Contents 23/25 V.J.O.
Presentation 34/35
English 25/40
82%

A Zinc Prospect in the Pend-d'Oreille Series

Kootenay District

British Columbia

An essay submitted in partial
fulfillment of the requirements
of the course in Applied Science,
third year, at the University
of British Columbia.

Cecil G. Hewlett

November 15, 1947.

Vancouver, British Columbia
November 15, 1947

Faculty of Applied Science
University of British Columbia
Vancouver, British Columbia

Gentlemen:

In compliance with your requests, I am submitting this, my term essay. This essay reports observations I made during the summer of 1947 in the Salmo area of the Kootenay district, British Columbia. Here I was employed by the Valley Mining Company as field assistant to Dr. E.P. Kaiser, Dr. H.C. Gunning, and Mr. R.C. Macdonald.

In May and June, 1947, I was employed in surveying and mapping a small zinc prospect optioned by the Valley Mining Company. Later in the summer when diamond drilling was in progress on the prospect I helped to map in detail the regional geology of the area. This report is therefore an account of the exploratory work done on a small zinc prospect, its geology, and its place in the regional picture.

I am indebted to Dr. E.P. Kaiser, Dr. H.C. Gunning, and to Mr. R.C. Macdonald for their invaluable instruction in the field. However, the Valley Mining Company is not responsible for the information and opinions contained in this report. I am also indebted to Dr. V.J. Okulitch for his helpfull suggestions concerning the regional geology of the Salmo area.

