

GEOLOGY OF THE CARBIDE CARBONATE HOSTED AG-ZN-PB DEPOSIT SHUSWAP TERRANE, EAST CENTRAL B.C.

by

GORDON LEASK

ABSTRACT

The Carbide Property is a stratabound, carbonate hosted Ag-Zn-Pb occurrence located 85 km north of Revelstoke in the Central Monashee Mountains, central-eastern British Columbia. The deposit is located within a thick sequence of Lower Cambrian metasedimentary rocks.

Results of this study indicated the following:

1) Carbide deposit is a stratabound carbonate hosted deposit.
2) Grades of the deposit increase to the east, possibly because it is more proximal to the source of the metals in this direction.
3) An exploration drill target exists to the northeast of the Carbide showing. This target was determined by structural projections (Fig.6).

4) Most of the deposits in the Shuswap Terrane are within the calcsilicate horizon. This is not the case with the Carbide deposit which is hosted in the carbonate (marble) horizon.
5) Carbide deposit is situated on the upper limb of a major Phase 1 recumbent fold.
6) Mineralization within the marble occurs as elongate pods, up to 2m by 10m in length and with average grades of Ag 60.8 g/tonne, Zn 5%, and Pb 2.7 %.

The Carbide property is a recent discovery. It appears to be a showing of economic significance.

ABSTRACT

The Carbide Property is a stratabound, carbonate hosted Ag-Zn-Pb occurrence located 85 km north of Revelstoke in the Central Monashee Mountains, central-eastern British Columbia. The deposit is located within a thick sequence of Lower Cambrian metasedimentary rocks.

Results of this study indicated the following:

1) Carbide deposit is a stratabound carbonate hosted deposit.
2) Grades of the deposit increase to the east, possibly because it is more proximal to the source of the metals in this direction.
3) An exploration drill target exists to the northeast of the Carbide showing. This target was determined by structural projections (Fig. 6).
4) Most of the deposits in the Shuswap Terrane are within the calcsilicate horizon. This is not the case with the Carbide deposit which is hosted in the carbonate (marble) horizon.
5) Carbide deposit is situated on the upper limb of a major Phase 1 recumbent fold.
6) Mineralization within the marble occurs as elongate pods, up to 2m by 10m in length and with average grades of Ag 60.8 g/tonne, Zn 5%, and Pb 2.7 %.

The Carbide property is a recent discovery. It appears to be a showing of economic significance.

CHAPTER I. INTRODUCTION

The Carbide property, at the head waters of North Fissure Creek, is within the Monashee Mountains of the Ominica Crystalline Belt (Fig. 3). Several stratabound, carbonate hosted and massive sulphide deposits occur within this region. The Carbide property is a stratabound carbonate hosted Ag-Zn-Pb deposit. Lithologies within the project area (Fig. 5) are shallow dipping and include metasedimentary quartzites, calcsilicates, carbonatite, gneisses, biotite-sillimanite schist, and marble.

This thesis presents a geological map and interpretation of the map, and a polished section analysis which has been described in detail and used extensively in the study.

Geologic mapping has outlined the host horizon of the mineralization. Galena and sphalerite are present in large quantities with tetrahedrite, pyrite and chalcopyrite existing in subordinate amounts.

The Carbide property is anomalous for the region because significant silver (up to 310 g/tonne) is present. This contrasts with the minor silver content of the other stratabound occurrences within the same host sequence.

I.1. Location, Access and Physiography

The Carbide property, located within the northern Monashee Mountains, 85 km north of Revelstoke (NTS: 82M10E; latitude 51.5 north, longitude 119 west, elevation 2,000 m). Carbide claim group consists of 20 units (a 4 west by 5 south claim block) located at the headwaters of North Fissure Creek (Fig. 2).

Access to the Carbide property is by foot along the north slopes of North Fissure Creek. There are no existing trails and the going is difficult. Convenient access is facilitated by several helicopters based in either Revelstoke or Kamloops. Steep cliff forming ridges and deep V-shaped valleys typify the the rugged Alpine topography of the Monashee Mountains. Tree line is at approximately 1,600 m elevation, above which bedrock exposures are abundant. Dense vegetation within the valley makes walking difficult. Snow cover often exeeds 3 m in winter months which makes viewing of the Carbide property possible from mid May to late October only.

I.2 Exploration History

The Carbide property was aquired in the early spring of 1983 by J.M. Leask of 4,200 Mayberry Street, Burnaby B.C. A total of 20 units were staked, using the modified grid method, to encompass the mineralized horizon and geologically promising areas. Geologic mapping at a scale of 1:10,000 was done during the 1983 field season by the writer with the aid of J.M. Leask. Prospecting was conducted to

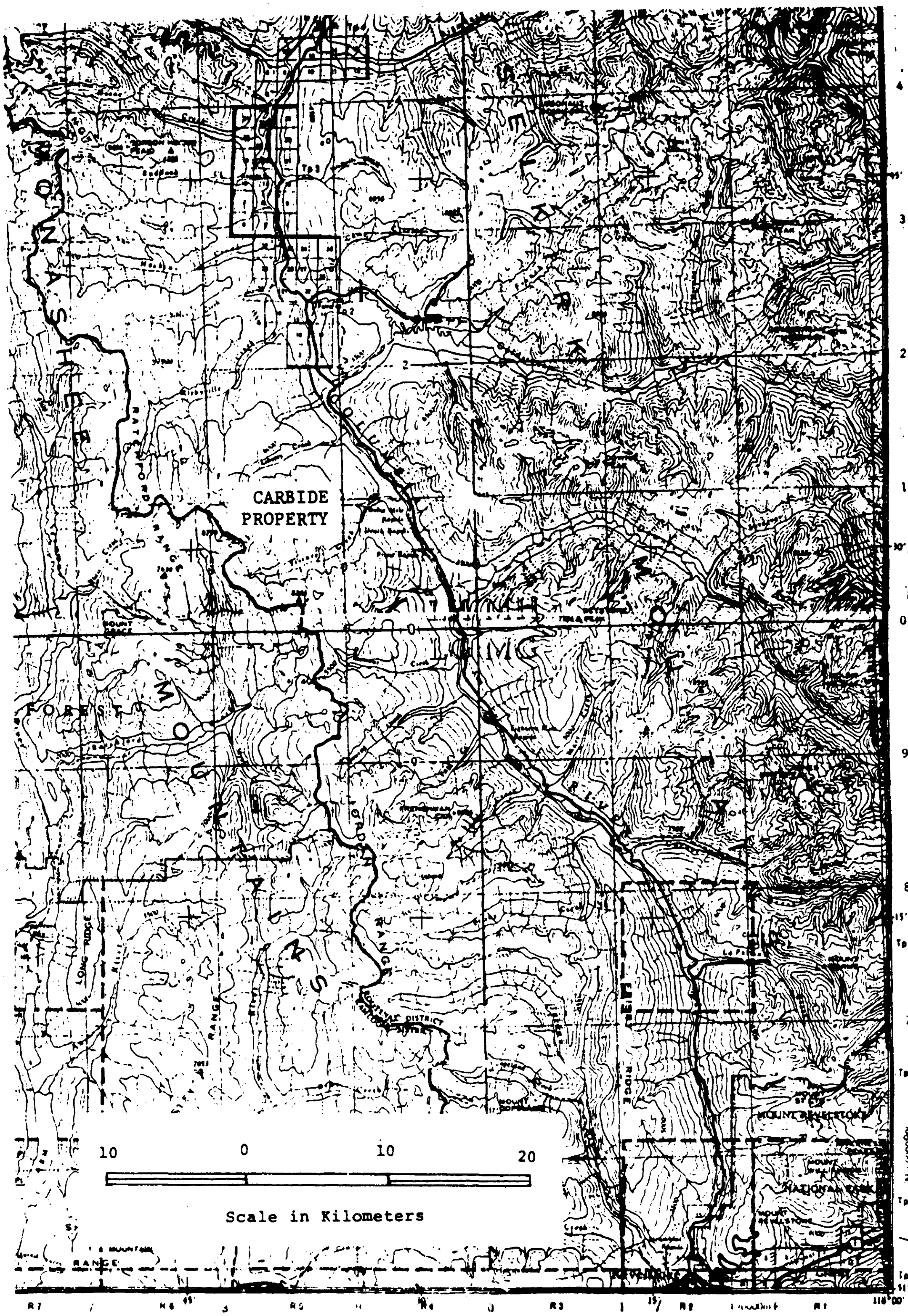


Figure 1. Location Map of the Carbide Deposit Central Eastern British Columbia.

