U of W. Senior Thesis
The Red Bird Claims
by
John A. Thorp Mar 15, 1961

GEOLOGY AND ORE DEPOSITS OF THE RED BIRD MINING CLAIMS, WHATCOM COUNTY, WASHINGTON

In the first quarter of the writer's senior year at the University of Washington, Mr. Donald L. Anderson, Associate Professor of Mining Engineering, suggested the copper deposit of the Red Bird Claims as a thesis program for a Bachelors degree in Mining Engineering. This property had been pointed out to Mr. Anderson as a possible area for an undergraduate thesis by a friend, who was familiar with the School of Mineral Engineering's thesis program.

In early September 1960, the writer, accompanied by Mr. Anderson and two of the owners, made the first of three visits to the area. Upon seeing the copper deposit, Mr. Anderson decided that it would be acceptable as a senior project.

Aside from limited mapping and sampling by one or two mining companies, little work had been done on this property prior to this thesis.

Although it was not the author's intent to provide a property evaluation, it is hoped that any economic interests in prospects in this area will be aided by this thesis.

OBJECT OF THE THESIS

The object of this thesis is to describe and determine the mineralization, structural control, and surface geology of several claims which contain mineralization in the form of pyrite and chalcopyrite. The mineralization is exposed in several open cuts on the south slope of Church Mountain, Whatcom County, Washington.

In order to do this it was necessary to map and sample the deposit. Further study included microscopic study of thin sections and polished sections of the minerals and parent rock.

ACKNOWLEDGMENTS

The writer wishes to thank Mr. William Todd and Mr. Dick Douglas, both students in Mining Engineering, for their help in mapping; Mr. F. B. Brien, Associate Professor of Mineral Engineering, for his aid and advice concerning the preparation and evaluation of the polished sections; Mr. J. A. Vance, Assistant Professor in Geology, for his aid and advice in Petrography; and Mr. P. H. Misch, Professor in Geology, for his advice concerning regional geology and structure.

The writer also wishes to express his appreciation to Mr. Donald L. Anderson, Associate Professor of Mining Engineering, for his advice, suggestions, and constructive

criticism given during the preparation of this thesis.

Lastly, thanks are due to Mr. Newton Baker and Mr. Oliver Lynn, two of the owners of the claims, for their information, kind hospitality, time and effort in conducting the writer around the property, and for their permission to make this examination of the Red Bird Claims. Finally, the writer wishes to thank Mr. Ross Young, the third owner, for his information, specifically the assays presented in this thesis.

LOCATION AND ACCESS

The Red Bird claims are situated on the south slope of Church Mountain in the southeast 1/4, Section 28, Township 40 north, Range ~~15~~ 7 east, at an elevation of 3700 to 4000 feet. This property is about 42 miles east of Bellingham, Whatcom County, Washington. There is a paved road from Bellingham to the Canyon Creek Road. The Canyon Creek Road is in constant use by logging companies and is improved for about four miles. The remaining portion of the road, which is passable by automobile for three miles, is in poor condition. It is bumpy, partially blocked by log and rock slides and in several places is in danger of being washed out by flooding streams. About one-quarter mile from Coal Creek the road is blocked by a huge slide of rock and timber. At this point the road is traversing the south face of Church Mountain, which has a

slope of about forty-five degrees. The elevation of the intersection of Coal Creek and the road is about 2350 feet.

The property can be reached from this point by following Coal Creek up Church Mountain to outcrop number eight which is on the west side of Coal Creek at an elevation of 3700 feet.

This area has an annual snowfall of about 40 inches, and is generally covered with snow from November to May.

OWNERSHIP

The Red Bird Claims are held by Mr. Newton Baker, Mr. Oliver Lynn, and Mr. Ross Young. These eleven claims were recorded on August 19, 1957.

In addition to the copper prospect described in this thesis, other claims in this same area, held by these same men, include a lime and a barite deposit.

