OFR 1973-25

THE OLDMAN RIVER LEAD-ZINC OCCURRENCE
SOUTHWESTERN ALBERTA

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Introduction

The Oldman River lead-zinc occurrence, situated in southwestern Alberta (Fig. 1), was first discovered in outcrop by a group of hunters in 1912. The property was staked in 1950 by the Oldman Mining Syndicate, a company formed by a group of Nanton, Alberta businessmen. West Canadian Collieries acquired an interest in the prospect in 1952 and took the initiative in evaluation studies during 1953 and 1954. This work was documented in some detail by the late Mr. Sid Ward, geologist for West Canadian Collieries, who met with an untimely death in 1955. The information became the property of Scurry-Rainbow Oil Limited, Calgary upon the company's acquisition of West Canadian Collieries' holdings in 1969. Mineral claims are now being held by Alberta Silver Mines Ltd., Turner Valley.

The prospect, although unconfirmed as a potential mine, is important for a number of reasons. First, it consitutes one of the few cases of metallic mineralization within the province. Second, the mineralization is uniquely fault-controlled within Devonian carbonate strata along the eastern edge of the Cordilleran region. Finally, the prospect is reasonably well-documented, a fact which may add to a better understanding of any similar occurrences of the eastern Cordillera.

The study is largely a review of work performed by West Canadian Colleries. It is, therefore, the writer's wish that any value in the study be credited to the late Mr. Sid Ward, whose resourcefullness and initiative are readily apparent in the original evaluation records. Thanks are extended to Mr. Dave Lane of Scurry-Rainbow Oil Limited for his assistance and cooperation and to Alberta Silver Mines Limited for permission to disclose the information.

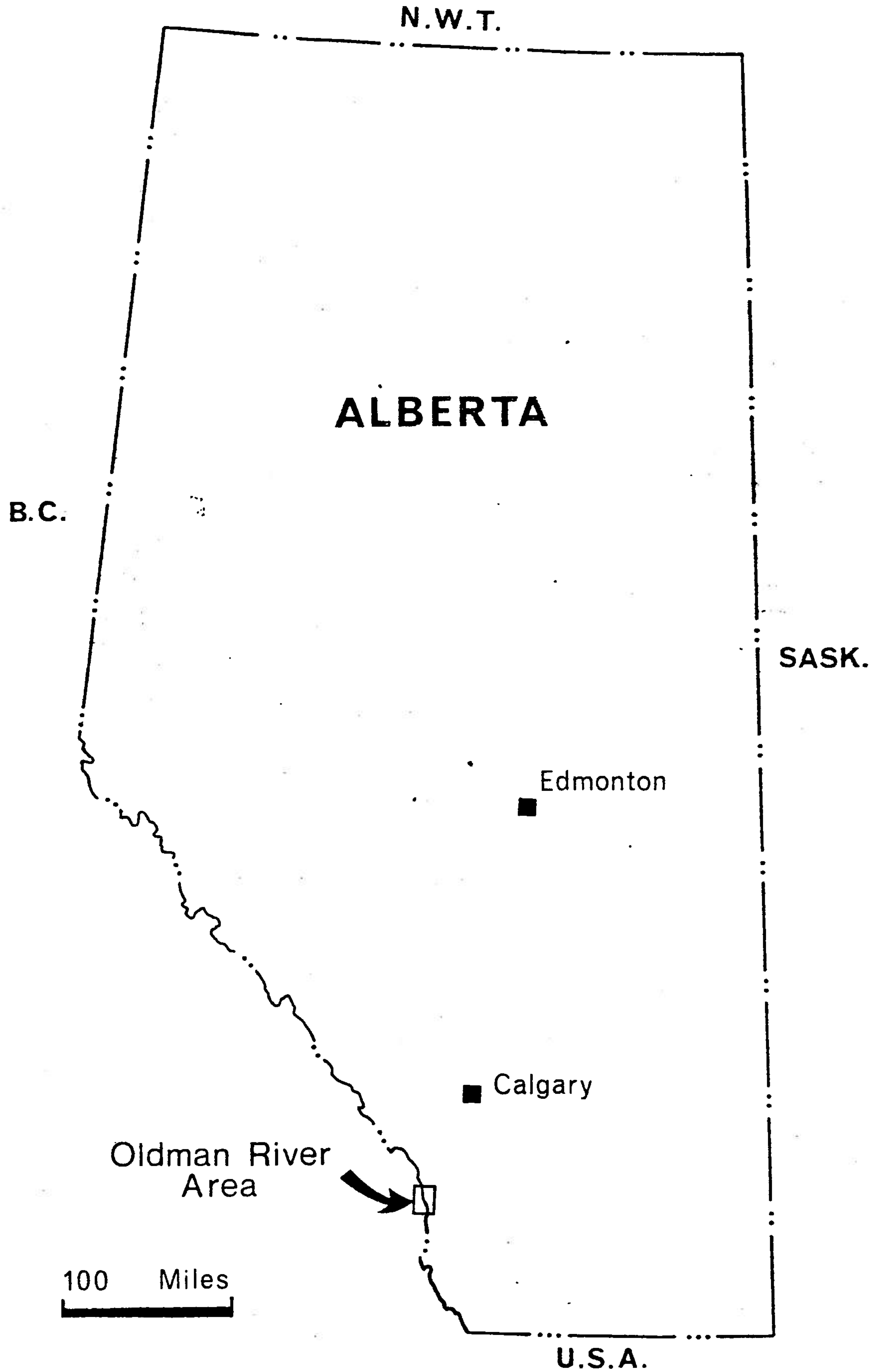


Figure 1. Location map.

Location and Physiography

The prospect is located at the headwaters of the Oldman River on the east flank of the High Rock Range in Lsd. 13, Sec. 35, Tp. 13, Rge. 6, W.5M (Fig. 2, in pocket). Access is by means of the Kananaskis Highway 30 miles north from Coleman (or 85 miles south from Seebee) and thence 20 miles west on a forestry road and bulldozed trail parallel to the Oldman River. The final switchback to the site was found to be covered by talus when visited by the writer and W. N. Hamilton in 1970. Recently, the Canadian Pacific Railway has constructed a spur line north to the Fording Coal Limited Mine from Sparwood, B.C., which is approximately 25 miles south of the prospect on the main C.P.R. line. The railway is situated about 5 miles west of the prospect in the Fording River valley and on the west side of the High Rock Range.

The local topography is very rugged with elevations ranging from 5000 to 9000 feet above sea level. The mineralization occurs at an elevation of about 7500 feet on a spur on the east slope of Mount Gass (Fig. 3).

An integrated study of the vegetation, soils and surficial geology of the area was published by Jeffrey _et al_. in 1968.