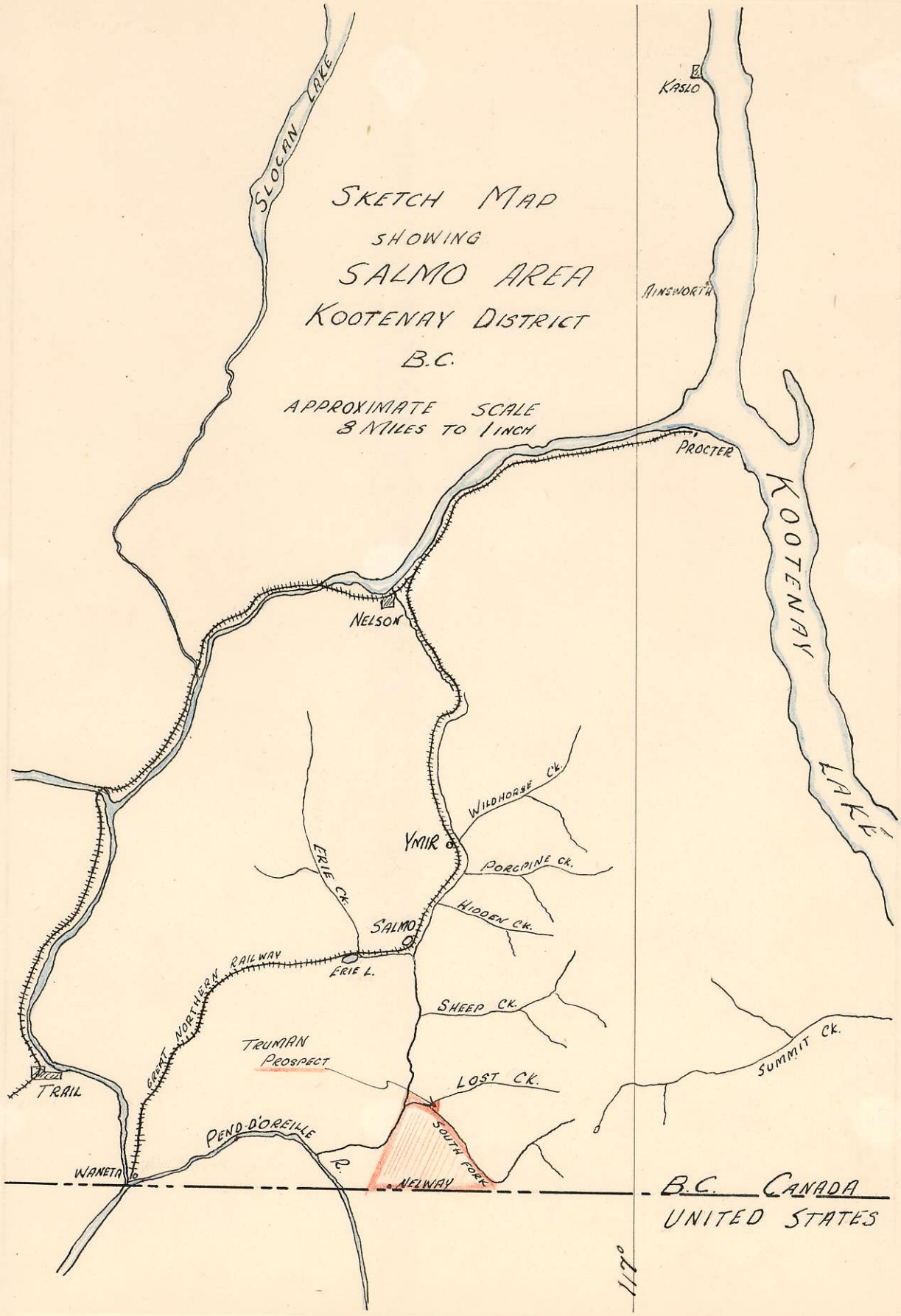
Yours truly,

Cecil G. Hewlett

Cecil G. Hewlett.

Table of Contents

List of Illustrations


SLOCAN LAKE
KASLO
SKETCH MAP
SHOWING
SALMO AREA
KOOTENAY DISTRICT
B.C.
APPROXIMATE SCALE
8 MILES TO 1 INCH
AINSWORTH
PROCTER
KOOTENAY LAKE
NELSON
WILDHORSE CK.
YMIR
ERIE CK.
PORCPINE CK.
HIDDEN CK.
SALMO
ERIE L.
GREAT NORTHERN RAILWAY
SHEEP CK.
SUMMIT CK.
TRUMAN PROSPECT
LOST CK.
TRAIL
SOUTH FORK
PEND D'OREILLE R.
WANETA
NELWAY
B.C. CANADA
UNITED STATES
117°

Introduction

Location

The triangular area covered in this report is situated in the South Kootenay district of British Columbia and is bounded by the South Fork of the Salmo River, the Salmo River valley, and by the International Boundary. This area lies within the southern extremity of the Nelson Range where relief varies from 2200 feet above sea level in the Salmo River valley to 5100 feet.

Topography

Topography is mature and everywhere shows evidence of glaciation. Drift-filled valleys and the wide distribution of granite erratics are the most noticeable glacial features of the area. Valley glaciation is less obvious.

Although the area is not rugged it is difficult to traverse. This difficulty is due to the thick second growth vegetation which has sprung up over large burned areas. Fortunately the area is well served by logging-roads since most of the old pack trails have become overgrown.

EVIDENCE OF GLACIATION

BEDDED GLACIAL SEDIMENTS OVERLAIN BY DRIFT

ROSEBUD LAKE – A RESULT OF GLACIATION.
NOTE: ROUNDED HILLS, BURNED AREA AND SECOND GROWTH VEGITATION

The Truman Prospect

"The Truman prospect" is the name of a zinc prospect owned by Mr. L.R. Clubine of Salmo, B.C. It was optioned by the Valley Mining Company in the fall of 1946 so that exploratory work could begin early in 1947. The prospect covers an area of 13 mineral claims on a limestone ridge just east of the junction of Lost Creek with the South Fork of the Salmo River. It is eight miles from the village of Salmo and is easily accessible by good truck road.

The Truman prospect was originally staked as the "Mona prospect" and is described by Walker (1934) under that name. I do not know the date of the original staking. In 1927 the prospect was bonded by the Consolidated Mining and Smelting Company of Canada. In 1928 they diamond drilled the property. After sinking four holes totalling 2073 feet without intersecting ore they dropped the option.

