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THE CASCADE CREEK AREA

SALMON RIVER DISTRICT, PORTLAND CANAL,

SKEENA MINING DIVISION

November, 1962.

by R. V. Best, Ph.D.

Mineral Claims: E.V. Group - Glacier, Glacier Nos. 1 and 2, Boundary Nos. 1 and 4, Vancouver, Vancouver Nos. 1, 2 and 3, Kitchener, Woodbine, EV Nos. 1 and 2, 3 Fr., 4 Fr., 5 Fr., 6 Fr., Tom Fr.,

Lakeshore Group - O.B. No. 1 Fr., Bush No. 3 and 4, Lakeshore, Maple Leaf Nos. 4, Start Fr., Start Nos. 2 and 3.

56° 130° 104B/1E, 104A/4W

Owner:-

E. Meredith, W. O. Bush, New Indian Mines Ltd., Grant H. Bush

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Wm. H. White Dec. 7/62

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ILLUSTRATIONS

ABSTRACT

About 90 claims and fractions owned or controlled by New Indian Mines Ltd. in the Cascade Creek area, seven of them restaked this summer, were examined by a 5-man party between the end of May and beginning of September, 1962. Over 200 of the old claim corners were located, more than 6 miles of trail were slashed and a reconnaissance geological map prepared on a scale of 500 feet to the inch.

The map area is underlain by rocks of the Hazelton Group, most of it by greenstones of the lower Bear River Formation which are cut and almost engulfed by large porphyry sills. The upper Bear River on Slate Mountain (mainly purple and red pyroclastics) is overlain in turn by the Salmon River grey volcanics (about 300 feet thick) and the lower 700 feet of the Nass slates.

Folding, primary and secondary shearing, intrusion of granodiorite and lamprophyre dykes, tertiary shearing and ore deposition are all consecutively related to one long-continued period of waxing and waning compression from the west during Coast Range orogenic activity.

Ore appears to be associated with primary (N-S) and secondary (NW-SE and NE-SW) shears which were reopened late in the structural history of the area. It is most likely to occur at intersections of shears of differing trends or of opposing dips. Purple tuffs at Silbak Premier Mine may have exerted a chemical control in ore deposition: similar control may be looked for at appropriate fault intersections identified within the map area.

RECOMMENDATIONS

Further detailed investigation should include exploratory drilling of the most favourable showings and some attempt to find new deposits by surface work, including geochemical means, at localities where structure and rocktype seem suitable.

Dr. W. H. White, in a separate report, has made specific recommendations on drilling, etc. at sites already known to be mineralized. The writer outlines below a few additional areas where surface work should be done and includes notes which may apply if drilling is planned.

Geophysical exploration is not recommended at this time. The electrical and electromagnetic properties of pyrite might give an anomaly over every shear which would be indistinguishable from that caused by ore minerals. Silbak Premier drilled at least one strong self-potential anomaly with no success. On the other hand, geochemical testing along shear-controlled gullies filled with overburden might save a great deal of unnecessary trenching.

The ore-forming fluids were carried by shears. At both Silbak Premier and New Indian Mines ore occurs at fault-intersections. At Premier purple tuffs may have reacted with the fluids to accelerate ore deposition. Restricting the search to shears which are mineralized and to those which most probably are, the following localities appear to justify more detailed investigation:-

1. The top of Big Missouri Ridge north and northwest of New Indian Mine is cut by numerous shear zones of which the best known and most notably mineralized made the mine itself. The showing on the SW corner of Payroll No. 4 M.C. may be in another shear (see Fig. 2) or be related to the intersection of the two shear zones. The second shear should be prospected. Purple tuff should be present 400-500 feet vertically below the showing.

2. The N-S Long Lake fault zone meets the major NE-SW fault zone in Bush No. 1 M.C. At a depth of no more than 500 feet the faults should pass into the base of the upper purple tuffs. Surface showings on the Lake Shore and Sunshine claims suggest that ore bearing fluids followed the N-S shears.

3. The New Indian shear zone cuts purple tuff at the trail under the tramline at about 1,500 feet elevation. Fallen logs, brush and over-burden conceal the place where the shear should cut the projected footwall so that it is impossible to say whether it has ever been thoroughly prospected: if not, it should be.

4. Several strong faults intersect just south of Maple Leaf No. 3 M.C., about 600 feet east of the N-W corner of X 10 U 8 No. 6 M.C. The bedrock surface there has never been prospected (it is covered with gravels) and the base of the upper purple tuffs should be no more than 300 feet beneath this intersection.

5. The aerial photos show that at least three strong shear trends intersect at or near the point where the large creek on Forty Five M.C. joins Cascade Creek. This locality is difficult of access and was not examined in as much detail as the structural picture seems to warrant.

6. The main NE-SW shear zone, which is probably continuous between the Salmon River and Long Lake valleys, crosses Indian Creek practically on the claim line between Ruby Silver and Ruby Silver No. 1 claims. At this point there is a swamp. Perhaps geochemical testing of the water in the deeper part of the swamp (where it is presumably not moving fast) would indicate whether further investigation were warranted.

7. A N-S fault can be traced on the air photos (see Fig. 2) from Silbak Premier Mine across the Cabin M.C. and International Fraction: it should be prospected.