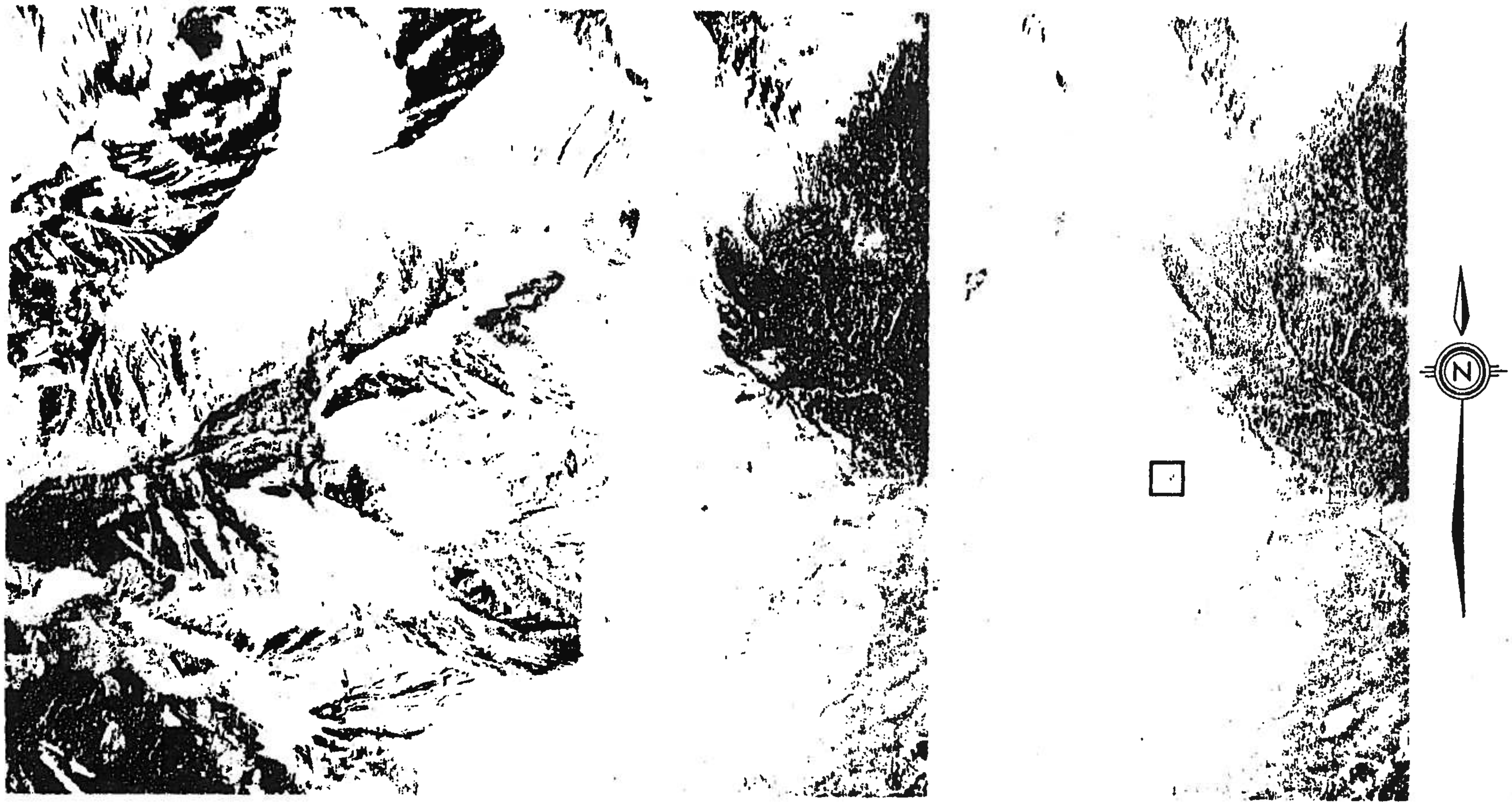


Figure 3. Air photo of the Oldman River Area.

History of Investigation

During the summer of 1953 West Canadian Collieries concentrated on proving-up mineralized showings at the 7500-foot elevation on an east-west oriented spur of Gass Mountain. An adit was opened on the north face of the spur at a point where there were high concentrations of mineralization. Drifting was carried 80 feet to the south. In addition, two east-west oriented trenches were dug on top of the spur 100 feet and 200 feet respectively, south of the adit mouth. Another trench was excavated to the north, at the base of the spur. Two holes were drilled about 120 feet south of the adit mouth; one was drilled vertically to a depth of 135 feet and the second hole was drilled with an inclination of 60° north to a depth of 157 feet. During the later part of the same season a bench was developed 120 feet west of the upper adit near a highly mineralized zone at the 7450-foot elevation in preparation for the opening of a second adit.

During 1954 the adit at the 7450-foot level was driven 85 feet to the south. A crosscut was then extended 29 feet to the east and 5 feet to the west. Within the same season Ward carried out reconnaissance investigations for mineralization from an area 12 miles south of the prospect 60 miles north along the First Ranges to as far as Whiteman's Pass on Cross River. A few gossan areas were noted but no extensive mineralization was found. The close of the 1954 season marked the end of serious evaluation work by West Canadian Collieries. Several efforts to interest other mining concerns in the property proved unsuccessful.

A 10-ton sample of hand-cobbed ore from the mouth of the upper adit was shipped to Consolidated Mining and Smelting Company of Canada Limited in Trail, B.C. for treatment. Numerous analyses were run on representative samples from faces in both adits. Four hundred pounds of ore was sent to the Mines Branch in Ottawa for mineral dressing and processing tests.

Geology

The bedrock geology of the areas was mapped by Norris (1958) and strata range in age from Devonian to Cretaceous (Fig. 2). The oldest rocks are carbonates belonging to the upper 250 feet of the Devonian Palliser Formation and these and the overlying Mississippian carbonate strata (up to 4000 feet or more in thickness) have been brought to surface along the west-dipping Lewis Thrust to override Cretaceous clastic beds along the abrupt eastern face of the High Rock Range.

In the area of the lead-zinc prospect the highly resistant Palliser Formation has been thrust eastward over nonmarine shales, sandstones, and coal beds of the Lower Cretaceous Kootenay Formation. Sulfides are associated with coarse crystalline calcite and dolomite within a dolomitic limestone approximately 50 feet from the top of the Palliser Formation and approximately 200 feet stratigraphically above the Lewis Thrust.

Mineralogy

The mineralogy of the deposit is relatively simple. Galena, pyrite and dark brown sphalerite (in order of decreasing amounts) are the predominant minerals in the deposit. There is a minor amount of alteration of pyrite to marcasite. Dr. R. M. Thompson, formerly of the University of British Columbia, briefly studied samples in 1953 and noted small amounts of cerussite which showed some alteration to anglisite (correspondence). X-ray diffraction analyses confirm the presence of small amounts of smithsonite in association with the galena. No native silver or silver minerals were detected in samples studied. Limonite is very common, particularly within fault gouge material. Dolomite in the coarsely crystalline veins is characteristically dark grey and contains traces of iron and magnesium (Dr. Thompson, correspondence). The dolomite is intimately mixed with white, coarsely crystalline calcite.

Results of Investigations

Early in the evaluation of the property it was noted that the mineralization is associated with points at which major faults intersect. The upper adit was driven south along a thrust fault (interpreted to be a splay from the Lewis Fault and delineated by a prominent fault gouge) and sulfides were only found near the mouth of the adit where the splay was intersected by an east-west, high angle tear fault (Figs. 4, 5, and 6). Figures 6 and 7 illustrate in some detail the mode of occurrence of the mineralization. Galena is concentrated below the fault gouge and lenses-out laterally from the plane of the tear fault. Coarse crystalline dolomite and calcite forms a central pod which is enveloped by massive galena. A zone of galena dissemminated within the country rock surrounds the massive form. Sphalerite occurs in lower amounts and is less obvious macroscopically. The records do not indicate its distribution relative to the fault planes. Narrow calcite veins are common and they are usually orientated normal to the plane of the splay fault and above it. One vein was noted to cut laterally across the entire adit face. A minor fault occurs below the splay fault and calite veins are similarly developed above it and normal to its plane.

The adit was extended 60 feet south of the mineralized zone through barren limestone before encountering an area of massive dolomite. A thin lense of pyrite adjacent to the splay fault was the only anomalous sulfide occurring within the dolomite.

The test hole drilled vertically from a position above the upper adit encountered no mineralization. The second hole drilled at the same site with a 60° inclination to the north yielded inconclusive results. Drill cuttings thought to be from an interval between approximately 5 and 15 feet below the adit floor and about 50 feet south of the portal formed a dense sludge thought to be comprised of galena particles. Assays confirmed the presence of galena in low amounts.