Previous to this the old Trillion Tunnel had been driven to its present length of approximately 100 feet, at elevation 2200 feet. Sparse mineralization in this tunnel appears to have no simple relation to the main horizon of mineralization at elevation 3000 feet and cannot be considered as a valuable asset to the property.

Exploration of the Truman Prospect

The Truman prospect was optioned by the Valley Mining Company on the basis of opencuts exposing mineralization on a small limestone ridge. The study of surface outcrops suggested that mineralization occurred on the crest of a plunging anticlinal structure. It was therefore postulated that mineralization would persist in the same horizon down the plunge of the anticline and to the east and west limbs. A program of exploration was drawn up to accurately determine the structure, and the continuity and extent of mineralization.

Mapping

Detailed mapping was decided upon to determine the anticlinal structure of the limestone. A base line was measured and a triangulation system laid out to facilitate plane table mapping. This was done with transit and chain. The first plane table map to be made was to the scale of 100 feet to one inch with a contour interval of 25 feet. This map showed the geological boundaries, opencuts, and roads with minor emphasis on the detailed geology. This map determined the important area of limestone which was later mapped to the scale of 40 feet to one inch. The 40-scale map showed in detail the extent of each out - crop with its rock type and attitude. From this information

the limestones were shown to be folded into several tight isoclinal folds with axes striking S 15°W and plunging to the south at 30 degrees.

Diamond Drilling

Diamond drill holes were located on the basis of the structure as determined by detailed mapping. Their location was established so that a total of 1000 feet of drilling between four holes would yield the maximum information about the continuity of the mineral deposit. Three holes were drilled in a line at right angles to the plunge of the structure to determine the extent of mineralization to the limbs of the fold, and a fourth hole was drilled down the plunge. All holes were drilled striking N 15°E and dipping -60 degrees to intersect the ore horizon at right angles.

Core recoveries were 100 % in all holes since the rock drilled through was chiefly a dense, unfractured, limestone. Ore was intersected at the predicted depth in two of the three lateral holes. The fourth hole, down the plunge of the structure, had not reached bedrock after passing through 70 feet of glacial drift containing granite boulders. Continued drilling at mush greater cost was considered unwarranted to prove the continuity of a small possible ore deposit. It was decided therefore to discontinue the drilling program.

DRIVING PIPE THROUGH OVERBURDEN

DIAMOND DRILL CREW ON THE TRUMAN PROSPECT

DRILLING CASING

Mineral Occurrence at the Truman Prospect

Mineralization at the Truman prospect occurs in a light grey, thin-bedded limestone presumed to be the lowest band of the Reeves-Macdonald formation. The deposit is a replacement type with the highest concentration of mineral occurring at the crest of an anticlinal fold.

Sphalerite is the chief economic mineral. It is brown to yellowish-brown in colour and occurs as a fine grained dissemination throughout a favourable horizon in the limestone. Pyrite, pyrrhotite, and galena are also present in very small quantities. It is significant to note that silver assays were only obtained when the ore samples contained galena.

Structural Control at the Truman Prospect

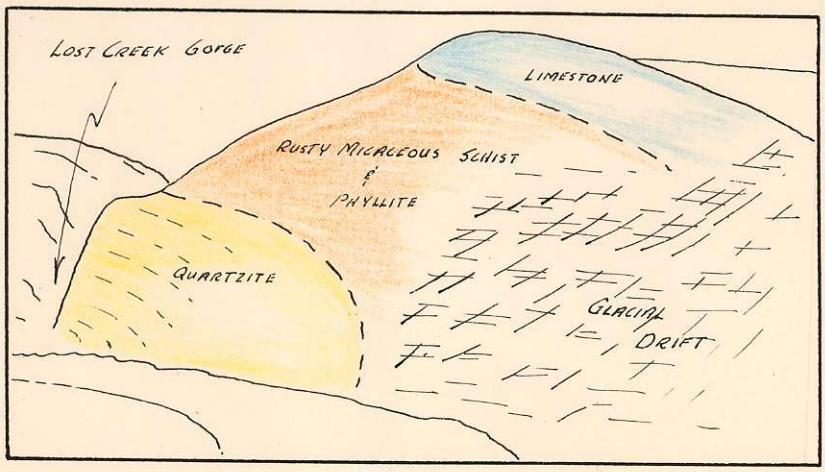
The major structure at the Truman prospect is an anticline with axis striking S 15°W and plunging to the south at an angle of 30 degrees. This anticline may be easily seen from the Lost Creek road by looking south across Lost Creek to the Truman prospect. (See photo.) Here the gorge of Lost Creek has exposed the core of the anticline which is in a competent buff-coloured quartzite. Conformably overlying the quartzite is a series of phyllitic rocks and rusty micaceous schists. These are succeeded conformably by the grey, thin-banded limestones in which the Truman mineralization occurs. Structure in the highly incomptent host limestones is however far more