GEOLOGY OF THE CASCADE CREEK AREA

INTRODUCTION

GENERAL:

The property owned and controlled by New Indian Mines in the Salmon River district comprises 93 claims and fractions lying between the valley of the Salmon River on the west and Long Lake valley on the east, between 14 and 20 miles north of Stewart, B.C. It surrounds to the west and north the property of Silbak Premier Mines Ltd.

It is very rugged, recently glaciated country, ranging in elevation from 600 feet along the Salmon River and lower reaches of Cascade Creek to over 4,000 on Slate Mountain. Precipitation averages over 70 inches annually in Stewart and considerably more than this in the drainage basin of Cascade Creek. Total winter snowfalls of more than 20 feet are common, so that, with drifting and sliding, practically all buildings collapse within a year or two of being left unoccupied.

Below 3,000 feet on Slate Mountain and below 2,500 feet over the rest of the area the country is covered with a heavy growth of hemlock trees and blueberry bush or slide alder and devils club. Visibility is restricted, outcrops are scattered and travel is necessarily slow and laborious. Except for black bears there is no big game, so that there are no natural game trails.

The writer's party, comprising two geologists and three assistants, spent nearly 100 days in the area between the end of May and beginning of September, 1962. In addition to geological work, time had to be spent in cleaning out more than 6 miles of trail, locating old claim corners, marking claim lines and tying in all geological observations by compass and tape to established corners for over 90 claims and fractions. Throughout June and most of August the weather was poor. Considering everything, it is not surprising that geological mapping could only be done in reconnaissance style. But the main rock units and structures have been outlined and related to known mineral occurrences sufficiently to serve as the basis for more detailed exploration.

The writer acknowledges with thanks the very able assistance of Mr. C. C. Buckland in all phases of the work. Messrs. Tom John, Dave Mason and Dean Goard worked willingly in the field and are to be commended for their excellent cooking. All four were cheerfully conscientious under adverse conditions.

Special thanks are due to Dr. W. H. White for spending a week in the field checking the party's progress, going over the important showings and carrying out detailed examination of the New Indian workings. Both then and since the writer has profited from discussions with him on the geology of the area.

ACCESS:

Until recently a good road ran from Stewart and Hyder along the east side of the Salmon and Cascade Creek valleys to Silbak Premier Mine and to the Big Missouri Mine north of the New Indian property. In December, 1961, a violent flood of the Salmon River removed about two miles of the road. In protected bends the roadbed remains but on some projecting corners everything went, leaving a sheer 150 foot cliff rising directly from the water. Until mid summer supplies had to be backpacked along these cliffs with the aid of ropes, but, in July, Silbak Premier personnel, using a Mammoth Silver Co. portable drill, blasted a foot trail. Meanwhile, roads are falling into disrepair north of the washout: between Silbak Premier and Big Missouri culverts are blocked, bridge abutments are collapsing and in places the road is becoming a ravine.

All trails shown on the accompanying geological map were badly overgrown but have now been cleaned out, except for the part traversing the tramline slash below New Indian Mine and for a few big logs and boulders, etc., elsewhere. A new trail has also been cleared from New Indian Mine northwest to the showing on Pay roll No. 4 M. C.

The cable crossing at Cascade Forks is now in good working order: the old one at the mouth of Logan Creek is not, but could be used in an emergency.

At present the only efficient means of transporting men, equipment and supplies is by helicopter or, in the northern part, if many loads were involved, float 'plane to Long Lake using helicopter for final hauling.

MAPPING:

It is difficult to map an area such as this with any precision. In steep bush-covered country (and most of it is) pacing is impossible, so that all outcrops must be tied in by compass and tape to established claim corners. But corners are not easy to find: claim maps summarize the activities of many surveyors of 40 years ago, some of whom must have been careless, to say the least. Some claim lines are as much as 5 degrees out in direction or 100 feet out in distance. In a few instances corners never were properly located (e.g.: those NW and NE of Five Fraction lack bearing trees and iron pins and probably never did have corner posts). On the other hand, on bare, steep slopes posts and pins have been swept away by sliding snow. Nevertheless, more than 230 of the old corners were found, cleared and blazed, and hung with coloured plastic streamers.

For the first two or three weeks of June snow is up to six feet deep at elevations less than 1,000 feet: as that melts, going becomes treacherous. For reasons of safety and the necessities of taping and of covering as much ground at one time as possible, a geologist cannot work efficiently on his own. Even then, outcrops are either sparse and hard to find or else present inaccessible cliffs. Many of the rocks themselves are too weathered or too altered to be identified without full sunlight (which is not always in evidence). In the time available it was impossible to examine the whole area in detail.

The main objectives were to outline the main rock types and structures and, if possible, to relate them to known mineral occurrences. Within the limitations of reconnaissance geological mapping these objectives were accomplished, but there is no doubt that more detailed mapping would disclose additional and perhaps valuable information.

GEOLOGY

GENERAL SUCCESSION:

The rocks of the Cascade Creek area consist of a complex association of altered pyroclastics, flows, feldspar porphyry and sediments, which have been folded and foliated, cut by offshoots of the neighbouring Coast Range batholith, and broken everywhere by shears of several successive ages.

