Watson Lake MD

MAP No.	ASSESSMENT REPORT N. M. E. A. P. CONFIDENTIAL OPEN FILE	TYPE OF WORK:
95-D-6	☐ ☐ ☐ ☒	Geol

REPORT FILED UNDER	St. Joseph Explorations Ltd. DOCUMENT NO. 061961
DATE PERFORMED	1979 DATE FILED: Dec. 4, 1979.
LOCATION - LAT.	60° 21'N AREA: Coal River, Yukon.
LONG.	127° 24'W
CLAIM NO.	MEL Deposit
VALUE $	
WORK DONE BY	D.C. Miller
WORK DONE FOR	St. Joseph Explorations Ltd.
REMARKS	A paper given at the Geoscience Forum in Whitehorse detailing geology, reserves, etc. of the deposit.

MEL BARITE-LEAD-ZINC DEPOSIT, YUKON TERRITORY

BY

D.C. MILLER

ST. JOSEPH EXPLORATIONS LIMITED

CONTENTS

ILLUSTRATIONS

Abstract

The Mel deposit is located in southern Yukon within 44 km of the Alaska Highway. The deposit is thought to be epigenetic and occurs at a contact between Lower Cambrian Limestone and Cambrian to Ordovician shale. To date, diamond drilling has indicated 4.8 million tonnes of mineralization grading 52.1% barite, 2.05% lead and 5.61% zinc. This mineralization occurs in a tabular, lens-shaped body, up to 21.7 m thick centrally, which gradually thins towards both ends over a total strike-length of 800 metres. The deposit has been drilled to a depth of about 330 m and is open at depth. Preliminary metallurgical testwork to date has been encouraging.

Introduction

Barite deposits are widely distributed throughout the world and occur in a variety of geological environments. In recent years, a number of deposits of barite and barite-lead-zinc have been discovered in northern British Columbia, Yukon Territory and Alaska. Most of these deposits are associated with Devonian-Mississippian age sediments and many are syngenetic, bedded type deposits. The Mel is a barite-lead-zinc deposit (average grade 52.1% barite with 7.7% combined lead-zinc) which occurs within lower Cambrian strata and appears to be an epigenetic replacement deposit.

In this paper, present knowledge of the Mel deposit is summarized and a possible model for its deposition is proposed. Observations are largely based on field work, megascopic studies and two recent B.A.Sc. theses (Biasucci, 1979; Rennie, 1979).

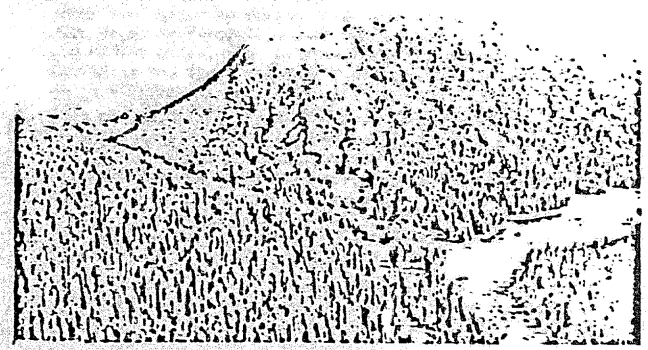


Figure 1: Aerial View of the Mel Property Viewed from the south.

Location and Physiography

The Mel barite-lead-zinc deposit is located 80 km east-northeast of Watson Lake, Yukon at Lat. 60°21'N, Long. 127°24'W (N.T.S. Map 95 D-6). A winter caterpillar trail leads to the property from Contact Creek, located 44 km southward of the property on the Alaska Highway.

The base elevation at the property is 850 m and nearby mountains rise to 1300 m. Topography is generally moderate although prominent cliffs are present in one location immediately northwest of the deposit. Hillsides are densely forested with principally spruce and balsam. Open, marshy areas containing several small lakes, ponds and connecting streams are found within broad northward trending valleys.

The area has been affected by Pleistocene glaciation and ice movement was eastward and northward. North of the deposit, soil cover is relatively thin and outcrops are fairly numerous. To the south, relatively thick deposits of till and alluvium are present and outcrops are sparse.