The lower adit was opened adjacent to an outcrop bearing galena and massive calcite (Fig. 8) on the plane of another east-west tear fault. A high angle north-south striking fault immediately east of the mouth of the

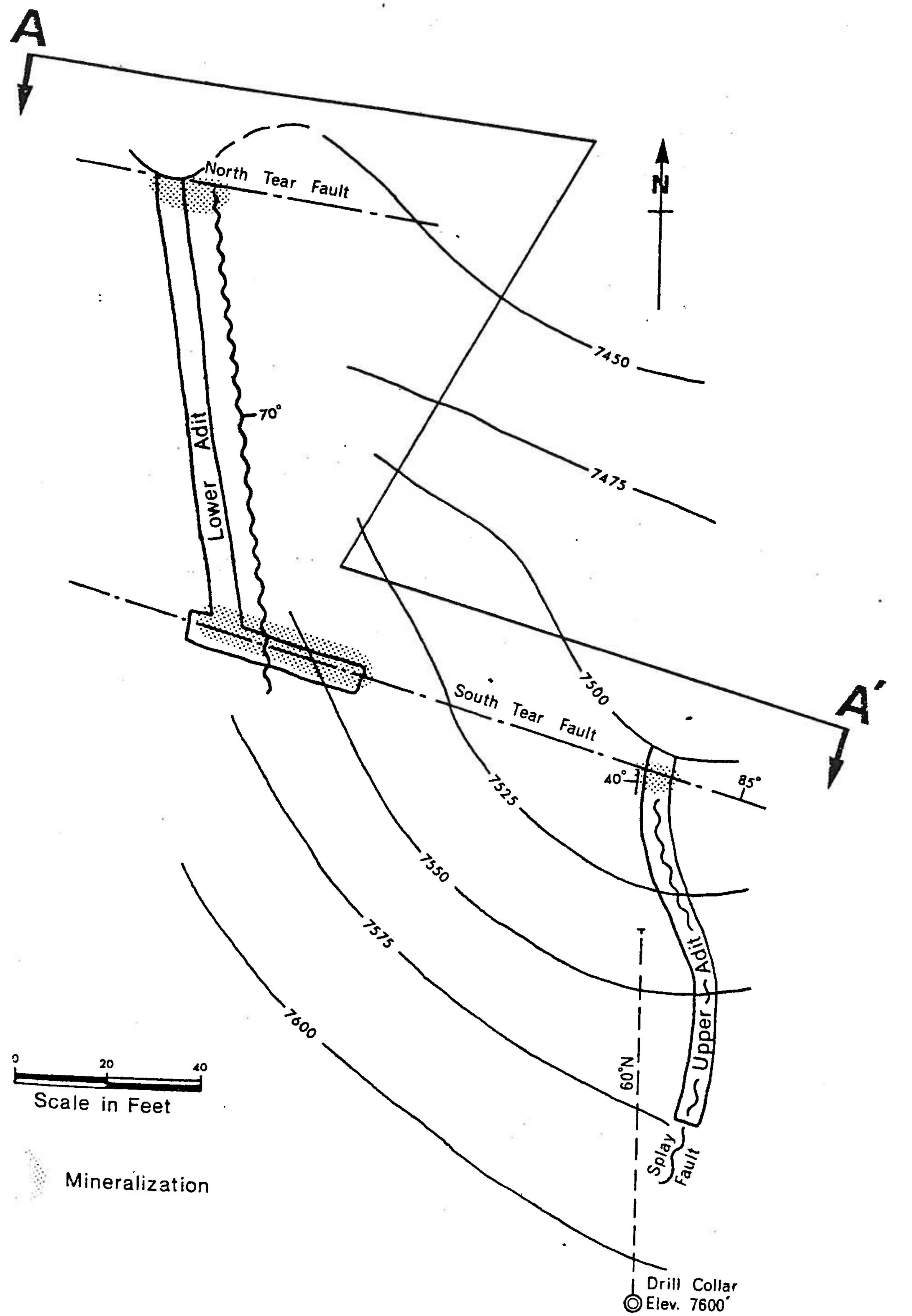


Figure 4. Underground workings and surface contours.

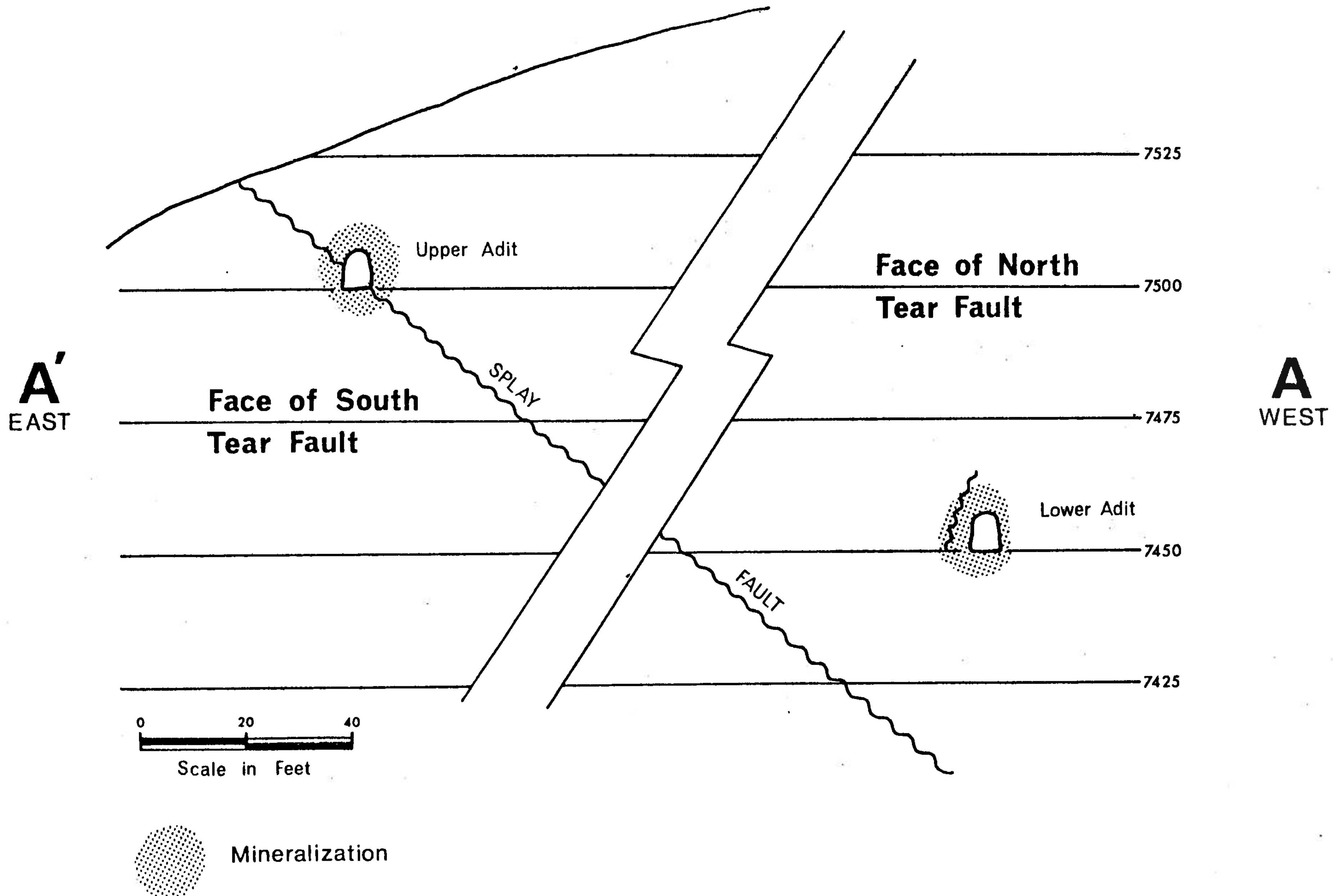


Figure 5. East-west cross section.