Schofield and Hanson (1922) recognized three volcanic and sedimentary formations which are correlated with the Hazelton Group of Jurassic (and possibly partly Lower Cretaceous) age: the Bear River greenstone (cut by porphyry sills) which covers most of the area, overlain in turn by the Salmon River "conglomerate" and the Nass slates. Although Hanson (1935, p. 4) later decided to combine all the volcanics and sediments under the single term Hazelton Group, the earlier subdivision still holds for the Cascade Creek area (except that the writer's party saw no conglomerate).

The three units, as recognized by the writer, include:-

first, a lower greenstone sequence of considerable but unknown thickness, cut and possibly partly underlain by feldspar porphyry, with the upper few hundred feet characterized by red and purple pyroclastics;

second, a series of about 300 feet of dark grey to black, cherty, porphyritic flows and pyroclastics;

third, a formation of at least 700 feet of dark grey to black slates from which Slate Mountain gets its name.

TERMINOLOGY:

The rocks of the map area could be described and named strictly on the basis of superficial appearance in hand specimens. Thus all green rocks without obvious feldspar phenocrysts would be termed greenstones and those with well-formed large phenocrysts porphyry. But the ultimate objective is economic, and ore is associated in quantity with certain specific rock types in the Silbak Premier Mine. Using terms different from those current in such a well known area might have obscured similarities or essential differences in the rocks of Premier and the map area.

Fortunately, before mapping was fully under way, a copy was obtained of a surface geological map of Premier hill, prepared some years ago but recently brought up to date. After checking it against road exposures and taking samples to use as a standard, the same terminology was adopted for the 1962 field work.

Throughout this report frequent reference has to be made to large-scale fracture surfaces. On the ground, genuine faults, with slickensided or brecciated walls, could be distinguished from zones consisting of numerous, closely-spaced, minor shears. However, very little movement seems to have occurred along even the most obvious faults: practically all faults and shear-zones alike, fit the structural pattern of shear joints (strike and diagonal shears of Billings, 1942, p. 126). Consequently, to avoid tedious repetition, the terms fault, shear and break are used interchangeably.

PREMIER PORPHYRY:

The term "porphyry", as applied on Premier hill, includes a heterogeneous assemblage of greyish, green and even white rocks which are massive to schistose, generally with coarsely interlocking grains of feldspar and hornblende, with or without obvious quartz, in varying degree smeared and altered to chlorite, sericite, serpentine and calcite, in places silicified, and in part containing carlsbad-twinned phenocrysts of orthoclase up to 2 inches long. The contact with greenstone is everywhere gradational, the outcrop width of the gradational zone varying from a few feet up to 30 feet on Premier hill and up to 200-300 feet in places on the south end of Big Missouri Ridge.

Varieties noted in the field, but changing from one to the other too frequently to be distinguished on the map, include:-

(a)	"porphyritic" porphyry:	usually massive, characteristically containing large orthoclase phenocrysts
(b)	quartz porphyry:	usually massive with equidimensional quartz phenocrysts up to 1/4 inch across
(c)	"pink" porphyry:	carrying coarse, orange-pink feldspar and chloritized hornblende and (usually) some finer quartz
(d)	silicified porphyry:	hard, massive to schistose, usually light green or, where pyrite is abundant, leached almost white
(e)	"plain" porphyry:	soft, generally schistose, with chlorite, serpentine, sericite (sometimes calcite) and traces of feldspar and smeared hornblende.

Although any of these varieties can carry large orthoclase phenocrysts, they are uncommon in the last three types mentioned.

The distribution of the various kinds of porphyry is erratic, but a few broad generalizations can be made:-

(1) Quartz porphyry is particularly common along the border south of Indian Lake (Acc fraction and Glacier No. 7).

(2) "Pink" porphyry is commoner towards the top of the same ridge (Bill fraction and Ruby Silver M.C.) than it is elsewhere.

(3) "Porphyritic" porphyry dominates the whole west slope of Big Missouri Ridge; along the border on Glacier No. 7 and Acc fraction it is so much fresher in appearance than it is farther east that it is clearly identifiable as coarse granite and granodiorite.

(4) Silicified porphyry is abundant, commonly carrying up to 1 - 2 percent pyrite, in that part of the area including the Bluebird, Kitchener, Woodbine and Vancouver group of claims.

It should be noted that where either porphyry or greenstone is highly silicified and pyritized it is bleached to a compact, white rock, with sugary texture (much like an aplite) so that it is impossible to say in the field which of the two the original might have been. Gradational zones between greenstone and porphyry provide similar difficulties in the field. Fortunately, however, the problem usually resolves itself as mapping proceeds and contacts can be drawn with some confidence. Temporary terms used in the field for such rocks have no place in a formal report.

Porphyry is not restricted to the map area: it is recorded as far north as Big Missouri Mine (Hanson, 1935); it may also be seen occasionally outcropping in the exposed roadbed more than two miles down the Salmon River from the mouth of Cascade Creek. It is most conspicuous and fresh in appearance in the vicinity of the batholithic margin near the geographic centre of exposure.

Schofield and Hanson (1922), Hanson (1935) and Langille (1948) all remark on the sill-like form of most of the Premier porphyry, though the latter two agree that the sills appear to emanate "from a stock of orthoclase porphyry 2 miles in diameter". Whether or not the dimensions are those of a stock, the wide exposure of porphyry on the west flank of Big Missouri Ridge, where the structure is interpreted as west-dipping, suggests a dip slope. A stock of sill-like form seems to fit the facts.

