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# PROSPECTING POSSIBILITIES IN NICKEL PLATE MT. HEDLEY, B. C.

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# PROSPECTING POSSIBILITIES

# IN NICKEL PLATE MT.

# HEDLEY, B. C.

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## INTRODUCTION

Nickel Plate Mt., northeast of the town of Hedley, British Columbia, is a compact block about two miles long on its northeast axis by one and one-half miles wide. It rises from a base of 1700 feet at Hedley to an elevation of 6100 feet. The upper half of the mountain, above the 4000-foot contour, shows widespread mineralization, the principal sulphides being pyrrhotite, chalcopyrite, and especially arsenopyrite, the latter, with its silvery lustre, giving the mountain its name.

This mineralization carries some gold, and at four points on the surface important stopes have been opened. Three of these, Sunnysides 2, 3, and 4, while rich, failed to continue to depth. The fourth, at Nickel Plate glory hole, led ultimately into an associated group of ore bodies of great persistence. About $14, 000,000 in gold has been produced from these four occurrences, ninety per cent. coming from the Nickel Plate, principally from ore bodies which did not outcrop.

The productive period of these ore bodies extended from 1904 to 1931. The big output followed 1910, at which time it had become evident that the Nickel Plate ore bodies were both large and rich. The mill capacity was then increased and the mine forced to its limit to earn large dividends. Development work was of necessity concentrated upon the effort to keep the ore reserves in the main group of ore bodies one jump ahead of extraction. Since the rock is hard and crosscutting costs $20 a foot, this close-in development was done entirely by diamond drilling, and no underground workings were run except those essential

for getting to and extracting ore found in short drill holes. Thus it happens that while the workings follow the westward-dipping ore chambers down their course for 2000 feet, there is no lateral development whatever.

Ultimately, in the years 1925 to 1931, a few drill holes were put down from the surface, at widely spaced intervals, in a generalized effort to find another productive part of the mountain, but this campaign, lacking correlation with the fundamental ore-bearing structures, was inconclusive.

As a matter of fact it was probably not possible to interpret correctly the Nickel Plate ore structure until recent years. Some essential elements are seen only on the lower mine levels, and the entire pattern was foreign to the experience of mining geology until the type was developed recently in the Tintic Standard, North Lily and Chief Consolidated mines in Tintic, in the Campbell at Bisbee, and the La Colorada at Cananea. Like these, Nickel Plate Mt. is an example of a mineral funnel; and the ore bodies of the Nickel Plate mine are the characteristic "manto" phase of that type of structure.

MINERAL FUNNELS

The salient features of a mineral funnel are well shown in the case of the North Lily. (See Plate I.)

An old northwest fault, the East Fissure, is intersected by a thrust crumple. Leakage from the depths of rock and ore fluids took place at this intersection, forming on the one hand a lobe of monzonite porphyry and on the other, a mineral funnel. The latter is best seen on the cross section. It consists at the base of roots, deep in the involution of the thrust crumple, of broken shattered quartzite, fissured and mineralized with low-grade siliceous ore. Above the quartzite this root zone merges into a well defined breccia pipe, containing fragments of all the deep formations, including porphyry, cemented

by silica, with some of the mixed sulphides. This breccia is in part commercial lead-zinc ore. Above the 900 level, at the top of the shale member, the breccia gives way, along its northern margin, to bedded silver-lead ore replacing limestone. Fingers of this bedded ore, true "mantos", extend upward with the dip of the bedding for hundreds of feet. Finally they die out, but intense alteration extends on for more hundreds of feet. This alone reaches the surface, forming a great alteration blot which marks the position of the deeply buried mineral funnel.

In this brief summary we have emphasized:

(a) the thrust crumple-fault intersection,

(b) the low-grade fissure roots;

(c) the breccia pipe,

(d) the high-grade ore manto fingers,

(e) the alteration blot.

These features are characteristic of every funnel which has been carefully studied, and they are well exhibited in the Nickel Plate area. Their recognition greatly clarifies the prospecting problem, for it fixes closely the places where additional high-grade manto ore may be anticipated.

STRUCTURE OF NICKEL PLATE MT.

The upper portion of Nickel Plate Mt. is composed of westerly dipping sedimentary rocks--limestones, argillites and quartzites. The ore-bearing member is the Nickel Plate argillite, which rests on the Sunnyside limestone. The Sunnyside limestone is distinctive and forms a good basal marker horizon. On the map (see Plate II) the belts of outcrop bend sharply to the west across the southern slopes of the summit ridge. This bend is not structural but is a trick of erosion. The true strike is everywhere nearly north-south, except where modi-

fied by local faults and crumples.