complex than suggested by the simple anticline exposed in the gorge of Lost Creek. Isoclinal folding, drag folding, and crumpling have complicated the major structure and in many places the bedding has been completely obscured by flowage and recrystallization of the limestone.

Mineralizing solutions appear to have been concentrated at the crest of the major anticlinal structure. Here they favoured a thin limestone horizon which they followed in minute detail.

CORE OF ANTICLINE AS EXPOSED IN LOST CREEK.
THESE ROCKS ARE QUARTZITES.

THE TRUMAN PROSPECT — LOOKING EAST



Regional Geology

Considerable time was spent during exploration of the Truman prospect to obtain in detail the regional geology in the vicinity of, and to the south of , the prospect. It was our hope that in so doing we might establish some correlations between the limestone horizon at the Truman prospect and a similar horizon at the Reeves-Macdonald mine in the same district. It was also our problem to either prove or disprove the correlations made by Park and Cannon (1943) who correlated limestones of the Pend-d'Oreille series in Canada with limestones of the Metaline formation in the United States.

Our chief interest was therefore within the area bounded by the International Boundary, the South Fork of the Salmo River, and the Salmo River valley. The rocks of this area, as mapped by Walker (1934), lie within the Pend-d'Oreille series with the exception of a small area of Reno quartzite.

A subdivision of the Pend-d'Oreille series shall be the only one attempted in this report since the base metal deposits of the Salmo area lie almost entirely within the Pend-d'Oreille series.

Stratigraphy

The Pend-d'Oreille group as origionally named and described by Daly (1912) was divided into two lithologic groups, the Pend-d'Oreille schists and the Pend-d'Oreille marbles. The Pend-d'Oreille schists included chiefly carbonaceous phyllite

with minor amounts of amphibolitic schist and quartzite. The Pend-d'Oreille marbles included the four limestone members in the lower part of the group plus limestone now concidered to be in the lower Metaline formation.

Walker (1934) maintained the name Pend-d'Oreille series but did not further subdivide the series into formations. However, he describes the heterogeneous character of the series by listing a complete section of the series as seen along the Pend-d'Oreille River. He also maps the boundries of the limestone members within the series.

V.J. Okulitch (1945) subdivided the Pend-d'Oreille series into the following formations on the basis of the section exposed along the Pend-d'Oreille River.

Oldest:

Salmo River Phyllite: Greenish to silvery-grey sericite schist conformably overlying the Reno formation. 2400 feet.

Reeves-Macdonald Limestone: Thin bedded, light grey limestone conformably overlying the Salmo River Phyllite. 3200 feet.

Creggan Creek Slate: Black argillite and slate conformably overlying the Reeves-Macdonald Limestone. 3360 feet.

Metaline Limestone: Only the lower horizons exposed in Canada.

On the basis of personal observations and information obtained from the Valley Mining Company I have divided the sedimentary rocks younger than the Reno formation into five lithologic units. (See map #1) The Reeves-Macdonald Limestone shall be the oldest formation concidered in this report. The rocks immediately underlying the Reeves-Macdonald Limestone

are a series of micaceous schists and phyllites which grade down into white massive quartzite. These have all been mapped here as Reno Quartzite.