Porphyry intrusion may have taken place at shallow depths; at any rate it had cooled before Bear River pyroclastic activity ceased: at one place near the south end of Slate Mountain angular fragments of undoubted porphyry were recognised in a green phase of the purple tuffs.

BEAR RIVER GREENSTONES:

The lower part of the Bear River Formation consists of porphyry and what was, before the emplacement of the porphyry, a thick sequence of volcanic breccias and tuffs, minor andesitic flows and a few beds of light coloured chert, quartzite and argillite. The volcanics are restricted (except on the east flank of Big Missouri Ridge) to isolated patches of schistose greenstones. These grade into each other across the strike and, as primary structures have for the most part been obliterated, attitudes of bedding can only rarely be measured: in only two instances could the "tops" be established with any certainty.

On the east flank of Big Missouri Ridge north of Indian Creek the greenstones are of two main types: grey-green, medium to coarse grained, crystalline tuffs, with small angular feldspars and with hornblende needles up to 4 mm long, and coarse tuff with angular, orange to orange pink feldspars, green chloritized hornblende and minor quartz. The fragmental texture of the latter is very difficult to see but, were it not for that and the slightly finer grain size, this tupe would be indistinguishable from the "pink" porphyry seen further south.

PURPLE TUFFS AND "PORPHYRY":

The upper 600-700 feet of the Bear River Formation comprises a series of interbedded green, purple, red and brown, coarse to aphanitic tuffs and volcanic breccias. They are exposed over most of the south end of Slate Mountain.

The lower purple tuffs consist of discontinuous schistose lenses, with finely disseminated specular hematite and minute, hexagonal flakes of muscovite. The upper members are comparatively unaltered, ranging from aphanitic red argillite or tuff to green or green and red volcanic breccia and agglomerate. Jasper and hematite, presumably derived from the red members, permeate much of the west flank of Slate Mountain down to Cascade Creek, staining the shear surfaces of schistose green tuffs and in places forming veinlets of almost pure hematite.

On the trail just south of the New Indian tramline about 100 feet of purple tuff, striking north and dipping 30 degrees west, is almost identical with that exposed on the road beside Lesley Creek on Premier hill.

"Purple porphyry" was mapped separately: except for its colour it superficially resembles the Premier porphyry, with which it is in contact. It carries both very large and small, angular, highly altered feldspars and medium-sized phenocrysts of quartz and muscovite set in a fine-grained, fragmental, jasperized matrix. It occurs where the purple tuffs attain their maximum thickness in the area: perhaps this was close to the vent from which these pyroclastics were blown.

SALMON RIVER (?) AND NASS FORMATIONS:

The 1962 field party mapped as a stratigraphic unit about 300 feet of dark grey, porphyritic pyroclastics and flows, in part veined and cemented with black chert, lying between the Bear River and Nass formations on Slate Mountain. Although no conglomerate was seen, there is little doubt that this is the Salmon River formation of Schofield and Hanson (1922). Its contact with the Bear River is drawn at the base of the main sequence of dark grey beds; its upper contact with the Nass was walked out: in the only place (W. corner O.B. No. 1) where the contact with the overlying slates is clearly exposed the two formations appear to be dis-conformable, but there is no basal conglomerate.

Two prospect tunnels (Start No. 2) and numerous small prospect pits just below the slate contact and the showings on the Lake Shore and Sunshine claims all suggest that the Salmon River provided favourable host rock for ore.

About 600-700 feet of dark grey to black slates, representing the lower part of the Nass formation, occupy the upturned southern end of a northward trending syncline at the top of Slate Mountain. The lower contact, as previously stated, seems to be disconformable on the underlying Salmon River formation. Though fossils have been reported from further north, in this southern end of its outcrop cleavage is oblique to bedding so that none are likely to be found. No mineralization was observed in the Nass slates.

COAST RANGE DYKES:

Dykes up to 150 feet thick, generally granodiorite or monzonite, are abundant in the south and southwest of the area, close to the batholith.

They vary in composition, becoming richer in dark minerals and lower in quartz towards their margins; quartz is minor as a rule but may rarely exceed 20 percent. Towards the northeast dykes tend to become less numerous, thinner, finer in texture and to contain less quartz. The northernmost dyke of this type (on Payroll No. 3 M.C.) is a fine hornblende monzonite or diorite no more than 10 feet thick.

The strike and dip of the Coast Range dykes is remarkably consistent, averaging about N. 30° W/60° SW: the only NE dip was observed within a few hundred feet of the Alaskan border. Nearly all have one set of joints parallel to the margins and a second set perpendicular to the first, dipping about 70° NW. As the intrusion of these dykes seems to have followed secondary faulting, it probably occurred after the Coast Range orogenic climax (White, 1959), so they would be of Cretaceous age.

LAMPROPHYRE DYKES:

The latest dykes in the area are grey to greenish in colour and vary in thickness from a few inches to 10 feet. West of Cascade Creek their trend is approximately parallel to that of the Coast Range dykes, which they cut. In the vicinity of Slate Mountain, though most strike N 20° W with dips vertical to steeply SW, a second set strikes about E-W, with vertical to steep northerly dips.

