CIM Structural Geology of Canadian Ore Deposits 1948

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to the bedding where these rocks are widest due to a small embayment in the batholith where its contact changes trend.

Surface and underground studies indicate that the silicated rocks favoured the development of straight, well-defined fissures. Their hardness reduced to a minimum the formation of gouge by fault movement. Furthermore, they were relatively inert in the vein-forming solutions and, therefore, were not softened by hydrothermal alteration to the same extent as quartz diorite. This again reduced the development of gouge during the mineralizing period when some movement continued. The net effect was a relatively straight continuous fissure, unobstructed by gouge and altered wall-rock. The stage was set for deposition of the rich, persistent orebodies.

TWIN "J" MINE*

By JOHN S. STEVENSON†

The Twin "J" mine is on mount Sicker, 8 miles by road northwest from Duncan, on Vancouver island. It includes the old Lenora, Tyee, and Richard III mines, formerly under separate ownership but now under the single ownership of Twin "J" Mines, Limited.

During the main period of production from 1898 to 1909 the old mines produced 253,000 tons of copper-gold ore. During the recent period of production from July 1943 to May 1944 the Twin "J" mine produced 35,000 tons of ore with an average grade of: gold 0.075 oz. a ton; silver 2.05 oz. a ton; copper 1.32 per cent; lead 0.6 per cent; and zinc 6.12 per cent.

GENERAL GEOLOGY

The rocks in the Twin "J" mine and nearby area include cherty tuffs, graphitic schists, rhyolite porphyry, and diorite.

The cherty tuffs and graphitic schist together form a band of sediments 100 to 150 feet wide that near the workings is at least 2,100 feet long. It may be longer, but the scarcity of outcrops prevents tracing it with certainty. The trend of the band and the strike of the sediments is N.70°W. The dip of the sediments is 50° southwest. Where relatively undeformed, the rocks are slaty, where moderately deformed their laminæ are bent into small canoe-shaped folds, and where intensely deformed, either by close folding or shearing, they are highly schistose.

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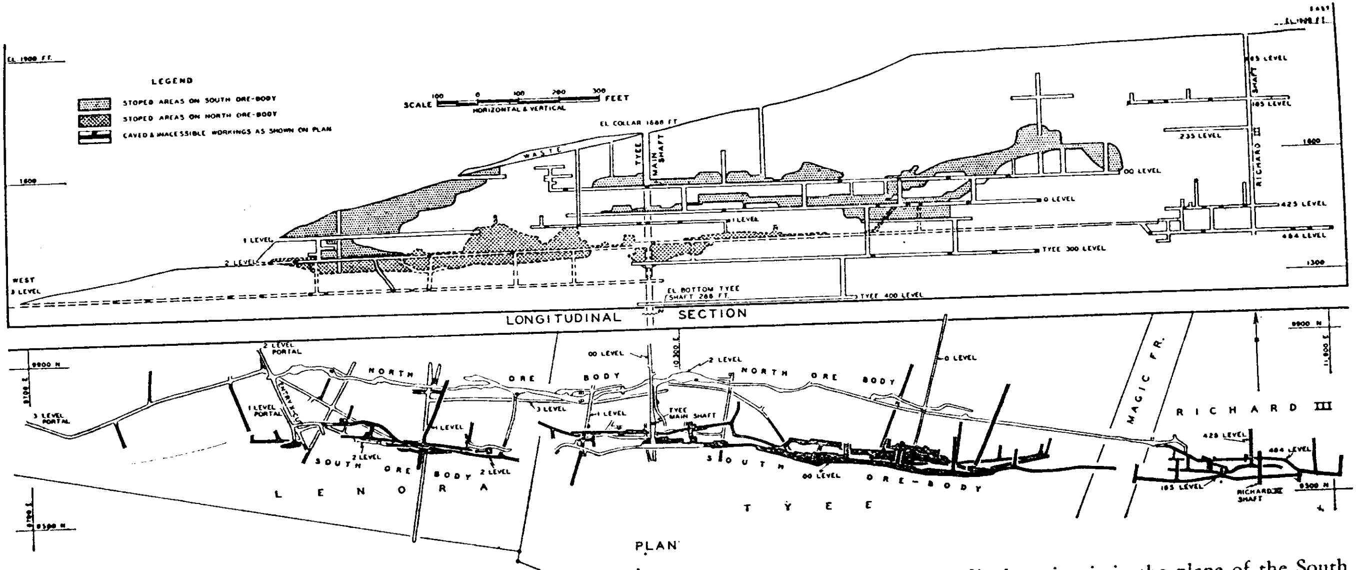

Fig. 1.—Longitudinal section and plan of workings on Lenora, Tyee, and Richard III claims. Longitudinal section is in the plane of the South orebody, with the North orebody projected 150 feet southward into plane of the South.