HISTORY

The Red Bird Claims are the only copper claims in this area. The prospect was first discovered in the early 1900's by a Mr. Burt Lawry. Until 1956, when the present owners exposed mineralization in a number of locations and staked the present claims, the prospect had been untouched.

DEVELOPMENT

Development work on the Red Bird Claims consists primarily of a number of open cuts. The overburden has been removed, where minerals could be determined, either in bed rock or as gossan in the overburden, exposing fresh mineralization. The largest of these open cuts is at location "one" where for 35 feet along the strike overburden has been removed exposing the massive sulfides. The other open cuts are very shallow, with a total of only a few cubic yards of overburden removed.

Besides the open cuts, four diamond drill holes have been attempted. These holes were drilled with a portable, homemade diamond drill by the claim owners. The longest of these holes is 18 feet down the dip of the massive sulfide vein at location "one." It proved the massive vein extends to at least that depth.

Also at location "one" is a stockpile of about five tons of the massive sulfides in pieces of about 20 pounds each.

REGIONAL GEOLOGY

The area of study for this thesis lies to the west of the axis of the Cascade Mountains, which trends slightly west of south across the state. The Cascades are a part of a great mountain chain which extends from Alaska to Mexico. The width of this chain in northern Washington, at the Canadian border,

is 120 miles. Reaching up from the Cascades are five high volcanic cones all of which are now extinct. One of these, Mount Baker, is located 14 miles south of Church Mountain.

The topography of the Northern Cascades shows the effect of glaciation which has cut many deep glacial valleys with steep valley walls rising to precipitous divides at elevations of 5000 to 8000 feet.

The North Fork of the Nooksack River in the vicinity of Mount Baker lies in one of these deep-cut, glaciated valleys, and is bordered on the north by Church Mountain (elevation 6,315 feet) and on the south by Mount Baker (elevation 10,778 feet).

The geology of this region between Mount Baker and the Canadian border has been studied in detail by Peter Misch, Professor in Geology, University of Washington.

In the northern Cascades near the 49th parallel he has described two large overthrusts, one of which crosses the south face of Church Mountain; consequently, he named it the Church Mountain Overthrust. He has mapped it from Glacier, Washington, on the south, to the lower Tomyhoi Creek area in southern British Columbia. This thrust brings Upper Paleozoic rocks over Upper Jurassic--Lower Cretaceous rocks and is internally complexly folded and imbricated.[3]

Writing in "The Mountaineer," December 1952, he describes the Upper Jurassic--Lower Cretaceous rocks as the Nooksack Formation. "Nooksack rocks underlie a wide region north of

Mount Baker and on both sides of the North Fork of the Nooksack River. They are black shales, slates, shaly siltstones, and dark greenish, hard, fine grained sandstones and greywackes, with interbedded coarse grained sandstones and local conglomerates, and with rare and thin limy beds. On the east (of Glacier) it is in fault contact with the older sediments and volcanics (Chillawack)."[2] In more recent field work he has also described acidic volcanics, mainly dacites, which occur with the previously described sediments.

The Late Paleozoic sediments and volcanics consist of "black slates, silty mudstones, impure sandstones, and greywackes. The chief chemical sediments in our area is chert. The widespread submarine volcanic eruptions produced lava flows and, where erruptions were violently explosive, ash and loose fragmentary deposits consolidated into tuffs and volcanic breccias. The composition of the volcanics was predominately "andesitic." Metamorphism, due to intense mechanical deformation is common of these Late Paleozoic sediments and volcanics."[2] The age of these rocks is Pennsylvanian and Permian, and they are called the Chillawack Formation.

Along the large overthrust on the south face of Church Mountain, which Professor Misch dates as Cretaceous, imbrications have caused the sequence of Late Paleozoic rocks over Upper Jurassic--Lower Cretaceous rocks to be repeated several times. This is beautifully exposed below the Church Mountain Lookout, just east of the thesis area.

It is along this thrust that the mineralization of the Red Bird Claims occurs.