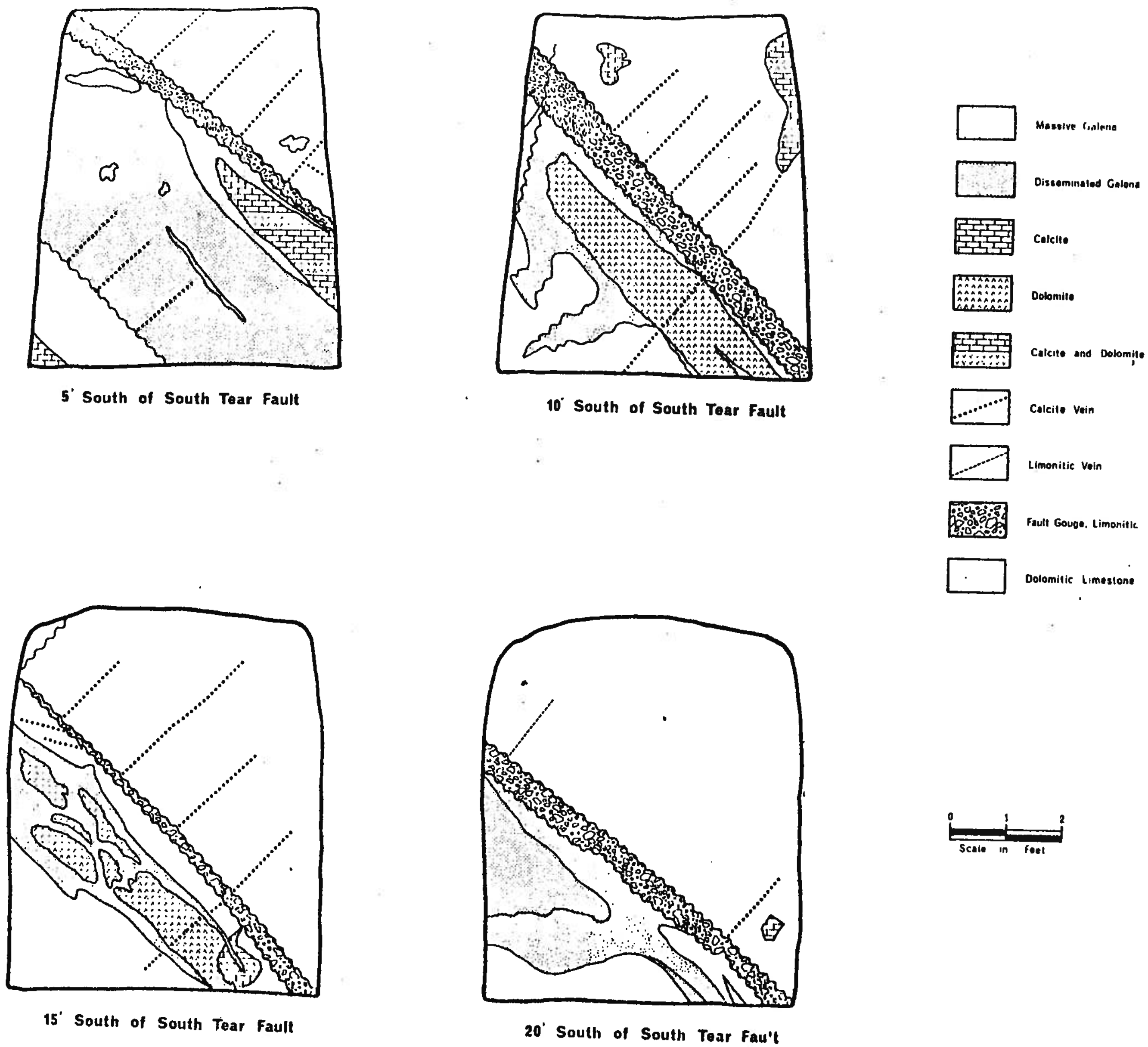


Figure 6. Mineralization on faces of upper adit.

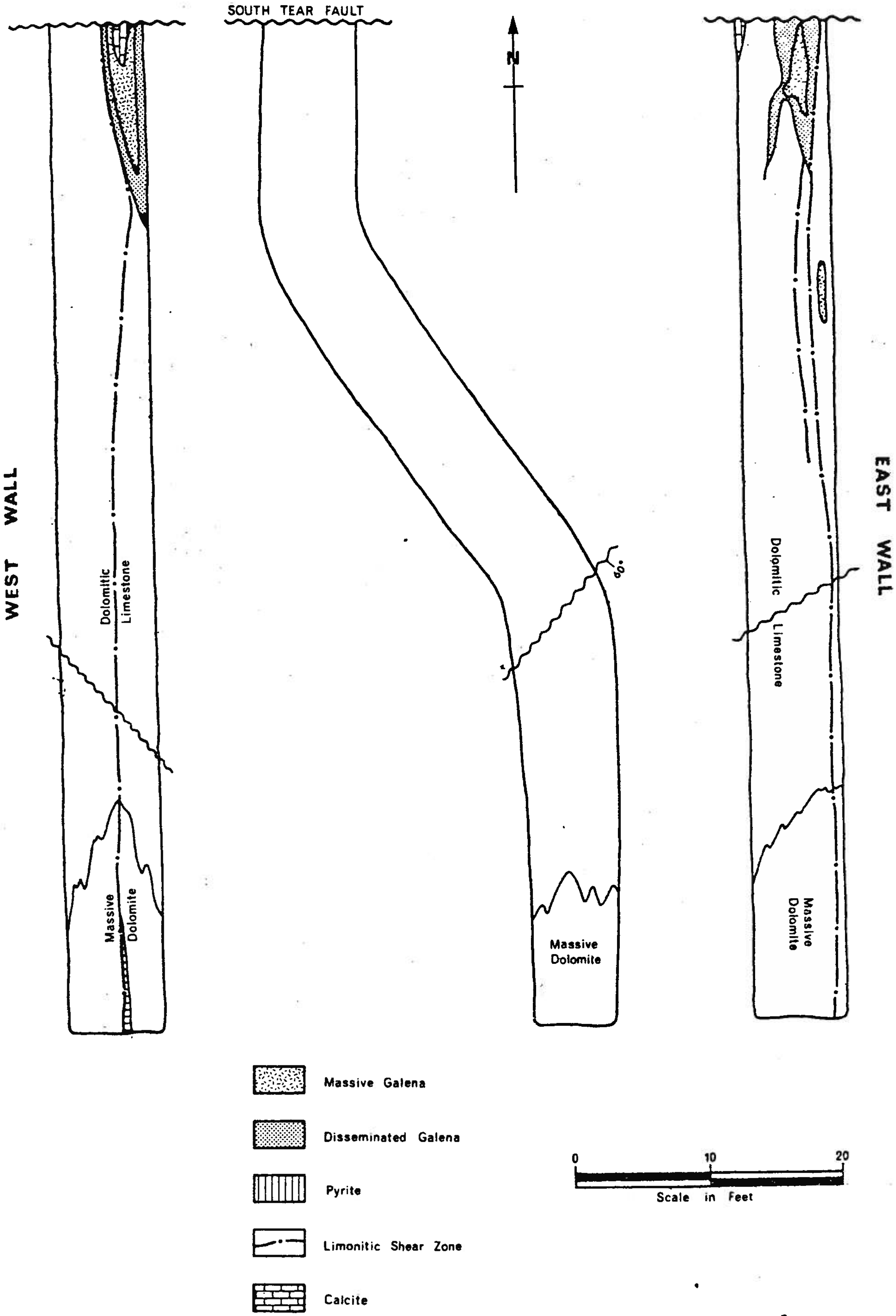


Figure 7. Dis r cution of mineralization, upper adit.