History

The location of barite outcrops were apparently known for some time prior to staking. The property was first staked in 1967 by J. Melnychuk and T. Flint and optioned to Newmont Mining Corporation Ltd. Newmont built a caterpillar road to the property and conducted bulldozer trenching and a geochemical survey. Following this work, Newmont dropped their option and the claims lapsed. In 1973, Melnychuk restaked the property and sold his interest to Sovereign Metals Corporation Ltd. (formerly Empire Metals Corporation Ltd.). Sovereign optioned the property to Granby Mining Corporation Ltd. which drilled 18 AQ diamond drill holes totalling 1952 m during 1974 and 1975. Granby also conducted geological mapping, geochemical sampling and prospecting. During June 1976, R.C. Carne of the Department of Indian and Northern Affairs, conducted geological mapping and core logging and wrote a report on the property later in 1976 (Open File Report EGS 1976-16).

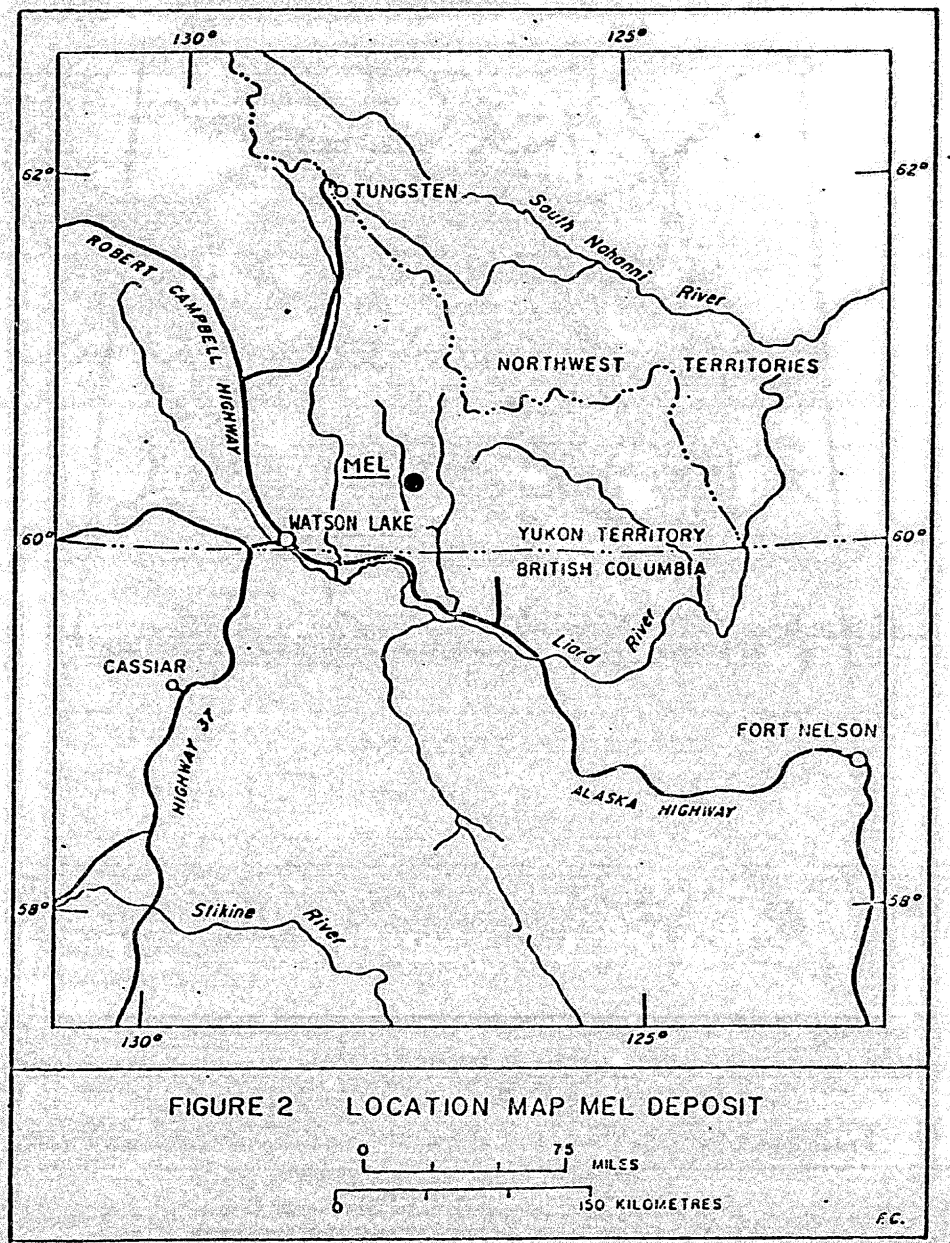


FIGURE 2 LOCATION MAP MEL DEPOSIT

In December 1976, St. Joseph Explorations Ltd. concluded an agreement with Granby Mining Corporation Ltd. by which St. Joseph would undertake further exploration of the property in return for equity. During 1977 to 1979, St. Joseph conducted geological, geochemical and geophysical surveys and completed 4054.2 m of BQ diamond drilling in 19 holes. Work to date has indicated a lens shaped deposit containing 4,782,380 tonnes grading 52.1% barite, 2.05% lead and 5.61% zinc to a maximum depth of 330 m below surface. Below this depth, the zone continues but is yet untested.

Regional Geology

The Mel deposit is located in Coal River map-area NTS 95 O (Gabrielse and Blusson, 1968). In this area deposition of marine sediments was nearly continuous from Hadrynian to Carboniferous time. Basic volcanic rocks were extruded during three events and dated stratigraphically as late Upper Proterozoic and/or early Lower Cambrian, late Lower Cambrian and Middle Ordovician. Despite the presence of these volcanic rocks, Gabrielse and Blusson (1968) considered the total aspect of stratigraphy to be miogeosynclinal rather than eugeosynclinal.

