The Geology of the Sunshine Lardeau Mine

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Introduction

THE Sunshine Lardeau mine, owned by Sunshine Lardeau Mines, Limited, is about seven miles northeast of Beaton in the Lardeau area of British Columbia. The nucleus of the present property is the Spider claim, from which spasmodic shipments of sorted ore were made during the period 1911 to 1949. Work carried out by the present Company during 1950 and 1951 disclosed larger bodies of ore than had been found previously and, as a result, milling commenced in May, 1952. Total production to the end of June, 1956, has been approximately 7,300 oz. gold, 1,100,000 oz. silver, 15,300,000 lb. lead, and 15,360,000 lb. zinc from 82,280 tons of ore. Millheads have averaged about 10 per cent lead, 12 per cent zinc, and 0.08 oz. gold and 12 oz. silver per ton. The above production includes 1,500 tons of oxidized direct-shipping ore that averaged 26.5 per cent lead, 3.8 per cent zinc, and 0.38 oz. gold and 75 oz. silver per ton.

General Geology

The mine area is underlain by sediments and volcanics of late Precambrian age (see Figure 1). These rocks, which are part of the Windermere series, are conformable, strike northwesterly, and generally dip steeply to the northeast. They lie on the southwest limb of an anticline that has been slightly overturned to the southwest.

Volcanic rocks are the host for most of the ore. They underlie a lens-shaped area roughly 7,500 feet long by a maximum of 2,000 feet wide and are comprised mainly of fragmental rocks of several varieties, including well-bedded tuffs in which the beds generally do not exceed ¼-inch in thickness. Some thin-bedded, lean iron formation and small amounts of uniform-textured rocks that may be flows or sills are also present. Chlorite is a characteristic and abundant constituent of all the volcanic rocks. In many of the fragmental beds, extreme elongation of the fragments has imparted a crude stratification to the rock that, in limited exposures such as are afforded by drill cores, resembles bedding.

The volcanics on the whole are not schistose. The few schist zones that are found are generally only a few feet in width and are believed to represent strike or bedding faults. As a unit, the volcanics are considerably more competent than the sediments.

The nature of the volcanic formation varies considerably along the strike. Thus, in the northwestern part of the belt, as far as is known, well-bedded tuffs predominate over coarser fragmentals. In the productive central area the coarse fragmentals are most abundant, and in the southeastern part the rocks are thin-bedded tuffs with about 20 per cent interbedded iron formation. This is the only part of the belt in which iron formation has been found.

The sediments are mainly of light- and medium-grey to greenish quartzites, partly carbonaceous argillites and phyllites, and greywackes. Metamorphism has produced a considerable amount of sericite in most of the sediments.

Structure

Much folding is displayed in the mine area. In general, the folds are tight and isoclinal. Large folds with many associated drag folds appear to be confined to the central part of the volcanic belt. In the extremities of the belt, the folding appears to be limited to tight drag folds. The axes of all the folds strike northwesterly, and the axial planes are inclined steeply to the northeast. The folds plunge to the southeast at angles that range from a few degrees to 45 degrees. The average plunge is probably between 25 and 30 degrees.

The major structures have been inferred from the relationship of the sediments and volcanics and the attitude of drag folds. Knowledge of the detailed structure is limited owing to lack of a reliable marker horizon.

Major faults are not in evidence but several faults do occur and some of them are of economic significance. The veins occupy normal faults that strike within a few degrees of north and dip steeply to the east. They, therefore, cross the bedding or lamination of the rocks at an angle of about 50 degrees. Most of the movement appears to have been in the horizontal plane, with the eastern sides moving south relative to the western. The amount of movement has not been measured accurately, but the horizontal component on each fault is indicated to be between 100 and 150 feet. These faults are spaced at intervals of about 900 feet. Four main faults are known. Their northern limits have not been found, but underground development appears to have reached the southern limit of one fault at least. In this case it has been found that, as the fault weakens, it splits into bedding-plane slips along which the movement has been dissipated.

As noted previously, schistose zones lying parallel to the stratification of the rocks are believed to represent strike or bedding-plane faults.