Most of these dykes are too fine grained for field identification of minerals: some seem to be very fine grained equivalents of the Coast Range dykes, others in which biotite and pink feldspar phenocrysts were recognized are probably lamprophyres. All are grouped under the latter name.

One peculiarity, for which no plausible explanation can be offered, is that several of these lamprophyre dykes appear to have one of the margins chilled for an inch or two, but not the other.

QUARTZ VEINS:

Secondary quartz is found in two main forms: in simple veins up to 3 feet thick developed in the late stages of Coast Range intrusive activity, and in zones of silicification (generally associated with shear zones) with the quartz either permeating the rock or else forming a network of closely spaced veinlets.

The simple veins are barren where they outcrop. Their strike parallels that of the Coast Range dykes but they tend to dip NE instead of SW. In one instance (NE Kitchener M.C.) a shear which cuts the country rock and granodiorite is cut in turn by a 6 inch quartz vein, but veins of the same type on Exchange No. 4 M.C. are cut by a lamprophyre dyke. Thus the evidence, sketchy as it is, suggests that the simple, barren veins are post-granodiorite and pre-lamprophyre in age.

The zones of silicification and of quartz veinlets tend to coincide with shear zones but, just as faulting was spread over a long time, so there seems to be more than one age of silicification. For example, on Slate Mountain several small shear zones consist of brecciated veinquartz cemented in turn by quartz, showing that shearing and fracture filling occurred at least twice.

Because significant mineralization (i.e. other than pyrite) is in every case accompanied by some degree of silicification, it might be hoped that a common direction or attitude would characterize the silicified zones, but they seem to have no single preferred orientation. Nor can their time of origin be fixed: most appear to be post-lamprophyre but they cut and are cut by faults having almost every possible attitude.

STRUCTURAL GEOLOGY

A generalized picture of major structural trends is provided in the accompanying cross-section (Fig. 3), but in detail the structure is complicated by numerous faults and associated minor flexures.

The Bear River greenstones and porphyry are folded and foliated primarily in a northwest trend parallel to that of the Coast Range dykes. It seems likely, therefore, that folding, intrusion of dykes and shearing are all related.

Although the folds in the upper part of the sequence (on Slate Mountain) have developed on them a series of gentle cross-folds, some undulation is to be expected in folds produced by a single compressional episode. Furthermore, the directions of faulting do not anywhere suggest a separate period of N-S compression.

It is apparent from the direction of foliation that low-grade regional metamorphism accompanied folding in the early stages of Coast Range orogeny and was followed by granodiorite and lamprophyre intrusion along lines of weakness set up by the folding. Faulting occurred intermittently throughout the whole time during which compression built up and finally relaxed.

It may be observed in the cross-section (Fig. 3) that north and northwesterly-trending shears tend to dip the opposite way to bedding. (The direction and approximate amount of dip of each was deduced from the air photos). A pattern of folds and strike-shears of this kind is the product of compression with the direction of least stress upwards; in other words, folding and faulting took place at relatively shallow depth. This in turn confirms the deduction made on mineralogical grounds that ore deposition such as that at Silbak Premier also occurred fairly near the surface.

Faulting is the most characteristic structural feature of the whole area. Because of pyritization and fracturing of the wallrocks, fault zones are susceptible to erosion, so that nearly every creek and gully, for at least part of its course, follows or parallels a fault. (In no case could gullies be attributed to differential erosion of weak strata).

Breaks which have no obvious surface trace cannot generally be recognized but, in one instance, indirect evidence is available. The creek in Exchange No. 4 M.C., down to where it crosses the road, is dry by mid-August but continues to flow strongly 100 feet lower down. It gets its water by an underground route, following a NE-SW shear from the larger creek to the north.

Because of the potential significance of faults as ore carriers and controls and the probability that many would be missed on the ground, aerial photographs were examined in some detail. These proved very useful in establishing the distribution of at least some of the major breaks and in locating several intersections which may be worth prospecting (see Fig. 2).

Neither surface exploration nor photographic interpretation indicates much movement along faults and their pattern within the area gives no reason for postulating completely separate periods of faulting. Breaks which are locally oblique to dyke trends either swing or split into parallel or perpendicular alignment and, although dykes may cut or be cut by shears, all faulting can be explained in terms of a single period of compression.

The granodiorite dykes which cut across Cascade Creek are not appreciably offset although the valley itself is undeniably fault-controlled. In most of the later faults, because the contacts they cut are gradational or because outcrop is sparse, the amount of movement can seldom be established: it seems generally to be small, seldom exceeding 100 feet.

It is concluded that, as stresses built up, the first abrupt movements took place along north-south lines (e.g. Cascade Creek and Long Lake valleys). As further stress kept these primary shears tight, secondary shears opened up in a northwesterly direction, permitting intrusion of granodiorite. Later, tertiary faulting occurred parallel and perpendicular to both the earlier sets of shears, in some cases reactivating the older ones.

Intrusion of lamprophyre dykes and migration of mineralizing solutions appear to have taken place throughout this latest period of final relaxation of compression but, as faulting occurred intermittently whenever the local conditions permitted it, some faults must of necessity be pre-ore and others post-ore.

In short, no single preferred orientation can be expected for ore-bearing shears except that they may follow any of three or four regional trends.