In general, outcrop exposures are poor in Coal River map-area and contact relationships between various units are not often seen. One unconformable contact occurs below basal Silurian strata which unconformably overlie Ordovician strata. In the adjoining Flat River map-area, where rock exposures are better, a number of unconformities are recognized. Here, two unconformities are recognized in Proterozoic rocks and unconformities are present below and above Middle Cambrian strata and above Middle Ordovician strata.

In Lower to Middle Cretaceous time, intrusive rocks, mainly quartz monzonite and granodiorite, were emplaced in northeastern Coal River map-area and northward of this map-area. The closest intrusive to the Mel deposit is about 60 km distant.

Much of the deformation of sedimentary strata in Coal River map-area apparently occurred in post-Carboniferous time as all units deposited prior to this time sustained similar deformation. Probably major deformation occurred during the Upper Jurassic to Upper Cretaceous Columbian Orogeny and during the later Tertiary Laramide Orogeny. In adjacent Flat River and Watson Lake map-areas, some deformation occurred in Lower Cambrian strata prior to Upper Cambrian sedimentation. Major faults in Coal River map-area strike north-south and have easterly directed thrust movements in the order of 3000 m or more. These faults are of post-Carboniferous age as all units have been affected.

In Lower Cambrian time sedimentary strata in Coal River map-area show marked facies changes from east to west (Fig. 3), probably reflecting progressively deeper water westward. The Mel deposit occurs at a facies boundary between limestone-siltstone facies with some volcanics to a predominantly siltstone-shale facies.

Property Geology

The Mel area is underlain by folded Lower Paleozoic strata including carbonates, phyllites, shales and siltstones. These rocks strike northerly and dip both westerly and easterly. The Mel deposit, which is composed of relatively coarse grained sphalerite and galena mineralization within a barite-rich host rock, is conformable with enclosing strata, strikes northward, dips westward near surface and eastward at depth. The deposit is lens shaped, about 800 m long and up to 21.7 m thick near it center.

A second parallel zone west of the main deposit has been traced for 120 m on surface and is considered to be a faulted portion of the main zone. The west zone appears to have little tonnage potential. Drill holes below it and surface exploration along strike failed to disclose further mineralization.