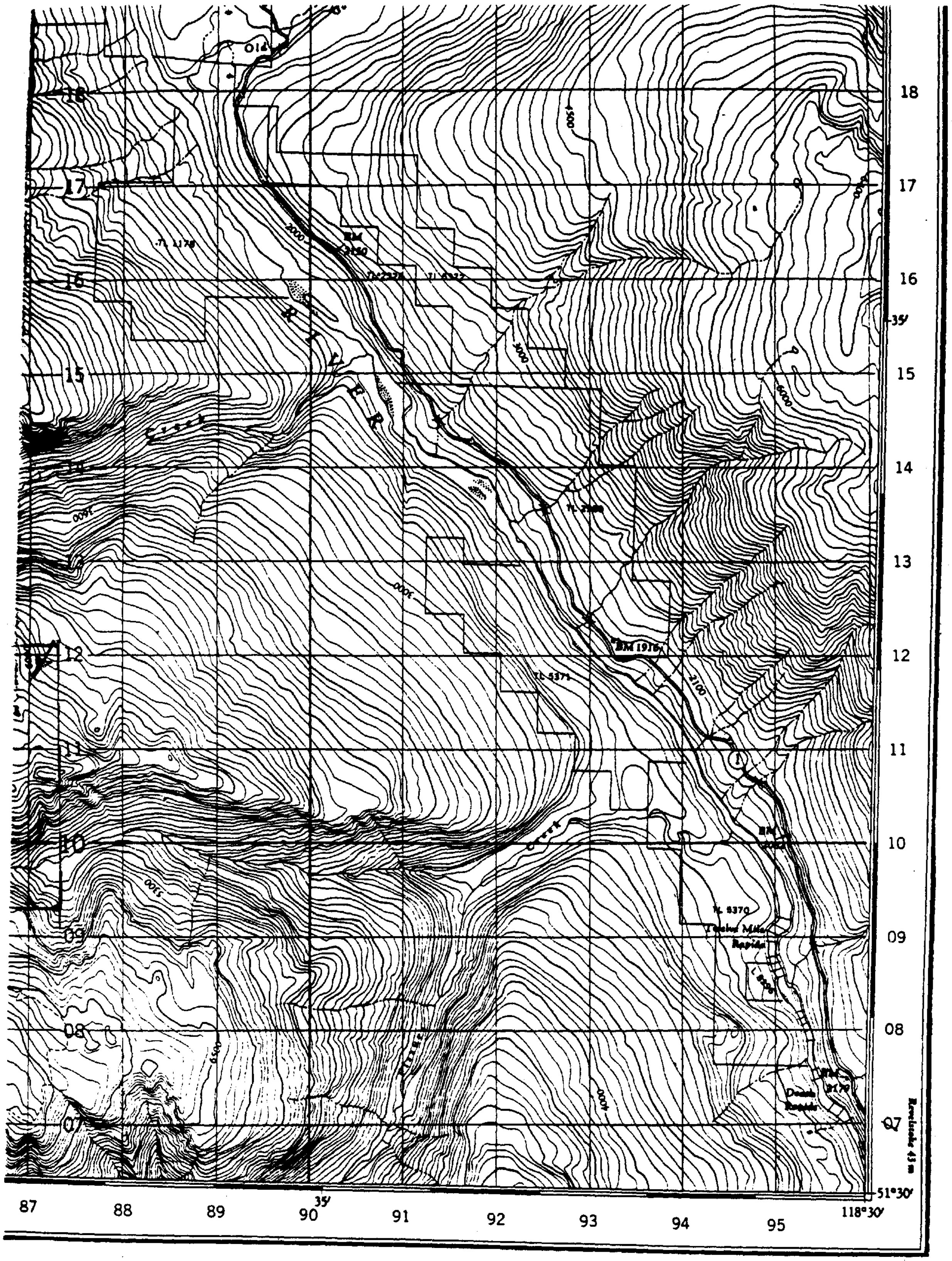
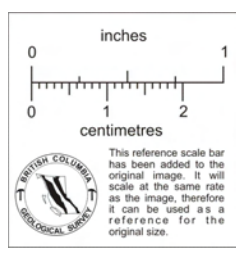


Figure 2. Location Map of Carbide Claim Group.



extend the strike length of the known occurrence. Several grab samples of the mineralized horizon were gathered during field mapping and were later studied in the laboratory to help determine the genesis of the mineralization.

I.3 Previous Geological Exploration Work

Mineralization on the Carbide property was discovered in 1966 by Cominco Ltd. They conducted geologic mapping of the mineralized horizon only, and did not attempt to delineate the controlling geologic structure.

No drilling has been carried out on the Carbide property to date. Several assays of the mineralized horizon, and several soil samples below the horizon were taken in 1966 (Table 3). No geologic exploration work on the Carbide property exists prior to the work done by Cominco Ltd.

I.4 Analysis and Recommendations

The Carbide deposit is a stratabound, carbonate hosted, Ag-Zn-Pb deposit which varies in thickness from 0.7 m to 2.0 m. Mineralization is not continuous over the entire 1,800 m strike length, rather, the mineralization occurs as elongate pods with silver, zinc, and lead values increasing along strike to the east. This may indicate that the source of metal is more proximal to the eastern portion of the deposit. (Strike length of the mineralized horizon was extended in 1983 to at least 1,800 m. Strike length of the deposit has not been delineated due to lack of time and difficulty of access to the area to which the deposit was trending.) Grades of the Carbide deposit range as high as ; 15.0% Pb, 23.4% Zn, 310 g Ag/tonne (Table 4) with an average grade of 2.7% Pb, 5.0% Zn, and 60.8 g/tonne Ag. Tonnage estimates cannot be made until holes are drilled to test the mineralized horizon in the down dip extension to the north. Geologic examination resulted in the conclusion that this occurrence falls within the criteria for a silver rich zinc-lead carbonate hosted deposits known as "Alpine type" (B. Price, personal communication). Major examples of this type of deposit are Midway on the B.C.- Yukon border, Pioche Camp in Neveda, and Leadville in Colorado. In these camps the mineralization is associated with major faults which act as conduits for the ore forming metal bearing fluids to travel in. As a result of this interpretation further work on the Carbide property is warranted.

I.5 Acknowledgements

The writer appreciates the help and cooperation of J.M. Leask, Chris Wild, Mike Davies, and C. I. Godwin of The University of British Columbia.

CHAPTER II. REGIONAL GEOLOGY

II.1. Tectonic Setting

Frenchman cap is one of several gneiss domes within the Shuswap Metamorphic Complex. The origin of these core complexes is not known in detail (Davis and Coney 1979), although an Aphebian age for the basement rocks of the Frenchman cap gneiss dome has been proposed by Brown(1979)who also suggested that these gneiss domes may have been part of Cratonic North American basement. Proterozoic to Paleozoic (?) mantling gneiss of the Shuswap Terrane overlies the gneiss dome.

Primary sedimentary features are only locally preserved in the allocthonous cover rocks but the presence of cross bedded sandstones, rapid facies changes of calcareous muds and clastics, combined with the laterally continuous fetid white marble indicates a shallow marine platform environment. It has been theorized (Brown 1979) that the Shuswap Terrane lay offshore from North America in Proterozoic to Paleozoic time. Subsequently it slid over the basement in Jurrasic time resulting in a major event that deformed the allocthonous cover. This deformation and metamorphism are related to the closing of a marginal basin that between North America and the Shuswap Terrane (R.L. Brown 1979).