Reeves-Macdonald Limestone:

The limestone as exposed at the Reeves-Macdonald mine and at the Truman prospect is a grey and white, thin banded rock. Locally the limestone has been recrystallized to a sugary white rock showing none of the characeristic thin bedded structure. Locally the limestone has also been dolimitized and silisifiad.

The Reeves-Macdonald limestone appears to have been a resistant rock to erosion and outcrops in conspicuous bluffs at the mouth of the South Fork of the Salmo River, also in the form of a small resistant ridge at the Truman prospect. (See photos.) Similar outcrops can be found along the Pend-d'Oreille River, at the Reeves-Macdonald mine, and along the North and west side of the Salmo River.

Mineralization in the form of disseminated pyrite, pyrrhotite, sphalerite, and galena occurs in numerous small replacement deposits in the Reeves-Macdonald limestone. However the Reeves-Macdonald mine was the only base metal deposit of economic importance in the area in the summer of 1947.

Creggan Creek Slate:

The Creggan Creek formation conformably overlies the Reeves-Macdonald limestone and can be followed in almost complete outcrop along the main highway running South from Salmo. The formation is predominantly black argil-

BLUFFS OF REEVES – MACDONALD LIMESTONE AT THE MOUTH OF THE SOUTH FORK OF THE SALMO RIVER. LOST MOUNTAIN IN BACKGROUND IS IN RENO QUARTZITE

RESISTANT RIDGE OF REEVES – MACDONALD LIMESTONE AT THE TRUMAN PROSPECT. LOOKING WEST.

lite and slate with several bands of dark limestone. Towards the top of the formation the argillite grades into a dark phyllite, highly crumpled and drag folded.

Numerous small prospects have been staked in the Creggan Creek formation. These are all small quartz veins with disseminated sulphides carrying gold values. Because they cut the highly incompetent slates and argillites these veins are small and inconsistent. It is therefore not surprising to note that none of these prospects have developed into profitable mines.

Transition Zone Phyllite

The Transition Zone Phyllite is chiefly a brown, grey, and silver-grey phyllite. Within the phyllite is a thick band of dark blue limestone containing buff shaley partings which average $\frac{1}{2}$ inch in thickness. Drag folds and schistocity in the transition zone rocks everywhere indicate structures plunging in a southwesterly direction. The base of the Transition Zone Phyllite grades conformably into the Creggan Creek formation. The top of the zone is a sharp contact with the base of the Metaline formation which is a dense white-weathering dolomite.

Metaline Formation

The Metaline formation exposed in Canada is chiefly a dense white-weathering dolomite, also alternating beds of black and white dolomite. This is undoubtedly the 1200 foot section described by Park and Cannon (1945) as "fine grained

cream-coloured dolomite, particularly in upper part. Alternating layers of black and white dolomite". Trilobite fossils found in the Metaline limestone have established the age of the formation as Middle Cambrian.

Section East of Metaline Falls

According to Park and Cannon (1943)

Top Mottled dense grey limestone; few chert nodules.	150 feet
Mottled dense grey limestone; many chert nodules.	450 feet
Fine-grained cream-coloured dolomite, particularly in upper part. Alternating layers of black and white dolomite.	1200 feet
Interbedded limestones and limy shales, locally dolomitic. Grades conformably into Maitlen phyllite.	1200 feet
	3000 feet

Ledbetter Slate

The Ledbetter slate is a black fissile slate containing graptolites which definitely establish the age of the formation as Middle Ordovician. The only exposure of Ledbetter slate in the area is in the southeast corner of the triangle where it is in fault contact with the Metaline formation. This represents a down faulted block. In the complete stratigraphic sequence an erosional unconformity exists between the Middle Cambrian limestone and the Middle Ordovician slate.

Regional Structure

Folding

Folding on both a large and small scale is an obvious and very important structure in this map area. Drag folds on the limbs of the major folds indicate a consistent regional plunge of 15 to 30 degrees at an azimuth of 195 degrees. Schistosity in the phyllites and slates completely masks bedding in many areas and makes the determination of structure impossible.