In addition to the normal fault which has offset the west zone, there are a few northwest striking reverse faults that cause small offsets within the main zone. A larger, northwest striking reverse fault west of the deposit displaces strata immediately south of the deposit.

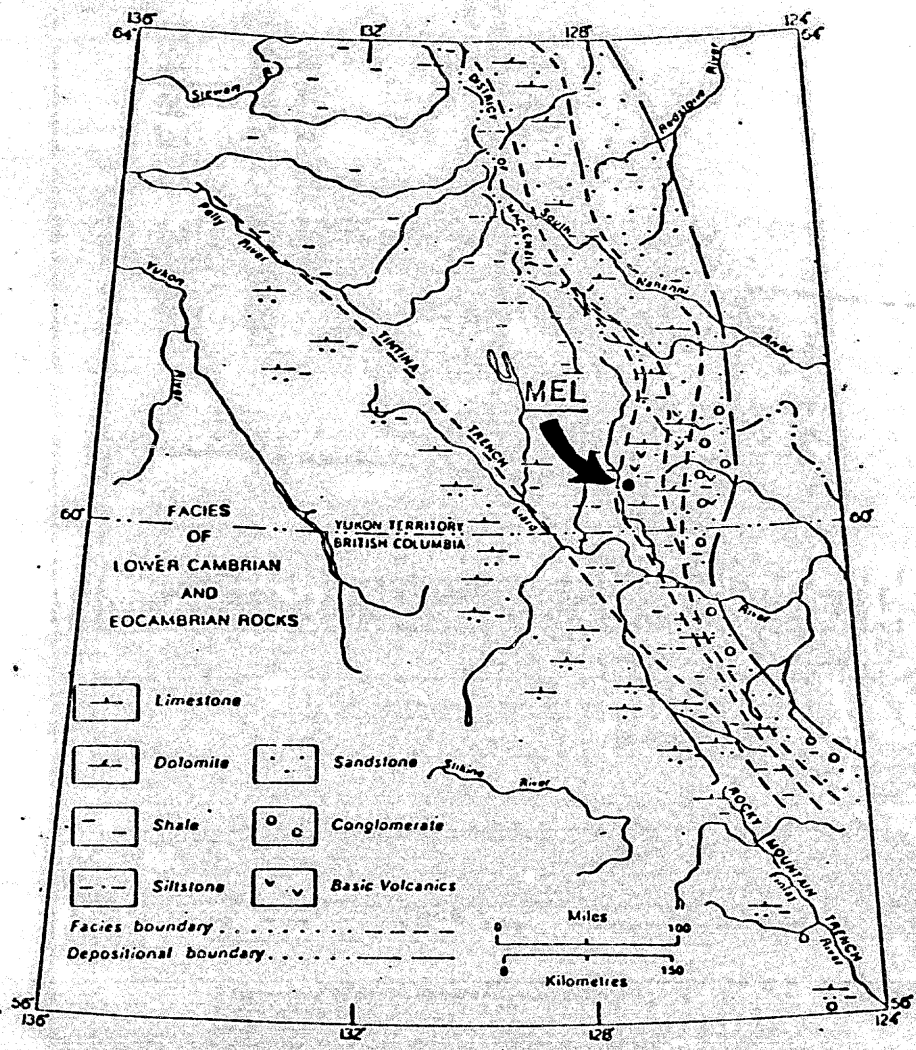


FIGURE 3. LOCATION OF MEL WITH RESPECT TO LOWER CAMBRIAN SEDIMENTATION

(Adapted from GSC Memoir 366, 1973)

Stratigraphy

TABLE OF FORMATIONS

Period	Property Map Unit	Lithology	Thickness (metres)
Cambrian to Ordovician	5	Dark grey, wavy banded, silty limestone	700+
	4	Brown to grey, laminated calcareous phyllite and shale	10-45
Lower Cambrian	**		
	3	Light grey fine-grained limestone	150
	2	Buff dolomite and variably dolomitized limestone	0-40
	1	Medium to dark grey calcareous shale and siltstone, minor limestone	400+

** The Mel deposit lies between property map units 3 and 4 and is conformable with both units.

(a) Unit 1

This unit underlies the western part of the property and consists of brown, maroon and grey weathered, finely laminated medium to dark grey calcareous shale and siltstone and minor buff weathered grey limestone. Fine grained pyrite in some siltstone laminae has oxidized to form sharp rusty bands.