These are numerous, as Plate II shows. The principal faults and intervening segments of the bedding are shown, somewhat simplified, in Plate III. It will be noted that these major faults radiate out fanwise to the southeast from a focal point which lies approximately beneath the crest of the mountain. The greatest distortion of the beds occurs in the block between the Sunnyside and Nickel Plate Faults. In this trough the beds, which normally strike north-south, turn to east-west, dipping north, and are steep and crumpled. This structure is essentially a thrust involution like the one shown on the North Lily section on Plate I. It is one of the main structural features of the mine area of Nickel Plate Mt.

The other main feature is the line of thrust faulting from the west marked by the extensive breccia cappings of the summit ridge. This zone enters the area from the southwest, follows up on Climax Bluff ridge to the summit and thence passes northerly off the mountain. It contains two main lobes of intrusive and injected breccia: one, the Climax lobe, intensely garnetized and silicified; the other, Copperfield lobe, somewhat silicified but for the most part weakly consolidated or fresh. On Plate IV these lobes of breccia are shown in their relationship to the fan-shaped sedimentary structure. Their roots, at about the 4500-foot level are close to the intersection with the Sunnyside trough mentioned above.

This intersection of breccia axis and trough axis seems to act as the focus for the alteration and mineralization of the area. These effects extend principally southeastward, in the directions of the radiating structures (see Plate III). The mineralized unit is, therefore, a quadrant bounded on the north by the North Fault, on the west by the breccia edge, and on the southeast by the outcrop of basal limestone. Throughout this quadrant alteration is intense, and mineralization widespread, and commercial ore has been found from Sunnyside

Sunnyside

on the southeast are to the lower Nickel Plate stopes at the north edge well toward the focus. The known commercial ore bodies, however, do not adequately fill in the pattern made by structure and alteration in this quadrant. The Nickel Plate stopes are not central to the alteration blot, but close to its northern edge; and they are tied to no structural feature which is not duplicated elsewhere in the area. The Sunnyside stopes occupy over one-third of the outcrop strip of their ore bed, but this same bed has yielded no ore down its dip. It is inconceivable that all the ore in the Sunnyside ore bed is aligned along such an accidental trace as the intersection with the present post-glacial surface. It is, therefore, highly probable that properly coordinated exploration will discover new ore bodies within this well defined quadrant of intense alteration.

DETAILS OF ORE BODIES--NICKEL PLATE

The existing stopes indicate that, within the essential mineralized area, ore bodies are localized by certain relationships of favorable beds, sills, dikes, and folds or crumples.

The beds are certain members of the Nickel Plate argillite formation. The most widespread ore is near the base (Sunnyside ore bed), overlain more or less closely by the Lower Sill of bleached andesite porphyry. (See Plate II.) On the surface, above the Lower Sill, the Nickel Plate formation is barren for about 150 to 200 feet, until the Middle Sill is reached. Between this and the Upper Sill, the formation, about 200 feet in thickness, is intensely garnetized and mineralized, and contains many lesser sills. The Nickel Plate glory hole (No. 1 Ore Body) is in this part of the series, immediately beneath the Upper Sill. As Plate V shows, the deeper Nickel Plate ore bodies "underlap" each other like shingles downward through the formation, until No. 6 is essentially

in the Sunnyside ore bed immediately above the limestone. Above the Upper Sill is 150 feet of silicified argillite, traversed by sundry sills, which I call the Top Sill group. This part of the formation is barren. The ore on the whole, then, spreads most widely on the basal Sunnyside bed, but in at least one place works up in big shingled ore bodies into the central portion of the Nickel Plate formation. Above it, in this place, is a capping of silica, locally called chert. The habitat of the ore is, therefore, in the 400 feet of argillites between the overlying silicified beds and the underlying limestone. Sills, forking and fingering out, and dikes, subdivide this sedimentary layer and, while themselves barren, seem closely related to the adjacent ore bodies.