Certain features suggest the presence of a fault under Pool creek

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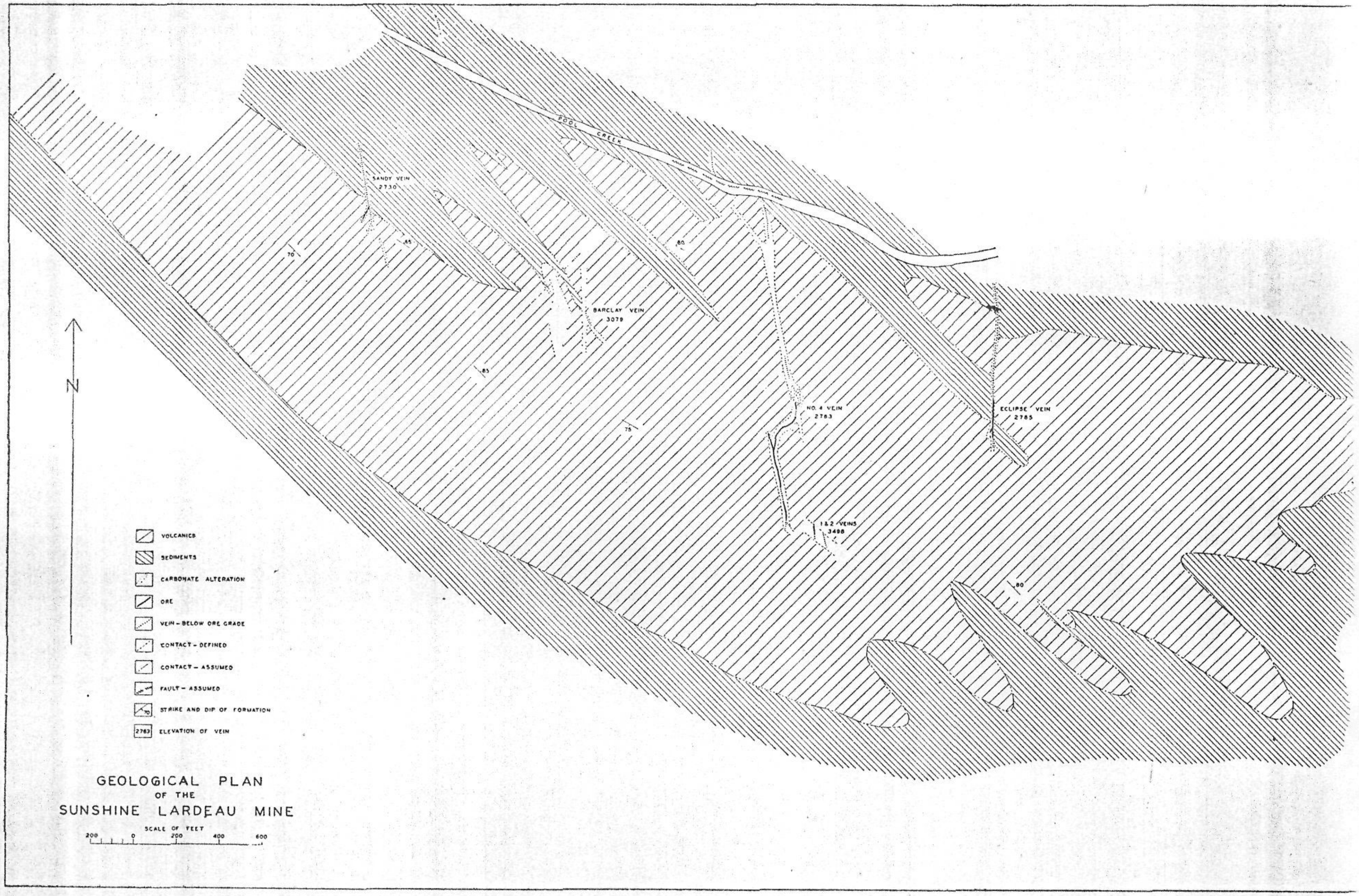
POOL CREEK
SANDY VEIN
2730
BARCLAY VEIN
3079
NO. 4 VEIN
2783
ECLIPSE VEIN
2785
1 & 2 VEINS
3498
N
VOLCANICS
SEDIMENTS
CARBONATE ALTERATION
ORE
VEIN – BELOW ORE GRADE
CONTACT – DEFINED
CONTACT – ASSUMED
FAULT – ASSUMED
STRIKE AND DIP OF FORMATION
ELEVATION OF VEIN
GEOLOGICAL PLAN
OF THE
SUNSHINE LARDEAU MINE
SCALE OF FEET
200 0 200 400 600

Figure 1.

