ARTICLE F

680087

THE H.B. MINE

(Latitude 49 09' N., Longitude 117 13' W., Elevation 2800 feet)

LOCATION, ACCESS

The H.B. Mine and concentrator is situated on the North side of the Sheep Creek valley some six miles south-east of the village of Salmo, B.C., in the Nelson Mining District.

Access to the property is by way of a 2½ mile long, gravel road off Highway 3, three and a half miles south of Salmo.

HISTORY AND OWNERSHIP

The property was originally staked by Horton and Benson (hence H.B.); and was purchased by Cominco in 1927. Intermittent work was carried out until 1946. Later an extensive diamond drilling program was undertaken followed by underground exploration.

With sufficient ore outlined, construction of a 1,200 ton-a-day concentrator was started in April of 1952 and completed in the spring of 1953. Due to unfavourable metal prices, operation did not commence until May, 1955 and was suspended in October 1966. Production was resumed at the mine in February 1973.

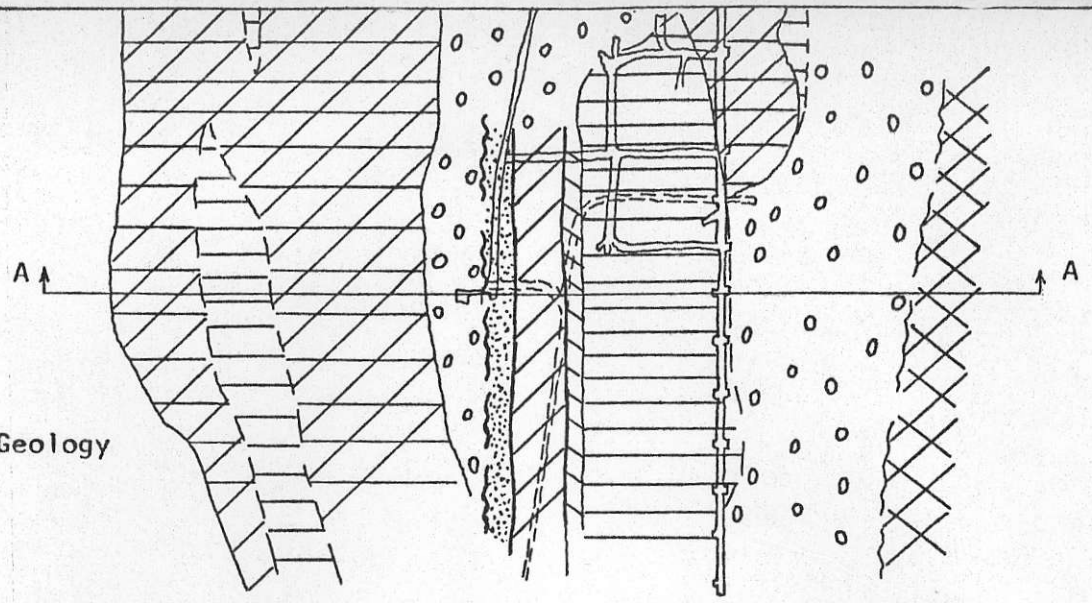
GEOLOGY

The H.B. Mine is located within the Kootenay Arc structural belt. At the Mine this belt is characterized by an assemblage of quartzites, through argillites to limestones and back into argillites as illustrated by Figure #1.