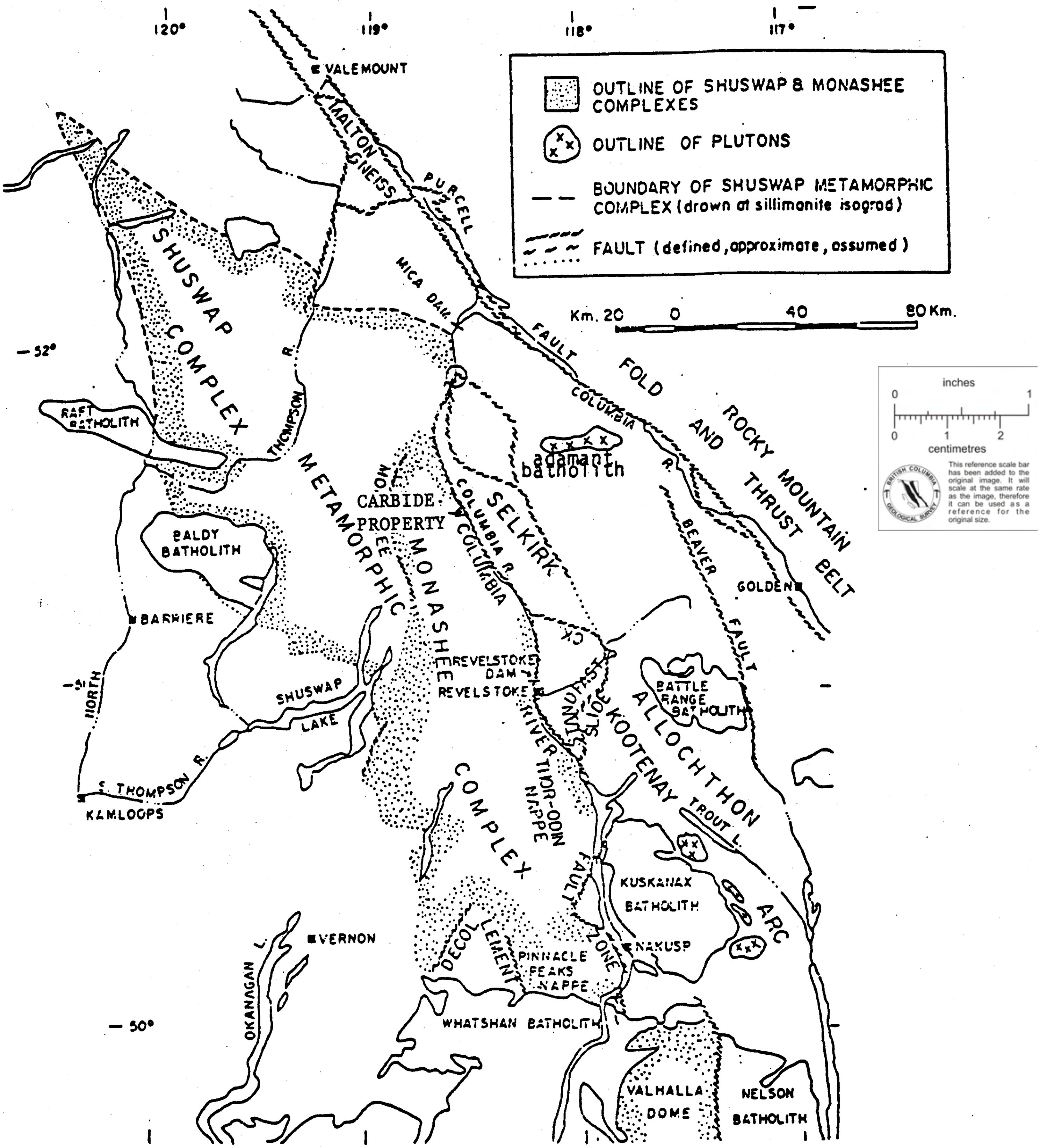
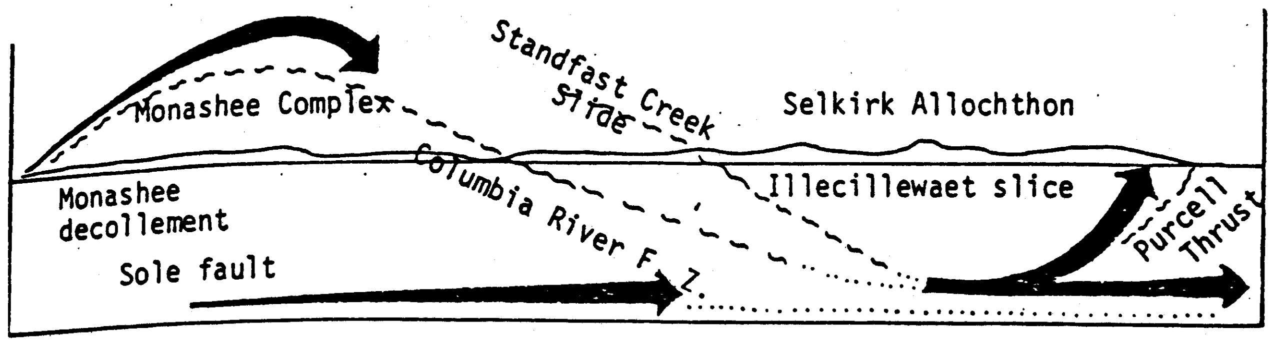


Figure 3. Regional Tectonic Map of the Shuswap and Monashee Metamorphic Complexes, and the Selkirk Allochthon, southeastern British Columbia. (The Carbide property is within the Monashee Complex) (Read and Brown, 1981)

SW NE



(After Read and Brown, 1981)

Time	Fault Movement in the Columbia River Fault Zone
45-75 Ma	Late displacement of the Columbia River Fault Zone; listric normal faulting. Eastward movement on Sole fault beneath Shuswap and Monashee Complexes and Selkirk Allocthon.
141± 16 Ma	Early eastward displacement of Selkirk Allocthon along Columbia River Fault Zone.
150 Ma	Early eastward displacement of the Columbia River Fault Zone and Monashee decollement.
160± 10 Ma	Earliest displacement of the Standfast Creek Slide. Illecillewaet slice moved eastward relative to the Clachnacudainn slice.

Figure 3a. Regional Tectonic Movement of the Shuswap and Monashee Metamorphic Complexes.

II.2. Regional Stratigraphy

Portions of two major tectonic elements of the Columbian Orogen underlie the area of interest (Fig.3a). These are the core gneiss of the Shuswap Complex ~~, the~~ and mantling rocks in the northwest and the core gneiss of the Monashee Complex and mantling rocks in the Southeast.

Core-Gneiss: Felspar-augen gneiss characterizes the deepest exposed levels of both Shuswap and Monashee complexes. This in turn is overlain by paragneiss composed of semipelite, psammite, and amphibolite. This core gneiss is radiometrically dated by Rb-Sr methods to an Aphebian age (2.1 $\pm$ .09 Ga).

Allocthonous Cover (Upper Hadrynian to Lower Cambrian and Younger): Core gneisses are overlain by an allocthonous cover comprized mainly of clastics and carbonates. Basal quartzite rests with structural unconformity on the basement gneiss.

Recent work has demonstrated that a simple breakdown into stratigraphic units is complicated by facies changes. Rocks overlying the basal quartzites are calcsilicates, psammites, pelites, semipelites, and minor talc-actinolite-biotite schist. This distinct sequence hosts all known stratabound sulphide deposits and will be referred to here as the "lead-zinc sequence". Lying above this sequence is a fetid white marble unit tentatively correlated with the Lower Cambrian Badshot Formation.

Stratigraphy: The following units have been identified and are mapped on Figure 4.

Unit 1. Mixed Gneiss: Includes various granitic gneisses of which the most common is medium grained, medium to dark grey K-feldspar augen gneiss. Locally, lenticular masses of dark green to grey biotite gneiss are present.

Unit 2. Paragneiss: This unit consists of interbedded semipelite, amphibolite and psammite.

Unit 3. Quartzite, Conglomerate and Semipelite: Consists of a 3 meter thick lenticular quartz pebble conglomerate at the base overlain by a white quartzite with interbedded rusty weathering schists.

Unit 4. Calcsilicate, Sillimanite-Biotite Schist (pelite); Zinc-Lead-Barite, Marble: Rocks of Unit 4 are medium-grained brown weathering biotite-sillimanite schists. They rarely contain thin layers of cream colored marble overlain by calcsilicate, quartzite, and mica schist. The lower portion of the calcareous division hosts the bedded zinc-lead sulphides. This calcareous division is immediately overlain by the distinctive "fetid white marble" which is associated with carbonatite. These carbonatites occasionally host rare earth elements, niobium and tantalum.

Unit 5: Consists of pelite with minor calcsilicate and grit.

Unit 6: This unit is quartzite that is locally interbedded with amphibolite, and amphibolite with minor quartzite.

Unit G. Granitic Intrusions: Granitic intrusions in the area include:
a) sill-like masses of leucogranite, biotite granite and granodiorite;
b) porphyritic granite gneiss is greyish-white, medium to coarse grained, granitic rocks with porphyroblasts of potash feldspar.

Unit A. Syenite Gneiss: Grey, medium-grained, locally calcareous, is widespread in the southern portion of the area of interest. It occurs with or without nepheline, muscovite, biotite, aegerine, aegerine augite, or hornblende.

Interstitial calcite and accessory apatite, sphene, zircon, fluorite and magnetite are common.