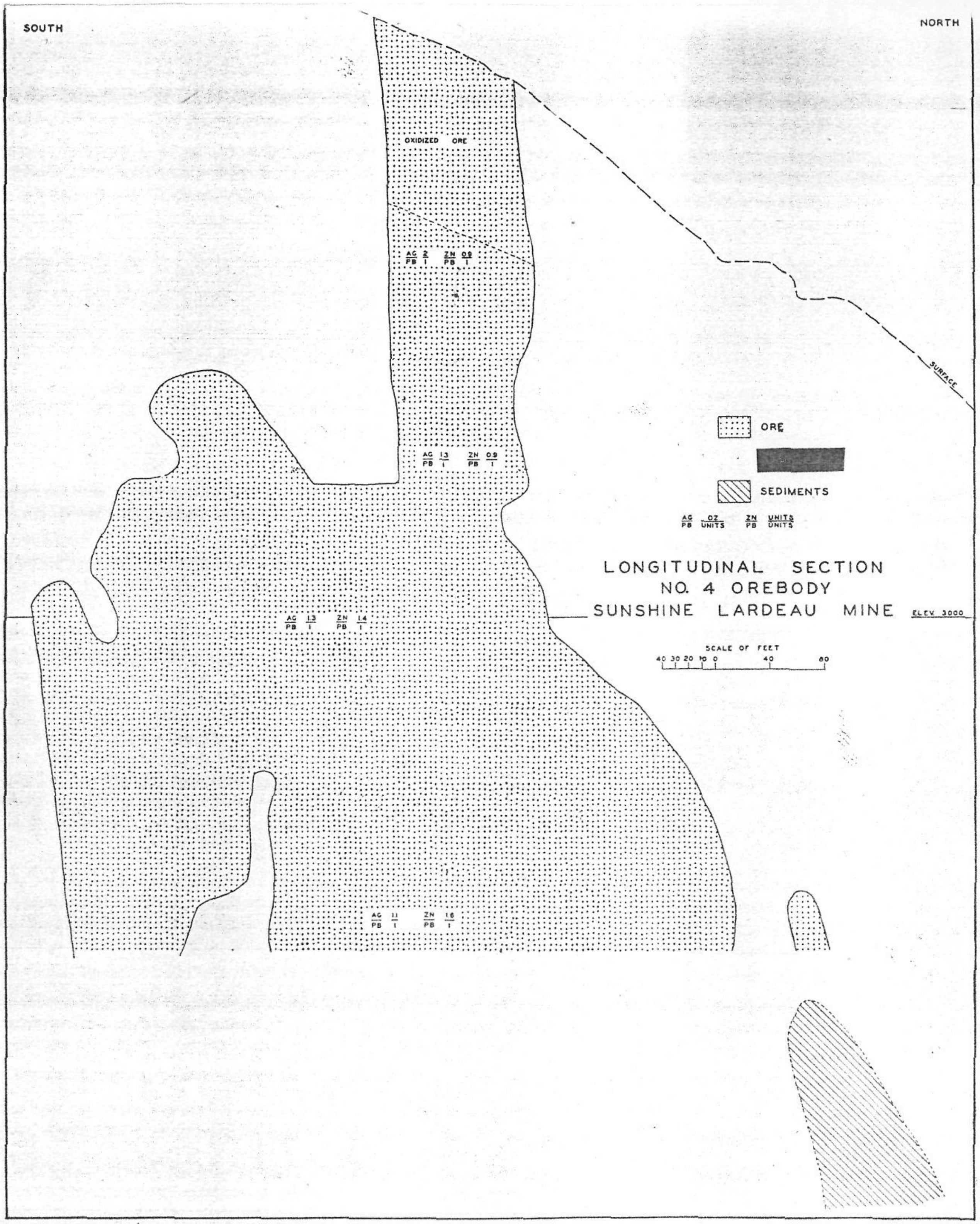

Figure 2.

just north of the mine. In the No. 4 vein area the volcanics extend as far north as the creek but are not found on the north side of it. The No. 4 vein fault, containing some vein material, may be traced as far north as the creek but is not found on strike on the north side. However, a strong vein with the same attitude as No. 4 vein is found only on the north side of the creek at a point 225 feet west of the projection of No. 4 vein. These features suggest a fault under the creek, although no shearing has been found that would further substantiate this. If such a fault exists, it would strike about N.70°W. and could possibly have had some control over the formation of the vein-bearing faults.

Orebodies and Alteration

The orebodies are mineralized fissure veins that occupy normal faults of moderate displacement. Four main veins have been found, spaced at roughly 900-foot intervals. From northwest to southeast these are the Sandy, Barclay, No. 4, and Eclipse veins. No. 4 vein has provided most of the production. Ore is also being mined from the Eclipse, and a small shoot of ore grade has been developed in the Sandy but the tonnage available has not warranted production. No ore has been found in the Barclay zone. To date only one ore shoot has been found in any single vein.