DEPOSIT GEOLOGY

The major thrust described by Peter Misch can be easily traced along the south face of Church Mountain in regions where there is no vegetation or overburden covering the bedrock, especially to the east where the face of the mountain is steep. However, in the thesis area studied, the hillside is covered by dense undergrowth and large fir trees up to five feet in diameter. Only in washes of intermittent streams is the bedrock exposed, and in these few locations the thrust is not pronounced; only the mineralization associated with the fault zone can be easily traced. Where both forks of Coal Creek cross the fault zone there is no strong evidence of faulting, and there is only minor mineralization present in parallel zones. To the east, at locations "three" through "seven" where intermittent streams have washed the bedrock free of soil and vegetation, a series of parallel reddish-orange streaks can be traced in the bedrock (see Plate III). These reddish-orange streaks are the result of weathering of pyrite which occurs in all of the mineralized zones found. The strikes and dips of these individual zones, where they can be determined, vary from north 50-60 degrees east and 33-35 degrees north, respectively. The mineralized zones themselves vary from eight to twenty-two feet in thickness

and have no definite contacts with the country rock. The trends of these mineralized zones is the same as the strike and dip of the overthrust as determined by Peter Misch. In addition, all of the mineralized zones are overlain by andesitic rocks of the Chilliwack Formation and underlain by dacitic rocks of the Nooksack Formation.

It is of interest to note that the massive sulfides, occurring at locations "one" and "two," and at no other locations along the mineralized zones, are indicative of an epithermal deposit in which replacement and cavity filling are the modes of implacement. In a shear zone of this type, replacement of the sheared rock and filling of openings, caused by movement of irregular surfaces past each other, is a common phenomenon. Minerals which commonly are associated with this type of deposit and which are found here are quartz, pyrite, chalcopyrite, with minor amounts of gold, and silver.

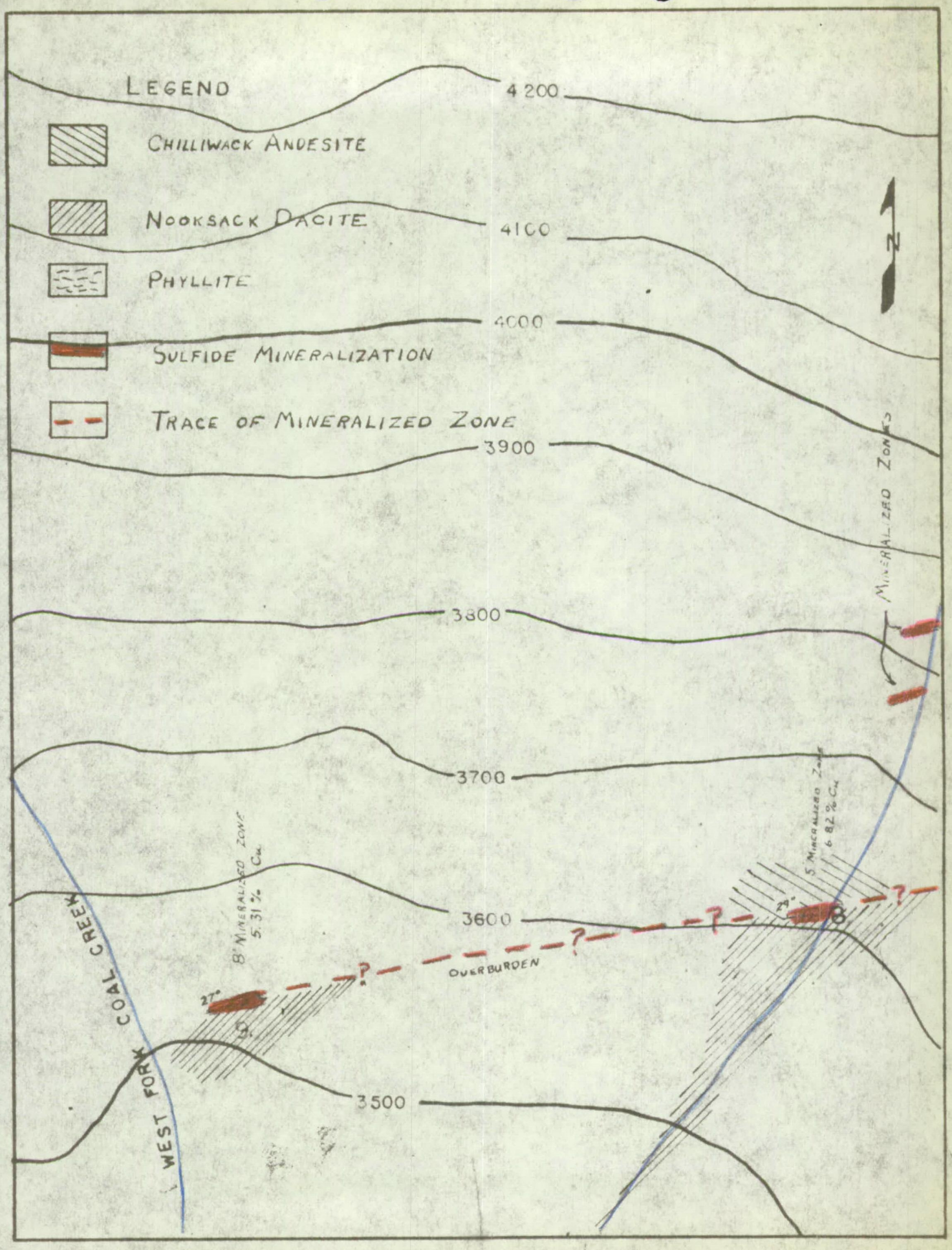
Gangue minerals and alterations of epithermal deposits which are found here are quartz and calcite--the gangue minerals; and chlorite, sericite, pumpellyite, and limonite--the epithermal alterations.