(b) Unit 2

Buff to orange weathered pale brown to light grey dolomite and dolomitized limestone is found as a narrow band between units 1 and 3. Although exposures are limited, it appears to be of local extent and is thought to be an altered portion of unit 3.

(c) Unit 3

This unit comprises pale grey generally very fine grained limestone with minor thin discontinuous bands and clasts of brown mudstone and occasional limy clasts with an oolitic texture. The muddy layers and clasts, which are best seen in drill core, are often pyritic. Possible fossil remnants were seen in drill core at one location near the stratigraphic top of this unit. At surface, this unit is overturned and forms the structural hanging wall of the Mel deposit.

(d) Unit 4

Brown to grey, laminated, calcareous phyllite (grading to shale) forms the structural footwall of the Mel deposit near surface. At depth, because of folding, it becomes the hanging wall of the deposit.

(e) Unit 5

Dark grey, wavy banded, silty limestone underlies much of the eastern part of the property. It is also found near the western limit of property mapping. This unit is grey to brown weathering and has a distinctive texture because of differential weathering between silty and limy components. Bedding attitudes in this unit are similar to those in the underlying unit. Because of sparse outcrops actual contact relationships are not seen. In nearby areas, an unconformity occurs above Lower Cambrian strata.

Structure

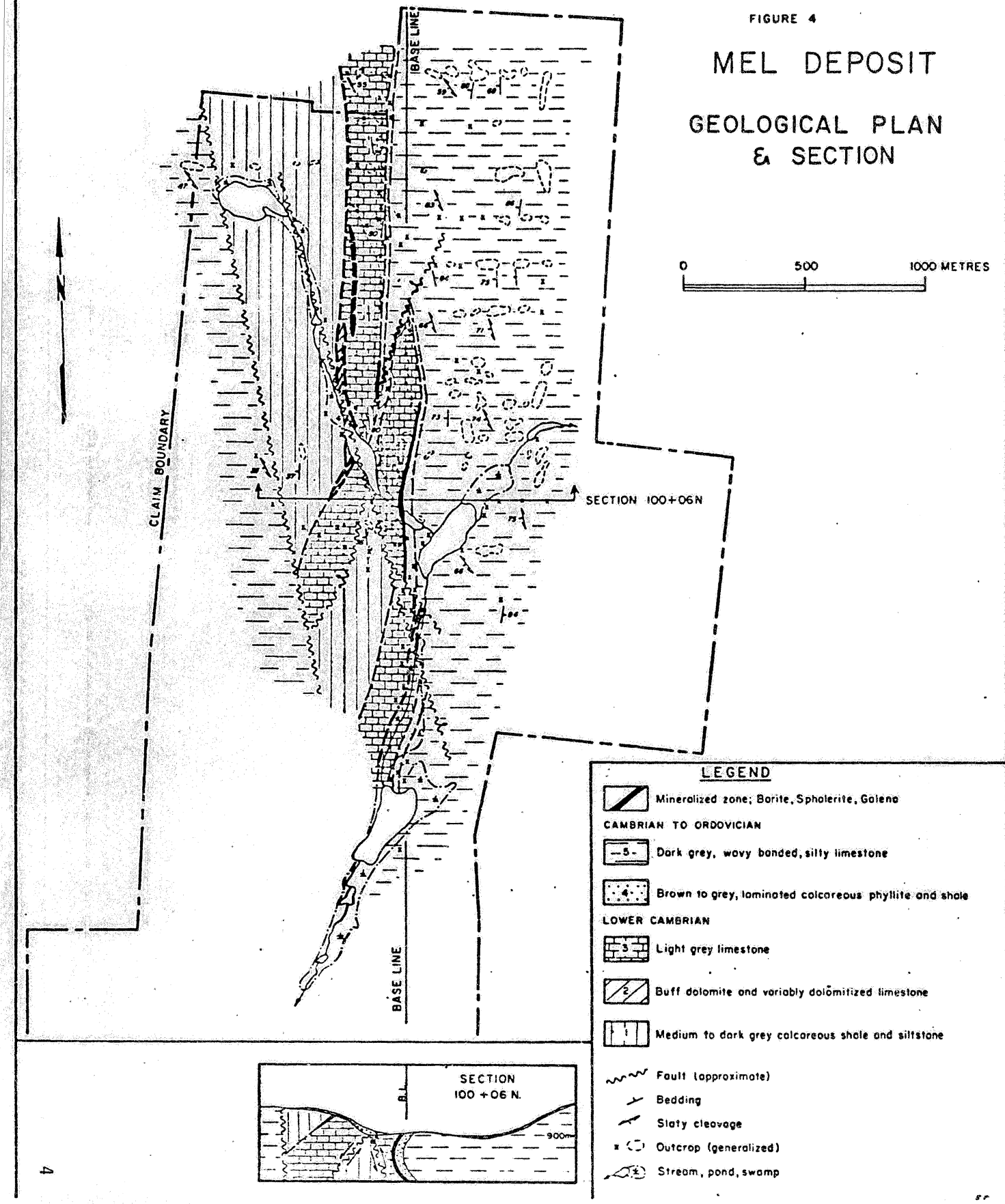
The Mel deposit and enclosing strata, dipping about 65° westward at surface, occupy the western limb of an overturned syncline. Strikes are nearly north-south. Near the center of the deposit, at a depth of about 120 m below surface, the mineralized zone and wall rocks are folded and dips become about 60° eastward.