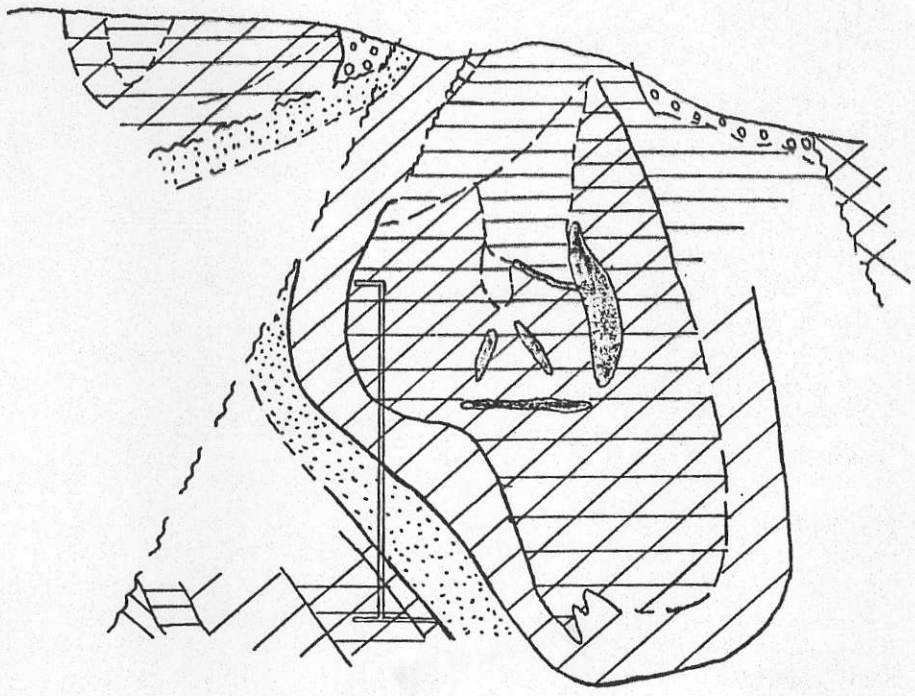
In the mine vicinity, the Lower Laib formation which contains the Reeves Limestone is folded isoclinally with axial planes striking north-south and inclined steeply east. The folds at the mine plunge twenty degrees to the south. The main orebodies are confined to a syncline approximately 3500 feet in length and 200 to 400 feet wide. A smaller ore zone five hundred feet to the west is in a different and smaller syncline. In the main syncline, there are two types of orebodies, a steeply dipping variety of ore stringers and a flat lying variety. Both types conform to the twenty degree flunge of the fold.

The mineralogy is simple consisting of sphalerite, galena, and pyrite with occasional pyrrhotite. Overall the Zn:Pb ratio is about 5:1 with much higher Pb in the flat zones.

The boundaries of the H.B. orebodies are determined by the structure, lithology, and topography. From the north, the ore zones plunge to the south from surface and are completely oxidized within 300 feet to surface. To the south, the ore zones pinch-out apparently caused by an upward re-folding of the synclinal package.



Plan View of Geology



Section A-A

Legend

	Overburden		
Ordovician	Active Argillite		
	Emerald Argillite		Ore Zones
	Reeves Limestone		Mine Workings
L. Cambrian	Reeves Dolomite		
	Truman Argillite		
	Reno Quartzite		

SCALE 1" = 400'

Figure 1 Geologic Setting Of H.B. Orebodies

COMINCO LTD.

SULLIVAN MINE - KIMBERLEY, B. C.

(Latitude 49° 42' N, Longitude 116° 00' W, Elevation 3,900 Feet)

LOCATION

The Sullivan mine and concentrator are located within the City limits of Kimberley, B.C. in the Purcell range of southeastern B.C. The mine is located on Mark Creek, approximately two miles north of the City centre and the concentrator two miles south of the City centre. The holdings include 680 Crown-granted claims and fractions and 582 recorded claims.

CLIMATE

The air temperature ranges from a January minimum of minus 20 degrees Fahrenheit to a June maximum of 89 degrees Fahrenheit, measured in 1973. Freezing conditions commence in October and persist for the ensuing six and a half months. Snowfalls account for 12.24 of the 21.20 inches of annual precipitation, with the fallen snow cover reaching a maximum thickness of 41.5 inches during late March at the Sullivan snow station. This is located 5,100 feet above sea level on the surface above the Sullivan Hill.

HISTORY

Two original claims, the "Hamlet" and "Shylock", of what was later to develop into the Sullivan Mine, were located by four prospectors, Pat Sullivan, Ed Smith, John Cleaver and Walter Burchett, in August 1892, following a 37 day trek overland on foot from Kootenay Lake to St. Mary's Prairie. One of the partners, Sullivan, was killed in the Coeur d'Alene district of Idaho in the winter of 1892, but the remaining three continued work on their claims at intervals, when finances permitted, until 1896.

In that year the partners were bought out by the Sullivan Group Mining Company, formed by a group of Spokane men who were also interested in the Le Roi Mine at Rossland. The Sullivan Group Company also built a smelter at Marysville, which was completed in 1903 but, beset by financial and metallurgical problems, was shut down in 1907.

The mine was purchased in 1909 by the Federal Mining and Smelting Company which formed a subsidiary, the Fort Steele Mining and Smelting Company. The Consolidated Mining and Smelting Company (Cominco) took a lease and option on the property in December 1909. The following year the Company commenced the purchase, which was completed in 1913.

Development work for the next few years was directed at finding sufficient lead ore which would be low enough in zinc for smelting in the Company's plant at Trail, B.C.

This method of selective mining was extremely profitable and by 1914 the Sullivan had become the largest producer of lead in the British Empire, production in that year being 35,500 tons of ore containing 12,000 tons of lead and 500,000 ounces of silver. At the same time, development and diamond drilling programs had proved up a considerable tonnage of what was then considered as low grade lead ore because of its high zinc content.