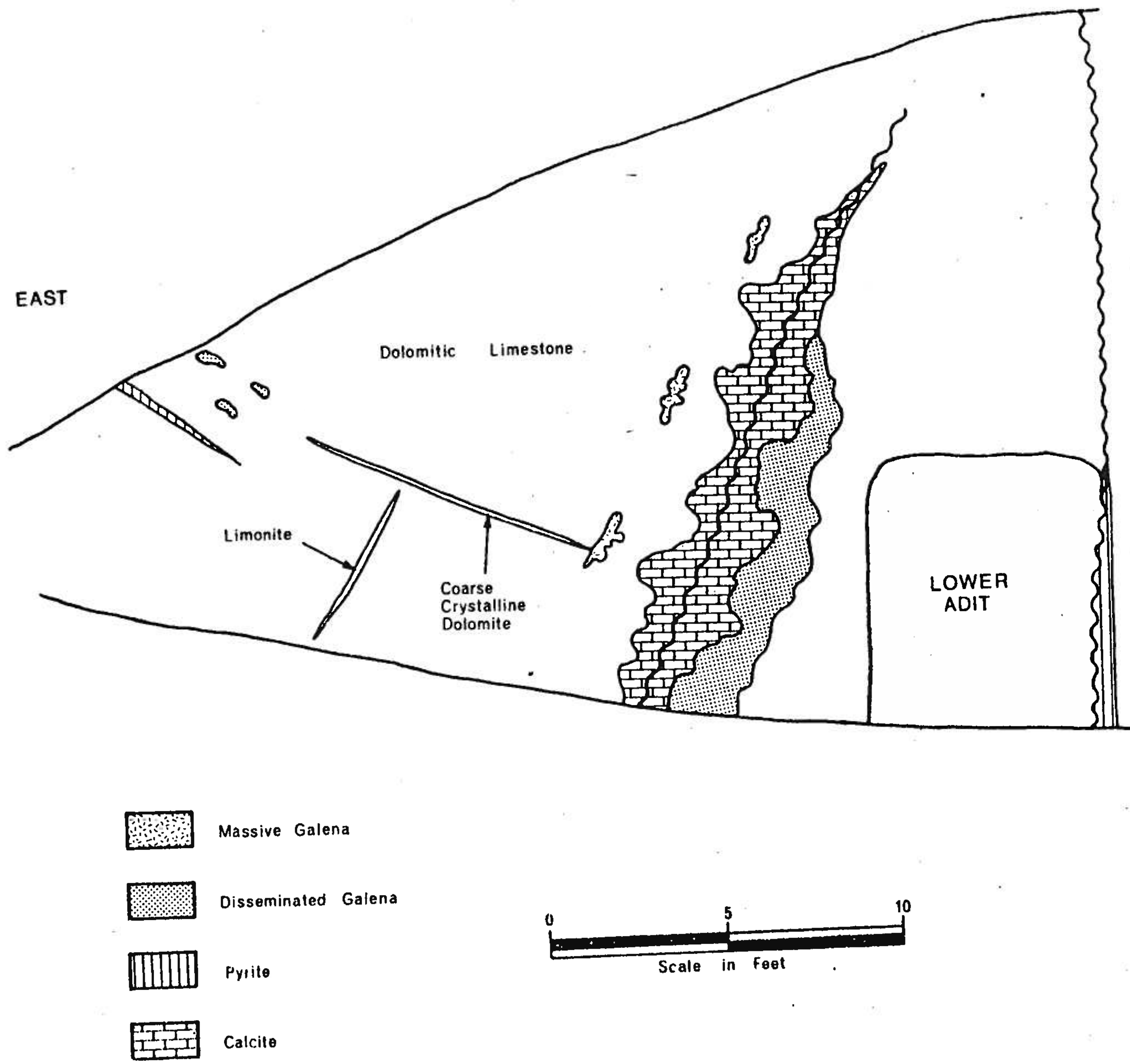


Figure 8. Mineralization at portal of lower adit.

adit is surrounded on the hangingwall and footwall by the coarse crystalline calcite. Galena, disseminated within dolomitic limestone, forms a narrow lense adjacent to the calcite on the footwall. A few small pods of massive galena were noted within the limestone on the hangingwall. A second fault on the west side of the adit entry is bordered by a narrow lense of pyrite. Mineralization persisted only a few feet south of the tear fault within the adit but was again encountered 85 feet to the south where the south tear fault was intersected (Fig. 4). An east-west crosscut parallel to the fault indicated limited mineralization to the west. The drift was advanced 29 feet to the east without termination of the sulfides. The high angle fault mapped east of the adit portal was encountered 5 feet into the east crosscut thus confirming that the adit had been opened parallel to the fault. Mineralization was anomalously high close to the fault and mainly on the north wall of the crosscut.

The bulk sample from the portal of the upper adit was assayed with the following results:

Lead	31.5%	Arsenic	0.1%
Zinc	7.3%	Antimony	0.1%
Silver	2.2 oz per dry ton	Sulphur	6.9%
Gold	trace	Silica	1.4%
Iron	3.2%		

A total value of $390.40 was realized for the sale of the ore to Consolidate Mining and Smelting of Canada Limited.

The results of analyses from the two adits are summarized in tables I and II.

Table 1. Assays of samples from upper adit

Distance[1] (feet)	Silver (oz per ton)	Lead (percent)	Zinc (percent)
West wall, channel samples			
10	0.10	0.52	1.10
20	0.10	0.54	2.30
30	trace	0.60	0.90
40	trace	0.70	0.50
50	trace	0.40	0.45
60	trace	0.50	0.45
70	trace	0.50	0.45
East wall, channel samples			
10	1.4	17.10	12.50
20	0.6	4.20	6.20
30	0.2	0.60	1.80
40	trace	0.30	0.70
50	trace	0.40	0.45
60	trace	0.30	0.30
70	trace	0.20	0.50
Face sample			
0	1.10	13.20	6.00
76	0.20	0.40	0.45

[1] Distance from portal

Table II. Assays of samples from lower adit

Distance[1] (feet)	Distance[2] (feet)	Silver (oz per ton)	Lead (percent)	Zinc (percent)
West wall, channel samples				
10		trace	0.70	0.60
20		trace	0.35	0.40
30		trace	0.10	0.25
40		trace	0.30	0.30
50		trace	0.35	0.20
60		trace	0.40	0.80
70		trace	0.25	0.40
80		trace	0.35	0.20
East wall, channel samples				
0		1.10	13.20	6.00
10		0.20	0.60	4.07
20		trace	0.20	0.90
30		trace	0.20	0.75
40		trace	0.35	0.60
50		trace	0.40	0.60
60		trace	0.40	1.40
70		trace	0.50	0.40
80		0.80	0.80	8.60
Face sample				
50		0.90	1.30	6.70
95		0.10	0.35	0.60
West crosscut, face sample				
	5	0.10	0.30	0.95
East crosscut, south wall, channel samples				
	0	trace	0.20	0.40
	10	1.2	14.80	8.00
	20	0.9	1.00	8.45
East crosscut, north wall, channel samples				
	0	0.70	1.00	5.40
	5 (over 5' width)	0.70	4.20	3.70
	10	trace	0.90	1.10
	20	trace	0.40	0.40
East crosscut, face sample				
	29	trace	0.20	1.10
East of portal (over 5' width)				
	-	0.60	21.90	2.70

[1] Distance from portal
[2] Distance from north-south adit

Ore Petrography

Galena varies from finely disseminated to massive and the average particle size is between 0.5 cm and 1 cm in diameter. Grain boundary contacts with the dolomitic limestone or dolomite and calcite vein minerals are typically very irregular (Pl. 3, Fig. 1) suggesting late replacement by the galena. Scattered inclusions of the country rock in the galena are common. Cleavage planes show some evidence of distortion (Pl. 3, Fig. 2) and sporadic euhedral grains of galena are in evidence (Pl. 3, Fig. 3). Mechanical separation of the sulfide would not appear to be a problem.

The sphalerite is fine-grained, usually less than 2 mm in diameter. Grain boundaries are uneven adjacent to both galena and the country rock (Pl. 3, Fig. 3 and 4). Sphalerite commonly contains pyrite inclusions (Pl. 3, Fig. 4) or is bordered by very fine grains of pyrite (Pl. 4, Fig. 1). As a result, sphalerite would probably be difficult to isolate from the associated pyrite.

Pyrite is invariably anhedral and ranges in size from a few microns in diameter to massive. Finer grains show evidence of oxidation on the margins or alteration to marcasite (Pl. 4, Fig. 2). Massive pyrite is commonly comprised of rounded to tabular-shaped particles supported by a matrix of calcite or dolomite (Pl. 4, Figs. 3 and 4). This distinctive fabric is suggestive of brecciation of the sulfide and subsequent annealing by the interstitial carbonates.