The largest simple fold of the area is an anticline the east limb of which brings the Reeves-Macdonald limestone north along the Salmo River to the bluffs at the South Fork of the Salmo River. Another anticlinal fold is easily determined along the south side of the South Fork of the Salmo River. The tightly folded syncline between these two anticlines is less obvious because the core of this fold is in the massive white dolomite of the Metaline formation which shows very little bedding. (See section along South Fork.)

Faulting

Major faulting is evident in very few places. The scarp of the Ripple Creek fault may be seen plainly where the fault cuts the highly competent Reno quartzite. However where the fault passes into the extremely incompetent phyllites and limestones of the area the surface expression of faulting

is seldom seen. A few faults of minor importance are evident where the grey Reeves-Macdonald limestone is faulted against the black Creggan Creek slate. It may therefore be postulated that many faults exist within the phyllites, schists, argillites, and limestones of the Pend-d'Oreille series and yet show little or no surface expression.

Attention may be drawn to the unusual course of the South Fork of the Salmo River and to the arrangement of its tributaries. The following points may be noted as possible evidence of a fault controlled stream pattern. The South Fork of the Salmo River is unusually straight; it flows northwest whereas the Salmo River flows due south; it is parallel to the Ripple Creek fault; its tributaries meet it at right angles and in some cases are diametrically opposite one another. These facts and the discontinuities encountered on the north side of the South Fork of the Salmo River may be evidence for postulating a fault along the course of the river.

LOOKING SOUTH EAST UP THE VALLEY OF THE SOUTH FORK OF THE SALMO RIVER.

POSSIBLE EVIDENCE OF FAULTING
IN THE CREGGAN CREEK FORMATION

Correlations of Formations in the Metaline Quadrangle and the Salmo Map Area.

According to Park and Cannon.

Metaline Quadrangle (1943)		J.F. Walker (1934)	
Limestone 700 feet	Devonian		
Ledbetter Slate 2500 feet	Ordovician	Pend-d'Oreille Group	
Metaline Limestone 3000 feet	Middle Cambrian		
Maitlen Phyllite 5000 feet	Cambrian		
Gypsy Quartzite 5300-8500 feet		Reno Formation 3500 feet	
		Quartzite Range 4400 feet	
		Three Sisters Series 5400 feet	
Monk Formation 3800 feet	Cambrian ?	Horsethief Creek Series 4200 feet	WINDERMERE - LATE PRECAMBRIAN
Unconformity			
Leola Volcanics 5000 feet	Pre-Cambrian	Irene Volcanic? Formation	
Shedroof Conglomerate 5000 feet			
Unconformity			
Priest River Group ?			

Conclusions

The ore deposit at the Truman prospect, as indicated by exploration, is small and of low grade. Nevertheless at some future date a profitable mining operation may be carried on there. Mining costs would have to be minimized to extract the 7% zinc ore which carries very small precious metal values. Therefore the future development of the Truman prospect may depend upon a low cost mining method to remove the thin width of ore inclined at 30 degrees to the horizontal.

Of greater significance are the conclusions that may be drawn concerning the regional geology. Regional mapping of the Pend-d'Oreille series has proved that the correlations made by Park and Cannon (1943) were false and that the Reeves-Macdonald formation is stratigraphically below the Metaline formation and is possibly of Late Precambrian age. The Truman prospect and the Reeves-Macdonald mine were proved by mapping to occur in the same formation.