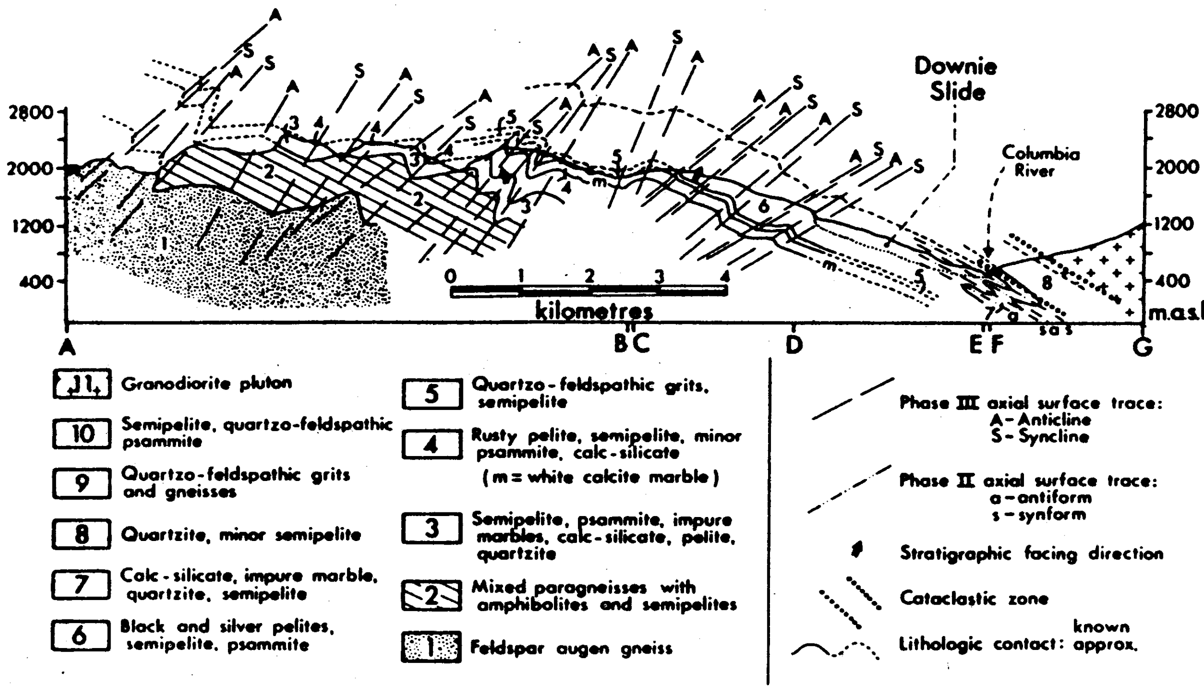
Lamprophyre Dykes: Dark grey to brown dykes, called lamprophyres, are common throughout the area. Thicknesses range from a few centimeters to 3 meters. Many have aphanitic and porphyritic phases. Mineral constituents include biotite, pyroxene and feldspar, and minor olivine and hornblende.

Carbonatites: Two types of carbonatite occur within the area

TABLE 1. REGIONAL LITHOLOGY AGE CORRELATION

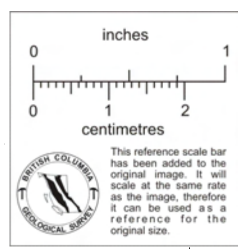
Stratigraphic Sequence	UNIT	Rock Types
Devonian	G	Granitic rocks
	A	Nephaline Syenite Gneiss
Lardeau	6	Quartzite with Amphibolite
	5	Pelite with minor calcsilicate and grit
Badshot Fm. (L. Cambrian)	4m	White fetid marble
	4	Calcsilicate, Sillimanite-schist, sulphide
Horsethief Creek (Hadrynian)	3	Quartzite, Conglomerate, Semipelite
Salient Contact		----------------------
Aphebian	2	Mixed paragneiss-amphibolite, semipelite, psammite
	1	K-feldspar augen gneiss

(McMillan et al., 1974). The first type (Type 1) have metasomatic envelopes and are associated with nepheline syenite gneiss. The second type (Type 2) have no alteration along the contact and are associated stratigraphically with white marble. Both types of carbonatites occur as concordant layers in the metasedimentary cover. Both appear to have been in place prior to the earliest deformation of the sedimentary cover (MacMillan, 1970). Type 1 carbonatite matrix consists of calcite, aergirine, riebeckite, sphene and apatite (MacMillan, 1970). Type 1 carbonatite weathers buff and reveals knots up to 5 cm of biotite, ilmenite and magnetite. Type 2 carbonatite contains pebble to cobble sized fragments of biotite or albite; apatite is also usually present in small quantities. Apatite, molybdenite, pyrite, and columbite-



(After Brown and Psutka)

Figure 4. Regional Cross Section of the Shuswap and Monashee Terranes.



HADRYNIAN - ALLOCTHONOUS

1	Semipelite, Amphibolite, Pegmatite minor marble and quartzite.

AGE UNKNOWN ALLOCTHONOUS COVER

2	Nephaline syenite gneiss.
3	Amphibolite,locally interbedded with quartzite
4	Quartzite, locally interbedded with amphibolite.
5	Pelite with minor calcsilicate and grit.
6	Carbonatite, associated with marble and calcareous schist.
7	Marble, ussually white.
8	Calcsilicate with minor pelite.
9	Basal quartzite, locally interbedded with semipelite, calcsilicate, conglomerate.

APHEBIAN - CORE GNEISS

10	Mixed paragneiss - amphibolite, semipelite, psammite.
11	K - Feldspar augen gneiss.

(A stratigraphic thickness cannot be assigned to these units as they vary in thickness from location to location, although a total thickness of 2 km has been established, Brown, 1979)

Figure 4a. Regional Stratigraphic Column of the Shuswap Terrane.

tantalite are common accessory minerals. The white marble is stratigraphically above both the Type 1 and Type 2 carbonatites.

II.3. Regional Folding

Three phases of folding are recognized within the Fissure Creek area. Characteristics of Phase 1 to 3 are described below. Descriptions follow those of Brown and Psutka, 1980.

Phase 1 folds are characterized by large isoclinal structures several km in amplitude. Rare minor scale, primary bedding (S_0) on the limbs of these folds is parallel to first phase axial surfaces (S_2) defined by mica foliation, except in hinge areas where the foliation transects bedding at high angles. Folds, regardless of the rock type in which they are found, are typically isoclinal and rootless with attenuated limbs and substantially thickened hinge areas. Fold axes are rarely observable (after Brown and Psutka 1980).

Phase 2 folds are tight to isoclinal. They characteristically exhibit an axial plane cleavage (S_2) in which metamorphic minerals (kyanite, sillimanite) are alligned with the long dimension parallel to fold hinge lines. Moderate thickening in the hinge area occurs in these folds. They can be distinguished from Phase 1 folds by the presence of S_1 foliation that is folded together about the hinges of the minor and major folds. They are usually nearly coaxial with Phase 1 and likely arose from a progression in the same stress regime.

Phase 3 folds control the outcrop pattern in the Fissure Creek area. The intensity of the Phase 3 structure increases from east to west. Restricted to crenulations in pelite rocks and broad gentle warps in siliceous rocks, they are megascopic flexural flow folds.

II.4. Regional Metamorphism

Stratigraphic units on the east flank of Frenchman Cap dome have been metamorphosed to upper amphibolite grade (Brown et al., 1979) while east of the Columbia River, Proterozoic and Lower Paleozoic strata have attained only greenschist grade. These two terranes were emplaced side by side on the valley floor of the Columbia River (Brown and Psutka 1979).

TABLE 2. STRUCTURAL AND METAMORPHIC EVENTS, CARBIDE AREA

Estimated time		Event
Eocene	40 Ma	Regional uplift and assumed time of brittle faulting along the Columbia River Fault zone.
Middle Cretaceous	100 Ma	Ductile faulting = development of
Upper Jurassic	140 Ma	Columbia River Cataclastic zone
Middle Jurassic	150 ma	Phase 3 folding of Shuswap and Selkirk terranes, regional metamorphism and plutonism Phase 2 folding of Shuswap and Selkirk terranes. Development of axial plane foliation (S_2).
Devonian		Clachnacudainn salient intruded by granitic pluton Phase 1 minor isoclinal folding and local development of large scale nappes in Selkirk terrane.

(After Read and Brown, 1980)

CHAPTER III. PROPERTY GEOLOGY

III.1. Property Structure

Structure within the boundaries of the Carbide property consists of flat gently dipping metasediments which are repeated across the closure of a major Phase 1 recumbent anticline which has its closure to the east near the Columbia River. Both upright and overturned limbs have been gently warped in a domed fashion with its eroded apex over North Fissure Creek, Fig. 11 in pocket.

III.2. Property Lithology

The following units occur within the property (Fig. 5).

Pelite: Pelitic rocks make up a major portion of the stratagraphic thickness. The pelite is characterized by thinly layered recessive weathering layers having a well defined mineral foliation outlined by mica mineral grains which are axially planer to the Phase 2 folds. Pyrite is an abundant mineral, it occurs diseminated throughout the rock and causes the rusty weathering of the pelite unit.

Quartzite: occurs as massive to well graded beds, from less than 10 cm up to 50 cm thick. Interlayers of pelite occur within the quartzite. The quartzite outcrops are very hard and resistant to weathering. Where talus slopes of quartzite occur, the quartzite is platey to blocky and typified by grey to green weathering.

Biotite-Silliminite Schist: contains fine to medium grained biotite, muscovite, and quartz. Common allignment of the lensoidal quartz and the lamellar mica gives the unit a distinctively layered appearance. Pyrrhotite and pyrite are abundant and occur as fine disseminations or as streaky parallel layers comprizing up to 10% of the rock. The pyrite produces the rusty weathering of outcrops. Garnets become prominent in lower portion of the biotite silliminite schist where the unit grades into calcsilicate. The contact between the calcsilicate and the biotite-silliminite schist is gradational.