Geochemistry and Genesis

Sulfur isotope analyses for galena, sphalerite, and pyrite are given in Table III. Geochemical results are available on a number of other base-metal occurrences in the Eastern Cordillera (Fig. 9) and comparisons of average sulfur isotope values and geological settings of the deposits are provided in Figure 10. Geochemical information on the Hawk Creek, Kicking Horse, Monarch, Eldon and Baker Creek sites is derived from Evans, Campbell and Krouse (1968). The Spray Lakes analysis was run on a single sample in the collections of the Research Council of Alberta originally obtained from

Table III. Sulfur Isotope Analyses[1]

Sample	δS^{34} (weighted mean)
Galena	+ 9.89 ± 0.28
Sphalerite	+15.64 ± 0.02
Pyrite	+15.85 ± 0.02

[1] Analyses performed by Dr. M. L. Coleman, University of Alberta, Edmonton

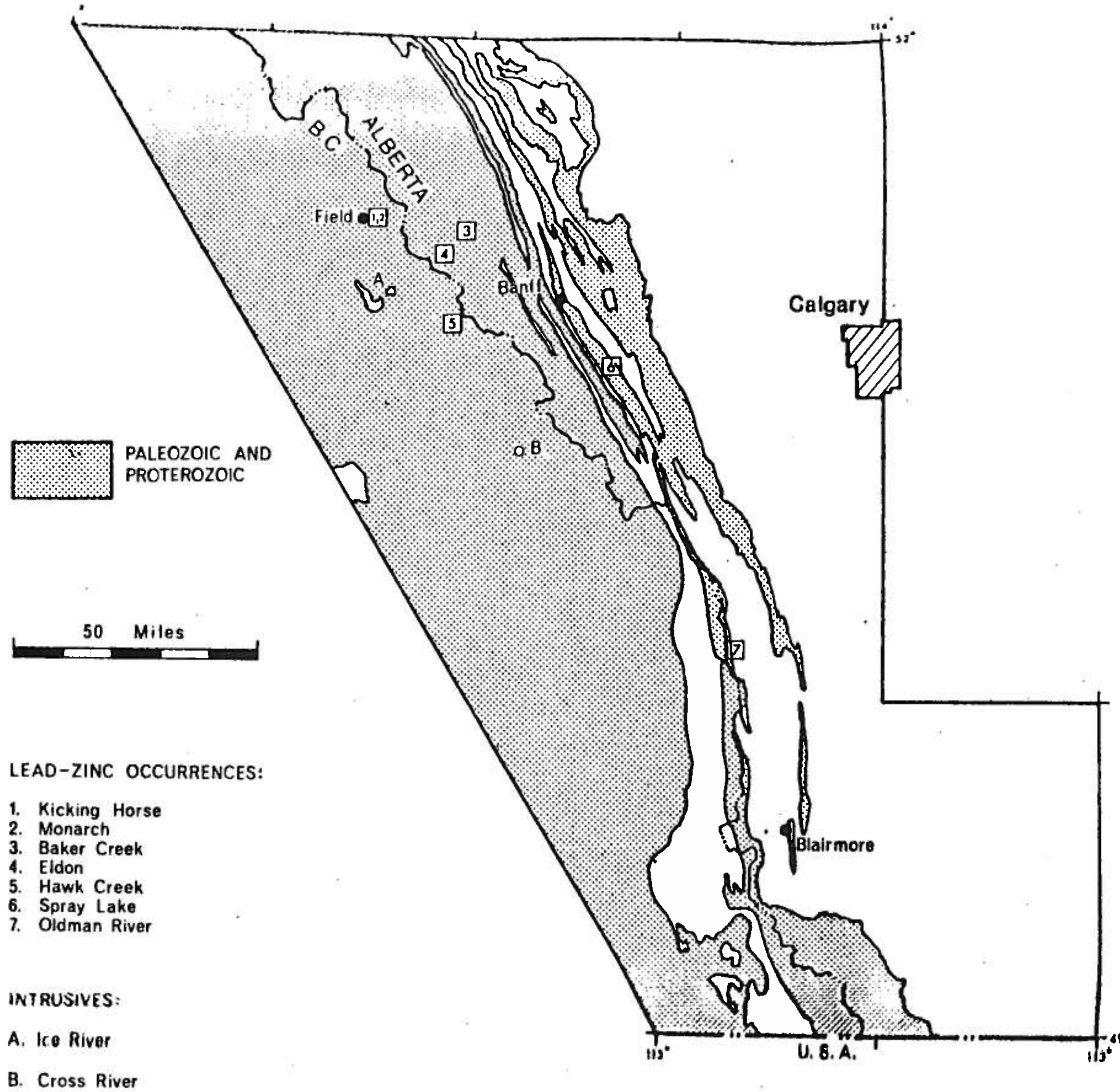
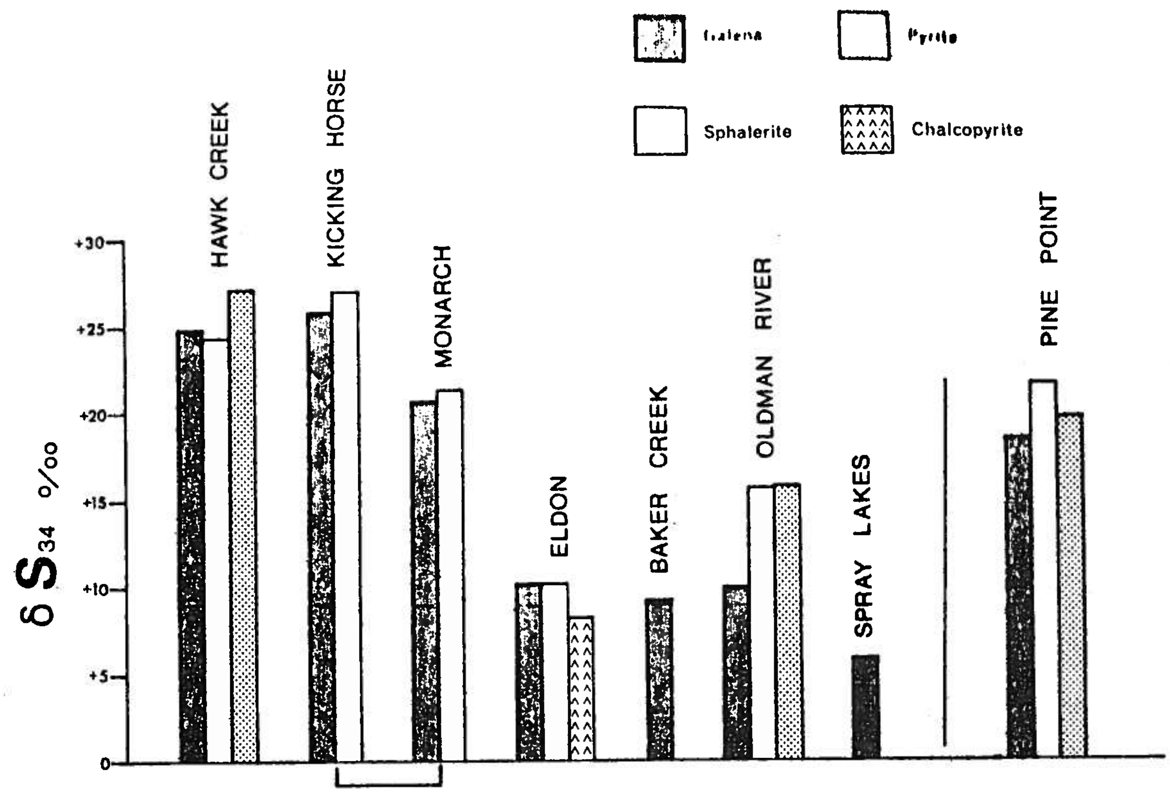


Figure 9. Sulfide occurrences of the east-central Cordillera.