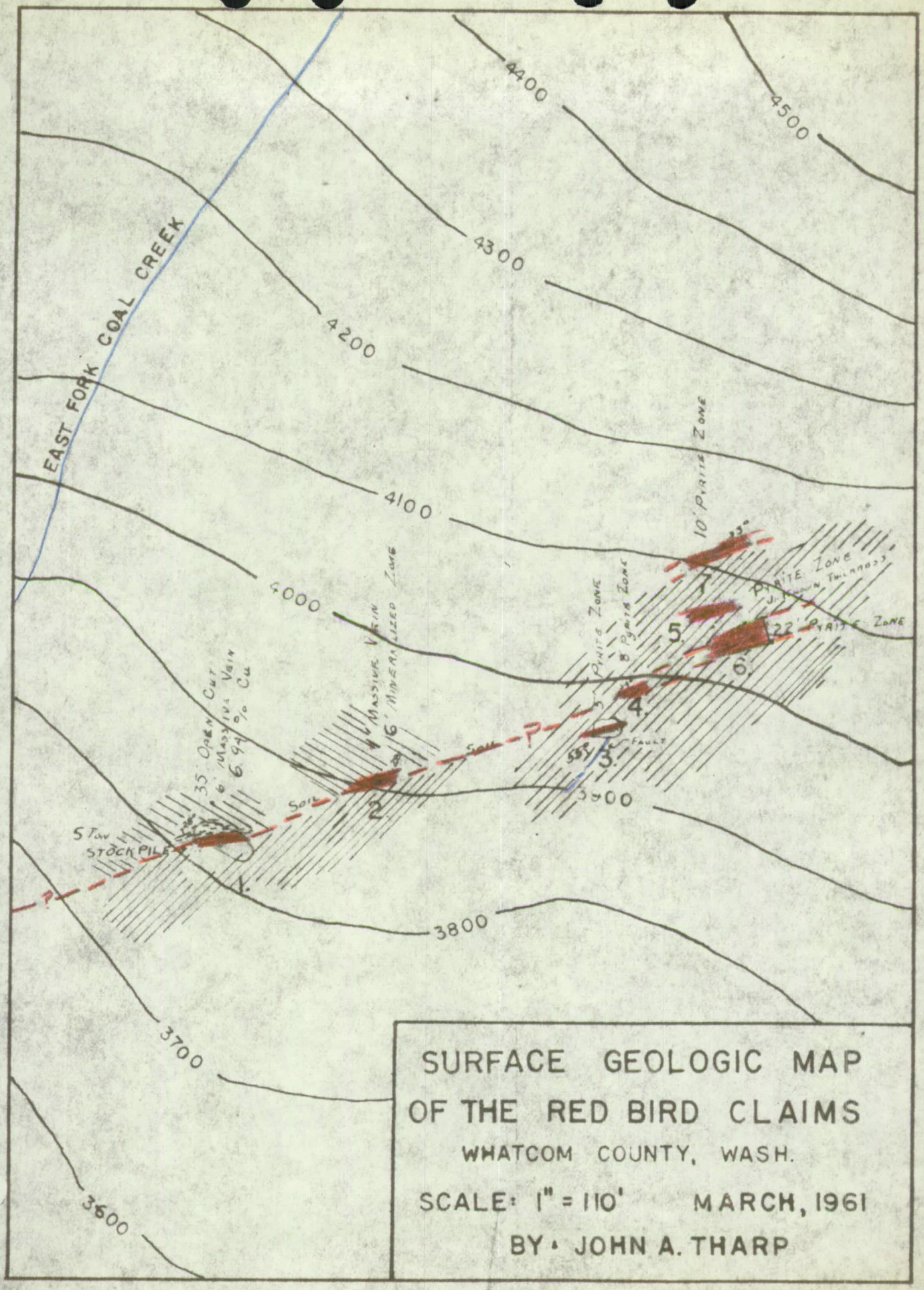
The shear zone has been replaced in most places along the outcrop by quartz, calcite, and sulfides which consist of pyrite and chalcopyrite. The massive sulfides are predominately pyrite with chalcopyrite and quartz gangue. The numerous mineralized zones on the east end of the thesis area are predominately quartz and pyrite with minor chalcopyrite.