Calcsilicate: This lithology is relatively common within the map area, and is the host for a number of major deposits (Ruddock Creek, Sherpa-Rebar, Rift, Big Ledge). Calcsilicate occurs mainly as dark green to greyish layers up to several meters thick. The calcsilicate is mainly composed of clear quartz, chlorite, salmon pink garnets and hornblende make up the major constituents of the calcsilicate layer. Near the base of the calcsilicate interlayers with the marble, sulfide mineralization can be seen frequently within the calcsilicate.

Marble: Fetid white marble forms an important marker within the stratigraphic sequence, it is well displayed on the lower slopes of Fissure Creek basin (Fig. 2). This marble horizon has been traced in outcrop as a continuous unit from Ruddock Creek to Revelstoke and south around the Thorodin Gneiss dome (Fig. 1). Generally the marble unit is resistant weathering forming prominent outcrops weathering light grey to buff brown weathering colors. Upper and lower contacts of the marble are generally well defined with the over and underlying calcsilicates. Typically the marble is

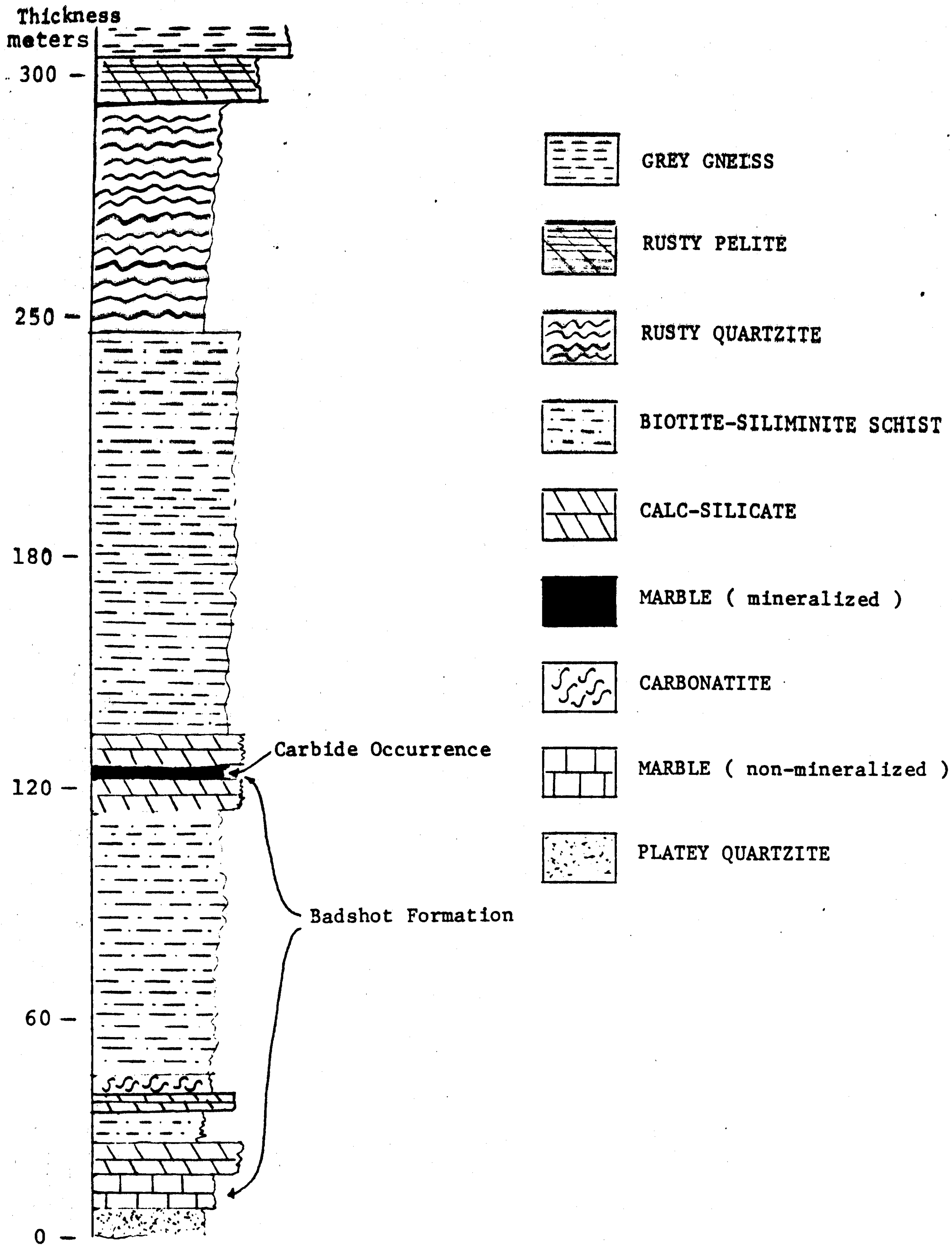


Figure 5. Columnar Section of the Rocks Hosting the Carbide Deposit.