	Hawk Creek	Kicking Horse / Monarch	Eldon	Baker Creek	Oldman River	Spray Lakes	Pine Point
COUNTRY ROCK	Argillaceous limestone	Dolomitic limestone	Dolomitic limestone	Dolomite	Dolomitic limestone	Dolomitic limestone	Dolomite
STRATIGRAPHIC INTERVAL	Cambrian	Middle Cambrian Cathedral Fm.	Lower or Middle Cambrian	Middle Cambrian Cathedral Fm.	Upper Devonian Palliser Fm.	Upper Devonian	Middle Devonian Pres'quile Fm.
ACCESSORY MINERALS	Dolomite	Dolomite	Quartz, Siderite, Sericite	Dolomite, Limonite	Calcite, Dolomite	Calcite	Dolomite
MINERALIZATION CONTROL	Faulting, limestone replacement	Fault	Vein		Fault		Reefal limestone replacement

Figure 10. Sulfur isotope values of sulfides from carbonate strata of Western Canada.

the vicinity of Sec. 34, Tp. 23, Rge. 10 W.5M. Isotope values for the mineralization at Pine Point, Northwest Territories were derived from Sasaki and Krouse (1969).

Further details regarding the geology of the Monarch and Kicking Horse mines are available in Allan (1914), Brown (1948), Goranson (1937), and Ney (1954). Henderson (1953) has reported on the Hawk Creek deposit. Recent definitive papers on the Pine Point area include: Campbell (1967), Jackson and Beales (1967), and Jackson and Folinsbee (1969). A summary of the geological conditions at each of the above occurrences is provided in Evans (1965).

The Oldman River prospect appears to show greatest affinity to the Baker Creek and Spray Lakes occurrences in terms of geochemistry, host rocks and associated minerals. The Hawk Creek, Kicking Horse and Monarch deposits, although of similar structural and lithologic character, possess δS_{34} values almost double those of more easterly occurrences. The graphical results given in Figure 10 are arranged in an approximate order of decreasing distance from the Eastern Cordilleran front. The apparent decreasing sulfur isotope values in the same direction could suggest δS_{34} losses from hydrothermal fluids moving from deep-seated western sources. The contents in eastern occurrences such as at Oldman River may thus be vastly altered from those contained in deposits nearer western regions from which metals may have migrated.

Evans, Campbell and Krouse (1968) proposed that metals in the Paleozoic strata of the Eastern Cordillera came from subsurface brines and the sulfur from hydrogen sulfide associated with petroleum and natural gas accumulations. Presumably, the Oldman River mineralization can be regarded as having a similar origin. The relative sparcity of sulfate-bearing evaporite beds in the local successions would tend to exclude the possibility of sulfur having been derived from sea-water sulfate as postulated by Sasaki and Krouse (1969) for the Pine Point mineralization.

The relatively high positive values of δS_{34} (including those of the Oldman River area) appear to be inconsistent with a magmatic origin. It is interesting to note, however, the location of intrusive masses at Ice River and Cross River with respect to the known deposits (Fig. 9). A small amount of mineralization has been recognized in association with the Ice River Complex (Allan, 1914; Campbell, 1961) and Dawson (1886) described a body of diorite on Cross River which also included minor mineralization. No other intrusives have been documented in or adjacent to the southern Rocky Mountains with the exception of the Purcell Intrusives and the Nelson Batholith, both of which are some distance removed from the area under consideration.

Age of Mineralization

The definite association of ore with thrust faulting initiated by the Laramide Orogeny clearly places the age of the Oldman River mineralization as post-Laramide (100 to 50 million years ago, Cretaceous and early Tertiary times). Evans (1965) reports a minimum K-Ar age of 250 M.Y. for sericite from the Eldon mine area. However, the Eldon ores anomalously contain chalcopyrite and vein quartz and therefore may not share a common genesis with other Eastern Cordilleran mineralizations. Influences of intrusive events on sulfide emplacement at Oldman River can largely be disregarded on the basis of dating information. Baadsgaard, Folinsbee and Lipson (1959) dated mica (lepidomelane) from the Ice River Complex by the potassium-argon method at 350 million years. In addition, the Nelson Batholith is pre-Laramide in age and as such, cannot be regarded as influencing mineralization at Oldman River.

Conclusions

Investigations have established a number of important conclusions with regard to mineralization at Oldman River:

1. Thrust faulting has been instrumental in introducing sulfides to the carbonate strata.
2. Mineralization has been concentrated at the intersection of north-south thrust or high-angle faults and east-west tear faults.
3. Emplacement of mineralization is post-Laramide and is probably genetically related to subsurface brine movements. A relationship to magmatic or evaporite influences is deemed unlikely.
4. Mineralization controls may equally apply to undiscovered deposits elsewhere in the Western Cordillera.
5. Encouragingly high assays of lead, zinc and silver warrant further investigation of the immediate area.

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PLATE 1.

Oldman River lead-zinc occurrence. The individual in the photograph is standing at the mouth of the upper adit and the portal of the lower adit can be seen at the extreme right. Note the abundant calcite veins subparallel to bedding.

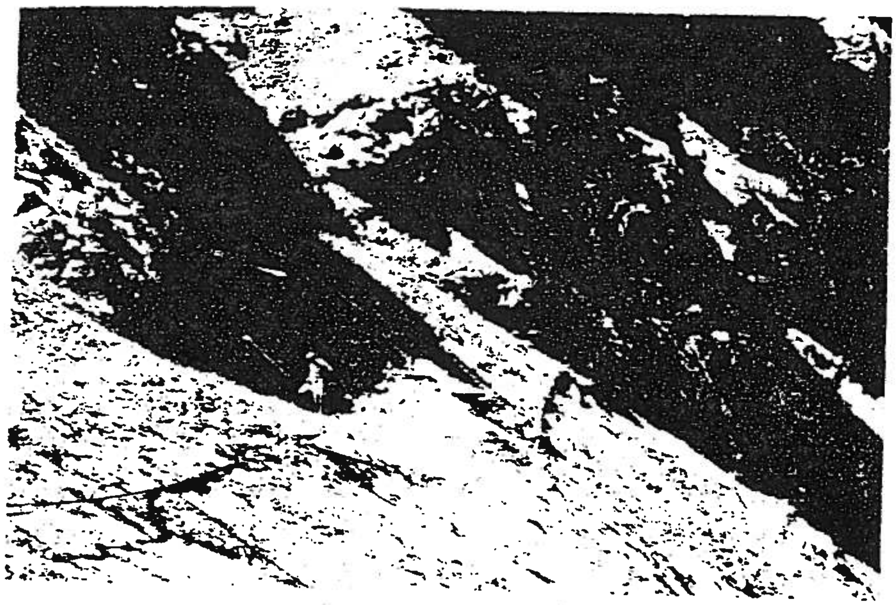

PLATE 2.

Figure 1. Looking north from the lead-zinc occurrence towards Mt. O'Rourke.

Figure 2. Looking south towards Beehive Mountain (left) and Mt. Lyall (right).

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PLATE 3.

Polished Sections

Figure 1. Galena (light) in a matrix of dolomitic limestone. X40.

Figure 2. Galena showing slight warping of cleavage planes. X63.

Figure 3. Euhedral galena (G) and sphalerite (S) in a matrix of calcite and fragmented dolomitic limestone. X63.

Figure 4. Galena (G) and sphalerite (S) with minor inclusions of pyrite (P). X100.