HISTORY

The geological history of the Cascade Creek area may be summarized in tabular form as follows:

Age	Formation	Rock Type	Diastrophic Events
Recent		modern drainage patterns established	
Pleistocene		glaciation: enlargement of valleys, deposition of drift	
Pre-Pleistocene	//////////////	//	Uplift (and erosion)
Cretaceous	Coast Range orogenic structures and intrusives etc.	lamprophyre dykes — deposition of ore	tertiary shearing
		quartz veins	NW-SE (and NE-SW) secondary shearing
		granodiorite dykes	
			folding and primary shearing along N-S axes, accompanied by regional metamorphism
Lower Cretaceous and Jurassic (and ? Triassic)	Nass	grey-black slate	
	//////////////	//	Uplift, erosion (no tilting)
	Salmon River	grey-black porphyritic flows and pyroclastics	
	Upper Bear River	purple (and green) tuffs, volcanic breccias (with occ. fragments of porphyry); one grey flow near the top.	
	Lower Bear River	Premier porphyry: variously altered "granodioritic" stock and sills (may also underlie all other Bear River)	
		green, altered andesitic tuffs, volcanic breccias and flows; rare beds of chert, argillite, etc.	

ECONOMIC GEOLOGY

Shears are the conduits through which ore-bearing solutions have passed and intersections of shears have served as important structural controls at Silbak Premier and New Indian Mines. The ore minerals at both these mines either are themselves, or are associated with, sulphides such as galena, sphalerite, chalcopyrite and tetrahedrite. Pyrite occurs nearly everywhere but only where it is concentrated in or along shears is it of any interest: greenstones and porphyry in the southern part of the area contain up to 1 - 2 percent of disseminated coarse pyrite cubes, but this type of pyrite appears to have grown slowly in place and does not seem to carry values.

Shears may be looked upon as favourable sites for exploration. But even if search for ore were restricted to the most obvious intersections, a glance at Fig. 2 suggests that this could be a formidable undertaking. But there are possibly other limiting factors which permit narrowing down the search still further.

Because purple tuffs seem to have played an important role in ore deposition at Silbak Premier, a few observations made in the field may be significant:

1. They comprise a lenticular sequence of beds about 700 feet in maximum thickness, in which texture ranges from aphanitic to very coarse: most of the aphanitic members are fairly high in the sequence.

2. Ferric iron (as hematite) varies from a trace in the green members to a considerable percentage in the red and purple ones. Although it is not absolutely certain that total iron content (other than pyrite) is higher in red and purple tuffs than in adjacent green rocks, it certainly appears to be (this could be checked).

3. Purple tuffs grade laterally and vertically into green tuffs of apparently identical texture and content of non-ferrous minerals.

4. Purple tuffs carry practically no pyrite: green tuffs, otherwise identical, may contain up to 1 - 2 percent over large areas.

5. Both purple tuffs and greenstones (and porphyry) are bleached in the vicinity of shears; all shears in the area, regardless of attitude or host rock, do carry pyrite: under its influence purple tuffs first turn green and then greenish white, green tuffs turn white. It seems, then, that sulphide, carried in solution in the shears, has removed the iron from the rocks through which they pass to form pyrite.

As the ores of Silbak Premier and New Indian Mines either consist of sulphides or are invariably associated with them, they must have been carried in sulphide-rich solutions. For such solutions there has to be a threshold value of sulphide concentration below which ore minerals are bound to precipitate. Solutions of this kind seem to have travelled through shears, reacting with ferrous iron on the way, but generally not enough iron was present in any one place to lower the sulphide concentration abruptly. However, at Silbak Premier they encountered purple tuffs, which are not only high in iron but iron in the form of hematite, which requires additional chemical energy to reduce it from the ferric to the ferrous form.

It has been noted above that "green tuffs" below "purple tuffs" appear to be identical except for colour. It is suggested here that in some cases they were originally one and the same: that purple tuff beds, originally thicker and more continuous, have been reduced in apparent size and continuity to lenses in green tuff by reduction of red ferric iron to green ferrous iron by reaction with sulphide-rich solutions and that lowering the sulphide concentration of the ore-bearing fluid has necessarily resulted in ore deposition. Thus, instead of acting as a purely physical barrier through which the ore-bearing solutions could not pass because of impermeability, or through which the ore-bearing shears could not penetrate because of resistance to fracture, purple tuff served as a chemical, sulphide-iron barrier.

Of course this hypothesis does not deny the influence of physical features or the near-surface position of the purple tuff: if flow of fluids were restricted by pinching out of shears there would be more time for the sulphide-plus-iron reaction to take place, so that physical impermeability and temperature gradients would play their part, but they would not be the only factors in ore deposition. But this hypothesis does explain why ore at Silbak Premier is found as much as 480 feet below the footwall of the lowest purple tuff and as much as 400 feet about it (Langille, 1948). It suggests too that evaluation of concentration gradients of total iron (uncombined with sulphur) along known fractures, particularly those in which some mineralization is already evident, might be a fruitful field for investigation.

NOTE: Every locality previously reported or even rumoured to be mineralized with more than straight pyrite was visited during the field season. Significant mineralization is discussed by Dr. W. H. White in a separate report.

CONCLUSIONS

In the general vicinity of Cascade Creek successful mines are located at intersections of shears, with unusually high grade ore being deposited under the influence of particular rock types. Geological reconnaissance and and interpretation of aerial photographs have disclosed several localities where these conditions are met and a few are singled out for immediate attention. It must be emphasized, however, that only a very general picture emerges from a single field season and that more precise photographic interpretation could be accomplished by an experienced photogeologist.