Although it is concordant with wall rocks, the deposit lacks primary sedimentary features. After deposition it has undergone considerable shearing, brecciation and folding together with enclosing strata.

FIGURE 4

MEL DEPOSIT

GEOLOGICAL PLAN & SECTION



Two prominent faults are present near the Mel deposit, but fortunately, the mineralized zone is relatively unaffected by the displacements of these faults. With reference to the accompanying geology plan, an early northeast trending normal fault has apparent left lateral displacement of 350 m and apparent dip displacement of 200-300 m. Core holes indicate this fault dips about 50° westward. The west zone, formerly part of the main deposit, has been offset to its present location by this fault.

A later northwest trending reverse fault with an apparent 150-200 m of left lateral displacement has offset strata and the earlier fault. Drilling indicates this fault dips eastward. A branch of this fault has cut the south end of the deposit and has caused a left lateral offset of 50 m.

Near the western limit of property mapping, unit 5 is in apparent fault contact with unit 1. The northwest trending trace of this contact is inferred from sparse outcrops. The magnitude and direction of movement on this inferred fault are presently unresolved.

Mineralization and Alteration

The deposit consists of coarse white to light grey barite (52.1%) with 5.61% zinc and 2.05% lead present in the form of relatively coarse grained sphalerite and galena. Other sulphides present include pyrite and very minor chalcopyrite, tetrahedrite and covellite. Non-sulphide constituents include grey to white cherty quartz, brown to grey mudstone (in part altered to sericite) and very minor limestone remnants.

The deposit is lens-shaped and displays gross lithological and mineralogical zoning features. Centrally, where the deposit is thickest, barite content is the highest. Towards both ends, where the deposit thins, barite content decreases, sphalerite content increases and cherty quartz gangue content increases. Above average galena grades are found in the northern and lower parts of the deposit associated with both high and low barite content. A zone of white to grey cherty quartz, generally over a metre thick, is found along the stratigraphic top of the deposit. This siliceous zone may represent silicification of the base of the shale-phyllite (unit 4).