A thin section from the fault zone at location "six" showed it to contain only quartz and pyrite. Most of these mineralized zones contain chalcopyrite along with the secondary minerals and alterations.

The dacitic rock which underlies the mineralized zone varies in crystallinity from nearly holocrystalline to nearly holohyalline. Hypocrystalline, or about half glass and half crystals would be the average degree of crystallinity. It is commonly mineralized by first pyrite and later chalcopyrite. The pyrite occurs as replacement porphyroblasts and in fractures. The chalcopyrite occurs disseminated throughout the dacite in small porphyroblasts, except in the later quartz and calcite veins. The calcite and quartz veins are very common, and they show both replacement and filling textures. Movement has occurred in most of the rock samples in at least one stage of the rock's history. This movement has caused fractures which are commonly filled with quartz and calcite and the latest ones with limonite. Sericite and chlorite are common alteration products of the original feldspar phenocrysts.

The andesitic rock which overlies the fault zone in the thesis area is also hypocrystalline. It is characterized by its amygdules and pyroxene phenocrysts which vary in size from microlites to large phenocrysts. The amygdules are filled with quartz, feldspars, and calcite. A corona structure of secondary minerals has formed around many of the amygdules. These secondary minerals are sericite, chlorite, and


LEGEND
CHILLIWACK ANDESITE
NOOKSACK DACITE
PHYLLITE
SULFIDE MINERALIZATION
TRACE OF MINERALIZED ZONE
4200
4100
4000
3900
3800
3700
3600
3500
N
MINERALIZED ZONES
8' MINERALIZED ZONE
5.31% Cu
5' MINERALIZED ZONE
6.82% Cu
27°
23°
OVERBURDEN
WEST FORK COAL CREEK



SURFACE GEOLOGIC MAP
OF THE RED BIRD CLAIMS
WHATCOM COUNTY, WASH.
SCALE: 1" = 110' MARCH, 1961
BY: JOHN A. THARP

pumpellyite. Pyrite is the only sulfide occurring in the andesitic rock in the amygdules and in fractures.