The first obstacle to thorough exploration of the Cascade Creek area is lack of roads. Nevertheless, after spending three months in the field and another two trying to place the information and impressions gained in perspective, the writer is inclined to be optimistic. Detailed exploration of the most favourable structures of the many which are potentially mineralized seems to stand a good chance of success.

R V Best

R. V. Best, M.A.Sc., Ph.D.

Vancouver, B.C.
November, 1962.

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SUPPLEMENTARY STATEMENT

- by -

Dr. W. H. WHITE, P. ENG.

The foregoing geological survey and report was conducted under my supervision.

As a result of five days spent in the field with Dr. R. V. Best and of subsequent discussions with him, the writer concludes that this report with its maps and cross-section fairly presents the geology of New Indian Mines property in the Salmon River area. Dr. Best rightly points out that because of the large size of the property and great difficulties attending field mapping, the geological and prospecting work accomplished during the past summer was of reconnaissance nature. Its chief value lies in pinpointing places where further more detailed investigations seem warranted.

At nearby Premier mine the original ore bodies were in fractures and fracture intersections along or close to contacts of porphyry 'sills' with green tuffs, and an early belief was that porphyry was a prime requisite of ore deposition. Discovery of the 'West Ore Zone' in 1939, well removed from any porphyry bodies, plus subsequent investigations by the writer and others, modified this view:

(a) Porphyry is an intrusive phase genetically related to the Bear River volcanic sequence; much older than, and completely unrelated to granitic rocks of the nearby Coast Intrusions.

(b) Deposition of commercial ore deposits does not require the nearby presence of porphyry.

(c) Premier ore deposits occur in greenstones and green tuffs <u>only</u> near the contacts of such rocks with purple tuffs and pyroclastics.

Mapping on Premier ground seemed to restrict purple tuffs and pyroclastics to a stratigraphically high position in the Bear River volcanic sequence. However, Dr. Best's mapping of contiguous ground shows that purple tuffs and pyroclastics are not so restricted; that they occur at various stratigraphic horizons throughout the volcanic sequence. Thus, favourable stratigraphic and lithologic relations are not unique to Premier but exist at many places on New Indian Mines ground.

Figure 2 is a map of topographic lineaments visible on air photographs, some but not all of which were identified on the ground as pre-ore fractures. This map is a most interesting structural analysis, but Dr. Best has stressed that ore deposition may be expected only at or near fracture intersections or junctions, particularly in the general vicinity of greenstone - purple tuff contacts. He has listed such favourable locations in this Report.

Vancouver, B.C.
December 7, 1962.

Wm. H. White, P. Eng.

LEGEND

- silicification
- faults
- shears
- mineralization - other than pyrite
- bedding
- foliation & cleavage
- lineation
- joints
- adit
- trail
- road
- property boundary
- border monument
- aerial tramway

- Late Intrusives — with free quartz (granodiorite, quartz diorite, etc.)
- Late Intrusives — lacking free quartz (syenite, monzonite, diorite, etc)
- Premier Porphyry — variously altered, may lack phenocrysts.
- Greenstones and Tuffs
- Flows and Tuffs — dark grey to black
- Purple Tuff — agglomeratic in part — also red phase
- Purple Porphyry — large feldspars in a tuffaceous matrix
- Slate — grey to black

SCALE

0 500 1000 1500 2000 2500 3000

NEW INDIAN MINES LTD.
RECONNAISSANCE GEOLOGY
CASCADE CREEK AREA — SKEENA M.D.

SCALE: 1" = 500'

Geology By : R.V. Best & C.C.Buckland

Drawn By : C.C.Buckland

May — Sept. 1962

Fig. 1

Geology of Silbak-Premier property copied from company maps

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(MI)