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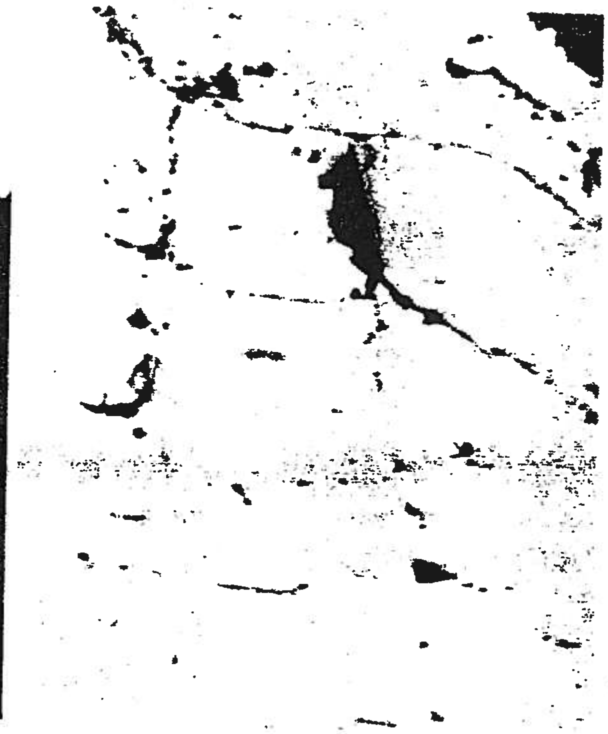

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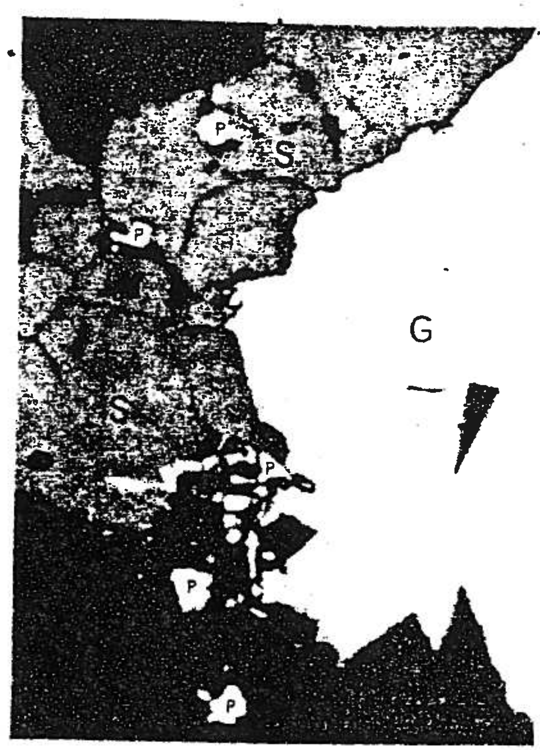

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PLATE 4.

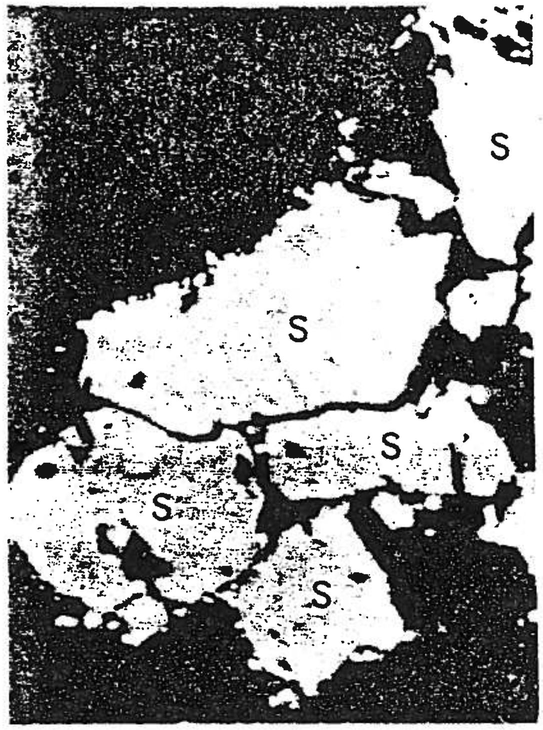
Polished Sections

Figure 1. Sphalerite (S) bordered by fine particles of pyrite (light) in a matrix of fragmented, crystalline dolomite. X80.

Figure 2. Sphalerite bearing inclusions of pyrite (light) with oxidized(?) margins. X100.

Figure 3. Brecciated pyrite (light) in a matrix of crystalline dolomite. X63.

Figure 4. Fragmented pyrite slabs (light) with calcite. X40.



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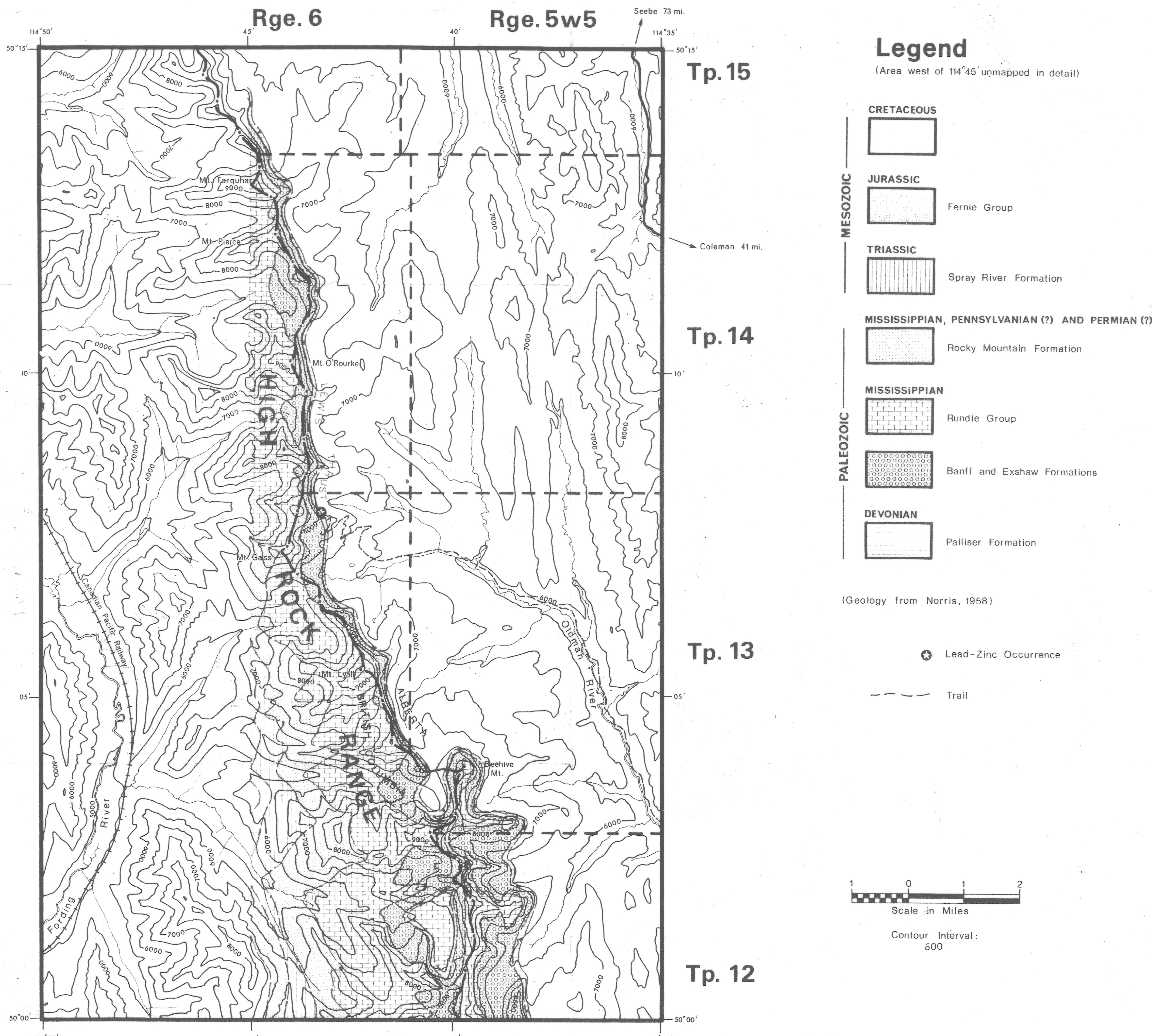

FIGURE 2. GEOLOGICAL MAP OF THE OLDMAN RIVER AREA.

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