The abundant sills of bleached andesite-diorite or gabbro porphyry are characteristic of the ore-bearing quadrant of Nickel Plate Mt. and are absent from the unmineralized areas. They form the immediate foot- and hanging walls of stopes (Plate VI) and show very intense alteration close to the ore. While containing only low values of gold, they are surely associated with the origin of the ore bodies. Probably they were the first fluid to leak up from the breccia focus. Pushing outward among the layers of argillite, they led and prepared the way for the later emanations of ore fluids. They do not always precisely follow the bedding, but angle acutely across it in the manner of thrust shear planes. Such surfaces in the formation, developed to adjust the stresses of thrusting and deformation, are the fundamental guides which have controlled all subsequent events,--intrusion, alteration, and mineralization.

Several dikes trend southeasterly across the summit ridge and down the eastern slope. Some are dark, distinctly diorite, others light, silicified and pyritized, and some show transition phases. Probably all are forms of the Climax stock intrusive rock, a finely granular diorite or monzonite porphyry. In addition to these are numerous small dark glassy dikes, always fresh and probably

later than the important mineralization. Three dikes are found in the Nickel Plate mine itself--the North, Central and South Dikes. The ore outcrops close to the South Dike, but diverges from it in depth, passing over to impinge on the Central Dike. This interrupts the stopes, which, however, resume on the north side, with a small downward displacement, and extend on downward, gradually leaving this Central Dike in turn as they left the South Dike. At the bottom of the mine the ore bodies are far to the north of the Central Dike and must be close to the North Dike. These relationships are shown on Plate VII.

This plate shows also the minor folding in the beds. There is a syncline close to the South Dike, an anticlinal nose along the Central Dike, and a second syncline north of the Central Dike. The ore bodies, so far as developed do not coincide in position with any one of these minor folds. Above No. 3 Adit, Ore Bodies No. 1 and 2 are close to the south syncline. Going downward, however, they work northward to the anticline, and in the central part of the mine Numbers 2, 3 and 4 Ore Bodies are on the flanks of this nose. Still deeper, all the ore bodies pass to the north syncline, where they reach their maximum thickness in the Bull Ring area. On the lowest levels the stopes are on the northern flank of this north syncline.

Finally, about 200 feet southwesterly of the line of stopes, is the rim of the Climax breccia lobe. At the bottom of the mine the ore bodies abut against it and end, but upward from this point the breccia diverges southward from the stopes, so that on the surface its rim lies about 500 feet southwest of the glory hole (see Plate VII). In the intervening distance it must intersect the Central Dike, the anticlinal nose, the South Dike, and the south syncline.

The north limit of the Nickel Plate mine is formed by the North Dike, a complex zone of brecciation with diorite intrusives, both dikes and sills. The formations north of this zone are relatively higher than in the mine block, so that basal Sunnyside limestone lies opposite ore beds which are 200 feet

stratigraphically above it. No workings have entered this shelf beyond the North Dike, although half a dozen drill holes have encountered $7 to $10 ore in the beds above the limestone.

DETAILS OF ORE BODIES--SUNNYSIDE

The Synnyside ore bodies are spread along the outcrop of the argillite bed immediately above the Sunnyside limestone. They lie principally, as Plate III shows, in the segment of beds between the Mound Thrust and the Sunnyside Fault. The only exception is Sunnyside No. 4, which lies across the trough and north of the Nickel Plate fault. The structure of this area is shown on Plate VIII. Contours are on the top of the limestone, as shown on surface and in drill holes. The workings, being full of water, can not now be mapped.

The stopes are found in the argillites which intervene between the limestone below and the Lower Sill above. This interval is not constant. In Sunnyside No. 1 the sill is less than 50 feet above the limestone. While in Sunnyside No. 3 it is about 250 feet. The sill apparently angles up through the formation toward the north, following some flat shear plane. Where the interval becomes great the ore remains in the lower 50 feet of the argillite. In Sunnysides Numbers 2 and 3 a dike with an unusual northeast strike is found in the glory holes.

The bedding in the Sunnyside area exhibits (a) gentle folding, (b) minor block faulting, and (c) the thrust involution or trough. The gentle folding comprises a broad anticlinal nose near Sunnyside No. 2, with a somewhat tighter syncline between No. 2 and No. 3. The minor faulting is as shown on Plate VIII. It seemingly has no relationship to the ore bodies.

The trough, lying between Synnyside No. 3 and No. 4, with the Sunnyside Fault on the west and the Nickel Plate on the east side, is the outstanding

structural feature of the area. Its bounding faults are visible on the surface, and the intervening block shows the beds dropped, and turned to east-west strikes with steep north dips. Drill holes, and old notes from Sunnyside No. 4 indicate that the Nickel Plate Fault dips west at about 45 degrees, and has a normal throw, west side down. The Sunnyside Fault is probably steep, and acts like a thrust, with the west side up. The stopes in Sunnyside No. 3 follow closely the intersection of the ore bed with this latter fault, and hence are marginal to the trough. Sunnyside No. 4 is marginal also, on the opposite side. It is rather likely that this pronounced structure has controlled the distribution of Sunnyside ore.