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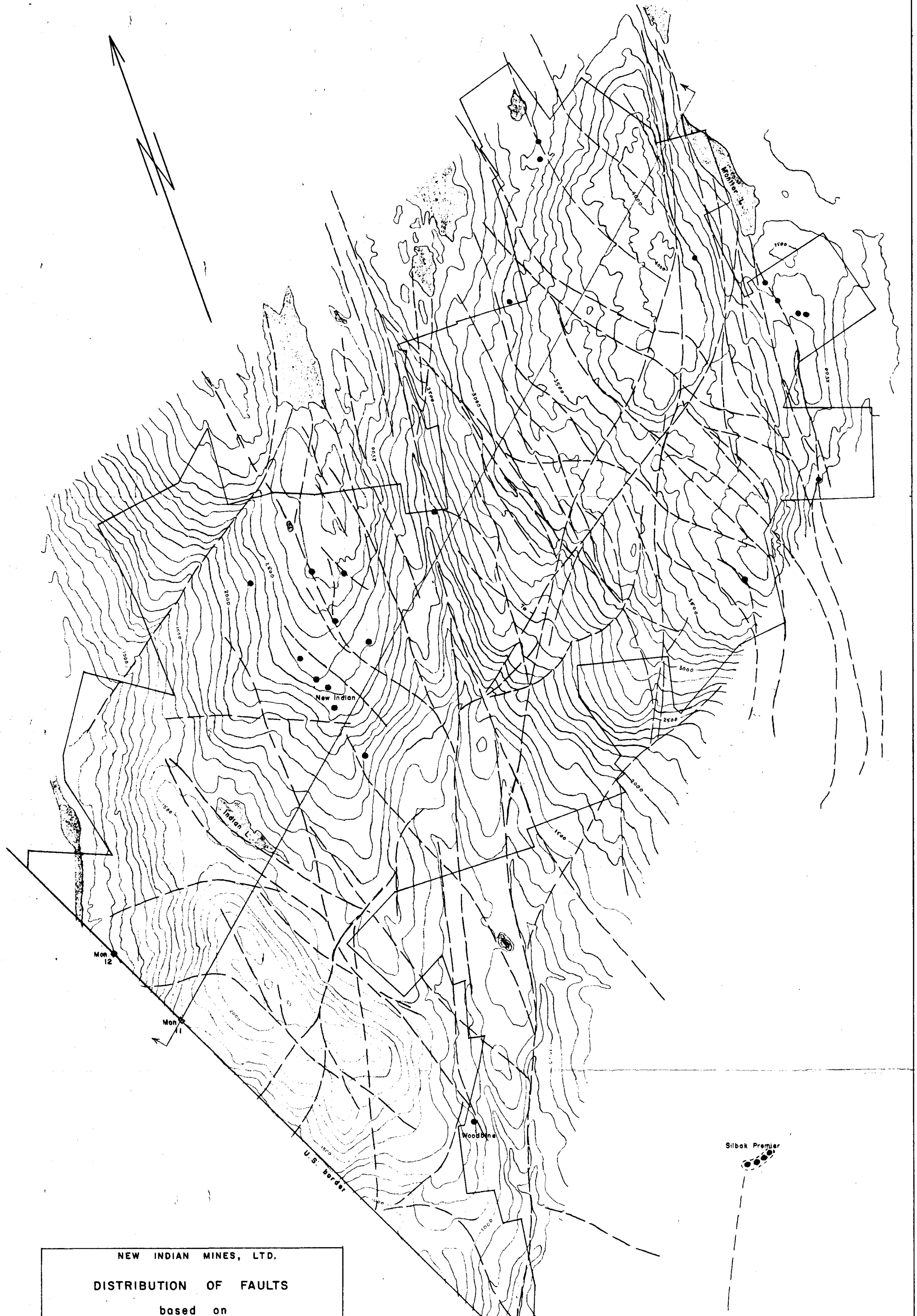
ASSESSMENT REPORT
NO. 448 MAP 1



NEW INDIAN MINES, LTD.

DISTRIBUTION OF FAULTS

based on

AIR PHOTO INTERPRETATION

CASCADE CREEK AREA

Scale : 1" = 1000' ; Contour Interval : 100'

● : mineralization other than pyrite

╲ : fault (position deduced from photos)

Fig. 2 (to accompany report by R.V. Best, 1962)

R.V. Best

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ASSESSMENT REPORT
NO. 449 MAP 2

(M2)

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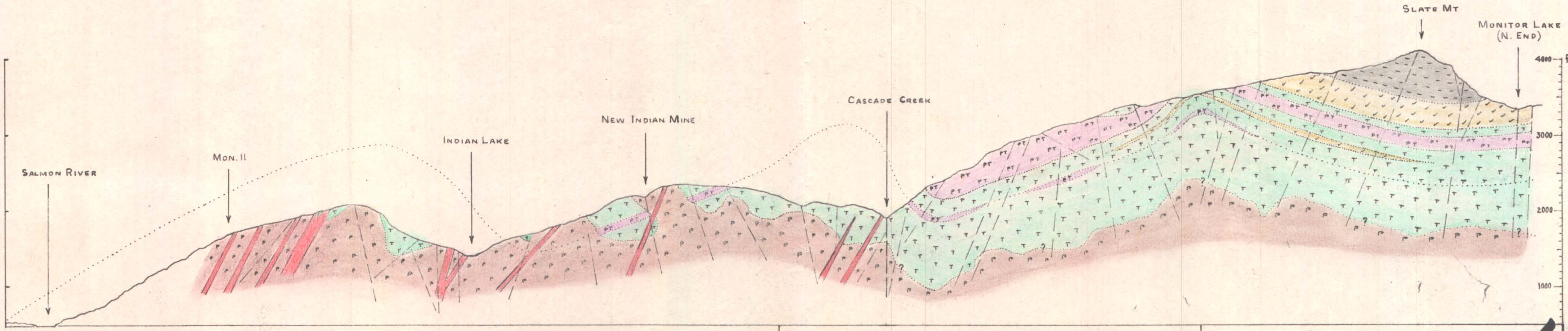
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 448 MAP 3



- late intrusives (Coast Range granodiorite, monzonite, etc.)
- grey and black slates (Nass Formation)
- dark grey volcanics (mainly Salmon River Formation)
- purple tuffs (Upper Bear River Formation)
- greenstones and tuffs (Bear River Formation)
- Premier porphyry (intrudes and ? underlies Bear R. Fm.)

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NE-SW CROSS SECTION

CASCADE CREEK AREA

R.V. Best.

Scale: 1" = 1000'

Fig. 3

(to accompany report by R.V. Best, 1962)

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