The phyllite which overlies the massive sulfides at location "one" has been formed by low grade metamorphism of an impure sandstone. This metamorphism was caused by the deformation along the fault surface, and it has produced the intense folding and shear planes along with the breakdown of quartz grains into elongated crystals in the plane of movement. Mineralization consists of very small pyrite porphyroblasts which were introduced into the original rock as replacement porphyroblasts and have been crushed into small fragments by the deformation. Also minor chalcopyrite is present in the phyllite.

The black shale which underlies the massive sulfide vein at location "one" is only a few feet thick and contains both pyrite and chalcopyrite.

PETROLOGY AND PETROGRAPHY

Thirteen sample rocks of ore, gangue, and host rock were taken for thin section analysis. These samples were taken at various points along the surface of the outcrop and are thought to be representative of the ore and gangue minerals present in and adjacent to the mineralized zones. The locations of the individual specimens and ore minerals can be noted on the surface geology map.

PARAGENESIS:

Dacite, pyrite, chalcopyrite, quartz, calcite, chlorite, sericite, and limonite.

POLISHED SECTIONS:

These sections were cut from the massive sulfide zone at location "one." They were cut in order to determine the minerals present and their relationships.

Pyrite made up the majority of these sections. It consists of euhedral crystals of various sizes. Most of the pyrite, however, was fine grained.

Chalcopyrite occurs in these sections in blebs, drops, and vermicular shapes in the pyrite. It is scattered throughout the pyrite, replacing the pyrite and gangue, and replacing the brecciated material along fault surfaces.

The quartz gangue contained in the massive sulfides is only minor and it appears to have crystallized after the pyrite.

A weathered surface shows small areas stained with iron oxide.

MINERALOGY

The following list of minerals are those that were found in the rock specimens and thin sections.

QUARTZ:

Quartz occurs in all the thin sections and is the most abundant mineral found. It is a constituent of both the

volcanic rock types and in the mineralized zone as well. Secondary quartz has also filled small fractures and has been recrystallized due to deformation in some of the sections.

FELDSPARS:

Both plagioclase and orthoclase occur in most sections, both as a primary mineral and as a secondary mineral along with the quartz in some of the fractures.

CALCITE:

Calcite also occurs in most sections as a secondary mineral, filling fractures and amygdules in the andesite.

PYRITE:

Pyrite occurs as euhedral porphyroblasts in all of the sections. It is the more abundant of the two sulfides. It occurs as a replacement mineral in some sections and as a cavity filling in others.

CHALCOPYRITE:

Chalcopyrite occurs as a disseminated mineral throughout the dacite and mineralized zone, but not in the overlying andesite. The extent of this sulfide below the mineralized zones was not determined, but the amount of chalcopyrite decreases as the distance below the mineralized zone increases.

PUMPELLYITE:

This is a hydrous calcium aluminum silicate which is a common alteration product in amygdaloidal basic volcanics, and it is in this relationship that it occurs here.

CHLORITE:

Chlorite occurs as an alteration product in both the dacite and the andesite.

SERICITE:

This secondary mineral occurs in the dacite and is derived from alteration of the feldspars.

LIMONITE:

Limonite is present in most rocks of the deposit. It is derived from the weathering of pyrite.

ASSAYS

A total of six assays have been performed on rock samples reportedly taken from the mineralized zone.

Three of these samples were taken from location "one" in August 1958. Two of these samples were chip samples from the open cut. Sample B-19 was a chip sample taken from the massive sulfide zone, and gave values of 6.94 percent copper, 3.06 ounces of silver per ton and 0.02 ounces of gold per ton. Sample B-20 was a chip sample taken in the mineralized black shale below location "one." It gave values of 0.96 percent copper, 1.04 ounces of silver per ton, and only a trace of gold. The third sample taken here was of a piece of the massive sulfide taken from the stockpile. It gave values of 7.86 percent copper, 2.86 ounces of silver per ton, and 0.02 ounces of gold per ton (see Plate IV).