Although at this stage, the froth flotation process had been developed, the problem with the complex Sullivan ore was one of selective flotation.

In 1917, Mr. R. W. Diamond took charge of what had become an intensive investigation of the various methods for separating this complex ore into three sulphide products - lead, zinc and iron. As a result of this investigation and at a time when zinc prices were falling rapidly, a differential flotation process was successfully achieved in 1919. The following year, large scale testing - in Trail - proved the process to be economical.

This technological discovery in the mineral processing field also lead to a radical change in mining methods at the Sullivan Mine.

Selective mining was no longer necessary and a more systematic method of mining the hitherto low grade ores could be commenced.

The information and experience obtained from this test work was immediately used to design a concentrator which was to be built in Kimberley.

In the spring of 1922, construction of the Sullivan mill commenced on the Chapman Camp site three miles from the mine portal. It commenced operation in August 1923 at a daily rate of 3,000 tons. The size of the concentrator was increased in steps until by 1949, when the sink-float plant was introduced, the capacity was 11,000 tons per day.

In the interval between August 1923 and December 31, 1973, the concentrator has treated about 109,736,000 tons of Sullivan ore. The total production from the approximate date of its acquisition by the present owners to December 31, 1973 is about 110,735,850 tons of ore.

GEOLOGY

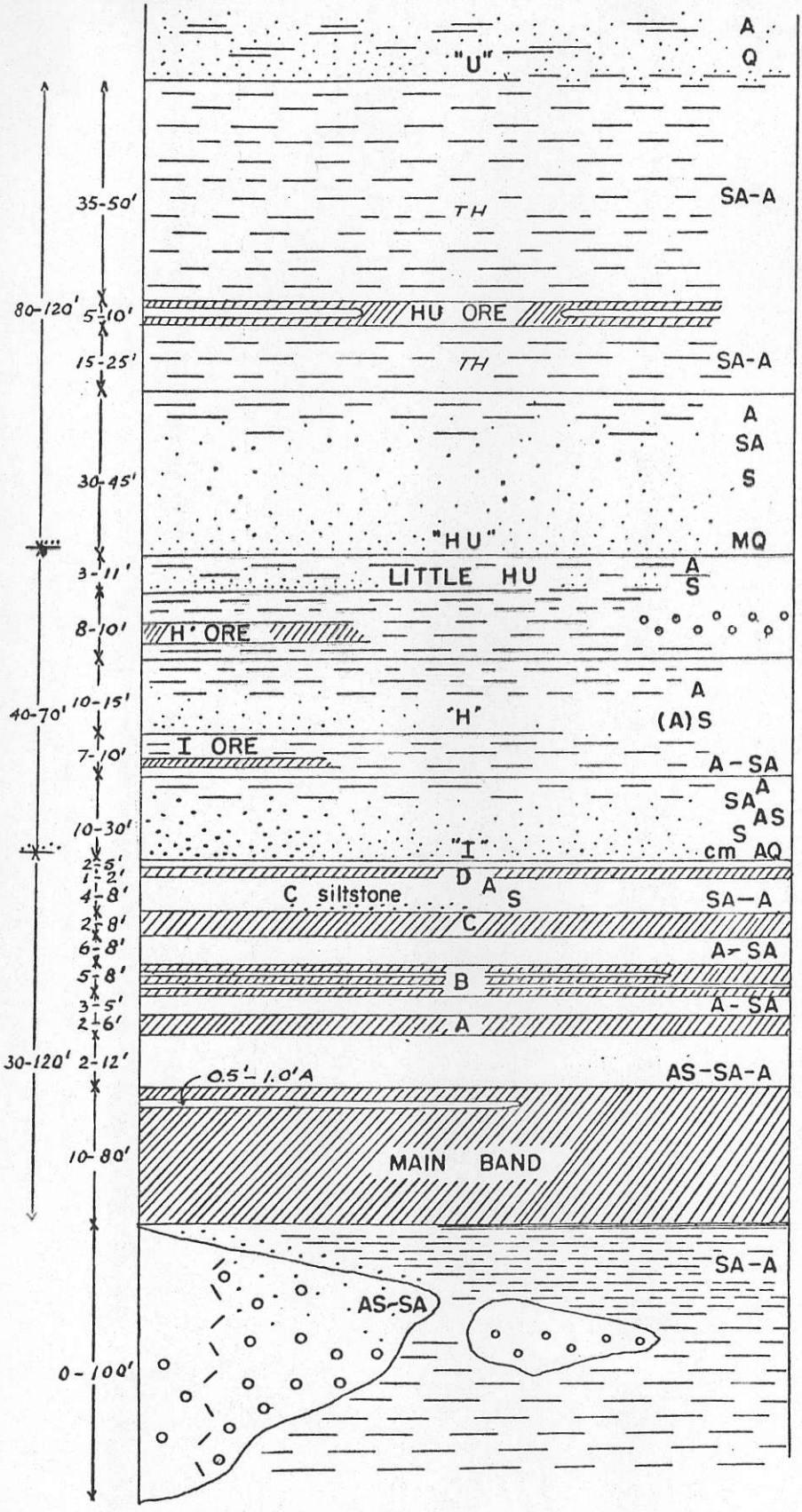
The orebody is 7,000 feet long, from several feet to 300 feet thick, and roughly resembles an inverted saucer. The strike is north-south and the dip averages about 30 degrees to the east, gentle in the upper part of the mine, steepening in the central portion and flattening along the eastern edge.