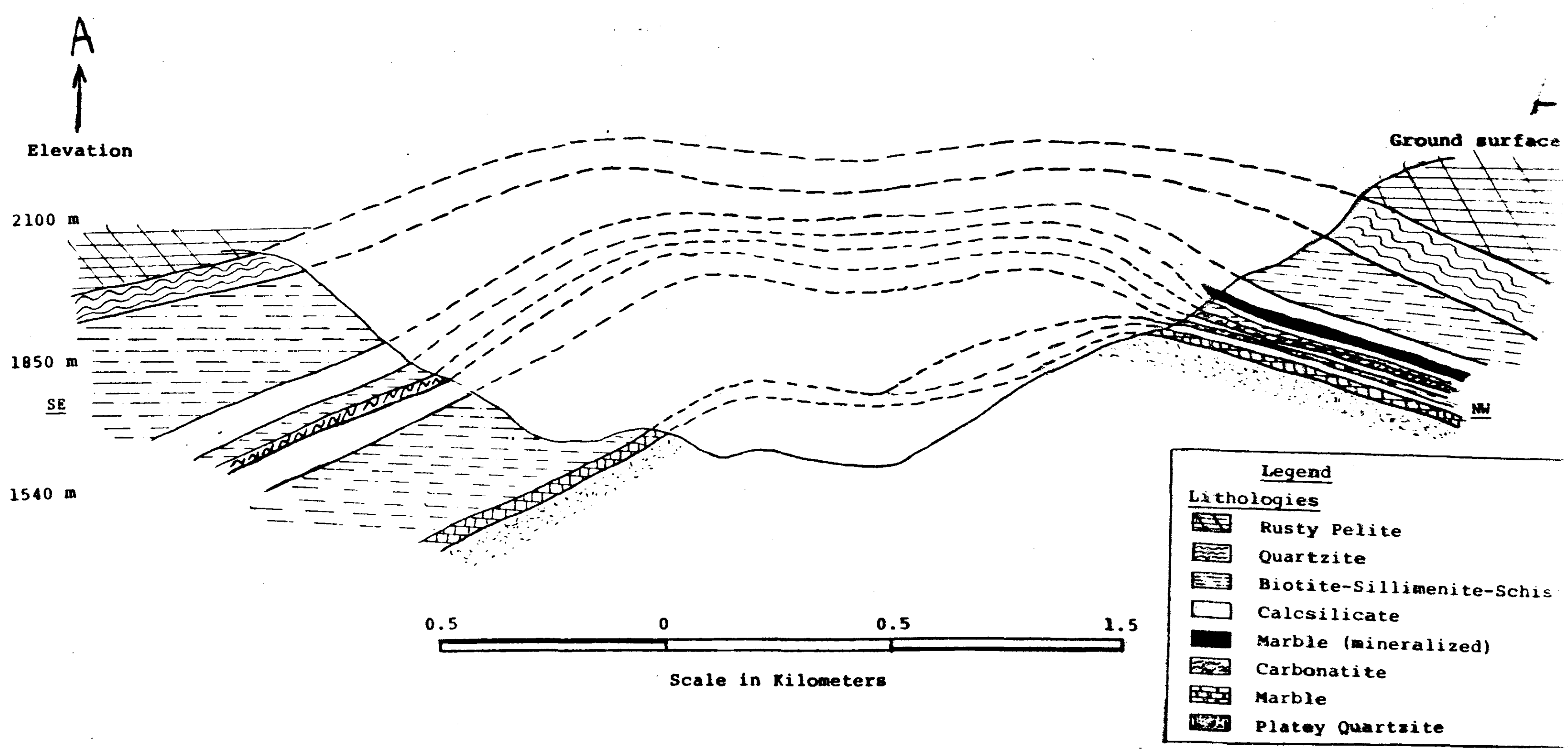


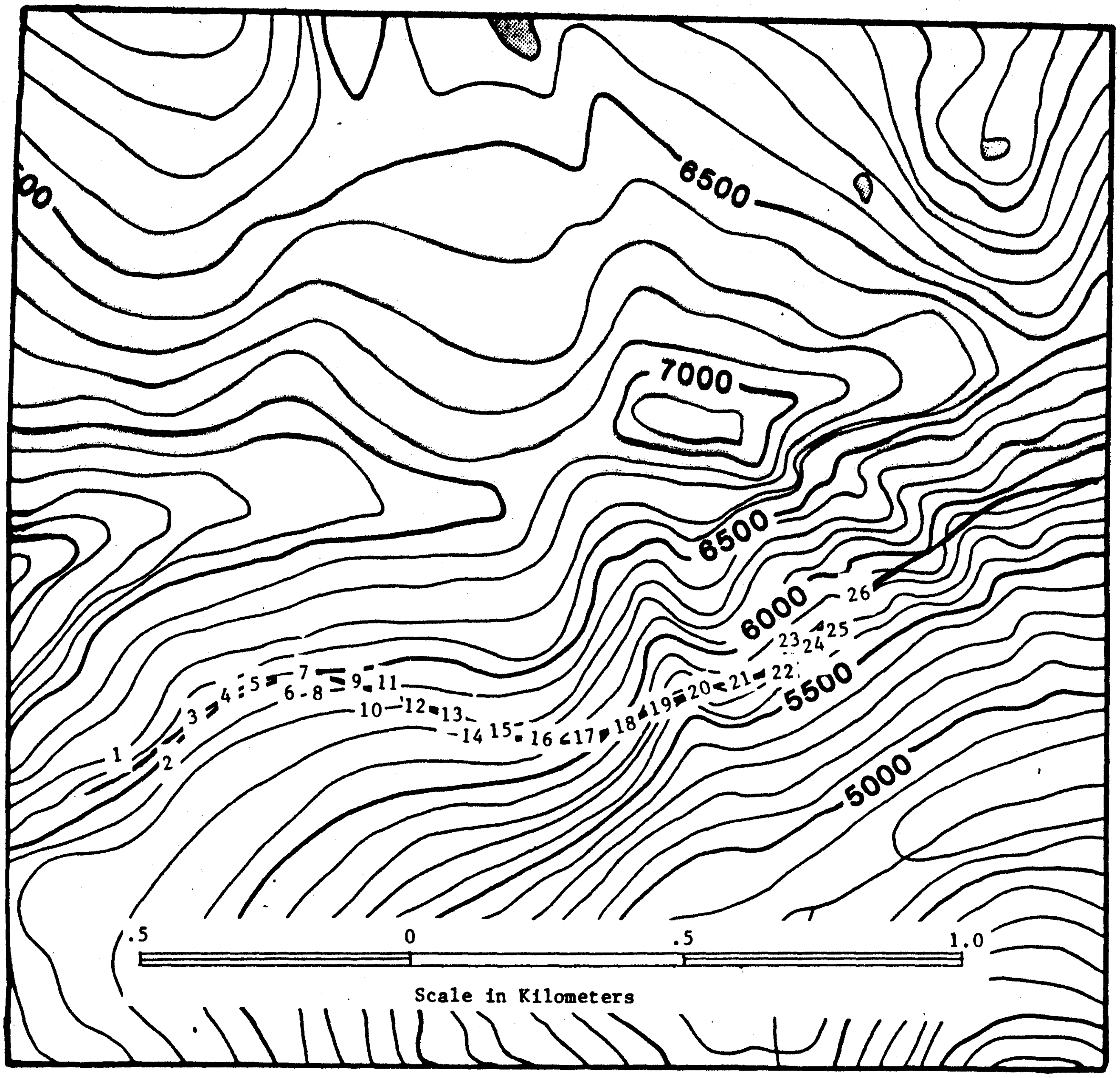
Figure 6. Geologic Cross-Section of Rocks Hosting the Carbide Deposit. (Viewing direction, looking to the SW)

medium to coarse grained, strongly recrystalized, and ranges from massive to well banded with alternating grey and white layers ranging in thickness from 2cm to 10 cm. Total thickness of the marble unit ranges from 2 m to 50 m. The marble horizon grades' into the overlying calcsilicate. It is this upper region of the marble which is most prominantly mineralized. Thus at the Carbide property the mineralization is hosted within the upper part of the fetid white marble, whereas most of the other major deposits within this area, including Ruddock Creek, Cottonbelt, Jordan River, Sherpa-Rebar, and Big Ledge are contained within the calcsilicate immediately below the marble (Fig. 5, Leask 1982).

Carbonatite: The carbonatite layer (Fig. 5) shows no fenitization at its contact. Carbonatite occurs as a concordant layer within the sequence of metasedimentary rocks, and has been subjected to high grade metamorphism. Carbonatite weathers buff to rusty, producing a weathered rind composed mainly of large calcite crystals, which is distinct from the weathering of the marble unit. As the carbonate matrix of the carbonatite weathers it produces a light brown rind with a surface rind composed of the non-weathered mineral components. Phlogopite of the muscovite series is a common mineral within the carbonatite. Also present in small quantities are zircon, apatite and minor pyrochlore. These minerals are not present in the marble.

III.3. Property Mineralization

Discrete elongate pods of sphalerite-galena mineralization occur



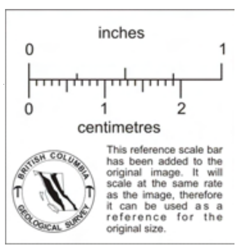


Figure 7. Location Map of Samples taken from Mineralized Horizon of the Carbide Deposit.

TABLE 3 ASSAY RESULTS FROM THE MINERALIZED HORIZON OF THE CARBIDE DEPOSIT.

SAMPLE	g/tonne Ag	% Zn	% Pb	thickness (m)
1	3.93	0.22	0.17	0.1
2	75.02	2.20	3.0	0.1
3	3.58	0.22	0.18	2.3
4	2.86	0.32	0.26	1.0
5	6.44	0.11	0.24	1.2
6	2.15	0.07	0.06	1.3
7	107.18	14.30	5.75	1.2
8	33.28	1.90	1.64	1.2
9	75.03	16.20	4.00	0.21
10	17.15	5.90	0.66	0.1
11	25.01	0.40	0.10	1.2
12	0.72	3.40	0.30	1.3
13	5.01	0.23	0.22	1.0
14	5.01	0.42	0.40	1.5
15	0.72	0.06	0.12	2.7
16	53.59	0.24	2.00	0.5
17	203.64	2.46	11.00	0.5
18	57.17	1.30	2.60	0.8
19	292.97	23.40	15.00	0.7
20	133.76	24.60	7.20	0.55
21	10.00	11.00	0.57	4.7
22	110.75	7.00	6.00	0.5
23	9.65	0.42	0.41	1.7
24	5.01	0.12	0.15	0.9
25	2.50	0.10	0.09	3.0
26	300.11	8.80	7.70	1.2
AVERAGE	55.21	5.00	2.70	0.7

over a strike length of 1,800 m (in the upright limb, Fig. 6) within the stratigraphically conformable fetid white marble layer. Confined to the structural top of the marble layer, these closely spaced pods of mineralization vary in size from less than 1 m in diameter to as large as 2 m by 10 m. Grade of the mineralization increases along strike to the east.