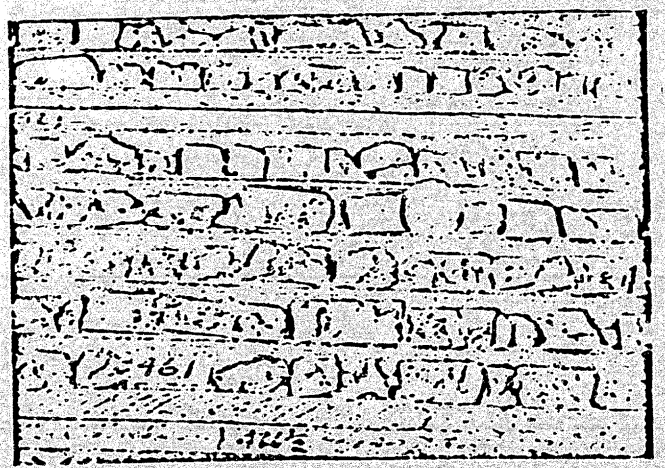


Figure 5: Mel Diamond Drill core - Sphalerite (dark) and Barite (light)

Barite is the most common economic mineral. It is typically white to grey, coarse grained and partly recrystallized. Some fine grained anhedral barite occurs with quartz in late veinlets cutting both previous barite and sulphides.

Sphalerite occurs in sub-rounded blebs and is mainly brownish in colour. Most grains range from 1 to 5 mm in size but some larger and smaller grains are present. Some sphalerite grains have clear colourless rims.

Galena occurs mainly as veinlets cutting cherty quartz, barite and sphalerite or is present between grains of these minerals. Grain size of galena is variable but in general is finer than that of sphalerite.

Pyrite is the third most common sulphide and is mainly fine grained. It occurs as disseminations in mudstone clasts and cherty quartz and as veinlets cutting other sulphdies, along grain boundaries, and within wall rocks.

Chalcopyrite and tetrahedrite are present in trace amounts commonly intergrown with galena along sphalerite grain boundaries. Covellite was identified in one polished section between chalcopyrite and sphalerite grains.

Geochemistry

Geochemical soil sampling for lead, zinc and copper was conducted over a large area in the vicinity of the Mel deposit. Samples were collected from the B horizon at depths ranging from 20 to 50 cm. Minus 80 mesh portions of samples were digested with perchloric acid and analyzed by the atomic absorption method. No significant copper anomalies were found. Lead and zinc values were greater than 70 and 300 ppm respectively directly over the deposit. Zinc values were also relatively high in a large dispersion haloe around the deposit, particularly in the direction of ice movement, down slope movement and along channels of recent alluvial deposition. In much of the area south of the deposit, soil cover is probably too deep for soil geochemistry to be effective. Background values for lead, zinc and copper are 10, 60 and 15 ppm respectively.

Geophysics

Gravity and induced polarization surveys were conducted over and south of the deposit. Equipment used included a Sodin W.S. 410 gravity meter and a Huntec LOPO MK-3 induced polarization transmitter coupled with an Elliot R-20A receiver. A dipole-dipole array was used for induced polarization work. Weak gravity and induced polarization anomalies were obtained over the deposit and also on some lines south of the deposit. One of the southern anomalies was subsequently drilled but no mineralization was intersected. It was found that overburden depths were deeper than expected and faulting had offset the projected position of the mineralized zone.

Metallurgical Testwork

Approximately 110 kg of mineralized drill core was submitted to Lakefield Research for metallurgical tests. This material assayed 2.30% lead, 4.80% zinc and 51.60% barite. Assays were also done for sulphur, strontium and tin which assayed 9.54%, 0.31% and 0.002% respectively. Test results were encouraging and concentrate grades for lead, zinc and barite were in the order of 79%, 64.7% and 95% respectively with recoveries of 97.7%, 94.5% and 92.6% respectively. Zinc concentrates were assayed for a number of elements and found to contain 0.25% cadmium and 0.07% mercury. Further testwork showed mercury reported entirely to sphalerite and could be satisfactorily removed by roasting the zinc concentrate for 16 hours.

Genesis of Mel Deposit

Evidence which suggest the Mel is an epigenetic deposit includes the following:

(1) lack of primary bedding;
(2) veining of wall rocks by sulphides and rarely barite;
(3) coarse grain size of barite, galena and sphalerite;
(4) erratic distribution of galena and sphalerite in barite and cherty quartz with cross-cutting relationships;
(5) occasional limestone remnants within the barite deposit.