The orebody occupies one limb of a north-plunging anticline, the crest of the anticline coinciding approximately with the western margin of the orebody. It occurs in the lower Proterozoic Aldridge formation, which in the Kimberley area is composed of at least 15,000 feet of alternating argillites, siltites, and dirty quartzites. The Aldridge is the lower member of the 35,000 foot thick Purcell group of sediments. It contains a high proportion of turbidite-type beds and is thought to represent the early basin filling of the Purcell geosyncline.

COMINCO LTD.

SULLIVAN MINE, KIMBERLEY, B.C.

IDEAL GEOLOGY SECTION



UPPER QUARTZITE
quartzite with argillite partings base not recognized as definite horizon

THIN BEDDED HANGINGWALL
beds, fraction of inch to several feet.

HANGINGWALL UPPER ORE ZONE

HANGINGWALL UPPER SILTSTONE
prom. Q or AQ base with Q grains for several feet

LITTLE "HU" SILTSTONE

HANGINGWALL CONGLOMERATE
recog. south and east of mine

HANGINGWALL SILTSTONE
Q grains rarely conc. at base.

INTERMEDIATE SILTSTONE
Q grains usually prom. at base

color zone.. fine P and Zn. lams in soft argillite between D and I

"B" band triplets - two 2-12" A bands separated by three narrow sulphide bands.

MAIN BAND ORE
massive to laminated sulphides

FOOTWALL "SLATES" 6" to 1.0'