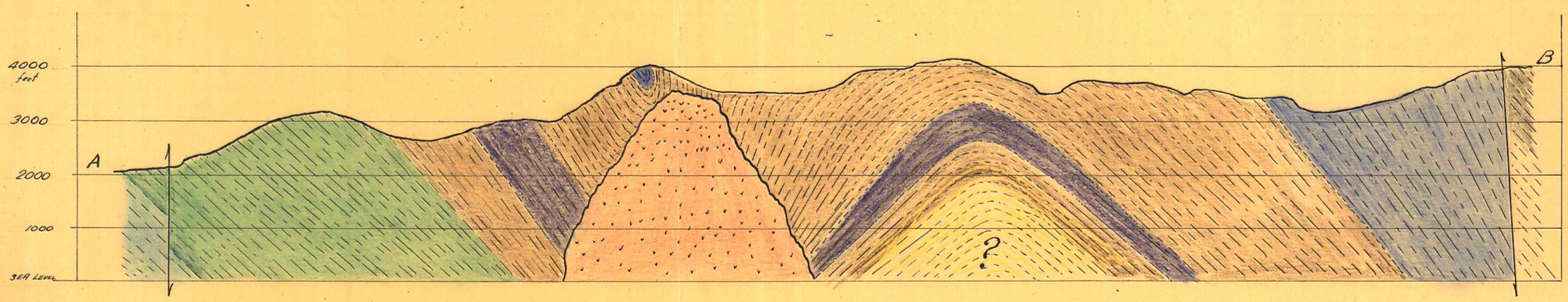
Bibliography

Daly, R.A., "Geology of the North American Cordillera at the Forty-Ninth Parallel." Geological Survey of Canada, Memoir No. 38, 1912.

Walker, J.F., "Geology and Mineral Deposits of Salmo Map-Area, British Columbia." Geological Survey of Canada, Memoir No. 172, 1934.

Okulitch, V.J., "Report on the Presence of Ore-Bearing Horizons in the Metaline Limestone in Southern British Columbia." Valley Mining Company, 1945.

Parks, C.F. and Cannon, R.S., "Geology and Ore Deposits of the Metaline Quadrangle, Washington." United States Geological Survey, Professional Paper 202, 1943.



GENERALIZED STRUCTURAL SECTION ALONG LINE AB

HORIZONTAL SCALE ½ MILE = 1 INCH VERTICAL SCALE 2000 FEET = 1 INCH

inches
0 1
0 1 2
centimetres

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

TABLE OF FORMATIONS

- LEDBETTER SLATE
- METALINE LIMESTONE & DOLOMITE
- TRANSITION ZONE
- CREGGAN CREEK SLATE
- REEVES - MACDONALD LIMESTONE
- RENO QUARTZITE (Projected from Map 299A, Salmo Sheet)
- NELSON BATHOLITH

49°5'

SALMO RIVER

To Salmo 8 miles

LOST CREEK

TRUMAN PROSPECT

SOUTH FORK OF SALMO RIVER

ROSEBUD LAKE

SALMO RIVER

ROSEBUD CREEK

REEVES-MACONALD MINE

CREGGAN CREEK

ELDORADO CREEK

BIGEY CREEK

LOMOND LAKE

B.C. Wash.

NELWAY N

117°20'

STAGLEAP CREEK

Maitlen phyllite U.S.G.S.

BC 49°00' Wash.

117°10'

TABLE OF FORMATIONS

ORDOVICIAN	LEDBETTER SLATE	Black slate with local black quartzite
MIDDLE CAMBRIAN	METALINE LIMESTONE & DOLOMITE	Chiefly dense white dolomite
	TRANSITION ZONE	Chiefly phyllite; Agillaceous, limestone
	CREGGAN CREEK SLATE	Black slate with local black limestone.
LATE PRECAMBRIAN	REEVES - MACDONALD LIMESTONE	Banded, grey and white limestone.
	RENO QUARTZITE	White quartzite, buff-coloured near top.
POST-TRIASSIC	NELSON BATHOLITH	Granite, monzonite, quartz, quartz diorite, syenite, granodiorite.

LEGEND

GEOLOGICAL BOUNDARY (Position defined)

GEOLOGICAL BOUNDARY (According to Walker (1934) Map 299A Salmo Sheet

BEDDING (INCLINED & VERTICAL) 30

PLUNGE of FOLD AXIS 30

FAULT

inches 0 1

centimetres 0 1 2

SCALE

½ MILE = 1 INCH

CONTOUR INERVAL 100 FEET

GEOLOGY BY KIND PERMISSION OF THE VALLEY MINING COMPANY.