A sample taken from location "one" at an earlier date by the owners and sent to The Colorado Assaying Company gave the following results.

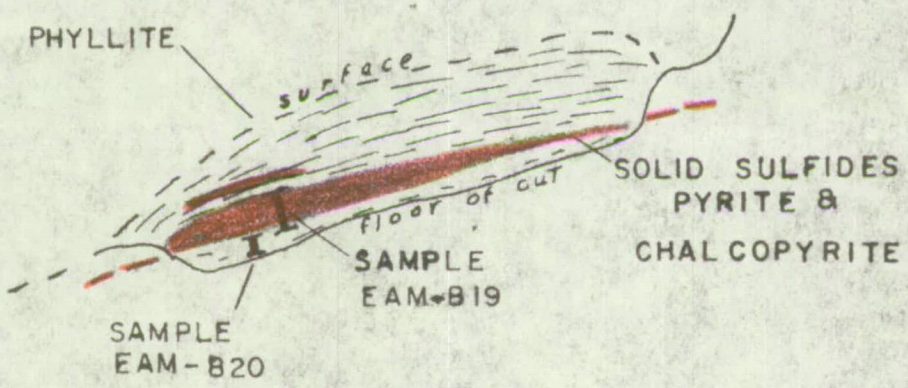
Elements Present	Percentages
Combined Water	0.10
Silica	1.88
Aluminum Oxide	0.47
Iron Oxide	1.08
Iron	39.20
Sulfur	45.26
Copper	10.65
Zinc	0.65
Calcium Oxide	0.35
Magnesium Oxide	0.15
Manganese Oxide	0.10
Sodium and Potassium Oxide	0.05

Gold -- 0.04 oz./ton
Silver- 2.10 oz./ton
Arsenic, Lead, and Nickel - Trace
Uranium - None
Platinum Group Metals - None

Two other assays were made on rocks from locations "eight" and "nine." They gave values as listed below.

	Sample 1	Sample 2
Gold	0.02 oz./ton	0.02 oz./ton
Silver	2.38 oz./ton	2.22 oz./ton
Copper	6.82 percent	5.31 percent

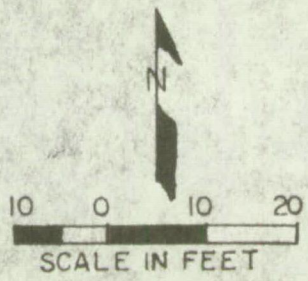
PLAN



LONGITUDINAL SECTION

ASSAY DATA

SAMPLE NO.	LENGTH FEET	TYPE	GOLD OZ/TON	SILVER OZ/TON	COPPER %
EAM-B19	4.0	CHIP	0.02	3.06	6.94
EAM-B20	1.0	"	TR.	1.04	0.96
EAM-B21	-	SELECT	0.02	2.86	7.86



RED BIRD CLAIM
COMPASS-TAPE SURVEY
AUGUST, 1958
E. A. M.

CONCLUSIONS

The foregoing examination has revealed that mineralization at the Red Bird Claims consists of pyrite and chalcopyrite in a major over thrust zone. This shear zone served as an avenue for hydrothermal solutions which contained the two sulfides along with quartz and calcite.

The major movement on this fault is dated as Cretaceous, but due to the freshness of the mineralization in the fairly unconsolidated shear zone, the writer theorizes that mineralization is more recent than the major fault movement. However, it is obvious by the presence of shear planes in the hand specimens, brecciation of quartz in the thin sections which has partially recrystallized, post mineralization fractures filled with quartz and calcite, and the fractures in which the mineralization itself occurs, that movement along the fault plane continued after the major faulting. Minor movement seems to have continued over a long period of time; before, during, and after mineralization.