III.4. Property Mineralogy

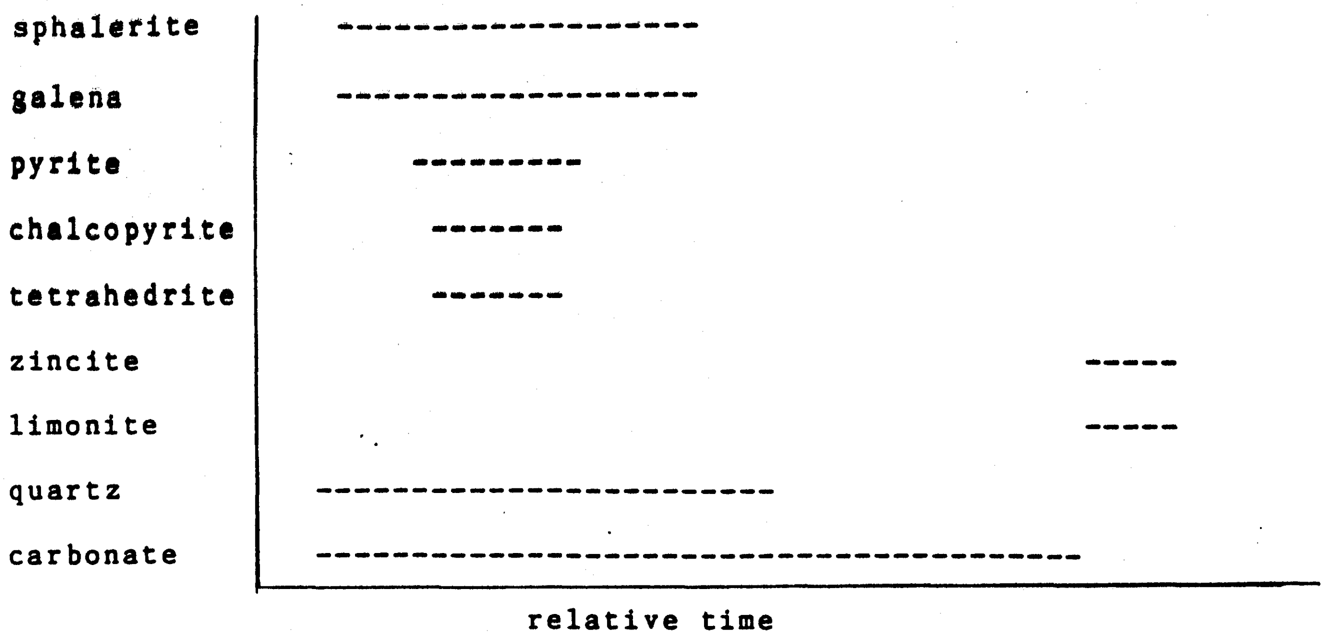
Sulphides observed include banded sphalerite, galena, and traces of pyrite and chalcopyrite. Typical modes for high grade samples are: galena 10-15%, and trace amounts of pyrite and chalopyrite. Weathered surfaces include; limonite, zinc oxide and malachite in varying amounts depending on the freshness of the sample. The principal gangue minerals are quartz, calcite and dolomite with quartz occuring as small pebbles and grains with the sulphides usually within the carbonate. The rounded quartz pebbles give some rocks a breccia appearance. Galena is interstial to the grains while the sphalerite is much more granular, grain size is quite coarse reaching as large as 5 mm. Pyrite and chalcopyrite are very fine grained relative to the galena, spalerite and quartz-carbonate. Mineralogy is straight forward; sphalerite, galena, pyrite, chalcophyrite, and tetrahedrite. Quartz-carbonate gangue is easily distinguished and is included in the analysis and paragenesis. The most abundant suphide observed is sphalerite. The grains are ususally round or pseudo-hexagonal, varying in size from 0.05 mm to 4 mm. Foam textures are observed in some samples indicating a degree of recrystallization in the deposit. Triple junctions are generally equiangular, however with galena a smaller dihedral angle is obeserved. Many grains show good cleavages and fractures, some grains show deformation twinning. A few grains show galena, pyrite and chalcopyrite inclusions. Near surface, sphalerite oxidizes to zincite or zinc-oxide. The oxidation rims the mineral grain and follows the cleavages and fractures. Sphalerite and the other associated suphides occur in beds or laminations whose thicknesses vary from 0.5 mm to about 5 cm or greater. In these sections, the amount of sphalerite varies from 50% to totally absent.

Galena is almost as abundant as sphalertie and very closely associated with it. Some galena occurs in foam texture, although most occurs intersticially with the large sphalerite and quartz grains. Small euhedral grains are noted in the sphalerite. Generally, the galena shows well developed cleavages, some of which are curved. Galena is also associated with the pyrite, chalcopyrite, and tetrahedrite that occurs along sphalerite-galena interfaces.

Pyrite occurs much the same way as sphalerite and galena. Other occurrences include in the quartz, and along the grain boundaries. Contacts with surrounding minerals are smooth and grains are euhedral. Traces of chalcopyrite and tetrahedrite are visible in a few sections. Chalcopyrite and tetrahedrite occur together but chalcopyrite can occur without tetrahedrite. Both occur in sphalerite as inclusions and along sphalerite-galena interfaces (Wild, 1983).

III.5 Paragenesis

The sulphide mineral assemblage includes sphalerite, galena, pyrite, chalcopyrite, and tetrahedrite. All appear to be in equilibrium. Oxidation has produced zincite and limonite near the surface.



Figure(8) Line diagram of the Carbide property Sulphide Assembledge

Equilibrium for the sulphides is assumed because recrystallization has occurred as revealed by the foam textures present. The Pb and Zn sulphide systems are stable over large temperature ranges. Galena and sphalerite are the only phases that formed from a Pb-Zn-S rich fluid.

The property is a stratabound Ag-Pb-Zn deposit within a thick sequence of metasedimentary rocks. A possible mode of origin may be that a hot spring environment pumped sulphides on to the ocean floor where they mixed with calcareous sand and mud. This "smoker" was run by a convection cell that circulated water through the country

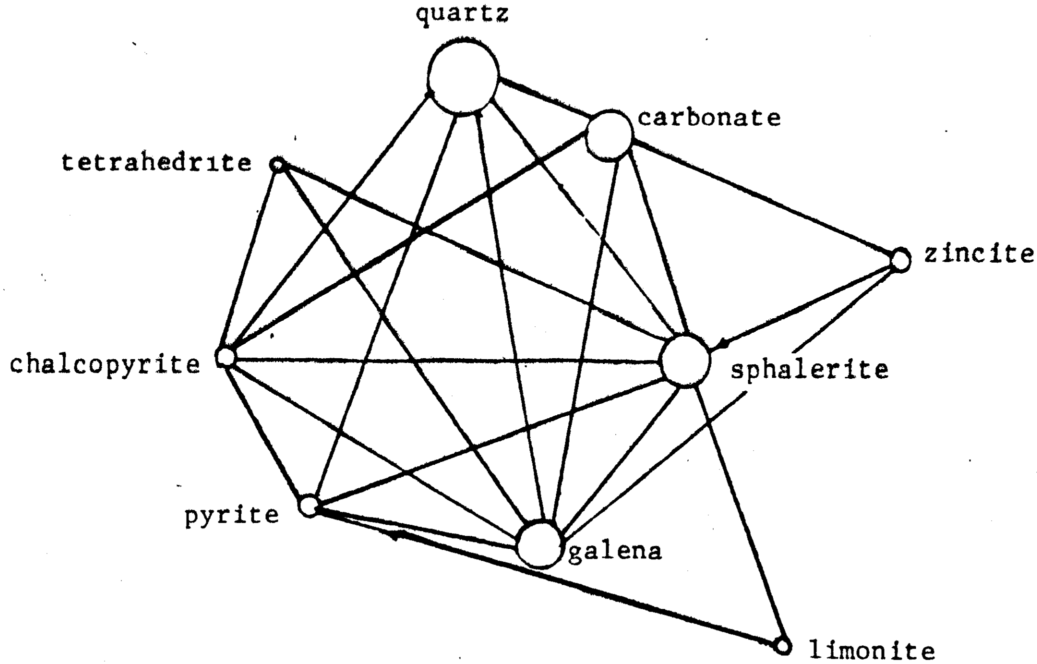


Figure 9. Van de Veer Diagram of the Sulphide Minerals and their Weathering products

rocks. This water picked up base and precious metals and deposited them on the sea floor. Such smokers are closely associated with mid-ocean ridges or rift zones. Polished sections exhibit sulphides mixed with the dissolved and deposited siliceous sediments where round quartz grains and sulphides are strongly intermixed. After a period of deposition and subsequent lithification these rocks underwent high grade metamorphism. Foam textures and large crystals indicate recrystallization. Deformation features are also evident where galena and carbonate have been remobilized and fill numerous fractures and voids between grains. Sphalerite and galena show deformation twins. Carbonate rims many grains indicating that it was the last phase to recrystallize.

III.6. Other Known Stratabound Occurrences

RIFT

The Rift deposit is located 110 km north of Revelstoke in a small west flowing tributary of the Columbia River. The outcrop elevation of the Rift deposit is 745 m above mean sea level.

Rift mineralization consists of a 2.5 m stratabound massive sulphide layer of pyrite, pyrrhotite, sphalerite and galena with minor chalcopyrite. Visible mineralization is restricted to the north and south by overburden. A dark green ultramafic flow (serpentenite) overlies the massive sulphide horizon. Grades for the Rift deposit approach 30% combined zinc and lead with 34 g/tonne silver. The deposit is currently being explored by E & B Explorations Ltd. of Vancouver and Leask Associates of Vancouver (Hicks, 1982).

King Fissure

The King Fissure property, also known as the Jordan River, is located on the upper northeast slopes of Mount Copeland, approximately 20 km northwest of Revelstoke B.C.

The massive sulphide mineralized horizon ranges in thickness from 0.0 m to 7 m with a strike length of 300 m. Pyrite, pyrrhotite, sphalerite, galena and minor barite are the primary sulphide mineral constituents of the mineralized horizon. A 3.2 million ton deposit of 40 g/tonne silver, 5.1% lead, 5.6% zinc has been proven by drilling. A dark green ultramafic (dunite-serpentinite) is spacially related to this deposit.