These features are compatible with deposition of barite and sulphides from hydrothermal ore fluids (possibly related to nearby late Cambrian volcanism). It is speculated that ascending hydrothermal ore fluids encountered a relatively impervious shale horizon above limestone and spread out laterally below the shale. Assuming that strata were slightly inclined at this time, these fluids would gradually ascend up the base of the shale. At some point the solubility of metallic elements and barium would decrease because of cooling and possibly mixing with sea water or meteoric water. It is speculated that by metasomatic processes, galena, sphalerite and barite preferentially replace limestone along bedding planes over a long period of time producing coarse mineralization. Following deposition, the deposit was uplifted, deformed and eroded together with enclosing strata. It is estimated that at least 200 m of original dip-component of mineralization has been eroded.

Hopefully, future work, including fluid inclusion, metallographic and sulphur isotope studies will help to more fully understand the genesis of this deposit.

Acknowledgments

Thanks are extended to St. Joseph Explorations Limited, Granby Mining Corporation Ltd. and Sovereign Metals Corporation Ltd. for permission to publish this paper. Thanks are also extended to St. Joseph staff members who assisted in field work, in drafting and in preparing this paper.

SELECTED REFERENCES

Boyle, R.W. (1972): The Geology, Geochemistry and Origin of the Barite, Manganese and Lead-Zinc-Copper-Silver Deposits of the Walton-Cheverie Area, Nova Scotia, Geol. Surv. Canada, Bull. 166.

Brobst, D.A. (1975): Barium Minerals, Soc. of Mining Engineers, A.I.M.E., Seeley Mudd Series, Industrial Minerals and Rocks, 4th Ed., pp. 427-442.

Carne, R.C. (1976): Geology of the Stratabound Barite-Lead-Zinc Deposit on the Mel and Jean Claim Group, Coal River, Yukon, Dept. of Indian and Northern Affairs EGS Report 1976-16.

Douglas, R.J.W. et al (1969): Geology and Economic Minerals of Canada, Geol. Surv. Canada, Econ. Geol. Rept. No. 1, Chap. 8.

Dawson, K.M. (1977): Regional Metallogeny of the Northern Cordillera, report of Activities, Part A. Geol. Surv. Canada, Paper 77-1A, pp. 1-4.

Gabrielse, H. and Blusson, S.L. (1968): Geology of Coal River Map-Area, Yukon Territory and District of Mackenzie (95 D), Geol. Surv. Canada, Paper 68-38.

Gabrielse, H., Blusson, S.L. and Roddick, J.A. (1973): Geology of Flat River, Glacier Lake and Wrigley Lake Map-Areas, District of Mackenzie and Yukon Territory, Geol. Surv. Canada, Memoir 366.

Morrow, D.W. et al (1978): A Hypothesis Concerning the Origin of Barite in Devonian Carbonate Rocks of Northeastern British Columbia, Canadian Journal of Earth Sciences, Vol. 15, No. 9, pp. 1391-1406.

White, Donald E. (1955): Thermal Springs and Epthermal Ore Deposits, Ec. Geol., Fiftieth Anniversary Vol., Part I, PP. 99-154.

Biasucci, Ellen, (1979): A Microscopic Study of Fluid Inclusions, Mineralogy, and Deformational Textures of the Mel Deposit with Reference to Ore Genesis, B.A.Sc. Thesis, University of Toronto.

Renni, D.W. (1979): A Mineralographic Study of Ore Samples from the Mel Lead-Zinc-Barite Deposit, Southeast Yukon Territory, B.A.Sc. Thesis, University of British Columbia.

Biography

D.C. (Dave) Miller, a native of British Columbia, received a B.A.Sc. degree in geological engineering from the University of British Columbia in 1959. Since 1959, he has been employed in mining geology as both a mine geologist and an exploration geologist primarily in western Canada. Since 1976, he has been employed by St. Joseph Explorations Limited as Senior Exploration Geologist based in Kamloops, B.C.