Intrusive rhyolite porphyry and diorite are the two most widespread rocks on the property. Rhyolite porphyry sills follow the folding of the sediments and dykes cut early phases of the diorite. Two phases of diorite, fine grained and coarse grained, are present. Fine grained diorite occurs as sills in the sediments; coarse grained diorite is found as irregular intrusive bodies, and as well-defined dykes. Although all phases of the diorite are younger than the sediments, some phases are older and others younger than the rhyolite porphyry. Both rocks contain an abundance of albite, and are more fully described as sodic rhyolite porphyry and sodic diorite.

OREBODIES

Mineralogy of the Ore. The ore is a fine-grained replacement of folded tuffs, the finely laminated bedding of the tuffs being faithfully reproduced in much of the ore. Two mineralogical types of ore are found: a 'barite-ore'

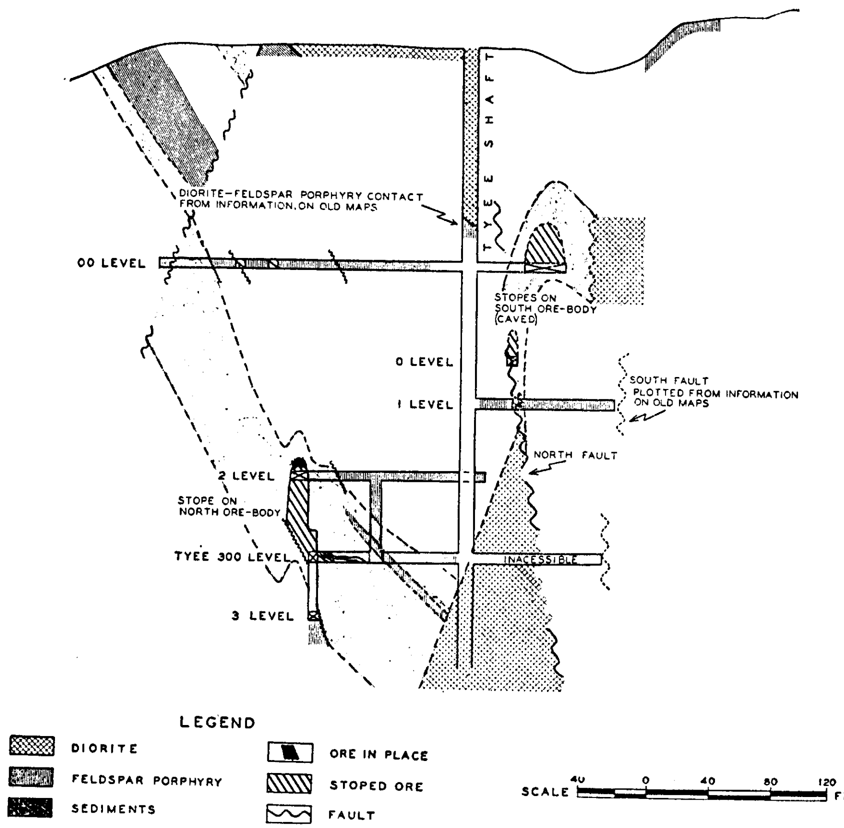

Fig. 2.—North-south cross-section through the Tyee shaft, showing stopes on the North and South orebodies. Information not found in those workings in the plane of the section has been compiled from diamond-drill hole data and from nearby cross-sections.

consisting of a fine-grained mixture of pyrite, chalcopyrite, sphalerite, and a little galena in a gangue of barite, quartz, and calcite, and a 'quartz-ore' consisting mainly of quartz and small amounts of chalcopyrite. These two types of ore are found together, with the 'quartz ore' replacing 'barite ore'.

Form and Size of Orebodies. The two main orebodies, known as the North orebody and South orebody (Fig. 1) are long, lenticular bodies lying along two main drag folds in the band of sediments (Fig. 2). The North orebody measures about 1,700 feet along the strike, 120 feet down the dip, and from 1 to 10 feet in thickness. The South orebody, which is 150 feet from the North, and has its upper limit 150 feet higher, measures 2,100 feet along the strike, 150 feet down the dip, and is about 20 feet in thickness.