Ruddock Creek

The Ruddock Creek deposit, located on Gordon Horne peak from an elevation of 1,200 m to an elevation of 2,400 m, contains sulphide mineralization that has been traced for 3,000 m.

The sulphide mineralization consists of many stratiform but disjointed pods of massive sulphide. The pody nature of the deposit is likely due to remobilization of a prexisting sulphide layer during metamorphism and folding (J.M. Leask 1984). The largest of the pods is at the E showing where the sulphide bed has been remobilized and repeated in a tight F_1 fold. Drilling has indicated several million tons grading 12% combined zinc and lead with 34 g/tonne silver. More drilling is required to determine the full extent of the mineralization.

Principal sulphides are sphalerite, pyrrhotite, galena, pyrite, and minor chalcopyrite and barite. A dunite-serpentenite is located adjacent to the massive suphide.

Sherpa-Rebar

The Sherpa-Rebar property is at an elevation of 1,100m on the north slope of Tsuius Creek a tributary of Mabel Lake, approximately 50 km southwest of Revelstoke.

Sherpa-Rebar mineralization consists of massive pyrrhotite, sphalerite and galena boulders which occur in shallow overburden and outcrop over a strike length of 10km. Mineralization is primarily sphalerite with subordinate galena. Sulphide grades average approximately 14% combined zinc and lead with some high grade boulders approaching 25% combined zinc-lead. The mineralized

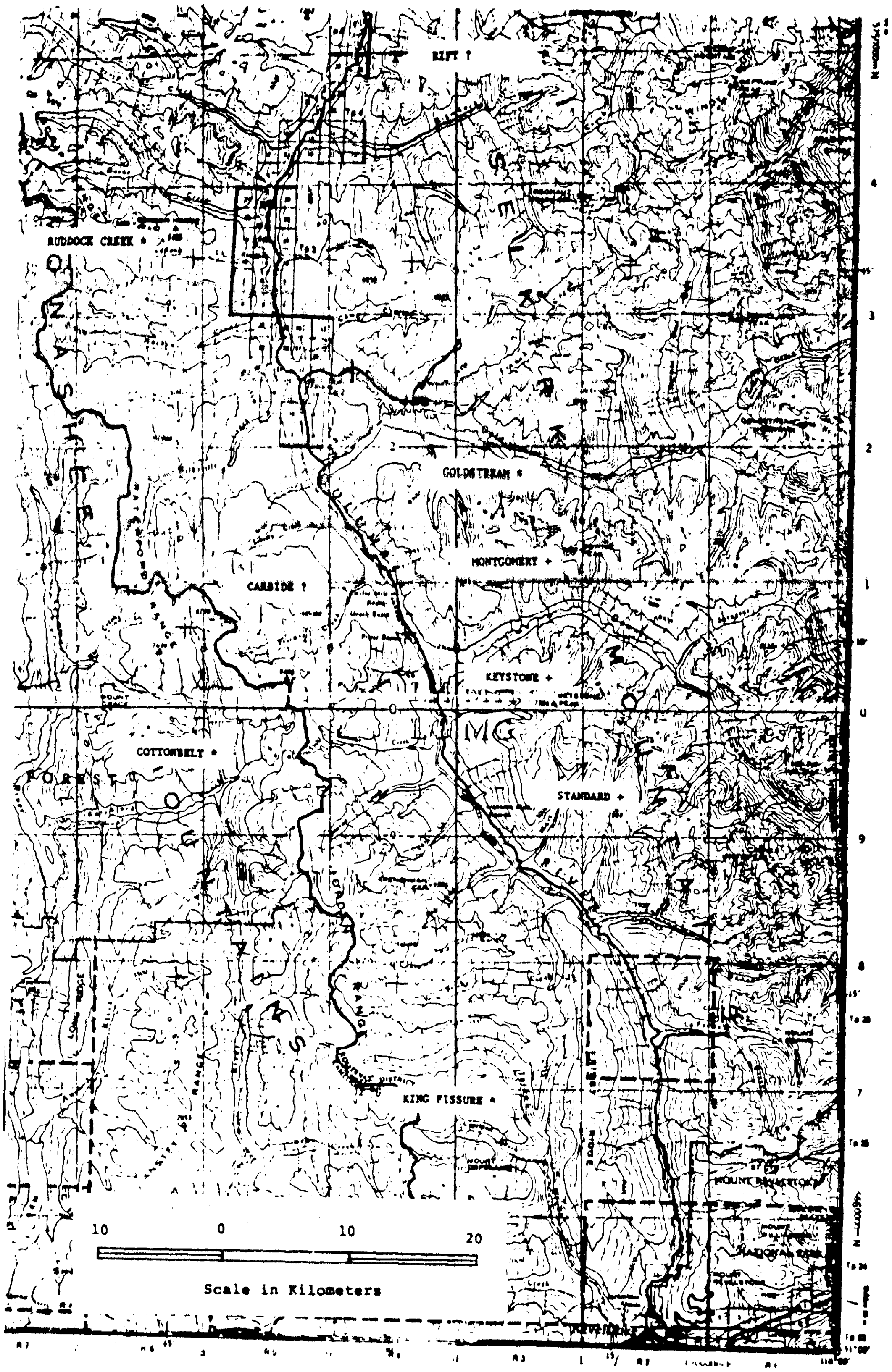


Figure 10. Location Map of Mineral Deposits within the Shuswap and Monashee Metamorphic Complexes.

Legend of deposit size: * large, + small, ? unknown.

horizon is partially exposed on the Rebar claim group. At this location the sulphide layer is interbedded with calcsilicate, this interbedding forms a 15 m thick layer of sulphide. The Sherpa-Rebar property is currently being explored by Noranda Ltd. and the Big Bend Joint Venture operated by J.M. Leask of Burnaby, B.C.

Other Occurrences

Other deposits (Fig. 10) occuring in this stratagraphic sequence exhibiting similar mineralization includes the CK, on the north fork of the Raft River, the Cottonbelt on Grace Mountain, Wigwam on Alkokolex River, and the Big Ledge 15 km west of Galena Bay.

III.7 Stratigraphic Indicators

The single most identifiable unit within the Shuswap Metamorphic complex is the fetid white marble. Fetid white marble unit exists as a continuous mapable horizon from Ruddock Creek to Revelstoke and south around the Thor-Odin Gneiss dome. Fetid white marble is stratigraphically related to the host horizons of Ruddock Creek, Carbide and Jordan River (King Fissure) deposits. Extensive prospecting based on the fetid white marble as a stratigraphic indicator has resulted in the discovery of the Sherpa-Rebar claim group east of Mabel Lake (Leask Associates 1983).

III.8 Geothermometry

Application of conventional geologic thermometers, that rely on sphalerite or pyrrhotite composition, would be of little consequence on the Carbide deposit because of the high grade of metamorphic alteration of the mineral assembly as seen in polished sections. Use of the iron, pyrrhotite or sphalerite content to determine formation temperature is inadequate in regions of high grade metamorphism due to the thermal dissociation of pyrite to pyrrhotite which produces an increase in sulphur fugacity (McDonald, 1967).

CHAPTER IV. CLASSIFICATION OF CARBIDE DEPOSIT

The Carbide deposit is situated within a thick sequence of Lower Cambrian calcsilicate and metasedimentary rocks. The Carbide deposit is a geologically distinct occurrence within the Shuswap Metamorphic Terrance. Only the Colby deposit bears any resemblence to the Carbide occurrence. The Colby deposit occurs as distinct pods of pyrrohotite-sphalerite rich mineralization in the fetid white marble but is low in silver content. Interesting features of the Carbide occurrence are:

- high silver-lead ratio
- high silver content - up to 320 g/tonne

Several other known occurrences such as Midway (B.C.-Yukon border), Pioche Camp (Nevada) and Leadville (Colorade) show similar features. From analysis of the polished sections it appears the Carbide occurrence exists as a possible "Alpine Deposit". Metals were deposited when tectonic activity such as rifting was prevailent. Hot metalliferous fluids travelled along the conduit rupture dissolving and replacing the existing carbonate.

CHAPTER V. CONCLUSIONS

The Carbide property is a carbonate hosted stratabound Silver-Zinc-Lead deposit located within a thick sequence of Lower Cambrian metasedimentary rocks.

Carbide deposit contains straight forward mineralogy consisting of sphalerite, galena, pyrite, chalcopyrite, and subordinate tetrahedrite.

Carbide deposit is hosted within a major isoclinal Phase 1 fold structure with its hinge zone located near the west bank of the Columbia River. Slight doming exists within the property structure, the apex of this dome has since been eroded to leave the present geologic configuration. The sulphide mineralization was likely deposited during tectonic activities such as rifting where the mineral rich fluids traveled along the rupture and dissolved and selectively replaced the carbonate unit.