DEVELOPMENT POSSIBILITIES

The development program for Nickel Plate Mt. should obviously be calculated to complete the exploration of critical portions of the funnel pattern.

Most important is the Climax breccia rim, where it intersects the Nickel Plate and Sunnyside ore horizons. The limited portion now developed in the mine adjoins the roots of the Nickel Plate Mine ore bodies. These lie in minor folds, close to dikes, in the structural segment north of the "trough". Development to the southward will first encounter the same beds in other minor folds, with other dikes, and will ultimately reach the Nickel Plate Fault and the northern margin of the trough. The breccia and trough intersection will be the principal objective for this southward exploration from the Nickel Plate mine. If successful this breccia rim development can be extended southward beyond the trough toward Climax Bluff and its strong area of mineralization (Climax and I. X. L. Pits, Plate II).

The remaining critical portions of the funnel pattern consist of the radial structures of the southeast quadrant; the North Fault; the Trough, with its marginal faults, Nickel Plate and Sunnyside; and the Mound Thrust. The North

Fault area can be reached from the Nickel Plate mine. The Trough can best be explored from Sunnyside No. 3 incline, which extends down to an elevation of 5435 feet, equivalent to the 400 level of the Nickel Plate.

Detailed recommendations to carry out this combined program are given in a separate report. I believe that it should be undertaken, for it possesses many of the conditions which make for success in hunting for hidden ore. These are:

1. The existence in the area of large-scale commercial mineralization, proved by the ore bodies already found;
2. Widespread surface alteration, proving the penetration of mineralization throughout a large area (i. e., the Southeast Quadrant);
3. The recognition in the area of a distinctive pattern of ore deposition, the mineral funnel, with resulting clarification of objectives for exploration;
4. The fact that the best of these objectives, the breccia margin and the radial faults, etc. lie entirely within the area of strong alteration and even in part between existing stopes;
5. The available workings, shafts, etc. which minimise the cost of reaching the desired objectives.
6. See Appendix A.

Respectfully submitted,

September, 1932

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## APPENDIX A (Confidential)

On Plate VII a triangular fractional claim is shown lying across the lower part of the Nickel Plate ore bodies. This is the Mascot Fraction, owned by Duncan Woods of Hedley. It contains unstoped portions of Numbers 3, 4 and 5-6 Ore Bodies.

The size and grade of these ore bodies is known from stopes along the property lines, corroborated by some drill holes in Mascot ground and by a single crosscut through the claim on the 1200 level Nickel Plate. The latter showed very high-grade ore in No. 4 Ore Body--$50 plus--and is not considered in the tabulation below.

| | No. 3 | No. 4 | No. 5-6 | Total |
|---|---|---|---|---|
| East of Mascot | 100 x 20, 3.00 | 60 x 15, 9.00 | 60 x 10, 9.00 | |
| West of Mascot | 60 x 15, 9.00 | 120 x 30, 17.00 | ? | |
| Length in Mascot | 280 | 280 | 100 | |
| Tons | 34,000, 8.30 | 50,000, 15.00 | 6,000, 9.00* | 90,000, 12.00 |

*May be more

In mining this ore there will be a dilution of say 12% of hanging wall waste, so that the actual production will be about 100,000 tons of $10.00 ore. The Hedley mill will recover 88%, or $8.80 a ton.

| | |
|---|---|
| Total recovery - - - - - | $880,000 |
| Total cost @ $7.50 - - - | 750,000 (Hedley cost averaged $6.70 from 1926 to 1930 inclusive.) |
| Balance - - - - - - - - | $130,000 |

For personal reasons (hostility to the management) Woods would never give the Hedley Gold Mining Company either lease or option on his ground, although the ore can be mined only through the Nickel Plate workings. Last spring (1932) he did give a lease to the Consolidated Mining and Smelting Company,

asking for himself 35% of the profits. The Consolidated company failed to act on this lease, and the Mascot is now available on approximately these same terms. If optioned on a satisfactory basis it is capable of yielding enough profit to pay for the comprehensive exploration of the entire Nickel Plate Mt. area.