Drag Fold Structure. A drag fold in the south-dipping sediments has been replaced to form the North orebody. This drag fold consists of two minor folds, one above the other (*see* left-hand sketch, Fig. 3) but close enough to be considered almost as one drag fold. Many small wrinkles are found within the larger folds (*see* the two right-hand sketches, Fig. 3). The distance measured across the width of each of the folds ranges from 10 to 20

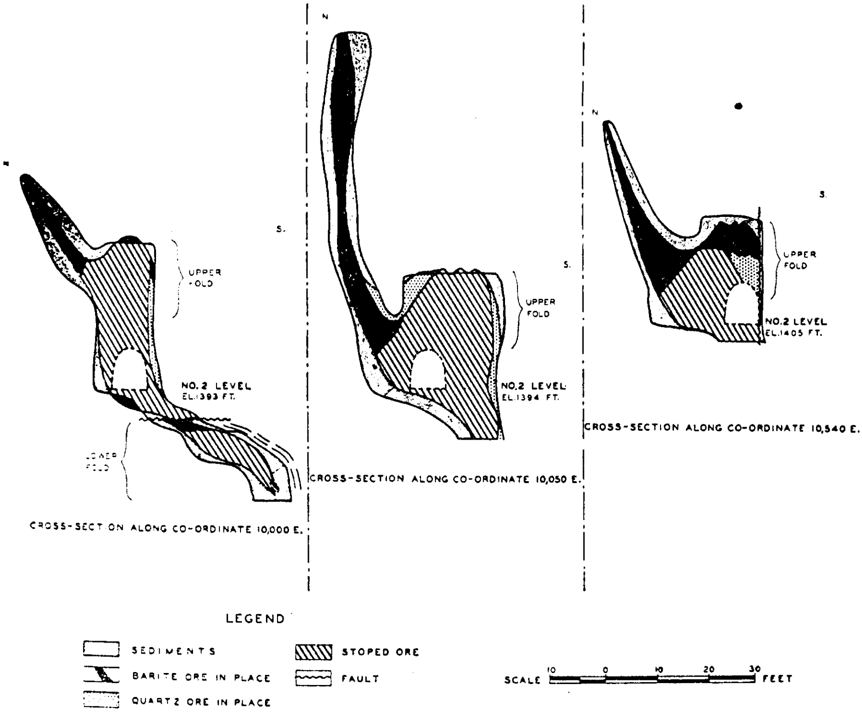

Fig. 3.—North-south cross-sections looking east through stopes on North orebody, showing details of drag fold in this orebody.

fracture zone, barite-quartz ore is found only in the Twin "J" mine. This is the only place that the fracture zone cuts the band of drag-folded sediments; the intersection extends westward into space and eastward into the hill.

The mineralizing solutions from which the Twin "J" orebodies were deposited probably found access from an underlying magma chamber by way of the fracture zone, and where the fracture zone intersected sediments the solutions spread up the dip of the sediments and deposited much of their load of barite and ore minerals in the two main drag folds. These relatively open structures where zones of tension could exist would be favourable for the precipitation of ore minerals from the vein solutions. Thus were formed the South orebody, and, farther upward, the North orebody. Subsequent faulting has displaced the South orebody upward with respect to the North orebody, so that its upper limit is now above that of the latter (Fig. 2).

ORIGIN OF ORE SOLUTIONS

It is improbable that the ore solutions originated in the nearby intrusives, rhyolite porphyry and diorite, but the presence of albite in the vein matter, and abundance of it in these intrusives, suggests that the ore solutions originated in the same magma from which these rocks differentiated. An area of granodiorite, 1 mile square, is found 3 miles to the northwest on mount Brenton, and larger areas lie 6 miles northwest of and 14 miles southeast of mount Sicker. Although the outcrops of granodiorite are some distance from the Twin "J" orebodies, granodiorite probably underlies the orebodies at no great depth. It is probably that one magma was the source of the sodic rocks, the granodiorite, and the ore solutions.

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feet, and the distance measured from top to bottom of the double fold is about 50 feet (Fig. 3). The crest lines of the double fold are horizontal and trend N.70°E., with the strike of the sediments.

Although nearly all the workings on the South orebody are caved and inaccessible, the parts of the orebody that the writer was able to examine in 1944 suggest that a drag fold similar to, but larger than, that of the North orebody has been replaced to form the South orebody.

Age of the Ore. The ore is later than the folding and metamorphism of the sediments. That the ore is later than the folding is indicated by narrow veins of barite ore that cut folded sediments, and unreplaced fragments of schistose sediments within the ore indicate that the ore is later in age than the metamorphism. The ore is cut by veinlets of late calcite, many of which have been found to follow post-ore faults.

Faults. Two main faults, striking east and west and nearly vertical, displace the orebodies (Fig. 2).

The north fault is between the two orebodies, and in going westward strikes into the South orebody at a small angle. This fault displaces the South orebody about 200 feet upward (Fig. 2) and an unknown distance eastward with respect to the North orebody. Long sections of barite drag-ore may be seen in the north fault below the South orebody. The south fault, 80 to 100 feet south of the shaft, is definitely south of the South orebody (Fig. 2). Because of the inaccessibility of critical workings the displacement on this fault could not be measured.