By far the greater amount of ore has been found entirely within the volcanics. In the Eclipse vein, however, sediments form one wall of the ore along most of the ore shoot. In this vein the ore does not extend far into areas where either sediments or volcanics form both walls.

Zones of carbonate alteration are found along the faults in which the veins occur and may be present with or without vein material. These alteration zones range in width from a few feet to several tens of feet. They are comprised of altered remnants of country rock, siderite, and a minor amount of bright-green chrome mica. Where no definite vein occurs in alteration zones, irregular disconnected stringers of barren quartz are commonly present. Although most of the alteration is found along the northerly striking faults, in some cases alteration zones occur parallel to the bedding. These may have been localized by strike or bedding faults. Carbonate alteration has developed much more extensively in the volcanics than in the sediments.

The main constituents of the orebodies are quartz, pyrite, sphalerite, and galena; with these are minor amounts of siderite, chalcopyrite, and tetrahedrite. Sections composed essentially of pyrite, sphalerite, and galena are common. The order of deposition of the vein minerals was probably as follows: siderite, quartz, pyrite, sphalerite, chalcopyrite, galena. Fine-grained and coarse-grained varieties of galena are present. The proportion of ore to waste varies greatly in different veins. Considerably greater amounts of barren or below-ore-grade material occur to the north of the ore shoots than to the south. Where not of ore grade the main constituents of the veins are quartz and siderite with more or less pyrite.

The No. 4 orebody was oxidized for a vertical distance of about 140 feet below surface. The ore was a mixture of clay-like material, limonite, and galena. Most of the pyrite, sphalerite, and gangue had been leached. There was some enrichment of silver in addition to that caused by the removal of certain vein materials.

The orebodies range from 100 feet to 400 feet in length and from 1.5 feet to 15 feet in width. The average width is about 4 feet. They are essentially tabular, but a certain amount of pinching and swelling does occur. This is generally not sufficiently pronounced to affect mining operations seriously. Tension-type branch veins are fairly common. Most of these pinch out a few feet from the main vein, but some are up to 100 feet long and persist for a vertical distance of at least 300 feet. Greater widths of ore are found where these stronger branch veins join the main vein. Nearly horizontal slips of no apparent displacement are fairly common in the orebodies. Generally, these have had little effect on the ore but in a few cases the vein is much wider on one side of them than on the other.

In the vertical plane the greatest range of development has been on No. 4 vein. This vein has been developed from surface to a depth of 650 feet. Below this block, ore grade material was found in the deepest drill intersection at an additional depth of 230 feet. Weighted silver-to-lead and zinc-to-lead ratios for each level in primary ore in the developed block are shown on the longitudinal section (Figure 2). These figures give the ratios of total metal in the ore shoot at the several levels. When it is considered likely that the uppermost level has had some enrichment in silver, being just below the oxidized zone, it seems a reasonable conclusion that the upper 200 feet of primary ore had fairly constant metal ratios. Below this horizon the silver-to-lead ratio decreases, and the zinc-to-lead ratio increases, with depth and with respect to the upper block. Drilling to the additional depth of 230 feet suggests that the silver-to-lead ratio remains the same as or is slightly higher than on the lowest developed level, and that the zinc-to-lead ratio decreases. However, drill results have been found to deviate somewhat from development sampling averages in this respect so that the trend below the developed block is not as reliably established as in the developed area.

In addition to the above observations on metal ratios for the No. 4 orebody as a whole, there are certain more local variations in metal content. In places, the silver-to-lead ratio does not show a constant trend with respect to the zinc-to-lead ratio. On all levels, the orebody contains a more or less central ore in which the zinc-to-lead ratio is lower than at the ends. This is more pronounced below a depth of 300 feet because of the progressively smaller size of the core relative to that of the whole orebody.

The Eclipse vein has only been developed through a vertical range of 150 feet, exposing the top of the orebody. In it the overall trend in metal ratios is the reverse of that found in No. 4 vein. On the two levels developed, the silver-to-lead ratio increases and the zinc-to-lead ratio decreases with depth.

In summary, positive conclusions regarding the trend of metal ratios do not seem possible. In the developed part of the orebody on which most information is available, the trend is to higher zinc-to-lead and lower silver-to-lead ratios with depth. There is a suggestion that this trend reverses at greater depth.

Ore Controls

(1) Faulting in the volcanics, which are more competent than the sediments

(2) Later fracturing at places along the faults

(3) Intersection of faults with larger folds

Acknowledgments

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Reference

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