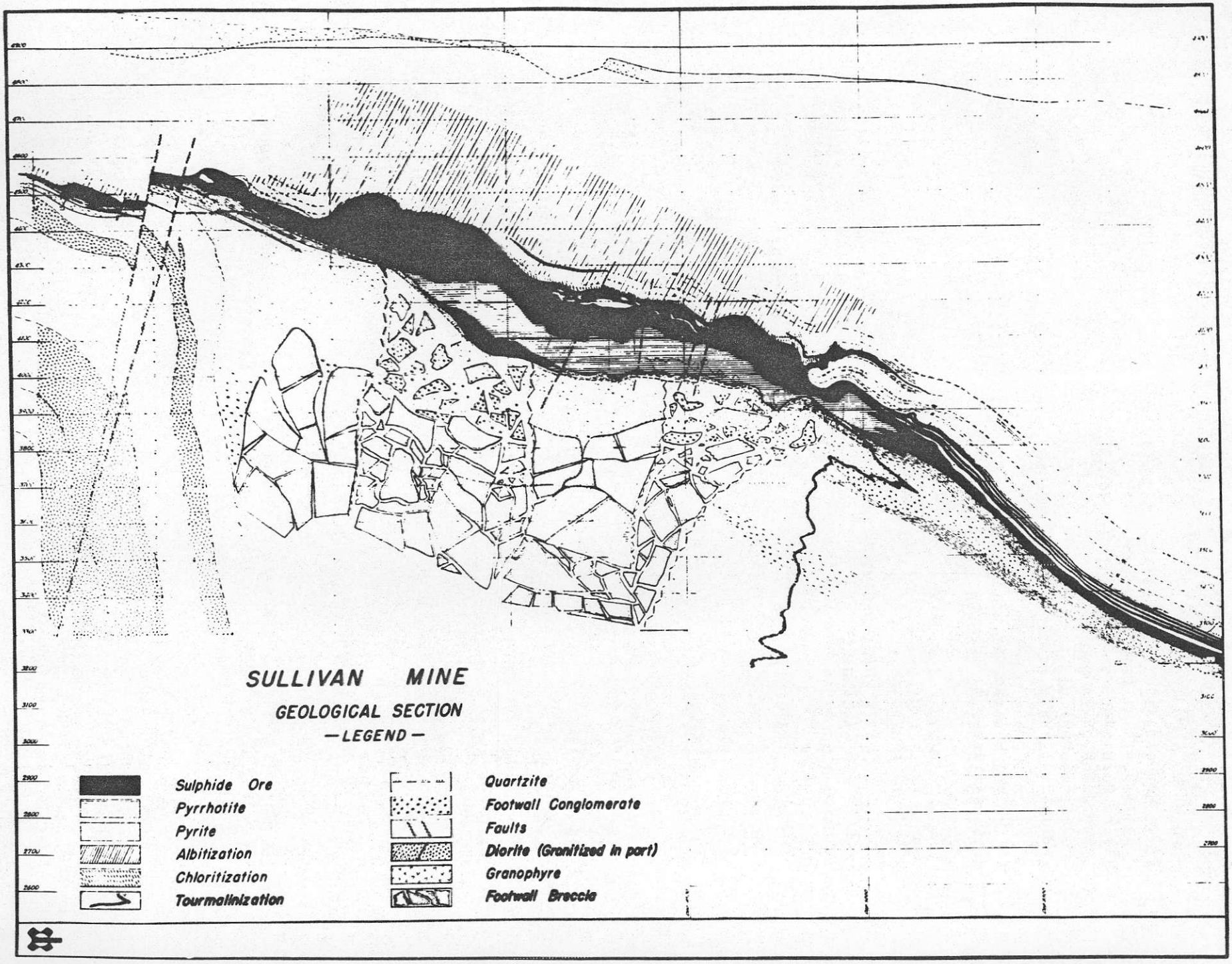
FOOTWALL LAMINATED ZONE

FOOTWALL CONGLOMERATE

FOOTWALL THIN BEDDED SERIES

Q - Quartzite S - Siltstone A - argillite AQ - argillaceous quartzite
AS - argillaceous siltstone SA - silty argillite
c.m.f.g. = coarse, medium, fine grained

Quartzite Siltstone Ore Thin bedded
Laminated Conglomerate


SULLIVAN MINE
GEOLOGICAL SECTION
—LEGEND—
Sulphide Ore
Pyrrhotite
Pyrite
Albitization
Chloritization
Tourmalinization
Quartzite
Footwall Conglomerate
Faults
Diorite (Granitized in part)
Granophyre
Footwall Breccia

In the lower section of the mine, stratigraphy in the ore zone is very regular, with bands of sulphides interbedded with bands of barren rock, and sedimentary structures are preserved in great detail. In the upper portion of the mine, this delicate layering is only present in very small areas, large areas of massive ore occur, and there are large zones of essentially pure iron sulphide with little or no lead or zinc. The upper zone also varies broadly from place to place, with confused streaking or banding in some locations and no internal structure in others. The principle sulphides are pyrrhotite, sphalerite, galena, and pyrite. Chalcopyrite and arsenopyrite are minor constituents.

Magnetite is farily common in some parts of the orebody and cassiterite is present in small amounts. In the oxide zone, cerrusite and pyromorphite are common.

Concepts of the ore gensis of the Sullivan orebody have evolved with time, with major difficulties in interpretation arising due to regional metamorphism and to the striking difference in the mode of mineralization from one part of the orebody to another. Any syngenetic theory based on the finely preserved sedimentary features in the lower orebody must explain the massive concentrations of metal in the upper orebody. On the other hand, conventional hydrothermal replacement theory fails to explain the apparently sedimentary nature of deposits in the lower mine. Neither theory alone fully accounts for the complex structure of the orebody and it is possible that a more complete explanation of the genesis of Sullivan ore will be forthcoming when regional metamorphism in the Kimberley area is better understood.

While ore reserves for the mine have not been released by the Company, Cominco's annual report for 1973 states a combined figure for the Sullivan and HB mines of 62,000,000 tons with a lead-zinc content of 6,700,000 tons. The HB mine accounts for less than 10% of this.

MINING

Development of Mining Methods

Early mining at the Sullivan was by open stoping in very competent ground. Pillars left in this part of the mine were quite irregular due to the selective mining of high grade lead ore. A more orderly stoping pattern was adopted after development of differential flotation permitted extraction of mixed, lower grade lead-zinc ores.

Open stoping using short hole percussion drills for benching continued as the proven ore reserves increased, leaving extensive openings in the mine and large unsupported areas. As a safety measure against extensive hanging wall collapse, and accompanying air blasts, and as an aid to future pillar recovery, backfilling operations using surface gravel were commenced in 1935 and continued until 1961.