Several diagonal faults cut the orebodies, but displace them only a few feet horizontally and vertically. A few flat, or very gently dipping, faults also cut the orebodies, but these displace the ore even less than most of the diagonal faults. In addition to movement along well-defined faults, considerable slippage has occurred between sharply folded beds in the graphitic schists.

Fracture Zone. A regional silicified and pyritized fracture zone can be traced by widely separated, mineralized outcrops, from mount Richards on the east through the Twin "J" on mount Sicker to mount Brenton on the west, a total distance of 8 miles. The displacement along this 'break' is unknown. At the Twin "J", the fracture zone is manifested by vertical, silicified zones on the south sides of both the North and South orebodies and by post-mineral 'breaks' such as the north and south faults.

LOCALIZATION OF THE OREBODIES

The Twin "J" orebodies have been localized structurally by the regional fracture zone and by drag folds in the narrow band of sediments. Although quartz, pyrite, and some chalcopyrite are regionally characteristic of the

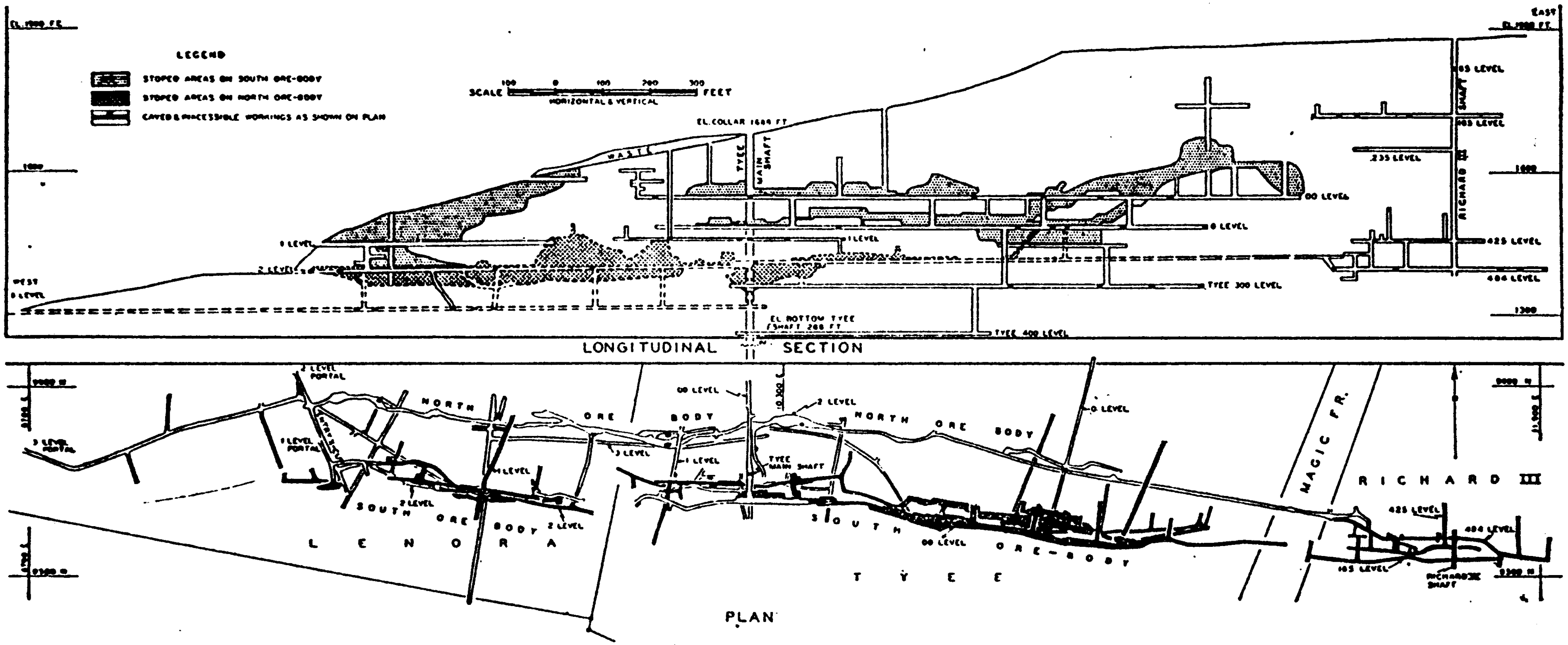

Figure 4.—Longitudinal section and plan of workings on Lenora, Tyee, and Richard III claims. Longitudinal section is in plane of the South orebody, with the North orebody projected 150 feet southward into plane of the South.