As stated in the paragenesis of the thin sections, pyrite was the first of the two sulfides to occur. It formed porphyroblasts in the shear zone and the host rocks. Chalcopyrite mineralization occurred later and was disseminated throughout the entire mineralized zone in very small porphyroblasts, except in the andesitic rocks.

The mineral assemblages and types of implacement of the sulfides, quartz, and calcite, indicate the deposit is of hydrothermal origin in the epithermal zone.

The mineralized zone extends across the entire thesis area; and therefore, no horizontal limits can be put on the mineralization. Likewise, due to the complex imbrications of the fault plane and the irregularities of mineralization in this type of deposit, the depth to which mineralization extends cannot be determined in this study.

REPORT

to accompany

APPLICATION FOR FINANCIAL ASSISTANCE IN MINERALS EXPLORATION

on

Church Mountain claims

Whatcom County
State of Washington

by

Harold Reade
219 S. Olympic St.
Arlington, Wash

Financial eligibility:

(a) See inclosed copies

(B) This property is in my sole name. However, B. C. Konnerup ~~and~~, Kirkland, Wash. and S. H. F. Vevelstad, Juneau, Alaska, have a legal and moral interest. S. H. F. Vevelstad is supplying our part of the financing. B. C. Konnerup will be able to supply part of the labor. My contribution will be supervision of the work and, next year, part of the cost.

Applicant's rights:

(a) My rights in this property are those of locator. There are no encumbrances.

(b) These claims are recorded in Mining Records, Vol. 21, pages 359 to 368 inclusive, Whatcom County Recorder, Bellingham, Wash. They lie in Sec.27, T40 N., R. 7E. W.M., Whatcom County.

Physical Descriptions:

(a) No mining operations other than surficial trenching

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SPOKANE, WASH.

compass and chain surveys, surficial exploration, sampling and mapping have been performed.

The deposibe is an east-west system of fracture veins and zonal enrichment about 200 feet long and 35 feet wide. Alpine glagiation exposed rich seems of ore at the west end. (It was mining operations in the glacial debris on the valley floor that led to my tracing and staking the source veins.) Eastward for about 1000 feet the continuity of the deposites is ~~mk~~ marked by a bed of limonite. At 100 ~~xx~~ and 300 feet from the west exposure I found traces of the veins across some 75 feet in width. At the east end the intersection on pyrite vein broadens the mineralized zone to about 500 feet. In the west exposure are seams and nodules of heavy chalcopyrite (chalcocite float was found in the scree below) with intersecting belts showing only limonite. The deposite dips into the mountain about 70°.

Accessibility:

The railroad is at Glacier, three miles from the base of the mountain. A surfaced highway passes its foot, 1½ miles from the ore body. This latter statement, though true, is misleading. It is important for future mining developments. A camp will be established four miles by forest service lookout trail from end of ~~xxxx~~ auto road and one mile by crude but easy trail from the orebody.

Glacier is forty miles from Bellingham on the Mt. Baker Highway. Arlingham is fifty miles south of Bellingham.

Exploration work:

Only one item proposed in this development project is a set of small core drill holes 20 to 75 feet in depth using a portable drill marketed by The Diamond Drill Contracting Co., Spokane, Wash. From the data supplied by this company one hole per two days by three men seems reasonable. If these arrangements are expedited so that a crew can be on the ground before the end of September, I believe that five holes or one cross-sectional sample of the east wide zone can be completed this fall. A remainder of fifty holes can be completed as the snow withdraws in the spring.

An attempt to work on fresh snow in this area

would be suicidal.

Experience:

(a) B.A., Geology, University of Wisconsin.
(b) Work on this mountain: expert
(c) This equipment: none

Costs:

The estimate by the Diamond Drill Contracting Company, enclosed, indicates that the rental of the equipment, with purchase of non returnable items, would be about $150 per week. Fifteen operating weeks would total $2,250. A total crew of 5 @ $20 per day total cost amounts to $10,500. A toltal cost of $12,750.

Harold Roade
219 S. Olympic St
Arlington, Wash.